August 28, 2020

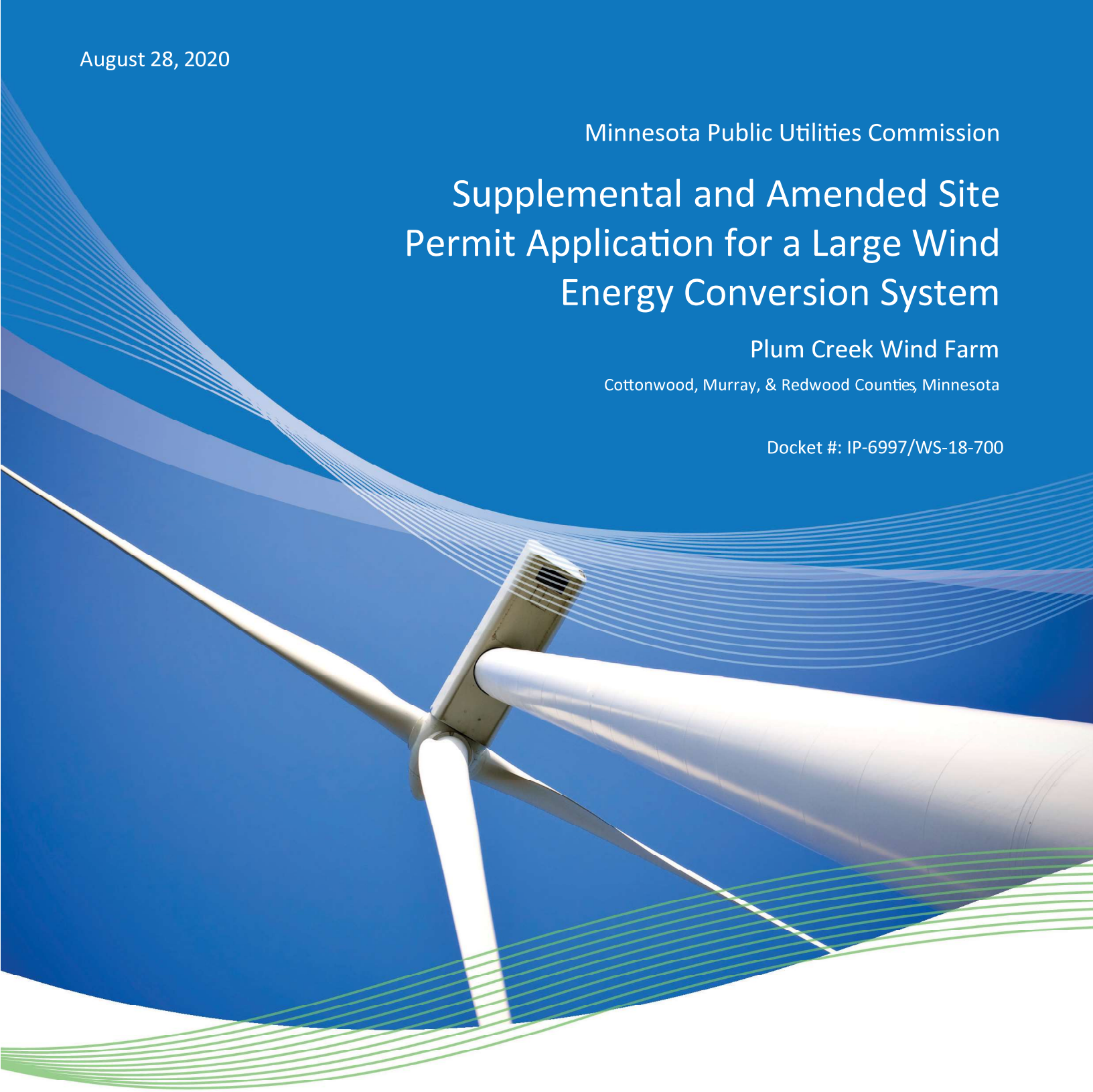
Minnesota Public Utilities Commission

Supplemental and Amended Site Permit Application for a Large Wind Energy Conversion System

Plum Creek Wind Farm

Cottonwood, Murray, & Redwood Counties, Minnesota

Docket #: IP-6997/WS-18-700



GERONIMO® ENERGY
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PLUM CREEK WIND FARM

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Revised 8-28-2020

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ACRONYM LIST

Acronym	Definition
AADT	Annual Average Daily Traffic
ABPP	Avian and Bat Protection Plan
ADLS	Aircraft Detection Lighting System
AMA	Aquatic Management Area
Amended Application or Application	Supplemental and Amended Site Permit Application
ANSI	American National Standards Institute
Applicant	Plum Creek Wind Farm, LLC
AWWI	American Wind Wildlife Institute
BCC	Birds of Conservation Concern
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practice
BWSR	Board of Water and Soil Resources
Cadna-A	Computer Aided Design for Noise Abatement
Commission	Minnesota Public Utilities Commission
CN	Certificate of Need
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
dB	decibels
dB(A)	decibels using the A-weighted scale
DNH	Determination of No Hazard
DOC	Minnesota Department of Commerce
DOC-EERA	Minnesota Department of Commerce – Energy Environmental Review and Analysis
ECD	Erosion Control Devices
ECPG	Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2
EDA	Economic Development Authority
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FPPA	Farmland Protection Act

Acronym	Definition
FRS	Facility Registry Service
FSA	Farm Service Agency
Geronimo	Geronimo Energy, LLC
Hz	hertz
IARC	International Agency for Research on Cancer
IBA	Important Bird Area
ICNIRP	International Commission on Non-Ionizing Radiation Protection
kV	kilovolt
kV/m	kilovolts per meter
L_{10}	ten percent of an hour
L_{50}	fifty percent of an hour
LGU	Local Government Unit
LiDAR	Light Detection and Ranging
LNTE	low-noise trailing edges
LWECS	Large Wind Energy Conversion System
LWECS Application Guidance	Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota (Revised July 2019)
M	meters
mG	milliGauss
m/s	meters per second
MBS	Minnesota Biological Survey
MBTA	Migratory Bird Treaty Act
Mbps	megabytes per second
MGS	Minnesota Geological Survey
MISO	Midcontinent Independent System Operator
MN DEED	Minnesota Department of Employment and Economic Development
MNDNR	Minnesota Department of Natural Resources
MNDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MPUC	Minnesota Public Utilities Commission
MW	megawatt
MWFRA	Migratory Waterfowl Feeding and Resting Area
NAC	Noise Area Classification
NASA	National Aeronautics and Space Administration
NHIS	Natural Heritage Information System
NIEHS	National Institute of Environmental Health Sciences
NLCD	National Land Cover Database

Acronym	Definition
NOAA	National Oceanic and Atmospheric Administration
NPC	native plant community
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
O&M	Operations and maintenance
OSA	Office of the State Archaeologist
PEM	palustrine emergent
PFO	palustrine forested
Phase I ESA	Phase I Environmental Site Assessment
Plum Creek	Plum Creek Wind Farm, LLC
Project	Plum Creek Wind Farm
Project Area	The area within the Project boundary identified in Figure 1 of this Application
Project Location	Project boundaries identified in Figure 1
PSS	Palustrine scrub-shrub
PWI	Public Waters Inventory
RCRA	Resource Conservation and Recovery Act
RD	rotor diameters
RIM	Reinvest in Minnesota
RP	Route Permit
Rpm	revolutions per minute
SCADA	Supervisory Control and Data Acquisition
SCS	Site Characterization Study
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SNA	Scientific and Natural Area
SOBS	Sites of Biodiversity Significance
SoDAR	Sonic Detection and Ranging
SSI	Swedish Radiation Protection Authority
SSM	Swedish Radiation Safety Authority
STE	serrated trailing edges
SWAP	State Wildlife Action Plan
SWPPP	Stormwater Pollution Prevention Plan
TI	Turbulence Intensity

Acronym	Definition
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
WCA	Wetland Conservation Act
WEG	Wind Energy Guidelines
WEST	Western EcoSystems Technology, Inc
WHO	World Health Organization
WIA	Walk-In Access
WIMN	MPCA's *What's in My Neighborhood* Database
WMA	Wildlife Management Area
WPA	Waterfowl Production Area

1.0 APPLICANT INFORMATION

Plum Creek Wind Farm, LLC (Plum Creek or Applicant), an affiliate of Geronimo Energy, LLC, a National Grid Company (Geronimo), respectfully submits this Supplemental and Amended Site Permit Application (the Amended Application or Application) to the Minnesota Public Utilities Commission (MPUC or Commission) for a Site Permit to construct and operate the up-to-414 megawatt (MW) nameplate capacity Plum Creek Wind Farm (the Project). Plum Creek filed an initial Site Permit Application on November 12, 2019. Since that filing, Plum Creek has withdrawn the GE-2.8-127 and Vestas 5.6-V150 turbine models for consideration, modified the layout for the Vestas 5.6-V162 turbine, and added the Siemens Gamesa 6.2-SG170 turbine and associated layout for consideration. This Amended Application is updated throughout to reflect change in the V162 layout and addition of the SG170 turbine/layout. As described in the Application, the Project is a Large Wind Energy Conversion System (LWECS), as defined in the Wind Siting Act, Minn. Stat. Ch. 216F. The Project is located in southwestern Minnesota's Cottonwood, Murray, and Redwood Counties and its footprint spans approximately 73,000 acres in portions of Germantown, Highwater, Ann, and Westbrook Townships in Cottonwood County; Holly, Murray, Dovray, and Des Moines River Townships in Murray County; and North Hero and Lamberton Townships in Redwood County.

Plum Creek is developing the Project and would be the permittee. Plum Creek proposes to connect the Project to the Brookings-to-Hampton 345 kilovolt (kV) transmission line, part of the Midcontinent Independent System Operator, Inc. (MISO) Multi-Value Project Transmission line portfolio approximately 20 miles north of the Project Area. Plum Creek will need to build approximately 30 miles of 345 kV transmission line to connect to the Brookings-Hampton 345 kV transmission line. Because the proposed transmission line is 345 kV and more than 1,500 feet in length, a Route Permit (RP) from the Commission will be required, pursuant to Minn. Stat. Ch. 216E and Minn. R. Ch. 7850. Plum Creek's RP Application is available in Docket No. IP6997/TL-18-701.

Plum Creek's parent, Geronimo, is a utility-scale renewable energy developer headquartered in Edina, Minnesota, with satellite offices located in southwest Minnesota, North Dakota, South Dakota, Illinois, Michigan, New York, and Colorado. Geronimo has developed several operating wind farms and solar projects throughout the United States and currently has more than 2,500 MW of renewable energy projects under construction or operational. In Minnesota, Geronimo has developed more than 850 MW of renewable energy, including seven wind farms and 200 MW of solar energy. For example, Geronimo developed the Prairie Rose, Odell, Blazing Star, and Blazing Star 2 Wind Farms, which are in the same region as the Project. Prairie Rose is a 200 MW wind farm constructed in Rock and Pipestone Counties; Odell is a 200 MW wind farm constructed in Cottonwood, Jackson, Martin, and Watonwan Counties; Blazing Star is a 200 MW wind farm currently under construction in Lincoln County; and Blazing Star 2 is a 200 MW wind farm in Lincoln County that will be under construction soon. Each project is expected to result in approximately $1.1 million in landowner payments, $40,000 in a community fund, and approximately $850,000 in tax revenue per year. Geronimo and its subsidiaries partner with community members to meet common goals while constructing new wind energy generation sources that benefit the state and the region.

Geronimo is committed to developing renewable energy projects that meet the Minnesota state policies of locating energy facilities in an orderly manner compatible with environmental preservation and the efficient use of resources.

2.0 CERTIFICATE OF NEED

A Certificate of Need (CN) is required for all "large energy facilities," as defined in Minn. Stat. § 216B.2421, subd. 2(1), unless the facility falls within a statutory exemption from the CN requirements. Because the Project is a generating plant larger than 50 MW, it meets the definition of a large energy facility. Plum Creek's CN Application is available in MPUC Docket No. IP-6997/CN-18-699.

3.0 STATE POLICY

The contents and treatment of applications for LWECS site permits are governed by Minn. R. Ch. 7854 under the Wind Siting Act. The Wind Siting Act also requires the Commission to consider the criteria set forth in Minn. Stat. § 216E.03, subd. 7, including effects on land, water and air resources, economic impacts, and other factors. This Amended Application provides information necessary to demonstrate compliance with these criteria and Minn. R. Ch. 7854. In addition, this Amended Application has been organized following the Minnesota Department of Commerce – Energy Environmental Review and Analysis (DOC-EERA), Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota (Revised July 2019; LWECS Application Guidance).

State policy supports LWECS siting in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources (Minn. Stat. § 216F.03). Plum Creek has designed the Project to comply with the Commission's wind turbine setback and siting guidelines. Table 3-1 provides a completeness checklist for the Amended Application, identifying the Minnesota Administrative Rules for a LWECS site permit application contents and where each element of those rules is addressed in the Amended Application.

Table 3-1
Completeness Checklist

Authority	Required Information	Location
Minn. R. Ch. 7854		
Minn. R. 7854.0500	**SITE PERMIT APPLICATION CONTENTS**	
Minn. R. 7854.0500, subp. 1	**Applicant**. An applicant for a site permit must provide the following background information regarding the applicant:	
A.	A letter of transmittal signed by an authorized representative or agent of the applicant;	*See* Application Filing Letter and Cover Page
B.	The complete name, address, and telephone number of the applicant and any authorized representative;	*See* Application Filing Letter and Cover Page
C.	The signature of the preparer of the application if prepared by an agent or consultant of the applicant;	*See* Application Filing Letter and Cover Page
D.	The role of the permit applicant in the construction and operation of the LWECS;	Section 1.0
E.	The identity of any other LWECS located in Minnesota in which the applicant, or a principal of the applicant, has an ownership or other financial interest;	Section 1.0
F.	The operator of the LWECS if different from the applicant; and	Section 1.0
G.	The name of the person or persons to be the permittees if a site permit is issued.	Section 1.0

Table 3-1 Completeness Checklist		
Authority	**Required Information**	**Location**
Minn. R. 7854.0500, subp. 2	**Certificate of need or other commitment**.	
A.	The applicant shall state in the application whether a certificate of need for the system is required from the commission and, if so, the anticipated schedule for obtaining the certificate of need. The commission shall not issue a site permit for an LWECS for which a certificate of need is required until the applicant obtains the certificate, although the commission may process the application while the certificate of need request is pending before the commission.	Section 2.0
B.	The commission may determine if a certificate of need is required for a particular LWECS for which the commission has received a site permit application.	N/A
C.	If a certificate of need is not required from the commission, the applicant shall include with the application a discussion of what the applicant intends to do with the power that is generated. If the applicant has a power purchase agreement or some other enforceable mechanism for sale of the power to be generated by the LWECS, the applicant shall, upon the request of the commission, provide the commission with a copy of the document.	N/A
Minn. R. 7854.0500, subp. 3	**State policy**. The applicant shall describe in the application how the proposed LWECS project furthers state policy to site such projects in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources.	Section 3.0
Minn. R. 7854.0500, subp. 4	**Proposed site**. The applicant shall include the following information about the site proposed for the LWECS and any associated facilities:	
A.	The boundaries of the site proposed for the LWECS, which must be delineated on a United States Geological Survey Map or other map as appropriate;	Section 4.0 and Figure 1
B.	The following characteristics of the wind at the proposed site: (1) interannual variation; (2) seasonal variation; (3) diurnal conditions; (4) atmospheric stability, to the extent available; (5) turbulence, to the extent available; (6) extreme conditions; (7) speed frequency distribution; (8) variation with height;	Section 9.1

Table 3-1 Completeness Checklist		
Authority	**Required Information**	**Location**
	(9) spatial variations; and (10) wind rose, in eight or more directions;	
C.	Other meteorological conditions at the proposed site, including the temperature, rainfall, snowfall, and extreme weather conditions; and	Section 9.1.11
D.	The location of other wind turbines in the general area of the proposed LWECS.	Section 9.2
Minn. R. 7854.0500, subp. 5	**Wind rights**. The applicant shall include in the application information describing the applicant's wind rights within the boundaries of the proposed site.	Section 7.0
Minn. R. 7854.0500, subp. 6	**Design of project**. The applicant shall provide the following information regarding the design of the proposed project:	
A.	A project layout, including a map showing a proposed array spacing of the turbines;	Section 5.1 and Figures 1, and 2a – 2c
B.	A description of the turbines and towers and other equipment to be used in the project, including the name of the manufacturers of the equipment;	Section 5.2
C.	A description of the LWECS electrical system, including transformers at both low voltage and medium voltage; and	Section 5.3
D.	A description and location of associated facilities.	Section 6.0
Minn. R. 7854.0500, subp. 7	**Environmental impacts**. An applicant for a site permit shall include with the application an analysis of the potential impacts of the project, proposed mitigative measures, and any adverse environmental effects that cannot be avoided, in the following areas:	
A.	Demographics, including people, homes, and businesses;	Sections 8.1 and 8.2
B.	Noise;	Section 8.4
C.	Visual impacts;	Section 8.5
D.	Public services and infrastructure;	Section 8.6
E.	Cultural and archaeological impacts;	Section 8.7
F.	Recreational resources;	Section 8.8
G.	Public health and safety, including air traffic, electromagnetic fields, and security and traffic;	Section 8.9
H.	Hazardous materials;	Section 8.10
I.	Land-based economics, including agriculture, forestry, and mining;	Section 8.11

Table 3-1
Completeness Checklist

Authority	Required Information	Location
J.	Tourism and community benefits;	Sections 8.12 and 8.13
K.	Topography;	Section 8.14
L.	Soils;	Section 8.15
M.	Geologic and groundwater resources;	Section 8.16
N.	Surface water and floodplain resources;	Section 8.17
O.	Wetlands;	Section 8.18
P.	Vegetation;	Section 8.19
Q.	Wildlife; and	Section 8.20
R.	Rare and unique natural resources.	Section 8.21
Minn. R. 7854.0500, subp. 8	**Construction of project**. The applicant shall describe the manner in which the project, including associated facilities, will be constructed.	Sections 10.1, 10.2, 10.3, 10.4, and 10.5
Minn. R. 7854.0500, subp. 9	**Operation of project**. The applicant shall describe how the project will be operated and maintained after construction, including a maintenance schedule.	Section 10.6
Minn. R. 7854.0500, subp. 10	**Costs**. The applicant shall describe the estimated costs of design and construction of the project and the expected operating costs.	Section 10.7
Minn. R. 7854.0500, subp. 11	**Schedule**. The applicant shall include an anticipated schedule for completion of the project, including the time periods for land acquisition, obtaining a site permit, obtaining financing, procuring equipment, and completing construction. The applicant shall identify the expected date of commercial operation.	Section 10.8
Minn. R. 7854.0500, subp. 12	**Energy projections**. The applicant shall identify the energy expected to be generated by the project.	Section 10.9
Minn. R. 7854.0500, subp. 13	**Decommissioning and restoration**. The applicant shall include the following information regarding decommissioning of the project and restoring the site:	
A.	The anticipated life of the project;	Section 11.1
B.	The estimated decommissioning costs in dollars;	Section 11.2
C.	The method and schedule for updating the costs of decommissioning and restoration;	Section 11.2
D.	The method of ensuring that funds will be available for decommissioning and restoration; and	Section 11.3
E.	The anticipated manner in which the project will be decommissioned and the site restored.	Section 11.4
Minn. R. 7854.0500, subp. 14	**Identification of other permits.** The applicant shall include in the application a list of all known federal, state, and local agencies or authorities, and titles of the	Section 12.0

Table 3-1 Completeness Checklist		
Authority	**Required Information**	**Location**
	permits they issue that are required for the proposed LWECS.	

4.0 PROJECT DESCRIPTION AND OVERVIEW

Plum Creek selected the three-county (Cottonwood, Murray, and Redwood) area to target for wind-farm development based on the area's wind resources, geographic characteristics, environmental resources, and transmission availability. Plum Creek then further refined target areas within the counties through discussions with landowners and the local jurisdictions. The Project boundary included in this Amended Application avoids sensitive resources such as wildlife management areas and waterfowl production areas.

After analyzing these broader target areas for environmental features, easement availability, landowner interest, and economic wind potential, Plum Creek selected an area that includes portions of northwestern Cottonwood, northeastern Murray, and southern Redwood Counties, Minnesota. The Project boundaries are identified in Figure 1 (Project Location) of this Amended Application (the Project Area). Table 4.1 lists the counties, townships, sections, and ranges that are included in the Project Area.

Table 4-1
Project Location

County Name	Township Name	Township	Range	Sections
Cottonwood	Germantown	108	36	7, 18
	Highwater	108	37	1-14, 16-18, 20-21, 24-25
	Ann	108	38	1-36
	Westbrook	107	38	2-9
Murray	Holly	108	39	1-2, 11-15, 21-28, 30-36
	Dovray	107	39	1-16, 19-24, 28-33
	Murray	107	40	1, 12, 23-26, 36
	Des Moines River	106	39	4-5
Redwood	North Hero	109	38	27-36
	Lamberton	109	37	31-36

The Project Area contains approximately 73,000 acres, of which 52,708 are currently leased for the Project (72 percent)[1]. Plum Creek continues to acquire public and private agreements to construct and operate the Project, including associated wind rights. The Project's aboveground facilities will occupy less than one percent of the Project Area.

The Project Area was selected based on its excellent wind resources, access to transmission infrastructure, landowner interest, and the relatively low environmental impacts compared with other potentially developable areas in the region. Once the Project Area was identified, Plum Creek conducted further due diligence on environmental factors through coordination with relevant federal and state environmental agencies, analysis of available desktop data, and field visits. Plum

[1] This acreage has been updated to remove duplicate parcels for which multiple easements are signed (i.e., wind easement and transmission easement).

Creek used this information to refine the Project Area and confirm that no environmental fatal flaws were present.

The Project will have up to 414 MW of nameplate wind energy capacity. Plum Creek is currently proposing two wind turbine models with rated nameplate capacity ranging from 5.6 MW to 6.2 MW, corresponding to between 67 and 74 wind turbines. As described more fully in Section 5.1, each turbine model has a unique layout. Plum Creek provides environmental analyses for both layouts in Section 8.

As described in Sections 5.2, 5.3, and 6.0, the Project's facilities will include:

- Up to 74 wind turbines and related equipment
- New gravel access roads and improvements to existing roads
- Underground and/or aboveground electrical collection and communication lines
- Operations and maintenance (O&M) facility[2]
- Two collector substations
- Up to four permanent meteorological towers
- Sonic Detection and Ranging (SoDAR) or Light Detection and Ranging (LiDAR) unit
- Up to three laydown areas
- Aboveground electrical feeder line
- Up to two Aircraft Detection Lighting Systems (ADLS) radars
- Up to two temporary batch plant areas for construction of the Project

As described in this Amended Application, the number and location of certain Project facilities (e.g., permanent meteorological towers, laydown yards, ADLS) may vary based on the turbine model selected, regulatory approvals, contractor specifications, and landowner input. Accordingly, Plum Creek has provided environmental information, anticipated impacts, and proposed mitigation measures for the Project Area and each turbine layout (where applicable) to allow the Commission to consider the potential impacts and evaluate conditions for the LWECS site permit.

[2] Plum Creek will seek a local land use permit for the operations facility.

5.0 PROJECT DESIGN

5.1 Description of Project Layouts

The two proposed layouts for the Project optimize the wind resource and minimize impacts to potentially sensitive infrastructure, ecological resources, and cultural features. As discussed in this section, the interaction among the local topography, the wind resource, regulatory setbacks, landowner input, site control, turbine model, collection-line requirements, and engineering also influences the layout of the Project's facilities. The Project Area contains approximately 73,000 acres, of which 52,708 are currently under lease agreement. Descriptions of the proposed turbine models are provided in Section 5.2.

The Project's layouts follow 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; Commission's General Permit Standards), applicable local government ordinances, and Geronimo's best practices. In instances when setbacks differ for the same feature, the most stringent setback distance is used. Table 5.1-1 shows turbine setbacks and Figures 2a-2c illustrate the relevant Project setbacks.

Murray County has assumed permitting authority under Minn. Stat. § 216F.08 for a LWECS up to 25 MW (Murray County, 2010). Conversely, Cottonwood and Redwood Counties have not assumed permitting authority for an LWECS (*see* Docket 07-1102). Therefore, Plum Creek implemented setbacks described in the Murray County Renewable Energy Ordinance for at least the portion of the Project within Murray County and, in some cases, across all three Project counties. Table 5.1-1 below describes the setbacks applied to the design of the Plum Creek Wind Farm. Figures 2a-2c display the Turbine Layout and Constraints for each of the three turbine models under consideration.

Table 5.1-1
Wind Turbine Setback Requirements for the Project

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Plum Creek Wind Farm
Wind Access Buffer – Prevailing Wind Directions	5 x rotor diameter (RD)	Commission's General Permit Standards	5 x RD
Wind Access Buffer – Non-Prevailing Wind Directions	3 x RD	Commission's General Permit Standards	3 x RD
Residences	500 feet, or the minimum distance required to meet the state noise standard of 50 decibels (dB) using the A-weighted scale (dB(A)), whichever is greater	Commission's General Permit Standards	1,000 feet from residences

Table 5.1-1
Wind Turbine Setback Requirements for the Project

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Plum Creek Wind Farm
	1,000 feet and/or sufficient distance to meet state noise standards, whichever is greater[1]	Murray County Renewable Energy Ordinance	
Noise Requirements	Distance must meet the state noise standard of 50 dB(A)[2]	Minnesota Pollution Control Agency (MPCA)	Turbines are sited for turbine-only noise to be < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences
Property Lines	3 x RD on east-west axis and 5 x RD on north-south axis	Murray County Renewable Energy Ordinance	3 x RD in non-prevailing wind direction and 5 x RD in prevailing wind direction
Public Roads and Trails	Minimum 250 feet	Commission's General Permit Standards	1.1 x total turbine height
Other Rights-of-Way (powerline, pipeline)	1.1 x the total height	Murray County Renewable Energy Ordinance	1.1 x total turbine height
Public Conservation Land Managed as Grasslands	3 x RD on east-west axis and 5 x RD on north-south axis[3]	Murray County Renewable Energy Ordinance	3 x RD in non-prevailing wind direction and 5 x RD in prevailing wind direction
U.S. Fish and Wildlife Service Wetlands Types III, IV, and V which are 10 acres or greater	3 x RD on east-west axis and 5 x RD on north-south axis	Murray County Renewable Energy Ordinance	3 x RD in non-prevailing wind direction and 5 x RD in prevailing wind direction (in Murray County only)
Other Structures (barns, grain bins, etc.)	1.1 x the total height	Murray County Renewable Energy Ordinance	1.1 x total turbine height (in Murray County only)
Other Existing WECS and Internal Spacing	3 x RD on east-west axis and 5 x RD on north-south axis	Murray County Renewable Energy Ordinance	N/A

[1] Commission's General Permit Standards identify the minimum setback from residences as 500 feet, or the minimum distance required to meet the state noise standard of 50 decibels dB(A), whichever is greater. Plum Creek follows the practice of siting turbines at least 1,000 feet from residences or the minimum distance required to meet the state noise standard of 50 decibels dB(A), whichever is greater.

Table 5.1-1
Wind Turbine Setback Requirements for the Project

Turbine Setback Requirement	Distance for Setback	Authority	Setback applied to Plum Creek Wind Farm

[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. Additionally, based on the 2019 LWECS Application Guidance, DOC-EERA staff recommend turbine-only noise to be < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences. The layouts included in this Amended Application meet this recommendation.

[3] Plum Creek implemented this setback based on the prevailing and non-prevailing wind directions. The Project's "wind rose" displaying the prevailing and non-prevailing wind directions is provided in Section 9.1.10.

As shown in Table 5.1-1, Plum Creek adheres to siting turbines at least one thousand (1,000) feet from residences. Additionally, based on the LWECS Application Guidance, all turbines are sited to meet the recommendation of less than 45 dB(A) turbine-only noise at non-participating residences and less than 47 dB(A) turbine-only noise at participating residences. In doing so, and as described in more detail in Section 8.4 (Noise), the Project complies with the MPCA limit of 50 decibels (dB) using the A-weighted scale (dB(A)) nighttime L_{50} (the level exceeded for 50 percent of the time) noise level.

Plum Creek applied a minimum setback of 1.1x turbine height from all public roads, trails, and other rights-of-way (i.e., powerline and pipeline). All turbines will be located a minimum of five rotor diameters (RD) from non-leased properties in the prevailing wind direction (generally the northern and southern edge of leased areas) and 3 RDs in the non-prevailing wind direction (generally the eastern and western edge of leased areas) to accommodate disruption of normal wind flow and protect the wind rights of non-participating landowners. Similarly, internal turbine spacing will be at least 5 RD in the prevailing wind direction and 3 RD in the non-prevailing wind direction, with no more than twenty percent (20%) of the Project's turbines closer than the prescribed internal setbacks. Table 5.1-2 reflects the differing setbacks based on RD for the types of turbines under consideration for the Project.

Specific to Murray County, Plum Creek applied a setback of 3 x RD in the non-prevailing wind direction and 5 x RD in the prevailing wind direction from public conservations lands managed as grasslands (National Wildlife Refuge [NWR] parcel; *see* Section 8.8 – Recreation) and U.S. Fish and Wildlife Service (USFWS) wetland Types III, IV, and V that are 10 acres or larger in size. Plum Creek notes that it received a letter in June 2019 from the Murray County Board of Commissioners that clarifies the intent of setbacks from USFWS Types III, IV, and V was to include only those wetlands 10 acres or greater; that is, there is no setback from these types of wetlands that are less than 10 acres in size (Appendix A). Finally, Plum Creek applied a 1.1x total turbine height setback to "other structures" such as barns and grain bins.

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

Turbine Description	5 RD[1] (m)	3 RD[1] (m)	1.1x Total Height (including blades, m)
Vestas V162	810	486	220

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

Turbine Description	5 RD[1] (m)	3 RD[1] (m)	1.1x Total Height (including blades, m)
SG170	850	510	220

[1] The listed RDs provide the range of rotor sizes; depending on the final turbine selection, the RD may vary from the listed values.

In addition to the regulatory setbacks applied to the Project in Table 5.1-1, Plum Creek has designed both layouts to minimize shadow flicker to 30 hours or less of shadow flicker per year at non-participating residences. Additionally, both layouts incorporate Minnesota Department of Natural Resources (MNDNR) feedback on siting turbines more than 1,000 feet from riparian areas associated with Highwater and Dutch Charley Creeks, as these corridors likely provide good bat habitat and avoiding permanent impacts (turbines, access roads, collector substations) and minimizing temporary impacts (crane paths, collection lines, and workspace associated with access roads and turbines) to MNDNR-mapped native prairie, native plant communities, and sites of biodiversity significance.

Both layouts include primary and alternate positions: there are six alternate turbine positions in the V162 layout and eleven alternate turbine positions in the SG170 layout.

Additional turbine siting considerations and an approximate schedule for determining these factors are included in Table 5.1-3.

Table 5.1-3
Turbine Siting Considerations and Approximate Schedule

Issue	Expected Resolution Schedule	Siting Consideration
Exclusion areas	At issuance of permit	All exclusion areas in the Amended Application are those proposed by Plum Creek and are based on environmental and existing infrastructure constraints. Additional exclusion areas, if any, will be determined through the site permit process.
Setbacks	At issuance of permit	All setbacks in the Amended Application are proposed by Plum Creek and are based on the Commission's General Permit Standards and Murray County setbacks (as applicable), as well as Plum Creek's other commitments.
Turbine type	Once turbine purchase negotiations are complete	Siting turbines is based on: A) Manufacturer specs and standards B) Turbine interaction within the Project microclimate, etc.
Final leased land boundary	Once final lease and easement negotiations are complete with landowners	Plum Creek will not site turbines on unleased properties and will observe a wind rights buffer from unleased property lines.
Title clearance	After site control is complete	Plum Creek will site turbines on leased land that has been properly cleared using any necessary Subordination, Non-Disturbance and Attornment agreements and consent forms from appropriate parties. All signed land is to be insured through a title insurance policy. Plum Creek will not site turbines on non-participating landowner properties.
Energy optimization	After all final leases and setbacks requirements are complete	Wind energy will be optimized by considering the turbine interaction with the site's microclimate and internal spacing between turbines within the Project.
Geotechnical analysis	After all other field surveys and turbine micrositing are complete	Geotechnical soil borings will be conducted at the location of final turbine placement to determine the soil suitability to support turbine foundations.
Wetlands	Jurisdictional wetlands and waters within the construction limits of Project facilities will be delineated prior to construction. Necessary state and/or federal permits for unavoidable impacts must be obtained before construction commences in wetlands	Permanent impacts to wetlands/waters subject to state and federal jurisdiction will be avoided or minimized as practicable.

Table 5.1-3
Turbine Siting Considerations and Approximate Schedule

Issue	Expected Resolution Schedule	Siting Consideration
Cultural	All areas with proposed ground disturbance will be surveyed for cultural resources	Cultural resources identified within the proposed construction areas and existing known resources in the area will be avoided as feasible. If avoidance is not practical, 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.

This Amended Application contains two site layouts that reflect Plum Creek's best effort to maximize the energy production of the Project, follow applicable setbacks, and minimize human and environmental impacts to the land and surrounding community (Figures 3a and 3b – Project Area and Facilities). Within each of the layouts, Plum Creek selected the proposed turbine locations to minimize the potential land use and environmental impacts from the Project. Plum Creek proposes to construct one of the Project layouts presented in this Amended Application but also recognizes that changes to the location of some Project facilities may occur as a result of the Commission's and other permitting processes, further landowner input, and micrositing activities.

5.2 Description of Turbines and Towers

5.2.1 Wind Turbine Design and Operation

A wind turbine generally consists of a nacelle, hub, blades, tower, and foundation. The nacelle houses the generator, gear boxes, upper controls, generator cabling, hoist, generator cooling, and other miscellaneous equipment. The hub supports the blades and connecting rotor, yaw motors, mechanical braking system, and a power supply for emergency braking. The hub also contains an emergency power supply to allow the mechanical brakes to work if electric power from the grid is lost. Each turbine has three blades composed of carbon fibers, fiberglass, and internal supports to provide a lightweight but strong component. The tip of each blade is equipped with a lightning receptor.

The tower supports the nacelle, hub, and blades. The tower houses electrical, control, and communication cables and a control system located at the base of the tower. Towers may include lifts for use by Project personnel. Tubular towers are painted a non-glare white or off-white. Electrical equipment at the base of each tower conditions the generated electricity to match electric grid requirements. The expected tower foundation will be a spread-foundation design. The above-ground portion of the foundation will be approximately 20 feet in diameter.

The wind turbine blades convert linear energy from wind into rotational energy. An anemometer and weathervane located on the turbine nacelle continuously sense wind speed and wind direction.

The hub and nacelle are constantly being rotated to match wind speed direction. Yaw motors rotate the blades to optimize blade angles in relation to wind speed and direction. The hub transfers mechanical force from the blades to the shaft connecting the hub to the gear box located within the nacelle. The mechanical braking system, located within the hub, locks the blade rotor to prevent the blades from spinning during maintenance periods or other times when the turbine is out of service. The gear box adjusts shaft speeds to match the required generator speed. Electricity is produced by the generator and transmitted through insulated cables to the electrical conditioning unit, known as a pad-mount transformer, located at the base of the tower or within the tower section of the turbine.

5.2.2 Turbine Model Selection and Types

Plum Creek has not yet finalized the specific turbine choice for the Project. The decision will be finalized prior to construction to create the most viable, cost-effective, and optimal design for the Project given the known conditions of the Project Area and the turbines that are commercially available when the Project is constructed. Further, since turbine technology is continually evolving, flexibility in selecting a turbine model will enable the Project to take advantage of the latest technology advancements. The turbines Plum Creek is considering for the Project span the energy production range of 5.6 MW to 6.2 MW. Proposed turbine hub heights range from 115 to 119 m (377 to 391 feet) and the RD range from 162 to 170 m (532 to 558 feet). Table 5.2-1 shows the range of characteristics for the two proposed turbines as well as the number of primary and alternate turbine positions for each of the turbine layouts.

Table 5.2-1
Wind Turbine Characteristics

Characteristic	Turbine	
	Vestas 5.6-V162	SG170
Nameplate capacity (kilowatts)	5,600	6,200
Hub height in meters (m)[1]	119	115
Rotor Diameter (m)	162	170
Total height[2] (m)	200	200
Cut-in wind speed[3] meters per second (m/s)	3	3
Rated capacity wind speed[4] (m/s)	12	11
Cut-out wind speed[5] (m/s)	24	25
Maximum sustained wind speed[6] (m/s)	52.5	52.5
Wind Swept Area (m^2)	21,520	22,698
Rotor speed (rpm)	4.3-12.1	3.8-8.5
Primary Turbine Positions	74	67
Alternate Turbine Positions	6	11

Table 5.2-1 Wind Turbine Characteristics		
	Turbine	
Characteristic	Vestas 5.6-V162	SG170
[1] Hub height = the turbine height from the ground to the top of the nacelle.		
[2] Total height = the total turbine height from the ground to the tip of the blade in an upright position.		
[3] Cut-in wind speed = wind speed at which turbine begins operation		
[4] Rated capacity wind speed = wind speed at which turbine reaches its rated capacity		
[5] Cut-out wind speed = wind speed above which turbine shuts down operation		
[6] Maximum sustained wind speed = wind speed up to which turbine is designed to withstand		

Turbine

Table 5.2-1 provides details on the hub height, RD, and wind speed operation parameters for the Vestas V162 and SG170 turbines. Both models have active yaw and pitch regulation. The SG170 uses an asynchronous double-fed induction generator, while the V162 turbine uses a permanent magnet synchronous generator with a full-scale power converter. The turbines use a bedplate drive-train design where all nacelle components are joined on common structures to improve durability. Both turbine models are capable of operating with adjusted cut-in speeds and full blade feathering.

