Environmental Report

Paynesville Wind Farm

In the Matter of the Application of Paynesville Wind, LLC for a
Certificate of Need for the 95 MW Paynesville Wind Farm,
in Stearns County in Central Minnesota

PUC Docket No. IP-6830/CN-09-1110

Energy Facilities Permitting
85 7th Place East, Suite 500
Saint Paul, MN 55101

August 2010

Responsible Governmental Unit	Project Proposer
Minnesota Office of Energy Security	**Paynesville Wind, LLC**
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Abstract

On December 8, 2009, Paynesville Wind, LLC (Applicant), filed a certificate of need application with the Minnesota Public Utilities Commission (Commission) for the Paynesville Wind Farm (Project). The Applicant is proposing to construct a 95 megawatt (MW) large wind energy conversion system in Stearns County, Minnesota.

The proposed Project is a large energy facility as defined by Minnesota Statute section 216B.2421. Such a facility requires a certificate of need from the Commission (Minn. Stat. § 216B.243). Additionally, the Minnesota Department of Commerce must prepare an environmental report (ER) for the Project (Minn. Rule 7849.1200).

Office of Energy Security, Energy Facility Permitting (OES EFP) staff is responsible for preparing the ER. This ER has been prepared as per Minnesota Rules 7849.1100-2100. The ER is part of the record which the Commission will consider in making a decision on a certificate of need for the Project.

Information about this Project can be found on the Commission's energy facilities permitting website: http://energyfacilities.puc.state.mn.us/Docket.html?Id=25836, or obtained by contacting Ingrid Bjorklund, Office of Energy Security, 85 7th Place East, Suite 500, St. Paul, Minnesota 55101, phone: (651) 297-7039, email: ingrid.bjorklund@state.mn.us.

Information about the Commission's certificate of need process can be obtained by contacting Bret Eknes, Minnesota Public Utilities Commission, 121 7th Place E., Suite 350, Saint Paul, MN 55101, phone: (651) 201-2236, email: bret.eknes@state.mn.us.

The record for the certificate of need for this Project can be found on the eDockets system at: https://www.eDockets.state.mn.us/EFiling/search.jsp; search on the year "**09**" and number "**1110**".

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1.0 Introduction

On October 27, 2009, Paynesville Wind, LLC (Applicant), filed a certificate of need application with the Minnesota Public Utilities Commission (Commission) for the Paynesville Wind Farm (Project). The Applicant is proposing to construct a 95 megawatt (MW) large wind energy conversion system in Stearns County, Minnesota.

A final decision on turbine selection and design has not be made, but the Project will consist of turbines with a rated output between 1.5 and 2.3 MW in such number and combination as to yield 95 MW. Facilities associated with the Project include gravel access roads, an operations and maintenance building, an electrical collection system, project substation, transmission line, a permanent meteorological tower, and Sonic Detection and Ranging (SODAR) unit or Light Detection and Ranging (LIDAR) unit.

The Project would be located north of Paynesville and south and east of Lake Henry in Stearns County, within a Project area of approximately 15,000 acres. The Project would be located in Zion, Paynesville, Spring Hill, and Lake Henry townships in Stearns County. Electricity from a group of wind turbines totaling 50 MW would be transported via the collection system, operating at 34.5 kV, to a new substation, which will step up the voltage to 69 kV and be transported on a new 69 kV line of less than one mile in length to the existing Paynesville substation. The electricity from the remaining turbines will be transported via the collection system and delivered to a new metering yard adjacent to the Paynesville substation where it will connect to transmission grid via the Paynesville substation.

In addition to a certificate of need (CN), the Project requires a site permit for the wind farm from the Commission. The site permit is being considered by the Commission in separate docket (WS-10-49).

The proposed Project is a large energy facility as defined by Minnesota Statutes section 216B.2421. As a result, the Minnesota Department of Commerce must prepare an environmental report (ER) for the Project (Minn. Rule 7849.1200). Office of Energy Security, Energy Facility Permitting (OES EFP) staff has prepared this ER to fulfill this requirement. The ER is part of the record which the Commission will consider in making a decision on a CN for the Project.

The proposed Project is intended to produce renewable energy in furtherance of Minnesota's renewable energy standard (Minn. Stat. § 216B.1691). Accordingly, alternatives examined in the Environmental Report will be limited to renewable energy technologies as defined in Minnesota Statutes section 216B.1691. These alternatives include: (1) a generic 95 MW wind generation project sited elsewhere in Minnesota, (2) a 35.6 MW biomass plant, and (3) a "no-build" option. Section 2 of this ER outlines the regulatory framework governing the Project. Section 3 describes the proposed Project. Section 4 describes alternatives to the Project and feasibility and availability for each alternative. Section 5 describes the potential impacts of the no build alternative. Section 6 discusses the potential human and environmental impacts of the Project and alternatives, including possible mitigations. Section 7 describes the additional permits that may be required for this Project.

Sources of Information

Information for this report is drawn from multiple sources, which are noted throughout. Primary sources include applications submitted by Paynesville Wind, LLC to the Commission:

- Application for Certificate of Need, Paynesville Wind, LLC, December 8, 2009.[1]
- Paynesville Wind, LLC, Application for Large Wind Energy Conversion Site Permit, January 29, 2010.[2]

Additional information has been incorporated from related Environmental Quality Board and Department of Commerce reports.

[1] Application for Certificate of Need, Paynesville Wind, LLC, December 8, 2009 [hereafter CN Application], https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=viewDocument&documentId={3A3822D2-F0EF-47C5-AEEF-C92C0CFCF548}&documentTitle=200912-44838-01&userType=public

[2] Paynesville Wind, LLC, Application for Large Wind Energy Conversion Site Permit, January 29, 2010, [hereafter Site Permit Application], http://energyfacilities.puc.state.mn.us/resource.html?Id=25843.

2.0 Regulatory Framework

Paynesville Wind, LLC (Applicant), is proposing to construct the Paynesville Wind Farm (Project) in Stearns County in Minnesota. The Project is a large wind energy conversion system as defined in the Wind Siting Act (Minnesota Statutes chapter 216F). The Project is designed to produce 95 megawatts (MW) of power and thus is a large energy facility per Minnesota Statutes section 216B.2421.

In accordance with Minnesota Statutes section 216B.243, no large energy facility may be sited or constructed in Minnesota without issuance of a certificate of need (CN) by the Minnesota Public Utilities Commission (Commission). Accordingly, on December 8, 2009, the Applicant submitted a CN application to the Commission. On February 5, 2010, the Commission issued an order accepting the application as complete and authorizing an informal review process.[3]

The informal review process includes several steps designed to develop a record upon which a CN decision can be made, including: (1) a notice and comment period, (2) analysis by Department of Commerce, Office of Energy Security, Energy Regulation and Planning (OES ERP) staff, (3) analysis by Office of Energy Security, Energy Facility Permitting (OES EFP) staff, and (4) a public hearing conducted by an administrative law judge (ALJ). Based on the ALJ's hearing report and entire record, Commission staff will make a recommendation to the Commission on issuance of the certificate of need. The Commission is the final decision-making body.

2.1 Environmental Report

Pursuant to Minnesota Rule 7849.1200, the analysis provided by OES EFP staff takes the form of an environmental report (ER). The ER provides an analysis of potential human and environmental impacts of the Project, as well as alternatives to the Project. To develop the ER, OES EFP staff is required to hold one public meeting in the proposed Project area. The purpose of the meeting is to advise the public of the Project and to solicit public input into the scope of the ER. A "scope" is a determination of what needs to be assessed in the ER in order to inform decision-makers and the public about the possible impacts of the Project and potential alternatives.

OES EFP staff held an afternoon and evening public meeting on April 19, 2010, in Lake Henry, Minnesota. Approximately 115 people attended each meeting. A public comment period followed the meetings, which closed on May 10, 2010. Thirty-two written comments were received from 26 individuals during the comment period. Five comments were received after the comment period closed, but were included in the comment period. Concerns that were raised at the public meeting and in written comments included potential impacts to property values, aesthetics, livestock, pets, wildlife, wildlife habitat, population density, TV and cell phone reception, GPS interference, emergency medical services, and aerial crop applications. Impacts

[3] Order Finding Application Complete and Authorizing Informal Review Process, February 5, 2010, *available at* https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={EFAAD94B-D500-4FCB-8866-601BACDD4754}&documentTitle=20102-46830-01.

from noise, shadow flicker, stray voltage, and electric and magnetic fields are a concern to area residents. A number of commenters expressed concerns regarding the terms of the wind easements and leases between landowners and the Applicant.

Based on the scoping comments received and the rules governing the scope of an ER (Minn. Rule 7849.1500), the Director of OES issued a scoping decision on May 26, 2010 (Appendix A). This environmental report has been developed in accordance with the scoping decision.

As noted above (and in the scoping decision), a public hearing conducted by an ALJ will be held in the Project area to further develop the record for a Commission decision. This ER will be introduced into the hearing record by OES EFP staff.

2.2 Permits

Site Permit

In addition to a certificate of need, the proposed Project requires a site permit for the wind farm (Minn. Stat. § 216F.04). This permit is issued by the Commission and is being considered by the Commission in a separate docket.[4] A site permit (authorizing the siting and constructing of the Project) may not be issued before a certificate of need has been issued for the Project (Minn. Stat. § 216B.243).

Additional Permits

In addition to approvals issued by the Commission, the Project will require permits and approvals from federal agencies, additional state agencies, and local governments. These permits are discussed in Section 7.

[4] The Commission docket number for the site permit is: WS-10-49; see http://energyfacilities.puc.state.mn.us/Docket.html?Id=25836 .

3.0 Description of the Proposed Project

Paynesville Wind, LLC (Applicant), is proposing to construct the Paynesville Wind Farm (Project), a 95 MW wind farm in Stearns County in Minnesota. Paynesville Wind, LLC is a wholly owned subsidiary of Geronimo Wind Energy. Geronimo Wind Energy stated it may sell or assign the Project to another entity before, during, or after construction of the Project.[5] The Project is intended to produce renewable energy in furtherance of Minnesota's renewable energy standard (Minn. Stat. § 216B.1691).

3.1 Project Location

The Project would be located north of Paynesville and south and east of Lake Henry in Stearns County, within a Project area of approximately 15,000 acres. The Project would be located in Zion, Paynesville, Spring Hill, and Lake Henry townships in Stearns County. Cultivated land comprises approximately 12,401 acres (81.1 percent) of the Project area.[6] The Project area is predominantly in agricultural use including corn, soybeans, small grains, forage crops, and livestock (Figure 2).[7]

The Project area topography is level to gently sloping; elevations range from 1,161 to 1,332 feet above sea level.[8] Surface water drainage is affected by agricultural ditches and drain tile (Figure 3).

The Project area has low to average population density with an estimated population density of 9 persons per square mile in Lake Henry Township and 46 persons per square mile in Paynesville Township.[9] The city of Paynesville (population of 2,267[10]) is located 1.5 miles south of the Project area.[11]

3.2 Project Description

The Paynesville Wind Farm will have a nameplate capacity of 95 MW. A final decision on turbine selection and design has not been made, but the Project will consist of between 42 and 63 turbines with a rated output between 1.5 and 2.3 MW in such number and combination as to produce 95 MW.[12] Characteristics of turbines currently considered for use in the Project are shown in Table 1. Turbines would be placed on towers 80 meters (263 ft) in height.[13] Rotor

[5] Site Permit Application, Section 1.3.
[6] Site Permit Application, Section 5.10.1.1.
[7] *Id*.
[8] Site Permit Application, Section 5.12.1.
[9] Site Permit Application, Section 5.2.1; Department of Administration, Office of Geographic and Demographic Analysis, State Demographic Center, http://www.demography.state.mn.us/resource.html?Id=5238 (follow "population density" hyperlink). The average population density for the State of Minnesota is 61.8 persons per square mile.
[10] U.S. Census Bureau, http://www.census.gov/prod/cen2000/phc-3-25.pdf (population data for 2000).
[11] Site Permit Application, Section 5.5.1.
[12] Site Permit Application, Sections 2.1 and 2.2.
[13] Site Permit Application, Section 2.1.

diameters vary from 82.5 to 101 meters (270 to 331 ft).[14] The total height from the ground to the tip of a fully-extended rotor blade would be 390 to 423 feet.[15]

Some site permit conditions for large wind energy conversion systems (LWECS) are based on criteria which are dependent on turbine size.[16] Turbines must be placed within the Project boundary and meet all permit conditions. Accordingly, the final siting ("micro-siting") of wind turbines for the Project will depend on, among other factors, the size of the turbines chosen for the Project. A preliminary layout using 1.5 MW turbines is shown in Figure 4. A preliminary layout using 1.8 MW turbines is shown in Figure 5. A preliminary layout using 2.3 MW turbines in shown in Figure 6.

