Community Wind Project Assessment and
Development - Game Changer Grant

Community Owned Wind... **Just Right** for **Your** Community

Community Wind Feasibility Study

Piney Reservoir Dam, Frostburg, Maryland

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ASSOCIATED
WIND DEVELOPERS

Maryland Energy
ADMINISTRATION
Powering Maryland's Future

Rev. 6-2-13

Community Wind Feasibility Study

Piney Reservoir Dam, Frostburg, Maryland

Prepared For: The State of Maryland Energy Administration, and
The Land and Cultural Preservation Fund, 4 E. Church St., Frederick, MD 21701

Prepared by: **Associated Wind Developers, LLC, 11 Resnik Road, Plymouth, MA 02360**

June 2013

Executive Summary

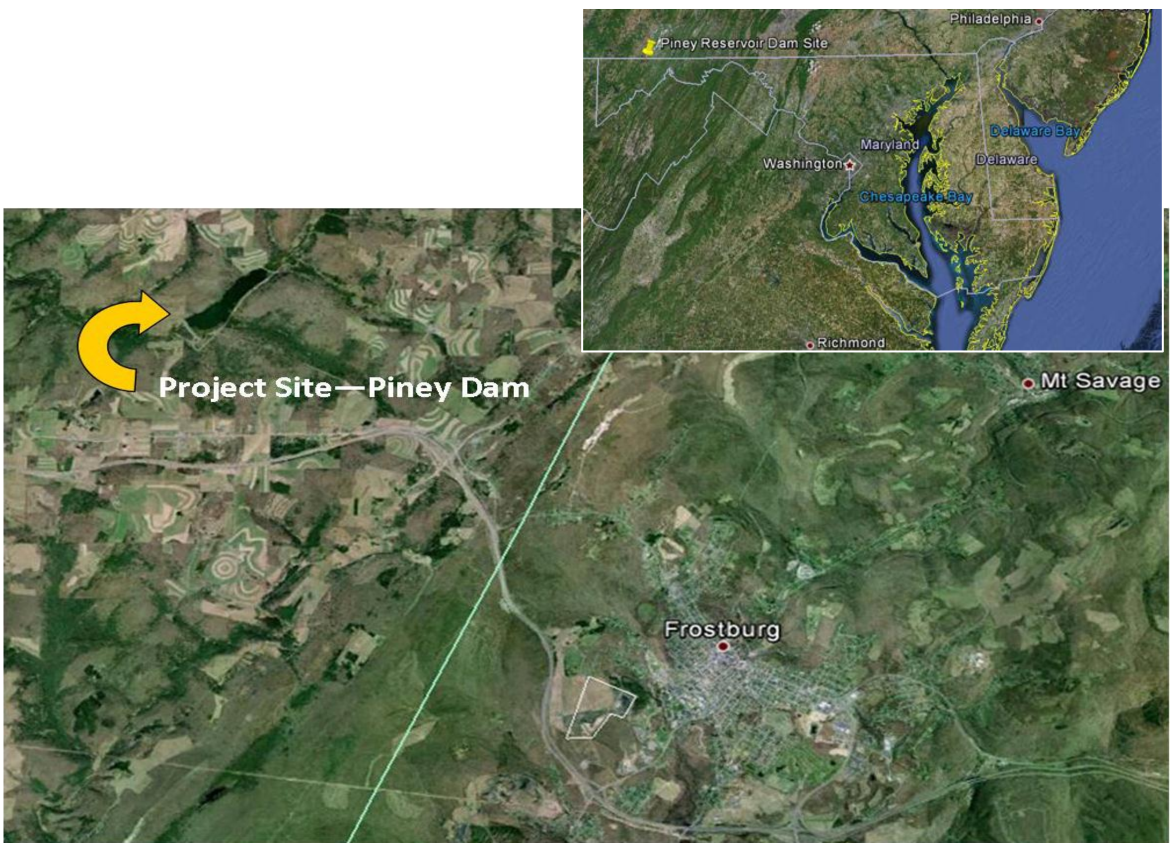
With the help of a "Game Changer" Competitive Grant from the Maryland Energy Administration (MEA) and under an agreement with the Land and Cultural Preservation Fund (LCPF), Associated Wind Developers, LLC (AWD) (the "Consultant"), has completed this Feasibility Report, examining the feasibility of installing community wind turbine(s) (the Project) at the location shown in this report (the "Project Site").

Power generated from the wind turbine would be used to power the existing infrastructure (Pump House) on the Project Site, with any excess power being sold to the wholesale electricity market or net metered. Presented below is a summary of the findings detailed in the Feasibility Report.

Site Considerations

Project Site Description

The Project Site consists of approximately 1,371 acres of wooded land, overlooking the City of Frostburg's Piney Reservoir Dam in Garrett County, Maryland.



Wind Data Collection

A preliminary wind study was conducted for the site using a 'Virtual Met Tower' study from Wind Analytics and published wind maps. This study indicated favorable winds at heights above 30m. Therefore the site has been recommended to receive a one year meteorological study using a uniquely specified met tower through Maryland's Anemometer Loan Program to confirm the wind resource.

This Feasibility study uses the Virtual Met Tower report as a basis for production and analysis, and provides a range of expected results which can be compared to the outcome of the one year met tower study when completed in order to validate production results.

More information about the Wind Resource may be found in Section 1.10 and Appendix D.

Table ES – 1 Average Annual Wind Speeds at Heights

Study Height:	**40m**	**60m**
Mean Wind Speed:	**5.59 m/s**	**6.28 m/s**
Weibull K:	**1.973**	**2.135**

Potential Wind Turbine Locations

Based on the opportunistic location of an elevated geography near the load and electric line interconnection point, one primary location for a turbine became apparent at this site. The location is in proximity to the Piney Dam Pump House, and the interconnecting electric lines of Potomac Edison. It is also located next to an existing high-altitude wind monitoring station operated by the Maryland Department of the Environment, with access to Grantville Road and then Piney Run Road. Being situated at a remote location, the final design of the selected wind turbine(s) will need to take into consideration appropriate safety measures to mitigate potential risks. Specific safety measures may include security fencing/locks on equipment and structures.

Alternate locations on the parcel are available, should permitting criterion change between the time of this report and any actual construction of a project. These locations would require longer access roads and interconnection wiring, but should prove feasible.

More information about the Wind Resource may be found in Section 1.10 and Appendix D.

Analysis of Environmental Impacts

Potential environmental impacts, including noise, flicker, impacts to wetland resources (if any) and visual impacts of the Project were evaluated for the turbine location and the study confirmed that the site appears suitable for wind turbine construction. Further, existing telecommunications infrastructure in the area was evaluated and this study concluded that the Project would not be expected to impact any of these facilities.

The study concluded that significant environmental benefits will result from the installation of a wind turbine which includes a reduction in regional air pollution from the displacement of fossil fuel generated electricity from the grid. Up to 1,265 tons per year of carbon dioxide emissions can be eliminated through the operation of this Project.

In conducting the analysis of the environmental impacts, the Current and Historical and Rare, Threatened, and Endangered Species of Garret County where evaluated. Appendix G represents a compilation of information in the Wildlife and Heritage Service's Biological and Conservation Data system. As part of this study, environmental impacts of sensitive areas have been studied using the state's MERLIN system.

In general, no environmental issues were found that would affect the feasibility of the project. Additional information about environmental issues may be found in Section 1.5.

Construction Staging and Site Access

Also evaluated were construction access, staging areas and overall access to the Site for wind turbine components. There is more than sufficient area for staging, erection and construction of a wind turbine at the site location. It is expected that a wind turbine and tower can be transported to the location via I-89 to Piney Run Road and Grantville Road. As an approach to the site is made on Piney Run or Grantsville Roads, there may be a need to raise or lower electrical lines to allow the access of larger tower sections. The location is accessed over the road which exists on Piney Dam itself, and although this road should be evaluated by a civil engineer for the live loads that would be encountered from transportation of tower sections in order to avert potential damage to the dam itself, no particular problem seemed apparent. Alternate access to the site is available if needed.

Electrical Interconnection

Off-taking of electrical power for this project is proposed under the new Net-Metering regulations of Maryland. Interconnection to the electric distribution line that feeds the Piney Dam Pump House at the Pump House connection is considered so that most of the power will be consumed on the site, with excess power flowing out to the grid. Initial analysis indicates that sufficient electrical infrastructure exists in the vicinity of the Site to ensure that electrical interconnection for wind energy production on the Project Site is feasible.

Project Permitting

Any wind energy project involves varying levels of review and permitting by local, state, and federal entities. In lieu of a complete Environmental Impact Statement, which would have been outside the scope of this study, a review of pertinent environmental and cultural restrictions was undertaken to determine which, if any, of the issues may affect a proposed project. Under applicable local zoning regulations, the overall site is located within an unincorporated area of Frostburg district which lies in Garrett County (the incorporated City of Frostburg lies in Allegheny County). A discussion of the potential of such a wind project was held with the local building and zoning authorities. The results of the environmental review and permitting issues may be found in Section 1.12 of this report, but do not appear to offer conditions that would preclude development of a project. An initial filing with the FAA indicated that the heights of the wind turbines considered would not be an issue.

Turbine Size

The project design attempts to maximize the size of the wind turbine(s) suggested at the site in order to take advantage of the Economies of Scale that are part of any wind energy project. This is feasible at this location due to the existence of a sizable load on the site, as well as additional loads of the owner within the service area of the local utility. Under Maryland's new Net-Metering and Pilot Meter Aggregation regulations, up to 20 meters can be aggregated by a Municipal meter owner and net metered. For this site both large (2MW) as well as mid-scale (225, 500 and 750kW) turbines were studied. The 2MW machine is the maximum allowed under the current Net Metering regulation (see Section 2.2). A vetting process was employed to determine which factors (interconnection, regulatory, land use, access to the site, etc.) would be the restricting factors that would limit turbine size and selection. In the case of this project that factor appears to be the limitation of the Net-Metering regulations to only allow 200% of the on-site load to be serviced. With an estimated load ranging between 821,791 and 510,000 kWhrs (excluding existing net metering from micro-hydro facility, see Section 2) this regulation would allow for approximately 1,600,000 kWhrs/yr, which roughly correlates to the output of a 750kW wind turbine in the site's wind regime. This does not include the planned load from a 4th pump in power station in the future. Therefore the focus of this report quickly centered on a 750kW maximum sized turbine.

Favorable Results

This report concludes that a 750kW community wind turbine project as outlined herein is feasible at this site, although marginally so due to the low power prices currently being enjoyed by the town's energy purchase agreement with UGI services. The inclusion of higher priced meters within the meter aggregation creates a higher 'blended price' which is used in the analysis. A pro forma economic analysis was performed using the financial assumptions outlined herein. The 750kW wind turbine presents the best financial results due to the economies of scale inherent in wind projects and the restrictions at the site, in this case represented by the ability to inject a certain amount of energy into the distribution leg present on the site. Larger wind turbines typically demonstrate more favorable financial results at the location based on a 20 yr NPV basis than smaller machines. The project will assure the City of Frostburg long term energy pricing security as well for the capacity that is generated on-site.

Sensitivity Analysis

Extensive sensitivity analyses were completed (Tables 2.7 – 2.9) that outline the sensitivity of the financial results to changes in major assumptions, primarily project cost, wind speed margin of error (P50, 70 and 90 levels are shown in Appendix F), cost of power, as well as interest rates (cost of money).

Next Steps

With the submittal of this report at this site, the feasibility study is complete. Overall, the study concludes that the construction of a community wind turbine project of the scale shown is economically feasible on the Site and will result in significant regional environmental benefits, provided the following items are addressed:

- Refined engineering of the turbine's actual location at the site.
- Review of market availability for wind turbines of the size suggested.
- Application for Interconnection and final studies by Potomac Electric.
- Review of on-going efforts between the City of Frostburg and Garrett County as they relate to Wind turbine by-laws to insure that any changes do not affect the project.
- Pursuit of additional State grants for design/construction financing as appropriate.
- Design and implement public outreach program regarding wind and renewable energy initiatives on the Site.
- Procure funding for project.
- Initiate design and construction activities, final filings with FAA.

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List of Abbreviations

ASL	Above Sea Level
AM	Amplitude Modulation
BTM	Behind the Meter
CF	Capacity Factor
COMAR	Code of Maryland Regulations
CO2e	Carbon Dioxide Equivalent
DB	Decibel
FM	Frequency Modulation
FCC	Federal Communications Commission
IRR	Internal Rate of Return
ISO(1)	International Organization of Standards
ISO(2)	Independent System Operator
GPS	Global Position System (or Satellite)
kW	Kilowatt
kWhr	Kilowatt-hour
LCPF	Land and Cultural Preservation Fund
LIDAR	Light Detection and Ranging
MDE	Maryland Department of the Environment
MEA	Maryland Energy Administration
MW	Megawatt
NEG	Net Excess Generation
NM	Net Metering
NOAA	National Oceanic and Atmospheric Administration
NCDC	National Climatic Data Center
REC	Renewable Energy Credit
SODAR	Sonic Detection and Ranging
VMT	Virtual Met Tower

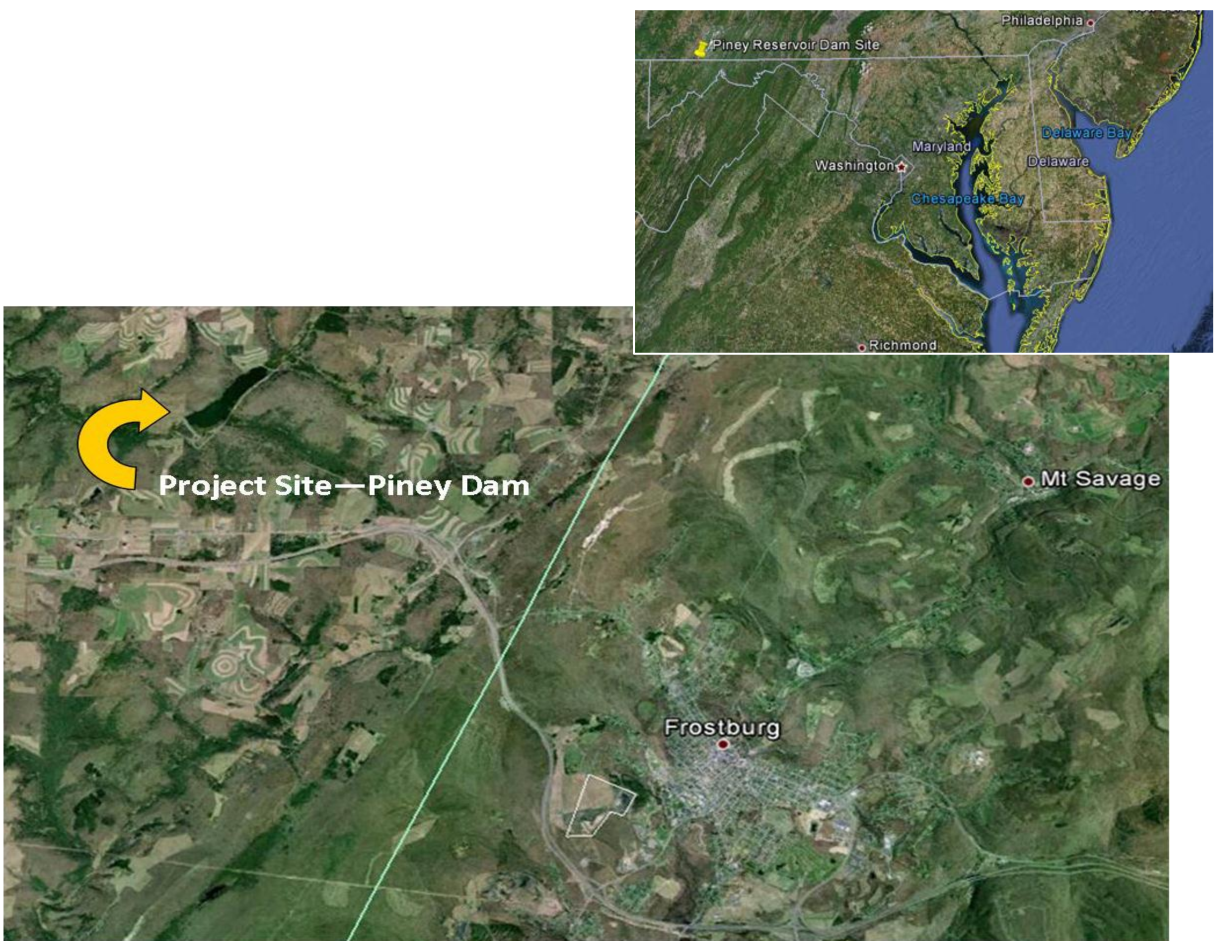
1

1.0 Site Considerations

1.1 Introduction and Background

As outlined in the grant agreement between the Maryland Energy Administration (MEA) and The Land and Cultural Preservation Fund (LCPF), the Consultant has examined the feasibility of installing a community wind scale wind turbine(s) (the Project) within approximately 1371 acres of land that is owned and controlled by the City of Frostburg (the "Project Site") around the Piney Reservoir. Refer to Figure 1.1 for a site locus map of the Project Site.

Figure 1.1 – Site Locus Plan



Power generated from the wind turbine would be used to power the existing infrastructure on the Project Site with any excess power being net metered.

This feasibility study investigates the potential for building and operating a wind turbine project at the site for the benefit of the town as a 'Community Wind' project. The conceptualized project will be designed to avoid on-site natural resources including wetlands and other areas of environmental concern.

1.2 Project Location

Figure 1.2 shows the Project Site. The Project Site is in proximity to the fresh water pumping station which supplies fresh water to the City. An earthen dam, forming the western boundary of the reservoir, provides access to the site and utility easements for power lines. Secondary access to the site can be made available from Piney Run Road.

Figure 1.2 – Project Site Location

In general, the Project Site slopes from water level at the reservoir (approximately 2,355' ASL) at the southeastern property boundary up to a ridgeline above the reservoir running northeast to Southwest. The highest point on the Project Site is at approximately elevation 2,505' ASL and is located near to the proposed turbine location. The proposed turbine site is located approximately 400' horizontally to the North from the pumping station and associated electrical transformers, which offers a connection point to the grid.

The property is identified as Account Number 006338, District 09 in the Maryland Department of Assessments and Taxation Real Property Database.

Figure 1.2a – Secondary Sites

Secondary sites are available on other parts of the parcel along Piney Run Road should the primary site become unfeasible to construct in the future. The secondary sites have the disadvantage of requiring extensive site clearing at the turbine locations, as well as clearing for access roads and electrical interconnections.

1.3 Met Tower and Turbine Location(s)

The proposed turbine location is in close proximity to a LIDAR atmospheric monitoring station operated by the Maryland Department of Environment, which is studying high altitude wind patterns. The data being collected by the LIDAR device is focused on elevations in excess of that being considered for Community Wind turbines (>500'), a smaller, 10 meter met tower is also on the site, but this height places its sensors below treetop levels.

A Virtual Met Tower report was ordered for the site from Wind Analytics (see Appendix D). The location chosen for this report was the same as proposed for the turbine location.

A meteorological tower (met tower) is being permitted for erection under the Maryland Energy Office's Met Tower Loaner program in order to verify the Virtual Met Tower and Wind Map Analysis. The met tower will be situated on a portion of the Project Site within close proximity to the proposed turbine location (See Figure 1.2).

The primary potential turbine location was determined based on an analysis of the existing and proposed land uses and access to the site, proximity to the interconnection location and coordination with the City of Frostburg.

The turbine location is the highest point on the Project Site and provides sufficient open space and buffer from any commercial or residential structures (of which there are none) and natural features.

The location of the Project Site is on the top of a ridgeline offering an unobstructed view to the west and southwest. The closest residential dwelling to the location lies over 1,900 feet to the southeast. This is the residence of the Dam Keeper. The next closest residence is over 3,500’ from the met tower location.

Figure 1.3 – Met Tower and Turbine Location

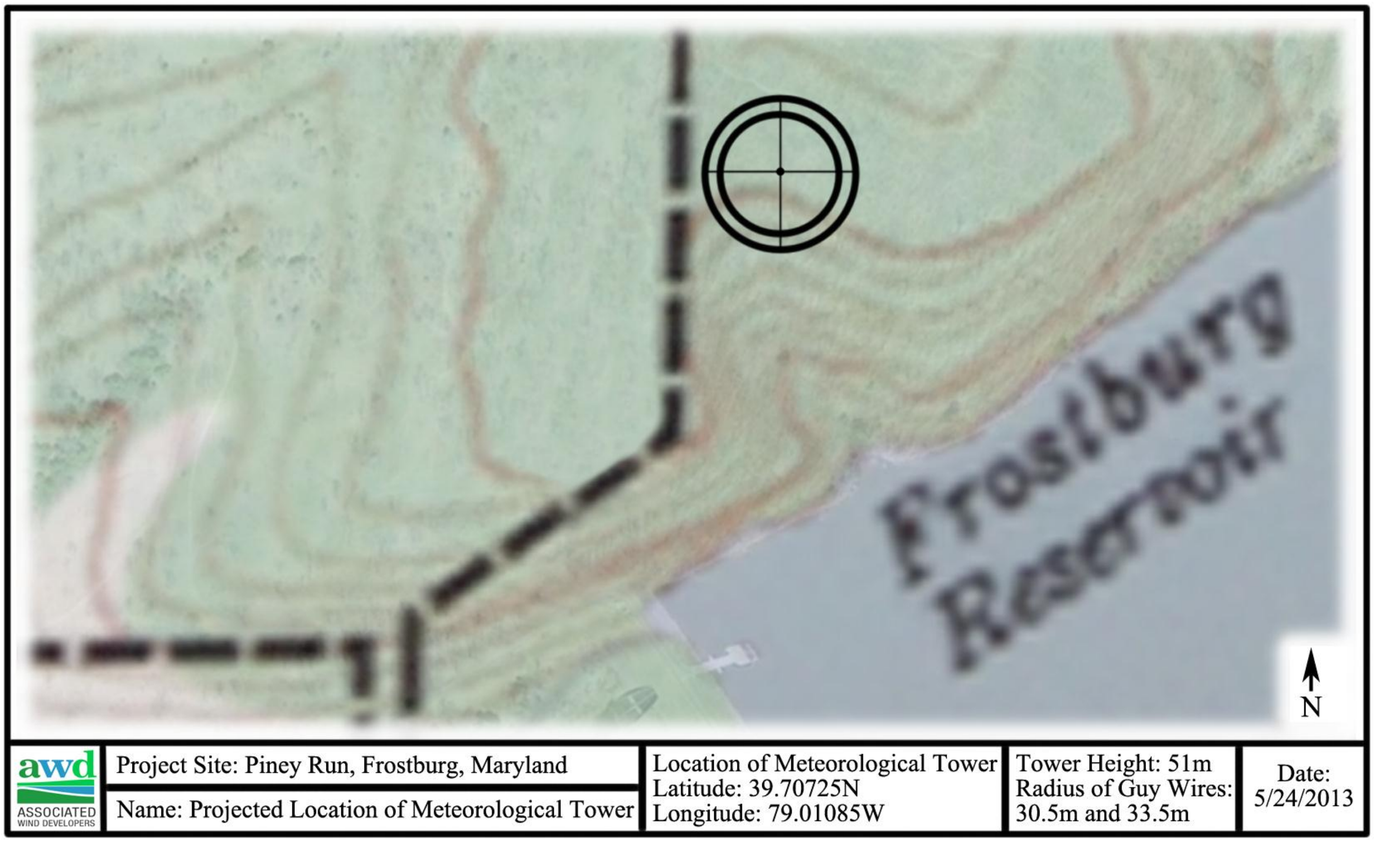


Figure 1.4 – Existing LIDAR near Turbine Location

1.4 Turbine Selection and Siting Considerations

Table 1-1 presents the criteria that were taken into consideration when siting the turbine(s) at the Project Site.

Table 1-1 Turbine Siting Criteria and Findings

Physical Criteria	Location 1 (Primary)	Location 2
1. Sufficient Area	Yes	Yes
2. Accessibility	Yes	Limited
3. Geotechnical	Unknown, but deemed acceptable	Unknown
4. Existing Operations	LIDAR interference clearance	Woods
Presence of Jurisdictional Wetlands or Rare, Threatened or Endangered (RTE) Species	Location was evaluated for the presence of jurisdictional wetlands and rare threatened or endangered species using the MERLIN system and none were determined to exist in the vicinity. Sensitive resource areas, taken from the MERLIN system, are shown on Figure 1 in Appendix G.	N/A
5. Existing Major Structures in Vicinity	LIDAR monitoring station only	N/A
6. Existing Tree Cover	Location is at edge of existing forested areas and some tree clearing will be required. If optional access to site from Piney Run Road is used access road will need to be cleared.	N/A
Operational Criteria 1. Electrical Engineering/Interconnectivity 2. Sensitive Environmental Receptors 3. Wind Speed Resources 4. Returns	1. Feasible 2. None 3. Highest portion of site 4. Good	N/A
Community Criteria		
1. Sufficient Buffer (Noise/Shadow/Flicker)	Location Is Feasible	N/A
2. Aesthetics	Rural application	N/A
3. Permitting/Public Review	Feasible	N/A
4. Aeronautical Impact	Outside of 3-mile airport buffer	N/A
5. Environmental Benefits	Significant reductions in air emissions from displaced	N/A

Turbine Selection

When beginning the process of evaluating a community wind project site, a decision must be made as to which factors will determine the size of the turbine being selected. There are many such influencing factors, such as height limitations, the amount of power that can be injected into the distribution lines, or the zoning or grid regulations in place for what is permissible. One of the reasons for conducting a Feasibility Study is therefore to analyze all such pertinent factors in order to determine the most applicable turbine for the site.

In the sections that follow various factors are considered that would have just such an impact so as to narrow the choice of machine for the site. In the case of this specific project, the overriding factors became the amount of power that could be injected into the line serving the dam's pump station, and the desire to have the wind turbine be applicable for the state's net-metering regulation, which tends to maximize the power value at full retail rates. (see Section 1.12)

When all such factors are evaluated, the turbine of choice for this project becomes a 750kW wind turbine. Reference is made to the Game Changer Project turbine list for specific turbines (See Appendix I) for a list of specific machines that meet this designation.

Given the selection of such a machine to fit the most restrictive factors, many of the Feasibility analyses in this report were limited to the 750kW turbine size.

1.5 Environmental Issues

A review of any potentially sensitive areas was undertaken using the State of Maryland's Department of Natural Resources on-line MERLIN system. Appendix G depicts the list of issues checked. No issues appear to negatively affect the primary site.

1.6 Shadow/Flicker

Shadow Flicker is the result of the shadow cast from the sun by the moving turbine blades. It is usually most prominent at low sun angles.

A preliminary shadow flicker analysis has been completed to analyze the wind turbine location being evaluated in this study. The shadow flicker analysis was completed using the shadow module of the WindPRO software. When using the WindPRO software, a model is created that calculates the amount of shadow flicker based on the position of the sun relative to the specified turbine location. The model calculates whether a shadow is generated for each day throughout the year at 1 minute intervals for the duration of daylight hours. The output from the modeling includes a summary of the input data and results, a tabulation of time of day with shadow flicker at each receptor, a tabulation of time of impact from the turbine at each receptor, as well as a color-coded shadow flicker map of the site and surrounding areas, showing iso-lines representing hours per year of potential shadow flicker. The result of this analysis is an estimate of potential shadow impact for areas surrounding the turbine location.

The shadow flicker analysis presented herein is based on on-site wind distribution data that is currently available for the Project. Two sizes of wind turbines have been analyzed for use on the Project. To be conservative, this analysis has been completed using the largest of the proposed wind turbines, a 750kW machine on a 65 meter tower.

Analysis Locations

As shown in Tables 1-2 and 1-3, a number of representative locations (Receptors) in the general vicinity of the primary turbine location were used in the model to evaluate potential shadow flicker impacts.

Figure 1.5 - Turbine Shadow Flicker Receptor Locations

These receptor locations were chosen to provide a general idea of the shadow flicker impacts around the Project Site.

Methodology

In the shadow module, WindPRO sets defaults for use in the calculation, but also allows the user to modify those defaults. For the calculation of the shadow flicker, the defaults identified by WindPRO were not modified. These defaults include calculating shadow flicker only when 20 percent or more of the sun is covered by the turbine's blade and only when the angle of the sun above the horizon is more than 3 degrees. These are common settings used in shadow flicker calculations.

WindPRO also allows two options for identifying the analysis locations: greenhouse mode and directional mode. The greenhouse mode is more conservative than the directional mode, and calculates shadow flicker at all angles. The directional mode is more detailed, allowing the user to identify the location of a window, the dimensions of a window, the height of a window above the ground, and the direction the window faces. The purpose of this study is to generally identify potential shadow flicker impacts in the vicinity of the Project Site, rather than at a specific location; therefore, the more conservative greenhouse mode was used.

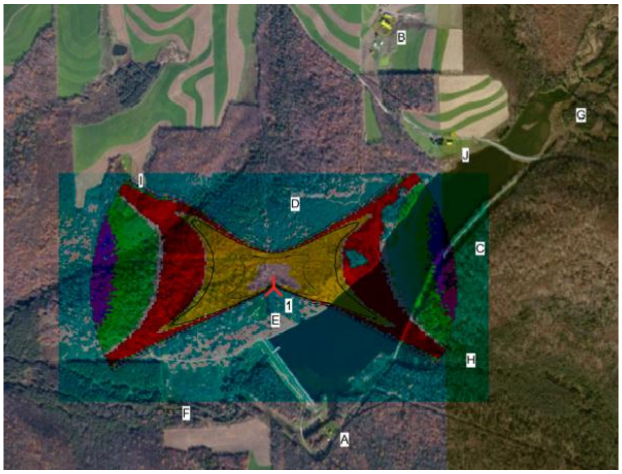
It should be noted that to be more conservative, the analysis does not take into account trees, vegetation, other buildings, fences or other obstructions that may exist in the line of sight between the analysis locations and the turbines that would subsequently reduce the amount of actual experienced shadow flicker. Because vegetation of this type blocks sunlight at low angles, the results tend be quite exaggerated during early morning and evening hours.

Results

Appendix A includes the WindPRO Shadow module outputs. These WindPRO reports illustrate the output of the Shadow model to provide a clearer visualization of the shadow flicker impacts on the surrounding area by delineating color coded areas for different ranges of estimated shadow flicker time that can be expected.

In general, potential shadow flicker impacts are within the range of levels that would generally be considered acceptable with little or no mitigation. If the project is constructed and a turbine other than the proposed turbine is considered, this flicker analysis will need to be recomputed. Table 1-3 below shows potential shadow flicker impacts at various receptor locations.

Figure 1.6 - Estimated Shadow Flicker at Analysis Locations



A wind turbine located as shown has little flicker effect on any residential or commercial structures, due to the remote location of the site. The nearest residential building to the site is the Dam Keeper's house, at over 1,900' away. Due to its location to the south of the flicker zone this residence will not be impacted by flicker. This report ignores small camps and what appear to be abandoned trailers used for occasional hunting around the site.

The WindPRO Shadow module outputs in Appendix A provides color coded areas for different ranges of estimated shadow flicker time that can be expected on the surrounding area.

1.7 Telecommunications

Most radio, microwave and TV signals are unaffected by the operation of wind turbines. However, in some instances, AM radio and over-the-air TV digital signals can be affected. Microwave signals also can be blocked by a wind turbine if it is in a direct line between a transmitter and receiver. FM transmissions which are affected by a turbine can often be corrected by 'de-tuning' of the turbine tower. Generally, towers outside of a 3 mile radius of the turbine location should not be affected by turbine operations.

A review of all communication towers within proximity of the turbine site was conducted via the Federal Communications Commission (FCC) web database (5 mile radius) and through a private database (AntennaSearch.com) (4 mile radius).

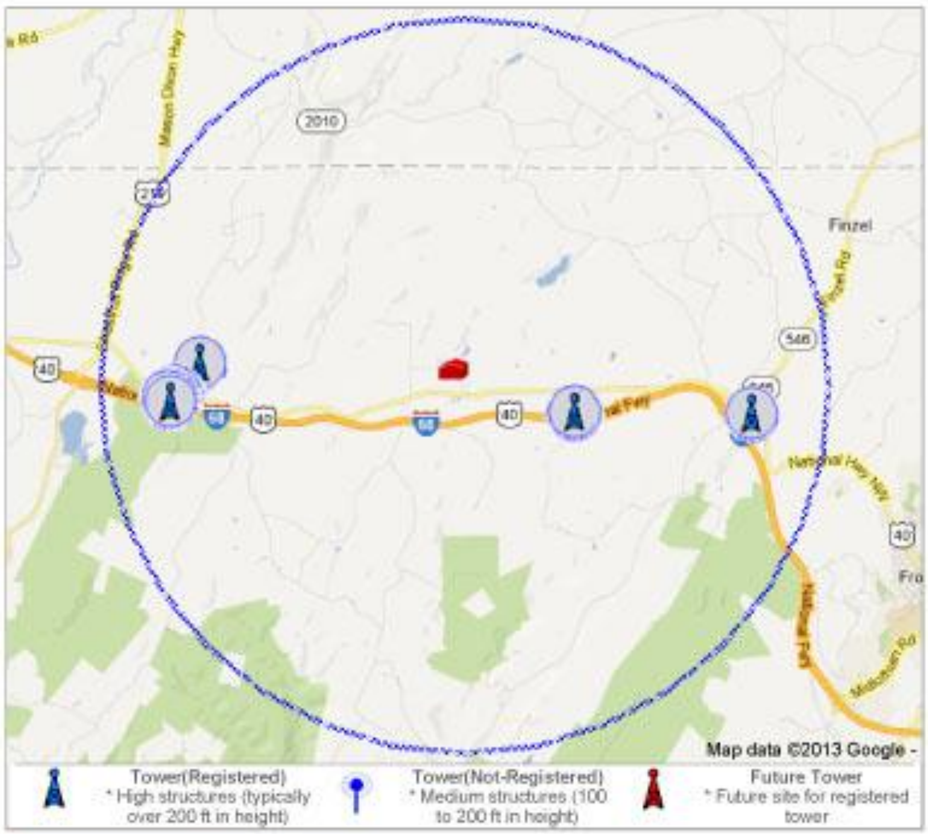
11 valid locations of towers registered with the FCC exist within this airspace. The closest of these are:

- a tower owned by Crown Communications, located on a parcel approximately 8,375' to the southeast of the turbine location. This tower appears to be a cell tower, and at 1.6 miles distant is not expected to present a problem to turbine siting.
- a tower owned by WTBO WKGO Corporation, located on a parcel approximately 2.9 miles (15,458') to the east-southeast. This tower appears to offer AM broadcasting, which is 'line of site' oriented. However, the WTBO tower is at the fringe of the 3 mile radius, and is located at a higher elevation than the proposed turbine site, therefore any impact is expected to be relatively insignificant.