Both proposed turbine models have Supervisory Control and Data Acquisition (SCADA) communication technology to control and monitor the Project. The SCADA communications system permits automatic, independent operation and remote supervision, allowing the simultaneous control of the wind turbines.

Operations, maintenance, and service arrangements between the turbine manufacturer and the Applicant will be structured to provide timely and efficient O&M. The computerized data network will provide detailed operating and performance information for each wind turbine. Plum Creek will maintain a computer program and database for tracking each wind turbine's operational history.

Other turbine specifications are outlined for the three representative turbine models in Table 5.2-2.

Table 5.2-2 Other Turbine Specifications		
Sub-System	Vestas V162	SG170
Pitch Regulation	Individual hydraulic	Individual hydraulic
Gearbox	2-stage planetary	3-stage (2 planetary + 1 parallel)
Yaw Control	6 planetary gears	8 planetary gears
Braking System	Main aerodynamic brake (individual blade), mechanical brake on medium-speed shaft	Main aerodynamic brake, hydraulic disk brake on high-speed shaft
Main Bearing	Cylindrical roller	2x tapered roller

Both of the turbines being considered also incorporate new technology compared to turbines currently installed on the landscape, including:

- 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
- SCADA-controlled generation modulation

Rotor

The rotor consists of three blades mounted to a rotor hub. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system, and other electrical and mechanical systems. Summary technical characteristics for each turbine model can be found in Table 5.2-1.

Tower

The towers are conical tubular in shape with a hub height of 115 to 119 m (377 to 391 feet). The turbine tower, where the nacelle is mounted, consists of three to four 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 (ANSI) 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 connecting four platforms and equipped with a fall arresting safety system.

5.3 Description of Electrical and Fiber Optic Communication System

Construction of the Project will include up to 74 wind turbines. At the base of or within the tower section of each turbine, a step-up transformer will be installed to raise the voltage of the electricity generated by the turbine to the power collection line voltage of 34.5 kV. In both V162 and SG170 turbines, the step-up transformer is located within the nacelle. Electrical collection and fiber optic communication systems will connect the Project's wind turbines to the collector substations and provide communications between the wind turbines, substations, O&M facility and electrical grid. The collection and fiber-optic systems will be underground, unless unanticipated site-specific conditions require aboveground wiring. Where underground, the wires will be placed in the same trench wherever possible and will include a marking system and occasional aboveground junction boxes. All of the collection circuits will connect to Plum Creek's two collector substations, which will have a fiber-optic connection to the O&M facility and a communication system to the grid operator. The power delivered to the Project substation will be converted to 345 kV. There will then be a 345-kV transmission line segment connecting Collector Substation 1 to Collector Substation 2 and an additional segment connecting Collector Substation 2 to the switching station which will interconnect into the existing Brookings to Hampton 345 kV transmission line. This transmission line and switching station will be addressed in a separate RP application. All grid to Project communications will be specified by the interconnecting utility(ies) under a Generator Interconnection Agreement.

6.0 DESCRIPTION AND LOCATION OF ASSOCIATED FACILITIES

A number of facilities will be constructed to support the operation of the wind turbines and facilitate the delivery of the electricity to consumers. Plum Creek seeks permitting approval from the Commission through a LWECS site permit for the following associated facilities: permanent meteorological towers and other weather data collection systems, up to two ADLS radars, an electrical collection and communications system, access roads, temporary laydown and staging areas, the two collector substations, and associated equipment, and an O&M facility. The two collector substations will require approximately 10 acres of land each within the Project Area. The O&M facility may be located adjacent to Collector Substation 2. These facilities have been sited such that the disturbance from installation of the collection system and fiber-optic communications is minimized to the extent feasible. As discussed in Section 5.3 of this Amended Application, Plum Creek also proposes to construct an approximately five-mile 345-kV transmission line between the two collector substations within the Project Area and an approximately 25-mile 345 kV transmission line between Collector Substation 1 and the proposed switching station approximately 16 miles north of the Project Area. The proposed transmission lines will be permitted under an RP application. A potential location for the Project facilities, including the collector substations, is shown on Figures 3a-3b (Project Area and Facilities).

6.1 Collector Lines and Feeder Lines

Power will run through an underground and/or aboveground collection system to one of the two collector substations, which will raise the voltage to 345 kV. The electrical collection system will consist of a network of electrical cabling operating at 34.5 kV. Approximately 121 miles of underground lines will be installed for the V162 layout and 131 miles for the SG170 layout by trenching, plowing, and/or, where needed, directionally boring the cables underground. Generally, the electrical collection lines will be buried in trenches. Additionally, collector system cabling may go aboveground when conflicts with existing underground utilities, other infrastructure, or sensitive environmental conditions such as native prairie remnants cannot be resolved and aboveground cabling will resolve the conflict. Where electrical collectors meet public road right-of-way, 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 require an aboveground junction box when the lines from separate spools need to be spliced together.

Proposed electrical layouts based on the turbine layouts are shown on Figures 3a-3b (Project Area and Facilities).

6.2 Additional Associated Facilities

An O&M facility will be constructed in the Project Area and will provide access and storage for Project O&M. The O&M facility is proposed to be co-located with the Collector Substation 2. The buildings typically used for this purpose are approximately 3,000 to 5,000 square feet and house

the equipment to operate and maintain the Project. The parking lot adjacent to the building is typically approximately 3,000 square feet.

Plum Creek proposes to construct up to four permanent meteorological towers with the potential for a SoDAR and/or a LiDAR unit(s). Met towers will monitor meteorological data. The preliminary locations of the four permanent meteorological towers or SoDAR/LiDAR units are shown on Figures 3a-3b (Project Area and Facilities).

Plum Creek will coordinate with the FAA on potential implementation of an ADLS radar. Plum Creek expects up to two radar units will be needed to provide coverage for the Project. The location of the radar unit(s) will be determined based on participating landowners, environmental conditions, an analysis of radar coverage from an ADLS technology vendor, and ultimately a review and approval by the FAA.

Plum Creek will also grade up to three temporary laydown areas totaling 18.4 acres that are distributed throughout the Project Area, to serve both as a parking area for construction personnel and staging area for turbine components during construction. The temporary laydown areas are included on Figures 3a-3b (Project Area and Facilities).

6.3 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 150 feet wide to accommodate transportation of heavy construction equipment. Once Plum Creek completes construction of the turbines, the roads will be reduced to their permanent width of 20 feet. Total access road length will be approximately 20.5 miles for the V162 layout and 22 miles for the SG170 layout, with final lengths determined by civil engineering and the final turbine layout.

Plum Creek designed the access road network to efficiently serve the Project, minimize environmental impacts, and reduce overall length as practicable. Plum Creek also takes landowner input on road locations into consideration.

6.4 Permitting for Associated Facilities

Plum Creek will obtain all permits and licenses that are required following issuance of the LWECS Site Permit.

7.0 WIND RIGHTS

Land rights secured from each landowner vary, and may include, but are not limited to, the rights to construct wind turbines and Project facilities, including access roads, rights to wind and buffer easements, and authorization to construct collection lines in public road right-of-way. Plum Creek currently leases 52,708 acres of the 72,968 acres within the Project Area (72 percent of the Project Area). Plum Creek remains in negotiation with multiple landowners within the Project Area and anticipates acreage being added to the Project's leased lands within the Project Area before construction. Figures 4a-4b (Land Ownership) provide maps of the turbine layout and the property lines within the Project Area. Figures 2a-2c depict 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, along with an analysis of the potential impacts of the Project, mitigative measures, and any adverse environmental effects that cannot be avoided. Consistent with Commission procedures on siting LWECS and with applicable portions of the Power Plant Siting Act, various exclusion and avoidance criteria were considered in selecting the Project Area.

Plum Creek has defined impacts by their duration, size, intensity, and location. This context is used to determine an overall resource-level impact. Impact levels are described using qualitative descriptors that are not intended as value judgement, but rather as a measure to ensure a common understanding among readers and to compare resource impacts.

- **Minimal –** Minimal impacts do not considerably alter an existing resource condition or function. Minimal impacts may, for some resources and at some locations, be noticeable to an average observer. These impacts generally affect common resources over the short-term.
- **Moderate –** Moderate impacts alter an existing resource condition or function and are generally noticeable or predictable for the average observer. Effects may be spread out over a large area, making them difficult to observe, but can be estimated by modeling or other means. Moderate impacts may be long term or permanent to common resources but are generally short- to long-term for rare and unique resources.
- **Significant –** Significant impacts alter an existing resource or condition or function to the extent that the resource is severely impaired or cannot function. Significant impacts are likely noticeable or predictable for the average observer. Effects may be spread out over a large area making them difficult to observe but can be estimated by modeling. Significant impacts can be of any duration and may affect common and rare and unique resources.

In addition to identifying existing resources and the potential effects on those resources, Plum Creek identified measures that can be used to avoid, minimize, or mitigate effects. These actions are collectively referred to as mitigation.

- **Avoid –** Avoiding an impact means that the impact is eliminated altogether by moving or not undertaking parts or all of a project.
- **Minimize –** Minimizing an impact means to limit its intensity by reducing the project size or moving a portion of the project from a given location.
- **Mitigate –** Impacts that cannot be avoided or minimized could be mitigated. Impacts can be mitigated by repairing, rehabilitating, or restoring the affected environment, or compensating for it by replacing or providing a substitute somewhere else.

Plum Creek analyzed potential impacts to human and environmental resources based on a specific impact assessment area. The impact assessment area for each resource is the geographic area within which the Project may exert some influence. These impact assessment areas vary with the resource being analyzed and the potential impact and are summarized in Table 8.0-1.

The following impact assessment areas will be used:

- **Footprint of Facilities**. The temporary and permanent footprint of facilities for construction and operation of the Project are described below and in Table 8.0-2.
- **One mile**. A distance of one mile from the Project Area is used as the impact assessment area for analyzing potential impacts to archaeological and historic resources and rare and unique species. Residences within one mile of the Project Area are included in the impact assessment area for noise and shadow flicker.
- **Ten Miles.** A distance of ten miles from the Project Area is used as the impact assessment area for analyzing potential impacts to air traffic and visual resources.
- **Project Counties**. The Project counties are those in which the Project is located and include Cottonwood, Murray, and Redwood Counties.

Table 8.0-1
Impact Assessment Area

Impact Assessment Area	Environmental Resource
Footprint of Facilities	Conservation Easements, Public Services and Infrastructure, Recreation, Electromagnetic Fields and Stray Voltage, Hazardous Materials, Land-Based Economies, Topography, Soils, Geologic and Groundwater Resources, Surface Waters and Floodplains, Wetlands, Vegetation, Wildlife
One Mile	Noise, Shadow Flicker, Cultural and Archaeological Resources, Rare and Unique Natural Resources
Ten Miles	Air Traffic and Visual Impacts
Project Counties	Demographics, Land Use, Tourism, Local Economies and Community Benefits

Table 8.0-2 summarizes the permanent and temporary footprint for each Project feature for each layout. The assumptions for permanent and temporary footprints are the same regardless of turbine model and layout. For example, the turbine pad/transformer (permanent impact) and construction workspace for each turbine (temporary impact) are the same for both theV162 and SG170 layouts. The differences in the total footprints for each layout are reflected by differences in total number of proposed turbines (as shown in Table 5.2-1). Plum Creek has co-located access roads, collection lines, and crane paths to the extent practicable to minimize the Project's footprint. These footprint assumptions are based on Plum Creek's development experience and the size of the turbines. Plum Creek notes that the V162 layout is preliminarily designed for all 80 turbines, including the six alternate turbine positions. Similarly, the SG170 layout is preliminarily designed for all 78 turbines, including eleven alternate turbine positions. Therefore, the impacts included in this Amended Application overestimate the acreage.

Table 8.0-2
Summary of Permanent and Temporary Footprint from Project Facilities (acres)

Project Facility[1]	Description of Footprint	V162		SG170	
		Permanent	Temporary	Permanent	Temporary
Turbines	50-foot radius for turbine pad	14.4	-	14.1	-
	300-foot radius for construction workspace	-	494.5	-	481.2
Access Roads	20-foot-wide road	48.0	-	51.6	-
	150-foot-wide construction workspace	-	243.4	-	263.6
Crane Paths	120-foot-wide corridor	-	534.0	-	538.9
Collection Lines	75-foot-wide corridor	-	670.9	-	657.3
Permanent Met Towers	75-foot by 75-foot workspace	-	0.6	-	0.6
Laydown/Staging Areas	Footprint of 3 laydown/staging areas dispersed throughout the Project	-	18.4	-	18.4
Collector Substation 1	Footprint of facility	10.7	-	10.7	-
Collector Substation 2/ O&M facility	Footprint of facility	10.2	-	10.2	-
	Total	**83.3**	**1,961.8**	**86.6**	**1960.0**

[1] Plum Creek will construct up to two ADLS radars. The number and location of radar unit(s) will be determined based on coordination with the FAA. Temporary workspace associated with ADLS is expected to be similar to the permanent met towers (75-foot by 75-foot workspace), resulting in 0.1 to 0.2 acres of temporary impacts. Because the location of the ADLS radar(s) is unknown, they are not accounted for in this table.

8.1 Demographics

Information about demographics provides important insight into existing human settlement patterns in a given area. LWECS projects have the potential to affect the existing demographics of an area in the short term through an influx of construction personnel which can influence demand for temporary housing. In the long term, addition of personnel to the area for operation of LWECS project could affect area demographics if the total number of personnel is large enough to affect total population, existing population density, demand for housing, or represent a significant change to the ethnicity or race of the local populace. A discussion of demographic information such as per capita income, unemployment rates, and total persons living below the poverty level is presented with the discussion of local economy and community benefits in Section 8.13.

8.1.1 Description of Resources

Demographic information for the counties within the Project Area is based on the U.S. Census Bureau 2010 Census and the 2018: American Community Survey (ACS) 5-year Estimates Data Profiles, available on Explore Census Data and QuickFacts websites. (U.S. Census Bureau, 2019a, 2018a, and 2018b). Demographic information is summarized in tables 8.1-1, 8.1-2, and 8.1-3.

Demographic information for the counties within the Project Area is provided at the county level to characterize the demographics in the Project Area and at the state level for the purpose of comparison. Comparable census data about population, housing, race and ethnicity, employment industries, and population density is not available for townships, towns, and cities with a population of less than 5,000 persons on the new U.S. Census Bureau websites. For this reason, township level data is not provided.

The three counties in the Project Area have very small populations compared to the State of Minnesota as a whole, comprising less than one percent of the state's total population (*see* Table 8.1-1). According to 2019 population estimates U.S. Census Bureau, the total population in Minnesota increased by 6.3 percent as compared to 2010 census data, while the estimated 2019 population in Cottonwood, Murray, and Redwood Counties decreased by an average of 5.2 percent since the 2010 census (U.S. Census Bureau, 2019a).

The 2018: ACS 5-year Estimates Data Profiles data indicates that the total number of housing units in the counties in the Project Area is 5,435 in Cottonwood County, 4,621 in Murray County, and 7,314 in Redwood County (*see* Table 8.1-1).

The top three industries of employment in the State of Minnesota are "education, health, and social services" at 25.2 percent, "manufacturing" at 13.4 percent, and "retail trade" at 11.0 percent (U.S. Census Bureau, 2018a). The top three industries of employment in the counties within the Project Area are similar to the state level, but "agriculture, forestry, fishing, and hunting, and mining" plays a larger role than manufacturing and retail trade in Murray County and "arts, entertainment, and recreation, and accommodation and food service" plays a larger role than retail trade in Redwood County. Table 8.1-1 provides the top three industries of employment for Minnesota and the counties in the Project Area.

Table 8.1-1
Demographics in the Project Area

Counties and Townships	Population, Census, April 1, 2010[1]	ACS Population Estimates July 1, 2019[1]	Percent Change 2010 - 2019[1]	2018 Estimated Total Housing Units[2]	2018 Estimated Total Vacant Housing Units[2]	Top 3 Industries[3, 4]
Minnesota	**5,303,925**	**5,639,632**	**6.3**	**2,420,473**	**252,672**	**E (25.2%), M (13.4%), R (11.0%)**
Cottonwood County	11,687	11,196	-4.2	5,435	585	E (23.2%), M (20.0%), R (11.5%)
Murray County	8,725	8,194	-6.1	4,621	919	E (22.6%), Ag (13.2%), M (12.7%)
Redwood County	16,059	15,170	-5.5	7,314	1,074	E (23.8%), M (13.8%), A (11.1%)

1 U.S. Census Bureau, 2019a
2 U.S. Census Bureau, 2018a
3 U.S. Census Bureau, 2018b
4 Industries are defined under the 2012 North American Industry Classification System (NAICS) and abbreviated as follows: E = Educational, Health and Social Services; M = Manufacturing; R = Retail Trade, Ag = Agriculture, forestry, fishing and hunting, and mining; A = Arts, entertainment, and recreation, and accommodation and food service.

Table 8.1-2
Race and Ethnicity of the Population in the Project Area

Location	White Alone, Not Hispanic or Latino (%)	Black or African American Alone (%)	American Indian or Alaska Native Alone (%)	Asian Alone (%)	Native Hawaiian/ Pacific Islander Alone (%)	Two or More Races (%)	Hispanic or Latino (%)	Total Minority (%)[1]
Minnesota	79.1	7.0	1.4	5.2	0.1	2.6	5.6	20.9
Cottonwood County	84.7	1.3	0.9	4.1	0.4	2.0	8.4	15.3
Murray County	92.2	0.5	0.5	1.6	0.2	1.3	4.4	7.8
Redwood County	86.4	1.1	5.0	2.6	0.1	2.3	3.8	13.6

[1] Total minority percentage equals the total population minus the population of white, non-Hispanic or Latino.
Source: U.S. Census Bureau, 2019a

On average, over 87 percent of the population in the Project Area identifies as White Alone, Not Hispanic or Latino, which is slightly higher than the state level of 79.1 percent (*see* Table 8.1-2). The percentage of total minority residents in Cottonwood, Murray, and Redwood Counties is generally lower than the state level.

According to 2010 U.S. Census data, population densities within five miles of the Project Area boundary range from 42.4 people per square mile in Brown County, which is east of the Project Area, to 12.4 people per square mile in Murray County (*see* Table 8.1-3).

There are 205 residences within the Project Area (Figures 3a-3b). There is no indication that any minority or low-income population is concentrated in any one area of the Project (*see* Table 8.1-2), or that the wind turbines will be placed in an area occupied primarily by any minority population.

Table 8.1-3
Population Density within Five Miles of the Project Area

Counties and Townships[1]	Total Land Area (sq. mi.)	Population Density per square mile of land area
Minnesota	79,626.74	66.6
Cottonwood County	638.61	18.3
Murray County	704.70	12.4
Redwood County	878.57	18.3
Brown County	*611.09*	*42.4*
Lyon County	*714.56*	*36.2*

[1] Counties shown in italics are located outside of the Project Area.
Source: U.S. Census Bureau, 2019b

8.1.2 Impacts

Construction and operation of the Project will not displace residents and is expected to have a minimal, temporary to long-term impact on the demographics of the Project Area. Approximately 250 construction personnel will be required for construction and 11 to 15 permanent personnel will be needed for operation and maintenance of the Project. Plum Creek will use local contractors for portions of the construction process, as available. If no local contractors are available, the influx of 250 construction personnel would equate to a total population increase of approximately 2.1 percent in Cottonwood County, 2.9 percent in Murray County, and 1.5 percent in Redwood County over 2010 census numbers. This would represent a minimal, temporary increase in the total population of the counties in Project Area.

Temporary housing for construction personnel is available in the form of motels and hotels in municipalities near the Project Area such as Windom, Marshall, Redwood Falls, and Worthington, all of which are within 25 miles of the Project Area. According to the website Hotels.com, there are three hotels in Windom, six hotels in Marshall, eight hotels in Redwood Falls and nearby Morton, and six hotels in Worthington (Hotels.com, 2019). If necessary, construction personnel could also travel to larger municipalities that are between 50 and 60 miles from the Project Area such as, New Ulm or Fairmont, Minnesota or Brookings or Sioux Falls, South Dakota. In addition, as shown in Table 8.1-1, a combined total of 2,578 vacant housing units are available in

Cottonwood, Murray, and Redwood Counties (U.S. Census, 2017). Overall, the demand for temporary housing for construction personnel would represent a minimal, temporary impact on the availability of temporary housing in Cottonwood, Murray, and Redwood Counties.

The addition of 11 to 15 permanent personnel for the Project would result in a minimal but long-term impact on population levels and housing in the counties in the Project Area. Permanent personnel would likely relocate to the Project Area which would increase total population and the demand for permanent housing. The addition of 11 to 15 persons would represent a population increase of less than one percent in the counties affected by the Project. Furthermore, the availability of 2,578 vacant housing units throughout Cottonwood, Murray, and Redwood Counties would be sufficient to house 11 to 15 permanent personnel.

The Project will not affect environmental justice communities. Minority populations make up a relatively small percentage (generally, less than 20 percent) of the total population in the townships within the Project Area. Furthermore, as shown in Table 8.1-4, population densities at the township level are generally sparser (i.e., fewer than 20 people per square mile).

8.1.1 Mitigative Measures

No impacts are anticipated, and as such, no mitigation is necessary.

8.2 Land Use and Zoning

Information about land use and zoning provides important insight into existing human settlement patterns and future development. Plum Creek reviewed land use and county zoning information for Cottonwood, Murray, and Redwood Counties to assess the Project's potential to impact existing land uses and to identify any additional siting constraints that should be considered for the development of a wind farm. A discussion of existing land cover types, based on data from the National Land Cover Database, is presented in Section 8.19.

The Project Area is predominantly rural with sparsely scattered rural residences, farmsteads, commercial livestock operations, agricultural support facilities, and commercial business throughout. The Project Area was developed to avoid municipalities to the extent possible. The municipal boundary of Dovray is partially within the Project Area in Murray County.

The Project is subject to Minnesota's Wind Siting Act (Minn. R. Ch. 7854), Minn. Stat. Ch. 216F for siting of wind energy conversion systems, and the Power Plant Siting Act (Minn. Stat. § 216E). As such, and pursuant to Minn. Stat. § 216F.07, a site permit issued by the Commission, "supersedes and preempts all zoning, building or land use rules, regulations or ordinances adopted by regional, county, local and special purpose governments." Therefore, Plum Creek is not required to apply to county zoning authorities for additional permits or approvals for the Project. However, pursuant to Minn. Stat. § 216F.081, "The commission, in considering a permit application for LWECS in a county that has adopted more stringent standards, shall consider and apply those more stringent standards, unless the commission finds good cause not to apply the standards." To assist the Commission in its review of the Project, Plum Creek reviewed and

incorporated pertinent county zoning requirements for wind energy development in this Amended Application. The results of Plum Creek's review are presented in the subsections that follow.

8.2.1 Local Zoning and Comprehensive Plans

A comprehensive plan is a land-use and community-planning tool used to guide the direction and intent of growth for a county or municipality. Generally, comprehensive plans discuss existing and future land uses, population and housing trends, economic development goals and opportunities, and environmental characteristics of the county or municipality. In preparing this Amended Application, Plum Creek reviewed and analyzed zoning ordinances and the land use section (and other applicable sections of) the most recently adopted comprehensive plans from the counties and townships within and adjacent to the proposed Project Area. Table 8.2-1 provides an inventory of the zoning ordinances and comprehensive plans that were reviewed.

Table 8.2-1
Comprehensive Plan Inventory for Local Governments within the Project Area

Governing Body[1]	Name of Plan	Year Adopted	Associated Development Plan(s)
Cottonwood County	Cottonwood County Zoning Ordinance	2016	Comprehensive Land Use Plan (2005)
Murray County	Murray County Zoning Ordinance	2014	Comprehensive Plan (2016)
Redwood County	Redwood County Zoning Ordinance (Draft as of March 2, 2018)	Unknown	Comprehensive Plan (Final Draft Document, 2007)

[1] Townships in the Project Area are included in the comprehensive plans for their respective counties.

In determining the existing and future land-use and zoning classifications for the proposed Project, the Applicant reviewed the zoning ordinances and comprehensive plans listed in Table 8.2-1 and the official zoning maps for Cottonwood, Murray, and Redwood Counties. Regarding future land use planning, Plum Creek reviewed the future planning map for Murray County; future planning maps for Cottonwood and Redwood Counties were not available. Zoning and future land use for the Project Area are displayed on Figures 5a and 5b (Zoning Map).

8.2.1.1 Cottonwood County

The Cottonwood County Comprehensive Land Use Plan (2005) states that, similar to other counties in southwestern Minnesota, agricultural production will continue to be the predominant industry in the county. However, the plan lists a number of opportunities for industry diversification that would contribute to future economic growth, including renewable energy development. Specifically, the plan discusses opportunities related to wind power and ethanol and bio-diesel production.

Portions of the Project Area fall within the Floodplain and Shoreland Districts in Cottonwood County, though most of the Project Area is within the Agricultural District, as identified in the Cottonwood County Zoning Ordinance, as amended January 1, 2016 (Cottonwood County, 2016). These districts are defined in the Cottonwood County Zoning Ordinance as follows:

- **Floodplain District**: All areas identified as having special flood hazards by the Federal Emergency Management Agency and designated as flood hazard zones A-1 through A-30 and unnumbered A zones on the Cottonwood County Flood Insurance Rate Map (January 2, 1981). Siting of LWECS in the Floodplain District is prohibited according to the Cottonwood County Renewable Energy Ordinance (Cottonwood County, 2016).
- **Agricultural District**: All unincorporated areas of the County, including unincorporated area of Delft, which are not included in the Floodplain District, Residential District, Commercial District, Industrial District, and the Shoreland District. Siting of LWECS is conditionally permitted within the Agricultural District according to the Cottonwood County Renewable Energy Ordinance (Cottonwood County, 2016).
- **Shoreland District**: Areas within 1,000 feet from the ordinary high-water level of a lake, pond, or flowage greater than 25 acres in size in unincorporated areas, and 300 feet from a river or stream or the landward extent of a floodplain designated by this Ordinance on a river or stream, whichever is greater. Siting of LWECS in the Shoreland District is prohibited according to the Cottonwood County Renewable Energy Ordinance (Cottonwood County, 2016).

The Comprehensive Plan for Murray County (2016) states that the goal of economic development in Murray County is "To promote sustainable economic development and opportunity, foster effective communication and transportation systems, enhance and protect the environment, and balance resources through sound management of development." The Economic Development section of the plan goes on to list renewable energy development (e.g., wind and solar) as one of the key development opportunities for future economic growth.

8.2.1.2 Murray County

The Murray County Zoning Ordinance applies to all townships and unincorporated areas within the county. Portions of the Project Area fall within the Agricultural District, as identified in the Murray County Zoning Ordinance, as amended May 6, 2014 (Murray County, 2014). In addition to the underlying zoning districts established in the Zoning Ordinance, the county has established overlay districts to protect environmental resources. Portions of the Project Area fall within the Floodplain Management District, Shoreland Management District, and the Special Protection District. All districts are defined in the Murray County Zoning Ordinance (2014) as follows:

- **Agricultural District**: All unincorporated areas of Murray County that do not fall within the Rural Residence District, General Business District, or the Industry District. Siting of LWECS is conditionally permitted within the Agricultural District according to the Murray County Renewable Energy Ordinance (Murray County, 2010).
- **Floodplain Management District**: All lands within the boundaries of the Floodway, Flood Fringe, or General Flood Plain District. Murray County has adopted the Federal Emergency Management Agency (FEMA) Flood Insurance Study and Flood Insurance Rate Map dated May 3, 1990 by reference. Siting of LWECS in the Floodplain Management District is conditionally permitted

according to the Murray County Renewable Energy Ordinance (Murray County, 2010).

- **Shoreland Management District**: Land within 1,000 feet of the normal high-water mark of a lake, pond, or flowage and 300 feet from a river or stream or the landward extension of a floodplain designated by the Murray County Zoning Ordinance on such a river or stream, whichever is greater. The practical limits of shoreland may be less than the statutory limits whenever the waters involved are bounded by natural topographic divides or when approved by the MNDNR and the County Commissioners (Murray County, 2014). All shoreland of public waters is classified in subd. 3 of Section 16 of the Murray County Zoning Ordinance (Murray County, 2014). The Shoreland Management District is intended to be overlain upon or in addition to the other underlying zoning districts defined in subd. 5 of the Murray County Ordinance. Siting of LWECS in the Shoreland Management District is not permitted according to the Murray County Renewable Energy Ordinance (Murray County, 2010).
- **Special Protection District**: Areas in this zone are based on topographic, vegetative, and soil conditions and intended to protect environmentally sensitive and scenic areas, retain major areas of natural ground cover for conservation purposes, and deter abuse of water resources and conserve other natural resources of the county. Siting of LWECS in the Special Protection District is not permitted according to the Murray County Renewable Energy Ordinance (Murray County, 2010).

The future land use maps for Murray County depict a one-mile buffer around the municipal limits of Dovray; the Project Area overlaps two small portions of this buffered area. The buffered area around Dovray is intended to encourage future urban development in the county within one mile of existing municipal boundaries in order to maximize use of existing infrastructure and provide for orderly annexation (Murray County Comprehensive Planning Advisory Committee, 2016). In addition, the Project Area overlaps with a Conservation Core Area in northeast Murray County. Conservation Core Areas are intended to protect large blocks of natural habitat within the county (Murray County Comprehensive Planning Advisory Committee, 2016).

8.2.1.3 Redwood County

Redwood County's Comprehensive Plan (Final Draft Document, 2007) notes that future economic development in the county will focus on utilization of the existing resources available in rural areas of the county to create a ". . . community where natural resources are cherished and valued and utilized in a sustainable manner to support a growing economy." The plan lists a number of initiatives that would help the county meet its economic development goals; two initiatives that apply to wind energy development include:

- "Economic development programs that encourage innovative approaches to manufacturing, agriculture, value-added agriculture, and energy production."
- "Long-term energy independence where, through wind, bio-mass, and other technologies, energy is produced and utilized within the county, and excess energy is sold to utility companies for export outside the county."

The Redwood County Zoning Ordinance applies to all unincorporated areas of Redwood County (Redwood County, 2018). Portions of the Project Area fall within the Floodplain District, Agricultural District, and the Shore Land District. These districts are defined in the Redwood County Zoning Ordinance as follows:

- **Floodplain District**: All lands within the boundaries of the Floodway, Flood Fringe, or General Flood Plain District. Redwood County has adopted by reference FEMA Flood Insurance Study, Redwood County, Minnesota and Incorporated Areas with Map Numbers 27127CIND1A and 27127CIND2A and all Flood Insurance Rate Maps for Redwood County. Siting of LWECS is not permitted in the Floodplain District according to the Redwood County Wind Power Management Ordinance (Redwood County, 2018).
- **Agricultural District**: All land within the county which is not included in the Scenic River District, Shoreland District, Small Cities Production Zones, City of Redwood Falls Protection Zone, and the County Future Development Zone. Siting of LWECS is conditionally permitted in the Agricultural District according to the Redwood County Wind Power Management Ordinance (Redwood County, 2018).
- **Shore Land District**: Area on either side of all rivers, creeks, streams, and tributaries listed in the MNDNR's Protected Waters Inventory. Siting of LWECS is not permitted in the Shore Land District according to the Redwood County Wind Power Management Ordinance (Redwood County, 2018).

Plum Creek reviewed available FEMA 100-year floodplain mapping of the Project Area in determining the location of facilities. As illustrated in Figures 16a and 16b, none of the proposed Project turbines or substation facilities are located within the 100-year floodplain zones. The Applicant also reviewed available Cottonwood County Shoreland District, Murray County Shoreland Management District, and Redwood County Shore Land District digital data in determining proposed facility locations (refer to Figures 5a and 5b); none of the proposed Project facilities would be located within the Shoreland Management District.

8.2.2 Impacts

The Project design is consistent with the county zoning ordinances regarding siting of LWECS projects and future economic development goals noted in the comprehensive plans for Cottonwood, Murray, and Redwood Counties. As noted previously, the majority of the Project Area falls within the Agricultural Districts in Cottonwood, Murray, and Redwood Counties, and consistent with the purpose of that zoning district, agricultural use of the Project Area will continue after construction of the Project is complete. Turbines in both layouts are sited in cultivated cropland; Plum Creek will avoid placing turbines within the floodplain, shoreland, and other special protection districts and overlays where siting of LWECS is not permitted by the counties. Figures 5a and 5b display the layout of the Project in relation to zoning districts within Cottonwood, Murray, and Redwood Counties.

Plum Creek reviewed future land use planning information in the comprehensive plans from Cottonwood, Murray, and Redwood Counties, as well as the future land use planning map for Murray County (similar maps for Cottonwood and Redwood Counties were not available). Overall, the Project is not expected to affect the future land use planning goals of the counties in the Project Area. As noted in Sections 8.2.1.1 through 8.2.1.3, renewable energy development is one of the stated future development goals of the counties in the Project Area.

Murray County has established a one-mile future development buffer around the town of Dovray to help focus expansion beyond the current municipal boundary and reduce sprawl. This one-mile buffer is identified in the Murray County Future Land Use Planning map and depicted in Figures 5a and 5b – Zoning. Murray County also established a Conservation Core Area that runs throughout the county and is intended to protect and conserve valuable natural resources in the county. For the V162 layout, there is approximately 2,280 feet of co-located collection lines and crane paths on participating land within the municipal boundary of Dovray, which are temporary impacts during construction. For the SG170 layout, there is approximately 575 feet of co-located collection lines and crane paths on the same participating parcel within the municipal boundary of Dovray. Additionally, there is one alternate turbine in the V162 layout and two turbines in the SG170 layout within the one-mile buffer of Dovray (*see* Figures 5a and 5b – Zoning). There are no turbines in either layout within the Conservation Core Area identified on the Murray County Future Land Use Planning Map.

8.2.3 Mitigative Measures

The Project is generally consistent with the comprehensive planning documents and zoning requirements of Cottonwood, Murray, and Redwood Counties. No Project facilities would be sited or operated within zoning districts that are not compatible with wind energy project development. Accordingly, no mitigative measures are proposed.

8.3 Conservation Easements

Conservation easements are land that has been sold or leased by the landowner to a federal, state, or county agency, who will in turn apply specific development or activity restrictions designed to protect and conserve natural resources. Depending on the governing conservation program, specific restrictions may be applied that would limit or restrict development of LWECS projects. Plum Creek reviewed publicly available information to identify conservation easements within the Project Area.

8.3.1 Description of Resources

There are several parcels of agricultural land in the Project Area that are enrolled in the Conservation Reserve Enhancement Program (CREP). The CREP is an offshoot of the Conservation Reserve Program (CRP) which is a land conservation program established by the U.S. Department of Agriculture (USDA) and administered by the Farm Service Agency (FSA) that pays farmers a yearly rental fee for agreeing to take environmentally sensitive land out of agricultural production in an effort to improve environmental health and quality (USDA, 2019). Minnesota implemented the CREP to target state-identified, high-priority conservation resources by offering payments to farmers and agricultural landowners to retire environmentally sensitive

land using the Reinvest in Minnesota (RIM) Reserve Program (Minnesota Board of Water and Soil Resources [BWSR], 2019).

Enrollment in the CRP and CREP is voluntary. Based on publicly available data, there are approximately 1,689 acres (approximately two percent) of the Project Area in Cottonwood and Murray Counties currently enrolled in CREP and RIM easements, which are also shown on Figures 6a and 6b (Public Land Ownership and Recreation). There are no CREP or RIM easements mapped in the Redwood County portion of the Project Area. These CREP and RIM easements are also discussed in Section 8.11.1.

The USFWS holds easements in the Project Area for three FSA parcels and an easement for an access road to a National Wildlife Refuge (NWR) parcel (*see* Section 8.8 – Recreation), all of which total 35 acres (less than 0.1 percent) of the Project Area in Murray and Cottonwood Counties (Figures 6a and 6b). There are no USFWS wetland or grassland easements in the Project Area.

8.3.2 Impacts

Based on the publicly available information, the Project design for both the V162 and SG170 layouts avoids impacts to NWR, FSA, CREP, and RIM conservation easements. As part of Project title clearance for participating landowners, Plum Creek is actively completing a title search for all Project participants that will also identify any other conservation easements in the Project Area. If additional conservation easements are identified, Plum Creek will coordinate with landowner and the agency that administers the conservation easements to identify their trust resources and address any potential impacts. Additionally, Plum Creek is coordinating with the Natural Resource Conservation Service (NRCS), Board of Water and Soil Resources (BWSR), and MNDNR on the accuracy of the publicly available easement data.

8.3.3 Mitigative Measures

Plum Creek has designed the Project to avoid conservation easements identified through review of publicly available data. If additional conservation easements are identified during the title search or in consultation with the NRCS, BWSR, or MNDNR, and impacts to such conservation easements are unavoidable, Plum Creek will work with easement holders to obtain all necessary consents to construct and operate the Project.

8.4 Noise

Sound level is measured in units of dB on a logarithmic scale. It may be made up of a variety of sounds of different magnitudes, across the entire frequency spectrum. The human ear is not equally sensitive to sound at all frequencies and magnitudes. Some frequencies, despite being the same dB level (that is, magnitude), seem louder than others. For example, a 500 hertz (Hz) tone at 80 dB will sound louder than a 63 Hz tone at the same level. In addition, the relative loudness of these tones will change with magnitude. For example, the perceived difference in loudness between those two tones is less when both are at 110 dB than when they are at 40 dB.