Table 1. Wind Turbine Specifications[17]

Characteristic	General Electric 1.5 MW	Vestas 1.8 MW	Siemens 2.3 MW
Hub Height	80 m (263 ft)	80 m (263 ft)	80 m (263 ft)
Rotor Diameter	82.5 m (270 ft)	90 m (295 ft)	101 m (331 ft)
Total Height	119 m (390 ft)	124 m (407 ft)	129 m (423 ft)
Cut-in Wind Speed	3.5 m/s (7.8 mph)	3.5 m/s (7.8 mph)	4 m/s (8.9 mph)
Cut-out Wind Speed	25 m/s (56 mph)	25 m/s (56 mph)	25 m/s (56 mph)
Rotor Speed	10.1 to 20.4 rpm	9.0 to 14.9 rpm	6 to 16 rpm
3 Rotor Diameters	247.5 m (812 ft)	270.1 m (886 ft)	303 m (994 ft)
5 Rotor Diameters	412.4 m (1,353 ft)	450 m (1,475 ft)	505 m (1,656 ft)

m = meters, ft = feet, m/s = meters per second, mph = miles per hour, rpm = revolutions per minute

Turbine towers will be secured by concrete foundations that vary in size and design depending on turbine size and soil and substrate conditions. A control panel inside the base of each turbine tower houses communication and electronic circuitry. Each turbine will be connected to a

[14] *Id*.
[15] *Id*.
[16] For example, turbine setbacks from the Project boundary and all non-participating lands are expressed in rotor diameters (RD). Rotor diameters vary with turbine size.
[17] Adapted from Site Permit Application, Sections 2.1 and 2.2.

supervisory control and data acquisition (SCADA) system. The SCADA system allows for real-time monitoring and control of turbine operation.

Facilities associated with the Project include gravel access roads, an electrical collection system, an operations and maintenance building, project substation, a metering yard, transmission line, a permanent meteorological tower, and Sonic Detection and Ranging (SODAR) unit or Light Detection and Ranging (LIDAR) unit. The Project would connect to the electrical transmission grid at the existing Paynesville Substation southeast of the Project area and north of the city of Paynesville. The area of permanent, direct land use for the Project will be approximately 50 acres.[18]

Electricity generated by each turbine is stepped up by a pad-mounted transformer at the base of each turbine to a collection line voltage (34.5 kV). The collection lines and SCADA fiber optic cable will be buried. The collection lines will carry power from a group of turbines totaling 50 MW will be transported via the collection system, operating at 34.5 kV, to a project substation, which will step up the voltage to 69 kV and be transported on a new 69 kV line of less than one mile in length to the Paynesville substation.[19] The electricity from the remaining turbines totaling 45 MW will be transported via the collection system and delivered to a new metering yard adjacent to the Paynesville substation where it will connect to the Paynesville substation.[20] The Project substation and transmission line are being permitted by Stearns County. The project substation will require less than one acre of land.[21]

Gravel roads will provide access to turbine sites for construction, maintenance, and eventual decommissioning. The extent of access roads depends on the turbines used for the Project and the Project layout. Access roads will be approximately 16 to 33 feet wide.[22] Roads will be designed and built to accommodate heavy loads. In addition to new access roads, existing public and private roads may require temporary additions to accommodate turbine delivery.

The Project will have an operations and maintenance (O&M) building.[23] The location of the O&M building has not yet been determined, but will be located central to future potential projects.[24] The O&M building will be large enough to house supervisors and crews to monitor and maintain the Project, which will be approximately 3,000 to 5,000 square feet.[25] The parking lot adjacent to the building will be approximately 3,000 square feet.[26]

There are currently two temporary meteorological towers installed on the Project site.[27] After construction, there will be one meteorological tower that will be maintained permanently for the

[18] Site Permit Application, Section 3.1. The area of permanent land use depends on the type of number of turbines used for the Project.
[19] *Id.*
[20] *Id.*
[21] Site Permit Application, Section 2.3
[22] *Id.*
[23] Site Permit Application, Section 4.1
[24] Site Permit Application, Section 4.9
[25] *Id.*
[26] *Id.*
[27] Site Permit Application, Section 3.1

life of the Project. Meteorological towers provide real-time data to the SCADA system and allow for remote monitoring of weather conditions. The permanent meteorological tower will likely house a Sonic Detection and Ranging (SODAR) unit or Light Detection and Ranging (LIDAR) unit.[28]

3.3 Project Cost and Schedule

The cost of developing and constructing the Paynesville Wind Farm is estimated to be $197 million.[29] On-going operations and maintenance costs, including administrative costs, are estimate to be $4.8 million per year.[30] Project construction would begin once all necessary permits are obtained. The Applicant anticipates commercial operation of the Project in the third quarter of 2011.[31] The date of commercial operation depends on interconnection, permitting, and other Project development activities.

[28] Site Permit Application, Section 2.4
[29] Site Permit Application, Section 3.6
[30] *Id*.
[31] Site Permit Application, Section 1.1

4.0 Project Alternatives

Typically, alternatives to the Project evaluated in an ER would include generation facilities of all types, including plants that use coal, natural gas, fuel oil, or similar non-renewable fuels. Alternatives would also include constructing transmission facilities (to import energy) in lieu of generation. However, the proposed Project is intended to produce renewable energy in furtherance of Minnesota's renewable energy standard. Accordingly, alternatives considered here are technologies eligible to be counted toward these standards.[32]

Alternatives to the Paynesville Wind Farm examined in this ER are: (1) a generic 95 MW wind generation plant (LWECS) sited elsewhere in Minnesota, (2) a 35.6 MW biomass plant, and (3) a "no build" alternative. Impacts of the generic 95 MW LWECS and 35.6 MW biomass plant are discussed in Section 6. Impacts of the "no build" alternative are discussed in Section 5.

4.1 95 MW LWECS

An alternative to the proposed Project, which would utilize renewable energy (i.e., wind), is a large wind energy conversion system (LWECS) sited elsewhere in Minnesota. Such a project could, theoretically, be a 95 MW Project or a combination of smaller dispersed projects. The analysis in this ER will attempt to describe differences in the impacts associated with a generic 95 MW wind project sited in Minnesota and the Paynesville Wind Farm sited in Stearns County.

4.2 35.6 MW Biomass Plant

A biomass alternative to the proposed Project would be a renewable energy technology. There are various possible sources of biomass fuel that could be used. St. Paul District Energy, a combined heat and power facility in downtown St. Paul, is fueled primarily by waste wood and has an electric generation capacity of 25 MW. The 55 MW Fibrominn plant in Benson burns turkey litter. The Laurentian Energy Authority operates facilities in Hibbing and Virginia with a combined capacity of 35 MW that convert wood, wood wastes, and agricultural biomass into electricity.

The biomass alternative analyzed in this ER is one that would burn a combination of hybrid willows, poplars, and corn stover, with natural gas as a backup fuel. This alternative is considered because such a plant, the NGPP Minnesota Biomass, LLC, electric generation facility, has already undergone environmental review in Minnesota, and data regarding potential environmental impacts associated with such a plant are available. Additionally, given the potential available feedstock in the Project area, such a biomass plant is feasible.
The NGPP project was reviewed by the Environmental Quality Board (Board) in 2003 when it prepared an environmental assessment worksheet (EAW) on the proposed facility.[33] At the time it was reviewed by the Board, the NGPP project was a 38.5 MW project. The analysis that was

[32] Minn. Stat. § 216B.1691, subd. 1. Eligible energy technologies include technologies that generate electricity from solar, wind, hydroelectric, hydrogen, or biomass.
[33] EQB Docket No. 03-67-EAW-NGPP Biomass [hereafter Minnesota Biomass EAW], *available at* http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452

conducted on that facility by the Board is valid for use as an alternative analysis in this ER. The Paynesville Wind Farm will have a capacity of 95 MW, with an estimated capacity factor of 37.5 percent. The 35.6 MW biomass alternative examined in this ER is an appropriately-sized generation alternative.[34]

4.3 No Build Alternative

The no build alternative means that no wind project is constructed. Analysis for this alternative will consider the potential benefits and drawbacks of not constructing the proposed Project (see Section 5).

4.4 Feasibility and Availability of Alternatives

The feasibility and availability of alternatives to the Paynesville Wind Farm depend on a number of factors. In general, an alternative is feasible and available if (1) the technology is commercially available at a scale similar to the proposed Project and (2) natural resources are available in Minnesota similar to those where commercial development is taking place.

95 MW LWECS

A generic 95 MW LWECS is feasible and likely available. Wind farms are in development across the state and Minnesota's wind resources are sufficient to facilitate a 95 MW project. Feasibility and availably are dependent on the ease of interconnection to the electrical transmission grid. In some parts of the state, the transmission grid is very near capacity and the connection of additional generating capacity is not easily achieved.

35.6 MW Biomass Plant

A 35.6 MW biomass plant is feasible and likely available. There are biomass plants of this size operating in Minnesota.

No Build Alternative

The no build alternative is feasible and available, but would not further Minnesota's renewable energy standard.

[34] 95 MW x 0.375 = 35.6 MW. The biomass alternative, because it has natural gas backup, is assumed for analysis purposes to have a capacity factor of 1.0. Scheduled and unscheduled maintenance would make the effective capacity factor slightly less than 1.0.

5.0 The No Build Alternative

Analysis of the no build alternative involves a discussion of the environmental impacts of continuing the status quo. For example, a no build alternative to a proposed highway project would take into account the impacts associated with increased traffic and development along existing roads and highways. Potential impacts and benefits of the no build alternative for the Paynesville Wind Farm are discussed below.

5.1 Impacts

At least two categories of impacts can be identified if the Paynesville Wind Farm is not built: (1) a hampering of the state's ability to meet its renewable portfolio standard, and (2) the loss of economic benefits in the Project area.

Renewable Energy Standard

Minnesota has committed to a renewable energy standard of generating 25 percent of its electricity from eligible renewable sources by the year 2025.[35] By the year 2025, Minnesota utilities forecast the need for an additional 2,600 MW of renewable generation to meet the renewable energy standard and an additional 1,500 MW to meet renewable portfolio standards or objectives in other states that are served by Minnesota utilities.[36] If the Paynesville Wind Farm is not built, it could hinder the ability of the state to meet its renewable energy standard. There are wind resources in other parts of the state and wind farms could be placed in these areas (Figure 7). However, the wind resources of the state are finite. The wind resource in the Project area is very good, and if untapped, could hinder the state's ability to meet its renewable energy standard.

Loss of Economic Benefits

If the Paynesville Wind Farm is not built, there will be a loss of economic benefits in the Project area. Landowners would lose wind easement payments over the life of the Project. Local contractors and suppliers will be used for portions of the construction of the Paynesville Wind Farm.[37] The Paynesville Wind Farm is expected to generate approximately 100 to 150 temporary construction jobs and 4 to 5 permanent jobs.[38] Employment opportunities and their associated income would be lost if the Project is not built. Local governments would lose wind energy production tax revenues; these revenues are estimated at $350,000 to $400,000 annually.[39]

[35] Minn. Stat. § 216B.1691, subd. 2a.
[36] 2009 Minnesota Biennial Transmission Projects Report, Section 8.4, Docket No. E999/M-09-602, https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={00D61C53-85D2-4052-93E4-95D03AFE5532}&documentTitle=200911-43520-01.
[37] CN Application, Section 4.3.
[38] CN Application, Section 11.9.
[39] *Id*.