Full information on all actively registered towers within 5 miles of the project location is shown in Table 1-5. The tower locations do not appear to affect the feasibility of the project. As the design of any proposed wind turbine advances, these issues should be re-evaluated with an experienced radio interference professional and the survey brought up to date if required.

Figure 1.7 – Communications Devices within a 3 Mile Radius of Project Site

- **Tower Structures - (Field Rd, Frostburg, MD 21532)**



Tower Search Results!

Alert! 7 Towers (4 Registered,3 Not Registered) found within 4.00 miles of **Field Rd, Frostburg, MD 21532**.

Info! The NEAREST Tower is 1.44 miles away and is owned by **Crown Communication Llc**.

Ok! No Applications for Future Towers detected as of 04/15/13.

Tower Type	ID Num	Site Owner	Height	Dist
Registered	(1)	Crown Communication Llc	326 feet	1.44 miles
	(2)	Global Tower, Llc	350 feet	3.42 miles
	(3)	Wtbo Wkgo Corporation Llc	446 feet	3.72 miles
	(4)	United States Cellular Corporation	360 feet	3.79 miles
Not Registered	(1)	Dobson Cellular Systems Inc	130 feet	3.72 miles
	(2)	First Cellular Of Maryland Inc	110 feet	3.77 miles
	(3)	Us Cellular Corp	310 feet	3.85 miles
Future		(No Towers Detected)		

Figure 1.8 – Details of Crown Communications Tower Located 1.6 miles from Project

Registered Tower Detail - Tower (1)

- Ownership Info

Rep	Company:	CROWN COMMUNICATION LLC	Address:	2000 CORPORATE DRIVE CANONSBURG, PA, 15317
	Contact:	CHRISTINE A VERRE		
	Phone:	(336)643-2524		
	Email:	CHRISTINE.VERRE@CROWNCASTLE.COM		
Owner	Company:	CROWN COMMUNICATION LLC	Attn:	REGULATORY DEPARTMENT
			Address:	2000 CORPORATE DRIVE CANONSBURG, PA, 15317
	Contact:	Not Recorded		
	Phone:	(336)643-2524		
	Email:	REGULATORY.DEPARTMENT@CROWNCASTLE.COM		

- Tower Characteristics

Registration #:	1204562	Ground Elev:	2650.1 feet
Latitude:	39.6839	Height Of Structure:	306.1 feet
Longitude:	-79.0022	Overall Height:	2976.2 feet
Structure Type:	Tower	Structure Address:	Intersection of Old Frostburg Rd and I68 Overpass Frostburg, MD
Status:	Constructed		
Date Constructed:	06/28/2000		

- History

Purpose	Status	Date	Addnl Info
New Reg	Granted	10/15/1999	---
Constructed	Granted	08/15/2000	---
Adm Update	Granted	11/27/2001	---
Adm Update	Granted	11/10/2002	---
Adm Update	Granted	11/10/2002	---
Constructed	Granted	10/05/2004	---
Modification	Granted	10/05/2004	---
Adm Update	Granted	02/01/2011	---

Table 1.2 – Communications Towers within a 5 Mile Radius of Project Site

ASR Registration Search

Registration Search Results

Displayed Results

PA = Pending Application(s)

Specified Search

Latitude=**'39-42-17.3 N'**, Longitude=**'79-0-42.8 W'**, Radius=**8 Kilometers**

	Registration Number	Status	File Number	Owner Name	Latitude/Longitude	Structure City/State	Overall Height Above Ground (AGL)
1	1027756	Constructed	A0032943	HES ALIVE INC	39-42-14.0N 079-05-30.0W	GRANTSVILLE, MD	98.0
2	1037025	Constructed	A0043669	WTBO WKGO CORPORATION LLC	39-41-02.0N 078-57-56.0W	FROSTBURG, MD	136.0
3	1037683	Constructed	A0396027	United States Cellular Corporation	39-41-09.3N 079-05-08.1W	GRANTSVILLE, MD	109.7
4	1037843	Constructed	A0815190	American Towers, LLC	39-40-43.7N 078-57-33.0W	Fredrick, MD	66.4
5	1045836	Terminated	A0054011	WTBO WKGO CORPORATION	39-41-02.0N 078-57-56.0W	FROSTBURG, MD	136.0
6	1204562	Constructed	A0713105	CROWN COMMUNICATION LLC	39-41-02.0N 079-00-08.0W	Frostburg, MD	99.4
7	1220835	Cancelled	A0358235	Crown Communication Inc.	39-40-33.7N 078-57-38.5W	Frostburg, MD	99.1
8	1235175	Constructed	A0829409	Global Tower, LLC	39-41-30.6N 079-04-46.9W	Grantsville, MD	106.7
9	1247630	Constructed	A0476975	State of Maryland, MIEMSS	39-41-17.9N 079-05-31.8W	Grantsville, MD	106.1
10	1251177	Constructed	A0484031	United States Cellular Corporation	39-39-29.9N 078-55-46.0W	Frostburg, MD	38.1
11	1259435	Constructed	A0708207	United States Cellular Corporation	39-38-59.9N 078-56-21.8W	Frostburg, MD	36.5
12	1260770	Constructed	A0713987	CROWN COMMUNICATION LLC	39-40-33.7N 078-57-38.5W	Frostburg, MD	92.6
13	1275816	Constructed	A0800002	New Cingular Wireless PCS, LLC	39-45-13.7N 079-04-31.6W	Salisbury, PA	78.6

1.8 Noise Analysis

Maryland Sound Regulations

In October of 2012 the State of Maryland transferred enforcement authority for noise issues to local governments. According to the State's Department of Environment website:

Effective October 1, 2012, the Maryland Department of the Environment is no longer responsible for noise enforcement. During the 2012 legislative session, House Bill 190 effectively transferred noise enforcement authority to local governments. MDE will continue to be responsible for setting statewide standards and general exemptions. See related MDE article. To ensure consistency with the new law, MDE adopted changes to the noise regulations. This action was published in the January 25, 2013 edition of the Maryland Register.

The overall site is located on a parcel that is situated in the unincorporated portion of Frostburg, which is part of Garrett County. The City of Frostburg itself, which owns the parcel, is located in Garrett County. This is of significance, there has been no wind ordinance in Garrett County until April, 2013 with the passing of Senate Bill 370 which has not yet been adopted locally. For the sake of this study however, it was assumed that by the time such a project would be actually constructed, Garrett County would adopt such regulations, and that the adopted regulations would mimic the more restrictive City of Frostburg regulations in Allegheny County or those in line with Comar 26.02.03 (below). Therefore those are the regulations this study used as a basis of permitting law.

Section 321 of the City of Frostburg's Zoning Ordinances refers to the installation of windmills (this report, see Section 1, Permitting), and also a Wind Turbine Ordinance. Although the overall Zoning Ordinances do not mention noise criteria, the Wind Turbine Ordinance states, in part, that:

- Noise will not be louder than 55 decibels.

These levels are in line with the Department of Environment's standards in COMAR 26.02.03 (see Appendix H). It is unclear from the ordinance whether the regulation refers to a location at the nearest lot line, or other buildings (sound 'receptors'), but for conservative purposes and to stay with COMAR state regulations, this report will assume that the nearest lot line is the point in question. Also unclear is the specific type of decibel rating – whether weighted averages or other values should be used. This report will consider 'A' weighted decibel values and use the 55 decibel level in its analysis.

Turbine Reference

A preliminary noise evaluation was conducted to determine the potential noise impacts of locating a wind turbine on the Project Site using WindPro software. Based on the turbine selection criteria as determined in Appendix D due to injectable load and interconnection capability, the following turbine was selected for the noise study:

- a 54 meter diameter, 750kW turbine

The noise analysis evaluated sound levels associated with this 750kW machine with a hub height of approximately 213 feet (65 meters) which produces a sound level of 99.5 decibels at the nacelle at 8 m/s. See Appendix B for the Noise Report.

Noise Methodology

Noise analysis consists of two components: existing ambient sound levels and wind turbine contributions. Due to the rural nature of the location, ambient sound levels were considered to be negligible. The wind turbine sound levels were calculated using manufacturer's sound data and follows the methodology outlined by the International

Organization of Standardization (ISO). Contour lines of projected noise levels at 55 decibels (see below, Town Wind Turbine Ordinance) are shown in Figure 1.5. This threshold was selected in order to meet the more stringent regulations of Allegheny, instead of Garrett County.

The calculations of the sound level projections to the receptor locations are based on the following equation, from the publication ISO 9613-2: Attenuation of sound during propagation outdoors – Part2: General method of calculation:

Lft(DW) = Lw + Dc – A,

where…

- Lw is the sound power level produced by the sound source.
- Dc is the directivity correction to account for deviation of the sound power level in a specified direction. For an omni-directional sound source radiating into open space, Dc = 0.
- A is the attenuation occurring during propagation from sound source to receptor location. Attenuation may include geometrical divergences (or spherical spreading), atmospheric absorption, ground effect, barrier, and other miscellaneous effects, such density of vegetation and buildings. For this report no attenuation was considered.

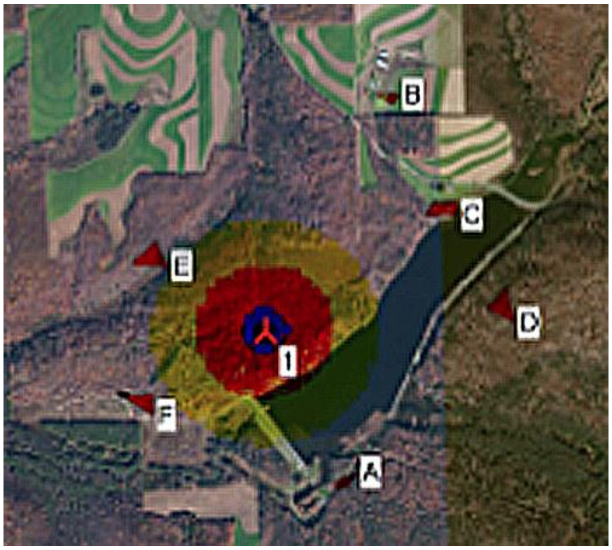
Results

Figure 1.5 shows a map indicating lines of sound levels emanating from the selected wind turbine. Note that this map indicates that no noise over 55 dB is expected to be heard from the turbines at any receptor.

This preliminary feasibility noise evaluation is based on sound level projections at the site without measuring an ambient noise level due to the rural, wooded nature of the site. A more detailed study, including the collection of additional ambient noise measurements on and around the Project Site may be required by local authorities if a wind turbine project moves forward or if turbine selection changes.

See Appendix B for a complete Noise Report.

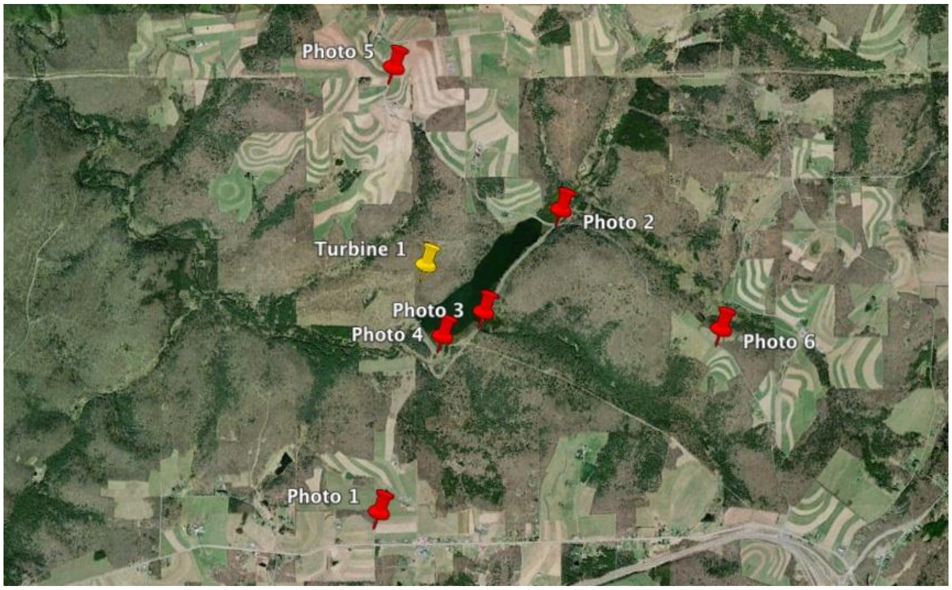
Figure 1.9 - Projected Sound Levels, 55 dbA



1.9 Photo Simulations

Photo simulation is a procedure where an object (such as a wind turbine) is superimposed onto a photograph at the proper scale, location and elevation to provide a visual representation of what the proposed object (turbine) would look like if it appeared in the photograph.

In April and May of 2013, photographs of the proposed Turbine Location were taken from a number of locations as shown in the following image:



Photographs were taken using a digital camera which is GPS enabled, allowing it to record GPS coordinates in the metadata of each picture. The photo simulation process was completed using computer software which uses the location where a photograph was taken and the location of a turbine, applies the topography and other camera settings, such as focal length, and develops a photo simulation of each photograph taken in the field.

The photo simulations are derived from photos taken from 5 chosen locations. The complete set of photo simulations may be found in Appendix C in this report. Each photo simulation photograph shows a visual representation of the proposed turbine as it would appear from the location where the photograph was taken. In some cases the turbine would be obscured by the intervening vegetation or other geographic blockage and in this case the photograph is noted.

Figure 1.10 – Photo simulation of a 750kW Turbine at the Piney Dam Location

(See additional photo simulations in Appendix C)

1.10 Wind Resource Assessment

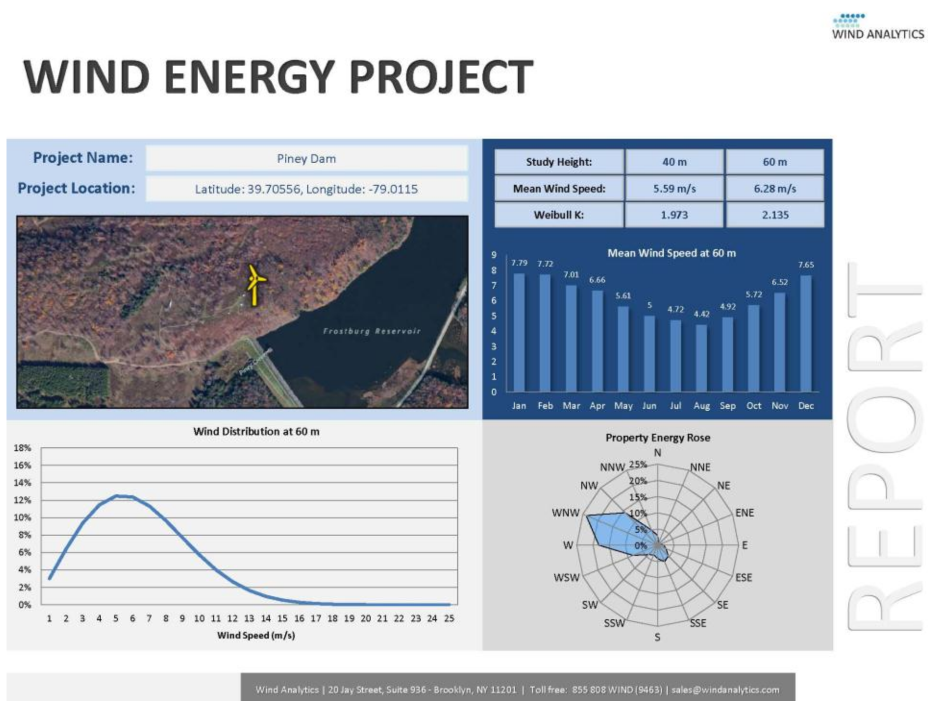
The sections below present a summary of the wind resource assessment completed for the Project. Additional detail and calculations are included in Appendix D.

Data Collection

Although there is a LIDAR wind monitoring station located adjacent to the project site, the data from the station was unfortunately deemed unusable for this study. This is due to the fact that the LIDAR station is studying high altitude winds (>500'), and a smaller 10m tall met tower is located below the level of surrounding treetops. Extrapolated results from either of these two resources would contain an excessive degree of error.

As an 'Alternate' champion candidate site for the grant funding this feasibility study series, this site has been selected to receive a full met tower study during the period from July of 2013 to July of 2014. The met tower will be supplied under the Maryland Energy Office's Anemometer Loan program.

In order to immediately evaluate the site while data is being recorded the Feasibility Study drew upon interim data from two published sources: NREL Wind Maps and a 'Virtual Met Tower' report from Wind Analytics of Brooklyn NY. The Feasibility Study will use this data to determine an estimated wind regime for the site along with a sensitivity analysis that can be used to adjust production numbers when the actual data collection effort is finished.



The 'Virtual Met Tower' process is described by Wind Analytics as follows:

The underlying wind data used by Wind Analytics is derived from a global network of Automated Surface Observing System (ASOS) station data, acquired through the National Climatic Data Center (NCDC), an extension of the National Oceanic and Atmospheric Administration (NOAA). With Wind Analytics, UW has access to 28,000 datasets globally, with over 6,000 stations across the US. The data is provided as an hourly average of wind speed and direction, with typical station record history of 30+years. Once a study location is *selected, Wind Analytics identifies and triangulates three nearby met stations. Station data is downloaded and weighted to account for station location and data quality. To account for variations in the wind profile from nearby stations to the study site, land cover effects are removed from met stations. To account for the impacts of nearby features such as trees, obstructions, or turbines, Wind Analytics creates an obstruction model for each study site. For each obstacle, the analyst inputs the corresponding height, width, and porosity using aerial oblique imagery. A final wind profile is developed for each location and height and turbine production is calculated by matching the certified wind turbine efficiency curve to the wind speed distribution.*

Additional information about the Virtual Met Tower process may be found in Appendix D.

The published wind maps from the National Renewable Energy Labs indicate winds in the 5.6 to 6.4 m/s range at a hub height of 50 meters.

Figure 1.11 – NREL 50m Wind Speed Map

(Yellow grids indicate 5.6 to 6.4m/s winds. Orange grids indicate 6.5 to 7.0m/s)

Methodology

While some might consider conducting a feasibility study before an actual wind study as putting 'the cart before the horse', this method of evaluating a site allows longer term (1 year), expensive site wind studies to only be conducted at locations where, in most other respects, the feasibility of a project has already been validated. When done by experienced wind industry professionals who can usually spot significant flaws or good project sites early in the process, this method saves both time and money when evaluating sites.

It should be noted that financing sources will differ on the need for actual vs. published wind data for smaller community wind sites. While larger wind projects certainly require one (or more) met towers to validate the wind resource, smaller community wind projects can often obtain financing without an on-site wind study, especially if:

- multiple wind data resources are employed which all suggest a similar result,
- other existing met tower studies or turbines have been constructed in the area,
- or if the winds are considered strong enough that the margin of error can be removed from the financial pro forma instead.

The location of the met tower selected for the Maryland Energy Office Anemometer Loan program was selected because it represents an on-site location relatively uncompromised by trees, buildings, or other structures. This site is located in close proximity to the proposed turbine location and there are no other obstacles other than vegetation surrounding the met tower site. Figure 1.2 displays the location of the met tower installation in reference to potential turbine locations.

Long-term Wind Speed Estimation

Both published wind maps and Virtual Met Tower reports are based on 20 year wind speed history. Based on a combination of the wind map and Virtual Met Tower report, estimated annual long-term wind speeds at various heights are estimated to be as follows. These values will be used in this report until the actual wind study is completed.

Table 1.3 Average Annual Wind Speeds

Height (m)	Wind Map	VMT
40		5.59
50	6.0	
60		6.28
80	6.5	

Wind Shear Estimates

Analysis of the Wind Speeds from the Virtual Met Tower study allows us to calculate a wind shear exponent of .287, which is typical of other sites with similar terrain and heights.

Further information about wind spear may be found in Appendix D.

Wind Resource Uncertainty

A number of factors contribute to the uncertainty of wind resource data. Using standard statistical principles, a general level of resource uncertainty can be obtained.

Energy industry standard for conveying uncertainty results is to calculate what is known as a P90 value representing a conservative estimate of a value. Based on project data, long-term P90 wind speeds are estimated to be 89.9% as strong as the values displayed in Table 1-7 of the next section. The Financial Modeling in Section 2 incorporates both P-50 and P-90 modeling for comparative purposes. An option for decreasing this uncertainty is to pursue a long-term dataset of higher quality from a resource forecaster such as Wind Analytics.

Wind Modeling

The Average Annual Wind Speeds as calculated from the Virtual Met Tower report will be used to model electrical and financial performance.

From table 1.6 an estimated value for the wind speed at 50, 65 and 80 meters may be calculated, which are common hub heights for many wind turbines.

Table 1.4 Average Annual Wind Speeds at Various Heights

Height (m)	Wind Map	VMT	Calc. (1)
40		5.59	5.59
50	6.0		5.96
60		6.28	6.28
65			6.43
80	6.5		6.82

Since this Feasibility has found that a 750kW turbine appears to best fit the site, and since 65 meters is a typical height for 750kW turbines, this is the wind speed value that will be used in this report for the average annual wind speed pending the results of the 1 year wind study. When the production and financial models for the project are run, values of +/- 5% of this value (6.10 and 6.75m/s) will also be calculated, in order to enable future readers to easily correlate the results from the met tower study.

In general, the site demonstrates acceptable conditions for wind energy development.

1.11 Energy Infrastructure, Consumption and Generation

Energy Generation

The Project Site has relatively significant actual load (734,000 kWhs/year). This value is taken from 2010 and 11 electric bills before the net metering activities from the micro-hydro plant before the water treatment facility was used to offset the load using net metering. The 2012 electricity usage at the Piney Dam Pumping House was 490,000 kWh with demands that range from 131 to 241 kW. Representative Electric bills are included in Appendix E – Interconnection Analysis.

It is noted that the City of Frostburg already utilizes net-metering to offset its electric bills through the use of a micro-hydro facility located near the water treatment plant. Water descending from Savage Mountain is tapped in this plant to recover a portion of the kinetic energy used to pump up the other side of the mountain.

The amount of electricity produced by a specific wind turbine is primarily a function of the wind speed at the hub of the turbine combined with the size of the turbine rotor. A key variable of this function is the height of the turbine tower, as wind speeds are almost invariably greater at higher elevations.

Based on the expected wind resources on-site and the manufacturer-specified power curves for turbines considered to be applicable to the study (see Appendix I), estimated generation values for a range of other example turbines are shown below for comparative purposes.

Table 1.5 – Estimated Generation of Suggested Turbines

Turbine Size	Hub Height	Estimated Avg. Wind Speed	Energy Production (kWhrs/yr.)	% of On-Site Load	Capacity Factor
50kW	50m	5.96	165531	21	31
100kW	50m	5.96	222090	28	25
225kW	50m	5.96	520493	66	26
750kW	65m	6.43	1832699	252	27
2000kW	80m	6.82	4621305	585	26

The net capacity factors listed in Table 1-8 are computed as the estimated electricity produced as a percentage of the turbine at full capacity over a static period of time – a standard measurement of how effective a turbine installation is. Capacity factors between 20% and 30% are considered typical of mid-scale wind turbines situated in the wind regime found in Maryland, while larger turbines of over 1 MW will typically exhibit Capacity Factors of 28-36%.

Turbines analyzed above represent our understanding of the machines that could potentially best suit the Project Site in terms of turbine efficiency, availability, the ability to get the machines to the site, and the ability to optimize production based on the off-taking ability of the power lines running to the dam pump house. As the turbine market is ever-changing, specific inquiries should be sought from additional manufacturers when further pursuing one of the turbines from this selection.

Carbon Savings

A noteworthy positive impact of any renewable energy project is its ability to offset electricity that otherwise would have been generated by fossil fuel combustion, thus avoiding fossil fuel's inherent environmental emissions and impacts. For the Project, a single turbine is expected to reduce regional air emissions, based on the P50 generation results, as shown below:

Table 1.6 – Estimated Carbon Offsets of Suggested Turbines

Turbine Size	Metric Tons CO2equivilent
50 kW	114
100kW	147
225kW	366
750kW	1263
2000kW	3251

1.12 Engineering and Interconnection

Staging/Erection/Construction

For a 225 to 750 kW wind turbine, 1 to 1.5 acres is typically needed for lay down of equipment and erection. The project site location has significant area available for lay down and construction of a turbine of the size being considered by this study. A small amount of land may need to be cleared for road construction and staging areas. Sufficient land area appears to be available to allow a final turbine placement in a location so as not to interfere with the LIDAR installation of the Department of the Environment.

Construction activities can be scheduled so that the foundation and wiring runs will be built prior to the turbine's arrival. The construction of the foundation and wiring runs is estimated to take approximately one month with three to four weeks for foundation curing. Turbine and tower installation, including crane set-up and break down, is expected to take approximately one month depending on weather (windy conditions can extend construction schedules). Construction will be arranged as to not interfere with operations on the Project Site.

The binding constraints on installation are turbine availability and permit approval schedules. It is likely that construction can be completed within 18-24 months after project is given approval to proceed.

Transportation

It is expected that a wind turbine and tower can be transported to the Location via Interstate 89 (US 40) and Piney Run Road. Site inspections during a visit with Mr. Chris Hovatter, Director of Public Works of the City of Frostburg, indicated that a 225 to 750kW machine might be brought to the site using Grantville Road, along the dam and up to the site. A larger machine such as a 2MW turbine, would probably need to be delivered via construction of a new access road to the site from Piney Run Road directly. Not only is the shipping of the wind turbines of concern, but the cranes used to install the turbines need to be considered. While either a 225 or 750kW machine may be installed using rubber-wheeled, telescoping cranes on truck chassis, larger turbines require a crawler-type crane that requires many supporting flatbed trailers just to erect the crane.

The cost of such a road appears to be prohibitive to a single turbine site such as this. This becomes one of the deciding factors for the proposal of a 750kW machine at this site.

Some on-site roadway upgrades may be needed in order to deliver the turbine to the specified location, especially from the dam to the hilltop location, including grade leveling and in some cases perhaps temporarily expanding the road at some curves to avoid sharp turning radii.

Electrical Engineering and Interconnection Requirements

Discussions about electrical interconnection at the site were conducted with Mr. John Emerick of Potomac Edison/First Energy as part of this feasibility study and the results are included in Appendix E. The electrical line that feeds the pump house was built to service (4) 250kW pumps (one pump is for future use) and this location is at the end of the leg. The availability of this line is another determining factor in the selection of a 750kW machine over a larger turbine. The analysis concludes that interconnection at the potential turbine location appears feasible however additional design and coordination with Potomac Edison will be required once a turbine location is selected and a connection strategy is finalized.

Permitting

If this project moves forward towards construction, it will involve varying levels of review and permitting by local, state, and federal entities. The potential wind turbine location is within an area that has already been developed to include industrial electrical components of the pump house, transformers, etc.

Under applicable local zoning regulations, the overall site is located on a parcel that is situated in the unincorporated portion of Frostburg, which is part of Garrett County. The City of Frostburg itself is located in Allegeny County. This is of significance because at the time of the study there was no wind ordinance in Garrett County. Every Jurisdiction in the State of Maryland must adopt a building code per the Maryland Building Code Standard. Garrett County adopts the International 2012 Building Code with amendments per the County's Building Code Ordinance. Theoretically therefore, greater flexibility should be available to this site than within the City of Frostburg, which does have Zoning Ordinances which includes a Wind Turbine Bylaw. For the sake of this study, it was assumed that by the time such a project would be actually constructed, Garrett County would adopt such regulations, and that the adopted regulations would mimic the more restrictive regulations in Allegheny County. Therefore those are the regulations this study used as a basis of permitting law. Discussions with Garrett County Planning and Development office indicate that the county will adopt Senate Bill 370 (SB 370): "Garrett County-County Commissioners-Industrial Wind Energy Conversion Systems." As of April, 2013 SB 370 has been passed by the House and Senate in the Maryland General Assembly.

Table 1-8 lists the potential permits and/or approvals required for the Project.

Table 1.7 – List of Potential Permits and/or Approvals for the Project

Effective Date: January 1, 2012

2012 IBC - International Building Code (IBC) 2012 w/ the Department of Housing and Community Development (DHCD) modifications (Ref: COMAR 05.02.07)

2012 IRC - International Residential Code (IRC) 2012 w/ the DHCD modifications (Ref: COMAR 05.02.07)

2012 IECC - International Energy Conservation Code (IECC) (Ref: COMAR 05.02.07)

The modifications to the above referenced codes include the following codes and standards:

2009 IEBC - Maryland Building Rehabilitation Code (MBRC) incorporating the International Existing Building Code (IEBC) 2009 (Ref: COMAR 05.16)

2012 NFPA 101 Life Safety Code - The State Fire Prevention Code incorporating the (National Fire Protection Association - NFPA 101 Life Safety Code 2009 (Ref: COMAR 29.06.01) including State Fire Marshal modifications

2012 MAC - Maryland Accessibility Code (MAC) (Ref: COMAR 05.02.02)

2012 IBC - Safety glazing requirements set forth in the IBC 2012, and in the Public Safety Article Title 12, Subtitle 4, Annotated Code of Maryland (Ref: COMAR 05.02.07) in addition to the Department of Labor Licensing and Regulations (DLLR) requirements

2011 NEC - National Electrical Code (NEC) 2011 (Ref: COMAR 05.02.07; Public Safety Article Title 12, Subtitle 6. Annotated Code of Maryland)

2006 IMC - International Mechanical Code (IMC) 2006 with modifications (Ref: COMAR 05.02.07: Business Regulation Article, section 9A-205, Annotated Code of Maryland)

2006 NSPC and 2007 supplement to 2006 NSPC; and NFGC - National Standard Plumbing Code (NSPC) 2006 illustrated with modifications, 2007 supplement to 2006 National Standard Plumbing Code. National Fuel Gas Code (NFGC), ANSI Z223.1.NFPA 54, 2006, and Liquefied Petroleum Gas Code (LPGC), NFPA 58. 2004 (Ref: COMAR 05.02.07; Business Occupations and Professions Article 12. Annotated Code of Maryland)

2012 IBC - Elevators and conveying systems requirements set forth in the IBC 2012, and in the Public Safety Article, Title 12, Subtitle 8. Annotated Code of Maryland (Ref: COMAR 05.02.07) in addition to the DLLR requirements.