To account for the difference in the perceived loudness of a sound by frequency and magnitude, acousticians apply frequency weightings to sound levels. The most common weighting scale used in environmental noise analysis is the "A-weighting," which represents the sensitivity of the human ear at low to moderate sound pressure levels. The A-weighting is the most appropriate weighting when overall sound pressure levels are relatively low (up to about 70 dB(A)). The A-weighting de-emphasizes sounds at lower and very high frequencies, since the human ear is less sensitive to sound at these frequencies at low magnitude.

The A-weighting is the most appropriate weighting for wind turbine sound for two reasons. The first is that sound pressure levels due to wind turbine sound are typically in the appropriate range for the A-weighting at typical receiver distances (50 dB(A) or less). The second is that various studies of wind turbine acoustics have shown that the potential effects of wind turbine noise on people are correlated with A-weighted sound level (Pedersen and Waye, 2008) as well as to the perceived loudness of wind turbine sound. Other researchers found that 51 percent of the energy making up a C-weighted measurement of wind turbine sound is not audible. Thus, it is more difficult to relate the level of C-weighted sound to human perception. That is, two sounds may be perceived exactly alike, but there could be significant variations in the C-weighted sound level depending on the content of inaudible sound in each.

8.4.1 Description of Resources

The term "ambient acoustic environment" refers to the all-encompassing sound in a given environment or community. The outdoor ambient acoustic environment is a composite of sound from varying sources, distances, and directions. The Applicant has conducted background sound level monitoring throughout the Project Area to quantify the existing sound levels and to identify existing sources of sound. Monitoring was conducted at five locations distributed throughout the Project Area and at two offsite locations. Daytime sound levels throughout the Project Area generally ranged from 37 to 45 dB(A) for 50 percent of the daytime (L_{50}), while nighttime sound levels were generally between 39 and 46 dB(A) (L_{50}). The average daytime L_{50} across the Project Area was 41 dB(A), and the average nighttime L_{50} across the Project Area was 42 dB(A). The nighttime L_{50} was generally higher than the daytime L_{50} due to insect sounds at night. Common sources of sound included wind rustling through vegetation, roadway traffic, aircraft overflights, agricultural operations, and biogenic sources such as birds and insects.

Higher sound levels typically exist near roadways and near areas that experience greater human activities such as farming. Agricultural/rural areas with higher wind resources generally experience higher sound levels compared to agricultural/rural areas with lower wind resources. Different communities can experience a wide variety of sound levels within their given ambient acoustic environments, and the variability of sound sources creates their respective spectral content. A comparison of typical noise generators is outlined below in Table 8.4-1.

Table 8.4-1 Decibel Levels of Common Noise Sources	
Sound Pressure Level (dB(A))	**Noise Source**
140	Jet Engine (at 25 m)
130	Jet Aircraft (at 100 m)
120	Rock and Roll Concert
110	Pneumatic Chipper
100	Jointer/Planer
90	Chainsaw
80	Heavy Truck Traffic (at 15 m)
70	Business Office
60	Conversational Speech
50	Library
40	Bedroom
30	Secluded Woods
20	Whisper
Source: MPCA, 2008	

The MPCA has the authority to adopt noise standards pursuant to Minn. Stat. § 116.07, subd. 2. The adopted standards are set forth in Minn. R. Ch. 7030. The MPCA standards require A-weighted noise measurements. Different standards are specified for daytime (7:00 AM – 10:00 PM) and nighttime (10:00 PM – 7:00 AM) hours. The noise standards specify the maximum allowable noise levels that may not be exceeded for more than 10 percent of an hour (L_{10}) and 50 percent of an hour (L_{50}), respectively. Household units, including farmhouses, are included in Land Use Noise Area Classification (NAC) 1. Table 8.4-2 shows the MPCA State noise standards. All the land within the Project Area is considered Land Use NAC 1.

Table 8.4-2 MPCA State Noise Standards – Hourly A-Weighted Decibels					
		Day (7:00am – 10:00pm) dB(A)		**Night (10:00pm – 7:00am) dB(A)**	
Land Use	**Code**	**L_{10}**	**L_{50}**	**L_{10}**	**L_{50}**
Residential	NAC-1	65	60	55	50
Commercial	NAC-2	70	65	70	65
Industrial	NAC-3	80	75	80	75

8.4.2 Impacts

When in motion, the wind turbines emit audible sound. The level of this sound varies with the speed of the turbine and the distance of the listener from the turbine. Sound is generated from the wind turbine at points near the hub or nacelle and from the blade tips and trailing edges as they rotate. The most stringent noise standards, as regulated by the MPCA under Minn. R. Ch. 7030, is a 50 dB(A) L_{50} limit for nighttime noise levels.

Plum Creek proposes siting turbines the minimum 1,000 feet from residences plus the distance required to comply with the MPCA limit of a 50 dB(A) nighttime L_{50} noise level, if necessary (L_{50} is the median noise level or the level exceeded 50 percent of the time) (MPCA, 2015). The closest turbine to a non-participant residence in the V162 layout is 2,496 feet and in the SG170 layout is 2,124 feet. The closest turbine to a participating residence in the V162 layout is 1,046 feet and in the SG170 layout is 1,246 feet.

Plum Creek incorporated the project-specific background sound monitoring data with turbine sound modeling using the Computer Aided Design for Noise Abatement (Cadna-A) software program to determine the sound levels at receptors within one mile of the Project Area. The monitoring methodologies and results are detailed in Appendix B. The Cadna-A acoustical analysis software is designed for evaluating environmental noise from stationary and mobile sources and was used to calculate the L_{50} for all three turbine models. Assuming that wind speeds are at the maximum sound power level wind speed for each turbine model and are constant for an entire one-hour period, the L_{50} calculated by Cadna-A was compared to the MPCA L_{50} standard.

The analysis accounted for all noise generating elements associated with the proposed wind turbine models and layouts for the Project. All proposed primary wind turbines and the transformers within the two Collector substations (noise sources) were modeled in Cadna-A and Project-related noise levels were calculated at 461 noise-sensitive receptors within the Project Area and one-mile buffer. Table 8.4-3 presents analysis results. The baseline noise isopleths of turbine-only sound (a line or curve of equal values) are depicted in Figures 7a-7c (Sound/Noise).

Table 8.4-3
Summary of Noise Assessment

Turbine Model	Noise Source	Statistic	Residence Classification		
			dB(A) Levels at All Residences	dB(A) Levels at Participating	dB(A) Levels at Non-Participating
V162	Turbine-Only Noise	Avg L_{50} Modeled	28	33	26
		Max L_{50} Modeled	47	47	40
		Min L_{50} Modeled	1	8	1
		Avg L_{50} Modeled	42	43	42

Table 8.4-3
Summary of Noise Assessment

Turbine Model	Noise Source	Statistic	Residence Classification		
			dB(A) Levels at All Residences	dB(A) Levels at Participating	dB(A) Levels at Non-Participating
SG170	Total Sound (Background + Turbine)[1]	Max L_{50} Modeled	48	48	44
		Min L_{50} Modeled	42	42	42
	Turbine-Only Noise	Avg L_{50} Modeled	30	35	27
		Max L_{50} Modeled	46	46	41
		Min L_{50} Modeled	11	17	11
	Total Sound (Background + Turbine)[1]	Avg L_{50} Modeled	42	43	42
		Max L_{50} Modeled	47	47	45
		Min L_{50} Modeled	42	42	42

[1] The average Project nighttime sound was monitored at 42 dB(A) (L_{50})

Maximum calculated sound levels at all residential receptors from the two turbine models are below the nighttime L_{50} noise limit of 50 dB(A). The maximum calculated sound level, based on assumptions incorporated into the Cadna-A model and the turbine layouts, results in a 47 dB(A) L_{50} at the nearest noise-sensitive receptor (maximum Project-related L_{50} range from 40 to 47 dB(A)). Average Project-related sound levels at residences for all turbine models range from 28 to 30 dB(A), on an hourly L_{50} basis. As depicted in the multi-turbine constraint maps and in Table 8.4-3, all turbine models and layouts comply with MPCA noise guidelines at residential receptors.

8.4.3 Mitigative Measures

Plum Creek has sited turbines to minimize noise impacts to residents. In addition, each proposed turbine model has sound mitigation built into the turbine in the form of serrated trailing edges (STE) on the Vestas turbines or noise reduction add-ons on the SG turbines. In addition, two of the turbines in the V162 use noise reduced operations. The modeling assumptions related to these sound mitigation measures are discussed in Appendix B.

Plum Creek has incorporated the 2019 LWECS Application Guidance and sited turbines so that turbine-only noise is < 45 dB(A) at non-participating residences and < 47 dB(A) at participating residences. The layouts have been modeled to help ensure cumulative impacts from all wind turbines, and maximum calculated noise levels for all turbine models are below the MPCA's nighttime L_{50} noise limit of 50 dB(A) at residential receptors. To the extent that the sound

characteristics of the selected turbine vary, Plum Creek will ensure compliance with MPCA noise standards by re-running the noise modeling.

8.5 Visual Resources

The introduction of wind turbines and collector substations has the potential to alter the existing visual resource within 10 miles of the Project Area where they are most perceptible. During construction, visual impacts associated with the Project facilities would include the removal of existing vegetation and the exposure of bare soils, as well as earthwork and grading scars associated with heavy equipment tracks, trenching, and machinery and tool storage. Other visual effects could result from the removal or alteration of vegetation that may currently provide a visual barrier, or landform changes that introduce contrasts in visual scale, spatial characteristics, form, line, color, or texture. Due to the general lack of development in the immediate Project Area, visual scale is uniform, with little contrast in line, form, color, or texture, and no dominant features. Construction in flat terrains would disrupt and dominate foreground and middle ground views with the introduction of equipment, materials, the trench, and spoil piles.

During operation, visual impacts associated with the development of wind energy facilities in the Project Area include the presence of wind turbine structures, movement of the rotor blades, shadow flicker, turbine marker lights, and other lighting on control buildings and other ancillary structures, roads, vehicles, and workers conducting maintenance activities. The Federal Aviation Administration (FAA) requires obstruction lighting or marking of structures more than 200 feet above ground to provide safe air navigation, which is synchronized flashing of red lights for wind turbines (FAA, 2005).

8.5.1 Existing Aesthetics

8.5.1.1 Description of Resources

The topography of the Project Area is glaciated, gently rolling plains with elevations ranging from 1,086 to 1,614 feet (331 to 492 m) above sea level. Elevations increase in a northeast to southwest direction; the highest elevations are in the southwest corner of the Project Area. Agricultural fields, farmsteads, and gently rolling topography visually dominate the Project Area. The landscape can be classified as rural open space. Figures 8a and 8b (Topographic Map) show the general topography within the Project Area.

Viewsheds in this area are generally broad and uninterrupted, with only small scattered areas where they are defined by trees or topography. The settlements in the vicinity are residences and farm buildings (inhabited and uninhabited farmsteads) scattered along rural county roads. The area is also shaped by a built environment. Horizontal elements, such as highways and county roads, are consistent with the long and open viewsheds in the area. Vertical elements such as transmission lines and wind turbines are visible from considerable distances and are the tallest and often the most dominant visual feature on the landscape.

The Jeffers Wind Energy Center, located approximately five miles south of the Project Area and west of Jeffers, consists of 20 turbines that are visible to residences within the Plum Creek Project Area.

8.5.1.2 Visual Impacts on Public Resources

The Project will be located within the viewshed of MNDNR-managed Wildlife Management Areas (WMAs), Lake Shetek State Park, USFWS Waterfowl Production Areas (WPAs), USFWS NWR lands, or other natural areas and may be visible by people using those areas. Figures 6a and 6b identify recreation and wildlife areas within the Project's vicinity.

Visual impacts on public resources during construction will be dependent on the construction activity and proximity to the public resource. For example, site clearing and grading would be visible from public resources adjacent to the Project boundary or within one to two miles of the Project's footprint. Other activities, such as turbine erection, would be visible from longer distances due to the height of the crane and towers.

During operation, the wind turbines will impact the visual surroundings of the Project Area, but the degree of the visual and unavoidable impact on public resources will vary based upon the distance from the Project, obstructions such as trees between the public resource and Project, a viewer's orientation to the Project (i.e., facing towards or away), and the viewer's personal preferences. For example, a person utilizing the state trail at Lake Shetek State Park may see the wind turbines in open areas of the trail, but not in areas with trees immediately adjacent to the trail or when the trail travels away from the Project. Regardless of turbine model, turbines will be set back from public lands based on a minimum of the 3 RD by 5 RD setbacks from all non-leased properties per the Commission siting guidelines (MPUC, 2008). To the extent public resources are utilized at night, turbine lighting may be visible.

8.5.1.3 Visual Impacts on Private Lands and Homes

The impact of the Project's aesthetics is based on subjective human responses. For some viewers, the Project could be perceived as a visual intrusion; for other viewers, the Project may have its own positive aesthetic qualities. While people living in or traveling through the area are accustomed to viewing wind turbines associated with the Jeffers Wind Energy Center, the Project will add to the cumulative visual impacts by adding up to 110 new turbines in the area.

The turbine models under evaluation for the Project will be similar in appearance, with a monopole tower, a single hub, and three blades. The primary difference between layouts will be the RD and the number of turbines. In general, larger RD turbines will have larger maximum output and thus the Project will require fewer turbines. The two turbine models will have the following RD and number of turbines and are shown in Table 8.5-1.

Table 8.5-1
Rotor Diameter and Number of Turbines

Turbine Model	Rotor Diameter	Rotor Tip Height – Top/Bottom of Rotor Diameter	Number of Primary Turbines	Number of Alternate Turbines
V162	162 m	200/38 m	74	6
SG170	170 m	200/30 m	67	11

The V162 and SG170 turbines have the same total height at 200 meters. The SG710 layout has seven fewer turbine positions than the V162 layout, which would be expected to have a slightly smaller overall visual impact on the surrounding area.

The placement of turbines in the landscape will have an unavoidable effect on the existing visual experience of the Project Area to residents and persons traveling along highways in the Project Area and vicinity. Residences with turbines and associated infrastructure closest to their homes are those that are participating in the Project by signing easements. The closest turbine to a participating residence in the Vestas V162 layout is 1,046 feet and in the SG170 layout is 1,246 feet. The closest turbine to a non-participant residence in the Vestas V162 layout is 2,496 feet and in the SG170 layout is 2,124 feet. Visual impacts to those traveling on highways in the vicinity will be most evident to people traveling east and west along U.S. Highway 14 on the north side of the Project and north and south along U.S. Highway 71 approximately five miles east of the Project Area. These highways carry more vehicles on a daily basis (average annual daily traffic) than the county and township roads within the Project Area (Minnesota Department of Transportation [MNDOT], 2019).

The collector substations will be visible to those residents that live within one mile of these facilities. The collector substations will be lower profile than the wind turbines. Access roads have been designed to provide direct access from the public road to the turbine and minimize impacts to the agricultural fields. Where possible, the access roads follow field edges. To the extent possible, Plum Creek has collocated linear facilities (access roads, crane paths, and collection lines) to minimize visual impacts. Post-construction, Plum Creek anticipates minimal visual impacts from temporary facilities (crane paths, collection lines, and workspace associated with wider access roads and turbines) because all turbines in both layouts and most associated facilities are sited in cropland and will continue to be cropped during operation (*see* Section 8.19.2).

8.5.1.4 Mitigative Measures

Plum Creek will implement the following mitigation measures for visual resources:

- Wind turbines will exhibit visual uniformity in the shape, color, and size of rotor blades, nacelles, and towers.
- Collection cables or lines on the site will be buried in a manner that minimizes additional surface disturbance (e.g., collocating them with access roads, where feasible).
- For ancillary buildings and other structures, low-profile structures will be chosen whenever possible to reduce their visibility.
- Turbine foundations and roads have been designed to minimize and balance cuts and fills.
- Facilities, structures, and roads will be located in stable fertile soils to reduce visual contrasts from erosion and to better support rapid and complete regrowth of vegetation.
- Lighting for facilities will not exceed the minimum required for safety and security, and full-cutoff designs that minimize upward light pollution will be selected. Plum Creek will install lights that are off until aircraft approach.
- Commercial messages and symbols on wind turbines will be avoided.

Additionally, Plum Creek will coordinate with the FAA on potential implementation of an ADLS radar. With this radar system, turbine lighting (synchronized flashing red lights) is off until the radar detects an aircraft within a prescribed distance to the Project, at which time, the blinking red lights turn on. After the aircraft is safely beyond the Project, the blinking lights are again turned off. Implementation of this radar system will depend on FAA review and approval.

8.5.2 Shadow Flicker

8.5.2.1 Description of Resources

Shadow flicker caused by wind turbines is defined as alternating changes in light intensity at a given stationary location (or "receptor"), such as the window of a home. In order for shadow flicker to occur, three conditions must be met: (1) the sun must be shining with no clouds to obscure it; (2) the rotor blades must be spinning and must be located between the receptor and the sun; and (3) the receptor must be sufficiently close to the turbine to be able to distinguish a shadow created by it (generally 1500 feet because the shadow is at this distance, the shadow is sufficiently diffuse that the shadow is not seen as a solid obstruction). Shadow flicker intensity and frequency at a given receptor are determined by a number of interacting factors:

- **Sun angle and sun path**: As the sun moves across the sky on a given day, shadows are longest during periods nearest sunrise and sunset, and shortest near midday. They are longer in winter than in summer. On the longest day of the year (the summer solstice), the sun's path tracks much farther to the north and much higher in the sky than on the shortest day of the day (the winter solstice). As a result, the duration of shadow flicker at a given receptor will change significantly from one season to the next.
- **Turbine and receptor locations**: The frequency of shadow flicker at a given receptor tends to decrease with greater distance between the turbine and receptor. The frequency of occurrence is also affected by the sightline direction between turbine and receptor. A turbine placed due east of a given receptor will cause shadow flicker at the receptor at some point during the year, while a turbine placed due north of the same receptor at the same distance will not, due to the path of the sun at Plum Creek's latitude.
- **Cloud cover and degree of visibility**: As noted above, shadow flicker will not occur when the sun is obscured by clouds. A clear day has more opportunity for shadow flicker than a cloudy day. Likewise, smoke, fog, haze, or other phenomena limiting visibility would reduce the intensity of the shadow flicker.
- **Wind direction**: The size of the area affected by shadow flicker caused by a single wind turbine is based on the direction that the turbine is facing in relation to the sun and location of the receptor. The turbine is designed to rotate to face into the wind, and as a result, turbine direction is determined by wind direction. Shadow flicker will affect a larger area if the wind is blowing from a direction such that the turbine rotor is near perpendicular to the sun-receptor view line. Similarly, shadow flicker will affect a smaller area if the wind is blowing from a direction such that the turbine rotor is near parallel to the sun-receptor view line.

- **Wind speed**: Shadow flicker can only occur if the turbine is in operation. Turbines are designed to operate within a specific range of wind speeds. If the wind speed is too low or too high, the turbine will not operate, eliminating shadow flicker.
- **Obstacles**: Obstacles, such as trees or buildings, can have a screening effect and reduce or eliminate the occurrence of shadow flicker if they lie between the wind turbine and the receptor.
- **Contrast**: Because shadow flicker is defined as a change in light intensity, the effects of shadow flicker can be reduced by increasing the amount of light within a home or room experiencing shadowing flicker.
- **Local topography**: Changes in elevation between the turbine location and the receptor can either reduce or increase frequency of occurrence of shadow flicker, compared to flat terrain.

Currently, shadow flicker impacts are not regulated by state and federal law. A general threshold of 30 hours of shadow flicker exposure is often used as a reference within the wind industry based on a German court case in which it was determined that 30 hours of actual observed shadow flicker at a neighboring property was tolerable (WindPower, 2003).

Shadow flicker modeling for the Plum Creek Wind Project incorporated long-term sunshine probability from the Minneapolis-St. Paul weather station between 1981-2010 (Table 8.5-2). Wind speed and direction is displayed in Chart 9.1-3 Plum Creek Wind Rose in Section 9.1.10.

Table 8.5-2
Minneapolis-St. Paul Average Sunshine (hours/month)[1]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
140	166	200	230	272	302	343	296	235	193	115	112

[1] Data gathered from National Climatic Data Center for Minneapolis, Minnesota, the closest, most representative station (1981-2010)

8.5.2.2 Shadow Flicker Impacts

Shadow flicker frequency calculations for the Project were modeled for 461 residences (receptors) with WindPRO based on the primary turbines in each layout. These receptors are those within the Project Area and one-mile buffer that could receive shadow flicker. As demonstrated in Table 8.5-3, all non-participating residences are expected to experience below 30 hours per year of shadow flicker. Figures 9a – 9b (Shadow Flicker) provide a visual representation of shadow flicker across the Plum Creek Wind Project for each of the three turbine models. Appendix C shows results of the shadow flicker assessment at the Project.

Table 8.5-3
Summary of Shadow Flicker Assessment

Turbine Model	Shadow Flicker (hr/year)	Participating		Non-Participating		Total	
		No Receptors	% of Receptors	No. Receptors	% of Receptors	No. Receptors	% of Receptors
V162	0	75	52.4%	269	84.6%	344	74.7%
	0.1 to 20	32	22.4%	45	14.1%	77	16.7%
	20.1 to 30	10	7.0%	4	1.3%	14	3.0%
	30.1 to 40	12	8.4%	0	0.0%	12	2.6%
	40.1 to 50	7	4.9%	0	0.0%	7	1.5%
	50.1 to 60	0	0.0%	0	0.0%	0	0.0%
	60.1 or more	7	4.9%	0	0.0%	7	1.5%
SG170	0	69	48.3%	247	77.7%	316	68.5%
	0.1 to 20	38	26.6%	64	20.1%	102	22.1%
	20.1 to 30	12	8.4%	7	2.2%	19	4.1%
	30.1 to 40	12	8.4%	0	0.0%	12	2.6%
	40.1 to 50	6	4.2%	0	0.0%	6	1.3%
	50.1 to 60	4	2.8%	0	0.0%	4	0.9%
	60.1 or more	2	1.4%	0	0.0%	2	0.4%

WindPRO calculates the number of 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. The maximum shadow flicker (hours per year) for each layout is summarized in Table 8.5-4.

Table 8.5-4
Maximum Shadow Flicker (hours/year)

Turbine Model	Maximum Shadow Flicker (hours/year)	
	Participating	Non-Participating
V162	119.9	28.4
SG170	99.6	28.5

The shadow flicker modeling is conservative and does not take in consideration several factors including:

- availability of the turbines (i.e., whether they are operating or not based on meteorological conditions and/or maintenance);
- turbines not operating below cut-in and above cut-out wind speeds;
- obstacles (like trees or buildings) obstructing shadow flicker from a receptor; and
- dust or aerosols in the air which reduce the impact of shadow flicker.

For example, the participating residence modeled to receive the maximum amount of shadow flicker in the V162 layout is surrounded by trees that are not accounted for by the model. Similarly, the participating residence modeled to receive the maximum amount of shadow flicker in the SG170 layout is also surrounded by trees that are not accounted for by the model. These trees provide an obstruction to shadows from nearby proposed turbines. There are no non-participating residences which the model calculates will receive more than 30 hours of shadow flicker per year for either of the turbine models.

At a distance of 1,000 feet or greater (the Project minimum setback for residences), receptors will typically experience shadow flicker only when the sun is low in the sky, and when certain meteorological and operational factors 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 one 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 Epilepsy Foundation has determined that generally, the frequency of flashing lights most likely to trigger seizures is between five and 30 flashes per second (Epilepsy Foundation, 2013).The frequency of shadow flicker due to wind turbines is a function of the rotor speed and number of blades, and it is generally no greater than approximately 1.5 Hz (i.e., 1.5 flashes per second). Because the frequency of wind turbine shadow flicker is so much lower than the frequency range that can trigger seizures, there is no potential for causing seizures.

8.5.2.3 Shadow Flicker Mitigative Measures

Plum Creek has sited turbines in both layouts to minimize shadow flicker at residences. Based on the results of the Project's shadow flicker modeling, no specific mitigation is currently proposed. To the extent that a residence experiences inordinately more flicker than anticipated by modeling during Project operation, mitigation would be addressed at that time. However, because of the conservative methods used for the modeling, it is highly unlikely that more flicker than modeled will occur. In order to assess site-specific mitigation measures, flicker occurrences should be documented daily for several consecutive months including location, date, time of day, and duration. Mitigation measures will be considered and implemented based on individual circumstances of residences experiencing shadow flicker, and as a reasonable function of the amount of flicker experienced. Such mitigation measures may include Plum Creek taking the following actions:

- Providing education to landowners about how to minimize the effect of shadow flicker.
- Providing 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.
- Implementing Turbine Control Software programmed to temporarily shut down a specific turbine for a few minutes if conditions are present to create flicker.

8.6 Public Services and Infrastructure

LWECS projects have the potential to impact public services during both construction and operation. This section provides information about public services in the Project Area including emergency services; utilities; roads and railroads; communication systems; television service; and cell towers and broadband service, and discusses whether the Project has the potential to affect these public services. A discussion of potential Project effects on public health and safety is provided in Sections 8.9.

Plum Creek conducted online research to identify emergency services, existing utilities, roads and railroads, and communication systems within the Project Area. The results of this review and a discussion of potential impacts to these services from construction and operation of the Project is presented below.

8.6.1 Emergency Services

Use of heavy equipment during construction presents the potential for injuries such as falls, equipment-use related injuries, or electrocution. Operation of an LWECS project presents a potential risk to public safety if the wind turbines or collector substations are damaged by inclement weather or not operated in compliance with safety standards. Injuries as a result of construction or operation of an LWECS project would require use of local emergency services such as police, fire, ambulance, or hospitals and could affect the availability of these services for the local population.

8.6.1.1 Description of Resources

The Project is located in a rural area in southwestern Minnesota (Figure 1 – Project Location). Within the Project Area, local law enforcement and emergency response agencies are available in Cottonwood, Murray, and Redwood Counties and nearby communities. Cottonwood, Murray, and Redwood Counties have sheriff departments that provide services to their respective counties. Additionally, the Cities of Windom, Redwood Falls, Marshall, Lamberton, Wabasso, Walnut Grove, and Tracy have local police departments.

Fire services near the Project Area are provided by city and community fire departments, including Windom, Redwood Falls, Marshall, Lamberton, Wabasso, Walnut Grove, Westbrook, Tracy, Sanborn, Stordon, and Currie.

Ambulance response is provided by regional and local ambulance services. The Windom Ambulance Service provides response services to a 200-square-mile region surrounding Windom, Minnesota. North Memorial Health Ambulance provides service to area surrounding Marshall, Minnesota, including Redwood Falls. The Wabasso Ambulance Association provides ambulance service in the center of Redwood County, Minnesota. Local ambulance services are also provided by the communities of Walnut Grove, Tracy, Lamberton, and Sanborn.

Hospitals near the Project Area include the Redwood Area Hospital in Redwood Falls, Windom Area Health in Windom, and Murray County Medical Center in Slayton. Smaller medical clinics or medical centers in the area include the Murray County Clinic in Fulda, Mayo Clinic Health System in Lamberton, Sanford Tracy Walnut Grove Clinic in Walnut Grove, Sanford Tracy Medical Center in Tracy, Sanford Westbrook Clinic in Westbrook, and various eye clinics, dental offices, and chiropractors.

8.6.1.2 Impacts

Construction and operation of the Project is not expected to impact the availability of emergency services. Plum Creek will coordinate with emergency services providers to determine appropriate safety precautions and standards, and develop measures to address these precautions and standards. If emergency services are required during constriction or operation of the Project, the numerous law enforcement, fire departments, ambulance services, and hospitals near the Project Area would be adequate to address Project-related emergency service needs without negatively impacting the availability of these services for the local populace.

8.6.1.3 Mitigation Measures

Because no impacts to emergency services are anticipated, no mitigation measures are proposed.

8.6.2 Existing Utility Infrastructure

The location of existing utilities is an important factor to be considered when siting an LWECS project. Turbines should be sited at least 1.1x the turbine height to avoid potential impacts to existing infrastructure.

8.6.2.1 Description of Resources

Electrical providers in the Project Area include Redwood Electric Coop, Nobles Cooperative Electric, and South Central Electric Association (Minnesota Geospatial Commons, 2018). Natural gas in the Project Area is provided by Minnesota Energy Resources (Minnesota Energy Resources, 2019). Water is supplied by the Red Rock Rural Water System (Red Rock Rural Water System, 2019).

There is an Alliant Energy 69 kV transmission line running north-south along parcel lines between 390th Avenue and CSAH 5 in the eastern portion of the Project Area for three miles in Cottonwood County. There is one Northern Natural Gas transmission pipeline that travels in a northwest to southeast direction through the Project Area. Infrastructure within the Project Area including existing transmission lines and pipelines is shown on Figures 3a-3b.

8.6.2.1 Impacts

Plum Creek has sited turbines in both layouts at least 1.1x the turbine height from exiting utilities, including natural gas pipelines and transmission lines. Other utilities that are common along roads and to residences, such as rural water lines and distribution lines, will be surveyed prior to construction as part of the ALTA survey. The Project will be constructed to avoid impacts to all underground infrastructure as well as overhead transmission lines.

8.6.2.2 Mitigation Measures

Plum Creek will conduct a Gopher One Call and the pipeline company prior to and during construction to identify the locations of any buried utilities and safety concerns and to prevent possible structural conflicts.

8.6.3 Roads and Railroads

Use of heavy equipment during construction also may damage existing road surfaces and local roadways could experience temporary road and/or lane closures during construction. In addition, the influx of construction contractors could increase traffic volumes on local roadways. In addition, if a wind turbine or collector substation is sited too close to an operating railroad, it could interfere with safe operation of the railroad.

8.6.3.1 Description of Resources

In general, the existing roadway infrastructure in and around the Project Area is characterized by state, county, and township roads that generally follow section lines. Various county and township roads provide access to and throughout the Project Area. Roadway infrastructure throughout the Project Area also includes two-lane paved and gravel roads. In agricultural areas, many landowners use private, single-lane farm roads and driveways on their property.

The Minnesota Department of Transportation (MNDOT) conducts traffic counts on roads in Minnesota. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day, or Annual Average Daily Traffic (AADT). Based on 2019 data, the highest existing AADT in the Project Area is 1,100 vehicles per day along Minnesota Highway 30

immediately south of Dovray. Along the county highways, the AADTs are below 770 vehicles per day and range from 15 to 770 vehicles per day (MNDOT, 2019). Traffic counts are generally higher in proximity to nearby cities.

The Dakota, Minnesota, and Eastern Railroad is immediately adjacent to the northern portion of the Project Area between Walnut Grove and Revere. No railroads are located within the Project Area.

8.6.3.2 Impacts

During the construction phase, temporary impacts are anticipated on some public roads within the Project Area. Roads will be affected by the transportation of equipment to and from the Project Area and Project facilities. Some roads may also be expanded along specific routes as necessary to facilitate the movement of equipment. Construction traffic will use the existing county, state, and federal roadway system to access the Project Area and deliver construction materials and personnel.

Construction activities will increase the amount of traffic using local roadways, and may temporarily affect traffic numbers in the area, but such use is not anticipated to result in adverse traffic impacts. During the construction phase, several types of light, medium, and heavy-duty construction vehicles will travel to and from the Project Area, as well as private vehicles used by construction personnel. Truck access to the Project Area is generally served by U.S. 14 on the north side of the Project and potentially U.S. 71 approximately five miles east of the Project. Specific additional truck routes will be dictated by the location required for delivery.

Plum Creek estimates that there will be 475 large truck trips per day and up to 950 small-vehicle (pickups and automobiles) trips per day in the area during peak construction periods. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day. Currently, the heaviest traffic is on Minnesota Highway 30 located immediately south of Dovray at 1,100 AADT. Since many of the area roadways have AADTs that are currently well below capacity, the addition of 1,425 vehicle trips during peak construction would be perceptible, but similar to seasonal variations such as spring planting or autumn harvest.

After construction is complete, traffic impacts during the operations phase of the Project will be minimal. Operation and maintenance activities will not noticeably increase traffic in the Project Area, as these activities tend to be sporadic and spread out through the Project Area. A small maintenance crew driving through the area in pickup trucks on a regular basis will monitor and maintain the wind turbines as needed. There would be a slight increase in traffic for occasional turbine and substation repair, but traffic function will not be impacted as a result. Furthermore, the availability of existing roadways throughout the Project Area will allow access roads to turbines to extend from existing public roads directly to the turbines, thereby minimizing impacts on adjacent agricultural land.

8.6.3.3 Mitigative Measures

Plum Creek is currently coordinating with all Cottonwood, Murray, and Redwood Counties and townships within the Project Area on the development and execution of a single, cooperative Development, Road Use, and Drainage Agreement to minimize and mitigate impacts on existing

roadways. This approach was also suggested by the Southwest Regional Development Commission in correspondence about the Project (Appendix A). Plum Creek will ensure that the general contractor communicates with the road authorities throughout the construction process, particularly regarding the movement of equipment on roads and the terms of the development agreement.

If roadways are impacted by the use of heavy construction equipment, they will be restored per the Development, Road Use, and Drainage Agreement. Additional operating permits will be obtained for over-sized truck movements.

Plum Creek has mitigated impacts to existing roadways from operation of the Project by siting wind turbines with a setback of 1.1x the total turbine height from all public roads, which exceeds the Commission standard of a 250-foot setback.

8.6.4 Communication Systems

Operation of an LWECS project has the potential to interfere with communication networks such as radio, television, cellular towers, and broadband services. Interference could occur if the placement of wind turbines creates line-of-sight interference with existing communication networks. Plum Creek conducted online research to identify local radio, landline telephone service, television, cell towers, and broadband services that could be affected by the Project. The results of this review are presented in Section 8.6.4 through 8.6.6.

8.6.4.1 Description of Resources

Plum Creek commissioned a communication tower study by Comsearch, which identified three communication tower structures and twelve communication antennas in the Project Area (Appendix D). These three tower structures are registered with the Federal Communications Commission (FCC). The twelve antennas may be located on a variety of structure types such as guyed towers, monopoles, silos, rooftops, or portable structures. Additionally, five of the antennas are located on two of the communications towers in the Project Area; some towers host multiple antennas. A summary of the types of communication systems in the Project Area are listed in Table 8.6-1.

Table 8.6-1
Communication Towers and Antennas in the Project Area

Communication System Type		Number of Towers
Antenna[1]	Microwave	5
	Land Mobile	5
	Cellular	2
Tower	Communication	3

[1] There are five antennas on two of the three tower locations in the Project Area; there are 10 unique tower and antenna locations. Some towers hold multiple antennas.

Source: Comsearch (Appendix D)

Comsearch also provided a report on AM and FM Radio broadcast stations in the Project vicinity whose service could potentially be affected by the Project (Appendix D). The closest AM station to the Project is over 30 km (18.6 mi) southeast of the Plum Creek Wind Project. Similarly, the nearest FM station to the Project is nearly 14 kilometers (8.7 miles) southeast of the Project. There are no AM or FM Radio station towers in the Project Area.

Landline telephone service in the area is provided to farmsteads, rural residences, and businesses by Spectrum and CableOne.

Plum Creek also conducted a microwave beam path analysis, which identified twelve microwave beam paths intersecting the Project Area (Appendix D and Figures 10a and 10b – Microwave Beam Path). The microwave beam paths in the Project Area are primarily oriented in a northeast-to-southwest direction.

8.6.4.2 Impacts

Construction and operation of the Project are not expected to impact communication systems, AM/FM radio, and microwave beam paths. Because of their height, modern wind turbines have the potential to interfere with existing communications systems licensed to operate in the United States. The required separation distance based on the characteristics of the communication systems varies depending on the type of communication antennas that are installed on the tower. In general, turbines should be setback at least the fall distance (1.1x turbine height) from a communication tower. Some communication systems (such as AM broadcast antennas) have a more specific setback, and are discussed below. Turbines at the Project are sited at least 2,800 feet from a communication tower, which is nearly four times the fall distance for the V162 and SG170 turbines. As such, impacts to communication systems are not anticipated.

Comsearch conducted a Licensed Microwave Study for Plum Creek (Appendix D). Plum Creek has sited the Project's turbines in a manner that avoids all identified microwave beam paths and communication systems (*see* Figures 10a and 10b – Microwave Beam Path). As such, impacts to microwave beam paths are not anticipated.

Turbines sited within three kilometers (1.9 miles) of an AM broadcast station can cause impacts to AM broadcast coverage. The closest AM station to the Plum Creek Wind Project is more than 31.7 kilometers (19.7 miles) from the Project Area. Therefore, impacts to AM broadcast stations are not anticipated. The coverage of FM stations is generally not susceptible to interference caused by wind turbines. However, at distances less than 450 m, radiation patter distortion can become a factor. The closest FM station to the Plum Creek Wind Project is approximately 14 kilometers (8.7 miles); therefore, impacts to FM stations are not anticipated. Plum Creek will not operate the Project so as to cause microwave, radio, or navigation interference contrary to FCC regulations or other law.

The National Telecommunications and Information Administration stated that no agencies have issues with Project placement in response to a Plum Creek letter request from September 26, 2018.

Construction and operation of the Project are also not expected to impact landline phone service.

8.6.4.3 Mitigative Measures

If communication interference is identified during or after construction of the Project, Plum Creek will address the interference on a case-by-case basis. Plum Creek does not propose mitigative measures at this time.

Gopher One Call will be contacted prior to construction to locate and enable avoidance of all underground facilities. To the extent Project facilities cross or otherwise affect existing telephone lines or equipment, Plum Creek will enter into agreements with service providers to avoid interference with their facilities. If the Project negatively impacts telecommunication services, Plum Creek will provide a specific mitigation plan and take the necessary steps to restore all impacted services at that time.