5.2 Benefits

Benefits of not building the Paynesville Wind Farm would include avoidance of potential human and environmental impacts associated with the Project. These impacts are discussed in Section 6 of this report.

6.0 Human and Environmental Impacts

Potential human and environmental impacts of the Paynesville Wind Farm and alternatives to the Project are discussed below. The alternatives include: (1) a generic 95 wind energy conversion system (LWECS) sited elsewhere in Minnesota, and (2) a 35.6 MW biomass plant. The potential impacts of the no build alternative are discussed in Section 5. Additionally, this section discusses mitigation strategies for potential impacts.

6.1 Air Emissions – Criteria Pollutants

Electric generation facilities have the potential to emit air pollutants during construction and operation. Minnesota Rule 7849.1500 requires this ER to examine emissions of the following pollutants: sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon dioxide (CO_2), mercury (Hg), and particulate matter (PM). These common pollutants (other than mercury) are known as criteria pollutants.[40]

Paynesville Wind Farm

The Paynesville Wind Farm will emit no criteria pollutants during operation. A minimal amount of these pollutants will be produced during construction, e.g., due to the operation of heavy machinery. Transmission lines, under certain conditions, produce limited amounts of ozone and nitrogen oxide emissions. Emissions of these pollutants will be minimal.

Generic 95 MW LWECS

A generic 95 MW LWECS would emit no criteria pollutants during operation, and would have ancillary emissions (construction, transmission line) similar to those from the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would emit criteria pollutants (Table 2). These pollutants are based on a plant similar to the NGPP Minnesota Biomass plant (see Section 4.2). Each of these pollutants has potential to cause to human and environmental health impacts. Sulfur oxides (SO_x) cause acid rain and human respiratory illness.[41] Nitrous oxides (NO_x) are greenhouse gases that cause ozone and related respiratory illnesses.[42] Carbon dioxide (CO_2) is a greenhouse gas that is, in part, responsible for global warming and associated impacts including significant changes to world ecosystems.[43] Mercury can cause impaired neurological development in children.[44] Inhalation of particulate matter causes human respiratory illness.[45]

[40] What Are the Six Common Air Pollutants?, http://www.epa.gov/air/urbanair/.
[41] Health and Environmental Impacts of SO_2, http://www.epa.gov/air/urbanair/so2/.
[42] Health and Environmental Impacts of NO_x, http://www.epa.gov/air/nitrogenoxides/.
[43] Climate Change 2007: Synthesis Report, Summary for Policymakers, An Assessment of the Intergovernmental Panel on Climate Change (IPCC), http://www.ipcc.ch/.
[44] Health Effects, http://www.epa.gov/mercury/effects.htm.
[45] Health and Environment, http://www.epa.gov/air/particlepollution/health.html.

Table 2. Biomass Plant Emissions, Criteria Pollutants[46]

Pollutant	Emissions Rate lbs/kWh	Annual Emissions tons/year
Sulfur Dioxide (SO_2)	3.46 E-04	53.6
Nitrogen Oxides (NO_x)	1.98 E-03	308.7
Carbon Dioxide (CO_2) [47]	0.66	102,912
Mercury (Hg)	1.19 E-08	0.0019
Particulate Matter (PM)	7.18 E-04	112

lbs/kWh = pounds per kilowatt-hour

Because these pollutants are diffused into a global atmosphere, regional impacts are difficult to quantify. However, impacts due to particulate matter and ground-level ozone can be localized. Particulate matter and ozone are the pollutants of most concern in Minnesota, and they are tracked regionally by the Minnesota Pollution Control Agency.[48] Because the plant is fired primarily with biomass, net impacts from carbon dioxide will be minimal. Carbon dioxide released by the plant will be incorporated into plant matter, which in time will serve as fuel for the plant. The plant will operate, to a great extent, as a closed carbon dioxide loop.[49]

Mercury exists throughout the environment; however, the primary source of mercury in air emissions is coal, i.e., the burning of coal in a coal-fired power plant. The biomass plant considered here would use biomass as a primary fuel and natural gas as a backup fuel. Thus, emissions of mercury, and related impacts, are anticipated to be minimal.

Mitigation

Emissions of some criteria air pollutants can be mitigated through control technologies. Nitrous oxides emissions could be reduced by approximately 75 percent through use of a selective non-

[46] Adapted from Minnesota Biomass EAW, *available at* http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452. Boiler heat input capacity = (35.6/38.5) x 527.5 MMBtu/hr = 487.77 MMBtu/hr.

[47] *See* AP-42, Fifth Edition, Volume 1, Chapter 1 External Combustion Sources, Section 1.6 Wood Residue Combustion in Boilers, *available at* http://www.epa.gov/ttn/chief/ap42/ch01/final/c01s06.pdf (emissions rate). Because the plant is fired with biomass (except for the natural gas backup), net carbon dioxide emissions from the plant would be minimal. Carbon dioxide released from the plant would be integrated into new biomass materials which, in time, would be harvested and used to fire the plant. There would be carbon dioxide emissions related to transport of biomass and plant operations.

[48] Air Quality Index for Minnesota, http://aqi.pca.state.mn.us/.

[49] Fuels used to collect and transport biomass would likely not be carbon neutral and would create carbon dioxide emissions.

catalytic reduction (SNCR) system on the biomass boiler.[50] Particulate matter emissions could be reduced by 90 percent with add-on devices such as a multi-cyclone and dust collector.[51]

In addition to the use of control equipment to mitigate pollutant impacts, a 35.6 MW biomass plant would conduct a best available control technology (BACT) analysis. The BACT analysis is a requirement of new facilities under federal new source review prevention of significant deterioration (PSD). A BACT analysis and implementation could limit emissions from the plant to less than those presented in Table 2.

6.2 Air Emissions – Hazardous Air Pollutants and Volatile Organic Compounds

Electric generation facilities have to potential to emit air pollutants during construction and operation. Minnesota Rule 7849.1500 requires this ER to examine emissions of hazardous air pollutants (HAP) and volatile organic compounds (VOC). These classes of pollutants are known or suspected of causing cancer and other serious health effects.[52]

Paynesville Wind Farm

The Paynesville Wind Farm will not emit HAPs or VOCs during operation. There are petroleum-based fluids used in the operation of wind turbines. These fluids include: gear box oil, hydraulic fluid, and gear grease. These fluids have a low vapor pressure and thus release of VOCs will be minimal. A minimal amount of HAPs and VOCs will be produced during construction, due to the use of diesel fuel in heavy machinery.

Generic 95 MW LWECS

A generic 95 MW LWECS would have HAP and VOC emissions similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would emit HAPs and VOCs (Table 3). These pollutants are based on a plant similar to the NGPP Minnesota Biomass plant (see Section 4.2). Because these pollutants are diffused into a global atmosphere, regional impacts are difficult to quantify. The only area in Minnesota with a cancer risk due to HAPs greater than 100 in a million is the Minneapolis - Saint Paul metro area.[53] The emissions from the biomass plant are, compared with other sources, relatively small.

Mitigation

It is possible to mitigate HAP and VOC emissions with control technologies. However, given the relatively small amounts of HAP and VOC emissions compared with the costs of control equipment, it is likely that control technologies will not be employed.

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[50] Minnesota Biomass EAW.
[51] *Id.*
[52] U.S. Environmental Protection Agency, About Air Toxics, http://www.epa.gov/ttn/atw/allabout.html;
[53] U.S. Environmental Protection Agency, Summary of Results for the 2002 National-Scale Assessment, http://www.epa.gov/ttn/atw/nata2002/risksum.html.

Table 3. Biomass Plant Emissions, Hazardous Air Pollutants and Volatile Organic Compounds[54]

Pollutant	lbs/kWh	tons/year
Hazardous Air Pollutants (HAPs)	5.55 E-04	86.5
Volatile Organic Compounds (VOCs)	1.80 E-04	28.07

lbs/kWh = pounds per kilowatt-hour

6.3 Aesthetic Impact and Visibility Impairment, Including Shadow Flicker and Viewshed

Wind turbines are tall towers with large, rotating blades. Consequently, they can be seen for long distances and impact the visual environment. This section discusses potential visual impacts related to shadow flicker, viewshed, and aesthetics. Impacts related to general visibility impairment, which is associated with air emissions, are also mentioned. For a discussion on air emissions, see sections 6.1 and 6.2.

Paynesville Wind Farm

The Paynesville Wind Farm would cause shadow flicker. The Project would also introduce industrial wind turbines to an otherwise rural countryside. Visibility impairment would not be an issue because wind turbines do not emit air emissions.

Viewshed and Aesthetics

The potential impact of introducing wind turbines depends somewhat on the aesthetic values of the observer. For some, wind turbines are an intrusion on a rural landscape. For others, wind turbines have a grace that is harmonious with a rural landscape. Wind turbines, as gatherers of a renewable wind harvest, are in some sense compatible with a rural, agricultural heritage. Development of an objective measure of aesthetic impacts is a difficult task. Current methods used to assess visual impacts include viewshed mapping, photographic simulations, and video animation.[55] All of these methods depend, to some extent, on assessing the current aesthetic resources of the Project area, i.e., the aesthetics of the area before construction of a wind farm.

The Project area does not contain any state or federal designated scenic areas. There are 10 state Wildlife Management Areas (WMAs) and seven federal Wildlife Production Areas (WPAs) within five miles of the Project area.[56] One WMA is located in the interior of the Project Area.[57]

[54] Adapted from Minnesota Biomass EAW, *available at* http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452. Boiler heat input capacity = (35.6/38.5) x 527.5 MMBtu/hr = 487.8 MMBtu/hr.
[55] Visual Considerations: Public Perceptions, Regulatory Environment and Assessment Methods in the Eastern U.S., http://www.nationalwind.org/assets/blog/Allen-NWCC_2009.pdf.
[56] Site Permit Application, Section 5.7.1.

The Roscoe Prairie Scientific and Natural Area (SNA) is located 1.5 miles south of the Project area.[58] These protected areas are shown in Figure 8. These resources could be perceived as visually valuable. Residents and visitors enjoying these areas could experience an aesthetic impact because users would likely see wind turbines in their viewshed.

Wind turbines, due Federal Aviation Administration (FAA) requirements and height, would be lighted.[59] In general, turbines have flashing white lights during the day and red lights during the evening.

Shadow Flicker

Shadow flicker is the intermittent change in light intensity due to rotating wind turbine blades casting shadows on the ground. This change in light intensity can cause annoyance.[60] Shadow intensity, or how "light" or "dark" a shadow appears at a specific receptor, such as a house, will vary with the distance from the turbine. When receptors are located closer to a turbine, turbine blades will block out a larger portion of the sun's rays and shadows will be wider and darker. Receptors located farther away from a turbine will experience thinner and less distinct shadows.

Shadow flicker varies with the angle of sun, i.e., the time of year and the time of day. Shadow flicker does not occur during cloudy days or when turbines are not rotating. Shadow flicker is reduced or eliminated when light-blocking materials, e.g., buildings, trees, shades, are located between turbines and a receptor. Because of the number of variables involved, an estimate of the potential impact of shadow flicker for a specific receptor requires modeling.

Mitigation

In general, siting wind projects in rural areas minimizes human impacts. Viewshed and aesthetic impacts can be mitigated by siting wind projects outside of areas deemed visually valuable by the state, e.g., state parks.