2012 Garrett County Building Ordinance

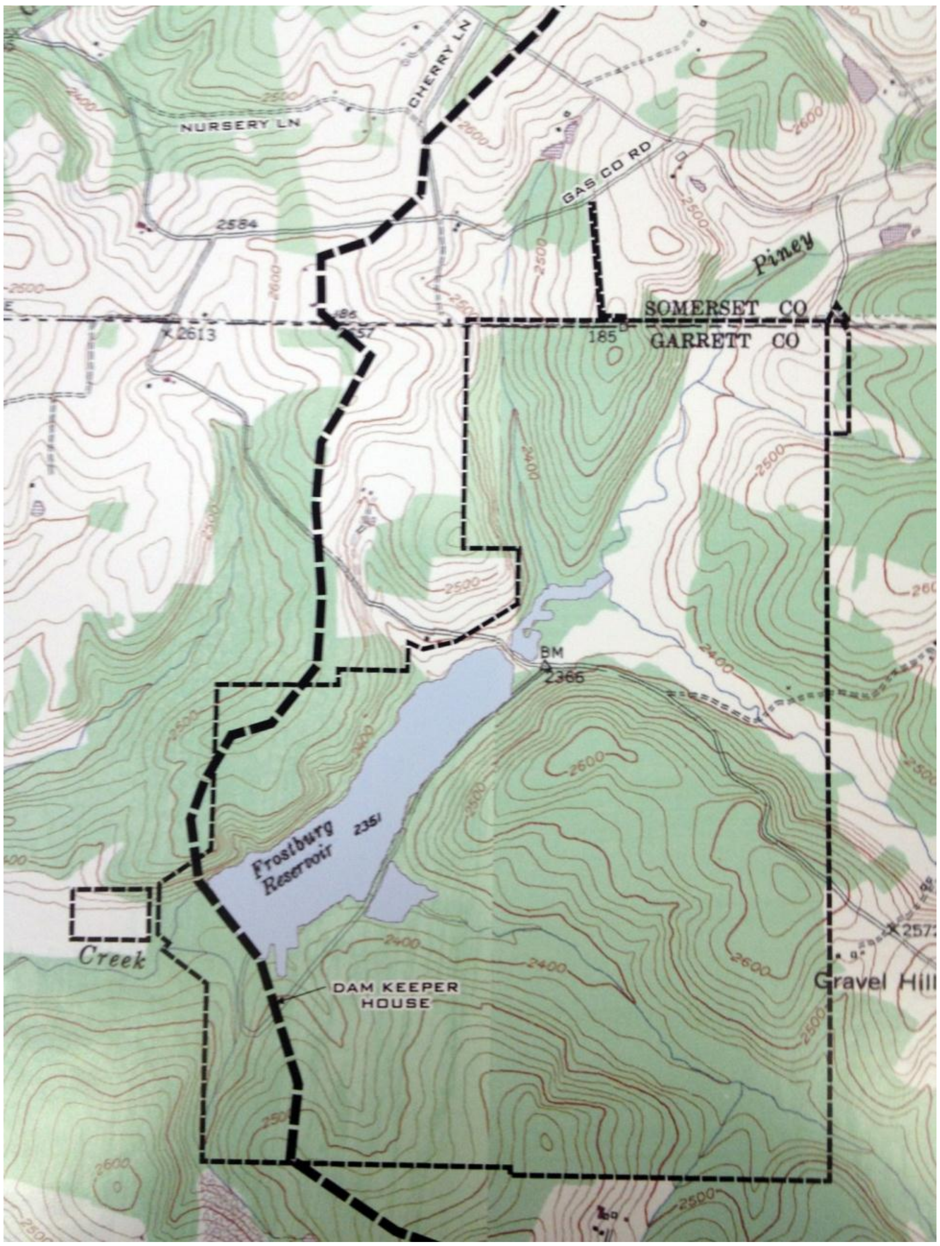
(http://www.garrettcounty.org/permits-inspections/maryland-building-performance-standards)

Figure 1.12 – Frostburg City Land Holdings Around the Frostburg Reservoir

The smaller dashed line represents the boundaries of the City of Frostburg's land holdings.

2

2.0 Economic Feasibility Analysis



2.1 Introduction

The Economic Feasibility Analysis presents the results of preliminary analysis of the economic viability of installing wind turbine(s) at the Project Site. Included in this section is a comparison of the turbine locations, costs, financing options, and benefits of installing a wind turbine on-site.

2.2 Costs for Major Scenarios

Capital Costs

The capital costs for wind turbines are substantial. Major categories of costs include:

- Turbine
- Turbine and Tower
- Freight
- FAA Lighting
- Balance of Plant
- Site Development
- Pad Mount Transformer
- Concrete and Rebar
- Foundation Labor
- Tower Imbeds / Bolts
- Cranes, Crane and Erection Labor
- Construction Supervision
- Monitoring and Control System
- Interconnection
- High Voltage Line Extension
- Interconnection and Metering
- Electrical Labor
- Soft Costs
- Legal
- Permitting
- Development & Engineering
- Insurance
- Bid Oversight
- Contingencies

For Distributed Generation and Community Wind projects we estimate capital costs somewhat higher than is generally described in industry publications and papers because:

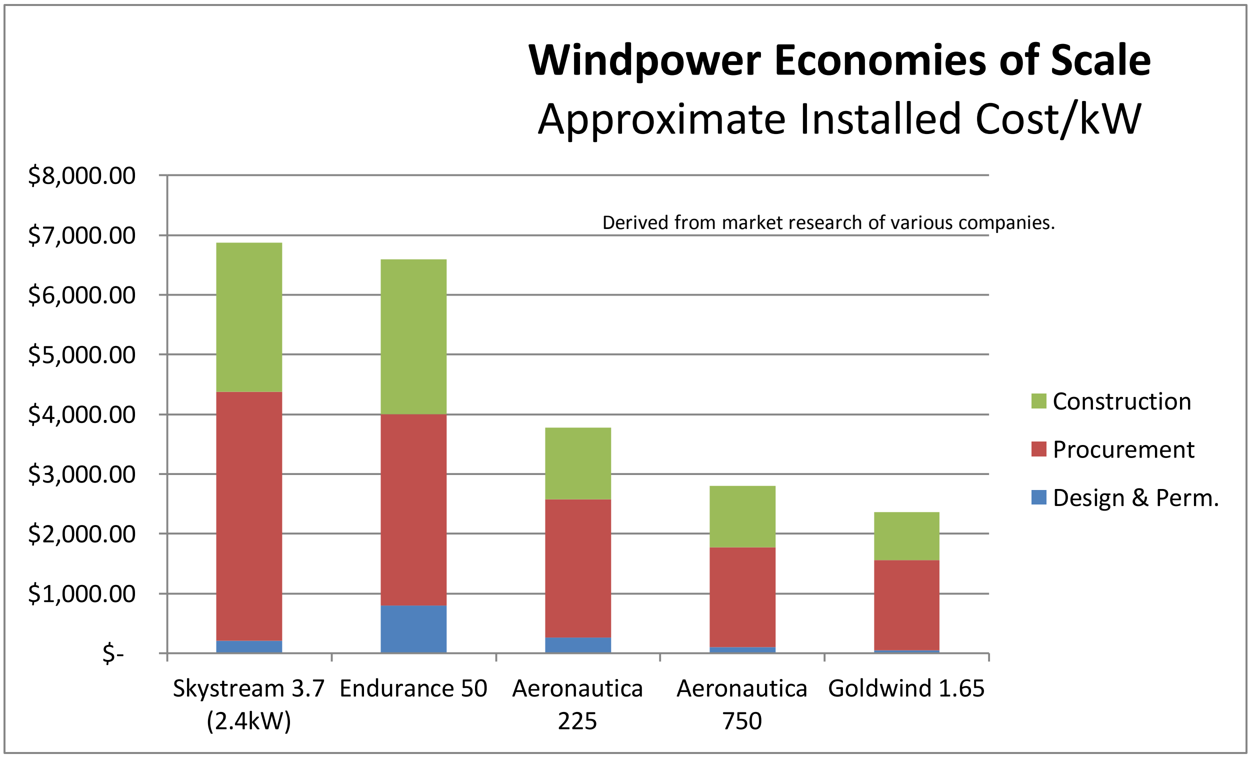
- Most estimates assume larger wind farm installations where fixed costs can be spread over many more turbines.
- Construction costs are typically higher in the eastern U.S. as compared to the rest of the country.

Economies of Scale

Wind energy systems are subject to what is referred to as the 'Economies of Scale' curve, and this curve can be significant. For example, turbines with estimated 750 kW to 2 MW nameplate capacity, costs can range from roughly $3,000/kW to $2,000/kW installed. As the size of the turbine decreases, the installed cost per kW, and the price of the energy delivered rises. A 225 class turbine, for instance, installs for approximately $3,750/kW. ***It is because of these economies of scale that a wind developer will typically try to design the largest size turbine into the project as is possible.***

Figure 2.1 displays the breakdown of turbine costs, applicable to single turbine project sizes considered in this project, which is focused on community wind type projects. These costs come from a variety of sources including: recent turbine manufacturer bids and publicly available proposals for similar projects and from secondary market wind turbine vendors. In many cases, the economies of scale are readily apparent. In addition, actual project costs can only be known via a firm bid in response to a proposal with specific terms and conditions.

Figure 2.1 – Indicative Summary Design, Procurement, and Construction Costs[1]



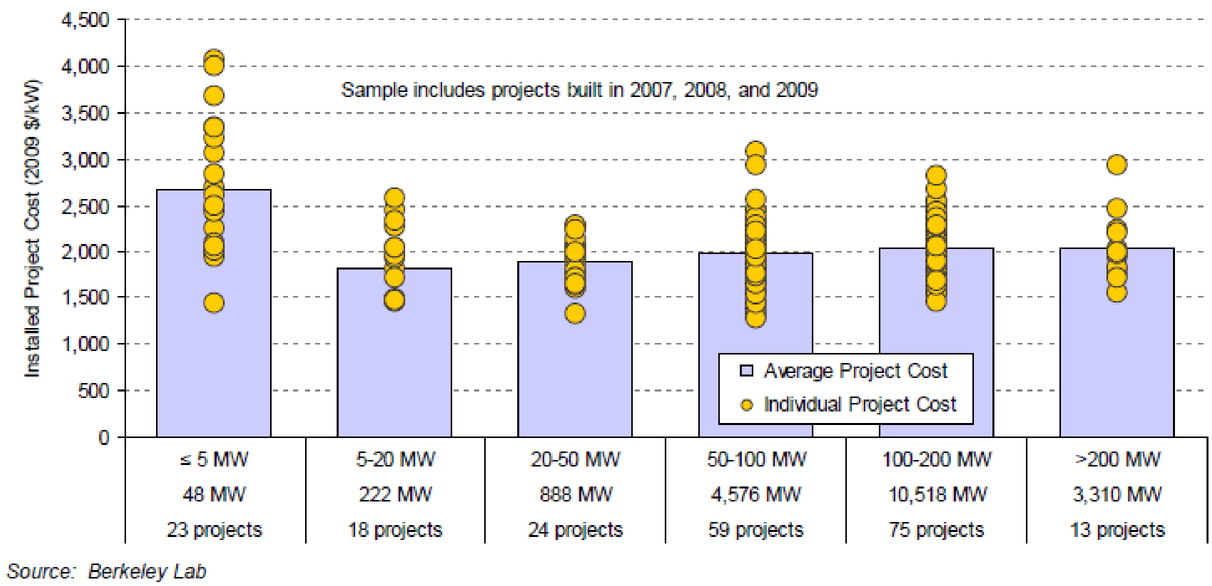
1 While prices can objectively be compared via the metrics displayed in this table, it is important to note that since the market for turbines of this size is in continual flux turbine manufacturers have varying levels of credibility that are linked to many factors including established sales relationships, number of machines installed locally, and general company reputation and reliability.

Because of the low costs, of particular interest is the secondary market for wind turbines. This market is generally made up of new turbines purchased for wind farms, where the development was decreased by one or more turbines or the project was cancelled altogether, and thus the developer is attempting to sell their extra turbines at a steep discount. This market is dynamic, but AWD recently received an offer for a GE 1.5 wind turbine for $1,100,000 currently located in the northeastern U.S. With an assumed $200,000 delivery cost, this could be a very effective purchase for Community Wind Projects. However, the availability of such machines varies tremendously and cannot often be counted on for RFPS with specific response times.

For this specific site, we believe that turbines larger than the 750kW class of machines will be cost prohibitive because of issues related to access to the site, capacity of existing electric line availability and more. Regardless, both the 750 and 2MW class machines are shown for comparison.

Once a wind project gets over a certain size – typically 3 to 5 MW – the cost of installation tends to level out as can be seen in the following chart, which reflects more wind projects greater than 5MW. Note how the project costs are reduced from nearly $7,000 per kW ($7/watt) to approximately $2,000/kW ($2/W). This shows why, all other variables being equal, larger wind projects have better economics than small projects, and why community wind projects should strive to create the largest size project as possible within the constraints of the regulatory and permitting environments.

Figure 2.2 Installed Wind Power Project Costs by Project Size, 2007 – 2009 Projects



(Figure 2.2 taken from USDOE report '2009 Wind Technologies Market Report, Wiser and Bolinger (http://www.nrel.gov/docs/fy10osti/48666.pdf)

When viewed over a longer term analysis of larger wind projects, a clear pattern of the economies of scale in wind projects stands out – especially at the small project end, where many community wind projects exist.

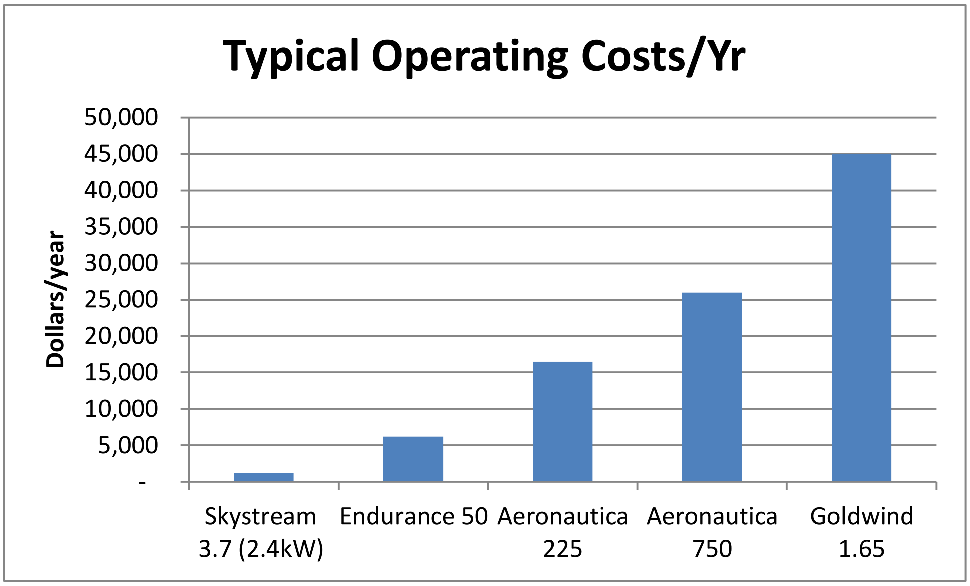
Operating Costs

While there are no fuel costs for a wind turbine, there are still ongoing operating costs. These include[2]:

- Operations and Maintenance (O&M)
- Warranty
- Equipment Repair and Replacement Fund (a/k/a sinking fund)
- Equipment Insurance
- Management / Administrative
- Miscellaneous

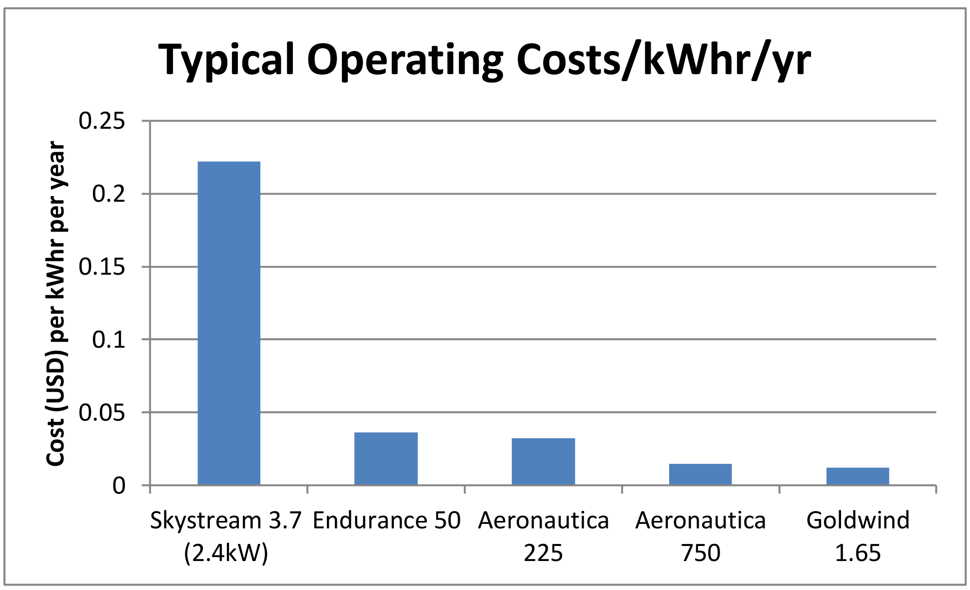
Figure 2.3 displays the estimated annual costs for each of the example turbines. O&M costs were taken from various turbine offers, warranty and sinking fund costs were estimated to be equivalent to the O&M costs based on literature review and operational experience. The "Other" costs were estimated from other projects.

Figure 2.3 – Estimated Annual Operating Cost/Year per Turbine for Example Turbines[1]



(1) Includes estimates of insurance, Operating and Maintenance and normal service.

Figure 2.4 – Estimated Annual Operating Costs per Kilowatt Hour for Example Turbines



When divided by the annual production of electricity, Figure 2.4 once again shows the economies of scale inherent in wind systems with regard to operating costs.

Benefits of Electricity Production

A wind turbine project at the Project Site could be configured in one of two ways:

Serve the existing or planned electric account for the dam pump house first and then export any real-time excess to the Potomac Edison distribution system. This is known as a “behind-the-meter” configuration (that is behind the utility meter, from the utility’s point-of-view).

Connect directly to the Potomac Edison distribution system, and sell power to the wholesale market, which we will call a “wholesale” configuration.

In Maryland there are three types of energy revenue and/or avoided costs resulting from distributed generation (DG) behind-the-meter wind turbines. First is to avoid paying utility bill energy charges (demand charges are hard to offset due to wind’s variable nature). Second, if there is any excess power, is to sell part or all of the production of a wind turbine into the wholesale market or to be credited for net metering (see below). Third, is to capture revenue from selling renewable energy certificates (RECs) that are available for wind turbines (or any renewable generation). Reference is made to Table 2.4 below.

The balance of this section describes these revenue streams in turn, and then describes potential environmental benefits from wind turbine electricity production.

The Project Site has relatively significant actual load (734,000 kWhs/year). This value is taken from 2010 and 11 electric bills before the net metering activities from the micro-hydro plant before the water treatment facility was used to offset the load using net metering. Recent bills reflect the reduction of this net metering application to reduce the demand to about 450,000 kWhrs.

Benefits of Avoiding Utility Bill Charges

An electric bill from Potomac Edison consists of four types of charges:

- Customer charges
- Demand (kW) charges
- Energy (kWh) charges
- Other (e.g., metering, environmental surcharges)

Customer, demand, and “other” charges all are considered purely utility “wire charges” and generally are not offset by the installation of a wind turbine. The energy charges are a mixture of “wire” and “generation” charges, and are offset by the installation of a wind turbine.

The above charges (e.g., demand-kW, energy-kWh) are assessed for various “services” and include:

- Generation - Generation services currently can be purchased in two different ways:
- Basic Service; and,
- Competitive supply service (e.g., UGI, Washington Gas Energy Service, Suez, Direct Energy, Dominion, Constellation NewEnergy, ConEd Solutions. etc.)
- Distribution;
- Service Fees;
- EmPower Surcharges
- Demand Resource Charges; and,
- MD Environmental Surcharge.

Unless a customer opts to totally disconnect from the grid and rely on a combination of wind turbines and other sources of electricity (e.g., photovoltaics, banks of batteries, micro-turbines), they cannot avoid monthly customer charges nor demand (kW) charges.

What can be avoided (in part) by the installation of a wind turbine are energy charges. The amount of energy charges a customer pays on the utility bill varies by their location, rate class and consumption patterns.

Thus, if a wind turbine could connect "behind-the-meter" virtually all of its production could physically offset electricity used onsite. To physically connect, the wind turbine will have to be on the same parcel or a contiguous parcel as the electric load, per the net metering regulations.

Value of Net Metered Electricity

A wind turbine project of 750kW or less at the Project Site should qualify for net metering of the electricity. The following section is a Summary of Maryland's Net Metering Regulations. A full copy of the Net Metering Regulations and Meter Aggregation Regulations may be found in Appendix H.

Maryland's Net Metering Regulation:

Maryland's net-metering law has been expanded several times since it was originally enacted in 1997. In their current form, the rules apply to all utilities -- investor-owned utilities (IOUs), electric cooperatives and municipal utilities. Residents, businesses, schools or government entities with systems that generate electricity using solar, wind, biomass, fuel cell, closed-conduit hydroelectric, and micro-CHP resources are eligible for net metering. The law permits outright ownership by the customer-generators as well as third-party ownership structures (e.g., leases and power purchase agreements). The provisions allowing for micro-CHP systems (H.B. 1057) and certain third-party ownership structures (S.B. 981) were added in May 2009 and took effect July 1, 2009. Net metering was extended to fuel cell electricity generation systems in May 2010 (H.B. 821) and closed-conduit hydroelectric facilities in April 2011 (S.B. 271).

Other important details of Maryland's net metering policy include:

Net metering is available statewide until the aggregate capacity of all net-metered systems reaches 1,500 MW. The aggregate limit on net metering was 34.7 MW prior to the 2007 amendments.

System size is generally limited to 2 MW, except micro-CHP resources are limited to 30 kilowatts (kW). Systems must be primarily intended to offset all or a portion of a customer's on-site energy requirements and are limited in size to that needed to meet 200% of the customer's baseline annual electricity use.

Net excess generation (NEG) is generally carried over as a kilowatt-hour credit (i.e., at the retail rate) for 12 months. Compensation for any NEG remaining in a customer's account after a 12-month period ending in April of each year is paid to the customer at the commodity energy supply rate.

Customers own and have title to all renewable-energy credits (REC) associated with electricity generation by net-metered systems.

Meter aggregation (either physical or virtual) is permitted for customers that use electrical service for agriculture, as well as non-profit organizations and municipal governments or their affiliates.

The PSC must file with the Maryland General Assembly detailed annual reports (see 2012 Net Metering Report) describing the status of the state's net-metering program.

Utilities must install a meter at a customer's facility capable of measuring the flow of electricity in both direction (if necessary), and must offer net metering through a tariff or contract at non-discriminatory rates compared to those offered to customers that do not net meter. Customers with systems that meet all applicable safety and performance standards established by the National Electrical Code (NEC), the Institute of Electrical and Electronics Engineers (IEEE), Underwriters Laboratories (UL) and any other PSC requirements may not be required by utilities to install additional controls, to perform or pay for additional tests, or to purchase additional liability insurance.

Renewable Energy Certificate Revenue

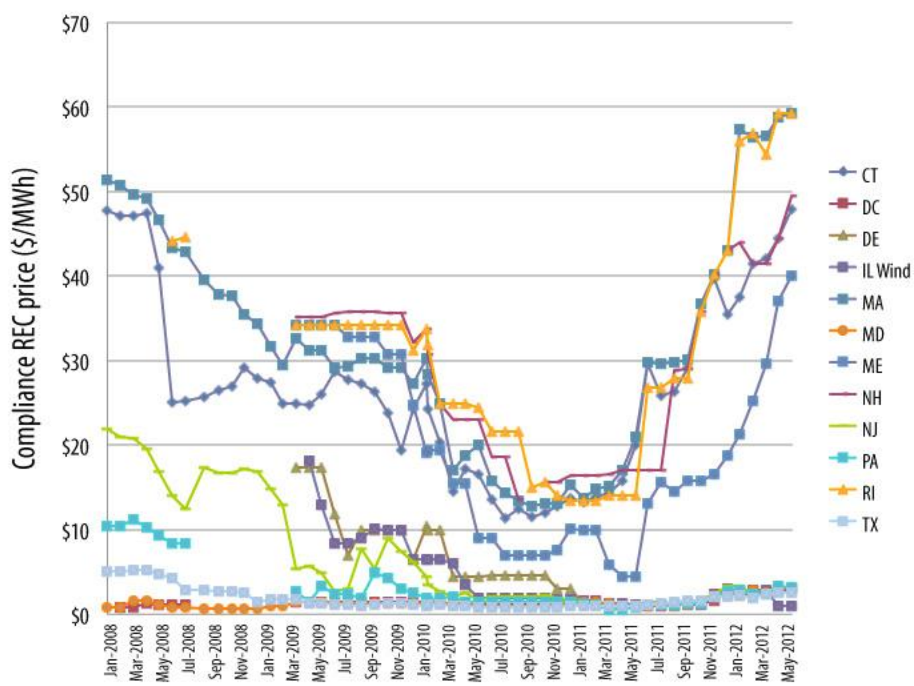
An additional revenue stream for wind turbines in Maryland comes from a legislative mandate to promote renewable energy sources. The potential revenue comes from the sale of Renewable Energy Certificates (RECs), or so called "green certificates." RECs are a tool created as a result of the Renewable Portfolio Standard (RPS) legislation adopted in Maryland.

Accounting for RECs is the method to certify compliance with an RPS. The primary purpose of the RPS legislation is to create demand and financial support for new renewable electric generation sources which have significantly fewer environmental impacts than traditional fossil fuel based generation and which help diversify the domestic electricity generation mix thereby leading to greater long-term price stability.

PJM states adopted RPSs in the mid-2000s. The Maryland RPS mandated that 20% of all in-state investor owned utility service territory electric consumption come from new renewable resources by the end of 2022. PJM states originally depended on smaller generating facilities such as landfill gas to supply the demand, and supply was not met, causing a spike in REC prices. Then, over the past 5 years in the PJM region, wind farms were built in Illinois, Indiana, Pennsylvania and West Virginia. Due to the fact that most top tier RPSs allowed wind projects to count if they were located anywhere within PJM, REC prices soon collapsed and remain low today.

Facilities located in PJM or in a control area adjacent to the PJM region are eligible for the Maryland RPS Program, as long as the electricity is delivered into the PJM region. To certify a Renewable Energy Facility (REF), Commission Staff must determine whether the facility meets the standards set forth by the Maryland RPS Program.

Table 2.1 Historic Value of RECs in the PJM Market



Energy used for on-site loads from the wind turbine can be used to satisfy the Maryland RPSs.

REC prices are driven by a combination of actual and anticipated supply and demand, the ACP levels and, importantly, state rules regarding eligibility which affect both supply and demand. Given the uncertainty of and long lead times to implement renewable energy projects, and the legislative and regulatory risks associated with these government-mandated markets, there is great uncertainty of REC prices in the long-term. Recent prices can be seen in Table 2.1.

RECs are not created simultaneously with the production of energy. They are tentatively created on a quarterly basis and then it takes additional months for accounting to be completed and the RECs created. Thus, wind production of the last quarter of 2013 would have RECs created in May 2014.

Given the limited ability to sell into the PJM market for behind-the-meter RECs, an assumption of a flat rate of $5/REC is made for the course of the project.

2.3 Financial Analysis

A full set of financial analyses has been incorporated into this feasibility study based on met tower data recordings and analysis, wind farm modeling for multiple turbine scenarios, updated turbine cost information, interconnection cost estimation details, and financial assumptions.

Grants

There are a number of grant programs available for both the study and construction of community wind projects in Maryland. This Feasibility Study itself was created under a 'Game Changer' grant from the MEA.

Reference is made to the Overview Publication submitted as part of this Feasibility Study under the Game Changer Grant for a complete list of potential grant sources. Note: many community scale grants are currently awarded on a rolling basis.

NO grants were included in this Feasibility Study. The effect of a large construction grant could easily be seen by comparing the grant size to the variance in Table 2.3 below, which illustrates how sensitive the project results are to Project Cost.

This Project's Financial Analysis

The goal of this analysis is to compute the financial analysis of ownership and turbine configuration options in a realistic fashion and to confirm the suitability of utilizing historic wind resource and anticipated electric use data for forward-looking projections. For the feasibility study, we have estimated the amount of annual kWh production to be used on-site, to be net metered to the site, to be net metered to other accounts off-site.

A wind turbine has an expected 20-25 year equipment life, after which some residual value remains but the turbines require refurbishment. For future years we will assume replication of wind resources and the Project electricity consumption. This would change if the water use of the City dictates the installation of the fourth pump that has been allowed for at the Dam's pump house. We increased electrical prices by a factor of 2.48%, which represents the 20 year historic average retail power cost escalation in Maryland (See Appendix J). Additionally we make explicit assumptions about the cost of the wind turbine installation, O&M costs, percent of time the wind turbine is available (i.e., not undergoing repair or maintenance), line losses, REC revenue, tax rates (for third-party ownership option), availability of the PTC / ITC, interest rates, loan terms, potential grants, and inflation rates. All such assumptions may be viewed on the INPUT page of the FOCUS financial model found in Appendix F.

Due to both the timing of the project construction in the future and the nature of the perceived ownership's inability to use it, we do not assume the 30% investment tax credit (ITC) will be available for this project, and is not calculated. Therefore, the model of ownership used in this study is not very particular as to maximizing tax benefits – as there are none assumed (except the depreciation write-off, which is difficult to 'sell' to other parties alone).

The project assumes that no down payment (equity) for the project's financing will be required. The type of financing assumed is that of MCAP Bond financing on a 20 year tenure. Obviously the cash flow from the project would significantly improve if equity was used instead of 100% financing.

As shown in the following tables, the Project does have the opportunity for significant economic benefit from installing a wind turbine. The economies of scale of installing larger machines are clearly visible.

Financial paybacks for the various scenarios are shown in the next few tables. The full financial model is shown in Appendix F, along with all input values used.

Table 2.2 Financial Summary - Piney Dam Wind Turbine

	P-50	P-70	P-90
Annual Energy Production:	1,832,699	1,707,941	1,525,596
First Year Gross Revenue (Savings) ($):	$168,608	$157,131	$140,355
25 Year Total Revenue (Savings):	$5,690,998	$5,303,593	$4,737,365
First Year Net Revenue (Savings) ($):	$5,262	-$6,216	-$22,992
25 Year Net Revenue (Savings) ($)	$2,222,111	$1,834,706	$1,268,477
Internal Rate of Return:	6.9%	6.1%	5.6%
Simple Payback (no grants, ITC) years	15.02	16.32	18.68

Sensitivity Analysis / Uncertainty Calculations

The project was modeled under certain baseline assumptions that were considered the most likely given the current economic environment, and assuming the project goes forward relatively soon. In order to evaluate the sensitivity of the financial results to factors which could potentially change between the time of the study and construction, a series of sensitivity analyses were conducted. These results may be seen in tables 2.3 to 2.6, where the baseline assumptions were both increased and decreased in amounts deemed reasonable in order to view the effect of the change on both the annual revenue (savings) and the project's Internal Rate of Return (IRR).

Sensitivity to Project Costs

Table 2.3 shows the sensitivity of the project results to adjustment of project costs. The project is sensitive to project costs. If costs can be decreased to 90% of estimated levels (potentially attainable with weak turbine and construction market), then cash flows improved to less than 12 years.

Because of the timing of this study, which was conducted at a time during 2013 when it is still possible for a private developer to make 'safe harbor' under IRS guidelines by depositing a 5% down payment before the end of 2013 and then finishing the project over the next year or so, the value of the tax credits under some 'flip' type of ownership should not be completely discounted. If desired, the project could be pushed forward to allow for inclusion of the ITC credit for a private partner. Although this is considered a low probability, the study shows the result of such an effect in Table 2.3 (ITC column) by simply reducing the project cost by nearly $390,000. This is the estimated value of selling the 30% ITC credit and depreciation deductions to a private developer during the initial years of a 'flip' ownership model, at 50% of the face value of the credits and deductions.

The project cost could also be drastically decreased by the procurement of readily available grants (although none were used in this analysis), or by the monetization (sale) of any tax credits and/or depreciation to private parties with tax reduction appetites through a 'flip' ownership model if state or local tax incentives are offered.

Table 2.3 Financial Results: Sensitivity to Project Costs

	ITC	-10%	Baseline	+10%
Values	$1,774,500	$1,948,050	$2,164,500	$2,380,950
$ Savings in First Year	$30,279	$19,146	$5,262	-$8,623
Change in 25 yr. IRR	8.9	7.9	6.9	5.9

Sensitivity to Interest Rates

Table 2.4 displays the sensitivity of the financial returns to varying interest rates. The project is not as sensitive to interest rate changes, though any reduction from the assumed rate would be beneficial.

The US is currently at a historic low when it comes to interest rates, including the bonding rates estimated by MCAP. It is a great time to lock in finance charges, which are the largest 'cost of goods sold' in any renewable energy project. This is the equivalent of 'pre-purchasing' a 25 year supply of electricity or fossil fuels while the prices are low.

As part of the Game Changer grant under which this feasibility study was conducted, discussions were held with the Maryland Capital Access Program (MCAP) which is operated under the Maryland Energy Administration. Bond funding to community programs for renewable energy programs is being made available, and this program was used to model baseline rates in the study. Reference is made to the companion volume of this report for details about the MCAP programs.

Table 2.4 Financial Results: Sensitivity to Interest Rates

	-20%	Baseline	+20%
Values	2.0%	2.5%	3.0%
Additional (neg) Savings/yr	$11,735	$5,262	-$1,380
Change in 25 yr. IRR	6.9%	6.9%	6.9%

Sensitivity to the Cost of Energy

Table 2.5 displays the sensitivity of the financial returns to varying costs of energy. The project is sensitive to changes to changes in the cost of energy. Like any wind project, it benefits from higher costs of electricity for which it is compared against.

In regards to Maryland's net metering and Virtual Meter Aggregation regulations, a special note should be made. Because the net excess generation (NEG) of the meter at the load site can be aggregated and applied to other meters owned by the same customer – but paying potentially higher prices for energy under different rate structures - a 'blended' price of energy occurs. Such was the case in this project, where a relatively low cost of energy ($.069/kWhr, as determined in Appendix J) was combined with other, more expensive meter rates in order to raise the effective electrical rate to $.087/kWhr. This creates a strategy decision for community wind project planners, as a project should always try to displace the highest priced power possible.

It should be noted again that electricity prices have been depressed in part because of the economic downturn and decreased demand for energy, and that energy prices were at least 50% higher less than three years ago. The recent introduction of additional natural gas to the market via 'fracking' has also had the effect of depressing electricity prices, although it will be interesting to see if any of the negative environmental effects fracking creates will be attributed to the fuel costs. All things being equal, a stronger economy will drive up electricity prices again.

Table 2.5   Financial Payback: Cost of Energy

	-15%	Baseline	+15%
Values	$0.074	$0.087	$0.100
Additional (neg) Savings/yr	-$18,655	$5,262	$29,179
Change in 25 yr. IRR	5.2%	6.9%	8.4%

Sensitivity to Wind Speeds

Table 2.6 displays the sensitivity of the financial returns to variances in the Average Annual Windspeed (Ws). All wind projects are quite sensitive to changes in wind speed, since the power in the wind is not linear, but rather varies as the cube of the wind speed.

