

**FINAL  
ENVIRONMENTAL ASSESSMENT  
FOR  
PETTISVILLE LOCAL SCHOOLS  
WIND ENERGY PROJECT  
PETTISVILLE  
FULTON COUNTY, OHIO**

**U.S. Department of Energy  
Office of Energy Efficiency and Renewable Energy  
Golden Field Office**



**FEBRUARY 2011**

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**FEBRUARY 2011**

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## COVER SHEET

**RESPONSIBLE AGENCY:** U.S. Department of Energy

**TITLE:** *Final Environmental Assessment: Pettisville Local Schools Wind Energy Project, Pettisville, Fulton County, Ohio* (DOE/EA-1818)

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**Abstract:** The U.S. Department of Energy (DOE) provided Federal funding to the Ohio Department of Development (ODOD) under the State Energy Program (SEP). ODOD proposes to provide \$1,225,000 of its SEP funds to the Pettisville Local Schools (Pettisville). Pettisville would use these funds to design, permit, and construct a 750-kilowatt wind turbine at the Pettisville Pre-Kindergarten through Twelfth Grade School located at 255 Summit Street, Pettisville, Ohio. DOE has authorized ODOD to use a percentage of the Federal funding for preliminary activities, which include preparing this EA, conducting analysis, and agency consultation. Such activities are associated with the Proposed Action and do not significantly impact the environment nor represent an irreversible or irretrievable commitment by DOE in advance of its conclusion of the potential environmental impacts from the proposed project.

The wind turbine would provide 750 kilowatts of renewable energy, which would fulfill 98 percent of the school's annual electricity demands and help to reduce greenhouse gas emissions. Pettisville has selected an Aeronautica 750 model wind turbine with a 177-foot rotor diameter and a 213-foot tower height. Overall, the turbine would stand 302 feet at its tallest blade tip extent. Approximately 1,000 linear feet of associated underground electrical transmission equipment would be installed to connect the wind turbine to the existing school switchgear. No new access roads or road improvements would be required for this project.

This EA analyzes the potential environmental impacts of the proposed construction, operation, and decommissioning of the Pettisville Local Schools Wind Energy Project and the alternative of not implementing this project (the No-Action Alternative).

**Availability:** This EA is available for review on the DOE Golden Field Office Reading Room Website, [http://www.eere.energy.gov/golden/Reading\\_Room.aspx](http://www.eere.energy.gov/golden/Reading_Room.aspx), and the DOE NEPA Website, [http://nepa.energy.gov/DOE\\_NEPA\\_documents.htm](http://nepa.energy.gov/DOE_NEPA_documents.htm).

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## ACRONYMS AND ABBREVIATIONS

|              |   |
|--------------|---|
| APE          | area of potential effect  |
| BMPs         | best management practices   |
| CFR          | <i>Code of Federal Regulations</i>  |
| dBA          | decibel on an A-weighted scale, used to approximate the human ear's response to sound |
| DNL          | Day Night Average Sound Level (also $L_{dn}$ )  |
| DOE          | U.S. Department of Energy   |
| EA           | Environmental Assessment  |
| EMF          | electromagnetic fields  |
| EPA          | U.S. Environmental Protection Agency  |
| FAA          | Federal Aviation Administration   |
| FONSI        | Finding of No Significant Impact  |
| $L_{eq}$     | equivalent noise level  |
| $L_{max}$    | maximum noise level   |
| MBTA         | <i>Migratory Bird Treaty Act</i>  |
| NEPA         | <i>National Environmental Policy Act</i>  |
| NHPA         | <i>National Historic Preservation Act</i>   |
| NPDES        | National Pollutant Discharge Elimination System                                       |
| NTIA         | National Telecommunications and Information Administration                            |
| ODOD         | Ohio Department of Development  |
| ODNR         | Ohio Department of Natural Resources  |
| ODOW         | Ohio Department of Natural Resources Division of Wildlife                             |
| OHPO         | Ohio Historic Preservation Office   |
| OSHA         | Occupational Safety and Health Administration   |
| Pettisville  | Pettisville Local Schools   |
| $PM_n$       | particulate matter with an aerodynamic diameter less than or equal to $n$ micrometers |
| Recovery Act | <i>American Recovery and Reinvestment Act of 2009</i>                                 |
| SEP          | State Energy Program  |
| SHPO         | State Historic Preservation Officer   |
| U.S.C.       | <i>United State Code</i>  |
| USFWS        | U.S. Fish and Wildlife Service  |



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## 1. INTRODUCTION

### 1.1 National Environmental Policy Act and Related Procedures

The *National Environmental Policy Act* [42 *United States Code* (U.S.C.) 4321 *et seq.*; NEPA], the Council on Environmental Quality's NEPA regulation's [40 *Code of Federal Regulations* (CFR), Parts 1500 to 1508], and the U.S. Department of Energy's (DOE's) NEPA implementing procedures (10 CFR Part 1021) require that DOE consider the potential environmental impacts of a proposed action before making a decision to implement the Proposed Action. This requirement applies to decisions about whether to provide Federal financial assistance to States and private entities.

In compliance with these regulations, this Environmental Assessment (EA)

- Examines the potential environmental impacts of the Proposed Action and the No-Action Alternative;
- Identifies unavoidable adverse environmental impacts of the Proposed Action;
- Describes the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- Characterizes any irreversible and irretrievable commitments of resources that would be involved should DOE decide to implement its Proposed Action.

DOE must meet these requirements before it can make a final decision to proceed with any proposed Federal action that could cause adverse impacts to human health or the environment. This EA provides DOE and other decisionmakers the information needed to make an informed decision about the installation, operation, and eventual decommissioning of the proposed wind turbine. The EA evaluates the potential individual and cumulative impacts of the proposed project. For purposes of comparison, this EA also evaluates the impacts that could occur if DOE did not provide funding (the No-Action Alternative), under which DOE assumes the project would not proceed without Federal funds. The EA does not analyze other action alternatives.

### 1.2 Background

Pettisville Local Schools (Pettisville) proposes to construct, operate, and eventually decommission a single 750-kilowatt wind turbine, along with approximately 1,000 feet of associated underground electrical transmission equipment at the newly constructed Pettisville Pre-Kindergarten through Twelfth Grade School campus located at 255 Summit Street in Pettisville, Ohio (proposed project). The proposed turbine location is County Road D, in the school's newly constructed athletic complex (see Appendix A Figures 1a, 1b, 2, and 3). The estimated project cost is \$1,875,000. The Ohio Department of Development's (ODOD's) Energy Resources Division selected this project to receive a \$1,225,000 sub-grant. This sub-grant would come from a grant that the State of Ohio received from DOE under the DOE's State Energy Program (SEP) and the *American Recovery and Reinvestment Act of 2009* (Pub. L. 111-5, 123 Stat. 115; ARRA or Recovery Act). The purpose of SEP is to promote the conservation of energy

and reduce dependence on imported oil by helping states develop comprehensive energy programs and by providing them with technical and financial assistance. SEP is authorized under the *Energy Policy and Conservation Act*, as amended (42 U.S.C. 6321 *et seq.*).

States can use SEP funds for a wide variety of activities related to energy efficiency and renewable energy. In the Recovery Act, Congress appropriated \$3.1 billion to SEP, and DOE issued the State of Ohio a grant in the amount of \$96,083,000, pursuant to a Federal statutory formula for distributing the SEP funds. The potential use of Federal SEP funds to assist in the financing of the proposed project constitutes a Federal action subject to review under NEPA.

In compliance with Council on Environmental Quality and DOE NEPA regulations, this EA examines the potential environmental impacts of the DOE's Proposed Action (providing funding for the design, permitting, and construction of the Pettisville Wind Energy Project) and the No-Action Alternative. This EA also describes options that Pettisville (sub-recipient) considered during development of its application to the State of Ohio, which is the recipient of Federal funding under the DOE SEP. This EA will provide DOE with the information needed to make an informed decision about whether allowing the State of Ohio to provide a portion of its Federal funds for the proposed project might result in significant environmental impacts.

## **1.3 Purpose and Need**

### **1.3.1 DOE'S PURPOSE AND NEED**

DOE's purpose and need is to ensure that SEP funds are used for activities that meet congressional statutory aims to improve energy efficiency, reduce dependence on imported oil, decrease energy consumption, and promote renewable energy. Funding provided as part of the State of Ohio's SEP sub-grant to Pettisville would partially satisfy the needs of DOE to assist U.S. cities, counties, states, and American Indian tribes through SEP to develop, promote, implement, and manage energy efficiency and conservation projects and programs designed to:

- Reduce fossil fuel emissions;
- Reduce the total energy use of the eligible entities;
- Improve energy efficiency in the transportation, building, and other appropriate sectors; and
- Create and retain jobs.

Congress enacted the Recovery Act to create jobs and restore economic growth through measures that, among other things, modernize the nation's infrastructure and improve energy efficiency. Provision of SEP funds for the proposed project would partially meet these goals.

### **1.3.2 OHIO'S PURPOSE AND NEED**

Ohio's purpose and need is to grow the economy of the state by connecting companies and communities to financial and technical resources to deploy renewable energy technologies, and to support the goals of SEP and the Recovery Act to reduce energy costs, reduce reliance on imported energy, reduce the impacts of energy production and energy use on the environment, and to preserve and create jobs.

Ohio is using its SEP Recovery Act funding for programs to increase the energy efficiency of businesses and industry while promoting deployment of clean energy projects that will help improve the cost-effectiveness and economic stability of businesses and industry in the state.

## **1.4 Ohio's SEP Project Selection Process**

The Ohio SEP, administered by ODOD, includes five sub-programs:

- Deploying Renewable Energy in Ohio
- Making Efficiency Work
- Targeting Industry Efficiency
- Banking on New Energy Financing
- Setting the Stage for Ohio's Carbon Management Strategy

ODOD selected the Pettisville Local Schools Wind Energy Project to receive a sub-grant through ODOD's sub-program, "Deploying Renewable Energy in Ohio," which provides grants to public and private entities to fund a variety of renewable energy projects, including solar, wind, fuel cell, and waste to energy technologies. ODOD issued a Request for Proposals for the "Deploying Renewable Energy in Ohio" sub-program and used the following criteria for selection: project readiness; matching capabilities, financing, and cost effectiveness; economic impact on Ohio; project characteristics and potential for innovation; and a project's ability to (1) provide emission-free energy, and (2) create jobs during the construction of the project.

## **1.5 Public and Agency Involvement**

### **1.5.1 DOE'S PUBLIC SCOPING PROCESS**

On August 19, 2010, DOE sent postcards announcing the public scoping process and directing stakeholders to the DOE Golden Field Office Public Reading Room, where the scoping letter was available for review. DOE sent notices of public scoping to stakeholders and interested parties including local, State, and Federal agencies, the tribal representatives that are regularly notified regarding Federal actions in the state of Ohio, organizations, and the general public, to solicit public comments (see Appendix D, Attachment D1). The scoping letter described the proposed project and requested assistance in identifying potential issues to be evaluated in this EA. The public scoping period closed on September 9, 2010.

In response to the scoping letter, DOE received a letter from the U.S. Fish and Wildlife Service (USFWS) that was part of the ongoing consultation between DOE and USFWS and is discussed in detail in Section 3.2.2.6 of this EA. This letter (dated September 2, 2010; see Appendix C, Attachment C3) concluded the USFWS consultation for the proposed project and indicated that the USFWS determined the proposed project is not likely to adversely affect the Indiana bat (*Myotis sodalis*).

### **1.5.2 PUBLIC INVOLVEMENT**

Pettisville has provided opportunities for public involvement since August 12, 2008, in an attempt to educate the public about this project and provide an opportunity for public comment.

The opportunities have included public meetings, school newsletter articles, and a survey, as well as coverage of the project in local media outlets (media coverage is included in Appendix D, Attachment D2).

Because the wind turbine was part of a \$7.86 million school bond for a new building that was passed on the first try in November of 2008, the proposed project was discussed at all of the public sessions held regarding the bond, featured in several school newsletters (which is sent via bulk mail to residents in the school district), included as part of regular and special School Board meetings, and discussed at public meeting at the Rotary Club in the neighboring town of Archbold. Pettisville also sent a survey to the families of students and nearby residents. Of the 300 surveys that were distributed, a total of 249 were returned in support of the proposed project.

The following information itemizes specific public involvement efforts Pettisville made.

Public meetings for the school that included discussions of the proposed wind turbine:

- August 12, 2008
- August 14, 2008
- August 15, 2008
- September 8, 2008

School Newsletter articles:

- 2008 Pettisville School Newsletter
- 2009 Pettisville School Newsletter
- 2010 Pettisville School Newsletter

The proposed wind turbine was also part of 12 School Board Meeting Superintendent's reports:

- January 10, 2011
- December 13, 2010
- November 1, 2010
- September 13, 2010
- July 8, 2010
- June 14, 2010
- June 4, 2010
- May 10, 2010
- April 29, 2010
- March 10, 2010
- February 8, 2010
- January 13, 2010

Other Public Meetings:

- January 14, 2011 – Archbold Rotary Club



- March 1, 2010 – Special Combined Board Meeting with Archbold and Pettisville Schools Special Report – Wind Turbine Projects

#### Public Survey:

In September 2009, of the approximately 300 surveys regarding the wind turbine and use of the DOE grant, 249 were returned and all were in support of the proposed project. Table 1-1 lists the summary of the respondents.

**Table 1-1. Summary of Respondents**

| Description of Respondent   | Number     |
|---|------------|
| Adjacent to site  | 22         |
| Within 0.25 mile of site  | 12         |
| Lives in the city of Pettisville                                  | 19         |
| Attends Pettisville Pre-Kindergarten through Twelfth Grade School | 168        |
| Other Supports the Project  | 28         |
| <b>Total Numbers of Support</b>                                   | <b>249</b> |

In addition, DOE contacted the following agencies and organizations:

- USFWS
- Federal Aviation Administration (FAA)
- U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA)
- Ohio Historic Preservation Office (OHPO)
- Ohio Department of Natural Resources (ODNR), Division of Wildlife (ODOW)
- Ohio Department of Transportation, Office of Aviation

### 1.5.3 DRAFT ENVIRONMENTAL ASSESSMENT

DOE issued the Draft EA for comment on February 10, 2011, and posted it on the DOE Golden Field Office Reading Room Website ([http://www.eere.energy.gov/golden/Reading\\_Room.aspx](http://www.eere.energy.gov/golden/Reading_Room.aspx)) and the DOE NEPA Website (<http://nepa.energy.gov>). DOE sent postcards to the individuals listed in Appendix D, Attachment D9 of this EA to notify them of the EA's availability on the web and to announce a 15-day public comment period on the Draft EA. A Notice of Availability was published in the local newspapers, the *Archbold Buckeye* and the *Crescent News*, and on the Pettisville Local Schools Website and newsletter (see Appendix D, Attachments D10 and D11). The comment period ended on February 25, 2011. DOE received no comments on the Draft EA.

## **2. PROPOSED ACTION AND ALTERNATIVES**

### **2.1 DOE's Proposed Action**

DOE is proposing to authorize ODOD's expenditure of Federal SEP funding through a sub-grant to Pettisville to design, permit, and construct a 750-kilowatt wind turbine to provide renewable energy to the Pettisville Pre-Kindergarten through Twelfth Grade School (Proposed Action).

DOE authorized ODOD and Pettisville to use a percentage of the Federal funding for preliminary activities, which include EA preparation and studies. These activities are associated with the Proposed Action and would not significantly impact the environment nor represent an irreversible or irretrievable commitment of resources in advance of DOE completing the NEPA process for the Proposed Action.

### **2.2 Ohio's Proposed Project**

This proposed project was chosen based on the following ODOD criteria: project readiness; cost effectiveness; economic impact for Ohio; project characteristics and potential for innovation; and its ability to (1) provide emission-free energy, and (2) create jobs during the construction of the project. For this proposed project, DOE is the Federal agency whose Proposed Action is to authorize the expenditure of funding. ODOD is the recipient of Federal funding and Pettisville is the sub-recipient of this funding. The project would be implemented on the Pettisville Pre-Kindergarten through Twelfth Grade School campus in Pettisville, Ohio.

The proposed project would include the installation, operation, and eventual decommissioning<sup>1</sup> of a single 750-kilowatt wind turbine on the Pettisville Pre-Kindergarten through Twelfth Grade School campus. The turbine model selected is an Aeronautica 54-750 with a 177-foot rotor diameter and a 213-foot tower height. Overall, the turbine would stand 302 feet at its tallest blade tip extent. The turbine would be mounted on a monopole made up of tubular conical steel segments. This design would eliminate the need for guy wires for support of the wind turbine. Guy wires can be a challenge for birds and bats to locate and maneuver around, which can lead to injury or death. The proposed design would not include the use of lattice towers for support, which have been found to be roosting sites for birds at other wind project sites.

Approximately 1,000 linear feet of associated underground electrical transmission equipment would be installed to connect the wind turbine to the existing school switchgear across County Road D to the north. No new access roads or improvements to existing roads would be required for this project.

#### **2.2.1 PROPOSED PROJECT LOCATION**

The turbine would be located south of the Pettisville Pre-Kindergarten through Twelfth Grade School campus in what is currently a construction site for a future parking lot (previously an

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1. DOE's Proposed Action includes provision of partial funding for the design, permitting, and construction of the Pettisville Wind Energy Project, whereas the proposed project also includes the operation and decommissioning of the project. While the DOE Proposed Action does not include authorizing Federal funding for operation and decommissioning, this EA analyzed those actions as connected actions.

agricultural field) (Figure 2-1 and Appendix A, Figures 1a, 1b, 2, and 3). The approximate center point of the turbine would be located at  $41^{\circ}31'40.68''$  north latitude and  $84^{\circ}13'31.51''$  west longitude and 748 feet above mean sea level. The turbine site is approximately 350 feet south of County Road D and 1,030 feet east of County Road 19 (see Appendix A, Figure 4). The site is surrounded by residential areas to the north, northwest, and to the west-southwest, with the nearest homes approximately 650 feet northeast and approximately 685 feet northwest. The high school building is approximately 790 feet north of the turbine site. Cultivated agricultural fields are south and east of the turbine location. The final footprint of the turbine base once the project is installed would be approximately 256 square feet.



**Figure 2-1. Pettisville Project Site and Vicinity**

## 2.2.2 CONSTRUCTION AND INSTALLATION

Site construction would include installation of the foundation, turbine, transformer, electrical distribution wiring, and switchgear (see Figure 2-2 and Appendix A, Figure 5).

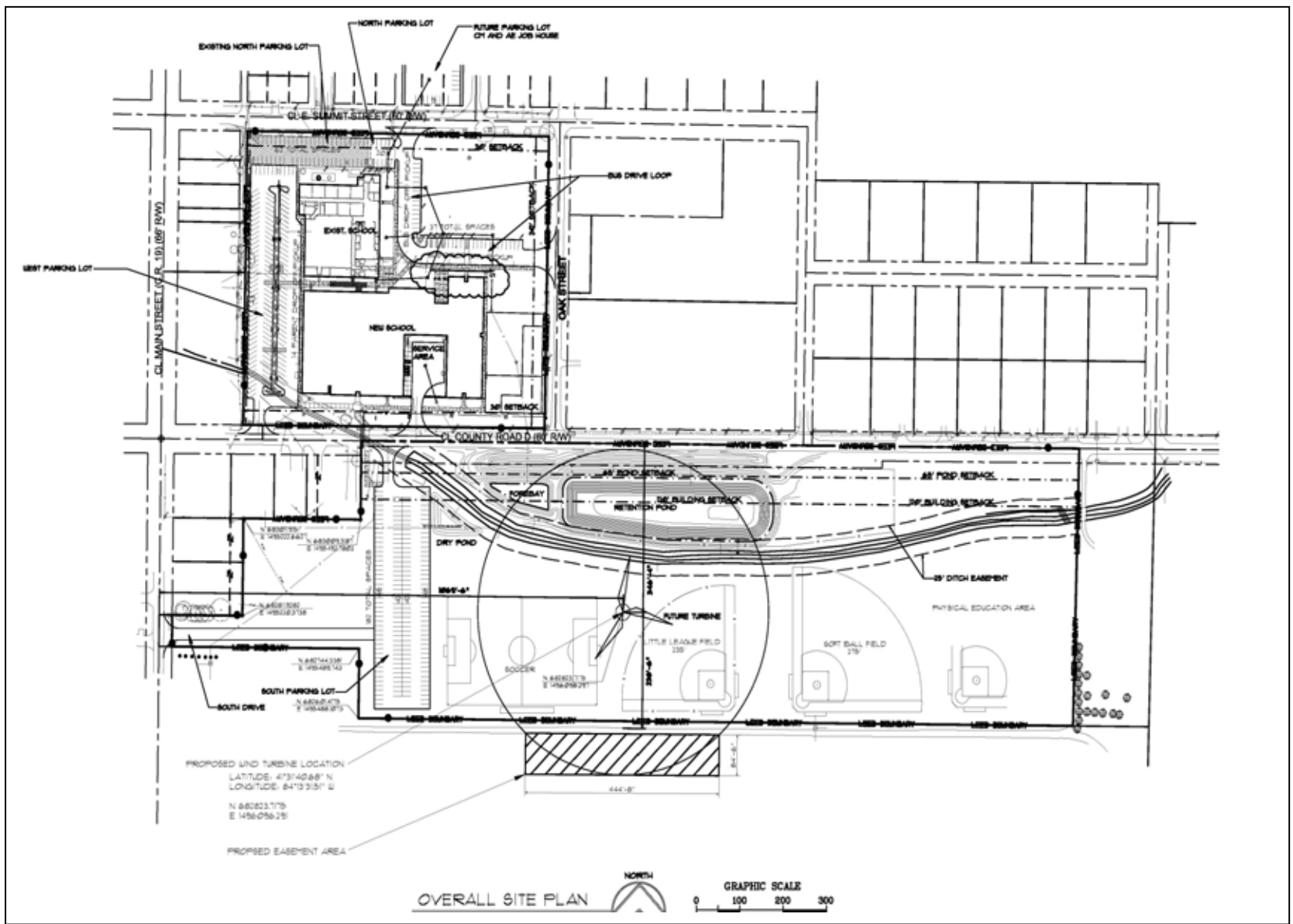


Figure 2-2. Site Plan

The turbine nacelle, blades, and tower would be staged on the Pettisville Pre-Kindergarten through Twelfth Grade School campus in what is currently a construction site for a future parking lot (previously an agricultural field).

An area equal to the possible fall zone (335-foot radius) would be closed during the erection phase of the project. Crane pads would be used during erection as needed to protect the existing school roadways and ground surfaces. The foundation for the turbine would be composed of approximately 300 cubic yards of reinforced concrete. The foundation would be buried 10 feet underground and would require approximately 23,000 pounds of reinforcing steel.

The electrical grid interconnect of the turbine would be composed of the turbine's controller (contained within the turbine tower base section), approximately 1,000 linear feet of buried 4-inch electrical conduits, including the portions of the run embedded within the turbine tower foundation, a 690- to 12,470-volt transformer, an automatic disconnect switch, a UL1741-compliant monitoring and control device, and a fused disconnect within the school's existing switchgear. The system would also have a parallel run of 2-inch conduit for data transfer and control runs. The full system would meet all local, State, and Federal codes and regulations.

Construction would use best management practices (BMPs) and be performed in accordance with an approved erosion and sedimentation control plan and in compliance with other applicable local, State, and Federal requirements. Construction activities for wind turbine foundation, tower erection, turbine nacelle placement, and blade installation would be contingent on temperature and weather conditions. The turbine nacelle and blades would be installed during calm wind periods. The foundation would not be installed during cold winter months. These and similar factors would determine the final construction timeline. The proposed project temporary disturbance area would not exceed 1 acre; thus, it would not exceed the threshold for National Pollutant Discharge Elimination System (NPDES) permitting.

The installation of the wind turbine and its related infrastructure, including site preparation, erection, final commissioning, generator installation, and overall systems tie-in and startup is scheduled to be completed within approximately 10 months of groundbreaking.

Temporary and permanent soil disturbance would affect less than 1 acre of earth. During construction, the construction area would be closed with secured fencing and locked gates to prevent unauthorized individuals from entering the work zone. The permanent disturbed ground area would be equal to the wind turbine foundation, approximately 256 square feet.

### **Aviation Lighting**

Aviation lighting would be in compliance with the FAA standards (FAA 2007). The project has been reviewed by and received a favorable aeronautical determination from the FAA (see Appendix C, Attachment C5). White strobe lights at the minimum number, minimum intensity, and minimum number of flashes per minute allowable by the FAA would be used.

### **2.2.3 OPERATIONS AND MAINTENANCE**

Pettisville would operate and maintain the wind turbine and its related infrastructure according to operating, maintenance, and safety procedures and requirements specifically recommended by the turbine's manufacturer, Aeronautica. Routine preventive maintenance and inspection of the

turbine would be necessary to maximize performance and identify potential problems or escalating maintenance issues. The turbine would be remotely monitored daily to ensure operations were proceeding efficiently. This monitoring would occur through the use of trained onsite staff and remote monitoring via a service provider contract. The turbine would have equipment installed with the ability to monitor and report faulty operations both locally and remotely, as well as the ability to automatically shut itself down if a fault should occur outside the normal operating parameters of the turbine per the manufacturer's specifications. The turbine would also have the ability for local remote shutdown by authorized personnel.

For the first 5 years of operation, Pettisville would contract out all formal service and maintenance functions to a nationally experienced firm. During this period, local staff and resources would be trained and gain experience in the maintenance and service procedures for the machine. A 5-year extended warranty would also be included in the initial purchase contract of the turbine from the original provider to optimize performance and safety. After this 5-year period, the service and maintenance plans and providers would be reevaluated and contracted as necessary. Most servicing would be performed up-tower by a maintenance crew who would not need to use a crane to remove the turbine from the tower. In addition, pads, and trenched areas would be regularly inspected and maintained.

## **2.2.4 DECOMMISSIONING**

Impacts from decommissioning the turbine would be similar to those related to construction. The turbine and other infrastructure are expected to have a useful life of at least 20 years. Retrofitting the turbine with upgrades may allow the turbine to produce efficiently for many years after the original useful life. When the project is terminated, Pettisville would be responsible for decommissioning the turbine and other infrastructure and removing all facilities to a depth of approximately 3 feet below grade. Pettisville would restore the soil surface as closely as possible to its original condition. Pettisville would either remove underground facilities or they would be safely secured and left in place. Salvageable items (including fluids) would be sold, reused, or recycled as appropriate; unsalvageable material would be disposed of at authorized and approved disposal sites. Pettisville would perform all decommissioning construction activities in accordance with the manufacturer's guidelines as well as all applicable Federal, State, and local regulations.

## **2.3 Alternatives**

### **2.3.1 DOE ACTION ALTERNATIVE**

The Ohio SEP funds are from a formula grant in which the amount granted to the State is determined pursuant to a formula established in DOE's SEP grant procedures (10 CFR 420.11). Allocation of funds among the states is based on population and other factors. Recipients of these formula grants have broad discretion in how they use these funds.

This EA examines the potential environmental impacts of DOE's Proposed Action (authorizing the expenditure of Federal funds for the design, permitting, and construction of the Pettisville Wind Energy Project) and the No-Action Alternative. This EA also describes options that Pettisville (sub-recipient) considered during development of its application to the State of Ohio,

(direct SEP recipient). This EA will provide DOE with the information needed to make an informed decision about whether authorizing the State of Ohio to provide a portion of its Federal funds for the design, permitting, and construction of the proposed project might result in significant environmental impacts.

### 2.3.2 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not authorize Ohio to use SEP funds for the design, permitting, and construction of the Pettisville Wind Energy Project. DOE assumed for purposes of this EA that the project would not proceed without SEP funding. This assumption allows a comparison between the potential impacts of the project as proposed and the impacts of not proceeding with the project. Without the proposed project, Pettisville Pre-Kindergarten through Twelfth Grade School operations would continue as otherwise planned, but without the installation or operation of the proposed wind turbine.

### 2.3.3 SITING OPTIONS CONSIDERED BY PETTISVILLE

Pettisville considered only one site for installing the wind turbine at the Pettisville Pre-Kindergarten through Twelfth Grade School, as only one viable option on the property met the basic set-back requirements of the turbine. Pettisville owns the site, and it is compatible with such environmental considerations as avoiding wildlife, wetlands, and streams. Further, the property is compatible with existing zoning and land uses.

## 2.4 Permits, Approvals, and Notifications

Prior to construction, Pettisville would obtain all required Federal, State, and local permits and approvals. The required permits and approvals are listed in Table 2-1. All permit documentation and approval letters are contained in Appendix C of this EA.

**Table 2-1. Federal, State, and Local Permits, and Notifications**

| Agency  | Permit Approval / Type   |
|---|--|
| <b>Federal</b>                                |  |
| FAA   | FAA Aeronautical Determination (issued August 19, 2010)  |
| NTIA  | Radio Frequency Transmission Approval (received October 18, 2010)  |
| USFWS   | Compliance with the <i>Endangered Species Act</i> , the <i>Migratory Bird Treaty Act</i> , and the <i>Bald and Golden Eagle Protection Act</i> (letter issued September 2, 2010) |
| <b>State</b>                                  |  |
| OHPO  | Compliance with the <i>National Historic Preservation Act</i> (letter issued February 7, 2011)   |
| ODOW  | Concurrence that the proposed project does not pose a substantial risk to State-protected species, including birds (pursuant to Ohio Revised Code Chapter 1531).                 |
| <b>Local</b>                                  |  |
| Clinton Township Planning & Zoning Commission | Building Zoning Permit (received November 23, 2009)  |

## **2.5 Project Proponent-Committed Practices**

Pettisville has committed to the following measures and procedures to minimize or avoid environmental impacts if the proposed project is implemented.

### **2.5.1 BIRD, BAT, AND RAPTOR AVOIDANCE AND MINIMIZATION MEASURES**

Project coordination occurred with USFWS and ODOW concerning the project's location and potential impacts on birds, bats, and other wildlife; rare, threatened, and endangered species; and other protected natural features. There are no known bald eagle nests in Fulton County and the proposed project does not provide suitable habitat for migratory birds. The USFWS issued letters for the proposed project on September 18, 2009 and on September 2, 2010, wherein they determined it is unlikely that the Pettisville Local Schools Wind Energy Project would adversely affect Federally listed species (see Appendix C, Attachments C2 and C3). The ODOW issued a letter on August 27, 2010 indicating that State-listed species whose range coincides with the proposed project were not anticipated (see Appendix C, Attachments C1).

Pettisville considered the USFWS *Interim Guidelines to Avoid and Minimize Wildlife Impacts* (USFWS 2003) and would take actions to minimize any potential adverse effects on wildlife through the following actions: use of a previously developed site, a smooth monopole tower, wildlife-friendly FAA obstruction lighting equipment and operation procedures, soil erosion/run-off prevention measures, and proper recycling and waste management procedures; and minimization of construction areas.

### **2.5.2 HEALTH, SAFETY AND NOISE**

Pettisville has prepared a health and safety plan, and would follow this plan, as well as all Occupational Safety and Health Administration (OSHA) requirements and Aeronautica 54-750 guidelines. Therefore, all facilities would include high-voltage warning signs. All construction activities would occur during normal working hours (7 a.m. to 7 p.m. Monday through Saturday) to avoid noise disturbances to surrounding areas. The construction of the proposed project would comply with all applicable Federal, State, and local requirements.

### **2.5.3 SOIL**

Temporary and permanent soil disturbance would not exceed 1 acre and would not require an NPDES permit under the *Clean Water Act*. Pettisville's Sediment and Erosion Control Plan would identify BMPs during construction and operation to protect topsoil and minimize soil erosion. BMPs would include, at a minimum, the following: containing excavated material, using silt fences, protecting exposed soil, stabilizing restored material, and revegetating disturbed areas with native plant species.

### **2.5.4 WASTE MANAGEMENT**

Any waste generated during construction, operation, and decommissioning, including used lubricants, would be handled, collected, transferred, and reused/recycled in accordance with applicable Federal, State, and local regulations.



### **2.5.5 CULTURAL RESOURCES**

Based on the archaeological study results, encountering archaeological resources during excavation activities is not anticipated. However, if archaeological resources were identified in areas that would be excavated, all ground-disturbing activities would be halted immediately and OHPO would be consulted for resolution.

### **2.5.6 FLICKER EFFECTS**

Based on the shadow flicker assessment prepared for this project (Appendix B, Attachment B2), shadow flicker is not expected to have more than a minimal impact on any potential receptors (e.g., private residences or businesses). However, the analysis indicates that shadow flicker effects would be noticeable on Pettisville's future ball fields. If the future ball fields are constructed and, based on additional analysis, if it is found that shadow flicker affects participants or spectators, Pettisville would temporarily shut down the turbine to lessen the shadow's impact during periods when shadowing events would overlap scheduled sporting or other use events. Additionally, Pettisville would use commercially reasonable efforts to remedy any potential problems due to shadow flicker on a case-by-case basis by undertaking measures such as planting trees or installing blinds or awnings to impacted residences.

### **2.5.7 ICING AND FIRE**

The turbine system would have an automated system fault shut-off triggered at a minimum by the following sensors: system temperature, power quality, vibration, over-speed, fire, and icing (vibration caused by blade icing-induced imbalances automatically shut down the turbine). This system is designed to automatically send fault codes to preauthorized personnel through a web interface. The turbine's nacelle would have a cold-weather package including nacelle heaters. All icing-related turbine shutdowns would require a direct inspection and an on-site manual restart. The site personnel and the system maintenance personnel would shut down the turbine in the event of an icing condition. The site would adopt an ice safety zone around the turbine for implementation during icing events. Further discussion of this topic can be found in Section 3.2.2.7.

### **3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS**

This chapter of the EA examines in detail the potential environmental impacts of the proposed project and the No-Action Alternative on the affected environmental resource areas.

#### **3.1 No-Action Alternative**

Under the No-Action Alternative, DOE would not authorize the use of Federal funds for the design, construction, and operation of the Pettisville Wind Energy Project and assumes, for purposes of this EA, that the project would not go forward without SEP funding. Therefore, there would not be any impacts to the resource areas analyzed in this EA; however, the school would continue to use energy generated from primarily fossil fuels and no additional jobs would be created.

If the proposed project is not implemented, 1,390,127 kilowatt-hours of the school's electrical power that the proposed project could provide would continue to be purchased from First Energy Solutions. In 2009, First Energy Solutions generated electricity using coal (72.8 percent), oil (0.4 percent), natural gas (2.7 percent), nuclear (22.3 percent), and renewable energy sources (1.1 percent), which is similar to the overall national composition and includes emissions of carbon dioxide, nitrogen oxides, and sulfur dioxide (EPA 2010a). Thus, carbon dioxide emissions from electricity generation to serve the school would be higher under the No-Action Alternative and ODOD would not meet its objective of deploying emission-free energy.

#### **3.2 Ohio's Proposed Project**

##### **3.2.1 CONSIDERATIONS NOT CARRIED FORWARD FOR FURTHER ANALYSIS**

Consistent with Council on Environmental Quality and DOE NEPA implementing regulations and guidance, DOE focuses the analysis in an EA on topics with the greatest potential for significant environmental impact. For the reasons discussed below, the proposed project is not expected to have any measurable effects on certain resources; therefore, these resources are not carried forward for further analysis.

###### **3.2.1.1 Water Resources**

###### **Floodplains and Wetlands**

Pursuant to 10 CFR Part 1022, DOE reviewed USFWS National Wetlands Inventory maps (USFWS 2010) and Federal Emergency Management Agency floodplain maps (see Appendix A, Figures 6 and 7) and identified no floodplains, wetlands, or surface-water sources, such as streams or drainage channels, that are located on the proposed project site or that could be affected by the construction and operation of the proposed project.

In compliance with the *Clean Water Act*, the project site was investigated for the presence of wetlands. Although no wetlands were listed on USFWS's National Wetlands Inventory map, the jurisdictional wetlands delineation, which was completed in October 2009 as part of the new ball field construction project (see Section 2.2.2), found jurisdictional wetlands in the vicinity of the proposed project site. However, the construction and operation of the proposed project is not

sited in or adjacent to any wetlands and would avoid these areas. Therefore, the proposed project would not affect floodplains or jurisdictional wetlands.

### **Wild and Scenic Rivers**

No Ohio Scenic Rivers or waterways included in the National Wild and Scenic River System occur in the proposed project vicinity (see Appendix A, Figure 8). The closest Ohio Scenic River is the Maumee, located in Henry County, approximately 14.5 miles southeast of the proposed project site (ODNR 2010). The closest National Scenic River is the Big and Little Darby Creek system, located in Union, Madison, Franklin, and Pickaway Counties and about 99 miles southeast of the proposed site (USDA Forest Service 2009). The proposed project would not affect Federal or State wild and scenic rivers.

### **Groundwater**

Based on the review of existing Ohio Environmental Protection Agency and ODNR groundwater resource maps, the proposed project area is not located in an endorsed well head protection area, where certain activities are restricted within an Ohio Environmental Protection Agency-designated protection area. Additionally, the proposed project area is not located within any designated Public Water System supply areas (sole-source aquifer, community/non-community systems, drinking water source protection areas using groundwater/surface water). Groundwater is generally not a source of drinking water in this part of Fulton County. There are no private well-water supplies on or near the project site. The proposed project would have no adverse effect on any groundwater resources.

### **Surface Water**

In compliance with the *Clean Water Act*, the proposed project site was investigated for surface water. There are several small ponds located within 0.25 mile of the project site. The majority of these ponds are to the northeast of the school and are privately owned or adjacent to residential areas. The nearest stream is an unnamed tributary to Flat Run located immediately to the north of the project site, which is part of the Lake Erie drainage system. No runoff or discharges from the proposed project construction area would directly enter neighboring bodies of water, including the series of small ponds to the northeast or the unnamed stream to the south. Because ground-disturbing activity would affect less than 1 acre, a NPDES permit would not be required prior to any construction-related earthwork. However, Pettisville has committed to using sediment and erosion pollution control BMPs in conformance with a plan specific to the proposed project.

#### **3.2.1.2 Waste Management**

Solid wastes that are anticipated to be generated during construction include equipment packaging materials and construction-related material debris. Solid wastes generated during operation of the turbines would be minimal. Solid wastes that are anticipated to be generated during decommissioning include dismantled equipment, which would likely be recycled, and construction-related material debris. Hazardous, regulated nonhazardous, and universal wastes are not anticipated to be generated during construction, operation, or decommissioning. All wastes generated over the life of the proposed project would be handled, collected, transferred, reused/recycled, and disposed of in accordance with all applicable Federal, State, and local regulations. Used oil (e.g., spent gear box oil, hydraulic fluid, and gear grease) would not be

considered a waste because it can be reused and/or recycled. Used oil would be generated during operation of the proposed project and recycled utilizing a qualified recycling facility.

### **3.2.1.3 Intentional Destructive Acts**

DOE considers intentional destructive acts (i.e., acts of sabotage or terrorism) in all its EAs and environmental impact statements. Construction and operation of the proposed project would not involve the transportation, storage, or use of radioactive, explosive, or toxic materials. The proposed project would not offer any particularly attractive targets of opportunity for terrorists or saboteurs to inflict adverse impacts on human life, health, or safety.

## **3.2.2 CONSIDERATIONS CARRIED FORWARD FOR FURTHER ANALYSIS**

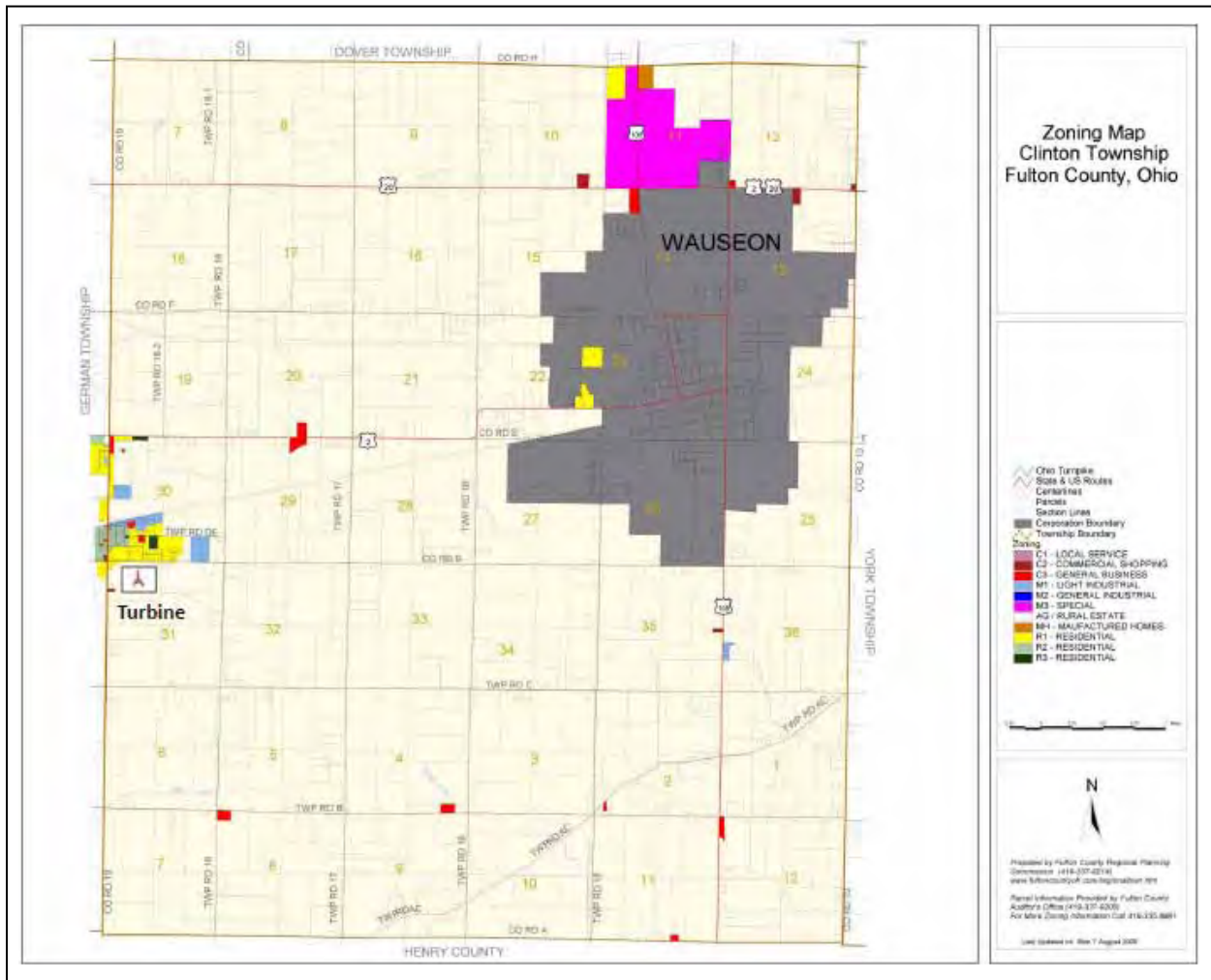
This section of the EA examines in detail the potential environmental impacts of the proposed project on the following resource areas.

- Land use
- Visual quality
- Noise
- Cultural resources
- Geology and soils
- Biological resources
- Human health and safety
- Transportation
- Socioeconomics and environmental justice
- Air quality and climate change
- Utilities and energy

### **3.2.2.1 Land Use**

The proposed project site is located on the Pettisville Pre-Kindergarten through Twelfth Grade School campus. Land use surrounding the turbine site is mainly rural residential and agricultural. The turbine would be located approximately 350 feet south of County Road “D” and 1,030 feet east of County Road 19. The residential areas are to the north and to the west-southwest, with the nearest homes approximately 650 feet northeast and approximately 685 feet northwest. Cultivated agricultural fields are located due south and east of the turbine location (see Appendix A, Figure 3 for aerial view).

The majority of land in the immediate vicinity of the school is zoned as Residential (R-1) and Agricultural/Rural Estate (see Figure 3-1 and Appendix A, Figure 9). In addition to Residential and Agricultural, the following zoning areas exist within a 1-mile radius of the proposed turbine location: Residential (R-2), Residential (R-3), General Business (C-3), and Light Industrial (M-1) (FCRPC 2008).



**Figure 3-1. Clinton Township Zoning Map**

### Direct and Indirect Impacts

Construction activities would result in temporary ground disturbance of 1,600 square feet of previously disturbed, developed, and agricultural land for the turbine foundation (ultimately a 256-square-foot permanent footprint) and 2,000 square feet of temporary ground disturbance associated with installation of the underground electrical wires. The proposed project received approval from the Clinton Township Zoning Board on November 23, 2010 (Appendix C, Attachment C7). The overall use of the general area would not change as a result of construction and operation of the proposed project.

Neither direct nor indirect impacts on land use are expected to occur outside of the immediate project site. Land-disturbing activities would be relegated to the area needed for construction and operation of the proposed project. No other lands, including natural or residential areas, would be affected.

### 3.2.2.2 Visual Resources

#### Local Viewshed

The Village of Pettisville is a rural community comprising the developed town area with residential development located north, northeast and west/southwest of the site and cultivated agriculture to the south and to the east. The landscape surrounding the school property is generally flat. Residential development, and associated landscaping, act to limit views and residents on the outer edges of development that are nearest to the school have the most direct, ground level views of the project site. Expansive views over agricultural lands are often present because there are few trees to obscure views. Trees vary in height, but tend to range from 18 to 70 feet tall, and features taller than this would be visible above the tree line.

Vertical elements present in the landscape include farm silos, buildings, industrial facilities, power line poles, and communication towers (see Figures 3-2 and 3-3); however, only silos and communication towers, one which measures over 365 feet tall, are most often seen rising above



**Figure 3-2. Nearby Communication Tower and Power Lines**

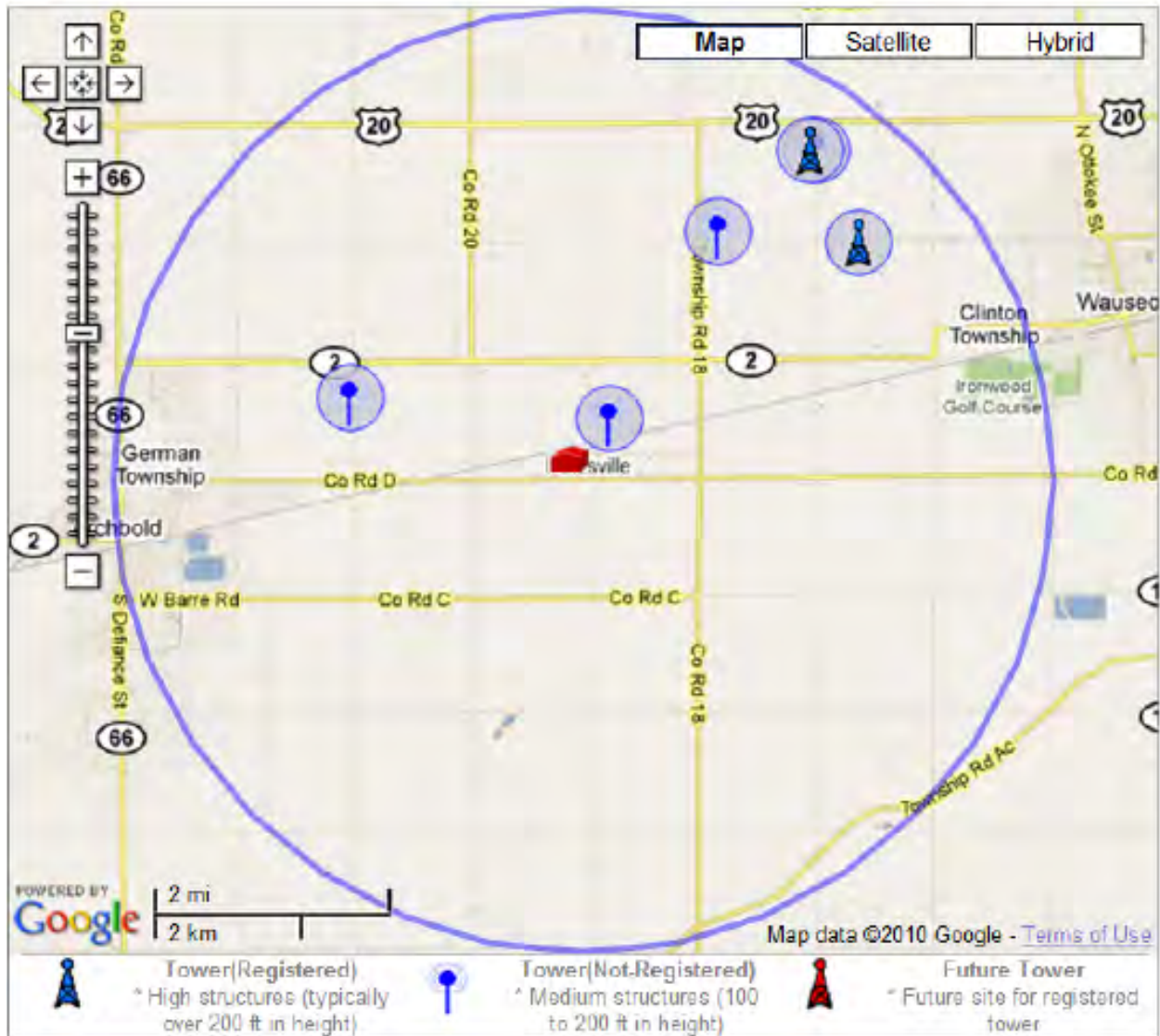


**Figure 3-3. Nearby Farm Silo**

the tree line. A number of these communication towers are located within 4 miles of the proposed project site (Figure 3-4). Existing viewer groups in the area include residents, roadway users, recreationists, and occupants of nearby commercial facilities and educational facilities.

A visual analysis was conducted for the proposed project area to assess potential impacts on the local viewshed (Appendix B, Attachment B1). The results of a visual analysis are intended to give a sense of how the proposed wind turbine would appear to potential receptors in the surrounding landscape. The actual visibility of a wind turbine in the surrounding area is affected by many factors: the size of the machine, the number of machines; tower and blade tip heights; turbine color; distance to the viewer; obstructions such as trees, hills, and buildings; atmospheric conditions; sun angle; and the curvature of the Earth. Of these factors, the overall height of a turbine, obstructions in the sightline between the viewer and the turbine, and the distance between the machine and the viewer have the greatest impact. Visual simulations were used to

illustrate the effect of the proposed project from vantage points that are representative of typical views that would be affected and include the 213-foot tower and blades, for a combined total height of 302 feet to the tallest blade.



**Figure 3-4. Existing Tall Towers within 4 Miles of the Proposed Turbine Site**

Visual simulations and an overview of photo locations for the properties listed in Table 3-1 are located in Appendix B, Attachment B1. Table 3-1 shows readings from the visualization log.



**Table 3-1. Pettisville Visualization Receptor Locations**

| Set Number | Picture Number | Distance from Turbine (miles) | Site Description  | Latitude      | Longitude     | Direction |
|------------|----------------|-------------------------------|---|---------------|---------------|-----------|
| P-V-1      | 2309           | 1.38                          | State Route 2 – School House (NE)                           | 41°32'37.38"N | 84°12'34.13"W | 225°      |
| P-V-2      | 2311           | 1.82                          | County Road 17 – Between State Route 2 and County Road D    | 41°32'09.69"N | 84°11'31.08"W | 255°      |
| P-V-3      | 2316           | 1.55                          | County Road C – Between Township Road 17 and County Road 17 | 41°30'51.65"N | 84°12'08.17"W | 314°      |
| P-V-4      | 2321           | 0.11                          | Corner Willow and County Road D Northwest of the Turbine    | 41°31'44.46"N | 84°17'25.80"W | 228°      |
| P-V-5      | 2323           | 0.24                          | Corner of Ballpark and County Road D                        | 41°31'44.52"N | 84°13'15.99"W | 252°      |
| P-V-6      | 2324           | 0.21                          | Corner of Summit and Willow                                 | 41°31'50.84"N | 84°13'26.65"W | 199°      |
| P-V-7      | 2327           | 0.35                          | Corner of Main and Dame                                     | 41°31'55.67"N | 84°13'45.87"W | 144°      |
| P-V-8      | 2336           | 1.11                          | 5037 County Road 19 Driveway                                | 41°32'37.83"N | 84°13'46.32"W | 164°      |
| P-V-9      | 2337           | 0.35                          | Parking Lot of Pettisville Missionary Church                | 41°31'43.55"N | 84°13'55.25"W | 95°       |
| P-V-10     | 2343           | 2.21                          | Corner of County Road 21 and County Road D                  | 41°31'43.98"N | 84°16'04.57"W | 91°       |
| P-V-11     | 2347           | 1.20                          | Historic Home – 4208 County Road 20                         | 41°31'55.22"N | 84°14'52.04"W | 102°      |
| P-V-12     | SSS002         | 0.12                          | County Road D North West of the Turbine                     | 41°31'43.61"N | 84°13'39.09"W | 115°      |

Source: Appendix B, Attachment B1 of this EA.

Figures 3-5 and 3-6 depict the wind turbine views from the nearest receptors which are the closest residences along County Road D directly across from the proposed turbine site.



**Figure 3-5. Visual Simulation Depicted from Residence at Corner of Willow and County Road D Northwest of the Turbine**



**Figure 3-6. Visual Simulation Depicted from Residence at County Road D Northwest of the Turbine**



The simulations depict the turbine being readily seen in the foreground from some vantages and would be a prominent visual element to the few residents near the proposed project site. Figure 3-7 displays the result of a visual simulation of how the proposed project would look from the corner of Ballpark and County Road D.

Figure 3-8 displays the result of a visual simulation of how the proposed project would look from the Pettisville Missionary Church and the turbine rising over the tree line. Note that atmospheric conditions allow the turbine to recede, somewhat, into the view. The turbine appears to be slightly taller than the trees and other infrastructure, such as signage, utility poles and lines, and the church.



**Figure 3-7. Visual Simulation Depicted from the Intersection of Ballpark and County Road D**



**Figure 3-8. Visual Simulation Depicted from Pettisville Missionary Church**

### **Direct and Indirect Impacts to the Local Viewshed**

Visual resource impacts associated with installation of the turbine including construction equipment, excavated ground, and construction fencing would result in temporary impacts while the turbine is under construction. Residents, roadway users, recreationists, and occupants of nearby facilities would have a prominent view of the construction activities including site preparation, erection of the turbine, and the staging areas of the turbine nacelles, blades, and tower during the 10 month period of construction. Many of the surrounding farms would be able to see the proposed project due to the general openness of the region’s farming landscape and the overall flat terrain surrounding the project site. Similar views would be present from within the town where open vantages present views of the turbine.

The results of the visual analysis indicate that the proposed project would be visible to some of the local residents especially those in close proximity to the school and projects site, i.e., along County Road “D”. The proposed turbine’s light-colored surface makes it stand out against its surroundings. While the turbine appears to be of similar height to the parking lot lighting standards, the turbine is much wider, which creates a larger visual massing. This, combined with the light coloring, makes the turbine stand out as a contrasting, dominant visual element in the landscape for the few residents located less than 0.25 mile from the project site.

The visibility of the proposed project to residents would be reduced as the distance from the proposed site location increased due to local obstruction proximities and densities to typical sightlines such as trees and buildings. Due to perspective, the turbine would appear as a very small element of the skyline for most locations, similar to the region's existing communication towers and granaries. However, because of trees, buildings and other tall structures in the vicinity of the proposed project, there would be a minimal impact to the local viewshed and much of the broader community would not be able to see the turbine. However, the turbine would be a dominant feature in the viewshed to the adjacent property owners.

Safety lighting in accordance with standards (FAA 2007) would be required on the turbine. Residential structures, public facilities, and commercial buildings are located close together within the town. Orientation of buildings and the presence of neighboring structures limit views to the immediate surroundings for most viewers, precluding views of the proposed project. In addition, existing trees within the town further act to limit views. Because of these factors, most views of the proposed project are seen by residents adjacent to the school while entering or exiting buildings and most of these viewers are often focused on their immediate surroundings. For those few that do have views of the site, safety light intensity and the number of lights being installed would not distract viewers in the project vicinity. Accordingly, the safety lights would not adversely affect viewers.

### **Shadow Flicker**

Shadow flicker is the moving/flickering shadows produced when sunlight passes through the spinning rotor blades of a turbine. This phenomenon can become an annoyance to nearby residents when the shadows pass directly over their line of sight, i.e., windows or other transparent surfaces. While the adverse effects of shadows can be subjective, the shadows themselves can be precisely modeled for location and duration. For shadow receptor sites within a turbine's shadow's reach, not all would receive shadow due to existing obstructions that block the shadow's path such as other buildings, hills, or trees.

While evergreen trees would fairly consistently block shadows year-round, deciduous trees would have a lesser impact in the winter months when they have no leaves. Additionally, the farther an observer is from the wind turbine, the smaller the portion of the sun being blocked, and this distance allows the shadow to diffuse (weaken). Although no official U.S. policy has been adopted, international standards appear to be in consensus that flickering shadows in excess of up to 30 hours per year is a tolerable threshold.

A shadow flicker analysis (see Appendix B, Attachment B2) was completed for the proposed project to evaluate the amount of shadow flicker that local residents would experience. The analysis considered several aspects affecting the casting of shadows and potential impacts on local receptors, including the distance to receptors, angle of incoming solar insolation, and the amount of sunlight experienced at the project site during each of the four seasons. Below are the closest receptors to the proposed project:

Receptor A: 112 Main St, approximately 960 feet from turbine. Shadows would be highly diffused, if visible at all, as the receptor is substantially blocked by trees and other structures, but shadow flicker may be possible in an open landscape from mid-February to early-March

mornings and mid-October to early-November mornings with a total average of less than 7 hours of shadow flicker per year.

Receptor B: 18372 County Road D, approximately 1,950 feet from turbine. Shadows would be highly diffused, if visible at all, as the receptor is well outside 10 rotor diameters and likely substantially blocked by trees, but shadow flicker may be possible for very short durations during portions of late-February to early-March and mid-October evenings with an average of less than 3 hours of shadow flicker per year.

Receptor C: 3770 County Road 19, approximately 1,238 feet from turbine. Site would receive 0 hours of shadow flicker.

Receptor D: 18519 County Road D, approximately 1,080 feet from turbine. Shadows would be diffused, as the receptor is substantially blocked by evergreen trees, but shadow flicker may be possible during portions of April, August, and early-September evenings with an average of less than 9 hours of shadow flicker per year.

Receptor E: 18636 County Road D, approximately 646 feet from turbine. Shadows would be diffused, as the receptor is shaded by trees, but shadow flicker may be possible during portions of January, February, October, November, and very early-December evenings with an average of less than 19 hours of shadow flicker per year.

Receptor F: Pettisville is proposing to construct ball fields on its property, which would be located approximately 175 feet east from the turbine. Shadows would be distinct late-April through mid-September afternoons and evenings with a total average of 159 hours of shadow flicker per year. If the shadows were found to affect participants or spectators, Pettisville would temporarily shut down the turbine.

Receptor G: Pettisville is proposing to construct ball fields on its property, which would be located approximately 175 feet west from the turbine. Shadows would be distinct mid-April through mid- to late-August mornings with a total average of 85 hours of shadow flicker per year. If the shadows were found to affect participants or spectators, Pettisville would temporarily shut down the turbine.

Receptor H: 3902 County Road 19, approximately 897 feet from turbine. Shadows would be substantially blocked by the farm's outbuildings, but shadow flicker may be possible during portions of mid-April to late-June and mid-July to late-August early mornings with an average of less than 17 hours of shadow flicker per year.

Receptor I: 18863 County Road D, approximately 686 feet from turbine. Shadows may be diffused due to existing trees, but shadow flicker may be possible during portions of late-February to late-March and mid-September to mid-October mornings with a total average of less than 13 hours of shadow flicker per year.

Receptor J: 8578 County Road D, approximately 888 feet from turbine. Shadows would be diffused, if visible at all, as the receptor is shaded by existing trees, but shadow flicker may be possible during portions of late-January to early-March and mid-October to mid-November evenings with an average of less than 12 hours of shadow flicker per year.

Receptor K: 18520 County Road D, approximately 1,181 feet from turbine. Shadows would be highly diffused, if visible at all, due to distance and existing trees, but shadow flicker may be possible during portions of mid-February to mid-March and mid-October evenings with an average of less than 7 hours of shadow flicker per year.

Receptor L: 3940 County Road 19, approximately 896 feet from turbine. Shadows would be visible through one window during portions of late-March to late-April and late-August to mid-September mornings with a total average of less than 11 hours of shadow flicker per year.

Although there is no established maximum standard for acceptable levels of exposure to shadow flicker, the Danish Wind Industry Association cites a court case in which the judge determined that 30 hours of shadow flicker per year as a tolerable level of shadow flicker (DWIA 2003). Therefore, shadow flicker effects would be below the threshold of potential concern at the closest receptor locations.

Because of the strobe-like effect of shadow flicker, there have been investigations into whether it might have the potential to produce epileptic seizures in individuals with photosensitivity. It has been determined that modern utility-scale wind turbines do not have the potential to cause these types of problems because of their relatively slow blade rotation. One study (Harding et al. 2008) reported that flickers with a frequency greater than 3 hertz could pose a potential for inducing photosensitive seizures (that is, a light flashing at a rate of more than 3 times per second). The American Epilepsy Foundation reports that lights flashing in the range of 5 to 30 hertz are most likely to trigger seizures and recommends that flash rates of visual alarms be kept under 2 hertz (Epilepsy Foundation 2010). A wind turbine with three blades would have to make a full revolution every second (or 60 revolutions per minute) to reach a frequency of 3 hertz. The Aeronautica 750 wind turbine proposed for this project operates at 25.3 revolutions per minute (Appendix D, Attachment D3). This would indicate a flicker frequency created by this wind turbine at less than one-half the rates identified with photosensitivity issues.

Some data suggest that shadow flicker has the potential to cause a disorienting effect on a small segment of the population. The data also suggest that rotor rotation below 2.5 hertz can avoid such effects (BLM 2005). As stated above, the rotor speeds involved with the project would be well below this level.

### **Direct and indirect impacts from Shadow Flicker**

Results of the shadow flicker analysis indicate that no homes or occupied business structures outside the school would receive flickering shadows of over 30 hours per year. Parts of the farm to the southwest (Receptor H) would receive summer morning shadows; however, the farm's outbuildings would block most of the shadows from reaching the farmhouse. The planned playing fields on the Pettisville school property to the east and west of the site would also receive shadows year-round. Based on additional analysis, if the shadows were found to affect participants or spectators, Pettisville would temporarily shut down the turbine. No occupied receptors would receive an excess of 30 hours of shadow flicker per year. However, should a local resident find shadow flicker to be an annoyance, Pettisville would plant screening trees or purchase window coverings for the resident.