Mitigation of impacts from shadow flicker is best accomplished by proper siting of the project and individual wind turbines. The further a residence (receptor) is from a wind turbine, the less the impact from shadow flicker. Distance minimizes the number of hours that shadow flicker occurs at a particular residence and the shadow intensity. Further, shadow flicker does not occur when the turbine rotor is oriented parallel to the receptor. In Minnesota, shadows from a wind turbine are cast generally to the north of the wind turbine because Minnesota is in the northern hemisphere. Siting turbines north of a receptor would mitigate shadow flicker. Setbacks from individual turbines, as embodied by Minnesota's general permit standards, can also mitigate shadow flicker.[61] These standards include setbacks to protect wind rights and mitigate noise

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[57] *Id.*
[58] *Id.*
[59] FAA Advisory Circular AC 70/7460-2K, HTTP://RGL.FAA.GOV/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146DB0931F186256C2A00721867/$FILE/AC70-7460-2K.PDF.
[60] Public Health Impacts of Wind Turbines, Minnesota Department of Health, May 22, 2009, p. 14, [hereafter Minnesota Dept. of Health Report], *available at* http://www.health.state.mn.us/divs/eh/hazardous/topics/windturbines.pdf.
[61] Commission Order Establishing General Permit Standards, *available at* http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.

impacts.[62] For the Paynesville Wind Farm, the applicant agreed to maintain 750 foot setbacks from residences.[63]

Minnesota does not have a standard that addresses potential impacts of shadow flicker, i.e., there is not a descriptive or numeric standard that would categorize a certain amount of flicker as acceptable or unacceptable. No other state in the United States has adopted such a standard. However, other countries have examined the issue and have adopted standards and recommendations. Standards depend on assumptions about how flicker impacts are to be calculated:

- Germany has proposed a standard such that shadow flicker does not exceed 30 hours/yr. or 30 minutes/day at a receptor.[64] It is unclear whether this is a worst-case scenario (e.g., clear skies every day) or an actual-case scenario (e.g., weather representative of the project area).[65]
- Belgium has adopted the German standard.[66]
- Denmark recommends a maximum of 10 hours/yr. assuming actual weather conditions in the project area.[67]
- France has adopted no standard but requires shadow flicker modeling.[68]
- The Netherlands have adopted a yearly maximum of 5 hours and 40 minutes assuming clear skies.[69]
- The State of Victoria, Australia, has adopted a shadow flicker standard of 30 hours/yr.[70]

If siting and distance do not mitigate shadow flicker impacts, such impacts could be mitigated by other barriers, e.g., vegetative barriers could be planted, shades or curtains could be used on windows.

In general, wind turbines must be set back from non-participating properties a distance of 5 rotor diameters (RD) on the prevailing wind direction and 3 RD on the non-prevailing wind direction.[71] The potential setback distances for the Paynesville Wind Farm are shown in Table 1. Additional setbacks may be required to meet Minnesota noise standards.[72] These setbacks

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[62] Wind turbines must be set back from non-participating properties a distance of 5 rotor diameters (RD) on the prevailing wind direction and 3 RD on the non-prevailing wind direction. Potential setback distances for the Paynesville Wind Farm are shown in Table 1. See Section 6.10 for a discussion of noise setbacks.
[63] Site Permit Application, Section 6.3.
[64] Spatial Planning of Wind Turbines, European Actions for Renewable Energy (PREDAC) [hereafter Spatial Planning Report], *available at* http://www.cler.org/info/IMG/pdf/WP8_ANG_guide.pdf.
[65] Shadow Flicker Assessment – Honeywood, Final Report, p. 5, *available at* http://www.eolectric.com/assets/honeywood/pdf/en/appendix%20k.pdf.
[66] Spatial Planning Report, p. 21.
[67] *Id*.
[68] *Id*.
[69] *Id*.
[70] Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria, p. 26, *available at* http://www.sustainability.vic.gov.au/resources/documents/WindEnergyGuidelines.pdf.
[71] Commission Order Establishing General Permit Standards, http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.
[72] Minnesota Rules Chapter 7030.

minimize the general visibility of the wind turbines and also shadow flicker.[73] Finally, turbines are designed to be a uniform off-white color to blend in with the horizon and reduce visual impacts. Lighting required by the FAA is similar to that for other tall structures in rural areas, and mitigation is not expected to be necessary.

Generic 95 MW LWECS

A generic 95 MW LWECS located elsewhere in Minnesota would have visual impacts and mitigation strategies similar to that of the Paynesville Wind Farm. Impacts could be mitigated by possibly locating in a more rural area of Minnesota; however, such a location would need to also have wind resources and transmission interconnection availability similar to those in Stearns County.[74] Impacts could also be mitigated by utilizing wind turbines capable of generating more energy. For example, a 95 MW project consisting of 1.5 MW turbines requires 64 turbines; a similar project consisting of 2.3 MW turbines requires 42 turbines. The larger turbines would create a larger individual "eyeprint," but the smaller number of turbines would likely create a relatively smaller visual impact for the project.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would be visible in the immediate area of plant, and to the extent a stack plume is visible, in the greater area. A biomass plant would not cause shadow flicker due to the lack of exterior moving parts that could cast alternating shadows.

A biomass plant would be industrial in nature with many buildings, conveyors, biomass piles, and a boiler stack. The building that houses the boiler is likely to be at least 100 feet tall. The conveyors and biomass piles could range from 30 to 50 feet in height. The plant buildings, conveyors, and piles would likely be lighted to allow for nighttime operation. Lighting would also be necessary for wood fuel loading/unloading points, truck scales, and vehicle parking areas.

The estimated height for the boiler stack is approximately 150 feet. Particulate matter control devices would capture most of the particulates from the boiler exhaust gas stream. Thus, the majority of the plume from the boiler stack would be water vapor. This transparent plume may be seen during cold weather conditions, but would likely be virtually clear during warm weather. This plume could impair visibility. If taller than 200 feet, the boiler stack may require FAA lighting, similar to wind turbines.

Mitigation

Mitigation of visual impacts is best accomplished through selective location of the biomass plant. The site for the biomass plant does not need to be a rural, agricultural setting. The plant could be

[73] Minnesota does not have a standard that addresses potential impacts of shadow flicker. Ten rotor diameters has been suggested as a mitigating distance for shadow flicker; see Minnesota Dept. of Health Report, p. 14. However, shadow flicker is site and time specific and likely poorly suited for a general mitigation distance. See, e.g., Glacier Hills Wind Park Project, Volume 1, Final Environmental Impact Statement [hereafter Glacier Hills FEIS], Section 5.7.1, *available at* http://www.we-energies.com/environmental/gh_final_eis.pdf.

[74] Stearns County includes rural and urban areas. Stearns County has a population density slightly higher than the Minnesota average. The average population density for Stearns County is 99 persons per square mile; the population density for the State of Minnesota is 61.8 persons per square mile. *See* http://www.demography.state.mn.us/resource.html?Id=5238.

located in an industrial location allowing it to blend in with other industry. Thus, the plant could be located away from aesthetically valuable resources. However, the biomass plant would need to be located in an area where biomass is readily available in large quantities. Vegetative screening (trees, shrubs) could be used to partially block views of the industrial buildings, silos, conveyors, and boiler stack.

6.4 Ozone Formation

Large electric power generating facilities, such as biomass facilities, have the potential to produce reactive organic gases, which can lead to ground-level ozone formation. Wind turbines do not produce ozone or ozone precursors. Minnesota Rules 7849.1500, subpart 2 requires that this ER address anticipated ozone formation. Ozone can cause human health risks, and can also damage crops, trees, and other vegetation.[75]

Paynesville Wind Farm

The Paynesville Wind Farm would not produce ozone or ozone precursors. Thus, there would no human or environmental impacts due to ozone formation.

Generic 95 MW LWECS

A generic 95 MW LWECS would have ozone formation similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would produce ozone precursors (e.g., NO_x, VOC) that would lead to ozone formation. Impacts from ozone can be localized. The state of Minnesota is currently designated as in attainment for ozone by the Environmental Protection Agency (EPA). Ground level ozone formation and associated impacts are anticipated to be minimal.

Mitigation

Ozone formation could be mitigated by mitigating ozone precursors. See discussion in Sections 6.1 and 6.2 regarding nitrous oxides (NO_X) and volatile organic compounds (VOC) respectively.

6.5 Fuel Availability

Large electric power generating facilities require some type of fuel. This section discusses the availability of fuel for the proposed Project and alternatives.

Paynesville Wind Farm

The Paynesville Wind Farm relies on wind to generate electricity. Winds are generated by earth and solar processes; accordingly, the fuel for the Project is a very long-term renewable resource. Wind is not consumed by wind turbines. Wind turbines extract kinetic energy as the wind passes through the blades and creates turbulence in the wake of the turbine. To operative effectively,

[75] U.S. Environmental Protection Agency, http://www.epa.gov/Ozone/ (ozone); Minnesota Department of Health http://www.health.state.mn.us/divs/eh/air/ozone.htm (Air Quality – Ozone).

turbines must be set back a distance from other turbines to compensate for turbulences, known as wake loss.[76]

The availability of wind varies considerably across Minnesota, and has been analyzed by the Minnesota Department of Commerce.[77] Wind resources in Stearns County are relatively good (Figure 7). The expected average annual wind speed for the Paynesville Wind Farm is 17 miles per hour (7.62 meters per second).[78] Power generation by the Project depends not only on how quickly the wind blows (how much energy it contains), but also how frequently it blows. Wind turbines generate power only when the wind is blowing.[79] This frequency is expressed as capacity factor, i.e., how much power the turbine is generating compared to how much it could generate if it was operating all the time. Capacity factors of 35 to 43 percent are typically achievable in Minnesota for large wind farms. The Paynesville Wind Project is estimated to have a capacity factor in this range.[80]

Generic 95 MW LWECS

A generic 95 MW LWECS would utilize the same fuel as the Paynesville Wind Farm – wind. To be economically feasible, a 95 MW LWECS sited elsewhere in Minnesota would need to be placed in a good wind resource. The availability of good, undeveloped wind resources in Minnesota remains high. Impacts on the fuel (wind) resources would be similar to those for the Paynesville Wind Farm.

35.6 MW Biomass Plant

A combination of wood chips and agricultural biomass would be the main fuel sources for a 35.6 MW biomass plant. Natural gas would be used as a fuel backup. Such a plant would consume approximately 36,944 tons of biomass per month.

It is possible that rail could be used for delivery of fuel to the plant, depending on its location. However, the most likely method of delivery for wood and agricultural biomass fuel would be by semi-trailer trucks. Trucks would likely deliver wood and agricultural biomass by loads of 20 tons or greater. The biomass facility would operate 24 hours a day, but fuel delivery times would likely be limited between the hours of 6:00 a.m. to 6:00 p.m. The total number of daily truck trips is estimated to be approximately 50 trips. The origin of the biomass trucks and the total trip length required for delivery would depend on the location of the biomass source relative to the biomass plant.

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[76] The distance between turbines necessary for effective operation is approximately 6 rotor diameters (RD) on the non-prevailing wind axis and 10 RD on the prevailing wind axis. Accordingly, Minnesota requires setbacks of 3 x 5 RD for each turbine. *See* PUC Order Establishing General Permit Standards, *available at* http://energyfacilities.puc.state.mn.us/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf.
[77] Wind Resource Analysis Program 2002, *available at* http://www.state.mn.us/mn/externalDocs/Commerce/WRAP_Report_110702040352_WRAP2002.pdf.
[78] Site Permit Application, Section 3.3.1. Based on analysis from a meteorological tower in the Project area.
[79] *See* Table 1 which list includes "Cut-in Wind Speeds," i.e., the minimum wind speed necessary for the turbine to operate.
[80] CN Application, Section 2.1.

A back-up fuel source would be required for the biomass plant, to assist with plant start-up and to sustain the plant temporarily when the biomass fuel supplies are low. Natural gas would be used as a backup fuel. The construction of a natural gas pipeline would be required to deliver the natural gas to the biomass plant.

Potential impacts to the environment related to fuel for a biomass plant include possible degradation of the environment due to biomass removal (e.g., increased soil erosion due to removal of agricultural biomass and loss of wildlife habitat), air pollution due to biomass transport, and the impacts associated with building a natural gas pipeline.

Mitigation

Impacts related to fuel for a biomass plant could be mitigated by using guidelines for biomass harvest that minimize impacts and by siting the plant to minimize impacts related to biomass transportation. As an example, the Minnesota Forest Resource Council (MFRC) has developed woody biomass harvest guidelines to lessen impacts to wildlife habitat.[81] If harvesting guidelines are used to mitigate impacts, following biomass harvest guidelines would be required.