As has been discussed in Appendix D, the project used a 'Virtual Met Tower' in order to evaluate the estimated baseline wind speed to be expected at the site while actual data is being gathered. This is becoming increasingly common for smaller community wind projects, especially where corroboration can be found from other local sources.

This site has also been selected for measurement of the wind speed using the MEA's Anemometer Loan program. For the next 12 months the site will be monitored for actual wind speeds. Table 2.6 will then allow the results to be interpreted in light of the overall feasibility study.

Table 2.6   Financial Results: Wind Speed

	-5%	Baseline	+5%
Values (m/s)	6.11	6.43	6.75
Additional (neg) Savings/yr	-$11,539	$5,262	$21,658
Change in 25 yr. IRR	5.7%	6.9%	7.9%

Economic Feasibility Conclusions

1. This analysis was funded under a MEA Game Changer grant for Community Wind systems. The results of the analysis indicate marginal, but beneficial financial results for such a project at the Project location. The project is an example of how turbines of this size (upper mid-scale) can be used in a community wind projects to begin to achieve economies of turbine scale and to take advantage of new regulations such as net metering and Virtual Meter Aggregation in order to defer the highest power costs available.
2. Of important note is that these results did not depend on any tax credits, or any special ownership methodology (private/public flip models), or on any grant money. The economic study ignored these funding options due to the ending of the Investment and Production Tax Credits at the end of 2013. That this project is still viable (although marginally so) is an indication that community wind projects such as this can still be built to allow communities to begin switching from 'black' to 'green', sustainable energy sources without paying a premium for sustainable energy, and often with a lucrative financial gain. Should any of these incentives become available in the future, it will only serve to greatly increase the profitability of the project.
3. Because of the timing of this study, which was conducted at a time during 2013 when it is still possible for a private developer to make 'safe harbor' under IRS guidelines by depositing a 5% down payment before the end of 2013 and then finishing the project over the next year or so, the value of the tax credits under some 'flip' type of ownership should not be completely discounted. If desired, the project could be pushed forward to allow for inclusion of the ITC credit for a private partner. Although this is considered a low probability, the study shows the result of such an effect in Table 2.2 by simply reducing the project cost by nearly $390,000. This is the estimated value of selling the 30% ITC credit and depreciation deductions to a private developer during the initial years of a 'flip' ownership model, at 50% of the face value of the credits and deductions.
4. If the project does get built, attention should be paid to the current factors of interest rates, project cost, and of course, the results of the follow up wind study, and compare these to the results of this study for their effect on profitability. Extensive sensitivity analyses were completed (Tables 2.3 -2.6) which outlines the sensitivity of the financial results to changes in assumptions. The US is currently at a historic low when it comes to interest rates, including the bonding rates estimated by MCAP. It is a great time to lock in finance charges, which are the largest 'cost of goods sold' in any renewable energy project. This is the equivalent of 'pre-purchasing' a 25 year supply of electricity or fossil fuels while the prices are low. The project cost could be drastically decreased by the procurement of readily available grants (although none were used in this analysis), or by the monetization (sale) of any tax credits and/or depreciation to private parties with tax reduction appetites through a 'flip' ownership model if state or local tax incentives are offered.
5. This analysis identified what we believe to be the most ideal location for a turbine at the site due to siting, wind resource and off-taking rationale, but there are other potential locations on the town's land around the Reservoir should the prime site be deemed unusable for some reason.
6. Using the financial assumptions outlined herein, a 750kW wind turbine with a Class II/III rotor presents the best financial results. Larger machines will not be able to take advantage of the Net Metering regulations of the State due to the limitation of injecting 200% of on-site load, as well as the electrical infrastructure available going to the site. This is the limiting factor of this project. Smaller turbines will suffer from decreasing returns and loss of economies of scale. This is illustrative of how community wind projects which can deploy larger wind turbines can be economically viable even in wind class II and III areas like Maryland.

Appendix A

Shadow Flicker Analysis

Project
Piney Dam

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Calculated
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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

The calculated times are "worst case" given by the following assumptions:
- The sun is shining all the day, from sunrise to sunset
- The rotor plane is always perpendicular to the line from the WTG to the sun
- The WTG is always operating

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: DEM_Cont2a.wpo (2)
Obstacles used in calculation
Eye height: 1.5 m
Grid resolution: 10 m

Scale 1:40,000
New WTG   Shadow receptor

WTGs

	Geo DMS: WGS 84				WTG type						Shadow data	
	Longitude	Latitude	Z	Row data/Description	Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	-79°00'40.32" East	39°42'24.23" North	760.7	Aeronautica AW 54-7...	Yes	Aeronautica	AW 54-750-750/180	750	54.0	65.0	805	25.8

Shadow receptor-Input

No.	Name	Geo DMS: WGS 84 Longitude	Latitude	Z	Width	Height	Height a.g.l.	Degrees from south cw	Slope of window	Direction mode
				[m]	[m]	[m]	[m]	[°]	[°]	
A	Dam Keeper's House	-79°00'30.85" East	39°42'03.98" North	730.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
B		-79°00'18.64" East	39°43'01.27" North	764.5	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
C		-79°00'05.01" East	39°42'30.81" North	728.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
D		-79°00'39.09" East	39°42'37.77" North	760.7	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
E	LIDAR station	-79°00'43.16" East	39°42'21.22" North	763.9	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
F		-79°00'59.99" East	39°42'08.24" North	710.2	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
G		-78°59'45.83" East	39°42'49.60" North	722.4	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
H		-79°00'07.17" East	39°42'14.92" North	721.8	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
I		-79°01'07.11" East	39°42'41.58" North	761.0	1.0	1.0	1.0	-180.0	90.0	"Green house mode"
J		-79°00'07.07" East	39°42'44.17" North	730.3	1.0	1.0	1.0	-180.0	90.0	"Green house mode"

Calculation Results

Shadow receptor

No.	Name	Shadow, worst case Shadow hours per year	Shadow days per year	Max shadow hours per day
		[h/year]	[days/year]	[h/day]
A	Dam Keeper's House	0:00	0	0:00
B		0:00	0	0:00
C		0:00	0	0:00
D		0:00	0	0:00

To be continued on next page...

Project
Piney Dam

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SHADOW - Main Result

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No.	Name	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]
E	LIDAR station	0:00	0	0:00
F		0:00	0	0:00
G		0:00	0	0:00
H		0:00	0	0:00
I		0:00	0	0:00
J		0:00	0	0:00

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

No.	Name	Worst case [h/year]	Expected [h/year]
1	Aeronautica AW 54-750 750-180 54.0 !O! hub: 65.0 m (7)	0:00	

Project
Piney Dam

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SHADOW - Calendar

Shadow receptor: A - Dam Keeper's House

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:48	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
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	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
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	17:10	17:45	19:17	19:48	20:17	20:42	20:47	20:23	19:36	18:48	17:07	16:52
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11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
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12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
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13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:36	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:45	20:44	20:15	19:26	18:38	17:02	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
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	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:54
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	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
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	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:03	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:22	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:32	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:47	20:41	20:07	19:17	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:35	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:31	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:35	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:04	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:10	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:32	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:59
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:56	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:52	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	348	301	292
Total, worst case												

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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Project
Piney Dam

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Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: B - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (35)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:49	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:59	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:38	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:19	06:49	07:17	06:50	07:23
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:52	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:48	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:43	20:47	20:23	19:36	18:47	17:07	16:52
10	07:38	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:59	06:25	06:54	07:23	06:57	07:28
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13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:37	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:46	20:44	20:15	19:26	18:38	17:01	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:53
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:03	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:21	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:31	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:16	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:34	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:32	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:36	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:03	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:09	06:38	07:07	07:38	07:12	07:36
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27	07:29	06:54	07:10	06:23	05:53	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:58
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:55	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:51	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	346	301	292
Total, worst case												

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)

Project
Piney Dam

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Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: C - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (36)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:48	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:59	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:39	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:19	06:48	07:17	06:50	07:22
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:52	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:48	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:42	20:47	20:23	19:36	18:47	17:07	16:52
10	07:37	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:36	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:45	20:44	20:15	19:26	18:38	17:01	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:02	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:53
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:32
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:03	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:21	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:31	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:47	20:41	20:07	19:16	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:34	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:31	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:35	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:03	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:09	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:32	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:53	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:59
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:56	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:53	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:51	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	346	301	292
Total, worst case												

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)

Project
Piney Dam

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Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: D - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (37)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:49	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:49	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:59	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:38	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:19	06:49	07:17	06:50	07:23
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:52	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:49	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:43	20:47	20:23	19:36	18:48	17:07	16:52
10	07:38	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:37	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:46	20:44	20:15	19:26	18:38	17:02	16:53
16	07:36	07:08	07:28	06:39	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:54
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:04	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:21	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:32	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:17	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:35	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:32	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:36	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:03	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:04	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
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27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:59
28	07:28	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:55	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:52	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	346	301	292
Total, worst case												

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)

Project
Piney Dam

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Calculated
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SHADOW - Calendar

Shadow receptor: E - LIDAR station

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:49	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:49	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:59	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:39	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:50	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:20	06:49	07:17	06:50	07:23
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:53	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:49	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:43	20:47	20:23	19:36	18:48	17:07	16:52
10	07:38	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
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12	07:37	07:14	07:34	06:45	06:06	05:48	05:59	06:25	06:54	07:23	06:57	07:28
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13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:37	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:46	20:44	20:15	19:26	18:38	17:02	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:54
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:04	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:22	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
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	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:17	18:30	16:57	16:55
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	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:32	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:36	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:04	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:10	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:33	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:59
28	07:28	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:55	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:52	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	348	301	292
Total, worst case												

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)

Project
Piney Dam

Printed/Page
6/13/2013 2:16 PM / 6

Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: F - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (39)

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
The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:03	17:36	18:08	19:40	20:09	20:37	20:49	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:58	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:38	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:54	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:50	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:20	06:49	07:17	06:50	07:23
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:53	06:11	05:49	05:55	06:20	06:50	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:16	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:38	06:49	06:09	05:49	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:43	20:47	20:23	19:36	18:48	17:07	16:52
10	07:38	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:48	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:53
14	07:37	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:46	20:44	20:15	19:26	18:38	17:02	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:36	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:54
18	07:35	07:06	07:25	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:04	07:21	06:33	05:58	05:48	06:05	06:33	07:02	07:31	07:06	07:33
	17:22	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:32	05:58	05:49	06:05	06:34	07:03	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:17	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:35	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:32	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:36	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:03	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:04	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:10	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:33	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:59
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:55	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:54	17:00
30	07:27		07:05	06:19	05:52	05:52	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	346	301	292
Total, worst case												

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)

Project:
Piney Dam

Printed/Page
6/13/2013 2:16 PM / 7

Calculated:
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: G - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (41)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:48	20:31	19:49	19:00	17:15	16:53
2	07:38	07:24	06:49	07:00	06:17	05:50	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:59	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:38	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:19	06:48	07:17	06:50	07:22
	17:07	17:41	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:52	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:48	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:16	19:48	20:17	20:42	20:47	20:22	19:36	18:47	17:07	16:52
10	07:37	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:34	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:36	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:45	20:44	20:15	19:26	18:38	17:01	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:02	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:53
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:32
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:58	16:54
20	07:34	07:03	07:21	06:33	05:58	05:48	06:04	06:33	07:01	07:31	07:06	07:33
	17:21	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:31	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:47	20:41	20:07	19:16	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:34	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:31	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:35	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:03	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:09	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:32	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:53	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:58
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:55	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:53	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:51	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	346	301	292
Total, worst case												

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)

Project
Piney Dam

Printed/Page
6/13/2013 2:16 PM / 8

Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: H - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (42)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:48	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:58	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:38	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:19	06:49	07:17	06:50	07:22
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	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:48	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:42	20:47	20:22	19:36	18:47	17:07	16:52
10	07:37	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
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14	07:36	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:45	20:44	20:15	19:26	18:38	17:01	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:02	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:53
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
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	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:03	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:21	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:31	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:47	20:41	20:07	19:16	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:34	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:40	20:04	19:13	18:27	16:56	16:56
24	07:31	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:35	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:35
	17:27	18:03	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:10	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:32	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:59
28	07:28	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:48	20:35	19:55	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:53	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:51	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	346	301	292
Total, worst case												

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)

Project
Piney Dam

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Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: I - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (43)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:49	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:46	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:58	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:39	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:56	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:50	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:20	06:49	07:17	06:50	07:23
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:53	06:11	05:49	05:55	06:20	06:50	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:16	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:38	06:49	06:09	05:49	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:43	20:47	20:23	19:36	18:48	17:07	16:52
10	07:38	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:59	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:37	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:46	20:45	20:15	19:26	18:38	17:02	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:54
18	07:35	07:06	07:25	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:26	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:04	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:22	17:58	19:28	19:59	20:27	20:47	20:42	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:32	05:58	05:49	06:05	06:34	07:03	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:17	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:35	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:32	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:36	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:03	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:04	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:10	06:38	07:07	07:38	07:13	07:36
	17:28	18:05	19:34	20:04	20:33	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:49	20:36	19:57	19:07	18:22	16:54	16:59
28	07:28	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
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29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:54	17:00
30	07:27		07:05	06:19	05:52	05:52	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:37		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	348	301	292
Total, worst case												

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)

Project
Piney Dam

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Calculated
6/13/2013 2:03 PM/2.7.486

SHADOW - Calendar

Shadow receptor: J - Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (44)

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

The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:48	20:31	19:49	19:00	17:15	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:48	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:59	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:39	20:48	20:29	19:46	18:57	17:13	16:52
4	07:38	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:48	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:19	06:49	07:17	06:50	07:23
	17:07	17:41	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:52	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:48	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:42	20:47	20:23	19:36	18:47	17:07	16:52
10	07:37	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:59	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:36	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:45	20:44	20:15	19:26	18:38	17:01	16:53
16	07:36	07:08	07:28	06:38	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:53
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:03	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:21	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:31	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:16	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:34	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:31	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:35	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:48	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:03	19:33	20:03	20:32	20:48	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:55	07:12	06:25	05:54	05:50	06:09	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:32	20:48	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:53	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:48	20:36	19:57	19:07	18:22	16:54	16:58
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:56	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:53	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:51	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	387	445	448	455	428	374	348	301	292
Total, worst case												

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)

Project:
Piney Dam

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Calculated:
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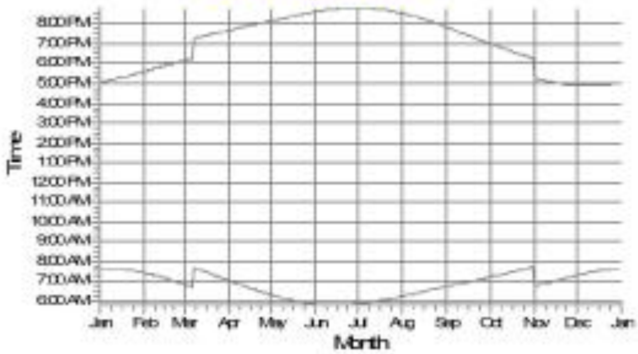
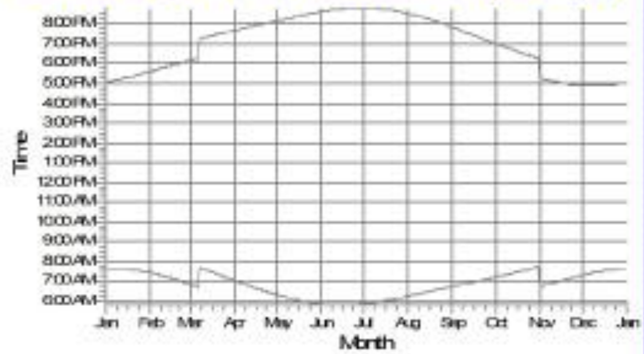
SHADOW - Calendar, graphical

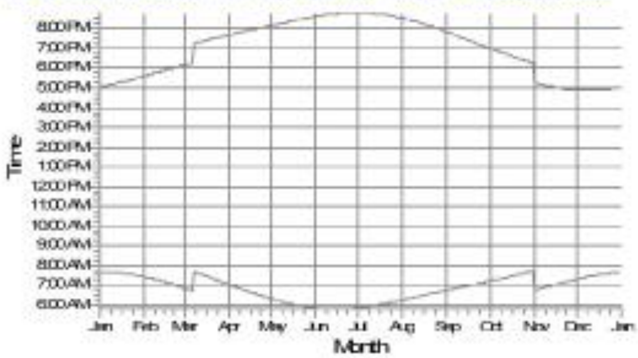
A: DamKeeper's House



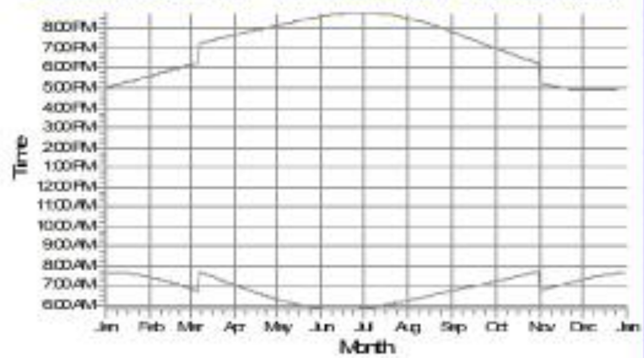
B: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (35)



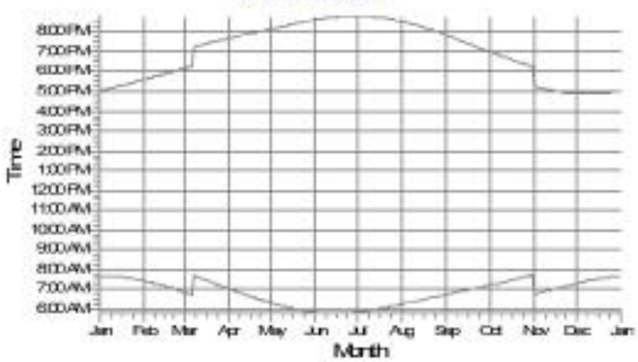
C: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (36)



D: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (37)



E: LIDAR station



F: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (39)

WTGs

Project

Piney Dam

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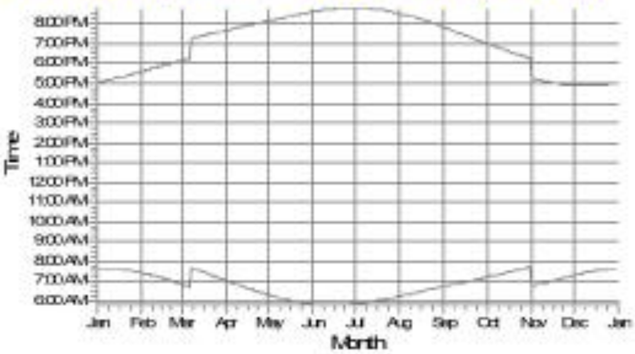
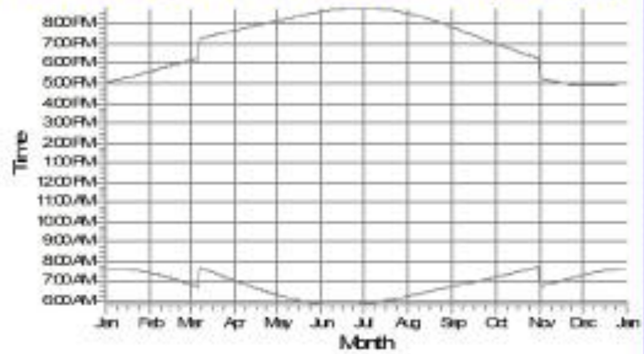
SHADOW - Calendar, graphical

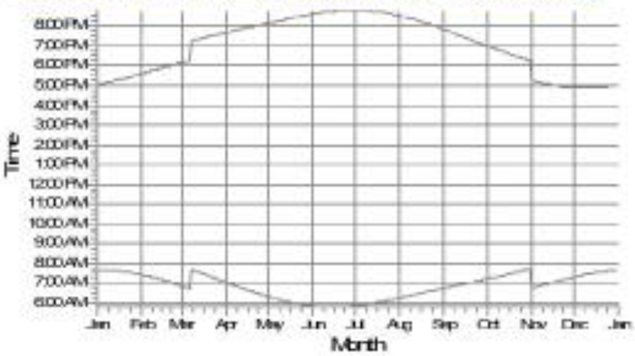
G: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (41)



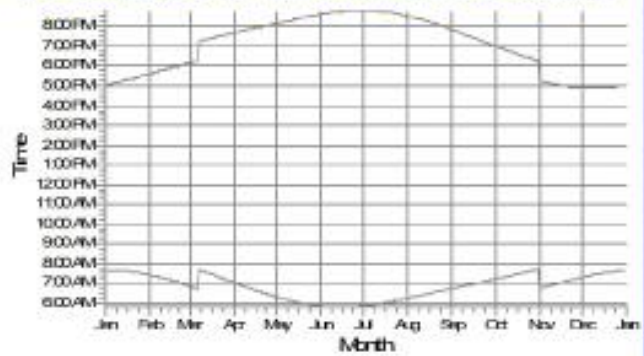
H: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (42)



I: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (43)



J: Shadow Receptor: 1.0 × 1.0 Azimuth: -180.0° Slope: 90.0° (44)



WTGs

Project
Piney Dam

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SHADOW - Calendar per WTG

WTG: 1 - Aeronautica AW 54-750 750-180 54.0 !O! hub: 65.0 m (7)

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
The calculated times are "worst case" given by the following assumptions:
The sun is shining all the day, from sunrise to sunset
The rotor plane is always perpendicular to the line from the WTG to the sun
The WTG is always operating

	January	February	March	April	May	June	July	August	September	October	November	December
1	07:38	07:25	06:51	07:02	06:18	05:51	05:52	06:15	06:44	07:12	06:44	07:18
	17:02	17:36	18:08	19:40	20:09	20:37	20:49	20:31	19:49	19:00	17:16	16:53
2	07:38	07:24	06:49	07:00	06:17	05:51	05:52	06:16	06:45	07:13	06:45	07:19
	17:03	17:37	18:09	19:41	20:10	20:38	20:49	20:30	19:47	18:59	17:14	16:53
3	07:38	07:23	06:48	06:58	06:16	05:50	05:53	06:17	06:46	07:14	06:47	07:20
	17:04	17:38	18:10	19:42	20:11	20:39	20:49	20:29	19:46	18:57	17:13	16:52
4	07:39	07:22	06:46	06:57	06:14	05:50	05:53	06:18	06:47	07:15	06:48	07:21
	17:05	17:39	18:11	19:43	20:12	20:39	20:49	20:28	19:44	18:55	17:12	16:52
5	07:38	07:21	06:45	06:56	06:13	05:49	05:54	06:19	06:48	07:16	06:49	07:22
	17:06	17:40	18:12	19:44	20:13	20:40	20:48	20:27	19:43	18:54	17:11	16:52
6	07:38	07:20	06:43	06:54	06:12	05:49	05:55	06:20	06:49	07:17	06:50	07:23
	17:07	17:42	18:13	19:45	20:14	20:41	20:48	20:26	19:41	18:52	17:10	16:52
7	07:38	07:19	06:42	06:53	06:11	05:49	05:55	06:20	06:49	07:18	06:51	07:23
	17:08	17:43	18:14	19:46	20:15	20:41	20:48	20:25	19:39	18:51	17:09	16:52
8	07:38	07:18	07:40	06:51	06:10	05:49	05:56	06:21	06:50	07:19	06:52	07:24
	17:09	17:44	19:15	19:47	20:16	20:42	20:47	20:24	19:38	18:49	17:08	16:52
9	07:38	07:17	07:39	06:49	06:09	05:49	05:56	06:22	06:51	07:20	06:53	07:25
	17:10	17:45	19:17	19:48	20:17	20:43	20:47	20:23	19:36	18:48	17:07	16:52
10	07:38	07:16	07:37	06:48	06:08	05:48	05:57	06:23	06:52	07:21	06:55	07:26
	17:11	17:46	19:18	19:49	20:18	20:43	20:47	20:21	19:35	18:46	17:06	16:52
11	07:37	07:15	07:36	06:46	06:07	05:48	05:58	06:24	06:53	07:22	06:56	07:27
	17:12	17:47	19:19	19:50	20:19	20:44	20:46	20:20	19:33	18:44	17:05	16:52
12	07:37	07:14	07:34	06:45	06:06	05:48	05:58	06:25	06:54	07:23	06:57	07:28
	17:13	17:49	19:20	19:51	20:20	20:44	20:46	20:19	19:31	18:43	17:04	16:52
13	07:37	07:12	07:32	06:43	06:05	05:48	05:59	06:26	06:55	07:24	06:58	07:28
	17:14	17:50	19:21	19:52	20:21	20:45	20:45	20:18	19:30	18:41	17:03	16:52
14	07:37	07:11	07:31	06:42	06:04	05:48	06:00	06:27	06:56	07:25	06:59	07:29
	17:15	17:51	19:22	19:53	20:22	20:45	20:45	20:16	19:28	18:40	17:02	16:53
15	07:36	07:10	07:29	06:40	06:03	05:48	06:01	06:28	06:57	07:26	07:00	07:30
	17:16	17:52	19:23	19:54	20:23	20:46	20:44	20:15	19:26	18:38	17:02	16:53
16	07:36	07:09	07:28	06:39	06:02	05:48	06:01	06:29	06:58	07:27	07:01	07:31
	17:17	17:53	19:24	19:55	20:24	20:46	20:44	20:14	19:25	18:37	17:01	16:53
17	07:35	07:07	07:26	06:37	06:01	05:48	06:02	06:30	06:59	07:28	07:03	07:31
	17:18	17:54	19:25	19:56	20:25	20:46	20:43	20:12	19:23	18:35	17:00	16:54
18	07:35	07:06	07:24	06:36	06:00	05:48	06:03	06:31	07:00	07:29	07:04	07:32
	17:19	17:56	19:26	19:57	20:25	20:47	20:43	20:11	19:21	18:34	16:59	16:54
19	07:34	07:05	07:23	06:34	05:59	05:48	06:04	06:32	07:01	07:30	07:05	07:33
	17:20	17:57	19:27	19:58	20:26	20:47	20:42	20:10	19:20	18:33	16:59	16:54
20	07:34	07:04	07:21	06:33	05:58	05:48	06:04	06:33	07:02	07:31	07:06	07:33
	17:22	17:58	19:28	19:59	20:27	20:47	20:41	20:08	19:18	18:31	16:58	16:55
21	07:33	07:02	07:20	06:32	05:58	05:49	06:05	06:34	07:02	07:32	07:07	07:34
	17:23	17:59	19:29	20:00	20:28	20:48	20:41	20:07	19:17	18:30	16:57	16:55
22	07:33	07:01	07:18	06:30	05:57	05:49	06:06	06:35	07:03	07:33	07:08	07:34
	17:24	18:00	19:30	20:00	20:29	20:48	20:40	20:05	19:15	18:28	16:57	16:56
23	07:32	06:59	07:16	06:29	05:56	05:49	06:07	06:35	07:04	07:34	07:09	07:35
	17:25	18:01	19:31	20:01	20:30	20:48	20:39	20:04	19:13	18:27	16:56	16:56
24	07:32	06:58	07:15	06:27	05:55	05:49	06:08	06:36	07:05	07:36	07:10	07:35
	17:26	18:02	19:32	20:02	20:31	20:49	20:39	20:02	19:12	18:26	16:56	16:57
25	07:31	06:57	07:13	06:26	05:55	05:50	06:09	06:37	07:06	07:37	07:11	07:36
	17:27	18:04	19:33	20:03	20:32	20:49	20:38	20:01	19:10	18:24	16:55	16:57
26	07:30	06:56	07:12	06:25	05:54	05:50	06:10	06:38	07:07	07:38	07:12	07:36
	17:28	18:05	19:34	20:04	20:33	20:49	20:37	20:00	19:08	18:23	16:55	16:58
27	07:29	06:54	07:10	06:23	05:54	05:50	06:10	06:39	07:08	07:39	07:14	07:36
	17:30	18:06	19:35	20:05	20:33	20:49	20:36	19:57	19:07	18:22	16:54	16:59
28	07:29	06:52	07:08	06:22	05:53	05:51	06:11	06:40	07:09	07:40	07:15	07:37
	17:31	18:07	19:36	20:06	20:34	20:49	20:35	19:56	19:05	18:20	16:54	16:59
29	07:28		07:07	06:21	05:52	05:51	06:12	06:41	07:10	07:41	07:16	07:37
	17:32		19:37	20:07	20:35	20:49	20:34	19:54	19:03	18:19	16:53	17:00
30	07:27		07:05	06:19	05:52	05:52	06:13	06:42	07:11	07:42	07:17	07:37
	17:33		19:38	20:08	20:36	20:49	20:33	19:52	19:02	18:18	16:53	17:01
31	07:26		07:04		05:51		06:14	06:43		07:43		07:37
	17:34		19:39		20:36		20:32	19:50		18:17		17:01
Potential sun hours	301	299	370	397	445	460	455	426	374	348	301	292
Sum of minutes with flicker	0	0	0	0	0	0	0	0	0	0	0	0

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-Last time (hh:mm) with flicker/Minutes with flicker
	Sun set (hh:mm)	First time (hh:mm) with flicker-Last time (hh:mm) with flicker/Minutes with flicker

Project
Piney Dam

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Calculated
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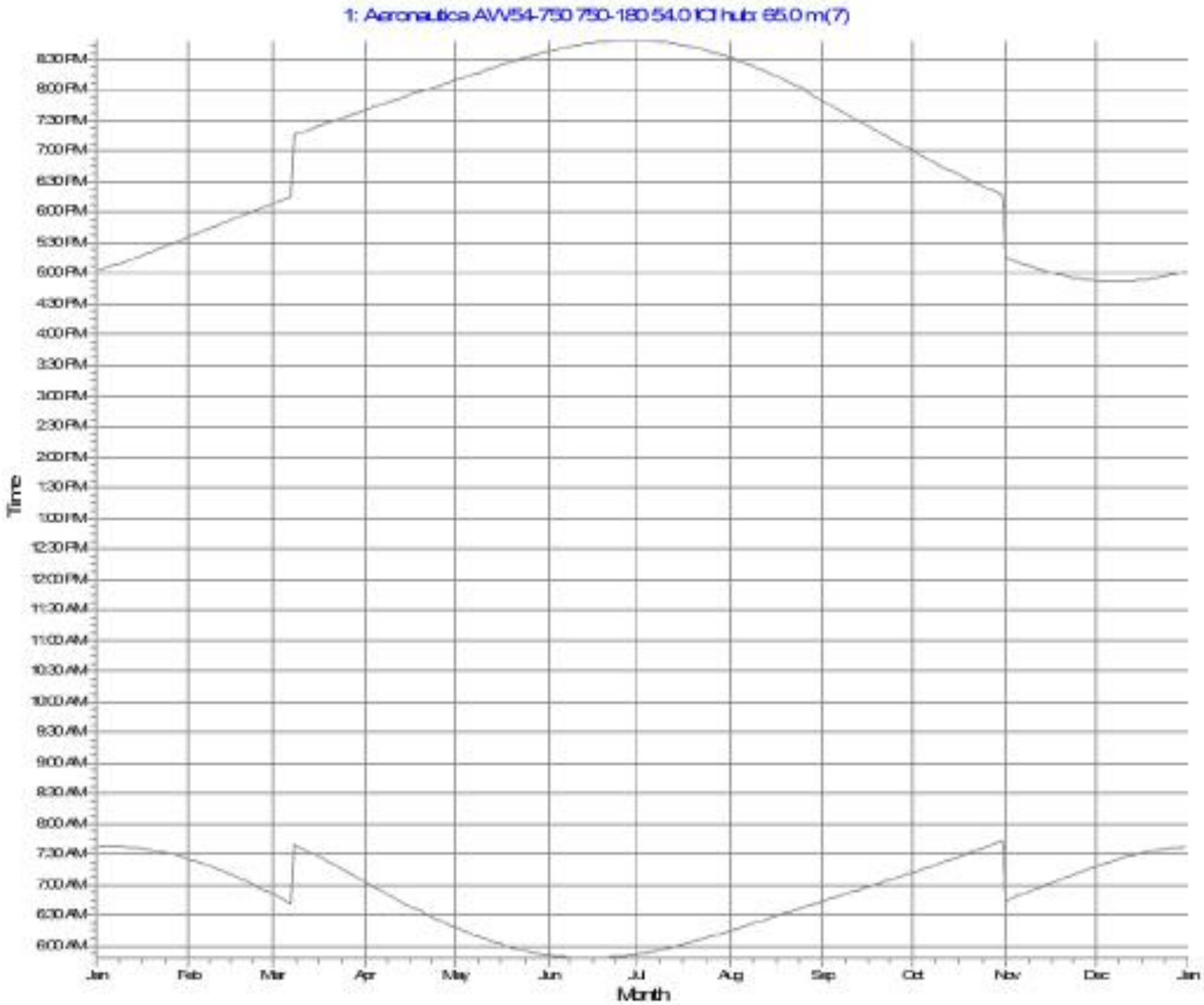
SHADOW - Calendar per WTG, graphical

WTG: 1 - Aeronautica AW 54-750 750-180 54.0 !O! hub: 65.0 m (7)



