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

February 21, 2006

Amended March 10, 2006

PPM Energy
A ScottishPower Company

MinnDakota Wind Project – Lincoln, Minnesota

PUC Docket Number: E6530/WS-06-157

HDR

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Prepared for:

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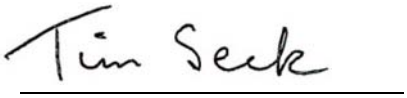
Signature: 

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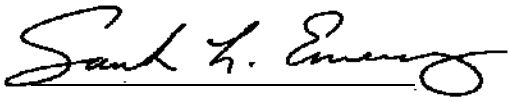
Signature: 

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1.0 INTRODUCTION

MinnDakota Wind, LLC is submitting this application for a site permit to construct and operate the MinnDakota Wind Project (the Project) to the Minnesota Public Utilities Commission (PUC). MinnDakota Wind, LLC is an unregulated wholly owned affiliate of PPM Energy, Inc. (PPM). The Project is a large wind energy conversion system (LWECS), as defined in the Wind Siting Act, Minnesota Stat. §116C.691. The portion of the Project proposed for location in Lincoln County, Minnesota (Figure 1-1) will be up to 100 megawatts (MW) in size, consisting of up to 66 wind turbine generators. The balance of the Project will be located in South Dakota. PPM has not made a final selection on turbines for the Project and proposes to permit the Project for a range in turbine size from 1.5 to 3.0 MW. The application uses the General Electric (GE) 1.5 MW machine as a representative turbine for the 1.5 MW Class. The application uses the Vestas 3.0 MW machine as a representative turbine for the 3.0 MW Class. Together these two turbines span the spectrum of the turbine models in the 1.5 to 3.0 MW range. PPM may elect to select turbines by other turbine vendors in the 1.5 to 3.0 MW range. Associated facilities include gravel access roads, Project Substation, Operations and Maintenance building, and wind farm electrical collection system. A dual-circuit 34.5-kV overhead power line will bring energy from turbines located in South Dakota to the Project Substation. The Project was selected by Xcel Energy through the Minnesota PUC-approved 2001 All Source Request for Proposal (RFP) to fulfill Xcel's obligations under Minnesota Stat. §216B.2423, subp. 2. The Project is expected to come online in 2007 to coincide with the transmission upgrades in the area.

PPM develops environmentally responsible generation in the United States. PPM owns and operates or markets the output for over 800 MW of renewable energy generation capacity. PPM owns the 51 MW Moraine Wind Project located in Pipestone and Murray Counties in Minnesota and the 100 MW Trimont Wind Project in Jackson and Martin Counties in Minnesota. PPM also owns the 44 MW Flying Cloud Wind Project in Dickinson County, Iowa and additional wind facilities in New York, Kansas, Colorado, Oregon, and California. PPM owns gas storage and gas-fired generation facilities in the western United States. PPM is headquartered in Portland, Oregon.

Consistent with the PUC objectives, PPM is committed to optimizing the wind resource for the Projects. All decisions with respect to equipment selection, site layout, and spacing are designed to make the most efficient use of land and wind resources. PPM will evaluate the site to optimize wind resources, transmission interconnection opportunities, and economic factors, while avoiding and minimizing impacts to environmental resources. The turbine selected for the Project will be dependent on the most appropriate technology available at the time of ordering equipment prior to construction. The electrical interconnection facilities will be constructed by Xcel Energy.

1.1 PROJECT SUMMARY

Through the 2001 All Source RFP process, Xcel Energy selected PPM to supply 150 MW of wind generation. As with its previous projects, it is anticipated that PPM will design, construct, finance, operate, and maintain the Project. PPM expects to initiate construction as early as 2006 and complete construction of the Project by the end of 2007.

1.1.1 PROPOSED SITE

The MinnDakota Project extends from Lincoln County, Minnesota into Brookings County, South Dakota (Figure 1-1). The proposed wind Project would include up to 100 MW in Minnesota and up to 99 MW in South Dakota, for a total of up to 199 MW. The majority of the Project is proposed in Lincoln County with a portion extending into Brookings County. This LWECS Application will only address the facility in Minnesota.

In Minnesota, the Project is located in Lincoln County within the following townships (Figure 1-2):

- Verdi Township (T 109 N, R 46 W), Sections 1-18
- Drammen Township (T110 N, R46 W), Sections 6, 7, 13-15, 18-36
- Richland Township (T110 N, R 47 W), Sections 1, 12, 13, 24, 25, and 36
- Shaokatan Township (T111N, R 46 W), Sections 19, 30, and 31
- Lake Hendricks Township (T 111 N, R 47 W), Sections 24, 25, and 36

The 31,084-acre Project site lies west and north of Lake Benton (Figure 1-2). The Project's preliminary site layout for 100 MW is shown in Figure 1-3. See Section 3.0 for a description of the Project site.

1.1.2 PROJECTED OUTPUT

The Project will have a nameplate capacity of up to 100 MW. Assuming net capacity factors of approximately 39 percent, projected average annual output will be approximately 341,000 MWh. As with all wind projects, output will be dependent on final design, site-specific features, and equipment.

1.1.3 SITING PLAN

The turbines and associated facilities will be sited primarily on agricultural land in Lincoln County, Minnesota. PPM will prepare the final siting layout to optimize wind resources while minimizing the impact on land resources and potentially sensitive resources. The topography of the site and the selected turbine technology will dictate turbine spacing. A description of turbine technology is presented in Section 4.2.

MinnDakota Wind Project equipment will have a rotor diameter (RD) of 70.5 meters (m) (231 feet [ft]) to 82 m (269 ft) for a 1.5 MW turbine to 90 m (295 ft) for a 3.0 MW turbine. Turbine spacing (Table 1-1) internally within the Project site would range from 3 RD east-west spacing to 6 RD north-south spacing. The setback from the site perimeter and unleased lands would be 5 RD on the north-south axis and 2.5 RD on the east-west axis. PPM turbines would be setback at least 5 RD from existing wind turbines.

Table 1-1
Turbine Spacing Distances

Turbine Description	Internal East-West Spacing	Internal North-South Spacing	N-S Perimeter Setback	E-W Perimeter Setback
	3 RD	6 RD	5 RD	2.5 RD
1.5 MW Turbine with 70.5 m RD	212 m (694 ft)	423 m (1388 ft)	353 m (1156 ft)	176 m (578 ft)
1.5 MW Turbine with 80 m RD	240 m (787 ft)	480 m (1575 ft)	400 m (1312 ft)	200 m (656 ft)
3.0 MW Turbine with 90 m RD	270 m (886 ft)	540 m (1772 ft)	450 m (1476 ft)	225 m (738 ft)

The perimeter setback is slightly less than a quarter mile on the north-south axis and approximately a tenth of a mile in the east-west axis. Previous LWECS Site Permit requirements identify minimum setbacks from residences of 500 feet and setbacks from public or developed roads of 250 feet.

1.1.4 OPERATION AND MAINTENANCE

The Project is anticipated to be operational in the fourth calendar quarter of 2007. PPM will be responsible for the operation and maintenance of the wind farm for the life of the Project, which is anticipated to be a minimum of 20 years. PPM will manage the operation and maintenance (O&M) of the Facility. The nearest O&M facility that PPM owns is at the PPM Moraine Wind site located in Cameron Township, Murray County. PPM has three maintenance facilities within 200 miles of the MinnDakota site. PPM will construct a new O&M facility for the Project.

1.1.5 SITE CONTROL

PPM has site control on land sufficient to support the MinnDakota Project.

1.1.6 PERMITS AND LICENSES

PPM will obtain all permits and approvals that are necessary and not covered by this LWECS Site Permit. Permits and approvals for the Project are identified in Section 6.0.

1.1.7 DEVELOPMENT AND CONSTRUCTION

PPM and its engineering and construction contractors will perform or manage all development and installation activities. Specifically, PPM will:

- perform site resource analysis and siting
- undertake environmental review
- obtain specific permits and licenses for the Project

Under the oversight of PPM's engineering and construction management staff, the engineering and construction contractors:

- perform civil engineering for roads and turbine foundations
- construct foundations, towers, and transformers
- assemble and install wind turbines
- install the communication system, including supervisory control and data acquisition software and hardware, telephone and fiber-optic cable, and construct the electrical feeder and collection system

1.2 COMPLIANCE WITH THE WIND SITING ACT AND MINNESOTA RULES 4401

The Wind Siting Act requires an application for a site permit for a LWECS to meet the substantive criteria set forth in Minn. Stat. §116C.57, subd. 4. This application provides information necessary to demonstrate compliance with these criteria and the Minnesota Rules Chapter 4401. The siting of LWECS is to be made in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources (Minn. Stat. §116C.693).

The Wind Siting Rules (Minnesota Rules Chapter 4401) govern the contents and treatment of applications for LWECS site permits under the Wind Siting Act. To the extent available, PPM has presented information required by the Wind Siting Rules. In addition, sufficient project design, wind resource, and technical information have been provided for a thorough evaluation of the reasonableness of the proposed site as a location for the Project.

1.2.1 CERTIFICATE OF NEED

Under Minnesota Rules Chapter 4401.0450, subp. 2, a Certificate of Need (CON) is not required from the Minnesota PUC for the MinnDakota Wind Project. Under the rules, a CON is only required if the power

generated is sold on the open market or for projects not approved by the PUC. The Project was selected to supply power under an Xcel Energy, PUC-approved bidding process.

1.2.2 STATE POLICY

PPM will further the state policy (Minnesota Statute 116C.693) by siting the Project in an orderly manner compatible with environmental preservation, sustainable development, and the efficient use of resources. PPM is designing the Project to include closer spacing of turbines to maximize wind development while minimizing the use of land resources.

1.3 OWNERSHIP OF THE PROPOSED FACILITY

It is anticipated that the Project will be developed, owned, and managed by MinnDakota Wind, LLC an unregulated wholly owned affiliate of PPM. PPM and its engineering and construction contractors will perform all engineering, procurement, and construction of the wind farm.

It is anticipated that PPM will construct and own all equipment up to the low side of the busbar at the Xcel Energy Yankee Substation or other designated points of interconnection.

The local utility (Xcel Energy) or transmission provider typically owns and operates the interconnection facilities, including any new substation or transmission system upgrades on Buffalo Ridge, which may be necessary for the Project. The ownership and allocation of responsibility for costs, construction, and operations of interconnection and transmission facilities will be detailed in the Interconnection Agreement and Power Purchase Agreement (PPA). The interconnection study has been completed by the Midwest Independent Transmission System Operator (MISO) and an interconnection queue position has been assigned for the Project.

2.0 GENERAL DESCRIPTION OF THE PROPOSED FACILITY

2.1 WIND POWER TECHNOLOGY

As the wind passes over the blades of a wind turbine, it creates lift and causes the rotor to turn. The rotor is connected by a hub and main shaft to a gearbox, which is connected to a generator. Exact turbine models are subject to change to ensure selection of a turbine that is both cost effective and optimizes land and wind resources. PPM is proposing to use wind turbines in the 1.5 MW to 3.0 MW size range. If PPM selects a 1.5 MW turbine, up to 66 turbines would be used, while the selection of a 3.0 MW turbine would result in the use of up to 33 turbines. PPM proposes to finalize its turbine choice when it submits its final site plan to the PUC prior to construction.

The application uses the GE 1.5 MW machine as a representative turbine for the 1.5 MW Class. The application uses the Vestas 3.0 MW machine as a representative turbine for the 3.0 MW Class. Together these two turbines span the spectrum of the turbine models in the 1.5 to 3.0 MW range. PPM may elect to select turbines by other turbine vendors in the 1.5 to 3.0 MW range.

The GE Wind Energy 1.5 MW utility-grade wind turbine has a nominal nameplate rating of 1,500 kW. Each turbine will have an 80-meter (262 ft) hub height and 70 to 82 meter (231 to 269 ft) RD (Figure 2-1). The total turbine height from the ground to the tip of the blade in an upright position would be 115 m (378 ft) to 121 m (397 ft). The GE 1.5 MW turbine begins operation in wind speeds of 3 m/s (6.7 mph) and reaches its rated capacity (1.5 MW) at a wind speed of 11.8 m/s (26.4 mph). The turbine is designed to operate in wind speeds of up to 25 m/s (45 mph) and can withstand sustained wind speeds of over 45 m/s (100 mph).

On the other end of the size spectrum is the Vestas V90-100 3.0 MW turbine. The 3.0 MW turbines have a rating of 3,000 kW. Each turbine will have an 80 to 105 meter (262 to 345 ft) hub height and a 90 meter (295 ft) RD (Figure 2-1). The total turbine height from the ground to the tip of the blade in an upright position would be 125 m (410 ft) to 150 m (493 ft). The 3.0 MW turbine begins operation in wind speeds of 4 m/s (8.9 mph) and reaches it rated capacity (3.0 MW) at a wind speed of 15 m/s (33.6 mph). The turbine is designed to operate in wind speeds up to 25 m/s (45 mph) and can withstand sustained wind speeds of over 42.5 m/s (95 mph).

Each tower will be secured by a concrete foundation that can vary in design depending on the soil conditions. A control panel inside the base of each turbine tower houses communication and electronic circuitry. Each turbine is equipped with a wind speed and direction sensor that communicates to the

turbine's control system to signal when sufficient winds are present for operation. Both turbines feature variable-speed control and independent blade pitch to assure aerodynamic efficiency.

The electricity generated by each turbine is brought to a pad-mounted transformer where the voltage is raised (stepped up) to power a collection line voltage of 34.5 kV. The electricity is collected by a system of underground or overhead power collection lines within the Project site. Both power collection lines and communication cables will be buried in trenches or may be constructed as overhead lines on private property or public right-of-way (ROW). Typically, this infrastructure is run adjacent to the Project access roads or along public ROWs or easements. In cases where such infrastructure must be sited on property that is not governed by the existing wind easement and land lease options, PPM will obtain easements for the necessary property.

Each wind turbine will be accessible via all-weather gravel roads approximately 16 feet in width providing access to the turbines via public roads. At the point where the access and public roads meet, the communication and power lines will either rise from underground to overhead lines or continue as underground lines. In Minnesota, PPM anticipates having 3 to 4 miles of dual-circuit aboveground 34.5 kV transmission line and the rest of the collection lines will be underground unless the terrain or high-cost obstructions dictate that aboveground line be used for short stretches. The collection system delivers power to the Project Substation. From the Project Substation, the power will be transmitted via 34.5 kV lines to Xcel Energy's Yankee Substation. At the Yankee Substation the power from the Project will be transformed to 115 kV for delivery into the transmission grid. The Project Substation and interconnection into the Yankee Substation will conform to MISO standards. Figure 2-2 is a diagram of the path of energy from the wind farm to energy users. Figure 2-3 shows a typical wind farm facility layout.

2.2 WIND FARM PROJECT LAYOUT

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

The Project will consist of wind turbines in the 1.5 MW to 3.0 MW size range. If PPM selects a 1.5 MW turbine, 66 turbines would be used, while the selection of a 3.0 MW turbine would result in the use of 33 turbines. A preliminary 100 MW site layout based on 66 1.5 MW turbines is presented as Figure 1-3.

Wind-powered electric generation is entirely dependent on the availability of the wind resource at a specific location. The energy available from the wind is proportional to the cube of the wind velocity. In other words, a doubling of the wind velocity will increase the available energy by a factor of eight times. Analysis of wind direction data suggests that the optimal turbine string alignments are from west to east and from west-northwest to east-southeast. Turbine placement was designed to provide 3 RD crosswind

spacing and 6 RD downwind spacing between turbines. Design of the turbine array and collection system will minimize energy loss due to wind turbine wakes, turbulence, and electrical line losses.

In accordance with previous LWECS Site Permit requirements, PPM has incorporated setbacks of at least 500 feet from inhabited (not vacant or abandoned) residences and 250 feet from public roads. PPM will maintain an appropriate setback from inhabited residence to stay below the MPCA Nighttime Noise Limit of 50 dBA. Based on 1.5 to 3.0 MW turbines the setback from residences would range from 623 to 788 feet. PPM proposes a 5 RD setback from the perimeter along the north-south axis (downwind spacing) and a 2.5 RD setback from the perimeter on the east-west axis (crosswind spacing). PPM turbines would be setback at least 5 RD from existing wind turbines.

Table 2-1 identifies the most conservative setbacks applicable to the Project.

Table 2-1
Setback Distances for Wind Turbines

Turbine Description	N-S Perimeter Setback	E-W Perimeter Setback	Occupied Residences	Public Roads	Transmission
	5 RD (ft)	2.5 RD (ft)	500 ft minimum	250 ft minimum	400 ft minimum
1.5 MW Turbine with 70.5 m RD	1156 ft	578 ft	623 ft	250 ft	400 ft
1.5 MW Turbine with 80 m RD	1312 ft	656 ft	623 ft	250 ft	400 ft
3.0 MW Turbine with 90 m RD	1476 ft	738 ft	788 ft	250 ft	400 ft

2.3 ASSOCIATED FACILITIES

In addition to the wind turbines and the step-up transformers, the Project will include gravel access roads that allow for easy access to the wind turbines year-round. These roads will be approximately 4.9 meters (16 feet) wide and low profile to allow cross-travel by farm equipment. PPM will work closely with the landowners in locating access roads to minimize land use disruptions to the extent possible. Consideration will be taken in locating access roads to minimize impact on current or future row crop agriculture, grazing, and environmentally sensitive areas.

An O&M building will likely be constructed within the Project area. Please see Section 4.5.4 for a description of this facility.