8.6.5 Television

8.6.5.1 Description of Resources

The Comsearch study also identified 218 off-air television stations within 150 kilometers (93.2 miles) of the Project Area (Appendix D). TV stations at a distance of 150 kilometers or less are the most likely to provide off-air coverage to the Project Area and neighboring communities. Of these 218 stations, only 151 are currently licensed and operating; the other 67 stations are either in construction or have applied for a construction permit. Of the 151 licensed and operating stations, 139 are low-power stations or translators. Translator stations are low-power stations that receive signals from distance broadcasters and retransmit the signal to a local audience. These stations serve local audiences and have limited range, which is a function of their transmit power and the height of their transmit antenna. The other 12 licensed and operating stations are digital television broadcast stations.

8.6.5.2 Impacts

Construction of wind turbines has the potential to impact television reception as a result of an obstruction in the line of sight between digital antennas at residences and the television station antennas. Based on the Comsearch analysis of licensed television stations within 150 kilometers of the Plum Creek Wind Project Area, seven full-power digital stations and 11 low-power digital stations currently serve the Project Area; these stations may experience reception disruptions related to the Project. The areas primarily affected by such a disruption would include the Project Area and extend to 10 kilometers beyond the Project Area; however, the full-power and low-power signals themselves have a broadcast range that extends from 29 to 114 kilometers beyond the Project Area.

The Comsearch TV Coverage Impact Study concluded that the Project may result in degraded reception of digital television signals to residences if Project facilities cause obstruction in the line of sight between the television station antennas and the residence. The true impact of this obstruction is unknown; however, modern digital television receivers have undergone significant improvements to mitigate the effects of signal scattering, which may limit the likelihood that disruptions to digital television would occur. Television reception at residences relying on cable or satellite television service will not be impacted by construction or operation of the Project.

8.6.5.3 Mitigative Measures

If interference to a residence's or business's television service is reported to Plum Creek, Plum Creek will work with affected parties to determine the cause of interference and, when necessary, reestablish television reception and service.

Plum Creek plans to address any post-construction television interference concerns on a case-by-case basis. If television interference is reported to Plum Creek, Project representatives will:

- Log the contact in Plum Creek's complaint database to track resolution efforts.
- Review results of the report to assess whether impacts are likely Project related.
- Meet with the landowner and a local communication technician to determine the current status of their television reception infrastructure.
- Discuss with the landowner the option of (1) installing a combination of high gain antenna and/or a low noise amplifier, or (2) entering into an agreement to provide a monetary contribution (equal to the cost of installing the recommended equipment) toward comparable satellite television services at the residence.
- At the landowner's election, Plum Creek will either install the necessary equipment or enter into an agreement to reimburse the landowner for the cost of comparable satellite television services.
- If the landowner chooses satellite service, Plum Creek will consider the matter closed upon installation of the satellite dish.
- If the landowner chooses to have the antenna and/or amplifier installed and later complains of continued interference issues, Plum Creek will send a technician to the site to assess whether the equipment is working properly and fix the equipment as needed and evaluate the reported interference issues.
- If Project-related interference remains an issue, Plum Creek will propose an agreement that reimburses the landowner for the costs of comparable satellite television services and will remove the antenna and amplifier equipment, unless it was initially installed to serve multiple households.
- If Plum Creek and the landowner are unable to reach an agreement to resolve interference-related issues, Plum Creek will report the concern as an unresolved complaint and follow the Commission's dispute resolution process to resolve the matter.

8.6.6 Cell Towers and Broadband Interference

8.6.6.1 Description of Resources

As noted in the Land Mobile and Emergency Services report (Appendix D), cellular services in the Project Area are provided by many carriers including AT&T, DISH network, Sprint, Standing Rock Telecommunications, TerreStar, T-Mobile, and Verizon. Similarly, as described in Section 8.6.2 (Communication Systems), and there are five land mobile antennas in the Project Area. Additionally, Comsearch conducted a specific study on land mobile and emergency services for the Project Area (Appendix D). The study identified the same five land mobile antennas in the Project Area as the Communication Tower Study.

Minnesota is prioritizing border-to-border high-speed internet access throughout the state. The Border to Border Broadband Development Grant Program was created in Minn. Stat. § 116J.395 in 2014. The legislative focus of this grant program is to provide state resources that help make the financial case for new and existing providers to invest in building broadband infrastructure to unserved and underserved areas of the state. Based on data from the Minnesota Department of Employment and Economic Development (MN DEED), the majority of the Project Area is identified as an Unserved Area (no wireline broadband of at least 25 megabytes per second (Mbps) download and 3 Mbps upload [25M/3M]). A small portion of the Project Area near Walnut Grove (Redwood County), Dovray (Murray County), and certain sections in Cottonwood County are identified as Underserved Area (wireline broadband of at least 25M/3M but less than 100M/20M) (MN DEED, 2019a, 2019b, and 2019c).

8.6.6.2 Impacts

Plum Creek does not anticipate any impacts to cellular services as a result of construction and operation of the Project. Each of the cellular-provider networks in the Project Area is designed to operate reliably in a non-line-of-sight environment. Many land mobile systems are designed with multiple base transmitter stations covering a large geographic area with overlap between adjacent transmitter sites in order to provide handoff between cells. Therefore, any line-of-sight signal blockage caused by placement of the proposed wind turbines would not materially degrade the reception because the end user is likely receiving signals from multiple transmitter locations.

Plum Creek also does not anticipate any impacts to land mobile communication systems. Per FCC interference emissions from electrical devices in the land mobile frequency bands, turbines within 77.5 m of land mobile fixed-base stations can cause impacts. The closest turbine to a land mobile tower/antenna is 560 m, well beyond the recommended FCC interference setback.

Based on data from the MN DEED, the Project Area is considered an Unserved Area for broadband. As such, impacts to broadband service are not likely or anticipated. Additionally, Plum Creek is unaware of potential interference or disruptions to broadband service that could be caused by operation of wind turbines.

8.6.6.3 Mitigative Measures

If cell tower signal or broadband interference is identified during or after construction of the Project, Plum Creek will address the interference on a case-by-case basis. Plum Creek does not propose mitigative measures at this time.

8.7 Cultural and Archaeological Resources

Cultural resources include archaeological and historic architectural resources that provide important information about the history of human occupation and alteration of the landscape over time. Archaeological resources include prehistoric and historic artifacts, structural ruins, or earthworks that are typically found either partially or completely below the ground surface. Historic architectural resources include standing structures, such as buildings and bridges, as well as historic districts and landscapes.

Plum Creek conducted background research on known cultural resources in October 2019 by requesting information from the Minnesota Office of the State Archaeologist (OSA) and the State Historic Preservation Office (SHPO). Data regarding known cultural resources information resulting from previous professional cultural resources surveys and reported archaeological sites and historic architectural resources was received from the agencies and reviewed. This information was used to identify types of archaeological sites that may be encountered and landforms or geographic features that have a higher potential for containing significant cultural resources. This investigation reviewed archaeological and historic architectural resources within one mile of the Project Area. A copy of Plum Creek's background literature review is provided in Appendix E.

The Project Area is located within the Prairie Lakes Archaeological Region (Region 2), which covers most of southwestern and south-central Minnesota. It includes Big Stone, Blue Earth, Brown, Carver, Chippewa, Cottonwood, Faribault, Freeborn, Jackson, Lac Qui Parle, Le Sueur, Lyon McLeod, Martin, Murray, Nicollet, Redwood, Renville, Scott, Sibley, Stevens, Swift, Watonwan, and Yellow Medicine Counties and portions of Douglas, Grant, Kandiyohi, Lincoln, Meeker, Nobles, Otter Tail, Pipestone, Pope, Rive, Steele, Traverse, and Waseca Counties. The region extends into northeastern South Dakota and north central Iowa (Gibbon, et. al. 2002).

Regionally, archaeological sites are generally located in proximity to established water resources. Early and Middle Prehistoric Sites may be deeply buried in the colluvium and alluvium along major river valleys, especially in the Minnesota River Valley. Middle to Late Prehistoric Sites can be found on the islands and peninsulas of moderate to large-sized lakes, as well as in the wooded areas of galley forests along the major rivers where indigenous populations would winter. Late Prehistoric Sites include large agricultural village sites located on terraces of perennial waterways. Large Cambria villages are largely confined to the Minnesota River Valley and Oneota villages to the Blue Earth River Valley (Anfinson 1987). Small campsites and special activity sites from all periods are scattered throughout the region.

Contact period sites (circa 1700) are typically associated with the Yankton and Wahpeton-Sisseton Dakota and found along the Minnesota River. Early Anglo fur traders such as the French, English, and eventually Americans established posts along the upper Minnesota River between 1750-1800. American traders established posts further into the wooded interior by the early 1800s.

8.7.1 Previously Recorded Archaeological and Historic Architectural Resources

Table 8.7-1 summarizes previously recorded archaeological sites and historic architectural resources that were identified within the Project Area or within one mile of the Project Area during background literature review. Information regarding National Register of Historic Places (NRHP) eligibility of the previously recorded sites was also reviewed. These resources are displayed on Figures 11a and 11b (Unique Natural Features).

Table 8.7-1
Previously Recorded Cultural Resources within the Project Area and Within 1-mile Buffer

Resource Type	Project Area	1-Mile Buffer
Archaeological Sites	1	15
Total listed in NRHP[1]	0	0

Table 8.7-1
Previously Recorded Cultural Resources within the Project Area and Within 1-mile Buffer

Resource Type	Project Area	1-Mile Buffer
Historic Architectural Resources	6	24
Total listed in NRHP[1]	0	2
Total Previously Recorded Cultural Resources	**7**	**39**
Total Listed in NRHP[1]	**0**	**2**

[1] The number of NRHP-eligible resources shown is a subset of the total number of archaeological sites or historic architectural resources in each category.

One previously recorded archaeological site was identified within the Project Area boundary. Site 21MUh marks the purported location of a historic ghost town known as Ben Franklin; this site location has never been verified and it is not listed in the NRHP.

Plum Creek's background literature review identified 15 previously recorded archaeological sites within one mile of the Project Area. Of the 15 previously recorded archaeological sites within the one-mile buffer of the Project Area, 10 are prehistoric sites of undetermined age and consist of either isolated finds or diffuse artifact scatters; three are artifact scatters that can be attributed to the Woodland tradition; and the two remaining sites are the historic remains of a dugout home (Charlie Zierkey's Dug Out/Dutch Charlie's) and the ruins of a railroad station (Walnut Grove Whistle Stop). None of the previously recorded archaeological sites within one mile of the Project Area were evaluated for listing in the NRHP.

A total of six previously recorded historic architectural resources were identified within the Project Area. These historic architectural resources are the St. Olaf Lutheran Church, District School No. 43, the Anderson Dodecagonal Barn, Bridge No. L6568, a school, and the Holly Township Hall. None of these historic architectural resources is listed in the NRHP.

A total of 24 previously recorded historic architectural resources were identified within one mile of the Project Area. These resources consist of four agricultural processing, five commercial, three domestic, two educational, two government, one recreational, five religious, and two transportation-related properties (refer to Appendix E for additional details). Most of these resources are concentrated in and near the small towns of Dovray, Walnut Grove, and Revere, outside of the Project boundary. Of the 24 previously recorded historic architectural resources within one mile of the Project Area, two are listed in the NRHP. The Walnut Grove Creamery Association stands in downtown Walnut Grove, approximately 2,500 feet northwest of the Project Area. The creamery was listed in the NRHP in 2006. The Revere Fire Hall is located approximately 4,500 feet north of the Project Area in the town of Revere and was listed in the NRHP in 1980.

8.7.2 Impacts

LWECS projects have the potential to impact archaeological and historic architectural resources. Archaeological resources could be impacted by the disruption or removal of subsurface archaeological materials, structural remains, or earthworks during LWECS construction. Historic architectural resources may be impacted by the placement of a turbine or substation within the

established viewshed of an historic property, which could affect the integrity of the viewshed in a way that decreases the historic value of the resource.

Information regarding the location of previously documented cultural resources sites was taken into consideration during initial Project design. Plum Creek has designed the Project to avoid any impacts to all previously documented archaeological or historic architectural resources either by Project alteration or structure placement. As such, no impacts to previously documented archaeological or historic architectural resources would occur as a result of the Project.

8.7.3 Mitigative Measures

Plum Creek understands that additional previously undocumented cultural resources could be present within the Project Area. Archaeological resources would most likely be located on or near elevated landforms near permanent water sources. Historic architectural resources would most likely be located near existing municipalities, farmsteads, and infrastructure such as roads and bridges.

During Spring/Summer 2020 and in consideration of the literature search results and future coordination with SHPO, Plum Creek will conduct field surveys in high-potential areas that could contain previously unrecorded cultural resources. The study will meet the standards established in the SHPO Manual for Archaeological Projects in Minnesota. This investigation 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. The survey protocol and report will be coordinated with and approved by SHPO. If archaeological or historic architectural resources are identified as a result of field surveys, Plum Creek will work with SHPO to identify measures to avoid or mitigate any effects to these resources.

If cultural resources are identified as a result of the field survey, Plum Creek will alter the placement of Project components to avoid impacts to archaeological and historic architectural resources. Avoidance of resources may include minor adjustments to the Project design and designation of environmentally sensitive areas to be left undisturbed by the Project. If archaeological resources are discovered during construction, ground disturbing activity would be halted in that location, the SHPO would be notified, and measures will be developed in conjunction with SHPO to assess and protect the resource. Additionally, if unanticipated human remains are discovered during construction, they will be reported to the State Archaeologist per Minn. Stat. § 307.08 and construction will cease in that area until adequate mitigation measures have been developed between Plum Creek and the State Archaeologist.

8.8 Recreation

Construction and operation of the Project has the potential to affect public access to and enjoyment of recreational opportunities in Cottonwood, Murray, and Redwood Counties through introduction of a physical, long-term aesthetic change to the predominantly agrarian landscape.

8.8.1 Description of Resources

Recreational opportunities near the Project Area include hiking, biking, boating, fishing, camping, swimming, snowmobiling, hunting, golfing, and nature viewing. Figures 6a and 6b depict the locations of Aquatic Management Areas (AMAs), WMAs, Scientific and Natural Areas (SNAs), WPAs, NWRs, and state parks; golf courses; and snowmobile, water, and state trails within 10 miles of the Project Area.

Minnesota AMAs are managed to protect, develop, and manage lakes, rivers, streams, and adjacent wetlands and lands that are critical for fish and other aquatic life, for water quality, and for their intrinsic biological value, public fishing, or other compatible outdoor recreational uses. There are no AMAs within the Project Area and six AMAs within 10 miles of the Project Area. The closest AMA to the Project is the Buttermilk Run AMA approximately 2.1 miles west and immediately adjacent to Lake Shetek. AMAs located within 10 miles of the Project Area are included in Table 8.8-1.

Table 8.8-1
Aquatic Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	AMA Name	General Location	AMA Area (Acres)
2.1	Buttermilk Run AMA	West	27.7
2.6	Sanborn AMA (multiple parcels)	Northeast	61.0
4.2	Shetek Lake AMA (multiple parcels)	West	6.2
4.4	Shetek Rearing Pond AMA	West	26.6
8.0	Augusta Lake AMA	South	6.6
8.5	Sarah Lake AMA (multiple parcels)	West	1.9

Minnesota 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. There are no WMAs within the Project Area and five WMAs immediately adjacent to the Project Area. WMAs located within 10 miles of the Project Area are included in Table 8.8-2.

Table 8.8-2
Wildlife Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	WMA Name	Direction from Project Area Boundary	WMA Area (Acres)
0.0	Budolfson WMA	Adjacent	449.0
0.0	Buffalo Lake WMA (multiple parcels)	Adjacent	563.6
0.0	Dovray WMA (multiple parcels)	Adjacent	963.5
0.0	Plum Creek WMA	Adjacent	280.6

Table 8.8-2
Wildlife Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	WMA Name	Direction from Project Area Boundary	WMA Area (Acres)
0.0	Typhoon WMA	Adjacent	82.5
<0.1	Gora Prairie WMA	North	152.6
0.5	Devils Run WMA	South	89.8
0.5	Hurricane Lake WMA	South	263.3
0.9	Dutch Charley Creek WMA	North	164.7
0.9	Sweetman WMA	West	35.1
1.1	Phelan WMA	Southwest	69.2
1.6	Buttermilk Run WMA	West	55.8
2.1	Rupp WMA	West	82.7
2.1	Lamberton WMA	North	1,361.0
2.2	Shetek WMA (multiple parcels)	West	618.4
2.6	Irruption WMA	South	208.4
3.3	Two Rivers WMA	North	724.4
3.5	Grunflur WMA	East	162.9
3.6	Beaver Creek WMA (multiple parcels)	West	512.5
6.8	Coal Mine Creek WMA	Northeast	145.7
5.2	Avoca WMA	Southwest	60.4
5.5	Wahpeton Prairie WMA	North	81.6
6.1	Elder WMA	West	20.5
6.2	Highwater WMA	South	80.3
6.6	H.C. Southwick WMA (multiple parcels)	Southwest	569.6
6.6	Talcot Lake WMA	South	5,268.5
7.4	Mcgee WMA	Southwest	43.3
7.4	Willow Lake WMA	North	178.3
7.8	Haberman WMA	South	95.8
7.9	Greenhead WMA	Northwest	48.1
8.0	Sarah-Mason WMA (multiple parcels)	West	109.2
8.5	Mammenga WMA	North	120.5
8.7	Engebretson WMA (multiple parcels)	West	55.0
8.1	Waterbury WMA	North	81.2

Table 8.8-2
Wildlife Management Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	WMA Name	Direction from Project Area Boundary	WMA Area (Acres)
8.7	Wajer WMA	Southwest	81.2
8.5	Vogel WMA	East	166.5
9.1	Badger WMA	Southwest	403.0
9.2	Gales WMA (multiple parcels)	North	267.9
9.4	Expandere WMA	South	893.1
9.7	Arnolds Lake WMA	Southeast	123.3
9.9	Johnsonville WMA	North	113.3

SNAs are areas designated to protect rare and endangered species habitat, unique plant communities, and significant geologic features that possess exceptional scientific or educational values. There are no SNAs within the Project Area and three SNAs located within 10 miles of the Project Area. SNAs located within 10 miles of the Project boundary are shown on Table 8.8-3.

Table 8.8-3
Scientific and Natural Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (miles)	SNA Name	General Location	SNA Area (Acres)
4.9	Cottonwood River Prairie SNA (multiple parcels)	East	350.4
7.1	Rock Ridge Prairie SNA	East	198.6
8.7	Lundblad Prairie SNA	Southwest	79.5

WPAs are managed by USFWS to protect breeding, forage, shelter, and migratory habitat for waterfowl or wading birds, such as ducks, geese, herons, and egrets. WPAs provide opportunities for viewing wildlife and intact ecosystems. There are no WPAs within the Project Area and four WPAs are adjacent to the Project Area. An additional 11 WPAs located within 10 miles of the Project boundary are shown on Table 8.8-4.

Table 8.8-4
Waterfowl Production Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (mi)	WPA Name	General Location	WPA Area (Acres)
0.0	Buffalo Lake WPA	Adjacent	80.5
0.0	Devils Run WPA	Adjacent	155.6
0.0	Dutch Creek WPA	Adjacent	19.0
0.0	Lake Julia WPA	Adjacent	64.0

Table 8.8-4
Waterfowl Production Areas within 10 Miles of the Project Area

Distance from Project Area Boundary (mi)	WPA Name	General Location	WPA Area (Acres)
0.3	Watonwan River WPA (multiple parcels)	Southeast	238.5
0.3	Westbrook WPA (multiple parcels)	South	68.4
0.5	Dovray WPA	West	79.2
0.5	Slaughter Slough WPA	West	641.2
6.5	Storden WPA	South	441.9
6.6	5-Mile Corner WPA (multiple parcels)	West	244.2
6.7	Big Slough WPA (multiple parcels)	Southwest	812.0
6.9	Long Lake WPA (multiple parcels)	South	235.6
7.1	Mason WPA	West	76.3
8.0	Lake Augusta WPA (multiple parcels)	South	503.7
9.9	Giese WPA	South	316.8

The USFWS manages one 60-acre NWR parcel called Pell Creek associated with the Northern Tallgrass Prairie NWR in the northeastern Murray County portion of the Project Area. The Northern Tallgrass Prairie NWR was established to address the loss of America's grasslands and the decline of grassland wildlife (USFWS, 2014a). The NWR provides habitat for a number of grassland dependent species. The Northern Tallgrass Prairie NWR encompasses all or part of 85 counties in western Minnesota and northwestern Iowa and includes nearly 3,000 acres of land owned by the refuge system and an additional 2,500 acres protected in conservation easements. Easements and purchased lands are managed or overseen by the NWR or wetland management district office covering the area where the lands are located. There are no other NWRs within 10 miles of the Project boundary.

Lake Shetek State Park, located approximately 3.5 miles west of the Project Area, offers camping, fishing, hiking, and bike-trail opportunities, and also features a historic monument and nature center. There are no other state parks within 10 miles of the Project Area.

The MNDNR offers a Walk-In Access (WIA) Program for public hunting on private land. There are three WIA parcels within the Project Area covering 287.6 acres. All three WIA parcels are also part of the RIM Program, previously discussed in Section 8.3.1. WIA areas are shown on Figures 6a and 6b (Public Land Ownership and Recreation). The WIA Program includes walk-in agreements with the landowner that typically last two to three years (MNDNR, 2019g).

There are no state trails or water trails within the Project Area. The closest state trail is associated with Lake Shetek State Park, which is located approximately 3.5 miles west of the Project Area and is discussed further above; and the closest water trail, a segment of the Cottonwood River, is located approximately 4.2 miles east of the Project boundary.

As described in Section 8.5.1.2, a section of the Cottonwood and Jackson County Snowmobile Trail bisects the Project running north along County Road 54 for approximately 2.2 miles and then turning east along 100th Street for approximately 2 miles.

The Rolling Hills Golf Course is immediately adjacent to the southern Project Boundary, west of Westbrook in Murray County.

8.8.2 Impacts

Construction and operation of the Project is not anticipated to affect public access to or enjoyment of nearby recreational opportunities. Impacts to recreation would mostly be related to Project construction, which will be minimal, temporary, and isolated to specific areas throughout the Project Area. During operations, impacts will be visual in nature and are discussed in Section 8.5.1.2.

While there are several recreation lands within 10 miles of the Project Area, only one NWR parcel and a snowmobile trail are within the Project Area. Plum Creek has sited turbines at least 3 RD x 5 RD from the NWR recreation area and routed collection lines and crane paths around this parcel. A co-located collection line and crane path cross the Cottonwood and Jackson County Snowmobile Trail. This would result in a minimal, temporary impact to the trail but no permanent impacts to the trail would occur. As this recreational trail is only used during winter months, potential impacts will depend on the timing of construction. If construction in this area is completed during non-winter months, snowmobilers would not notice an impact. The collection line will be buried and, as such, no impacts to the snowmobile trail will occur from operation of the Project.

Introduction of an aesthetic change to the predominantly agrarian landscape in the Project Area could impact public enjoyment of available recreation areas. A detailed discussion of how the Project could impact aesthetics and the measures Plum Creek would use to mitigate aesthetic impacts is provided in Section 8.5.

8.8.3 Mitigative Measures

Plum Creek has mitigated potential Project effects on recreation opportunities in Cottonwood, Murray, and Redwood Counties by siting Project facilities to avoid recreation areas. Project turbines and facilities will not be located within public parks, trails, WMAs, or in USFWS lands. Turbines will be set back from public lands based on a minimum of the 3 RD by 5 RD setbacks from all non-leased properties per the Commission siting guidelines (MPUC, 2008). Plum Creek will work with the Cottonwood and Jackson County Snowmobile Club on construction timing and to determine if rerouting of the path is needed and facilitate any modifications.

8.9 Public Health and Safety

LWECS projects have the potential to affect public health and safety by introducing collection lines carrying electricity from the wind turbines to the collector substations and their associated electromagnetic fields. Electromagnetic fields have been widely studied for potential health concerns. Additionally, LWECS can introduce air space hazards for aircraft traveling to and from local airports; there is a six-mile buffer from public use airports for which turbines cannot be sited.

8.9.1 Electromagnetic Fields and Stray Voltage

8.9.1.1 Description of Resource

The term electromagnetic field (EMF) refers to electric and magnetic fields that are present around any electrical device. Electric fields arise from the voltage or electrical charges, and magnetic fields arise from the flow of electricity or current that travels along transmission lines, power collection (feeder) lines, substation transformers, house wiring, and electrical appliances. 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 (wire). EMF can occur indoors and outdoors. However, there are no discernible health impacts from power lines (National Institute of Environmental Health Sciences [NIEHS], 1999).

The source of EMF for the Plum Creek Wind Project will be from electrical collection lines and wind turbines. EMF from electrical collection lines, transmission lines, and transformers dissipates rapidly with distance from the source (NEIHS, 2002). Generally speaking, higher-voltage electrical lines produce higher levels of EMF at the source before dissipating with distance. There is no federal standard for transmission line electric fields. The Commission, however, has imposed a maximum electric field limit of 8 kV per meter (kV/m) measured at one meter (3.28 feet) above the ground. There are presently no Minnesota regulations pertaining to magnetic field exposure.

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. Stray voltage can occur with electrical distribution lines to residences and high voltage transmission lines that parallel them. While both the distribution line and transmission lines are grounded, there is not a dedicated neutral wire connecting the electrical systems, so the earth can be used as a conductor to carry the neutral current. This voltage may be felt by animals standing on the ground.

8.9.1.2 Impacts

Levels of EMF from the Project will be considerably below accepted guidelines. Project-specific EMF levels were not modeled for the 34.5 kV electrical collection lines; however, several studies have documented EMF exposure of various high voltage transmission lines. The NIEHS provides typical EMF levels for power transmission lines (NIEHS, 2002). For 115-kV transmission lines, the lowest voltage with typical EMF levels reported in the study, electric fields directly below the transmission line were reported at 1.0 kV/m before dissipating to 0.5 kV/m at 50 feet (approximate edge of right-of-way). A Canadian study of collection lines at a wind facility measured EMF (magnetic fields) of the Project's 27.5-kV collection lines, slightly lower voltage than the electrical collection lines proposed for the Plum Creek Wind Project. This study found magnetic fields associated with buried electrical collection lines to be within background levels at 1 m above ground (McCallum et al., 2014). EMF from underground electrical collection lines dissipates very close to the lines because they are installed below ground within insulated shielding. The electrical fields are negligible, and there is a small magnetic field directly above the lines that, based on engineering analysis, dissipates within 20 feet on either side of the installed cable. The closest collection line to a residence is at least 160 feet, well beyond the distance where magnetic fields dissipate to background levels. Similarly, EMF associated with the transformers at the base of each

turbine completely dissipates within 500 feet, so the 1,000-foot turbine setback from residences will avoid any EMF exposure to homes.

Research on the potential influence of EMF on organisms and human health has been conducted over many decades to understand basic interactions of EMF with biological organisms and cells, and to investigate potential therapeutic applications. In the 1970s, questions arose about potential adverse health effects from EMF and health conditions, including cancer. Over the past 40 years, considerable additional research has been conducted to address uncertainties in those studies and to determine if there was any consistent pattern of results from human, animal, and cell studies that would support such an association[3,4,5,6]. The quantity and complexity of the research has led scientific and government health agencies to assemble multidisciplinary panels of scientists to conduct weight-of-evidence reviews and arrive at conclusions about the possible effects associated with EMFs.

Overall, the published conclusions of these scientific review panels have been consistent. None of the panels concluded that either electric fields or magnetic fields are a known or likely cause of any adverse health effect at the long-term, low exposure levels found in the environment. As a result, no standards or guidelines have been recommended to prevent this type of exposure; however, from all the research that has been conducted, it was confirmed that short-term exposure to higher intensities of EMF (above exposure levels of electrical and industrial workers) could produce adverse stimulation of nerves and muscles (World Health Organization [WHO], 2018).

[3] The NIEHS assembled a 30-person Working Group to review the cumulative body of epidemiologic and experimental data and provide conclusions and recommendations to the U.S. government (NIEHS, 1999).

[4] The International Agency for Research on Cancer (IARC) completed a full carcinogenic evaluation of EMF in 2002 (IARC, 2002).

[5] The International Commission on Non-Ionizing Radiation Protection (ICNIRP), the formally recognized organization for providing guidance on standards for non-ionizing radiation exposure for the WHO, published a review of the cumulative body of epidemiologic and experimental data on EMF in 2003. The ICNIRP released exposure guidelines in 2010 that updated their 1998 exposure guidelines. For both guidelines, they relied heavily on previous reviews of the literature related to long-term exposure, but provided some relevant conclusions as part of their update process (ICNIRP, 2010).

[6] The Swedish Radiation Protection Authority (SSI), which became the Swedish Radiation Safety Authority (SSM) in 2009, evaluated current studies in several reports, using other major scientific reviews as a starting point (SSI, 2007 and 2008; SSM, 2009, 2010, 2013, 2014, 2015, 2018).

Although electric and magnetic fields induce voltages and currents in the body, the induced currents directly beneath high-voltage transmission lines are very small compared to thresholds for producing shock and other harmful electrical effects (WHO, 2018).

There is one dairy operation in the Project Area. Plum Creek has sited turbines in both layouts nearly one mile from this operation. Similarly, collection lines, at their closest in the V162 layout, are also nearly one mile from this dairy farm. These distances are adequate such that there will be no stray voltage impacts to this dairy operation.

8.9.1.3 Mitigative Measures

No impacts due to EMF or stray voltage are anticipated and no mitigation is proposed. Plum Creek is committed to siting turbines and associated facilities to avoid conflicts with dairy farmers in the Project Area.

8.9.2 Air Traffic

8.9.2.1 Description of Resource

There are two public airports and two private airports/heliports within 10 miles of the Project Area (Table 8.9-1; AirNav, 2019). The nearest airport is the Sanford Westbrook Clinic Heliport, located approximately 1.3 miles south of the Project. These airports have runway approaches and restricted airspace for aircraft to approach and take off from.

Table 8.9-1
Airports within 10 Miles of the Project Area

Airport Name	City	County	Distance/ Direction[1]	Runway Information[2]	Runway Elevation (feet)[3]
Sanford Westbrook Clinic Heliport[4]	Westbrook	Cottonwood	1.3 miles south	Heliport	--
Tracy Municipal Airport	Tracy	Lyon	6.4 miles northwest	Asphalt/turf, good	1340
Ewen Landing Field[4]	Jeffers	Cottonwood	7.1 miles southeast	Turf, good	1483
Slayton Municipal Airport	Slayton	Murray	9.1 miles southwest	Asphalt, good	1623

[1] Distance in miles from the nearest portion of the Plum Creek Wind Project boundary.
[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] Private airport/heliport.

In addition to air traffic to and from the public and private airports/heliports identified above, air traffic may also be present near the Project Area for crop dusting of agricultural fields. Crop dusting is typically carried out during the day by highly maneuverable airplanes or helicopters.

8.9.2.2 Impacts

The closest public airport to the proposed Project is the Tracy Municipal airport, located approximately 6.4 miles from the Project Area and outside the six-mile buffer from public use airports. Turbines have been sited to avoid any impacts to restricted airspace.

The installation of wind turbine towers in active croplands will create a potential for collisions with crop-dusting aircraft. However, the turbines would be visible from a distance. Plum Creek will notify local airports about the Project including locations of new towers in the area to minimize impacts and reduce potential risks to crop dusters.

8.9.2.3 Mitigative Measures

Plum Creek will coordinate with the Tracy Municipal Airport, the FAA, and MNDOT prior to construction to understand potential impacts. The FAA will review the Plum Creek turbine layouts. Turbines over 500 feet tall have a lengthier review timeline, but regardless of turbine height, the FAA approval is a "Determination of No Hazard" (DNH). Further, Plum Creek will appropriately mark and light the turbines to comply with FAA requirements and, as mentioned in Section 8.5.1.4, Plum Creek is coordinating with the FAA on implementing an ADLS. Plum Creek will notify local airports about the Project and new towers in the area to reduce the risk to crop dusters. Additionally, Plum Creek will coordinate with landowners within and adjacent to the Project regarding crop-dusting activities.

Permanent meteorological towers will be freestanding with no guy wires. Temporary meteorological towers have supporting guy wires which are marked with alternating red and white paint at the top and colored marking balls on guy wires for increased visibility. The temporary meteorological towers will be removed after the Project is operational.

8.10 Hazardous Materials

LWECS projects have the potential to affect known contaminated sites if construction of the project facilities would cause ground disturbance within these sites. In addition, LWECS project construction and operation may utilize petroleum products and other products that could result in site contamination if these materials are not managed and disposed of in compliance with the requirements of applicable laws and regulations

8.10.1 Description of Resources

The land within the Project Area is primarily rural and used for agriculture. Potential hazardous materials within the Project Area are associated with agricultural activities, and include petroleum products (fuel and lubricants), pesticides, and herbicides. Older farmsteads may also have lead-based paint, asbestos shingles, and polychlorinated biphenyls in transformers. Trash and farm equipment dumps are common in rural settings.

Plum Creek reviewed the U.S. Environmental Protection Agency's (EPA) Facility Registry Service (FRS) to identify sites that are listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (also known as Superfund sites); Resource Conservation and Recovery Act (RCRA) Treatment, Storage, and Disposal; RCRA hazardous waste generators; the Assessment, Cleanup, and Redevelopment Exchange System; Minnesota Permitting, Compliance, and Enforcement Information Management System; and the Leaking Underground Storage Tank—American Recovery and Reinvestment Act database (EPA, 2019). Plum Creek also reviewed the MPCA's *What's in my Neighborhood* (WIMN) database to identify any potential contaminated sites in the Project Area (MPCA, 2019a).

Review of the FRS and WIMN databases identified 39 licensed feedlots, one licensed feedlot/solid waste generating site, one inactive hazardous waste generator (automotive repair shop), two active solid waste generating sites, one licensed septic installer, and six open stormwater permits in the Project Area. No Superfund sites were identified within the Project Area.

In addition to the research described above, and as part of the Project financing process, an ASTM conforming Phase I Environmental Site Assessment (Phase I ESA) will be conducted for the Project Area. 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.

8.10.2 Impacts

Construction of the Project will not impact known contaminated sites. Plum Creek has designed the Project to avoid known contaminated sites within the Project Area. Plum Creek also will conduct a Phase I ESA prior to construction to locate any additional contaminated sites in the Project Area that require avoidance.

Spill-related impacts from construction are primarily associated with fuel storage, equipment refueling, and equipment maintenance. To avoid spill-related impacts during construction, Plum Creek will develop a Spill Prevention, Control, and Countermeasures Plan that will outline measures to be implemented to prevent accidental releases of fuels and other hazardous substances and describe the required response, containment, and cleanup procedures to be used in the event of a spill.

During operation of the Project, three types of petroleum-product fluids will be used for turbine operation:

- Gear box oil – synthetic or mineral depending on application (approximately 300 liters)
- Hydraulic fluid
- Gear grease

Turbine hydraulic oils and lubricants will be contained within the wind turbine nacelle, or in the case of car, truck, and equipment fuel and lubricants, within the vehicle. Transformer oil will be contained within the transformer. Fluids will be monitored during maintenance at each turbine and transformer. A small amount of hydraulic oil, lube oil, grease, and cleaning solvent will be stored in the O&M facility. When fluids are replaced, the waste products will be handled according to

regulations and disposed of through an approved waste disposal firm in compliance with the requirements of applicable laws and regulations.

8.10.3 Mitigative Measures

Because any potentially hazardous waste sites identified through online research or the Phase I ESA of the Project Area will be avoided, no mitigative measures are necessary. If any wastes, fluids, or pollutants are generated during any phase of construction or operation of the Project, they will be handled, processed, treated, stored, and disposed of in accordance with Minn. R. Ch. 7045.

8.11 Land-Based Economies

Construction and operation of the Project has the potential to affect land-based economies in Cottonwood, Murray, and Redwood Counties through introduction of a physical, long-term presence which could prevent or otherwise limit use of the land for other purposes. The placement of wind turbines, access roads, and collector substations in cultivated cropland has the potential to interfere with farming operations based on the placement of these facilities in agricultural fields. Interference with farming operations can negatively affect farm income. Additionally, if tree clearing is required for the Project it could affect forestry businesses in the Project Area, if present. Placement of wind turbines, collector substations, or other associated facilities near mining operations could interfere with access to existing mines and could limit the expansion of the mines. The following subsections present an overview of agricultural, forestry, and mining operations in the Project Area, discuss how the proposed Project may affect these industries, and what measures Plum Creek will implement to mitigate Project effects.

8.11.1 Agriculture/Farming

8.11.1.1 Description of Resources

The majority of land use in the Project Area is cultivated crop land (approximately 66,654 acres or 91.2 percent), as shown in Figures 12a and 12b (Land Cover) and discussed in Section 8.19. Pasture/hay lands comprise approximately 1,302 acres (1.8 percent) of the Project Area.

According to the USDA's 2012 Census of Agriculture, the average farm size in Cottonwood, Murray, and Redwood Counties was similar, averaging 454 acres, and generally larger than the average size of all Minnesota farms, 349 acres.

Crop sales account for a larger percentage of total market value of agricultural products compared to livestock sales in Cottonwood County ($234 million vs. $140 million, annually), Murray County ($233 million vs. $133 million, annually), and in Redwood County ($365 million vs. $153 million, annually). Corn and soybeans are the dominant agricultural crops by acreage in all three counties followed by forage crops in Cottonwood and Murray Counties and sugar beets in Redwood County. Cattle, hogs and pigs, and sheep and lambs are the dominant livestock raised in all three counties. Agricultural statistics for the counties within the Project Area are summarized in Table 8.11-1.