### 3.2.2.3 Noise

Noise is any unwanted, undesirable sound. It has the potential to interfere with communication, damage hearing, and, in many cases, is viewed as an annoyance. Noise can occur at different levels and frequencies, depending on the type of source and the distance away from the listener.

Sound is the result of fluctuating air pressure. The standard unit for measuring sound pressure levels is the decibel. A decibel is a unit that describes the amplitude (or difference between levels) of sound, equal to 20 times the logarithm to the base 10 of the ratio of the measured pressure to the reference pressure, which is 20 micropascals. Typically, environmental and occupational sound pressure levels are measured in decibels on an A-weighted scale (dBA). The A-weighted scale de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear [i.e., using the A-weighting filter adjusts certain frequency ranges (those that humans detect poorly)] (Colby et al. 2009). Table 3-2 shows some sound pressure levels associated with common activities measured in dBA.

**Table 3-2. Typical Sound Pressure Levels Measured in the Environment and Industry**

| Noise Source<br>At a Given Distance | A-Weighted Sound<br>Level in Decibels | Qualitative Description                      |
|-------------------------------------|---------------------------------------|--|
| Carrier deck jet operation          | 140                                   |  |
|                                     | 130                                   | Pain threshold                               |
| Jet takeoff (200 feet)              | 120                                   |  |
| Auto horn (3 feet)                  | 110                                   | Maximum vocal effort                         |
| Jet takeoff (1000 feet)             | 100                                   |  |
| Shout (0.5 feet)                    |                                       |  |
| N.Y. subway station                 | 90                                    | Very annoying                                |
| Heavy truck (50 feet)               |                                       | Hearing damage (8-hour, continuous exposure) |
| Pneumatic drill (50 feet)           | 80                                    | Annoying                                     |
| Freight train (50 feet)             | 70 to 80                              |  |
| Freeway traffic (50 feet)           |                                       |  |
|                                     | 70                                    | Intrusive<br>(Telephone use difficult)       |
| Air conditioning unit (20 feet)     | 60                                    |  |
| Light auto traffic (50 feet)        | 50                                    | Quiet  |
| Living room                         | 40                                    |  |
| Bedroom                             |                                       |  |
| Library                             | 30                                    | Very quiet                                   |
| Soft whisper (5 feet)               |                                       |  |
| Broadcasting/Recording studio       | 20                                    |  |
|                                     | 10                                    | Just audible                                 |

Adapted from Table E, "Assessing and Mitigating Noise Impacts", NY DEC, February 2001.  
Table 3-2 is cited in Colby et al. 2009.

For a point source such as a stationary compressor or construction equipment, sound attenuates based on geometry at rate of 6 dBA per doubling of distance. For a line source such as free flowing traffic on a freeway, sound attenuates at a rate of 3 dBA per doubling of distance. Atmospheric conditions including wind, temperature gradients, molecular absorption, and humidity can change how sound propagates over distance and can affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy also affects sound propagation for sources located close to the ground. Sound that travels over an acoustically absorptive surface such as grass attenuates at a greater rate than sound that travels over a hard surface such as pavement. The increased attenuation is typically about 1.5 per doubling of distance (Caltrans 2009). Barriers such as buildings and topography that block the line of sight between a source and receiver also increase the attenuation of sound over distance.

Table 3-3 provides definitions of commonly used acoustical terms.

**Table 3-3. Definitions of Commonly Used Acoustical Terms**

| Sound Measurements                               | Definition   |
|--|--|
| Decibel  | A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micropascals.  |
| A-Weighted decibel (dBA)                         | An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.   |
| Maximum Sound Level ( $L_{max}$ )                | The maximum sound level measured during the measurement period.  |
| Minimum Sound Level ( $L_{min}$ )                | The minimum sound level measured during the measurement period.  |
| Equivalent Sound Level ( $L_{eq}$ )              | The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy as a time-varying sound level.  |
| Percentile-Exceeded Sound Level ( $L_{xx}$ )     | The sound level exceeded “x” percent of a specific time period. $L_{10}$ is the sound level exceeded 10 percent of the time. $L_{90}$ is the sound level exceeded 90 percent of the time. $L_{90}$ is often considered to be representative of the background ambient noise level in a given area. |
| Day Night Average Sound Level (DNL or $L_{dn}$ ) | The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 decibels added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.  |
| Frequency: hertz                                 | The number of complete pressure fluctuations per second above and below atmospheric pressure.  |

### Noise Guidelines and Regulations

The U.S. Environmental Protection Agency (EPA) identifies noise levels necessary to protect public health and welfare against hearing loss, annoyance, and activity interference in its document, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This criteria document recommends an exterior Day Night Average Sound Level (DNL) of 55 dBA for residential uses. However, the document contains recommendations only and the levels are not Federally enforceable. Furthermore, in 1981 the Federal Government concluded that noise issues were best handled at the State or local government level. As a result, EPA phased out Federal oversight of noise issues to transfer the primary responsibility of regulating noise to the State and local governments. However, EPA recommendations are useful for assessing the affected environment.

EPA has also evaluated general public response to changes in noise levels. In general, an increase to ambient or average noise levels of 5 dBA would be noticeable to most people and may elicit widespread complaints. An increase of 20 dBA would likely result in vigorous community response. An increase of ambient noise levels of less than 3 dBA is generally considered minute.

Section 100-5.9 of the Pettisville (Clinton Township) zoning ordinance relates to wind turbines and states:

Decibel levels for the system shall not exceed 60 decibels (dBA) measured at the closest neighboring inhabited dwelling, except during short-term events such as utility outages and severe windstorms (see Appendix D, Attachment D6).

### **Background Information on Wind Turbines**

Operating wind turbines can generate two types of sound: first, the mechanical sound from components such as gearboxes, generators, yaw drives, and cooling fans, and second, the aerodynamic sound from the flow of air over and past the rotor blades. Modern wind turbine design has greatly reduced mechanical sound and it generally can be ignored in comparison to the aerodynamic sound, which is often described as a “swishing” or “whooshing” sound (BLM 2005).

Wind turbines produce a broad-band sound; that is, the sound occurs over a wide range of frequencies, including low-frequencies. Low-frequency sounds are in the range of 20 to 100 hertz and infrasound (or infrasound) is low-frequency sound of less than 20 hertz. Compared to higher frequency sound, low-frequency sound propagates over longer distances, is transmitted through buildings more readily, and can excite structural vibrations (for example, rattling windows or doors). The threshold of perception, in decibels, also increases as the frequency decreases. For example, in the frequency range where humans hear best (in the low kilohertz), the threshold of hearing is at about 0 decibel, but at a frequency of only 10 hertz, the threshold of human hearing is at about 100 decibels (Rogers 2006).

Older designs of wind turbines, particularly those in which the blades were on the downwind side of the turbine tower, produced more low frequency sound as a result of the blades passing through more turbulent air as a result of the tower blocking wind flow. Modern, upwind turbines produce a broad band sound emission that includes low-frequency sounds, but not at the levels produced by older wind turbines. A primary cause for low-frequency sounds in modern turbines is the blade passing through the change in airflow at the front of the tower and this can be aggravated by unusually turbulent wind conditions.

The University of Massachusetts at Amherst reported (Rogers 2006) on noise measurements made at four different wind turbines ranging in size from 450 kilowatts to 2 megawatts. The results indicated that at distances of no more than 118 meters (387 feet) from the turbines, all infrasound levels were below human perception levels. The report further states that there is “no reliable evidence that infrasound below the hearing threshold produces physiological or psychological effects.” This lack of effects at levels below the hearing threshold was supported by a scientific advisory panel comprised of medical doctors, audiologists, and acoustic professionals established by the American and Canadian Wind Energy Associations to review



wind turbine sound and health effects (Colby et al. 2009). It was also supported by the findings from Canadian and Australian government reviews of available scientific literature (CMOH 2010; Australia NHMRC 2010).

### 3.2.2.3.1 Existing Noise Conditions

Ambient noise monitoring was conducted to establish baseline sound conditions in the area of the proposed wind turbine. Ambient noise monitoring was conducted at three locations indicated in Figure 3-9 and Appendix A, Figure 10. The monitoring sites surround the proposed wind turbine site and were selected to be representative of several residential receptor areas near the wind turbine. The measurement positions were as follows:

Position 1: 18636 County Road D; Position 2: 3800 County Road 19; Position 3: 3960 County Road



**Figure 3-9. Monitoring Sites for Measuring Baseline Sound Conditions and Predicted Turbine Sound Level Contours**

Measurements were conducted using Larson-Davis Model 820 Type I sound level meters. Data at each site were collected between the hours of 2 p.m. on Saturday, November 13, 2010, and 2 p.m. on Sunday, November 14, 2010. Table 3-4 provides a summary of the baseline sound monitoring results.



**Table 3-4. Summary of Baseline Sound Monitoring Results in A-weighted Decibels**

| Monitoring Site | Distance to Turbine Site (feet) | L <sub>eq</sub><br>24 Hours | Hourly L <sub>90</sub> Range | L <sub>eq</sub> | L <sub>eq</sub> | DNL  |
|-----------------|---------------------------------|-----------------------------|------------------------------|-----------------|-----------------|------|
|                 |                                 |                             |                              | Daytime         | Nighttime       |      |
| Position 1      | 615                             | 54.8                        | 30.8 to 51.2                 | 55.6            | 53.0            | 59.9 |
| Position 2      | 1,015                           | 56.9                        | 29.7 to 42.9                 | 58.7            | 46.7            | 58.1 |
| Position 3      | 650                             | 50.5                        | 26.8 to 46.0                 | 50.1            | 51.1            | 57.4 |

Daytime: 7 a.m. to 10 p.m.

Nighttime: 10 p.m. to 7 a.m.

DNL = Day Night Average Sound Level.

Noise sources in the project area include auto and truck traffic, air-conditioning units, insects, birds, trains on the track north of the site, and activities at the school.

**Direct and Indirect Impacts**

Construction of the wind turbine would temporarily result in increased noise and vibration. Operation of the wind turbine would be a permanent source of noise until the turbine is decommissioned.

Construction of the turbine would involve the use of heavy construction including the equipment listed in Table 3-5. Table 3-5 also presents typical noise levels produced by this equipment. L<sub>max</sub> sound levels at 50 feet are shown along with the typical acoustic use factor. The acoustic use factor is the percentage of time each piece of construction equipment is assumed to be operating at full power (i.e., its noisiest condition) during construction and is used to estimate L<sub>eq</sub> values from L<sub>max</sub> values. For example the L<sub>eq</sub> value for a piece of equipment that operates at full power 50 percent of the time (acoustical use factor of 50) is 3 decibels less than the L<sub>max</sub> value.

**Table 3-5. Typical Construction Noise Emission Levels**

| Equipment          | Typical Noise Level (L <sub>max</sub> ) <sup>a</sup> | Acoustical Use Factor | Typical Noise Level (L <sub>eq</sub> ) <sup>a</sup> |
|--------------------|--|-----------------------|---|
| Compactor (ground) | 83   | 20                    | 76  |
| Dozer              | 82   | 40                    | 78  |
| Dump Truck         | 76   | 40                    | 72  |
| Excavator          | 81   | 40                    | 77  |
| Generator          | 81   | 50                    | 78  |
| Grader             | 85   | 40                    | 81  |
| Pickup Truck       | 75   | 40                    | 71  |
| Warning Horn       | 83   | 5                     | 70  |
| Crane              | 81   | 16                    | 73  |

Source: US DOT 2006.

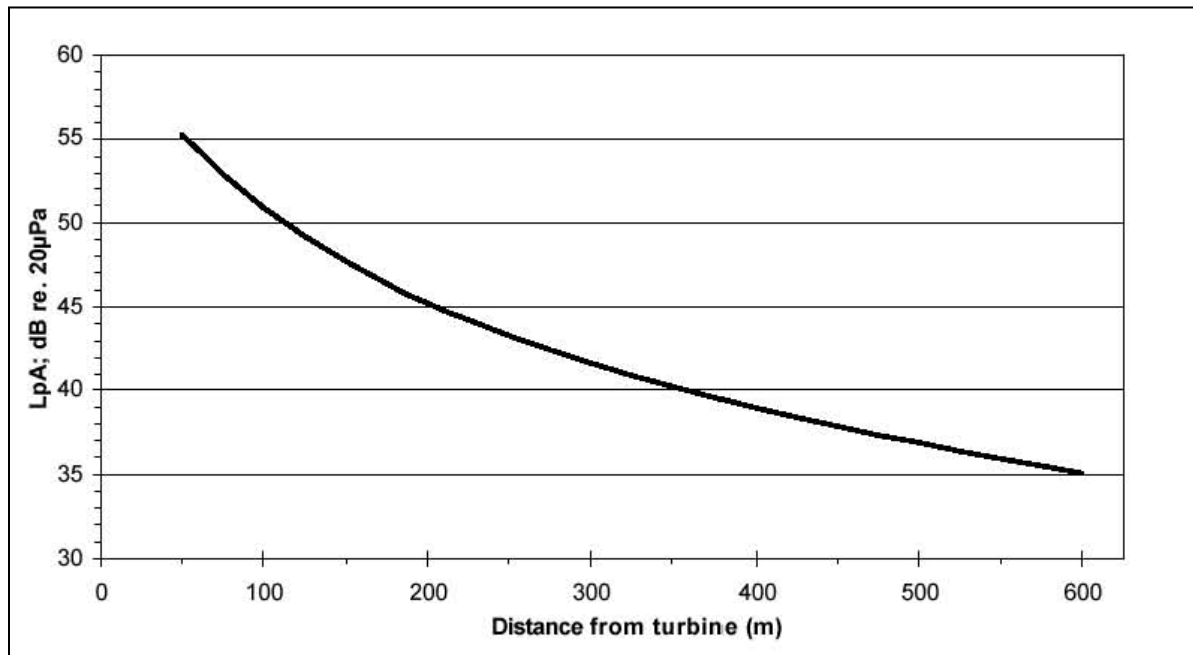
a. A-weighted decibel level, measured at 50 feet.

The three noisiest pieces of equipment likely to operate at the same time include a grader, a dozer, and a generator. Simultaneous operation of this equipment would result in a noise level of 84 dBA (L<sub>eq</sub>) at 50 feet. Based on the assumed simple geometric attenuation of 6 decibels per doubling of distance the noise level at the nearest residences (at about 600 feet) would be 62 dBA (L<sub>eq</sub>). Because construction noise would be temporary and intermittent during daytime hours, no adverse effect from construction noise is expected. With regard to vibration no highly dynamic equipment such as a pile driver would be used. Given this and the fact that residences

are about 600 feet from the turbine site, no adverse vibration impacts from construction activity would occur.

Pettisville has selected the Aeronautica 54-750 wind turbine,<sup>2</sup> and it has several characteristics that reduce aerodynamic sounds levels in comparison with other and primarily older wind turbine designs. The Aeronautica 54-750 is an upwind turbine, meaning the turbine faces into the wind and the wind encounters the rotor blades before the tower and the nacelle, which makes for quieter operations than a downwind turbine. It has relatively low rotational speeds and pitch control on the rotors, both of which reduce sound levels. Complete technical information including sound data is provided in Appendix D, Attachment D3.

Figure 3-10 shows A-weighted wind turbine sound pressure levels at 1.5 meters (5 feet) above the ground calculated by the wind turbine manufacturer at a wind speed of 8 meters (26 feet) per second.



**Figure 3-10. Aeronautica 54-750 Sound Pressure Level as a Function of Distance**

Table 3-6 presents sound level values that have been provided by the manufacturer.

**Table 3-6. Turbine Sound Levels at Various Distances**

| Distance (feet) | A-Weighted Sound Level |
|-----------------|------------------------|
| 1,992           | 35                     |
| 1,178           | 40                     |
| 676             | 45                     |

2. The noise analysis presented in this EA represents data for the Aeronautica 47-750 turbine. However, both the 54-750 and 47-750 are reported to have an A-weighted sound power level of 100.0 decibels. Accordingly, data for the Aeronautica 47-750 are considered to be representative of the Aeronautica 54-750, which is the turbine Archbold has selected.

Table 3-7 summarizes the predicted steady state turbine sound level and the corresponding DNL value at each receptor location. Measured DNL values are also shown. DNL can be calculated from the steady state sound level value assuming that the turbine operates continuously over a 24-hour period. The conversion between a steady state sound level and DNL is 6.4 dBA. For conservative purposes, 7 dBA has been added to the steady state sound level to estimate DNL.

The predicted turbine sound levels in the range of 42 to 47 dBA are below the Pettisville wind turbine noise standard of 60 dBA and the DNL values in the range of 49 to 54 dBA are below the EPA recommended sound level of 55 DNL.

**Table 3-7. Predicted Turbine DNL Sound Levels**

| Monitoring Site | Distance to Turbine Site (feet) | Predicted Turbine Steady State Sound Level (dBA) | Predicted Turbine DNL | Measured DNL |
|-----------------|---------------------------------|--|-----------------------|--------------|
| Position 1      | 615                             | 47   | 54                    | 59.9         |
| Position 2      | 1,015                           | 42   | 49                    | 58.1         |
| Position 3      | 650                             | 45   | 52                    | 57.4         |

DNL = Day Night Average Sound Level.

Figure 3-9 (above) shows the estimated 40 dBA and 50 dBA wind turbine noise contours. These contours indicate that no off-campus receptors or school buildings would be included within the 60 DNL or the 50 dBA (equivalent to 55 DNL) noise contours. Table 3-8 compares predicted steady state turbine sound levels to the range of L<sub>90</sub> values measured at each site.

**Table 3-8. Comparison of Predicted Turbine Noise Levels to Measured L<sub>90</sub> Values**

| Monitoring Site | Distance to Turbine Site (feet) | Predicted Turbine Steady State Sound Level (dBA) | Hourly L <sub>90</sub> Range |
|-----------------|---------------------------------|--|------------------------------|
| Position 1      | 615                             | 47   | 30.8 to 51.2                 |
| Position 2      | 1,015                           | 42   | 29.7 to 42.9                 |
| Position 3      | 650                             | 45   | 26.8 to 46.0                 |

dBA = A-weighted decibel.

Table 3-9 indicates that predicted wind turbine noise levels are expected to be at or above many of the hourly L<sub>90</sub> values measured at each site. Therefore, turbine sound may be audible at nearby residences. Audibility does not necessarily mean an adverse noise effect would occur. The magnitude of the increase in noise level relative to ambient noise conditions is evaluated to determine the severity of the noise impact.

An adverse noise impact is considered to occur if the wind turbine noise is predicted to increase the ambient daytime or nighttime Leq value at residences by more than 3 dBA. Tables 3-9 and 3-10 summarize the noise impact analysis.

**Table 3-9. Daytime Noise Impact Analysis**

| Site | Daytime Ambient L <sub>eq</sub> (dBA) | Turbine Sound (dBA) | Daytime Ambient plus Turbine Sound | Increase (dBA) |
|------|---------------------------------------|---------------------|------------------------------------|----------------|
| 1    | 55.6                                  | 47                  | 56.2                               | 0.6            |
| 2    | 58.7                                  | 42                  | 58.8                               | 0.1            |
| 3    | 50.1                                  | 45                  | 51.3                               | 1.2            |

dBA = A-weighted decibel; L<sub>eq</sub> = equivalent continuous sound level.

**Table 3-10. Nighttime Noise Impact Analysis**

| Site | Nighttime Ambient<br>L <sub>eq</sub> (dBA) | Turbine Sound<br>(dBA) | Nighttime Ambient<br>plus Turbine Sound | Increase (dBA) |
|------|--|------------------------|---|----------------|
| 1    | 53.0                                       | 47                     | 54.0                                    | 1.0            |
| 2    | 46.7                                       | 42                     | 48.0                                    | 1.3            |
| 3    | 51.1                                       | 45                     | 52.1                                    | 1.0            |

dBA = A-weighted decibel; L<sub>eq</sub> = equivalent continuous sound level.

The results in Tables 3-9 and 3-10 indicate that operation of the proposed wind turbine would not result in noise increases greater than 3 dBA at residences in the project vicinity. Operation of the proposed wind turbine is, therefore, not expected to result in an adverse noise impact.

The proposed wind turbine would be located in close proximity to the Pettisville Pre-Kindergarten through Twelfth Grade School. As indicated in Figure 3-9, turbine sound levels are predicted to be less than 50 dBA across the school campus. Speech communication capabilities when background noise levels are greater than 50 dBA could require raised voices for distances up to 20 feet. Normal voice communications can occur when background noise levels are at or below 50 dBA (Nelson 1987). Therefore, normal speech communication would be maintained and individuals would be able to communicate with normal outdoor voices in the areas surrounding the school. In addition, the school buildings would provide further noise attenuation and turbine noise would not be audible by occupants of the buildings (students and teachers).

Based on the results presented above, operation of the proposed wind turbine would not result in adverse noise impacts.

### 3.2.2.4 Cultural Resources

The *National Historic Preservation Act* (16 U.S.C. 470 *et seq.*; NHPA) is the primary Federal law protecting cultural, historic, American Indian, and Native Hawaiian resources. Section 106 of the NHPA (36 CFR Part 800) requires Federal agencies to assess and determine the potential effects of their proposed undertakings on prehistoric and historic resources (e.g., sites, buildings, structures, and objects) and to develop measures to avoid or mitigate any adverse effects. Compliance with Section 106 requires consultation with a State Historic Preservation Officer (SHPO). On October 25, 2010, DOE requested Ohio SHPO consultation and submitted a Section 106 Compliance Report to OHPO (Appendix E, Attachments E1, E2, and E3).

The Renaissance Group conducted analyses and data retrieval for historic properties located within 2 miles of the proposed turbine site. These underlying data were reviewed and analyzed by a senior architectural historian who meets the Secretary of the Interior's Professional Qualification Standards (36 CFR Part 61) in architectural history, history or archaeology.

In addition, pursuant to Section 106, DOE is required to consult with American Indian tribes about the potential effects of DOE's proposed undertakings on prehistoric and historic resources and to develop measures to avoid or mitigate any adverse effects. DOE uses a list maintained by the U.S. Bureau of Indian Affairs, entitled "Indian Entities Recognized and Eligible to Receive Services from the U.S. Bureau of Indian Affairs" (72 FR 13648, March 22, 2007), to determine which tribes to contact. Based on this document, DOE determined that there are no Federally recognized tribes in the state of Ohio. Moreover, there is no Tribal Historic Preservation Officer

for the state of Ohio according to the National Association of Tribal Historic Preservation Officers. However, DOE provided the Notice of Scoping and the Draft EA to 57 Tribal Nation representatives that are regularly notified of Federal actions in the State of Ohio.<sup>3</sup> To date, none of the tribes contacted has responded to DOE's scoping letter. DOE will continue its outreach to these tribal representatives by providing them with the Notice of Availability of this Final EA. On February 7, 2011, OHPO issued a response and concurrence letter to DOE (Appendix E, Attachment E4).

### **Consulting Party Participation**

As part of DOE's responsibilities under NHPA, DOE sent a copy of the Draft EA and appendices for comment to the following organizations, which were also notified of the project through the DOE EA scoping process:

- Fulton County Historical Society
- Fulton County Commissioners
- Western Reserve Historical Society
- Western Reserve Heritage Association
- The Clinton Township Trustees

Prior to the OHPO submission, the project was reviewed and made available for public comment in both School Board and Village Planning and Zoning meetings. The project has also been extensively covered in the local media. Appendix D, Attachment D2 contains a list of public meetings and newspaper articles related to the proposed project. Although Pettisville has conducted public outreach for the proposed project, to ensure DOE compliance with NHPA, the public was afforded the opportunity to comment on historic resources via the same method for commenting on the Draft EA.

### **Archaeological and Aboveground Areas of Potential Effect**

The direct area of potential effect (APE) is defined as the area disturbed for construction of a project. However, there is no definitive rule for determining an indirect APE for a wind turbine, which can create both visual and audible effects on the adjacent properties (the aboveground APE).

### **Clarification of the Archaeological APE**

The APE determined for archaeological resources focuses on the zone of direct ground disturbance associated with the construction of the proposed project. The installation of the proposed project would result in temporary ground disturbing activities to 1,600 square feet for the turbine foundation (ultimately a 256-square-foot permanent footprint) and 2,000 square feet of temporary ground disturbance associated with installation of the underground electrical wires (1,000 linear feet by 2 feet wide). The final permanent footprint of the turbine would be 256 square feet. The wind turbine foundation would extend approximately 10 feet below the ground surface.

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2. List used by the U.S. Army Corps of Engineers Buffalo District for actions occurring in the State of Ohio.

### **Clarification of the Aboveground APE**

In defining the aboveground APE, both direct and indirect effects were considered. As a conservative measure, a 2-mile APE for indirect effects was established based on the height of the proposed wind turbine, the surrounding topography, tree cover and urban forest in the vicinity of the proposed tower and simulated visualizations of the proposed wind turbine. Noise and flicker effects are quite localized and do not extend far beyond the school property, and, therefore, did not affect the indirect APE. Visual effects became the driver for selecting the APE. The 2-mile APE was selected as the maximum distance in which the tower would be seen (see Appendix E, Attachment E2 and E3). In determining the APE for indirect effects, the visual character and the setting of the surrounding area was considered, especially the presence of existing vertical structures in the viewshed. A computer-generated visual simulation of the proposed project as it would be viewed from public spaces was analyzed to determine an appropriate APE as well as potential impacts on the visual character of the community and the region's associated landscape. These are discussed in greater detail in Section 3.2.2.2 of this EA.

The likelihood of a clear, unobstructed view of the proposed project beyond 2 miles is small and diminishes rapidly as one travels farther away from the site. Varied topography, such as elevation changes, and other site-specific characteristics, such as power line corridors, structures associated with human development, tall towers, the tree canopy, and other natural areas all serve as common visual obstructions that block expansive views of a given project site from various directions. In particular, the extent to which a single turbine dominates the landscape diminishes with distance. A 2-mile APE was identified by the project proponent for determining the effects, including visual effects, of the proposed project because it represented a reasonable effort to assess visual effects of the project based on available technology and the existing physical character of the area.

### **Identification of Historic Aboveground Properties in APE**

No properties listed on the *National Register of Historic Places* were identified within the APE. No properties listed on the Ohio State Register of Historic Places in accordance with ORC 149.30 were found to be located within the 2-mile APE. No archaeological sites exist within or adjacent to the APE. No American Indian sites are listed, reported, or found within or near the APE. However, the absence of designated properties, does not indicate that no properties could be listed or determined eligible. Pettisville is a small farming community of about 2,000 people and has likely been bypassed by the types of activities from which determinations of eligibility typically arise, such as Federally funded highway projects.

Because the APE for this undertaking is so large—a 2-mile radius around the turbine site—there were found to be hundreds of potentially eligible properties within the APE. For the purpose of analyzing potential effects to historic properties, the Section 106 submission assumed that all pre-1960s properties were eligible for listing in the *National Register of Historic Places*. The assumption applied only to the proposed project.

The Renaissance Group inventoried all buildings and structures built before 1960, located within the 2-mile radius indirect APE. The results of this inventory are presented in Appendix E, Attachment E3. In all, 140 properties were found to be constructed prior to 1960 within the 2-mile radius. These properties fall into two basic categories: urban use properties (almost all of them single-family homes) found in the Central Quadrant; and rural properties (nearly all of

them farmhouses and farm structures) located within the other four quadrants. The qualities of these properties differ considerably from one quadrant to the next.

### **Identification of Historic Below-Ground Properties in APE**

There are no National Register-listed properties within the direct APE for this undertaking. The direct APE, as discussed earlier, is limited to the area zone where ground-disturbing activities would occur for the proposed project. The direct APE is in an area that is currently under construction for the development of a ball field and associated facilities. This property was farmed up until a year ago. There are no buildings on the site. In terms of potential for buried properties (e.g., archaeological sites), the parcel is so extensively modified, that no suspected, intact archaeological sites are believed to exist at the location.

### ***Direct and Indirect Impacts***

As discussed in Section 3.2.2.3, no property adjacent to the project site would be adversely affected by noise above or near the local ordinance levels or above the existing ambient levels. Further, no property adjacent to the project site would be affected by shadow flicker at or near internationally accepted thresholds and no listed or potentially listed historical property would receive any shadow (see Section 3.2.2.2). No direct impacts (ground-disturbing impacts) on listed or potentially listed historic properties or cultural assets are anticipated.

Visual impacts to historic properties are diminished greatly by the three variables which affect the potential for such impact: distance from the source; intervening barriers, and the degree to which the significance of historic properties depends upon an unobstructed setting. The closest properties—those within the community of Pettisville—are shielded from visual impacts by the urban forest. The rural properties do not benefit from the urban forest but are generally at such a distance as to make the visual impact insignificant. Finally, the presence of other vertical elements (granaries, silos, communication towers, and others) indicate that the potential significance of these properties does not derive from a pristine setting. Rather, these tall elements, particularly silos and granaries, have been around for as long as most of the potential historic properties. Considering these elements of visual impacts, DOE concluded that the undertaking would result in No Adverse Effect to any of the assumed historic properties within the APE and, therefore, the project would have minimal impacts to any potential historic properties within the direct and indirect APE. However, if archaeological resources were encountered during construction, activities would cease, and the OHPO would be contacted for further instruction regarding additional studies and/or potential mitigation measures required in accordance with the NHPA.

### **3.2.2.5 Geology and Soils**

The majority (about 70 percent) of the soil found within the project site consists of Ottokee fine sand, Gilford fine sandy loam, and Colonie fine sand (NRCS 2010; Appendix D, Attachment D8). Although in certain areas Gilford fine sandy loam is considered prime farmlands, it is not a prime farmland soil here due to the site's developed nature. No other soils listed by the U.S. Department of Agriculture as prime farmlands or unique or rare soils exist within the project area (NRCS 2010). Table 3-11 shows a complete list of soils present within the project site.

The nearest county for which seismic activity is available is Shelby County, located approximately 100 miles south of Fulton County and is not considered a significant seismic risk. Shelby County, has experienced more earthquakes than any other area in the state of Ohio, most of which were small (ODNR 2007). Approximately 40 felt earthquakes have occurred in this part of western Ohio, although most caused little to no damage.

**Table 3-11. Fulton County, Ohio Project Area Soil Composition**

| Map Unit Symbol                | Map Unit Name                                  | Acres in Area of Interest | Percent of Area of Interest |
|--------------------------------|--|---------------------------|-----------------------------|
| ByA                            | Brady sandy loam, 0 to 3 percent slopes        | 6.1                       | 5.3                         |
| CoB                            | Colonie fine sand, 1 to 6 percent slopes       | 13.4                      | 11.6                        |
| DtA                            | Dixboro fine sandy loam, 0 to 3 percent slopes | 6.0                       | 5.1                         |
| Gf                             | Gilford fine sandy loam                        | 23.2                      | 20.0                        |
| KfA                            | Kibbie loam, 0 to 3 percent slopes             | 7.1                       | 6.1                         |
| Mf                             | Mermill loam                                   | 2.7                       | 2.3                         |
| OtB                            | Ottokee fine sand, 0 to 6 percent slopes       | 43.5                      | 37.5                        |
| Pm                             | Pewamo clay loam                               | 8.1                       | 7.0                         |
| TdA                            | Tedrow loamy fine sand, 0 to 3 percent slopes  | 6.0                       | 5.2                         |
| <b>Totals for Project Site</b> |  | <b>116.0</b>              | <b>100.0</b>                |

**Direct and Indirect Impacts**

Soil disturbance would occur as a result of site preparation and project construction. As part of project construction, approximately 1,600 square feet of current open space would be temporarily disturbed for the foundation (ultimately a permanent 256 square foot foundation) and another approximately 2,000 square feet of open space would be temporarily disturbed for the electrical interconnecting trench, for a total of approximately 3,600 square feet of ground disturbance. Ultimately only 256 square feet would be permanent disturbed for the foundation, all other areas would be returned to their previous state. Temporary and permanent ground-disturbing activities would be less than 1 acre and not require an NPDES Storm Water Program Permit. However, Pettisville has committed to using sediment and erosion pollution control BMPs in conformance with a plan specific to the proposed project.

**3.2.2.6 Biological Resources**

Biological resources include native or naturalized plants and animals and the habitats that support their various life stages. Species that are considered sensitive, either under pertinent Federal or State agencies, are specifically addressed in this section.

**Project Site**

The proposed project site is surrounded by residential areas to the north-northwest and to the west-southwest, with the nearest homes approximately 650 feet northeast and approximately 685 feet northwest. The high school is approximately 790 feet north of the turbine site. Cultivated agricultural fields are to the south and east of the turbine location. The site is currently under construction for a new stadium and associated parking lot. The nearest stand of trees is approximately 1,465 feet southeast of the turbine site, and it is isolated from any other stand or tree grouping by approximately 980 feet. This wooded lot is completely isolated and lacks



connectivity to any other wooded areas. The nearest stream corridor is approximately 1 mile northwest of the site and does contain a riparian canopy, except in a few scattered reaches of the stream.

### **Federally and State-Listed Species**

Information regarding the potential occurrence of Federally listed species was reviewed using the USFWS Endangered Species website and a list of potentially occurring listed species for Fulton County, Ohio (USFWS 2010). Federally listed species potentially occurring in Fulton County include Indiana bat (*Myotis sodalis*), endangered; Eastern Massasauga (*Sistrurus catenatus*), candidate species; and rayed bean mussel (*Villosa fabalis*), proposed as endangered.

The Renaissance Group requested that ODNR complete a review of the proposed project. According to the letter received from ODNR dated August 27, 2010, its review was conducted by an interdisciplinary team within ODOW in accordance with its authority under the *Fish and Wildlife Coordination Act* (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*), NEPA, the *Coastal Zone Management Act*, Ohio Revised Code, and other applicable laws and regulations (see Appendix C, Attachment C1).

ODOW, a division under ODNR, identified State-listed species that may occur within the vicinity of the proposed project site and the project's potential impacts on wildlife species. The ODOW Ohio Biodiversity Database contains no data at this project site. ODOW's letter indicated that the project lies within the range of the Indiana bat, a State- and Federally endangered species. Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed below with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed below with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. ODOW identified the following species of trees as having relatively high value as potential Indiana bat roost trees: shagbark hickory (*Carya ovata*), shellbark hickory (*Carya laciniosa*), bitternut hickory (*Carya cordiformis*), black ash (*Fraxinus nigra*), green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), shingle oak (*Quercus imbricaria*), northern red oak (*Quercus rubra*), slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), eastern cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), sassafras (*Sassafras albidum*), post oak (*Quercus stellata*), and white oak (*Quercus alba*).

ODOW also identified the project site as being within the range of the rayed bean (*Villosa fabalis*), a State-endangered and Federal candidate mussel species. This species requires small headwater streams or sometimes large rivers for its habitat. The project site does not contain either small headwater streams or large rivers.

The project site also lies within the range of the Eastern Massasauga rattlesnake (*Sistrurus catenatus*), a State-endangered and a Federal candidate snake species that is typically found near sedge meadows, peatlands, wet prairies, open woodlands, and shrublands, none of which exist within the project area.

### **Migratory Birds and Bald Eagle**

The *Migratory Bird Treaty Act* (16 U.S.C. 703-7012; MBTA) implements four international conventions that provide for international protection of migratory birds. The MBTA prohibits

taking, killing, possessing, transporting, or importing migratory birds, their eggs, parts, and nests, except when specifically authorized by the U.S. Department of the Interior. While the MBTA has no provision for allowing unauthorized take, USFWS recognizes that some migratory birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid a take have been implemented.

Bald and golden eagles are included under the MBTA, and are afforded additional legal protection under the *Bald and Golden Eagle Protection Act* (16 U.S.C. 668-668d). Both USFWS and ODNR reviewed the proposed project for potential adverse environmental impacts. USFWS indicated in its letter dated September 2, 2010, that it has no records of bald eagle nesting within 5 miles.

The proposed project site is located in an area that is predominantly cultivated crops, which do not provide suitable nesting habitat for migrating birds or suitable stopover habitat for migrating birds that may move across the project area. The nearest Audubon-designated Important Bird Area is over 18 miles northeast, at the Oak Openings Park in Swanton, Ohio.

### ***Direct and Indirect Impacts***

The USFWS and ODOW determined that, due to the location of the proposed project and lack of suitable habitat, it was not likely to affect the Eastern Massasauga rattlesnake (see Appendix C, Attachments C1 and C3). Additionally, no in-water work is proposed; therefore, the USFWS and ODOW determined the proposed project is not likely to affect the rayed bean mussel and ODOW further determined that a rayed bean survey would not be necessary.

ODOW determined that no effects to the Indiana bat would occur as a result of the proposed project unless potential tree habitat would be affected. The proposed project site is surrounded by residential and agricultural lands with a few scattered trees in yards of the residences, and the nearest small stand of trees is approximately 0.5 mile to the south. No suitable trees occur within the project site and no trees would be cut or affected by the construction and installation of the proposed project.

The USFWS provided a response to DOE's Notice of Scoping in which it stated that the proposed project lies within the range of the Indiana bat, but is not within 20 miles of hibernacula nor within 1,000 feet of a wooded lot. Based on this, the USFWS determined that the proposed wind turbine would not affect maternity, roosting, foraging, or commuting habitats and, thus, would not adversely affect the Indiana bat (see Appendix C, Attachment C3). The USFWS determined in its letter dated September 2, 2010, that although the project lies within the range of the bald eagle, the site did not provide high-quality bald eagle habitat and, coupled with the small rotor sweep area of the single turbine, led to the determination that a take of a bald eagle as a result of the proposed project was unlikely (see Appendix C, Attachment C3). Both ODNR and USFWS determined that the proposed project was not anticipated to impact any Federally or State-listed species.

During turbine siting, design, and installation of the proposed wind project, Pettisville will give consideration to the recommendations contained within the *Interim Guidelines to Avoid and Minimize Wildlife Impact from Wind Turbines* (USFWS 2003) and will incorporate those recommendations to avoid and minimize potential impacts to migratory birds and bald and

golden eagles. The project is a single wind turbine located in already disturbed habitat. The proposed turbine design is a monopole, with no external features, and all electrical lines would be underground. The area around the proposed turbine location is mainly residential and agricultural and does not provide significant bird habitat nor does the project fragment any such habitat.

Any impacts to migratory birds are anticipated to be minor as a result of the proposed project. Additionally, because bald eagles are not known to nest within 5 miles of the turbine site and the turbine was sited in an area that does not provide high-quality bald eagle habitat, take of bald eagles is unlikely.

### **3.2.2.7 Human Health and Safety**

Workers have the potential to be injured or killed during construction, operation, and decommissioning of wind turbines through industrial accidents such as falls, fires, and dropping or collapsing equipment. Such accidents are uncommon in the wind industry and are avoidable through implementation of proper safety practices and equipment maintenance.

Collapse of a turbine or breakage (and throwing) of one or more turbine blades is possible, but both are very unlikely occurrences. Debris falling from these occurrences would likely be limited to a calculated fall zone, which is defined to approximate the area around the base of the turbine that would likely receive the tower and turbine if it were to fall. The calculated fall zone for the project site was determined as an area equal to 1.1 times the total turbine height or a radius of approximately 335 feet (see Appendix A, Figure 4). No structures or buildings exist within this fall zone; however, the school ball fields that are under construction on Pettisville property are approximately 175 feet east and 175 feet west of the turbine site. Portions of these fields would be within the 335-foot fall zone. Estimates of blade throw vary, but MacQueen et al. (1983) estimate the probability of being struck outside the fall zones (i.e., within one blade diameter of the tower base) is about  $10^{-7}$  per year (or one chance in 10 million) for a fixed building, and substantially less for people who are mobile.

Other potential source of accidents are ice shedding and lightning. Ice shedding, or ice throw, refers to the phenomenon that can occur when ice accumulates on rotor blades and subsequently breaks free or melts and falls to the ground. Although a potential safety concern, it is important to note that, while more than 90,000 wind turbines have been installed worldwide, there has been no reported injury caused by ice thrown from a turbine (Tetra Tech EC, Inc. 2007). The proposed project is to be supplied with ice sensors on the turbine blades. When ice forms, the sensors would engage and the turbine would not be permitted to rotate until the ice had melted. This technology is intended to prevent ice throws. Ice that has accumulated on the blades would fall to the foot of the turbine as it melts. To prevent accident or injury from ice that falls as it melts, the turbine manufacturer requires the area directly underneath to be a clear zone (equal to the fall zone).

A study conducted for the National Renewable Energy Laboratory was successful in identifying damage mechanisms due to direct and indirect effects of lightning strikes on wind turbines. Lightning strikes can cause extensive damage to the turbine blades, controllers, and power electronics (NREL 2002). However, this damage can be reduced by protection from tall nearby

communication towers, integral blade protection in the form of conductors, bonding to minimize arcing, good turbine grounding, controller cable and controller shielding, and transient voltage surge suppression. The amount of lightning damage is a factor of the lightning activity in the area, the height and prominence of the turbine, the terrain, and the lightning protection system in place. According to the National Oceanic and Atmospheric Administration, Ohio has mid-range lightning activity (an average of 40 annual thunderstorm days).

According to the FAA, no airports are within the impact range of less than 10 miles (see Appendix C, Attachment C5). The Ohio Department of Transportation Aviation issued its letter clearing the proposed project from requiring a permit on August 5, 2010 (Appendix C, Attachment C4).

The term electromagnetic field (EMF) refers to electric and magnetic fields that are present around any electrical device. Electric fields arise from the voltage or electrical charges and magnetic fields arise from the flow of electricity or current that travels along transmission lines, collector 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. 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. However, wind turbines are not considered a significant source of EMF exposure since emissions levels around wind farms are low (CMOH 2010).

Because no fuel is used in wind energy projects, there would be no process waste streams generated during operation of the wind turbine that could cause health and safety concerns. Some lubricants are used in wind turbines, including gearbox oil, hydraulic fluid, and gear grease, that require periodic replacement. These lubricants would be managed in accordance with Federal, State, and local regulations.

### **Direct and Indirect Impacts**

No adverse public health and safety impacts are anticipated from the proposed project. Safety signage would be posted around the tower (where necessary); transformers and other high-voltage facilities would be in conformance with applicable Federal, State, and local regulations.

All contractors, subcontractors, and their personnel would be required to comply with all Federal and State worker safety requirements, specifically all of the applicable requirements of OSHA. Safety procedures specific to the Aeronautica 54-750 turbine would be observed whenever work is done on the turbine.

The soil sample collected as part of the initial soil field and laboratory study did not exhibit concentrations of volatile organic compounds, semivolatile organic compounds, and metals above or even close to Ohio Voluntary Action Program standards. Therefore, excavation of the soils would pose no risks to contractor health or to the environment in general (TTL 2009).

During construction, the project site would be secured as described in *Turbine Use, Safety Policies and General Background* (see Appendix D, Attachment D5). In addition, the Aeronautica 54-750 would not allow opportunities for outside climbing.

As described earlier, risk of turbine collapse is very rare (Klepinger 2007). Based on the extreme rarity of tower collapse or blade throw and the fact that people would not be located within the fall zone for extended periods of time, the risk to public safety due to such occurrences would be negligible.

The turbine system would have an automated system fault shut-off triggered, at a minimum, by the following sensors: system temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing-induced imbalances would automatically shut down the turbine). This system would also automatically send fault codes to preauthorized personnel through a web interface. The turbine's nacelle would have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system would automatically melt snow and ice accumulation on top of the nacelle. The turbine system would have a staff-accessible emergency shut-off. All icing-related turbine shutdowns would require a direct inspection and an onsite manual restart. The site personnel and the system maintenance personnel would shut down the turbine in the event of an icing condition. The site would adopt an ice safety zone around the turbine for implementation during icing events. If climatic conditions create or increase risk, Pettisville would ensure the area is cleared

The FAA issued a Determination of No Hazard to Air Navigation on August 19, 2010, for the proposed project. Based on this determination, the proposed project would not have more than a negligible effect on the safe and efficient use of navigable airspace by aircraft or on the operation of air navigation facilities. Aviation lighting would be in compliance with FAA standards (FAA 2007).

Based on the most current research on EMFs, the proposed wind turbine would not impact public health and safety due to EMF because wind turbines are not considered a significant source of EMF.

### **3.2.2.8 Transportation**

The project site is served locally by County Road 19, County Road D, and Township Road 18. Direct access to the turbine site is available from County Road D. No new access or other roads would be required for construction and operation of the proposed project. Construction equipment would travel to the project site via Interstate (I)-80/I-90, to County Road 24, and then take U.S. Highway 20 East to County Road 2. From County Road 2 direct access to the school is via County Road D (see Appendix D, Attachment D4).

#### **Direct and Indirect Impacts**

During the construction phase of the project, a minor increase in vehicular traffic on the local roads surrounding the project site is anticipated. This traffic increase would occur for a total of approximately 6 to 8 weeks during the entire 10-month construction timeline. It is doubtful that this increase would be noticeable over the present traffic generated on a daily basis with the

school's normal activities. No long-term or permanent impacts on the local transportation systems would occur as a result of the proposed project. No new access or other roads would be required for construction and operation of the proposed project.

### **3.2.2.9 Socioeconomics and Environmental Justice**

Executive Order 12898 (February 11, 1994) directs Federal agencies to identify and address “disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” The racial makeup of Fulton County in the 2000 Census was 97.6 percent white, compared with 84.7 percent for the state of Ohio as a whole, with the remainder of both populations constituting minorities. The median household income for a household in Fulton County in 2008 was \$51,772, compared with \$48,011 for the state of Ohio as a whole. About 7.8 percent of individuals were below the poverty level in 2008, compared with 13.3 percent for the state of Ohio as a whole (Bureau of the Census 2010).

#### **Direct and Indirect Impacts**

No potential high and adverse impacts to socioeconomics or environmental justice would occur as a result of the proposed project. Therefore, there would be no disproportionately high and adverse socioeconomics- or environmental justice-related impacts on minority or low-income populations.

The construction of the proposed project is expected to generate a small, short-term increase in employment from the temporary construction-related jobs for the wind turbine. Operation of the proposed project is not anticipated to generate new jobs, as it would be maintained by the school district.

### **3.2.2.10 Air Quality and Climate Change**

The affected air environment can be characterized in terms of concentrations of the criteria pollutants carbon monoxide, sulfur dioxide, particulate matter, nitrogen oxides, ozone, and lead. EPA has established National Ambient Air Quality affected environment and environmental impacts standards for these pollutants. There are two standards for particulate matter, one for particulates with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM<sub>10</sub>) and one for particulates with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers (PM<sub>2.5</sub>). Fulton County is an attainment area for all criteria pollutants, which means the levels of these pollutants in the air are all below the EPA standards (EPA 2010b). The EPA has found that the “aggregate group of the well-mixed greenhouse gases” constitutes an air pollutant that contributes to climate change (EPA 2010a). Carbon dioxide is a greenhouse gas and the Pettisville wind turbine would have an indirect impact on reducing carbon dioxide emissions from fossil fuel sources.

First Energy Solutions provides electricity to the Pettisville Pre-Kindergarten through Twelfth Grade School. First Energy Solutions currently has a mix of fuel sources, as shown in Table 3-12. First Energy Solutions reports an average estimated grid line loss of 6.14 percent, resulting in higher realized grid power offsets for renewable energy generating sites than their actual onsite production (EPA 2010b).

**Table 3-12. First Energy Solutions Fuel Mix**

| Source Fuel Mix (percent) |      |
|---------------------------|------|
| Coal                      | 72.8 |
| Oil                       | 0.4  |
| Natural Gas               | 2.7  |
| Nuclear                   | 22.3 |
| Renewable                 | 1.1  |

**Direct and Indirect Impacts**

The proposed project would be an emissions-free energy generation project that would not degrade air quality. Grading and construction for the proposed project would result in short-term air quality impacts, such as dust generated by clearing and grading activities, exhaust emissions from gas- and diesel-powered construction equipment, and vehicular emissions associated with the commuting of construction workers. Emissions from construction would be minimized to the extent practicable (for example, by watering dry roads) by following BMPs.

The proposed wind energy project is expected to generate approximately 1,390,127 kilowatt-hours per year, offsetting approximately 98 percent of electricity used by Pettisville Pre-Kindergarten through Twelfth Grade School.

The information reported from the EPA's eGRID database for calendar year 2005 shows the fuel mix for the Pettisville area as 72.8 percent coal, 2.7 percent natural gas, and 0.4 percent oil, resulting in 75.9 percent fossil fuel use (EPA 2010a). Therefore, the annual carbon dioxide reduction associated with the proposed project is calculated as follows:

$$75.9 \text{ percent fossil fuel use} \times 2.0562 \text{ pounds of carbon dioxide per kilowatt-hour} \\ \times 1,390,127 \text{ kilowatt-hours per year} = 2,169,509 \text{ pounds of carbon dioxide per year.}$$

The proposed project would reduce Pettisville's carbon footprint by reducing its reliance on fossil fuels.

**3.2.2.11 Utilities and Energy**

The Pettisville Pre-Kindergarten through Twelfth Grade School is well served by utility infrastructure, including electric power transmission and municipal potable water and sanitary sewer. Electricity is provided to the school by First Energy Solutions.

The National Telecommunications and Information Administration (NTIA) is responsible for managing the Federal spectrum and is involved in resolving technical telecommunications issues for the Federal Government and private sector. This information aids in siting wind turbines, so they do not cause interference in radio, microwave, radar, and other frequencies, disrupting critical lines of communication. Upon submittal by a wind project proponent, the NTIA provides project specific information to the members of the NTIA's Interdepartment Radio Advisory Committee for review and comment on whether the proposed project could potentially interfere with Federal radio communication links.

### **Direct and Indirect Impacts**

The proposed project would have a nameplate capacity of 750 kilowatts and would generate approximately 1,390,127 kilowatt-hours per year on average, or enough electricity to supply up to 141 homes each year (DOE 2010). The energy generated from the proposed project would meet approximately 98 percent of the school's annual electricity needs. The proposed project is anticipated to produce a total of 31,181,320 kilowatt-hours of clean electricity for the 20-year design life of the proposed project.

On October 18, 2010, NTIA issued a letter indicating that no Federal agencies identified any concerns regarding the blockage of their radio frequency transmissions (see Appendix C, Attachment C6). No microwave communications exist in the areas surrounding the project site.

### **3.3 Irreversible/Irretrievable Commitment of Resources**

A commitment of resources is irreversible when its primary or secondary impacts limit the future options for a resource or limit those factors that are renewable only over long periods of time. Examples of nonrenewable resources are minerals, including petroleum. An irretrievable commitment of resources refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. Examples of irretrievable resources are the loss of a recreational use of an area. While an action may result in the loss of a resource that is irretrievable, the action may be reversible. Irreversible and irretrievable commitments of resources are primarily related to construction activities.

For the proposed project, resources consumed during construction of the project, including labor, fossil fuels, and construction materials, would be committed for the life of the project. Nonrenewable fossil fuels would be irretrievably lost through the use of gasoline- and diesel-powered construction equipment during construction. Approximately 256 square feet of land would be irreversibly committed during the functional life of the project. The expenditure of Recovery Act funding from DOE would also be irreversible.

### **3.4 Unavoidable Adverse Impacts**

Unavoidable adverse impacts associated with the proposed project include:

- Long-term loss of approximately 256 square feet of vegetation resulting from the construction of the tower foundation;
- A minimal increase in noise levels during construction and noise during operation;
- Introduction of an additional vertical element into the existing viewshed; and
- Shadow flicker impacts to the future ball fields.

These impacts are both temporary, in the case of the construction noise, and long-term, in regard to the loss of vegetation, and visual and shadow flicker impacts.



### **3.5 The Relationship Between Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity**

Short-term use of the environment, as the term is used in this document, is that used during the life of the project, whereas long-term productivity refers to the period of time after the project has been decommissioned, the equipment removed, and the land reclaimed and stabilized. The short-term use of the project area for the proposed project would not affect the long-term productivity of the area. If it is decided at some time in the future that the project has reached its useful life, the turbine, tower, and foundation could be decommissioned and the site reclaimed and revegetated to resemble the pre-disturbance conditions (agricultural field). The installation of a wind turbine at this site would not preclude using the land for purposes that were suitable prior to this project.

## 4. CUMULATIVE IMPACTS

Cumulative impacts are those potential environmental impacts that result “from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (40 CFR 1508.7).

### 4.1 Reasonably Foreseeable Projects

DOE examined several other proposed wind turbine projects for which Recovery Act grants have been sought in Ohio. DOE also examined other proposed wind turbine projects in the vicinity of the proposed project with respect to potential cumulative impacts. There are two non-DOE-funded wind turbine projects within 50 miles of Pettisville: (1) the proposed Timber Road II 98-megawatt wind turbine project in Paulding County, Ohio, and (2) the recently expanded 1.8-megawatt Bowling Green wind turbine facility in Bowling Green, Ohio. According to the Ohio Siting Board (<http://www.opsb.ohio.gov/Opsb/>), there are two additional proposed wind turbine projects in the State of Ohio, both of which are over 100 miles from the Pettisville site. The following list includes Recovery Act SEP-funded projects and reflects the status of NEPA documentation being developed (information related to these projects is located on the Golden Reading Room website at [http://www.eere.energy.gov/golden/Reading\\_Room.aspx](http://www.eere.energy.gov/golden/Reading_Room.aspx)):

Green City Growers Wind Development – DOE/EA-1817

(Notice of Scoping issued August 2010)

1.5-megawatt wind turbine

Inner City of Cleveland Greenhouse 55th St. and Woodland Ave, Cleveland, Ohio 44104

Archbold Area Schools Wind Energy Project – DOE/EA-1820

(Final EA and FONSI issued February 2011)

500-kilowatt wind turbine

600 Lafayette Street, Archbold, Ohio 43502

Toledo Joint Apprenticeship and Training Committee

(Categorical Exclusion issued February 2010)

100-kilowatt wind turbine

803 Lime City Road, Rossford, Ohio, 43460

Lincoln Electric – DOE/EA-1777

(Final EA and FONSI issued August 2010)

2.5-megawatt wind turbine

22800 St. Clair Ave, Euclid, OH

Cuyahoga County Agriculture Society – DOE/EA-1815

(Final EA and FONSI issued February 2011)

600-kilowatt wind turbine

Cuyahoga County Fairgrounds, 164 Eastland Road, Berea, Ohio 44017

City of Toledo

(Categorical Exclusion issued December 2010)

1- megawatt Wind Turbine at Collins Park Wastewater Treatment Facility

Toledo, Ohio

Kilowatts for Kenston – DOE/EA-1819

(Final EA and FONSI issued February 2011)

600-kilowatt wind turbine

9500 Bainbridge Road, Chagrin Falls, Ohio 44023

Each of the DOE-funded projects includes the construction and operation of a single wind turbine. Of these projects, only the Archbold Area Local Schools Wind Energy Project is located within Fulton County. The three projects closest to the Pettisville Wind Energy Project are DOE-funded single turbines. The Archbold project is just over 5 miles southwest of the Pettisville project site. The Toledo Joint Apprenticeship and Training Committee and the City of Toledo projects are approximately 35 miles to the northeast of Pettisville in Wood County, Ohio. The Bowling Green wind turbine facility is approximately 40 miles east of the Pettisville Wind Energy Project. Finally, the Timber Road II Wind Project is located approximately 45 mile southwest of the Pettisville Wind Energy Project. All other listed DOE Recovery Act-funded wind projects, Cuyahoga County Agricultural Society Project, Green City Growers, and Kilowatts for Kenston, are well over 100 miles east of the proposed project.

The closest projects, Toledo Joint Apprenticeship, City of Toledo, Timber Road II, and Bowling Green, do not share a known migratory bird pathway with the proposed Pettisville project. The proposed project is not located within a known major migratory bird pathway, and areas between these projects are mainly cultivated fields or small- to medium-sized towns. Agricultural areas do not generally provide high-quality habitat for migratory birds. The USFWS determined that the proposed project was not likely to adversely affect the Indiana bat, but it is within the overall range of migrating Indiana bats. Although impacts to migrating Indiana bats as a result of the proposed project are unlikely, the proposed project may add to the overall small potential cumulative impact to migrating Indiana bats. DOE considers the proposed project's potential to add to cumulative impacts to migratory birds to be minimal.

## **4.2 Summary of Cumulative Impacts**

### **4.2.1 GREENHOUSE GAS IMPACTS**

While the scientific understanding of climate change continues to evolve, the Intergovernmental Panel on Climate Change Fourth Assessment Report has stated that warming of the earth's climate is unequivocal, and that warming is very likely attributable to increases in atmospheric greenhouse gases caused by human activities (anthropogenic) (IPCC 2007). The Panel's Fourth Assessment Report indicates that changes in many physical and biological systems, such as increases in global temperatures, more-frequent heat waves, rising sea levels, coastal flooding, loss of wildlife habitat, spread of infectious disease, and other potential environmental impacts are linked to changes in the climate system, and that some changes may be irreversible (IPCC 2007).

The proposed project would not have direct greenhouse gas emissions but would result in the reduction of emissions of greenhouse gases associated with electricity previously generated from fossil fuel sources. The Pettisville Wind Energy Project would generate 1,390,127 kilowatts of emission-free electricity per year, corresponding to a reduction of 2,169,509 pounds per year of carbon dioxide-equivalent emissions. There would be small amounts of greenhouse gases emitted as a result of construction and transportation activities related to the proposed project.

#### **4.2.2 VISUAL RESOURCES**

The only other turbine visible from the Pettisville location would be the proposed turbine in Archbold, and it would only be visible in a few isolated locations. None of the other projects can be seen from Pettisville. Thus, no cumulative impacts on visual resources are expected. The closest communication tower is approximately one-half mile from the proposed project, is approximately 200 feet tall, and can be seen from the proposed project site and surrounding area. The addition of the proposed wind turbine would provide an additional vertical structure within the viewshed. Overall, there would be a minimal cumulative impact on visual resources.

#### **4.2.3 BIOLOGICAL RESOURCES**

All of the DOE-funded wind turbine projects are reasonably foreseeable single wind turbine projects. Almost all of the listed projects (with the exception of the City of Toledo Project and the Toledo Joint Apprenticeship project, which received categorical exclusions) have received a letter from the USFWS and ODNR indicating that the Indiana bat is not likely to be adversely affected as a result of the turbines individually. ODOW and USFWS would require all of the above-referenced wind projects to consider or have considered the recommendations contained in the *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (USFWS 2003) as part of their siting, design, and installation, thereby reducing potential impacts to migratory birds and other species. The two non-DOE-funded wind turbine projects (Timber Road II and Bowling Green) do not share a known migratory bird pathway with the proposed project, and the areas between these projects are mainly used for agricultural purposes. The potential to cumulatively impact migratory birds is minimal. The installation of the single wind turbine at the nearby Archbold site and other projects in eastern Ohio (Bowling Green, Toledo, and Timber Road II) would negligibly increase a potentially low cumulative impact on migrating Indiana bats.

Because of the small scale of each individual project and the sufficient distance between projects, there are no other reasonably foreseeable potential cumulative impacts.