The electricity generated by each turbine is stepped up by a pad-mounted transformer at the base of each turbine to power collection line voltage of 34.5 kV. The electricity generated at each turbine is collected by a system of underground or overhead power collection lines within the Project site and brought to the Project Substation. The power collection lines from the turbines will be trenched underground adjacent to the access roads, or they will cut across property to another turbine string. At the point where the access and public roads meet, the power collection lines will either rise from underground to overhead lines or continue as underground lines. In Minnesota, PPM anticipates having 3 to 4 miles of dual-circuit aboveground 34.5 kV transmission line and the rest of the collection lines will be underground unless the terrain or high-cost obstruction dictate that aboveground line be used for short stretches. The Project Substation will be adjacent to Xcel Energy's Yankee Substation. The electric energy collected at the Project Substation will be transmitted to Yankee Substation on 34.5-kV lines in accordance with Xcel and MISO guidance provided in the interconnection agreement.

At the Yankee Substation the power from the Project will be transformed to 115 kV interconnecting with the transmission grid.

PPM has constructed several temporary meteorological towers within the Project site boundaries. It is anticipated that the site will include one or two permanent meteorological towers to house an anemometer. The tower will be painted red on top and lighted to comply with Federal Aviation Administration (FAA) guidelines.

2.4 LAND RIGHTS

PPM has obtained wind rights and easements to support the MinnDakota Project. Land rights will encompass the proposed wind farm and all associated facilities, including but not limited to wind and buffer easements, wind turbines, access, transmission feeder lines located on public roads when necessary, and possibly land to mitigate environmental impacts incurred due to development. Where necessary, PPM will negotiate with landowners for placement of overhead transmission facilities.

3.0 PROPOSED SITE

3.1 IDENTIFICATION OF PROJECT SITE

In addition to wind resource considerations, the Project site was selected based on its close proximity to available transmission infrastructure, substation, and landowners' interest in participating in the Project. Land-use patterns and environmentally sensitive features were factored into the site selection criteria. The site boundary in Minnesota encompasses an area of approximately 31,084 acres. However, the land occupied by the wind farm would be less than one percent of this area, assuming up to 66 turbines and access roads. It is anticipated that the area of direct land use for 66 1.5 MW turbines and gravel access roads would be approximately 44 acres. If 33 3.0 MW turbines are used, approximately 32 acres of direct land use will be required for the turbines and access roads.

The approximate location of existing wind farms immediately adjacent to the Project is shown on Figure 5-3. There is some overlap with the site boundary and existing wind farms because there are available wind resources within the existing wind farm areas and additional land is needed to meet setback requirements. PPM has obtained wind rights for these areas. See Section 5.0 for a detailed description of the Project impacts and mitigation. Figure 1-3 shows preliminary turbine locations for a 100 MW layout of 1.5 MW turbines, which are subject to change during micrositing.

3.2 WIND RESOURCE AREAS – GENERAL

The United States Department of Energy (DOE) and the Minnesota Department of Commerce (DOC) have conducted wind resource assessment studies in Minnesota since 1982. In October 2002, the DOC published the latest "Wind Resource Analysis Program" (WRAP) report that presents wind analysis data from monitoring stations across the state of Minnesota. In the vicinity of the Project area, the mean annual wind speed at an elevation of 50 m (164 ft) is mapped as 7.66 to 8.00 m/s (17.13 to 17.90 mph). At an elevation of 70 m (230 ft) above ground level, mean annual wind speed is mapped as 7.66 to 8.05 m/s (17.13 to 18.00 mph).

PPM has reviewed and analyzed meteorological information for Buffalo Ridge and the Project site. This information is described below in Section 3.3.

3.3 WIND CHARACTERISTICS IN PROJECT AREA

PPM has several meteorological towers in the Project area that have been collecting data since August of 2002. To supplement the data from the Project site, historical data from the DOC meteorological site in Hatfield, located approximately 20 miles southeast of the Project area, were correlated with the wind data

from the Project site to provide a more robust data set. The Hatfield meteorological tower is at an elevation of 1,761 feet and the Project site is at an elevation of 1,747 to 1,992 feet.

WindPRO and WAsP software were used to analyze the available wind data from the Hatfield meteorological tower and make corrections for the site effects (topography, surface roughness, and obstacles) to produce a site-independent characterization of the local wind climate. The resulting local wind climate was applied in conjunction with the Project area site effects to predict the spatial wind variations at the Project site.

Various site layouts and wind turbine generator parameters can be tested to predict the energy production and array efficiency to optimize the site layout and turbine selection. Project site data has been compared to the long term Hatfield data and other regional wind measurements using a parallel time period. There is a good correlation between the long-term wind measurements and the short-term Project site wind measurements. Based on the available data, the Hatfield and MinnDakota sites can be judged as having similar wind climates.

3.3.1 INTERANNUAL VARIATION

Based on adjusted data from DOC's Hatfield site, the estimated average annual wind speed at the Project site from 1999 to 2002 was 8.1 m/s (18.1 mph), with a range of 7.9 to 8.4 m/s (17.7 to 18.8 mph), or a variation of approximately six percent.

3.3.2 SEASONAL VARIATION

The expected wind speed in the Project area at 65 meters is shown in Table 3-1. The strongest winds are typically during the transition months of April, 9.1 m/s (20.4 mph), and November, 8.8 m/s (19.7 mph). The summer months of July and August have the lowest average wind speeds of 6.7 and 7.0 m/s (15.0 and 15.7 mph), respectively.

Table 3-1
Estimated Wind Speed (m/s) at 65 meters in the Project Area

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Ann
1988	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	8.6	8.6	NA
1999	8.4	9.2	8.5	9.1	8.8	7.9	7.4	7.4	8.2	8.9	8.8	8.0	8.4
2000	8.4	8.2	7.7	8.6	8.5	8.3	5.8	6.8	8.0	7.6	8.6	7.9	7.9
2001	8.5	6.0	7.4	9.4	8.0	7.5	6.4	6.6	7.2	9.1	9.1	9.1	7.9
2002	7.7	10.1	8.5	9.3	8.5	8.4	7.0	7.1	8.0	7.3		8.4	8.2
2003	NA	8.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mean of Means	**8.3**	**8.4**	**8.0**	**9.1**	**8.5**	**8.0**	**6.7**	**7.0**	**7.8**	**8.2**	**8.8**	**8.4**	**8.1**

NA – data not available

3.3.3 DIURNAL CONDITIONS

Figure 3-1 shows the expected diurnal variations of wind speeds. Wind speeds are generally greatest during nighttime and early morning hours and decline at midday.

3.3.4 ATMOSPHERIC STABILITY

The atmospheric stability is defined by lateral fluctuation of the wind, or sigma theta. Stability level is characterized by sigma theta 0 to 2.5 degrees as stable, 2.5 to 7 as moderately stable, 7 to 9 as neutral, 9 to 15 as moderately unstable, and greater than 15 degrees as very unstable (these categories are from Meteorology and Atomic Energy, Slade D.H., 1968). The atmospheric stability at the site is stable to moderately stable (Table 3-2).

Table 3-2
Frequency of Stability Class

Stability Level	Frequency
Stable	42 %
Moderately Stable	42 %
Neutral	6 %
Moderately Unstable	6 %
Unstable	4 %

3.3.5 HUB HEIGHT TURBULENCE

The Turbulence Intensity (TI) is defined as the measured standard deviation of wind speed over an hour, divided by the mean for the same time period. For wind speeds greater than 5 m/s the expected TI at the Project is 10.3 percent. For wind speeds greater than 15 m/s, the expected TI at the Project is 9.8 percent.

3.3.6 EXTREME WIND CONDITIONS

The maximum hourly wind speed measured at DOC's Hatfield tower from November 1999 to 2001 was 25 m/s (56 mph). Using a conservative gust factor of 1.3, the expected highest one-second gust would have been 33 m/s (74 mph).

The extreme temperature range measured in Tyler, Minnesota is between 105 and -31 degrees Fahrenheit (°F). Glaze icing may occur up to two percent of the operating hours of the year for wind turbines.

3.3.7 WIND SPEED FREQUENCY DISTRIBUTION

Figure 3-2 presents a wind speed frequency distribution for the Project area. Wind speeds range from 4 to 11 m/s (9 to 25 mph) approximately 75 percent of the time, and from 6 to 10 m/s (13 to 22 mph) approximately 50 percent of the time.

3.3.8 WIND VARIATION WITH HEIGHT

Wind shear is the relative change in wind speed as a function of height. Wind shear is calculated using a power function based upon the relative distance from the ground.

The general equation used for calculating wind shear is $S/S0 = (H/H0)\alpha$, where S0 and H0 are the speed and height of the lower level and α is the power coefficient. The power coefficient can vary greatly due to the terrain roughness and atmospheric stability. The power coefficient will also change slightly with variation in height. The expected vertical variation with height or shear coefficient is 0.19. This is more conservative than the value measured on the DOC's Hatfield 90-meter tower. The vertical variation with height or shear coefficient is 0.29 for the 30 to 60 meter level at Hatfield and 0.25 for the 60 to 90 meter level.

3.3.9 SPATIAL WIND VARIATION

A map of the spatial variation of the wind in Minnesota has been prepared by the DOC. The model used to develop the map takes into account wind data, topography, and surface roughness characteristics. The map shows that well-exposed terrain in the Project area is in the 7.7 to 8.3 m/s (17.2 to 18.6 mph) range of wind speeds at 70 meters (229.7 feet).

Little variation is expected across the Project area, because of the relatively flat, open terrain. Wind speeds should be similar at all the tower sites proposed for this Project.

3.3.10 WIND ROSE

A wind rose is a graphical presentation that shows the various compass points, and specifies the frequency that the wind is observed to blow from a given compass point. Small-scale variations are expected at the proposed site depending on individual turbine height and exposure.

Figure 3-3 shows the expected energy rose for the Project area. The prevailing energy wind direction is SSE-SSW, with significant energy from the NW and NE sectors. The wind rose in the Project area has a higher predominance of southerly wind than the Hatfield area.

3.4 OTHER METEROLOGICAL CONDITIONS

3.4.1 AVERAGE AND EXTREME WEATHER CONDITIONS

The Project area has a subhumid, continental climate that is characterized by cold winters and hot summers. Summers provide long periods of sunshine and southerly winds bring warm, moist air from the Gulf of Mexico. In winter, the climate cools rapidly because solar insulation is reduced and northerly winds bring in cold, dry air from high latitudes. The climate of the Project area is quite uniform because there are no large bodies of water or sharply marked differences in topography within the area.

There is no existing long-term data available specifically for the Project site. However, the data from Tyler, Minnesota located 9 miles east of the Project site, should be representative of the site. Table 3-3 provides data on temperature and precipitation for the Project vicinity, as recorded at Tyler, Minnesota during the period 1971 to 2000. This period is assumed to be representative of the climate for the study area. In the winter (December to February), the average maximum temperature is 25 degrees Fahrenheit (°F), and the average minimum temperature is 7° F. The lowest temperature recorded at Tyler, Minnesota during the representative period is -31° F, which occurred on January 15, 1972. In the summer (June to August), the average maximum temperature is 80° F and the average daily minimum temperature is 58° F. The highest temperature recorded at Tyler, Minnesota during the representative period is 105° F, which occurred on August 15, 1988.

Table 3-3
Temperature and Precipitation

(Recorded in the Period 1971-2000 at Tyler, Minnesota)

Month	Temperature			Precipitation	
	Average Daily Maximum °F	Average Daily Minimum °F	Average °F	Average In	Average Snowfall In
January	22.7	4.3	13.5	0.66	6.5
February	27.1	9.6	18.3	0.57	4.8
March	38.7	21.1	29.9	1.64	5.8
April	55.1	33.7	44.4	2.36	3.5
May	69.5	46.3	57.9	3.44	0.0
June	78.4	55.4	66.9	4.11	0.0
July	83.5	60.8	72.1	3.33	0.0
August	80.4	58.6	69.5	3.08	0.0
September	71.0	48.6	59.8	2.52	0.0
October	57.7	35.9	46.8	1.98	0.3
November	39.1	22.5	30.8	1.60	7.8
December	25.1	8.2	16.7	0.64	6.1
Yearly					
Average	54.0	33.7	43.9		
Total	--			**25.93**	**34.7**

Source: Natural Resource Conservation Service, September 2002.

The total annual average precipitation is about 26 inches. More than 18 inches, about 70 percent, falls in April through September. Thunderstorms occur on about 44 days each year. Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent, are of short duration, and can result in damage to isolated areas. Hail occasionally falls in scattered small areas during the summer.

The average seasonal snowfall is about 35 inches. On average, 43 days of the year have at least one inch of snow on the ground. The number of such days varies greatly from year to year.

The National Climatic Data Center (NCDC) has records of 193 extreme weather events for Lincoln County for the period from January 1, 1950 to October 31, 2005. These events include thunderstorms, tornadoes, hail, heavy snow and ice, extreme cold, heat waves, and drought. Tornadoes and severe thunderstorms strike occasionally. The state of Minnesota sees approximately 15 to 20 tornadoes a year. The NCDC has records of 16 tornadoes and 56 thunderstorms and high wind events in Lincoln County

for the period January 1, 1950 to October 31, 2005. These storms are local in extent and of short duration. They result in damage to small geographic areas.

Hail occasionally falls in scattered areas during the warmer periods. Neither hail nor lightning from severe storms presents a problem for operation of the proposed development. Wind turbines, however, are not designed to survive tornado-force winds of over 89 m/s (200+ mph). In the winter, icing events are variable in frequency. It is expected that the average annual energy loss will be 2 percent due to icing.

3.5 ENERGY PROJECTIONS

3.5.1 PROPOSED ARRAY SPACING FOR WIND TURBINES

Wind turbines will be placed along higher elevation features at the site to provide maximum exposure to wind resources. The proposed internal array spacing for the 1.5 MW turbines at the Project is a minimum of 3 RD in an east-west direction (crosswind spacing) and a minimum of 6 RD in a north-south direction (downwind spacing). The spacing is dependent upon the selected equipment and the topography of the site. PPM will develop the site to minimize array wake losses and to optimize efficient use of wind and land resources.

3.5.2 BASE ENERGY PROJECTIONS

The Project will have a nameplate capacity of up to 100 MW. Assuming net capacity factors of approximately 39 percent, projected average annual output will be approximately 341,000 MWh. As with all wind projects, output will be dependent on final design, site-specific features, and equipment. Gross to net calculations take into account, among other factors, energy losses in the gathering system, mechanical availability, array losses, and system losses. An industry-wide estimate of energy losses ranges from 8 to 10 percent of maximum output.

3.6 COST ANALYSIS

PPM has estimated the cost for a large mid-continent wind farm to be approximately $1,400 to $1,600 per kW, pending final interconnection costs. For purposes of comparison, a service life of 30 years has been assumed in order to estimate annualized capital costs. The actual price that the Project will obtain from the sale of its energy and environmental attributes to Xcel Energy is proprietary and confidential.

4.0 ENGINEERING AND OPERATIONAL DESIGN ANALYSIS

This section provides a summary description of the Project, which includes a description of the Project layout, turbines, electrical system, and associated facilities. Additional information addressed in this section is Project construction, schedule, operation, and decommissioning of the site. PPM wishes to preserve the right to evaluate and select turbine equipment of varying sizes and outputs.

There are other turbines that are feasible choices for the MinnDakota site that are available from various manufacturers, and include turbines up to 3.0 MW in size. Turbine type may affect the number and configuration of the turbine array.

4.1 MINNDAKOTA WIND PROJECT LAYOUT AND ASSOCIATED FACILITIES

The Project will consist of an array of wind turbines, transformers, access roads, and an Operations and Maintenance (O&M) building. The turbines will be interconnected by communication and electric power collection cable within the wind farm. In addition, the wind farm facilities will include electrical lines that deliver the electricity to a Project Substation that will be connected to Xcel Energy's transmission system through Xcel Energy's Yankee Substation.

Land will be graded on-site for the turbine pads. Drainage systems, access roads, storage areas, and shop facilities will be installed as necessary to fully accommodate all aspects of the construction, operation, and maintenance of the wind farm.

The electrical system design and interconnection details will be determined as a result of studies and discussions with Xcel Energy and MISO. The electrical system will deliver the power to Xcel Energy's Yankee Substation. At the Yankee Substation, the electric voltage will be stepped up to transmission level voltage of 115 kV.

The Project includes a computer-controlled communications system that permits automatic, independent operation, and remote supervision, thus allowing the simultaneous control of the wind turbines. PPM will be responsible for the operation and maintenance of the Project. PPM may contract with suppliers of operations and maintenance services at the time of operation. PPM will maintain a computer program and database for tracking each wind turbine's operational history.

4.2 DESCRIPTION OF WIND TURBINES

PPM anticipates using up to 66 1.5 MW turbines. PPM seeks the flexibility to select the most appropriate technology at the time for the Project to ensure optimization of wind and land resources and cost efficiency. The preliminary site layout is 100 MW based on 66 1.5 MW wind turbines (Figure 1-3). PPM will update the site layout, consistent with the parameters laid out in the LWECS Permit, when equipment is selected and if information regarding the wind resource identifies opportunities to further optimize the site. As stated previously, other turbines up to 3.0 MW in size are also under consideration. A comparison of the smallest turbine under consideration, the 1.5 MW generator, and the 3.0 MW generator are presented below.

4.2.1 TURBINE

In this application PPM provides information on the GE 1.5 MW machine as a proxy for the 1.5 MW class of turbine. Figure 2-1 represents the components of a typical wind turbine. The GE 1.5 MW turbine begins operation in wind speeds of 3 m/s (6.7 mph) and reaches its rated capacity (1.5 MW) at a wind speed of 11.8 m/s (26.4 mph). The turbine is designed to operate in wind speeds of up to 25 m/s (45 mph) and can withstand sustained wind speeds of over 45 m/s (100 mph).

In this application, PPM provides information on the Vestas V90 3.0 MW wind turbines as an example of a 3.0 MW class of turbine. They have a rating of 3,000 kW. The 3.0 MW turbine begins operation in wind speeds of 4 m/s (8.9 mph) and reaches its rated capacity (3.0 MW) at a wind speed of 15 m/s (33.6 mph). The turbine is designed to operate in wind speeds up to 25 m/s (45 mph) and can withstand sustained wind speeds of over 42.5 m/s (95 mph).