6.6 Associated Transmission Facilities

Electrical generation facilities typically require construction of transmission facilities such as transmission lines and substations to connect to the transmission grid. This section discusses these associated transmission facilities and their potential impacts.

Transmission lines over 100 kilovolts (kV) and longer than 1,500 feet are defined as "high voltage transmission lines" and are subject to regulation by the Commission.[82] Transmission, collector, and feeder lines less than 100 kV are permitted by local governments. Collector lines (typically 34.5 kV) carry electrical power from each individual transformer associated with a wind turbine to an internal project interconnection point and are typically buried underground. Feeder lines carry power from an internal project interconnection point to the project substation or interconnection point on the electrical grid and may be overhead or underground.

Paynesville Wind Farm

The Paynesville Wind Farm will require a substation in the Project area and an associated transmission line. The electricity from a group of turbines totaling 50 MW will be transported via the collection system, operating at 34.5 kV, to a new substation, which will step up the voltage to 69 kV and be transported on a new 69 kV transmission line of less than one mile in length to the Paynesville substation.[83] The electricity from the remaining turbines totaling 45 MW will be transported via the collection system and delivered to a new metering yard adjacent to the Paynesville substation where it will connect to the Paynesville substation.[84] The Project substation and transmission line are being permitted by Stearns County.

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[81] Minnesota Forest Resources Council, Forest Biomass and Biofuels Harvest, http://www.frc.state.mn.us/initiatives_policy_biofuels.html.
[82] Minn. Stat. § 216E.01, subd. 4. Under Minn. Stat. § 216E.05, high voltage transmission lines between 100 and 200 kV may be permitted by local governments.
[83] *Id*.
[84] *Id*.

Impacts from the Project's associated transmission facilities would include impacts due to construction and impacts due to operation. Construction impacts would include impacts related to land clearing and materials transport. Operation impacts would include impacts related to electromagnetic fields (EMF), stray voltage, noise, and visibility.

Power moving through a transmission line creates EMF. These fields decrease with distance from the transmission line. Stray voltage is a grounding issue that can occur on the electric service entrances to structures from distribution lines, not transmission lines.[85] However, transmission lines can induce stray voltage on a distribution circuit that is parallel to and immediately under the transmission line. More precisely, stray voltage exists between the neutral wire of the electrical service entrance and objects connected to the ground to prevent voltage buildup (grounded) in buildings such as barns and milking parlors. Stray voltage may also occur in enclosed areas between two grounded objects. When an animal comes into contact with the earth between two grounded objects when a current is passing through the earth, this is commonly known as stray voltage. Stray voltage has been raised as a concern on some dairy farms because it can impact operations and milk production.

During wet weather, water can be ionized adjacent to transmission lines creating a crackling noise. Visual impacts of a transmission line depend on context. High visual impacts occur when a line is located near areas with relatively higher population densities, e.g., residential areas.

Collector lines will create temporary construction impacts; however, once underground, they will not create visual impacts. The Project includes no distribution lines to residences and relatively lower voltage transmission; thus, impacts from stray voltage will be minimal. Potential impacts from EMF, stray voltage, noise, and visibility are anticipated to be minimal.

Mitigation

Construction impacts can be mitigated by minimizing the amount of land clearing required. Typically, collector lines for a wind project will be routed along the shortest routes possible. Operation impacts can be mitigated by placing transmission lines away from population densities. Visual impacts can be mitigated by placing collector lines underground, while aesthetic impacts from overhead feeder and transmission lines can be mitigated through design and pole placement. Impacts due to stray voltage can be mitigated by grounding electrical systems (i.e., ensure connection to the earth). Proper design and pole placement can reduce or eliminate stray voltage effects from the transmission lines.

[85] *See* A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options, Minnesota State Interagency Working Group on EMF Issues, Sept. 2002, *available at* http://energyfacilities.puc.state.mn.us/documents/EMF%20White%20Paper%20-%20MN%20Workgroup%20Sep%202002.pdf, for a discussion of EMF and stray voltage; *see also* Brookings County – Hampton 345 kV Transmission Line Project, Draft Environmental Impact Statement [hereafter Brookings DEIS], Section 6.2, *available at* http://energyfacilities.puc.state.mn.us/resource.html?Id=25589.

Generic 95 MW LWECS

A generic 95 MW LWECS would have transmission facilities similar to the Paynesville Wind Farm. Accordingly, potential impacts and mitigation strategies are also similar. The primary driver of potential impacts is the length and voltage of the transmission line required to interconnect the wind project with the transmission grid. A relatively longer line or higher voltage would create greater construction and operation impacts.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would have transmission facilities similar to the Paynesville Wind Farm; however, an electrical collection system and collection substations would not be required. The plant would include a transformer to transform the voltage to transmission levels and a transmission line between the plant and a substation where the power would enter the grid.

Potential impacts and mitigation strategies would be similar to those for the Paynesville Wind Farm. Again, the primary driver of potential impacts is the length and voltage of the transmission line required to connect the biomass plant to the transmission grid. A relatively longer line or higher voltage would create greater construction and operation impacts.

6.7 Water Appropriations

Large electric power generating facilities may require water for operations. This section discusses potential water appropriation impacts from such facilities.

Paynesville Wind Farm

The Paynesville Wind Farm would require water appropriations for potable and sanitary water for the operations and maintenance facility. Water would be supplied through either rural water or a single domestic-sized well. The amount of water used would be roughly equivalent to the amount consumed by a residence or farmstead in the area, and would likely not require mitigation.

Generic 95 MW LWECS

A generic 95 MW LWECS would have water appropriations similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would require water appropriations for energy production (process water) and sanitation. Process water could come from a private well, a municipal water source, or an effluent or other non-potable water source, such as a river or a nearby wastewater treatment plant. Water for sanitation would likely come from a well or municipal water source. For some aspects of the process, such as in the cooling tower, effluent water could be used. Thus, the sources of water would depend on the type and availability of water sources near the facility location.

The required quantity of water would depend on plant design and water quality. Functions within the plant that require water include cooling, sanitation, washing, and separations. The

average anticipated water use would be approximately 572 gallons per minute. If a source of effluent water were available, the appropriation of well or municipal water would be relatively lower. If the plant used only well or municipal water, the water appropriation would be relatively higher. Based on anticipated water use, the plant would require a water appropriations permit from the Minnesota Department of Natural Resources (DNR).[86]

Mitigation

Mitigation of well water and municipal water use by the plant could be achieved through plant equipment choices and through the use of effluent water (non-potable water). If municipal water were used for the plant, modifications or an expansion of the municipal water treatment plant may be required to accommodate the increase in demand.

6.8 Wastewater

Large electric generation facilities have the potential to generate significant amounts of wastewater. This section discusses potential impacts from wastewater generation.

Paynesville Wind Farm

The Paynesville Wind Farm does not create wastewater during the generation of electricity. However, wastewater would be created by the operations and maintenance (O&M) building. This wastewater would likely be discharged into a septic system associated with the building. The potential impacts of this wastewater and septic system are anticipated to be minimal. Thus, mitigation of the impacts, beyond a properly functioning septic system, is not required.

Generic 95 MW LWECS

A generic 95 MW LWECS would have wastewater impacts similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would have process and sanitary wastewater discharges. The amount of wastewater discharge would depend on the water sources used for the plant (see Section 6.7). For example, a high quality water source used for processing would be able to cycle more before it is discharged. Total wastewater discharge could range from 75 million gallons per year to 223 million gallons per year, depending on the quality water source.[87]

Mitigation

Wastewater impacts could be mitigated by proper processing. The most likely scenario is transference of the wastewater to a municipal sewage system for treatment and release. Wastewater could be held or pre-treated at the biomass plant. Holding could reduce discharges through evaporation. However, holding introduces risks related to storing wastewater away from surface and ground waters.

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[86] Minnesota Department of Natural Resouces, Water Use Permits, http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html.

[87] Calculation based on Minnesota Biomass EAW, p. 14, *available at* http://energyfacilities.puc.state.mn.us/Docket.html?Id=4452

6.9 Solid and Hazardous Wastes

Large electric generation facilities have the potential to generate solid and hazardous wastes. This section discusses potential impacts from such wastes.

Paynesville Wind Farm

The Paynesville Wind Farm would create solid and hazardous wastes. Solid wastes would be generated during construction, e.g., scrap wood, plastics, cardboard, wire. Small amounts of solid and hazardous wastes would be generated during operation, e.g., oils, grease, hydraulic fluids, solvents. Lubricants and fluids would be stored at the operations and maintenance building.

Solid and hazardous wastes, if not properly handled, can contaminate surface and ground waters. This contamination can cause human health impacts, e.g., cancer.[88]

Mitigation

Solid wastes would be disposed of according to solid waste plans in Stearns County. Hazardous wastes would be handled appropriately. Leaks or spills would be mitigated using appropriate clean up techniques. A listing of all potentially hazardous materials related to the Project will be maintained for the Project. It is not anticipated that the Project will require a hazardous waste license. Hazardous waste generation would likely fall below the quantity required for a very small quantity generator license (220 pounds per month).[89]

Generic 95 MW LWECS

A generic 95 MW LWECS would have solid and hazardous waste impacts similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would create solid and hazardous wastes. Solid wastes would be generated during construction, e.g., scrap wood, plastics, cardboard, wire. Solid waste generated from operations would consist primarily of ash from the biomass boiler. Small amounts of hazardous wastes would be generated during operation, e.g., oils, grease, hydraulic fluids, solvents. Hazardous materials would likely be stored on site, e.g., diesel fuel.

Mitigation

Mitigation of wastes would be similar to the Paynesville Wind Farm. Ash generated by the plant would be held on-site in an ash holding facility or removed to an off-site disposal facility. Storage tanks would be registered and maintained in accordance with Minnesota Pollution Control Agency (MPCA) guidelines.

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[88] Minnesota Pollution Control Agency, Volatile Organic Compounds (VOCs) in Minnesota's Ground Water, http://www.pca.state.mn.us/water/groundwater/gwmap/voc-fs.pdf.

[89] Minnesota Pollution Control Agency, Very Small Quantity Generator Hazardous Waste Collection Program, http://www.pca.state.mn.us/publications/w-hw2-50.pdf.

6.10 Noise

Large electric generation facilities have the potential to generate noise. This section discusses potential impacts from such noise.

Noise can be defined as unwanted or inappropriate sound. Sound has multiple characteristics which determine whether a sound is too loud or otherwise inappropriate. Sound travels in a wave motion and produces a sound pressure level. This sound pressure level is commonly measured in decibels (dB). Sounds also consists of frequencies, e.g., the high frequency (or pitch) of a whistle. Most sounds are not a single frequency but a mixture of frequencies. Finally, sounds can be constant or intermittent. The perceived loudness of a sound depends on all of these characteristics.

Typically, a sound meter is used to measure loudness. The meter sums up the sound pressure levels for all frequencies of a sound and calculates a single loudness reading. This loudness reading is reported in decibels, with a suffix indicating the type of calculation used. For example, "dB(A)" indicates a loudness reading using an A-weighted calculation (or "scale").

The State of Minnesota has promulgated noise standards designed to ensure public health and minimize citizen exposure to inappropriate sounds (Table 4). The rules for permissible noise vary according to land use, i.e., according to their noise area classification (NAC). In a residential setting, for example, noise restrictions are more stringent than in an industrial setting. Rural residential homes are considered NAC 1 (residential), while agricultural land and agricultural activities are classified as NAC 3 (industrial). The rules also distinguish between nighttime and daytime noise; less noise is permitted at night. The rules list the sound levels not to be exceeded for 10 percent and 50 percent of the time in a one-hour survey (L_{10} and L_{50}) for each noise area classification.

Potential human impacts due to noise include hearing loss, stress, annoyance, and sleep disturbance.[90] Table 4 lists Minnesota's Noise Standards by noise area classification.

[90] World Health Organization, Occupational and Community Noise, http://www.who.int/mediacentre/factsheets/fs258/en/.