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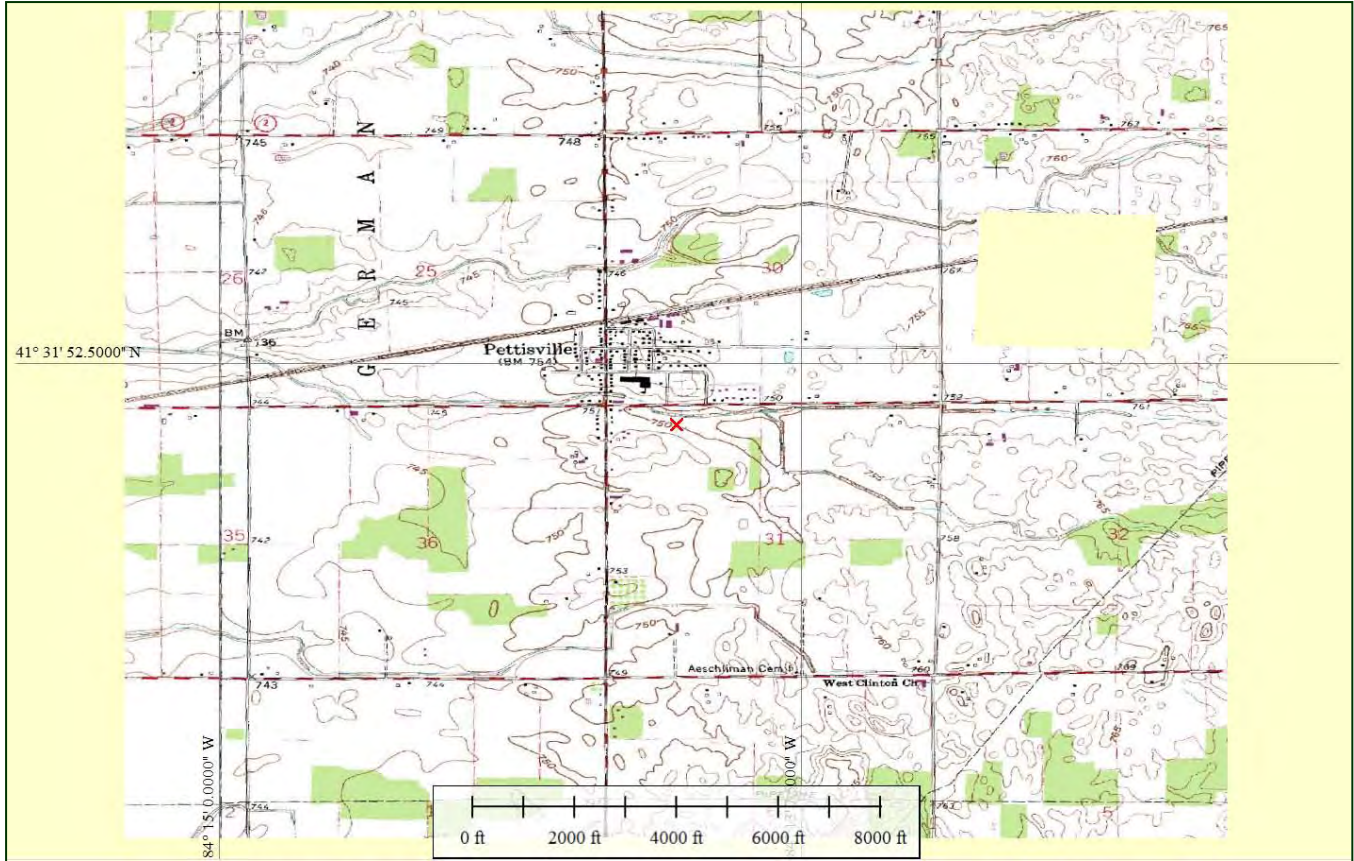
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## **APPENDIX A: FIGURES**



# Pettisville Schools Wind Turbine Location



USGS Wauseon Quad

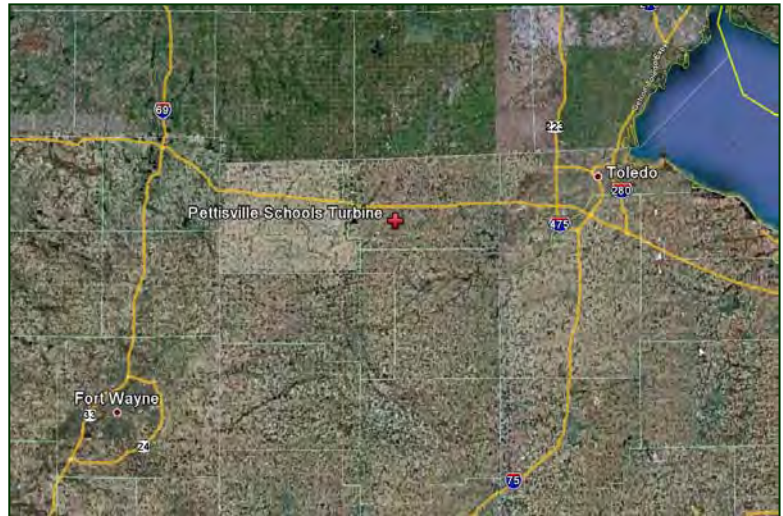
✗ Wind Turbine Site Location:

Pettisville Local Schools  
 232 Summit Street  
 Pettisville, Ohio 43553

Latitude: 41.527967

Longitude: -84.225419

Elevation: 748 Feet



Project Name: **Pettisville Local Schools Wind Turbine**

Source Information: *USGS, TRG Survey*

Notes: ✗ *Turbine Location*

THE RENAISSANCE



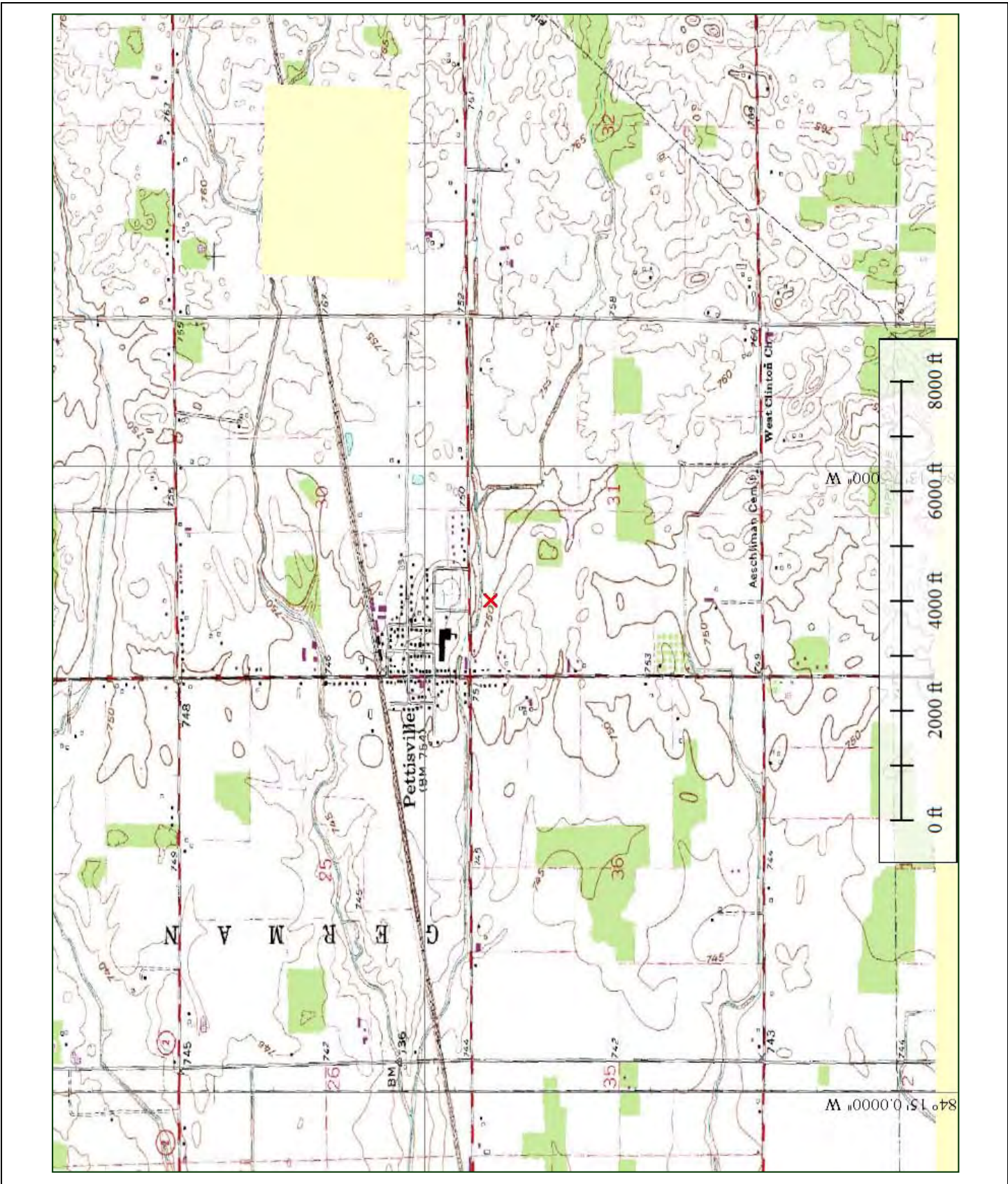
A Conserve First Company

GROUP

TRG

Figure Name: *Turbine Location*





Project Name: **Pettisville Local Schools Wind Turbine**

Source Information: *USGS, TRG Survey*

Notes: **X** *Turbine Location, USGS Wauseon Quad*

THE RENAISSANCE



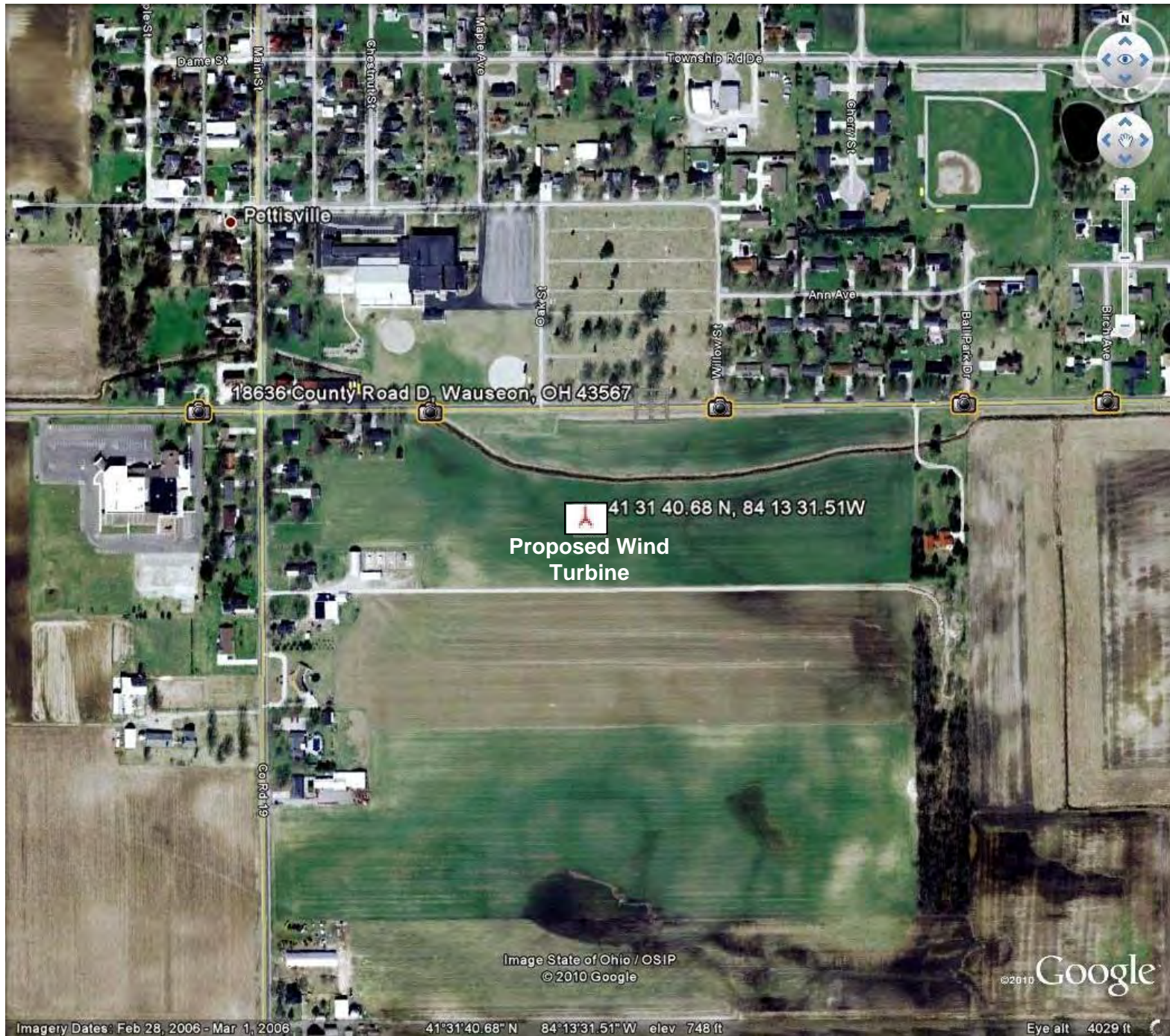
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GROUP

TRG

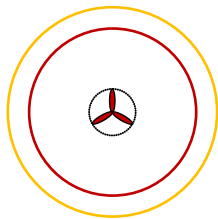
Figure Name: *Topographic Map*







## Pettisville Local Schools Turbine Placement, Fall Zone and Alternate Locations



**Maximum Radius (1X Blade Tip Height) 335'**  
**Maximum Radius (1.25X Blade Tip Height) 419'**  
 Maximum Hub Height: 246'  
 Actual Blade Reach (Critical Fall Zone)

Proposed Turbine Location:

41° 31' 40.68" N  
 84° 13' 31.51" W  
 Elevation 748' (above sea-level)

Approximate Distances to Key Locations:

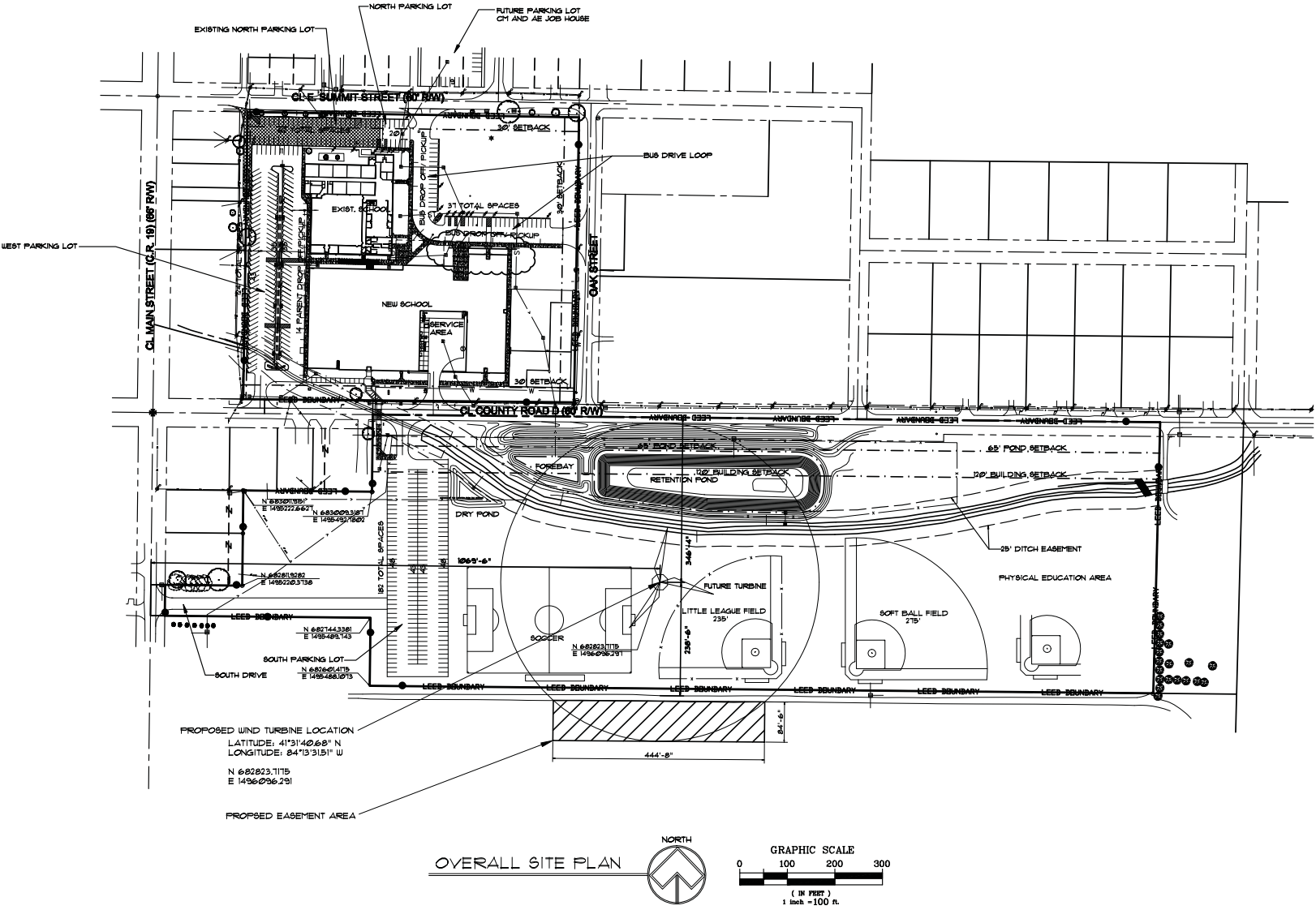
- 500' to School Addition Under Construction
- 690' to Nearest House to Northwest
- 650' To Nearest House to Northeast
- 1080' to Nearest House to East
- 700' to Nearest Farm to Southwest

No Significantly Different Alternate Locations Exist on School Property. Final Positioning Was Optimized Through The Following Criteria:

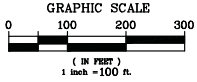
- Distances to residences and inhabited structures.
- Proximities to overall population densities.
- Minimum 1X blade tip height from County Road D
- Reduced possibility for shadow flicker impacts.
- Access for heavy construction equipment.
- Electrical interconnect distances.
- Least chance of acoustic propagation.
- Installation costs.
- Minimizing built environment and tree obstruction induced turbulence.

All sites are located on previously developed land and have similar benign environmental resource attributes and thus did not play into the final site selections. (Concurrence from ODNR and USFWS on selected site.)

|  |  |
|--|--|
| Project Name: <i><b>Pettisville Local Schools Wind Turbine</b></i> |  |
| Source Information: <i>Aerial Photo, TRG Survey</i>                |  |
| Notes: <i>Turbine Location</i>                                     | Figure Name: <i>Turbine Placement, Fall Zone and Alternate Locations</i> |



OVERALL SITE PLAN



NEW PK-12 SCHOOL  
FOR  
PETTISVILLE  
LOCAL SCHOOLS  
PETTISVILLE, OHIO

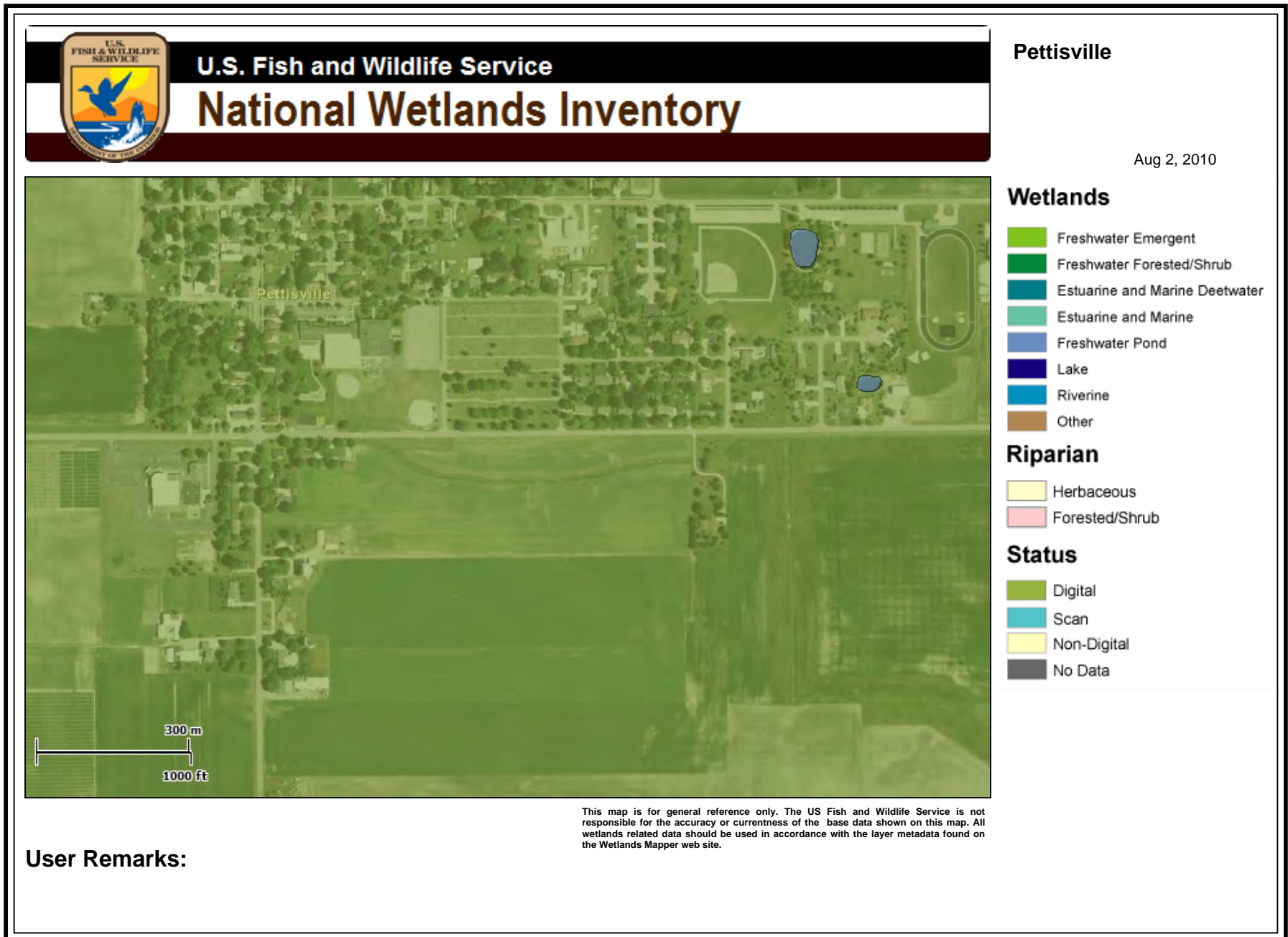
**BUEHRER GROUP**  
ARCHITECTURE & ENGINEERING, INC.  
314 CONANT STREET  
MAINEE, OHIO 43051



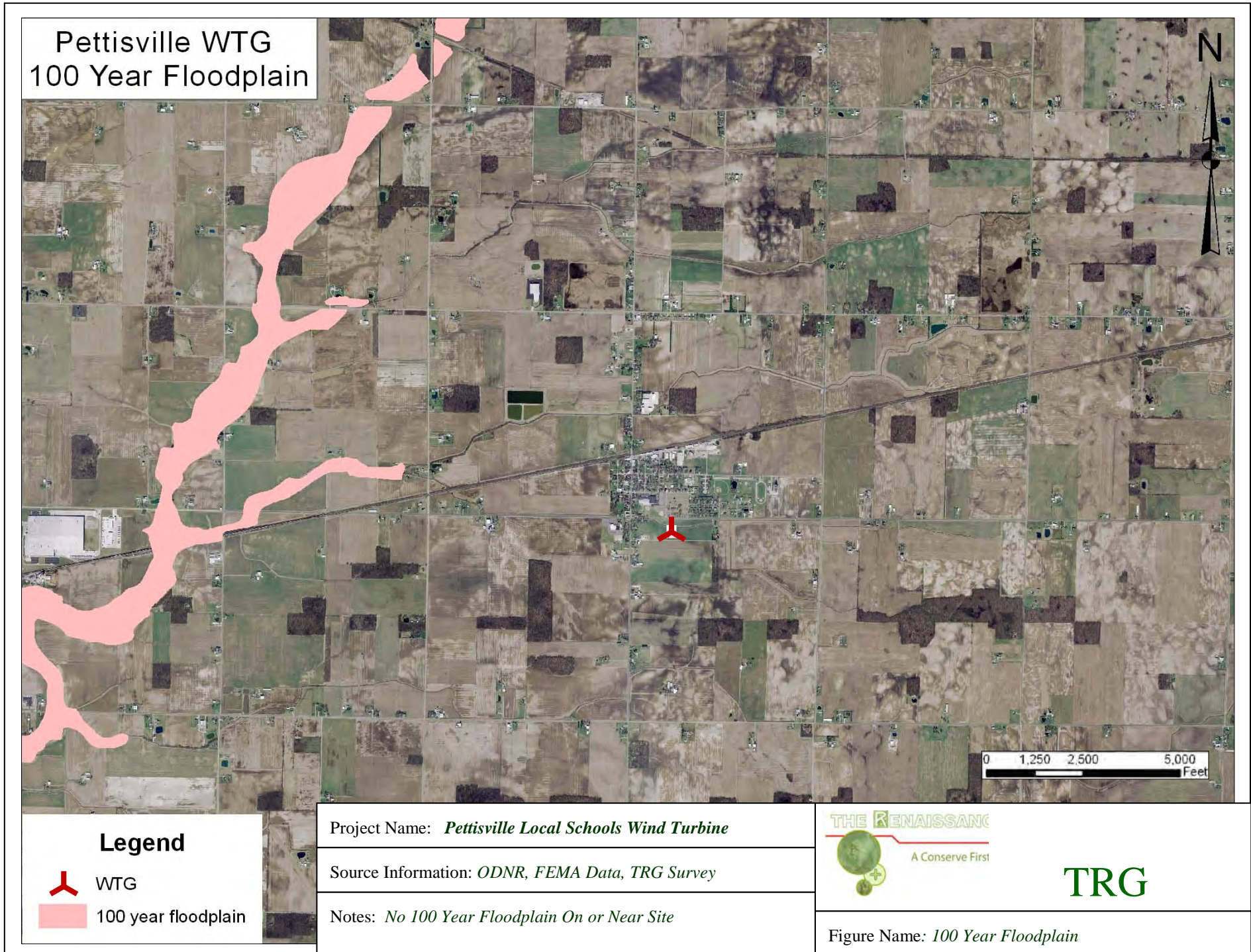
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|-----------|------------|
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| DATE:     | 3/8/10     |
| FILE:     | CADIS      |
| SCALE:    | 1"=100'-0" |
| REVISION: |            |

BID DOCUMENTS

C4











*Ohio Department of Natural Resources  
Natural Areas, Ohio Scenic Rivers Program  
2045 Morse Road, Building C-3  
Columbus, OH 43229-6693  
(614) 265-6453*

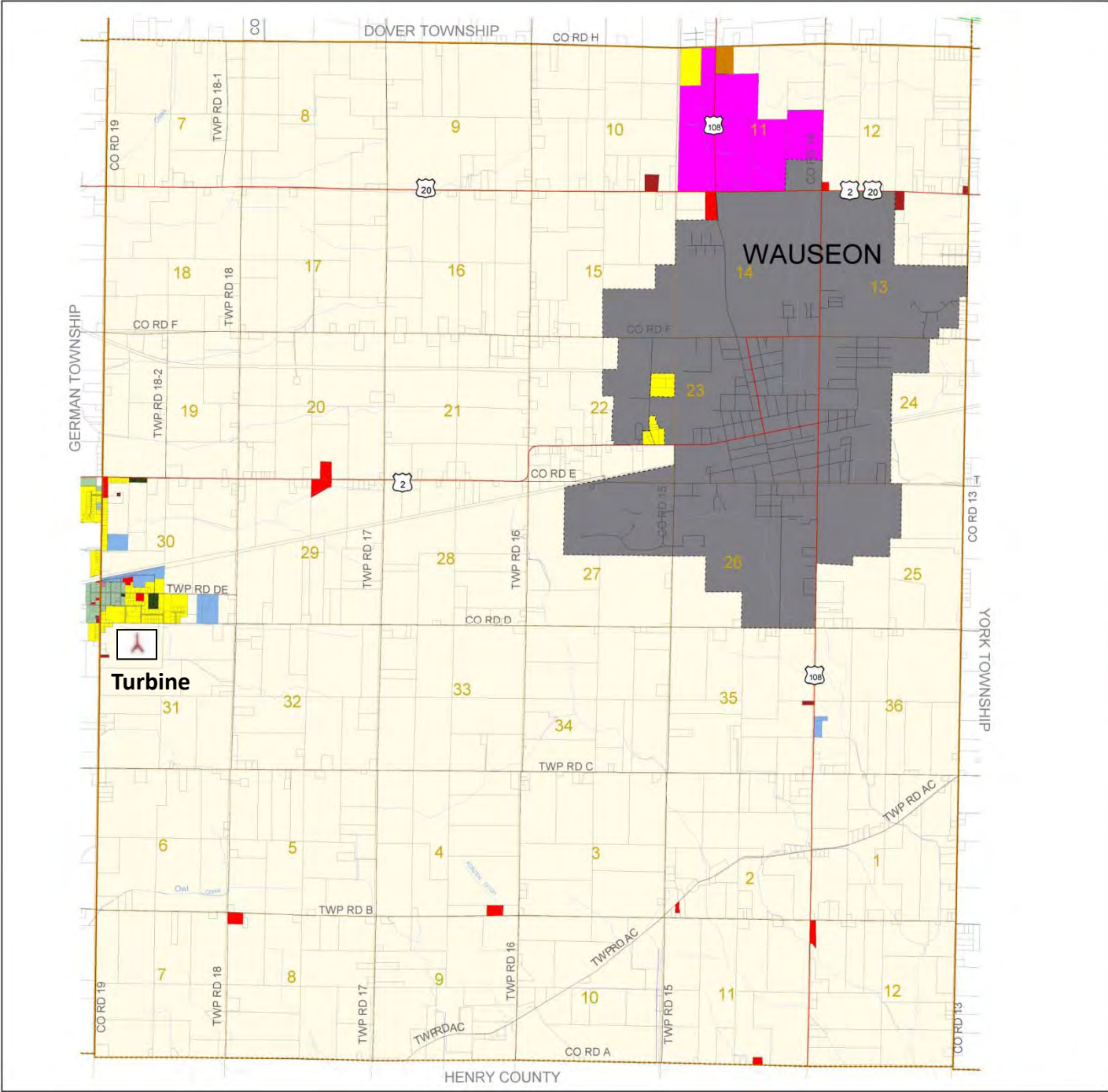


# Ohio Scenic Rivers Program



**Ohio Rivers also listed as National Wild and Scenic Rivers**  
Little Beaver Creek, Big and Little Darby Creeks and Little Miami River





### Zoning Map Clinton Township Fulton County, Ohio

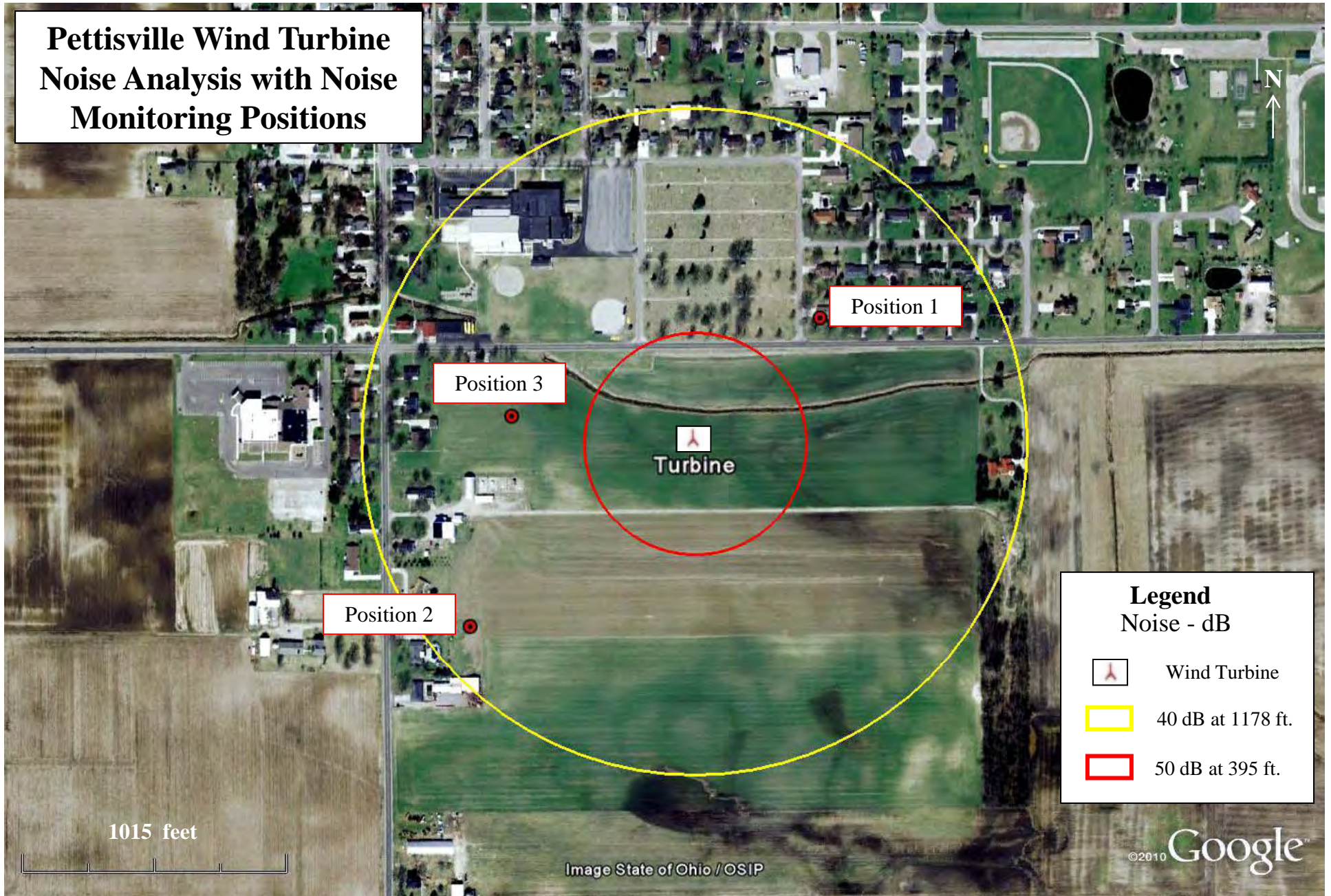
- Ohio Turnpike
  - State & US Routes
  - Centerlines
  - Parcels
  - Section Lines
  - Corporation Boundary
  - Township Boundary
- Zoning**
- C1 - LOCAL SERVICE
  - C2 - COMMERCIAL SHOPPING
  - C3 - GENERAL BUSINESS
  - M1 - LIGHT INDUSTRIAL
  - M2 - GENERAL INDUSTRIAL
  - M3 - SPECIAL
  - AG / RURAL ESTATE
  - MH - MAUFACTURED HOMES
  - R1 - RESIDENTIAL
  - R2 - RESIDENTIAL
  - R3 - RESIDENTIAL



Prepared by Fulton County Regional Planning Commission (419-337-9214)  
[www.fultoncountyoh.com/regionalplan.htm](http://www.fultoncountyoh.com/regionalplan.htm)  
 Parcel Information Provided by Fulton County Auditor's Office (419-337-9200)  
 For More Zoning Information Call 419-335-8961

Last Updated on Mon 7 August 2006







### ARRA SEP - Awarded Wind Turbine Projects in Ohio



|  |
|--|
| Project Name: <i>Applicable to All Ohio ARRA Wind Turbine Projects</i> |
| Source Information: <i>TRG Survey</i>                                  |
| Notes:   |


  
 A Conserve First Company
 

Figure Name: *ARRA SEP – Awarded Wind Turbine Projects in Ohio*

**APPENDIX B:**

**VISUALIZATION, PHOTO ANALYSIS & SHADOW FLICKER ANALYSIS**



A Conserve First Company



## **Pettisville Local Schools Wind Turbine Project Turbine Visualization and Photo Analysis**

*Prepared for:  
Pettisville Local Schools*

*Prepared by:*  
*The Renaissance Group, a Conserve First LLC Company*  
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***Submitted September 2, 2010***

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***Thank You for Choosing The Renaissance Group, a Conserve First LLC Company***

## Introduction

Although the visual impact of wind turbine installations is highly subjective, some people consider them a tremendous asset to their landscape and community and others say “not in my backyard”. This said, it is often beneficial to get a sense of what an installation will look like before it is installed. The actual visibility of a turbine installation is affected by many factors: the size of the machine, the number of machines, tower and blade tip heights, turbine color, distance to the viewer, obstructions such as trees, hills and buildings, atmospheric conditions, Sun angle and even the curvature of the Earth. All things considered, the overall height of a turbine, obstructions in the sightline between the viewer and the turbine and the distance between the machine and the viewer has the greatest impact. Even in open unobstructed ground very tall towers become very small in the distance and even the largest of machines can be blocked by relatively short obstructions close to the viewer. All this said, when in an open sightline in close proximity, a modern wind turbine can be an imposing or an awe inspiring presence in the view-shed pending ones point of view. In all such cases, few would argue that the turbine was not a significant element of the said view-shed. (Further understanding concerning the relative view-shed size of turbines at distance and their visibility in relation to obstructions can be viewed on the following addendums at the end of this report: Horizon View Impact Calculator, Example Turbine View Calculator, Wind Turbine Visibility Over Obstruction Tables and Sample Wind Turbine View Calculator.)

## Methods

Using field surveys, mathematical modeling and stake holder interests, the study team identified representative sightline locations for actual turbine visualization studies. At these sites, precise location logs were taken with accompanying photographs toward the turbine site. Camera bearings were confirmed using detailed maps and compass bearings. The camera height above ground was approximately 68” and the tilt was maintained at zero degrees/level. The camera's focal length was maintained at 28 mm which was entered into the rendering software and which approximates a typical person's field of view for the camera used, or approximately 65%. WindPro 2.7, an internationally accepted wind project modeling software, was used to create the visualizations. The software uses the input data such as turbine location, viewer location, topographical baselines maps, turbine model and height, camera bearing, camera tilt and camera focal length to calculate the distance of the turbine, its perspective height, differential ground levels and Sun angles to correctly locate, scale and shade the turbine onto the base sightline photograph. The technician then verifies for scale and location using secondary plots. The technician also manually removes the portions of the turbine overlay that would be blocked by the obstruction shown in the photo that would be between the viewer and the turbine.

Special consideration was given to identifying potentially historically or culturally significant view-sheds for historic buildings, sites and landscapes. This review was done in conjunction with the local Historical Society and utilizing the Ohio Historic Preservation Office database.

Panoramic photos were also taken at sample locations including the turbine installation site.

A Sony DSC-HX1 camera was used for all source imagery.

## Results

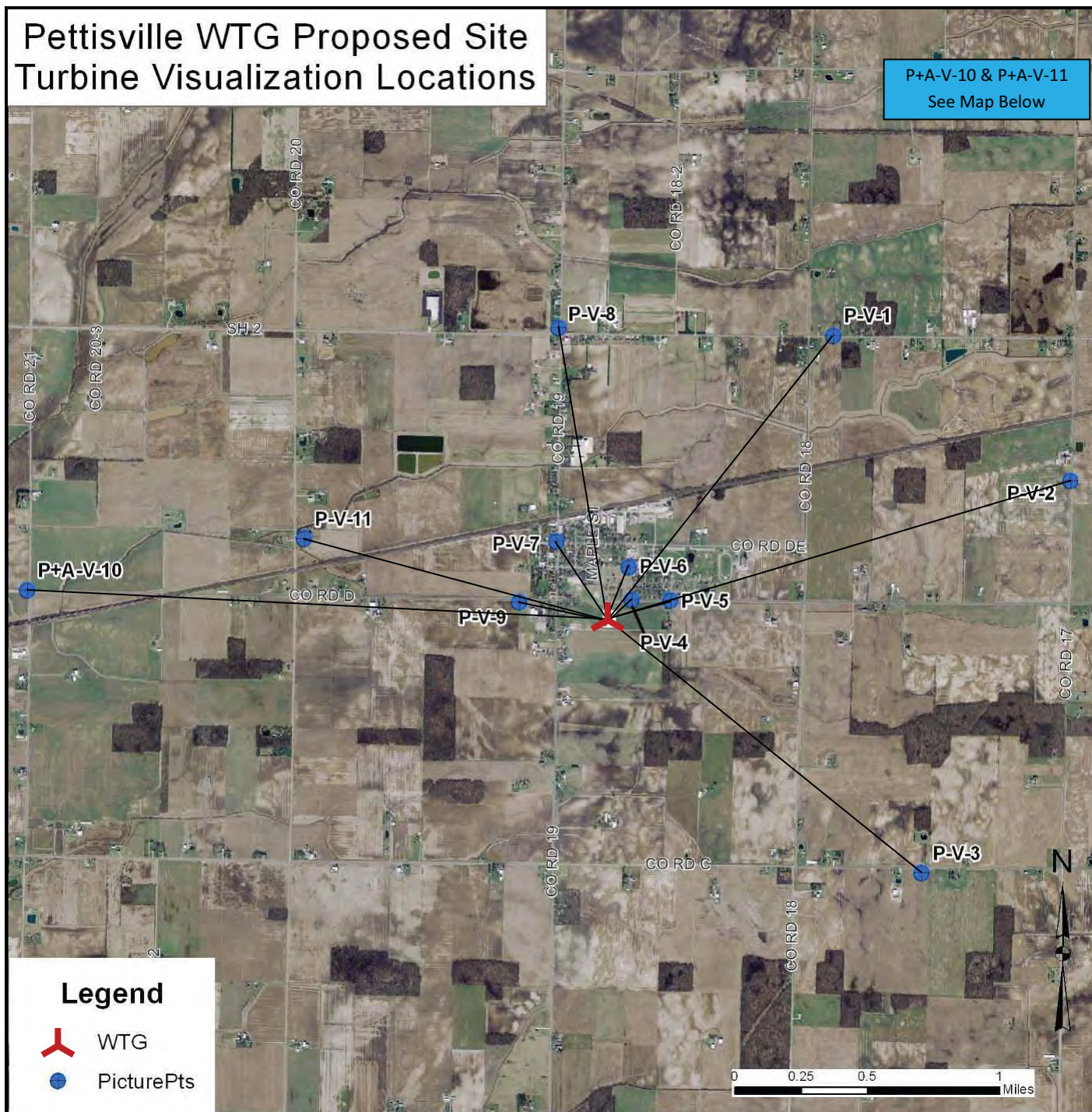
See the following pages for representative turbine visualizations. Due to local obstruction proximities and densities to typical sightlines such as trees and buildings, much of the community will not be able to see the turbine. This said much of the surrounding farms will be able to see the turbine due to the general openness of the regions farming landscape and its overall flat terrain that surrounds the Village. This said,



due to perspective, the turbine will appear as a very small element of the skyline for most locations similar to the regions existing communication towers and granaries.

No historical or cultural site view-sheds were found that would be significantly impacted by the turbines installation.

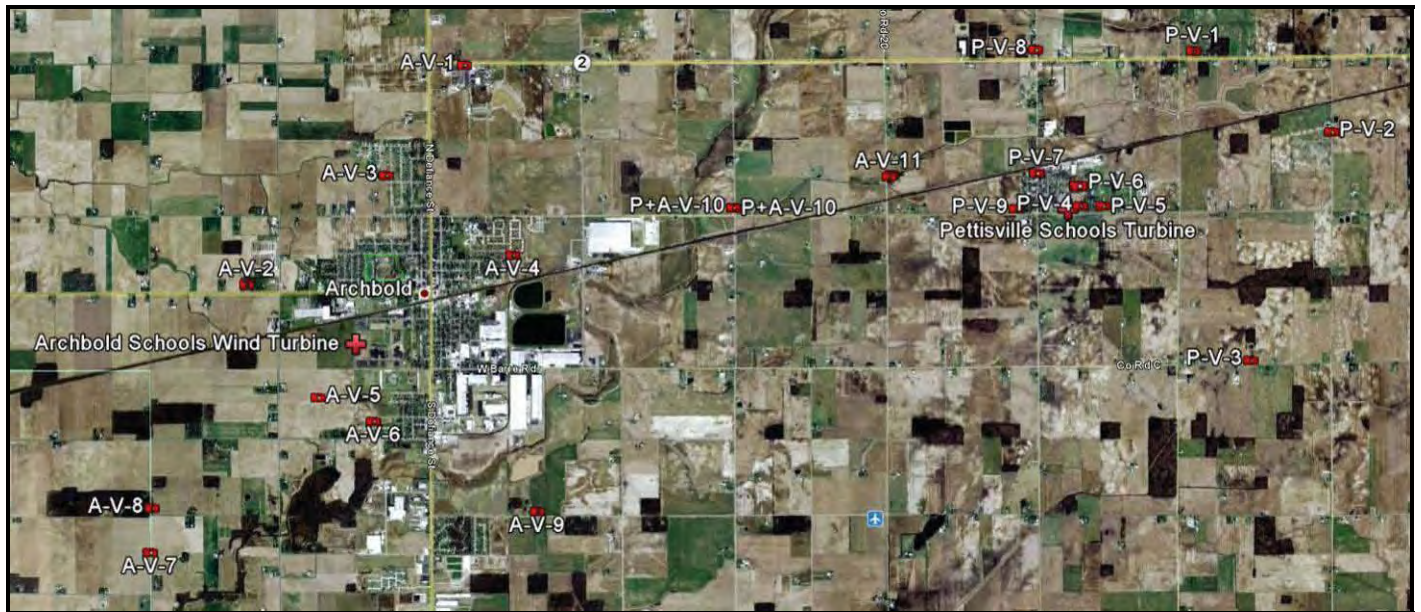
For sites not modeled, the Report's included "Visualization Tables" can be used to determine approximate turbine visibility in relationship to viewer obstructions. A "Sample Wind Turbine View Calculator" has also been developed to mathematically model locations of concern upon community request, a sample of which is included in this report.





In addition to the above visualization, two visualizations were done from sample locations between Archbold and Pettisville where the turbines of both locations might be seen on the horizon, P+A-V-10 and P+A-V-11 (See map and the visualization photo log below).

### Archbold and Pettisville Turbine Projects Visualization Locations Map



#### Pettisville Visualizations

| Set Number | Picture Number | Distance from Turbine (miles) | Site Description  | Latitude      | Longitude     | Direction |
|------------|----------------|-------------------------------|---|---------------|---------------|-----------|
| P-V-1      | 2309           | 1.38                          | State Route 2 – School House (NE)                           | 41°32'37.38"N | 84°12'34.13"W | 225°      |
| P-V-2      | 2311           | 1.82                          | County Road 17 – Between State Route 2 and County Road D    | 41°32'09.69"N | 84°11'31.08"W | 255°      |
| P-V-3      | 2316           | 1.55                          | County Road C – Between Township Road 17 and County Road 17 | 41°30'51.65"N | 84°12'08.17"W | 314°      |
| P-V-4      | 2321           | 0.11                          | Corner Willow and County Road D Northwest of the Turbine    | 41°31'44.46"N | 84°17'25.80"W | 228°      |
| P-V-5      | 2323           | 0.24                          | Corner of Ballpark and County Road D                        | 41°31'44.52"N | 84°13'15.99"W | 252°      |
| P-V-6      | 2324           | 0.21                          | Corner of Summit and Willow                                 | 41°31'50.84"N | 84°13'26.65"W | 199°      |
| P-V-7      | 2327           | 0.35                          | Corner of Main and Dame                                     | 41°31'55.67"N | 84°13'45.87"W | 144°      |
| P-V-8      | 2336           | 1.11                          | 5037 County Road 19 Driveway                                | 41°32'37.83"N | 84°13'46.32"W | 164°      |
| P-V-9      | 2337           | 0.35                          | Parking Lot of Pettisville Missionary Church                | 41°31'43.55"N | 84°13'55.25"W | 95°       |
| P-V-10     | 2343           | 2.21                          | Corner of County Road 21 and County Road D                  | 41°31'43.98"N | 84°16'04.57"W | 91°       |
| P-V-11     | 2347           | 1.20                          | Historic Home – 4208 County Road 20                         | 41°31'55.22"N | 84°14'52.04"W | 102°      |
| P-V-12     | SSS002         | 0.12                          | County Road D North West of the Turbine                     | 41°31'43.61"N | 84°13'39.09"W | 115°      |



**Proposed Site Panoramic Photos Looking Out**

**Looking East**



**Looking South**



**Looking West**



**Looking North**





### Turbine View Visualizations

P-V-1

State Route 2 - School House (NE)



P-V-2

County Road 17 - Between State Route 2 and County Road D





P-V-3

County Road C - Between Township Road 18 and County Road 17



P-V-4

Corner of Willow and County Road D





P-V-5

Corner of Ballpark & County Road D



P-V-6

Corner of Summit & Willow





P-V-7

Corner of Main and Dame  
Not visible behind trees





P-V-8

5037 County Road 19 Driveway  
Not visible behind trees



P-V-9

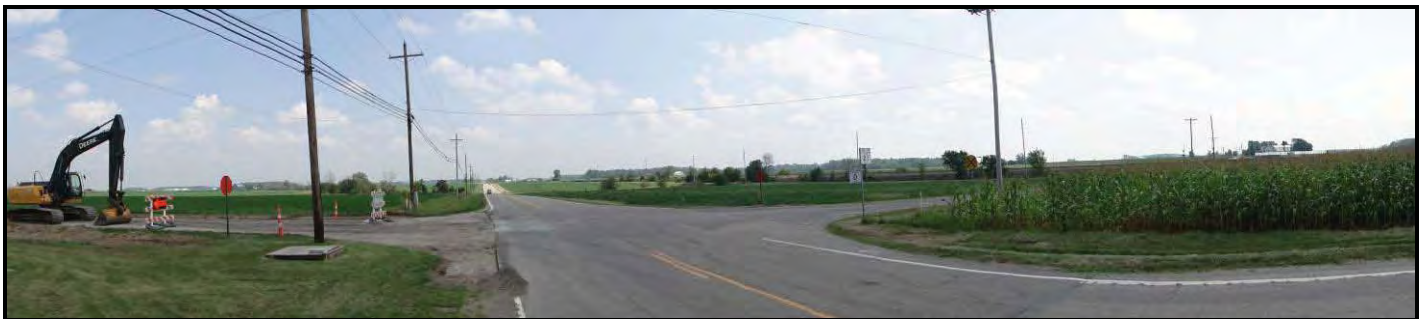
Parking Lot of Pettisville Missionary Church





P-V-10

Corner of County Road 21 and County Road D  
Turbine Barely Visible





P-V-11

4208 County Road 21  
Turbine Barely Visible



P-V-12

County Road D North West of the Turbine





Downtown Pettisville



Example Images of Other Regional Tall Structures

Local Granaries





Local Communication Relay Tower



Area Farm Silos and Cell Towers

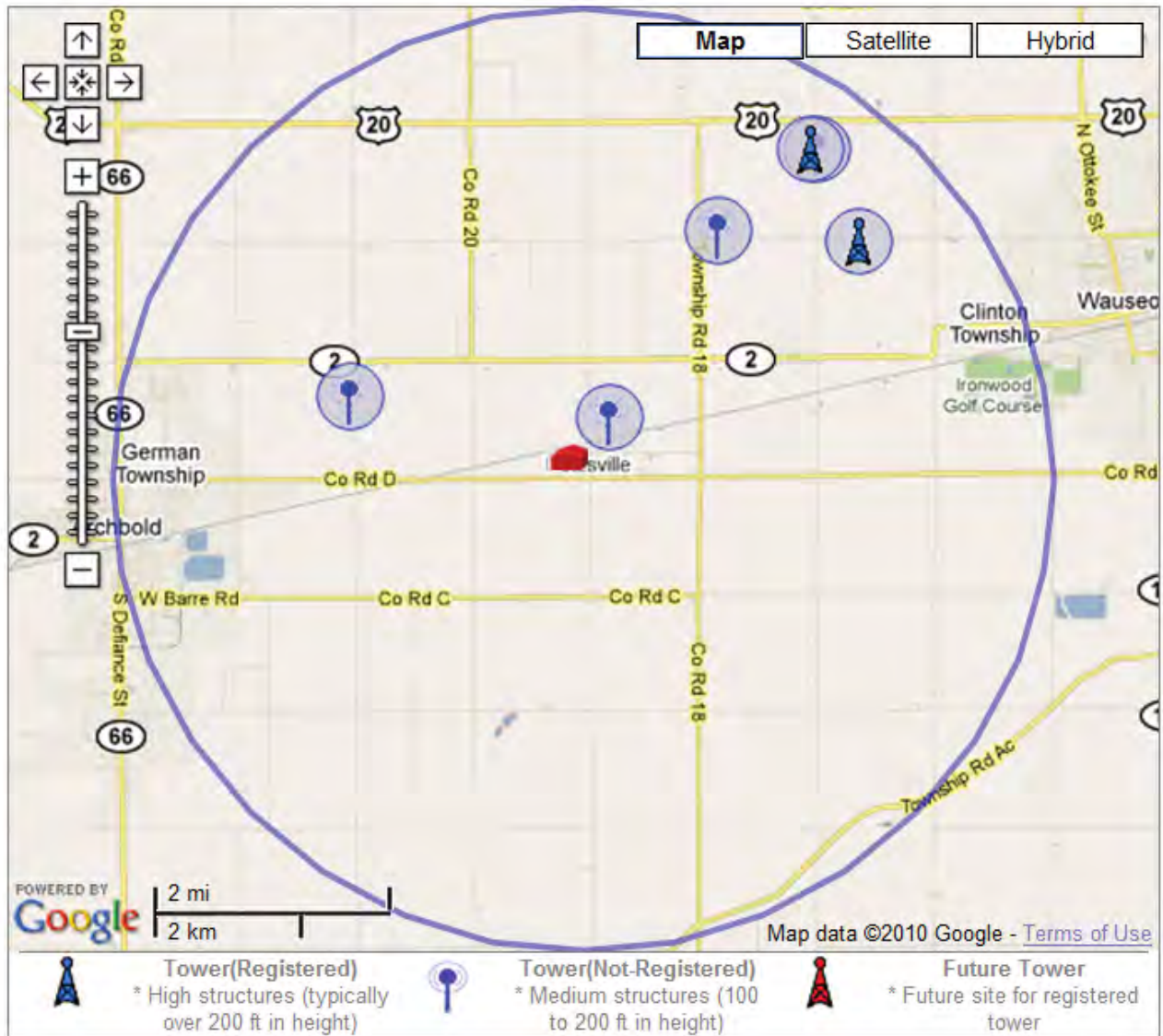


(Also See Tall Tower Map and Tables Below)



### Existing Tall Towers Within 4 Miles of The Proposed Turbine Site

- Tower Structures - (Pettisville, Ohio, United States)



| Registered Towers |  |          |            |
|-------------------|--|----------|------------|
| 1                 | <a href="#">Nobco Inc. Db a = Wmtr Radio</a> | 367 feet | 3.35 miles |
| 2                 | <a href="#">New Par</a>                      | 212 feet | 3.44 miles |

| Non-Registered Towers |   |          |            |
|-----------------------|---|----------|------------|
| 1                     | <a href="#">Mr Daniel Cunningham</a>              | 323 feet | .56 miles  |
| 2                     | <a href="#">Xl Group Inc</a>                      | 313 feet | 2.36 miles |
| 3                     | <a href="#">Roger Arnos</a>                       | 328 feet | 2.47 miles |
| 4                     | <a href="#">Toledo Cellular Telephone Company</a> | 225 feet | 3.48 miles |

| Multiple Antennas |   |          |            |
|-------------------|---|----------|------------|
| 1                 | <a href="#">Pearl Gas Co</a>                      | NA       | 2.47 miles |
|                   | <a href="#">Laidlaw Waste Systems Inc</a>         | 328 feet | 2.47 miles |
|                   | <a href="#">Ams Spectrum Holdings, Llc</a>        | 109 feet | 2.47 miles |
|                   | <a href="#">Futronics Paging Inc.</a>             | NA       | 2.47 miles |
|                   | <a href="#">Ams Spectrum Holdings, Llc</a>        | 328 feet | 2.47 miles |
|                   | <a href="#">Nextel License Holdings 4, Inc</a>    | 98 feet  | 2.47 miles |
|                   | <a href="#">Quadco Rehabilitation Center Inc</a>  | NA       | 2.47 miles |
|                   | <a href="#">Beck, Kevin J</a>                     | 328 feet | 2.47 miles |
|                   | <a href="#">Overnite Transportation Company</a>   | 312 feet | 2.47 miles |
|                   | <a href="#">Mohre Electronics Company</a>         | 328 feet | 2.48 miles |
|                   | <a href="#">Snows Fire Protection Service Inc</a> | NA       | 2.47 miles |
|                   | <a href="#">Nofziger Door Sales Inc</a>           | NA       | 2.47 miles |
| 2                 | <a href="#">M &amp; R Redi Mix</a>                | NA       | .39 miles  |
|                   | <a href="#">M &amp; R Redi Mix</a>                | NA       | .39 miles  |
| 3                 | <a href="#">Buckeye Communications Inc</a>        | 177 feet | 1.87 miles |
|                   | <a href="#">Rupp, Donald</a>                      | 177 feet | 1.87 miles |
| 4                 | <a href="#">S W Mills Inc</a>                     | NA       | 3.48 miles |
|                   | <a href="#">S W Mills Inc</a>                     | NA       | 3.48 miles |
|                   | <a href="#">Aeschliman, John</a>                  | NA       | 3.48 miles |
| 5                 | <a href="#">Roadway Express</a>                   | NA       | 3.89 miles |
|                   | <a href="#">Roadway Express</a>                   | 98 feet  | 3.89 miles |
|                   | <a href="#">Archbold Lawn Service</a>             | 20 feet  | 3.89 miles |
| 6                 | <a href="#">New Par</a>                           | 212 feet | 3.44 miles |
|                   | <a href="#">Newpar</a>                            | 223 feet | 3.44 miles |

See the Website below for full details on these sites including precise locations, heights and frequencies.

<http://www.antennasearch.com/>

| Single Antennas |   |          |            |
|-----------------|---|----------|------------|
| 7               | <a href="#">Pettisville School Corporation</a>                            | NA       | .40 miles  |
| 8               | <a href="#">Norfolk Southern Railway Company</a>                          | 10 feet  | 1.29 miles |
| 9               | <a href="#">Four County Joint Vocational School</a>                       | NA       | 1.50 miles |
| 10              | <a href="#">Nofziger, Melvin:nofziger, Mark Dba Nofziger Farm Service</a> | NA       | 1.56 miles |
| 11              | <a href="#">Nafziger, Dan</a>   | 105 feet | 2.63 miles |
| 12              | <a href="#">Worthington Steel Corporation</a>                             | 174 feet | 3.59 miles |
| 13              | <a href="#">Hoffman, Thomas</a>   | NA       | 3.71 miles |
| 14              | <a href="#">Nofzinger Electric Inc</a>                                    | NA       | 3.79 miles |
| 15              | <a href="#">Fibertower Spectrum Holdings Llc</a>                          | 20 feet  | 2.17 miles |

See the Website below for full details on these sites including but not limited to: precise locations, heights, frequencies and owners.

<http://www.antennasearch.com/>

## Sample Horizon View Impact Calculator

Rotor Diameter  Feet

| Viewer Distance From Turbine |       | Percent of Total Horizon View-shed Affected | Percent of Total Average Persons Field of View Affected |
|------------------------------|-------|---|---|
| Feet                         | Miles |   |   |
| 100                          | 0.02  | 29.76%                                      | 100.00%   |
| 200                          | 0.04  | 14.88%                                      | 89.29%  |
| 400                          | 0.08  | 7.44%                                       | 44.64%  |
| 800                          | 0.15  | 3.72%                                       | 22.32%  |
| 1,600                        | 0.30  | 1.86%                                       | 11.16%  |
| 3,200                        | 0.61  | 0.93%                                       | 5.58%   |
| 5,280                        | 1.00  | 0.56%                                       | 3.38%   |
| 10,560                       | 2.00  | 0.28%                                       | 1.69%   |
| 15,840                       | 3.00  | 0.19%                                       | 1.13%   |
| 21,120                       | 4.00  | 0.14%                                       | 0.85%   |
| 26,400                       | 5.00  | 0.11%                                       | 0.68%   |
| 52,800                       | 10.00 | 0.06%                                       | 0.34%   |

### Assumptions:

Model assumes absolute worst case for all variables.

Viewer is stationary, focused and looking directly at and centered on the turbine.

Viewer's field of view is 60 degrees.

Model assumes no sightline obstructions, crystal clear atmospheric visibility and 100% of the turbine is visible.

Model assumes the largest rotor diameter under consideration for the site.

Model assumes the turbine rotor is perpendicular to and fully visible to the viewer.

Model assumes worst case as if the turbine rotor diameter influences the entire column of the horizon as if the turbine was a solid plane covering the entire portion of the horizon at a width of the turbine's rotor.

# Sample Turbine View Calculations

## Baselines For Calculations

|                             |          |
|-----------------------------|----------|
| Turbine Height to Blade Tip | 334 Feet |
| Turbine Height to Hub       | 246 Feet |
| Persons Eye Height          | 5.5 Feet |
| Based on Level Ground.      |          |

### Listed Obstruction Height (Feet)

#### Will Block Turbine View

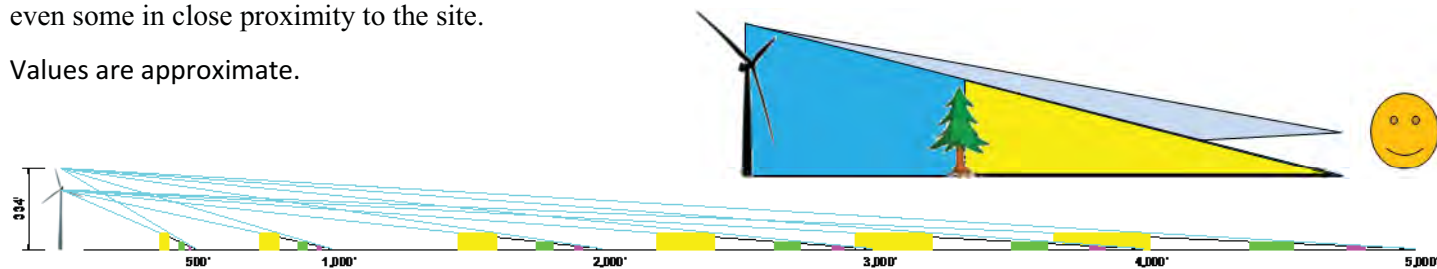
#### Within Listed Distance of Viewer (Feet)

| Obstruction Height (Feet)            |      | Typical One Story House or Short Tree |           | Typical Two Story House or Tree |           | Typical Tall Tree or Tall Building |           | Apparent Height of Turbine at 3' Arm's Length (Inches Tall) (If You Could See the Entire Turbine) |
|--------------------------------------|------|---------------------------------------|-----------|---------------------------------|-----------|------------------------------------|-----------|---|
|                                      |      | 17.5                                  |           | 35                              |           | 70                                 |           |   |
| Minimum Visible Target to be Blocked |      | Hub Up                                | Blade Tip | Hub Up                          | Blade Tip | Hub Up                             | Blade Tip |   |
| Viewer Distance From Turbine (Feet)  | 500  | 23                                    | 18        | 57                              | 44        | 126                                | 97        | 23.9  |
|                                      | 1000 | 47                                    | 36        | 115                             | 88        | 251                                | 193       | 11.9  |
|                                      | 1500 | 70                                    | 54        | 172                             | 133       | 377                                | 290       | 8.0   |
|                                      | 2000 | 93                                    | 72        | 230                             | 177       | 502                                | 387       | 6.0   |
|                                      | 2500 | 117                                   | 90        | 287                             | 221       | 628                                | 483       | 4.8   |
|                                      | 3000 | 140                                   | 108       | 344                             | 265       | 753                                | 580       | 4.0   |
|                                      | 3500 | 163                                   | 126       | 402                             | 310       | 879                                | 677       | 3.4   |
|                                      | 4000 | 187                                   | 144       | 459                             | 354       | 1004                               | 774       | 3.0   |
|                                      | 4500 | 210                                   | 162       | 517                             | 398       | 1130                               | 870       | 2.7   |
|                                      | 5000 | 234                                   | 180       | 574                             | 442       | 1255                               | 967       | 2.4   |

Example: At a distance of 2,500 feet from the turbine your view of the turbine would be blocked by any 17.5 foot structure or tree if it was less than 90 feet from you. The apparent height of an unobstructed turbine view at this distance would 4.8 inches tall at a 3 foot arms length from your eye.

Typical community and natural obstructions will block the view of the turbine for many residences and businesses, even some in close proximity to the site.

Values are approximate.