Shadow receptor

Project
Piney Dam

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Calculated
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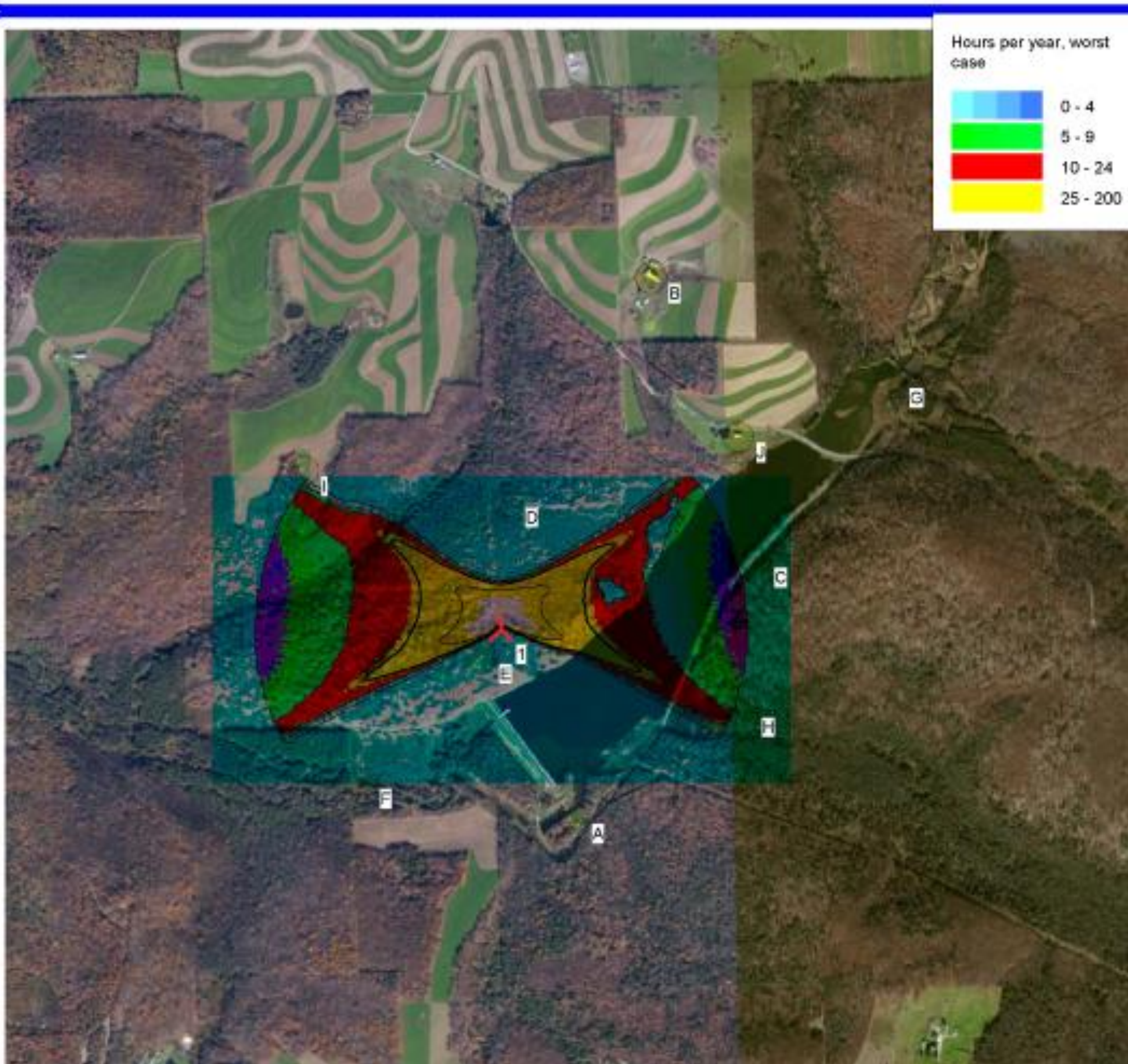
SHADOW - Map



0 250 500 750 1000m

Map: , Print scale 1:20,000, Map center Geo WGS 84 East: -79°00'30.84" North: 39°42'32.62"

New WTG   Shadow receptor

Isolines showing shadow in Hours per year, worst case

— 0 — 10 — 30 — 100

Appendix B

Noise Study

ASSOCIATED
WIND DEVELOPERS

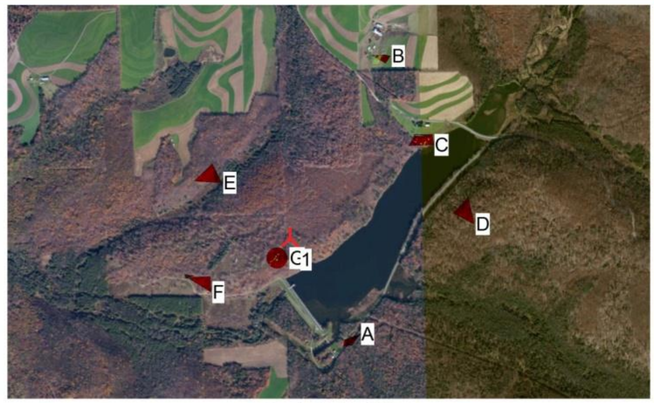
Project:
Piney Dam

Printed/Page
6/5/2013 1:14 PM / 1

Calculated:
6/5/2013 1:13 PM/2.7.486

DECIBEL - Main Result

Noise calculation model:
ISO 9613-2 General
Wind speed:
6.0 m/s - 8.0 m/s, step 2.0 m/s
Ground attenuation:
None
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure tone penalty are added to demand: 5.0 dB(A)
Height above ground level, when no value in NSA object:
1.5 m Don't allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
11.0 dB(A)



Scale 1:40,000
New WTG
Noise sensitive area

WTGs

	Geo DMS: WGS 84 Longitude	Latitude	Z [m]	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Noise data Creator	Name	First wind speed [m/s]	LwaRef [dB(A)]	Last wind speed [m/s]	LwaRef [dB(A)]	Pure tones	Octave data	
1	-79°00'40.32" East	39°42'24.23" North	760.7	Aeronautica AW 54-750 750-180...	Yes	Aeronautica	AW 54-750-750/180	750	54.0	65.0	USER	Runtime input	6.0	98.2	8.0	100.2	No	Generic	*)

***)Notice: One or more noise data for this WTG is generic or input by user**

Calculation Results

Sound Level

Noise sensitive area No.	Name	Geo DMS: WGS 84 Longitude	Latitude	Z [m]	Imission height [m]	Demands Max Noise [dB(A)]	Sound Level Max From WTGs [dB(A)]	Demands fulfilled ? Noise
A	Noise sensitive area: (31)	-79°00'28.07" East	39°42'05.39" North	725.4	1.5	0.0+11.0=11.0	33.8	Yes
B	Noise sensitive area: (32)	-79°00'16.80" East	39°42'55.85" North	755.8	1.5	0.0+11.0=11.0	28.1	Yes
C	Noise sensitive area: (33)	-79°00'11.69" East	39°42'40.71" North	725.4	1.5	0.0+11.0=11.0	31.1	Yes
D	Noise sensitive area: (34)	-79°00'01.53" East	39°42'28.12" North	765.5	1.5	0.0+11.0=11.0	30.2	Yes
E	Noise sensitive area: (35)	-79°00'56.25" East	39°42'34.66" North	744.4	1.5	0.0+11.0=11.0	36.5	Yes
F	Noise sensitive area: (36)	-79°00'59.44" East	39°42'17.57" North	728.8	1.5	0.0+11.0=11.0	36.4	Yes
G	Noise sensitive point: (38)	-79°00'43.53" East	39°42'20.62" North	763.1	1.5	0.0+11.0=11.0	48.1	Yes

Distances (m)

NSA	WTG 1
A	651
B	1125
C	849
D	929
E	497
F	499
G	135

Project:
Piney Dam

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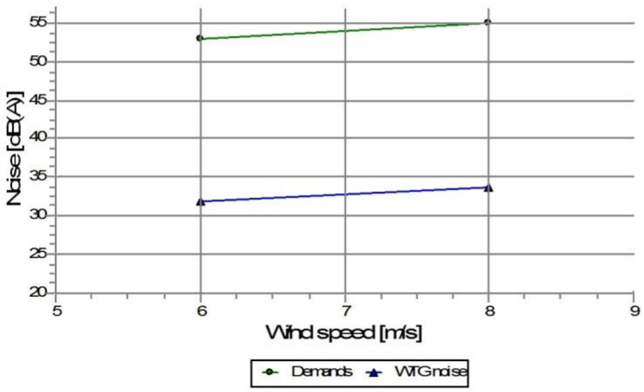
DECIBEL - Detailed results

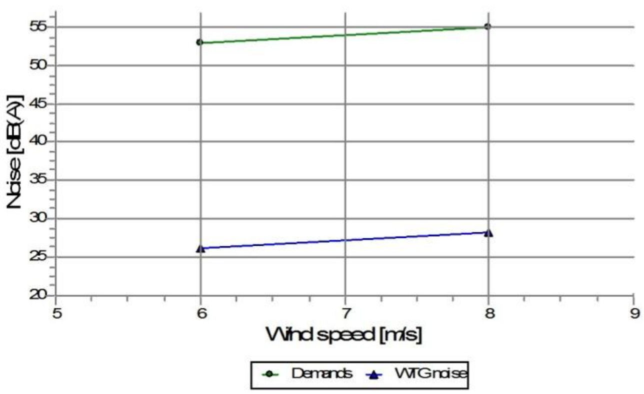
Noise calculation model: ISO 9613-2 General

Noise sensitive area: (31) (A)



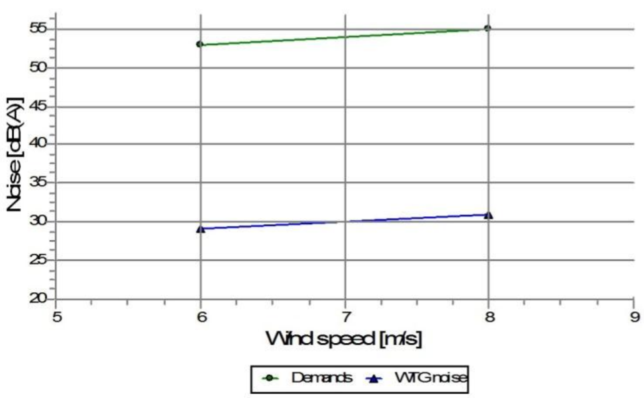
Wind speed [m/s]	Demands [dB(A)]	Sound Level WTG noise [dB(A)]	Demands fulfilled ?
6.0	42.0+11.0=53.0	31.8	Yes
8.0	44.0+11.0=55.0	33.8	Yes

Noise sensitive area: (32) (B)



Wind speed [m/s]	Demands [dB(A)]	Sound Level WTG noise [dB(A)]	Demands fulfilled ?
6.0	42.0+11.0=53.0	26.1	Yes
8.0	44.0+11.0=55.0	28.1	Yes

Noise sensitive area: (33) (C)



Wind speed [m/s]	Demands [dB(A)]	Sound Level WTG noise [dB(A)]	Demands fulfilled ?
6.0	42.0+11.0=53.0	29.1	Yes
8.0	44.0+11.0=55.0	31.1	Yes

Project:
Piney Dam

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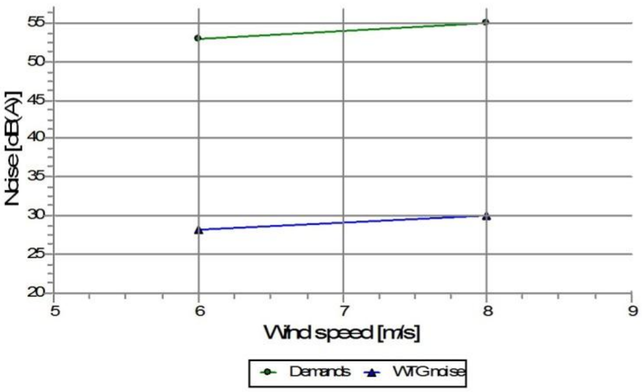
DECIBEL - Detailed results

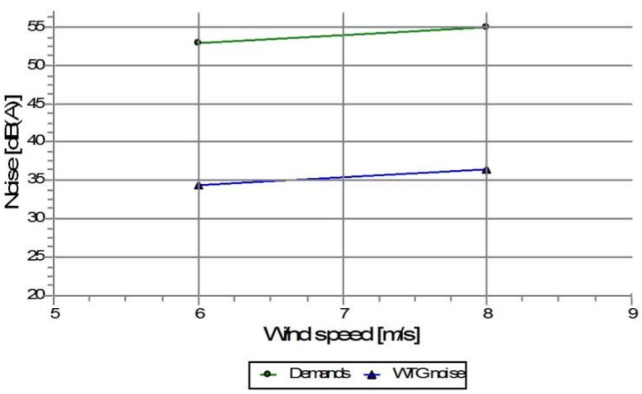
Noise calculation model: ISO 9613-2 General

Noise sensitive area: (34) (D)



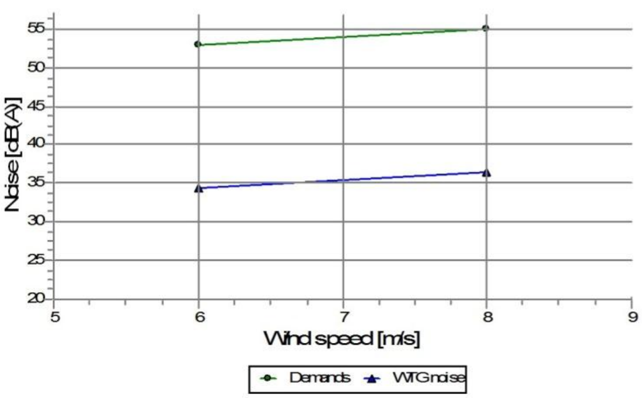
		Sound Level	
Wind speed	Demands	WTG noise	Demands fulfilled ?
[m/s]	[dB(A)]	[dB(A)]	
6.0	42.0+11.0=53.0	28.2	Yes
8.0	44.0+11.0=55.0	30.2	Yes

Noise sensitive area: (35) (E)



		Sound Level	
Wind speed	Demands	WTG noise	Demands fulfilled ?
[m/s]	[dB(A)]	[dB(A)]	
6.0	42.0+11.0=53.0	34.5	Yes
8.0	44.0+11.0=55.0	36.5	Yes

Noise sensitive area: (36) (F)



		Sound Level	
Wind speed	Demands	WTG noise	Demands fulfilled ?
[m/s]	[dB(A)]	[dB(A)]	
6.0	42.0+11.0=53.0	34.4	Yes
8.0	44.0+11.0=55.0	36.4	Yes

Project:
Piney Dam

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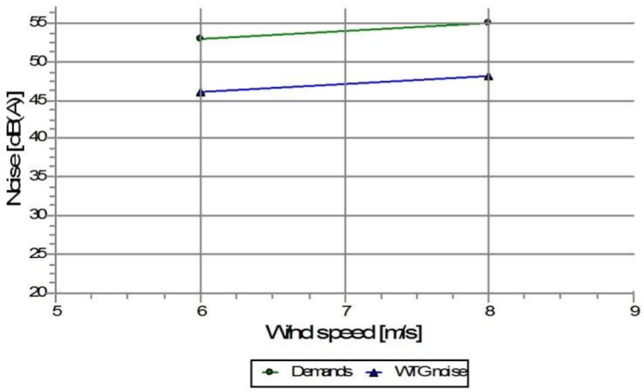
DECIBEL - Detailed results

Noise calculation model: ISO 9613-2 General

Noise sensitive point: (38) (G)



Wind speed [m/s]	Demands [dB(A)]	Sound Level WTG noise [dB(A)]	Demands fulfilled ?
6.0	42.0+11.0=53.0	46.1	Yes
8.0	44.0+11.0=55.0	48.1	Yes

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DECIBEL - Assumptions for noise calculation

Noise calculation model:
ISO 9613-2 General
Wind speed:
6.0 m/s - 8.0 m/s, step 2.0 m/s
Ground attenuation:
None
Meteorological coefficient, C0:
0.0 dB
Type of demand in calculation:
1: WTG noise is compared to demand (DK, DE, SE, NL etc.)
Noise values in calculation:
All noise values are mean values (Lwa) (Normal)
Pure tones:
Pure tone penalty are added to demand: 5.0 dB(A)
Height above ground level, when no value in NSA object:
1.5 m Don't allow override of model height with height from NSA object
Deviation from "official" noise demands. Negative is more restrictive, positive is less restrictive.:
11.0 dB(A)
Octave data required
Air absorption

63	125	250	500	1,000	2,000	4,000	8,000
[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]	[db/km]
0.1	0.4	1.0	1.9	3.7	9.7	32.8	117.0

WTG: Aeronautica AW 54-750 750-180 54.0 !O!
Noise: Runtime input

Status	Hub height	Wind speed	LwA,ref	Pure tones		Octave data 63	125	250	500	1000	2000	4000	8000
	[m]	[m/s]	[dB(A)]			[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
User value	65.0	6.0	98.2	No	Generic data	79.8	86.8	90.2	92.8	92.6	89.7	84.9	75.4
User value	65.0	8.0	100.2	No	Generic data	81.8	88.8	92.2	94.8	94.6	91.7	86.9	77.4

NSA: Noise sensitive area: (31)-A
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand:

6.0 [m/s]	8.0 [m/s]
42.0 dB(A)	44.0 dB(A)

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)
Distance demand: 0.0 m

NSA: Noise sensitive area: (32)-B
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand:

6.0 [m/s]	8.0 [m/s]
42.0 dB(A)	44.0 dB(A)

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)

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Piney Dam

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DECIBEL - Assumptions for noise calculation

Distance demand: 0.0 m

NSA: Noise sensitive area: (33)-C
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand:

6.0 [m/s]	8.0 [m/s]
42.0 dB(A)	44.0 dB(A)

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)
Distance demand: 0.0 m

NSA: Noise sensitive area: (34)-D
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand:

6.0 [m/s]	8.0 [m/s]
42.0 dB(A)	44.0 dB(A)

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)
Distance demand: 0.0 m

NSA: Noise sensitive area: (35)-E
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand:

6.0 [m/s]	8.0 [m/s]
42.0 dB(A)	44.0 dB(A)

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)
Distance demand: 0.0 m

NSA: Noise sensitive area: (36)-F
Predefined calculation standard:
Imission height(a.g.l.): Use standard value from calculation model

Noise demand:

6.0 [m/s]	8.0 [m/s]
42.0 dB(A)	44.0 dB(A)

Ambient noise: 0.0 dB(A)
Margin or Allowed additional exposure: 0.0 dB(A)
Sound level always accepted: 0.0 dB(A)
Distance demand: 0.0 m

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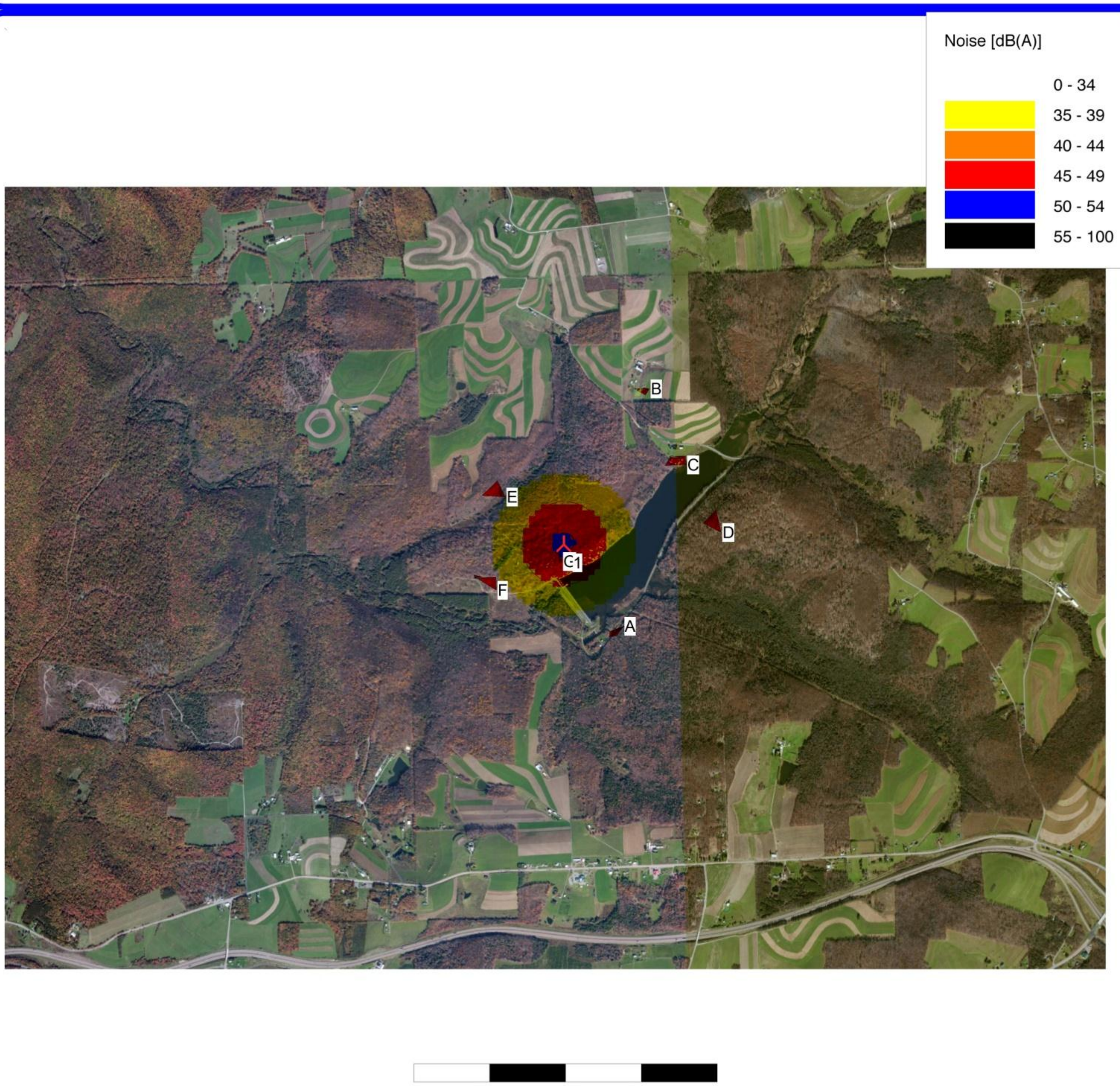
DECIBEL - Map 6.0 m/s



Map: , Print scale 1:40,000, Map center Geo WGS 84 East: -79°00'40.29" North: 39°42'24.22"
Noise calculation model: ISO 9613-2 General. Wind speed: 6.0 m/s

New WTG   Noise sensitive area

Height above sea level from active line object

35.0 dB(A)   40.0 dB(A)   45.0 dB(A)   50.0 dB(A)   55.0 dB(A)

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

Appendix C

Photo-Simulations

ASSOCIATED
WIND DEVELOPERS

The following photosimulations depict the selected turbine at the project location. The photos were taken from the locations in the index image below:

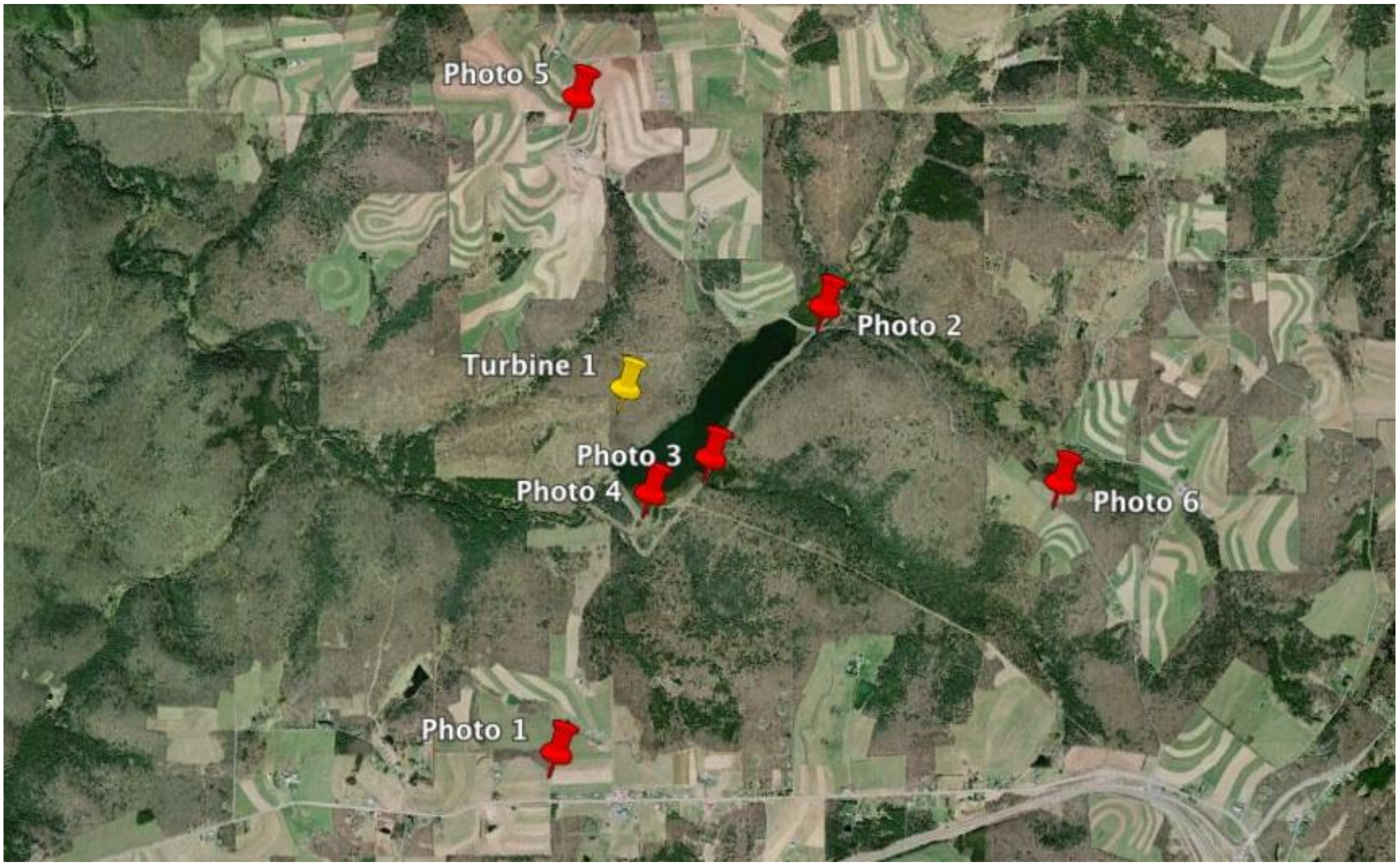


Photo 1 - View of Location from I-40

awd ASSOCIATED WIND DEVELOPERS	Project Site: Piney Run	Location of Photo	
	Name: Photo 1	Latitude: 39.68858N Longitude: 79.01537W	
	Date Created: 5/23/2013	Distance to Turbine: 6,865 ft.	

Photo 2 - View of Location from Piney Run Road

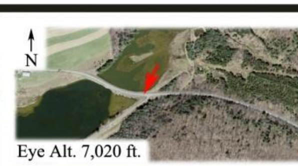
Project Site: Piney Run	Location of Photo	
Name: Photo 2	Latitude: 39.71149N Longitude: 78.99753W	
Date Created: 5/23/2013	Distance to Turbine: 4,040 ft.	

Photo 3 - View of Location from Across the Reservoir

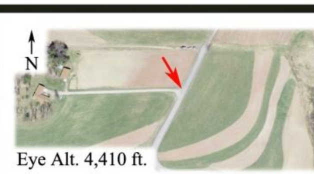
ASSOCIATED WIND DEVELOPERS	Project Site: Piney Run	Location of Photo	
	Name: Photo 3	Latitude: 39.70371N Longitude: 79.00519W	
	Date Created: 5/23/2013	Distance to Turbine: 2,000 ft.	

PhotoSimulation Appendix

Photo 4 - View of Location from Gatekeepers House

awd ASSOCIATED WIND DEVELOPERS	Project Site: Piney Run	Location of Photo	
	Name: Photo 4	Latitude: 39.70187N Longitude: 79.00925W	
	Date Created: 5/23/2013	Distance to Turbine: 1,971 ft.	

Photo 5 - View of Location from Near Pennsylvania Line

ASSOCIATED WIND DEVELOPERS	Project Site: Piney Run	Location of Photo	
	Name: Photo 5	Latitude: 39.72213N Longitude: 79.01395W	
	Date Created: 5/23/2013	Distance to Turbine: 5,490 ft.	

Appendix D

Wind Resource Assessment

ASSOCIATED WIND DEVELOPERS

The section below presents details of the wind resource assessment completed for the Project.

Data Acquisition

Data used in a wind project analysis takes two different forms: calculated data and empirical (actual) data.

Empirical Data: Traditionally, in confirming the strength of on-site resources, wind speeds are measured for a full calendar year at a location as close as possible to the proposed turbine site. Wind speeds are recorded by erecting a meteorological (met) mast of great enough height to access wind uncompromised by trees, buildings, or other structures. Newer measures of empirical data acquisition include SODAR (Sonic Detection and Ranging) and LIDAR (Light Detection and Ranging) devices. SODAR and LIDAR devices use Sound and Light, respectively, to pulse the atmosphere and then record information from the resulting reflections to estimate air particle movements such as speed and direction.

Calculated Data: Weather data sets which rely on Doppler sensing have allowed the creation of wind maps of different heights, such as those published by the National Renewable Energy Labs. This data is considered to be Meso data, or macro level data, as it corresponds to a broader area than a single on-site location. While it is used as a first-order approximation for wind project analysis it contains a relatively high degree of error due to data resolution. A newer technology, the Virtual Met Tower (VMT), offers a more refined calculation of macro data by using actual data from other local weather stations (airports, etc.) and then performing 'Computational Fluid Dynamics' calculations on the data to account for terrain and obstruction variations.

As an 'Alternate' champion candidate site for the grant funding this feasibility study series, this site has been selected to receive a full met tower study during the period from July of 2013 to July of 2014. The met tower will be supplied under the Maryland Energy Office's Anemometer Loan program.

In order to immediately evaluate the site while data is being recorded the Feasibility Study drew upon interim data from two published sources: NREL Wind Maps and a 'Virtual Met Tower' report from Wind Analytics of Brooklyn NY. The Feasibility Study used this data to determine an estimated wind regime for the site along with a sensitivity analysis that can be used to adjust production numbers when the actual data collection effort is finished.

The 'Virtual Met Tower' process is described by Wind Analytics as follows:

> *The underlying wind data used by Wind Analytics is derived from a global network of Automated Surface Observing System (ASOS) station data, acquired through the National Climatic Data Center (NCDC), an extension of the National Oceanic and Atmospheric Administration (NOAA). With Wind Analytics, UW has access to 28,000 datasets globally, with over 6,000 stations across the US. The data is provided as an hourly average of wind speed and direction, with typical station record history of 30+years. Once a study location is selected, Wind Analytics identifies and triangulates three nearby met stations. Station data is downloaded and weighted to account for station location and data quality. To account for variations in the wind profile from nearby stations to the study site, land cover effects are removed from met stations. To account for the impacts of nearby features such as trees, obstructions, or turbines , Wind Analytics creates an obstruction model for each study site. For each obstacle, the analyst inputs the corresponding height, width, and porosity using aerial oblique imagery. A final wind profile is developed for each location and height and turbine production is calculated by matching the certified wind turbine efficiency curve to the wind speed distribution.*

Additional information about the Virtual Met Tower process may be found in Appendix D.

The published wind maps from the National Renewable Energy Labs indicate winds in the 5.6 to 6.4 m/s range at a hub height of 50 meters.

Although there is a LIDAR wind monitoring station located adjacent to the project site, the data from the station was unfortunately deemed unusable for this study. This is due to the fact that the LIDAR station is studying high altitude winds (>500'), and a smaller 10m tall met tower is located below the level of surrounding treetops. Extrapolated results from either of these two resources would contain an excessive degree of error.

Figure 1.7 – NREL 50m Wind Speed Map

(1) NREL data overlaid on Google Earth amp. Yellow grids indicate 5.6 to 6.4m/s winds. Orange grids indicate 6.5 to 7.0m/s)

Methodology

While some might consider conducting a feasibility study before an actual wind study as putting 'the cart before the horse', this method of evaluating a site allows longer term (1 year), expensive site wind studies to only be conducted at locations where, in most other respects, the feasibility of a project has already been validated. When done by experienced wind industry professionals who can usually spot significant flaws or good project sites early in the process, this method saves both time and money when evaluating sites.

It should be noted that financing sources will differ on the need for actual vs. published wind data for smaller community wind sites. While larger wind projects certainly require one (or more) met towers to validate the wind resource, smaller community wind projects can often obtain financing without an on-site wind study, especially if:

- multiple wind data resources are employed which all suggest a similar result,
- other existing met tower studies or turbines have been constructed in the area,

- or if the winds are considered strong enough that the margin of error can be removed from the financial pro forma instead.

The location of the met tower selected for the Maryland Energy Office Anemometer Loan program was selected because it represents an on-site location relatively uncompromised by trees, buildings, or other structures. This site is located in close proximity to the proposed turbine location and there are no other obstacles other than vegetation surrounding the met tower site. Figure 1.2 displays the location of the met tower installation in reference to potential turbine locations.

Long-term Wind Speed Estimation

Both published wind maps and Virtual Met Tower reports are based on 20 year wind speed history. Based on a combination of the wind map and Virtual Met Tower report, estimated annual long-term wind speeds at various heights are estimated to be as follows. These values will be used in this report until the actual wind study is completed.