Specialty crops typically include nurseries, vineyards, orchards, citrus groves, dairies, aquaculture, and tree farms; to date, no farmland engaged in specialty crop production has been identified in the Project Area. Plum Creek will continue to work with individual landowners through the

easement process to identify any specialty crops or livestock operations that may be impacted by the Project. If any specialty crops or livestock operations are identified, Plum Creek will work with landowners to determine measures to avoid and minimize impacts to these resources.

As discussed in Section 8.3, Conservation Easements, approximately 1,689 acres of the Project Area within Cottonwood and Murray Counties, are currently enrolled in CREP and RIM easements (*see* also Figures 6a and 6b – Public Land Ownership and Recreation). No CREP or RIM easements are mapped in the Redwood County portion of the Project Area, based on review of publicly available information. Lands enrolled in these easements are typically pasture/hay, not cultivated cropland.

Table 8.11-1
Agricultural Statistics of Counties Within the Project Area

County	Number of Farms	Average Farm Size (acres)	Land in Farms (acres)	Market Value of Agricultural Production - Crops	Top 3 Crops by Acreage	Market Value of Agricultural Production - Livestock	Top 3 Livestock Inventories by Farms
Cottonwood	813	459	372,767 (92 % of county)	$234 million (63 %)	Corn, soybeans, forage	$140 million (37 %)	Cattle, hogs and pigs, sheep and lambs
Redwood	1,163	448	521,453 (93 % of county)	$365 million (70 %)	Corn, soybeans, sugar beets	$153 million (30 %)	Cattle, hogs and pigs, sheep and lambs
Murray	895	456	407,919 (88 % of county)	$233 million (63 %)	Corn, soybeans, forage	$133 million (36 %)	Hogs and pigs, cattle, sheep and lambs

8.11.1.2 Impacts

Construction of the Project could cause minimal, temporary impacts to farmland from soil compaction and rutting, accelerated soil erosion, crop damage, temporary disruption to normal farming activities, drain tile damage, and introduction of noxious weeds to the soil surface. However, the presence of the Project will not significantly impact use of land for agricultural production. As demonstrated by other wind energy projects in the Midwest, agricultural practices continue during construction and operations.

All turbines in both layouts are sited in cultivated crop lands. Therefore, operation of the Project will require agricultural land to be taken out of production where the turbines and access roads are sited (approximately 0.5 to 1 acre per turbine). Additionally, land will also be taken out of agricultural production for the collector substations and O&M facility, which together would total approximately 21 acres. Landowners may continue to plant crops near and up to the turbine pads and access roads. In some instances, agricultural practices will be impacted by requiring new maneuvering routes around the turbine structures for agricultural equipment. The collector substations and O&M facility would be fenced, but agricultural production would be allowed to continue beyond the fenced area. Agricultural land taken out of production for access roads would be a permanent loss and agricultural production would not be allowed to continue within the footprint of access roads. Access roads are designed in such a way that they do not unnecessarily impede agricultural production beyond the footprint of the access road. For example, an access road is designed either at the field edge or sufficient distance from the field edge to allow agricultural equipment sufficient distance for operating (i.e., planting, maintaining, harvesting). This means that the narrow strip between the access road and field edge can continue to be farmed.

The loss of agricultural land to the construction of the Project will reduce the amount of land that can be cultivated in the Project Area; however, less than one half of one percent of the Project Area will be converted to non-agricultural land use (i.e., wind turbines, access roads, collector substations, and O&M facility). This represents an unavoidable yet minimal impact to agricultural land in the Project Area boundary but will not significantly alter agricultural production in the Project Area or Cottonwood, Murray, and Redwood Counties.

Turbine and associated facility siting will include discussions with landowners to identify features on their property, including drain tile, which should be avoided. Impacts to drain tile due to Project construction and operation are not anticipated. However, in the event that there is damage to drain tile as a result of construction activities or operation of the LWECS, the tile will be repaired according to the lease agreement between Plum Creek and the owner.

After construction of the Project is complete, farming will be allowed to continue on all land surrounding the turbines, access roads, collector substations, and O&M facility. The permanent loss of up to 82.8 acres of cultivated crop land (*see* Table 8.19-2 – Summary of Land Cover Impacts; this acreage represents impacts from the SG170 layout, which would impact more acres of cultivated cropland than the V162 layout) in the Project Area will not result in the loss of any agriculture-related jobs or a net loss of income.

As noted in Section 8.3, Plum Creek has sited both layouts to avoid permanent and temporary impacts to conservation easements held by public agencies or private organizations. Avoidance of parcels enrolled in the CREP or RIM programs will further minimize impacts to landowners engaged in agricultural production.

8.11.1.3 Mitigative Measures

Plum Creek has designed both layouts to minimize impacts to agricultural lands. Revenue lost from the removal of land from agricultural production will be offset by lease payments to landowners hosting the Project facilities. If possible, constructing the Project during winter months would further minimize impacts to agricultural land by avoiding planting and harvesting seasons, avoiding the risk of crop damage, and minimizing the likelihood of rutting, accelerated soil erosion, and introduction of noxious weeds to the soil surface.

Plum Creek will coordinate with property owners to identify features on their property, including drain tile to avoid any permanent impact. While avoidance of drain tile is planned, Plum Creek recognizes that excavation and heavy equipment operation during construction has the potential to 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, Plum Creek will work with affected property owners to repair the damaged drain tile in accordance with the lease agreements between Plum Creek and the landowner.

As discussed in Section 8.3.2 (Impacts to Conservation Easements), if additional CREP or RIM easements are identified during the title search or in consultation with the BWSR, and impacts to such conservation easements are unavoidable, Plum Creek will work with easement holders to obtain all necessary consents to construct and operate the Project.

8.11.2 Forestry

8.11.2.1 Description of Resources

Economically important forestry resources are not found in this region of Minnesota. Forested areas are primarily associated with homes in the form of woodlots, shelterbelts, and along the margin of waterbodies within the Project Area.

8.11.2.2 Impacts

No impacts to forestry resources would occur from construction or operation of the Project.

8.11.2.3 Mitigative Measures

No impacts to forestry resources would occur; therefore, no mitigation will be necessary.

8.11.3 Mining

8.11.3.1 Description of Resources

Mining does not comprise a major industry in the Project counties. Many of the gravel operations found in Cottonwood, Murray, and Redwood Counties are inactive, abandoned, or their use is limited to the landowner. Because land uses can change over time, and keeping up with these changes can be challenging, Plum Creek reviewed topographic maps, MNDOT's Aggregate Source Information System data (MNDOT, 2018), County Pit Maps (MNDOT, 2002, 2003a, and 2003b), and several years of aerial photography to identify mining operations in the Project Area. Review and comparison of these sources indicates that no mining operations are present within the Project Area (*see* Figures 14a and 14b – Site Geology and Depth to Bedrock).

8.11.3.2 Impacts

Because there are currently no mining operations in the Project Area, impacts to these resources would not occur.

8.11.3.3 Mitigative Measures

No impacts to mining resources would occur and, as such, no mitigation will be necessary.

8.12 Tourism

Construction and operation of the Project has the potential to affect tourism in Cottonwood, Murray, and Redwood Counties through temporary increases of construction vehicles and an introduction of a physical, long-term aesthetic change to the predominantly agrarian landscape.

8.12.1 Description of Resources

Tourism in the Project Area centers around various festivals and activities hosted by the cities near the Project Area, such as Walnut Grove and outdoor recreational opportunities described in Section 8.8.

The Laura Ingalls Wilder Museum and Gift Store is in Walnut Grove just south of the intersection of U.S. 14 and 8th Street and approximately 0.6 mile north and west of the Project Area (Walnutgrove.com, 2017). The museum is open between April and October and features collections of historical documents, quilts, and other household items that belonged to the Ingalls family, as well as memorabilia from the popular television show *Little House on the Prairie*. The museum is spread out between a number of buildings including an 1898 depot, a chapel, an onion-domed house, a dugout display, little red schoolhouse, early settler home, and a covered wagon display.

Various festivals associated with the museum are held each year during the month of July including, the Wilder Pageant, Family Festival, Little House TV Cast Reunion, Black Powder Shoot Rendezvous, Laura and Nellie Look-alike Contest, and various bus and walking tours (Walnutgrove.com, 2017). One popular tourist attraction is the Ingalls Dugout Site, located approximately 1.5 miles north of the town of Walnut Grove and approximately 1.8 miles from the

Project Area along the banks of Plum Creek (Walnutgrove.com, 2017). The site is open to tourists between May and October each year.

Outside these municipalities, residents and tourists enjoy recreational opportunities at the NWRs, WPAs, Shetek State Park, AMAs, SNAs, WMAs, WIAs, and snowmobile trails in Cottonwood, Murray, and Redwood Counties. *See* Section 8.8 for more details on public recreation opportunities in the Project Area.

8.12.2 Impacts

Construction and operation of the Project will have minimal impact to tourism opportunities in the Project vicinity. Construction impacts would mostly be related to increased traffic due to construction activities that may be perceptible to persons traveling through the Project Area to visit tourist destinations in Walnut Grove or nearby recreation lands. These impacts will be minimal, temporary, and isolated to specific areas throughout the Project Area.

Because all Project facilities will be located on private lands, and outside of municipal boundaries, there will be no impacts to recreational areas, public lands, or other tourism-related activities. Additionally, all recreation lands will be setback from turbines as described in Section 5.1.

During operations, introduction of an aesthetic change to the predominantly agrarian landscape in the Project Area could impact public enjoyment of tourist attractions. However, these impacts would be minimal. A detailed discussion of how the Project could impact aesthetics and the measures Plum Creek would use to mitigate aesthetic impacts is provided in Section 8.5.

8.12.3 Mitigative Measures

Plum Creek has mitigated potential Project effects on tourism opportunities in Cottonwood, Murray, and Redwood Counties by siting Project facilities to avoid recreation areas and municipalities where tourism opportunities are available.

8.13 Local Economies and Community Benefits

LWECS projects have the potential to impact the socioeconomic conditions of an area in the short term through an influx of construction personnel expenditures, creation of construction jobs, construction material and other purchases from local businesses, and expenditures on temporary housing and other items by construction personnel. In the long term, LWECS projects provide beneficial impacts to the local tax base in the form of revenues from wind production tax payments and the development of a community fund. Additionally, permanent job creation or relocation of project personnel to the area for operation of a wind farm project could provide additional tax revenue in the form of income taxes and property taxes.

8.13.1 Description of Existing Socioeconomic Conditions

Socioeconomic information for the counties within the Project Area is provided at the county level to characterize the socioeconomic conditions in the Project Area and at the state level for the purpose of comparison. Comparable census data about income, poverty, and unemployment is not available for townships, towns, and cities with a population of less than 5,000 persons on the new U.S. Census Bureau websites. For this reason, township level data is not provided. Table 8.13-1, summarizes the existing economic conditions in the Project Area.

According to 2010 U.S. Census Bureau economic data, of the top three industries employing residents in Cottonwood, Murray, and Redwood Counties, the educational, health, and social services (average of 23.2 percent) and manufacturing (average of 15.5 percent) industries are common amongst all three counties. Where the counties differ is, in Cottonwood County the retail trade industry employs about 11.5 percent of the population; in Murray County, agriculture, forestry, fishing, hunting, and mining employs about 13.2 percent of the population; and, in Redwood County arts, entertainment, and recreation, and accommodation and food service employs about 11.1 percent of the population (*see* Table 8.1-1 in Section 8.1).

Table 8.13-1
Existing Economic Conditions in the Project Area

	Per Capita Income Level (U.S. dollars)	Unemployment Rate (%)	Persons Living Below the Poverty Level (%)
Minnesota	**36,245**	3.9	10.1
Cottonwood County	27,209	4.1	12.5
Murray County	31,768	2.6	7.4
Redwood County	28,011	2.5	11.4

Source: U.S. Census Bureau, 2018b

Per capita income in Cottonwood, Murray, and Redwood Counties is approximately $4k to $9k less than per capita income at the state level, which is $36,245 (*see* Table 8.13-1). Unemployment rates in Murray and Redwood Counties are slightly lower than the state level of 3.9 percent, while Cottonwood County has an unemployment rate that is slightly higher than the state rate (*see* Table 8.13-1).

The percentage of persons living below the poverty level in Cottonwood and Redwood Counties (12.5 percent and 11.4 percent, respectively) is higher than the state level of 10.1 percent, while the percentage of persons living below the poverty level in Murray County (7.4 percent) is lower than the state level.

8.13.2 County Economic Development Goals

Each of the counties in the Project Area has a Comprehensive Plan that outlines the opportunities and goals for future economic development. In the Economic Development section of the Cottonwood County Comprehensive Plan Land Use Plan (2005), renewable energy development (specifically wind power, ethanol, and biofuels) is noted as a potential source of economic growth and diversification for the county.

The Murray County Comprehensive Plan describes the objectives of economic development in the county as focused on ensuring economic growth is coordinated with the infrastructure and service needs of the county (Murray County Comprehensive Planning Advisory Committee, 2016). In Chapter 3 of the Comprehensive Plan, Murray County lists renewable energy development as a potential economic opportunity for the county.

According to the Redwood County Comprehensive Plan (2007), in 2005 the Redwood County Board established the Economic Development Authority (EDA) to assist the county with diversifying its economic base. The EDA's primary focus is to attract businesses that complement the county's dominant industry, agricultural production, and provide alternatives to agricultural production. The comprehensive plan notes that the EDA will continue to focus on development of renewable energy, bioscience, manufacturing, and wood products businesses in Redwood County.

8.13.3 Impacts

The overall impact of the Project on the local economies and communities of Cottonwood, Murray, and Redwood Counties will be positive in both the short term and long term. Community benefits associated with the Project closely correspond with the stated economic development goals of the county comprehensive plans. Development of the Project helps to promote the diversification of economic development in the agricultural sector and promotes efforts to attract additional employment opportunities and tax revenues while retaining and growing the existing business base.

Approximately 250 construction personnel will be required for construction and 11 to 15 permanent personnel will be needed for operation and maintenance of the Project. Plum Creek will use local contractors and suppliers for portions of the construction process, as available. Total wages and salaries paid to construction personnel and permanent Project employees in Cottonwood, Murray, and Redwood Counties will contribute positively to the total personal income of the region. Additional personal income will be generated for residents in the county and state by circulation and recirculation of dollars paid out by the Applicant for business expenditures and for state and local taxes. Expenditures made for equipment, fuel, operating supplies, construction personnel lodging, and other products and services benefit businesses in the counties and the state.

Wind-energy harvesting provides a new investment opportunity in Cottonwood, Murray, and Redwood Counties. The Project provides landowners and farmers with opportunities for higher agricultural profitability and a more diverse revenue stream. Wind energy is an income-generating opportunity that will provide a long-term, annual benefit to landowners who have chosen to participate in the Project. Landowners having turbines or other Project facilities on their land will

receive a royalty or lease payment annually for the life of the Project. This payment diversifies and strengthens revenue generation for the landowner which would have a positive impact on the local economy.

Long-term beneficial impacts to the tax base of each county, as a result of the construction and operation of the Project, will have an additional positive impact on the local economy in this area of Minnesota. 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 $0.0012 per kilowatt hour of electricity produced, resulting in annual Wind Energy Production tax revenue from approximately $1,750,000 to $2 million. On November 5, 2019, the Redwood County Board of Commissioners provided a letter of support for the Project, citing significant economic development and long-term financial benefit to the area (Appendix A).

Plum Creek will form the "Plum Creek Community Fund," a 501(c)(3) organization for the purpose of engaging in and contributing money to the support of charitable activities within the communities near the Project. Assuming the Project is constructed at 414 MW, the Project will contribute $82,800 annually to the Plum Creek Community Fund to support charitable activities within the neighboring communities. The funds will be administered by a volunteer board of directors consisting of, but may not be limited to, participating landowners, township officials and one at-large community member. The Plum Creek Community Fund will help ensure that the entire community surrounding the Project, not just the participating landowners, see benefits from construction and operation of the Project. The annual and 20-year total community economic benefits are summarized in Table 8.13-2.

Table 8.13-2
Community Economic Benefits

Community Economic Benefits	Annual	20-Year Total
Tax Revenue (County & Townships)	$1,740,000	$34,800,000
Plum Creek Community Fund	$82,800	$1,656,000
Total Landowner Group Revenue	$2,900,000	$58,000,000
Total Economic Benefit	**$4,722,800**	**$94,456,000**

8.13.4 Mitigative Measures

Socioeconomic impacts associated with the Project will be positive with an influx of wages and expenditures made at local businesses during Project construction and an increase in the counties' tax bases from the construction and operation of the wind turbines. Because the impacts of the Project would be primarily positive, no mitigation measures are proposed.

8.14 Topography

Construction of a wind farm has the potential to impact the existing topography with the introduction of new access roads, turbine foundations, collector substations, and O&M facility. These facilities require a level surface and therefore can require cut and fill of the existing ground elevation to create the level surface.

8.14.1 Description of Resources

The Project is located in the Minnesota River Prairie and Coteau Moraines subsections of the MNDNR's Ecological Classification System (MNDNR, 2000). Subsection boundaries delineate a significant regional change in geology, topography, and vegetation. The Minnesota River Prairie subsection boundaries coincide with large till plains flanking the Minnesota River. This subsection consists of a gently rolling ground moraine about 60 miles wide. Most of the Minnesota River Prairie subsection is covered by up to 400 feet of glacial till. The Coteau Moraines subsection consists of a high glacial landform occupying portions of southwestern Minnesota and extending into southeastern South Dakota and northwestern Iowa. The highest elevation is at Buffalo Ridge in northern Pipestone County, situated 1,995 feet above sea level. The maximum elevation is the result of thick deposits of pre-Wisconsin-age till which can range to upwards of 800 feet in thickness.

The eastern third of the Project Area is within the Minnesota River Prairie subsection; the other central and western portions of the Project are within the Coteau Moraines subsection. In the Project Area, elevations range from 1,086 to 1,614 feet (331 to 492 m) above sea level. This elevation change is gradual; there are not areas of significant elevation change in the Project Area. Elevations are higher in the southwestern portion of the Project Area. A topographic map of the Project Area is shown in Figures 8a and 8b (Topographic Map).

8.14.2 Impacts

Impacts to topography will be minimal as the Project Area has gently rolling terrain that is currently used for agricultural activities, including large machinery similar to that of which will be required for construction. Additionally, while the Project Area has approximately 500 feet of elevation change, this change is dispersed across the nearly 20-mile wide Project Area and is not localized to a specific area. Therefore, wind turbines and access roads will not require significant excavation or fill beyond that which will be required for turbine foundations or road bases.

8.14.3 Mitigative Measures

Plum Creek has designed the Project layouts to minimize the amount of cut and fill; no mitigative measures are necessary.

8.15 Soils

Project construction will temporarily disrupt soils by compaction and erosion, which, if unmitigated, can affect agricultural activities and water quality, respectively. Soils categorized as prime farmland and farmland of statewide importance are protected under the Farmland Protection Policy Act because of their value for agricultural production, and a significant or irreversible loss of these high-quality farmlands could have local economic impacts for the agricultural industry.

8.15.1 Description of Resources

Six soil associations are found within the Project Area (Table 8.15-1, Figures 13 a and 13b - Soils). 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 8.15-1
Soil Associations in Project Area

Soil Association	Area (acres)
Wilmonton-Letri Everly (s3714)	51,156
Delft-Clarion (s3558)	11,035
Mayer-Estherville-Biscay (s3510)	4,166
Webster-Ves-Normania-Canisteo (s3529)	3,289
Webster-Nicollet-Clarion-Canisteo (s1750)	2,922
Marysland-Egeland-Arvilla (s3536)	400
Total	**72,968**

The Wilmonton-Letri-Everly Association is a complex of three soil types. The Wilmonton series consists of very deep, somewhat poorly drained soils found on dissected ground moraines with slope ranges from 0 to 3 percent. The Letri series consists of very deep poorly drained soils found on dissected ground moraines with slopes less than two percent. The Everly series consists of very deep, moderately well drained soils found on ground moraines and till plains with slopes ranging from 0 to 8 percent (Soil Survey Staff, 2019).

The Delft-Clarion Association is a complex of two soil types. The Delft series consists of very deep, poorly drained and somewhat poorly drained soils that formed on till plains and moraines with slopes ranging from 0 to 4 percent. The Clarion series consists of very deep, moderately well drained soils on uplands. These soils formed in glacial till with slopes ranging from 1 to 9 percent (Soil Survey Staff, 2019).

The Mayer-Estherville-Biscay Association is a complex of three soil types. The Mayer series consists of very deep, poorly and very poorly drained soils that formed on glacial outwash plains, till plains, and stream terraces and have slopes ranging from 0 to 2 percent. The Estherville series consists of very deep, somewhat excessively drained soils that formed on outwash plains, stream terraces, valley trains, and kames on moraines and have slopes that range from 0 to 70 percent. The Biscay series consists of very deep, poorly drained and very poorly drained soils on glacial outwash plains, till plains, valley trains, stream terraces and flood plains and have slopes that range from 0 to 2 percent (Soil Survey Staff, 2019).

The Webster-Ves-Normania-Canisteo Association is a complex of four soil types. The Webster series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands with slopes ranging from 0 to 3 percent. The Ves series consists of very deep, well drained soils that formed in loamy, calcareous, friable till and have slopes that range from 3 to 25 percent. The Normania series consists of very deep, moderately well drained soils on ground moraines and till plains with slopes that range from 0 to 3 percent. The Canisteo series consists of very deep, poorly and very poorly drained soils that formed on rims of depressions, depressions and flats on moraines or till plains and have slope ranges from 0 to 2 percent (Soil Survey Staff, 2019).

The Webster-Nicollet-Clarion-Canisteo Association is a complex of four soil types. The Webster series consists of very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands with slopes ranging from 0 to 3 percent. The Nicollet series consists of very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines and have slopes ranging from 0 to 5 percent. The Clarion series consists of very deep, moderately well drained soils on uplands. These soils formed in glacial till with slopes ranging from 1 to 9 percent. The Canisteo series consists of very deep, poorly and very poorly drained soils that formed on rims of depressions, depressions, and flats on moraines or till plains and have slope ranges from 0 to 2 percent (Soil Survey Staff, 2019).

The Marysland-Egeland-Arvilla Association is a complex of three soil types. The Marysland series consists of very deep, poorly and very poorly drained soils that formed in glacial lacustrine, alluvium, or outwash sediments. These soils are on stream terraces, outwash channels, outwash plains, floodplains, and lake plains, and have slopes that range from 0 to 2 percent. The Egeland series consists of very deep, well drained soils formed in glaciofluvial deposits. These soils are on terraces, outwash plains, and uplands with slope ranges from 0 to 20 percent. The Arvilla series consists of very deep, somewhat excessively drained soils formed in moderately coarse textured glacial outwash and the underlying sand and gravel on glacial lake beaches, stream valley terraces, and outwash plains and have slopes that range from 0 to 25 percent (Soil Survey Staff, 2019).

In addition to the soil associations, the USDA, NRCS identifies areas that are important to agricultural use, such as prime farmland and farmland of statewide importance. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forestland, or other land. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance (Soil Survey Staff, 2019). As shown in Table 8.15-2, 91 percent of the soils in the Project Area are classified as prime farmland, including those soils identified as prime farmland if the limiting factor is mitigated. Soils are mapped on Figure 13a and 13b (Soils).

Table 8.15-2
Prime Farmland Within the Project Area (acres)

Prime Farmland Classification	Acres	Percent of Project Area
Prime Farmland[1]	66,154	90.7%
Farmland of Statewide Importance	3,692	5.0%
Not Prime Farmland	3,122	4.3%
Total	**72,968**	**100%**

[1] This includes soils classified as prime farmland or prime farmland if the limiting factor is mitigated.

8.15.2 Impacts

Construction activities such as clearing, grading, foundation excavation, and backfilling, as well as the movement of construction equipment within the construction workspace, may result in impacts to soil resources. Potential impacts to soil resources include soil erosion, soil compaction, reduction of soil fertility, and changes to other soil characteristics. Clearing removes protective cover and exposes soil to the effects of wind and precipitation, which may increase the potential for soil erosion and movement of sediments into sensitive environmental areas such as wetlands. Grading and equipment traffic may compact soil, reducing porosity and percolation rates, which could result in increased runoff potential. These impacts will be temporary and localized to the footprint of facilities.

Construction of the wind turbines, access roads, collector substations, and O&M facility will convert prime farmland from agricultural uses to industrial uses. The V162 layout would impact 78.6 acres of prime farmland and the SG170 layout would impact 82.9 acres of prime farmland. Regardless of which layout is constructed, these impacts would represent 0.1 percent of the prime farmland in the Project Area. As such, impacts to prime farmland will be minimal.

Table 8.11-3
Summary of Permanent Impacts to Prime Farmland (acres)

Prime Farmland Classification	V162		SG170	
	# Turbines	Acres[3]	# Turbines[2]	Acres[3]
Prime Farmland[1]	70	78.6	66	82.9
Farmland of Statewide Importance	4	3.8	1	2.2
Not Prime Farmland	--	0.9	--	1.5
Total	**74**	**83.3**	**67**	**86.6**

[1] This includes soils classified as prime farmland or prime farmland if the limiting factor is mitigated.
[2] Number of turbines includes primary turbines only.
[3] Acreage of impacts includes all permanent facilities (turbines, access roads, collector substations, and O&M facility).

8.15.3 Mitigative Measures

Plum Creek will obtain a National Pollutant Discharge Elimination System (NPDES) permit to discharge stormwater from construction facilities from the MPCA. Under this permit 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 Stormwater Pollution Prevention Plan (SWPPP) will be developed prior to construction that will include Erosion Control Devices (ECDs) such as silt fencing, revegetation plans, and management of exposed soils to prevent erosion. Because the Project will impact more than 50 acres, Plum Creek will submit the SWPPP to the MPCA for review prior to finalizing.

Both layouts site access roads away from steep slopes to the degree possible to minimize the amount of grading and soil disturbance. Additionally, access roads, collection lines, and crane paths are co-located to the extent practicable to minimize the footprint of facilities and reduce soil disturbance. Geotechnical soil borings will be conducted at wind turbine foundation locations prior to construction to determine the soil suitability to support turbine foundations; this information will help dictate final design parameters of the turbine and structure foundations.

Once construction is complete, Plum Creek will backfill graded and excavated areas with the stored native material and return surface conditions to pre-construction conditions to the extent practicable. Plum Creek would also implement ECDs and seed and mulch the construction workspace consistent with the Project's SWPPP. These BMPs and mitigation measures will include:

- During construction, certain activities may be suspended in wet soil conditions. The contractor will cease work until Plum Creek determines that site conditions are such that work may continue without damage. Plum Creek construction management will ultimately decide if wet weather shutdown is necessary in a given location.
- Plum Creek will strip topsoil in upland areas as specified in the project plans, commitments, and/or permits. Excavated topsoil and subsoil will be stockpiled separately in the approved construction workspace and stored so the area subject to erosion is minimized.
- Temporary ECDs, such as slope breakers, sediment barriers (e.g., silt fences, straw bales, bio-logs), stormwater diversions, trench breakers, mulch, and revegetation will be installed following soil disturbance and maintained until site is restored. The contractor will maintain erosion and sediment control structures as required in the Project construction documents and as required by all applicable permits. Non-functional ECDs will be repaired, replaced, or supplemented with functional materials within 24 hours after discovery, or as otherwise specified in project permits.
- Temporary ECDs installed across the travel lane may be removed during active daytime construction; however, ECDs will be properly reinstalled after equipment passage, or activities in the area are completed for the day. These ECDs will also be repaired and/or replaced prior to forecasted inclement weather.
- Following construction, Plum Creek will reestablish the original grade and drainage pattern of the construction workspace to the extent practicable.
- During site restoration, Plum Creek will decompact subsoil, and replace stored soils to the construction workspace, temporary access roads, and crane pathways. The contractor will implement ECDs, including seeding the site with weed-free native plants in accordance with landowner or local agency requests.
- During operations, Plum Creek will regularly inspect access roads, utility and transmission line corridors, and tower site areas for damage from erosion, washouts, and rutting. Plum Creek will initiate corrective measures immediately upon evidence of damage.

8.16 Geologic and Groundwater Resources

Due to their size, wind turbines must be sited in areas that are geologically stable. Certain geological environments, such as karst, can present turbine siting challenges due to its instability and erodibility. Similarly, presence of groundwater resources can create unstable foundations. These resources are described below.

8.16.1 Description of Resources

8.16.1.1 Surficial Geology

Surficial geology of the Project Area consists of glacial deposits associated with the Des Moines Lobe. This Project Area is part of a high glacial landform occupying Southwestern Minnesota topped by Buffalo Ridge (1995 feet above sea level) in northern Pipestone County. The high elevation is caused by thick deposits of pre-Wisconsin age glacial till (up to 800 feet thick). The underlying bedrock is covered by 400 to 800 feet of glacial till, which consists of calcareous loamy sediment (MNDNR, 2019a and 2019b).

The Altamont moraine makes up the quaternary geology of the Project Area and southcentral Minnesota (Minnesota Geological Survey [MGS], 2007). The Altamont moraine is sufficiently clayey making it good agricultural land.

8.16.1.2 Bedrock Geology

The bedrock underlying the glacial material in the Project Area consists of conglomerate, sandstone, mudstone, shale, marlstone, siltstone, and minor lignite from the Mesozoic Era and is shown on Figures 14a and 14b – Site Geology and Depth to Bedrock (MGS, 2011). This Cretaceous undifferentiated rock consists of largely gray shale and friable sandstone. Most sandstone is quartzose, light gray to pale brown or yellow, and fine-to medium-grained. Dark gray to black, lignitic organic matter is common in both the sandstone and shale.

8.16.1.3 Aquifers and Wells

Groundwater in the region is supplied by the Cretaceous aquifer. The aquifer consists of thick to thin, discontinuous sandstone beds overlain in places by limestone and shale beds that confine the aquifer. In other places, the aquifer is directly overlain by glacial deposits. In its principal area of use, the Cretaceous aquifer ranges from about 90 to 170 feet in thickness. The water tends to contain large concentrations of dissolved solids; in some areas, wells have small yields of less than two to 10 gallons per minute. The aquifer is buried by glacial deposits to depths of 700 feet or more near the southern Minnesota border. Although the aquifer contains gypsum, which can increase sulfate concentrations in the groundwater, the aquifer is extensively pumped to supply domestic, small-community, and agricultural needs (Olcott, 1992).

Homes and farms in the Project Area typically use private wells and septic systems for their household needs. According to the Minnesota Department of Health's Minnesota Well Index online database, there are 105 located wells, and an additional 25 unverified well locations within the Project Area and generally associated with residences (Minnesota Department of Health, 2019).

8.16.2 Impacts

Plum Creek does not anticipate any impacts to bedrock during construction or operation of the Project as bedrock within the Project Area is at depths greater than proposed foundation depths of four-to-six feet deep. Similarly, Plum Creek does not expect any impacts to groundwater resources as the aquifers are also at depths deeper than the excavation for the turbine foundations and permanent Project facilities are not located near previously identified wells.

Water use during construction will provide dust control and water for concrete mixes. Up to two temporary batch plants may be needed to supply concrete for construction of the Project. The batch plants may be able to use rural water service, but is more likely to require well water. The water source will be determined prior to construction when a contractor is selected to construct the Project.

The O&M facility will likely require a new private well water supply. Water usage during the operating period will be similar to household volume; less than five gallons per minute. Use of water for operations will be negligible. 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.

8.16.3 Mitigative Measures

Because impacts are not expected to geologic resources during the Project construction and operation, mitigation measures are not anticipated. The batch plant operator will obtain the local permits and access to water supply and will address supply and drawdown issues in those permits. If temporary dewatering is required, Plum Creek will obtain a permit from MNDNR.

8.17 Surface Water and Floodplain Resources

Construction and operation of a LWECS can impact surface waters by creating crossings with access roads or temporary facilities such as crane paths and collection lines. Construction activity can also make soil erosion more prevalent, which can impact water quality. Siting permanent facilities within a floodplain can impact its flood storage capacity. These resources are discussed below.

8.17.1 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 majority of the Project Area occurs within the Cottonwood River watershed; the southwestern corner of the Project Area in Murray County occurs within the Des Moines River watershed (MNDNR, 2017b, Figures 15a and 15b – Surface Waters). Named streams within the Project Area include Pell Creek, Dutch Charley Creek, Plum Creek, the Des Moines River, and Highwater Creek. There are no trout streams within the Project Area; the nearest trout stream is Scheldorf Creek, located approximately 9.5 miles south of the Project Area (MNDNR, 2018). Similarly, none of the waterbodies within the Project Area are identified as Outstanding Resource Value Waters under Minn. R. 7050.0335, subp. 3. Figures 15a-15b (Surface

Waters) show the locations of surface waters, federal Clean Water Act (CWA) 303(d) impaired waters, and Minnesota PWI waters within the Project vicinity, all of which were downloaded from the Minnesota Geospatial Commons.

8.17.1.1 Minnesota Public Waters Inventory

Public waters are all waters that meet the criteria set forth in Minn. Stat. § 103G.005, subd. 15 that are identified on PWI maps authorized by Minn. Stat., § 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. These watercourses are regulated as public waters under the MNDNR's Public Waters Permit Program. There are 27 PWI watercourses, two PWI basins, and two PWI wetlands in the Project Area that are listed as MNDNR PWI public waters. The waters shown on the PWI maps and located at least partially within the Project Area are presented in Table 8.17-1.

Table 8.17-1
Public Waters Inventory

PWI Type	PWI Feature Name
PWI Watercourse	Highwater Creek (M-055-095-061-001)
	Unnamed Stream (M-055-095-072-021)
	Unnamed Stream (M-055-095-066-011)
	Unnamed Stream (M-055-095-066-010)
	Unnamed Stream (M-055-095-061-005)
	County Ditch 4 (I-037-048)
	Unnamed Stream (M-055-095-057-007)
	Unnamed Stream (M-055-095-057-005)
	Dutch Charley Creek (M-055-095-061)
	Judicial Ditch 3 (M-055-095-061-012)
	Unnamed Stream (M-055-095-061-005-002)
	Unnamed Stream (M-055-095-061-005-001)
	County Ditch 4 (I-037-048)
	Unnamed Stream (M-055-095-066-009-003)
	Unnamed Stream (M-055-095-066-008)
	Unnamed Stream (M-055-095-061-018)
	Des Moines River (I-037)
	Pell Creek (M-055-095-066)
	Unnamed Stream (M-055-095-061-001-001)
	Unnamed Stream (M-055-095-066-002)
	Dry Creek (M-055-095-057)
	Plum Creek (M-055-095-072)

Table 8.17-1
Public Waters Inventory

PWI Type	PWI Feature Name
	Unnamed Stream (M-055-095-066-008)
	Judicial Ditch 3 (M-055-095-061-012)
	Unnamed Stream (M-055-095-066-009)
	Dutch Charley Creek (M-055-095-061)
	Unnamed Stream (M-055-095-061-002)
PWI Basin	Julia
	Dovray Marsh
PWI Wetland	Unnamed (51015100)
	Unnamed (51011100)

8.17.1.2 Impaired Waters

Section 303(d) of the CWA requires each state to 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 standard violations are considered impaired. There are five 303(d) impaired waters within the Project Area: the Des Moines River, Plum Creek (Judicial Ditch 20A), Pell Creek, Dutch Charlie Creek, and Devils Run Creek (Figures 15a and 15b). The Des Moines River and Plum Creek (Judicial Ditch 20A) are listed as impaired for fecal coliform and turbidity; Pell Creek is impaired for turbidity; Dutch Charlie Creek is impaired for turbidity and fishes bioassessments; and Devils Run Creek is impaired for fish bioassessments (MPCA, 2019b).

8.17.1.3 Wildlife Lakes in and Adjacent to Project Boundary

The MNDNR commissioner may formally designate lakes for wildlife management under the authority of Minn. Stat. § 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. There are no MNDNR designated wildlife lakes in Cottonwood, Murray, or Redwood Counties (MNDNR, 2014).

8.17.1.4 Migratory Waterfowl Feeding and Resting Lakes

Migratory Waterfowl Feeding and Resting Areas (MWFRA) protect waterfowl from disturbance on selected waters of the state by prohibiting motors on these lakes during waterfowl season. These lakes are nominated by a petition process and approved or denied by the MNDNR after public input is received. There are no migratory waterfowl feeding and resting lakes in Cottonwood, Murray, or Redwood Counties (MNDNR, 2014).

8.17.1.5 Federal Emergency Management Agency Floodplains within Project Area

FEMA-designated floodplains are digitally available for the Project Area (FEMA, 2019 and MNDNR, 2019h). There are approximately 1,100 acres of 100-year floodplains within the Project

Area that are associated with Dutch Charley Creek, Dry Creek, Highwater Creek, Des Moines River, Plum Creek, Pell Creek, Judicial Ditch 3, and two unnamed tributaries (Table 8.17-2 and Figures 16a and16b – FEMA Floodplain).

Table 8.17-2
FEMA Floodplains in the Project Area

County	Associated Streams	Acres
Cottonwood	Dutch Charley Creek Judicial Ditch 3 Dry Creek Unnamed tributary to Dry Creek Highwater Creek	471.7
Murray	Des Moines River Unnamed tributary to Dutch Charley Creek Dutch Charley Creek Plum Creek	135.0
Redwood	Pell Creek Plum Creek Highway Creek Dutch Charley Creek	500.1
	Total	**1,106.8**

8.17.2 Impacts

The Project will have minor, mostly short-term effects on surface water resources. Project facilities have been designed to avoid impacts on surface water resources to the extent practicable. Wind turbines will be built on uplands to avoid surface water resources in the lower elevations. Some access roads cross streams; however, they will be designed to maintain flow of the waterway.