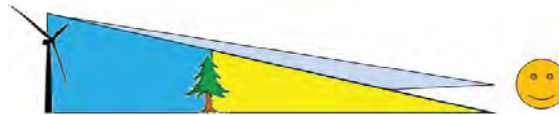
## Sample Wind Turbine View Calculator

|                 | Address  | Longitude        | Latitude         |
|-----------------|--|------------------|------------------|
| Project Turbine | Pettisville Local Schools     232 Summit<br>Pettisville Ohio | 84° 13' 31.51" W | 41° 31' 40.68" N |

Subject Viewpoint Property

Point of View

Sample



| User Inputs | Calculations |
|-------------|--------------|
|-------------|--------------|

**Turbine Information:**

|  | Feet  | Meters |
|--|-------|--------|
| Tower Height                               | 213.3 | 65.0   |
| Rotor Diameter                             | 177.2 | 54.0   |
| Tip Height                                 | 301.8 | 92.0   |
| Turbine Location Elevation Above Sea-level | 748.0 | 228.0  |

Notes:

**Viewpoint Information:**

|  | Feet  | Meters |
|--|-------|--------|
| Viewpoint Distance From Turbine                | 500.0 | 152.4  |
| Viewpoint Eye Height Above Ground              | 5.5   | 1.7    |
| Viewpoint Ground Elevation Above Sea-level     | 730.0 | 222.5  |
| Net Viewpoint Ground Elevation Above Sea-level | 735.5 | 224.2  |

Notes:

Eye height + ground elevation above sea-level (Level Line For Calculations)

**Obstruction Information:**

|  | Feet  | Meters |
|--|-------|--------|
| Obstruction Distance From Viewpoint          | 125.0 | 38.1   |
| Obstruction Height Above Ground              | 35.0  | 10.7   |
| Obstruction Ground Elevation Above Sea-level | 729.0 | 222.2  |
| Net Obstruction Height Above Sea-Level       | 764.0 | 232.9  |

Notes:

**Results:**

|   |       |       |
|---|-------|-------|
| Will The Turbine Be Visible?  | Yes   | 68.9% |
| Relative Visible Turbine Height at Obstruction Distance                   | 56.3  | 17.2  |
| Actual Portion of Turbine Showing   | 208.1 | 63.4  |
| Will Blades Be Visible?   | Yes   | 100%  |
| Will Hub Be Visible?  | Yes   |       |
| Apparent Height of Visible Portion of Turbine, at Distance From Eye Below | 0.901 | 0.3   |
|   | 10.8  | 27.5  |
| Distance From Eye   | 2     | 0.61  |

Notes:

Percent of Total Turbine and Tower

Feet / Meters     Usefull for landscape scale

Feet / Meters

Percent Rotor Diameter

Feet / Meters

Inches / Centimeters

Feet / Meters

Although this calculator does take into account relative topography, it does not take into account the width of obstructions or their shape. It calculates on a single vertical plane at a time. Although a good guide, it should only be used as a rough indicator of the magnitude of potential turbine visibility from a particular viewpoint.





# Pettisville Local Schools Wind Turbine Project Shadow Flicker Analysis

Prepared for:  
Pettisville Local Schools

Prepared by:  
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Submitted September 2, 2010

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*Thank You for Choosing The Renaissance Group, a Conserve First LLC Company*



## Introduction

**Proposed Turbine Location:** Pettisville Local Schools  
232 Summit Street  
Pettisville, Ohio 43553

Latitude: 41°31'40.68" N

Longitude: 84°13'31.51" W

While all tall objects cast shadows, wind turbines, due to their spinning blades, can cause moving/flickering shadows which can become an annoyance, especially in residential areas when they pass over windows. Fortunately, while the adverse effects of shadows can be subjective, the shadows themselves can be precisely modeled for location and duration. While modeling shadows for location knowing the latitude of site, the topography and the height and rotor diameter of a wind turbine is a precise science, quantifying the frequency of the shadow's actual occurrence is more difficult due to changing weather patterns affecting the actual Sun's intensity and presence. Further, weather patterns affect the orientation of the wind turbines blades as they follow the wind and hence their orientation to the Sun and the site. In short, on a cloudy day, there will be no shadows, and similarly, when the blades are parallel or close to parallel to the observer, none to limited moving shadow will be visible, and of course, if the wind is not sufficiently blowing to rotate the blades of the turbine, you will not have any moving shadow. Further, it is important to note the higher the angle of the Sun, the shorter the reach of the shadow and the smaller the area of potential impact. Further yet, it also important to note, due to the diffusion of light over distance, shadow intensity drops off significantly with distance. The thickness of the obstruction to the Sun, in this case the blades, also plays significantly into the actual apparent intensity and realized length of shadows. It is for these reasons that shadow distances over ten rotor diameters away from the turbine are considered insignificant. For shadow receptor sites within a turbine's shadow's reach, not all will receive shadow due to existing obstructions that block the shadows path such as other buildings, hills or trees. While evergreen trees will fairly consistently block shadows year-round, deciduous trees will have a lesser impact in the winter months when they have no leaves. Pending the density of the tree stand, single tree to an entire wooded area, winter shadows in these situations can go from being just slightly diffused to still totally obstructed. To properly model the true impacts of shadow flicker, all these considerations must be taken into account. Unobstructed shadows in latitudes similar to this study site will typically have a bow tie or flatten cross shape. In the winter, the sun rises lower on the horizon in the Southeast and sets in the Southwest and in the Summer, the Sun rises in the Northeast and sets in the Northwest all creating a path or area of potential shadow. The southern portion of the bowtie typically is larger due to there being more sunny days in the Summer although Winter shadows will be longer overall and tend to last for longer periods due to the lower angle of the Sun's rays. You will typically see more impacts in alignment with the site's predominate wind direction due to the corresponding predominate turbine blade orientation perpendicular to this direction and thus more visible moving shadows in this direction.

Although no official US policy has been adopted, international standards appear to be in consensus that flickering shadows in excess of thirty hours per year impacting a particular location are considered a potential nuisance.<sup>i</sup> This said, the qualitative impacts of the shadows are subjective.

When considering potential health impacts from wind turbine shadows/flicker, photosensitivity triggered epilepsy is the only issue that is discussed and has been dismissed for mid to large scale modern wind turbines such as the one being considered by the site due to turbine operating frequencies being too low to trigger seizures. According to the British Epilepsy Association, approximately five percent of individuals with epilepsy have sensitivity to light, and most people with photosensitive epilepsy are sensitive to flickering around 16-25Hz (Hertz or Hz = 1 flash per second), although some people may be sensitive to rates as low as 3Hz and as high as 60Hz (British Epilepsy Association, 2007). Specific to wind power projects, the British Epilepsy Association (2007) states that there is no evidence that wind turbines can trigger seizures, and newer wind commercial scale turbines are built to operate at a frequency of 1Hz or less. This conclusion is also supported by the epilepsy thresholds published by the American Epilepsy Foundation.<sup>ii</sup> Therefore, health effects due to projected shadow flicker are not anticipated or further evaluated. The primary concern with shadow flicker is the annoyance it could cause for adjacent home and business owners.

## Methods

WindPro 2.7, an internationally accepted software modeling tool, was used to generate the areas of potential shadow flicker impact around the proposed turbine installation site. The software imports historic weather variable averages from the nearest national weather station to obtain average numbers of days with sunshine and the average wind direction distributions. Local Latitude drives the solar path models. Local topographical information is input to determine if there are any natural geographic influences such as hills or valleys. The turbine information including tower height and rotor diameter are input as variables to the location's shadow source models. Rotor diameter is also used to determine the study area of influence, a ten rotor diameters radius around the turbine or 1870 feet for the largest rotor diameter being considered for this site, based on internationally accepted standards.<sup>iii</sup> Wind turbine operational variables for the site are also input which correspond to the turbine's overall percentage of operational time such as percentage of time when the wind speed is too low to rotate the blades and industry norms for availability driven from scheduled and unscheduled maintenance downtime. Wind speed Weibull distributions are from The Renaissance Group and State of Ohio wind data sets and models. Trees and other local obstructions are not considered in the base model (although can be added if desired) and thus the model can be considered a worst case, as if no obstructions existed. If a particular shadow receptor is found to be of potential concern, a receptor specific analysis of potential shadow flicker hours and occurrence periods/times is conducted, otherwise, the results are plotted for the area as a whole as average not-to-exceed threshold iso-lines on the map. Models were run at a two thousand meter hyper-conservative distance well beyond the likely observable shadows for this location and the turbines under consideration. For the playing field locations, extra-wide

and tall receptor windows were used of 100' x 100' to better insure potential impact recording. With this in mind, it is important to note that the model records all potential impacts as if they impacted the entire receptor, while in reality, they will only impact a relatively small portion of these large receptors at a given time.

## Results

See "Pettisville WTG Shadow Flicker Analysis" map for a visualization of the results. No homes or occupied business structures outside the owner's property within the turbines shadow influence will receive significant flickering shadows of over 30 hours per year. While some of the farm to the southwest (Receptor H) will receive significant summer morning shadows, the farm's outbuildings will block most of the shadows from reaching the farmhouse (The newly planned playing fields to the East and West of the site will receive significant shadows year-round (See WindPro Receptor Analysis for detailed data for this receptor location). For the periods when shadowing events will overlap scheduled sporting or other use events, the school has adopted a policy that will temporarily shut down the turbine during the shadows impact on the playing fields. The financial loss to the school district from this policy will be minimal due to the short duration of the shadow events and the fact the sporting events typically only last a few hours, and further, the shutdowns will only need to occur during sunny weather. The houses Northeast of County Road D, the Southern exposure of the new School and a few of the houses to the west will receive less than 10 hours of shadow per year, although much of these shadows will be blocked by existing trees. (See below for further information and recommendations for the potentially impacted receptor sites.) (Also see "Turbine Use, Safety Policies and General Background" document for information on the Schools Turbine policies relating to shadow flicker.)

Models were run using a hyper-conservative two thousand meters, a distance well beyond the industry norm of ten rotor diameters, to insure full reporting of potential impacts. The models show the same iso-lines contour results for general shadow hour thresholds based on the actual average site conditions, but the tabular information shows worse case shadow hours and the potential hours of impact for particular receptor locations, as if it was always sunny. Also, note the further away from the turbine a receptor is the less intense the shadow will be. Beyond ten rotor diameters, shadows will be diffuse and difficult to see.

### Overview of Tabular Results for Particular Sample Receptors:

- Receptor A: 960 Feet Away: 112 Main St.: Shadows will be highly diffuse, if visible at all, as the receptor is substantially blocked by trees and other structures, but possible in an open landscape from mid-February to early-March mornings and mid-October to early-November mornings with a total average of less than 7 hours of moving shadow per year possible.
- Receptor B: 1,950 Feet Away: 18372 County Road D: Shadows will be highly diffuse, if visible at all, as the receptor is well outside ten rotor diameters and likely substantially blocked by trees, but possible for very short durations during portions of late-February to early-March and mid-October evenings with a total average of less than 3 hours of moving shadow per year.

- Receptor C: 1238 Feet Away: 3770 County Road 19: Site will receive 0 hours of moving shadow.
- Receptor D: 1,080 Feet Away: 18519 County Road D: Shadows will be diffuse as the receptor is substantially blocked by evergreen trees, but possible during portions of April, August and early-September evenings with a total average of less than 9 hours of moving shadow per year.
- Receptor E: 646 Feet Away: 18636 County Road D: Shadows will be diffuse, as the receptor is shaded by trees, but possible during portions of January, February, October, November and very Early December evenings with a total average of less than 19 hours of moving shadow per year.
- Receptor F: 175 Feet Away: Proposed playing fields to the East: Shadows will be distinct late-April through mid-September afternoons and evenings with a total average of less than 159 hours of moving shadow per year.
- Receptor G: 175 Feet Away: Proposed playing fields to the West: Shadows will be distinct mid-April through mid to late August mornings with a total average of less than 85 hours of moving shadow per year.
- Receptor H: 897 Feet Away: 3902 County Road 19: Shadows will be substantially blocked by the farms outbuildings, but possible during portions of mid-April to Late June and mid-July to Late August early mornings with a total average of less than 17 hours of moving shadow per year.
- Receptor I: 686 Feet Away: 18863 County Road D: Shadows may be diffuse due to existing trees, but possible during portions of Late February to late-March and mid-September to mid-October mornings with a total average of less than 13 hours of shadow per year.
- Receptor J: 888 Feet Away: 18578 County Road D: Shadows will be diffuse, if visible at all, as the receptor is shaded by existing trees, but possible during portions of very late-January to early-March and mid-October to mid-November evenings (occurring in 16:00 to 17:00 hours) with a total average of less than 12 hours of moving shadow per year.
- Receptor K: 1181 Feet Away: 18520 County Road D: Shadows will be highly diffuse, if visible at all, due to distance and existing trees, but possible during portions of mid-February to mid-March and mid-October evenings (occurring in 16:00 to 18:00 hours) with a total average of less than 7 hours of moving shadow per year.
- Receptor L: 896 Feet Away: 3940 County Road 19: Shadows will be visible through one window during portions of late-March to late-April and late-August to mid-September mornings (all occurring in the 8:00 hour) with a total average of less than 11 hours of moving shadow per year.

The duration of particular shadow events can vary from a minute to hours pending the receptor. See the following tables at the end of this report for precise dates and times where shadows could occur for each listed sample receptor.



Note the iso-line diagram on the following page shows hour thresholds of shadow impact based on average site conditions with results being referenced to one meter squares of potential impact, i.e. a meter square area within an iso-line area will receive up to the threshold of shadow hours per year. As the tabular information represents larger areas and adds up the entire receptor as if it was one location, its cumulative hour results may be higher. This equates to watching if a shadow will enter a window to watching if it will enter any portion of an entire ball field or yard. Although impacts can be subjective, shadows impacting a specific receptor window are considered significantly more severe than those that impact a yard.

## **Recommendations**

Based on the study findings, no occupied structure will receive over 30 hours of moving shadow per year, the currently accepted consensus on nuisance thresholds for moving shadows/flickering. No local, State or Federal policy or regulation exists to govern shadow flicker thresholds. This said, some receptors will receive some shadow which the affect of will be subjective to the receptor owners' views on the project and their sensitivity. With this in mind, the study authors would recommend that the project site owner follow the guidelines and mediation strategies outlined in "Turbine Use, Safety Policies and General Background".

# Pettisville WTG Shadow Flicker Analysis



**Legend**

- WTG
- Sample Receptors
- Shadow Model Isolines hours / year
  - 10 or less
  - 20 or less
  - 30 or less
  - 40 or less
  - 50 or less
  - 100 or less
- Parcels
- Streets

THE RENAISSANCE  
A Conserve First Company

TRG GROUP

Source Data: WindPro 2.7



Project:

Pettisville Shadow Receptor Potential Impacts Analysis, 2000 Meters

Printed/Page

8/28/2010 7:07 PM / 1

Licensed user:

Conserve First LLC, d/b/a The Renaissance Group, Renewables

8281 Euclid Chardon Road, Suite E

US-44094 Kirtland, Ohio

4717

AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

8/28/2010 7:06 PM/2.7.473



## SHADOW - Main Result

### Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

| Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul   | Aug  | Sep  | Oct  | Nov  | Dec  |
|------|------|------|------|------|------|-------|------|------|------|------|------|
| 3.47 | 4.37 | 4.90 | 7.57 | 8.91 | 9.33 | 10.21 | 9.01 | 6.89 | 5.70 | 2.71 | 1.87 |

Operational time

| N   | NNE | NE  | ENE | E   | ESE | SE  | SSE | S   | SSW | SW  | WSW |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 236 | 212 | 320 | 568 | 507 | 352 | 282 | 294 | 417 | 671 | 766 | 834 |

W WNW NW NNW Sum

753 674 453 318 7,657

Idle start wind speed: Cut in wind speed from power curve

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:

Height contours used: Height Contours: FultonXYZ.wpo (1)

Obstacles used in calculation

Eye height: 1.5 m

Grid resolution: 10 m



New WTG

Scale 1:12,500  
Shadow receptor

### WTGs

| UTM WGS84 Zone: 16     |         |           |                                 | WTG type |           |                |                   | Shadow data        |                |                          |           |
|------------------------|---------|-----------|---------------------------------|----------|-----------|----------------|-------------------|--------------------|----------------|--------------------------|-----------|
| East                   | North   | Z         | Row data/Description            | Valid    | Manufact. | Type-generator | Power, rated [kW] | Rotor diameter [m] | Hub height [m] | Calculation distance [m] | RPM [RPM] |
| UTM WGS84 Zone: 16 [m] |         |           |                                 |          |           |                |                   |                    |                |                          |           |
| 1                      | 731,486 | 4,601,087 | 227.0 Unison U54-750kW 750 5... | Yes      | Unison    | U54-750kW-750  | 750               | 54.0               | 75.0           | 1,088                    | 25.0      |

### Shadow receptor-Input

| UTM WGS84 Zone: 16 |         |           |       |       |        |               |                       |                 |                    |  |  |
|--------------------|---------|-----------|-------|-------|--------|---------------|-----------------------|-----------------|--------------------|--|--|
| No.                | East    | North     | Z     | Width | Height | Height a.g.l. | Degrees from south cw | Slope of window | Direction mode     |  |  |
|                    | [m]     | [m]       | [m]   | [m]   | [m]    | [m]           | [°]                   | [°]             |                    |  |  |
| A                  | 731,185 | 4,601,222 | 227.8 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| B                  | 732,075 | 4,601,266 | 229.6 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| C                  | 731,205 | 4,600,817 | 230.7 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| D                  | 731,834 | 4,601,080 | 228.2 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| E                  | 731,629 | 4,601,227 | 229.4 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| F                  | 731,556 | 4,601,073 | 226.7 | 30.0  | 30.0   | 0.2           | -180.0                | 90.0            | "Green house mode" |  |  |
| G                  | 731,427 | 4,601,067 | 227.8 | 30.0  | 30.0   | 0.2           | -180.0                | 90.0            | Fixed direction    |  |  |
| H                  | 731,197 | 4,601,030 | 230.4 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| I                  | 731,276 | 4,601,166 | 228.5 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| J                  | 731,699 | 4,601,229 | 228.4 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| K                  | 731,792 | 4,601,229 | 228.2 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |
| L                  | 731,199 | 4,601,091 | 229.2 | 1.0   | 1.0    | 1.0           | -180.0                | 90.0            | "Green house mode" |  |  |

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8281 Euclid Chardon Road, Suite E

US-44094 Kirtland, Ohio

4717

AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

8/28/2010 7:06 PM/2.7.473

**SHADOW - Main Result****Calculation Results**

Shadow receptor

**Shadow, expected values**

| No. | Shadow hours<br>per year<br>[h/year] |
|-----|--------------------------------------|
| A   | 6:23                                 |
| B   | 2:04                                 |
| C   | 0:00                                 |
| D   | 8:25                                 |
| E   | 18:09                                |
| F   | 158:55                               |
| G   | 84:37                                |
| H   | 16:10                                |
| I   | 12:12                                |
| J   | 11:25                                |
| K   | 6:50                                 |
| L   | 10:49                                |

Total amount of flickering on the shadow receptors caused by each WTG

| No. | Name  | Worst case<br>[h/year] | Expected<br>[h/year] |
|-----|---|------------------------|----------------------|
| 1   | Unison U54-750kW 750 54.0 !O! hub: 75.0 m (3) | 930:39                 | 319:36               |



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Calculated:

8/28/2010 7:06 PM/2.7.473



SHADOW - Calendar

Shadow receptor: A - Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (2)

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3 °
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
3.47 4.37 4.90 7.57 8.91 9.33 10.21 9.01 6.89 5.70 2.71 1.87

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
236 212 320 568 507 352 282 294 417 671 766 834 753 674 453 318 7,657
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January-December) and rows for each day (1-31) showing sunrise and sunset times. Includes summary rows for 'Potential sun hours', 'Total, worst case', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker
First time (hh:mm) with flicker Last time (hh:mm) with flicker
(WTG causing flicker first time) (WTG causing flicker last time)

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 4717  
 Aaron Godwin / AARON@ConserveFirst.com  
 Calculated:  
 8/28/2010 7:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: B - Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (3)

Assumptions for shadow calculations

Maximum distance for influence

2,000 m

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

| Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul   | Aug  | Sep  | Oct  | Nov  | Dec  |
|------|------|------|------|------|------|-------|------|------|------|------|------|
| 3.47 | 4.37 | 4.90 | 7.57 | 8.91 | 9.33 | 10.21 | 9.01 | 6.89 | 5.70 | 2.71 | 1.87 |

Operational time

| N   | NNE | NE  | ENE | E   | ESE | SE  | SSE | S   | SSW | SW  | WSW | W   | WNW | NW  | NNW | Sum   |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| 236 | 212 | 320 | 568 | 507 | 352 | 282 | 294 | 417 | 671 | 766 | 834 | 753 | 674 | 453 | 318 | 7,657 |

Idle start wind speed: Cut in wind speed from power curve

|                     | January        | February       | March          | April              | May            | June           | July           | August         | September      | October        | November           | December       |
|---------------------|----------------|----------------|----------------|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|--------------------|----------------|
| 1                   | 08:04<br>17:18 | 07:50<br>17:53 | 07:13<br>18:27 | 17:40 (1)<br>20:01 | 07:22<br>20:33 | 06:35<br>21:04 | 06:07<br>21:15 | 06:31<br>20:57 | 07:03<br>20:13 | 07:33<br>19:20 | 07:08<br>17:33     | 07:44<br>17:09 |
| 2                   | 08:04<br>17:19 | 07:49<br>17:54 | 07:12<br>18:28 | 17:39 (1)<br>20:02 | 07:20<br>20:34 | 06:34<br>21:04 | 06:07<br>21:15 | 06:32<br>20:56 | 07:04<br>20:12 | 07:34<br>19:19 | 07:10<br>17:32     | 07:45<br>17:08 |
| 3                   | 08:04<br>17:19 | 07:48<br>17:55 | 07:10<br>18:30 | 17:39 (1)<br>20:03 | 07:18<br>20:36 | 06:33<br>21:05 | 06:08<br>21:15 | 06:33<br>20:54 | 07:05<br>20:10 | 07:36<br>19:17 | 07:11<br>17:31     | 07:46<br>17:08 |
| 4                   | 08:04<br>17:20 | 07:47<br>17:56 | 07:09<br>18:31 | 17:39 (1)<br>20:04 | 07:17<br>20:37 | 06:31<br>21:06 | 06:08<br>21:15 | 06:34<br>20:53 | 07:06<br>20:08 | 07:37<br>19:15 | 18:22 (1)<br>17:29 | 07:47<br>17:08 |
| 5                   | 08:04<br>17:21 | 07:46<br>17:58 | 07:07<br>18:32 | 17:38 (1)<br>20:05 | 07:15<br>20:38 | 06:30<br>21:07 | 06:09<br>21:15 | 06:35<br>20:52 | 07:07<br>20:07 | 07:38<br>19:14 | 18:19 (1)<br>17:28 | 07:48<br>17:08 |
| 6                   | 08:04<br>17:22 | 07:45<br>17:59 | 07:05<br>18:33 | 17:39 (1)<br>20:06 | 07:13<br>20:39 | 06:29<br>21:07 | 06:10<br>21:15 | 06:36<br>20:51 | 07:08<br>20:05 | 07:39<br>19:12 | 18:17 (1)<br>17:27 | 07:49<br>17:07 |
| 7                   | 08:04<br>17:23 | 07:44<br>18:00 | 07:04<br>18:34 | 17:40 (1)<br>20:07 | 07:12<br>20:40 | 06:28<br>21:08 | 06:10<br>21:14 | 06:37<br>20:50 | 07:09<br>20:03 | 07:40<br>19:10 | 18:16 (1)<br>17:26 | 07:50<br>17:07 |
| 8                   | 08:04<br>17:24 | 07:42<br>18:01 | 08:02<br>19:35 | 18:41 (1)<br>20:08 | 07:10<br>20:41 | 06:27<br>21:09 | 06:11<br>21:14 | 06:38<br>20:49 | 07:10<br>20:02 | 07:41<br>19:09 | 18:14 (1)<br>17:25 | 07:51<br>17:07 |
| 9                   | 08:04<br>17:25 | 07:41<br>18:03 | 08:00<br>19:37 | 18:43 (1)<br>20:10 | 07:08<br>20:42 | 06:25<br>21:09 | 06:11<br>21:14 | 06:39<br>20:47 | 07:11<br>20:00 | 07:42<br>19:07 | 18:14 (1)<br>17:24 | 07:52<br>17:07 |
| 10                  | 08:04<br>17:26 | 07:40<br>18:04 | 07:59<br>19:38 | 18:53 (1)<br>20:11 | 07:07<br>20:43 | 06:24<br>21:10 | 06:12<br>21:13 | 06:40<br>20:46 | 07:12<br>19:57 | 07:43<br>19:05 | 18:13 (1)<br>17:23 | 07:52<br>17:07 |
| 11                  | 08:03<br>17:27 | 07:39<br>18:05 | 07:57<br>19:39 | 19:39<br>20:12     | 07:05<br>20:44 | 06:23<br>21:10 | 06:13<br>21:13 | 06:41<br>20:45 | 07:13<br>19:55 | 07:44<br>19:04 | 18:13 (1)<br>17:22 | 07:53<br>17:07 |
| 12                  | 08:03<br>17:28 | 07:38<br>18:06 | 07:55<br>19:40 | 07:04<br>20:13     | 06:22<br>20:45 | 06:03<br>21:11 | 06:14<br>21:12 | 06:42<br>20:43 | 07:14<br>19:53 | 07:45<br>19:02 | 18:13 (1)<br>17:21 | 07:54<br>17:08 |
| 13                  | 08:03<br>17:30 | 07:36<br>18:08 | 07:54<br>19:41 | 07:02<br>20:14     | 06:21<br>20:46 | 06:03<br>21:11 | 06:14<br>21:12 | 06:43<br>20:42 | 07:15<br>19:51 | 07:46<br>19:01 | 18:14 (1)<br>17:20 | 07:55<br>17:08 |
| 14                  | 08:02<br>17:31 | 07:35<br>18:09 | 07:52<br>19:42 | 07:00<br>20:15     | 06:20<br>20:47 | 06:03<br>21:12 | 06:15<br>21:11 | 06:44<br>20:41 | 07:16<br>19:50 | 07:47<br>18:59 | 18:14 (1)<br>17:19 | 07:56<br>17:08 |
| 15                  | 08:02<br>17:32 | 07:34<br>18:10 | 07:50<br>19:43 | 06:59<br>20:16     | 06:19<br>20:48 | 06:03<br>21:12 | 06:16<br>21:11 | 06:45<br>20:39 | 07:17<br>19:48 | 07:49<br>18:57 | 18:15 (1)<br>17:18 | 07:56<br>17:08 |
| 16                  | 08:02<br>17:33 | 07:32<br>18:11 | 07:49<br>19:44 | 06:57<br>20:17     | 06:18<br>20:49 | 06:03<br>21:13 | 06:17<br>21:10 | 06:46<br>20:38 | 07:18<br>19:46 | 07:50<br>18:56 | 18:16 (1)<br>17:17 | 07:57<br>17:08 |
| 17                  | 08:01<br>17:34 | 07:31<br>18:13 | 07:47<br>19:46 | 06:56<br>20:18     | 06:17<br>20:50 | 06:03<br>21:13 | 06:18<br>21:10 | 06:47<br>20:36 | 07:19<br>19:45 | 07:51<br>18:54 | 18:20 (1)<br>17:16 | 07:58<br>17:09 |
| 18                  | 08:01<br>17:35 | 07:30<br>18:14 | 07:45<br>19:47 | 06:54<br>20:19     | 06:16<br>20:51 | 06:03<br>21:14 | 06:18<br>21:09 | 06:48<br>20:35 | 07:20<br>19:43 | 07:52<br>18:53 | 18:23 (1)<br>17:15 | 07:59<br>17:09 |
| 19                  | 08:00<br>17:36 | 07:28<br>18:15 | 07:44<br>19:48 | 06:53<br>20:20     | 06:15<br>20:52 | 06:03<br>21:14 | 06:19<br>21:08 | 06:49<br>20:34 | 07:21<br>19:41 | 07:53<br>18:51 | 18:20 (1)<br>17:14 | 07:59<br>17:09 |
| 20                  | 07:59<br>17:38 | 07:27<br>18:16 | 07:42<br>19:49 | 06:51<br>20:22     | 06:14<br>20:53 | 06:03<br>21:14 | 06:20<br>21:08 | 06:50<br>20:32 | 07:22<br>19:39 | 07:54<br>18:50 | 18:19 (1)<br>17:14 | 08:00<br>17:10 |
| 21                  | 07:59<br>17:39 | 07:25<br>18:18 | 07:40<br>19:50 | 06:50<br>20:23     | 06:13<br>20:54 | 06:03<br>21:14 | 06:21<br>21:07 | 06:51<br>20:31 | 07:23<br>19:38 | 07:55<br>18:48 | 18:18 (1)<br>17:13 | 08:00<br>17:10 |
| 22                  | 07:58<br>17:40 | 07:24<br>18:19 | 07:39<br>19:51 | 06:48<br>20:24     | 06:13<br>20:55 | 06:04<br>21:15 | 06:22<br>21:06 | 06:52<br>20:29 | 07:24<br>19:36 | 07:57<br>18:47 | 18:20 (1)<br>17:13 | 08:01<br>17:11 |
| 23                  | 07:58<br>17:41 | 07:22<br>18:20 | 07:37<br>19:52 | 06:47<br>20:25     | 06:12<br>20:56 | 06:04<br>21:15 | 06:23<br>21:05 | 06:54<br>20:28 | 07:25<br>19:34 | 07:58<br>18:45 | 18:19 (1)<br>17:12 | 08:01<br>17:11 |
| 24                  | 07:57<br>17:42 | 07:21<br>18:21 | 07:35<br>19:53 | 06:45<br>20:26     | 06:11<br>20:57 | 06:04<br>21:15 | 06:24<br>21:04 | 06:55<br>20:26 | 07:26<br>19:32 | 07:59<br>18:44 | 18:20 (1)<br>17:12 | 08:02<br>17:12 |
| 25                  | 07:56<br>17:44 | 07:19<br>18:22 | 07:34<br>19:54 | 17:46 (1)<br>20:27 | 07:34<br>20:58 | 06:34<br>21:15 | 06:25<br>21:04 | 06:56<br>20:24 | 07:27<br>19:31 | 08:00<br>18:43 | 18:21 (1)<br>17:11 | 08:02<br>17:12 |
| 26                  | 07:55<br>17:45 | 07:18<br>18:24 | 07:32<br>19:55 | 17:43 (1)<br>20:28 | 07:32<br>20:59 | 06:33<br>21:15 | 06:25<br>21:03 | 06:57<br>20:23 | 07:28<br>19:29 | 08:01<br>18:41 | 18:22 (1)<br>17:11 | 08:02<br>17:13 |
| 27                  | 07:54<br>17:46 | 07:16<br>18:25 | 07:30<br>19:57 | 17:42 (1)<br>20:29 | 07:30<br>21:00 | 06:32<br>21:15 | 06:26<br>21:02 | 06:58<br>20:21 | 07:29<br>19:27 | 08:02<br>18:40 | 18:23 (1)<br>17:10 | 08:03<br>17:14 |
| 28                  | 07:54<br>17:47 | 07:15<br>18:26 | 07:28<br>19:58 | 17:40 (1)<br>20:29 | 07:28<br>21:00 | 06:31<br>21:15 | 06:27<br>21:01 | 06:59<br>20:20 | 07:30<br>19:26 | 08:04<br>18:38 | 18:24 (1)<br>17:10 | 08:04<br>17:14 |
| 29                  | 07:53<br>17:49 | 07:14<br>18:26 | 07:27<br>19:59 | 17:58 (1)<br>20:31 | 07:27<br>21:01 | 06:30<br>21:15 | 06:28<br>21:00 | 06:59<br>20:18 | 07:30<br>19:24 | 08:04<br>18:37 | 18:25 (1)<br>17:09 | 08:04<br>17:15 |
| 30                  | 07:52<br>17:50 | 07:13<br>18:27 | 07:25<br>19:52 | 18:00 (1)<br>20:32 | 07:25<br>21:02 | 06:29<br>21:15 | 06:29<br>20:59 | 07:01<br>20:17 | 07:32<br>19:22 | 08:06<br>18:36 | 18:26 (1)<br>17:09 | 08:04<br>17:16 |
| 31                  | 07:51<br>17:51 | 07:12<br>18:28 | 07:23<br>19:53 | 18:00 (1)<br>20:33 | 07:23<br>21:03 | 06:28<br>21:03 | 06:30<br>20:58 | 07:02<br>20:15 | 07:33<br>18:34 | 08:07<br>18:34 | 18:27 (1)<br>17:17 | 08:04<br>17:17 |
| Potential sun hours | 296            | 297            | 370            | 399                | 449            | 454            | 461            | 429            | 375            | 344            | 297                | 286            |
| Total, worst case   |                | 55             | 160            |                    |                |                |                |                |                | 217            |                    |                |
| Sun reduction       |                | 0.41           | 0.41           |                    |                |                |                |                |                | 0.51           |                    |                |
| Oper. time red.     |                | 0.87           | 0.87           |                    |                |                |                |                |                | 0.87           |                    |                |
| Wind dir. red.      |                | 0.71           | 0.71           |                    |                |                |                |                |                | 0.71           |                    |                |
| Total reduction     |                | 0.26           | 0.26           |                    |                |                |                |                |                | 0.32           |                    |                |
| Total, real         |                | 14             | 41             |                    |                |                |                |                |                | 69             |                    |                |

Table layout: For each day in each month the following matrix apply

|              |                      |                                 |                                  |
|--------------|----------------------|---------------------------------|----------------------------------|
| Day in month | Sun rise (hh:mm)     | First time (hh:mm) with flicker | (WTG causing flicker first time) |
|              | Sun set (hh:mm)      | Last time (hh:mm) with flicker  | (WTG causing flicker last time)  |
|              | Minutes with flicker |                                 |                                  |

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US-44094 Kirtland, Ohio

4717

AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

8/28/2010 7:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: C - Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (4)

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3°
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
3.47 4.37 4.90 7.57 8.91 9.33 10.21 9.01 6.89 5.70 2.71 1.87

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
236 212 320 568 507 352 282 294 417 671 766 834 753 674 453 318 7,657
Idle start wind speed: Cut in wind speed from power curve

Table with 12 columns for months (January to December) and rows for each day of the month showing sunrise and sunset times. Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)





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 US-44094 Kirtland, Ohio  
 4717  
 Aaron Godwin / AARON@ConserveFirst.com  
 Calculated:  
 8/28/2010 7:06 PM/2.7.473

**SHADOW - Calendar**

Shadow receptor: E - Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (6)

**Assumptions for shadow calculations**

Maximum distance for influence 2,000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 3.47 4.37 4.90 7.57 8.91 9.33 10.21 9.01 6.89 5.70 2.71 1.87

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum  
 236 212 320 568 507 352 282 294 417 671 766 834 753 674 453 318 7,657  
 Idle start wind speed: Cut in wind speed from power curve

|                     | January | February        | March              | April | May   | June  | July  | August | September | October | November | December        |           |
|---------------------|---------|-----------------|--------------------|-------|-------|-------|-------|--------|-----------|---------|----------|-----------------|-----------|
| 1                   | 08:04   | 07:50           | 15:24 (1) 07:13    | 07:22 | 06:35 | 06:06 | 06:07 | 06:31  | 07:03     | 07:33   | 07:08    | 14:54 (1) 07:44 | 15:20 (1) |
| 2                   | 08:04   | 07:49           | 58 16:22 (1) 07:12 | 07:20 | 06:34 | 06:06 | 06:07 | 06:32  | 07:04     | 07:34   | 61 17:33 | 14:54 (1) 07:45 | 15:24 (1) |
| 3                   | 08:04   | 07:48           | 58 16:22 (1) 07:10 | 07:18 | 06:33 | 06:05 | 06:08 | 06:33  | 07:05     | 07:36   | 60 17:32 | 14:53 (1) 07:46 | 15:34 (1) |
| 4                   | 08:04   | 07:47           | 59 16:23 (1) 07:09 | 07:17 | 06:31 | 06:05 | 06:08 | 06:34  | 07:06     | 07:37   | 61 17:31 | 14:54 (1) 07:47 |           |
| 5                   | 08:04   | 07:46           | 60 16:24 (1) 07:07 | 07:15 | 06:30 | 06:05 | 06:09 | 06:35  | 07:07     | 07:38   | 61 17:30 | 14:54 (1) 07:48 |           |
| 6                   | 08:04   | 07:45           | 60 16:24 (1) 07:05 | 07:13 | 06:29 | 06:04 | 06:10 | 06:36  | 07:08     | 07:39   | 60 17:28 | 14:54 (1) 07:49 |           |
| 7                   | 08:04   | 07:44           | 60 16:24 (1) 07:04 | 07:12 | 06:28 | 06:04 | 06:10 | 06:37  | 07:09     | 07:40   | 60 17:27 | 14:54 (1) 07:50 |           |
| 8                   | 08:04   | 07:42           | 61 16:25 (1) 08:02 | 07:10 | 06:27 | 06:04 | 06:11 | 06:38  | 07:10     | 07:41   | 60 17:26 | 14:54 (1) 07:51 |           |
| 9                   | 08:04   | 07:41           | 61 16:25 (1) 08:00 | 07:08 | 06:25 | 06:03 | 06:12 | 06:39  | 07:11     | 07:42   | 60 17:25 | 14:54 (1) 07:52 |           |
| 10                  | 08:04   | 15:42 (1) 07:40 | 61 16:25 (1) 07:59 | 07:07 | 06:24 | 06:03 | 06:12 | 06:40  | 07:12     | 07:43   | 59 17:24 | 14:55 (1) 07:52 |           |
| 11                  | 08:03   | 15:58 (1) 07:39 | 61 16:25 (1) 07:57 | 07:05 | 06:23 | 06:03 | 06:13 | 06:41  | 07:13     | 07:44   | 58 17:23 | 14:56 (1) 07:53 |           |
| 12                  | 08:03   | 15:57 (1) 07:38 | 60 16:25 (1) 07:56 | 07:04 | 06:22 | 06:03 | 06:14 | 06:42  | 07:14     | 07:45   | 57 17:22 | 14:56 (1) 07:54 |           |
| 13                  | 08:03   | 15:56 (1) 07:36 | 59 16:25 (1) 07:54 | 07:02 | 06:21 | 06:03 | 06:14 | 06:43  | 07:15     | 07:46   | 56 17:21 | 14:56 (1) 07:55 |           |
| 14                  | 08:02   | 15:54 (1) 07:35 | 59 16:24 (1) 07:52 | 07:00 | 06:20 | 06:03 | 06:15 | 06:44  | 07:16     | 07:47   | 56 17:20 | 14:57 (1) 07:56 |           |
| 15                  | 08:02   | 15:53 (1) 07:34 | 58 16:24 (1) 07:50 | 06:59 | 06:19 | 06:03 | 06:16 | 06:45  | 07:17     | 07:49   | 54 17:19 | 14:58 (1) 07:56 |           |
| 16                  | 08:02   | 15:52 (1) 07:32 | 57 16:24 (1) 07:49 | 06:57 | 06:18 | 06:03 | 06:17 | 06:46  | 07:18     | 07:50   | 53 17:18 | 14:59 (1) 07:57 |           |
| 17                  | 08:01   | 15:51 (1) 07:31 | 56 16:23 (1) 07:47 | 06:56 | 06:17 | 06:03 | 06:18 | 06:47  | 07:19     | 07:51   | 52 17:17 | 14:59 (1) 07:58 |           |
| 18                  | 08:01   | 15:50 (1) 07:30 | 55 16:23 (1) 07:45 | 06:54 | 06:16 | 06:03 | 06:18 | 06:48  | 07:20     | 07:52   | 51 17:16 | 14:59 (1) 07:58 |           |
| 19                  | 08:00   | 15:49 (1) 07:28 | 53 16:22 (1) 07:44 | 06:53 | 06:15 | 06:03 | 06:19 | 06:49  | 07:21     | 07:53   | 49 17:15 | 14:59 (1) 07:59 |           |
| 20                  | 08:00   | 15:48 (1) 07:27 | 52 16:22 (1) 07:42 | 06:51 | 06:14 | 06:03 | 06:20 | 06:50  | 07:22     | 07:54   | 47 17:14 | 14:59 (1) 08:00 |           |
| 21                  | 07:59   | 15:47 (1) 07:25 | 49 16:21 (1) 07:40 | 06:50 | 06:13 | 06:03 | 06:21 | 06:51  | 07:23     | 07:55   | 45 17:13 | 14:59 (1) 08:00 |           |
| 22                  | 07:58   | 15:46 (1) 07:24 | 48 16:20 (1) 07:39 | 06:48 | 06:13 | 06:04 | 06:22 | 06:52  | 07:24     | 07:57   | 44 17:12 | 14:59 (1) 08:01 |           |
| 23                  | 07:58   | 15:45 (1) 07:22 | 45 16:19 (1) 07:37 | 06:47 | 06:12 | 06:04 | 06:23 | 06:54  | 07:25     | 07:58   | 42 17:11 | 14:59 (1) 08:01 |           |
| 24                  | 07:57   | 15:44 (1) 07:21 | 42 16:17 (1) 07:35 | 06:45 | 06:11 | 06:04 | 06:24 | 06:55  | 07:26     | 07:59   | 40 17:10 | 14:59 (1) 08:02 |           |
| 25                  | 07:56   | 15:43 (1) 07:19 | 39 16:16 (1) 07:34 | 06:44 | 06:10 | 06:04 | 06:25 | 06:56  | 07:27     | 08:00   | 37 17:09 | 14:59 (1) 08:02 |           |
| 26                  | 07:55   | 15:42 (1) 07:18 | 35 16:14 (1) 07:32 | 06:42 | 06:10 | 06:05 | 06:26 | 06:57  | 07:28     | 08:01   | 35 17:08 | 14:59 (1) 08:02 |           |
| 27                  | 07:54   | 15:41 (1) 07:16 | 30 16:12 (1) 07:30 | 06:41 | 06:09 | 06:05 | 06:26 | 06:58  | 07:29     | 08:02   | 33 17:07 | 14:59 (1) 08:03 |           |
| 28                  | 07:54   | 15:40 (1) 07:15 | 25 16:09 (1) 07:28 | 06:39 | 06:08 | 06:05 | 06:27 | 06:59  | 07:30     | 08:04   | 30 17:06 | 14:59 (1) 08:03 |           |
| 29                  | 07:53   | 15:39 (1) 07:14 | 17 16:05 (1) 07:26 | 06:38 | 06:08 | 06:06 | 06:28 | 07:00  | 07:31     | 08:05   | 28 17:05 | 14:59 (1) 08:03 |           |
| 30                  | 07:52   | 15:38 (1) 07:13 | 15:38 (1) 07:25    | 06:37 | 06:07 | 06:06 | 06:29 | 07:01  | 07:32     | 08:06   | 24 17:04 | 14:59 (1) 08:04 |           |
| 31                  | 07:51   | 15:37 (1) 07:12 | 15:37 (1) 07:23    | 06:36 | 06:07 | 06:07 | 06:30 | 07:02  | 07:33     | 08:07   | 21 17:03 | 14:59 (1) 08:04 |           |
| Potential sun hours | 296     | 297             | 370                | 399   | 449   | 454   | 461   | 429    | 375       | 344     | 297      | 286             |           |
| Total, worst case   | 880     | 1438            |                    |       |       |       |       |        | 861       |         | 1454     |                 | 27        |
| Sun reduction       | 0.36    | 0.41            |                    |       |       |       |       |        | 0.51      |         | 0.27     |                 | 0.20      |
| Oper. time red.     | 0.87    | 0.87            |                    |       |       |       |       |        | 0.87      |         | 0.87     |                 | 0.87      |
| Wind dir. red.      | 0.71    | 0.71            |                    |       |       |       |       |        | 0.71      |         | 0.71     |                 | 0.71      |
| Total reduction     | 0.22    | 0.26            |                    |       |       |       |       |        | 0.32      |         | 0.17     |                 | 0.13      |
| Total, real         | 198     | 367             |                    |       |       |       |       |        | 274       |         | 247      |                 | 3         |

Table layout: For each day in each month the following matrix apply

| Day in month | Sun rise (hh:mm) | First time (hh:mm) with flicker | (WTG causing flicker first time) |                                 |
|--------------|------------------|---------------------------------|----------------------------------|---------------------------------|
|              | Sun set (hh:mm)  | Minutes with flicker            | Last time (hh:mm) with flicker   | (WTG causing flicker last time) |

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Pettisville



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8/28/2010 7:07 PM / 8

Licensed user:

**Conserve First LLC, d/b/a The Renaissance Group, Renewables**  
 8281 Euclid Chardon Road, Suite E  
 US-44094 Kirtland, Ohio  
 4717

AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

8/28/2010 7:06 PM/2.7.473

### SHADOW - Calendar

Shadow receptor: F - Shadow Receptor: 30.0 x 30.0 Azimuth: -180.0° Slope: 90.0° (9)

#### Assumptions for shadow calculations

Maximum distance for influence 2,000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 3.47 4.37 4.90 7.57 8.91 9.33 10.21 9.01 6.89 5.70 2.71 1.87

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum  
 236 212 320 568 507 352 282 294 417 671 766 834 753 674 453 318 7,657  
 Idle start wind speed: Cut in wind speed from power curve

|                     | January | February | March | April             | May                   | June              |
|---------------------|---------|----------|-------|-------------------|-----------------------|-------------------|
| 1                   | 08:04   | 07:50    | 07:13 | 07:22             | 17:40 (1)   06:35     | 16:36 (1)   06:06 |
|                     | 17:18   | 17:53    | 18:27 | 20:01             | 47 18:27 (1)   20:33  | 19:10 (1)   21:04 |
| 2                   | 08:04   | 07:49    | 07:12 | 07:20             | 17:35 (1)   06:34     | 16:34 (1)   06:06 |
|                     | 17:19   | 17:54    | 18:28 | 20:02             | 56 18:31 (1)   20:35  | 19:11 (1)   21:04 |
| 3                   | 08:04   | 07:48    | 07:10 | 07:18             | 17:30 (1)   06:33     | 16:33 (1)   06:05 |
|                     | 17:19   | 17:55    | 18:30 | 20:03             | 64 18:34 (1)   20:36  | 19:12 (1)   21:05 |
| 4                   | 08:04   | 07:47    | 07:09 | 07:17             | 17:27 (1)   06:31     | 16:31 (1)   06:05 |
|                     | 17:20   | 17:56    | 18:31 | 20:04             | 71 18:38 (1)   20:37  | 19:12 (1)   21:06 |
| 5                   | 08:04   | 07:46    | 07:07 | 07:15             | 17:23 (1)   06:30     | 16:30 (1)   06:05 |
|                     | 17:21   | 17:58    | 18:32 | 20:05             | 77 18:40 (1)   20:38  | 19:14 (1)   21:07 |
| 6                   | 08:04   | 07:45    | 07:05 | 07:13             | 17:20 (1)   06:29     | 16:29 (1)   06:04 |
|                     | 17:22   | 17:59    | 18:33 | 20:06             | 82 18:42 (1)   20:39  | 19:15 (1)   21:07 |
| 7                   | 08:04   | 07:44    | 07:04 | 07:12             | 17:18 (1)   06:28     | 16:27 (1)   06:04 |
|                     | 17:23   | 18:00    | 18:34 | 20:07             | 87 18:45 (1)   20:40  | 19:16 (1)   21:08 |
| 8                   | 08:04   | 07:42    | 08:02 | 07:10             | 17:15 (1)   06:27     | 16:26 (1)   06:04 |
|                     | 17:24   | 18:01    | 19:35 | 20:09             | 91 18:46 (1)   20:41  | 19:17 (1)   21:09 |
| 9                   | 08:04   | 07:41    | 08:00 | 07:08             | 17:13 (1)   06:25     | 16:25 (1)   06:03 |
|                     | 17:25   | 18:03    | 19:37 | 20:10             | 96 18:49 (1)   20:42  | 19:18 (1)   21:09 |
| 10                  | 08:04   | 07:40    | 07:59 | 07:07             | 17:11 (1)   06:24     | 16:24 (1)   06:03 |
|                     | 17:26   | 18:04    | 19:38 | 20:11             | 99 18:50 (1)   20:43  | 19:18 (1)   21:10 |
| 11                  | 08:03   | 07:39    | 07:57 | 07:05             | 17:08 (1)   06:23     | 16:23 (1)   06:03 |
|                     | 17:27   | 18:05    | 19:39 | 20:12             | 103 18:51 (1)   20:44 | 19:19 (1)   21:10 |
| 12                  | 08:03   | 07:38    | 07:56 | 07:04             | 17:07 (1)   06:22     | 16:22 (1)   06:03 |
|                     | 17:28   | 18:07    | 19:40 | 20:13             | 106 18:53 (1)   20:45 | 19:20 (1)   21:11 |
| 13                  | 08:03   | 07:36    | 07:54 | 07:02             | 17:05 (1)   06:21     | 16:20 (1)   06:03 |
|                     | 17:30   | 18:08    | 19:41 | 20:14             | 109 18:54 (1)   20:46 | 19:21 (1)   21:11 |
| 14                  | 08:02   | 07:35    | 07:52 | 07:00             | 17:04 (1)   06:20     | 16:19 (1)   06:03 |
|                     | 17:31   | 18:09    | 19:42 | 20:15             | 112 18:56 (1)   20:47 | 19:22 (1)   21:12 |
| 15                  | 08:02   | 07:34    | 07:51 | 06:59             | 17:02 (1)   06:19     | 16:18 (1)   06:03 |
|                     | 17:32   | 18:10    | 19:43 | 20:16             | 114 18:56 (1)   20:48 | 19:23 (1)   21:12 |
| 16                  | 08:02   | 07:32    | 07:49 | 06:57             | 16:59 (1)   06:18     | 16:17 (1)   06:03 |
|                     | 17:33   | 18:11    | 19:44 | 20:17             | 118 18:57 (1)   20:49 | 19:23 (1)   21:13 |
| 17                  | 08:01   | 07:31    | 07:47 | 06:56             | 16:58 (1)   06:17     | 16:16 (1)   06:03 |
|                     | 17:34   | 18:13    | 19:46 | 20:18             | 121 18:59 (1)   20:50 | 19:24 (1)   21:13 |
| 18                  | 08:01   | 07:30    | 07:45 | 06:54             | 16:56 (1)   06:16     | 16:15 (1)   06:03 |
|                     | 17:35   | 18:14    | 19:47 | 20:19             | 123 18:59 (1)   20:51 | 19:25 (1)   21:14 |
| 19                  | 08:00   | 07:28    | 07:44 | 06:53             | 16:55 (1)   06:15     | 16:15 (1)   06:03 |
|                     | 17:36   | 18:15    | 19:48 | 20:20             | 125 19:00 (1)   20:52 | 19:25 (1)   21:14 |
| 20                  | 08:00   | 07:27    | 07:42 | 06:51             | 16:53 (1)   06:14     | 16:14 (1)   06:03 |
|                     | 17:38   | 18:16    | 19:49 | 20:22             | 128 19:01 (1)   20:53 | 19:26 (1)   21:14 |
| 21                  | 07:59   | 07:25    | 07:40 | 06:50             | 16:51 (1)   06:13     | 16:14 (1)   06:03 |
|                     | 17:39   | 18:18    | 19:50 | 20:23             | 131 19:02 (1)   20:54 | 19:28 (1)   21:14 |
| 22                  | 07:58   | 07:24    | 07:39 | 06:48             | 16:49 (1)   06:13     | 16:13 (1)   06:04 |
|                     | 17:40   | 18:19    | 19:51 | 20:24             | 133 19:02 (1)   20:55 | 19:28 (1)   21:15 |
| 23                  | 07:58   | 07:22    | 07:37 | 06:47             | 16:48 (1)   06:12     | 16:13 (1)   06:04 |
|                     | 17:41   | 18:20    | 19:52 | 20:25             | 136 19:04 (1)   20:56 | 19:28 (1)   21:15 |
| 24                  | 07:57   | 07:21    | 07:35 | 06:45             | 16:47 (1)   06:11     | 16:12 (1)   06:04 |
|                     | 17:43   | 18:21    | 19:53 | 20:26             | 138 19:05 (1)   20:57 | 19:29 (1)   21:15 |
| 25                  | 07:56   | 07:19    | 07:34 | 06:44             | 16:45 (1)   06:10     | 16:13 (1)   06:04 |
|                     | 17:44   | 18:22    | 19:54 | 20:27             | 140 19:05 (1)   20:58 | 19:30 (1)   21:15 |
| 26                  | 07:55   | 07:18    | 07:32 | 06:42             | 16:44 (1)   06:10     | 16:12 (1)   06:05 |
|                     | 17:45   | 18:24    | 19:55 | 20:28             | 142 19:06 (1)   20:59 | 19:31 (1)   21:15 |
| 27                  | 07:54   | 07:16    | 07:30 | 06:41             | 16:41 (1)   06:09     | 16:12 (1)   06:05 |
|                     | 17:46   | 18:25    | 19:57 | 20:29             | 145 19:06 (1)   21:00 | 19:31 (1)   21:15 |
| 28                  | 07:54   | 07:15    | 07:28 | 06:39             | 16:40 (1)   06:08     | 16:12 (1)   06:05 |
|                     | 17:47   | 18:26    | 19:58 | 20:30             | 148 19:08 (1)   21:00 | 19:32 (1)   21:15 |
| 29                  | 07:53   |          | 07:27 | 06:38             | 16:39 (1)   06:08     | 16:12 (1)   06:06 |
|                     | 17:49   |          | 19:59 | 20:31             | 150 19:09 (1)   21:01 | 19:32 (1)   21:15 |
| 30                  | 07:52   |          | 07:25 | 17:58 (1)   06:37 | 16:37 (1)   06:07     | 16:12 (1)   06:06 |
|                     | 17:50   |          | 20:00 | 18:10 (1)   20:32 | 152 19:09 (1)   21:02 | 19:34 (1)   21:15 |
| 31                  | 07:51   |          | 07:23 | 17:46 (1)   06:37 | 16:37 (1)   06:07     | 16:12 (1)   06:06 |
|                     | 17:51   |          | 20:00 | 18:20 (1)   20:33 | 202 21:03             | 19:34 (1)   21:15 |
| Potential sun hours | 296     | 297      | 370   | 399               | 449                   | 454               |
| Total, worst case   |         |          | 46    | 3344              | 5677                  | 6198              |
| Sun reduction       |         |          | 0.41  | 0.57              | 0.61                  | 0.62              |
| Oper. time red.     |         |          | 0.87  | 0.87              | 0.87                  | 0.87              |
| Wind dir. red.      |         |          | 0.65  | 0.65              | 0.65                  | 0.65              |
| Total reduction     |         |          | 0.23  | 0.32              | 0.35                  | 0.35              |
| Total, real         |         |          | 11    | 1077              | 1974                  | 2164              |

Table layout: For each day in each month the following matrix apply

| Day in month | Sun rise (hh:mm) | Sun set (hh:mm) | Minutes with flicker | First time (hh:mm) with flicker | Last time (hh:mm) with flicker | (WTG causing flicker first time) | (WTG causing flicker last time) |
|--------------|------------------|-----------------|----------------------|---------------------------------|--------------------------------|----------------------------------|---------------------------------|
|--------------|------------------|-----------------|----------------------|---------------------------------|--------------------------------|----------------------------------|---------------------------------|

Project:

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Licensed user:

**Conserve First LLC, d/b/a The Renaissance Group, Renewables**  
 8281 Euclid Chardon Road, Suite E  
 US-44094 Kirtland, Ohio  
 4717  
 AAaron Godwin / AAaron@ConserveFirst.com  
 Calculated:  
 8/28/2010 7:06 PM/2.7.473

**SHADOW - Calendar**

Shadow receptor: F - Shadow Receptor: 30.0 x 30.0 Azimuth: -180.0° Slope: 90.0° (9)

**Assumptions for shadow calculations**

Maximum distance for influence 2,000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec  
 3.47 4.37 4.90 7.57 8.91 9.33 10.21 9.01 6.89 5.70 2.71 1.87

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum  
 236 212 320 568 507 352 282 294 417 671 766 834 753 674 453 318 7,657  
 Idle start wind speed: Cut in wind speed from power curve

|                     | July  | August    | September | October   | November | December  |       |       |           |       |       |       |
|---------------------|-------|-----------|-----------|-----------|----------|-----------|-------|-------|-----------|-------|-------|-------|
| 1                   | 06:07 | 16:19 (1) | 06:31     | 16:32 (1) | 07:03    | 17:07 (1) | 07:33 | 07:08 | 07:44     |       |       |       |
|                     | 21:15 | 206       | 19:45 (1) | 20:57     | 177      | 19:29 (1) | 20:13 | 103   | 18:50 (1) | 19:20 | 17:33 | 17:09 |
| 2                   | 06:07 | 16:18 (1) | 06:32     | 16:33 (1) | 07:04    | 17:09 (1) | 07:34 | 07:10 | 07:45     |       |       |       |
|                     | 21:15 | 207       | 19:45 (1) | 20:56     | 176      | 19:29 (1) | 20:12 | 99    | 18:48 (1) | 19:19 | 17:32 | 17:08 |
| 3                   | 06:08 | 16:19 (1) | 06:33     | 16:34 (1) | 07:05    | 17:10 (1) | 07:36 | 07:11 | 07:46     |       |       |       |
|                     | 21:15 | 206       | 19:45 (1) | 20:55     | 174      | 19:28 (1) | 20:10 | 96    | 18:46 (1) | 19:17 | 17:31 | 17:08 |
| 4                   | 06:08 | 16:19 (1) | 06:34     | 16:35 (1) | 07:06    | 17:12 (1) | 07:37 | 07:12 | 07:47     |       |       |       |
|                     | 21:15 | 206       | 19:45 (1) | 20:53     | 172      | 19:27 (1) | 20:08 | 91    | 18:43 (1) | 19:15 | 17:30 | 17:08 |
| 5                   | 06:09 | 16:19 (1) | 06:35     | 16:36 (1) | 07:07    | 17:14 (1) | 07:38 | 07:13 | 07:48     |       |       |       |
|                     | 21:15 | 206       | 19:45 (1) | 20:52     | 170      | 19:26 (1) | 20:07 | 87    | 18:41 (1) | 19:14 | 17:28 | 17:08 |
| 6                   | 06:10 | 16:19 (1) | 06:36     | 16:38 (1) | 07:08    | 17:16 (1) | 07:39 | 07:14 | 07:49     |       |       |       |
|                     | 21:15 | 205       | 19:44 (1) | 20:51     | 167      | 19:25 (1) | 20:05 | 82    | 18:38 (1) | 19:12 | 17:27 | 17:08 |
| 7                   | 06:10 | 16:19 (1) | 06:37     | 16:39 (1) | 07:09    | 17:18 (1) | 07:40 | 07:16 | 07:50     |       |       |       |
|                     | 21:14 | 205       | 19:44 (1) | 20:50     | 165      | 19:24 (1) | 20:03 | 77    | 18:35 (1) | 19:10 | 17:26 | 17:07 |
| 8                   | 06:11 | 16:20 (1) | 06:38     | 16:40 (1) | 07:10    | 17:21 (1) | 07:41 | 07:17 | 07:51     |       |       |       |
|                     | 21:14 | 204       | 19:44 (1) | 20:49     | 163      | 19:23 (1) | 20:02 | 71    | 18:32 (1) | 19:09 | 17:25 | 17:07 |
| 9                   | 06:12 | 16:20 (1) | 06:39     | 16:41 (1) | 07:11    | 17:24 (1) | 07:42 | 07:18 | 07:52     |       |       |       |
|                     | 21:14 | 203       | 19:43 (1) | 20:47     | 161      | 19:22 (1) | 20:00 | 64    | 18:28 (1) | 19:07 | 17:24 | 17:07 |
| 10                  | 06:12 | 16:20 (1) | 06:40     | 16:42 (1) | 07:12    | 17:28 (1) | 07:43 | 07:19 | 07:52     |       |       |       |
|                     | 21:13 | 203       | 19:43 (1) | 20:46     | 159      | 19:21 (1) | 19:57 | 56    | 18:24 (1) | 19:05 | 17:23 | 17:07 |
| 11                  | 06:13 | 16:21 (1) | 06:41     | 16:43 (1) | 07:13    | 17:32 (1) | 07:44 | 07:21 | 07:53     |       |       |       |
|                     | 21:13 | 202       | 19:43 (1) | 20:45     | 157      | 19:20 (1) | 19:55 | 47    | 18:19 (1) | 19:04 | 17:22 | 17:07 |
| 12                  | 06:14 | 16:20 (1) | 06:42     | 16:45 (1) | 07:14    | 17:37 (1) | 07:45 | 07:22 | 07:54     |       |       |       |
|                     | 21:12 | 202       | 19:42 (1) | 20:43     | 154      | 19:19 (1) | 19:53 | 36    | 18:13 (1) | 19:02 | 17:21 | 17:08 |
| 13                  | 06:14 | 16:21 (1) | 06:43     | 16:46 (1) | 07:15    | 17:46 (1) | 07:46 | 07:23 | 07:55     |       |       |       |
|                     | 21:12 | 201       | 19:42 (1) | 20:42     | 152      | 19:18 (1) | 19:51 | 18    | 18:04 (1) | 19:01 | 17:20 | 17:08 |
| 14                  | 06:15 | 16:21 (1) | 06:44     | 16:47 (1) | 07:16    | 18:07 (1) | 07:47 | 07:24 | 07:56     |       |       |       |
|                     | 21:11 | 201       | 19:42 (1) | 20:41     | 149      | 19:16 (1) | 19:50 | 18    | 18:59     | 17:19 | 17:08 |       |
| 15                  | 06:16 | 16:21 (1) | 06:45     | 16:48 (1) | 07:17    | 18:09 (1) | 07:48 | 07:25 | 07:56     |       |       |       |
|                     | 21:11 | 200       | 19:41 (1) | 20:39     | 147      | 19:15 (1) | 19:48 | 18    | 18:57     | 17:18 | 17:08 |       |
| 16                  | 06:17 | 16:21 (1) | 06:46     | 16:49 (1) | 07:18    | 18:11 (1) | 07:49 | 07:26 | 07:57     |       |       |       |
|                     | 21:10 | 200       | 19:41 (1) | 20:38     | 145      | 19:14 (1) | 19:46 | 18    | 18:56     | 17:17 | 17:08 |       |
| 17                  | 06:18 | 16:22 (1) | 06:47     | 16:51 (1) | 07:19    | 18:15 (1) | 07:50 | 07:27 | 07:57     |       |       |       |
|                     | 21:10 | 198       | 19:40 (1) | 20:36     | 142      | 19:13 (1) | 19:45 | 18    | 18:54     | 17:16 | 17:09 |       |
| 18                  | 06:18 | 16:22 (1) | 06:48     | 16:52 (1) | 07:20    | 18:19 (1) | 07:51 | 07:28 | 07:58     |       |       |       |
|                     | 21:09 | 198       | 19:40 (1) | 20:35     | 140      | 19:12 (1) | 19:43 | 18    | 18:53     | 17:16 | 17:09 |       |
| 19                  | 06:19 | 16:23 (1) | 06:49     | 16:53 (1) | 07:21    | 18:23 (1) | 07:52 | 07:29 | 07:59     |       |       |       |
|                     | 21:08 | 197       | 19:40 (1) | 20:34     | 137      | 19:10 (1) | 19:41 | 18    | 18:51     | 17:15 | 17:09 |       |
| 20                  | 06:20 | 16:23 (1) | 06:50     | 16:54 (1) | 07:22    | 18:27 (1) | 07:53 | 07:30 | 08:00     |       |       |       |
|                     | 21:08 | 196       | 19:39 (1) | 20:32     | 135      | 19:09 (1) | 19:39 | 18    | 18:50     | 17:14 | 17:10 |       |
| 21                  | 06:21 | 16:23 (1) | 06:52     | 16:55 (1) | 07:23    | 18:31 (1) | 07:54 | 07:31 | 08:00     |       |       |       |
|                     | 21:07 | 195       | 19:38 (1) | 20:31     | 133      | 19:08 (1) | 19:38 | 18    | 18:48     | 17:13 | 17:10 |       |
| 22                  | 06:22 | 16:23 (1) | 06:53     | 16:56 (1) | 07:24    | 18:35 (1) | 07:55 | 07:32 | 08:01     |       |       |       |
|                     | 21:06 | 194       | 19:37 (1) | 20:29     | 131      | 19:07 (1) | 19:36 | 18    | 18:47     | 17:13 | 17:11 |       |
| 23                  | 06:23 | 16:24 (1) | 06:54     | 16:58 (1) | 07:25    | 18:40 (1) | 07:56 | 07:33 | 08:01     |       |       |       |
|                     | 21:05 | 193       | 19:37 (1) | 20:28     | 127      | 19:05 (1) | 19:34 | 18    | 18:45     | 17:12 | 17:11 |       |
| 24                  | 06:24 | 16:25 (1) | 06:55     | 16:59 (1) | 07:26    | 18:45 (1) | 07:57 | 07:34 | 08:02     |       |       |       |
|                     | 21:04 | 191       | 19:36 (1) | 20:26     | 125      | 19:04 (1) | 19:32 | 18    | 18:44     | 17:12 | 17:12 |       |
| 25                  | 06:25 | 16:25 (1) | 06:56     | 17:00 (1) | 07:27    | 18:50 (1) | 07:58 | 07:35 | 08:02     |       |       |       |
|                     | 21:04 | 191       | 19:36 (1) | 20:25     | 123      | 19:03 (1) | 19:31 | 18    | 18:43     | 17:11 | 17:12 |       |
| 26                  | 06:26 | 16:26 (1) | 06:57     | 17:01 (1) | 07:28    | 18:55 (1) | 07:59 | 07:36 | 08:02     |       |       |       |
|                     | 21:03 | 189       | 19:35 (1) | 20:23     | 120      | 19:01 (1) | 19:29 | 18    | 18:41     | 17:11 | 17:13 |       |
| 27                  | 06:26 | 16:27 (1) | 06:58     | 17:02 (1) | 07:29    | 19:00 (1) | 08:00 | 07:37 | 08:02     |       |       |       |
|                     | 21:02 | 187       | 19:34 (1) | 20:21     | 118      | 19:00 (1) | 19:27 | 18    | 18:40     | 17:10 | 17:14 |       |
| 28                  | 06:27 | 16:28 (1) | 06:59     | 17:04 (1) | 07:30    | 19:05 (1) | 08:01 | 07:38 | 08:02     |       |       |       |
|                     | 21:01 | 186       | 19:34 (1) | 20:20     | 114      | 18:58 (1) | 19:26 | 18    | 18:38     | 17:10 | 17:14 |       |
| 29                  | 06:28 | 16:29 (1) | 07:00     | 17:05 (1) | 07:31    | 19:10 (1) | 08:02 | 07:39 | 08:02     |       |       |       |
|                     | 21:00 | 184       | 19:33 (1) | 20:18     | 112      | 18:57 (1) | 19:24 | 18    | 18:37     | 17:09 | 17:15 |       |
| 30                  | 06:29 | 16:29 (1) | 07:01     | 17:05 (1) | 07:32    | 19:15 (1) | 08:03 | 07:40 | 08:03     |       |       |       |
|                     | 20:59 | 182       | 19:31 (1) | 20:17     | 109      | 18:54 (1) | 19:22 | 18    | 18:36     | 17:09 | 17:16 |       |
| 31                  | 06:30 | 16:30 (1) | 07:02     | 17:06 (1) | 07:33    | 19:20 (1) | 08:04 | 07:41 | 08:04     |       |       |       |
|                     | 20:58 | 180       | 19:30 (1) | 20:15     | 106      | 18:52 (1) | 19:20 | 18    | 18:34     | 17:08 | 17:17 |       |
| Potential sun hours | 461   | 429       | 375       | 344       | 297      | 286       |       |       |           |       |       |       |
| Total, worst case   | 6118  | 4460      | 927       |           |          |           |       |       |           |       |       |       |
| Sun reduction       | 0.69  | 0.65      | 0.55      |           |          |           |       |       |           |       |       |       |
| Oper. time red.     | 0.87  | 0.87      | 0.87      |           |          |           |       |       |           |       |       |       |
| Wind dir. red.      | 0.65  | 0.65      | 0.65      |           |          |           |       |       |           |       |       |       |
| Total reduction     | 0.39  | 0.37      | 0.31      |           |          |           |       |       |           |       |       |       |
| Total, real         | 2379  | 1642      | 289       |           |          |           |       |       |           |       |       |       |