The 1.5 MW and 3.0 MW turbines have active yaw and pitch regulation and asynchronous generators. The turbines use a bedplate drive train design where all nacelle components are joined on common structures to improve durability.

The 1.5 MW and 3.0 MW turbines have Supervisory Control and Data Acquisitions (SCADA) communication technology to control and monitor the wind farm. The SCADA communications system permits automatic, independent operation and remote supervision, thus allowing the simultaneous control of the wind turbines.

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

Other specifications of the turbines include:

- Rotor blade pitch regulation.
- Gearbox with three-step planetary spur gear system (1.5 MW) and a 2-stage planetary gear and a 1-stage helical gear (3.0 MW).
- Double fed three-phase asynchronous generator (1.5 MW) and an asynchronous 4-pole generator with a wound rotor.
- A braking system for each blade and a hydraulic parking brake (disc brake).
- Yaw systems are electromechanically driven.

4.2.2 ROTOR

The rotor consists of three blades mounted to a rotor hub. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system and other electrical and mechanical systems. The preliminary 1.5 MW turbine design identifies a 70.5 m (231 feet) to an 82 m (269 feet) RD, whereas the 3.0 MW turbine will have a RD of 90 m (295 ft). For the 1.5 MW turbine, the swept area for the 70.5 m RD would be 3,904 m^2 (42,022 ft^2), and the 82 m RD would be 5,281 m^2 (56,844 ft^2). The swept area for the 90 m RD would be 6,362 m^2 (68,480 ft^2). The rotor speed would be 10.1 to 20.4 rpm for the 1.5 MW turbines and 9.9 to 18.4 rpm for the 3.0 MW turbines.

4.2.3 TOWER

The towers are conical tubular steel with a hub height of 80 to 105 meters (262 to 345 feet). The turbine towers, where the nacelle is mounted, consist of three to four sections manufactured from certified steel plates. Welds are made in automatically controlled power welding machines and ultrasonically inspected during manufacturing per American National Standards Institute (ANSI) specifications. All surfaces are sandblasted and multi-layer coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Four platforms are connected with a ladder and a fall arresting safety system for access to the nacelle.

4.2.4 LIGHTNING PROTECTION

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

4.3 DESCRIPTION OF ELECTRICAL SYSTEM

At the base of each turbine a step-up transformer will be installed to raise the voltage to power collection line voltage of 34.5 kV. Power will be run through an underground and overhead collection system to the Project Substation and eventually the point of interconnection.

Generally, the electrical lines will be buried in trenches adjacent to the Project access roads. At the point where the access and public roads meet, the power collection lines will either rise from underground to overhead lines or continue as underground lines. In Minnesota, PPM anticipates having 3 to 4 miles of dual-circuit aboveground 34.5 kV transmission line and the rest of the feeder lines will be underground unless the terrain or high-cost obstruction dictate that aboveground line be used for short stretches. The Project Substation will be adjacent to Xcel Energy's Yankee Substation. The Project Substation will deliver 34.5 kV wind-generated energy to the Yankee Substation. At the Yankee Substation, the electric voltage will be stepped up to transmission level voltage of 115 kV.

The electrical system design and interconnection details will be determined as a result of studies and discussions with Xcel Energy and MISO. No details on the design have been determined at this time.

All utility protection and metering equipment will meet PPM, National Electric Safety Code (NESC), and Xcel Energy standards. The construction manager will work closely with Xcel Energy's engineers to ensure that proper interconnection protection is established. Detailed interconnection information will be supplied to the PUC as it becomes available.

4.4 MINNDAKOTA WIND FARM CONSTRUCTION

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

- ordering of all necessary components including towers, nacelles, blades, foundations, transformers, etc.
- final turbine micro-siting
- complete survey to establish locations of structures and roadways
- soil borings, testing and analysis for proper foundation design and materials
- complete construction of access roads, to be used for construction and maintenance
- construction of overhead or underground feeder lines

- design and construction of the Project Substation
- installation of tower foundations
- installation of underground cables
- tower placement and wind turbine setting
- acceptance testing of facility
- commencement of commercial production date

Access roads will be built adjacent to the towers, allowing access both during and after construction. The roads will be approximately 4.9 meters (16 feet) wide and have gravel as cover, adequate to support the size and weight of maintenance vehicles. These roads will meet state and local requirements. The specific turbine locations will determine the amount of roadway that will be constructed for this Project. In addition, there will be a 30 ft diameter gravel work area centered around the base of each turbine.

Temporary disturbances during construction of the Project include crane pads at each turbine site, temporary travel roads for the cranes, temporary laydown areas around each turbine, trenching in the underground electrical collection system, and storage/stockpile area. Construction of the GE 1.5 MW turbine will include temporary impacts of approximately an additional 12 ft of gravel roadway on either side of the permanent roadway (40 ft total width), a 40 ft by 120 ft gravel crane pad extending from the roadway to the turbine foundation which will be graded to a minimum of 1 percent, and a 150 ft diameter rotor laydown area centered around the turbine foundation which will be graded to a minimum of 5 percent.

During the construction phase, several types of light, medium, and heavy-duty construction vehicles will travel to and from the site, as well as private vehicles used by the construction personnel. PPM estimates that there will be 75 large truck trips per day and up to 200 small-vehicle (pickups and automobiles) trips per day in the area during peak construction periods. That volume will occur during the peak time when the majority of the foundation and tower assembly is taking place. At the completion of each construction phase this equipment will be removed from the site or reduced in number.

4.4.1 CONSTRUCTION MANAGEMENT

The civil contractor will be the lead entity for the construction management of the Project. The primary civil, erection and electrical contractors will use, where possible, the services of local contractors to assist in the construction of the wind farm. The contractors, in coordination with local contractors, will undertake the following activities:

- Securing building, electrical, grading, road, and utility permits
- Perform detailed civil, structural, and electrical engineering
- Schedule execution of construction activities
- Complete surveying and geotechnical investigations
- Forecast Project labor requirements and budgeting

The primary contractors also serve as key contacts and interface for subcontractor coordination. PPM has a site construction manager who is responsible to manage the overall coordination between contractors. The electrical contractor will oversee the installation of communication and power collection lines as well as the substation. The civil contractor will oversee the installation of roads and foundations, as well as the coordination of aggregate and concrete materials receiving, inventory, and distribution. The construction consists of the following tasks:

- Site development, including roads
- Foundation excavation
- Concrete foundations
- All electrical and communications installation
- Tower assembly and machine erection
- System testing

The construction team will be on site to handle materials purchasing, construction, and quality control. The primary contractors will select and manage their local subcontractors to complete all aspects of construction.

Throughout the construction phase, ongoing coordination occurs between the Project development and the construction teams. The PPM on-site manager helps to coordinate all aspects of the Project, including ongoing communication with local officials, citizens groups and landowners. Even before the Project becomes fully operational, the O&M staff is integrated into the construction phase of the Project. The construction manager and the O&M staff manager work together continuously to ensure a smooth transition from construction through wind farm commissioning and, finally, operations.

4.4.2 FOUNDATION DESIGN

The wind turbines' freestanding 80 to 105 meter (262 foot) tubular towers will be connected by anchor bolts to a concrete foundation. Geotechnical surveys, turbine tower load specifications and cost considerations will dictate final design parameters of the foundations. Foundations for similar sized turbines are approximately 40 to 60 feet across and 4 to 8 feet thick.

4.4.3 CIVIL WORKS

Completion of the Project will require various types of civil works and physical improvements to the land. These civil works include the following:

- Improvement of existing access roads to the Project site
- Construction of roads adjacent to the wind turbine strings to allow construction and continued servicing of the wind turbines
- Clearing and grading for wind turbine tower foundation installations
- Trenching for underground cabling for connecting the individual wind turbines
- Installation of an on-site feeder system for connecting wind turbine strings for delivery to the electricity collection/metering location
- Clearing and grading for pad-mount transformers and other installations
- Clearing and grading for Project Substation and O&M building
- Installation of any site fencing and security

Any improvements to existing access roads will consist of re-grading and filling of the gravel surface to allow access even in inclement weather. No asphalt or other paving is anticipated.

Access roads will be constructed along turbine strings or arrays. These roads will be sited in consultation with local landowners and completed in accordance with state and local requirements. They will be located to facilitate both construction (cranes) and continued operation and maintenance. Siting roads in areas with unstable soil will be avoided wherever possible. All roads will include appropriate drainage and culverts while still allowing for the crossing of farm equipment. The roads will be approximately 4.9 meters (16 feet) wide and will be covered with road base designed to allow passage under inclement weather conditions.

The roads will consist of graded dirt, overlaid with geotechnical fabric (if needed) and covered with gravel. To facilitate crane movement and equipment delivery, an additional 12 feet of gravel roadway will be temporarily installed on either side of the permanent roadway (40 ft total width).

In addition, for a 1.5 MW machine turbine assembly will require a 40 ft by 120 ft gravel crane pad extending from the access road to the turbine foundation which will be graded to a minimum of one percent, and a 150-ft diameter rotor laydown area centered around the turbine foundation which will be graded to a minimum of 5 percent. After construction, the temporary construction areas adjacent to the turbine pad and access road will be restored. The site will be graded to natural contours, soil will be loosened if needed, and the site will be seeded. Once construction is completed, the access roads will be regraded, filled, and dressed as needed.

4.4.4 COMMISSIONING

The Project will be commissioned after completion of the construction phase. The Project will undergo detailed inspection and testing procedures. Inspection and testing occurs for each component of the wind turbines, as well as the communication system, meteorological system, high voltage collection and feeder system, and the SCADA system.

4.5 PROJECT OPERATION AND MAINTENANCE

Each wind turbine in the Project will communicate directly with the SCADA system for the purposes of performance monitoring, energy reporting, and trouble-shooting. The SCADA system also provides the overall control of the wind farm.

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

4.5.1 PROJECT CONTROL, MANAGEMENT, AND SERVICE

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

The primary functions of the SCADA are to:

- Control and monitor the wind farm
- Alert operations personnel to wind farm conditions requiring resolution
- Provide a user/operator interface for controlling and monitoring wind turbines
- Collect performance data from turbines
- Monitor field communications
- Provide information on wind turbine performance for operators and maintenance personnel
- Collect data on wind turbine and wind farm maintenance
- Serve as an information archive
- Provide spare parts inventory control
- Generate operations and maintenance reports

4.5.2 MAINTENANCE SCHEDULE

Equipment will be monitored by on site O&M staff. PPM will also remotely monitor the Project. Performance testing is done during the early months of operation to see that the wind farm is operating within expected parameters.

Project inspection and maintenance is performed on the following intervals:

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

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

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

D) Two Years Service Inspection. The two years service inspection consists of the annual inspection, plus checking and tightening of electrical terminal connectors.

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

4.5.3 GENERAL MAINTENANCE DUTIES

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

- Maintenance on the wind turbines and on the mechanical, electrical power, and communications system
- Performance of all routine inspections
- Maintenance of all oil levels and changing oil filters
- Maintenance of the control systems, all structures associated with the wind farm, access roads, drainage systems, and other facilities necessary for the operation of the wind farm

- Maintenance of all O&M field maintenance manuals, service bulletins, revisions, and documentation for the wind farm
- Maintenance of all parts, price lists, and computer software
- Maintenance and operation of interconnection facilities
- Provide all labor, services, consumables, and parts required to perform scheduled and unscheduled maintenance on the wind farm, including repairs and replacement of parts and removal of failed parts
- Assist as needed with avian and other wildlife studies.
- Manage lubricants, solvents and other hazardous materials as required by local and/or state regulations
- Maintain appropriate levels of spare parts in order to service equipment
- Obtain all necessary equipment including the rental of industrial cranes for removal and reinstallation of turbine components
- Hire, train, and supervise a work force necessary to meet the general maintenance requirements
- Maintain site security

4.5.4 OPERATIONS AND MAINTENANCE FACILITY

The location of the O&M facility at the Project has not been determined at this time. The buildings used by PPM for this purpose are 3,000 to 5,000 square feet, and house the equipment to operate and maintain the wind farm.

4.6 PROJECT SCHEDULE

4.6.1 LAND ACQUISITION

PPM will be responsible for all land acquisition and will obtain the necessary easements from landowners.

4.6.2 PERMITS

PPM will be responsible for undertaking all required environmental review and will obtain all permits and licenses that are required following issuance of the LWECS Site Permit.

4.6.3 EQUIPMENT PROCUREMENT, MANUFACTURE AND DELIVERY

PPM has purchased turbines for its wind projects. Turbines will be allocated to the Project after meteorological and economic studies are completed to achieve the best match of turbines and sites. Turbines are expected to arrive on-site in mid-2007.

4.6.4 CONSTRUCTION

The primary contractors will be responsible for completing all Project construction, including roads, wind turbine assembly, electrical, and communications work. The construction will take approximately 8 months to complete. Limited site preparation may occur as early as fall 2006. The majority of construction is planned for 2007.

4.6.5 CONSTRUCTION FINANCING

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

4.6.6 PERMANENT FINANCING

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

PPM typically retains a long term interest in its wind projects.

4.6.7 EXPECTED COMMERCIAL OPERATION DATE

PPM anticipates that the Project would begin commercial operation in the fourth calendar quarter of 2007. The commercial operation date is dependent on the completion of the interconnection, permitting, and other development activities.

4.7 DECOMMISSIONING AND RESTORATION

The MinnDakota Wind Project decommissioning and restoration plan is in accordance with the requirements of Minn. Rules part 4401.0450, subp. 13. PPM anticipates that the life of the Project will be no less than 20 years and reserves the right to re-apply for a Site Permit and continue operation of the Project upon expiration of the original Site Permit.

4.7.1 DECOMMISSIONING AND RESTORATION

PPM will begin decommissioning the facility within 8 months from the time the facility ceases to operate. Decommissioning will be completed within 15 months from the time the facility ceases to operate.

PPM also reserves the right to explore alternatives regarding Project decommissioning at the end of the Project Site Permit term. One such option may be to re-apply for a Site Permit and continue operation of the Project, providing energy under a new long term contract or on a merchant basis. Retrofitting the turbines and power system with upgrades based on new technology may allow the wind farm to produce efficiently and successfully for many more years.

4.7.2 ESTIMATED DECOMMISSIONING COSTS IN CURRENT DOLLARS

PPM will be responsible for all costs to decommission the Project and associated facilities. Based on estimated costs of decommissioning and the salvage value of decommissioned equipment, the salvage value of the wind farm will exceed the cost of decommissioning. To the extent that there is an industry standard, decommissioning costs are estimated to range from $10,000 to $30,000 per turbine in current dollars. At the current scrap steel price of approximately $230 per ton and the past 20-year historical average of $106 per ton, the salvage value per turbine is estimate between $48,000 and $22,000. This more than offsets anticipated decommissioning costs. The scrap steel value of the turbines ensures that sufficient funds will be available to cover decommissioning and restoration costs. PPM will review and update the cost estimate of decommissioning and restoration for the Project in December 2022, 15 years after Project commissioning. This revised cost estimate of decommissioning and salvage value will then be submitted to the PUC for review and comment.

4.7.3 LIST OF DECOMMISSIONING ACTIVITIES

Decommissioning will involve removal of all wind facilities including towers, turbine generators, transformers, overhead and underground cables, foundations, buildings, and ancillary equipment up to a depth of 4 feet below grade. All access roads will be removed unless the affected landowner provides written notice that the road or portions of the road shall be retained. Additionally, any disturbed surface shall be graded, reseeded, and restored as nearly as possible to its preconstruction condition.

5.0 ENVIRONMENTAL ANALYSIS

This section provides a description of the environmental conditions that exist within the Project. Consistent with PUC procedures on siting LWECS and applicable portions of the Power Plant Siting Act, various exclusion and avoidance criteria were considered in the selection of the Project area.

The proposed Project area is approximately 31,084 acres in Minnesota. To support this siting process, maps of the area were generated that indicate the presence or absence of the following:

- National and state parks, wildlife refuges, wilderness areas, monuments, historic sites and districts, and special designation riverways and trails
- State wildlife management areas and scientific and natural areas
- Nature Conservancy preserves
- County and municipal parks
- Registered historic sites and districts
- Wetlands
- Streams
- Residences

5.1 DESCRIPTION OF ENVIRONMENTAL SETTING (INTRODUCTION)

The Project is located on a landform known as Buffalo Ridge in southwestern Minnesota. Buffalo Ridge is a part of the Bemis Moraine that runs diagonally northwest to southeast from roughly Watertown, South Dakota, across southwestern Minnesota, and into Iowa. It is located in the Coteau des Prairies physiographic region and ranges in elevation from 1,790 to 2,000 feet above sea level. Buffalo Ridge is the watershed divide between the Missouri and Mississippi River watersheds.

5.2 DEMOGRAPHICS

5.2.1 DESCRIPTION OF RESOURCES

The Project is located within a lightly populated rural area in southwestern Minnesota. There is no indication of any new residential construction on the site. Information on demographics and housing for this section was taken from the 2000 U.S. Census.

The site is located in Lincoln County, Minnesota. The population of Lincoln County is 6,429. The Project is located in parts of Verdi, Drammen, Shaokatan, Richland, and Lake Hendricks townships. The average household size in Lincoln County is 2.35, and the total number of housing units is 3,043.

According to the 2000 U.S. Census, the largest industries employing residents of Lincoln County are educational, health and social services. Agriculture is the second largest industry in Lincoln County, accounting for 16.7 percent of the workforce. The median household income for Lincoln County was $31,607. Table 5-1 summarizes some of the population and economic characteristics within the Project area. Census data was not available for Richland and Lake Hendricks townships.

Table 5-1
Population and Economic Characteristics

Location	Population	Per Capita Income	Percentage of Population Below Poverty Level
Lincoln County	6,429	$ 16,009	9.7 %
Verdi Township	240	$ 13,068	14.6 %
Drammen Township	141	$13,056	6 %
Shaokatan Township	192	$11,859	14.2 %

5.2.2 IMPACTS

Short-term impacts to socioeconomic resources will be relatively minor. Roughly 32 to 44 acres of agricultural land will be permanently removed from production. Landowner compensation will be established by their lease, and the areas surrounding each turbine may still be farmed. Project construction will not cause additional impacts to leading industries within the Project area. There is no indication that any minority or low-income population is concentrated in any one area of the Project, or that the wind turbines will be placed in an area occupied primarily by any minority group.