Table 4. Minnesota Noise Standards[91]

Noise Area Classification[92]	Daytime		Nighttime	
	L_{50}[93]	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Paynesville Wind Farm

The operation of wind turbines in the Paynesville Wind Farm would produce noise. Turbines produce mechanical noise (noise due to the gearbox and generator in the nacelle) and aerodynamic noise (noise due to wind passing over the turbine blades).[94] Perceived sound characteristics would depend on the type/size of turbine, the speed of the turbine (if turning), and the distance of the listener from the turbine.

Wind turbines produce audible, low frequency sound, and sub-audible sound (infrasound). These sounds can have a rhythmic modulation due to the spinning of the turbine blades.[95] Impacts due to these sound characteristics are subjective, i.e., human sensitivity, especially to low frequency sound, is variable. However, in general, low frequency sounds can cause annoyance and sleep disturbance.[96]

[91] Minn. Rule 7030.0040 (standards expressed in dB (A)).
[92] Minn. Rule 7030.0050. The noise area classification is based on the land use activity at the location of the receiver (listener).
[93] Minn. Rule 7030.0020. "L_{50}" means the sound level, expressed in dB(A), which is exceeded 50 percent of the time for a one hour survey. "L_{10}" means the sound level, expressed in dB(A), which is exceeded ten percent of the time for a one hour survey.
[94] Minnesota Dept. of Health Report, p. 11-14.
[95] *Id*.
[96] *Id*., Section IV.

Mitigation

The primary means of mitigating sound (noise) produced by wind turbines is proper siting. Turbines must be sited to comply with noise standards in Minnesota Rules Chapter 7030.[97] For rural residential areas in Stearns County, this means that sound levels must meet an L_{50} standard of 50 dB(A) (Table 4). The distance that turbines are setback from residences would depend on the type and size of turbine. Setback distances to the 50 dB(A) level for turbines under consideration for this Project will be further analyzed through additional noise modeling.[98] Typically, setbacks between 750 feet and 1500 feet are necessary to meet the noise standards. The Applicant has stated that no turbines will be placed within 750 feet of any home.

Cumulative noise impacts must also be considered. That is, if there are multiple turbines in the vicinity of a residence, the standards set by Minnesota Rules Chapter 7030 must still be met. This may require additional setbacks. Predicted noise levels for preliminary turbine layouts are shown in Figures 9, 10, and 11. Setback requirements are enforced by site permits issued by the Commission for wind farms. The Commission has reviewed LWECS setbacks and potential public health impacts, and evaluates each project on a case-by-case basis to determine if the setbacks remain appropriate and reasonable.[99]

Generic 95 MW LWECS

A generic 95 MW LWECS would likely have noise impacts similar to the Paynesville Wind Farm. However, if the generic 95 MW LWECS were to be located in a less populated area than the Paynesville Wind Farm, then noise impacts may affect fewer people. In 2009, densities in the Project area of the Paynesville Wind Farm ranged from 9 people per square mile in Lake Henry Township to 46 people per square mile in Paynesville Township.[100] In 2000, the average population density for Stearns County was 99 people per square mile.[101] The population density is generally greater in the east central and southeast regions of Minnesota compared to other areas in the state (Figure 12).

35.6 MW Biomass Plant

A 35.6 MW biomass plant would create noise during operation from a variety of sources including the turbine/boiler building, conveyor system, hammer mill and bale choppers, front end loaders, and idling trucks. Based on noise studies, the plant would need to be located approximately 2,100 feet from a residence to the meet the daytime L_{50} standard of 60 dB(A) and approximately 6,200 feet from a residence to meet the nighttime L_{50} standard of 50 dB(A). These are conservative estimates – they are based on maximum equipment operation and have not been adjusted for possible noise shielding.

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[97] Minn. Rule 7030.0040 (Noise Standard).
[98] Site Permit Application, Section 5.3.2.
[99] Commission Investigation into Large Wind Energy Conversion Systems Permit Conditions on Setbacks and the Minnesota Department of Health Environmental Health Division's White Paper on Public Health Impacts of Wind Turbines, CI-09-845, http://www.puc.state.mn.us/puc/energyfacilities/012254#windhealth.
[100] Site Permit Application, Section 5.2.1.
[101] Department of Administration, Office of Geographic and Demographic Analysis, State Demographic Center, http://www.demography.state.mn.us/resource.html?Id=5238 (follow "population density" hyperlink)

Mitigation

Sound (noise) from the biomass plant could be mitigated by proper siting. A study would likely be required to ensure that noise standards are met for all local residents. Enclosure of heavy equipment would reduce noise impacts. Vegetative screening, planted to lessen visual impacts, would provide noise mitigation. Fuel windrows could provide noise attenuation. Hours of operation, e.g., for fuel delivery or heavy equipment operation, could be managed to reduce noise impacts and meet daytime and nighttime standards.

6.11 Property Values

Large electric generation facilities have the potential to impact property values. This section discusses potential property value impacts from the operation of a generation facility in the Project area.

Paynesville Wind Farm

The Paynesville Wind Farm would be located in Stearns County in east central Minnesota. Stearns County has a population of 148,955 people.[102] The home ownership rate is approximately 73.8 percent.[103]

The impact on property values due to the Project is difficult to quantify because of the multitude of factors that influence a property's market value, including acreage, schools, parks, neighborhood characteristics, and improvements. A direct influence on property value is often the status of the housing/land market at the time of sale, i.e., a buyer's market or a seller's market.

Lawrence Berkeley National Laboratory recently completed a nationwide study on the potential impacts of wind Projects on property values.[104] Results indicate that property values near wind Projects are not negatively impacted. The study indicates that home buyers and sellers consider a property's scenic vista when determining an appropriate sales price; however, sales prices are not significantly affected by views of wind turbines. This study does not preclude the possibility of negative impacts to property values in specific situations.

Stearns County contacted seven counties in southern Minnesota (Dodge, Goodhue, Jackson, Lincoln, Martin, Mower, and Murray counties) with large wind energy conversions systems regarding impacts on property values by the presence of wind farms.[105] The assessors from these seven counties were asked whether they have seen a change in property values on properties

[102] U.S. Census Bureau, Dodge County, Minnesota, http://quickfacts.census.gov/qfd/states/27/27145.html .
[103] *Id*.
[104] The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis, December 2009, http://www1.eere.energy.gov/windandhydro/pdfs/wind_power_Projects_residential_property_values.pdf.
[105] Stearns County Board of Commissioners Meeting, June 8, 2010, http://stearnscountymn.iqm2.com/Citizens/Detail_Meeting.aspx?ID=1008 (follow "Agenda Item G.1.C. - Responses to Public Hearing Comments" hyperlink).

hosting a wind turbine or properties adjacent to wind turbines.[106] In general, the assessors found no change to property values on such properties; however, data are scant.[107]

Mitigation

Potential negative impacts to property values can be mitigated by siting turbines away from residences and viewsheds. Property value impacts related to annoyance (e.g., noise, shadow flicker) can be mitigated by setbacks and proper siting (see Sections 6.3 and 6.10). Property value impacts related to aesthetics and viewsheds can be mitigated by proper siting, but are relatively more difficult to mitigate due to the height of wind turbines.

Generic 95 MW LWECS

A generic 95 MW LWECS would have property value impacts similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would have the potential to negatively impact property values near the plant site and possibly along roads used to transport biomass. However, as with the Paynesville Wind Farm, impacts on property values due to a plant are difficult to quantify because of the multitude of factors that influence a property's market value. For example, if biomass for the plant were supplied by neighboring land parcels, these parcels might experience an increase in property value.

Mitigation

Because the plant is sited in one location, compared to multiple turbine locations, property value impacts could be mitigated by proper siting.

6.12 Communication Signals

Large electric generation facilities have the potential to impact electronic communications (e.g., radio, television, internet, cell phone, microwave). This section discusses potential impacts to communications from the operation of a generation facility in the Project area.

Paynesville Wind Farm

Wind turbines can cause interference with electronic communications by obstructing the reception of communication signals. Digital signals (e.g., digital television, internet, cell phones) are not impacted by wind turbines unless the turbines directly obstruct the signal, i.e., are in the line-of-sight.[108] Analog signals (e.g., AM and FM radio, microwaves) can be interfered with by direct obstruction and by indirect signal interference, e.g., ghosting of television pictures, signal fading.

Potential communications impacts due to the Paynesville Wind Farm are anticipated to be minimal. Digital television facilities provide signals to the Project area (e.g., Minneapolis, Big

[106] *Id.*
[107] *Id.*
[108] Post Digital Television Transition - The Evaluation and Mitigation Methods for Off-Air Digital Television Reception in-and-around Wind Energy Facilities, http://www.comsearch.com/files/Wind_Energy_White_Paper.pdf.

Woods, Bemidji).[109] Multiple signals reduce the potential for television impacts. FM radio is not impacted by wind turbines or transmission facilities; AM radio can be impacted near transmission facilities, e.g., signal fading underneath a transmission line.

Global positioning systems (GPS) use satellite signals to determine locations on the earth's surface and are commonly used to guide agricultural operations.[110] Because GPS uses multiple digital satellite signals, interference with the signals or subsequent uses is not anticipated. Obstruction of any one satellite signal would require direct line-of-sight obstruction due to a wind turbine. Such an obstruction would be temporary (i.e., there is concurrent GPS receiver movement, satellite movement, and wind turbine blade movement such that the obstruction would be resolved).

There are two microwave beam paths crossing portions of the Project area (Figures 4, 5, and 6).[111] Wind turbines can impact microwave communications by interfering with these beam paths (e.g., wind turbine blade slicing through a beam path). Thus, turbines need to be located within the Project area such that they do not obstruct microwave beam paths.[112]

Wind turbines may impact radar systems, e.g., radar used for aviation, if they are in the radar line of sight.[113] Impacts may include an impairment of the ability to detect and track aircraft. Impacts can be mitigated by avoiding the placement of wind farms in radar lines of sight.[114] The U.S. Department of Defense is responsible for compatibility of wind farms with military radar installations; the Federal Aviation Administration is responsible for compatibility with commercial aviation radar.[115]

Mitigation

Impacts to electronic communications due to the Paynesville Wind Farm are not anticipated. Potential impacts to microwave beam paths can be mitigated by proper wind turbine siting.

Generic 95 MW LWECS

A generic 95 MW LWECS would have communications impacts similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would have communications impacts less than the Paynesville Wind Farm. A biomass plant would be shorter in height than the Project's wind turbines and sited in one location (as opposed to multiple turbine locations). If the biomass plant location is well chosen, the plant would not impact electronic communications.

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[109] Minnesota – Full Powered Digital TV Channel Assignments, http://www.global-cm.net/FULL%20POWER%20DIG%20TV%20BY%20CH%20-%20MN.pdf.
[110] Precision Farming Tools: Global Positioning Systems (GPS), Virginia Cooperative Extension, http://www.pubs.ext.vt.edu/442/442-503/442-503.html.
[111] Site Permit Application, Section 5.5.2.
[112] *Id*.
[113] U.S. Department of Defense, The Effect of Windmill Farms on Military Readiness, 2006, http://www.defense.gov/pubs/pdfs/WindFarmReport.pdf.
[114] *Id*.
[115] *Id*.

6.13 Wildlife and Domesticated Animals, Including Wildlife Habitat

Large electric generation facilities have the potential to impact natural resources, including flora, fauna, habitat, soils, and water. This section discusses potential impacts to wildlife, wildlife habitat, and domesticated animals due to the operation of a generation facility in the Project area.

Wildlife Habitat
The Project area is dominated by agricultural lands and remnant native communities, such as native prairie and wetlands. The area lies in a major migratory flyway and serves as resting, feeding, and nesting areas to permanent and migratory wildlife species.

Ecological Setting
The Project is located at the intersection of the Minnesota River Prairie subsection and the Hardwood Hills subsection of the Ecological Classification System.[116] Subsection boundaries delineate a significant regional change in geology, topography, and vegetation. The Minnesota River Prairie subsection consists of gently rolling ground moraine. Loamy ground moraine (till plain) is the dominant landform, but end moraines and lake plains also occupy a significant area. Ground moraine topography is level to gently rolling and is underlain by thick glacial drift ranging from 100 to 400 feet deep. The Hardwood Hills subsection consists of steep slopes, high hills, and lakes formed in glacial end moraines and outwash plains. The Alexandria Moraine Complex forms the western and southern boundaries of this subsection. Kettle lakes frequent the landscape.