Table layout: For each day in each month the following matrix apply

| Day in month | Sun rise (hh:mm) | Sun set (hh:mm) | Minutes with flicker | First time (hh:mm) with flicker | Last time (hh:mm) with flicker | (WTG causing flicker first time) | (WTG causing flicker last time) |
|--------------|------------------|-----------------|----------------------|---------------------------------|--------------------------------|----------------------------------|---------------------------------|
|--------------|------------------|-----------------|----------------------|---------------------------------|--------------------------------|----------------------------------|---------------------------------|

Project:

Pettisville



Printed/Page

8/28/2010 7:07 PM / 10

Licensed user:

Conserve First LLC, d/b/a The Renaissance Group, Renewables

8281 Euclid Chardon Road, Suite E

US-44094 Kirtland, Ohio

4717

AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

8/28/2010 7:06 PM/2.7.473

**SHADOW - Calendar**

Shadow receptor: G - Shadow Receptor: 30.0 x 30.0 Azimuth: -180.0° Slope: 90.0° (10)

**Assumptions for shadow calculations**

Maximum distance for influence 2,000 m  
 Minimum sun height over horizon for influence 3 °  
 Day step for calculation 1 days  
 Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

|      |      |      |      |      |      |       |      |      |      |      |      |
|------|------|------|------|------|------|-------|------|------|------|------|------|
| Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul   | Aug  | Sep  | Oct  | Nov  | Dec  |
| 3.47 | 4.37 | 4.90 | 7.57 | 8.91 | 9.33 | 10.21 | 9.01 | 6.89 | 5.70 | 2.71 | 1.87 |

Operational time

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |       |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| N   | NNE | NE  | ENE | E   | ESE | SE  | SSE | S   | SSW | SW  | WSW | W   | WNW | NW  | NNW | Sum   |
| 236 | 212 | 320 | 568 | 507 | 352 | 282 | 294 | 417 | 671 | 766 | 834 | 753 | 674 | 453 | 318 | 7,657 |

Idle start wind speed: Cut in wind speed from power curve

|                     | January        | February       | March          | April          | May            | June                   | July           | August             | September      | October            | November       | December       |     |
|---------------------|----------------|----------------|----------------|----------------|----------------|------------------------|----------------|--------------------|----------------|--------------------|----------------|----------------|-----|
| 1                   | 08:04<br>17:18 | 07:50<br>17:53 | 07:13<br>18:27 | 07:22<br>20:01 | 06:35<br>20:33 | 07:50 (1)<br>08:55 (1) | 06:06<br>21:04 | 07:27 (1)<br>21:15 | 06:07<br>20:57 | 07:31 (1)<br>20:57 | 06:31<br>19:20 | 07:08<br>17:33 |     |
| 2                   | 08:04<br>17:19 | 07:49<br>17:54 | 07:12<br>18:28 | 07:20<br>20:02 | 06:34<br>20:35 | 07:49 (1)<br>08:57 (1) | 06:06<br>21:04 | 07:27 (1)<br>21:15 | 06:07<br>20:56 | 07:31 (1)<br>20:56 | 06:32<br>19:18 | 07:04<br>17:32 |     |
| 3                   | 08:04<br>17:19 | 07:48<br>17:55 | 07:10<br>18:30 | 07:18<br>20:03 | 06:33<br>20:36 | 07:47 (1)<br>08:58 (1) | 06:05<br>21:05 | 07:26 (1)<br>21:15 | 06:08<br>20:55 | 07:32 (1)<br>20:55 | 06:33<br>19:17 | 07:05<br>17:31 |     |
| 4                   | 08:04<br>17:20 | 07:47<br>17:56 | 07:09<br>18:31 | 07:17<br>20:04 | 06:31<br>20:37 | 07:45 (1)<br>08:59 (1) | 06:05<br>21:06 | 07:27 (1)<br>21:15 | 06:08<br>20:53 | 07:32 (1)<br>20:53 | 06:34<br>19:16 | 07:06<br>17:30 |     |
| 5                   | 08:04<br>17:21 | 07:46<br>17:58 | 07:07<br>18:32 | 07:15<br>20:05 | 06:30<br>20:38 | 07:44 (1)<br>09:00 (1) | 06:05<br>21:07 | 07:27 (1)<br>21:15 | 06:09<br>20:52 | 07:32 (1)<br>20:52 | 06:35<br>19:14 | 07:07<br>17:28 |     |
| 6                   | 08:04<br>17:22 | 07:45<br>17:59 | 07:05<br>18:33 | 07:13<br>20:06 | 06:29<br>20:39 | 07:42 (1)<br>09:02 (1) | 06:04<br>21:07 | 07:26 (1)<br>21:15 | 06:10<br>20:51 | 07:32 (1)<br>20:51 | 06:36<br>19:13 | 07:08<br>17:27 |     |
| 7                   | 08:04<br>17:23 | 07:44<br>18:00 | 07:04<br>18:34 | 07:12<br>20:07 | 06:28<br>20:40 | 07:41 (1)<br>09:04 (1) | 06:04<br>21:08 | 07:26 (1)<br>21:14 | 06:10<br>20:50 | 07:33 (1)<br>20:50 | 06:37<br>19:11 | 07:09<br>17:26 |     |
| 8                   | 08:04<br>17:24 | 07:42<br>18:01 | 08:02<br>19:35 | 07:10<br>20:09 | 06:27<br>20:41 | 07:40 (1)<br>09:05 (1) | 06:04<br>21:09 | 07:27 (1)<br>21:14 | 06:11<br>20:49 | 07:34 (1)<br>20:49 | 06:38<br>19:10 | 07:10<br>17:25 |     |
| 9                   | 08:04<br>17:25 | 07:41<br>18:03 | 08:00<br>19:37 | 07:08<br>20:10 | 06:25<br>20:42 | 07:39 (1)<br>09:07 (1) | 06:03<br>21:09 | 07:27 (1)<br>21:14 | 06:12<br>20:47 | 07:33 (1)<br>20:47 | 06:39<br>19:08 | 07:11<br>17:24 |     |
| 10                  | 08:04<br>17:26 | 07:40<br>18:04 | 07:59<br>19:38 | 07:07<br>20:11 | 06:24<br>20:43 | 07:38 (1)<br>09:08 (1) | 06:03<br>21:10 | 07:27 (1)<br>21:13 | 06:12<br>20:46 | 07:34 (1)<br>20:46 | 06:40<br>19:07 | 07:12<br>17:23 |     |
| 11                  | 08:03<br>17:27 | 07:39<br>18:05 | 07:57<br>19:39 | 07:05<br>20:12 | 06:23<br>20:44 | 07:37 (1)<br>09:09 (1) | 06:03<br>21:10 | 07:26 (1)<br>21:13 | 06:13<br>20:45 | 07:35 (1)<br>20:45 | 06:41<br>19:05 | 07:13<br>17:22 |     |
| 12                  | 08:03<br>17:28 | 07:38<br>18:07 | 07:56<br>19:40 | 07:04<br>20:13 | 06:22<br>20:45 | 07:36 (1)<br>09:11 (1) | 06:03<br>21:11 | 07:26 (1)<br>21:12 | 06:14<br>20:43 | 07:35 (1)<br>20:43 | 06:42<br>19:03 | 07:14<br>17:21 |     |
| 13                  | 08:03<br>17:30 | 07:36<br>18:08 | 07:54<br>19:41 | 07:02<br>20:14 | 06:21<br>20:46 | 07:36 (1)<br>09:12 (1) | 06:03<br>21:11 | 07:27 (1)<br>21:12 | 06:14<br>20:42 | 07:35 (1)<br>20:42 | 06:43<br>19:02 | 07:15<br>17:20 |     |
| 14                  | 08:02<br>17:31 | 07:35<br>18:09 | 07:52<br>19:42 | 07:00<br>20:15 | 06:20<br>20:47 | 07:35 (1)<br>09:13 (1) | 06:03<br>21:12 | 07:27 (1)<br>21:11 | 06:15<br>20:41 | 07:36 (1)<br>20:41 | 06:44<br>19:00 | 07:16<br>17:19 |     |
| 15                  | 08:02<br>17:32 | 07:34<br>18:10 | 07:51<br>19:43 | 06:59<br>20:16 | 06:19<br>20:48 | 07:34 (1)<br>09:15 (1) | 06:03<br>21:12 | 07:27 (1)<br>21:11 | 06:16<br>20:39 | 07:36 (1)<br>20:39 | 06:45<br>19:04 | 07:17<br>17:18 |     |
| 16                  | 08:02<br>17:33 | 07:32<br>18:12 | 07:49<br>19:44 | 06:57<br>20:17 | 06:18<br>20:49 | 07:33 (1)<br>09:16 (1) | 06:03<br>21:13 | 07:27 (1)<br>21:10 | 06:17<br>20:38 | 07:36 (1)<br>20:38 | 06:46<br>19:05 | 07:18<br>17:17 |     |
| 17                  | 08:01<br>17:34 | 07:31<br>18:13 | 07:47<br>19:46 | 06:56<br>20:18 | 06:17<br>20:50 | 07:32 (1)<br>09:17 (1) | 06:03<br>21:13 | 07:27 (1)<br>21:10 | 06:18<br>20:36 | 07:37 (1)<br>20:36 | 06:47<br>19:04 | 07:19<br>17:16 |     |
| 18                  | 08:01<br>17:35 | 07:30<br>18:14 | 07:45<br>19:47 | 06:54<br>20:19 | 06:16<br>20:51 | 07:32 (1)<br>09:18 (1) | 06:03<br>21:14 | 07:27 (1)<br>21:09 | 06:18<br>20:35 | 07:38 (1)<br>20:35 | 06:48<br>19:03 | 07:20<br>17:15 |     |
| 19                  | 08:00<br>17:36 | 07:28<br>18:15 | 07:44<br>19:48 | 06:53<br>20:20 | 06:15<br>20:52 | 07:31 (1)<br>09:19 (1) | 06:03<br>21:14 | 07:28 (1)<br>21:08 | 06:19<br>20:34 | 07:38 (1)<br>20:34 | 06:49<br>19:01 | 07:21<br>17:14 |     |
| 20                  | 08:00<br>17:37 | 07:27<br>18:16 | 07:42<br>19:49 | 06:51<br>20:22 | 06:14<br>20:53 | 08:25 (1)<br>08:39 (1) | 06:03<br>21:14 | 07:28 (1)<br>21:08 | 06:20<br>20:32 | 07:39 (1)<br>20:32 | 06:50<br>19:00 | 07:22<br>17:13 |     |
| 21                  | 07:59<br>17:39 | 07:25<br>18:18 | 07:40<br>19:50 | 06:50<br>20:23 | 06:13<br>20:54 | 08:19 (1)<br>08:41 (1) | 06:03<br>21:14 | 07:30 (1)<br>21:07 | 06:21<br>20:31 | 07:39 (1)<br>20:31 | 06:52<br>19:00 | 07:23<br>17:12 |     |
| 22                  | 07:58<br>17:40 | 07:24<br>18:19 | 07:39<br>19:51 | 06:48<br>20:24 | 06:13<br>20:55 | 08:14 (1)<br>08:42 (1) | 06:04<br>21:15 | 07:40 (1)<br>21:06 | 06:22<br>20:29 | 07:40 (1)<br>20:29 | 06:53<br>19:00 | 07:24<br>17:11 |     |
| 23                  | 07:58<br>17:41 | 07:22<br>18:20 | 07:37<br>19:52 | 06:47<br>20:25 | 06:12<br>20:56 | 08:10 (1)<br>08:44 (1) | 06:04<br>21:15 | 07:29 (1)<br>21:05 | 06:23<br>20:11 | 07:40 (1)<br>20:28 | 06:54<br>19:00 | 07:25<br>17:10 |     |
| 24                  | 07:57<br>17:43 | 07:21<br>18:21 | 07:35<br>19:53 | 06:45<br>20:26 | 06:11<br>20:57 | 08:07 (1)<br>08:46 (1) | 06:04<br>21:15 | 07:29 (1)<br>21:04 | 06:24<br>20:26 | 07:41 (1)<br>20:26 | 06:55<br>19:00 | 07:26<br>17:12 |     |
| 25                  | 07:56<br>17:44 | 07:19<br>18:22 | 07:34<br>19:54 | 06:44<br>20:27 | 06:10<br>20:58 | 08:04 (1)<br>08:46 (1) | 06:04<br>21:15 | 07:29 (1)<br>21:04 | 06:25<br>20:25 | 07:42 (1)<br>20:25 | 06:56<br>19:00 | 07:27<br>17:12 |     |
| 26                  | 07:55<br>17:45 | 07:18<br>18:24 | 07:32<br>19:55 | 06:42<br>20:28 | 06:10<br>20:59 | 08:01 (1)<br>08:48 (1) | 06:05<br>21:15 | 07:28 (1)<br>21:03 | 06:26<br>20:23 | 07:42 (1)<br>20:23 | 06:57<br>19:00 | 07:28<br>17:11 |     |
| 27                  | 07:55<br>17:46 | 07:16<br>18:25 | 07:30<br>19:57 | 06:41<br>20:29 | 06:11<br>21:00 | 07:58 (1)<br>08:49 (1) | 06:05<br>21:15 | 07:27 (1)<br>21:02 | 06:26<br>20:21 | 07:43 (1)<br>20:21 | 06:58<br>19:00 | 07:29<br>17:10 |     |
| 28                  | 07:54<br>17:48 | 07:15<br>18:26 | 07:28<br>19:58 | 06:39<br>20:30 | 06:08<br>21:00 | 07:56 (1)<br>08:51 (1) | 06:08<br>21:15 | 07:28 (1)<br>21:01 | 06:27<br>20:20 | 07:44 (1)<br>20:20 | 06:59<br>19:00 | 07:30<br>17:10 |     |
| 29                  | 07:53<br>17:49 | 07:14<br>18:27 | 07:27<br>19:59 | 06:38<br>20:31 | 06:08<br>21:01 | 07:54 (1)<br>08:53 (1) | 06:08<br>21:15 | 07:27 (1)<br>21:06 | 06:28<br>20:18 | 07:45 (1)<br>20:18 | 07:00<br>19:00 | 07:26<br>17:09 |     |
| 30                  | 07:52<br>17:50 | 07:13<br>18:36 | 07:25<br>20:00 | 06:37<br>20:32 | 06:07<br>21:02 | 07:52 (1)<br>08:53 (1) | 06:07<br>21:15 | 07:27 (1)<br>21:06 | 06:29<br>20:17 | 07:45 (1)<br>20:17 | 07:01<br>19:00 | 07:32<br>17:09 |     |
| 31                  | 07:51<br>17:51 | 07:12<br>18:45 | 07:23<br>20:00 | 06:36<br>20:31 | 06:06<br>21:03 | 07:51 (1)<br>08:52 (1) | 06:06<br>21:15 | 07:26 (1)<br>21:06 | 06:30<br>20:15 | 07:46 (1)<br>20:15 | 07:02<br>19:00 | 08:07<br>17:10 |     |
| Potential sun hours | 296            | 297            | 370            | 399            | 452            | 449                    | 454            | 461                | 429            | 375                | 344            | 297            | 286 |
| Total, worst case   |                |                |                |                | 3105           |                        | 4048           |                    | 3697           |                    | 1397           |                |     |
| Sun reduction       |                |                |                |                | 0.57           |                        | 0.62           |                    | 0.69           |                    | 0.65           |                |     |
| Oper. time red.     |                |                |                |                | 0.87           |                        | 0.87           |                    | 0.87           |                    | 0.87           |                |     |
| Wind dir. red.      |                |                |                |                | 0.72           |                        | 0.72           |                    | 0.72           |                    | 0.72           |                |     |
| Total reduction     |                |                |                |                | 0.36           |                        | 0.39           |                    | 0.43           |                    | 0.41           |                |     |
| Total, real         |                |                |                |                | 161            |                        | 1195           |                    | 1590           |                    | 569            |                |     |

Table layout: For each day in each month the following matrix apply

|              |                      |                                 |                                  |
|--------------|----------------------|---------------------------------|----------------------------------|
| Day in month | Sun rise (hh:mm)     | First time (hh:mm) with flicker | (WTG causing flicker first time) |
|              | Sun set (hh:mm)      | Last time (hh:mm) with flicker  | (WTG causing flicker last time)  |
|              | Minutes with flicker |                                 |                                  |





Project:

Pettisville

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8281 Euclid Chardon Road, Suite E
US-44094 Kirtland, Ohio
4717

AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

8/28/2010 7:06 PM/2.7.473

SHADOW - Calendar

Shadow receptor: I - Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (12)

Assumptions for shadow calculations

Maximum distance for influence 2,000 m
Minimum sun height over horizon for influence 3°
Day step for calculation 1 days
Time step for calculation 1 minutes

Sunshine probability S (Average daily sunshine hours) [CLEVELAND]

Table with 12 columns (Jan-Dec) and 6 rows (Jan, Feb, Mar, Apr, May, Jun) showing sunshine probability values.

Operational time

Table with 17 columns (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum) and 2 rows (N, Idle start wind speed) showing wind speed data.

Main shadow calendar table with columns for months (January-December) and rows for days (1-31) showing sun rise and set times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Small table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

WindPRO is developed by EMD International A/S, Niels Jernesvej 10, DK-9220 Aalborg Ø, Tlf. +45 96 35 44 44, Fax +45 96 35 44 46, e-mail: windpro@emd.dk









Project:

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 4717

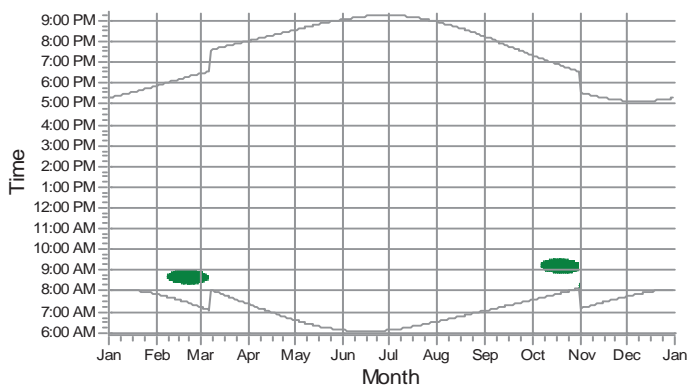
AAaron Godwin / AAaron@ConserveFirst.com

Calculated:

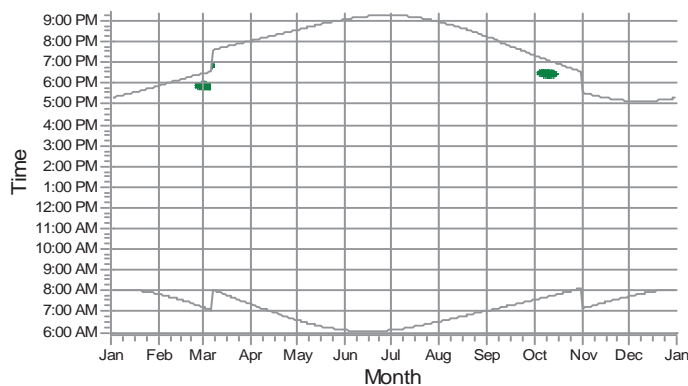
8/28/2010 7:06 PM/2.7.473

### SHADOW - Calendar, graphical

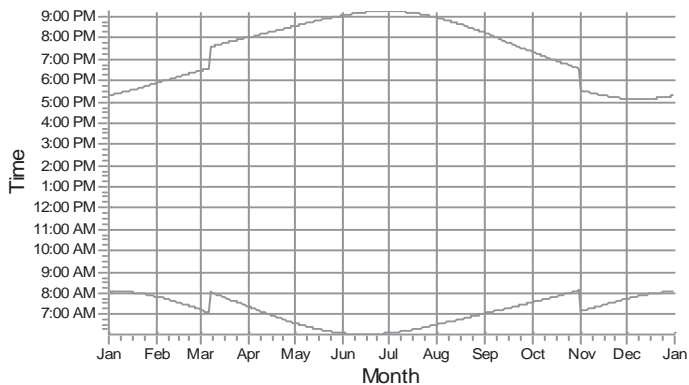
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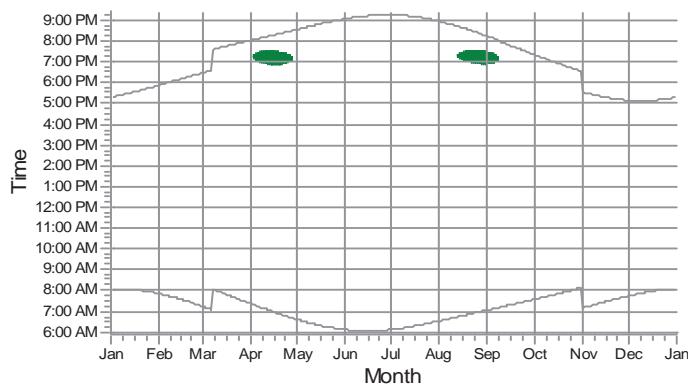
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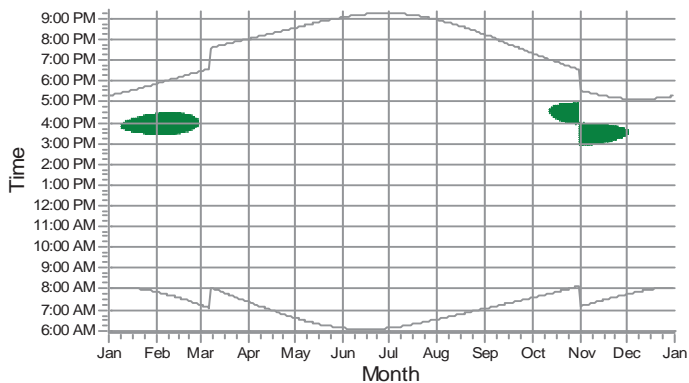
C: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (4)



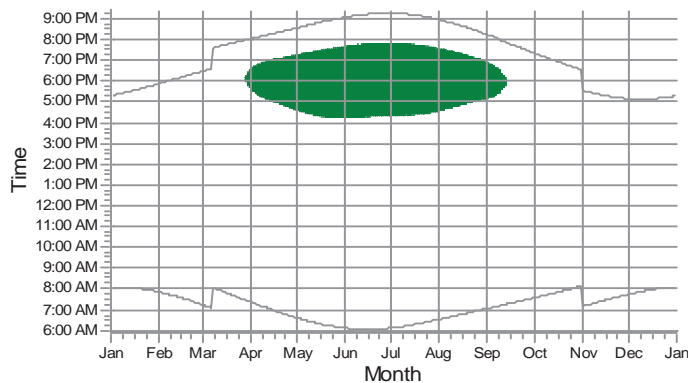
D: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (5)



E: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (6)



F: Shadow Receptor: 30.0 x 30.0 Azimuth: -180.0° Slope: 90.0° (9)



WTGs

- 1: Unison U54-750kW 750 54.0 !O! hub: 75.0 m (3)

Project:

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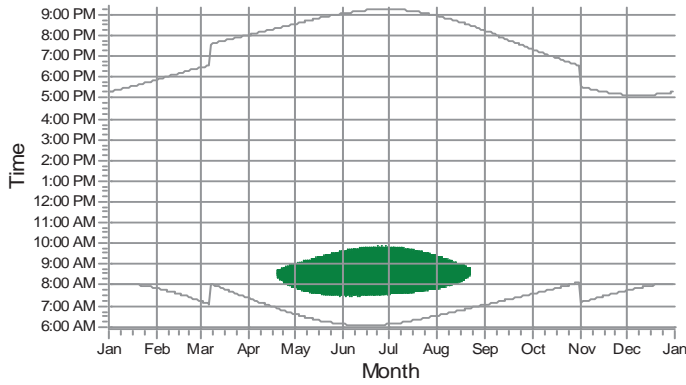
AAaron Godwin / AAaron@ConserveFirst.com

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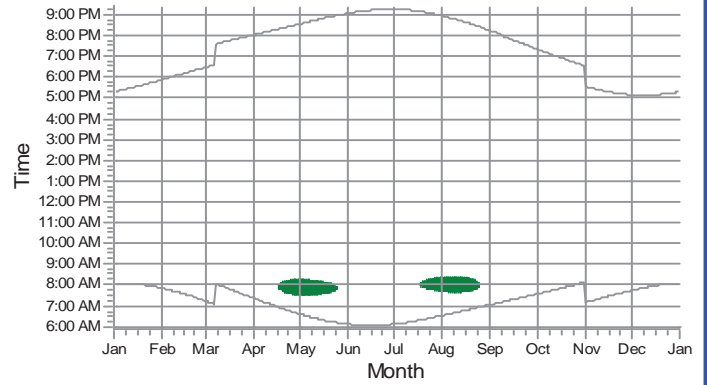
8/28/2010 7:06 PM/2.7.473

**SHADOW - Calendar, graphical**

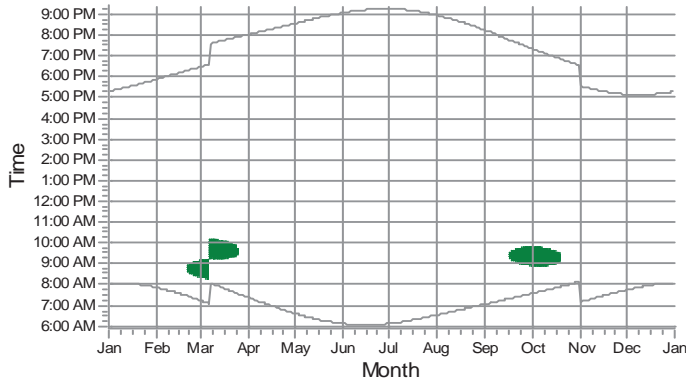
G: Shadow Receptor: 30.0 x 30.0 Azimuth: -180.0° Slope: 90.0° (10)



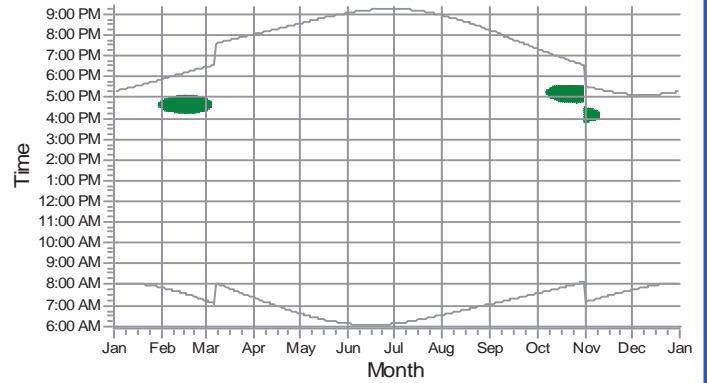
H: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (11)



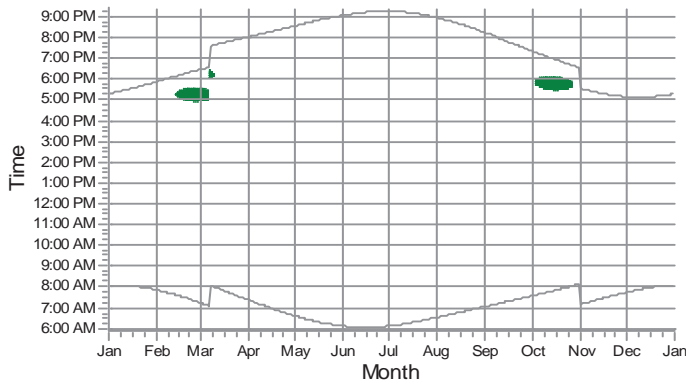
I: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (12)



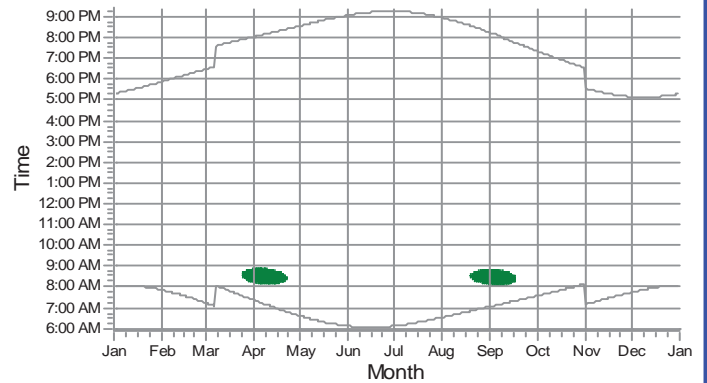
J: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (13)



K: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (14)



L: Shadow Receptor: 1.0 x 1.0 Azimuth: -180.0° Slope: 90.0° (15)



WTGs

1: Unison U54-750kW 750 54.0 !O! hub: 75.0 m (3)

## Turbine Use, Safety Policies and General Background

### Security:

- Tower Climbing: The wind turbine utilizes a smooth exterior monopole tower with no climbing surfaces or apparatus. Tower climbing is only achieved through the use of an internal ladder system. This system is only reachable through a locked plate steel door.
- Availability: Only preauthorized personnel will be given access to the internal tower and turbine systems.

### Tower Climbing Safety:

- Safety Climb: For maintenance personnel climbing of the tower, an OSHA approved “safety climb” system is included in the tower climbing system. This system is comprised of a ladder, a steel cable for the safety climb device, a full body harness designed and approved for the purpose, a locking safety climb device, safety lanyards with self-locking clips and additional tie-in points throughout the turbine system where a cable system is not available.
- OSHA approved safety equipment such as hardhats will be worn by all maintenance personnel climbing or working on the turbine.
- No individual shall climb the tower without a partner.

### Electrical Safety:

- All electrical components and their installations shall meet all Local, State and Federal applicable laws and regulations.
- The turbine system shall meet UL1741 and IEC requirements for Utility Grid Protection in case of Grid power failures or power quality abnormalities.
- All electrical supply/grid interconnect services to and from the turbine shall be in buried conduits.
- The turbine system will have a staff accessible emergency shut-offs.
  - Utility room
  - Tower base
  - Nacelle
  - Remote through “Web” interface.



- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
  - This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.
- All safety sensors and equipment shall fault to a turbine fault state in case of their own failure.

**Fire:**

- The turbine shall have fire detection devices at the tower base and within the nacelle that shall be linked to the Site’s existing fire detection/alarm systems (if present).
- The local fire department shall be contacted and a fire/emergency response plan shall be adopted.
- Although formal fire suppression systems are extremely rare for wind turbines, the site shall investigate passive and active fire suppression systems for possible implementation in the turbine system.
- Local fire department approved fire extinguishers shall be located within the tower base and within the nacelle.
- The turbine system will have staff accessible emergency shut-offs.
  - Utility room
  - Tower base
  - Nacelle
  - Remote through “Web” interface.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
  - This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.
- Safety zones similar to any fire related incident will be utilized, if a fire should occur.

**Lightening:**

- The turbine system is equipped with a full grounding loop meeting or exceeding all Local, State and Federal regulations concerning grounding and lightening protection.
- Surge suppressing technology will be utilized to protect key electronics.
- See fire policies above.

### **Icing:**

- Although icing of wind turbines is very rare and safety issues related to icing even rarer, it can occur, similar to any built structure (roofs, power lines, stadium lights, etc.).
- Although not an absolute brake, blade icing induced airfoil shape spoiling will naturally reduce the efficiency of the blades and thus reduce their rotational speed.
- Although formal icing detection systems are extremely rare for wind turbines, the site shall investigate active icing detection systems for possible implementation in the turbine system.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
  - This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.
- The turbine’s nacelle will have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system will automatically melt snow and ice accumulation on top of the nacelle.
- The turbine system will have a staff accessible emergency shut-offs.
  - Utility room
  - Tower base
  - Nacelle
  - Remote through “Web” interface.
- All icing related turbine shut-downs will require a direct inspection and an on-site manual restart.
- The site personnel and the system maintenance personnel will shut down the turbine in the event of an icing condition.
- The site shall adopt an ice safety zone around the turbine for implementation during icing events, if they should occur.

### **High Wind:**

- The turbine automatically shuts down in high winds and turns itself out of the wind.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration,

over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).

- This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.

#### **Aviation Safety:**

- The project has been review by both FAA and ODOT and “No Hazard to Aviation” determinations were issued.
- An FAA approved red obstruction marking light will be located on top of the nacelle.

#### **Shadow Flicker:**

- Although all structures cast shadows, shadows from wind turbines that reach occupied structures or areas can be considered a nuisance due to the fact that they move or flicker as the blades rotate in front of the Sun.
- A formal shadow flicker study has been conducted for the site based on the turbine’s rotor diameter and height, the site latitude and longitude, weather records, existing site topography and the existing area obstructions.
- Per international standards, shadow flicker impacting a particular location above 30 hours per year is considered a potential nuisance. While the turbine’s shadow will reach some of the area properties, no residential or business property locations will receive more than 30 hours of shadow per year. Other factors that mitigate the shadows’ impact include:
  - Shadow intensity drops off with distance. Shadow edges soften and shadow bodies become more muted. Shadows beyond ten rotor diameters from the tower base are considered insignificant with shadows within five rotor diameters being the most significant.
  - Shadows move and do not remain in one spot for extended periods of time.
  - The longest extended period shadows occur in the winter when there are fewer sunny days.
  - Many local natural and built environmental elements such as trees will block or significantly diffuse shadows.
- If extended adverse shadows should impact a particular dwelling, the wind turbine site owner will take one or more of the following mitigating measures:
  - Plant evergreen trees to block the shadow.
  - Provide blinds for the dwelling.
  - Turn off the turbine during the shadowing periods that excessively affect the dwelling.

**Sound:**

- Wind turbines of the size to be installed are inherently quite devices, especially over distance, and are typically very hard to hear over the wind itself and the existing ambient area noise levels.
  - Sound from a single wind turbines typically comes from the following areas:
    - Wind noise off of the blades as they are driven by the wind (swooshing that drops off over distance and typically competes with the area's natural wind noise).
    - Drive-train noise (mechanical sound typically not heard outside the immediate vicinity of the turbine).
    - Yaw system noise (mechanical sound typically not heard outside the immediate vicinity of the turbine and that is only present when the turbine turns into the wind).
    - Electrical noise from the turbine's electrical equipment and transformer (buzz, typically not heard outside the immediate vicinity of the turbine).
- Sound modeling for the proposed wind turbine supports that turbine produced audio levels will not exceed any local code or ordinance at the site's property lines. To be conservative, this modeling was done at an 8 mps/17.9 mph wind speed, well above site averages.
- Sound measurement of existing ambient sound levels for both day and evening periods at multiple locations surrounding the site show existing ambient sound levels above what the wind turbine will produce.



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*Final Programmatic Environmental Impact Statement on Wind Energy Development on BLM-Administered Lands in the Western United States.*  
 Bureau of Land Management.

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<sup>i</sup> The only known shadow flicker regulation to date was enacted in Germany, where a court ruled that the maximum allowable flicker would be 30 hours per year (Klepinger, 2007). In addition, Dobsch and Kury (2001) recommended that shadow flicker should not exceed 30 hours per year, and the guidelines for wind power development in the State of Victoria, Australia state that shadow flicker may not exceed 30 hours per year at any dwelling in the surrounding area (Sustainable Energy Authority Victoria, 2003). Since there are no known national or local regulations that govern shadow flicker in the United States, New York State, or Steuben County, the 30-hour per year threshold is used in this analysis to determine potentially impacted structures.

[http://www.eon.com/en/downloads/Appendix\\_M\\_Shadow\\_Flicker\\_Modeling\\_Report.pdf](http://www.eon.com/en/downloads/Appendix_M_Shadow_Flicker_Modeling_Report.pdf)

<sup>ii</sup> Epilepsy Foundation. (n.d.). Photosensitivity and Epilepsy.  
<http://www.epilepsyfoundation.org/about/photosensitivity/>

<sup>iii</sup> As there is a possibility of a turbine model change on the project, the worst case largest model under consideration was used for the shadow flicker models.

**APPENDIX C:**  
**AGENCY COORDINATION AND APPROVALS**

**Delivered by email****From:** Mitch, Brian ([Brian.Mitch@dnr.state.oh.us](mailto:Brian.Mitch@dnr.state.oh.us))**Sent:** Friday, August 27, 2010 12:21 PM**To:** Aaron Godwin ([AAaron@conservefirst.com](mailto:AAaron@conservefirst.com))**Subject:** 10-0277; Ohio Wind Schools Wind Turbine Projects**ODNR COMMENTS TO:****Aaron Goodwin, The Renaissance Group, 8281 Euclid Chardon Road, Suite E, Kirtland, Ohio 44094**

**Project:** The project consists of the installation of several single wind turbine projects located in the cities of Archbold, Pettisville, Berea, Cleveland, and Chagrin Falls, Ohio. All turbines will be less than 750kW.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced projects. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

**Fish and Wildlife:** The ODNR, Division of Wildlife (DOW) has the following comments.

**Archbold Area Schools Project:**

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis*), Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (*Populus deltoides*), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the rayed bean (*Villosa fabalis*), a state endangered and federal candidate mussel species. If there is a history of mussels near the proposed project area, it may be necessary for a professional malacologist approved by the DOW to conduct a mussel survey in the project area. *If no in-water work is proposed, the project is not likely to impact this species and a survey would not be necessary.*

The project is within the range of the Eastern massasauga (*Sistrurus catenatus*), a state endangered and a federal candidate snake species. *Due to the location of the project, the project is not likely to impact this species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

**Pettisville Local Schools Project:**

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis*), Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (*Populus deltoides*), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the rayed bean (*Villosa fabalis*), a state endangered and federal candidate mussel species. If there is a history of mussels near the proposed project area, it may be necessary for a professional malacologist approved by the DOW to conduct a mussel survey in the project area. *If no in-water work is proposed, the project is not likely to impact this species and a survey would not be necessary.*

The project is within the range of the Eastern massasauga (*Sistrurus catenatus*), a state endangered and a federal candidate snake species. *Due to the location of the project, the project is not likely to impact this species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

**Cuyahoga County Fairgrounds Project:**

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. There is a record for this species about 4.3 miles from this project site. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis*), Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (*Populus deltoides*), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. *However, the Ohio Biodiversity Database currently has no records of this species near the project area.*

The project is within the range of the Canada darner (*Aeshna canadensis*), a state endangered dragonfly. *Due to the mobility of this species, the project is not likely to impact this species.*

The project is within the range of the black bear (*Ursus americanus*), a state endangered species, and the bobcat (*Lynx rufus*), a state endangered species. *Due to the mobility of these species, the project is not likely to have an impact on these species.*

The project is within the range of the golden-winged warbler (*Vermivora chrysoptera*), a state endangered bird, the piping plover (*Charadrius melodus*), a state and federally endangered bird species, the king rail (*Rallus elegans*), a state endangered bird, and the yellow-bellied sapsucker (*Sphyrapicus varius*), a state endangered bird. *Due to the location of the project and the habitat requirements of these species, the project is not likely to impact these species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.



**Kenston Local Schools Project:**

The project is within the range of the Indiana bat (*Myotis sodalis*), a state and federally endangered species. There is a record for this species about seven miles from the project area. The following species of trees have relatively high value as potential Indiana bat roost trees: Shagbark hickory (*Carya ovata*), Shellbark hickory (*Carya laciniosa*), Bitternut hickory (*Carya cordiformis*), Black ash (*Fraxinus nigra*), Green ash (*Fraxinus pennsylvanica*), White ash (*Fraxinus americana*), Shingle oak (*Quercus imbricaria*), Northern red oak (*Quercus rubra*), Slippery elm (*Ulmus rubra*), American elm (*Ulmus americana*), Eastern cottonwood (*Populus deltoides*), Silver maple (*Acer saccharinum*), Sassafras (*Sassafras albidum*), Post oak (*Quercus stellata*), and White oak (*Quercus alba*). Indiana bat habitat consists of suitable trees that include dead and dying trees of the species listed above with exfoliating bark, crevices, or cavities in upland areas or riparian corridors and living trees of the species listed above with exfoliating bark, cavities, or hollow areas formed from broken branches or tops. If suitable trees occur within the project area, these trees must be conserved. If suitable habitat occurs on the project area and trees must be cut, cutting must occur between September 30 and April 1. If suitable trees must be cut during the summer months of April 2 to September 29, a net survey must be conducted in May or June prior to cutting. *If no tree removal is proposed, the project is not likely to impact this species.*

The project is within the range of the bald eagle (*Haliaeetus leucocephalus*), a state threatened species. *However, the Ohio Biodiversity Database currently has no records of this species near the project area.*

The project is within the range of the snuffbox (*Epioblasma triquetra*), a state endangered mussel, and the eastern pondmussel (*Ligumia nasuta*), a state endangered mussel. If there is a history of mussels near the proposed project area, it may be necessary for a professional malacologist approved by the DOW to conduct a mussel survey in the project area. *If no in-water work is proposed, the project is not likely to impact these species and a survey would not be necessary.*

The project is within the range of the American emerald (*Cordulia shurtleffi*), a state endangered dragonfly, the frosted whiteface (*Leucorrhinia frigida*), a state endangered dragonfly, and the racket-tailed emerald (*Dorocordulia libera*), a state endangered dragonfly. *Due to the mobility of these species, the project is not likely to impact these species.*

The project is within the range of the black bear (*Ursus americanus*), a state endangered species, and the bobcat (*Lynx rufus*), a state endangered species. *Due to the mobility of these species, the project is not likely to have an impact on these species.*

The project is within the range of the yellow-bellied sapsucker (*Sphyrapicus varius*), a state endangered bird. *Due to the location of the project and the habitat requirements of this species, the project is not likely to have an impact on this species.*

The project is in the range of the snowshoe hare (*Lepus americanus*), a state endangered species. *Due to the location of the project area, the project is not likely to have an impact on this species.*

The ODNR, Ohio Biodiversity Database contains no data at this project site.

**Geological Survey:** The ODNR, Division of Geological Survey has the following comments.

The Archbold site is on soft lacustrine silt and clay and the bedrock is 150 feet deep. The Pettisville site is on soft lacustrine sand and the bedrock is 145 feet deep. Both of these sites may require deepened foundations.

The Division of Geological Survey has no significant geologic concerns with the other two sites.

ODNR appreciates the opportunity to provide these comments. Please contact Brian Mitch at (614) 265-6378 if you have questions about these comments or need additional information.

Brian Mitch, Environmental Review Manager  
Ohio Department of Natural Resources  
Environmental Services Section  
2045 Morse Road, Building F-3  
Columbus, Ohio 43229-6693  
Office: (614) 265-6378  
Fax: (614) 262-2197  
[brian.mitch@dnr.state.oh.us](mailto:brian.mitch@dnr.state.oh.us)



# United States Department of the Interior

## FISH AND WILDLIFE SERVICE

Ecological Services  
 4625 Morse Road, Suite 104  
 Columbus, Ohio 43230  
 (614) 416-8993 / FAX (614) 416-8994

September 21, 2009

Mr. Aaron Godwin  
 The Renaissance Group  
 10299 Longview Drive  
 Kirtland, Ohio 44094

TAILS# 31420-2009-TA-1157

Dear Mr. Godwin:

This is in response to your September 14, 2009 letter requesting our review of a proposed wind energy project in Fulton County, Ohio. The project involves installation of a small (225 kW-750 kW), single wind turbine at the Pettisville Schools Site, Fulton County, Ohio. Currently, the project area is composed of an open field adjacent to an existing school. The landscape surrounding the school is residential and agricultural in nature. This information is solicited to support an application for ARRA stimulus funding.

There are no Federal wilderness areas, wildlife refuges, or designated critical habitat within the vicinity of the project area.

The following comments are being provided pursuant to the Endangered Species Act (ESA), Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and Fish and Wildlife Act of 1956. This information is being provided to assist you in making an informed decision regarding wildlife issues, site selection, project design, and compliance with applicable laws.

The Fish and Wildlife Service (Service) supports the development of wind power as an alternative energy source, however, wind power projects can have negative impacts on wildlife and their habitats if not sited and designed with potential wildlife and habitat impacts in mind. Selection of the best sites for turbine placement is enhanced by ruling out sites with known, high concentrations of birds and/or bats passing within the rotoswept area of the turbines or where the effects of habitat fragmentation will be detrimental. In support of wind power generation as a wildlife-friendly, renewable source of power, development sites with comparatively low bird, bat and other wildlife values, would be preferable and would have relatively lower impacts on wildlife.

### ENDANGERED SPECIES COMMENTS:

The proposed project lies within the range of the **Indiana bat** (*Myotis sodalis*), a Federally listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60%. Several factors have contributed to the decline of the Indiana bat, including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss and degradation of forested habitat, particularly stands of large, mature trees. Fragmentation of forest habitat may also contribute to declines. During the winter Indiana bats hibernate in caves and abandoned mines. Summer habitat requirements for the species are not well defined but the following are considered



important:

1. Dead or live trees and snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities, which may be used as maternity roost areas.
2. Live trees (such as shagbark hickory and oaks) which have exfoliating bark.
3. Stream corridors, riparian areas, and upland woodlots which provide forage sites.

The Service currently has no records for Indiana bats within 5 miles of the project area, and the immediate and greater project areas do not support suitable habitat. Therefore, we do not anticipate any impact on this species.

The project lies within the range of the rayed bean mussel and eastern massasauga federally listed candidate species. Due to the project type, size, and location, we do not anticipate any impact on these species or their habitats. Should the project design change, or during the term of this action, additional information on listed or proposed species or their critical habitat become available, or if new information reveals effects of the action that were not previously considered, consultation with the Service should be initiated to assess any potential impacts.

#### MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. Bald and golden eagles are afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Unlike the Endangered Species Act, neither the MBTA nor its implementing regulations at 50 CFR Part 21, provide for permitting of “incidental take” of migratory birds. No bald eagle nests are known to occur in Fulton County, and we are not aware of any eagle staging or congregation areas in this county. Therefore, we do not anticipate any impact on this species.

The Service’s Office of Law Enforcement serves its mission to protect Federal trust wildlife species, in part, by actively monitoring industries known to negatively impact wildlife, and assessing their compliance with Federal law. These industries include oil/gas production sites, cyanide heap/leach mining operations, industrial waste water sites, and wind power sites. There is no threshold as to the number of birds incidentally killed by wind power sites, or other industry, past which the Service will seek to initiate enforcement action. However, the Service is less likely to prioritize enforcement action against a site operator that is cooperative in seeking and implementing measures to mitigate takes of protected wildlife.

Research into the actual causes of bat and bird collisions with wind turbines is limited. To assist Service field staffs in review of wind farm proposals, as well as aid wind energy companies in developing best practices for siting and monitoring of wind farms, the Service published *Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines* (2003). We encourage any company/licensee proposing a new wind farm to consider the following excerpted suggestions from the guidelines in an effort to minimize impacts to migratory birds and bats.

- 1) Pre-development evaluations of potential wind farm sites to be conducted by a team of Federal and/or State agency wildlife professionals with no vested interest in potential sites;

- 2) Rank potential sites by risk to wildlife;
- 3) Avoid placing turbines in documented locations of federally-listed species;
- 4) Avoid locating turbines in known bird flyways or migration pathways, or near areas of high bird concentrations (i.e., rookeries, leks, refuges, riparian corridors, etc.);
- 5) Avoid locating turbines near known bat hibernation, breeding, or maternity colonies, in migration corridors, or in flight paths between colonies and feeding areas;
- 6) Configure turbine arrays to avoid potential avian mortality where feasible. Implement storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species;
- 7) Avoid fragmenting large, contiguous tracts of wildlife habitat;
- 8) Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities;
- 9) If taller turbines (top of rotorswept area is greater than 199 feet above ground level) require lights for aviation safety, the minimum amount of lighting specified by the Federal Aviation Administration (FAA) should be used. Unless otherwise requested by the FAA, only white strobe lights should be used at night, and should be of the minimum intensity and frequency of flashes allowable. Red lights should not be used, as they appear to attract night-migrating birds at a higher rate than white lights;
- 10) Adjust tower height to reduce risk of strikes in areas of high risk for wildlife.

The full text of the guidelines is available at <http://www.fws.gov/habitatconservation/wind.pdf>. The Service believes that implementing these guidelines may help reduce mortality caused by wind turbines. We encourage you to consider these guidelines in the planning and design of the project. We particularly encourage placement of turbines away from any large wetland, stream corridor, or wooded areas, including the areas mentioned previously, and avoid placing turbines between nearby habitat blocks.

Thank you for the opportunity to provide comments on this proposed project. Please contact biologist Megan Seymour at extension 16 in this office if we can be of further assistance.

Sincerely,



*f* Mary Knapp, Ph.D.  
Supervisor

Cc: Mr. Keith Lott, ODNR, Old Woman Creek, 2514 Cleveland Road East, Huron, OH 44839  
Mr. Brian Mitch, ODNR, REALM, Columbus, OH





## United States Department of the Interior

### FISH AND WILDLIFE SERVICE

Ecological Services  
 4625 Morse Road, Suite 104  
 Columbus, Ohio 43230  
 (614) 416-8993 / FAX (614) 416-8994

September 2, 2010

DOE Golden Field Office  
 c/o Melissa Rossiter  
 1617 Cole Boulevard  
 Golden, CO 80401

Dear Ms. Rossiter:

This is in response to your Notice of Public Scoping for the proposed Pettisville Local Schools Wind Energy Project, which involves the construction and operation of a single 600-750 kW wind turbine at the Pettisville School Campus in Pettisville, Fulton County, Ohio. Funding for the project is being sought through the Department of Energy (DOE). The following comments are being provided pursuant to the Endangered Species Act (ESA), Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, and Fish and Wildlife Act of 1956. This information is being provided to assist you in making informed decisions regarding wildlife issues, site selection, and project design, and to assist you with complying with the applicable Federal wildlife laws.

The Fish and Wildlife Service (Service) supports the development of wind power as an alternative energy source; however, wind power projects can have avoidable negative impacts on wildlife and their habitats if not sited and designed with potential wildlife and habitat impacts in mind. Generally speaking, selection of the best sites for turbine placement is enhanced by ruling out sites with known, high concentrations of birds and/or bats passing nearby the rotorswept area of the turbines or where the effects of habitat fragmentation will be detrimental.

#### ENDANGERED SPECIES COMMENTS:

The ESA prohibits the "take" of any listed species. Take is defined as, among other things, to harass, harm, wound, or kill. Harm and harass are further defined by regulation. Harm includes habitat modification or degradation that results in death or injury. Harass means to cause injury by disrupting normal behavior patterns such as breeding, feeding, or sheltering. The ESA also prohibits Federal agencies from funding, authorizing, or carrying-out, in full or in part, any action that is likely to adversely modify critical habitat. For reasons described below, we believe your project is not likely to adversely affect Indiana bats. The project additionally lies within the range of the **rayed bean** (*Villosa fabalis*) and **eastern massasauga** (*Sistrurus catenatus catenatus*), Federal candidate species. However no suitable habitat for either of these species occurs within the project area and no impact to these species is anticipated.

#### Indiana Bat

Your proposed project lies within the range of the Indiana bat (*Myotis sodalis*), a federally listed endangered species. Since first listed as endangered in 1967, their population has declined by nearly 60 percent. Several factors have contributed to the decline of the Indiana bat, including the loss and degradation of suitable hibernacula, human disturbance during hibernation, pesticides, and the loss,

fragmentation, and degradation of forested habitat, particularly stands of large, mature trees. During the winter, Indiana bats hibernate in caves and abandoned mines. These caves are critical for the survival of the species and several have been officially designated as critical habitat. In the spring and fall, Indiana bats migrate between their summer and winter habitats. Knowledge of the migratory behavior of Indiana bats is limited. Anecdotal information and available data give some insights into their flight behavior. Data from a few studies from the eastern portion of the range indicate that Indiana bats will fly at the canopy level during migration. Anecdotal information and data from closely related species, however, indicate that they may also fly at higher elevations especially over open areas. Upon arriving at their summer grounds, females form maternity colonies while males tend to roost singly. Summer habitat for Indiana bats includes roosting, foraging, and commuting areas. Roosting habitat is generally described as wooded areas containing trees or snags with peeling or exfoliating bark, split tree trunk and/or branches, or cavities. Foraging habitat includes stream corridors, riparian areas, and upland woodlots, and commuting habitat includes wooded areas, tree-lines or wooded hedgerows and other such wooded pathways that connect roosting and foraging areas. Information to date indicates that Indiana bats predominately forage, roost, and travel within wooded habitats or along their edges and are rarely found in open areas. Drawing from all existing data, we believe it is highly unlikely for summering Indiana bats to use open areas that are greater than 1000 feet from a wooded edge or area. Extensive research has shown that Indiana bats are highly philopatric to both their hibernation and summer areas. Thus, loss or degradation of these traditionally used areas is likely to cause harm to Indiana bats.

Wind energy facilities in various habitats across the U.S. and Canada have been documented to cause “widespread and often extensive fatalities of bats” (Arnett *et al.* 2008). At this time, research into the mechanisms that cause mortality of bats at wind power sites is ongoing but collision and barotrauma associated with moving turbine blades are clear proximate causes of death. Also, research on how to avoid fatalities is continuing. Currently, only a few operational tools have shown some success at avoiding or minimizing take, e.g., feathering of turbines during times when bats are most at risk has been shown to reduce mortality in some situations. Clearly, siting is important measure for avoiding and minimizing impacts. Siting recommendations to avoid impacts during the summer and winter periods are easier to provide, while the uncertainties relating to Indiana bat migration lend some difficulty to predicting where on the landscape we would expect Indiana bats to occur.

We have integrated what we know about Indiana bat ecology, the siting and operational specifics of your project, and what we know about turbine and bat interactions to assess the impacts of your project on Indiana bats. For reasons described below we believe your project is unlikely to adversely affect fall swarming and wintering Indiana bats but may adversely affect migrating and summering Indiana bats.

#### *Winter (and fall swarming) Period*

In fall just before entering caves for hibernation, Indiana bats use the surrounding forested area to forage and build up fat reserves for their 6-7 month hibernation period. Data available suggest that Indiana bats will forage up to 10 to 20 miles from their hibernacula. Turbines placed within this fall swarming range may take Indiana bats. As the location of your proposed wind turbine is not within 20 miles of any known or suspected Indiana bat hibernacula, we believe it is unlikely that your project will take Indiana bats during the fall swarming and hibernation periods.

#### *Migration Period*

The vast majority of the documented fatalities across U.S. and Canada have occurred during the fall migratory season (Arnett *et al.* 2008). Most of these mortalities were “long-distant migratory tree bats,” which are a group of bats that exhibit substantially different behaviors during migration than species like Indiana bat. It is currently suspected that these differences make the long-distant migratory tree bats more susceptible to exposure to wind turbines than other guilds of bats. Although not as frequently recorded,

there have been a notable number of fatalities for other species of bats as well, with a single Indiana bat mortality incident detected at a wind power facility in Indiana. These observations confirm that other bats, including Indiana bats, are also susceptible to mortality from wind turbines during the migration period.

Interactions between bats and wind turbines, particularly small-size, single turbines, are poorly understood, and therefore appropriate siting of wind power facilities to avoid and minimize take remains our most effective tool. Generally speaking, we expect that Indiana bats are substantially less vulnerable to take at small wind facilities. However, there is a confounding factor of blade height with the smaller-sized turbines. As indicated above, we lack data on the height at which Indiana bats fly while migrating. Mortality of little brown bat (*Myotis lucifugus*) at wind facilities across the range indicate that this closely related species migrates at heights typical of the rotorswept area of commercial turbines. This coupled with the record of an Indiana bat killed at a commercial wind facility suggest that Indiana bats may often fly at heights that intersect commercial sized turbines during migration. This mortality event occurred in an unforested area. Thus, we believe that Indiana bats are susceptible to wind turbine mortality anywhere within the range of Indiana bats. At small scale wind sites, the area of exposure is substantially less than the cumulative rotorswept area of a commercial sized facility, and thus, so too is the likelihood of an Indiana bat intersecting a turbine.

In areas where suitable habitat is nearby, however, the risk of mortality during migration is higher. Data from migration studies indicate that Indiana bats will fly at or above the tree canopy level during the migration period. The rotorswept area associated with small-size turbines will intersect the area that Indiana bats are known to use at times during migration. For this reason, we believe in order to minimize the chance of taking Indiana bats during the migratory period, the wind turbine should be located greater than 1000 feet from woodlots and forested streams corridors.

#### *Summer Period*

Although monitoring to date shows that mortality is greatest during the fall migration period, substantial bat fatalities have been recorded during the summer, including *Myotis* species. For this reason, we believe turbines sited within or near (1000 ft) suitable Indiana bat summer habitat may lead to the take of Indiana bats.

In addition to the direct take due to collision and barotrauma associated with turbine operation, habitat manipulation needed to construct the wind turbines can also have adverse effects on Indiana bats. Extensive research has been conducted on the behavior and habitat use of Indiana bats during the summer period. Briefly, female Indiana bats form colonies ranging from 25 to 300 adult bats, with an average around 80. Each female rears a single pup. The colony typically has a single tree within wooded areas in which they roost together for most of the summer with decreasing frequency/dependency in latter part of the summer. Male Indiana bats are sometimes found among females, but more typically they roost singly or smaller groups. At dusk, the adults and volant young depart the roost tree to search for insect prey throughout the night. Their foraging habitat is primarily restricted to woodlots and forested streams although they will forage along the forest edge and tend to avoid open areas. Although there are observations of Indiana bats flying over open space, the vast majority of the records are within 1000 feet of a forested edge. Thus, we believe wind turbines constructed within 1000 feet of suitable habitat are likely to pose a threat to Indiana bats. Data also show that colonies show strong fidelity to their summer areas. Loss, modification or fragmentation of their traditional summer areas—whether or not such destruction occurs during summer period—can lead to adverse impacts to colonies.