Local contractors and suppliers will be used for portions of the construction. Total wages and salaries paid to contractors and workers in Lincoln County will contribute to the total personal income of the region. Additional personal income will be generated for residents in the county and state by circulation and recirculation of dollars paid out by PPM for business expenditures and for state and local taxes. Expenditures made for equipment, fuel, operating supplies, and other products and services benefit businesses in the county and the state. Landowners having turbine or other Project facilities on their land will receive a royalty or lease payment annually for the life of the Project. This payment diversifies and strengthens the local economy as discussed below.

Long-term beneficial impacts to the county's tax base as a result of the construction and operation of the wind farm will contribute to improving the local economy in this area of Minnesota. The development of wind energy in this region has been important in diversifying and strengthening the economic base of southwestern Minnesota. Northwest Economic Associates prepared a report, "Assessing the Economic

Development Impacts of Wind Power," that includes a case study of the Lake Benton I wind project in Lincoln County, Minnesota. In addition to the creation of jobs and personal income, the development generated $611,200 in county property taxes in 2000, 13 percent of the property taxes collected in Lincoln County that year. The Project, as all LWECS installed after January 1, 2002, will pay a Wind Energy Production Tax to the counties of $0.0012 per kWh of electricity produced.

5.2.3 MITIGATIVE MEASURES

Socioeconomic impacts associated with the Project will be primarily positive with an influx of wages and expenditures made at local businesses during the Project construction and an increase in the counties' tax bases from the construction and operation of the wind turbines.

PPM proposes minimum setbacks for turbines from occupied residences of 623 feet for 1.5 MW turbines to 788 feet for 3.0 MW turbines. PPM proposes a minimum setback of 250 feet from public roads.

5.3 NOISE

5.3.1 DESCRIPTION OF RESOURCES

Background noise levels in the Project site are typical of those in rural settings, where existing nighttime noise levels are commonly in the low to mid-30 dBA. The dBA scale is A-weighted decibels based on the range of human hearing. Low to mid-30 dBA are relatively low background levels and are generally representative of the site. Higher levels exist near roads and other areas of human activity. The windy conditions in this region tend to increase ambient noise levels compared to other rural areas.

For the noise evaluation, PPM used representative sound power levels (Lp) of the GE 1.5 MW and Vestas 3.0 MW wind turbines that were provided by the manufacturers.

5.3.2 IMPACTS

When in motion, the wind turbines emit a perceptible sound. The level of this noise varies with the speed of the turbine and the distance of the listener from the turbine. On relatively windy days, the turbines create more noise; however, the ambient or natural wind noise level tends to override the turbine noise as distance from the turbines increases.

The wind turbines will create sources of additional noise. Since the noise levels provided did not include any time-weighted average sound levels, the sound power levels of 104.5 dBA for the 1.5 MW turbine and 106.7 dBA for the 3.0 MW turbine were converted to sound pressure levels and compared to the Minnesota Pollution Control Agency (MPCA) Daytime and Nighttime L10 and L50 Limits for residential receptors (NAC-1) as stated in the Minnesota Rule 7030.0040.

The Nighttime L50 limit of 50 dBA is the most stringent limit. The turbines were modeled to determine at what distance turbine noise would not exceed the 50 dBA limit. Turbines were modeled using the following equation for a hemispherical point source: $Lp = Lw - 10 \log (2\pi r2)-Aatm$ where Lp is defined as the sound pressure level at the distance of interest (r), Lw is the sound power level provided by the turbine manufacturers and Aatm is defined as the attenuation provided by atmospheric absorption. Sound is generated from the wind turbine at points near the hub or nacelle, 80 meters in the air, from the blade rotation, and motors near ground level. Therefore the noise source could be considered both spherical and hemispherical. Use of the sound propagation equation for a hemispherical point source is therefore conservative and predicts the maximum distance for noise exceedences.

The maximum distances calculated where an exceedence of the 50 dBA limit would no longer occur is 190 meters (623 feet) for the 1.5 MW turbine and 240 meters (788 feet) for the 3.0 MW turbine (Figure 5-1).

5.3.3 MITIGATIVE MEASURES

Impacts to nearby residents and other potentially affected parties in terms of noise will be taken into consideration as part of the siting of the turbines. PPM proposes minimum setbacks for turbines from occupied residences of 623 feet for 1.5 MW turbines to 788 feet for 3.0 MW turbines. To the extent that the sound characteristics of the selected turbine vary, PPM will ensure compliance with MPCA noise standards.

5.4 VISUAL IMPACTS

5.4.1 DESCRIPTION OF RESOURCES

The topography of the Project site is relatively flat with gently rolling hills and ridges with elevations that range from 1,747 to 1,992 feet above sea level. Agricultural fields, farmsteads, fallow fields, large open vistas, and gently rolling topography visually dominate the Project site. The landscape can be classified as rural open space. The photo in Figure 5-2 shows a typical landscape of an agricultural field within the Project site.

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

The settlements in Lincoln County are residences and farm buildings (inhabited and uninhabited) scattered along the rural county roads. These structures are focal points in the dominant open space character of the vicinity. A number of the farm structures date back to the late 19th or early 20th centuries and are representative of that era of Minnesota farm architecture. Typically, the farmsteads and residences are located at lower elevations to avoid winds common to the area.

A number of existing wind farms (NSP Phases I – III and other private wind projects totaling over 350 MW) are located northeast, east, and southeast of the Project site along Buffalo Ridge (Figure 5-3). These turbines are most visually apparent on the east side of Lake Benton from Highway 14 and looking north, east, and south from Highway 75 between Pipestone and Lake Benton. The turbines can also be seen from county roads adjacent to the Project.

5.4.2 IMPACTS

The placement of turbines will have an effect on the visual quality within the site vicinity. However, discussion of the aesthetic effect of the proposed wind farm is based on subjective human response. The wind farm would have a combination of effects on the visual quality/rural character of the area. For some viewers, the Project could be perceived as a visual intrusion, characterized as metal structures, 80 to 105 meters (262 to 345 feet) high at hub height for both the 1.5 and 3.0 MW turbines, intruding on the natural aesthetic value of the landscape.

The visual difference between the 1.5 MW and 3.0 MW turbines will be primarily in the RD. The 1.5 MW turbine design will have a maximum of an 82 m (269 feet) RD, whereas the 3.0 MW turbine will have a RD of 90 m (295 feet). The difference in visual impacts between the 1.5 and 3.0 MW turbines RD will be difficult to ascertain. The major difference will be in the number of turbines associated with the wind farm. The visual impact on the landscape will be reduced by half if the Project is built using 3.0 MW versus 1.5 MW turbines (33 versus 66 turbines).

On the other hand, wind farms have their own aesthetic quality, distinguishing them from other non-agricultural land uses. First, operation of the wind farm does not generate much traffic or significantly increase day-to-day human activity in the area. Therefore, the Project site would retain the rural sense and remote characteristic of the vicinity. Second, although "industrial" in form and purpose, turbines are essentially "farming" the wind for energy.

The proposed land use would not involve any ongoing industrial use of non-renewable resources or emissions into the environment. Although the turbines are high-tech in appearance, they are compatible with the rural, agricultural heritage and the other existing wind turbines in the area.

Essentially, the installation of the Project will alter the land use and visual quality of the site. The topography in the Buffalo Ridge area is generally flat and the vegetation cover is uniformly low, making the ridgelines of the landform in the vicinity highly vulnerable to visual disruptions. Wind turbines already existing near the Project have altered the landscape in the area from agricultural to wind farm/agricultural. The proposed Project will intensify the visual character imposed by the existing wind turbines.

Because the site is bordered on the north and east by wind farms developed by Enron Wind and Northern Alternative Energy, the combined projects will have a larger overall visual impact. Figure 5-3 shows the locations of existing wind farms near the Project site. The Project will increase both the "industrial" appearance of the wind farms on Buffalo Ridge and the areas from which they will be seen. Since wind generation development is likely to continue on the ridge, this visual impact is inevitable.

However, many members of the community embrace the change in their viewshed. The City of Lake Benton website touts that "Lake Benton is also known as the 'Original Wind Power Capital of the Midwest.' More than 200 wind turbines grace the skyline along the Buffalo Ridge, bringing clean, renewable energy to the forefront."

The Federal Aviation Administration (FAA) requires obstruction lighting or marking of structures over 200 feet above ground surface because they are considered obstructions to air navigation (US DOT FAA Advisory Circular 70/7460-IJ dated 11/29/95). The FAA recently released guidance (DOT/FAA/AR-TN05/50 dated 11/05) on standards for obstruction lighting for wind turbine farms. PPM will use this guidance when applying to the FAA for approval of a lighting plan that will light the MinnDakota Project as one large obstruction versus every structure over 200 feet in height. This will potentially reduce the number of lights on turbines in the Project, compared with what FAA required in the past.

In addition, the FAA now requires synchronized red strobe lights (compared to their earlier typical requirements for both red strobes at night and white strobes in the day).

It has been noted that the presence of turbines within the viewshed of wildlife management areas (WMAs) or other natural areas may diminish the natural quality of those areas and the experience of the persons utilizing those areas (Figure 5-4). While it may be true to some extent that the ability to see turbines in the background intrudes upon the purity of that experience, the same could be said of any human habitation or activity in the vicinity, and the presence of turbines may be less intrusive than many such activities. Nonetheless, this may be an impact which is perceived to be negative.

5.4.3 MITIGATIVE MEASURES

The following are proposed mitigative measures:

- Turbines will not be located in biologically sensitive areas such as parks, WMAs, or wetlands
- Turbines will be illuminated to meet the minimum requirements of FAA regulations including applying standards for obstruction lighting of wind turbine farms
- Existing roads will be used for construction and maintenance where possible. Road construction will be minimized
- Access roads created for the wind farm facility will be located on gentle grades to minimize visible cuts and fills
- Temporarily disturbed areas will be reseeded to minimize erosion and to blend in with existing vegetation

To attain maximum efficiency, wind power technology requires as much exposure to the wind as possible. As a result, the turbines are located on the ridgetops of Buffalo Ridge, which makes them highly visible to a wide range of surrounding areas. Shorter towers or placement of the turbines at alternate locations off the ridgelines are not considered as visual mitigation measures because it would result in less efficiency per unit and potentially limit the viability of the Project.

5.5 PUBLIC SERVICES AND INFRASTRUCTURE

5.5.1 DESCRIPTION OF RESOURCES

The Project is located in a lightly populated, rural area in southwestern Minnesota. There is an established transportation and utility network that provides access and necessary services to the light industry, small cities, homesteads, and farms existing near the study area. The closest town is Lake Benton, located just east of the Project.

The City provides sanitation, sanitary sewer, and library services. The Lincoln County Sheriff's Department offers 24-hour service for the citizens of Lincoln County. The Lincoln County Sheriff's Department Communications Center receives and dispatches all 911 calls for the county, including fire, medical, and police related emergencies.

The townships have limited public infrastructure services. Homes typically utilize septic systems for their household needs. Lincoln-Pipestone Rural Water is the water utility for Lincoln County and provides water to the residences within the Project area. Some homes may have private wells.

In general, the existing roadway infrastructure in and around the Project area is characterized by county and township roads that run coincident with section lines. Various county state aid highways (CSAHs), county roads, and township roads provide access to the proposed site. Access to the site also includes two-lane paved and gravel roads. In the agricultural areas, many landowners use single-lane farm roads and driveways on their property.

Within the Project area, CSAH 1, 2, and 3 are the main north-south roads. CSAH 12, 13, and 15 are east-west roads in the Project area. Trunk Highway (TH) access to the Project area is served by TH 14, which runs east-west through the Project site. Several miles east of the Project is TH 75, a north-south highway that connects to Interstate 90.

The existing traffic volumes on the area's county highways are documented in Table 5-2 and Figure 5-5. For purposes of comparison, the functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day, or Average Daily Traffic (ADT). The existing ADT in or near the Project area is between 115 and 1500 vehicles per day.

Table 5-2
Existing Daily Traffic Levels

Roadway Intersection Description	Average Daily Traffic (ADT)	Heavy Commercial Vehicles
At U.S. Highway 75 and CSAH 13	970	140
Along CSAH 13 between U.S. Highway 75 and CSAH 3	205	NA
Along CSAH 13 between CSAH 3 and CSAH 1	115	NA
Along CSAH 1 between CSAH 13 and U.S. Highway 14	305	NA
Along CSAH 12 between U.S. Highway 75 and CSAH 1	35	NA
Along County Road 101 between U.S. Highway 14 and CSAH 12	40	NA
Along U.S. Highway 14 between U.S. Highway 75 and CSAH 1	1500	210
Along U.S. Highway 14 between CSAH 1 and the MN/SD Stateline	1150	210
Along U.S. Highway 75 from Lake Benton City Limits south CSAH 9	970	130
Along CSAH 2 between U.S. Highway 14 and CSAH 9	80	NA

Source: 2004 ADT and HCADT Data, Minnesota Department of Transportation and 2001 ADT Data for Lincoln County, County State Aid Highway (CSAH), Minnesota Department of Transportation

Xcel Energy provides electrical service to the area. Xcel Energy has permitted the Buffalo-White 115 kV transmission line and the Yankee Substation which are to be located within part of the Project area. The transmission line and substation are proposed for construction in 2006 and 2007.

An active railroad line operated by Dakota, Minnesota, and Eastern Railroad currently runs to the south of the Project site from the Minnesota-South Dakota border and continues east through Verdi and Lake Benton.

Telephone service is provided by Qwest and other local telephone companies to the homes and businesses in the area.

There are three registered Federal Communications Commission (FCC) land mobile towers in the Project area. To the east of the Project area, near Lake Benton, there are four land mobile towers, a cell tower, and an FM tower; a microwave tower also is located one mile east of the Project area. The microwave tower located to the east does not have a beam path that crosses the Project area. There is one microwave beam path that crosses the northern portion of the Project area for Northern Border Pipeline in Section 19 of Shaokatan Township (Table 5-3). The microwave tower associated with the beam path is located west of the Minnesota Project area in Section 16 of Lake Hendricks Township in South Dakota. There are no FAA operated radar installations within a 10-mile radius of the site. Residents receive television signals from network and public stations in Sioux Falls and Brookings, South Dakota, and Marshall and Worthington, Minnesota.

Table 5-3
FCC Towers in Project Vicinity

Licensee	Tower Type	Project Area	Location
GE Wind Energy LLC (WQCS634)	Land Mobile - Private	Yes	Sec. 36, Drammen Township
Scott Trautman (WNWY815)	Land Mobile - Private	Yes	Sec. 1, Verdi Township
John Rybinski (WPZL538)	Land Mobile - Private	Yes	Sec. 13, Drammen Township
Dakota Minnesota & Eastern Railroad (WNFF949)	Land Mobile - Private	No	Sec. 31, Diamond Lake Township
Lincoln Pipestone Rural Water System (WNYR677)	Land Mobile - Private	No	Sec. 31, Diamond Lake Township
Ivanhoe Public Schools (WPWY742)	Land Mobile - Private	No	Sec. 6, Lake Benton Township
East River Electric Power Cooperative (WPII501)	Land Mobile - Private	No	Sec. 6, Lake Benton Township
East River Electric Power Cooperative (WPND589)	Microwave	No	Sec. 6, Lake Benton Township
KKCK (99.7 MHz)	FM Tower	No	Sec. 6, Lake Benton Township
Midwest Wireless Communications (KNKN422)	Cellular	No	Sec. 7, Lake Benton Township

5.5.2 IMPACTS

The MinnDakota Project is expected to have a minimal effect on the existing infrastructure. The following is a brief description of the impacts that may occur during the construction and operation of the Project at the proposed site.

- Electrical Service: Construction of the Project will add up to 66 wind turbines, a pad-mounted transformer at the base of each turbine, an underground and aboveground electrical collection system that will deliver power to the Project Substation. The power will then be transmitted to the point of interconnection at Xcel Energy's Yankee Substation where it will enter the grid.
- Roads: Constructing the Project will require approximately 16 to 22 miles of gravel access roads. In addition, during operation of the Project, the access roads will be used by operation and maintenance crews while inspecting and servicing the wind turbines. The access roads will be between towers and one road will be required for each string. The roads will be approximately 4.9 meters (16 feet) wide and low profile to allow cross-travel by farm equipment. PPM will work closely with the landowners to locate these access roads to minimize land-use disruptions to the extent possible. Construction traffic will use the existing county and state roadway system to access the Project site and deliver construction materials and personnel. During the peak of construction it is anticipated that there will be an additional 275 vehicle trips per day. Since the current traffic levels on the roadways in the Project area are well below roadway capacities, construction traffic will be perceptible but similar to seasonal variations in traffic such as autumn harvest. Construction is not anticipated to result in adverse traffic impacts. Operation and maintenance activities will not noticeably increase traffic in the Project area.
- Railroads: The Project will not affect the railroad.
- Water Supply: Construction and operation of the proposed wind farm Project will not significantly impact the water supply. No installation or abandonment of any wells is required for the Project unless a small well is needed to supply potable water to the O&M facility. However, in the event wells are abandoned, they will be capped as required by Minnesota law. The Project will not require the appropriation of surface water or permanent dewatering. Temporary dewatering may be required during construction for specific turbine foundations and/or electrical trenches. It is likely that rural water supply will be necessary for the operations and maintenance facility. Water usage will be similar to household volume; less then 5 gallons per minute. PPM will coordinate with Lincoln-Pipestone Rural Water to avoid impacts to their water lines in the Project area during construction.