This ecological area represents a transition zone between prairies and forest, with lake and wetland complexes, and provides a diverse habitat for a range of wildlife species. The area is also a major migratory corridor for forest birds and waterfowl.

Soils
Borolls and Aquolls are the dominant soils in the Project area. The diverse underlying bedrock is covered by 100 to 400 feet of glacial till, most of which is calcareous loamy sediment. Soils range from loamy sands to clay loams and are moderately well drained. [117]

Surface Waters and Wetlands
Surface water and floodplain resources for the Project area were identified by reviewing U.S. Geological Survey topographic maps and Minnesota Public Waters Inventory (PWI) map. Major surface waters located within the Project area are part of the Sauk River Watershed, which is a tributary to the Sauk River and the North Fork Crow River Watershed which is a tributary to the Crow River (Stearns County 2009).[118] Also within the Project area are a number of unnamed intermittent and perennial streams that are designated waters of the United States. A portion of one PWI Wetland is located within the Project area, but no PWI lakes are located within the

[116] Site Permit Application, Section 5.12.
[117] Site Permit Application, Section 5.13.
[118] Site Permit Application, Section 5.15.

Project area. Figure 3 shows the locations of surface waters and Minnesota Public Waters within the Project area. There are no 100-year floodplains within the Project area.

Wetlands near the Project area were identified by reviewing National Wetland Inventory (NWI) Maps and Minnesota PWI Maps. Some of the wetlands are associated with creeks and unnamed intermittent streams within the site and some of the wetlands are isolated basins.

Vegetation

Pre-settlement vegetation in the area was predominately prairie with scattered forests and wetlands.[119] Upland forests were common in river valleys. Currently, the Project area is mostly disturbed agricultural lands. While no areas of native prairie are mapped within the Project area, one mapped area of intact mesic prairie and one area of wet meadow are indicated adjacent to the Project area.[120] The areas of intact mesic prairie and wet meadow are located in the Lake Henry WPA and will not be impacted by the Project.

Wetlands have historically been ditched and drained in agricultural areas. Only a small fraction of the original prairie, wetlands, and upland forests remain as relic habitats due to ditching and tiling.[121] Trees were planted by landowners for shelter belts (windrows and homestead groves) or were established by natural means – transported to the area by animals, birds or winds (wooded ravines).[122] The grassland and wetland areas at the site may contain potential remnant native prairie areas.

Paynesville Wind Farm

The Project area is representative of both the Hardwood Hills and Minnesota Prairie Subsections with 80 percent of the area in agricultural use and the remaining 20 percent comprising all other land cover types (wetlands, forest, and water). Figure 2 represents land cover within the project area.

Soils will be disturbed during construction of the Project. Construction of the wind turbines and access roads will increase the potential for soil erosion during construction and convert prime farmland from agricultural use to industrial use. The exact amount of prime farmland that will be converted to wind turbines, transformer pads, and access roads will be determined once the site layout has been finalized.

Construction of the wind turbines, transformer pads, and access roads will disturb land within the Project area. The wind turbines, step-up substation, and an O&M building will likely be built on higher elevations, which will avoid lakes and streams located in the lower positions in the landscape. Access roads, electrical power lines, and underground cabling will be designed to minimize impacts to streams.

[119] Minnesota Department of Natural Resources, Tomorrow's Habitat for the Wild and Rare (2006).
[120] Site Permit Application, Section 5.17.
[121] *Id*.
[122] *Id*.

There are a total of 784 acres of NWI wetlands in the Project area and 35.54 acres of PWI wetlands located within the Project area.[123] In the preliminary turbine layouts (figures 4, 5, and 6), turbines are not currently sited in wetlands and no impacts to wetlands are anticipated. Surface waters for locations of wetlands within the site are shown in Figure 3.

The Project will impact wildlife habitat. A small portion of vegetation, primarily agricultural land (approximately 40-60 acres depending on turbine size and layout) would be permanently removed and replaced by wind turbines, access roads, and substation components. Construction of an O&M facility could permanently remove land from agricultural use. Additional areas may also be temporarily disturbed for the installation of underground power lines during construction. Approximately three acres of land will be temporarily impacted for contractor staging and lay down areas.

If native prairie is identified during pre-construction inventories of sites for turbine and associated facilities, a prairie management plan would be prepared.

Mitigation
Mitigation for potential impacts to soils, surface waters and wetlands, and vegetation is addressed below.

Soils
The Application must obtain a National Pollutant Discharge Elimination System (NPDES) permit application to discharge storm water from construction facilities from the MPCA. Best Management Practices (BMP) 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.

Surface Waters and Wetlands
If the Project will impact waters of the U.S. or Minnesota Public Waters, the Applicant must apply for the necessary permits prior to construction. Access roads constructed adjacent to streams and drainage ways will be designed in a manner so runoff from the upper portions of the watershed can flow unrestricted to the lower portion of the watershed. A Storm Water Pollution Prevention Plan (SWPPP) will be prepared and an NPDES permit will be obtained prior to the construction of the Project.

Formal wetland delineations of the Project area will be completed prior to construction, and the layout will be designed to avoid and minimize wetland impacts. Wetlands will be avoided to the extent possible during the construction phase of the Project. If wetland impacts cannot be avoided, the Applicant must submit Section 404 and Minnesota Wetland Conservation Act permit applications to the U.S. Army Corps of Engineers and the state prior to construction. LWECS site permits issued by the Public Utilities Commission do not allow turbines to be placed in wetlands.

[123] Site Permit Application, Section 5.16.1.

Vegetation
Temporarily disturbed areas will be reseeded to blend in with existing vegetation. The turbines will avoid forests and groves to maximize turbine output and reduce tree removal. Avoidance and minimization of impacts to wetlands and native prairies will reduce impacts to those vegetated areas.

LWECS site permits typically require that 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 DNR.

95 Generic MW LWECS
A generic 95 MW LWECS located elsewhere in Minnesota could have impacts to natural resources similar to those of the proposed project. Depending on site characteristics and natural resources, impacts would be greater or less than the Paynesville Wind Farm. Impacts to soils and waters are primarily due to construction activities. Construction practices can be modified to prevent soil loss and erosion that could directly impact water quality.

35.6 MW Biomass Plant
A 35.6 MW biomass plant would be expected to have similar impacts on natural resources as the proposed project depending natural resources on and near the project site. Siting of the biomass plant utilizing construction practices that minimize impacts to soil and surface water would likely mitigate impacts.

6.13.1 Wildlife

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

Numerous Wildlife Management Areas, Waterfowl Production Areas, and a Scientific and Natural Area are located within five miles of the Project (Table 5). Approximately, 80 percent of the Paynesville Wind Farm is cropland (Figure 2). Scattered patches of wetlands and forest comprise the remaining wildlife habitat in the Project area.

Table 5: Wildlife Management Areas, Waterfowl Production Areas, and Scientific and Natural Areas within Five Miles of the Project Boundary

MN DNR Wildlife Management Areas	Distance from Project Boundary (miles)
Zion Wildlife	Adjacent
Miller Spring Lea Farm	Adjacent
Salem Community Prairie Wildlife	Adjacent
Spirit Prairie	Adjacent
Roseville	0.5
Patters	2
Regal Flats	2.5
Stearns Prairie Heritage	3.5
Tribute	3.5
Paynesville Sportsman's Club	4.75
U.S. Fish and Wildlife Service Waterfowl Production Areas	
Bauman	Adjacent
Lake Henry	Adjacent
Zion Wildlife	Adjacent
Roscoe	2
Spring Hill	4
Lake George	4
Saint Martin	4.74
Scientific Natural Areas	
Roscoe Prairie	1.25

Paynesville Wind Farm

The Paynesville Wind Farm would negatively impact select wildlife in the Project area. Impacts to wildlife from construction would likely be minimal as turbines and access roads would be located in land currently used for agriculture. The physical footprint of a wind turbine is relatively small. Direct land use for the Project is anticipated to be approximately 40 to 60 acres (turbines, access roads, operation and maintenance building).[124] This is less than 1 percent of the estimated 15,297 acres of the Project area.

Impacts on ground species due to operation of the Project would be minimal. However, there would be negative impacts to avian species, i.e., birds and bats. Birds can collide with spinning

[124] Site Permit Application, Section 5.2.2.

turbine blades. Bats can avoid turbines blades, but appear to suffer injury to their respiratory systems when they fly through low pressure wakes near turbine blades.[125]

Birds

Various migratory and resident bird species utilize the Project area as a part of their life cycle. Migratory bird species are those that may use the Project area for resting, foraging, or breeding activities for only a portion of the year. Resident bird species occupy the proposed Project area throughout the year. Two general types of local impacts have been documented at existing wind facilities: (1) direct mortality from collisions, and (2) indirect impacts from avoidance of an area, habitat disruption, reduced nesting/breeding density, habitat abandonment, loss of refugia, habitat unsuitability, and behavioral effects.[126]

Studies conducted throughout the Midwest have attempted to quantify bird and bat mortality due to wind turbines. A study of bird mortality rates at a wind farm in Iowa resulted in estimated mortality rates between 0.3 and 0.8 birds per turbine per year.[127] This estimate is similar to results from studies in other states where mortality rates ranged between less than 1.0 to 2.83 birds per turbine per year.[128] Studies conducted in the Buffalo Ridge region of southwestern Minnesota resulted in estimated bird mortality rates between 1.0 and 4.5 birds per turbine per year.[129] Nocturnal migrants suffered relatively more mortalities; local grassland species suffered relatively less. The studies noted that birds tend to avoid turbine towers, but utilized surrounding habitat. A study conducted for the Bitter Root Wind Project (proposed to be located in Yellow Medicine and Lincoln County, Minn.) found that passerines (perching songbirds) are relatively more likely to suffer mortalities due to wind turbines while waterfowl are less vulnerable to turbine collisions.[130]

Nationwide, bird mortality rates vary, but are generally in the range of 1 to 4 bird fatalities per MW per year.[131] Migratory songbirds comprise about 75 percent of these fatalities.

Overall, studies of bird mortalities near wind farms indicate that mortalities will occur and that they will vary with bird type (e.g., passerine) and bird use (habitat). Due to the project being in the Mississippi flyway, the number of state and federal wildlife management areas, and riparian and wetland complexes within and adjacent to the Project area, it is possible that bird fatalities,

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[125] Extreme Pressure Changes near Blades Injures Bat Lungs, http://www.ucalgary.ca/news/aug2008/batdeaths.
[126] National Wind Coordinating Collaborative, Wind Turbine Interactions with Birds, Bats, and their Habitats (Spring 2010).
[127] Aaftab Ashok Jain, Master's Thesis: Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm (2005), http://www.batsandwind.org/pdf/Jain_2005.pdf.
[128] *Id*.
[129] Avian Monitoring Studies at the Buffalo Ridge, Minnesota Wind Resource Area: Results of a 4-Year Study, http://energyfacilities.puc.state.mn.us/documents/AvianMonitoringBuffaloRidge.pdf [hereafter Buffalo Ridge Studies].
[130] Wildlife Studies for the Bitter Root Wind Resource Area, Yellow Medicine and Lincoln Counties, Minnesota, April 2009, Application for a Site Permit, 138 MW Buffalo Ridge Wind Farm Project, Appendix F, http://energyfacilities.puc.state.mn.us/documents/25538/Appendix_%20F_Wildlife_Studies.pdf.
[131] National Wind Coordinating Collaborative, Wind Turbine Interactions with Birds, Bats, and their Habitats (Spring 2010).

particularly migratory songbirds, would be significantly impacted. It is not known how fatalities will impact populations.