*Based on the information provided, your wind turbine will be located greater than 1000 feet from woodlots and forested streams corridor and beyond 20 miles of any known hibernacula. Further, all*

*associated construction activity will not affect potentially suitable roosting, foraging or commuting habitats. These measures will, we believe, substantially minimize the potential exposure of Indiana bats to your wind turbine and harm through habitat modification. Therefore, we do not believe your project poses adverse impacts to Indiana bats. If this incorrect, however, further consultation with this office is necessary to comply with the ESA.*

*Note: Research on the interaction of wind turbines and bats is active but in the beginning stages. As we indicated previously, there is still a great amount of uncertainty regarding the impacts of wind turbines on Indiana bat, particularly small scale wind facilities. Data are rapidly becoming available, and hence, our conclusions and recommendations necessarily evolve as this new information becomes available. We understand that DOE, in consultation with the Service, may be undertaking a regional monitoring program to help resolve some of the uncertainty surrounding impacts from small scale wind turbines. As these data become available, we will adapt our conclusions and recommendations accordingly. Please note that we currently believe that sufficient evidence suggests siting turbines greater than 20 miles from known hibernacula and farther than 1000 feet from summer habitat will likely avoid adverse impacts to Indiana bats. However, if new information reveals that these beliefs are in err, DOE will reinstate consultation with the Service and you may be instructed to take further precautions (such as curtailing operations) to avoid or minimize the take of Indiana bats.*

#### MIGRATORY BIRD COMMENTS:

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the U.S. Fish and Wildlife Service (FWS) recognizes that some birds may be taken during activities such as wind turbine operation even if all reasonable measures to avoid take are implemented. The U.S. Fish and Wildlife Service's Office of Law Enforcement carries out its mission to protect migratory birds not only through investigation and enforcement, but also through fostering relationships with individuals and industries that proactively seeks to eliminate their impacts on migratory birds. Although it is not possible under the MBTA to absolve individuals, companies, or agencies from liability (even if they implement avian mortality avoidance or similar conservation measures), the Office of Law Enforcement focuses on those individuals, companies, or agencies that take migratory birds with disregard for their actions and the law, especially when conservation measures have been developed but are not properly implemented.

Your project lies within the range of the bald eagle (*Haliaeetus leucocephalus*), a species included under the Migratory Bird Treaty Act, but also afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). The Bald and Golden Eagle Act prohibits the take of eagles without a permit. Interactions between eagles and turbines, particularly small single turbines, are poorly understood, and therefore appropriate siting of wind power facilities to avoid and minimize take remains our most effective tool. Because so little is known about interactions between eagles and single, small turbines, and how multiple small turbines across the landscape may affect eagles, it is difficult to predict if and how this project may affect eagles. However, the siting of the turbine in areas that generally do not provide high quality eagle habitat, and the small size and rotor-swept area of the turbine, leads us to believe that take of bald eagles from operation of the turbine is unlikely to occur. Additionally, bald eagle nests are not known to currently occur within the project area or within 5 miles of the project area. The FWS has recently finalized official agency guidelines to assist project proponents in avoiding and minimizing impacts to migratory birds, including bald eagles. We encourage you to consider those aspects of the guidelines detailed below to minimize impacts to all migratory birds.



*Note: As explained above for endangered species, given the uncertainties associated with the effects of small scale turbines locally and cumulatively on birds and bats, we are working with DOE to develop a research program. Although the precise study design has yet to be agreed upon, we anticipate this program will entail monitoring at a subset of DOE-funded small-scale wind turbines. This would aid in our assessment of future wind power projects, test the assumptions we are currently making, and promote the conservation of eagles.*

The full text of the Service's guidelines is available at <http://www.fws.gov/habitatconservation/wind.pdf>. The Service believes that implementing these guidelines may help reduce mortality caused by wind turbines. We particularly encourage you to consider the following excerpted suggestions from the Service's guidelines in an effort to minimize impacts to all migratory birds and bats.

- 1) Pre-development evaluations of potential wind farm sites to be conducted by a team of Federal and/or State agency wildlife professions with no vested interest in potential sites.
- 2) Rank potential sites by risk to wildlife.
- 3) Avoid placing turbines in documented locations of federally-listed species.
- 4) Avoid locating turbines in known bird flyways or migration pathways, or near areas of high bird concentrations (i.e., rookeries, leks, State or Federal refuges, staging areas, wetlands, riparian corridors, etc.). Avoid known daily movement flyways and areas with a high incidence of fog, mist or low visibility.
- 5) Avoid placing turbines near known bat hibernation, breeding, or maternity colonies, in migration corridors, or in flight paths between colonies and feeding areas.
- 6) Configure turbine arrays to avoid potential avian mortality where feasible (i.e., group turbines and orient rows of turbines parallel to known bird movements). Implement storm water management practices that do not create attractions for birds, and maintain contiguous habitat for area-sensitive species.
- 7) Avoid fragmenting large, contiguous tracts of wildlife habitat. Wherever practical, place turbines on lands already disturbed and away from intact healthy native habitats. If not practical, select fragmented or degraded habitats over relatively intact areas.
- 8) Minimize roads, fences, and other infrastructure. Wherever possible, align collection lines and access roads to minimize disturbance.
- 9) Develop a habitat restoration plan for the proposed site that avoids or minimizes negative impacts on vulnerable wildlife while maintaining or enhancing habitat values for other species (i.e., avoid attracting prey animals used by raptors).
- 10) Use tubular supports with pointed tops rather than lattice supports to minimize bird perching and nesting opportunities. Avoid placing external ladders and platforms on tubular towers to minimize perching/nesting. Avoid use of guy wires for turbine or meteorological tower supports. All existing guy wires should be marked with bird deterrents (Avian Power Line Interaction Committee 1996).
- 11) If taller turbines (top of rotor-swept area is greater than 199 feet above ground level) require lights for aviation safety, the minimum amount of lighting specified by the Federal Aviation

Administration (FAA) should be used. Unless otherwise requested by the FAA, only white strobe lights should be used at night, and should be of the minimum intensity and frequency of flashes allowable.

12) Adjust tower height to reduce risk of strikes in areas of high risk for wildlife.

13) Wherever feasible, place electric power lines underground or on the surface as insulated, shielded wire to avoid electrocution of birds. Use recommendations of the Avian Power Line Interaction Committee (1996) for any required above-ground lines, transformers, or conductors.


WATER RESOURCE COMMENTS:

Generally speaking, streams and wetlands provide valuable habitat for fish and wildlife resources, and the filtering capacity of wetlands helps to improve water quality. Naturally vegetated buffers surrounding these systems are also important in preserving their wildlife-habitat and water quality-enhancement properties. Furthermore, forested riparian systems (wooded areas adjacent to streams) provide important stopover habitat for birds and bats migrating through the region. As such, we also recommend that impacts to streams and wetlands be avoided, and buffers surrounding these systems be preserved even in areas where endangered species are not to occur. The proposed activities do not constitute a water-dependent activity, as described in the Section 404(b)(1) guidelines, 40 CFR 230.10. Therefore, practicable alternatives that do not impact aquatic sites are presumed to be available, unless clearly demonstrated otherwise. Therefore, before applying for a Section 404 permit, the client should closely evaluate all project alternatives that do not affect streams or wetlands, and if possible, select an alternative that avoids impacts to the aquatic resource. If water resources will be impacted, the Corps of Engineers should be contacted for possible need of a Section 404 permit.

These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Endangered Species Act of 1973, as amended, and are consistent with the intent of the National Environmental Policy Act of 1969 and the U. S. Fish and Wildlife Service's Mitigation Policy. This letter provides technical assistance only and does not serve as a completed section 7 consultation document.

Thank you for the opportunity to provide comments on this proposed project. Please contact Megan Seymour of this office for further information.

Sincerely,

  
Mary Knapp, Ph.D.  
Field Supervisor

Cc: Brian Mitch, ODNR, Columbus, OH  
Keith Lott, ODNR, Huron, OH



# OHIO DEPARTMENT OF TRANSPORTATION AVIATION

2829 W. DUBLIN-GRANVILLE ROAD • COLUMBUS, OH • 43235-2786

August 5, 2010

Pettisville Schools  
Attn: Aaron Godwin  
8281 Euclid Chardon Rd. # E  
Kirtland, OH 44094

Proposal: Wind Turbine  
Lat: N41°-31'-40.68"  
Lon: W84°-13'-31.51"  
Height: 335 ft AGL 1083 ft AMSL

Subject: APPLICATION FOR CONSTRUCTION/ALTERATION PERMIT  
Aeronautical Study No: 2010-DOT-665-OE

To Whom It May Concern,

The purpose of this letter is to notify you that your application concerning construction at the specified latitude, longitude and proposed height does not require a permit from this office. Your proposal falls outside the limits set forth in Section 4561.32 of the Ohio Revised Code. However, this does not exempt you from filing with the FAA or contacting local zoning authorities regarding compliance with local zoning ordinances.

If you have any questions, please call; (614)387-2346.

Respectively,

E-SIGNATURE

---

John A. Milling, Aviation Specialist  
ODOT Office of Aviation  
2829 W. Dublin-Granville Road  
Columbus, OH 43235

AN EQUAL OPPORTUNITY EMPLOYER



Federal Aviation Administration  
 Air Traffic Airspace Branch, ASW-520  
 2601 Meacham Blvd.  
 Fort Worth, TX 76137-0520

Appendix C, Attachment C5  
 Aeronautical Study No.  
 2010-WTE-10897-OE  
 Prior Study No.  
 2009-WTE-8662-OE

Issued Date: 08/19/2010

Dr. Stephen Switzer  
 Pettisville Schools  
 232 Summit Street  
 Pettisville, OH 43553

**\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine Pettisville Schools Wind Turbine  
 Location: Pettisville, OH  
 Latitude: 41-31-40.68N NAD 83  
 Longitude: 84-13-31.51W  
 Heights: 335 feet above ground level (AGL)  
 1083 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

- \_\_\_\_\_ At least 10 days prior to start of construction (7460-2, Part I)
- X   Within 5 days after the construction reaches its greatest height (7460-2, Part II)

This determination expires on 08/19/2012 unless:

- (a) extended, revised or terminated by the issuing office.
- (b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

**NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO**



SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

Additional wind turbines or met towers proposed in the future may cause a cumulative effect on the national airspace system. This determination is based, in part, on the foregoing description which includes specific coordinates and heights . Any changes in coordinates will void this determination. Any future construction or alteration requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7081. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2010-WTE-10897-OE.

**Signature Control No: 128939299-129830046**

( DNE -WT )

Michael Blaich  
Specialist



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Telecommunications and**  
**Information Administration**  
Washington, D.C. 20230

OCT 18 2010

Ms. Caroline Mann  
Office of Energy Efficiency and Renewable Energy (EE-40)  
US Department of Energy  
1000 Independence Avenue, SW  
Washington, DC 20585

Re: Pettisville Schools Wind Project, in Fulton County, OH

Dear Ms. Mann:

In response to your request on August 19, 2010, the National Telecommunications and Information Administration provided to the federal agencies represented in the Interdepartment Radio Advisory Committee (IRAC) the plans for the Pettisville Local Schools Wind Energy Project, located in Fulton County, Ohio.

After a 45 day period of review, no federal agencies identified any concerns regarding blockage of their radio frequency transmissions.

While the IRAC agencies did not identify any concerns regarding radio frequency blockage, this does not eliminate the need for the wind energy facilities to meet any other requirements specified by law related to these agencies. For example, this review by the IRAC does not eliminate any need that may exist to coordinate with the Federal Aviation Administration concerning flight obstruction.

Thank you for the opportunity to review these proposals.

Sincerely,

A handwritten signature in black ink, appearing to read "Ed M. Davison".

Edward M. Davison  
Deputy Associate Administrator  
Office of Spectrum Management

Feb 03 11 06:45p  
01/24/2011 17:00

Clinton Township  
419-445-2992

419-335-0460  
PETTISVILLE SCHOOL

P. 1  
PAGE 01

CLINTON TOWNSHIP ZONING PERMIT APPLICATION

FULTON COUNTY, OHIO

Application # 11-01

To the Board of Township Trustees:

The undersigned hereby applies for a Zoning Permit for the following use, to be issued on the basis of the representations contained herein, all of which applicant swears to be true. The application is required. In addition to the information requested on this form, to submit plans (drawn to scale) showing the actual dimensions and shape of the lot, exact sizes and locations of existing buildings on the lot, and the location and dimensions of the proposed buildings or alterations. If the work described below has not been completed within one year from date of issuance of permit, said permit shall expire.

Locational Description (Township, Section, Range, etc.): Clinton Township Section # 31

Name of Owner: Pettisville Local Schools Phone #: ~~(home)~~ For 419-445-2492  
232 Summit Street Phone #: (business) 419-446-2705  
Address: P.O. Box 53001 Pettisville, OH 43553

Address Where Construction Will Occur: 18827 County Road D Pettisville, OH 43553

() Proposed Uses: Home Occupation \_\_\_\_\_ Fence/Deck/Porch \_\_\_\_\_ Commercial   
Sign \_\_\_\_\_ Addition \_\_\_\_\_ Accessory Building \_\_\_\_\_ Industrial \_\_\_\_\_  
Residential \_\_\_\_\_ # of Residential Units \_\_\_\_\_ Pool/Pond \_\_\_\_\_

If the proposed use is commercial or industrial, enclose a detailed description of the nature of the business.

() Type of Sewage System: Public  AA Private \_\_\_\_\_ Permit # \_\_\_\_\_

() Source of Water Supply: Public  AA Private \_\_\_\_\_ Permit # \_\_\_\_\_

Drive Permit: A drive permit is required for any new access to the highway. Permit # \_\_\_\_\_

Lot Size: Width 1.654 Depth 570' Lot Area \_\_\_\_\_ # of Acres 23.524

Setbacks: Front Yard \_\_\_\_\_ Rear Yard \_\_\_\_\_ Side Yard \_\_\_\_\_ Side Yard \_\_\_\_\_  
(The front yard setback is measured from the center of the road.)

Square Footage: Residence \_\_\_\_\_ Basement \_\_\_\_\_ Accessory Building \_\_\_\_\_  
Garage \_\_\_\_\_ Commercial \_\_\_\_\_ Industrial \_\_\_\_\_ Other \_\_\_\_\_

Dimension of Accessory Building: \_\_\_\_\_ Pool/Pond Dimensions: \_\_\_\_\_

Building Height: Stories \_\_\_\_\_ Feet 302' Fence Type & Height: \_\_\_\_\_

Number of off-street parking spaces to be provided: \_\_\_\_\_ Sign Dimensions: \_\_\_\_\_

Number of off-street loading berths to be provided: \_\_\_\_\_

Is development more than 30 feet from a ditch or stream? Yes  No \_\_\_\_\_

If no, how many feet from water body? \_\_\_\_\_

Estimated Cost of Construction: \$ 1,900,000 Stephen S. Swartz  
Signature of Applicant

(For Official Use Only)

Date Application Received: 1-31-11 Fee Paid: \$ 75.00

Date of Action on Application: 1-31-11 Approved:  Denied: \_\_\_\_\_

If denied, reason for denial: \_\_\_\_\_

Zoning Inspector: R. Uyan

**APPENDIX D:**  
**SUPPORTING DOCUMENTATION**





## Department of Energy

Golden Field Office  
1617 Cole Boulevard  
Golden, Colorado 80401-3393

August 19, 2010

SUBJECT: Notice of Scoping A-SEP- 62 ~ 600 to 750 kW Single Wind Turbine: *Pettisville Local Schools Wind Energy Project*, Fulton County, Clinton Township, Pettisville, Ohio

The U.S. Department of Energy (DOE) is proposing to provide federal funding to the Pettisville School District to construct and operate a 600 to 750 kW wind turbine in Fulton County, Ohio. The proposed project would construct and operate a wind turbine located on the Pettisville School District property within the town of Pettisville. Details of the proposed wind turbine are provided in the attachment to this Scoping Notice. Pursuant to the requirements of the National Environmental Policy Act (NEPA) the Council on Environmental Quality (CEQ) regulations for implementing the procedural provision of NEPA (40 CFR Parts 1500-1508), and DOE's implementing procedures for compliance with NEPA (10 CFR 1021), DOE is preparing an Environmental Assessment (EA) to:

- Identify any adverse environmental effects that cannot be avoided should this proposed project be implemented.
- Evaluate viable alternatives to the proposed project.
- Describe the relationship between local and short-term uses of the environment and the maintenance and enhancement of long-term productivity.
- Characterize any irreversible and irretrievable commitments of resources that would be involved should this proposed project be implemented.

### **Potential Environmental Effects or Issues Identified for the Environmental Assessment**

The EA will describe and analyze any potential impacts on the environment that would be caused by the project and will identify possible mitigation measures to reduce or eliminate those impacts. At a minimum, DOE will evaluate potential impacts that may result from the proposed project related to:

- Land Use
- Biological Resources
- Cultural Resources
- Noise
- Safety and Occupational Health
- Socioeconomics and Environmental Justice
- Utilities
- Traffic and Transportation
- Aviation Hazards
- Electromagnetic Interferences
- Aesthetics and Shadow Flicker
- Water Resources



**Development of a Reasonable Range of Alternatives**

DOE is required to consider a reasonable range of alternatives to the proposed action during an environmental review. The definition of alternatives is governed by the "rule of reason", as described within the CEQ regulations regarding the administration of NEPA. An EA must consider a reasonable range of options that could accomplish the agency's purpose and need reduce environmental effects. Reasonable alternatives are those that may be feasibly carried out based on environmental, technical, and economic factors.

The No Action Alternative will be addressed. The need for project redesign, or a project alternative, will be determined during the course of environmental review.

**Public Scoping**

The DOE is sending this letter to interested federal, state and local agencies to provide information on issues to be addressed in the EA. Agencies are invited to identify the issues within their statutory responsibilities that should be considered in the EA. The general public is also invited to submit comments on the scope of the EA. The general public is also invited to submit comments on the scope of the EA.

This letter and the draft EA, when it is available, will be posted in the DOE Golden Field Office online reading room: [http://www.eere.energy.gov/golden/Reading\\_Room.aspx](http://www.eere.energy.gov/golden/Reading_Room.aspx).

The DOE Golden Field Office welcomes your input throughout our NEPA process, but to ensure that your comments are received in time to be considered in the draft EA, please provide them on or before September 8, 2010 to:

Melissa Rossiter  
NEPA Document Manager  
Department of Energy  
1617 Cole Boulevard  
Golden, CO 80401  
[Melissa.Rossiter@go.doc.gov](mailto:Melissa.Rossiter@go.doc.gov)

We look forward to hearing from you.

Sincerely,



Melissa Rossiter

## Attachment

### Pettisville School District Wind Turbine

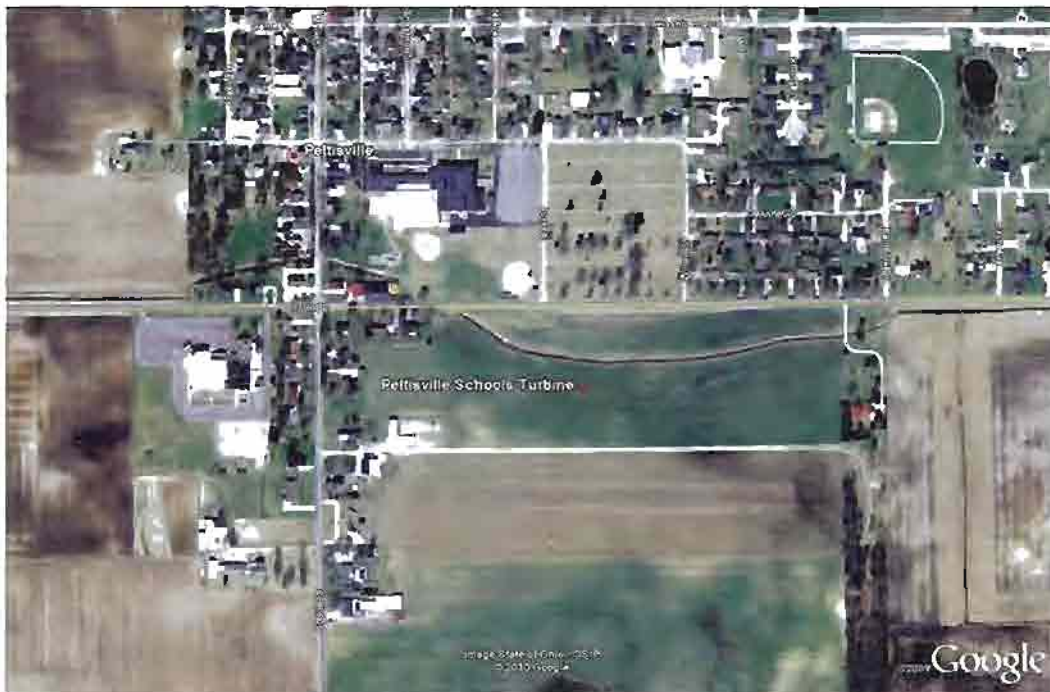
The U.S. Department of Energy is proposing to provide up to \$750,000 to Pettisville School District for construction and operation of a 600 to 750 kW single wind turbine. The School District proposes to design, permit, construct, operate and maintain the 600 to 750 kW wind turbine located at 232 Summit Street, Pettisville, Ohio.

Latitude: 41-31-40.68N NAD 83

Longitude: 84-13-31.51W

The DOE funding for this project would be paid for by the American Recovery and Reinvestment Act of 2009 and would include the following components:

- A single 600 to 750 kW new turbine on 60 to 75 meter tower
- Associated generator and below ground collector cables
- Underground transmission lines and connection to Pettisville School District's internal energy distribution system



### **Pettisville Public Involvement**

The Pettisville Local School District has provided opportunities for public involvement since August 19, 2010 in an attempt to educate the public about this project and provide an opportunity for public comment.

#### Media Coverage:

Archbold Buckeye – 12/15/2010 - [Pettisville School Board Seeks Wind Turbine Bids](#)  
 Crescent News – 12/15/2010 - [Pettisville school board updated on turbine](#)  
 Archbold Buckeye – 11/03/2010 - [Pettisville Schools Start Deficit Spending During 2012 Fiscal Year](#) - Story  
 Archbold Buckeye – 10/13/2010 - [Pettisville School Board Postpones Meeting](#)  
 Archbold Buckeye – 09/15/2010 - [New Pettisville School On Track To Open Fall 2011](#)  
 Crescent News – 09/14/2010 - [Architect gives board tour of the new school](#)  
 Archbold Buckeye – 08/18/2010 - [Final Wind Turbine Vote Next Month](#)  
 Archbold Buckeye – 07/28/2010 - [School Board Okays Wind Turbine Action](#)  
 Crescent News – 07/21/2010 - Archbold board approves resolution for wind turbines  
 Archbold Buckeye – 07/14/2010 - [Pettisville School Board Freezes Employee Pay](#)  
 Crescent News – 07/14/2010 - Pettisville qualifies as excellent school for 2009-10 school year  
 Archbold Buckeye – 06/16/2010 - [Pettisville Board Okays Environmental Study For Wind Turbine](#)  
 Archbold Buckeye – 06/16/2010 - [Archbold School Board Looking Into Wind Turbine Financing Options](#)  
 Crescent News – 06/16/2010 - Pettisville schools updated on wind turbine project  
 Crescent News – 06/15/2010 - Archbold board approves resolution for wind turbine project  
 Archbold Buckeye – 06/09/2010 - [Pettisville School Board Approves Funding For Wind Turbine Project](#)  
 Archbold Buckeye – 05/12/2010 - [Breezing Ahead](#)  
 Archbold Buckeye – 05/12/2010 - [Pettisville School Board To Accept School Bids Soon](#)  
 Crescent News – 5/11/2010 - Bids for Pettisville school project come in under estimate  
 Archbold Buckeye – 04/14/2010 - [Call For New Study Delays Wind Turbines](#)  
 Archbold Buckeye – 03/17/2010 - [No New Developments On Wind Turbine Project](#)  
 Archbold Buckeye – 03/10/2010 - [Consolidation Of Ohio Schools Unpopular Here](#)  
 Archbold Buckeye – 03/10/2010 - [Wind Turbine Funding Unclear](#)  
 Archbold Buckeye – 03/10/2010 - [Pettisville School Bids Go Out Friday](#)  
 Crescent News – 03/09/2010 - Pettisville school board hears update on construction  
 Archbold Buckeye – 02/23/2010 - [Should the Archbold School District proceed with the wind turbine project?](#)  
 Archbold Buckeye – 02/17/2010 - [Pettisville School Levy On May Ballot](#)  
 Crescent News – 02/17/2010 - Archbold updated on turbine project  
 Archbold Buckeye – 02/17/2010 - [Wind Project Up In The Air, Deskins Says](#)  
 Archbold Buckeye – 02/10/2010 - [Distrust Of Deskins Why?](#)  
 Crescent News – 02/09/2010 - Pettisville board OKs renewal levy  
 Archbold Buckeye – 02/03/2010 - [School Board Okays Wind Consultant Deal](#)  
 Archbold Buckeye – 01/27/2010 - [WEB EXTRA](#)

Archbold Buckeye – 01/20/2010 - [Pettisville Schools Board Discusses Levy Renewal](#)

Archbold Buckeye – 12/30/2009 - [New Pettisville School Ready By May 2011?](#)

Archbold Buckeye – 12/30/2009 - [Reap The Wind](#)

Crescent News – 12/24/2009 - Pettisville schools enter into contract for wind turbines Archbold Buckeye – 12/23/2009 - [Borrow \\$400,000 For School Wind Turbine?](#)

Crescent News – 12/15/2009 - Pettisville board eyes options on improvement levy

Crescent News – 12/07/2009 - Archbold, Pettisville land \$1.5M grant

Archbold Buckeye – 12/02/2009 - [Wind Power Money Comes To Archbold, Pettisville Schools](#)

Archbold Buckeye – 11/18/2009 - [School Board Hears About Success Day](#)

Crescent News – 10/13/2009 - Pettisville board hopes to catch money for project

Crescent News – 09/25/2009 - Pettisville seeks funding for wind turbine

Archbold Buckeye – 09/23/2009 - [Pettisville Students Break Ground For New School](#)

Crescent News – 09/17/2009 - New beginning: Pettisville holds ceremony for pre-k through grade 12 school building

Archbold Buckeye – 09/16/2009 - [Bid For New Pettisville School Far Under Estimate](#)

Crescent News – 10/15/2009 - Groundbreaking slated for new Pettisville school, wind tower

Archbold Buckeye – 09/02/2009 - [Preliminary Wind Data Promising](#)

Archbold Buckeye – 07/15/2009 - [Pettisville Gets Wind Test Tower Funding](#)

Archbold Buckeye – 06/03/2009 - [Pettisville Health, Physical Education Teacher Resigns](#)

Archbold Buckeye – 05/20/2009 - [Archbold Wind Study Continues; Fayette May Put Turbine Up First](#)

Archbold Buckeye – 04/15/2009 - [Ripke, Rychener Retire From Pettisville Schools; New Cell Phone Policy Approved](#)

Archbold Buckeye – 03/11/2009 - [Pettisville School Board Purchases Additional Land](#)

Archbold Buckeye – 01/21/2009 - [Wind Tower Data Promising: Deskins](#)

Archbold Buckeye – 01/21/2009 - [Arend: Get Local Companies Out Of Auto Supply Business](#)

Archbold Buckeye – 04/22/2009 - [Fayette Woman Helps Rescue Freighter Captain From Pirates](#)

Archbold Buckeye – 03/11/2009 - [Genter, Short In Washington Lobbying For County Projects](#)

Archbold Buckeye – 02/25/2009 - [Pettisville Grain Co. Turns To Wind Power](#)

Archbold Buckeye – 11/21/2007 - [Archbold Schools Wind Team Still Studies Issue](#)

Archbold Buckeye – 12/05/2007 - [Archbold Wind Study Reduces Electricity Bills](#)

Archbold Buckeye – 09/17/2008 - [Letter To The Editor](#)

Archbold Buckeye – 02/13/2008 - [Zoning Ordinances Keep Up With The Times](#)

Archbold Buckeye – 04/23/2008 - [Wind Turbine Could Be In Line For State Capital Budget Funds](#)

Archbold Buckeye – 03/05/2008 - [Planning Commission Approves Requests From Jim King, School Board](#)

Archbold Buckeye – 03/05/2008 - [CORRECTION](#)

Archbold Buckeye – 09/10/2008 - [Pettisville School Board Hosts Meeting; Residents Learn About Bond Issue](#)

Archbold Buckeye – 08/13/2008 - [Archbold Isn't The Only School Studying Wind Energy Benefits](#)

Archbold Buckeye – 07/16/2008 - [Funding For New School Building At Pettisville Studied By Board](#)

Archbold Buckeye – 06/04/2008 - [Council Grants Permit For Wind Test Tower](#)



- Archbold Buckeye – 06/04/2008 - [School Districts To Split Capital Budget Cash](#)
- Archbold Buckeye – 05/21/2008 - [Council Talks About Wind Turbine Ordinance](#)
- Archbold Buckeye – 04/16/2008 - [Zoning Board Approves Hulshof Garage Variance](#)
- Archbold Buckeye – 06/25/2008 - [Wind Test Tower Stands Tall](#)
- Archbold Buckeye – 06/18/2008 - [Council Approves Street Repairs, Wind Turbine Ordinance, New Police Officer](#)
- Archbold Buckeye – 04/16/2008 - [BREAKING NEWS](#)
- Archbold Buckeye – 04/09/2008 - [Town Council Considers Refinancing](#)
- Archbold Buckeye – 04/02/2008 - [Wind Test Tower Passes Hurdle](#)
- Archbold Buckeye – 02/20/2008 - [Wind Power Talks Exciting](#)
- Archbold Buckeye – 02/13/2008 - [School May Get Wind Study Tower](#)
- Archbold Buckeye – 02/06/2008 - [Study New Zoning Regs For Windmills](#)

For  
IEC Class III  
Wind Sites

# AERONAUTICA

## 54-750



### When Megawatt-Class Turbines Are Just Too Big

These workhorses provide plenty of power for schools, industrial parks, shopping centers, neighborhood net-metering, Green Communities, wind parks and more!

- ◆ 3/4 Megawatt (750kW) design - for Class III winds
- ◆ Low profile: less than 270' tall on a 55m tower
- ◆ Active Stall Regulation (ASR) allows blades to be optimized for both low and high wind conditions
- ◆ Dual-wound 200/750 kW Generator

Located in an IEC Class III wind area? *Aeronautica Windpower* is proud to introduce the 54-750: a Queen-size machine designed with a larger rotor for 'distributed wind' applications at lower wind sites. Many good wind sites just cannot accommodate huge, utility-scale turbines. A large number of sites, especially populated areas, are better suited to a smaller size machine. The 54-750 is the perfect fit.

More easily permitted, erected, and financed than its larger brothers, the 54-750 is a great choice for municipal projects, commercial/industrial sites, college or high school campuses, and other places where 'behind the meter', or net-metered power can be utilized.

With its low profile, ultra-low noise signature, and highly efficient output, the 54-750 provides the perfect balance between economic output and acceptable size. And *Aeronautica* wind turbines are *all manufactured in the United States*, reducing shipping costs and delivery times.

#### Fast Facts:

Orientation: *Upwind*  
Rotor Speed: *~25.3RPM*  
Hub Height: *65 or 55m*

Rotor Diameter: *54m*  
Active-Stall Regulated  
Blades: *Fiber Reinforced Polyester*

**Made in  
America**

*American Energy from America's Hometown*

AERONAUTICA  
Windpower



Plymouth, MA 1-800-360-0132 [www.AeronauticaWind.com](http://www.AeronauticaWind.com)

**54-750 kW System Specifications:**

**Blades**

3 blades, upwind orientation  
Fiberglass reinforced polyester

**Rotor**

Power regulation: Active Stall Regulation (ASR).  
Rotor size: 54m diameter (177') (std—other configs. avail.)  
Rotor speed: 25.3 rpm nominal  
Swept area: 2,289 m<sup>2</sup>  
Tilt angle: 4°  
Coning angle: 3.0° forward.

Tip speed: 62 – 63 m/s at full load.  
Pitch angle: Active Stall Regulation  
Pitch bearings: 4-point ball bearings.  
Air brake, normal: Pitch to -20°, actuated by the Active Stall Regulation system.  
Air brake, emergency: Pitch to -85° fail safe, activated by accumulators in hub.

Nominal pitch speed: 7.5°/sec  
Mechanical brake: A fail-safe type disk brake.  
Brake torque: 1.8 times of nominal torque (approx).  
RPM max. value: 1920 (60 Hz), 1600 (50 Hz), on the high-speed shaft.

**Generator**

Nom. Electric Power: 200/750 kW (dual wound)  
Generator: Closed, Synchronous induction, 4/6 pole DW, IP54 or 55.  
Generator speed: 1200/1800 (60 Hz) or 1000/1500 (50 Hz) rpm synchronous  
Loss in generator: 3 - 4 % at nominal power dependent on type  
Generator cut-in: Thyristor controlled gradual cut-in  
Grid connection: 60 Hz – 690V or 50 Hz – 690V

**Operational:**

Yaw motors: 4 pcs. w/electrical brakes built in  
Yaw brakes: 4 pcs. disk hydraulic brakes  
Yaw bearing: 4-point ball bearing  
Cut-in wind speed: 3-4 m/s, based on 10 min average  
Cut-out wind speed: 25 m/s, based on 2 min average  
Controller: CC—Electronic (Mitsubishi PLC)  
Noise: 100 dBA Sound Power (at Nacelle)

**Monopole Tower**

Conical Steel, White, 65m and 50m towers available  
Nacelle access: interior tower ladder through locked door

**Weights:**

Mass of blades: ( 3 ): Approx. 16,000 lbs ( 7,200 kg)  
Mass of nacelle: Approx. 48,400 lbs (22,000 kg)  
Mass of hub: Approx. 17,600 lbs ( 8,000 kg)  
Mass total, excl tower: Approx. 81,200 lbs (36,909 kg)

**Certification:** Variant of our 47-750 turbine, which is design Certified by DNV for IEC 61400 Ed. 3 Class IB and IIA

**Safety Issues**

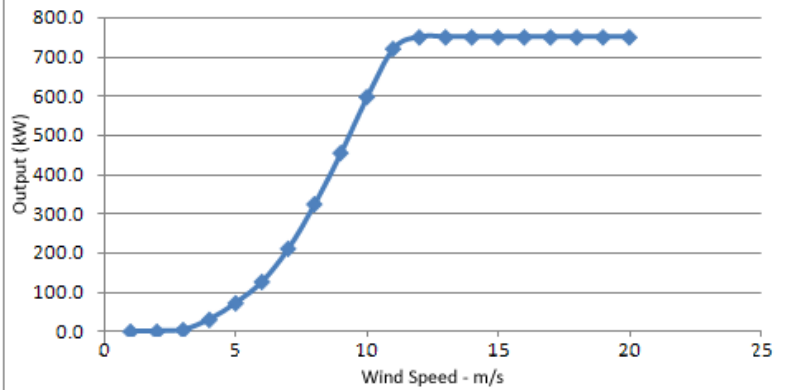
Induction generator has inherent anti-islanding  
Fail-safe hydraulic disk brake  
Grid monitoring for shutdown and operational performance  
**Shipping:** All Prices are FOB our plant

**Warranty:** Standard warranty is for two years on the drive train and on all major parts. Extended warranties are available.

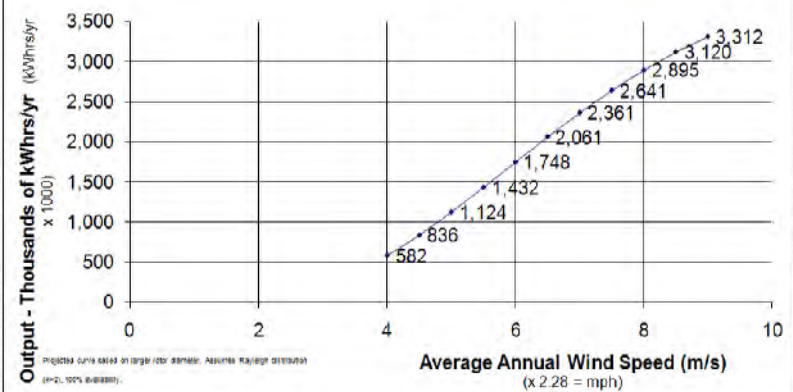
**Installation:** Aeronautica Windpower, LLC is only a supplier of equipment. We can, however, refer you to local installers or dealers for a complete installation.

**Service Agreements:** Annual Service Contracts are strongly advised and are available from local dealers and installers.

**Estimated Power Output - 54-750**



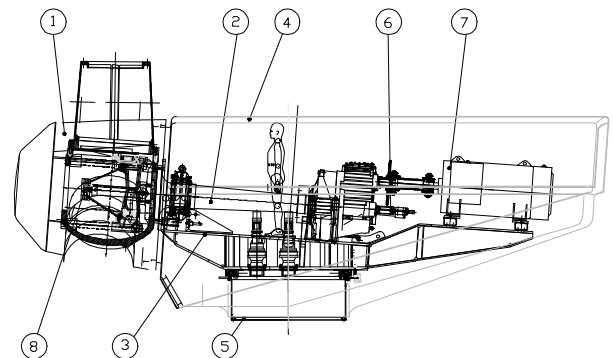
**54-750 Projected Energy Graph**



The Power and Energy Curves shown are estimated for a 750kW turbine, with a 54m rotor, double wound generator, and Active Stall Regulation. The power curve is valid for 1.225kg/m<sup>3</sup> air density, clean blades and undisturbed horizontal air flow. For the Energy Graph, a Rayleigh wind speed distribution and 100% availability is assumed.

**Power Curve Table**

| m/s | kW    |
|-----|-------|
| 1   | 0.0   |
| 2   | 0.0   |
| 3   | 4.0   |
| 4   | 30.4  |
| 5   | 72.6  |
| 6   | 126.7 |
| 7   | 211.2 |
| 8   | 324.7 |
| 9   | 455.4 |
| 10  | 598.0 |
| 11  | 720.7 |
| 12  | 750.0 |
| 13  | 750.0 |
| 14  | 750.0 |
| 15  | 750.0 |
| 16  | 750.0 |
| 17  | 750.0 |
| 18  | 750.0 |
| 19  | 750.0 |
| 20  | 750.0 |



- 1. Rotor System
- 2. Transmission
- 3. Yaw System and Mainframe
- 4. Nacelle Cover
- 5. Tower
- 6. Hydraulic Station (not shown)
- 7. Generator
- 8. Pitch system



## Technical note

## NOISE EMISSION FROM NORWIN-47-ASR-600 / 750 kW

## Summary:

The noise emission at the reference wind speed 8 m/s, 10 m above ground, expressed as the A-weighted sound level in dB re. 1 pW, ( $L_{WA,ref}$ ), is 100.00 dB. The relation between the noise emission and the wind speed is +0.3 dB pr. m/s.

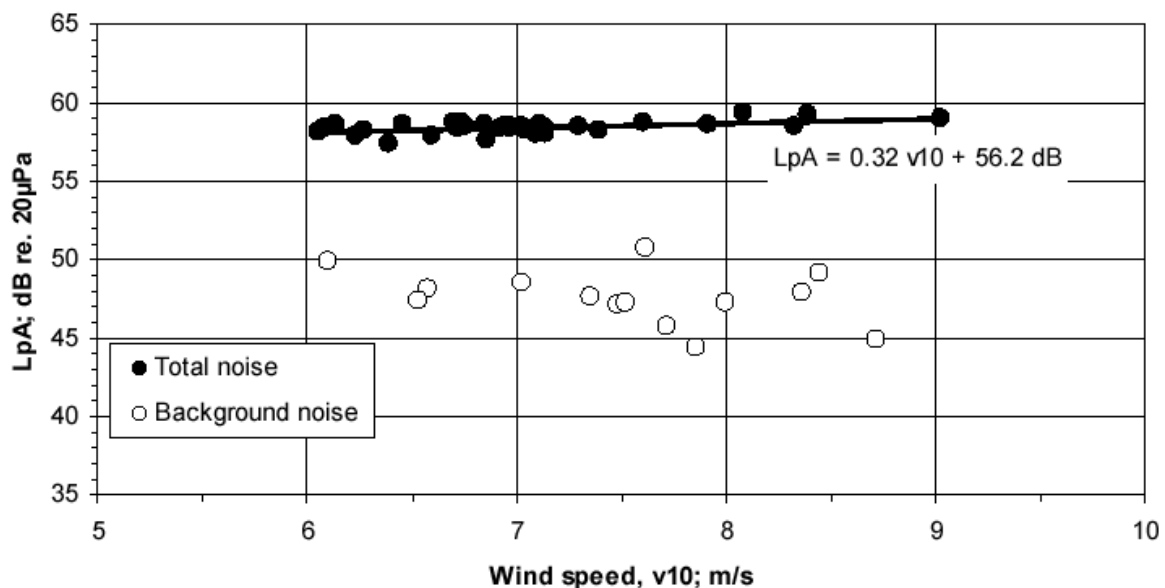
## Measuring setup and method:

The noise emission is measured in compliance to the guidelines given in regulation no. 304/1991, *Bekendtgørelse om støj fra vindmøller*, published by the Danish Environmental Agency. The noise is measured with a microphone placed on the ground (acoustically reflecting plate 1.5 x 2.0 m<sup>2</sup>), 50 m down-wind from the turbine. The noise is measured with and without the wind turbine operating, to establish the signal to noise relation.

The wind speed is measured with a cup-anemometer placed 10 m above ground, 50 m up-wind from the turbine.

## Noise emission curves:

Figure 1.: A-weighted sound pressure level on the ground 50 m down-wind from the turbine.



There are no clearly audible tones present in the noise.

Figure 2.: The A-weighted sound pressure level,  $L_{pA}$  in dB re 20  $\mu\text{Pa}$ , 1.5 m above ground, calculated as function of the distance from the wind turbine, according to DEA regulation no. 304/1991

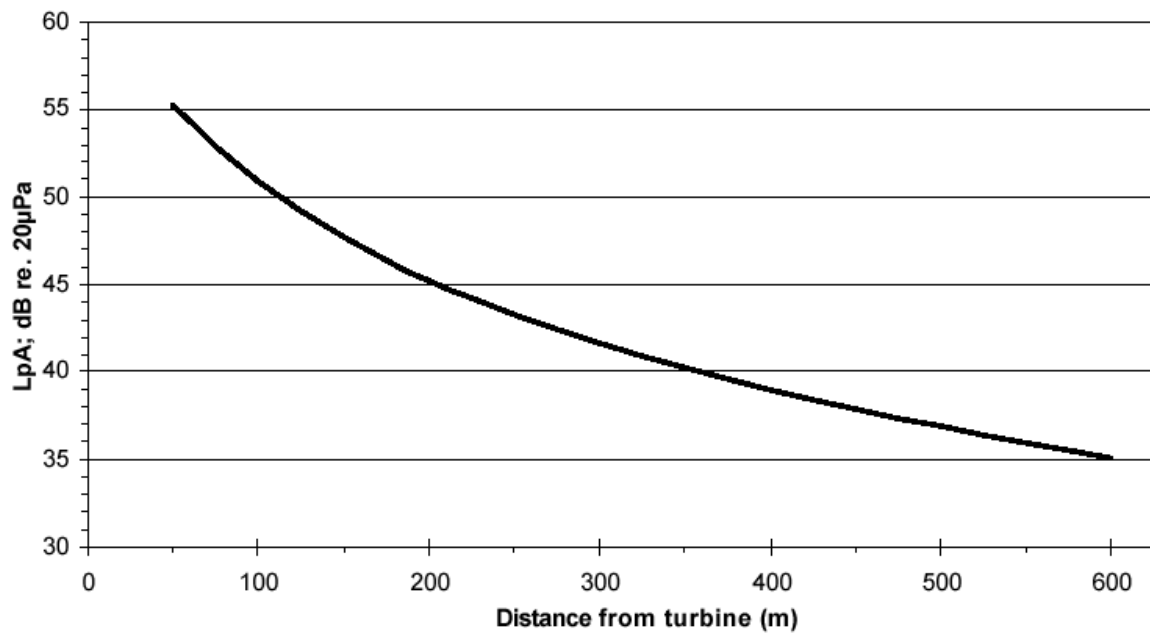


Figure 3.: From calculations the following key values have been extracted:
















| $L_{pA}$ ; dB re 20 $\mu\text{Pa}$ | Distance, m |
|------------------------------------|-------------|
| 35                                 | 607         |
| 40                                 | 359         |
| 45                                 | 206         |



## Pettisville Turbine Equipment Transportation Plan:

Likely delivery route for turbine: Subject to change with equal or greater weight handling roads being selected. In all cases for turbine components, cranes and other materials, oversized or overweight loads and routes will be permitted through the standard processes of the state/s of travel and utilize transport equipment and procedures suitable to meet or exceed all regulatory requirements for the path of travel and the equipment being transported. (Heaviest expected single turbine component load expected is 62,000 lbs with a max width of 14’):

Aeronautica Turbine Supply , 11 Resnik Rd, Plymouth, MA 02360\*

|   |  |                             |
|---|--|-----------------------------|
|   | 1. Head east on <b>Resnik Rd</b> toward <b>Scobee Cir</b><br>About 1 min   | go 0.4 mi<br>total 0.4 mi   |
|   | 2. Continue onto <b>Christa McAuliffe Blvd</b>   | go 0.1 mi<br>total 0.5 mi   |
|    | 3. Turn <b>right</b> at <b>Commerce Way</b><br>About 2 mins  | go 0.6 mi<br>total 1.1 mi   |
|    | 4. Turn <b>left</b> to merge onto <b>US-44 W</b><br>About 17 mins  | go 14.0 mi<br>total 15.2 mi |
|    | 5. At the traffic circle, continue straight to stay on <b>US-44 W</b><br>About 1 min   | go 0.2 mi<br>total 15.4 mi  |
|    | 6. Merge onto <b>I-495 N</b> via the ramp to <b>MA-24/Marlboro/Boston</b><br>About 40 mins   | go 43.0 mi<br>total 58.4 mi |
|    | 7. Take exit <b>22</b> for <b>I-90</b> toward <b>Mass/Pike/Boston/Albany Ny</b><br>Toll road<br>About 1 min  | go 0.6 mi<br>total 58.9 mi  |
|   | 8. Keep <b>left</b> at the fork, follow signs for <b>I-90 W/Springfield/Albany</b> and merge onto <b>I-90 W</b><br>Partial toll road<br>About 29 mins  | go 27.7 mi<br>total 86.6 mi |
|  | 9. Take exit <b>9</b> to merge onto <b>I-84 W</b> toward <b>US-20/Hartford/New York City</b><br>Partial toll road<br>Passing through Connecticut, New York<br>Entering Pennsylvania<br>About 3 hours 53 mins | go 231 mi<br>total 318 mi   |
|  | 10. Take the exit on the <b>left</b> onto <b>I-81 S</b> toward <b>Wilkes-Barre</b><br>About 34 mins  | go 36.3 mi<br>total 354 mi  |
|  | 11. Take exit <b>151B</b> to merge onto <b>I-80 W</b> toward <b>Bloomsburg</b><br>Entering Ohio<br>About 4 hours 15 mins   | go 277 mi<br>total 631 mi   |
|  | 12. Take the exit onto <b>I-80 W</b><br>Partial toll road<br>About 2 hours 50 mins   | go 184 mi<br>total 814 mi   |
|  | 13. Take exit <b>34</b> for <b>OH-108</b><br>Toll road<br>About 2 mins   | go 0.8 mi<br>total 815 mi   |
|  | 14. Turn <b>left</b> at <b>OH-108 S</b><br>About 2 mins  | go 1.3 mi<br>total 816 mi   |
|  | 15. Turn <b>right</b> at <b>US-20 Alt W</b><br>About 4 mins  | go 3.3 mi<br>total 820 mi   |
|  | 16. Turn <b>left</b> at <b>Co Rd 18</b><br>About 6 mins  | go 3.0 mi<br>total 823 mi   |
|  | 17. Turn <b>right</b> at <b>Co Rd D</b><br>About 2 mins  | go 0.8 mi<br>total 824 mi   |
| Turbine Installation Site, Pettisville, Ohio  |  |                             |

All other materials and equipment will likely be transported from within the State of Ohio and follow a similar route off of Route 80.

## Turbine Use, Safety Policies and General Background

### Security:

- Tower Climbing: The wind turbine utilizes a smooth exterior monopole tower with no climbing surfaces or apparatus. Tower climbing is only achieved through the use of an internal ladder system. This system is only reachable through a locked plate steel door.
- Availability: Only preauthorized personnel will be given access to the internal tower and turbine systems.

### Tower Climbing Safety:

- Safety Climb: For maintenance personnel climbing of the tower, an OSHA approved “safety climb” system is included in the tower climbing system. This system is comprised of a ladder, a steel cable for the safety climb device, a full body harness designed and approved for the purpose, a locking safety climb device, safety lanyards with self-locking clips and additional tie-in points throughout the turbine system where a cable system is not available.
- OSHA approved safety equipment such as hardhats will be worn by all maintenance personnel climbing or working on the turbine.
- No individual shall climb the tower without a partner.

### Electrical Safety:

- All electrical components and their installations shall meet all Local, State and Federal applicable laws and regulations.
- The turbine system shall meet UL1741 and IEC requirements for Utility Grid Protection in case of Grid power failures or power quality abnormalities.
- All electrical supply/grid interconnect services to and from the turbine shall be in buried conduits.
- The turbine system will have a staff accessible emergency shut-offs.
  - Utility room
  - Tower base
  - Nacelle
  - Remote through “Web” interface.

- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
  - This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.
- All safety sensors and equipment shall fault to a turbine fault state in case of their own failure.

**Fire:**

- The turbine shall have fire detection devices at the tower base and within the nacelle that shall be linked to the Site’s existing fire detection/alarm systems (if present).
- The local fire department shall be contacted and a fire/emergency response plan shall be adopted.
- Although formal fire suppression systems are extremely rare for wind turbines, the site shall investigate passive and active fire suppression systems for possible implementation in the turbine system.
- Local fire department approved fire extinguishers shall be located within the tower base and within the nacelle.
- The turbine system will have staff accessible emergency shut-offs.
  - Utility room
  - Tower base
  - Nacelle
  - Remote through “Web” interface.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing.
  - This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.
- Safety zones similar to any fire related incident will be utilized, if a fire should occur.

**Lightening:**

- The turbine system is equipped with a full grounding loop meeting or exceeding all Local, State and Federal regulations concerning grounding and lightening protection.
- Surge suppressing technology will be utilized to protect key electronics.
- See fire policies above.

**Icing:**

- Although icing of wind turbines is very rare and safety issues related to icing even rarer, it can occur, similar to any built structure (roofs, power lines, stadium lights, etc.).
- Although not an absolute brake, blade icing induced airfoil shape spoiling will naturally reduce the efficiency of the blades and thus reduce their rotational speed.
- Although formal icing detection systems are extremely rare for wind turbines, the site shall investigate active icing detection systems for possible implementation in the turbine system.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration, over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).
  - This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.
- The turbine’s nacelle will have a cold-weather package including nacelle heaters. These heaters are designed to maintain nacelle temperatures above the dew-point and well above freezing. This system will automatically melt snow and ice accumulation on top of the nacelle.
- The turbine system will have a staff accessible emergency shut-offs.
  - Utility room
  - Tower base
  - Nacelle
  - Remote through “Web” interface.
- All icing related turbine shut-downs will require a direct inspection and an on-site manual restart.
- The site personnel and the system maintenance personnel will shut down the turbine in the event of an icing condition.
- The site shall adopt an ice safety zone around the turbine for implementation during icing events, if they should occur.

**High Wind:**

- The turbine automatically shuts down in high winds and turns itself out of the wind.
- The turbine system will have an automated system fault shut-off triggered at a minimum by the following sensors: System temperature, power quality, vibration,

over-speed, fire and icing (vibration caused by blade icing induced imbalances will automatically shut down the turbine).

- This system will also automatically send fault codes to preauthorized personnel through a “Web” interface.

#### **Aviation Safety:**

- The project has been review by both FAA and ODOT and “No Hazard to Aviation” determinations were issued.
- An FAA approved red obstruction marking light will be located on top of the nacelle.

#### **Shadow Flicker:**

- Although all structures cast shadows, shadows from wind turbines that reach occupied structures or areas can be considered a nuisance due to the fact that they move or flicker as the blades rotate in front of the Sun.
- A formal shadow flicker study has been conducted for the site based on the turbine’s rotor diameter and height, the site latitude and longitude, weather records, existing site topography and the existing area obstructions.
- Per international standards, shadow flicker impacting a particular location above 30 hours per year is considered a potential nuisance. While the turbine’s shadow will reach some of the area properties, no residential or business property locations will receive more than 30 hours of shadow per year. Other factors that mitigate the shadows’ impact include:
  - Shadow intensity drops off with distance. Shadow edges soften and shadow bodies become more muted. Shadows beyond ten rotor diameters from the tower base are considered insignificant with shadows within five rotor diameters being the most significant.
  - Shadows move and do not remain in one spot for extended periods of time.
  - The longest extended period shadows occur in the winter when there are fewer sunny days.
  - Many local natural and built environmental elements such as trees will block or significantly diffuse shadows.
- If extended adverse shadows should impact a particular dwelling, the wind turbine site owner will take one or more of the following mitigating measures:
  - Plant evergreen trees to block the shadow.
  - Provide blinds for the dwelling.
  - Turn off the turbine during the shadowing periods that excessively affect the dwelling.



**Sound:**

- Wind turbines of the size to be installed are inherently quite devices, especially over distance, and are typically very hard to hear over the wind itself and the existing ambient area noise levels.
  - Sound from a single wind turbines typically comes from the following areas:
    - Wind noise off of the blades as they are driven by the wind (swooshing that drops off over distance and typically competes with the area's natural wind noise).
    - Drive-train noise (mechanical sound typically not heard outside the immediate vicinity of the turbine).
    - Yaw system noise (mechanical sound typically not heard outside the immediate vicinity of the turbine and that is only present when the turbine turns into the wind).
    - Electrical noise from the turbine's electrical equipment and transformer (buzz, typically not heard outside the immediate vicinity of the turbine).
- Sound modeling for the proposed wind turbine supports that turbine produced audio levels will not exceed any local code or ordinance at the site's property lines. To be conservative, this modeling was done at an 8 mps/17.9 mph wind speed, well above site averages.
- Sound measurement of existing ambient sound levels for both day and evening periods at multiple locations surrounding the site show existing ambient sound levels above what the wind turbine will produce.

## 100-5.9 WIND TURBINES

Purpose

The purpose of this section is to establish general guidelines for the location of wind turbine generators and anemometer towers. This section is consistent with the stated purpose of the Clinton Township Zoning Resolution: “Protecting the public health, safety, comfort, and general welfare” of its residents. The Township recognizes in some specific instances, under carefully controlled circumstances, it may be in the public interest to permit the placement of wind turbine generators in certain areas of the Township. The Township also recognizes the need to protect the scenic beauty of the Township from unnecessary and unreasonable visual interference, noise radiation, and that wind turbine generators may have negative health, safety, welfare, and aesthetic impacts upon adjoining and neighboring uses. As such, this section seeks to:

1. Protect residential and agricultural areas from potential adverse impact of wind turbine generators;
2. Permit wind turbine generators in selected areas by on-site residential, commercial, or industrial users, subject to the terms, conditions, and provisions hereof;
3. Ensure the public health, welfare, and safety of the Township’s residents in connection with wind turbine generators; and
4. Avoid potential damage to real and personal property from the wind turbine generators or anemometer towers or the failure of such structures and related operations.

Permitted Use

Small wind energy systems shall be a permitted use in all zoning districts where structures of any type are allowed, subject to the following regulations:

Height and Acreage

The maximum height of any turbine shall be 120 feet, which includes the tower and the maximum vertical height of the turbine’s blades. Maximum height shall be calculated by measuring the length of a prop at a maximum vertical rotation to the base of the tower. A wind turbine shall be located on a minimum of 1 acre. A height limitation does not apply to parcels 5 acres and larger, unless height restrictions are imposed by the F.A.A.

Setbacks

Any wind turbine system erected on a parcel of land must establish a “clear fall zone” from all neighboring property lines and habitable structures. A wind turbine must be erected and placed in such a manner that if it fell, the entire system would be contained solely on the property where the turbine was installed, and would not strike the primary dwelling. No part of the wind energy system, including guy wire anchors, which would require a waiver by the BZA, shall extend closer than ten (10) feet to the property boundaries of the installation site.

Lighting

The maximum lighting used for or on the structure is a low intensity red light designed by the Federal Aviation Administration.

Decibel Levels

Decibel levels for the system shall not exceed 60 decibels (dBA) measured at the closest neighboring inhabited dwelling, except during short-term events such as utility outages and severe windstorms.

Aesthetics

The wind energy system, including the prop blades, turbine, cowling, and tower shall be painted or coated either of white, gray or sky blue. Logos or other identification markers other than those of the manufacturer and model type shall not be permitted anywhere on the turbine.

Federal Aviation Administration

The FAA is required to receive notification of any construction or alteration of an object that is more than 200 feet in height above the ground level at the site or if the object is located within 10,000 feet of an airport per FAA, Title 14, Section 77.13.

Permits

A permit shall be required before construction of an individual wind turbine system. As part of the permit process, the applicant shall inquire with the Fulton County Regional Planning Commission as to whether or not additional height restrictions are applicable due to the turbine's location in relation to the Fulton County Airport or the Helicopter Overlay District.

The following items and or information shall be provided when applying for a permit:

1. Location of all public and private airports in relation to the location of the turbine, as well as any applicable FAA restrictions that may be applicable to the turbine.
2. An engineering report that shows:
  - a. The total size and height of the unit.
  - b. The total size and depth of the unit's concrete mounting pad.
  - c. An average decibel rating for that particular model.
  - d. A list and or depiction of all safety measures that will be on the unit including anti-climb devices, grounding devices, and lightning protection.
  - e. Data specifying the kilowatt size and generating capacity of the particular unit.
3. A site drawing showing the location of the unit in relation to existing structures on the property, roads and other public right-of-ways, and neighboring properties.
4. Evidence of a "clear fall zone" with the manufacturer recommendations must be attached to the engineering report.
5. Color of the unit as well as the location and size of the manufacturers identifying logos shall be included in the plan.
6. A maintenance schedule as well as a dismantling plan that outlines how the unit will be dismantled shall be required as part of the permit.
7. The small wind turbine wire shall be placed underground to any structures.
8. The applicant shall notify the Zoning Inspector if operations of the wind turbine cease and shall be removed within 60 days of ceasing operations.
9. No grid-interconnected wind energy system shall be installed until evidence has been given that the utility company has been informed of the customer's intent to install a grid-connected customer-owned generator. Off-grid systems shall be exempt from this requirement.