- Telephone: Construction and operation of the proposed wind farm will not impact the telephone service to the Project area. Gopher One Call will be contacted prior to construction to located and avoid all underground facilities. To the extent Project facilities cross or otherwise affect existing telephone lines or equipment, PPM will enter into agreements with service providers so as to avoid interference with their facilities.
- FCC Registered Towers: There are three private land mobile towers within the Project area that will be avoided. There are seven FCC registered towers located in or near Lake Benton. The tower ownership includes cellular, cable, power cooperative, and radio. A microwave beam path study indicated that the Project does not interfere with those beam paths. PPM shall not operate the wind farm so as to cause microwave, radio, telephone, or navigation interference contrary to FCC regulations or other law. In the event the wind farm or its operation causes such interference, PPM shall take the measures necessary to correct the problem.
- Radar: No radar towers are located in the vicinity of the proposed wind farm.
- Television Reception: PPM will conduct an off-air television reception analysis for the Project. PPM shall not operate the wind farm so as to cause television interference contrary to FCC regulations or other law. In the event of a material problem after construction, PPM will work with affected residents to determine the cause of interference and, where necessary, reestablish acceptable reception quality in a timely fashion.

5.5.3 MITIGATIVE MEASURES

Construction and operation of the proposed wind Project will be in accordance with all associated federal and state permits and laws, as well as industry construction and operation standards. Due to the minor impacts expected on the existing infrastructure during the Project construction and operation, extensive mitigation measures are not anticipated.

5.6 CULTURAL AND ARCHAEOLOGICAL RESOURCES

5.6.1 DESCRIPTION OF RESOURCES

The proposed Project area lies within the Southwest Riverine and Prairie Lake Archaeological Regions (Anfinson 1997). The Southwest Riverine Archaeological Region includes a small portion of Lincoln County, Minnesota as well as sections of southeastern South Dakota, including Brookings County. This area comprises the southern portion of the Project area. During the time of Euroamerican settlement, the landscape was devoid of lakes and trees and consisted mostly of tallgrass prairie and numerous streams. Soils consist mostly of fine silty loams. Predicted habitation site locations for this region include areas

along major streams on terraces. Due to the scarcity of a diverse subsistence resource base and a lack of wood, Woodland period sites are most likely uncommon (Anfinson 1997). Resource procurement sites and special use sites may be located within all areas of this region. In addition, mound sites and earthworks would most likely be on hilltops near rivers or on high river terraces.

The Prairie Lake Archaeological Region covers the northern portion of the Project area, including the remainder of Lincoln County and most of southwestern and south-central Minnesota. Topography includes typical swell and swale topography of a ground moraine. Soils within the Project area consist of medium to fine textured prairie soils. Habitation sites in this region are commonly located near wooded areas, near major lakes or river valleys. Resource procurement sites may be located in upland settings, but more commonly would be found along areas near waters edge.

HDR collected data from the State Historic Preservation Office (SHPO) in St. Paul, Minnesota on known cultural resources information, derived from previous professional cultural resources surveys and reported site leads. Collected data includes archaeological site files and previous cultural resources studies and reports. In addition, HDR reviewed 19th-century Public Land Survey (PLS) maps to identify potential historic-period cultural features that may yet exist in the Project area. Based on this information HDR prepared a Phase I Inventory (Appendix B) which documented 11 previous cultural resources reports which includes six cultural resources investigations within the Project area. Several of these reports pertain to investigations conducted in support of other wind farm construction.

Previous investigations in the Project area documented 15 archaeological resources, including lithic scatters, pre-contact and post-contact artifact scatters, earthworks and Native American forts. Three resources are within the MinnDakota Wind Project area and 12 resources are within one mile.

The PLS maps for the Project areas illustrate environmental conditions, including elevation variations across the landscape and watercourses, during the early 1880s. The maps indicate intensive historic-period land use near the Project area, including roads, active farmsteads and cultivated acreages.

5.6.2 IMPACTS

Cultural resources could be impacted directly during the construction of a wind energy facility. Construction within the turbine footprint, cable trenching, access roads, and borrow areas could impact cultural resources. In addition, construction of turbines may impact viewshed integrity from existing standing structures.

A letter was sent to the Minnesota SHPO on July 21, 2003 requesting a review of the proposed Project area and potential impacts to cultural resources. HDR received a response on August 25, 2003, stating

that the SHPO recommended the completion of a cultural resources survey prior to project construction. The proposed Project area expanded and a second letter was sent to the Minnesota SHPO on December 12, 2005, requesting a review of the proposed Project and potential impacts to cultural resources. Minnesota SHPO responded on January 27, 2006 and continued to recommend a cultural resources assessment/survey of the Project area prior to construction.

5.6.3 MITIGATIVE MEASURES

After review of the recorded archaeological site information and the information in previous survey reports, it appears that the Project area has a relatively high potential for pre-contact archaeological resources on elevated landforms and areas within 150 meters of permanent water sources.

HDR recommends a Phase I archaeological resources survey for areas proposed for Project construction, including wind turbine locations, associated access roads and other construction elements. These investigations must be conducted by a professional archaeologist meeting the Secretary of the Interior's Standards for Archeology as published in the Code of Federal Regulations, 36 CFR Part 6. Survey strategies would depend on surface exposure and the characteristics of the landforms proposed for development. These areas will most likely include portions of the Project construction areas within 150 meters of a permanent water source, areas of higher elevation, and areas near previously identified cultural resources.

If cultural resources are identified during the survey, HDR archaeologists will provide recommendations for National Register eligibility, and offer recommendations for site avoidance, impact minimization, or mitigation if necessary.

5.7 RECREATIONAL RESOURCES

5.7.1 DESCRIPTION OF RESOURCES

Recreational opportunities in Lincoln County include hiking, biking, boating, fishing, camping, swimming, horseback riding, skiing, hunting, and nature observation. Figure 5-6 depicts the locations of County Parks, Minnesota Department of Natural Resources (DNR) WMAs, and Nature Conservancy lands near the proposed Project site.

WMAs are managed to provide wildlife habitat, improve wildlife production, and provide public hunting and trapping opportunities. These Minnesota DNR lands were acquired and developed primarily with hunting license fees. WMAs are closed to all-terrain vehicles and horses because of potential detrimental effects on wildlife habitat. WMAs located within five miles of the Project are:

- Two Sloughs WMA located 0.5 miles east of the Project area
- Sioux Lookout WMA located 0.5 miles east of the Project area
- Schindel WMA located 0.5 miles south of the Project area
- Horse Slough WMA located 0.75 miles north of the Project area
- Collinson WMA located one mile northeast of the Project area
- Hole-in-the-Mountain WMA located one mile southeast of the Project area
- Emerald WMA located 1.5 miles northeast of the Project area
- Shaokatan WMA located 2 miles north of the Project area
- Weeks Lake WMA located 2.5 miles north of the Project area
- Altona WMA located 2.5 miles south of the Project area
- Muskrat Junction WMA located 3 miles northeast of the Project area
- Chen Bay WMA located 3.5 miles east of the Project area
- Herschberger WMA located 3.5 miles northeast of the Project area
- Suhr WMA located four miles north of the Project area

Hole-in-the-Mountain Prairie is a nature preserve established by the Nature Conservancy and is approximately one-mile southeast of the Project area boundary located north of the Hole-in-the-Mountain WMA. Hole-in-the-Mountain Prairie provides an example of dry prairie habitat and is also home to various state-listed special concern species. Camping, hiking, horseback riding, and picnicking are activities offered at the Hole-in-the-Mountain preserve. There are no Nature Conservancy lands within the Project area.

State scientific and natural areas (SNA) are areas designated to protect rare and endangered species habitat, unique plant communities, and significant geologic features that possess exceptional scientific or educational values. The nearest SNA is the Prairie Coteau SNA, located approximately 13 miles southeast of the Project area. There are no SNAs within the Project area.

Lake Benton is a 2,875 acre lake located 2 miles east of the Project. It is a popular fishing and recreation lake. There are three public access points located in Tyler, Lake Benton, and on the west shore at Norwegian Creek County Park. The lake is stocked with walleye. Fish include walleye, northern pike, perch, large mouth bass, bullheads, bluegill, and crappies. The lake is also used for recreational boating.

Lincoln County has several parks in the area surrounding the Project. To the southeast of the Project area is Hole-in-the-Mountain County Park, an 800 acre park with 29 campsites and 5 miles of hiking and horse trails. In the winter there is a downhill skiing area at the Hole-in-the-Mountain County Park. To the east

of the Project is Norwegian Creek County Park located on the west side of Benton Lake. It is a 128 acre park with two boat launches, swimming beach, hiking trail, and 30 campsites. To the north and east of the Project is Picnic Point County Park located on the south side of Lake Shaokatan. It is a 43 acre park with two boat launches, swimming area, and campground.

5.7.2 IMPACTS

The Project will avoid all WMAs, Nature Conservancy land, and public parks. In general, recreational impacts will be visual in nature affecting individuals using public land near the Project site for recreation. See Section 5.4 for additional discussion of visual impacts and proposed mitigative measures. Visual impacts will be most evident to visitors using the Hole-in-the-Mountain preserve and the WMAs within a one- to four-mile radius of the site. However, existing wind farms are operating near these recreational resources. No significant impacts to recreational resources are anticipated.

5.7.3 MITIGATIVE MEASURES

Project turbines and facilities will not be located within public parks, WMAs, SNAs or in Nature Conservancy land.

5.8 HUMAN HEALTH AND SAFETY

5.8.1 DESCRIPTION OF RESOURCES

5.8.1.1 Air Traffic

There are no airports located within the vicinity of the Project site. The nearest airport is Tyler Municipal Airport located 9 miles east of the Project. It is a turf landing strip. Air traffic may be present near the Project for aerial spraying or crop dusting of agricultural fields. Crop dusting is typically carried out during the day by highly maneuverable airplanes or helicopters. The installation of wind turbine towers in active croplands and installation of overhead distribution lines will create a potential for collisions with crop-dusting aircraft. However, distribution lines are expected to be similar to those that may be present already (located along the edges of fields and roadways) and the turbines themselves would be visible from a distance and lighted according to FAA guidelines.

5.8.1.2 Electromagnetic Fields

The term electromagnetic fields (EMF) refers to electric and magnetic fields that are present around any electrical device. Electric fields arise from the voltage or electrical charges and magnetic fields arise from the flow of electricity or current that travels along transmission lines, power collection (feeder) lines, substation transformers, house wiring, and electrical appliances. The intensity of the electric field is related to the voltage of the line and the intensity of the magnetic field is related to the current flow

through the conductors (wire). EMF can occur indoors and outdoors. However, there are no discernible health impacts from power lines. Wind turbine generators will be no closer than 623 feet from occupied residences where EMF will be at background levels.

5.8.1.3 Security

The proposed wind farm site is located in an area that has a low population density. Construction and operation of the Project will have minimal impacts on the security and safety of the local populace.

5.8.1.4 Traffic

The existing traffic levels for the U.S. trunk highways, county state aid highways, and county roads in the Project area are shown in Table 5-2 and Figure 5-5.

5.8.2 IMPACTS

5.8.2.1 Air Traffic

The proposed wind farm will have no significant impacts on air traffic in the region because there are no airports in the vicinity and the wind and meteorological towers will have lighting to comply with FAA requirements. PPM will notify local airports about the Project and new towers in the area to reduce the risk to crop dusters.

5.8.2.2 Electromagnetic Fields

While the general consensus is that electric fields pose no risk to humans, the question of whether exposure to magnetic fields potentially can cause biological responses or even health effects continues to be the subject of research and debate. Based on the most current research on electromagnetic fields, and the distance between any turbines or collector lines and houses, the Project will have no impact to public health and safety due to EMF.

5.8.2.3 Security

Project construction and operation will have no significant impact to security and safety of the local residents.

5.8.2.4 Traffic

The maximum construction workforce is expected to generate approximately 275 additional vehicle trips per day. The functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day. Currently, the heaviest traffic is on Highway 14 at 1,150 to 1,500 ADT between Highway 75 and the state line. Since many of the area roadways have ADTs currently well below capacity, the addition of 275 vehicle trips would be perceptible, but similar to seasonal variations such as autumn harvest.

Truck access to the Project area is generally served by TH 14. Specific additional truck routes will be dictated by the location required for delivery. Additional operating permits will be obtained for over-sized truck movements.

The operations phase of the new Project will require a two-person maintenance crew driving through the area to monitor and maintain the wind turbines. The maintenance crew will monitor the wind turbines as needed. There would be a slight increase in traffic for occasional turbine and substation repair.

5.8.3 MITIGATIVE MEASURES

5.8.3.1 Air Traffic

PPM will light the turbines to comply with FAA requirements. PPM will paint meteorological towers red at the top to improve visibility and will notify local airports about the Project and new towers in the area to reduce the risk to crop dusters.

5.8.3.2 Electromagnetic Fields

No impacts due to electromagnetic fields are anticipated and no mitigation is necessary.

5.8.3.3 Security

The following security measures will be taken to reduce the chance of physical and property damage, as well as personal injury, at the site:

- The towers will be placed 250 feet from public roads and a minimum of 623 feet (1.5 MW turbines) to 788 feet (3.0 MW turbines) from occupied homesteads. These distances are considered to be safe based on developer experience, and are consistent with prior LWECS site permits.
- Security measures will be taken during the construction and operation of the Project including temporary (safety) and permanent fencing, warning signs, and locks on equipment and wind power facilities.
- Turbines will sit on solid steel enclosed tubular towers in which all electrical equipment will be located, except for the pad-mounted transformer. Access to the tower is only through a solid steel door that will be locked when not in use.
- Where necessary or requested by landowners, PPM will construct gates or fences.

5.8.3.4 Traffic

No impacts to traffic are anticipated. No mitigation will be necessary.

5.9 HAZARDOUS MATERIALS

5.9.1 DESCRIPTION OF RESOURCES

PPM is not aware of any significant hazardous waste sites within the Project area. The land is primarily rural and used for agriculture. Potential hazardous materials within the Project area would be associated with agricultural activities, and include petroleum products (fuel and lubricants), pesticides, and herbicides. Older farmsteads may also have lead-base paint, asbestos shingles, and polychlorinated biphenyls (PCBs) in transformers. Trash and farm equipment dumps are common in rural settings

There will be three types of fluids used in the operation of the wind turbines that are petroleum products. These fluids are necessary for the operation of each turbine and include synthetic gear box oil, hydraulic fluid, and gear grease.

5.9.2 IMPACTS

PPM will conduct a Phase I Environmental Site Assessment prior to construction to avoid hazardous waste sites.

All fluids will be contained within the wind turbine structure. Fluids will be monitored during maintenance at each turbine. When fluids are replaced, the waste products will be handled according to regulations and disposed of through an approved waste disposal firm.

5.9.3 MITIGATIVE MEASURES

Because there are no proposed impacts to hazardous waste sites, no mitigative measures are necessary. If any wastes, fluids or pollutants are generated during any phase of the operation of the Project, they will be handled, processed, treated, stored and disposed of in accordance with Minnesota Rules Chapter 7045.

5.10 EFFECTS ON LAND-BASED ECONOMIES

5.10.1 AGRICULTURE/FARMING/FORESTRY/MINING

5.10.1.1 Description of Resources

Agriculture/Farming

The majority of the Project area is farmland and grassland, as shown in the Land Use Map, Figure 5-6. Cultivated land comprises approximately 21,957 acres of the Project area. Grasslands comprise approximately 8,924 acres of the site. Approximately 71 percent of the land is cropland and 28 percent is grassland. Essentially the whole Project area is used for agricultural purposes. Corn, soybeans, small

grains, and forage crops are grown throughout Lincoln County. Feeding cattle and hogs, raising livestock, and dairy farming are major sources of income in the study area. Within the area of the Project, the trend is toward fewer and larger farms. Converting cropland to the Conservation Reserve Program (CRP) and the Reinvest in Minnesota (RIM) program is another source of farm income. CRP and RIM lands are cropland planted to conservation grasses and legumes to protect and improve the soil and cannot be harvested or pastured. CRP is enrolled for 10-year periods, whereas RIM easements are permanent conservation easements.

Based on 2002 data, the majority of croplands are planted in soybeans and corn in Lincoln County. Alfalfa, small grains, forage, and pasture are additional crops in the study area.

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. Most of the 474 feedlots in Lincoln County are an average of 150 animal units (au) as defined by the MPCA.

Most of the soil within the Project area is prime farmland. The U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) identifies prime farmland as the land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pasture land, forestland, or other land. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance. Table 5-4 lists the soils considered Prime and other Important Farmlands for Lincoln County, Minnesota.