Bats

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 myotis (*Myotis septentrionalis*), eastern pipistrelle (*Pipistrellus subflavus*), and little brown bat (*Myotis lucifiugus)*. Bats are categorized as wither cave bats or tree bats, depending on their strategy for overwintering. Cave bats mostly congregate in large hibernacula such as caves and abandoned mines. Tree bats are generally solitary and migrate in early spring in late fall. Results from recent Wisconsin mortality studies have shown a more even split between tree and cave bat fatalities, which may be due to the proximity to cave hibernacula.[132]

Bat mortality has exceeded bird mortality at most wind farms where post-construction monitoring of both species has been conducted.[133] Many species of bats are long lived and have low reproductive rates.[134] If mortality rates from collisions with wind turbines are similar for birds and bats, there is a greater potential for impacting bat populations. Bat Conservation International estimates that more than 50 percent of American bat species are in decline. As the number of wind projects increase, cumulative impacts increase. Bat studies at an Iowa wind farm estimated bat mortality rates between 6 and 9 bats per turbine per year.[135] A Buffalo Ridge study estimated bat mortality rates at 2.2 bats per turbine per year.[136] Estimated bat mortality rates at wind farms have been lower in the Midwest than estimates for wind projects in the eastern United States.

Bat activity in the Project area is unknown. Wetland and forested habitat that support bat roosting and feeding is present in and adjacent to the Project area. Bat mortality will certainly occur, but it is not possible to predict the level and magnitude of bat mortality for this project or on bat populations.

Mitigation

Impacts to ground animals are expected to be minimal and mitigation is not required. Impacts to birds and bats are less understood and may be mitigated through micro-siting or turbine curtailment. Siting wind turbines away from bird habitat (grasslands, riparian areas) and bat feeding areas (forest, riparian areas) would reduce bird and bat mortalities. Additionally, weather patterns may factor into bird and bat activity and may be a predictor of fatality.

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[132] Glacier Hills FEIS.
[133] *Id*.
[134] National Wind Coordinating Collaborative, Wind Turbine Interactions with Birds, Bats, and their Habitats (Spring 2010).
[135] Aaftab Ashok Jain, Master's Thesis: Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm (2005), http://www.batsandwind.org/pdf/Jain_2005.pdf.
[136] Bat Interactions with Wind Turbines at the Buffalo Ridge, Minnesota Wind Resource Area, November 2003, http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=404&RaiseDocID=000000000001009178&RaiseDocType=Abstract_id.

Mitigation focusing on high risk periods may reduce bat fatalities significantly.[137] Increasing cut-in speed or by using SCADA system controls to implement a higher cut-in speed may also mitigate fatalities.[138]

Generic 95 MW LWECS

A generic 95 MW LWECS located elsewhere in the same ecological sub-sections of the proposed project would likely have similar impacts on wildlife. Information on local bird and bat populations in Minnesota is incomplete and predicting impacts on populations is inconclusive.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would have wildlife impacts similar to the Paynesville Wind Farm, and fewer impacts on avian and bat species, if built in agricultural land. Approximately 80 acres would be needed for a biomass plant. This acreage would be removed from use as wildlife habitat. Impacts from operation of the plant would be minimal. Emissions from the plant (e.g., hazardous air pollutants) could, through impacts to the environment, impact wildlife, although the extent of this impact is uncertain.

6.13.2 Domesticated Animals

Large electric generation facilities have the potential to impact domesticated animals (pets, livestock). This section discusses potential impacts to domesticated animals as a result of the operation of a generation facility in the Project area. Potential impacts to wildlife are discussed in Section 6.13.1.

Generation facilities that impair ecosystem functions can also negatively impact health of domesticated animals through emissions of hazardous air pollutants. Potential ecosystem impacts due to generation facilities are discussed elsewhere in this report (sections 6.1 and 6.2 discuss air pollutants).

Other potential impacts to domesticated animals health include annoyance or stress. Stress may result from a variety of impacts related to generation facility operations, such as lights, noise, and electrical shock. Impacts from shadow flicker are discussed in Section 6.3 and noise impacts are discussed in section 6.10.

Large-scale animal production has been a growing component of the agricultural industry in recent years. Feedlots used for the confined feeding, breeding, or holding of animals are a common practice for animal production. There are 2,469 feedlots, either registered or required to be registered, in Stearns County.[139]

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[137] National Wind Coordinating Collaborative, Wind Turbine Interactions with Birds, Bats, and their Habitats (Spring 2010).
[138] Effectiveness of Changing Wind Turbine Cut-In Speeds to Reduce Bat Fatalities at Wind Facilities, April 2009, http://www.batsandwind.org/pdf/curtailment_2008_final_report.pdf.
[139] Site Permit Application, Section 5.10

Stray voltage or induced voltage could cause electrical shock.[140] Stray voltage is a grounding issue that can occur on the electric service entrances to structures from distribution lines. Stray voltage exists between the neutral wire of the electrical service entrance and objects connected to the ground to prevent voltage buildup (grounded) in buildings, such as barns and milking parlors. Stray voltage may also occur in enclosed areas between two grounded objects. Induced voltage can occur from an electric field when a transmission line is coupled with a conductive object, such as a vehicle or a metal fence, which is in close proximity to the transmission line. This would induce a voltage on the object, which is dependent on many factors, including the weather, object shape, size, orientation, and location.

Stray voltage has been raised as a concern on dairy farms because of its potential to impact dairy cattle and milk production. Impacts, if they occur, are typically related to the grounding of electrical service to the farm (distribution lines) or on-farm electrical wiring. Stray voltage is discussed in Section 6.6.

Paynesville Wind Farm

Livestock in and adjacent to the Project area would be exposed to noise and shadow flicker created by wind turbines. Exposure levels would depend on factors such as grazing, housing, and on the distance between livestock and the turbines. Health impacts from turbine noise and shadow flicker are uncertain. Information about impacts to livestock is anecdotal and indicates that livestock are not impacted by turbine operations. Grazing animals appear to graze near, under, and up to turbine towers.

The Paynesville Wind Farm does not include distribution lines to residences but does include transmission lines. The transmission line proposed for this Project, depending on its location, may or may not parallel distribution lines. Thus, it is uncertain whether they would induce any stray voltage. Similarly, it is uncertain whether the transmission lines would parallel ungrounded metal objects such that they would produce an induced voltage. Due to the relatively low population density in the Project area (and associated low density of built infrastructure), health impacts to animals from stray or induced voltage are not anticipated.

Mitigation

Stray and induced voltage can be mitigated by proper grounding of facilities (e.g., buildings, fences, distribution line structures).

Generic 95 MW LWECS

A generic 95 MW LWECS located elsewhere in Minnesota would likely have potential impacts to domesticated animals similar to the Paynesville Wind Farm. However, if the generic 95 MW LWECS were to be located in an area with less population, there may be fewer domesticated animals that could potentially be impacted.

35.6 MW Biomass Plant

A 35.6 MW biomass plant could have fewer impacts to domesticated animals than those of the Paynesville Wind Farm. Biomass plant operations would create noise and lighting that could

[140] *See* Brookings DEIS, Section 6.2, *available at* http://energyfacilities.puc.state.mn.us/resource.html?Id=25589.

impact animal health. Additionally, the plant could have similar potential for issues associated with stray or induced voltage. However, the plant could be sited away from animals (e.g., livestock operations) to minimize impacts. A biomass plant represents a concentrated impact that can be moved away from animals whereas wind turbines represent a diffuse impact that exists within landscapes utilized by animals.

6.14 Aviation

Large electric generation facilities have the potential to impact aviation. This section discusses potential impacts to aviation from the operation of a generation facility in the Project area.

Paynesville Wind Farm

Due to their height, wind turbines have the potential to impact aviation. Wind turbines in the Paynesville Wind Farm will require notice to and evaluation by the Federal Aviation Administration (FAA)[141] and the Minnesota Department of Transportation (MN DOT).[142] Airports near the Project are listed in Table 6.

Table 6: Airports within 15 Miles of the Project Area

Name of Airport	Location	Distance From Project Boundary (Miles)
Paynesville Municipal	Paynesville, MN	2.3
Empire Valley	Paynesville, MN	8.3
Skalicky Airstrip	Albany, MN	13.2
Don's Landing Field	Watkins, MN	14.6
Pagel's Field	Atwater, MN	14.4
Tyler Farms	Watkins, MN	14.2
Brooten Municipal	Brooten, MN	14.4
Sauk Centre Municipal	Sauk Centre, MN	15.1

Wind turbines could impact local aviation operations, such as aerial crop dusting, and make them more difficult. Pilots making such applications would have their attention divided between aircraft systems, spraying requirements, weather conditions, and obstructions.[143] Additionally, when operating, wind turbines create turbulence wakes which would make aircraft operation difficult. However, aerial crop applications are typically made during low wind conditions. In these conditions, wind turbines would not be turning or creating turbulence wakes.

[141] FAA Advisory Circular AC 70/7460-2K, HTTP://RGL.FAA.GOV/REGULATORY_AND_GUIDANCE_LIBRARY/RGADVISORYCIRCULAR.NSF/0/22990146DB0931F186256C2A00721867/$FILE/AC70-7460-2K.PDF

[142] Minnesota Department of Transportation, Tall Towers, Minnesota Structure Height Regulations, http://www.dot.state.mn.us/aero/avoffice/talltowers.html.

[143] Glacial Hill FEIS, Section 5.4.2.2. Aerial crop sprayers in Wisconsin adopted a resolution in 2009 refusing to provide services within wind farm projects.

Concerns have been raised about the impacts of wind farms on emergency air transport. Officials at the Mayo Clinic in Rochester, Minnesota, have noted that impacts on helicopter operations due to wind projects in the area have been insignificant.[144]

Mitigation

Potential impacts to aviation can be mitigated by proper siting of the Project and adherence to FAA and MN DOT regulations. Impacts to aerial crop spraying would be difficult to mitigate.

Generic 95 MW LWECS

A generic 95 MW LWECS located elsewhere in Minnesota would likely have aviation impacts similar to the Paynesville Wind Farm.

35.6 MW Biomass Plant

A 35.6 MW biomass plant would have aviation impacts less than the Paynesville Wind Farm. A biomass plant would be significantly shorter and located on a single site. Thus, its potential to disrupt aviation would be minimal.

[144] Mayo: Turbines do not hamper medical helicopters, Rochester Post-Bulletin, May 18, 2010, http://www.postbulletin.com/newsmanager/templates/localnews_story.asp?z=2&a=452955.

7.0 Required Permits

The Paynesville Wind Farm will require permits and approvals from entities other than the Minnesota Public Utilities Commission. Federal, state, and local permits or approvals that have been identified for construction and operation of the Project are listed in Table 5.

Table 7: Permits and Approvals[145]

Agency	Type of Approval
Federal	
Federal Aviation Administration	Notice of Proposed Construction or Alteration; Determination of No Hazard
U.S. Fish and Wildlife Service	Consultation and Project Review Regarding Threatened and Endangered Species
U.S. Army Corps of Engineers	Wetland (Section 404) Permit
Federal Energy Regulatory Commission	Exempt Wholesale Generator Status
State of Minnesota	
Minnesota Public Utilities Commission	Certificate of Need; LWECS Site Permit
Minnesota State Historical Preservation Office	Cultural and Historic Resources Review
Minnesota Board of Water and Soil Resources	Wetland Conservation Act Approval
Minnesota Department of Natural Resources	Pubic Water Works Permit
	License to Cross Public Lands and Waters
	Consultation and Project Review Regarding Threatened and Endangered Species
Minnesota Pollution Control Agency	NDPES Stormwater Permit for Construction
	License for Small Quantity Generator of Hazardous Waste
	State Water Quality (Section 401) Certification

[145] Potential permits and approvals required for the Paynesville Wind Project. Adapted from Site Permit Application, Section 6.0.

Agency	Type of Approval
Minnesota Department of Health	Water Well Permit (for O&M building)
Minnesota Department of Transportation	Driveway Permit, Utility Access Permit, Highway Access Permit, Work Within Right-of-Way Permit
	Oversize and Overweight Vehicle Permit, Single Trip Permit
	Tall Towers Permit
Local Permits	
Stearns County	Building Permits for O&M building, Conditional Use Permits for transmission lines and substations
	Moving Permit, Access Drive and Entrance Permit, Utility Permit, Work Within Right-of-Way Permit or Excavation Permit
	Wetland Permit, Septic System Permit
Townships	Township Approvals