## Wind Resource Report, Site Wind Characteristics Pettisville Schools

Turbine Model Used For Estimates:

Aeronautica / Norwin 54-750

Meter Description:

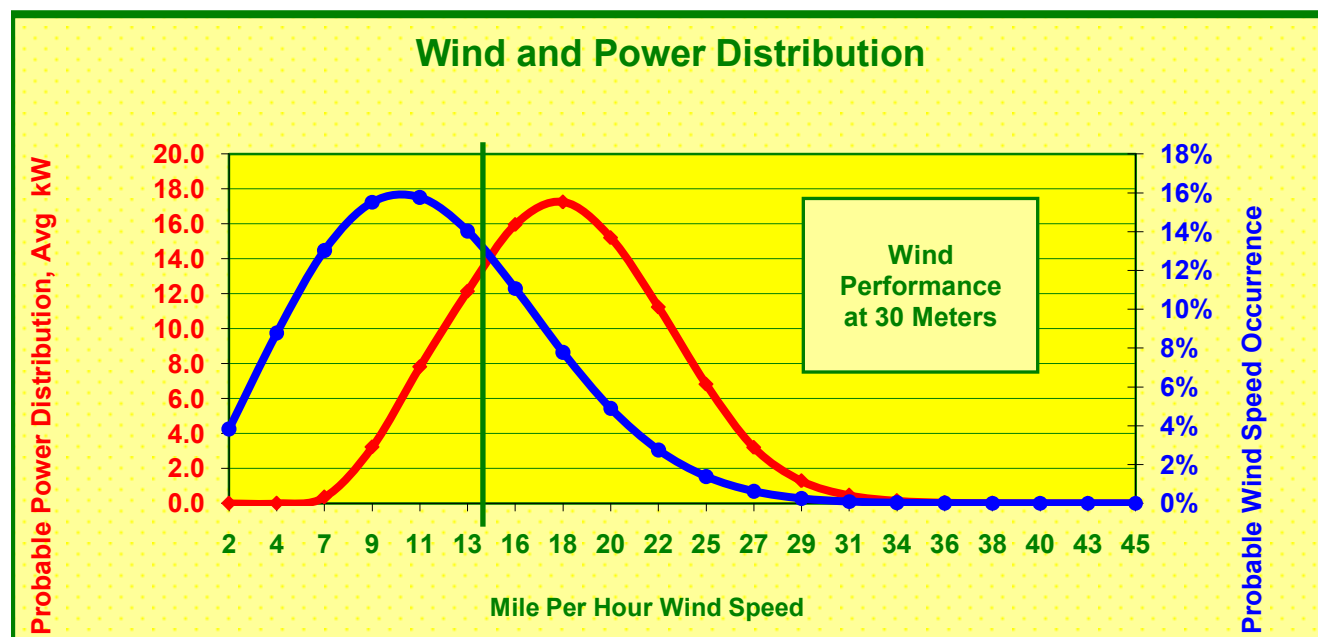
High School 1

### Weibull Performance Calculations:

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0.0  | 0.00                   | 3.84%                | 0.000              | 82.0%            | 41.5%             |
| 2                         | 4.47  | 0.0  | 0.00                   | 8.78%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4.0  | 2.73                   | 13.03%               | 0.356              |                  |                   |
| 4                         | 8.95  | 30.4   | 20.78                  | 15.51%               | 3.223              |                  |                   |
| 5                         | 11.18 | 72.6   | 49.62                  | 15.76%               | 7.821              |                  |                   |
| 6                         | 13.42 | 126.7  | 86.59                  | 14.03%               | 12.147             |                  |                   |
| 7                         | 15.66 | 211.2  | 144.34                 | 11.06%               | 15.969             |                  |                   |
| 8                         | 17.90 | 324.7  | 221.91                 | 7.78%                | 17.262             | 17.7%            | 57.8%             |
| 9                         | 20.13 | 455.4  | 311.23                 | 4.89%                | 15.217             |                  |                   |
| 10                        | 22.37 | 598.0  | 408.69                 | 2.75%                | 11.241             |                  |                   |
| 11                        | 24.61 | 720.7  | 492.54                 | 1.38%                | 6.821              |                  |                   |
| 12                        | 26.84 | 750.0  | 512.57                 | 0.62%                | 3.198              |                  |                   |
| 13                        | 29.08 | 750.0  | 512.57                 | 0.25%                | 1.288              | 0.1%             | 0.7%              |
| 14                        | 31.32 | 750.0  | 512.57                 | 0.09%                | 0.463              |                  |                   |
| 15                        | 33.55 | 750.0  | 512.57                 | 0.03%                | 0.148              |                  |                   |
| 16                        | 35.79 | 750.0  | 512.57                 | 0.01%                | 0.042              |                  |                   |
| 17                        | 38.03 | 750.0  | 512.57                 | 0.00%                | 0.011              |                  |                   |
| 18                        | 40.26 | 750.0  | 512.57                 | 0.00%                | 0.002              |                  |                   |
| 19                        | 42.50 | 750.0  | 512.57                 | 0.00%                | 0.000              |                  |                   |
| 20                        | 44.74 | 750.0  | 512.57                 | 0.00%                | 0.000              |                  |                   |
| Totals:                   |       |  |                        | 99.83%               | 95.211             | 99.8%            | 100.0%            |

11.79

Site Average Wind Speed (MPH) at 30 Meters



## Wind Resource Report, Site Wind Characteristics

18780 County Road,

Pettisville, Ohio 43553

Turbine Model Used For Estimates:

Aeronautica / Norwin 54-750

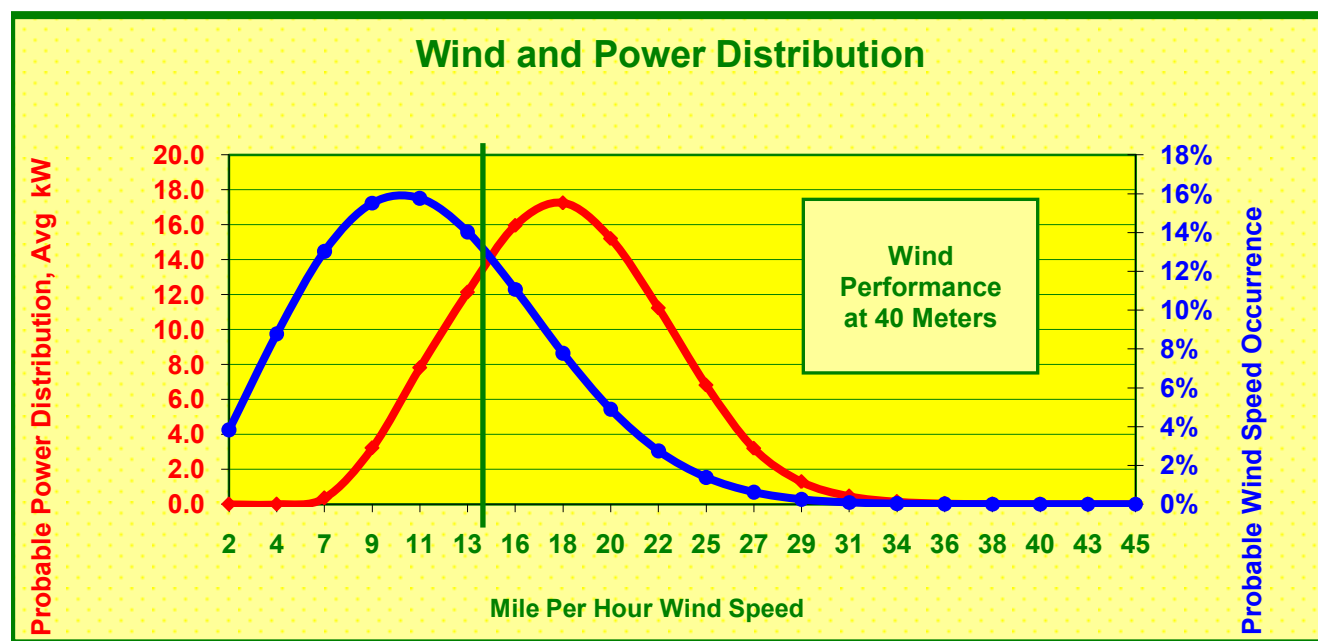
Meter Description:

High School 1

**Weibull Performance Calculations:**

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0.0  | 0.00                   | 3.06%                | 0.000              | 74.4%            | 31.6%             |
| 2                         | 4.47  | 0.0  | 0.00                   | 7.09%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4.0  | 2.83                   | 10.81%               | 0.306              |                  |                   |
| 4                         | 8.95  | 30.4   | 21.50                  | 13.40%               | 2.881              |                  |                   |
| 5                         | 11.18 | 72.6   | 51.34                  | 14.40%               | 7.393              |                  |                   |
| 6                         | 13.42 | 126.7  | 89.60                  | 13.77%               | 12.341             |                  |                   |
| 7                         | 15.66 | 211.2  | 149.35                 | 11.88%               | 17.747             |                  |                   |
| 8                         | 17.90 | 324.7  | 229.62                 | 9.31%                | 21.367             | 24.9%            | 66.3%             |
| 9                         | 20.13 | 455.4  | 322.04                 | 6.64%                | 21.380             |                  |                   |
| 10                        | 22.37 | 598.0  | 422.88                 | 4.32%                | 18.279             |                  |                   |
| 11                        | 24.61 | 720.7  | 509.65                 | 2.57%                | 13.099             |                  |                   |
| 12                        | 26.84 | 750.0  | 530.37                 | 1.40%                | 7.403              |                  |                   |
| 13                        | 29.08 | 750.0  | 530.37                 | 0.69%                | 3.671              | 0.5%             | 2.1%              |
| 14                        | 31.32 | 750.0  | 530.37                 | 0.31%                | 1.661              |                  |                   |
| 15                        | 33.55 | 750.0  | 530.37                 | 0.13%                | 0.685              |                  |                   |
| 16                        | 35.79 | 750.0  | 530.37                 | 0.05%                | 0.258              |                  |                   |
| 17                        | 38.03 | 750.0  | 530.37                 | 0.02%                | 0.088              |                  |                   |
| 18                        | 40.26 | 750.0  | 530.37                 | 0.01%                | 0.027              |                  |                   |
| 19                        | 42.50 | 750.0  | 530.37                 | 0.00%                | 0.008              |                  |                   |
| 20                        | 44.74 | 750.0  | 530.37                 | 0.00%                | 0.002              |                  |                   |
| Totals                    |       |  |                        | 99.86%               | 128.595            | 99.9%            | 100.0%            |

**13.04** Site Average Wind Speed (MPH) at 40 Meters





## Wind Resource Report, Site Wind Characteristics

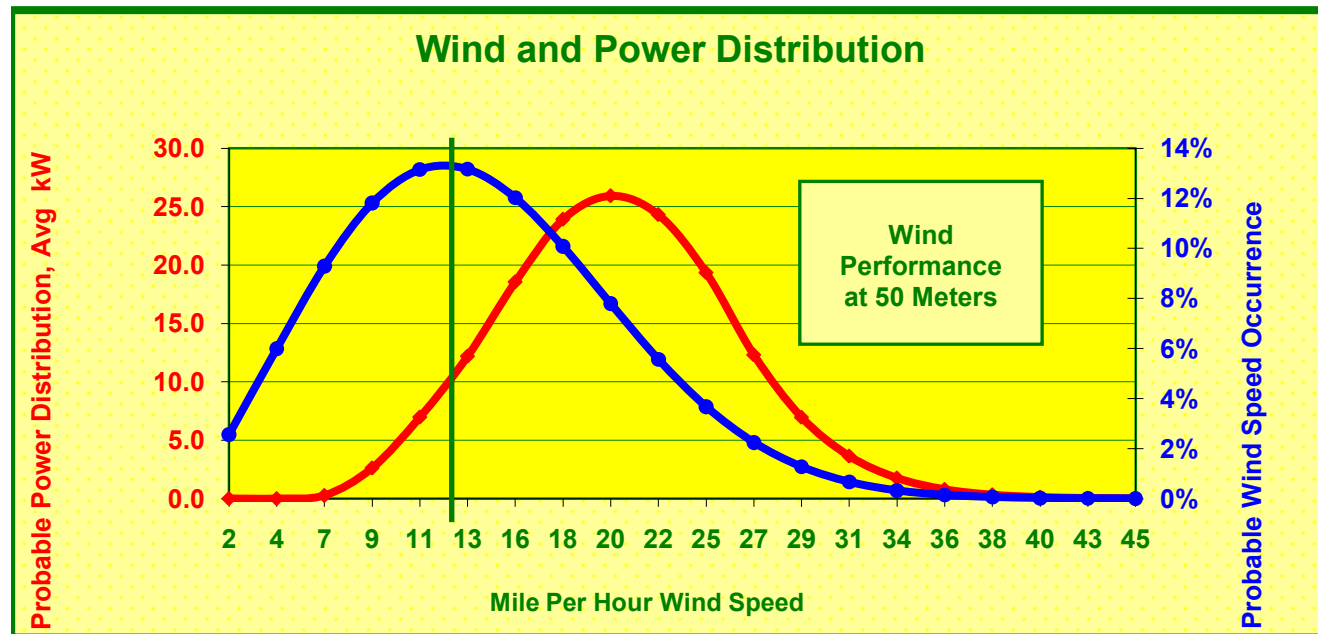
**18780 County Road, Pettisville, Ohio 43553**

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750  
 Meter Description: High School 1

### Weibull Performance Calculations:

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0  | 0.00                   | 2.57%                | 0.000              | 68.0%            | 25.4%             |
| 2                         | 4.47  | 0  | 0.00                   | 6.00%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4  | 2.92                   | 9.30%                | 0.272              |                  |                   |
| 4                         | 8.95  | 30.4   | 22.22                  | 11.82%               | 2.626              |                  |                   |
| 5                         | 11.18 | 72.6   | 53.06                  | 13.16%               | 6.980              |                  |                   |
| 6                         | 13.42 | 126.7  | 92.60                  | 13.17%               | 12.198             |                  |                   |
| 7                         | 15.66 | 211.2  | 154.36                 | 12.03%               | 18.563             |                  |                   |
| 8                         | 17.90 | 324.7  | 237.31                 | 10.08%               | 23.924             | 30.6%            | 70.4%             |
| 9                         | 20.13 | 455.4  | 332.83                 | 7.79%                | 25.933             |                  |                   |
| 10                        | 22.37 | 598  | 437.05                 | 5.56%                | 24.317             |                  |                   |
| 11                        | 24.61 | 720.7  | 526.73                 | 3.67%                | 19.356             |                  |                   |
| 12                        | 26.84 | 750  | 548.14                 | 2.25%                | 12.311             |                  |                   |
| 13                        | 29.08 | 750  | 548.14                 | 1.27%                | 6.963              |                  |                   |
| 14                        | 31.32 | 750  | 548.14                 | 0.66%                | 3.643              | 1.2%             | 4.2%              |
| 15                        | 33.55 | 750  | 548.14                 | 0.32%                | 1.763              |                  |                   |
| 16                        | 35.79 | 750  | 548.14                 | 0.14%                | 0.788              |                  |                   |
| 17                        | 38.03 | 750  | 548.14                 | 0.06%                | 0.325              |                  |                   |
| 18                        | 40.26 | 750  | 548.14                 | 0.02%                | 0.124              |                  |                   |
| 19                        | 42.50 | 750  | 548.14                 | 0.01%                | 0.044              |                  |                   |
| 20                        | 44.74 | 750  | 548.14                 | 0.00%                | 0.014              |                  |                   |
| Totals                    |       |  |                        | 99.88%               | 160.144            | 99.9%            | 100.0%            |

**14.09**      Site Average Wind Speed (MPH) at 50 Meters



## Wind Resource Report, Site Wind Characteristics

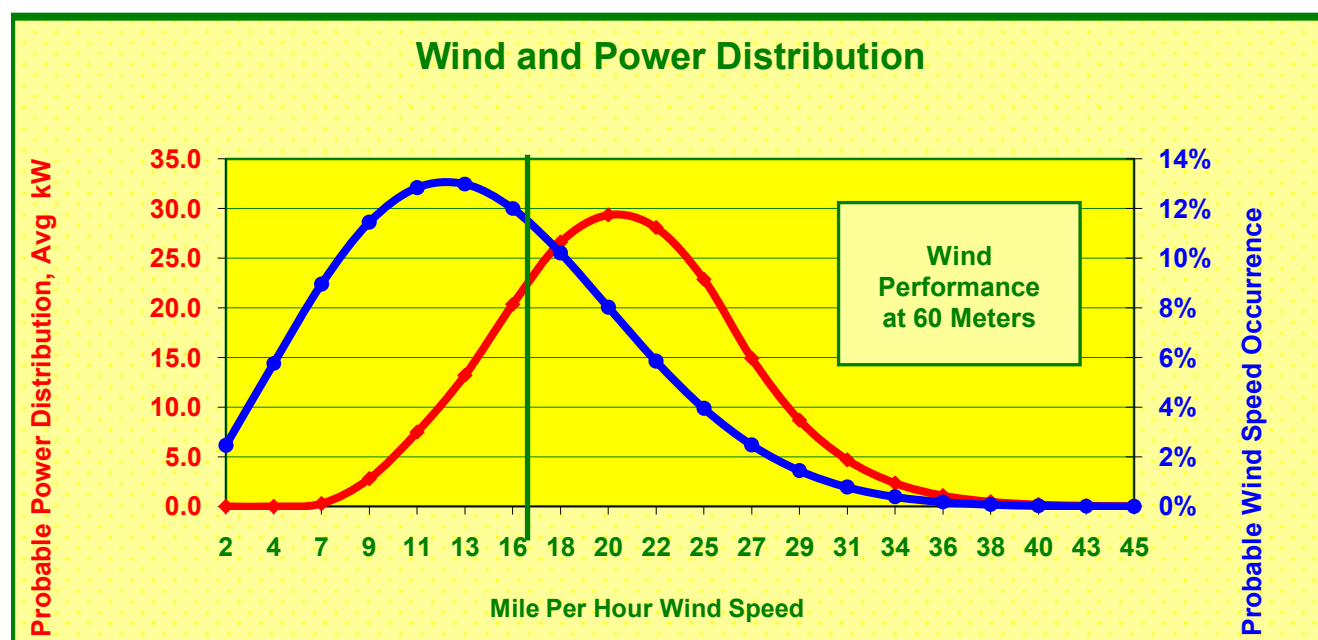
**18780 County Road, Pettisville, Ohio 43553**

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750  
 Meter Description: High School 1

**Weibull Performance Calculations:**

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0.00   | 0.00                   | 2.51%                | 0.000              | 67.2%            | 24.6%             |
| 2                         | 4.47  | 0.00   | 0.00                   | 5.87%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4.00   | 3.02                   | 9.11%                | 0.275              |                  |                   |
| 4                         | 8.95  | 30.40  | 22.94                  | 11.62%               | 2.665              |                  |                   |
| 5                         | 11.18 | 72.60  | 54.78                  | 12.99%               | 7.113              |                  |                   |
| 6                         | 13.42 | 126.70   | 95.60                  | 13.07%               | 12.498             |                  |                   |
| 7                         | 15.66 | 211.20   | 159.35                 | 12.02%               | 19.147             |                  |                   |
| 8                         | 17.90 | 324.70   | 244.99                 | 10.15%               | 24.877             | 31.4%            | 70.8%             |
| 9                         | 20.13 | 455.40   | 343.60                 | 7.92%                | 27.222             |                  |                   |
| 10                        | 22.37 | 598.00   | 451.20                 | 5.72%                | 25.806             |                  |                   |
| 11                        | 24.61 | 720.70   | 543.78                 | 3.82%                | 20.799             |                  |                   |
| 12                        | 26.84 | 750.00   | 565.88                 | 2.37%                | 13.415             |                  |                   |
| 13                        | 29.08 | 750.00   | 565.88                 | 1.36%                | 7.706              |                  |                   |
| 14                        | 31.32 | 750.00   | 565.88                 | 0.72%                | 4.102              | 1.4%             | 4.5%              |
| 15                        | 33.55 | 750.00   | 565.88                 | 0.36%                | 2.022              |                  |                   |
| 16                        | 35.79 | 750.00   | 565.88                 | 0.16%                | 0.923              |                  |                   |
| 17                        | 38.03 | 750.00   | 565.88                 | 0.07%                | 0.390              |                  |                   |
| 18                        | 40.26 | 750.00   | 565.88                 | 0.03%                | 0.152              |                  |                   |
| 19                        | 42.50 | 750.00   | 565.88                 | 0.01%                | 0.055              |                  |                   |
| 20                        | 44.74 | 750.00   | 565.88                 | 0.00%                | 0.018              |                  |                   |
| Totals:                   |       |  |                        | 99.89%               | 169.187            | 99.9%            | 100.0%            |

**14.24**      Site Average Wind Speed (MPH) at 60 Meters



## Wind Resource Report, Site Wind Characteristics Pettisville Local Schools

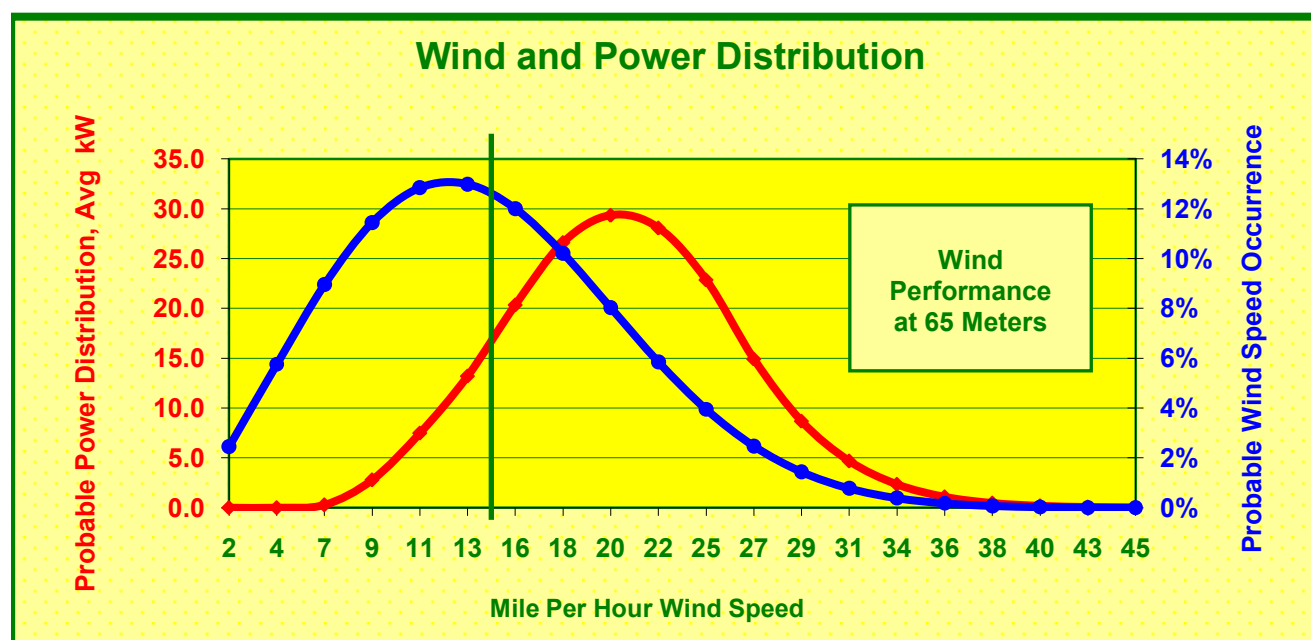
Turbine Model Used For Estimates:  
Meter Description:

|                             |
|-----------------------------|
| Aeronautica / Norwin 54-750 |
| High School 1               |

### Weibull Performance Calculations:

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0  | 0.00                   | 2.48%                | 0.000              | 66.8%            | 24.3%             |
| 2                         | 4.47  | 0  | 0.00                   | 5.81%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4  | 3.11                   | 9.03%                | 0.281              |                  |                   |
| 4                         | 8.95  | 30.4   | 23.67                  | 11.53%               | 2.729              |                  |                   |
| 5                         | 11.18 | 72.6   | 56.52                  | 12.91%               | 7.297              |                  |                   |
| 6                         | 13.42 | 126.7  | 98.63                  | 13.03%               | 12.851             |                  |                   |
| 7                         | 15.66 | 211.2  | 164.42                 | 12.01%               | 19.745             |                  |                   |
| 8                         | 17.90 | 324.7  | 252.77                 | 10.18%               | 25.743             | 31.7%            | 71.0%             |
| 9                         | 20.13 | 455.4  | 354.52                 | 7.98%                | 28.285             |                  |                   |
| 10                        | 22.37 | 598  | 465.53                 | 5.79%                | 26.941             |                  |                   |
| 11                        | 24.61 | 720.7  | 561.05                 | 3.89%                | 21.830             |                  |                   |
| 12                        | 26.84 | 750  | 583.86                 | 2.43%                | 14.166             |                  |                   |
| 13                        | 29.08 | 750  | 583.86                 | 1.40%                | 8.192              |                  |                   |
| 14                        | 31.32 | 750  | 583.86                 | 0.75%                | 4.393              | 1.4%             | 4.7%              |
| 15                        | 33.55 | 750  | 583.86                 | 0.37%                | 2.184              |                  |                   |
| 16                        | 35.79 | 750  | 583.86                 | 0.17%                | 1.006              |                  |                   |
| 17                        | 38.03 | 750  | 583.86                 | 0.07%                | 0.429              |                  |                   |
| 18                        | 40.26 | 750  | 583.86                 | 0.03%                | 0.169              |                  |                   |
| 19                        | 42.50 | 750  | 583.86                 | 0.01%                | 0.062              |                  |                   |
| 20                        | 44.74 | 750  | 583.86                 | 0.00%                | 0.021              |                  |                   |
| Totals                    |       |  |                        | 99.89%               | 176.323            | 99.9%            | 100.0%            |

|              |  |
|--------------|--|
| <b>14.30</b> | Site Average Wind Speed (MPH) at 65 Meters |
|--------------|--|



## Wind Resource Report, Site Wind Characteristics

**18780 County Road, Pettisville, Ohio 43553**

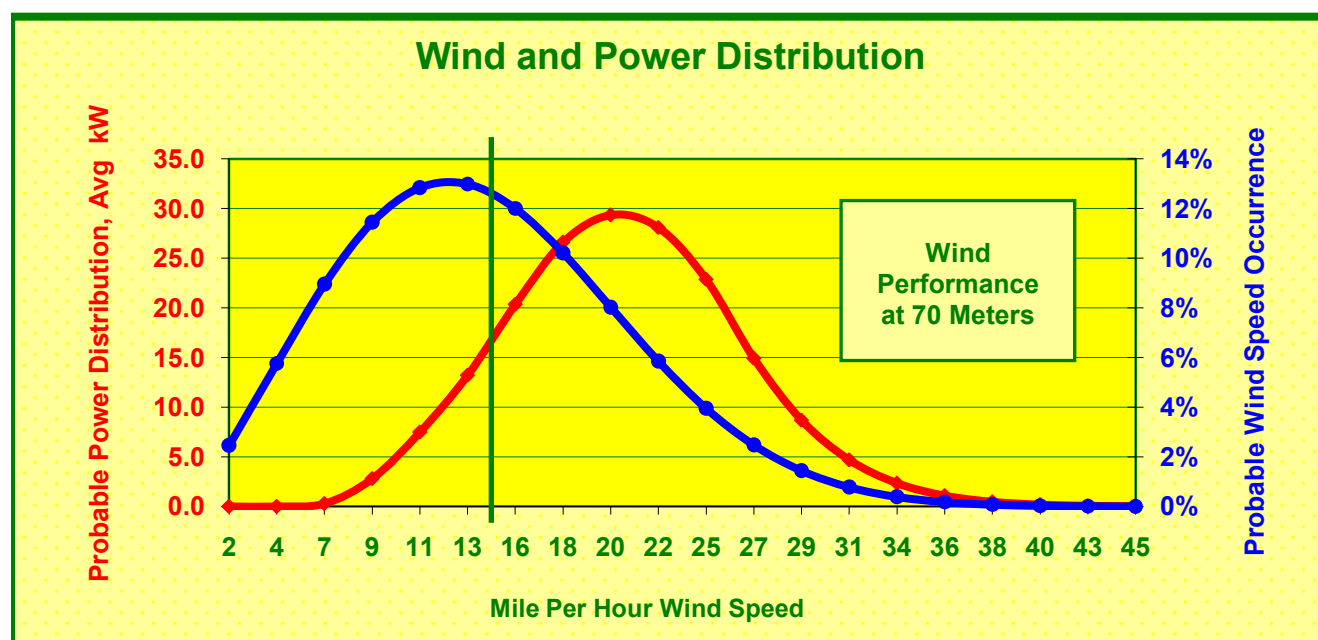
**0**

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750  
 Meter Description: High School 1

### Weibull Performance Calculations:

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0  | 0.00                   | 2.46%                | 0.000              | 66.5%            | 24.0%             |
| 2                         | 4.47  | 0  | 0.00                   | 5.76%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4  | 3.21                   | 8.96%                | 0.287              |                  |                   |
| 4                         | 8.95  | 30.4   | 24.39                  | 11.45%               | 2.793              |                  |                   |
| 5                         | 11.18 | 72.6   | 58.26                  | 12.84%               | 7.481              |                  |                   |
| 6                         | 13.42 | 126.7  | 101.67                 | 12.99%               | 13.203             |                  |                   |
| 7                         | 15.66 | 211.2  | 169.47                 | 12.00%               | 20.340             |                  |                   |
| 8                         | 17.90 | 324.7  | 260.55                 | 10.21%               | 26.604             | 32.0%            | 71.1%             |
| 9                         | 20.13 | 455.4  | 365.43                 | 8.03%                | 29.341             |                  |                   |
| 10                        | 22.37 | 598  | 479.85                 | 5.85%                | 28.068             |                  |                   |
| 11                        | 24.61 | 720.7  | 578.31                 | 3.95%                | 22.856             |                  |                   |
| 12                        | 26.84 | 750  | 601.82                 | 2.48%                | 14.913             |                  |                   |
| 13                        | 29.08 | 750  | 601.82                 | 1.44%                | 8.678              |                  |                   |
| 14                        | 31.32 | 750  | 601.82                 | 0.78%                | 4.685              | 1.5%             | 4.8%              |
| 15                        | 33.55 | 750  | 601.82                 | 0.39%                | 2.346              |                  |                   |
| 16                        | 35.79 | 750  | 601.82                 | 0.18%                | 1.089              |                  |                   |
| 17                        | 38.03 | 750  | 601.82                 | 0.08%                | 0.468              |                  |                   |
| 18                        | 40.26 | 750  | 601.82                 | 0.03%                | 0.187              |                  |                   |
| 19                        | 42.50 | 750  | 601.82                 | 0.01%                | 0.069              |                  |                   |
| 20                        | 44.74 | 750  | 601.82                 | 0.00%                | 0.023              |                  |                   |
| Totals                    |       |  |                        | 99.89%               | 183.433            | 99.9%            | 100.0%            |

**14.36**      Site Average Wind Speed (MPH) at 70 Meters



## Wind Resource Report, Site Wind Characteristics

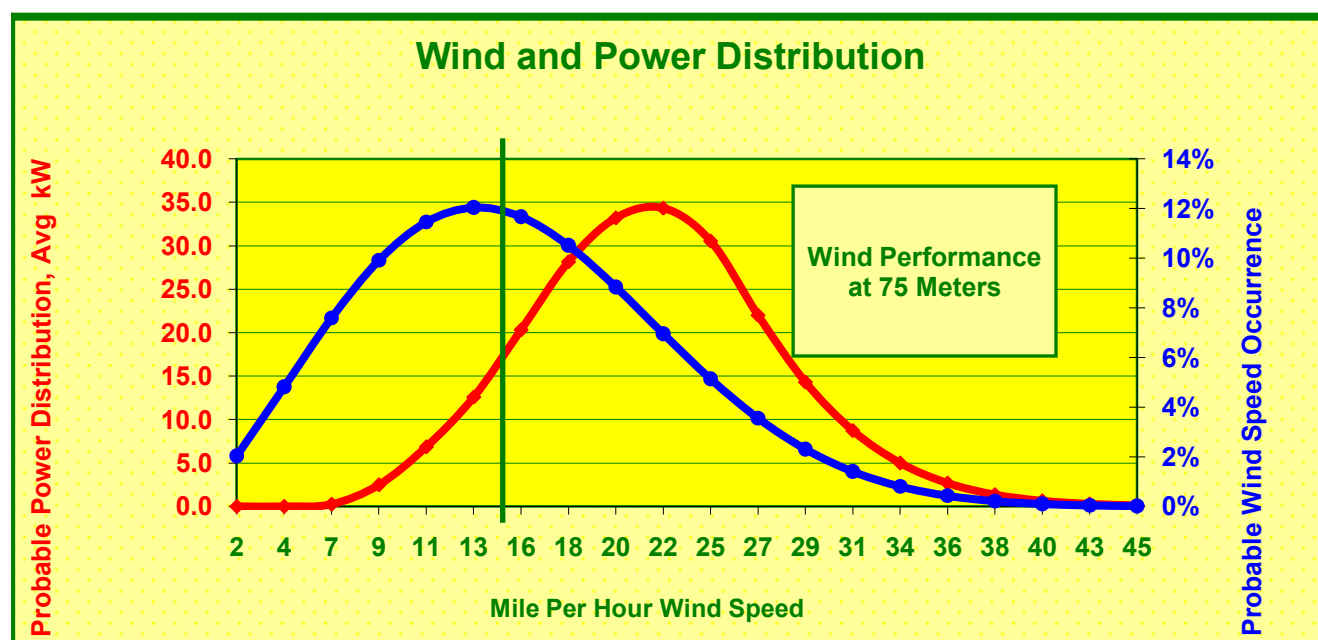
**18780 County Road, Pettisville, Ohio 43553**

Turbine Model Used For Estimates: Aeronautica / Norwin 54-750  
 Meter Description: High School 1

**Weibull Performance Calculations:**

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0.0  | 0.00                   | 2.37%                | 0.000              | 65.1%            | 23.0%             |
| 2                         | 4.47  | 0.0  | 0.00                   | 5.56%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4.0  | 3.46                   | 8.68%                | 0.300              |                  |                   |
| 4                         | 8.95  | 30.4   | 26.30                  | 11.14%               | 2.931              |                  |                   |
| 5                         | 11.18 | 72.6   | 62.82                  | 12.58%               | 7.900              |                  |                   |
| 6                         | 13.42 | 126.7  | 109.63                 | 12.82%               | 14.054             |                  |                   |
| 7                         | 15.66 | 211.2  | 182.74                 | 11.97%               | 21.866             |                  |                   |
| 8                         | 17.90 | 324.7  | 280.94                 | 10.30%               | 28.943             | 33.1%            | 71.6%             |
| 9                         | 20.13 | 455.4  | 394.03                 | 8.22%                | 32.371             |                  |                   |
| 10                        | 22.37 | 598.0  | 517.42                 | 6.08%                | 31.471             |                  |                   |
| 11                        | 24.61 | 720.7  | 623.58                 | 4.19%                | 26.103             |                  |                   |
| 12                        | 26.84 | 750.0  | 648.93                 | 2.68%                | 17.388             |                  |                   |
| 13                        | 29.08 | 750.0  | 648.93                 | 1.60%                | 10.354             |                  |                   |
| 14                        | 31.32 | 750.0  | 648.93                 | 0.88%                | 5.735              | 1.7%             | 5.4%              |
| 15                        | 33.55 | 750.0  | 648.93                 | 0.46%                | 2.953              |                  |                   |
| 16                        | 35.79 | 750.0  | 648.93                 | 0.22%                | 1.413              |                  |                   |
| 17                        | 38.03 | 750.0  | 648.93                 | 0.10%                | 0.628              |                  |                   |
| 18                        | 40.26 | 750.0  | 648.93                 | 0.04%                | 0.259              |                  |                   |
| 19                        | 42.50 | 750.0  | 648.93                 | 0.02%                | 0.099              |                  |                   |
| 20                        | 44.74 | 750.0  | 648.93                 | 0.01%                | 0.035              |                  |                   |
| Totals                    |       |  |                        | 99.89%               | 204.804            | 99.9%            | 100.0%            |

**14.59**      Site Average Wind Speed (MPH) at 75 Meters



## Wind Resource Report, Site Wind Characteristics

**18780 County Road, Pettisville, Ohio 43553**



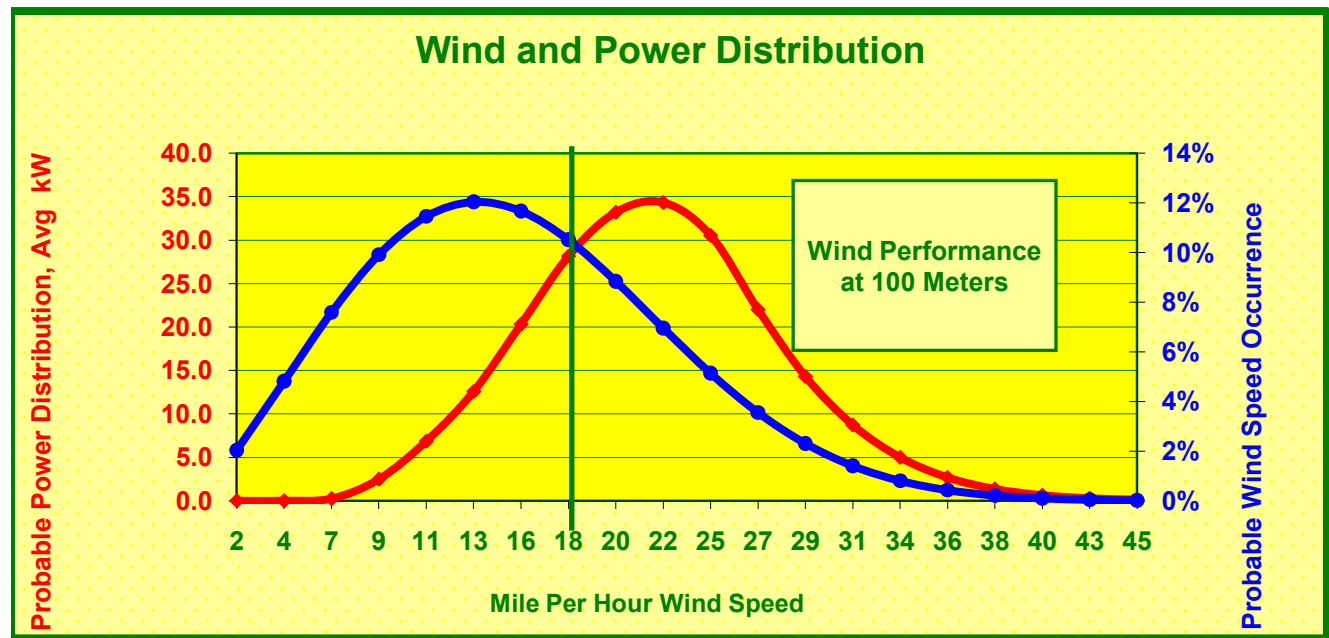
Turbine Model Used For Estimates:  
 Meter Description:

Aeronautica / Norwin 54-750  
 High School 1

**Weibull Performance Calculations:**

| Yearly Average Wind Speed |       | Turbine Power Curve For Given Average Wind Speeds (kW) | Site Weather Constants | Wind Probability (f) | Average Net kW @ V | Area Wind Dist.: | Area Power Dist.: |
|---------------------------|-------|--|------------------------|----------------------|--------------------|------------------|-------------------|
| Bin (m/s)                 | (mph) |  |                        |                      |                    |                  |                   |
| 1                         | 2.24  | 0  | 0.00                   | 2.04%                | 0.000              | 59.5%            | 19.0%             |
| 2                         | 4.47  | 0  | 0.00                   | 4.81%                | 0.000              |                  |                   |
| 3                         | 6.71  | 4  | 3.30                   | 7.59%                | 0.250              |                  |                   |
| 4                         | 8.95  | 30.4   | 25.06                  | 9.92%                | 2.485              |                  |                   |
| 5                         | 11.18 | 72.6   | 59.85                  | 11.46%               | 6.858              |                  |                   |
| 6                         | 13.42 | 126.7  | 104.45                 | 12.04%               | 12.577             |                  |                   |
| 7                         | 15.66 | 211.2  | 174.11                 | 11.67%               | 20.319             |                  |                   |
| 8                         | 17.90 | 324.7  | 267.68                 | 10.51%               | 28.142             | 37.3%            | 72.6%             |
| 9                         | 20.13 | 455.4  | 375.43                 | 8.84%                | 33.197             |                  |                   |
| 10                        | 22.37 | 598  | 492.99                 | 6.96%                | 34.320             |                  |                   |
| 11                        | 24.61 | 720.7  | 594.15                 | 5.14%                | 30.527             |                  |                   |
| 12                        | 26.84 | 750  | 618.30                 | 3.56%                | 21.998             |                  |                   |
| 13                        | 29.08 | 750  | 618.30                 | 2.31%                | 14.297             |                  |                   |
| 14                        | 31.32 | 750  | 618.30                 | 1.41%                | 8.722              | 3.0%             | 8.4%              |
| 15                        | 33.55 | 750  | 618.30                 | 0.81%                | 4.993              |                  |                   |
| 16                        | 35.79 | 750  | 618.30                 | 0.43%                | 2.682              |                  |                   |
| 17                        | 38.03 | 750  | 618.30                 | 0.22%                | 1.351              |                  |                   |
| 18                        | 40.26 | 750  | 618.30                 | 0.10%                | 0.638              |                  |                   |
| 19                        | 42.50 | 750  | 618.30                 | 0.05%                | 0.282              |                  |                   |
| 20                        | 44.74 | 750  | 618.30                 | 0.02%                | 0.117              |                  |                   |
| Totals                    |       |  |                        | 99.90%               | 223.757            | 99.9%            | 100.0%            |

**15.59** Site Average Wind Speed (MPH) at 100 Meters



**SOIL EXPLORATION,  
PROPOSED WIND TURBINE,  
PETTISVILLE HIGH SCHOOL,  
232 SUMMIT STREET,  
PETTISVILLE, FULTON COUNTY, OHIO**

**The Renaissance Group  
c/o Buehrer Group Architecture & Engineering, Inc.  
Attention: Sam Muhsen, P.E., SECB, LEED AP  
314 Conant Street  
Maumee, Ohio 43537-3358**

**Report No. 152730-1110-2622**

**November 22, 2010**



**BOWSER-MORNER**

1419 Miami Street (43605) • P. O. Box 838 • Toledo, Ohio 43697-0838  
419-691-4800

**Geotechnical Laboratory Report**

**Report To:** The Renaissance Group **Date:** November 22, 2010  
c/o Buehrer Group Architecture **Laboratory Job No.:** 152730  
& Engineering, Inc.  
**Attention:** Sam Muhsen, P.E., SECB, LEED AP **Report No.:** 152730-1110-2622  
314 Conant Street **Report Consists of 22 Pages**  
Maumee, Ohio 43537-3358

**Report On:** SOIL EXPLORATION,  
Proposed Wind Turbine, Pettisville High School, 232 Summit Street,  
Pettisville, Fulton County, Ohio

Ladies and Gentlemen:

Bowser-Morner, Inc. has completed the authorized subsurface exploration and geotechnical engineering evaluation at the above referenced project. The following report briefly reviews our exploration procedures, describes existing site and subsurface conditions, and presents our evaluations, conclusions, and recommendations.

**1.0 AUTHORIZATION**

The purpose of this subsurface exploration and geotechnical engineering evaluation was to determine the subsurface conditions at the project site and to analyze these conditions as they relate to foundation design and construction. All work was performed in accordance with Bowser-Morner technical proposal No. T-19885, dated October 26, 2010, and its attached *Proposal Acceptance Sheet* between The Renaissance Group and Bowser-Morner, Inc., dated November 3, 2010. The scope of the exploration included subsurface drilling and sampling, limited laboratory testing, engineering evaluation of the field and laboratory data, and the preparation of this report.

**2.0 WORK PERFORMED****2.1 Field Exploration**

During this exploration, two soil test borings were drilled at the approximate locations shown on the attached *Boring Location Plan*. The borings were drilled to a depth of 40 feet. Boring locations were established in the field by Bowser-Morner by measuring

distances and estimating right angles from existing site features. Boring elevations were interpolated from a site topographic map. Since these measurements are not precise, the locations shown on the *Boring Location Plan* should be considered approximate.

All soil sampling and standard penetration testing was conducted in general accordance with ASTM D 1586. The borings were advanced by a truck-mounted drilling rig by mechanically twisting hollow-stem augers into the soil. At regular intervals, soil samples were obtained with a standard 2-inch O. D. split spoon sampler driven 18 inches into the soil with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and designated the "standard penetration resistance." The standard penetration resistance, or "N" value, when properly evaluated, is an index of the soil's strength, density, and ability to support foundations. The disturbed samples recovered by the split spoon sampler were visually classified in the field, logged, sealed in glass jars, and returned to the laboratory for testing and evaluation by a geotechnical engineer.

In Boring 2, the split spoon samplers were fitted with liners to obtain samples of the subsurface soils for laboratory unconfined compressive strength testing. Although the liner samples are disturbed due to pounding from the standard penetration test and the thick sidewalls of the split spoon sampler and liner, they are protected from swelling and other post-sampling disturbances and, therefore, are less disturbed than conventional split spoon samples. The unconfined compressive strength test results obtained from liner samples, while approximate, do provide the geotechnical engineer with a means to evaluate relative soil strengths.

*Boring Logs* indicating soil descriptions, penetration resistances, and observed ground-water levels are attached.

## **2.2 Previous Soil Explorations**

TTL, Associates, Inc. previously performed a soil exploration for the new school in 2009. During this study, Bowser-Morner reviewed relevant soil boring and laboratory data from the previous geotechnical study to assist in the evaluation of this project.

### 2.3 Laboratory Testing

In the laboratory, each of the samples recovered from the borings was examined and visually classified by a geotechnical engineer. In addition, samples of cohesive soils from the split spoon samplers were tested to determine the soil's approximate strength using a hand-held, calibrated spring penetrometer. These values were used by the geotechnical engineer to assist in the evaluation of the relative strengths of the subsurface soils and to aid in classification of the samples.

Nine unconfined compressive strength tests were performed on the disturbed samples recovered by the liner samplers. These tests were performed on a constant rate of strain apparatus with a deformation rate adjusted to cause failure of the sample in less than 10 minutes. Note that care should be utilized in applying these test values due to the method of sampling. The results of these tests have been summarized and tabulated below.

| <b>Boring and Sample No.</b> | <b>Sample Depth (ft)</b> | <b>Moisture Content (%)</b> | <b>Dry Unit Weight (pcf)</b> | <b>Unconfined Compressive Strength (psf)</b> | <b>Strain at Failure (%)</b> |
|------------------------------|--------------------------|-----------------------------|------------------------------|--|------------------------------|
| 2-2                          | 3.5 - 5.0                | 16.7                        | 115.2                        | 12,393                                       | 13.0                         |
| 2-3                          | 6.0 - 7.5                | 19.6                        | 111.8                        | 9,835  | 20.0                         |
| 2-4                          | 8.5 - 10.0               | 19.9                        | 117.8                        | 7,700  | 19.3                         |
| 2-5                          | 13.5 - 15.0              | 20.9                        | 108.6                        | 6,334  | 20.0                         |
| 2-6                          | 18.5 - 20.0              | 22.0                        | 107.5                        | 4,199  | 20.0                         |
| 2-7                          | 23.5 - 25.0              | 23.0                        | 107.3                        | 4,542  | 20.0                         |
| 2-8                          | 28.5 - 30.0              | 24.3                        | 109.8                        | 1,671  | 19.8                         |
| 2-9                          | 33.5 - 35.0              | 23.2                        | 109.3                        | 3,202  | 20.0                         |
| 2-10                         | 38.5 - 40.0              | 21.9                        | 107.5                        | 2,844  | 20.0                         |

Soil samples are normally retained in our laboratory for a period of 60 days before they are discarded. To view the samples or arrange for longer storage of samples, please contact us.



### 3.0 SITE AND SUBSURFACE CONDITIONS

#### 3.1 Site Description

The proposed site is located on the Pettisville Schools campus in Pettisville, Fulton County, Ohio. Specifically, the wind turbine will be located about 350 feet south of County Road D between Oak and Willow Street.

#### 3.2 Soil Profile

Data from the soil test borings are shown on the attached *Boring Logs*. The subsurface conditions discussed in the following paragraphs and those shown on the *Boring Logs* represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Geologically, the project site is situated in a glacial ground moraine that consists of till containing an unsorted, unstratified mixture of clay, silt, sand and coarser fragments deposited discontinuously by advancing ice. Overlying the glacial till is a layer of laminated silts and clays of lacustrine origin.

Topsoil covers the ground surface at both boring locations and was recorded by the drillers as 14 inches in thickness. Below the topsoil is medium dense brown sand with varying amounts of silt and gravel. The sandy soil extended to depths between 2 and 3 feet. Underlying the sandy soil is glacial till. The glacial till was described as gray clay and silt with some sand and trace amounts of gravel. The gray glacial till extended to the bottom of both borings.

The sand has a consistency of medium dense. The glacial till soils found in the top 25 feet have an undrained shear strength in the range of 2,000 to greater than 5,000 pounds per square foot (psf). Below 25 feet, the soils have an undrained shear strength in the range of 1,000 to 1,600 psf.

#### 3.3 Groundwater Observations

During the field exploration, the drilling rods and sampling equipment were continuously checked by the drillers for indications of groundwater or seepage. The *Boring Logs* list

our driller's observations of groundwater or seepage. Three readings are recorded on the logs. The initial groundwater level indicates the depth(s) at which groundwater or seepage was initially noted by the drillers as the boring was being advanced and the intensity of the seepage. The completion groundwater level represents the depth groundwater was observed in the borehole immediately after the completion of the hole. The last reading on the *Boring Logs* represents the depth groundwater was observed in the borehole after an increment of time has passed. In this case, both the depth and time are listed.

Groundwater was not encountered in any of the borings.

Groundwater levels fluctuate with seasonal and climatic variations and may be different at other times. More specific information regarding groundwater levels, standard penetration resistances, and soil descriptions is detailed on the attached *Boring Logs*.

#### **4.0 PROPOSED CONSTRUCTION**

It is our understanding that the proposed construction is to consist of a new wind turbine. The turbine will be 197 feet tall to the hub. We understand that the vertical load for the tower will be about 115 kips with a lateral load of about 50 kips and an overturning moment of about 5,000 kip-ft. If these assumptions are not appropriate for the intended construction, please contact us so we can re-evaluate our recommendations.

#### **5.0 EVALUATIONS AND CONCLUSIONS**

The following evaluations and conclusions are based on our interpretation of the field and laboratory data obtained during the exploration and our experience with similar subsurface conditions. Soil penetration data and laboratory data have been used to estimate allowable bearing pressures using commonly accepted geotechnical engineering practices. Subsurface conditions in uninvestigated locations between borings may vary considerably from those encountered in the borings. If structure location, loadings, or levels are changed, we request we be advised so we may re-evaluate our recommendations.

##### **5.1 Foundations**

The proposed wind turbine may be supported on either a mat foundation bearing in the glacial soils or on deep foundations. Mat foundations bearing on the original undisturbed

glacial silty clay soil may be designed for a net allowable soil bearing capacity of 5,000 psf at frost depth (3.5 feet) or below.

Deep foundations may also be used. Drilled piers are typically selected for this application. Drilled piers may be designed for a combination of skin resistance and end-bearing. The following typical soil profile can be used to estimate drilled pier capacities.

| <b>Design Soil Profile</b><br>(Ultimates – Use F. S. = 3.0 for Design) |                             |   |                                   |
|--|-----------------------------|---|-----------------------------------|
| <b>Approx. Depth (ft)</b>  | <b>Typical Soil Deposit</b> | <b>Ultimate Skin Resistance {Compression} (psf)</b> | <b>Ultimate End Bearing (psf)</b> |
| 0 – 20.0   | Very Stiff Glacial Till     | 2,000   | 18,000                            |
| 20.0 – 40.0  | Medium Stiff Glacial Till   | 825   | 13,500                            |

The values given in the above tables are ultimates and should be divided by a suitable factor-of-safety to achieve the design working capacities of the piles. A factor-of-safety of 3.0 is recommended for this application.

Skin friction values are reduced for drilled piers for uplift conditions. For uplift capacity, the above skin friction values should be multiplied by 0.7.

Settlement under static load conditions for either a mat foundation or a drilled pier should be small and likely will be less than 0.5 inches for an octagonal mat foundation that is placed at a depth of 5 feet and has a nominal width of 40 feet.

## **5.2 Foundation Construction and Evaluation**

### **5.2.1 Spread Footings**

Bottoms of foundation excavations should be evaluated by a geotechnical engineer prior to the placement of reinforcing steel and concrete to verify adequate bearing materials are present and all debris, mud, and loose, frozen, or water-softened soils are removed.

Foundation excavations should be concreted as soon as practical after they are excavated. Water should not be allowed to pond in any excavation. If an exca-

vation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Foundation concrete should not be placed on frozen or flooded subgrades.

### **5.2.2 Drilled Piers**

If drilled piers are chosen as a design alternate, it would be our recommendation they be installed in substantial accordance with the attached *Suggested Items for Inclusion in the Specification for Drilled Piers*. Drilled piers installation should be continuously monitored by Bowser-Morner to verify adequate bearing materials are present, to check that the drilled piers are plumb and bells are properly sized, and to help ensure that the bottom of the caissons have been properly cleaned.

### **5.3 Special Inspections**

The International Building Code (IBC) requires “Special Inspections”. These inspections are required in 14 major categories of work and are over and above the inspections that building officials commonly provide per Section 109. The purpose of the special inspector is to review aspects of construction that require special knowledge and training that the code official does not possess.

For each project, the Department of Commerce’s Division of Industrial Compliance requires the principal designer to identify which materials and contracted work require special inspections and specify the frequency of inspection. The designer is to submit this completed list with the building permit application.

At the completion of the project, a *Final Report of Special Inspections* must be submitted by the registered design professional in responsible charge of the project in order to receive the final occupancy permit.

Bowser-Morner, Inc. is capable of providing the special inspection services. Based on our current understanding of your project, we have developed the following summary of the required Special Inspections:

| <b>SOILS AND FOUNDATIONS – 1704.4</b>  |  |
|--|--|
| <b>Item</b>                            | <b>Scope</b>   |
| 1. Shallow Foundations                 | <i>Inspect soils below footings for adequate bearing capacity and consistency with geotechnical report.<br/>Inspect removal of unsuitable material and preparation of subgrade prior to placement of controlled fill.</i>  |
| 2. Deep Foundations:<br>Drilled Piers: | <i>Inspect installation of drilled pier foundations. Verify pier diameter, bell diameter, lengths, embedment into bedrock, and suitability of end bearing strata.</i>  |
| 3. Load Testing                        | <i>Compressive load testing (ASTM D1143)<br/>Tensile load testing (ASTM D3689)</i>   |
| <b>Cast-in-Place Concrete – 1704.4</b> |  |
| 1. Mix Design                          | <i>Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design.<br/>Mix designs, mix verifications.</i>   |
| 2. Material Certification              |  |
| 3. Reinforcement Installation          | <i>Inspect size, spacing, cover, positioning, and grade of reinforcing steel. Verify that reinforcing bars are free of form oil or other deleterious materials. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters.</i> |
| 4. Post-Tensioning Operations          | <i>Inspect placement, stressing, grouting, and protection of post-tensioning tendons. Verify that tendons are correctly positioned, supported, tied, and wrapped.<br/>Record tendon elongations.</i>   |
| 5. Welding of Reinforcing              | <i>Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required.</i>   |
| 6. Anchor Rods                         | <i>Inspect size, positioning, and embedment of anchor rods. Inspect concrete placement and consolidation around anchors.</i>   |
| 7. Concrete Placement                  | <i>Inspect placement of concrete. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.</i>   |
| 8. Sampling and Testing of Concrete    | <i>Test concrete compressive strength (ASTM C31 and C39), slump (ASTM C143), air-content (ASTM C231 or C173), and temperature (ASTM C1064).</i>  |
| 9. Curing and Protection               | <i>Inspect curing, cold weather protection, and hot weather protection procedures.</i>   |



| <b>Structural Steel – 1704.2 and 1704.3</b>  |  |
|--|--|
| 1. Fabricator Certification/Quality Control Procedures<br><input type="checkbox"/> Fabricator Exempt | <i>Review shop fabrication and quality control procedures.</i>   |
| 2. Material Certification  | <i>Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts, and welding electrodes.</i>  |
| 3. Open Web Steel Joists   | <i>Inspect installation, field welding, and bridging of joists.</i>  |
| 4. Bolting   | <i>Inspect installation and tightening of high-strength bolts. Verify that splines have separated from tension control bolts. Verify proper tightening sequence. Continuous inspection of bolts in slip-critical connections</i> |
| 5. Welding   | <i>Visually inspect all welds. Inspect pre-heat, post-heat, and surface preparation between passes. Verify size and length of fillet welds.<br/>Ultrasonic testing of all full-penetration welds</i>                             |
| 6. Shear Connectors  | <i>Inspect size, number, positioning, and welding of shear connectors. Inspect studs for full 360-degree flash. Ring test all shear connectors with a 3-pound hammer. Bend test all questionable studs to 15 degrees.</i>        |
| 7. Structural Details  | <i>Inspect steel frame for compliance with structural drawings, including bracing, member configuration, and connection details.</i>   |
| 8. Metal Deck  | <i>Inspect welding and side-lap fastening of metal roof and floor deck.</i>  |

#### **5.4 Soil Seismic Site Classification**

We have evaluated the available soil profile data developed during this study to determine the Site Class in accordance with the 2009 International Building Code. The test borings for this project did not extend to 100 feet deep and, therefore, we have estimated the depth to rock based on records we keep on file. We have also estimated the soil strength and soil types below the bottoms of the on-site borings. Based on this analysis, we have determined the Site Class is D. We may be able to upgrade the class to C with seismic wave testing. We can perform this service.

### 5.5 Groundwater Control

During the field exploration, groundwater was not encountered during drilling or at the completion of drilling. We do not expect significant difficulties with groundwater during mat foundation or drilled pier construction. As with any open excavation, groundwater may accumulate in foundation excavations or drilled pier shafts. We anticipate that the amount of water, if any, that does accumulate will be light. Any water that does accumulate should be pumped out prior to placing concrete.

The amount and type of dewatering required during construction will depend on the weather and groundwater levels at the time of construction and the effectiveness of the contractor's techniques in preventing surface runoff from entering open excavations. Typically, groundwater levels are highest during winter and spring months and lower in summer and early fall.

### 5.6 Slopes and Temporary Excavation

The owner and the contractor should make themselves aware of and become familiar with applicable local, state, and federal safety regulations, including current OSHA excavation and trench safety standards. Construction site safety generally is the sole responsibility of the contractor. The contractor shall also be solely responsible for the means, methods, techniques, sequences, and operations of construction operations. Bowser-Morner is providing the following information solely as a service to the client. Under no circumstances should Bowser-Morner's provision of the following information be construed to mean Bowser-Morner is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not implied and should not be inferred.

The contractor should be aware that slope height, slope inclination, and excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations. Such regulations are strictly enforced and, if not followed, the owner, the contractor, or earthwork or utility subcontractors could be liable for substantial penalties.

For this site, the overburden soil encountered in our exploration is mostly glacial till silty clay. We anticipate OSHA will classify this material as Type B. The sand would be classified as Type C.

Note: Soils encountered in the construction excavations may vary significantly across the site. Our preliminary soil classifications are based solely on the materials encountered in widely spaced borings. The contractor should verify similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, Bowser-Morner recommends we be contacted immediately to evaluate the conditions encountered.

If any excavation, including a utility trench, is extended to a depth of more than 20 feet, OSHA requires the side slopes of such excavation be designed by a professional engineer.

## 6.0 QUALIFICATIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project, and our experience with similar sites and subsurface conditions. Data used during this exploration included, but was not necessarily limited to:

- two exploratory borings performed during this study;
- observations of the project site by our staff;
- results of limited laboratory soil testing;
- previous geotechnical soil boring and laboratory data obtained by TTL Associates, Inc. during a soil exploration for the new Pettisville School;
- preliminary site plans and drawings furnished by Buehrer Group Architecture & Engineering, Inc.;
- limited interaction with Mr. Sam Muhsen; and
- published soil or geologic data of this area.

In the event changes in the project characteristics are planned, or if additional information or differences from the conditions anticipated in this report become apparent, Bowser-Morner, Inc. should be notified so the conclusions and recommendations contained in this report can be reviewed and, if necessary, modified or verified in writing.

The subsurface conditions discussed in this report and those shown on the *Boring Logs* represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. Although individual test borings are representative

of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times.

Regardless of the thoroughness of a subsurface exploration, there is the possibility conditions between borings will differ from those at the boring locations, conditions are not as anticipated by designers, or the construction process has altered the soil conditions. As variations in the soil profile are encountered, additional subsurface sampling and testing may be necessary to provide data required to re-evaluate the recommendations of this report. Consequently, after submission of this report, it is recommended Bowser-Morner be authorized to perform additional services to work with the designer(s) to minimize errors and/or omissions regarding the interpretation and implementation of this report.

Prior to construction, we recommend that Bowser-Morner:

- work with the designers to implement the recommended geotechnical design parameters into plans and specifications;
- consult with the design team regarding interpretation of this report;
- establish criteria for the construction observation and testing for the soil conditions encountered at this site; and
- review final plans and specifications pertaining to geotechnical aspects of design.

During construction, we recommend that Bowser-Morner:

- observe the construction, particularly site preparation, fill placement, and foundation excavation or installation;
- perform in-place density testing of all compacted fill;
- perform materials testing of soil and other materials as required; and
- consult with the design team to make design changes in the event differing subsurface conditions are encountered.

If Bowser-Morner is not retained for these services, we shall assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. No other warranty, expressed or implied, is made.

The scope of our services did not include an environmental assessment for the presence or absence of hazardous or toxic materials in the soil, surfacewater, groundwater, or air, on, within, or beyond the site studied. Our work also did not include anything related to mold. Our scope of


services also did not include an evaluation for the presence or absence of wetlands or protected species. Any statements in the report or on the *Boring Logs* regarding odors, staining of soils, or other unusual items or conditions observed are strictly for the information of our client.


To evaluate the site for possible environmental liabilities, we recommend an environmental assessment, consisting of a detailed site reconnaissance, a record review, and report of findings. Additional subsurface drilling and sampling, including groundwater sampling, may be required. The presence or absence of wetlands or protected species should be determined by a wetlands study. Bowser-Morner, Inc. can provide these services and would be pleased to provide a cost proposal to perform these studies, if requested.

This report has been prepared for the exclusive use of The Renaissance Group for specific application to Proposed Wind Turbine at Pettisville High School in Pettisville, Fulton County, Ohio. Specific design and construction recommendations have been provided in the various sections of the report. The report should, therefore, be used in its entirety. This report is not a bidding document and shall not be used for that purpose. Anyone reviewing this report must interpret and draw their own conclusions regarding specific construction techniques and methods chosen. Bowser-Morner is not responsible for the independent conclusions, opinions, or recommendations made by others based on the field exploration and laboratory test data presented in this report.

Respectfully submitted,

BOWSER-MORNER, INC.

  
Ahmad K. Rashid, E.I.  
Geotechnical Engineer

  
J. Richard Hoppenjans, P.E., F. ASCE, D. GE  
Vice President, District Manager, Chief Engineer

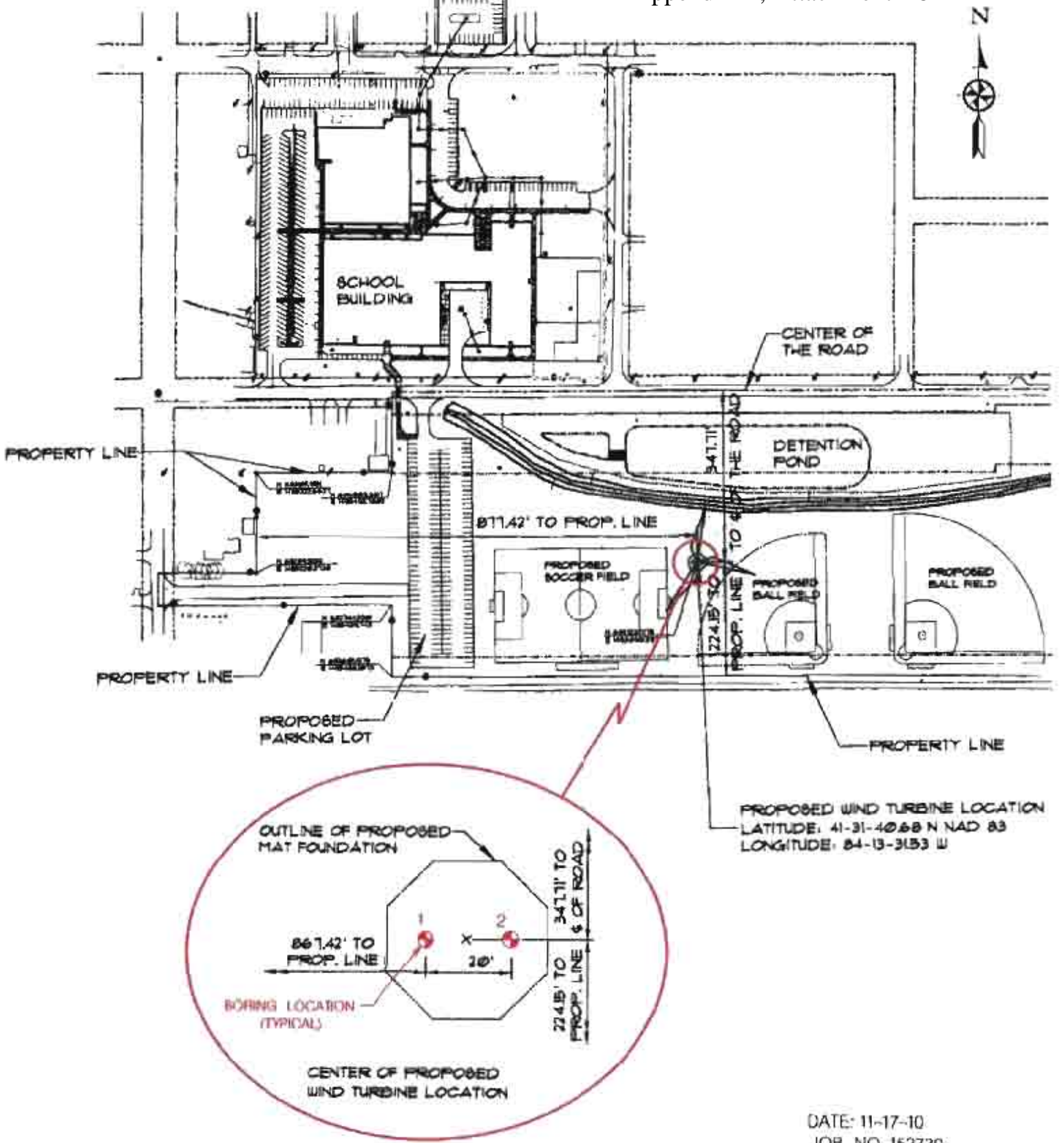
AKR/JRH:caw

Attachments: *Boring Location Plan*  
*Boring Log Terminology*  
*Boring Logs*  
*Suggested Items for Inclusion in the Specification for Drilled Piers*

1-Client (via e-mail to [sam@buehrergruop.com](mailto:sam@buehrergruop.com) and 1 bound via U. S. mail)

1- The Renaissance Group, Attn: Mr. Aaron Godwin (1 bound via U. S. mail)





SCALE: 1" = 260'

DATE: 11-17-10  
JOB NO. 152730

BORING LOCATION PLAN  
PROPOSED WIND TURBINE  
PETTISVILLE HIGH SCHOOL  
232 SUMMIT STREET  
PETTISVILLE, FULTON COUNTY, OHIO



## BORING LOG TERMINOLOGY

### Stratum Depth:

Distance in feet and/or inches below ground surface.