Construction of Project facilities (such as underground electrical collector lines, access roads, crane paths, turbine pads, step-up substation, and the O&M facility) will impact land, and therefore could potentially impact surface water runoff within the Project Area. Ground-disturbing construction activities may also cause sedimentation. These impacts are expected to be minimal and would only occur during construction.

There are no permanent impacts for either layout within floodplain areas; this includes turbines, access roads, met towers, collector substations, and the O&M facility.

8.17.3 Mitigative Measures

Turbines will be constructed on relatively high elevation portions of the Project Area to maximize the wind resource, and as such are likely to avoid direct impacts to surface waters and floodplains, which tend to be in lower topographical positions. Access roads and substations will be designed to minimize impacts on surface waters. Temporary impacts associated with crane walkways will also be minimized. Installation of underground utilities is expected to avoid impacts by boring under surface water features as necessary.

Plum Creek will obtain MNDNR License to Cross Public Waters for all facilities (access roads, crane paths, collection lines) that cross these watercourses. Plum Creek has co-located these facilities at PWI crossings to minimize the number of crossings.

Because there are impaired waters within the Project Area, the NPDES permit and SWPPP will require additional BMPs for potential runoff to these waters. As part of the NPDES permit process, Plum Creek will design BMPs for the entire Project, including near impaired waters. The MPCA will review the SWPPP prior to finalizing.

Plum Creek will permit access road, collection line, and crane path crossings of waterbodies (waters of the U.S.) with the U.S. Army Corps of Engineers (USACE) and Local Government Unit (LGU) under the Wetland Conservation Act (WCA). Access roads will be designed to maintain the waterbody's flow; crane path crossings of waterbodies will be matted.

Both layouts avoid permanent impacts to floodplains; therefore, no mitigation is proposed.

8.18 Wetlands

Similar to surface waters, construction and operation of a LWECS can impact wetlands with crossings of access roads, crane paths, or collection lines. Construction activity can also make soil erosion more prevalent, which can impact water quality.

8.18.1 Description of Resources

Wetlands are areas with hydric (wetland) soils, hydrophilic (water-loving) vegetation, and wetland hydrology (inundated or saturated much of the year). Wetlands are part of the foundation of water resources and are vital to the health of waterways and communities that are downstream. Wetlands detain floodwaters, recharge groundwater supplies, remove pollution, and provide fish and wildlife habitat. Wetlands are also economic drivers because of their key role in fishing, hunting, agriculture, and recreation. Wetland types include marshes, swamps, bogs, and fens. Wetlands vary widely due to differences in soils, topography, climate, hydrology, water chemistry, vegetation, and other factors.

Wetlands within the Project Area were identified using Minnesota's update to the National Wetlands Inventory (NWI). Some of the wetlands are associated with creeks and unnamed intermittent streams within the site and some of the wetlands are isolated basins. The Cowardin Classification System wetland types and their acreage within the Project Area are presented in Table 8.18-1.

Table 8.18-1
National Wetlands Inventory in the Project Area

NWI Wetland Type	Acres[1]
Palustrine Emergent Wetland (PEM)	1,776.2
Palustrine Forested Wetland (PFO)	246.5
Riverine	120.7
Freshwater Pond/Lake	91.6
Palustrine Scrub-shrub Wetland (PSS)	32.1
Wetland Total	**2,267.1**

[1] Wetland acreage is calculated using Minnesota's Update to NWI data.

There are approximately 2,267.1 acres of NWI-mapped wetlands in the Project Area, which constitutes approximately 3.1 percent of the Project Area. More than 78 percent (1,776 acres) of the NWI wetland acreage is mapped as palustrine emergent wetlands (PEM). Palustrine forested wetlands (PFO) comprise 10.9 percent (246.5 acres) of the NWI wetland acreage. Riverine wetlands comprise 5.3 percent (120.7 acres) of the NWI wetland acreage. The remaining 6.4 percent are freshwater pond/lake (91.6 acres) and palustrine scrub-shrub wetlands (PSS; 32.1 acres). Additionally, there are a total of 95.3 acres of PWI wetlands and PWI basins that are located within the Project Area, which may overlap with NWI. *See* Figures 17a and 17b – Wetlands Inventory Map - for locations of wetlands within the Project site.

8.18.2 Impacts

Turbines, collector substations, and meteorological towers will be constructed on high portions of the Project Area to maximize the wind resource, and as such, will not permanently impact wetlands. Permanent and temporary impacts on NWI-mapped wetlands are summarized in Table 8.18-2. Estimated permanent wetland impacts shown for the SG170 layout are related to an access road. All NWI-mapped water features will be field verified and final impact calculations will vary based on delineated wetlands. Additionally, after field verification of wetlands, Project facilities may be shifted to avoid wetland features to the extent practicable.

Table 8.18-2
Summary of NWI-mapped Wetland Impacts (acres)

	V162		SG170	
NWI Wetland Type	Permanent	Temporary	Permanent	Temporary
Palustrine Emergent Wetland (PEM)	-	19.2	0.3	10.8
Palustrine Forested Wetland (PFO)	-	3.5	-	0.6
Riverine	-	1.3	-	0.6
Freshwater Pond/Lake	-	-	-	-
Palustrine Scrub-shrub Wetland (PSS)	-	0.9	-	-
Total	-	**24.9**	**0.3**	**12.0**

There are no permanent impacts on PWI wetlands from turbines, access roads, collector substations, or the O&M facility from either layout. Both layouts have the same co-located crane path and collection line crossing of a PWI wetlands in the southern portion of the Project Area. Access roads, the O&M facility, and substations will be designed to avoid impacts to PWI wetlands. Temporary impacts associated with crane walkways will also be minimized. Installation of underground utilities is expected to minimize impacts to wetlands or where possible make them coincident with other impacts (e.g., crane walks).

8.18.3 Mitigative Measures

Formal wetland delineations of the Project Area will be completed prior to construction, and the layout will be refined to further avoid and minimize wetland impacts. If wetland impacts cannot be avoided, Plum Creek 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 under Section 401 of the CWA prior to construction. The USACE provided a general comment letter with these permitting recommendations (Appendix A).

Similar to infrastructure crossings of PWI watercourses, Plum Creek will obtain a license to cross PWI wetlands from MNDNR prior to construction. Plum Creek may bore the collection line under this PWI wetland complex and associated PWI waterbody. The crane path will be matted to minimize compaction and/or rutting to the PWI wetland.

Plum Creek will mitigate impacts to wetlands during construction and operation by protecting topsoil, minimizing soil erosion, and protecting adjacent wetland resources. Practices may include containing excavated material, use of silt fences, protecting exposed soil, stabilizing restored material, and re-vegetating disturbed areas with non-invasive species. If permanent wetland impacts from the access road in the SG170 layout cannot be avoided, Plum Creek will install a culvert under the access road to maintain water flow within the wetland and minimize impacts.

8.19 Vegetation

Construction of a LWECS will temporarily disturb vegetative cover. Operation of the Project will remove the permanent footprint of facilities from a vegetative to impervious surface (i.e., gravel). The various vegetative communities within a Project Area can influence the wildlife species present.

8.19.1 Description of Resources

8.19.1.1 Land Cover

The Project Area is in both the Minnesota River Prairie and Coteau Moraines subsections of the North Central Glaciated Plains Section in the Prairie Parkland Province, as defined by the ECS of Minnesota (MNDNR, 2000). Historically, tallgrass prairie covered most of this area and wet prairies covered a smaller proportion of the landscape. Forest was similarly restricted to floodplains along the Minnesota River and other streams. As a result of settlement in the mid-1800s, the area was converted to farmland, with only a few remnants of pre-settlement vegetation remaining (MNDNR, 2019a).

Based on review of aerial photographs and land use/land cover database information, Plum Creek determined that the majority of the land area at the site is cultivated crops (refer to Table 8.19-1 and Figures 12a and 12b – Land Cover). Corn and soybeans are the dominant agricultural crops by acreage in all three counties followed by forage crops in Cottonwood and Murray Counties and sugar beets in Redwood County (USDA, 2012). The relative abundance land cover types in the Project Area are shown in Table 8.19-1 (Yang et al., 2018).

Table 8.19-1
Land Cover Types and their Relative Abundance in the Project Area

Land Cover	Acres	Percent of Project Area
Cultivated Crops	66,564	91.2%
Developed	2,542	3.5%
Hay/Pasture	1,302	1.8%
Emergent Herbaceous Wetlands	1,223	1.7%
Grassland/Herbaceous	630	0.9%
Deciduous/Mixed Forest	521	0.7%
Woody Wetlands	101	0.1%
Barren Land	53	0.1%
Open Water	30	<0.1%
Shrub/Scrub	2	<0.1%
Total	**72,968**	**100%**

Source: 2016 NLCD (Yang et al., 2018)

Forested areas are primarily surrounding residences as windbreaks and riparian areas along Highwater and Dutch Charley Creeks in the eastern portion of the Project Area. Hay/Pasture and grassland/herbaceous lands are present primarily in the western portion of the Project Area. Wetlands are generally associated with streams. The grassland and wetland areas at the site may contain potential remnant native prairie areas. Native prairie is discussed in Section 8.21.2 and may be present within the Project Area.

8.19.2 Impacts

The primary impact from construction of Project would be the cutting, clearing, and removal of existing vegetation within the construction workspace. The degree of impact would depend on the type and amount of vegetation affected, the rate at which the vegetation would regenerate after construction, and whether periodic vegetation maintenance would be conducted during operation. Secondary effects from disturbances to vegetation could include increased soil erosion, increased potential for the introduction and establishment of invasive and noxious weed species, habitat fragmentation and edge effects, and a local reduction in available wildlife habitat.

In both layouts, cultivated cropland comprises over 95 percent of the permanent and temporary impacts. A summary of vegetation impacts is provided in Table 8.19-2. Vegetation will be permanently removed and replaced by wind turbines, access roads, and substation components. Temporary vegetation impacts will be associated with crane walkways, the installation of underground collection lines, workspace around turbines, wider access roads, and contractor staging and laydown areas. The turbines and access roads are sited to avoid forests and groves to maximize turbine output and avoid tree removal. Less than one quarter of one percent of the Project Area will be permanently converted to sites for wind turbines, access roads, and facilities.

Table 8.19-2
Summary of Land Cover Impacts (acres)

	V162		SG170	
Land Cover Type	**Permanent**	**Temporary**	**Permanent**	**Temporary**
Cultivated Crops	79.6	1,864.1	82.8	1,876.0
Developed (all categories)	3.7	72.6	3.7	76.1
Emergent Herbaceous Wetlands	<0.1	15.0	0.1	3.0
Hay/Pasture	-	4.4	<0.1	1.9
Grassland/Herbaceous	-	1.7	-	1.0
Deciduous/Mixed Forest	-	3.3	-	1.0
Woody Wetlands	-	0.7	-	1.0
Total	**83.3**	**1,961.8**	**86.6**	**1,960.0**

8.19.3 Mitigative Measures

Plum Creek will initiate restoration of disturbed soils and vegetation as soon as possible after construction activities are completed. Plum Creek will restore areas of disturbed soil in non-cropped areas using weed-free native grasses, forbs, and shrubs. In cropped areas, a temporary cover crop may be planted to stabilize soils depending on the timing of construction completion and the next growing season.

The following measures will be used to avoid and minimize potential impacts to land of the Project Area during siting, construction, and operation to the extent practicable:

- Prioritize turbine, access road, and collector substation siting on cultivated cropland.
- Avoid disturbance of wetlands during construction and operation of the Project. If jurisdictional wetland impacts are proposed, Plum Creek will obtain applicable wetland permits (*see* Section 8.18).
- Design the Project to minimize the need to clear existing trees and shrubs.
- Prepare a construction SWPPP and secure a NPDES Permit.
- Use BMPs during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil and stabilizing restored material, revegetating non-cropland and range areas with wildlife conservation species, and (wherever feasible) planting native tall grass prairie species in cooperation with landowners.

8.20 Wildlife

8.20.1 General Wildlife

8.20.1.1 Description of Resource

Regulatory Environment and Agency Guidance

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 (16 United States Code [U.S.C.] 703-712) regulates the taking, selling, transporting, and importing of migratory birds, their nests, eggs, parts, or products. The MBTA protects more than 800 species of birds that occur within the United States. A list of federally protected migratory birds may be found in 50 Code of Federal Regulations Part 10.13. Most birds within the Project Area would be afforded protection under this Act.

USFWS Land-Based Wind Energy Guidelines

On March 23, 2012, the USFWS issued the Land-Based Wind Energy Guidelines (WEGs; USFWS, 2012). The WEGs provides 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 WEGs is founded upon 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 I: Preliminary evaluation or screening of sites (landscape-level screening of possible project sites; generally based on readily available public information).
- Tier II: 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 III: 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, etc.).
- Tier IV: Post-construction mortality studies (to evaluate direct fatality impacts).
- Tier V: 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, etc.).

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 indicate that wind energy developers who voluntarily adhere to these guidelines will be undertaking 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.

At each tier, potential issues associated with developing or operating a project are identified and questions formulated to guide the decision process. The guidelines outline the questions to be posed at each tier and recommend methods and metrics for gathering the data needed to answer those questions. If sufficient data are available at a particular tier, the following outcomes are possible based on analysis of the information gathered:

- The project is abandoned because the risk is considered unacceptable.
- The project proceeds in the development process without additional data collection.
- An action, or combination of actions, such as project modification, mitigation, or specific post-construction monitoring, is indicated.

If data are deemed insufficient at a tier, more intensive study is conducted in the subsequent tier until sufficient data are available to make a decision to abandon the project, modify the project, or proceed with and expand the project (USFWS, 2012).

Results of Tier I and II Process

A Tier I and II Site Characterization Study (SCS) was completed for the proposed Project in July 2019 (Appendix F). The study was based on off-site resources and a site visit by a qualified biologist on July 19, 2018. Based on the results of the SCS, Tier III studies are in progress for the Project. This decision was reached by answering the following questions from the USFWS guidelines:

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

Based on Plum Creek's desktop analysis of available data, there are a few small areas designated by the Minnesota Biological Survey (MBS) as native plant communities within the Project Area that may provide limited suitable habitat for listed species such as the Dakota skipper (*Hesperia dacotae*), Ottoe skipper (*Hesperia ottoe*), and Poweshiek skipperling (*Oarisma poweshiek*). All of these native plant communities overlap areas designated as Sites of Biodiversity Significance (SOBS) ranked as moderate by the MNDNR. These areas, along with freshwater emergent wetlands, riverine areas, and freshwater forested/shrub wetlands and ponds may provide suitable habitat for several of the species listed in Table 3 of the SCS, including the northern long-eared bat, loggerhead shrike, Wilson's phalarope, bald eagles, trumpeter swan, Blanding's turtle, great plains toad, prairie bush clover, short-pointed umbrella-sedge, waterhyssop, and Wolf's spikerush. Other species included in Table 3 of the SCS are listed within the three counties that overlap the Project boundary, but there is little to no suitable habitat within the Project Area (Appendix F).

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 NGOs; or other local, state, regional, federal, tribal, or international organizations.

There are several protected areas within the Project Area, including a federally managed wildlife refuge and privately-owned conservation areas. There will be no impacts to these protected areas, and setbacks from the Project perimeter will result in a minimum buffer between these resources and any turbines.

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

Within the Project Area, several small areas have been evaluated as SOBS by the MBS. These sites within the Project Area are ranked as either "below" or "moderate"; there are no sites ranked with "high" or "outstanding" biodiversity significance within the Project Area. Small sites of MBS-mapped native plant communities (NPC) exist in the Project Area including dry hill prairie, southern west mesic hardwood forest, basswood-bur oak forest, prairie-wetland complexes, and mesic prairie, all of which are associated with sites identified as moderate biodiversity.

Turbines, access roads, permanent met towers, collector substations, and the O&M facility are sited to avoid mapped native prairie, native plant communities, and SOBS (all ranks). Plum Creek will continue coordination with MNDNR and prepare a Native Prairie Protection Plan if there is native prairie within the Project Area, as defined by Minn. Stat. § 84.02, subd. 5.

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

There is low potential for species of wildlife to congregate within the Project Area based on publicly available data. Areas where congregation would be most likely are within the WMAs present adjacent to the Project Area or in and around creeks and wetlands during peaks in avian

migration through the area. Areas of congregation within the Project were not observed during avian surveys.

Are there large areas of intact habitat with the potential for fragmentation, with respect to species of habitat fragmentation concern needing large contiguous blocks of habitat?

Most of the Project Area is fragmented and is a mosaic of cultivated cropland, developed areas, emergent herbaceous wetlands, herbaceous areas, and deciduous forests. NLCD data and aerial imagery indicate that relatively small areas of intact mixed herbaceous grasslands and wooded areas exist within the Project. The relatively small areas of intact grasslands do not appear contiguous, thus species requiring larger tracts of connected prairie are unlikely to occur within the Project. The intact contiguous forested areas may be suitable for some sensitive bat species, such as northern long-eared bat, as well as other tree bat species. Avoidance of these forested tracts would help reduce potential impacts to this species should it occur within the Project.

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 Project Area is highly fragmented and 91% cultivated crops, which provide limited habitat to avian species. Pre-construction avian surveys have identified several species of birds, one of which is state-listed (Henslow's sparrow; state-listed endangered and observed incidentally). The Project occurs within the known range of the northern long-eared bat, and occurrence is possible within the forested areas of the Project during the summer months as well as more generally during early fall migration throughout the area. Bald and golden eagles may also occur within the Project Area. Initial studies indicate that there are bald eagle nests outside of, but within one mile of, the Project, and bald eagles may occur as nesting pairs or as passing migrants within the Project boundary. Golden eagles are much less common in this area and are expected to occur, if at all, as uncommon migrants passing through in a broad-front fashion.

Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above?

Based on available information, the potential for significant adverse impacts to species of concern from development of the Project is relatively low. There is one species (Topeka shiner) with designated critical habitat in Murray County; however, the closest designated critical habitat for this species is in southwest Murray County along Chanarambie Creek and one of its tributaries within the Missouri River watershed, approximately 169 miles (271 kilometers) south of the Project. Figure 9 of the SCS shows details that support the unlikelihood of this species presence or impact on its habitat with the development of this Project specifically (Appendix F). Habitats within the Project are already highly fragmented.

Summary of Tier I and Tier II Process

Plum Creek initiated Tier III studies in June 2018 to provide baseline avian and bat use data. The Tier I and II questions identified several types of wildlife habitats including native prairie, WPAs, WMAs, NPC, USFWS NWR/conservation easements, and SOBS ranked as moderate within and adjacent to the Project Area. Habitat assessment work has informed the turbine siting process to minimize impacts to quality habitats. All turbines in both layouts are sited in cultivated crops;

turbines will not be sited in native prairie, WPAs, WMAs, NPC, USFWS NWR, or SOBS (any rank).

Baseline avian and bat data have been incorporated into the Avian and Bat Protection Plan (ABPP) (Appendix G). Plum Creek will continue to coordinate with USFWS and MNDNR on Tier III data and the ABPP.

Eagle Conservation Plan Guidelines

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 Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2 (ECPG; USFWS, 2013). The ECPG suggest specific questions that should be considered to help place a prospective project site into an appropriate risk category. Plum Creek has considered these questions and provided responses below.

Does existing or historical information indicate that eagles or eagle habitat may be present within the geographic region under development consideration?

Yes, eagles and eagle habitat are present within the geographic region under development consideration. The wildlife refuge and forested patches and riparian areas surrounding small creeks within the Project may provide limited suitable eagle habitat. Tier III avian use studies are currently underway at the Project (raptor nest survey and avian/eagle use surveys).

Within a prospective project site, are there areas of habitat known to be or potentially valuable to eagles that would be destroyed or degraded due to the project?

There is some potentially valuable habitat for eagles within or directly adjacent to the Project, but relatively higher eagle use areas can likely be avoided during construction and operation of the Project. Land cover within the Project is predominantly cultivated cropland. Tier III avian use studies are currently underway at the Project (raptor nest survey and avian/eagle use surveys).

Are there important eagle use areas or migration concentration sites documented or thought to occur in the project area?

There are no known important use areas or migration concentration sites within the Project. Tier III avian use studies are currently underway at the Project (raptor nest survey and avian/eagle use surveys).

Does existing or historical information indicate that habitat supporting abundant prey for eagles may be present within the geographic region under development consideration?

The wildlife refuge and creeks within the Project may provide habitat that supports prey for eagles. These resources compose a relatively small percentage of the total Project; the Project boundary also excludes some of the larger open water lakes in the vicinity.

For a given prospective site, is there potential for significant adverse impacts to eagles based on answers to above questions and considering the design of the proposed project?

Bald eagles have the potential to occur in the Project during all seasons. The areas at highest risk of eagle occurrence within the Project are the creeks and wildlife refuge, as well as areas within proximity of active nests. Avoiding or minimizing turbine siting in proximity to these features will reduce the potential for significant adverse impacts to eagles.

2018 and 2019 Nest Surveys

Plum Creek conducted aerial surveys for bald eagle nests on March 27-29, 2018 and March 25-26, 2019 in accordance with guidelines provided in the ECGP. Bald eagle nest surveys focused on locating eyries (large, stick nest structures) in suitable eagle nesting substrate (trees, transmission lines, cliff faces, etc.) within and around the proposed Project Area and a 1-mile and a 10-mile buffer area. No occupied or potential bald eagle nests were located within the Project Area. In 2018, a total of 14 occupied active bald eagle nests were observed within the 10-mile buffer area; in 2019, 17 occupied active bald eagle nests were documented within the 10-mile buffer area. The distance to the Project Area from the nests ranged from 0.1 to 9.8 miles. The results of the 2018 and 2019 raptor nest surveys are summarized in the ABPP (Appendix G).

The mean inter-nest distance of all 17 bald eagle nests observed (active and likely inactive nests) is 5.6 miles. The ECPG states that eagle pairs at nests within one-half the mean inter-nest distance, in this case 2.8 miles, are susceptible to disturbance take and blade strike mortality. However, it is anticipated that most flight corridors used by nesting bald eagles are located closer than 3.6 miles from the nest. The Draft Midwest Wind Energy Multi-Species Habitat Conservation Plan (USFWS, 2017a) lists 1.6 miles as a maximum area for turbine setbacks from bald eagle nests, with potential for turbines to be sited closer if evidence shows they are not located within higher use travel corridors. There are two active occupied bald eagle nests outside the Project Area that are located within the 1.6-mile turbine setback area; they are approximately 0.6 and 1.4 miles from the nearest wind turbine to each nest. Additional eagle-nest-activity studies at these nests are ongoing, and the results will be provided separately.

Fixed-point Avian Use Studies for Bald Eagles

Plum Creek also conducted fixed-point avian use studies for bald eagles. Bald eagle observations were recorded monthly during 60-minute sampling periods at 47 survey points with 800-m-radius plots. Between June 2018 and August 2019, 121 eagle flight minutes were recorded within the zone of risk (within 800 m of survey points and below 200 m in height) during 810 hours of survey. Eagle risk minutes were highest during the fall (September – November) with monthly sums ranging from 10 to 17 eagle risk minutes and spring (March – April) ranging from 17 to 20 eagle risk minutes. No golden eagles were observed. Fixed-point avian use studies for bald eagles are ongoing. Plum Creek will coordinate with USFWS and MNDNR on surveys and potential Project impacts on bald eagles.

Wildlife

Information on the existing wildlife in the Project Area was obtained from a variety of sources including MNDNR, USFWS, and avian and bat preconstruction surveys conducted by Plum Creek (initiated in June 2018). This wildlife information was supplemented by surveys conducted at nearby wind projects in Minnesota including Odell Wind Farm in 2013 (Cottonwood, Jackson, Martin, and Watonwan Counties), Red Pine Wind Project in 2013-2014 (Lincoln County), and Lakefield Wind Project in 2010 (Jackson County). Because these projects are in proximity to the Project Area and/or have similar land uses, they provide recent and relevant assessments of wildlife resources in the area as a supplement to current studies of the Project Area. The following sections include a discussion of general wildlife that occurs in the Project Area. Section 8.21 includes a discussion of wildlife considered by the state to be threatened, endangered, or of special concern.

Wildlife in the Project Area consists of birds, mammals, fish, reptiles, amphibians, and insects, both resident and migratory, that use the Project Area habitat for forage, breeding, and/or shelter. The resident species are representative of Minnesota game and non-game fauna that are associated with upland grass, farmlands, and wetland and forested areas. The majority of the migratory wildlife species are birds, including waterfowl, raptors, and songbirds.

Included below is a discussion of migratory and resident birds, mammals, reptiles, amphibians, and insects that are expected to exist in the Project Area.

Birds

Various migratory and resident bird species use the Project Area as a part of their life cycle. Migratory bird species may use the Project Area for resting, foraging, or breeding activities for only a portion of the year. Resident bird species occupy the Project Area throughout the year. A list of migratory and resident bird species documented by Western EcoSystems Technology, Inc (WEST) during the first year of avian surveys (June 2018 through August 2019) at the Project Area is presented in Table 8.20-1. The results of the pre-construction avian surveys at Odell, Red Pine, and Lakefield show that the site-specific avian point-count data contain a similar species composition to those observed in the Project Area. Therefore, it is anticipated that the species listed from current surveys supplemented by pre-construction surveys at nearby wind projects will be representative for bird use in the Project Area. Plum Creek will continue to conduct studies during the state site permit process and will provide the results of those studies to the MNDNR and the Commission.

Birds observed during June 2018 – August 2019 include upland game birds (ring-necked pheasant, mourning dove, wild turkey), ducks and geese (Canada goose, mallard, blue-winged teal, northern shoveler, wood duck), raptors (bald eagle, northern harrier, red-tailed hawk, American kestrel), shorebirds (killdeer, upland sandpiper, Wilson's snipe), woodpeckers (downy woodpecker, hairy woodpecker, northern flicker), and songbirds (wrens, sparrows, blackbirds, swallows). These species are similar to those observed during pre-construction surveys at Odell, Red Pine, and Lakefield (Table 8.20-1).

Table 8.20-1
Comparison of Birds Identified during Pre-construction Surveys

Species	Species Special Status [1]	Plum Creek [2]	Odell [3]	Red Pine [4]	Lakefield [5]
Canada Goose		x	x	x	x
Greater White-fronted Goose		x	x	x	
Trumpeter Swan	SOC, SGCN	x			
Snow Goose			x	x	
Cackling Goose		x			
Common Merganser	SGCN	x			
Wood Duck		x	x	x	x
Mallard		x	x	x	x
Blue-winged Teal		x	x	x	
Canvasback		x	x		
Northern Shoveler		x	x	x	x
Ruddy Duck		x		x	
Bufflehead				x	
American White Pelican	SOC, SGCN	x	x	x	x
Great Blue Heron		x	x	x	x
Great Egret				x	
Green Heron			x		
Gadwall		x			
Northern Pintail	SGCN	x	x		
American Coot		x	x		
Sandhill Crane		x			
Killdeer		x	x	x	x
Lesser Yellowlegs		x	x		
Greater Yellowlegs	SGCN	x			
Least Sandpiper		x			
Solitary Sandpiper	BCC	x			x
Upland Sandpiper	BCC, SGCN	x	x	x	
Pectoral Sandpiper		x			
Wilson's Snipe		x			
Franklin's Gull	SOC, SGCN	x	x	x	
Ring-billed Gull		x	x	x	
Black Tern	BCC, SGCN		x		
Common Tern	SGCN			x	
Pied-billed Grebe			x		
Double-crested Cormorant		x	x	x	
Belted Kingfisher	SGCN	x			
Turkey Vulture		x	x	x	
Bald Eagle	BCC	x	x	x	
Northern Harrier	SGCN	x	x	x	
Cooper's Hawk		x			x
Sharp-shinned Hawk		x			
Red-tailed Hawk		x	x	x	x
American Kestrel	SGCN	x	x	x	x

Table 8.20-1
Comparison of Birds Identified during Pre-construction Surveys

Species	Species Special Status [1]	Plum Creek [2]	Odell [3]	Red Pine [4]	Lakefield [5]
Prairie Falcon		x			
Swainson's Hawk	BCC	x		x	
Broad-winged Hawk		x			
Rough-legged Hawk		x	x		
Merlin					x
Osprey		x			
Great Horned Owl				x	
Rock Pigeon		x	x	x	
Mourning Dove		x	x	x	x
Eurasian Collared Dove		x			
Gray Partridge		x			
Ring-necked Pheasant		x	x	x	x
Wild Turkey		x			
Red-winged Blackbird		x	x	x	
Yellow-headed Blackbird	SGCN	x	x		
Blue Jay		x	x	x	x
American Crow		x	x	x	x
Rusty Blackbird		x			
Brewer's Blackbird		x			
Red-headed Woodpecker	BCC, SGCN	x	x		x
Red-bellied Woodpecker		x	x		
Hairy Woodpecker		x	x		x
Downy Woodpecker		x	x	x	
Northern Flicker		x	x	x	x
Eastern Wood-Pewee			x		x
Eastern Phoebe			x		
Least Flycatcher			x		x
Great Crested Flycatcher					x
Eastern Kingbird		x	x		
Common Nighthawk	SGCN	x			
Chimney Swift	SGCN		x		x
Red-eyed Vireo					x
Warbling Vireo			x		
Horned Lark		x	x	x	x
Purple Martin	SOC, SGCN		x		x
Tree Swallow		x	x		x
Bank Swallow		x			
Cliff Swallow		x	x	x	x
Barn Swallow		x	x	x	x
Northern Rough-winged Swallow	SGCN	x			
Dark-eyed Junco		x		x	
Snow Bunting		x		x	
Indigo Bunting		x			
House Wren					x

Table 8.20-1
Comparison of Birds Identified during Pre-construction Surveys

Species	Species Special Status [1]	Plum Creek [2]	Odell [3]	Red Pine [4]	Lakefield [5]
Sedge Wren	SGCN	x			x
Marsh Wren			x		
American Robin		x	x	x	x
Wood Thrush	SGCN		x		
Swainson's Thrush		x			
Gray Catbird		x	x		x
Brown Thrasher	SGCN	x	x		x
European Starling		x	x	x	x
American Pipit		x			x
Cedar Waxwing			x		x
Common Yellowthroat		x	x		x
Yellow Warbler		x	x		x
Nashville Warbler			x		
Chestnut-sided Warbler		x			
Orange-crowned Warbler		x			
Yellow-rumped Warbler		x			
American Tree Sparrow		x			
Chipping Sparrow		x	x		
Clay-colored Sparrow			x		
Vesper Sparrow		x	x		x
Lark Sparrow	SOC, SGCN				x
Savannah Sparrow		x	x		x
Grasshopper Sparrow	BCC, SGCN		x		
Song Sparrow		x	x		x
White-throated Sparrow		x			x
House Sparrow		x	x		
Harris's Sparrow		x	x		x
Field Sparrow		x	x		
Swamp Sparrow			x		
Henslow's Sparrow	SE, SGCN	x			
Lapland Longspur		x		x	x
Dickcissel	BCC, SGCN	x	x		x
Bobolink	SGCN	x	x		x
Western Meadowlark	SGCN	x	x	x	x
White-breasted Nuthatch		x	x		
Common Grackle		x	x	x	x
Brown-headed Cowbird		x	x	x	x
Baltimore Oriole		x	x		
Orchard Oriole			x		
Northern Cardinal			x		
Rose-breasted Grosbeak		x	x		
American Goldfinch		x	x	x	x
House Finch		x	x		
Ruby-throated Hummingbird			x		

Table 8.20-1
Comparison of Birds Identified during Pre-construction Surveys

Species	Species Special Status [1]	Plum Creek [2]	Odell [3]	Red Pine [4]	Lakefield [5]
Black-capped Chickadee		x	x		

[1] BCC = Bird of Conservation Concern, SE= State Endangered, SOC= State Species of Concern, W = State Watchlist Species, SGCN = Species of Greatest Conservation Need
[2] Plum Creek Avian Surveys (June 2018 – August 2019)
[3] Odell Wind Farm: Wildlife Assessment & Field Studies (Dunlap et al., 2015)
[4] Avian Use Surveys for the Red Pine Wind Resource Area (Derby and Rintz, 2014)
[5] Pre-Construction Avian Surveys, Lakefield Wind Project (Westwood, 2010)

Mammals

Mammals that may occur in the Project Area use the food and cover available from agricultural fields, grasslands, farm woodlots, wetland areas, and wooded ravines. Mammals that may occur in the Project Area include red fox (*Vulpes vulpes*), Virginia opossum (*Didelphis virginiana*), striped skunk (*Mephitis mephitis*), white-tailed jackrabbit (*Lepus townsendii*), eastern cottontail (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), and coyote (*Canis latrans*) (MNDNR, 2019a). White-tailed deer (*Odocoileus virginianus*), an economically important species, also have a strong affinity for agricultural crops and use farm woodlots, wooded ravines, and intermittent stream bottoms for shelter.

Bat species present in Minnesota include the hoary bat (*Lasiurus cinereus*), eastern red bat (*Lasiurus borealis*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), northern long-eared bat (*Myotis septentrionalis*), tricolored bat (formerly, the eastern pipistrelle) (*Pipistrellus subflavus*), and little brown bat (*Myotis lucifiugus*) (MNDNR, 2019a). Plum Creek conducted a bat activity study in the Project Area from May 3, 2019 to October 31, 2019. Plum Creek will provide the results of those studies to the MNDNR and the Commission.

Bat activity studies at the Red Pine Wind Project (Lincoln County, Minnesota) in 2013 found that bat activity in the Project Area was greatest near wetland and woodland areas; bats likely used these areas for both foraging and roosting. Activity was lower in agricultural areas. Low-frequency bat activity was found to be greater than high-frequency bat activity across the Project Area; species such as silver-haired bats, big brown bats, and hairy bats are likely the most common. Surveys recorded between 2.93 ± 0.42 and 15.92 ± 1.62 bat passes per detector night in studies conducted across the Project Area. Bat activity was low in areas of agriculture in comparison to areas with wetland and woodland features (Derby et al., 2014).

Bat acoustic studies were conducted at the Lakefield Farm (Jackson County, Minnesota) in 2011 to assess baseline activity. Activity was highest from mid-July until early September. Species detected were big brown bat, silver-haired bat, hoary bat, eastern red bat, and little brown bat. Most bat species detected were migratory species, with the exception of the big brown bat. (Rodriguez et al., 2011).

At the Odell Wind Farm (Cottonwood, Jackson, Martin, and Watonwan Counties, Minnesota), big brown, eastern red, hoary, and little brown bats were detected by survey equipment during surveys to monitor bat activity (Dunlap et al., 2015).

Reptiles and Amphibians

Reptile and amphibian species that may be present in the Project Area include Great Plains toad (*Anaxyrus cognatus*), northern leopard frog (*Lithobates pipiens*), and plains garter snake (*Thamnophis radix*) (MNDNR, 2019a). These species are typical of agricultural landscapes and grasslands.

Fish

Fish may be present in the streams that traverse the Project Area. Fish species typical of streams in the southeast portion of the state include the bullhead (*Ameiurus* spp.), channel catfish (*Ictalurus punctatus*), and long-nose gar (*Lepisosteus osseus*) (MNDNR 2019a).

Insects

Pollinator insects may be present in the Project Area including native bees, butterflies, and moths and non-native honeybees. Other insect groups that may occur in the Project Area include mayflies and katydids (MNDNR, 2019a).

8.20.1.2 Impacts

Development of the Project, including the construction and operation, is expected to produce a minimal impact to wildlife. Based on studies of existing wind power projects in the United States and Europe, the impact to wildlife would primarily occur to avian and bat populations. Although Plum Creek preconstruction surveys are ongoing, it can be expected that, similar to other wind developments, there is a high likelihood that individual bird and bat fatalities will occur at the Project. However, it is unlikely that Plum Creek will affect species at the population level.

Three recent studies are available with geographic proximity and comparable landscapes to Plum Creek that provide both pre- and post-construction data from which to draw correlative inferences about potential impacts on birds and bats: Odell Wind Farm (Odell) in Cottonwood, Jackson, Martin and Watonwan Counties, Minnesota; Red Pine Wind Energy Facility (Red Pine) in Lincoln County, Minnesota; and Lakefield Wind Project (Lakefield) in Jackson County, Minnesota. All three projects have similar land cover types, as shown in Table 8.20-2.

Table 8.20-2
Relative Percentage of Land Cover Types at Odell, Red Pine, and Lakefield

Land Cover	Odell (%)	Red Pine (%)	Lakefield (%)
Cultivated Crops	91.4	67.8	88.8
Grassland/Hay/Pasture	3.0	23.4	2.8
Disturbed/Developed Land/Open Space	4.7	4.6	6.6
Wetland/Water	0.5	3.7	0.9
Forest/shrub-scrub	0.0	< 1.0	1.0

Table 8.20-2
Relative Percentage of Land Cover Types at Odell, Red Pine, and Lakefield

Land Cover	Odell (%)	Red Pine (%)	Lakefield (%)

Note: This table shows approximate land cover types based on data reported in Site Permit Applications that use the following data sources: Odell (USGS NLCD 2001), Red Pine (USGS NLCD 2011), and Lakefield (USGS NLCD 2011).