Table 5-4
Prime and Other Important Farmlands

Map Symbol	Map Unit Name	Farmland Classification
AaA	Aastad clay loam, 0 to 2 percent slopes	All areas are prime farmland
BaA	Barnes loam, 0 to 2 percent slopes	All areas are prime farmland
BaB	Barnes loam, 2 to 6 percent slopes	All areas are prime farmland
BaB2	Barnes loam, 2 to 6 percent slopes, eroded	All areas are prime farmland
BbB2	Barnes and buse loams, 2 to 6 percent slopes, eroded	All areas are prime farmland
BeA	Beotia silt loam, 0 to 2 percent slopes	All areas are prime farmland
BeB	Beotia silt loam, 2 to 4 percent slopes	All areas are prime farmland
BkA	Brookings silty clay loam, 0 to 2 percent slopes	All areas are prime farmland
BkB	Brookings silty clay loam, 2 to 4 percent slopes	All areas are prime farmland

Map Symbol	Map Unit Name	Farmland Classification
DcA	Dickey sandy loam, silty variant, 0 to 2 percent slopes	All areas are prime farmland
DcB	Dickey sandy loam, silty variant, 2 to 6 percent slopes	All areas are prime farmland
Dv	Divide silt loam	All areas are prime farmland
EsA	Estelline silt loam, 0 to 2 percent slopes	All areas are prime farmland
FaA	Flandreau loam, 0 to 2 percent slopes	All areas are prime farmland
FaB	Flandreau loam, 2 to 6 percent slopes	All areas are prime farmland
FdA	Fordville loam, 0 to 2 percent slopes	All areas are prime farmland
FdB	Fordville loam, 2 to 6 percent slopes	All areas are prime farmland
FdB2	Fordville loam, 2 to 6 percent slopes, eroded	All areas are prime farmland
FmA	Forman clay loam, 0 to 2 percent slopes	All areas are prime farmland
FrB	Forman and Barnes soils, 2 to 6 percent slopes	All areas are prime farmland
FrB2	Forman and Barnes soils, 2 to 6 percent slopes, eroded	All areas are prime farmland
HaA	Hamerly loam, 0 to 3 percent slopes	All areas are prime farmland
KrA	Kranzburg silt loam 0 to 2 percent slopes	All areas are prime farmland
KrB	Kranzburg silt loam, 2 to 6 percent slopes	All areas are prime farmland
KrB2	Kranzburg silt loam, 2 to 6 percent slopes, eroded	All areas are prime farmland
LsA	Lismore silty clay loam, 0 to 3 percent slopes	All areas are prime farmland
OlA	Oak lake silty clay loam, 0 to 2 percent slopes	All areas are prime farmland
OlB	Oak lake silty clay loam, 2 to 4 percent slopes	All areas are prime farmland
PoB	Poinsett silty clay loam, 2 to 6 percent slopes	All areas are prime farmland
PoB2	Poinsett silty clay loam, 2 to 6 percent slopes, eroded	All areas are prime farmland
ScA	Sinai silty clay loam, 0 to 2 percent slopes	All areas are prime farmland
ScB	Sinai silty clay loam, 2 to 4 percent slopes	All areas are prime farmland
SgB	Singsaas silty clay loam, 2 to 6 percent slopes	All areas are prime farmland
SgB2	Singsaas silty clay loam, 2 to 6 percent slopes, eroded	All areas are prime farmland
SvA	Svea clay loam, 0 to 2 percent slopes	All areas are prime farmland
SvB	Svea clay loam, 2 to 4 percent slopes	All areas are prime farmland
TeB	Terril silt loam, 2 to 6 percent slopes	All areas are prime farmland
VeB	Vienna silt loam, 2 to 6 percent slopes	All areas are prime farmland
VeB2	Vienna silt loam, 2 to 6 percent slopes, eroded	All areas are prime farmland
WaA	Waubay silty clay loam, 0 to 2 percent slopes	All areas are prime farmland
WaB	Waubay silty clay loam, 2 to 4 percent slopes	All areas are prime farmland

Map Symbol	Map Unit Name	Farmland Classification
ArA	Arvilla sandy loam, 0 to 2 percent slopes	Farmland of statewide importance
ArB	Arvilla sandy loam, 2 to 6 percent slopes	Farmland of statewide importance
BbC	Barnes and buse loams, 6 to 12 percent slopes	Farmland of statewide importance
BbC2	Barnes and buse loams, 6 to 12 percent slopes, eroded	Farmland of statewide importance
BcB	Barnes-Buse-Arvilla complex, 2 to 6 percent slopes	Farmland of statewide importance
BcB2	Barnes-Buse-Arvilla complex, 2 to 6 percent slopes, eroded	Farmland of statewide importance
BcC2	Barnes-Buse-Arvilla complex, 6 to 12 percent slopes, eroded	Farmland of statewide importance
Bh	Blue Earth silt loam	Farmland of statewide importance

Forestry

Lincoln County is in the region of Minnesota historically known for its prairie grasslands. Economically important forestry resources are not found in this region of Minnesota. Forested areas are primarily associated with homes in the form of woodlots. Figure 5-6 identifies a large stand of trees east of the Project area near Lake Benton.

Mining

Mineral deposits in southwestern Minnesota consist of sand and gravel from unconsolidated surficial deposits, building stone from quartzite rock units, and scattered clay/shale deposits for brick making.

Sand and gravel resources occur in glacial till and outwash deposits. Many of the pits are inactive, abandoned or their use is limited to the landowner. Other than a few commercial sand and gravel operations, there are no active industrial pits or quarries in the Project area. There may be inactive clay/shale pits, brickyards, and stone quarries in the area.

Based on the soil survey and topographic maps for the Project area, several gravel pits are located within the Project area. The majority of the gravel pits are along the banks of Medary Creek. Within the Project area the gravel pits are at the following locations:

- Verdi Township, Township 109 North, Range 46 West, Section 9, 13, 16, and 18
- Drammen Township, Township 110 North, Range 46 West, Section 35
- Shaokatan Township, Township 111 North, Range 46 West, Section 31

5.10.2 IMPACTS

5.10.2.1 Agriculture/Farming

Expected impacts to this resource (approximately 32 to 44 acres) will be determined once turbine and road placement have been finalized. Most of the soil within the Project area is considered prime farmland. The loss of agricultural land to the construction of the wind farm will reduce the amount of land that can be cultivated. Approximately one percent of the Project area will be converted to non-agricultural land use. This will not significantly alter crop production in the Project area or Lincoln County.

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

5.10.2.2 Forestry

No impacts are anticipated to forestry resources. Since a majority of the woodlots are associated with homesteads, no impacts are anticipated to woodlots.

5.10.2.3 Mining

Impacts to sand and gravel mining are not anticipated. Sand and gravel operations tend to be small and other occurrences of these materials are likely to be present in nearby areas, including large commercial operations in the general area.

5.10.3 MITIGATIVE MEASURES

5.10.3.1 Agriculture/Farming

The wind turbines and access roads will be located so that the most productive farmland (prime farmland) will be avoided as much as possible. Only land for the turbine and access roads will be taken out of crop production. Once the wind turbines are constructed, all land surrounding the turbines and access roads may still be farmed.

In the event that there is damage to drain tile as a result of construction activities or operation of the LWECS, PPM will work with affected property owners to repair the damaged drain tile in accordance with the agreement between the Project Owner and the owner of any damaged tile.

5.10.3.2 Forestry

No impacts are anticipated. No mitigation will be necessary.

5.10.3.3 Mining

Towers will not be located within sand and gravel operations.

5.11 TOURISM AND COMMUNITY BENEFITS

5.11.1 DESCRIPTION OF RESOURCES

Tourism in southwestern Minnesota's Lincoln County focuses on promoting the area's abundant game and wildlife, lakes, farms, and villages. Also publicized are culture (museums, art, and antiques) and recreation activities (parks, hiking trails, camping, canoeing, horseback riding, fishing, wildlife refuges, snowmobiling, golf courses, swimming pools, tennis courts, and skiing). The county hosts a variety of festivities and cultural events throughout the year.

Wind development in southwest Minnesota is becoming a significant tourism attraction, bringing more visitors to the community. Wind generation is being promoted in local tourism and literature.

5.11.2 IMPACTS

No impacts are anticipated to tourism resources.

5.11.3 MITIGATIVE MEASURES

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

5.12 TOPOGRAPHY

5.12.1 DESCRIPTION OF RESOURCES

The Project is proposed to be located at one of the highest elevations in Minnesota. Elevations range between 1,700 and 2,000 feet on Buffalo Ridge, which crosses through the center of the Project area from northwest to southeast. The relief of Buffalo Ridge is predominantly hilly, with slopes that are rolling to steep. Buffalo Ridge is a glacial moraine landform also referred to as the Bemis Moraine. The Bemis Moraine was deposited by the outer reaches of the Des Moines Lobe about 14,000 years ago. The elevation in the Project area ranges from 1,747 feet to 1,992 feet. An elevation map of the Wind Farm Site is shown in Figure 5-8.

The area northeast of the moraine is gently undulating. Slopes are short and irregular and closed depressions are common. South and west of the moraine are broad ridgetops and long side slopes that end in drainageways. There are no closed depressions because loess (wind deposited silt) has filled the irregularities of the glacial till plain.

The crest of the Bemis Moraine forms the divide between the Mississippi and Missouri River basins. Streams northeast of the moraine drain into the Mississippi River drainage basin, and those southwest of it drain into the Missouri River drainage basin.

The topography of the proposed site is predominantly hilly and the slopes are rolling to steep. Much of the site consists of broad ridgetops with long gentle side slopes that end in drainageways. However, some of the drainageways have shorter steeper side slopes.

5.12.2 IMPACTS

No impacts to topography are anticipated. Wind turbines and access roads will not require significant excavation or fill.

5.12.3 MITIGATIVE MEASURES

No impacts are anticipated, as such, no mitigative measures are necessary.

5.13 SOILS

5.13.1 DESCRIPTION OF RESOURCES

There are four main soils associations found within the Project area (Table 5-5). Soil associations are mapped in Figure 5-7. A soil association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils.

Table 5-5
Soil Associations in Project Area

Soil Association	Area (acres)
Kranzburg-Vienna-Hidewood (MN 122)	23,701 acres
Brandt-Estelline-Fordville (MN 124)	3,046 acres
Barnes-Langhei-Hammerly (MN 043)	3,517 acres
Singsaas-Flom-Vallers (MN 120)	790 acres

The Kranzburg-Vienna-Hidewood Association comprises well drained to excessively drained soils found on gentle slopes, and poorly drained soils in drainageways. Along broad ridge tops and side slopes, the upland soils of this association formed in loess and loamy glacial till, while the soils in the drainageways formed in loess or loess-derived alluvium. Most areas of the association are covered by a thin mantle of loess that overlies glacial till. Slopes are long, smooth, and gentle because most irregularities in the glacial till have been filled in and leveled by wind-deposited silty material.

The Brandt-Estelline-Fordville Association consists of deep, well drained, nearly level to gently sloping soils formed in silty and sandy materials deposited by wind and water. This association is found on outwash plains and river terraces, and exhibits gently sloping areas with some steeper areas along drainageways.

The Barnes-Langhei-Hamerly Association generally consists of well drained and moderately well drained, gently undulating to very steep upland soils that formed in loamy glacial till. This association is found mainly on irregular slopes on glacial moraines. Slopes range from 2 to 55 percent.

The Singsaas-Flom-Vallers Association generally consists of deep, well drained soils on gently undulating hillsides, with nearly level, poorly drained soils in the depressions. The Vallers component is a poorly drained upland loam and clay loam usually found on the rims of depressions and drainageways. The upland components of this association developed in limy and nearly stone-free glacial till; the soils in the depressions formed in silty glacial till and alluvium. Typically this association is found in low areas, and represents a depressions and/or drainageways surrounded by gently hilly land.

5.13.2 IMPACTS

Construction of the wind turbines and access roads will increase the potential for soil erosion during construction and convert prime farmland from agricultural uses to industrial uses. The amount of land that will be converted to wind turbines, transformer pads, utility poles, and access roads will be determined once the site layout has been finalized. See Section 5.10.3 for a discussion of impacts to prime farmland.

5.13.3 MITIGATIVE MEASURES

A National Pollutant Discharge Elimination System (NPDES) permit application to discharge storm water from construction activities will be acquired by PPM 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 containing excavated material, protecting exposed soil, and stabilizing restored material.

5.14 GEOLOGIC AND GROUNDWATER RESOURCES

5.14.1 GENERAL DESCRIPTION OF RESOURCES

The Minnesota River Valley, a deep and wide trench, and the Coteau Des Prairies (Coteau), a broad regional topographic highland, dominate the geomorphology in southwestern Minnesota. The Coteau, of which Buffalo Ridge is a part, acts as a divide for the major drainage patterns in southwestern Minnesota. The Project area itself is situated along the ridge and flanks of the Coteau. The southwest side of the Coteau drains into the Big Sioux River and the northeast side drains into the Minnesota and the Des Moines Rivers. The northeastern flank of the Coteau consists of regional benches and terraces expressed as poorly drained belts of hummocky terrain, separated by steeper, fairly well drained areas.

The surficial geology of the site consists of glacial deposits, including end and ground moraines, outwash, glacial lake sediment, and loess. The main glacial deposits are loess-covered extra-morainic till with minor amounts of Bemis end moraine and glacial outwash deposits. The till deposits consist of silty, calcareous, shale-rich till and unweathered, bouldery gravel, overlain by thin loess. The Bemis end moraine consists of silty, calcareous shale-rich till. The glacial outwash deposits consist of shallow, bouldery sand and gravel deposited in glacial meltwater channels.

The Bemis end moraine and the till deposits are oriented northwest-to-southeast. The glacial outwash deposits are contiguous with surface water systems, and are oriented perpendicular to the Bemis end moraine and the till deposits.

Two types of bedrock underlie the glacial deposits of the Project area:

- Mafic rocks of Lower Precambrian age, consisting of undifferentiated crystalline rocks. The mafic rocks are probably mainly metavolcanic rocks with interbedded iron formations, as interpreted from gravity and magnetic data.
- Cretaceous sedimentary rocks, consisting of poorly consolidated shale and siltstone, with some sandstone. The Cretaceous rocks, where present, overlie the Precambrian rocks.

The predominant bedrock unit underlying the site consists of mafic rocks overlain by Cretaceous sedimentary rocks. A magnetic anomaly interpreted to be an iron formation occurs within the mafic rocks.

Geologic-related mineral resources in the Project area include groundwater and minor sand and gravel deposits. Groundwater resources in the study area are derived from three general hydrogeologic units:

- Weathered and fractured quartzite
- Cretaceous sandstones
- Glacial outwash deposits

Groundwater resources in the vicinity of the Project area are generally derived from buried glacial outwash deposits of sand and gravel. Water tends to be plentiful, yet hard, with high levels of iron and manganese. Although the groundwater is plentiful, the sensitivity of this resource to surficial pollutants can range from moderate to very high due to shallow water table and soil permeability. Domestic water supplies are obtained from Lincoln-Pipestone Rural Water System or from mainly discontinuous buried glacial sand and gravel aquifers. The County Well Index was reviewed for the Project area and it identified seven domestic wells and one irrigation well completed in the sand and gravel outwash lenses. The wells were completed at depths ranging from 68 feet to 390 feet below ground surface. Based on the age of many of the homesteads, the majority of the existing wells at the site are probably not recorded in the County Well Index. This may indicate more domestic wells in the area than what is documented. Domestic groundwater supply appears to be fairly accessible in the Project area and is dependant on the relative occurrences of sand and gravel aquifers at any given area.

5.14.2 IMPACTS

Impacts to geologic and groundwater resources are not anticipated. Water supply needs will be quite limited and local supplies are abundant. It is probable that operations and maintenance water requirements will be satisfied with rural water service.

5.14.3 MITIGATIVE MEASURES

Wind turbine locations will not impact the use of existing water wells because the turbines will not be sited within 623 to 788 feet of occupied structures.

5.15 SURFACE WATER AND FLOODPLAIN RESOURCES

5.15.1 DESCRIPTION OF RESOURCES

Surface water and floodplain resources for the study area were identified by reviewing U.S. Geological Survey topographic maps, Flood Insurance Rate Maps (FIRM) produced by the Federal Emergency Management Agency (FEMA), and Minnesota Public Waters and Wetlands Inventory (PWI) map. The major surface waters located within the study area include Medary Creek, Spring Creek, Norwegian Creek, and their tributaries. There are three water bodies within the site that are Public Waters: Medary Creek, Spring Creek, and Norwegian Creek. Lake Benton, a Minnesota Public Water, is located 2 miles east of the Project area. Also within the Project area are a number of unnamed intermittent and perennial

streams that are designated Waters of the U.S. Figure 5-9 shows the locations of surface waters and Minnesota Public Waters within the site.

Review of the FEMA Floodplain map (Figure 5-10) indicates that there is a 100-year floodway along the banks of Medary Creek south of U.S. Highway 14. There are low-lying areas that are classified within the 100-year flood elevation near the Project site. These areas are adjacent to Lake Benton and the Chen Bay State Wildlife Management Area.

5.15.2 IMPACTS

Construction of the wind turbines, transformer pads, and access roads will disturb land within the Project site. The wind turbines will be built on ridges, and this will avoid lakes and streams located in the lower positions in the landscape. Access roads will be designed to minimize impacts to streams.

5.15.3 MITIGATIVE MEASURES

If the Project will impact Waters of the U.S. or Minnesota Public Waters, PPM will apply for the necessary permits prior to construction. Access roads constructed adjacent to streams and drainageways 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 NPDES permit application and Storm Water Pollution Prevention Plan (SWPPP), will be obtained prior to the construction of the Project.

5.16 WETLANDS

5.16.1 DESCRIPTION OF RESOURCES

Wetlands near the Project area were identified by reviewing National Wetland Inventory (NWI) Maps and Minnesota PWI Maps. The wetlands are associated with creeks and unnamed intermittent streams within the site. The NWI wetland types and their acreage for the site are presented in Table 5-6.

Table 5-6
NWI Wetland Type and Acreage

Circular 39	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	Type 7
Cowardin Classification	PEMA, PEMAd	PEMB	PEMC, PEMCd, PEMCh, PUSCx	PEMF	PUBF, PUBFh, PUBFhx, PUBFx, PUBG	PSSA, PSSC	PFO1A, PFO1C
Acres[1]	36.5	1.4	269.0	18.8	54.4	0.5	4.63

[1] *Wetland acreage is calculated using USFWS NWI data.*

There are 385 acres of palustrine emergent wetlands within the Project area. There is 0.5 acres of riverine wetland (R2UBG) along Medary Creek. The major wetlands within the Project area are associated with Medary Creek and its tributaries. See the NWI Map in Figure 5-11 for locations of wetlands within the site.

5.16.2 IMPACTS

Wind turbines will be built on ridges and this will avoid wetlands on the lower positions in the landscape. Access roads will be designed to minimize impacts on the wetlands.

5.16.3 MITIGATIVE MEASURES

Wetlands will be avoided during the construction phase of the Project. If wetland impacts cannot be avoided, PPM will submit Section 404 and Minnesota Wetland Conservation Act permit applications to the U.S. Army Corps of Engineers and the State prior to construction.