Average Annual Wind Speeds

Height (m)	Wind Map	VMT	Calc.
40		5.59	5.59
50	6.0		5.96
60		6.28	6.28
65			6.43
80	6.5		6.82

Wind Shear Estimates

Wind Shear is a measurement of the relationship of wind speeds at various heights. The speeds are related by a 'roughness factor', and the wind shear formula between 2 heights may be expressed as:

V(1)/V(2) = (H(1)/H(2))^a

Where:

- V(1) is one height
- V(2) is the second height
- H(1) is the wind speed at Height 1
- H(2) is the wind speed at Height 2
- a is the 'roughness exponent.

This equation may be re-written to solve for the roughness factor, a, as follows:

a = ln(V(1)/V(2)) / ln (H(1)/H(2)

Given the 40 and 60 meter heights produced by the Virtual Met Tower report from Wind Analytics, the roughness factor is calculated to be **.287**, which corresponds to other roughness factors for similar terrain and heights.

From this an estimated value for the wind speed at 65meters may be calculated, which is a common hub height for 750kW wind turbines (See Table 1.5).

V(3) = (H(3)/H(2))^a x V(2) = 6.43 m/s

This is the value that will be used in this report for the average annual wind speed pending the results of the 1 year wind study. When the production and financial models for the project are run, values of +/- 5% of this value (6.10 and 6.75m/s) will also be calculated, in order to enable future readers to easily correlate the results from the met tower study.

Wind Resource Uncertainty

A number of factors contribute to the uncertainty of wind resource data. Using standard statistical principles, a general level of resource uncertainty can be obtained.

Wind maps can have errors of 10-25% or more, especially in areas of varying geography. Virtual Met Towers, which use Computational Fluid Dynamics to more accurately predict airflow over the terrain, can have errors ranging from 3 to 20%.

Energy industry standard for conveying uncertainty results is to calculate what is known as a P90 value representing a conservative estimate of a value in addition to the average P-50 wind speed. The Financial Modeling in Appendix F incorporates both P-50 and P-90 modeling for comparative purposes.

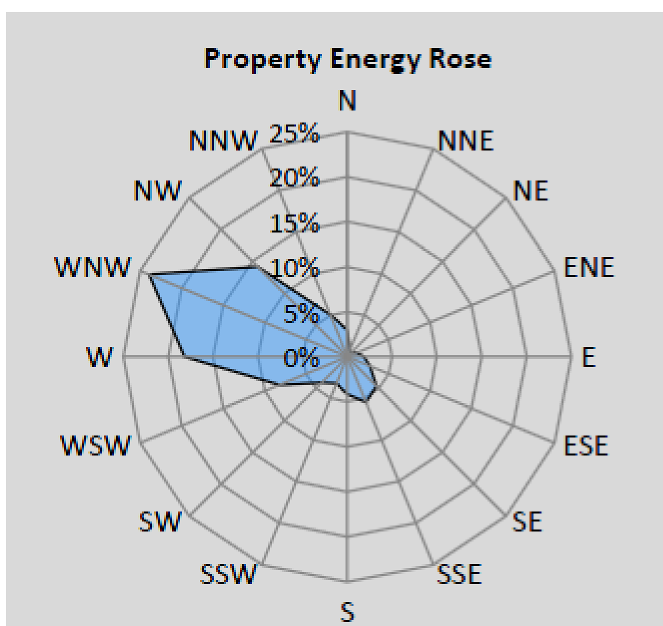
An option for decreasing this uncertainty is to install an actual met tower, which is being planned for this site.

Wind Modeling

Wind resource data from the virtual met tower, adjusted using the findings above, were used as input for calculation runs using FOCUS specialized wind energy modeling software. FOCUS uses site information and geospatial data to produce wind energy outputs (wind speed and turbine production values) based on calculations. In general, the site demonstrates acceptable conditions for wind energy development.

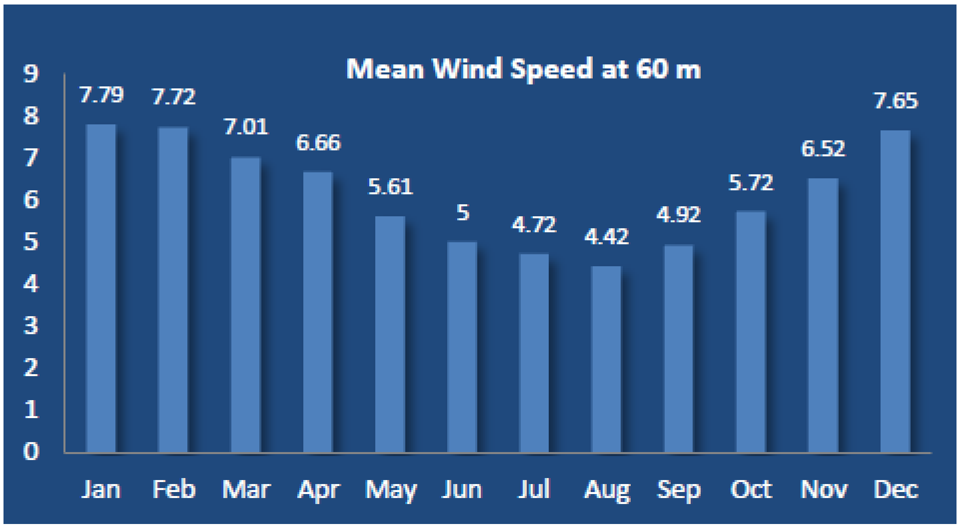
Wind Direction Recordings

The Virtual Met Tower report results in the following wind rose, which indicates how often the wind blows from different compass headings. The rose is valuable in siting the wind turbine near any obstructions in order to determine any losses that would occur over the year.



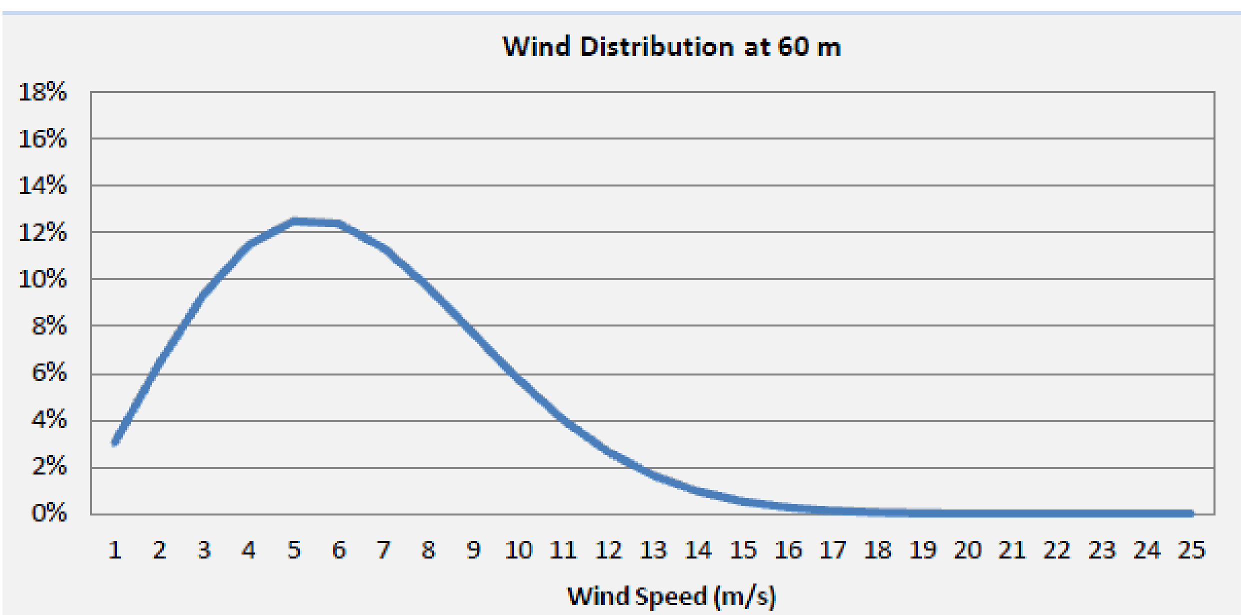
Monthly Variances in Wind Speed

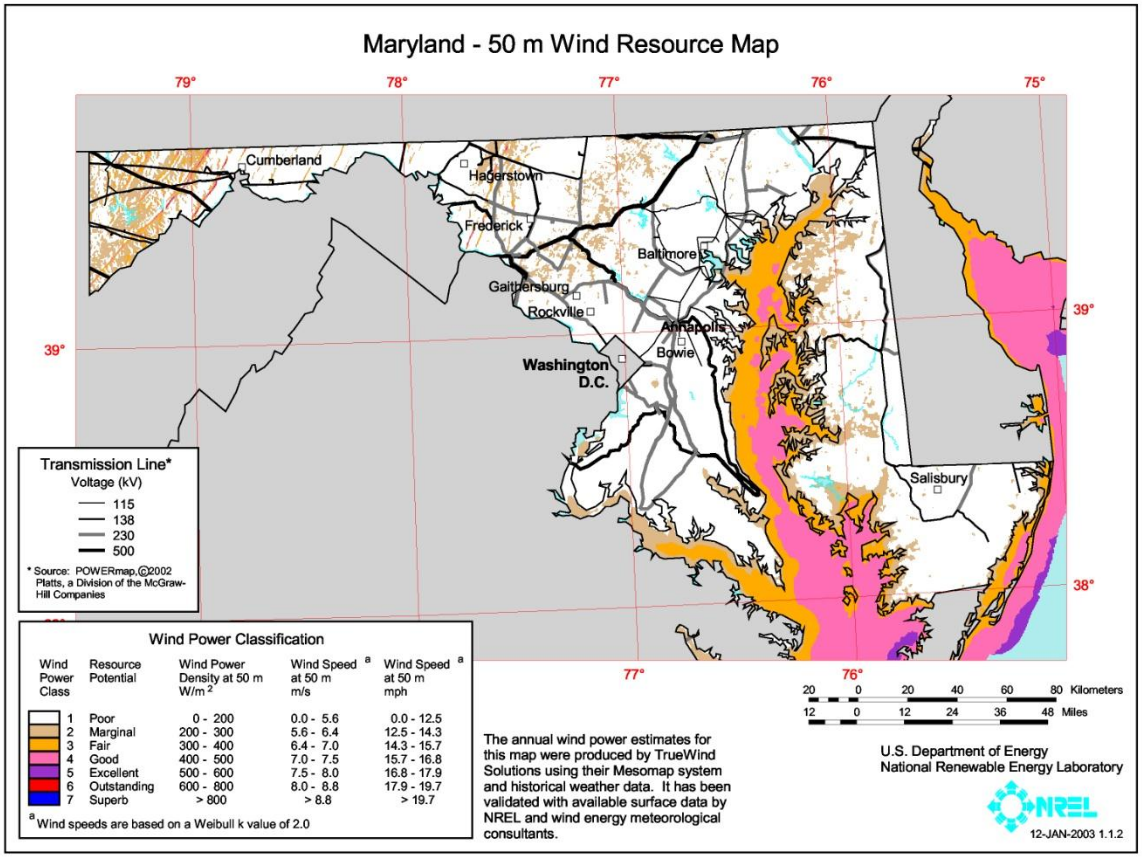
The Virtual Met Tower report results in the following monthly wind speed graph, which indicates the average annual wind speed on a monthly basis. This information is useful in determining production values across the year and for financial planning during low wind months.

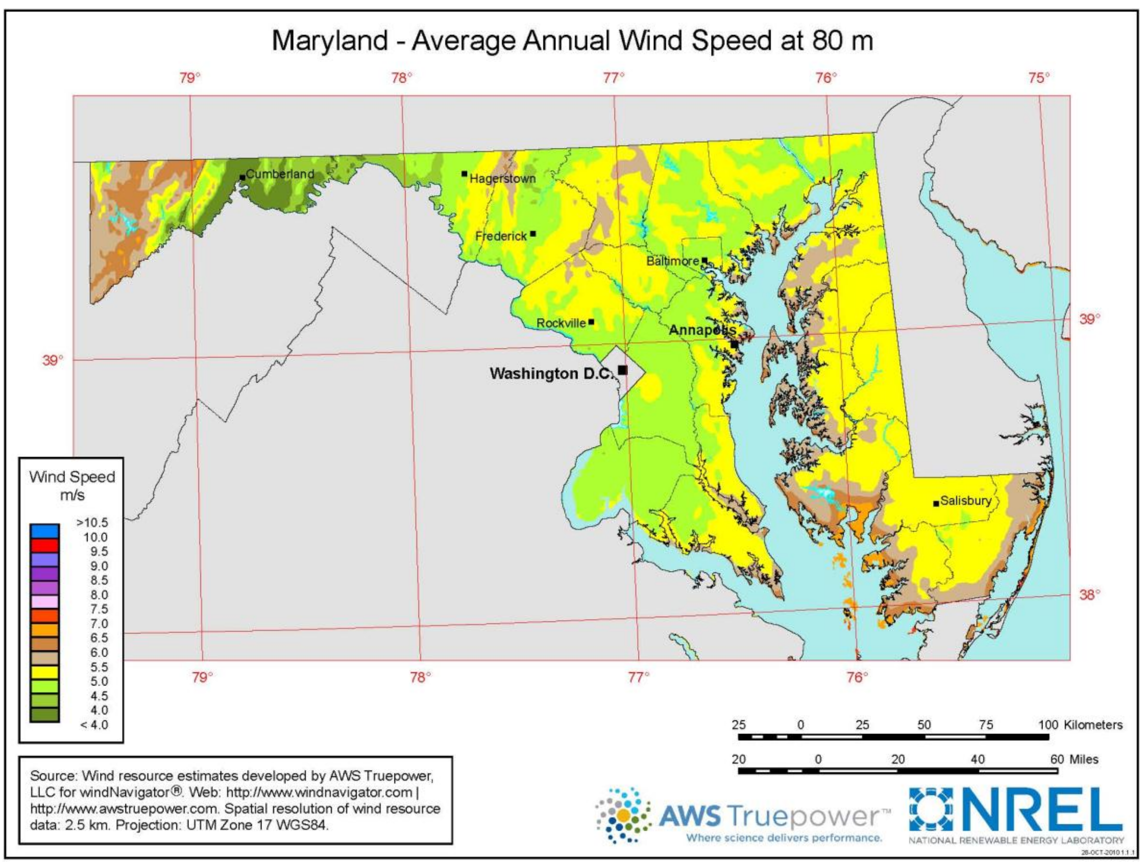


Weibull Distribution Curve

The Virtual Met Tower report results in the following distribution curve, which indicates the percentage of time over the year that the wind blows at different speeds. This information is useful in determining production values across the year both in terms of energy and revenue.




Maryland - 50 m Wind Resource Map
79°
78°
77°
76°
75°
39°
38°
Cumberland
Hagerstown
Frederick
Baltimore
Gaithersburg
Rockville
Annapolis
Bowie
Washington D.C.
Salisbury
Transmission Line*
Voltage (kV)
115
138
230
500
* Source: POWERmap, ©2002 Platts, a Division of the McGraw-Hill Companies
Wind Power Classification
Wind Power Class | Resource Potential | Wind Power Density at 50 m W/m² | Wind Speed at 50 m m/s [a] | Wind Speed at 50 m mph [a]
1 Poor 0 - 200 0.0 - 5.6 0.0 - 12.5
2 Marginal 200 - 300 5.6 - 6.4 12.5 - 14.3
3 Fair 300 - 400 6.4 - 7.0 14.3 - 15.7
4 Good 400 - 500 7.0 - 7.5 15.7 - 16.8
5 Excellent 500 - 600 7.5 - 8.0 16.8 - 17.9
6 Outstanding 600 - 800 8.0 - 8.8 17.9 - 19.7
7 Superb > 800 > 8.8 > 19.7
[a] Wind speeds are based on a Weibull k value of 2.0
20 0 20 40 60 80 Kilometers
12 0 12 24 36 48 Miles
The annual wind power estimates for this map were produced by TrueWind Solutions using their Mesomap system and historical weather data. It has been validated with available surface data by NREL and wind energy meteorological consultants.
U.S. Department of Energy
National Renewable Energy Laboratory
NREL
12-JAN-2003 1.1.2


Maryland - Average Annual Wind Speed at 80 m
79°
78°
77°
76°
75°
39°
38°
Cumberland
Hagerstown
Frederick
Baltimore
Rockville
Annapolis
Washington D.C.
Salisbury
Wind Speed m/s
>10.5
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
< 4.0
25 0 25 50 75 100 Kilometers
20 0 20 40 60 Miles
Source: Wind resource estimates developed by AWS Truepower, LLC for windNavigator®. Web: http://www.windnavigator.com | http://www.awstruepower.com. Spatial resolution of wind resource data: 2.5 km. Projection: UTM Zone 17 WGS84.
AWS Truepower™
Where science delivers performance.
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Appendix E

Interconnection Analysis

ASSOCIATED
WIND DEVELOPERS

Discussions were held with Mr. John Emerick, Manager of External Affairs for Potomac Edison relative to the interconnection of potential wind turbines at the proposed site.   Mr. Emerick supplied drawings of the interconnection (below) at the dam for use by the study.

As can be seen in the following drawings, the dam pumping station is serviced by a 750kVA, 277/480volt, 3phase pad mounted transformer, designated T15211.   This transformer is located within 200 yards of the proposed turbine location.

The circuit for the pumping station transformer is serviced by a pole mounted, 12kV, 3 phase line running to the #1 Frostburg substation on the 'Centertown' circuit.

Discussions with Mr. Emerick reveal no congestion on this line. The line was reportedly built for the purpose of servicing the pump station, and therefore has the capacity of powering the 4 (3 existing plus one future) pumps at the dam for a total of approximately 1MW of load.

Should this project proceed to the construction phase, it should be a priority to revisit this interconnection with the utilities and file a formal interconnection application.

Of note is the extension of the circuit to the 'Appalachian Environmental Lab Service'. This service feed the LIDAR observation station next to the proposed turbine location.

Mr. Emerick's contact information is as follows:

John R. Emerick
Manager, External Affairs
Potomac Edison/FirstEnergy
700 Fourth Street
Cumberland, Maryland 21502
Phone: 301-759-5757
Fax: 234-678-2266

Figure E-1: Potomac Edison drawing of the Piney Dam Pump House Connection.

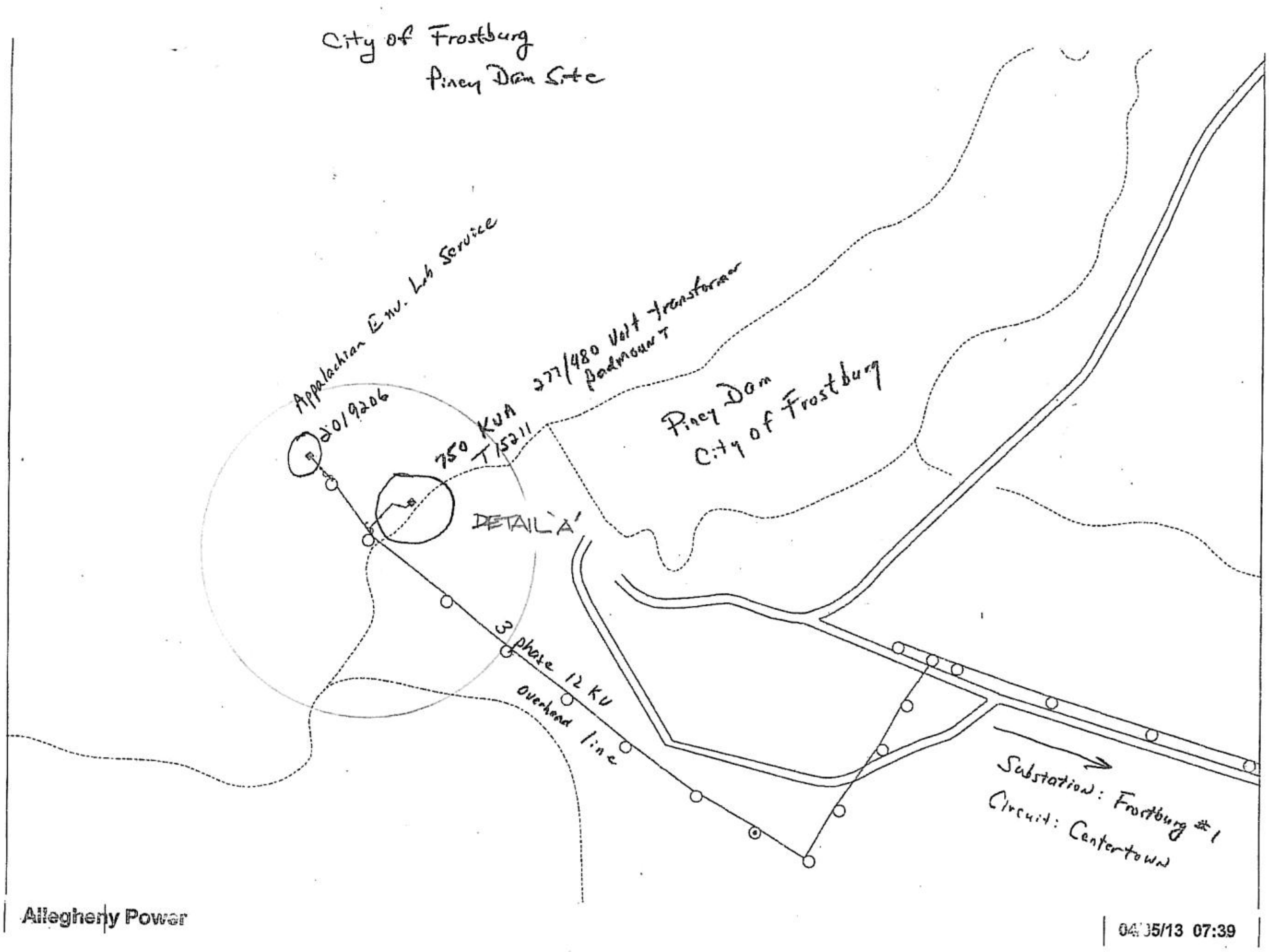
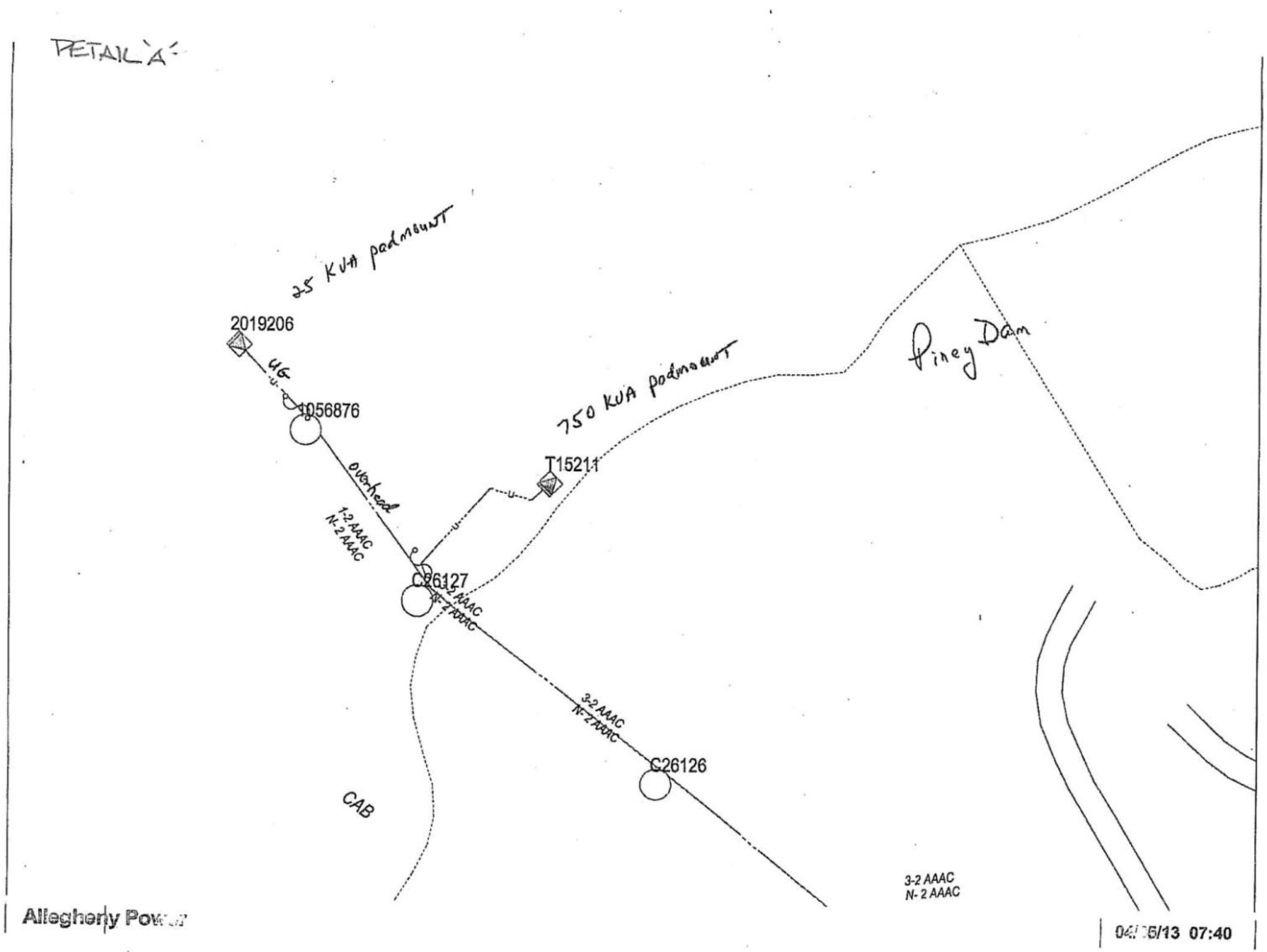


Figure E-2: Detail of Potomac Edison drawing of the Piney Dam Pump House Connection.



Appendix F

Project Financial Modeling

ASSOCIATED
WIND DEVELOPERS

The following pages reflect the Operational and Financial Results of the project when modeled in FOCUS Wind Project Analysis software. This proprietary software package is used by Associated Wind Developers to input all of the pertinent financial and operating variables that will affect wind energy projects.

The modeling was run for a 750kW wind turbine.

The following pages include:

- Input Screen
- Project Summary Page
- Pro forma (P50) Cash Flow
- Corporate View (showing depreciation and other tax implications, some of which will not be applicable should the project ownership not be able to take advantage of tax credits and deductions.)

Basic Input Values

(input in GREEN cells only)

Site Information:	***Piney Reservoir Dam***		
Owner Name:	Town of Frostburg		
	off Grantsville Road		
	Frostburg	Latitude	39°42'20.02"N
	MD	Longitude	79° 0'41.53"W
Developer Name:	AWD		
Point of Contact, Phone	TBD	POC Phone	TBD

Facility:				
Select the Wind Turbine Desired:		**AW54-750**	1	No. of Turbs
If 'Other' selected, name:				
Wind & Environmental				
Ave. Wind Spd (m/s):	**6.43**	Corrected Speed:	**6.43**	m/s
Hub Height (m):	65	Meas. Hgt (m):	65	
Wind Shear Exp.	0.287	Weibull K Factor	2	
Availability	95.00%	Safety Margin Loss	0.00%	
Turb. Intensity Loss:	0.00%	Ann. Energy Output	**1,832,699**	kWhrs/yr
Alt. Above Sea Lev. (m)	714	Avg. Temp. (Deg.C):	12	

Project Costs:			
A. Turbine Costs:			
Turbine base cost (order date):			$1,280,000
Shipping to site:			$85,000
Duties and Fees:			
Lighting, Lifts, cold weather pks, etc.			$0
Other options:			$0
Per turbine total from Mfgr:			**$1,365,000**
Per turbine foundation design cost:			$10,000
Per turbine foundation constr.cost			$85,000
Total per turbine cost:			**$1,460,000**
No. of turbines:	***1***	*Extended:*	***$1,460,000***
B. Balance of Plant:			
B1. PreDev and Permitting			
Wind Studies:			$0
Feasibility Study:			$0
Site Plans:			$20,000
Soil Geotechnic Study:			$2,500
Interconnection Studies:			$3,500
Noise Studies:			$0
Flicker Studies:			$0
Avian, Environmental Studies:			$0
Road Surveys			$1,500
Other:			$0
Legal:		below	$0
Total (B1) PreDev and Permitting:			**$27,500**
B2. Construction:			
Excavation:			$40,000
Site & Road Upgrades:			$40,000
Dewatering:			$0
Electrical to Grid:			$175,000
Grid Upgrades:			$0
Turbine Wiring:			$20,000
Erection Team:			$40,000
Crane:			$110,000
Storage:			$0
Landscaping:			$0
Commissioning:		in turb price	$0
Security and Details:			$2,000
Other:			
Contingency:			$100,000
Total (B2) Construction:			***$527,000***
Total Costs			***$2,014,500***
Soft Costs - Dev. Fees:			$50,000
Soft Costs - Legal:			$50,000
Soft Costs - Fin. Fees:			$50,000
Total Installed Cost			***$2,164,500***

Power Cost Assumptions:						
Percent of Power Mix: Retail vs. Resale					100%	Retail
Value of RETAIL Electricity (BTM or NM):					$0.0870	$/kWhr
Contracted Disc. over Current Price:					**0.0%**	
Adjusted Retail Rate					$0.087	$/kWh
Escalate:	(A or B, A is default if enetered.) A:				2.5%	
B:	0.0%	0.0%	0.0%	0.0%	0.0%	per term
	(^ allows rates like: 4% inc. for 5 years, then 2% for next 5 years...)					
Value of RESALE (Merchant Electric sold to grid):					$0.000	$/kWhr
	Resale escalator				0.0%	per year
Value of RECs or Green Tags				$	0.005	$/kWhr
	Annual escalator				1.00%	
Value of PTCs					0	$/kWHr
On-Site Usage					0	kWhr/yr
Expenses by Month						
Land Costs (choose 1):		% of Gr. Elec. Rev.:			**0.00%**	%Gr.Rev.
		Payment/Turbine:			**$0**	$/mo/Turb
Management Fee (Choose 1. Applied in January)						%Gr. Rev.
					$0	$/yr/Turb

Month	O&M	Insurance	Land	Mgt/Other	Financing
January	17,000	7,500	0	0	11,571
February			0	0	11,571
March			0	0	11,571
April			0	0	11,571
May			0	0	11,571
Jun			0	0	11,571
July			0	0	11,571
August			0	0	11,571
September			0	0	11,571
October			0	0	11,571
November			0	0	11,571
December			0	0	11,571
Totals	**17,000**	**7,500**	**0**	**0**	**138,846**
	O&M $/kWhr	% of Cost/yr		Mgt $/Mo	
Total:	0.00928	0.35%		$0	

Used in Annual Profroma:		
O&M	0.00928	$/kWh based on Net Ann. Output
Land Cost	0	% of Rev unless 0, then $/turb
Mgt Fee:	$0	$/mo
Insurance	0.35%	of Installed Cost/yr.
Inflation rate	1.00%	per year (affects ann. costs)

Ownership and Financing Structure:						
Type of Ownership		'S-Corp', LLC, Partnership		Comb. Fed. & ST Tax bracket:		0%
Target DSC	1.5	Addt'l Equity Req'd for DSC		Show Depreciation as:		5yr MACRS
Prop. Tax:	Land Valuation ($)		$0	Land Mil Rate ($/'000)		$0.00
	Equipment Valuation ($):		$1,948,050	Equip. Mil Rate ($/'000)		$0.00
or Payment in Lieu of Taxes (PILOT):				Show PropTx as 'Oth. Exp' (Y/N)		Y
Fed Tax Credit type		None	Grants to:	REVENUE	Fed Tax Grant:	$0
Financing Type:		Equity/Debt	Loan Term	20	Financed Amount:	$2,164,500
Down Pmt/Equity		0%	Int. Rate	2.50%	Down Paym't Amt.	$0
Constr. Delay Yr. 0 (mos.)		0				
If Lease:	Mo. Pmt.	0	Resid. Value			
	Resid. Pmt.	0	Resid. Years	0		
Recapitalization Target:		$0	Yrs to Accum:	0	Amt/Yr Required:	#DIV/0!
	Start Amt:	$0				
Salvg Value (% of inst cost)		10.00%	**$216,450**			

Version 9.3.5

Report Date:
6/5/2013 17:03

Piney Reservoir Dam

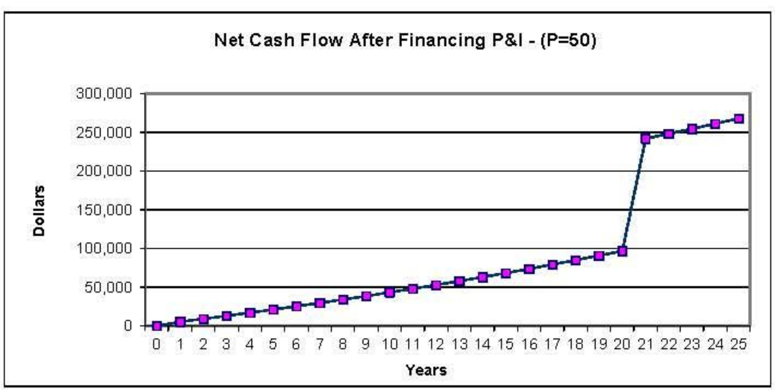
Town of Frostburg		Latitude:	39°42'20.02"N
off Grantsville Road		Longitude:	79° 0'41.53"W
Frostburg	MD	Elevation (ASL):	714