Data from these pre- and post-construction avian and bat studies at Odell, Red Pine, and Lakefield suggest the types and levels of impacts that may be realized at Plum Creek:

- Odell:
  - During pre-construction point count surveys at Odell, the species documented most frequently were species typical of agricultural regions: red-winged blackbird, common grackle, cliff swallow, tree swallow, American robin, and American goldfinch. These species comprised 52 percent of all individuals observed. Species diversity was significantly greater in grassland and riparian habitat compared to agricultural lands (i.e. cultivated crops).
  - Pre-construction acoustic monitoring for bats showed four species of bats: hoary, big brown, little brown, and eastern red. Overall, monitoring indicated that bat activity at Odell was relatively low (1.6 calls per detector-night), with slightly higher rates during the fall migration period (3.6 calls per detector-night) (Dunlap et al., 2015).
  - At Odell, post-construction surveys were conducted for one year between December 2016 and December 2017. Avian and bat fatalities were estimated as 4.69 and 6.74 fatalities per MW per year, respectively, based on the Huso estimator.
  - Most avian fatalities were recorded in September and October. Bat fatalities were recorded primarily in July through September. The seasonality of both avian and bat fatalities suggests that most fatalities were fall migrants. The most common bat species recorded during post-construction surveys was the hoary bat (Chodachek and Gustafson, 2018).
- Red Pine:
  - Pre-construction fixed-point avian use surveys at Red Pine were conducted from March 2013 to March 2014. Most raptor observations were comprised of red-tailed hawk, northern harrier, or bald eagle. One state threatened species, the common tern, and two special concern species in Minnesota, Franklin's gull and American white pelican, were recorded during surveys. No spatial patterns in avian use of the Red Pine project area were apparent (Derby and Rintz, 2014).
  - During bat activity surveys at Red Pine from April to October 2013, the majority of bats detected were low-frequency bats (e.g., big brown bats, hoary bats, and silver-haired bats) (Derby et al., 2014). During mist-net surveys for northern long-eared bats in August 2015, four species of bats were recorded big brown bat, silver-haired bat, eastern red bat, and hoary bat; no northern-long eared bats were recorded (Pickle et al., 2015).

- During post-construction studies at Red Pine (March 2018-November 2018), avian fatalities were estimated as 4.47 and 2.68 fatalities per MW per study period (March 18 to November 15, 2018) during cleared plot surveys and road and pad surveys, respectively, using the Huso estimator. The most common avian species identified were ruby-crowned kinglet, marsh wren, red-eyed vireo, and sedge wren. Eight bird species represented by 19 individuals were identified that are SGCN based on Minnesota's Wildlife Action Plan 2015-2025: marsh wren, Le Conte's sparrow, Philadelphia vireo, ovenbird, sedge wren, swamp sparrow, Swainson's hawk, and Virginia rail.
- Bat fatalities were estimated as 11.35 and 18.74 fatalities per MW per study period (March 18 to November 15, 2018) during cleared plot surveys and road and pad surveys, respectively, using the Huso estimator. Four bat species were documented during post-construction studies: hoary bat, big brown bat, eastern red bat, and silver-haired bat. The big brown bat is listed a species of concern in Minnesota, and the eastern red bat and hoary bat are listed as SGCN (Trana et al., 2019).

- Lakefield:
  - Pre-construction studies at Lakefield aimed to address wildlife agency concerns of a potential local waterbird flight path corridor between Boot Lake and South Heron Lake, both large lakes located outside the project area. The study was also designed to see what, if any, effect the proximity of wildlife areas had on breeding bird diversity. The study found no apparent waterbird flight path corridor through the project area between Boot Lake and south Heron Lake. Additionally, breeding bird diversity was not significantly higher at proposed turbine locations closer to water resources and wildlife lands than at distant turbines. The study concluded that turbines were sited in agricultural land and an adequate distance from water features and wildlife lands that harbor a higher diversity of birds due to better quality habitat (Westwood, 2010).
  - Post-construction fatality monitoring at Lakefield in 2012 (Westwood, 2013) estimated 2.75 and 19.97 fatalities per MW per study period (April 1 to November 17, 2012) for birds and bats, respectively. Searchers found 15 species of birds and 4 species of bat, none of which were state or federally endangered, threatened, or special concern species. Fatalities attributable to wind turbines did not include any raptors or waterfowl. Bat species identified included big brown bat, little brown bat, eastern red bat, and hoary bat. Additionally, the study found no significant differences in the number of fatalities at turbines located < 1.25 miles from protected conservation lands than those greater than 1.25 miles.
  - Post-construction fatality monitoring at Lakefield in 2014 (Westwood, 2015) estimated 1.07 bird fatalities per MW per study period (June 3rd to October 15, 2014) and 20.19 bat fatalities per MW per study period. Three of the fatalities were waterbirds: one mallard, one American coot, and one American white pelican. Most of the bat fatalities (65 percent) were solitary tree roosting bats (eastern red bat, hoary bat); fatalities were observed during

the migration (last week of July – mid-September) when bats are most at risk. Additionally, the study found no statistically significant relationship between number of fatalities and surrounding habitats or turbine proximity to conservation lands. The 2014 fatality rates are consistent with the 2012 fatality estimates. Avian fatality estimates fall in the low-range and bat fatality rates trend toward the mid-range when compared to fatality studies at other wind energy facilities (Westwood, 2015).

In addition to the pre- and post-construction data available from Odell, Red Pine, and Lakefield, several wind projects with similar locations and land-use have post-construction avian and bat data for forecasting potential post-construction impacts at Plum Creek. These projects include Prairie Rose, Big Blue, Grand Meadow, and Oak Glen. Prairie Rose Wind Project in Rock County, Minnesota has post-construction data from studies conducted in 2014. The Minnesota Department of Commerce (DOC) commissioned a bat fatality study at three wind farms in south-central Minnesota in 2013—Big Blue, Grand Meadow, and Oak Glen.

The Prairie Rose Wind Project is located approximately 40 miles southwest and comprised of predominately agricultural land. There are no wildlife lands in or adjacent to the Prairie Rose Wind Project. The Prairie Rose post-construction study (Chodachek et. al, 2015) identified the following impacts:

- Post-construction fatality monitoring was conducted during spring (April 15 to June 15) and fall (August 15 to October 31) in 2014. Additionally, there was an operational shut-down during part of the fall monitoring period (August 18 – August 28, 2014), a time when bat fatalities have been shown to be associated with fall migration. Post-construction fatality estimates provided for Prairie Rose are defined per study period (i.e., 8 weeks during spring migration and 10 weeks during fall migration) and not extrapolated to an annual rate, which is typical of most post-construction fatality studies.
- Post-construction fatality monitoring in 2014 estimated 0.44 bird fatality per MW per study period. The estimated bird fatality rate of 0.44 bird fatality per MW per study period at Prairie Rose is low compared to 33 other wind projects in the Midwest. Although, most of these studies typically included at least three seasons or an all year survey, it is unlikely that the bird fatality rate would change much with a summer survey as songbirds are the most common fatality reported at wind energy facilities, particularly during spring and fall migration.
- Post-construction fatality monitoring in 2014 estimated 0.41 bat fatality per MW per study period.

Post-construction fatality studies at the Big Blue, Grand Meadow, and Oak Glen Wind Farms in 2013 (Chodachek et al., 2014) focused on bat fatality, observing impacts to birds:

- Post-construction fatality monitoring in 2013 estimated a range of adjusted range of bat fatalities between 3.1 to 6.3 bat fatalities per MW per year for the three wind farms studied. Bat fatalities tended to peak twice; once in late July/early August and again in late August/early September. Fatalities were primarily composed of migratory tree-roosting bats, including the eastern red bat and the hoary bat.

- Post-construction fatality monitoring in 2013 estimated less than one bird fatality per MW per study period for the three wind farms included in the study. The overall fatality rate was 0.3 to 0.5 bird fatality per MW per study period. No large bird fatalities or threatened/endangered species fatalities were observed.

Overall, adjusted fatality rates for all bird species vary between three to six birds/MW/year for the majority of post-construction fatality studies nationwide. Fatality estimates are relatively constant across the country except for in the Great Plains, where there appears to be lower avian fatality rates, and the Pacific region, where there may be slightly higher fatality rates. Most avian fatalities due to wind turbines are small passerines, about 60 percent of avian fatalities in publicly available reports in the United States Fatality rates of migratory passerines increase in the spring and fall during migration (American Wind Wildlife Institute [AWWI], 2017). Based on the post-construction fatality studies outlined above, national averages for post-construction fatalities, and AWWI's conclusions about geographic trends, Plum Creek anticipates that unavoidable avian fatalities due to collision will be at or below the national average and may result in limited localized impacts to some groups of birds, such as small passerines.

Potential unavoidable impacts from the Project on bats are expected to be similar than the post-construction fatality rates at the above wind facilities, based on the similar land uses within the Project Area, geographic proximity of the projects, and similarities in species composition. Tree-roosting bats that migrate including the hoary bat, silver-haired bat, and eastern red bat, which were detected during the Project's pre-construction studies, may have the highest risk of collision based on previous bat fatality studies (AWWI, 2017). Overall, risk of mortality to bats in the Project Area is likely to be greatest on nights during fall migration, when bat migration rates are the highest. During the fall migration, weather conditions that are most conducive to higher mortality rates occur with warm temperatures (greater than 50 degrees Fahrenheit) and low wind speeds (less than 6.5 m/s or 14mph) (Baerwald and Barclay, 2009; Arnett et al., 2011; Good et al., 2011; Cryan and Brown, 2007). In addition, risk may be higher on the first night following the passage of a low-pressure system when the prevailing wind shifts from a southerly to a northerly direction (Cryan and Brown, 2007; Good et al., 2011). Additional impacts may include a small reduction in the available habitat that some wildlife uses for forage or cover; however, operation of the Project will not significantly change the existing land use.

8.20.1.3 Mitigative Measures

Plum Creek will implement the following measures to the extent practicable to help avoid potential impacts to wildlife in the Project Area during selection of the turbine locations and subsequent Project development and operation:

- Prioritize turbine siting in cultivated cropland.
- Avoid siting turbines in mapped native prairie, native plant communities, and SOBS (all ranks).
- Maintain, at a minimum, the three by five times the RD setback from adjacent WMAs and WPAs to reduce risk to waterfowl/waterbirds and grassland-associated birds when siting turbines in the Project Area.
- Avoid siting turbines within a 1,000-foot habitat connectivity buffer of forested areas associated with Highwater and Dutch Charley Creeks.

- Avoid or minimize disturbance of individual wetlands or drainage systems during Project construction. Wetland delineations will be conducted prior to construction to identify the limits of wetland boundaries in the vicinity of Project activities.
- Conduct one year of post-construction Project monitoring for birds and bats to assess operational impacts to birds and bats.
- Protect existing trees and shrubs by avoiding tree removal for turbines, access roads, and underground collector lines. These will be identified based on aerial photos and during field surveys.
- Maintain sound water and soil conservation practices during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. To minimize erosion during and after construction, BMPs for erosion and sediment control will be used. These practices include silt fencing, temporary seeding, permanent seeding, mulching, filter strips, erosion blankets, grassed waterways, and sod stabilization.
- Construct wind turbines using tubular monopole towers.
- Light turbines according to FAA requirements, which may include ADLS radar.
- Revegetate non-cropland and pasture areas disturbed during construction or operation with an appropriate native seeding mix.
- Inspect and control noxious weeds in areas disturbed by the construction and operation of the Project.
- Prepare and implement an ABPP during construction and operation of the Project. A draft ABPP is attached to this Amended Application as Appendix G. This ABPP consists of Geronimo's corporate standards for minimizing impacts to avian and bat species during construction and operation of wind energy projects. The ABPP has been developed in a manner that is consistent with the guidelines and recommendations of the USFWS WEG (USFWS, 2012). It includes Plum Creek's commitments to wind farm siting and transmission route suitability assessments, construction practices and design standards, operational practices, permit compliance, and construction and operation worker training. It also includes additional avoidance and minimization measures that may be implemented in consultation with the USFWS and MNDNR if avian and bat mortalities exceed an acceptable level.

Plum Creek is committed to minimizing wildlife impacts within the Project Area. Plum Creek has designed both layouts to minimize avian impacts by siting all turbines in cultivated crops and avoiding high use wildlife habitat (woodlands adjacent to farmsteads), using tubular towers to minimize perching, placing electrical collection lines underground as practicable, and minimizing infrastructure. Plum Creek continues to consult with the Commission, USFWS, and MNDNR regarding appropriate mitigation measures for wildlife impacts.

8.20.2 Migratory Waterfowl Feeding and Resting Areas

8.20.2.1 Description of Resources

MWFRA were authorized by the Minnesota legislature in 1969 to protect migratory waterfowl from disturbance. During the waterfowl season, electric motors are either prohibited or limited in size, depending on the MWFRA. In 2011, 30 MWFRAs were designated across the state. MWFRA

are typically nominated by local conservation groups for the MNDNR to consider and approve or deny (MNDNR, 2019b).

8.20.2.2 Impacts

No MWFRAs are within or adjacent to the Project Area, and thus Plum Creek anticipates no impacts.

8.20.2.3 Mitigative Measures

No mitigative measures are necessary related to MWFRAs because there are no MWFRAs within or adjacent to the Project Area.

8.20.3 Important Bird Areas

8.20.3.1 Description of Resources

Important Bird Areas (IBAs) are created under voluntary, non-regulatory, international conservation effort that identifies critically essential habitats for birds, designates these habitats as IBAs, monitors the IBAS for changes in avian distribution and abundance, and conserves IBAs to protect birds in the long- erm (MNDNR, 2019c). In Minnesota, the IBA program is led by the MNDNR's Nongame Wildlife Program and Audubon Minnesota.

8.20.3.2 Impacts

No IBAs are within or adjacent to the Project Area, and thus Plum Creek anticipates no impacts.

8.20.3.3 Mitigative Measures

No mitigative measures are necessary related to IBAs because there are no IBAs within or adjacent to the Project Area.

8.21 Rare and Unique Natural Resources

8.21.1 Rare and Unique Natural Resources

8.21.1.1 Description of Resources

Federal Regulations

Endangered Species Act

Section 7 of the Endangered Species Act of 1973 (ESA; 16 U.S.C 1531-1544) requires that all federal agencies consider and avoid, if possible, adverse impacts to federally listed threatened or endangered species or their critical habitats, which may result from their direct, regulatory, or funding actions. USFWS is responsible for compiling and maintaining the federal list of terrestrial threatened and endangered species. Section 7 of the ESA also prohibits the taking of any federally listed species by any person without prior authorization. The term "taking" is broadly defined at the federal level and explicitly extends to any habitat modifications that may significantly impair

the ability of that species to feed, reproduce, or otherwise survive. While the prohibition of "taking" federal species applies to anyone, the prohibition of the destruction or adverse modification of designated critical habitat only applies to federal agencies.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) of 1940 (16 U.S.C. 668-668d) protects and conserves bald eagles (*Halieetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) from intentional take of an individual bird, chick, egg, or nest, including alternate and inactive nests without a permit. Unlike the MBTA, BGEPA prohibits disturbance that may lead to biologically significant impacts, such as interference with feeding, sheltering, roosting, and breeding or abandonment of a nest (USFWS, 2007a).

Birds of Conservation Concern

The USFWS with its partners developed the Birds of Conservation Concern (BCC) to fulfill its mandate under the Fish and Wildlife Conservation Act's 1988 amendment to identify populations, subspecies, and species of nongame migratory birds that may become candidates for listing under ESA if they are not conserved (USFWS, 2008). BCC are avian species that represent the agency's highest conservation priorities. Plum Creek is located within the Prairie Potholes Bird Conservation Region (USFWS, 2008).

State Wildlife Action Plan

Minnesota's State Wildlife Action Plan (2015-2025) (SWAP) proactively addresses the state's conservation needs and catalyzes actions to prevent species from becoming listed under the state or federal ESAs. The SWAP also entailed revisions to the state's list of Species of Greatest Conservation Need (SGCN). SGCN are native animals with rare, declining, or vulnerable populations and species for which the state has a stewardship responsibility (MNDNR, 2016).

State Regulations

Minnesota's endangered species law (Minn. Stat. § 84.0895) and associated rules (Minn. R. Chs. 6212, 1800, 2300, and 6134) regulate the taking, importation, transportation, and sale of state endangered or threatened species. The MNDNR administers the state list of rare, threatened, and endangered species. The MNDNR also identifies and develops a list of species of special concern; species of special concern are not protected by the state endangered species law.

Federal and State Listed Species

Plum Creek reviewed the USFWS's Information for Planning and Conservation website (USFWS, 2019a) for federally listed species, candidate species, and designated or proposed critical habitat that may be present within the proposed Project Area (Table 8.21-1). Plum Creek also reviewed the MNDNR's Natural Heritage Information System (NHIS) for documented occurrences of federally listed species, state listed species, and state species of concern within one mile of the Project Area (MNDNR, 2019d). The MNDNR maintains NHIS database through their Natural Heritage Program and Nongame Game Research Program; the NHIS 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. Although these reviews do not represent a comprehensive survey, they provide information on the potential presence of rare and unique species and habitats (refer to Table 8.21-2). Plum Creek requested NHIS information from MNDNR in February 2017 (*see* Appendix A of the Avian and Bat Protection Plan – Appendix G).

Table 8.21-1
Federally Listed Species With the Potential to Occur in the Project Area [1]

Species	Counties of Occurrence	Federal Status
Northern Long-eared Bat (*Myotis septentrionalis*)	Cottonwood, Murray, Redwood	Threatened
Dakota Skipper (*Hesperia dacotae*)	Murray	Threatened
Prairie Bush-Clover (*Lespedeza leptostachya)*	Cottonwood, Redwood	Threatened

[1] Murray County has designated critical habitat for the Topeka Shiner (*Notropis topeka*). However, this critical habitat does not intersect the Project Area and is in a different watershed, the Missouri River watershed, than the Project, which is located in the Mississippi River watershed.

Table 8.21-2
Federal and State Listed Species Documented Within One Mile of the Project Area[1]

Type	Federal Status[2]	State Status[2]	Scientific Name	Common Name	NHIS Records within the Project Area (#)	NHIS Records within one Mile of Project Area Boundary (#)	Year of Most Current Observation
Bird	--	T	*Phalaropus tricolor*	Wilson's Phalarope	0	1	2006
	--	SPC	*Cygnus buccinator*	Trumpeter Swam	0	1	2009
	--	W	*Bartramia longicauda*	Upland Sandpiper	2	0	2007
Insect	E	E	*Oarisma poweshiek*	Poweshiek Skipperling	1	0	1975
Amphibian	--	SPC	*Anaxyrus cognatus*	Great Plains Toad	1	0	2008

[1] MNDNR, 2019d
[2] E=Endangered, T=Threatened, SPC=Species of Special Concern, W=Watchlist

Presence/absence acoustic surveys for the northern long-eared bat were conducted in the Project Area during July 2-10, 2019. Qualitative and acoustical-software verification demonstrated lack of species presence. As such, this species is considered likely absent from the Project Area. Surveys are considered complete, and no further action is recommended to confirm northern long-

eared bat absence pursuant to the 2019 Range-Wide Indiana Bat Summer Survey Guidelines (USFWS, 2019).

One federally listed species has been documented within the Project Area, a 1975 record of the Poweshiek skipperling. This species is also listed by the state as endangered. Poweshiek skipperlings are small butterflies that occur in native tallgrass prairie habitat. Approximately four percent of tallgrass prairie habitat remains in the United States, and the majority of remaining parcels are small and isolated (USFWS, 2014). Based on the age of the record and the absence of the Poweshiek skipperling on the USFWS species list for the Project Area, the Powershiek skipperling is not likely to occur in the Project Area. If individuals were present, they would be associated with the native prairie remnants. Based on the MNDNR's NHIS, there is one record of prairie in the Project Area (dry hill prairie (southern) type) that was most recently documented in 1977 partially within the Project boundary, but mostly adjacent to it. Additionally, as noted in Section 2.21.2 (Native Prairie), there is approximately 316 acres of MNDNR-mapped native prairie in the Project Area. The MNDNR NHIS record of dry hill prairie (southern) type is associated with MNDNR-mapped native prairie.

Based on Plum Creek's review of the NHIS, there is one special status bird (upland sandpiper) and one special status amphibian (Great Plains toad) within the Project Area and two special status birds (Wilson's phalarope and trumpeter swan) within the one-mile buffer. NHIS data show two records from 2007 of the upland sandpiper, a Minnesota watchlist species, within the Project Area and associated with Dutch Charley Creek and a wetland complex.

In addition, within one mile of the Project Area, NHIS data shows one record from 2006 of the state-threatened Wilson's phalarope and one record from 2009 of the trumpeter swan, a state species of special concern. The record for Wilson's phalarope is associated with a freshwater emergent wetland complex west of the Project Area; the record for the trumpeter swan is associated with a WPA/WMA complex that also has nesting habitat for this species (a lake); a SOBS ranked as moderate; a native prairie; an upland prairie NPC; and a complex of freshwater emergent wetlands, riverine areas, and a lake.

To date, the trumpeter swan and upland sandpiper were observed during on-going pre-construction avian studies; the Wilson's phalarope has not been documented during these studies to date (*see* Table 8.20-1). The Great Plains toad, a state species of concern, was documented in the Project Area in 2008; this record intersects a complex of freshwater emergent wetlands, freshwater forested wetlands, and ponds. Species of special concern and watchlist species do not have a legal or protected status but are tracked by the MNDNR.

In addition to the special status species reported in the NHIS within the Project Area or one mile of the Project Area, Project-specific pre-construction avian studies have also documented special status species (Table 8.20-1). There have been no federally listed species observed in the Project Area; one state-listed endangered Henslow's sparrow was observed incidentally during surveys. Henslow's sparrows are habitat specialists that nest in large grasslands with well-developed litter layers and dense vegetation (Cooper, 2012). Twenty-nine species observed during the Project's pre-construction avian use surveys to date are BCC, state species of special concern, and/or SGCN.

Plum Creek met with MNDNR staff on October 22, 2018 to discuss the Plum Creek Wind Project. Plum Creek provided a Project overview and status of ongoing avian and bat survey work at the Project and also discussed planned surveys for 2019. MNDNR had few comments specific to the Project:

- Avoid siting turbines within at least 1,000 feet of Highwater and Dutch Charley Creeks, as the riparian corridors associated with these waterbodies may provide good bat habitat.
- In addition to the 2018 bald eagle nest surveys, conduct a second year of bald eagle nest surveys in 2019 for the Project Area.
- Bat acoustic surveys should follow the MNDNR acoustic guidelines.
- Include alternate turbine positions in the layouts.

Similarly, Plum Creek met with USFWS staff on November 26, 2018 to discuss the Project. USFWS staff had few concerns about the Project Location, noting the Project Area was predominately cultivated crops and had limited habitat for rare species.

8.21.1.2 Impacts

Records of federal and state listed species documented within the Project Area include one NHIS record of Poweshiek skipperling (a federally endangered species) from 1975, one record of Henslow's sparrow (a state endangered species) during avian use surveys for the Project in 2019, and one NHIS record of Wilson's phalarope (a state threatened species) from 2006. Plum Creek has designed the Project to site all turbines in cultivated cropland and avoided permanent impacts from all Project components (e.g., turbines, access roads, permanent met towers, collector substations, and O&M facility) on MNDNR-mapped native prairie, native plant communities, and all SOBS. Plum Creek should therefore avoid impacts to the Poweshiek skipperling, a native prairie obligate. In addition, the record of Powershiek skippering in the Project Area was from 1975 over 40 years ago; subsequently, the probability of the species being present during Project development and operations is very low. Potential impacts on the state endangered Henslow's sparrow, which nests in large grasslands with a well-developed litter layer and dense vegetation, will be also avoided and minimized through siting turbines in cultivated cropland and by avoiding permanent impacts from other Project components on mapped native prairie, native plant communities, and SOBS. The NHIS record for the Wilson's phalarope was documented in freshwater emergent wetlands. Plum Creek will not site turbines in NWI wetlands and avoided wetlands when designing other Project components, including access roads, O&M facility, and collector substations to the extent practicable. Additionally, after field verification of wetlands, Project facilities may undergo minor shifts so as to avoid wetland features to the extent practicable.

Additionally, Plum Creek has sited turbines outside a northern-long-eared-bat connected-habitat buffer (1,000 feet from forested areas; *see* Figures 11a and 11b – Unique Natural Features). In doing so, the Project design minimizes impacts to bats, particularly along riparian areas associated with Dutch Charley Creek and Highwater Creek in the western portion of the Project Area. Further, Project-specific acoustic surveys for northern long-eared bats confirmed species absence in July 2019.

8.21.1.3 Mitigative Measures

Plum Creek 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 and operation:

- Avoid placement of turbines in MNDNR-mapped native prairie, native plant communities, and SOBS.
- If the Project will impact native prairie, as defined by Minn. Stat. § 84.02, subd. 5, Plum Creek will complete a Native Prairie Protection Plan in coordination with the MNDNR.
- Avoid or minimize disturbance of individual wetlands or drainage systems during Project construction.
- Setback the turbines from the WPAs and WMAs in adjacent properties by at least one-quarter mile because of the Project perimeter setback.
- Prepare and implement an ABPP during construction and operation of the Project.
- Feather turbines, 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.

A draft ABPP is attached to this Amended Application as Appendix G. This ABPP consists of Geronimo's corporate standards for minimizing impacts to wildlife, including the Wilson's phalarope, Henslow's sparrow, and northern long-eared bat, during construction and operation of wind energy projects. The ABPP has been developed in a manner that is consistent with the guidelines and recommendations of the USFWS WEG (USFWS, 2012). It includes Plum Creek's commitments to wind farm siting and transmission route suitability assessments, construction practices and design standards, operational practices, permit compliance, and construction and operation worker training. It also includes additional avoidance and minimization measures that may be implemented in consultation with the USFWS and MNDNR if avian and bat mortalities exceed an acceptable level.

Plum Creek is committed to minimizing wildlife impacts within the Project Area, including to federally and state listed birds. Plum Creek will design their facility to minimize avian impacts by avoiding high-use wildlife habitat (woodlands adjacent to farmsteads), using tubular towers to minimize perching, placing electrical collection lines underground as practicable, and minimizing infrastructure. Plum Creek continues to consult with the Commission, USFWS, and MNDNR regarding appropriate mitigation measures for wildlife impacts.

8.21.2 Native Prairie

8.21.2.1 Description of Resources

In addition to rare and sensitive species, the MNDNR also maps rare and unique plant communities that may include relatively rare habitats (e.g., prairie) or higher quality or good examples of more common plant communities (e.g., wet meadow). Although most native plant communities have no legal protection in Minnesota, these areas may have the potential to contain undocumented populations of rare plant species, which may be protected under Minnesota's state endangered

species law (Minn. Stat. § 84.0895). These native prairies and native plant communities may also provide essential habitat for rare species of fauna, such as those listed in Table 8.21-2 above.

Native prairies are typically untilled plant communities that are comprised primarily of native grasses and sedges along with a variety of broad-leaved forbs and scattered shrubs (MNDNR, 2011). Approximately 250,000 acres of native prairies ranked good to excellent remain in Minnesota (MNDNR, 2017a). Based on a review of the MNDNR's NHIS, one record of native prairie was documented in the Project Area in 1977, a Dry Hill Prairie (Southern Type). Additionally, MNDNR's native prairie data for the Project Area includes approximately 316 acres of dry hill prairie (southern) and mesic prairie (southern) (Table 8.21-3).

Table 8.21-3
MNDNR-mapped Native Prairie within the Project Area

Native Prairie Type	Acres
Dry Hill Prairie (southern)	291.4
Mesic Prairie (southern)	24.3
Total	**315.7**

The MNDNR's railroad prairie rights-of-way are native prairie remnants that occur along railroad rights-of-way. The railroad rights-of-way program was instituted in 1997 by the Minnesota legislature in the Prairie Parkland and Eastern Broadleaf Forest ECS Provinces (MNDNR, 2019e). There are no railroad prairie rights-of-way in or adjacent to the Project Area.

8.21.2.2 Impacts

Plum Creek has sited all turbines in cultivated cropland; the layout avoids permanent impacts from all Project components (e.g., turbines, access roads, permanent met towers, collector substations, and O&M facility) on MNDNR-mapped native prairie. Plum Creek will also minimize temporary impacts on the unit of MNDNR-mapped native prairie within the Project Area. Based on preliminary design, the V162 layout may temporarily impact 0.1 acre of MNDNR-mapped native prairie; the SG170 layout does not impact MNDNR-mapped native prairie.

8.21.2.3 Mitigative Measures

Plum Creek will continue to coordinate with MNDNR on native prairie. Plum Creek will, in consultation with the MNDNR, prepare a prairie protection and management plan. The plan will be submitted to the Commission and MNDNR after issuance of the site permit and prior to construction. The plan shall address steps to be taken to identify native prairie within the Project Area, measures to avoid impacts to native prairie, and measures to minimize and mitigate for impacts if unavoidable. Wind turbines and all associated facilities, including foundations, access roads, underground cable, and transformers, shall not be placed in native prairie unless addressed in the prairie management plan. Measures to be taken to mitigate unavoidable impacts to native prairie will be agreed to by the Applicant and MNDNR.

Plum Creek will implement the following measures to avoid and minimize potential impacts on MNDNR-mapped native prairie in the Project Area during Project development and operation:

- Avoid placement of turbines on MNDNR-mapped prairie.
- Avoid permanent impacts from other Project components (e.g., turbines, access roads, permanent met towers, collector substations, and O&M facility) on MNDNR-mapped prairie.
- Minimize temporary impacts on MNDNR-mapped prairie.

8.21.3 Native Plant Communities and Sites of Biodiversity Significance

8.21.3.1 Description of Resources

The MBS assesses and maps the distribution and status of the Minnesota's fauna, flora, NPCs, and SOBS.

Native Plant Communities (NPCs)

NPCs are assemblages of native plants that have not been substantially impacted by non-native species or human activities. NPCs are formed and classified by hydrology, soils, landforms, vegetation, and natural disturbance regimes such as floods, wildfires, and droughts. NPCs are named by their dominant or characteristic species and/or natural features (MNDNR, 2019f). NPCs may include native prairie. The MNDNR has classified NPCs within the state using plant species, soils, and other site-specific data from vegetation plots. The current NPC classification covers most of the wetland and terrestrial vegetation in the state and was completed in 2003. It is a six-level hierarchical classification that accounts for vegetation structure and geology, ecological processes, climate and paleohistory, local environmental conditions, canopy dominants, substrate, and environmental conditions (Aaseng et al., 2011).

Table 8.21-4 presents the MBS's NPCs that occur within the Project Area and the number of acres of each NPC within the Project Area.

Table 8.21-4
Native Plant Communities within the Project Area

Native Plant Community Type	Acres
Basswood - Bur Oak - (Green Ash) Forest	1.6
Southern Wet-Mesic Hardwood Forest	8.2
Prairie Wetland Complex	50.2
Dry Hill Prairie (Southern)	291.4
Mesic Prairie (Southern)	24.3
Southern Seepage Meadow/Carr	5.2
Seepage Meadow/Carr	2.2
Total	**383.1**

Sites of Biological Significance

The MBS is an assessment of Minnesota landscapes for native plant communities, rare animals, rare plants, and animal communities through desktop review and follow-up field survey. MBS designates and assigns rankings to SOBS, based on landscape context, native plant community, and occurrence of rare species populations. The MBS groups and ranks SOBS for each Minnesota's system subsections for the purpose of designating and cataloguing the state's most notable examples of native plant communities and rare species. 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 (MNDNR, 2009; MNDNR 2019f). Both native prairie and native plant communities may also be designated as SOBS. 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 MBS's 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 8.21-5 presents the MBS's SOBS that occur within the Project Area and their Biodiversity Significance Rank.

Table 8.21-5
Sites of Biodiversity Significance within the Project Area

Site of Biodiversity Significance Rank	Number of Sites Within Project Area	Acres
Below	11	530
Moderate	16	604
High	0	0
Outstanding	0	0
Total	**27**	**1,134**

8.21.3.2 Impacts

Plum Creek has sited all turbines in cultivated cropland; the layouts avoid permanent impacts from all Project components (e.g., turbines, access roads, permanent met towers, collector substations, and O&M facility) to MNDNR-mapped native prairie, native plant communities, and SOBS. Of the 1,134 SOBS within the Project Area, Plum Creek will avoid permanent impacts and minimize temporary impacts. As discussed in Section 8.21.2.2 – Impacts to Native Prairie), the V162 layout may temporarily impact 0.1 acre of NPC; the SG170 layout does not impact NPCs.

Based on the current design, co-located collection lines and crane paths may temporarily impact 2.5 acres and 0.1 acre of SOBS ranked below and moderate, respectively, for the V162 layout. Similarly, the design for the SG170 layout may temporarily impact 1.6 acres of below SOBS, also with co-located collection lines and crane paths. Plum Creek will continue to coordinate with MNDNR on impacts to SOBS, and, as the Project design advances, work with the state agency on

potential minimization measures such as narrower temporary construction corridors, boring collection cables, and implementing a native seed mix.

8.21.3.3 Mitigative Measures

Plum Creek will implement the following measures to avoid and minimize potential impacts on NPC and SOBS in the Project Area during Project development and operation:

- Avoid placement of turbines in NPCs and SOBS.
- Avoid permanent impacts from other Project components (e.g., turbines, access roads, permanent met towers, collector substations, and O&M facility) on NPCs and SOBS.
- Minimize temporary impacts on NPCs and SOBS.
- Avoid or minimize disturbance of individual wetlands or drainage systems during Project construction.
- Complete a Native Prairie Protection Plan in coordination with the MNDNR.
- Minimize clearing of trees and shrubs.

Continue to coordinate with the MNDNR as the Project layout is developed.

9.0 SITE CHARACTERIZATION

9.1 Site Wind Characteristics

Access to quality wind resources has guided site selection. However, other factors including environmental concerns, relative interest from communities and landowners, and access to cost effective transmission play a part in the selection of a site. This process allows Plum Creek to maximize the use of Minnesota's wind resource in a cost-effective manner.

The United States Department of Energy and the DOC have conducted wind resource assessment studies in Minnesota since 1982. In 2014, the National Renewable Energy Laboratory released the 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). Model data includes predicted wind speeds at hub heights of 80 and 100 m above ground level. Near the Project Area, the mean annual wind speed at 80 m (262 feet) above ground level is predicted to be 8.2 to 8.5 m/s.

Plum Creek initiated its wind resource assessment campaign in 2017 and has three temporary meteorological towers monitoring weather data in the Project Area.

9.1.1 Interannual Variation

Interannual variation is the expected variation in wind speeds from one year to the next. There is a very strong correlation between Plum Creek's meteorological tower data and the long-term reference data sets available through the National Oceanic and Atmospheric Administration's (NOAA) NCEP/NCAR reanalysis program and the weather monitoring stations available at airports in the vicinity. Based on analysis of reference datasets in the vicinity of the Project, annual wind-speed variation is expected to be three percent.

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 shows the estimated average seasonal variation based on long-term correlations with meteorological data collected in the Project Area. The months of September through April are expected to generally have the highest wind speeds, while the months of June and July are expected to have the lowest wind speeds.

Table 9.1-1
Average Wind Speed at Hub Height of Proposed Turbines

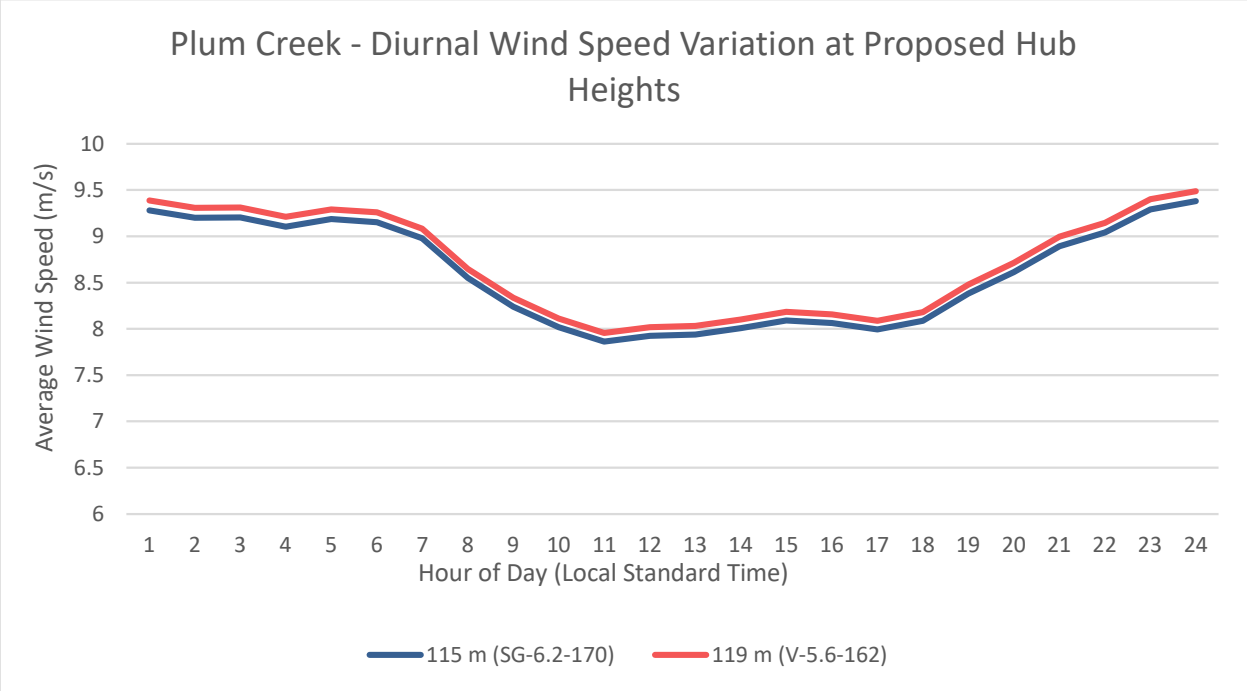
Month	Wind Speed (m/s)	
	115 m	119 m
January	9.1	9.2
February	9.3	9.4
March	8.9	9.0
April	8.6	8.7
May	8.1	8.2
June	7.9	8.0
July	7.1	7.2

Table 9.1-1 Average Wind Speed at Hub Height of Proposed Turbines		
	Wind Speed (m/s)	
Month	115 m	119 m
August	7.1	7.2
September	8.6	8.7
October	9.7	9.8
November	9.2	9.4
December	9.6	9.7
Annual Average	**8.6**	**8.7**

9.1.3 Diurnal Conditions

Diurnal variation occurs through the shift in day and nighttime weather patterns. Chart 9.1-1 shows the expected variation in wind speeds at the Project Area at hub height for both of the proposed turbine models. On average, the wind speeds are higher in the evening and nighttime hours, and lower in the morning and at midday.