5.17 VEGETATION

5.17.1 DESCRIPTION OF RESOURCES

The map of the natural vegetation of Minnesota (Coffin and Pfannmuller, 1988) identifies the areas of Lincoln County as upland prairie and prairie wetland. The upland prairie vegetation includes bluestems, Indian grass, needle grass, grama grasses, composites, and other forbs. The prairie wetland vegetation includes blue-joint grass, cord grass, cattails, rushes, and sedges. Tallgrass prairie developed with periodic fires that were either started by natural causes (i.e., lightning) or by Native Americans.

As a result of settlement in the mid-1800s, the area was converted into farmland. During this process, the wetland areas were frequently ditched and drained. Only a small fraction of the original prairie and wetlands remain as relic habitats. With the settlement of the area, periodic burning of the land halted since settlers did not want to endanger their property (homes, crops, livestock, etc.). Fires caused by natural means were controlled and human fire starting was prevented. Trees now had an opportunity to establish in the area. 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).

Today, native prairie managed areas in the vicinity of the Project area are located approximately one mile southeast of the study area in an area known as the Hole-in-the-Mountain Prairie. There may also be a few small tracts of native prairie located on private lands in the Project area.

Based on review of aerial photographs, land use database information, and a visit to the Project site, HDR determined that the majority of the land area at the site is cultivated. The grassland and wetland areas at the site may contain potential remnant native prairie areas. Native prairie is identified as lands that have never been plowed, with less than 10 percent tree cover, and presence of native prairie vegetation. Unplowed fields of native grassland or pasture, with 10 or more prairie plant indicator species, are considered to be prairie for the purposes of this site permit application. The relative abundance of the major habitats in the Project area are shown in Table 5-7.

Table 5-7
Major Habitats and their Relative Abundance in the Project Area

Habitat	Acreage	Percent of Project Area
Cultivated Land	21,957	70.6 %
Grassland[1]	8,924	28.7 %
Wooded	142	0.4 %
Wetland[2]	59	0.2 %
Other	1	<0.1 %

[1] *Native prairie area will be determined by a field survey prior to construction.*
[2] *Wetland area will be determined by a wetland delineation prior to construction.*

Crops include corn, soybeans, alfalfa, clover, wheat, oats, and hay. Range and pasture lands are used to graze cattle, sheep, and horses. Heavily grazed range/pasture lands contain Kentucky bluegrass, quack grass, and brome grasses. Lightly grazed or undisturbed range land may contain native grass species including big blue stem, needle grass, and grama grass. CRP land is typically covered by brome grasses, orchard grass, and alfalfa. Land is typically put into CRP for 10-year cycles. Additional information on agriculture and farming can be found in Section 5.10.

Approximately 142 acres of the site is wooded. This can be further broken down as 23 acres oak, 5 acres cottonwood, 47 acres lowland deciduous trees, and 66 acres upland shrub. Generally, the wooded areas are isolated groves or windrows established by the landowner/farmers to prevent wind erosion and shelter dwellings. Typical tree species include bur oak, cottonwood, American elm, silver maple, poplar, and willow.

5.17.2 IMPACTS

The amount of vegetation that will be removed as a result of the Project will be determined once a permanent site layout is determined. It is anticipated that approximately 44 acres of the Project site will be used for 1.5 MW turbines and 32 acres for 3.0 MW turbines and access roads. The vegetation will be permanently removed and replaced by wind turbines, access roads, and transformers. Approximately 5 acres of land will be used for the O&M facility and Project Substation. During the construction of the

wind power facilities, additional area may be temporarily disturbed for contractor staging areas and underground power lines. Approximately eight acres of land will be temporarily impacted for contractor staging and lay down areas. Temporarily disturbed areas will be reseeded to blend in with existing vegetation. The turbines will be constructed at a certain distance from 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.

5.17.3 MITIGATIVE MEASURES

The following measures will be used to avoid and minimize potential impacts to the vegetation of the Project area during selection of the individual turbine sites and its subsequent development and operation:

- Conduct a pre-construction inventory of the Project site for existing wildlife management areas, scientific and natural areas, recreation areas, wetlands, native prairie, and forests. The preconstruction inventories will have varying levels of detail with the most specific detail in the vicinity of construction.
- Exclude established wildlife management, recreation and scientific and natural areas from consideration for wind turbine, access road, or electrical line placement.
- Avoid disturbance of wetlands during construction and operation of the Project. If jurisdictional wetland impacts are proposed, then PPM will apply for wetland permits.
- Minimize impacts to existing trees and shrubs.
- Use BMPs during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containing excavated material, protecting exposed soil and stabilizing restored material, revegetating non-cropland and range areas with wildlife conservation species and, wherever feasible, planting native tall grass prairie species in cooperation with landowners.
- PPM shall, with the advice of the DNR, and any others selected by PPM, prepare a prairie protection and management plan and submit it to the PUC after issuance of the site permit and prior to construction. The plan shall address steps to be taken to identify native prairie within the Project area, measures to avoid impacts to native prairie, and measures to minimize and mitigate for impacts if unavoidable. Wind turbines and all associated facilities, including foundations, access roads, underground cable, and transformers, shall not be placed in native prairie unless addressed in the prairie management plan. Measures to be taken to mitigate unavoidable impacts to native prairie will be agreed to by PPM and DNR. Such measures may include restoration or management of other native prairie areas that are in degraded condition, conveyance of conservation easements, or other means agreed to by PPM and DNR.

Native prairie is identified as lands that have never been plowed, with less than 10 percent tree cover, and

presence of native prairie vegetation. Unplowed fields of native grassland or pasture, with 10 or more prairie plant species, are considered to be prairie for the purposes of this site permit. A list of prairie indicator species can be found in Appendix 3 and Supplement to Appendix 3 in *Minnesota's Native Vegetation: A Key to Natural Communities*, Minnesota Department of Natural Resources Natural Heritage Program, 1993.

5.18 WILDLIFE

5.18.1 DESCRIPTION OF RESOURCES

Information on the existing wildlife in the proposed wind farm area was obtained from a variety of sources including DNR, USFWS, and avian and bat monitoring studies at Buffalo Ridge prepared for Xcel Energy. The following sections do not include any discussions on wildlife species considered by the state to be threatened or endangered or of special concern. Refer to Section 5.19 for information on these resources.

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

5.18.1.1 Birds

Various migratory and resident bird species utilize the Project site as a part of their life cycle. Migratory bird species are those that may use the Project site for resting, foraging or breeding activities for only a portion of the year. Resident bird species occupy the proposed wind farm site throughout the year. A list of 218 bird species observed in the vicinity of Buffalo Ridge during the four-year wind avian study is presented in Appendix C.

The site vicinity on Buffalo Ridge is not a major waterfowl staging area or migration route, and passerines usually migrate at high altitudes through the area. State survey data for the immediate area indicate small breeding populations of mallards, blue-winged teal, and wood ducks.

Upland gamebirds in the region include pheasant and gray partridge. Common raptors in the region include red-tailed hawk, American kestrel, northern harrier, and Swainson's hawk.

5.18.1.2 Mammals

The Minnesota DNR conducts annual surveys in southwestern Minnesota to collect information on species abundance and distribution of white-tailed deer, cottontail rabbits, and white-tailed jackrabbits as a part of a statewide program. They also collect status information on fox, skunk, and squirrel. The avian studies also collected preliminary information on bats in the Buffalo Ridge Area. A list of species compiled from various sources is presented in Appendix C.

These species use the food and cover available from agricultural fields, grasslands, farm woodlots, wetland areas, and wooded ravines. Grassland areas and woody vegetation are also habitat for a variety of small mammals including house and deer mice, least and long-tailed weasels, and prairie and meadow voles. White-tailed deer, an economically important species, have a strong affinity for agricultural crops and use farm woodlots, wooded ravines, and intermittent stream bottoms for shelter.

The avian studies on Buffalo Ridge also collected data on bat mortality while collecting avian data. Bat mortality at the site for the Xcel Phase III wind farm is estimated at an annual rate of 1.87 bat fatalities per turbine. Researchers highlighted that bat mortality increased with reduced distance between turbines and wetlands or woodlands.

5.18.1.3 Reptiles and Amphibians

Reptile and amphibian species, which may be present in the Project vicinity, include the western plains garter snake, red-sided garter snake, western hognose snake, snapping turtle, western painted turtle, American toad, northern leopard frog, and western chorus frog. A list of reptile and amphibian species, which may use the grassland and forested areas is presented in Appendix C.

5.18.1.4 Insects

While many insect species are important to the indigenous vegetation and wildlife, honeybees are the only species economically important in the Project area. There are five licensed honey bee locations in the Project area in Sections 16 of Verdi Township, Sections 6 and 30 of Drammen Township, and Sections 19 and 30 Shaokatan Township. There are also butterfly species associated with native prairie plants.

5.18.2 IMPACTS

Development of the wind farm, including the construction and operation of the Project, is expected to produce a minimal impact to the wildlife. Based on studies of existing wind power projects in the United States and Europe, the impact to wildlife would primarily occur to avian and bat populations. The final report on avian monitoring studies at Buffalo Ridge, Minnesota identified the following impacts:

- Following construction of the wind turbines there is a reduction in use of the area within 100 meters of the turbines by seven of 22 species of grassland breeding birds. It was hypothesized that lower avian use may be associated with avoidance of turbine noise, maintenance activities, and less available habitat. The researchers stated "on a large scale basis, reduced use by birds associated with wind power development appears to be relatively minor and would not likely have any population consequences on a regional level."
- Avian mortality appears to be low on Buffalo Ridge, compared to other wind facilities in the United States, and is primarily related to nocturnal migrants. Resident bird mortality is very low and involves common species. The researchers stated that "based on the estimated number of birds that migrate through Buffalo Ridge each year, the number of wind plant related avian fatalities at Buffalo Ridge is likely inconsequential from a population standpoint."
- Bat mortality was studied at the Buffalo Ridge, Minnesota Wind Resource Area in 2001 and 2002 by WEST. They found an overall mortality average of 2.16 bats/turbine/year. Approximately 82 percent of the bat mortality occurred from mid-July to the end of August. WEST found that "both the bat detector and mist net data indicate there are relatively large breeding populations of bats in close proximity to the wind plant that experienced little to no wind plant related collision mortality." It appears that most bat mortality at Buffalo Ridge involves migrating bats.

The impact of the proposed Project on wildlife is expected to be minimal. There is potential for avian and bat collisions with facility turbines or meteorological towers. Additional impacts may include a small reduction in the available habitat that some of the wildlife uses for forage or cover. Operation of the wind farm will not change the existing land use.

5.18.3 MITIGATIVE MEASURES

The following measures will be used, to the extent practicable, to help avoid potential impacts to wildlife in the Project site during selection of the turbine locations and subsequent development and operation:

- PPM will conduct a pre-construction inventory of existing biological resources, native prairie, and wetlands in the Project area.
- PPM will exclude established wildlife management, recreation, and scientific and natural areas from consideration for wind turbine, access road, or feeder/collector line placement.
- PPM will avoid or minimize disturbance of individual wetlands or drainage systems during construction of the Project.
- PPM will avoid or minimize placement of turbines in high quality native prairie tracts.

- PPM will protect existing trees and shrubs that are important to the wildlife present in the area.
- PPM will avoid construction activities within deer-wintering yards during winter.
- PPM will maintain sound water and soil conservation practices during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. To minimize erosion during and after construction, BMPs for erosion and sediment control will be utilized. These practices include: Temporary Seeding, Permanent Seeding, Mulching, Filter Strips, Erosion Blankets, Grassed Waterways, and Sod Stabilization.
- PPM will construct wind turbines using tubular monopole towers and turbines will be minimally lit according to FAA requirements.
- PPM will revegetate non-cropland and pasture areas disturbed during construction or operation with an appropriate native seeding mix.
- PPM will inspect and control noxious weeds in areas disturbed during construction and operation of the Project.

PPM is committed to minimizing wildlife impacts within the Project site. PPM will design their facility to minimize avian impacts by avoiding high use wildlife habitat, using tubular towers to minimize perching, placing electrical collection lines underground as practicable, and minimizing infrastructure.

5.19 RARE AND UNIQUE NATURAL RESOURCES

5.19.1 DESCRIPTION OF RESOURCES

The USFWS and the DNR were contacted to review the Project for threatened and endangered (T&E) species and unique habitats. The DNR maintains a Natural Heritage Database (NHD) through their Natural Heritage Program and Nongame Game Wildlife Program, which is the most complete source of data on Minnesota's rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features. Response letters from the USFWS and the DNR are in Appendix A.

The USFWS identified the following federally-listed threatened and endangered species as potentially occurring in the Project area:

- Bald Eagle (*Haliaeetus leucocephalus*) - Threatened
- Topeka shiner (*Notropis topeka*) – Endangered

The Bald Eagle may use the area for migration and wintering. Currently there are no known eagle nests within the Project boundaries.

The USFWS has identified portions of Medary Creek in the Project area as Topeka shiner critical habitat. The Topeka shiner is a small, silvery minnow that is approximately 3 inches in length. It is found in small to mid-size prairie streams with relatively high water quality and cool-to-moderate temperatures. Critical habitat designates areas that contain habitat essential for the conservation of a threatened or endangered species and which may require special management considerations.

The DNR identified that portions of Medary Creek are Topeka shiner critical habitat. Actions which alter stream hydrology or decrease water quality (i.e. sedimentation, dredging and filling, stream dewatering, impoundment, channelization, and contamination) may adversely impact the Topeka shiner. The DNR also recommended a survey of the Project area for native prairie remnants. There are also documented records within prairie fragments near the north end of the Project area of several state-listed butterfly species (see Figure 5-12). The DNR recommend a butterfly survey between late June and early July in prairie remnants over 15 acres.

5.19.2 IMPACTS

No impacts to bald eagles or Topeka Shiners are anticipated for the Project construction or operation. Impacts to the Topeka Shiner are not anticipated as construction activities for wind turbines and access roads will in general be limited to ridges and will avoid area streams and wetlands. BMPs will be implemented during construction to control erosion at the Project site, and specifically in the Medary Creek watershed. Operation of the Project is not anticipated to affect the federal and state-listed Topeka shiner.

No impacts are anticipated to Rare and Unique Resources. A pre-construction inventory of existing native prairie, woodlands, and wetlands will be conducted in the Project site. PPM will avoid the resources identified to the extent practicable.

5.19.3 MITIGATIVE MEASURES

The following measures will be taken to avoid potential impacts to federal and state-listed species and rare or sensitive habitat in the area during selection of the wind turbines and access roads and the subsequent development and operation:

- PPM will conduct a pre-construction inventory of existing biological resources, native prairie, and wetlands in the Project area.
- PPM will avoid or minimize disturbance of individual wetlands or drainage systems during construction of the Project.
- PPM will avoid or minimize placement of turbines in high quality native prairie tracts.
- PPM will consult with the USFWS and DNR regarding Topeka Shiner habitat if waterway crossings of Medary Creek are necessary.

5.20 SUMMARY OF IMPACTS

5.20.1 VISUAL IMPACTS

The wind turbine arrays will be prominent features in the landscape. By design, these structures are placed in open areas of higher elevations. Some mitigative measures, as described in Section 5.4, can be implemented to somewhat limit visual impacts. However, there is no way to make these structures unnoticeable. The degree to which the visual impacts are considered adverse is subjective, and can be expected to vary depending, for example, on how often the viewer sees the turbines.

5.20.2 COMMITMENT OF LAND

The Project site includes a total of 31,084 acres of land. Of the 31,084 acres, less than 1 percent will be converted from natural vegetation or agricultural field to wind turbines, access roads, and transformer pads. Approximately 44 acres of land will be converted for the 1.5 MW turbines and 32 acres of land will be converted for the 3.0 MW turbines and access roads. Approximately 5 acres of land will be used for the O&M facility and Project Substation. The existing land use can continue on the remainder of the land.

5.20.3 NOISE

When in motion, the wind turbines emit a perceptible sound. The level of this noise varies with the speed of the turbine and the distance of the listener to the turbine. On relatively windy days, the turbines create more noise. However, the ambient or natural, noise level simply from the wind tends to override the turbine noise as distance from the turbines increases.

5.20.4 WILDLIFE

Birds and bats occasionally collide with wind turbines. The mortality associated with these collisions has been identified as inconsequential from a population standpoint. In addition, turbines may result in reduced use of habitat by grassland bird species within 100 meters of the turbine.

The impact of the proposed Project on wildlife is expected to be minimal. Roughly 37 to 49 acres of land will be converted for the access roads, turbine pads, maintenance facility, and substation. This will reduce available habitat that some of the wildlife uses for nesting, forage or cover.

5.21 SUMMARY OF PRECONSTRUCTION INVENTORIES

PPM will conduct the following resource inventories for the Project site prior to construction. PPM will submit copies of these preconstruction inventories to the PUC at the preconstruction meeting.

- Biological Preservation Survey – inventory of existing WMAs, SNAs, recreation areas, wetlands, native prairies, forests, and other biologically sensitive areas within the site.
- Archaeological Reconnaissance Survey
- Electromagnetic Interference Study – inventory of microwave beams and television signal reception within the site.
- Phase I Environmental Site Assessment

5.22 EXCLUSION AND AVOIDANCE CRITERIA AND SITE DESIGNATION SUMMARY

State law governing the siting of traditional electric generating facilities requires that certain environmental features be avoided. These requirements will be applied in determining the location of the proposed wind turbines and related appurtenances on the MinnDakota site. Table 5-8 identifies these features to be avoided and whether or not such features exist within the site. For those categories where these exclusion/avoidance features are present within the site boundaries, the final locations of the turbines will be selected to not interfere with them. Hence, this table reflects the ease, or degree of flexibility, in siting the turbines, for a given type of environmental feature.