Notes:

System:		
Turbine:	AW54-750	
Quantity:	1	
Turbine Portion of Project:	$1,460,000	
Balance of Wind Plant Portion:	$704,500	
Project Cost - Wind	$2,164,500	
Other Portions of Project, if any:		
Total Project Cost:	*$2,164,500*	
Environmental:		
Avg. Wind Speed:	6.43	
Hub Height:	65	
Shear:	0.287	
Corrected Speed at Hub:	6.43	
Total Losses (Avail., Turb., Safety)	5.00%	
Corrected Wind Speed:	6.43	
Greenhouse Gas Savings Equivlent (CO2)	1,263.76	metric tons/yr

Investment Ratings (at P-50) - w/o tax implications:			
Simple Paybacks:	w/NO grants	15.02	years
	w/FED grants	15.02	years
	w/ALL Grants	15.02	years
Cost/kW: (Uninstalled)		$1,820	
Cost/kW: (Inst. cost/nameplate rating)		$2,886	
	Before Fin.	*After Fin.*	
Year 1 Cash Flow:	$144,108	$5,262	
Year 2 Cash Flow:	$147,909	$9,063	
	10 yr.	***25 yr.***	
IRR (Excl. salv., 10 yr/25 yr)	-4.7%	6.9%	
Property Taxes Pd. (1 yr/25 yrs	$0	$0	

Net Present Value (NPV)	($31,272)	(w/out salv. value)
Avg. Annual ROI over 25 yrs	9.2%	(w/o fin. and depr.)
Ann. Ret. on Inv. Capital (over 25 yrs)	Infinite	(Infinite = $0 down)
Min. Cum Cash Position after Expenses:	$0	(Min position over 25 yrs)



Production:					
Energy	1,832,699	kWhrs/yr, or		152,725	kWhrs/mo
			kWhrs		$/kWhr
Supplemental Power				0	0
Grid Power (P50)				-	$0.000
Wind Int. Cost/kWh (yr1,P-50, incl. Fin., 25yr dep.):			$	0.136	
$Rev - 25y avg.	$199,962	$/year, or		$16,663	$/mo
Land Rental (1st year):				$0	$/year
Power Cost Assumptions:					
Percent of Power Mix: Retail vs. Resale				100%	Retail
Retail:					
Current value of Retail Elect. (BTM or NM):				$0.087	$/kWhr
Contracted Disc. over Current Price:				0.0%	
Adjusted Retail Rate				$0.087	$/kWhr
Retail Escalators:				2.5%	per year
	0.0%	0.0%	0.0%	0.0%	0.0%
Resale:					
Value of Resale (Sold to grid):				$0.000	$/kWhr
Resale Escal.				0.0%	per year
Value of RECs or Green Tags			$	0.005	$/kWhr
	Escalator:			1.00%	per year
Financing Structure:					
Is Project Financed? (Y/N)			N	Interest Rate	X
Down payment			0%	Loan term (years)	20
Total Invested Capital					$0
ITC Grant:				$	-
Total Financed				$	2,164,500

Sensitivity:	***P-50***	***P-70***	***P-90***
Wind Spd	6.43	6.21	5.89
Net kWhrs/yr	1,832,699	1,707,941	1,525,596
Year	*Net Cash Flow (from Ann. Proformas)*		
Yr. 0 - Constr.	$0	$0	$0
1	$5,262	($6,216)	($22,992)
2	$9,063	($2,690)	($19,869)
3	$12,960	$925	($16,666)
4	$16,956	$4,632	($13,381)
5	$21,054	$8,434	($10,012)
6	$25,256	$12,332	($6,557)
7	$29,564	$16,330	($3,014)
8	$33,982	$20,429	$620
9	$38,511	$24,632	$4,346
10	$43,156	$28,942	$8,168
11	$47,917	$33,362	$12,087
12	$52,800	$37,893	$16,106
13	$57,806	$42,540	$20,227
14	$62,939	$47,304	$24,453
15	$68,201	$52,190	$28,787
16	$73,597	$57,199	$33,232
17	$79,129	$62,335	$37,789
18	$84,801	$67,601	$42,463
19	$90,616	$73,001	$47,255
20	$96,579	$78,537	$52,169
21	$241,538	$223,060	$196,054
22	$247,805	$228,881	$201,221
23	$254,230	$234,848	$206,519
24	$260,818	$240,966	$211,951
25	$267,571	$247,239	$217,522

25 year Financial Proforma

Project: ***Piney Reservoir Dam***

Revenue Proformas - Cash Basis - w/out Tax Implications, P Value = 50

	Revenue (Cash Basis)							SG&A Expense					EBITDA	Financing Costs			Results			
Yr	Retail Revenue	Resale Revenue	*Ancillary Revenue*	REC Revenue	Federal Tax Grant (8)	Other Grants/Inc.	*Gross Revenue*	O&M	Insurance	Land Costs	Mgt	Other Exp. (Down Pmt.)	*Net Rev.*	Loan Interest	Loan Principal	Tot. Pmts. (CMLTD)	*Net Cash after CMLTD*	*Cum Net Cash Flow*	DCS w/RECs	
0			*(see breakout)*									0					*0*	*0*		
1	159,445	0	*0*	9,163	0	0	*168,608*	-17,000	-7,500	0	0		*144,108*	-54,113	-84,734	-138,846	*5,262*	*5,262*	1.04	
2	163,399	0	*0*	9,255			*172,654*	-17,170	-7,575	0	0		*147,909*	-51,994	-86,852	-138,846	*9,063*	*14,325*	1.07	
3	167,451	0	*0*	9,348			*176,799*	-17,342	-7,651	0	0		*151,807*	-49,823	-89,024	-138,846	*12,960*	*27,285*	1.09	
4	171,604	0	*0*	9,441			*181,045*	-17,515	-7,727	0	0		*155,803*	-47,597	-91,249	-138,846	*16,956*	*44,241*	1.12	
5	175,860	0	*0*	9,536			*185,395*	-17,690	-7,805	0	0		*159,901*	-45,316	-93,530	-138,846	*21,054*	*65,295*	1.15	
6	180,221	0	*0*	9,631			*189,852*	-17,867	-7,883	0	0		*164,102*	-42,978	-95,869	-138,846	*25,256*	*90,551*	1.18	
7	184,691	0	*0*	9,727			*194,418*	-18,046	-7,961	0	0		*168,411*	-40,581	-98,265	-138,846	*29,564*	*120,116*	1.21	
8	189,271	0	*0*	9,825			*199,096*	-18,226	-8,041	0	0		*172,828*	-38,124	-100,722	-138,846	*33,982*	*154,097*	1.24	
9	193,965	0	*0*	9,923			*203,888*	-18,409	-8,121	0	0		*177,358*	-35,606	-103,240	-138,846	*38,511*	*192,609*	1.28	
10	198,775	0	*0*	10,022			*208,797*	-18,593	-8,203	0	0		*182,002*	-33,025	-105,821	-138,846	*43,156*	*235,764*	1.31	
11	203,705	0	*0*	10,122			*213,827*	-18,779	-8,285	0	0		*186,764*	-30,380	-108,467	-138,846	*47,917*	*283,682*	1.35	1.27
12	208,757	0	*0*	10,223			*218,980*	-18,966	-8,368	0	0		*191,646*	-27,668	-111,178	-138,846	*52,800*	*336,481*	1.38	1.31
13	213,934	0	*0*	10,326			*224,260*	-19,156	-8,451	0	0		*196,652*	-24,889	-113,958	-138,846	*57,806*	*394,287*	1.42	1.34
14	219,240	0	*0*	10,429			*229,668*	-19,348	-8,536	0	0		*201,785*	-22,040	-116,807	-138,846	*62,939*	*457,226*	1.45	1.38
15	224,677	0	*0*	10,533			*235,210*	-19,541	-8,621	0	0		*207,048*	-19,120	-119,727	-138,846	*68,201*	*525,427*	1.49	1.42
16	230,249	0	*0*	10,639			*240,887*	-19,736	-8,707	0	0		*212,443*	-16,126	-122,720	-138,846	*73,597*	*599,024*	1.53	1.45
17	235,959	0	*0*	10,745			*246,704*	-19,934	-8,794	0	0		*217,976*	-13,058	-125,788	-138,846	*79,129*	*678,154*	1.57	1.49
18	241,811	0	*0*	10,852			*252,663*	-20,133	-8,882	0	0		*223,648*	-9,914	-128,933	-138,846	*84,801*	*762,955*	1.61	1.53
19	247,808	0	*0*	10,961			*258,768*	-20,335	-8,971	0	0		*229,463*	-6,690	-132,156	-138,846	*90,616*	*853,571*	1.65	1.57
20	253,953	0	*0*	11,070			*265,024*	-20,538	-9,061	0	0		*235,425*	-3,386	-135,460	-138,846	*96,579*	*950,149*	1.70	1.62
21	260,251	0	*0*	11,181			*271,432*	-20,743	-9,151	0	0		*241,538*	0	0	0	*241,538*	*1,191,687*		
22	266,705	0	*0*	11,293			*277,998*	-20,951	-9,243	0	0		*247,805*	0	0	0	*247,805*	*1,439,492*		
23	273,320	0	*0*	11,406			*284,726*	-21,160	-9,335	0	0		*254,230*	0	0	0	*254,230*	*1,693,722*		
24	280,098	0	*0*	11,520			*291,618*	-21,372	-9,429	0	0		*260,818*	0	0	0	*260,818*	*1,954,540*		
25	287,044	0	*0*	11,635			*298,680*	-21,585	-9,523	0	0		*267,571*	0	0	0	*267,571*	*2,222,111*		
	5,432,192		*0*	*258,806*	*0*	*0*	*5,690,998*	*-480,134*	*-211,824*	*0*	*0*	*0*	*4,999,040*	*-612,429*	*-2,164,500*	*-2,776,929*	*2,222,111*			

Ownership and Tax Implications - Operating Company View

Company: *Piney Reservoir Dam* ***Based on P-50***

Corporate View

Year	Revenue From Proforma (P50) Net Elect Revenue	Other Revenue	Less Recap. Fund Contrib.	*Total Net Revenue to Distribute*	Tax Credit and Deduction Pass Throughs Depreciation Amount	Depreciation Value	Fed. PTC/ITC Credits	State Tax Credits	Other Credits	*Total Dep. & Crs. Available*	Taxes Incurred Property Tax or PILOT	Fed & ST Taxes Owed	Cum. F&S Tax Carry Forward
0			0								IN EXPENSES!!!		
1	5,262		0	5,262	389,610	0	0			0	0	$ -	$ -
2	9,063		0	9,063	623,376	0	FALSE			0	0	$ -	$ -
3	12,960		0	12,960	374,026	0	FALSE			0	0	$ -	$ -
4	16,956		0	16,956	224,415	0	FALSE			0	0	$ -	$ -
5	21,054		0	21,054	224,415	0	FALSE			0	0	$ -	$ -
6	25,256		0	25,256	112,208	0	FALSE			0	0	$ -	$ -
7	29,564		0	29,564	0	0	FALSE			0	0	$ -	$ -
8	33,982		0	33,982	0	0	FALSE			0	0	$ -	$ -
9	38,511		0	38,511	0	0	FALSE			0	0	$ -	$ -
10	43,156		0	43,156	0	0	FALSE			0	0	$ -	$ -
11	47,917		0	47,917	0	0				0	0	$ -	$ -
12	52,800		0	52,800	0	0				0	0	$ -	$ -
13	57,806		0	57,806	0	0				0	0	$ -	$ -
14	62,939		0	62,939	0	0				0	0	$ -	$ -
15	68,201		0	68,201	0	0				0	0	$ -	$ -
16	73,597		0	73,597	0	0				0	0	$ -	$ -
17	79,129		0	79,129	0	0				0	0	$ -	$ -
18	84,801		0	84,801	0	0				0	0	$ -	$ -
19	90,616		0	90,616	0	0				0	0	$ -	$ -
20	96,579		0	96,579	0	0				0	0	$ -	$ -
21	241,538		0	241,538		0				0	0	$ -	$ -
22	247,805		0	247,805		0				0	0	$ -	$ -
23	254,230		0	254,230		0				0	0	$ -	$ -
24	260,818		0	260,818		0				0	0	$ -	$ -
25	267,571		0	267,571		0				0	0	$ -	$ -
Totals	2,222,111	0	0	2,222,111	1,948,050	0	0	0	0	0	0		$ -

Appendix G

Environmental/Cultural Issues

A review of any potentially sensitive areas was undertaken using the State of Maryland's Department of Natural Resources on-line MERLIN system. The following results were identified for the parcel in general and the turbine site specifically:

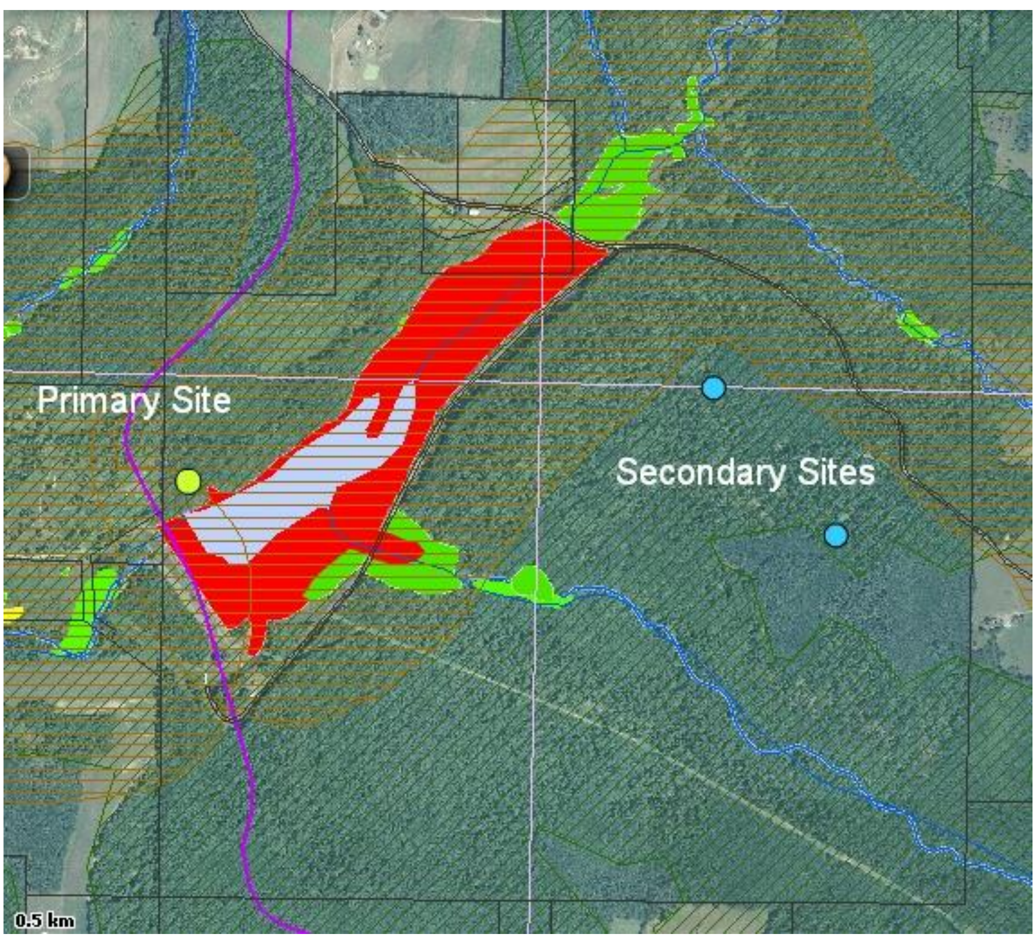
Environmental and Cultural Issues from MERLIN System

Issue	Parcel	Primary Site	Secondary Sites
Tributary Strategy Basins	None	None	None
Historic Shorelines	None	None	None
Shellfish	None	None	None
Living Resources	Positive – not considered problematic	Positive – not considered problematic	None
Sea Level Rise Vulnerability	None	None	None
Recreation	None	None	None
Hydrology	Positive – reservoir surface area	None	None
Submerged Aquatic Vegetation	None	None	None
Wetlands – DNR	Positive – reservoir perimeter	None	None
Wetlands of Special State Concern	None	None	None
Wetlands – NWI	Positive – reservoir surface area	None	None
Critical Areas	None	None	None
Protected Lands – DNR Program	None	None	None
Coastal and Estuarine Land Conservation Program	None	None	None
Forest Conservation Easements - Local	None	None	None
Permanently Preserved Agricultural Lands	None	None	None
County Lands	None	None	None
Private Conservation Lands	None	None	None
Federal Lands	None	None	None

Green Infrastructure Hubs and Corridors	Positive – not considered problematic	Positive – not considered problematic	Positive – not considered problematic
DNR Focal Areas	Positive – not considered problematic	Positive – not considered problematic	Positive – not considered problematic
National Register of Historic Places	None	None	None
MD Inventory of Historic Properties	None	None	None
MHT Preservation Easements	None	None	None
Designated Areas	None	None	None
Main Street Areas	None	None	None

Figure 2 – MERLIN Site Map

The following map depicts all issues shown above with the exception of the DNR Focal Area, which is not shown for clarity.



Current and Historical Rare, Threatened, and Endangered Species Of Garrett County, Maryland*

April 2010

Maryland Department of Natural Resources
Wildlife and Heritage Service

Scientific Name	Common Name	Global Rank	State Rank	State Status	Federal Status
Animals					
Accipiter gentilis	Northern Goshawk	G5	S1B	E	
Accipiter striatus	Sharp-shinned Hawk	G5	S1S2B		
Aegolius acadicus	Northern Saw-whet Owl	G5	S1B		
Aeshna canadensis	Canada Darner	G5	S2		
Aeshna tuberculifera	Black-tipped Darner	G4	S2		
Aimophila aestivalis	Bachman's Sparrow	G3	SHB	X	
Amblyscirtes hegon	Pepper and Salt Skipper	G4	S2	I	
Ammodramus henslowii	Henslow's Sparrow	G4	S1S2B	T	
Aneides aeneus	Green Salamander	G3G4	S2	E	
Apalone spinifera	Eastern Spiny Softshell	G5	S1	I	
Apamea mixta	A Noctuid Moth	GU	S1		
Arrhopalites sp. 1	Crabtree Cave Springtail	GNR	SU		
Bartramia longicauda	Upland Sandpiper	G5	S1B	E	
Boyeria grafiana	Ocellated Darner	G5	S1		
Caecidotea franzi	Franz's Cave Isopod	G2G4	S1	E	
Caecidotea sp. 1	An Isopod	G1	S1		
Caecidotea sp. 5	John Friend Cave Isopod	GNR	S1		
Caecidotea sp. 6	An Isopod	GNR	S2		
Callophrys irus	Frosted Elfin	G3	S1	E	
Calopteryx amata	Superb Jewelwing	G4	S1S2	T	
Catostomus catostomus	Longnose Sucker	G5	SH	X	
Chlosyne harrisii	Harris's Checkerspot	G4	S2	T	
Cicindela patruela	Green-patterned Tiger Beetle	G3	S1	E	
Circus cyaneus	Northern Harrier	G5	S2B		
Cistothorus platensis	Sedge Wren	G5	S1B	E	
Clinostomus elongatus	Redside Dace	G3G4	SX?		
Colias interior	Pink-edged Sulphur	G5	S1		
Contopus cooperi	Olive-sided Flycatcher	G4	SHB	E	
Cordulegaster obliqua	Arrowhead Spiketail	G4	S2		
Cryptobranchus alleganiensis	Eastern Hellbender	G3G4	S1	E	
Dactylocythere scotos	An Entocytherid Ostracod	GNR	S1		
Dendroica fusca	Blackburnian Warbler	G5	S1S2B	T	
Discus catskillensis	Angular Disc	G5	S1		
Empidonax alnorum	Alder Flycatcher	G5	S2B	I	
Enallagma annexum	Northern Bluet	G5	S1		
Enallagma antennatum	Rainbow Bluet	G5	S1		
Erethizon dorsatum	Porcupine	G5	S1S2	I	
Erora laeta	Early Hairstreak	GU	S1	E	
Euchloe olympia	Olympia Marble	G4G5	S2	I	
Eumeces anthracinus	Northern Coal Skink	G5	S1	E	
Euphyes bimacula	Two-spotted Skipper	G4	S1	E	
Fontigens bottimeri	Appalachian Spring Snail	G2	S2		
Gomphus rogersi	Sable Clubtail	G4	S2	I	
Haliaeetus leucocephalus	Bald Eagle	G5	S3B		

Ixobrychus exilis	Least Bittern	G5	S2S3B	I	
Junco hyemalis	Dark-eyed Junco	G5	S2B		
Lanthus parvulus	Northern Pygmy Clubtail	G4	S2		
Lanthus vernalis	Southern Pygmy Clubtail	G4	S2		
Lepus americanus	Snowshoe Hare	G5	SH	X	
Leucorrhinia glacialis	Crimson-ringed Whiteface	G5	S1		
Leucorrhinia hudsonica	Hudsonian Whiteface	G5	S1		
Lophodytes cucullatus	Hooded Merganser	G5	S1B		
Lycaena epixanthe	Bog Copper	G4G5	S1	E	
Microtus chrotorrhinus carolinensis	Southern Rock Vole	G4T3	S1	E	
Mustela nivalis	Least Weasel	G5	S2S3	I	
Myotis leibii	Eastern Small-footed Bat	G3	S1	E	
Myotis sodalis	Indiana Bat	G2	S1	E	LE
Necturus maculosus	Common Mudpuppy	G5	S1	X	
Neotoma magister	Allegheny Woodrat	G3G4	S1	E	
Noturus flavus	Stonecat	G5	S1	E	
Nymphalis vaualbum	Compton Tortoiseshell	G5	S1B	E	
Oporornis philadelphia	Mourning Warbler	G5	S1B	E	
Pararhinichthys bowersi	Cheat Minnow	G1G2Q	SX	X	
Planaria dactyligera	A Planarian	GNR	S2		
Plethodon wehrlei	Wehrle's Salamander	G4	S2	I	
Porzana carolina	Sora	G5	S1B		
Procotyla typhlops	A Planarian	G1G2	S1	E	
Pseudacris brachyphona	Mountain Chorus Frog	G5	S1	E	
Pseudanophthalmus sp. 15	Maryland Cave Beetle	G1	S1		
Regulus satrapa	Golden-crowned Kinglet	G5	S2B		
Rhionaeschna mutata	Spring Blue Darner	G4	S1	E	
Sitta canadensis	Red-breasted Nuthatch	G5	S1B		
Somatochlora elongata	Ski-tailed Emerald	G5	S2		
Sorex dispar	Long-tailed Shrew	G4	S2	I	
Sorex fumeus	Smoky Shrew	G5	S2S3	I	
Sorex palustris punctulatus	Southern Water Shrew	G5T3	S1	E	
Speyeria atlantis	Atlantis Fritillary	G5	S1	T	
Spilogale putorius	Eastern Spotted Skunk	G5	S1		
Strophitus undulatus	Creeper	G5	S2	I	
Stygobromus allegheniensis	Allegheny Cave Amphipod	G5	S2S3	I	
Stygobromus emarginatus	Greenbrier Cave Amphipod	G3	S1	E	
Stygobromus franzi	Franz's Cave Amphipod	G3G4	S2S3	I	
Stygobromus sp. 5	Barrelville Amphipod	GNR	S1		
Stylurus scudderi	Zebra Clubtail	G4	S1		
Sylvilagus obscurus	Appalachian Cottontail	G4	S1	I	
Thryomanes bewickii altus	Bewick's Wren	G5T2Q	S1B	E	
Triodopsis picea	Spruce Knob Threetooth	G3	S1		
Troglodytes troglodytes	Winter Wren	G5	S2B		
Vermivora ruficapilla	Nashville Warbler	G5	S1S2B	I	
Virginia valeriae pulchra	Mountain Earthsnake	G5T3T4	S1S2	E	
Webbhelix multilineata	Striped Whitelip	G5	S1		

Plants

Abies balsamea	Balsam Fir	G5	S1	
Aconitum uncinatum	Blue Monkshood	G4	S1	E
Actaea podocarpa	American Bugbane	G4	S2	
Adlumia fungosa	Climbing Fumitory	G4	S2	T
Ampelopsis cordata	Heartleaf Peppervine	G5	SU	
Angelica triquinata	Filmy Angelica	G4	S1	E
Aralia hispida	Bristly Sarsaparilla	G5	S1	E

Aristolochia macrophylla	Pipevine	G5	S1	T
Botrychium oneidense	Blunt-lobe Grape-fern	G4Q	S1	E
Bromus ciliatus	Fringed Brome	G5	S1?	
Bromus kalmii	Wild Chess	G5	S1	E
Calla palustris	Wild Calla	G5	S1	E
Calopogon tuberosus	Grass-pink	G5	S1	E
Calystegia spithamaea	Low Bindweed	G4G5	S2	
Campanula divaricata	Southern Harebell	G4	SU	X
Carex aestivalis	Summer Sedge	G4	S1	E
Carex appalachica	Appalachian Sedge	G4	S1?	
Carex buxbaumii	Buxbaum's Sedge	G5	S2	T
Carex careyana	Carey's Sedge	G4G5	S1	E
Carex diandra	Lesser Panicled Sedge	G5	S1	E
Carex haydenii	Cloud Sedge	G5	S1	E
Carex lacustris	Lake-bank Sedge	G5	S2	
Carex pedunculata	Long-stalked Sedge	G5	S1	E
Carex plantaginea	Plantain-leaved Sedge	G5	S1?	
Carex projecta	Necklace Sedge	G5	S2	
Carex tuckermanii	Tuckerman Sedge	G4	S1	E
Carex vesicaria	Inflated Sedge	G5	S1	T
Castilleja coccinea	Indian Paintbrush	G5	S1	E
Chenopodium gigantospermum	Maple-leaved Goosefoot	G5	S1	E
Clematis occidentalis	Purple Clematis	G5	S1	E
Clintonia alleghaniensis	Harned's Swamp Clintonia	G1Q	S1	
Clintonia borealis	Yellow Clintonia	G5	S2	T
Coeloglossum viride	Long-bracted Orchis	G5	S1	E
Coptis trifolia	Goldthread	G5	S1	E
Corallorhiza trifida	Early Coralroot	G5	S1	E
Cornus canadensis	Bunchberry	G5	S1	E
Cornus rugosa	Round-leaved Dogwood	G5	S1	E
Cuscuta coryli	Hazel Dodder	G5?	SH	X
Cuscuta rostrata	Beaked Dodder	G4	S1	E
Cymophyllus fraserianus	Fraser's Sedge	G4	S1	E
Desmodium rigidum	Rigid Tick-trefoil	GNRQ	S1	E
Dicentra eximia	Wild Bleeding-heart	G4	S2	T
Diplazium pycnocarpon	Glade Fern	G5	S2	T
Dirca palustris	Leatherwood	G4	S2	T
Dryopteris campyloptera	Mountain Wood-fern	G5	S1	E
Epilobium leptophyllum	Linear-leaved Willowherb	G5	S2S3	
Epilobium strictum	Downy Willowherb	G5?	S1	E
Equisetum sylvaticum	Wood Horsetail	G5	S1	E
Erigeron pulchellus var. brauniae	Lucy Braun's Robin Plantain	G5T4	S1	
Eupatorium maculatum	Spotted Joe-pye-weed	G5	SU	X
Eurybia radula	Rough-leaved Aster	G5	S1	E
Festuca paradoxa	Cluster Fescue	G5	SU	X
Galium boreale	Northern Bedstraw	G5	S1	E
Gaultheria hispidula	Creeping Snowberry	G5	S1	E
Gentiana andrewsii	Fringe-tip Closed Gentian	G5?	S2	T
Gentiana puberulenta	Downy Gentian	G4G5	SH	X
Gentianella quinquefolia	Stiff Gentian	G5	S1	E
Geum aleppicum	Yellow Avens	G5	S1	E
Glyceria grandis	American Mannagrass	G5	S1	E
Gymnocarpium dryopteris	Oak Fern	G5	S1	E
Gymnocladus dioicus	Kentucky Coffee-tree	G5	S1	
Hasteola suaveolens	Sweet-scented Indian-plantain	G4	S1	E
Huperzia porophila	Rock Clubmoss	G4	SX	
Hydrastis canadensis	Goldenseal	G4	S2	T

Hypericum adpressum	Creeping St. John's-wort	G3	S1	E
Juglans cinerea	Butternut	G4	S2S3	
Juncus articulatus	Jointed Rush	G5	S1	
Juncus brachycephalus	Small-headed Rush	G5	SH	X
Juncus brevicaudatus	Narrow-panicled Rush	G5	S2	
Larix laricina	Larch	G5	S1	E
Ligusticum canadense	American Lovage	G4	SH	X
Lilium philadelphicum	Wood Lily	G5	SH	X
Listera cordata	Heartleaf Twayblade	G5	SH	X
Listera smallii	Appalachian Twayblade	G4	S1	E
Lonicera canadensis	Canada Honeysuckle	G5	S1	E
Lycopodiella inundata	Bog Clubmoss	G5	S2	
Marshallia grandiflora	Barbara's Buttons	G2	SU	X
Matteuccia struthiopteris	Ostrich Fern	G5	S2	
Menyanthes trifoliata	Buckbean	G5	S1	E
Moehringia lateriflora	Grove Sandwort	G5	S1	E
Oligoneuron rigidum	Hard-leaved Goldenrod	G5	SH	X
Oryzopsis asperifolia	White-fruited Mountainrice	G5	S2	T
Oxydendrum arboreum	Sourwood	G5	S1	E
Pedicularis lanceolata	Swamp Lousewort	G5	S1	E
Phegopteris connectilis	Northern Beech Fern	G5	S2	
Piptatherum racemosum	Black-fruited Mountainrice	G5	S2	T
Platanthera flava	Pale Green Orchid	G4	S2	
Platanthera grandiflora	Large Purple Fringed Orchid	G5	S2	T
Platanthera peramoena	Purple Fringeless Orchid	G5	S1	T
Platanthera psycodes	Small Purple Fringed Orchid	G5	SH	X
Poa alsodes	Grove Meadow-grass	G4G5	S2	
Poa saltuensis	Drooping Bluegrass	G5	S1	E
Polemonium vanbruntiae	Jacob's-ladder	G3G4	S2	T
Porteranthus stipulatus	American Ipecac	G5	SH	X
Pycnanthemum verticillatum	Whorled Mountain-mint	G5	S1	E
Pycnanthemum virginianum	Virginia Mountain-mint	G5	S2	
Rhododendron calendulaceum	Flame Azalea	G5	S1	
Rosa blanda	Smooth Rose	G5	S1	E
Salix discolor	Pussy Willow	G5	SU	
Salix exigua	Sandbar Willow	G5	S1	E
Salix humilis var. tristis	Dwarf Prairie Willow	G4G5	S1	
Sanguisorba canadensis	Canada Burnet	G5	S2	T
Sarracenia purpurea	Northern Pitcher-plant	G5	S2	T
Schizachne purpurascens	Purple Oat	G5	S1	E
Scutellaria galericulata	Common Skullcap	G5	S1	
Solidago curtisii	Curtis' Goldenrod	G4G5	S1	E
Solidago roanensis	Mountain Goldenrod	G4G5	S1?	E
Solidago speciosa	Showy Goldenrod	G5	S2	T
Spiranthes lucida	Wide-leaved Ladys' Tresses	G5	S1	E
Spiranthes ochroleuca	Yellow Nodding Ladys' Tresses	G4	S1	E
Streptopus roseus	Rose Twisted-stalk	G5	S1S2	T
Symphyotrichum drummondii	Drummond Aster	G5	S1	
Symphyotrichum praealtum	Willow Aster	G5	S1	
Taxus canadensis	American Yew	G5	S2	T
Thaspium trifoliatum	Purple Meadow-parsnip	G5	S1	E
Thelypteris simulata	Bog Fern	G4G5	S2	T
Trillium nivale	Snow Trillium	G4	S1	E
Triosteum angustifolium	Narrow-leaved Horse-gentian	G5	S1	E
Uvularia grandiflora	Large-flowered Bellwort	G5	S1	
Vaccinium oxycoccos	Small Cranberry	G5	S2	T
Valerianella chenopodiifolia	Goose-foot Cornsalad	G5	S1	E
Viburnum lentago	Nannyberry	G5	S1	
Viola appalachiensis	Appalachian Blue Violet	G3	S2	

* This report represents a compilation of information in the Wildlife and Heritage Service's Biological and Conservation Data system as of the date on the report. It does not include species considered to be "watchlist" or more common species.

Appendix H

Cited Regulations

State of Maryland Noise Regulations

The following is an excerpt from COMAR 26.02.03.

The entire section on noise regulation for the state may be found at:
http://www.dsd.state.md.us/comar/SubtitleSearch.aspx?search=26.02.03

Section .02 Environmental Noise Standards.

A. Precepts.

(1) It is known that noise above certain levels is harmful to the health of humans. Although precise levels at which all adverse health effects occur have not definitely been ascertained, it is known that one's well-being can be affected by noise through loss of sleep, speech interference, hearing impairment, and a variety of other psychological and physiological factors. The establishment of ambient noise standards, or goals, must provide margins of safety in reaching conclusions based on available data which relate noise exposure to health and welfare effects, with due consideration to technical and economic factors.

(2) The environmental noise standards set forth here represent goals expressed in terms of equivalent A-weighted sound levels which are protective of the public health and welfare. The ambient noise levels shall be achieved through application, under provisions of laws or regulations or otherwise, of means for reducing noise levels including, but not limited to, isolation of noise producing equipment, dampening of sound waves by insulation, equipment modification and redesign, and land use management.