Chart 9.1-1: Diurnal Wind Speeds



9.1.4 Atmospheric Stability

The atmospheric stability is defined by lateral fluctuation of the wind, or sigma theta. A stability level of sigma theta of 0 to 2.5 degrees is characterized as stable, 2.5 to 7 as moderately stable, 7 to 9 as neutral, 9 to 15 as moderately unstable, and greater than 15 degrees as very unstable (Slade, 1968). The atmospheric stability based on the Plum Creek meteorological tower sites at the 60-meter level is 6.5 degrees, or moderately stable.

9.1.5 Hub Height Turbulence

The Turbulence Intensity (TI) is defined as 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 is 7.6 percent at 115 meters and 7.3 percent at 119 meters. For 15 m/s wind speeds, the representative TI is 11.1 percent at 115 meters and 10.9 percent at 119 meters. Representative TI accommodates the natural variation in TI associated with the variability of wind speed by being the normal TI plus 1.28 standard deviations of the TI at 15 m/s second.

9.1.6 Extreme Wind Conditions

The maximum hourly wind speed measured at the Plum Creek meteorological tower sites for hub heights 115m and 119 m were 35.1 and 35.2 m/s, respectively. 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 three meteorological towers at the Project Area. To extrapolate from the three-year data record at the Project Area to the longer periods in the table, a Gumbel distribution was fit 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 one percent probability of exceedance translates to a 100-year return period).

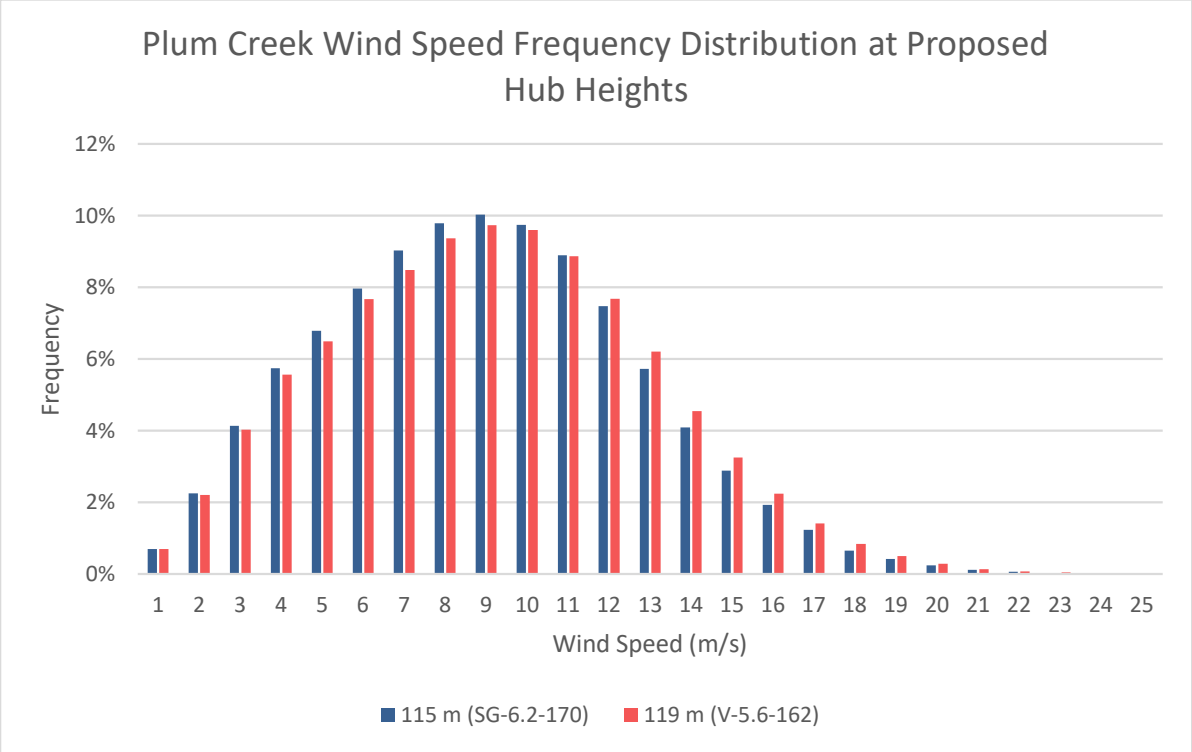
Table 9.1-2
Extreme Wind Events at Proposed Hub Heights (115m and 119m)

Period (yr.)	Extreme Wind Speed (m/s) at 115m		Extreme Wind Speed (m/s) at 119m	
	10 min means	Gust	10 min means	Gust
20	33.031.7	47.645.6	33.332.1	48.046.2
50	35.633.6	51.848.4	34.136.1	52.649.1
100	36.935.0	53.950.4	35.57.0	54.151.1

9.1.7 Wind Speed Frequency Distribution

Chart 9.1-2 shows the wind speed frequency distribution calculated from hourly 50-meter data at the nearest member grid point of the National Aeronautics and Space Administration (NASA) Modern Era Retrospective Analysis for Research and Applications dataset (Rienecker, et al., 2011). A majority of the winds occur between 3 m/s and 13 m/s. The characteristics of this distribution are consistent with wind regimes observed elsewhere in Minnesota.

Chart 9.1-2: 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 32 to 60-meter level at three Plum Creek meteorological tower sites that are representative of the Project, is approximately 0.20.

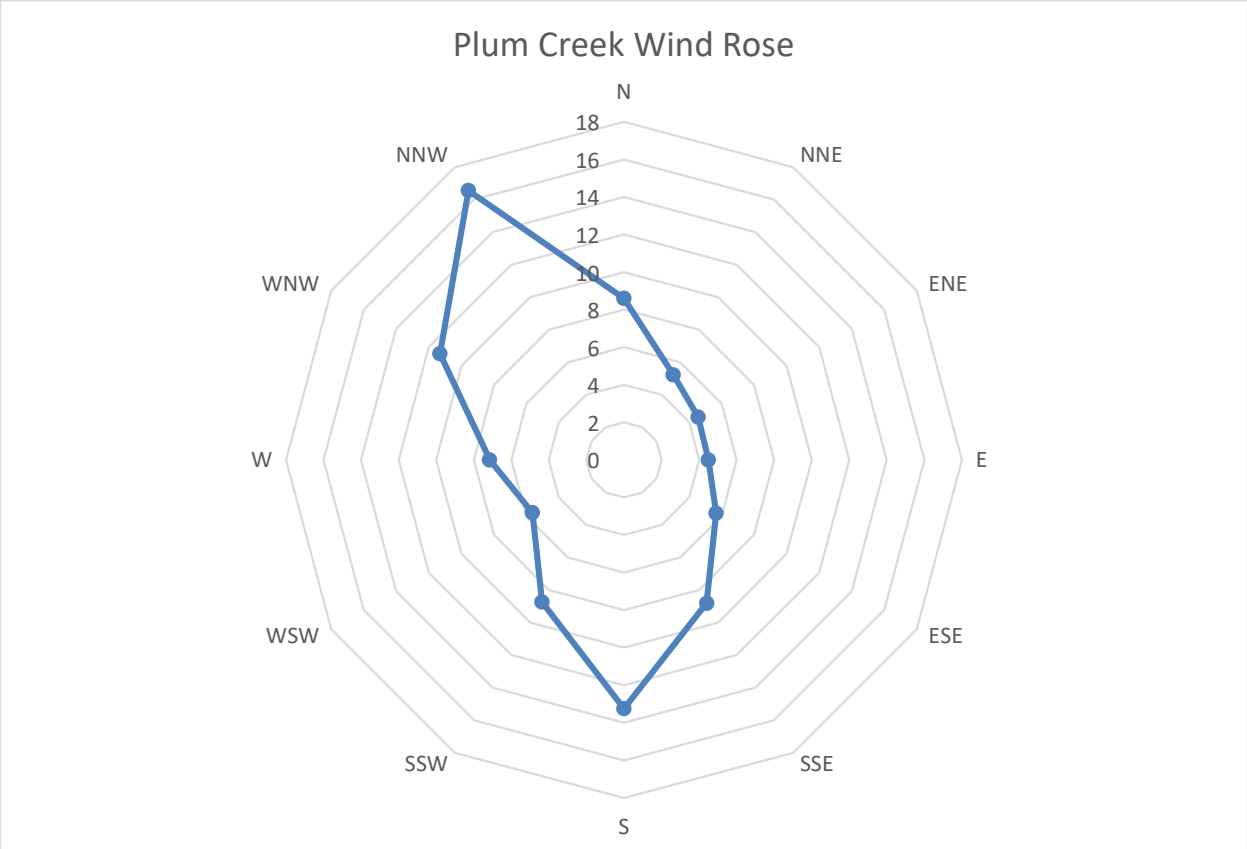
9.1.9 Spatial Wind Variation

As noted above, the DOC's wind resource analysis program estimates that the spatial variation in wind speed across the Project Area is between 8 and 9 m/s. This estimate is confirmed by the onsite data and the analysis performed by Plum Creek.

9.1.10 Wind Rose

A wind rose is a graphical representation of wind speeds based on the direction the wind comes from and the frequency it comes from each direction. Chart 9.1-3 shows a composite wind rose from the three Plum Creek meteorological tower locations.

Chart 9.1-3: Plum Creek Wind Rose



9.1.11 Other Meteorological Conditions

9.1.11.1 Average and Extreme Weather Conditions

Long-term average temperatures and precipitation were evaluated from the National Centers for Environmental Information Climate at a Glance for Cottonwood County. The average minimum temperature in the Project Area ranges from 2.2 degrees Fahrenheit in January to 59.7 degrees in July; the average maximum temperature ranges from 21.2 degrees in January to 83.6 degrees in July. Average precipitation in the Project Area ranges from 0.65 inches in January to 4.21 inches in June.

Extreme weather events for the Project Area include thunderstorms, tornadoes, hail, heavy snow and ice, extreme cold, heat waves, flash floods/floods, heavy rain, lightning, and drought. Tornadoes, thunderstorms, and extreme winds strike occasionally. The state of Minnesota experiences approximately 15 to 20 tornadoes per year (National Oceanic and Atmospheric Administration [NOAA], National Climatic Data Center, 2019).

National Climatic Data Center records in and near the Project Area include 278 thunderstorms, 56 high wind events, and 69 tornadoes from January 1950 to May 2019. 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 89+ m/s (200+ mph).

Turbines proposed 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 45-55 mph).

During the 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. Mechanical safeguards and turbine setbacks mitigate the potential hazards 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 this Project.

9.2 Location of Other Wind Turbines within 10 Miles of Project Boundary

Based on the U.S. Wind Turbine database (USGS, 2019), there are 20 existing wind turbines associated with the Jeffers Wind Energy Center in central Cottonwood County within 10 miles of the Project Area. The Jeffers Wind Energy Center has recently been granted an amended Site Permit to repower the existing 20 turbines. Figure 18 shows the location of existing wind turbines and wind energy projects. As displayed on Figure 18, there are several existing wind turbines 20-30 miles west, southwest, and south of the Project.

10.0 PROJECT CONSTRUCTION

Land will be graded for the turbine pads, access roads, laydown yards, collector substations, and the O&M facility. Storage areas, concrete batch plant(s), shop facilities, and associated access roads will be installed or utilized on site, if necessary, to fully accommodate all aspects of the construction, operation, and maintenance of the Project. These temporary facilities will be permitted locally by the contractor.

Several activities must be completed prior to the proposed commercial operation date. The majority of the activities relate to equipment ordering lead-time, as well as design and construction of the Project. Below is a preliminary schedule of activities necessary to develop the Project. Preconstruction, on-site construction, and post-construction activities for the Project include:

- Order all necessary components including towers, nacelles, blades, foundations, transformers, etc.
- Finalize turbine micrositing
- Complete survey to finalize locations of structures and roadways
- Complete soil borings, testing, and analysis for proper foundation design and materials
- Complete construction of access roads, to be used for construction and maintenance
- Construct aboveground or underground collection and feeder lines and communication cables
- Design and construct the metering station adjacent to the interconnection substation
- Design and construct the step-up substation
- Determine potential upgrades to the interconnection substation as determined by MISO
- Install tower foundations
- Place towers, set wind turbines, and install ADLS technology
- Complete Project acceptance testing
- Commence commercial production

Plum Creek and its engineering contractor will perform or manage all development activities. Specifically, Plum Creek will:

- Perform site resource analysis
- Complete site-specific environmental studies
- Obtain specific permits and licenses for the Project

Under the oversight of Plum Creek's staff, the engineering and construction contractors will:

- Perform civil engineering for access roads and turbine foundations
- Construct foundations, towers, and transformers
- Assemble and install turbines
- Install the communication system, including telephone and fiber-optic cable, and SCADA software and hardware
- Construct the Project collector substations
- Construct the electrical feeder and collection system
- Construct radial interconnection

10.1 Roads and Infrastructure

During the construction phase, several types of light, medium, and heavy-duty construction vehicles will travel to and from the Project Area, as well as private vehicles used by construction personnel. The Applicant estimates that there will be 475 large truck trips per day and up to 950 small-vehicle (pickups and automobiles) trips per day in the area during peak construction periods. That volume will occur when the majority of the foundation and tower assembly is taking place. Prior to construction, the Applicant will coordinate with local jurisdictions (counties and townships) to obtain the necessary road access and overwidth/overweight permits. At the completion of each construction phase, this equipment will be removed from the Project Area or reduced in number.

Improvements to existing access roads may include re-grading and filling of the gravel surface to allow access in inclement weather and widening of select intersections to accommodate truck traffic. No asphalt or other paving is anticipated. Plum Creek will coordinate with the county and the townships road authorities to execute a development agreement prior to construction.

10.2 Access Roads

Constructing the Project will require approximately up to 22 miles of gravel access roads, depending on the size of turbine selected and final design. They will be located to facilitate both construction access (cranes) and access by operation and maintenance crews while inspecting and servicing the wind turbines. The access roads will be between towers, with one road required for each string of wind turbines. The roads will be approximately 6 m (20 feet) wide and of low profile to allow cross-travel by farm equipment.

Plum Creek will work closely with landowners to locate access roads to minimize land-use disruptions. Siting of access road connections to public road right-of-way will be completed in accordance with state and local requirements. Siting roads in areas with unstable soil will be avoided whenever possible. All roads will include appropriate drainage and culverts and will allow for farm equipment crossing.

The roads will be approximately 6 m (20 feet) wide and will be improved with class-5 (gravel) cover, which is adequate to support the size and weight of maintenance vehicles. The specific turbine locations will determine the amount of roadway that will be constructed for this Project.

In addition, an up to 15.2-meter (50-foot) diameter gravel work area will surround each turbine base.

The roads will consist of graded dirt overlaid with geotechnical fabric or other suitable sub-base (if needed) covered with gravel. To facilitate crane movement and equipment delivery, an additional 1.0 to 3.7 meter (3.5 to 12 feet) of gravel roadway may be temporarily installed on either side of the permanent roadway (12.1 meter [40 foot] total width).

Long term, access roads will be maintained at a 6-meter (20 foot) width. Once construction is completed, the access roads will be regraded, filled, and dressed as needed.

Plum Creek will repair or replace any existing fences or gates that are impacted during construction, and will coordinate with participating landowners to provide suitable fencing or gates if access roads cross into existing pastures.

10.3 Associated Facilities

10.3.1 Operation and Maintenance (O&M) Facility

An O&M facility will be constructed in or near the Project Area and will provide access and storage for Project maintenance and operations. Such buildings are typically 3,000 to 5,000 square feet and house the equipment to operate and maintain the Project. The parking lot adjacent to the building is expected to be approximately 3,000 square feet. Plum Creek anticipates that a new well will provide water service for the O&M facility, and that an on-site septic system will provide for sanitary needs.

10.3.1 Collector Substations

The two collector substations will consist of switch gear, metering, transformers, electrical control and communications systems, and other high-voltage equipment needed to convert the electricity generated by the Project from 34.5 kV to 345 kV. Final specification of the substations will be determined by the agreements the Project has with MISO, as well as the transmission owner and power purchaser. The collector substations will be approximately 10 acres each including the graded area, which may be larger than the area actually fenced.

10.3.2 Laydown and Staging Areas

The laydown and staging areas will be temporary, disturbed and used during construction of the Project. They will be the primary location for construction and delivery activities for the Project as well as provide office space for the construction management team. Plum Creek proposes three temporary laydown areas totaling 18.4 acres that are distributed throughout the Project Area to serve both as a parking area for construction personnel and staging area for turbine components during construction (*see* Figures 3a and 3b). Each area will be comprised of gravel pads and will have geotextile fabric placed in between the gravel and the soil on the site to increase the ease of site restoration.

10.3.3 Meteorological Towers

Plum Creek also proposes to install up to four permanent meteorological towers to maintain the performance of the Project, conform to grid integration requirements, and validate wind turbine power curves. Additionally, Plum Creek plans to install up to two ADLS radar units, pending FAA review and approval.

10.4 Turbine Site Location

Construction of the turbines will include temporary impacts of approximately an additional 12 to 15 feet (3.6 to 4.6 m) of gravel roadway on either side of the permanent roadway (48 feet [14.6 m] total width), a 80-foot-by-120-foot (24.4-m-by-36.6-m) gravel crane pad extending from the roadway to the turbine foundation which will be graded to a minimum of one percent, and a component laydown and rotor assembly area centered close to the turbine foundation which will be graded to a minimum of five percent. The component laydown area will range from approximately 260 feet by 260 feet to 335 feet by 335 feet (79 m by 79 m to 102.1 m by 102.1 m), depending on the turbine size selected. In addition to the disturbances associated with temporary travel roads for cranes, it is possible that temporary impacts could occur when cranes move cross-country between strings of turbines.

Each turbine will be equipped with a lightning protection system. The turbine will be grounded and shielded to protect against lightning. The grounding system will be installed during foundation work and must be accommodated to local soil conditions. The resistance to neutral earth must be in accordance with local utility or code requirements. Lightning conductors are placed in each rotor blade and in the tower. The electrical components are also protected.

10.4.1 Foundation Design

The wind turbines' freestanding tubular towers will be connected by anchor bolts to a concrete foundation. Turbine foundations will use a pad-and-pier tower mounting system consisting of top and bottom templates. These templates consist of anchor bolts and reinforcing steel bar (rebar); they are placed within the excavated portion of the turbine footing and filled with concrete. The anchor bolts protrude from the concrete pad surface and the turbine base is fastened to these bolts. The excavated portion of the concrete turbine pad ranges from approximately 291 to 737 cubic yards depending on soil requirements and turbine size. The turbine pad dimensions are approximately 20 feet in above-ground diameter and typically range in depth from four to six feet; An approximate height of two to three feet of the turbine pad remains above grade. Geotechnical surveys, turbine tower load specifications, and cost considerations will dictate final design parameters of the foundations.

In addition, turbine assembly will require a 80 by 120 foot gravel crane pad extending from the access road to the turbine foundation, which will be graded to a maximum of one percent, and an approximate 260 by 260 feet to 335 by 335 feet area for component laydown and rotor assembly centered close to the turbine foundation, which will be graded to a maximum of five percent.

10.4.2 Tower

The towers are conical tubular steel with a hub height of 89 m to one 125 m (292 to 410 feet). The turbine towers, where the nacelle is mounted, consist of four to six sections manufactured from certified steel plates. Welds are made in automatically controlled power welding machines and are ultrasonically inspected during manufacturing per ANSI specifications. All surfaces are sand-blasted and 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 connecting four internal platforms and equipped with a fall arresting safety system.

10.5 Post Construction Clean-up and Site Restoration

After construction, temporary construction areas, such as crane pads adjacent to the turbine pad and access road additional width areas, will be restored. The temporary disturbance areas will be graded to natural contours and soil will be loosened and seeded in non-cropland areas. Once construction is completed, the permanent access roads will be regraded, filled, and dressed as needed. Although few, if any, temporary roads will be constructed with the Project, all temporary roads, staging areas, batch plant and the laydown area will be decommissioned and restored upon completion of construction of the Project. Erosion control methods will depend on the contours of the land, as well as requirements of the general contractor and relevant permits. Plum Creek anticipates that the post-construction clean-up and site restoration process will last approximately 30 days.

10.6 Operation of Project

Each wind turbine in the Project will communicate directly with the SCADA system for performance monitoring, energy reporting, and troubleshooting. The SCADA system will also provide the overall control of the Project.

The Applicant will augment its O&M staff as needed with appropriate contractors to service and maintain the Project.

10.6.1 Project Control, Management, and Service

In addition to providing Project control, the SCADA system offers access to wind turbine generation or production data, availability, and meteorological and communications data, as well as alarm and communication error information. Performance data and parameters for each machine (generator speed, wind speed, power output, etc.) can be viewed, and machine status can be changed. There is also a snapshot facility that collects frames of operating data to aid in diagnostics and problem troubleshooting.

The primary functions of the SCADA are to:

- Control and monitor the Project
- Alert operations personnel to Project conditions requiring resolution
- Provide a user/operator interface for controlling and monitoring wind turbines
- Collect performance data from turbines

- Monitor field communications
- Provide information on wind turbine performance for operators and maintenance personnel
- Collect data on wind turbine and Project maintenance
- Serve as an information archive
- Provide spare parts inventory control
- Generate O&M reports

General Maintenance Duties

The O&M field duties include performing all scheduled and unscheduled maintenance including periodic operational checks and tests, regular preventive maintenance on all turbines, related plant facilities and equipment, safety systems, controls, instruments, and machinery, including:

- Maintenance on the wind turbines and on the mechanical, electrical power, and communications system
- Performance of all routine inspections
- Maintenance of all oil levels and changing oil filters
- Maintenance of the control systems, all structures associated with the Project, access roads, drainage systems, and other facilities necessary for the operation of the Project
- Maintaining all O&M field maintenance manuals, service bulletins, revisions, and documentation for the Project
- Maintaining all parts, price lists, and computer software
- Maintenance and operation of interconnection facilities
- Providing all labor, services, consumables, and parts required to perform scheduled and unscheduled maintenance on the Project, including repair and replacement of parts and removal of failed parts
- Assisting as needed with avian, bat, and other environmental studies and compliance activities
- Management of lubricants, solvents, and other hazardous materials as required by local and/or state regulations
- Maintenance of all appropriate levels of spare parts in order to service equipment
- Obtaining all necessary equipment including the rental of industrial cranes for removal and reinstallation of turbine components
- Hiring, training, and supervising a work force necessary to meet Project general maintenance requirements
- Maintaining site security

Maintenance Schedule

Equipment will be monitored by local O&M staff and remotely by the Applicant's operations and power scheduling desk, which is staffed 24 hours a day. When needed during off hours, local personnel will be dispatched to the site by the remote monitoring staff. Performance testing is done during the early months of operation to see that the Project is operating within expected parameters.

Project inspection and maintenance is performed on the following intervals:

A. **First Service Inspection.** The first service inspection will take place one to three months after the turbines have been commissioned. At this inspection, particular attention is paid to tower bolt tensioning and equipment lubrication.

B. **Semi-Annual Service Inspection.** Regular service inspections commence six months after the first inspection. The semi-annual inspection consists of lubrication and a test of the turbine trip system.

C. **Annual Service Inspection.** The yearly service inspection consists of a semi-annual inspection plus a full component check. Bolts are checked with a torque wrench. The check covers 10 percent of the bolts. If any bolts are found to be loose, all bolts in that assembly are tightened and the event is logged.

D. **Two-Year Service Inspection.** The two-year service inspection consists of the annual inspection, plus checking and tightening of electrical terminal connectors.

E. **Five-Year Service Inspection.** The five-year inspection consists of the annual inspection, an extensive inspection of the wind braking system, checking and testing of oil and grease, balance check, and tightness of terminal connectors.

10.7 Costs

10.7.1 Capital and Operational Costs

The total Project-installed capital costs are estimated to be approximately $643 to $748 million and $693 to $803 million for the V162 and SG170 turbine models, respectively. These costs include wind turbines, associated electrical and communication systems, and access roads. Ongoing O&M costs and administrative costs are estimated to be approximately $20-25 million per year, including payments to landowners for wind lease and easement rights.

10.7.2 Site and Design Dependent Costs

The overall cost of developing the Project will depend primarily on site selection and construction timing. Site-dependent costs will include: the relative ease of access to the individual wind turbine locations, site-specific subsurface conditions that determine foundation design, access road design and layout, ease of underground work, and the layout of the turbine arrays which affects road and electrical cable cost. Both underground and aboveground cable may be employed to connect turbines, transformers, and the interconnect point. The underground placement of the cables is preferable.

10.8 Schedule

10.8.1 Land Acquisition

Plum Creek will be responsible for all land acquisition and will obtain the necessary easements, leases or purchase agreements from landowners. Plum Creek may either lease, secure easements or purchase the necessary parcels for the substation, O&M facilities, and temporary laydown and staging areas. Plum Creek has easements and wind rights to construct the Project as currently designed, however, land acquisition will continue until construction.

10.8.2 Equipment Procurement, Manufacture and Delivery

Plum Creek is in the process of procuring turbines for the Project. Turbines will be allocated to the Project after meteorological and economic studies are completed to achieve the best match of turbines for the Project. Turbines could arrive on site as early as fourth quarter 2021.

10.8.3 Construction

Plum Creek personnel will oversee the primary contractors performing onsite Project construction, including, but not limited to, roads, wind turbine assembly, electrical, and communications work. The construction will take approximately 12 months to complete; however, depending upon seasonal or weather-related constraints (i.e., minimal work would occur during winter months) it may take less time.

10.8.4 Construction Financing

The Applicant will be responsible for financing all predevelopment, development, and construction activities. The Applicant anticipates financing the cost of all predevelopment activities through internal funds. Construction will be financed with internal funds or a combination of internal funds and third-party sources of debt and equity capital.

10.8.5 Permanent Financing

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

10.8.6 Expected Commercial Operation Date

The Applicant anticipates that the Project would begin commercial operation by fourth quarter 2022. The commercial operation date is dependent on the completion of the interconnection process, 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 Plum Creek. 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), with up to 20 percent of the turbines spaced closer to each other. The internal turbine spacing is dependent upon the selected equipment and the site topography. Plum Creek developed the Project to maximize the wind resource and minimize array wake losses.

10.9.2 Base Energy Projections

The Project will have a nameplate generation capacity of up to 414 MW and a net capacity factor of between 42 to 46 percent. Plum Creek estimates an average annual output of between approximately 1,520,000 and 1,670,000 MW hours. Annual energy production output will depend on final design, site specific features, and the equipment selected for the Project. Gross to net calculations take into account, among other factors, energy losses in the gathering system, mechanical availability, array losses, and system losses. An industry-wide estimate of energy losses ranges from 8 to 10 percent of maximum output.

11.0 DECOMMISSIONING AND RESTORATION

The Project decommissioning and restoration plan must be developed in accordance with the requirements of Minn. R. 7854.0500, subp. 13. Plum Creek's decommissioning plan is provided in Appendix H and will be updated, as needed, prior to the Project's pre-operation meeting. At the end of commercial operation, Plum Creek or the Project owners will be responsible for removing wind facilities and removing the turbine foundations to a depth of four feet below grade. Plum Creek reserves the right to extend operations instead of decommissioning at the end of the site permit term. As necessary, Plum Creek may apply for an extension of the LWECS Site Permit to continue operation of the Project. In this case, a decision may be made on whether to continue operation with existing equipment or to retrofit the turbines and power system with upgrades based on newer technologies.

11.1 Anticipated Life of the Project

The anticipated Project life is approximately 30 years beyond the date of first commercial operation.

11.2 How the Project Will be Disconnected from the Grid

The overhead electrical lines associated with the Project connect the voltage step-up substation(s), located within Project footprint, to the interconnection switching station north of the Project. All poles, conductors, switches, and lines associated with this interconnection link will be removed and hauled off-site to a recycling facility or disposal site. Underground infrastructure such as pole foundations will be removed down to four feet below grade. Pole foundation holes will be filled with a suitable clean compactable material. Topsoil will be applied and the areas and re-vegetated to pre-construction conditions. The interconnection substation will continue to be owned by the transmission line owner.

11.3 Description of Component Removal

A detailed description of decommissioning and removal activities is included in Appendix H.

11.4 Decommissioning, Abandonment, and Removal Conditions

Under the terms of Plum Creek's standard wind lease, Plum Creek must remove all Project facilities, to a depth of four feet below grade, within twelve months from the date the lease expires or terminates. If Plum Creek were to fail to remove the facilities within that timeframe, the lease allows the lessor to remove and dispose of the facilities. Plum Creek is responsible for reimbursing the lessor for the costs of removal, less any salvage value received. Plum Creek must also maintain any security for removal of the Project that is required by any applicable permits or governmental rules or regulations, if any.

11.5 Site Restoration Objectives

Plum Creek will restore and reclaim the site to its pre-Project topography and topsoil quality using BMPs consistent with those outlined by 2012 USFWS Land-Based Wind Energy Guidelines. Plum Creek will also have a Native Prairie Protection Plan that will provide further BMPs to be used in areas where native prairie, as defined by Minn. Stat. § 84.02, subd. 5, based on specific site data collected in the Project Area. In non-cropland areas, the goal of decommissioning will be to restore natural hydrology and plant communities to the greatest extent practical while minimizing new disturbance and removal of native vegetation. The decommissioning BMPs that will be employed on the Project to the extent practicable with the intent of meeting this goal include:

1. Minimize new disturbance and removal of native vegetation to the greatest extent practicable.
2. Remove foundations to four feet below surrounding grade, and cover with soil to allow adequate root penetration for native plants, and so that subsurface structures do not substantially disrupt ground-water movements.
3. Segregate topsoil that is removed during decommissioning and use as topsoil during restoration. Once decommissioning activity is complete, restore topsoils to assist in establishing and maintaining pre-construction native plant communities to the extent possible, consistent with landowner objectives.
4. Stabilize soils by re-vegetating with a cover crop in cropland areas or a local seed mix in non-cropland areas.
5. Restore surface water flows to pre-disturbance conditions, including removal of stream crossings, roads, and pads, consistent with storm water management objectives and requirements.
6. Conduct survey, using qualified experts, to detect populations of invasive species, and implement and maintain comprehensive approaches to preventing and controlling invasive species as necessary.
7. Remove any unnecessary overhead electrical lines and associated poles.
8. After decommissioning, install erosion control measures in all disturbance areas where potential for erosion exists, consistent with storm water management objectives and requirements.
9. Remove fencing unless the landowner will be utilizing the fence.
10. Remediate any petroleum product leaks and chemical releases prior to completion of decommissioning.

Decommissioning and restoration activities will be completed within 12 months after the date the Project ceases to operate.

11.6 Cost to Decommission

The total estimated decommissioning costs, including salvage value, is approximately $4,423,180 for the 67 SG170 turbines ($66,018 per turbine after salvage value, including associated facilities. For the 74 V162 turbines, the total estimated decommissioning costs, including salvage value, is $4,581,950 ($61,918 per turbine after salvage value, including associated facilities). Plum Creek will be responsible for all costs to decommission the Project and associated facilities. The cost to decommission will depend upon the prevailing rates for salvage value of the equipment and labor costs.

Because of the uncertainties surrounding future decommissioning costs and salvage values, Plum Creek will review and update the cost estimate of decommissioning and restoration for the Project every five years after Project commissioning. This revised cost estimate of decommissioning and salvage value will be submitted to the Commission for review and comment.

11.7 Method and Schedule for Revising Cost Estimates

This cost estimate was prepared: (1) in current dollars; (2) with the salvage value of equipment or materials calculated separately. The estimate includes: (i) an analysis of the physical activities necessary to implement the approved reclamation plan, with physical construction and demolition costs based on applicable Minnesota Department of Transportation unit bid prices and RS Means material and labor cost indices; (ii) the level of effort or number of crews required to perform each of the activities; and (iii) an amount to cover contingencies above the calculated cost. Appendix H contains an estimate shown on a total-cost and on a per-turbine basis. The Project decommissioning cost will be reassessed every five years and updated if necessary. In year 10 following the Project's commercial operation date, Plum Creek will establish a financial surety in the form of escrow, bond, letter of credit, etc. to ensure that decommissioning funds are available at the time of decommissioning.

11.8 Decommissioning Assurance

The Project decommissioning cost will be reassessed every five years and updated if necessary. In year 10 following the Project's commercial operation date, Plum Creek will establish a financial surety in the form of escrow, bond, letter of credit, etc. to ensure that decommissioning funds are available at the time of decommissioning.

12.0 IDENTIFICATION OF OTHER POTENTIAL PERMITS

Plum Creek will be responsible for undertaking all required environmental review and will obtain all permits and licenses that are required following issuance of the LWECS Site Permit. The potential permits or approvals that have been identified as being required for the construction and operation of the Project are shown in Table 12-1. Copies of agency correspondence to date are provided in Appendix A.

Table 12-1
Potential Permits and Approvals

Administering Agency	Permit, Approval, or Consultation	Status and Applicability to the Project
Federal		
U.S. Army Corps of Engineers	Wetland Delineation Approvals	Wetland delineations will be completed prior to construction; Plum Creek anticipates impacts will be within the Nationwide Permit 51 threshold.
	Jurisdictional Determination	
	Federal Clean Water Act Section 404	
U.S. Fish and Wildlife Service	Review for Threatened and Endangered Species	Based on coordination with USFWS, a Take Permit is not anticipated for the Project.
Environmental Protection Agency (Region 5) in coordination with the Minnesota Pollution Control Agency (MPCA)	Spill Prevention Control and Countermeasure Plan	Plum Creek will develop a Spill Prevention Control and Countermeasure Plan for use during construction and operation of the Project to minimize risk of site contamination.
Federal Aviation Administration	Form 7460-1 Notice of Proposed Construction or Alteration (Determination of No Hazard)	Plum Creek will re-submit Form 7460-1 for the turbine locations in Q3 2020 to initiate FAA review of the layout and ADLS.
	Notice of Actual Construction or Alteration (Form 7460-2)	After construction is complete, Plum Creek will submit Form 7460-2 for the turbine locations.
State of Minnesota Approvals		
Board of Water and Soil Resources (BWSR)	Wetland Conservation Act approvals	Plum Creek has coordinated with the USACE and conducted a desktop review of wetlands and potential impacts with the MNDNR update to NWI data. Based on this desktop data, the Project will fall under the Nationwide Permit 51 threshold for impacts. Prior to construction, Plum Creek will conduct wetland delineations to confirm wetland boundaries and impacts based on final design.
Minnesota Public Utilities Commission	Certificate of Need	Submitted concurrent with this Site Permit Application.

Table 12-1
Potential Permits and Approvals

Administering Agency	Permit, Approval, or Consultation	Status and Applicability to the Project
	Site Permit for Large Wind Energy Conversion System	Submitted November 12, 2019.
	Route Permit for electric transmission line	Submitted concurrent with this Site Permit Application.
Minnesota State Historic Preservation Office (SHPO)	Minnesota Statute 138; Cultural and Historic Resources Review and Review of State and National Register of Historic Sites and Archeological Survey	Plum Creek has coordinated with SHPO, conducted a literature review of the Project Area, and Project Facilities avoided previously identified archaeological sites. Plum Creek will conduct surveys for previously unidentified cultural resources in high-potential areas in spring/summer 2020. Plum Creek will coordinate with SHPO on the protocol and any potential mitigation.
MPCA	Section 401 Water Quality Certification	Concurrent with Section 404, Clean Water Act – Plum Creek will meet the Minnesota conditions
	National Pollutant Discharge Elimination System Permit – MPCA General Stormwater Permit for Construction Activity	After the Site Permit is Ordered by the Commission, Plum Creek will submit NPDES Permit. The permit is required to be submitted within 30 days of the start of construction. The NPDES permit will cover the transmission line and wind farm.
	Very Small Quantity Generator License – Hazardous Waste Collection Program	To be obtained prior to construction.
	Aboveground Storage Tank Notification Form	To be obtained prior to construction.
Minnesota Department of Natural Resources	License to Cross Public Waters	Plum Creek will submit its License to Cross Public Waters based on a final Project design.
	Native Prairie Protection Plan	After the Site Permit is Ordered by the Commission, Plum Creek will submit its Native Prairie Protection Plan.

Table 12-1
Potential Permits and Approvals

Administering Agency	Permit, Approval, or Consultation	Status and Applicability to the Project
	General Permit for Water Appropriations (Dewatering)	To be obtained prior to construction.
	Public Waters Work Permit	To be obtained prior to construction.
Minnesota Department of Transportation (MNDOT)	Utility Permits on Trunk Highway Right-of-way (Long Form No. 2525)	To be obtained prior to construction.
	Oversize/Overweight Permit for State Highways	To be obtained prior to construction.
	Access Driveway Permits for MNDOT Roads	To be obtained prior to construction.
	Tall Structure Permit	To be obtained prior to construction.
Local Approvals		
Cottonwood, Murray, and Redwood Counties	Right-of-way permits, crossing permits, driveway permits for access roads, oversize/overweight permits for County Roads	Plum Creek will enter into a Development, Road Use, and Drainage Agreement prior to construction.
Townships	Right-of-way permits, crossing permits, driveway permits for access roads, oversize/overweight permits for township roads	Plum Creek will enter into a Development, Road Use, and Drainage Agreement prior to construction.

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