Table 5-8
Exclusion/Avoidance Features Relative to Project Area

Exclusion/Avoidance Feature	Presence in Project Area
National Parks	None
National Historic Sites	None
National Historic Districts	None
National Wildlife Refuges	None
National Monuments	None
National Wild, Scenic and Recreational Riverways	None
National Wilderness Areas	None
State Wild, Scenic and Recreational Rivers	None
State Parks	None
Nature Conservancy Preserves	None
State Scientific and Natural Areas	None
State Wilderness Areas	None
Registered Historic Sites/Dist.	15 archaeological resources in area - 3 are at site
State Wildlife Mgmt. Areas	None
County and Municipal Parks	None
State and Federal Rec. Trails	None
Designated Trout Streams	None
DNR Canoe/Boating Routes	None
Prime Farmlands	Present
Wetlands	Present (Figure 5-11)
Streams Within Site Boundaries	Present (Figure 5-9)
Residences	Approximately 94[1]

[1] *Residences were determined from Lincoln County GIS data for the purposes of this permit. These have not been verified by a field survey.*

6.0 IDENTIFICATION OF REQUIRED PERMITS/APPROVALS

The potential federal and state permits or approvals that have been identified as being required for the construction and operation of the Project are shown in Table 6-1.

Table 6-1
Permits and Approvals

Agency	Type of Approval
Federal Aviation Administration	Notice of Proposed Construction or Alteration within 6 miles of Public Aviation Facility and structures over 200 feet to complete a 7460 Proposed Construction or Alteration Form
U.S. Army Corps of Engineers	Section 404 Permit
State of Minnesota	
Minnesota Public Utilities Commission	LWECS Site Permit
Minnesota Board of Water and Soil Resources	Wetland Conservation Act Approval
Minnesota Department of Natural Resources	Public Water Works Permit
	License to Cross Public Land and Waters
Minnesota Pollution Control Agency	NPDES Permit: Construction
	License for Very Small-Quantity Generator of Hazardous Waste
Minnesota Department of Health	Water Well Permit
	Plumbing Plan Review
Minnesota Department of Transportation	Crossing Permit for Feeder Lines and Access Roads
Local Permits	
Lincoln County	Utility Permit for Feeder Lines Constructed Along Corridor Road Right of Ways
	Access Permit Application
	Application for Permit to Move Loads on Restricted Highways

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8.0 ABBREVIATIONS

ANSI	American National Standards Institute
APE	Area of Potential Effect
BMP	Best Management Practices
CON	Certificate of Need
CRP	Conservation Reserve Program
CSAH	County State Aid Highway
dBA	Decibels
DNR	Minnesota Department of Natural Resources
DOE	Department of Energy
DPS	Department of Public Service
ELF-EMF	Extremely Low Frequency – Electric and Magnetic Field
EPC	Engineering Procurement Construction
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
ft	Feet
GL	Germanischer Lloyd
IEC	International Electomechanical Commission
Kg	Kilogram
kV	Kilovolt
kVA	Kilovolt ampere
kW	Kilowatt
LWECS	Large Wind Energy Conversion System
m	Meter
m/s	Meters per second
MEQB	Minnesota Environmental Quality Board
MISO	Midwest Independent Transmission System Operator
MPCA	Minnesota Pollution Control Agency
mph	Miles per hour
MW	Megawatt
MWh	Megawatt hour

NAE	Northern Alternative Energy
NEMA	National Electrical Manufacturer's Association
NHD	Natural Heritage Database
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institute of Health
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Program
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSP	Northern States Power
NWI	National Wetland Inventory
O & M	Operations and Management
PCB	Polychlorinated Biphenyls
PPA	Power Purchase Agreement
PUC	Public Utilities Commission
PWI	Public Waters and Wetlands Inventory
RD	Rotor Diameter
RFP	Request for Proposal
RIM	Reinvest in Minnesota
SCADA	Supervisory Control and Data Acquisition System
SHPO	State Historic Preservation Office
SNA	Scientific and Natural Area
SWPPP	Storm Water Pollution Prevention Plan
T&E	Threatened and Endangered
TCP	Traditional Cultural Property
URD	Underground Rural Distribution
USFWS	United States Fish and Wildlife Service
V	Volts
VAR	Reactive Power Flow
WMA	Wildlife Management Area
WTG	Wind Turbine Generators

Figures

Appendices

Appendix A

Agency Correspondence

Appendix B

Cultural Resources Memorandum

Appendix C

Animals in Project Area

From "*Avian monitoring studies at the Buffalo Ridge, Minnesota wind resource area: results of a 4-year study,"* Western EcoSystems Technology, Inc. 2000.

Appendix A. List of birds seen in vicinity of Buffalo Ridge study area, 1996-1999.

Common Name	Scientific Name
Common Loon[b]	*Gavia immer*
Pied-billed Grebe[ab]	*Podilymbus podiceps*
Western Grebe[c]	*Aechmophorus occidentalis*
Horned Grebe[c]	*Podiceps auritus*
Eared Grebe[c]	*Podiceps nigricollis*
Red-necked Grebe[c]	*Podiceps grisegena*
American White Pelican[ab]	*Pelicanus erythrorhynchos*
Double-crested Cormorant[ab]	*Phalacrocorax auritus*
American Bittern[a]	*Botaurus lentiginosus*
Least Bittern[c]	*Ixobrychus exilis*
Green Heron[ab]	*Butorides striatus*
Cattle Egret[a]	*Bubulcus ibis*
Great Egret[ab]	*Casmerodius albus*
Great Blue Heron[ab]	*Ardea herodias*
Turkey Vulture[b]	*Cathartes aura*
Tundra Swan[c]	*Cygnus columbianus*
Canada Goose[ab]	*Branta canadensis*
Greater White-fronted Goose[ab]	*Anser albifrons*
Snow Goose[ab]	*Chen caerulescens*
Mallard[ab]	*Anas platyrhynchos*
Black Duck[c]	*Anas rubripes*
Gadwall[ab]	*Anas strepera*
American Wigeon[ab]	*Anas americana*
Northern Pintail[ab]	*Anas acuta*
Green-winged Teal[a]	*Anas crecca*
Blue-winged Teal[ab]	*Anas discors*
Northern Shoveler[ab]	*Anas clypeata*
Wood Duck[ab]	*Aix sponsa*
Canvasback[b]	*Aythya vallisineria*
Redhead[c]	*Aythya americana*
Ring-necked Duck[b]	*Aythya collaris*
Greater Scaup[a]	*Aythya marila*
Lesser Scaup[ab]	*Aythya affinis*
Common Goldeneye[a]	*Bucephala clangula*
Bufflehead[a]	*Bucephala albeola*
Ruddy Duck[c]	*Oxyura jamaicensis*
Hooded Merganser[c]	*Lophodytes cucullatus*
Common Merganser[ab]	*Mergus merganser*
Red-breasted Merganser[ab]	*Mergus serrator*
Northern Goshawk[ab]	*Accipiter gentilis*
Sharp-shinned Hawk[ab]	*Accipiter striatus*
Cooper's Hawk[ab]	*Accipiter cooperi*
Red-tailed Hawk[ab]	*Buteo jamaicensis*
Broad-winged Hawk[ab]	*Buteo platypterus*
Swainson's Hawk[ab]	*Buteo swainsoni*
Rough-legged Hawk[ab]	*Buteo lagopus*

[a] Observed during point count surveys; [b] Observed during RLB surveys;
[c] Observed only during incidental wildlife observations

Appendix A (Continued). List of birds seen in vicinity of Buffalo Ridge study area, 1996-1999.

Common Name	Scientific Name
Ferruginous Hawk[ab]	*Buteo regalis*
Northern Harrier[ab]	*Circus cyaneus*
Golden Eagle[ab]	*Aquila chrysaetos*
Bald Eagle[ab]	*Haliaeetus leucocephalus*
Osprey[ab]	*Pandion haliaetus*
Peregrine Falcon[ab]	*Falco peregrinus*
Merlin[a]	*Falco columbarius*
American Kestrel[ab]	*Falco sparverius*
Wild Turkey[b]	*Meleagris gallopavo*
Ring-necked Pheasant[ab]	*Phasianus colchicus*
Gray Partridge[ab]	*Perdix perdix*
Sandhill Crane[ab]	*Grus canadensis*
Sora[c]	*Porzana carolina*
Virginia Rail[c]	*Rallus limicola*
American Coot[ab]	*Fulica americana*
Semipalmated Plover[c]	*Charadrius semipalmatus*
Buff-breasted Sandpiper[a]	*Tryngites subruficollis*
American Golden-plover[ab]	*Pluvialis dominica*
Killdeer[a]	*Charadrius vociferus*
Black-bellied Plover[b]	*Pluvialis squatarola*
Common Snipe[ab]	*Gallinago gallinago*
Upland Sandpiper[ab]	*Bartramia longicauda*
Spotted Sandpiper[a]	*Actitis macularia*
Solitary Sandpiper[ab]	*Tringa solitaria*
Greater Yellowlegs[ab]	*Tringa melanoleuca*
Lesser Yellowlegs[ab]	*Tringa flavipes*
Marbled Godwit[c]	*Limosa fedoa*
Pectoral Sandpiper[ab]	*Calidris melanotos*
White-rumped Sandpiper[a]	*Caladris fuscicollis*
Least Sandpiper[a]	*Calidris minutilla*
Dowitcher[b]	*Limnodromus* sp.
Semipalmated Sandpiper[c]	*Calidris pusilla*
Wilson's Phalarope[c]	*Phalaropus tricolor*
Herring Gull[b]	*Larus argentatus*
California Gull[c]	*Larus californicus*
Ring-billed Gull[ab]	*Larus delawarensis*
Franklin's Gull[ab]	*Larus pipixcan*
Bonaparte's Gull[ab]	*Larus philadelphia*
Forster's Tern[ab]	*Sterna forsteri*
Common Tern[b]	*Sterna hirundo*
Black Tern[ab]	*Chlidonias niger*
Mourning Dove[a]	*Zenaida macroura*
Rock Dove[a]	*Columba livia*
Black-billed Cuckoo[a]	*Coccyzus erythropthalmus*
Yellow-billed Cuckoo[a]	*Coccyzus americanus*
Eastern Screech-owl[c]	*Otus asio*

[a] Observed during point count surveys; [b] Observed during RLB surveys;
[c] Observed only during incidental wildlife observations

Appendix A (Continued). List of birds seen in vicinity of Buffalo Ridge study area, 1996-1999.

Common Name	Scientific Name
Great Horned Owl[ab]	*Bubo virginianus*
Snowy Owl[c]	*Nyctea scandiaca*
Long-eared Owl[c]	*Asio otus*
Short-eared Owl[a]	*Asio flammeus*
Common Nighthawk[ab]	*Chordeiles minor*
Whip-poor-will[c]	*Caprimulgus carolinensis*
Chimney Swift[a]	*Chaetura pelagica*
Ruby-throated Hummingbird[a]	*Archilochus colubris*
Belted Kingfisher[ab]	*Ceryle alcyon*
Northern Flicker[a]	*Colaptes auratus*
Red-headed Woodpecker[a]	*Melanerpes erythrocephalus*
Red-bellied Woodpecker[a]	*Melanerpes carolinus*
Hairy Woodpecker[a]	*Picoides villosus*
Downy Woodpecker[a]	*Picoides pubescens*
Yellow-bellied Sapsucker[c]	*Sphyrapicus varius*
Eastern Kingbird[a]	*Tyrannus tyrannus*
Western Kingbird[a]	*Tyrannus verticalis*
Eastern Phoebe[a]	*Sayornis phoebe*
Say's Phoebe[a]	*Sayornis saya*
Eastern Wood Pewee[a]	*Contopus virens*
Least Flycatcher[a]	*Empidonax minimus*
Yellow-bellied Flycatcher[c]	*Empidonax flaviventris*
Olive-sided Flycatcher[c]	*Contopus borealis*
Great Crested Flycatcher[c]	*Myiarchus crinitus*
Horned Lark[a]	*Eremophila alpestris*
Purple Martin[a]	*Progne subis*
Tree Swallow[a]	*Tachycineta bicolor*
Bank Swallow[a]	*Riparia riparia*
Northern Rough-winged Swallow[a]	*Stelgidopteryx serripennis*
Barn Swallow[a]	*Hirundo rustica*
Cliff Swallow[a]	*Hirundo pyrrhonota*
Blue Jay[a]	*Cyanocitta cristata*
American Crow[ab]	*Corvus brachyrhynchos*
Black-capped Chickadee[a]	*Parus atricapillus*
White-breasted Nuthatch[a]	*Sitta carolinensis*
Red-breasted Nuthatch[c]	*Sitta canadensis*
Brown Creeper[a]	*Certhia americana*
House Wren[a]	*Troglodytes aedon*
Sedge Wren[a]	*Cistothorus platensis*
Marsh Wren[c]	*Cistothorus palustris*
Gray Catbird[a]	*Dumetella carolinensis*
Brown Thrasher[a]	*Toxostoma rufum*
American Robin[a]	*Turdus migratorius*
Hermit Thrush[a]	*Catharus guttatus*
Swainson's Thrush[a]	*Catharus ustulatus*
Gray-cheeked Thrush[a]	*Catharus minimus*

[a] Observed during point count surveys; [b] Observed during RLB surveys;
[c] Observed only during incidental wildlife observations

Appendix A (Continued). List of birds seen in vicinity of Buffalo Ridge study area, 1996-1999.

Common Name	Scientific Name
Eastern Bluebird[a]	*Sialia sialis*
Mountain Bluebird[c]	*Sialia currucoides*
Golden-crowned Kinglet[c]	*Regulus satrapa*
Ruby-crowned Kinglet[a]	*Regulus calendula*
Blue-gray Gnatcatcher[c]	*Polioptila caerulea*
American Pipit[a]	*Anthus spinoletta*
Cedar Waxwing[a]	*Bombycilla cedrorum*
Northern Shrike[a]	*Lanius excubitor*
Loggerhead Shrike[a]	*Lanius ludovicianus*
European Starling[a]	*Sturnus vulgaris*
Blue-headed Vireo[a]	*Vireo solitarius*
Red-eyed Vireo[a]	*Vireo olivaceus*
Warbling Vireo[a]	*Vireo gilvus*
Philadelphia Vireo[c]	*Vireo philadelphicus*
Yellow-throated Vireo[c]	*Vireo flavifrons*
Black-and-white Warbler[a]	*Mniotilta varia*
Tennessee Warbler[a]	*Vermivora peregrina*
Orange-crowned Warbler[a]	*Vermivora celata*
Nashville Warbler[a]	*Vermivora ruficapilla*
Brewster's Warbler[c]	*Vermivora chrysopterna X pinus*
Blue-winged Warbler[c]	*Vermivora pinus*
Yellow Warbler[a]	*Dendroica petechia*
Yellow-rumped Warbler[a]	*Dendroica coronata*
Black-throated Green Warbler[a]	*Dendroica virens*
Pine Warbler[c]	*Dendroica pinus*
Cape May Warbler[c]	*Dendroica tigrina*
Chestnut-sided Warbler[c]	*Dendroica pensylvanica*
Blackburnian Warbler[c]	*Dendroica fusca*
Magnolia Warbler[a]	*Dendroica magnolia*
Blackpoll Warbler[a]	*Dendroica striata*
Palm Warbler[a]	*Dendroica palmarum*
Northern Parula[c]	*Parula americana*
Connecticut Warbler[a]	*Oporornis agilis*
Mourning Warbler[a]	*Oporornis philadelphia*
Common Yellowthroat[a]	*Geothlypis trichas*
Wilson's Warbler[c]	*Wilsonia pusilla*
Canada Warbler[a]	*Wilsonia canadensis*
American Redstart[a]	*Setophaga ruticilla*
Ovenbird[c]	*Seiurus aurocapillus*
Northern Waterthrush[c]	*Seiurus noveboracensis*
House Sparrow[a]	*Passer domesticus*
Bobolink[a]	*Dolichonyx oryzivorus*
Western Meadowlark[a]	*Sturnella neglecta*
Yellow-headed Blackbird[a]	*Xanthocephalus xanthocephalus*
Red-winged Blackbird[a]	*Agelaius phoeniceus*

[a] Observed during point count surveys; [b] Observed during RLB surveys;
[c] Observed only during incidental wildlife observations

Mammals Expected to Occur in the Project Area

Common Name	Scientific Name
Badger	*Taxidea taxus*
Big brown bat	*Eptesieus fuscus*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Eastern cottontail	*Sylvilagus floridnus*
Eastern fox squirrel	*Sciurus niger*
Eastern gray squirrel	*Sciurus cardinensis*
Eastern pipistrelle	*Pipistrellus subflavus*
Hoary bat	*Laslurus cinereus*
House mouse	*Mus musculus*
Least weasel	*Mustela nivalis*
Little brown bat	*Myotis lucifugus*
Longtail weasel	*Mustela frenata*
Meadow vole	*Microtus pennsylvanicus*
Mink	*Mustela vision*
Plains pocket gopher	*Geomys bursarius*
Prairie vole	*Microtus ochrogaster*
Raccoon	*Procyon lotor*
Red bat	*Lasiurus borealis*
Red fox	*Vulpes fulva*
Short-tailed weasel	*Mustela erminea*
Silver-haired bat	*Lasionycteris noctivagans*
Stripped skunk	*Mephitis mephitis*
White-tailed deer	*Odocoileus virginianus*
White-tailed jackrabbit	*Lepus townsendi*

Reptiles and Amphibians Expected to Occur in the Project Area

Common Name	Scientific Name
Reptiles	
Bullsnake	*Pituophis melanoleucus*
Northern prairie skink	*Eumeces septentrionalis*
Red-bellied snake	*Storeria occipitomaculata*
Red-sided garter snake	*Thamnophis sirtalis*
Snapping turtle	*Chelydra serpentina*
Western fox snake	*Elaphe vulpine*
Western hognose snake	*Heterodon nasicus*
Western painted turtle	*Chrysemys picta*
Western plains garter snake	*Thamnophis radix*
Western smooth green snake	*Opheodrys vernalis*
Amphibians	
American toad	*Bufo americanus*
Eastern tiger salamander	*Ambystoma tigrinum*
Gray treefrog	*Hyla versicolor*
Great plains toad	*Bufo cognatus*
Northern leopard frog	*Rana pipiens*
Western chorus frog	*Pseadacris triseriata*