### Description of Materials:

When the color of the soil is uniform throughout, the color recorded will be such as brown, gray, or black and may be modified by adjectives such as light and dark. If the soil's predominant color is shaded by a secondary color, the secondary color precedes the primary color, such as gray and brown, yellow and brown. If two major and distinct colors are swirled throughout the soil, the colors will be modified by the term mottled, such as mottled brown and gray.

There are two types of visual classification methods currently used by Bowser-Morner, Inc. The first is ASTM D2488. This method results in classifications such as "lean clay". The second method is the ASEE system or Burmister system. This system results in classifications such as "silt and clay, with traces of sand" and is described below.

| Particle Size |        | Visual   |
|---------------|--------|--|
| Boulders      |        | Larger than 8"   |
| Cobbles       |        | 8" to 3"   |
| Gravel:       | Coarse | 3" to 3/4"   |
|               | Fine   | 3/4" to 2 mm   |
| Sand:         | Coarse | 2 mm to 0.6 mm<br>(pencil size)  |
|               | Medium | 0.6 mm to 0.2 mm<br>(table sugar & salt size)  |
|               | Fine   | 0.2 mm to 0.06 mm<br>(powdered sugar size)   |
| Silt          |        | 0.06 mm to 0.002 mm  |
| Clay          |        | 0.002 mm and smaller<br>(particles of silt and clay size are not visible to the naked eye) |

| Soil Components  |                      |
|------------------|----------------------|
| Major Components | Minor Component Term |
| Gravel           | Trace.....1 - 10%    |
| Sand             | Some.....11 - 35%    |
| Silt             | And.....36 - 50%     |
| Clay             |                      |

| Moisture Content |  |
|------------------|--|
| Term             | Relative Moisture  |
| Dry              | Powdery  |
| Damp             | Moisture content below plastic limit                         |
| Moist            | Moisture content above plastic limit, but below liquid limit |
| Wet              | Moisture content above liquid limit                          |

| Condition of Soil Relative to Compactness<br>(Granular Material) |                     |
|--|---------------------|
| Condition  | N                   |
| Very Loose   | 5 blows/ft or less  |
| Loose  | 6 to 10 blows/ft    |
| Medium Dense   | 11 to 30 blows/ft   |
| Dense  | 31 to 50 blows/ft   |
| Very Dense   | 51 blows/ft or more |

| Condition of Soil Relative to Consistency<br>(Cohesive Material) |                                      |
|--|--------------------------------------|
| Condition  | Approximate Undrained Shear Strength |
| Very Soft  | Less than 250 psf                    |
| Soft   | 250 to 500 psf                       |
| Medium Stiff   | 500 to 1,000 psf                     |
| Stiff  | 1,000 to 2,000 psf                   |
| Very Stiff   | 2,000 to 4,000 psf                   |
| Hard   | Greater than 4,000 psf               |

**Sample Number:**

Sample numbers are designated consecutively, increasing with depth for each boring.

**Sample Type:**

- "A" Split spoon, 2-inch O.D., 1-3/8-inch I.D., 18 inches in length.  
 "B" One of the following:  
     Power Auger Sample  
     Piston Sample  
     Liner Sample  
     Denison Sample  
     Sonic Sample  
 "C" Shelby Tube 3-inch O.D., except where noted.

**Sample Depth:**

The depth below top of ground at which the sample was taken.

**Blows per 6 inches on Sampler:**

The number of blows required to drive a 2-inch O.D., 1-3/8-inch I.D., split spoon sampler, using a 140-pound hammer with a 30-inch free fall, is recorded for 6 inch drive increments. (Example: 3/8/9)

**"N" Blows/Feet:**

Standard penetration resistance. This value is based on the total number of blows required for the last 12 inches of penetration. (Example: 3/8/9 : N = 8 + 9 = 17)

**Water Observations:**

The depth of water recorded in the test boring is measured from the top of ground to the top of the water level. Initial depth indicates the water level during boring, completion depth indicates the water level immediately after boring, and depth after "X" number of hours indicates the water level after letting the water rise or fall over a time period. Water observations in pervious (sand and gravel) soils are considered reliable ground water levels for that date, Water observations in impervious (silt and clay) soils cannot be considered accurate unless records are made over a time period of several days to a month. Factors such as weather, soil porosity, etc. will cause the ground water level to fluctuate for both pervious and impervious soils.

## SUGGESTED ITEMS FOR INCLUSION IN THE SPECIFICATION FOR DRILLED PIERS

1. The Contractor shall furnish all labor and equipment necessary or incidental to the completion of all drilled piers in strict accordance with drawings and specifications.
2. The piers shall be formed by means acceptable to the Owner.
3. The work includes the excavation of all materials encountered, both wet and dry, and the removal of all excavated material from the job site.
4. The maximum variation of the center of piers from the required location shall be no greater than 50 mm (1 inch) at the ground surface, and no pier shall be out of plumb more than 1% (one percent).
5. The diameter of each pier and bell shall conform to the dimensions shown on the drawings.
6. If boulders are encountered in the piers, they shall be removed as extra work. The Contractor shall establish in his contract a unit price for removing boulders. Boulders are considered as being larger than 0.028 cubic meter (one cubic foot) in size. Smaller material shall not be classified as boulders.
7. Drilled piers shall extend to the depth shown on the drawings unless otherwise specified by the Owner or his representative.
8. The depth of drilled piers, for contract work purposes, is shown on the drawings. If, in order to reach suitable material (as determined by the Owner or his representative), the depth of piers is deeper or more shallow, the price shall be adjusted in accordance with the contract.
9. Each pier shall be examined by the Owner or his representative to confirm that the pier is bearing on suitable material, that the bell is of the required size, and that it is free of debris and water before concrete is placed. The Contractor shall case any pier into which

workmen or other personnel will enter and will use confined space entry procedures. Concrete shall not be placed until the pier is approved by the Owner or his representative.

The Contractor shall provide a mechanical device on the belling tool to measure the size of any required bell. Observation of the soil cuttings and measurement made from the ground surface shall be used to assess the suitability of the bearing material and size and depth of the shaft. If there is any question as to the suitability of the excavation, the Contractor shall install a full-length casing into the shaft and provide all equipment necessary to enter the hole for inspection by the Owner or his representative. Confined space entry procedures will be required.

10. The Contractor shall provide and operate all equipment necessary to pump and remove all water that may be encountered in the construction of piers, without additional payment therefor. The Contractor shall case all piers where necessary to shut off the flow of water and belling shall be done in a dry shaft below the casing.
11. The drilled pier shall be filled with concrete as specified below. In instances where it is necessary to case a shaft, the shaft shall be filled with concrete prior to extraction of the casing. The casing shall be pulled by a slow, even lift. Once begun, the pulling shall be continuous and additional concrete shall be placed to keep the shaft full.
12. Concrete shall be produced, placed, and protected in accordance with ACI 301 unless otherwise stated. Concrete shall have a minimum compressive strength of 20,700 kPa (3,000 psi) in 28 days. It shall be placed with a slump of 75 mm to 150 mm (3 to 6 inches).
13. Concreting of the piers shall be done in such a manner that segregation of the concrete is avoided. The concrete shall be placed by means of an "elephant's trunk" or funnel so that the concrete is deposited in the center of the shaft and does not impact on reinforcing steel or the sides of the shaft.
14. The placing of concrete for any one pier shall be continuous. Any interruption in the progress of excavation, protection of the excavation with steel liners, or placing of the concrete must have the approval of the Owner or his representative.



|  |                                |  |                                  |
|--|--------------------------------|--|----------------------------------|
| <b>CLIENT</b><br><b>THE RENAISSANCE GROUP</b>  | JOB NO.<br><b>152730</b>       | <b>B-1</b><br>Boring No.<br><hr/> Sheet 1 of 2 |                                  |
| <b>PROJECT</b><br><b>PROPOSED WIND TURBINE, PETTISVILLE HIGH SCHOOL, 232 SUMMIT STREET, PETTISVILLE, FULTON COUNTY, OHIO</b> | BORING STARTED <b>11/15/10</b> |  | BORING COMPLETED <b>11/15/10</b> |
|  | DRILLER <b>Clint J.</b>        |  | METHOD <b>3 1/4" HSA</b>         |
|  | TYPED BY <b>kms</b>            |  |                                  |

| DEPTH | SAMPLE NO. | SAMPLER TYPE RECOVERY | GRAPHIC LOG  | PROJECT LOCATION                                     |       | BLOW COUNTS | COMMENTS | REMARKS |
|-------|------------|-----------------------|--|--|-------|-------------|----------|---------|
|       |            |                       |  | LAT.   | LONG. |             |          |         |
|       |            |                       |  | SURFACE ELEVATION <b>745.0</b>                       |       |             |          |         |
|       |            |                       |  | BORING LOCATION<br>As shown on Boring Location Plan. |       |             |          |         |
|       |            |                       |  | VISUAL CLASSIFICATION OF THE MATERIAL                |       |             |          |         |
|       |            |                       | Topsoil  |  |       |             |          |         |
| 1.0   | 1A         |                       | Medium dense brown sand, trace of silt, trace of gravel, moist   |  |       | 3           |          |         |
| 2.0   |            |                       | Very stiff gray clay and silt, some sand, trace of gravel, moist |  |       | 6           | 12       |         |
| 3.0   |            |                       |  |  |       | 6           |          |         |
| 4.0   | 2A         |                       |  |  |       | 6           |          |         |
| 5.0   |            |                       |  |  |       | 9           | 18       |         |
| 6.0   |            |                       |  |  |       | 9           |          |         |
| 7.0   | 3A         |                       |  |  |       | 5           |          |         |
| 8.0   |            |                       |  |  |       | 6           | 15       |         |
| 9.0   | 4A         |                       | (Becomes stiff at 8.5')  |  |       | 3           |          |         |
| 10.0  |            |                       |  |  |       | 5           |          |         |
| 11.0  |            |                       |  |  |       | 6           | 11       |         |
| 12.0  |            |                       |  |  |       |             |          |         |
| 13.0  |            |                       |  |  |       |             |          |         |
| 14.0  | 5A         |                       | (Becomes medium stiff at 13.5')                                  |  |       | 2           |          |         |
| 15.0  |            |                       |  |  |       | 3           | 8        |         |
| 16.0  |            |                       |  |  |       | 5           |          |         |
| 17.0  |            |                       |  |  |       |             |          |         |
| 18.0  |            |                       |  |  |       |             |          |         |
| 19.0  | 7A         |                       |  |  |       | 3           |          |         |
| 20.0  |            |                       |  |  |       | 4           | 9        |         |
| 21.0  |            |                       |  |  |       | 5           |          |         |
| 22.0  |            |                       |  |  |       |             |          |         |

Continued Next Page

WATER LEVEL MEASUREMENTS

|               |       |            |
|---------------|-------|------------|
| INITIAL       | DEPTH | DATE       |
| NONE          | NONE  | 11/15/2010 |
| AT COMPLETION | 32.0' | 11/15/2010 |
| OTHER         | N/A   | N/A        |

- A — SPLIT SPOON
- B — ROCK CORE
- C — SHELBY TUBE
- D — SOIL PROBE
- E — AUGER CUTTINGS
- F — SONIC

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GINT Report Used: NEWLOGIN Report No.: 152730.1110.XXXX.GPJ GINT Template Used: NEWLOGIN.GDT Date Printed: 11/22/10

|   |                                |                                  |  |
|---|--------------------------------|----------------------------------|--|
| CLIENT<br><b>THE RENAISSANCE GROUP</b>  | JOB NO.<br><b>152730</b>       |                                  | <b>B-1</b><br>Boring No.<br><br>Sheet 2 of 2 |
|   | BORING STARTED <b>11/15/10</b> | BORING COMPLETED <b>11/15/10</b> |  |
| PROJECT<br><b>PROPOSED WIND TURBINE, PETTISVILLE HIGH SCHOOL, 232 SUMMIT STREET, PETTISVILLE, FULTON COUNTY, OHIO</b> |                                | METHOD<br><b>3 1/4" HSA</b>      |  |
| DRILLER<br><b>Clint J.</b>  |                                | TYPED BY<br><b>kms</b>           |  |

| DEPTH | SAMPLE NO. | SAMPLER TYPE<br>RECOVERY | GRAPHIC LOG       | PROJECT LOCATION                                     |       | BLOW COUNTS | COMMENTS   | REMARKS |
|-------|------------|--------------------------|-------------------|--|-------|-------------|--|---------|
|       |            |                          |                   | LAT.   | LONG. |             |  |         |
|       |            |                          |                   | SURFACE ELEVATION <b>745.0</b>                       |       |             |  |         |
|       |            |                          |                   | BORING LOCATION<br>As shown on Boring Location Plan. |       |             |  |         |
|       |            |                          |                   | VISUAL CLASSIFICATION OF THE MATERIAL                |       |             |  |         |
|       |            |                          |                   |  |       |             | N VALUE, blows/ft.<br>10 20 30 40 50 60 70 80 90 |         |
| 23.0  |            |                          |                   |  |       |             |  |         |
| 24.0  | 8A         | ■                        | [Hatched Pattern] |  |       | 3<br>5<br>6 | 11   |         |
| 25.0  |            |                          |                   |  |       |             |  |         |
| 26.0  |            |                          |                   |  |       |             |  |         |
| 27.0  |            |                          |                   |  |       |             |  |         |
| 28.0  |            |                          |                   |  |       |             |  |         |
| 29.0  | 9A         | ■                        | [Hatched Pattern] |  |       | 3<br>5<br>7 | 12   |         |
| 30.0  |            |                          |                   |  |       |             |  |         |
| 31.0  |            |                          |                   |  |       |             |  |         |
| 32.0  |            |                          |                   |  |       |             |  |         |
| 33.0  |            |                          |                   |  |       |             |  |         |
| 34.0  | 10A        | ■                        | [Hatched Pattern] |  |       | 3<br>3<br>5 | 8  |         |
| 35.0  |            |                          |                   |  |       |             |  |         |
| 36.0  |            |                          |                   |  |       |             |  |         |
| 37.0  |            |                          |                   |  |       |             |  |         |
| 38.0  |            |                          |                   |  |       |             |  |         |
| 39.0  | 11A        | ■                        | [Hatched Pattern] |  |       | 4<br>5<br>6 | 11   |         |
| 40.0  |            |                          |                   | Bottom of boring at 40.0 feet                        |       |             |  |         |
| 41.0  |            |                          |                   |  |       |             |  |         |
| 42.0  |            |                          |                   |  |       |             |  |         |
| 43.0  |            |                          |                   |  |       |             |  |         |
| 44.0  |            |                          |                   |  |       |             |  |         |
| 45.0  |            |                          |                   |  |       |             |  |         |
| 46.0  |            |                          |                   |  |       |             |  |         |
| 47.0  |            |                          |                   |  |       |             |  |         |
| 48.0  |            |                          |                   |  |       |             |  |         |

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|   |                                |                                  |                          |
|---|--------------------------------|----------------------------------|--------------------------|
| CLIENT<br><b>THE RENAISSANCE GROUP</b>  | JOB NO.<br><b>152730</b>       |                                  | <b>B-2</b><br>Boring No. |
|   | BORING STARTED <b>11/15/10</b> | BORING COMPLETED <b>11/15/10</b> |                          |
| PROJECT<br><b>PROPOSED WIND TURBINE, PETTISVILLE HIGH SCHOOL, 232 SUMMIT STREET, PETTISVILLE, FULTON COUNTY, OHIO</b> | DRILLER<br><b>Clint J.</b>     | METHOD<br><b>3 1/4" HSA</b>      | <b>Sheet 1 of 2</b>      |
|   | TYPED BY<br><b>kms</b>         |                                  |                          |

| DEPTH | SAMPLE NO. | SAMPLER TYPE<br>RECOVERY | GRAPHIC LOG | PROJECT LOCATION  |       | BLOW COUNTS | COMMENTS | REMARKS |
|-------|------------|--------------------------|-------------|---|-------|-------------|----------|---------|
|       |            |                          |             | LAT.  | LONG. |             |          |         |
|       |            |                          |             | SURFACE ELEVATION <b>745.0</b>  |       |             |          |         |
|       |            |                          |             | BORING LOCATION<br>As shown on Boring Location Plan.                                    |       |             |          |         |
|       |            |                          |             | VISUAL CLASSIFICATION OF THE MATERIAL   |       |             |          |         |
|       |            |                          |             | Topsoil   |       |             |          |         |
| 1.0   | 1A         |                          |             | Medium dense brown sand, some gravel, some silt, moist                                  |       | 6           |          |         |
| 2.0   |            |                          |             |   |       | 5           | 11       |         |
| 3.0   | 2A         |                          |             | Very stiff clay and silt, some sand, trace of gravel, moist<br>(With sand seam at 4.0') |       | 6           |          |         |
| 4.0   |            |                          |             |   |       | 8           | 21       |         |
| 5.0   |            |                          |             |   |       | 13          |          |         |
| 6.0   | 3A         |                          |             |   |       | 6           |          |         |
| 7.0   |            |                          |             |   |       | 9           | 19       |         |
| 8.0   |            |                          |             |   |       | 10          |          |         |
| 9.0   | 4A         |                          |             | (Becomes stiff at 8.5')   |       | 3           |          |         |
| 10.0  |            |                          |             |   |       | 5           | 13       |         |
| 11.0  |            |                          |             |   |       | 8           |          |         |
| 12.0  |            |                          |             |   |       |             |          |         |
| 13.0  |            |                          |             |   |       |             |          |         |
| 14.0  | 5A         |                          |             |   |       | 3           |          |         |
| 15.0  |            |                          |             |   |       | 3           | 9        |         |
| 16.0  |            |                          |             |   |       | 6           |          |         |
| 17.0  |            |                          |             |   |       |             |          |         |
| 18.0  |            |                          |             |   |       |             |          |         |
| 19.0  | 6A         |                          |             | (Becomes medium stiff at 18.5')   |       | 4           |          |         |
| 20.0  |            |                          |             |   |       | 4           | 10       |         |
| 21.0  |            |                          |             |   |       | 6           |          |         |
| 22.0  |            |                          |             |   |       |             |          |         |

Continued Next Page

WATER LEVEL MEASUREMENTS

|               | DEPTH | DATE       |
|---------------|-------|------------|
| INITIAL       | NONE  | 11/15/2010 |
| AT COMPLETION | 32.0' | 11/15/2010 |
| OTHER         | N/A   | N/A        |

-  A — SPLIT SPOON
-  B — ROCK CORE
-  C — SHELBY TUBE
-  D — SOIL PROBE
-  E — AUGER CUTTINGS
-  F — SONIC

Bowser-Morner, Inc  
1419 Miami St.  
Toledo, OH 43605  
Telephone: (419) 691-4800  
Fax: (419) 691-4805



|   |                                |                                  |   |                             |
|---|--------------------------------|----------------------------------|---|-----------------------------|
| CLIENT<br><b>THE RENAISSANCE GROUP</b>  | JOB NO.<br><b>152730</b>       |                                  | <b>B-2</b><br>Boring No.<br><b>Sheet 2 of 2</b> |                             |
|   | BORING STARTED <b>11/15/10</b> | BORING COMPLETED <b>11/15/10</b> |   |                             |
| PROJECT<br><b>PROPOSED WIND TURBINE, PETTISVILLE HIGH SCHOOL, 232 SUMMIT STREET, PETTISVILLE, FULTON COUNTY, OHIO</b> |                                | DRILLER<br><b>Clint J. kms</b>   |   | METHOD<br><b>3 1/4" HSA</b> |
|   |                                | TYPED BY<br><b>kms</b>           |   |                             |

| DEPTH | SAMPLE NO.                    | SAMPLER TYPE<br>RECOVERY | GRAPHIC LOG | PROJECT LOCATION                                     |       | BLOW COUNTS | COMMENTS                   | REMARKS |
|-------|-------------------------------|--------------------------|-------------|--|-------|-------------|----------------------------|---------|
|       |                               |                          |             | LAT.   | LONG. |             |                            |         |
|       |                               |                          |             | SURFACE ELEVATION <b>745.0</b>                       |       |             |                            |         |
|       |                               |                          |             | BORING LOCATION<br>As shown on Boring Location Plan. |       |             |                            |         |
|       |                               |                          |             | VISUAL CLASSIFICATION OF THE MATERIAL                |       |             |                            |         |
|       |                               |                          |             |  |       |             | N VALUE, blows/ft.         |         |
|       |                               |                          |             |  |       |             | 10 20 30 40 50 60 70 80 90 |         |
| 23.0  |                               |                          |             |  |       | 5           |                            |         |
| 24.0  | 7A                            | ■                        | ▨           |  |       | 6           |                            |         |
| 25.0  |                               | ■                        | ▨           |  |       | 8           | 14                         |         |
| 26.0  |                               |                          |             |  |       |             |                            |         |
| 27.0  |                               |                          |             |  |       |             |                            |         |
| 28.0  |                               |                          |             |  |       |             |                            |         |
| 29.0  |                               |                          |             |  |       | 3           |                            |         |
| 29.0  | 8A                            | ■                        | ▨           |  |       | 3           |                            |         |
| 30.0  |                               |                          |             |  |       | 5           | 8                          |         |
| 31.0  |                               |                          |             |  |       |             |                            |         |
| 32.0  |                               |                          |             |  |       |             |                            |         |
| 33.0  |                               |                          |             |  |       |             |                            |         |
| 34.0  |                               |                          |             |  |       | 3           |                            |         |
| 34.0  | 9A                            | ■                        | ▨           |  |       | 3           |                            |         |
| 35.0  |                               |                          |             |  |       | 6           | 9                          |         |
| 36.0  |                               |                          |             |  |       |             |                            |         |
| 37.0  |                               |                          |             |  |       |             |                            |         |
| 38.0  |                               |                          |             |  |       |             |                            |         |
| 39.0  |                               |                          |             |  |       | 3           |                            |         |
| 39.0  | 10A                           | ■                        | ▨           |  |       | 4           |                            |         |
| 40.0  |                               |                          |             |  |       | 5           | 9                          |         |
| 40.0  | Bottom of boring at 40.0 feet |                          |             |  |       |             |                            |         |
| 41.0  |                               |                          |             |  |       |             |                            |         |
| 42.0  |                               |                          |             |  |       |             |                            |         |
| 43.0  |                               |                          |             |  |       |             |                            |         |
| 44.0  |                               |                          |             |  |       |             |                            |         |
| 45.0  |                               |                          |             |  |       |             |                            |         |
| 46.0  |                               |                          |             |  |       |             |                            |         |
| 47.0  |                               |                          |             |  |       |             |                            |         |
| 48.0  |                               |                          |             |  |       |             |                            |         |

GINT Report Used: NEWLOGIN Report No.: 152730.1110.XXXX.GPJ GINT Template Used: NEWLOGIN.GDT Date Printed: 11/22/10

**APPENDIX E:**  
**HISTORICAL AND CULTURAL DOCUMENTATION**





## Department of Energy

Golden Field Office  
 1617 Cole Boulevard  
 Golden, Colorado 80401-3393

October 25, 2010

Ms. Laura Segna  
 Resource Protection and Review  
 Ohio Historic Preservation Office  
 1982 Velma Avenue  
 Columbus, Ohio 43211-2497

RE: Pettisville Local Schools Wind Turbine Project (DOE/EA - 1818)  
 232 Summit Street, Pettisville, Fulton County, Ohio

Dear Ms. Segna:

The U.S. Department of Energy (DOE) has granted the Ohio Department of Development (ODOD) State Energy Program (SEP) funding through the Energy Policy and Conservation Act, as amended (43 U.S.C § 6321 et seq. with funds appropriated under the American Reinvestment and Recovery Act of 2009. ODOD selected Pettisville Local School District to receive a grant through Ohio's SEP to facilitate the construction and operation of a single 750 kilowatt wind turbine that would stand approximately 300 feet at its tallest extent that is intended to provide electricity to the newly constructed Pettisville Pre-Kindergarten through Twelfth Grade School Campus (proposed project). The DOE funding of the wind turbine represents the proposed federal undertaking.

This letter initiates consultation with your office pursuant to Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations 36 CFR Part 800 "Protection of Historic Properties" (Section 106) for the proposed project. An OHPO Section 106 Review - Project Summary Form is enclosed for your reference (Enclosure A).

To assist in the development of the Section 106 consultation materials, the DOE enlisted the assistance of Mr. Stephen D. Mikesell, a senior architectural historian who meets the Secretary of the Interior's Professional Qualification Standards (36 CFR Part 61) in architectural history, history or archeology. Mr. Mikesell's *Section 106 Compliance Report for Pettisville Local Schools Wind Energy Project* (report), utilized data gathered by The Renaissance Group (TRG) related to historic properties registered or eligible for listing on the National Register of Historic Places (NRHP) within the Area of Potential Effect (APE) (Enclosure B).

Although there are some cultural resources in the indirect APE, DOE has determined that the proposed undertaking will result in No Adverse Effect on any NRHP listed or eligible



properties or archeological resources. If you agree with DOE's determination that there will be no effects to historic or archaeological resources, please concur, as your concurrence is required for DOE's record of compliance under Section 106.

DOE is preparing an Environmental Assessment (EA) for the proposed project in compliance with the National Environmental Policy Act (NEPA). As part of the public notification for the EA for the proposed project, public participation will be integrated into the NEPA EA process. Documentation of DOE Section 106 consultation with OHPO will be included in the EA, which will be open for public comment for 15 days. Documentation of DOE's Section 106 consultation with OHPO will be included in the EA, which will be open for public comment for 15 days. All notices of the EA public comment period will reference the public's ability to comment on the proposed Undertaking's potential effects on NRHP listed and eligible properties. DOE finds this public participation process to be consistent with 36 CFR 800.2(d).

Should you have any questions about this information, please contact me at [Melissa.Rossiter@go.doe.gov](mailto:Melissa.Rossiter@go.doe.gov) or 720-356-1566.

Thank you in advance for your consideration.

Sincerely,



Melissa Rossiter  
NEPA Document Manager  
U.S. Department of Energy  
1617 Cole Boulevard  
Golden, CO 80401

Attachments

cc: Mark Epstein, Department Head, OHPO  
Franco Ruffini, Deputy SHPO, OHPO  
James Huth, Advanced Energy Program Manager, ODOD  
Aaron Godwin, Owners Representative, Renaissance Group  
Stephen Switzer, Pettisville School District Superintendent  
Steve Mikesell, ICF International



**OHIO HISTORIC PRESERVATION OFFICE:  
RESOURCE PROTECTION AND REVIEW**

**Section 106 Review - Project Summary Form**

**For projects requiring a license from the Federal Communications Commission, please use FCC Forms 620 or 621. DO NOT USE THIS FORM.**

**SECTION 1: GENERAL PROJECT INFORMATION**

All contact information provided must include the name, address and phone number of the person listed. Email addresses should also be included, if available. Please refer to the Instructions or contact an OHPO reviewer (mailto:Section106@ohiohistory.org) if you need help completing this Form. Unless otherwise requested, we will contact the person submitting this Form with questions or comments about this project.

Date: **October 22, 2010**

Name/Affiliation of person submitting form: **Melissa Rossiter, NEPA Document Manager, Department of Energy**

Mailing Address: **1617 Cole Boulevard, Golden, CO 80401**

Phone/Fax/Email: **720-356-1566/Melissa.Rossiter@go.doe.gov**

**A. Project Info:**

**1. This Form provides information about:**

New Project Submittal:  
YES  NO

Additional information relating to previously submitted project:  
YES  NO

OHPO/RPR Serial Number from previous submission:

**2. Project Name (if applicable):**

**Pettisville Local Schools Wind Energy Project**

**3. Internal tracking or reference number used by Federal Agency, consultant, and/or applicant to identify this project (if applicable):**

**DOE/EA 1818**

B. Project Address or vicinity:

**232 Summit Street**

C. City/Township:

**Pettisville**

D. County:

**Fulton**

E. Federal Agency and Agency Contact. *If you do not know the federal agency involved in your project, please contact the party asking you to apply for Section 106 Review, not OHPO, for this information. HUD Entitlement Communities acting under delegated environmental review authority should list their own contact information.*

**Melissa Rossiter**  
**NEPA Document Manager**  
**Department of Energy**  
**1617 Cole Boulevard**  
**Golden, CO 80401**  
**Melissa.Rossiter@go.doe.gov**

F. Type of Federal Assistance. *List all known federal sources of federal funding, approvals, and permits to avoid repeated reviews.*

**Grant, American Recovery and Reinvestment Act; DOE State Energy Program**

G. State Agency and Contact Person (if applicable):

**James Huth**  
**Advanced Energy Program Manager**  
**Ohio Energy Resources Division**  
**James.Huth@development.ohio.gov**

H. Type of State Assistance:

**Same as above, assistance is provided by Federal Government but being distributed by the State through the State Energy Program**

I. Is this project being submitted at the direction of a state agency **solely** under Ohio Revised Code 149.53 or at the direction of a State Agency? *Answering yes to this question means that you are sure that no federal funding, permits or approvals will be used for any part of your project, and that you are seeking comments only under ORC 149.53.*

YES  NO

J. Public Involvement- Describe how the public has been/will be informed about this project and its potential to affect historic properties. Please summarize how they will have an opportunity to provide comments about any effects to historic properties. (This step is required for all projects under 36 CFR § 800.2):

**Project has been in the local spotlight for the last 18 months.**

**The Fulton County Historical Society has been contacted and assisted in the identification of any Historical Properties within the APE. The project has been reviewed and was available for public comment in both School Board and Village Planning and Zoning meetings. The project has been extensively covered in the local media. See Attachment 3 for full list and copy of all articles and public involvement.**

- K. Please list other consulting parties that you have contacted/will contact about this project, such as Indian Tribes, Certified Local Governments, local officials, property owners, or preservation groups. (See 36 CFR § 800.2 for more information about involving other consulting parties). Please summarize how they will have an opportunity to provide comments:

**The following parties were notified of the project through the Department of Energy, Environmental Assessment Process. They were allowed an opportunity to comment on the project through the scoping process and will be notified again when the draft EA is released to allow for further comment.**

**Steven Brown, Director  
Fulton County Regional Planning Director  
152 South Fulton Street, Suite 230  
Wauseon, Ohio 43567**

**Lisa Arend, Director  
Fulton County Economic Development  
152 South Fulton Street, Suite 280  
Wauseon, Ohio 43567-1726**

**Fulton County Commissioners  
152 South Fulton Street  
Wauseon, Ohio 43567**

**Western Reserve Historical Society  
10825 East Blvd.  
Cleveland, OH 44106**

**Western Reserve Heritage Association  
P.O. Box 314  
14485 N. Cheshire Street  
Burton, OH 44021**

**The Clinton Township Trustees  
230 Clinton Street  
Wauseon, Ohio 43567**



**Fulton County Historical Society  
229 Monroe Street  
Wauseon, Ohio 43567**

**Tribes:**

**Bad River Band of the Lake Superior Tribe of Chippewa Indians  
Citizen Potawatomi Nation  
Forest County Potawatomi Community  
Keweenaw Bay Indian Community  
Little Traverse Bay Bands of Odawa Indians  
Pokagon Band of Potawatomi Indians  
Seneca-Cayuga Tribe  
Turtle Mountain Band of Chippewa Indians  
Bay Mills Indian Community  
Hannahville Indian Community  
Lac Courte Oreilles Band of Lake Superior Chippewa  
Match-e-be-nash-she-wish Band of Pottawatomi  
Prairie Band of Potawatomi Nation  
St. Croix Chippewa Band of Lake Superior Chippewa  
Sokaogon Chippewa Community  
Wyandotte Tribe of Oklahoma  
Chippewa-Cree Tribe of the Rocky Boy's Reservation  
Delaware Tribe of Indians  
Nottawaseppi Huron Band of the Potawatomi Indians  
Little River Band of Ottawa Indians  
Ottawa Tribe of Oklahoma  
Red Cliff Band of Lake Superior Chippewa  
Seneca Nation of Indians  
Tonawanda Seneca Nation**

**SECTION 2: PROJECT DESCRIPTION AND AREA OF POTENTIAL EFFECTS (APE)**

Provide a description of your project, its site, and geographical information. You will also describe your project's Area of Potential Effects (APE). Please refer to the Instructions or contact an OHPO reviewer if you need help with developing the APE or completing this form.

*For challenging projects, provide as much information as possible in all sections, and then check the box in Section 5.A. to ask OHPO to offer preliminary comments or make recommendations about how to proceed with your project consultation. This is recommended if your project involves effects to significant historic properties or if there may be challenging procedural issues related to your project. Please note that providing information to complete all Sections will still be required and that asking OHPO for preliminary comments may tend to delay completion of the review process for some projects.*

A. Does this project involve any Ground-Disturbing activity: YES  NO   
(If **Yes**, you must complete all of Section 2.A. If **No**, proceed directly to Section 2. B.)

1. General description of width, length and depth of proposed ground disturbing activity:

**The turbine's foundation will not be larger than 40' x 40' (or 1600 square feet). The base of the foundation will likely be 20' under the finished ground level. Other excavation will include electrical and data conduit runs, not to exceed 1,000' long x 2' wide x 3' deep for up to an additional 2,000 square feet of disturbed land. Of all of this, only a foundation pier, not to be larger than 16' x 16' will be visible above the finished ground (or 256 square feet).**

2. Narrative description of previous land use and past ground disturbances, if known:

**The previous use of the land includes farming, although construction is already underway for an unrelated addition to the schools and their associated playing fields and parking lots. All of the proposed ground disturbance will affect land that has been previously disturbed during prior use and construction projects on the campus.**

3. Narrative description of current land use and conditions:

**Construction is already underway on this project site for an unrelated addition to the schools and their associated playing fields and parking lots.**

4. Does the landowner know of any archaeological resources found on the property?  
YES  NO  If yes, please describe:

B. Submit the exact project site location on a USGS 7.5-minute topographic quadrangle map for all projects. Map sections, photocopies of map sections, and online versions of USGS maps are acceptable as long as the location is clearly marked. Show the project's Area of Potential Effects (APE). It should be clearly distinguished from other features shown on the map:

1. USGS Quad Map Name:

**Pettisville USGS Quad Map**

2. Township/City/Village Name:

**Pettisville, Ohio**

**See Attachment 2**

C. Provide a street-level map indicating the location of the project site; road names must be

identified and legible. Your map must show the exact location of the boundaries for the project site. Show the project's Area of Potential Effects (APE). It should be clearly distinguished from other features shown on the map:

- D. Provide a verbal description of the APE, including a discussion of how the APE will include areas with the potential for direct and indirect effects from the project. Explain the steps taken to identify the project's APE, and your justification for the specific boundaries chosen:

**See Enclosure B - Section 106 Compliance Report for Pettisville Local Schools Wind Energy Project**

- E. Provide a detailed description of the project. This is a critical part of your submission. Your description should be prepared for a cold reader who may not be an expert in this type of project. The information provided must help support your analysis of effects to historic properties, not other types of project impacts. Do not simply include copies of environmental documents or other types of specialized project reports. If there are multiple project alternatives, you should include information about all alternatives that are still under active consideration:

**See Attachment 1 - Project Overview**

### **SECTION 3: IDENTIFICATION OF HISTORIC PROPERTIES**

Describe whether there are historic properties located within your project APE. To make that determination, use information generated from your own Background Research and Field Survey. Then choose one of the following options to report your findings. Please refer to the Instructions and/or contact an OHPO reviewer if you are unsure about how to identify historic properties for your project.

*If you read the Instructions and you're still confused as to which reporting option best fits your project, or you are not sure if your project needs a survey, you may choose to skip this section, but provide as much supporting documentation as possible in all other Sections, then check the box in Section 5.A. to request preliminary comments from OHPO. After reviewing the information provided, OHPO will then offer comments as to which reporting option is best suited to document historic properties for your project. Please note that providing information to complete this Section will still be required and that asking OHPO for preliminary comments may tend to delay completion of the review process for some projects.*

#### **Recording the Results of Background Research and Field Survey:**

- A. Summary of discussions and/or consultation with OHPO** about this project that demonstrates how the Agency Official and OHPO have agreed that no Field Survey was necessary for this project (typically due to extreme ground disturbance or other special circumstances). Please **attach copies** of emails/correspondence that document this agreement. You must explain how the project's potential to affect both archaeological and historic resources were considered.
- B. A table that includes the minimum information** listed in the OHPO Section 106 Documentation Table (which is generally equivalent to the information found on an inventory form). This information must be printed and mailed with the Project Summary Form. To provide sufficient information to complete this Section, you must also include summary observations from your field survey, background research and eligibility determinations for each property that was evaluated in the project APE.
- C. OHI (Ohio Historic Inventory) or OAI (Ohio Archaeological Inventory) forms-** New or updated inventory forms may be prepared using the OHI pdf form with data population capabilities, the Internet IForm, or typed on archival quality inventory forms. To provide sufficient information to complete this Section, you must include summary observations

from your field survey and background research. You must also include eligibility determinations for each property that was evaluated in the project APE

- D. A historic or archaeological survey report** prepared by a qualified consultant that meets professional standards. The survey report should meet the Secretary of the Interior's Standards and Guidelines for Identification and OHPO Archaeological Guidelines. You may also include new inventory forms with your survey, or update previous inventory forms. To complete this section, your survey report must include summary observations from your field survey, background research and eligibility determinations for each property that was evaluated within the APE.
- E. Project Findings.** Based on the conclusions you reached in completing Section 3, please choose one finding for your project. There are (mark one):
- Historic Properties Present in the APE:
  - No Historic Properties Present in the APE:

#### **SECTION 4: SUPPORTING DOCUMENTATION**

This information must be provided for all projects.

- A. Photographs must be keyed to a street-level map, and should be included as attachments to this application. Please label all forms, tables and CDs with the date of your submission and project name, as identified in Section 1. You must present enough documentation to clearly show existing conditions at your project site and convey details about the buildings, structures or sites that are described in your submission. Faxed or photocopied photographs are not acceptable. See Instructions for more info about photo submissions or 36 CFR § 800.11 for federal documentation standards.
1. Provide photos of the entire project site and take photos to/from historic properties from/towards your project site to support your determination of effect in Section 5.
  2. Provide current photos of all buildings/structures/sites described.
- B. Project plan, specifications, site drawings and any other media presentation that conveys detailed information about your project and its potential to affect historic properties.
- C. Copies or summaries of any comments provided by consulting parties or the public.

#### **SECTION 5: DETERMINATION OF EFFECT**

- A. **Request Preliminary Comments.** For challenging projects, provide as much information as possible in previous sections and ask OHPO to offer preliminary comments or make recommendations about how to proceed with your project consultation. This is recommended if your project involves effects to significant historic properties, if the public has concerns about your project's potential to affect historic properties, or if there may be challenging procedural issues related to your project. Please be aware that providing information in all Sections will still be required and that asking OHPO for preliminary comments may tend to delay completion of the review process for some projects.

1. We request preliminary comments from OHPO about this project:  
YES  NO

2. Please specify as clearly as possible the particular issues that you would like OHPO to examine for your project (for example- help with developing an APE, addressing the concerns of consulting parties, survey methodology, etc.):

B. **Determination of Effect.** If you believe that you have gathered enough information to conclude the Section 106 process, you may be ready to make a determination of effect and ask OHPO for concurrence, while considering public comments. Please select and mark one of the following determinations, then explain the basis for your decision on an attached sheet of paper:

**No historic properties will be affected** based on 36 CFR § 800.4(d) (1). Please explain how you made this determination:

**No Adverse Effect** [36 CFR § 800.5(b)] on historic properties. This finding cannot be used if there are no historic properties present in your project APE. Please explain why the Criteria of Adverse Effect, [36 CFR Part 800.5(a) (1)], were found not to be applicable for your project:

**Although no Federally, State or Locally listed properties were found within the 2 Mile APE, some unlisted properties were found that could potentially qualify for future listing, although none would be considered iconic, historically unique or rare samples or locations of reported strong significant historic activities. Of these properties, none would be affected adversely by the installation of the wind turbine on the Pettisville Schools campus. None of these properties would receive noise from the turbine (see Attachment 7, "Ambient and Turbine Produced Sound Level Analysis") or flicker from the turbine (see attachment 9, "Shadow Flicker Analysis". None of the properties are within close proximity to the site. None of the properties have designed view elements facing the wind turbine site. None of the properties have a clear view of the turbine and of those that could potentially see the turbine from some location on their property, the turbine would only represent a partial view/minor visual element above the existing natural and environment horizon elements such as telephone poles and trees. (See Attachment 8, "Turbine Visualizations and Photo Report" for sample turbine views)**

**The nearest Federally listed property is over 3 miles from the site and will not be able to see the turbine.**

**At 1.5 miles, even if the turbine was fully visible through an unobstructed view on level terrain, due to perspective, the**



**turbine will only appear to be .9 inches tall at a distance of 2 feet from the viewer's eye, barely perceptible on the horizon. For almost all locations, some obstructions exist taking the likely visibility from no visibility to less than .9 inches at this distance.**

**No archeological or native american sites were reported or found.**

**The project was unanimously approved by the local planning and zoning board.**

- Adverse Effect** [36 CFR § 800.5(d) (2)] on historic properties. Please explain why the criteria of adverse effect, [36 CFR Part 800.5(a) (1)], were found to be applicable to your project. You may also include an explanation of how these adverse effects might be avoided, reduced or mitigated:

*Please print and mail completed form and supporting documentation to:*

*Ohio Historic Preservation Office  
Attn: Mark J. Epstein, Department Head  
Resource Protection and Review  
1982 Velma Avenue  
Columbus, OH 43211-2497*

**ARRA GRANT PROGRAM QUESTIONNAIRE  
OHIO STATE HISTORIC PRESERVATION OFFICE (SHPO)**

**This Section to be Completed by Grantee**

Grantee Name: Pettisville Local School District

Contact Person: Stephen Switzer  
AARon Godwin Title: Superintendent  
Owner's Representative

E-Mail Address: [sswitzer@pettisvilleschools.org](mailto:sswitzer@pettisvilleschools.org); [AARon@ConserveFirst.com](mailto:AARon@ConserveFirst.com)

Project Address: Post Office Box 53001, 232 Summit Street, Pettisville, Ohio 43553

Any Alteration of Structure or Site?: Building Structure/ Site is:  
(Check One if Applicable)

- 50 years of age or older?
- Listed on the National Register of Historic Places?
- Located in a historic district?

If you answered positively to any of the above questions,  
complete **Attachment D - Historic Preservation Compliance Form**

Date: May 5, 2010

# Section 106 Compliance Report for Pettisville Local Schools Wind Energy Project

*Pettisville, Fulton County, Ohio*

October 22, 2010

Prepared for: U.S. Department of Energy

Prepared by: Stephen D. Mikesell, ICF International



## **Purpose of Document**

This document was prepared on behalf of the U.S. Department of Energy (DOE), for an Ohio Department of Development (ODOD) State Energy Program (SEP) grant for a single wind turbine for Pettisville Local Schools (proposed project or proposed turbine). This report is intended to achieve Section 106 compliance for DOE for their funding of the proposed wind turbine project at the Pettisville School playing field. This report is a focused Section 106 compliance document and relies on technical studies prepared for this project by The Renaissance Group (TRG), who are acting as the Owner's Representative for Pettisville Schools. Also included in this submission are numerous other documents that were prepared as appendices for the National Environmental Policy Act (NEPA) compliant Environmental Assessment (EA) that DOE is preparing for this project. While all of the documents are attached to this Section 106 submission, the most pertinent of the documents which were used in this evaluation are referenced herein and located in Enclosure 1. The most relevant attachments are: Attachment 5, Pettisville Project Area Maps, and Attachment 6, Non-Listed Properties. Also useful for your review are Attachment 8, the Visualization Report, used to analyze visual impacts, Attachment 7, Sound Analysis, used to analyze the potential for noise impacts, and Attachment 9, Flicker Analysis, used to analyze shadow flicker impacts. The findings of these technical reports are summarized below to analyze the potential for adverse effects.

### **1. Qualifications of Preparer**

This Section 106 Compliance Document was prepared by Stephen D. Mikesell. Mr. Mikesell is a senior architectural historian with ICF International. He has worked for 30 years in the Section 106 compliance field. Before coming to ICF in February 2010, he worked for nine years as the Deputy State Historic Preservation Officer for the State of California. Between 1991 and 2001, he was a partner in a mid-sized cultural resource management firm, specializing in Section 106 compliance. Before 1980 and 1991, he worked as an architectural historian with the State of California, first with the State Historic Preservation Office (SHPO) and later with the California State Department of Transportation.

### **2. Summary of Findings**

Based on a review of the documents and data provided by TRG, DOE has determined that the proposed project will result in No Adverse Effect to properties that might qualify for listing in the National Register of Historic Places. Because the Area of Potential Effects (APE) for this undertaking is large – a two mile radius, or four mile diameter from the turbine site – there are hundreds of potentially eligible properties within the APE. For the purpose of analyzing potential effects to historic properties, this report assumes that all pre-1960s properties are eligible for listing in the National Register of Historic Places (NRHP). This assumption applies only to this proposed undertaking. This report concludes that, even if every older property was National Register eligible, there would not be an adverse effect to any historic properties.

### 3. Project Description

DOE has provided a SEP grant to ODOD, which selected Pettisville Local School District to receive a portion of its SEP grant funds. DOE would authorize the recipient to continue to expend Federal funding to design, permit, and construct the proposed project for which an EA is underway. The proposed project is a single 750-kilowatt wind turbine, and approximately 2,000 feet of associated electrical underground transmission equipment, at Pettisville's Pre-Kindergarten through Twelfth Grade School which is located at 232 Summit Street, Pettisville, Ohio. The proposed project would provide electricity directly to the high school, reducing electrical demands of the school and lowering the carbon footprint associated with daily operations. The proposed project would be an Aeronautica 750kW turbine mounted on a tower that is 213 feet tall with a 177 feet diameter rotor. At its tallest extent, when a rotor is straight up, the total height of the proposed project would be about 300 feet. (Attachment 1 contains a more detailed project overview).

The proposed turbine site is a parcel that has been farmed continuously until recently. The site has been under construction since 2009 for development of a high school ball field. (Attachment 2 contains the site location on a USGS Topographic Map).

The proposed project is an undertaking (36 CFR 800) because the majority of funding derives from a American Recovery and Reinvestment Act funded SEP grant, which is appropriated to the DOE and distributed through the state of Ohio.

### 4. Consulting Party Participation

As part of the public notification for the EA for the proposed project, public participation as allowed per 36 CFR Part 800 will be integrated into the NEPA EA. Documentation of DOE Section 106 consultation with OHPO will be included in the EA, which will be open for public comment for 15 days.

The following are some of the organizations notified of the project through the DOE EA scoping process and these organizations will be invited to comment on the Draft EA when it is released to the public.

- Fulton County Historical Society
- Fulton County Commissioners
- Western Reserve Historical Society
- Western Reserve Heritage Association
- The Clinton Township Trustees

According to Indian Entities Recognized and Eligible to Receive Services from the US Bureau of Indian Affairs in Federal Register, Volume 72, Number 55 dated March 22, 2007 (72 FR 13648) and the National Association of Historic Preservation Officers at <http://www.nathpo.org>, there are no Federally-recognized Tribes in the State of Ohio nor is there a Tribal Historic Preservation Officer for Ohio.



However, DOE has provided the Notice of Availability to 57 tribal representatives that are regularly notified of Federal Actions in the state of Ohio.

Prior to this submission, the proposed project was reviewed and made available for public comment at both School Board and Village Planning and Zoning meetings. The proposed project has also been extensively covered in the local media. Attachment 3 contains a list of public meetings and newspaper articles related to the proposed project.

## **5. Inventory and Evaluation**

The proposed project will directly impact a very small piece of land. The foundation for the turbine and associated equipment, and associated construction zones, are expected to be less than one acre in an area that is already under construction for the school's new ball field. The actual foundation will permanently affect approximately 256 square feet. The proposed turbine has the potential to have visual and noise impacts to properties far from the school grounds where the turbine would be installed.

### **a. Area of Potential Effect**

The Pettisville turbine project has two APEs. First, the direct APE, is the area of actual ground disturbance, the 1,600 square foot area that would be excavated for the 256 square foot foundation and an additional 2,000 feet that would be excavated for the associated underground electrical transmission equipment. The staging area would be approximately two acres, but no other excavation would take place within this area.

Second is indirect APE. There is no definitive rule for determining the indirect APE for a wind turbine, which can create both visual and audible effects on the adjacent properties. The proposed undertaking involves installation of a tower that is approximately 213 feet tall, with a total height of about 300 feet when the rotor is vertical. As a conservative measure, the proponent has elected to study a two mile APE for indirect effects. This indirect APE was developed based on the height of the proposed project, the surrounding topography, tree cover, and urban forest in the vicinity of the proposed project and simulated visualizations of the proposed project. Noise and flicker effects are quite localized and do not extend far beyond the school property. The two mile APE was selected as the maximum distance from which the proposed project will be seen.

### **b. Inventory of Properties Identified**

There are no previously-identified historic properties (properties previously listed in or determined eligible for listing in the National Register of Historic Places) within the direct or indirect APEs for this proposed undertaking (Attachment 4). The absence of designated properties does not indicate that no properties could be listed or determined eligible. Pettisville is a small farming community of approximately 2,000 people and has likely been bypassed by many of the activities from which determinations of eligibility typically arise, such as Tax Act projects, federally-funded highway projects, etc.

c. National Register eligibility of properties, direct APE

There are no National Register-listed properties within the direct APE for the proposed undertaking. The direct APE, as discussed earlier, is the construction zone for the proposed project. The direct APE is illustrated in the photograph below. As noted, the parcel for the proposed project was farmed until a year ago and is currently under construction to serve as a playing field for the school district. There are no buildings on the site. The parcel is so extensively modified, as shown in the photograph, that there is no reason to suspect that an intact archaeological site exists at this property.



d. National Register eligibility of properties, indirect APE

To determine the potential for adverse effects to historic properties TRG inventoried all buildings and structures built before 1960, located within the 2 mile radius from the proposed project. The results of this inventory may be seen in Attachment 5 “Pettisville Project Area Maps,” and Attachment 6, “Pettisville Non-Listed Properties.” Each entry in Attachment 6 includes a photograph of the property as well as the estimated date of construction (which was provided by the local auditor). Each entry also includes a “located in” field, with the name of the quadrant in which that property is located and a Map ID number, which corresponds to a number highlighted on the quadrant map in which the property is

located. To facilitate an assessment of potential visual impacts, each entry also includes a note of the radius (.5 mile, 1 mile, 1.5 mile, or 2 miles) in which the property is located.

There are 140 properties shown in Attachment 6. These properties fall into two categories: urban use properties (nearly all are single family homes) found in the Central Quadrant and rural properties (nearly all are farmhouses and farm structures), located within the other four quadrants. The qualities of these properties differ considerably from one quadrant to the next. The discussion below summarizes the properties within each quadrant. Attachment 6 contains photographs and more specific information about the properties discussed below.

*Central Quadrant Properties:* The Central Quadrant properties were mostly built in the first two decades of the 20<sup>th</sup> century. These were likely in-town homes for prosperous farmers or local merchants and service sector workers. There are 26 properties that were inventoried within this quadrant. All but six of these are single family urban homes. The other properties are two churches, a cemetery, a grain elevator, a store, and a barn which is now used as a store. Nearly all of the homes have an estimated date of construction around 1900, which was used by the local auditor for homes constructed in the 1880 to 1910 range. All of these properties are within ½ mile of the proposed project.

*Northwest Quadrant Properties:* There are only four properties within this quadrant, two of which are not 50 years old. The two older properties are a farm built in 1900 (423), which is one mile from the proposed project and a barn dating to 1900 (645), which is located two miles from the proposed project.

*Northeast quadrant properties:* There are six older farm complexes in this quadrant (23, 57, 158, 277, 287, and 295). Four of these have estimated dates of construction in 1900. 277 has an estimated date of construction in 1844, although from the picture it appears likely that the structure was constructed approximately a century later. 287 has an estimated date of construction in 1960 but it is likely a 19<sup>th</sup> century home. Three of these properties are 1.5 miles from the proposed project and the other three are 2 miles away.

*Southwest quadrant properties:* There are 16 potentially historic properties in this quadrant, one church and farms. The vast majority of these farm houses have an estimated date of construction of 1900 (an estimate used by the local auditor). Four of these properties are within the .5 mile radius from the proposed project and the rest are 1.5 mile to 2 miles from the proposed project.

*Southeast quadrant properties:* This quadrant has 15 potentially historic properties, a Mennonite Church and farms. Most of these properties have an estimated date of construction in 1900 (an estimate used by the local auditor). There are two homes from the 1860s, one from the 1940s (although it appears to be much older), and the Mennonite Church, which dates to 1960. Most of these properties are a considerable distance from the proposed project. Five are 2 miles away, three are 1.5 miles away, six are 1 mile away, and one farm is located less than a mile away from the proposed project.

## 6. Application of Criteria of Adverse Effect

In applying the Criteria of Adverse Effect, it is useful to consider both the nature of the potential impacts and the character of the resources, specifically the qualities that make them eligible for listing in the National Register. The definition of an adverse effect in 36 CFR 800.5 (a) (1) is when “an undertaking may alter, directly or indirectly, any of the characteristics that qualify the property for listing in the National Register in a manner that would diminish the integrity of the property’s location, design, setting, materials, workmanship, feeling or association.”

The ACHP regulations also provide specific examples of adverse effects. These examples are discussed below, as there are different examples that might apply to potential impacts from ground disturbance, noise, and visual impacts.

### a. Assessment of impacts from ground disturbance.

As noted in Section 4 above, there are no buildings at the project site and there is no reason to suspect that any intact archaeological sites could have survived the many years of farming and the more recent construction activity arising from conversion of this site from farming to school uses. DOE has determined that the proposed undertaking will have No Effect within the direct APE because there are no properties there that qualify for listing in the National Register and no intact archeological sites.

### b. Assessment of impacts from noise.

Potential noise impacts for this undertaking are discussed in detail in Attachment 7, “Pettisville Local Schools Wind Turbine Project Ambient and Turbine Produced Sound Level Analysis.” The analysis concludes two things which are pertinent to a potential adverse effect. First, the ambient noise level in the immediate vicinity of the proposed project site is relatively high because of the presence of a busy rail line nearby, as well as truck and automobile traffic. Second, it concludes that the projected project noise output will only exceed 50 dB within a 200 foot radius, which restricts this impact to the playfield in which the proposed project will be constructed.

Relying upon the analysis in Attachment 7, DOE has determined that there will be No Effect to historic properties owing to auditory impacts associated with the installation of the proposed project.

### c. Assessment of impacts from visual impacts.

Visual impacts vary due to at least three variables: the distance of a historic property from the visual intrusion; intervening barriers that might diminish visual impacts; and the degree to which the significance of a property hinges upon the presence or absence of visual intrusions.

The potential visual effects from the proposed project are simulated in a series of photo simulations in Attachment 8, “Pettisville Local Schools Wind Turbine Project Turbine Visualization and Photo Analysis.” These simulations take into account the distance from the turbine and intervening barriers. These

simulations do not take into account the degree to which the potential significance of historic properties hinge upon the absence of visual intrusions, which is discussed in this report.

As noted in Section 5 above, the potential historic resources within the indirect APE fall into two categories: urban properties which are mapped on the Central Quadrant; and rural properties, which are mapped on the other four quadrants. The Central Quadrant properties are mostly within a half mile of the proposed project, with a few located a mile away.

In Attachment 8, the photo simulations P-V-4, 6, 7, and 9 all illustrate the view of the proposed project within the Central Quadrant (within one-half mile of the proposed project). PV-4 shows the proposed project from just across the street, where it is highly visible. PV-6 shows the proposed project from a cemetery not far from the school. However, at the remainder of the downtown sites the proposed project cannot be seen, because of the dense urban forest of mature trees that block the view of the turbine. The photo simulation below is a typical scene near the center of Pettisville and the turbine is entirely masked by the urban forest. Most of the trees in this view will lose their leaves during fall and winter but the density of the tree cover makes it unlikely the turbine would be visible from this view, even during winter and fall.



PV-8 shows the view of from approximately 1.11 miles away from the proposed project. From here, the proposed project is invisible because of the urban forest, which disguises the proposed project from in most of the downtown area. PV-11 is 1.2 miles away and is from the vantage point of a historic resource (528). At this distance, the proposed project is scarcely visible and represents a small presence on the horizon (photo simulation below). The proposed project is barely visible to the left of the wooden power pole, near the center of the photo simulation.





PV-2 shows the turbine at less than two miles away but from an unbroken sightline across agricultural fields. The turbine can hardly be seen. PV-10 shows the turbine at a distance more than two miles. It can barely be detected.

The photo simulations in Attachment 8 show two things clearly. First, the downtown properties (those in the Central Quadrant) are protected from visual impacts by the presence of the urban forest. Second, the farm properties (in the other four quadrants) are protected chiefly by distance from the turbine.

Attachment 8 also helps analyze the impact of visual intrusions on the significance of the potential historic properties within the APE. The photographs on pages 17 and 18 and the table on pages 19 and 20 indicate that tall industrial structures are not unusual aspects of the rural landscape of Ohio. The photographs on page 17 show the visual presence of granaries, which are nearly as tall as the proposed project and larger in other respects. The photograph at the bottom of that page shows the visual presence of granaries behind a historic home, a 1900 residence in the southeast quadrant (352). The photographs on page 18 show other types of tall buildings in the area, including a communication tower that appears to be taller than the proposed project. A photograph at the bottom of that page shows one of the potential historic resources, a tall silo that appears to be as tall as a six or seven story building (170). The communications tower photograph is reproduced below.



The general conclusion from Attachment 8 is that the urban and rural properties in and near Pettisville do not exist in a setting free from industrial-type visual impacts. The granaries and silos are integral parts of the agricultural context while other tall structures such as communication towers are located where they can be free from obstructions. These types of tall structures have long been a part of this and most other rural areas of the United States.

This analysis shows that the potential significance of the many properties within a two mile radius of the proposed tower do not derive their significance from the absence of tall structures and visual intrusions. Therefore, it is unlikely that construction of the proposed project would diminish the setting for one of the properties within that radius and render it ineligible for listing in the National Register.

Visual impacts are based on at least three variables: the distance of a historic property from the visual intrusion; intervening barriers that might diminish visual impacts; and the degree to which the significance of a property hinges upon the presence or absence of visual intrusions.

Relying upon the analysis and photo simulations in Attachment 8, DOE has determined that there will be No Adverse Effect to historic properties because the proposed undertaking will not introduce a visible element that will diminish the integrity of the significant historic features of any of the properties within the APE. The closest properties, those located in the community of Pettisville, are shielded from visual impacts by the urban forest. The rural properties do not benefit from the urban forest but are generally at a distance as to make the visual impact insignificant. Finally, the presence of other vertical elements

such as granaries, silos, and communication towers indicate that the potential significance of these properties does not derive from a pristine setting. In fact, many of these tall elements, particularly silos and granaries, have been around for as long as most of the potential historic properties. Taking into account the three elements of visual impacts, DOE has determined that the proposed undertaking will result in No Adverse Effect to any of the assumed historic properties within the APE.

d. Assessment of impacts from shadow flicker impacts.

A shadow flicker analysis (Attachment 9) was completed for the proposed project area to determine the amount of shadow flicker that would be experienced for local receptors as a result of proposed turbine construction. The analysis considered several aspects affecting the casting of shadows and potential impacts on local receptors, including the distance to receptors, angle of incoming solar insolation, and the amount of sunlight experienced at the project site during each of the four seasons.

Results of the shadow flicker analysis indicate that no homes or occupied business structures outside the school would receive significant flickering shadows of over 30 hours per year. While some of the farm to the southwest would receive summer morning shadows, the farm's outbuildings would block most of the shadows from reaching the farmhouse.

Relying upon the analysis in Attachment 9, DOE has determined that there will be No Effect to historic properties owing to shadow flicker impacts associated with the installation of the proposed project.

**7. Conclusions**

This report supports DOE's conclusion that the proposed project will result in No Adverse Effects to properties that may qualify for listing in the National Register of Historic Places.



February 7, 2011

Melissa Rossiter  
 NEPA Document Manager  
 U.S. Department of Energy  
 1617 Cole Boulevard  
 Golden, CO 80401

Dear Ms. Rossiter:

RE: Pettisville Local Schools Wind Energy Project, Fulton County, Ohio

This is in response to your correspondence dated October 25, 2010, (received October 28, 2010). Our comments are made pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, and the associated regulations at 36 CFR Part 800.

The Pettisville Local School District proposes to use funds from the Ohio Department of Development (ODOD) State Energy Program to facilitate the construction of a 300' wind turbine adjacent to the new school playing fields south of County Road D. You have requested the comments of the Ohio Historic Preservation Office regarding the effects of this project on historic properties.

We have reviewed the information submitted by the Renaissance Group, consultant for this Section 106 submission. The Renaissance Group's report concludes that the proposed wind turbine will have no adverse effect on properties listed in or eligible for listing in the National Register of Historic Places (NRHP) located within the Area of Potential Effects (APE). Since the proposed wind turbine site is buffered by the Pettisville Local Schools complex, fields and several blocks of apparently non-historic development, mainly houses built in the later decades of the twentieth century, it is our opinion that no historic properties will be affected by this project. In addition, the project site is unlikely to yield significant archeological resources. In future submissions, however, please identify the location of all areas of ground disturbance.

No further coordination with this office is necessary unless there is a change in the project. If historic properties are identified during implementation of the project, please notify our office pursuant to 36 CFR Section 800.13.

If you have any questions, please contact me by phone at (614) 298-2000 or by email at [jbertram@ohiohistory.org](mailto:jbertram@ohiohistory.org). Thank you.

Sincerely,

Jamie Bertram, Project Reviews Manager  
 Resource Protection and Review

Cc: James Huth, Advanced Energy Program Manager, Ohio Energy Resources Division, Ohio Department of Development, Post Office Box 1001, Columbus, Ohio 43216-1001

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Stephen Switzer, Pettisville School District Superintendent, P.O. Box 53001, 232 Summit Street, Pettisville, Ohio 43553

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