B. Standards for Environmental Noise — General.

(1) A person may not cause or permit noise levels which exceed those specified in this table except as provided in §B(2) or (3), or §C, of this regulation.

Table 1 Maximum Allowable Noise Levels (dBA) for Receiving Land Use Categories			
Day/Night	Industrial	Commercial	Residential
Day	75	67	65
Night	75	62	55

(2) A person may not cause or permit noise levels emanating from construction or demolition site activities which exceed:

(a) 90 dBA during daytime hours;

(b) The levels specified in Table 1 during nighttime hours.

(3) A person may not cause or permit the emission of prominent discrete tones and periodic noises which exceed a level which is 5 dBA lower than the applicable level listed in Table 1.

(4) A person may not cause or permit, beyond the property line of a source, vibration of sufficient intensity to cause another person to be aware of the vibration by such direct means as sensation of touch or visual observation of moving objects. The observer shall be located at or within the property line of the receiving property when vibration determinations are made.

(5) A person may not operate or permit to be operated an off-road internal combustion engine powered recreational vehicle, including, but not limited to, a dirt bike, an all terrain vehicle, a go cart, a snowmobile, or a similar vehicle, on private property closer than 300 feet to a neighboring residence or the associated curtilage, without the written permission of the affected resident, unless it can be demonstrated to the Department that the vehicle can be operated within the noise limits specified in Table 1 under §B(1) of this regulation.

C. Exemptions.

(1) The provisions of this regulation may not apply to devices used solely for the purpose of warning, protecting, or alerting the public, or some segment thereof, of the existence of an emergency or hazardous situation.

(2) The provisions of this regulation do not apply to the following:

(a) Household tools and portable appliances in normal usage during daytime hours;

(b) Lawn care and snow removal equipment (daytime only) when used and maintained in accordance with the manufacturer's specifications;

(c) Agricultural field machinery when used and maintained in accordance with manufacturer's specifications;

(d) Blasting operations for demolition, construction, and mining or quarrying (daytime only);

(e) Motor vehicles on public roads;

(f) Aircraft and related airport operations at airports licensed by the Maryland Aviation Administration;

(g) Boats on State waters or motor vehicles on State lands under the jurisdiction of the Department of Natural Resources;

(h) Emergency operations;

(i) Pile driving equipment during the daytime hours of 8 a.m. to 5 p.m.;

(j) Sound except those sounds that are electronically amplified, between 7 a.m. and midnight, created by:

(i) Sporting events (except trap shooting, skeet shooting, or other target shooting);

(ii) Entertainment events; and

(iii) Other public gatherings operating under permit or permission of the appropriate local jurisdiction;

(k) Rapid rail transit vehicles and railroads;

(l) Construction and repair work on public property;

(m) Air conditioning or heat pump equipment used to cool or heat housing on residential property; for this equipment, a person may not cause or permit noise levels which exceed 70 dBA for air conditioning equipment at receiving residential property and 75 dBA for heat pump equipment at receiving residential property;

(n) Household pets on residential property that are maintained in accordance with local zoning requirements;

(o) Except in Allegany, Anne Arundel, Baltimore City, Calvert, Charles, Garrett, Howard, Montgomery, St. Mary's, and Washington Counties, trap shooting, skeet shooting, or other target shooting between the hours of 9 a.m. and 10 p.m. on any range or other property of a shooting sports club that is chartered and in operation as of January 1, 2001;

(p) Trash collection operations between the hours of 7 a.m. and 10 p.m.

(q) Marina equipment used to move boats during the period from 7 am to 7 pm provided that the noise level does not exceed 80 dBA at 20 meters from the equipment.

(3) The events and gatherings under §B(2)(j) of this regulation include, but are not limited to, athletic contests, amusement parks, carnivals, fairs at fairgrounds, sanctioned auto racing facilities, parades, and public celebrations.

(4) In Frederick County or Frederick City, a fair listed in the Maryland agricultural fairs and shows schedule that is maintained by the Maryland Agricultural Fair Board, or any other event held on the same grounds and listed by the Agricultural Fair Board, is exempt from this chapter.

D. Measurement.

(1) The equipment and techniques employed in the measurement of noise levels may be those recommended by the Department, which may, but need not, refer to currently accepted standards or recognized organizations, including, but not limited to, the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), Society of Automotive Engineers (SAE), International Electrotechnical Commission (IEC) and the United States Environmental Protection Agency (EPA).

(2) The measurement of noise levels shall be conducted at points on or within the property line of the receiving property or the boundary of a zoning district, and may be conducted at any point for the determination of identity in multiple source situations.

(3) Sound level meters used to determine compliance with Regulation .02 shall meet or exceed the specifications for Type II sound level meters.

321.06.1.d Guy wires as may support any WES shall be set back at least five (5) feet from all lot lines and shall be secured to stationary anchors properly and securely attached to the ground and may not be attached to a tree or a structure. Reflective material shall be placed on all guy wires within ten (10) feet of the ground in sufficient quantity and spacing to make the wires visible.

321.06.1.e The WES shall be designed with braking, governing, or feathering systems to prevent uncontrolled rotation, over-speeding, and excessive pressure on the components. This standard may be met by providing evidence of review and approval of the proposed WES by the Small Wind Certification Council (SWCC) or any other WES certification program recognized by the State of Maryland.

321.06.1.f Any and all exterior electric wiring required to connect the WES to the electric power grid must be placed in underground conduit.

321.06.1.g The WES shall not include lighting or illumination of any kind unless required by Federal Aviation Administration (FAA) regulations.

321.06.1.h No WES shall contain any lettering, advertisement, or signage of any kind except one (1) manufacturer's label bonded to or painted upon the structure and standard warning signage placed by the manufacturer.

321.06.1.i The WES shall be designed so that noise levels shall not exceed 55 dBA at the closest point from the WES structure to any point on a property line of the lot on which the WES is proposed as evidenced by a manufacturer's noise rating provided with the application.

321.06.1.j The WES shall contain a surface coating of non-reflective paint and shall not alter the manufacturer's default color.

321.06.1.k A site plan and drawings must accompany any permit application for a WES that includes the following:

i. Signature of a licensed engineer indicating compliance with all applicable Federal, State, and local government requirements, including FAA regulations.

ii. An engineer's certification that the WES has been designed to be in compliance with all applicable structural and electrical codes, and that the installation as shown on the site plan will not compromise the structural integrity of the tower or other WES components.

iii. The property owner's certification affirming that the WES shall:
   a. be constructed in accordance with the design specifications;
   b. be maintained in good operating condition in compliance with manufacturer's recommended maintenance specifications and applicable government regulations for structural, electrical, and mechanical components and maintenance of the 55 dBA maximum noise standard; and

c. be deconstructed and removed if and when the WES becomes inoperable for a period of at least six (6) consecutive months upon proper notice from the City, with the turbine to be removed within 30 days of proper notice and the balance of the structure removed within 180 days of proper notice, including in said certification prior advance consent for the City or the City's agent to inspect the WES with proper notice for evidence of abandonment; and consent for the City to request from the owner electric usage data necessary to demonstrate whether the WES is or has been in operation which data will not be unreasonably withheld.

iv. Any WES to be connected to the electric power grid must contain a certification signed by the property owner agreeing to comply with all applicable utility notification requirements as contained in the State of Maryland's net metering regulations and with the Small Generator Interconnection Rule as promulgated by the Maryland Public Service Commission."

Add a new sub-section to Section 303, Height Limits, as follows:

"303.03, Wind Energy Systems: Notwithstanding permissive language for manufacturing processes included in Section 303.02d, height limits for Wind Energy Systems as defined herein shall be governed by regulations found in Section 321 of this ordinance; shall in no case exceed 75 feet in height unless a variance is granted pursuant to Section 115.03.4 of this ordinance; and shall be governed by setbacks as set forth in said Section 321."

Introduced: July 16, 2009; AS REVISED: September 17, 2009
Second Hearing: August 20, 2009; AS REVISED: October 15, 2009
Adopted: October 15, 2009
Effective: November 4, 2009

MAYOR AND CITY COUNCIL OF FROSTBURG

BY [signature]
Arthur T. Bond, Mayor

Attest: [signature]
John R. Kirby, Jr.
City Administrator

Potomac Edison Net Metering Tariff

The following was obtained from Potomac Edison Web site 4/15/13 - https://www.firstenergycorp.com/content/dam/customer/Customer%20Choice/Files/maryland/tariffs/PotomacEdisonRetailTariff.pdf)

THE POTOMAC EDISON COMPANY Electric P. S. C. Md. No. 53

Fifth Revision of

Original Page No. 28

Canceling

Fourth Revision of

Original Page No. 28

NET ENERGY METERING RIDER

AVAILABILITY

This Rider is available to all Customers who own and operate a biomass, solar, fuel cell, wind, or closed conduit hydro electrical generating facility that has a capacity of not more than 2,000 kilowatts or a micro combined heat and power electric generating facility not exceeding 30 kilowatts, where such generating facility is connected for parallel operation with the service of the Company, and where such generating facility is located on the Customer's premises or contiguous property and is intended to offset part or all of the Customer's electrical requirements.

Terms and conditions for net excess generation by the Customer to the Company are included herein for reference only. The Customer may alternatively select other options to operate in parallel and sell power under terms of the Company's Schedule "CO-G".

In accordance with the Annotated Code of Maryland, Public Utility Companies, Section 7-306, Net energy metering, this Rider will be available to eligible Customers on a first-come, first-served basis until the rated generating capacity owned and operated by eligible Customers in the State reaches 1,500 MW.

RATES

A Customer receiving service under this Rider is subject to the identical energy, capacity, and reactive charges, rate structure, and monthly charges and minimum charges that would be assigned if the Customer were not an eligible customer-generator.

This Rider provides no adjustment to the demand billing determinant or capacity charge that a Customer eligible for service under this Rider may be subject to.

The Company shall provide metering that is capable of measuring the flow of electricity in two directions at no additional cost to Customers qualified to receive service under this Rider. The Customer shall pay the differential cost between any additional metering requested and the metering normally provided by the Company to Customers who do not receive service under this Rider. An eligible Customer-generator or the eligible Customer-generator assignee shall own and have title to all renewable energy attributes or renewable energy credits associated with any electricity produced by its electric generating system.

The Customer shall pay for any changes to the Company's distribution system made necessary by the connection of the Customer's equipment. This work will be performed by the Company at the Customer's expense and in the case of new facilities will include only the differential cost between those facilities required to serve the Customer-generator and a non-generating Customer.

SPECIAL CONDITIONS

1. Net Energy: Net Energy is the energy supplied by the Company minus the energy generated by the Customer, during a billing period, where, the energy generated by the Customer is that energy fed back into the Company's system at such times as Customer generation exceeds Customer requirements. Only if net energy is positive shall net energy charges be applied at the rates specified above except that the minimum charge will be applied in any case. If the calculation of net energy yields a negative result, all such negative net energy shall be considered net excess generation and shall be treated as stated in Special Condition No. 3 below. The components of net energy shall be determined by the use of metering capable of measuring the flow of electricity in two directions, to be provided by the Company at the same charge an eligible Customer would pay for a standard meter.

2. Net Excess Generation: Net excess generation occurs when the cumulative value of energy generated by the Customer exceeds the cumulative value of energy generated and supplied to the Customer by the Company during an entire billing period and is the amount by which the energy generated by the Customer and fed back into the Company's system exceeds the energy generated and supplied by the Company resulting in a negative kilowatt-hour reading at the end of the billing period. If electricity generated by the Customer exceeds the electricity supplied by the Company, the Customer shall be required to pay only Customer charges and minimum charges for that month, as required by the Rate Schedule under which the Customer is receiving service.

3. Billing and Billing Periods: The billing period to be used under this tariff shall be the customary billing period for ordinary residential or general service Rate Schedules. In any billing period where the energy generated and supplied by the Company exceeds the energy generated by the Customer, the Company will bill the Customer for

the Net Energy consumed per the terms of the Rate Schedule. In billing periods where the energy generated by the Customer exceeds the energy generated and supplied to the Customer by the Company, the Customer is required to pay only the Customer charges and minimums that the Customer would have otherwise paid under the applicable residential or general service Rate Schedule. Net excess generation will be carried forward until the Customer's consumption of electricity from the grid eliminates the net excess generation or the 12 month accrual period expires. The dollar value of net excess generation shall be equal to the generation or commodity portion of the rate that the Customer would have been charged by the Company averaged over the previous 12 month period ending with the billing cycle that is complete immediately prior to the end of April multiplied by the kilowatt-hours of net excess generation. For Customers served by an Electricity Supplier, the dollar value of the net excess generation shall be equal to the generation or commodity rate that the Customer would have been charged by the Electricity Supplier multiplied by the kilowatt-hours of net excess generation. Customers served by an Electricity Supplier are responsible for providing to the Company the commodity rate that would have been charged by the Electricity Supplier. Within 30 days after the billing cycle that is complete immediately prior to the end of April of each year, the Company shall pay each eligible Customer-generator for the dollar value of any accrued net excess generation remaining at the end of the previous 12 month period. Within 15 days that a Customer-generator closes their account, the Company shall pay the Customer-generator for the dollar value of any accrued net excess generation remaining at the time of the account closing.

4. Meter Accuracy: The metering supplied by the Company under this tariff shall be accurate to within ± 5% when registering in reverse, that is during those times when the energy generated by the Customer is greater than the energy generated by the Company. When the energy generated and supplied to the Customer by the Company is greater than the energy generated by the Customer, the meter must retain the ability to register consumption within the accuracy tolerances as specified in the applicable sections of the Annotated Code of Maryland and the

Code of Maryland Regulations.

5. Safety and Reliability: The design and installation of the Customer's generation must comply with all applicable laws and regulations and shall meet all applicable safety and performance standards established by the National Electric Code, The Institute of Electrical and Electronics Engineers and Underwriters Laboratory.

a. The Customer assumes sole responsibility to design and install its system for protection against faults or disturbances on the Company's system.

b. The Company shall have the right to inspect all the facilities and their operation, and to test all protective equipment, at any time that this Rider is in effect.

c. Customer generation must operate in parallel with Company generation. Customer must provide synchronizing equipment which will automatically isolate the Customer generation from the Company's system if the Company's circuit becomes de-energized or if the Customer should lose synchronization.

d. Parallel operation must cease immediately and automatically during electrical outages and other emergency or abnormal conditions as specified by the Company, or when maintenance on Company facilities is being performed and safety considerations require the de-energizing of the Customer. The Company is not liable for and accepts no responsibility whatsoever for any loss, cost, expense, damage or injury to any person or property resulting from the use or presence of electric current or voltage which originates from a Customer's generation facilities, or is caused by failure of the Customer to operate in compliance with Company requirements.

e. The Company may disconnect from the Customer's facilities in order that the Company can (1) construct, install, maintain, repair, replace, remove, investigate, or inspect any of its equipment or any part of its system; or (2) if the Company determines the curtailment, interruption or reduction of deliveries of energy or energy and capacity is necessary because of technical system emergencies including forced outages and operating conditions on its system, or as otherwise required by prudent electrical practices.

6. Periods During Which Purchases Are Not Required: The Company will not be required to receive energy or capacity during an electrical emergency or during periods of maintenance when safety considerations would require the de-energizing of facilities. Whenever possible the Company will notify the Customer by telephone, followed by written confirmation, of such circumstances.

7. General:

a. The Customer is solely responsible for the proper installation, operation, and maintenance of any equipment used, all costs, expense, pecuniary or other loss which may arise directly or indirectly from any act or omission of the Customer, its agents, servants, or employees.

b. Maintenance and operation of the generator and associated equipment will be the responsibility of the Customer.

c. Failure of the Customer to comply with any of the Company's provisions or requirements shall result in immediate disconnection from the Company's system and the Company will be under no obligation to reconnect the Customer’s service until, in the sole opinion of the Company, the Customer does comply.

ISSUED BY BRUCE E. WALENCZYK, VICE PRESIDENT

Issued March 7, 2002 To become effective on all bills rendered on or after April 10, 2002

Approved at Public Service Commission Administrative Meeting of April 10, 2002

Potomac Edison Net Energy Metering Virtual Meter Aggregation Tariff

The following was obtained from Potomac Edison Web site 4/15/13 - https://www.firstenergycorp.com/content/dam/customer/Customer%20Choice/Files/maryland/tariffs/PotomacEdisonRetailTariff.pdf)

THE POTOMAC EDISON COMPANY Electric P. S. C. Md. No. 53

First Revision of

Original Page No. 28-4

Canceling

Original Page No. 28-4

NET ENERGY METERING VIRTUAL METER AGGREGATION PILOT AND SERVICE

AVAILABILITY

This Pilot is available to any Customer who qualifies for service under the Net Energy Metering Rider of this tariff and where the eligible Customer-generator:

1. uses electrical service for

a. agriculture; or

b. a non-profit organization or business; or

c. a municipal government or its affiliated organizations; and

2. has up to twenty additional non-generating Customer meters (accounts) in the same name as the Customer generator and

3. has a generating facility that produces no more than 200% of the total Baseline Annual Usage of the meters to be aggregated, where Baseline Annual Usage is the total kilowatt-hours recorded in the twelve months immediately preceding the start of the Customer's participation in the Pilot. Baseline Annual Usage will be estimated based on a methodology that is mutually agreeable between the Company and the Customer in the event there is less than twelve months of historical meter data available.

This Pilot is available to a maximum of twenty eligible Customer-generators on a first-come, first-served basis. This Pilot shall terminate on December 1, 2013, at which point the Net Energy Metering Virtual Meter Aggregation Service will be available to all qualified customers.

SPECIAL CONDITIONS

1. Eligible Customer-generator shall provide a list of up to twenty additional Customer accounts to be aggregated.

All aggregated accounts must be established under the same legal entity as the Customer-generator account.

2. All aggregated accounts must have their meter read on the same meter reading cycle.

3. Net excess generation produced by the Customer-generator account, if any, will be applied each month as credit to the energy usage of the aggregated non-generator accounts in the order specified by the Customer.

4. Within sixty days after the date the Customer closes the account, the Company shall pay the Customer for the dollar value of any accrued Excess Generation remaining at the time the account is closed.

5. All other provisions of the Net Energy Metering Rider shall apply except as modified by this Pilot.

ISSUED BY CHARLES E. JONES, PRESIDENT

Issued November 1, 2012 To become effective on all bills rendered on or after December 1, 2012

Appendix I

Wind Turbines Useful For Community Wind Sites in Maryland

ASSOCIATED WIND DEVELOPERS

For the purpose of this project, the following turbines were considered as being applicable for Community Wind applications. These are certainly not the only wind turbines that are manufactured for this market sector, but these machines have been vetted and approved by qualified state-sponsored facilities and are generally considered suitable for grants and other funding requests.

Eligible Wind Turbines

Turbines of Less than 1MW –

For wind turbines to be qualified for incentives from NYSERDA, they must be reviewed and selected for their eligibility. The Interstate Turbine Advisory Council (ITAC), established under the Clean Energy States Alliance, has created a Unified List of Wind Turbines for turbines with a nameplate rating of less than or equal to 100 kW. PON 2439, the On-Site Wind Turbine Incentive Program, requires turbines of this size to be on the ITAC Unified List to be eligible for funding. The list below of turbines with a nameplate rating of less than 100 kW contains turbines that have been fully certified to the American Wind Energy Association's small wind turbine performance and safety standard.

For turbines with a nameplate rating of greater than 100 kW, PON 2439 provides requirements for eligibility and an Eligible Wind Turbine Application Form. Only commercially available wind turbines with a proven record of power performance, reliability, safety, and acoustics will be considered for funding. Turbines with a nameplate rating greater than two megawatts are not eligible for funding under PON 2439.

Turbines Applicable to Community Wind Projects

Turbines Eligible for Funding Through PON 2439 with a Nameplate Rating of ≤ 100 kW:

Small Wind Turbines:

Manufacturer	Model	Rotor Diameter (m)	kW Rating at 11 m/s	Rating at 5 m/s (kWh)
Bergey	Excel 10	7	8.9	13,800
Endurance	S343	6.4	5.4	8,910
Evance	R9000	5.5	4.6	9,167
Gaia	133	13.3	11	27,502
Seaforth	AOC 15-50	15	42	71,000
Wind Turbine Industries, Corp.	Jacobs 31-20	9.4	12	16,562
Xzeres	442SR	7.2	9.2	15,327

Turbines Eligible for Funding Through PON 2439 with a Nameplate Rating of ≤ 100 kW:

Medium Wind Turbines:

Manufacturer	Model	Rotor Diameter (m)	kW Rating at 11 m/s
Endurance	E-3120, 3-phase	19.2	54.8
Endurance	E-3120, single phase	19.2	48.3
Northern Power	NP 100-21	21	80

Turbines Eligible for Funding Through PON 2439 with a Nameplate Rating of >100 kW:

Manufacturer	Model	Rotor Diameter (m)	kW Rating at 11 m/s
225/250 Category			
ACSA	A27	27	181
Aeronautica	29-225	29	171
Vergnet	GEV MP	32	275
Vergnet	GEV	32	243
Wind Energy Solutions	WES 30	30	179
750/850 Category			
Aeronautica	47-750/660	47	549
Gamesa	G52-850	52	684.6
Gamesa	G58-850	58	798.4

Turbine Classes

For the purpose of this wind feasibility study project, machines larger than 225kW were subcategorized into classes of turbines. Each class of machine would have similar output to the results presented in the specific Feasibility Studies. When it came to modeling specific machines to calculate production output, shadow flicker, noise and other results the Aeronautica 225 and 750kW machines were used as models.

Turbines of over 1MW –

Because Community Wind projects may now be constructed of larger turbines, the following machines were considered representative of the type of machine that could be used at Community Wind sites. The list is NOT representative of all the turbines available in the market place, and a selection study should be conducted when any project is actually considered for construction.

Goldwind	1.5
Gamesa	2.0

Appendix J

Determination of Electricity Savings at the Site

ASSOCIATED
WIND DEVELOPERS

In order to evaluate the potential revenue (savings) of any wind project, we must first have a full understanding of how much the customer is paying for electricity, and therefore, how much can be saved.

The typical utility electric bill includes many charges, some of which are based on energy (Kilowatt-hour) usage and some of which are based on Power (Kilowatts, or Demand, or Capacity) usage.

Because wind energy is an intermittent energy source, it cannot be counted upon to reduce POWER charges, such as demand charges. Although in reality some of these charges are actually reduced, it becomes statistically inaccurate to try to predict the amount of savings from these charges, and such savings are therefore ignored.

Table 1 below shows a breakout of the ENERGY (only) portions of the site's electric bill which would be affected by behind the meter production or net-metering. In order to accurately predict what the effect of generating behind the meter energy at the site, will must calculate the details of all of the billing elements.

Table 2 contains the rate structures applicable to the subject property, which is under the PE-PH2D Rate Tariff of Potomac Edison, used in this study.

Table 1 - Calculation of Energy Savings on a Per Kilowatt Basis

Investigation into Detail of Potomac Edison (Piney Dam) Electric Bill

What elements of bill are affected by ENERGY COST as opposed to DEMAND COST, so that savings can be calculated from a reduction of energy?

Bill used:	Dec. 2012	
Rate Structure:	PE-PH2D	
Distribution Chg	0.00402	Energy portion only
Universal Service fee	0.001583	Step scale based on prev. year billings. Assume effect will be to zero out bill, thus full credit.
Cogen PURPA Surcharge	0.00441	energy portion only, per tariff step scale.
Franchise Tax	0.00062	minimum used, no credits. Per tariff.
EmPower Surcharge	0.00062	PH small used
Demand Resource Surcharge	0.0006	PH used
MD Environmental Surcharge	0.00015	only available to all cust.
Energy Cost	0.05699	From UGI Services
Total variable charges/kWhr	**0.068993**	

The above meter's rates must be part of the meter aggregation, although the other meters selected may have higher rates. For this study a blended rate of $.087 was created for financial evaluation purposes. This blended rate is comprised of 50% of energy priced at $.069 as above, plus another 50% of energy from other town meters (with higher energy costs and without demand charges), priced at an average of $.105/kWhr.

Table 2 - Applicable Rate Structures for Project Site

LIGHT AND POWER SERVICE
(High Load Factor)
SCHEDULE "PH"
AVAILABILITY
Available for loads of 50 kilowatts or greater at standard single phase and three phase voltages. The standard voltages available depend upon location, character and size of Customer's load. This information can be furnished at any of the Company's offices. Service shall not be available for Standby or Maintenance Service such as that required for Alternative Generation Facilities. All applicable surcharges, credits and taxes shall apply.
MONTHLY RATE
DISTRIBUTION CHARGES
Capacity Charge
Minimum kilowatts ....$1.09 per kilowatt
First block (0-500 kilowatts) ....$1.72 per kilowatt
Second block (over 500 kilowatts) ....$1.69 per kilowatt
Energy Charge
First block (0-100,000 kilowatt-hours)... $0.00402 per kilowatt-hour
Second block (over 100,000 kilowatt-hours)..................................... $0.00335 per kilowatt-hour
Voltage Discount
Company will furnish service at one voltage and at one point from the Company's existing distribution system voltage. A voltage discount of 25¢ per kilowatt will apply when the Customer takes service at a voltage between 2,000 and 15,000 volts and provides all facilities beyond the Point of Service. A voltage discount of 50¢ per kilowatt will apply when the Customer takes service at a voltage greater than 15,000 volts and provides all facilities beyond the Point of Service.
Reactive Kilovolt-Ampere Charge
Reactive kilovolt-ampere charge is applied to the Customer's reactive kilovolt-ampere capacity requirement in excess of 25% of the Customer's kilowatt capacity.
Billing reactive kilovolt-amperes .... $0.40 per reactive kilovolt-ampere
ISSUED BY JOSEPH H. RICHARDSON, PRESIDENT
Issued November 22, 2004 To become effective on
all service rendered on
or after January 6, 2005
Approved at Public Service Commission Administrative Meeting of January 5, 2005 in Case No. 8797

THE POTOMAC EDISON COMPANY Electric P. S. C. Md. No. 53
Doing Business As Twenty-Eighth Revision to
ALLEGHENY POWER Original Page No. 5
Canceling
Twenty-Seventh Revision to
Original Page No. 5
UNIVERSAL SERVICE PROGRAM SURCHARGE
Effective for bills rendered on and after August 18, 2006, there shall be a Universal Service Program Surcharge per Customer at rates set forth below to fund the Maryland statewide Universal Service Program. These rates shall be applied each month and are based on the distribution amount of customer bills rendered in the prior calendar year. Amounts included hereunder shall be subject to late pay charges.
Electric Bills
Rendered Customer Charge
(Prior Calendar Year) (per month)
Residential - Rate Schedule R
N/A $0.37
Commercial & Industrial - Rate Schedules C, G, C-A, CSH, PH, AGS, PP, Hagerstown, and Frederick.
Under $175 $0.42
$175 - $1,299 $3.09
$1,300 - $2,599 $10.29
$2,600 - $6,499 $20.59
$6,500 - $12,999 $41.18

$13,000 - $25,999 $61.77
$26,000 - $51,999 $82.36
$52,000 - $77,999 $154.42
$78,000 - $103,999 $205.89
$104,000 - $129,999 $308.83
$130,000 - $181,999 $463.25
$182,000 - $233,999 $617.67
$234,000 - $259,999 $926.50
$260,000 - $519,999 $1,235.33
$520,000 - $779,999 $1,647.11
$780,000 - $1,039,999 $2,058.89
$1,040,000 - $1,299,999 $2,470.67
$1,300,000 - $1,559,999 $2,882.45
$1,560,000 - $1,819,999 $3,294.22
$1,820,000 - $2,079,999 $3,603.06
$2,080,000 - $2,339,999 $3,911.89
$2,340,000 - $2,599,999 $4,117.78
$2,600,000 - $3,249,999 $4,323.67
Over $3,250,000 $4,632.50
ISSUED BY DAVID E. FLITMAN, PRESIDENT
Issued August 16, 2006 Effective August 18, 2006
Issued in accordance with the Commission's directive August 9, 2006 in Case No. 8903

COGENERATION PURPA PROJECT SURCHARGE

Effective for all service rendered on and after January 1, 2013, there shall be a surcharge at rates set forth below to recover costs associated with COGENERATION PURPA PROJECTS approved by the Maryland Public Service Commission. Applicable bills rendered shall include an amount equal to the surcharge rate times the number of kilowatts and kilowatt-hours used in the billing period. The resulting charge is in addition to any minimum charge set out in the Rate Schedule and is added to the Customer's charges before any tax surcharge is levied against the Customer's total bill. Amounts billed hereunder shall be subject to late pay charges.

COGENERATION PURPA SURCHARGE
Schedule Rate Per kW Rate Per kWh
R $0.01161
C 0.01131
G 0.01131
C-A 0.01068
CSH 0.01068
PH $2.02 0.00441
AGS 2.02 0.00441
PP 1.650 0.00357
OL 0.02274
AL 0.02274
MSL 0.02274
SL 0.02274
EMU 0.02274
MU 0.02274
Fred/Hag 0.01131
Rates for service under each of the Company's Rate Schedules are subject to this surcharge.
ISSUED BY CHARLES E. JONES, PRESIDENT
Issued November 28, 2012 To become effective on
all service rendered on
or after January 1, 2013
Approved at Public Service Commission Administrative Meeting of December 27, 2012 in Case No. 8797

THE POTOMAC EDISON COMPANY Electric P. S. C. Md. No. 53
Doing Business As Original Page No. 5-2
ALLEGHENY POWER Canceling
Thirty-First Revision of
Original Page No. 5B
FRANCHISE TAX SURCHARGE
APPLICABLE TO ALL SCHEDULES AND SPECIAL CONTRACTS
Effective with all bills rendered on and after January 7, 2000, there shall be a franchise tax surcharge at $0.00062 per kilowatt-hour which shall be billed under all Rate Schedules and contracts. A credit of $0.000020 shall apply to kilowatt-hours in excess of 500 million up to 1,500 million delivered during a calendar year to a single industrial customer for use in a production activity at the same location. A credit of $0.000455 shall apply to kilowatthours in excess of 1,500 million delivered during a calendar year to a single industrial customer for use in a production activity at the same location. All bills rendered shall include an amount equal to the Franchise Tax Surcharge times the kilowatt-hours used in the billing period. The resulting charge is in addition to any minimum charge set out in the Rate Schedule and is added to the Customer's bill before any surcharge is levied against the Customer's total bill. Amounts billed hereunder shall be subject to late pay charges.
ISSUED BY MICHAEL P. MORRELL, VICE PRESIDENT
Issued June 20, 2000 To become effective on
all bills rendered on
or after July 1, 2000
Issued in accordance with the Commission's directive June 2, 2000 in Case No. 8797

THE POTOMAC EDISON COMPANY Electric P. S. C. Md. No. 53
Eighth Revision of
Original Page No. 5-8
Canceling
Seventh Revision of
Original Page No. 5-8
EMPOWER MD SURCHARGE
In accordance with the Annotated Code of Maryland, Public Utility Companies, Section 7-211, Energy Efficiency Programs, there shall be a surcharge as set forth below to recover the costs associated with Companysponsored programs which promote energy efficiency and conservation and such other programs as approved by the Commission. This surcharge is applied to designated Rate Schedules to recover costs allocated to that Rate Schedule. This surcharge will be applied each month until changed by the Commission. The resulting surcharge is in addition to any minimum charge set out in the Rate Schedule and is added to the Customer's bill before any tax surcharge is levied against the Customer's total bill. Amounts billed hereunder shall be subject to late pay charges.
CALCULATION OF SURCHARGE
The EmPower MD Surcharge is a rate per kilowatt-hour and is calculated by dividing the costs allocated to each Rate Schedule by the distribution kilowatt-hour sales expected for the same Rate Schedule. The calculation includes a Reconciliation Factor adjustment, and an adjustment for gross receipts tax and the Commission assessment factor. Changes to the surcharge will be filed annually on or before December 1, to become effective the forthcoming 12-month period beginning January 1. Upon determination that the surcharge, if left unchanged, would result in a material over/under-collection, the Company may file a proposed interim revision of the surcharge for Commission approval.
Applicable bills rendered shall include an amount equal to the surcharge rate times the number of distribution kilowatt-hours as follows:

Schedule	Rate per kWh
R	$0.00244
C	$0.00065
G	$0.00065
C-A	$0.00055
CSH	$0.00055
PH (small)*	$0.00062
PH (large)*	$0.00066
PP	$0.00061

*PH (small) defined as Customers eligible to receive Type II SOS and PH (large) defined as Customers eligible to receive Hourly-Priced LCS.
ISSUED BY CHARLES E. JONES, PRESIDENT
Issued November 30, 2012 To become effective on
all service rendered on
or after January 1, 2013
Approved at Public Service Commission Administrative Meeting of December 27, 2012 in Case No. 9153

THE POTOMAC EDISON COMPANY
The following rates are effective June 1, 2013
Demand Resource Surcharge
Schedule Rate Per kWh
R $0.00073
C 0.00066
G 0.00073
C-A 0.00046
CSH 0.00045
PH 0.00060
AGS 0.00000
PP 0.00028
LIGHTING 0.00000

THE POTOMAC EDISON COMPANY Electric P. S. C. Md. No. 53
Tenth Revision of
Original Page No. 5-6
Canceling
Ninth Revision of
Original Page No. 5-6
MARYLAND ENVIRONMENTAL SURCHARGE
The charges to Customers served in Maryland, shall include, in addition to the charges specified in this tariff, an environmental surcharge, imposed by the State of Maryland on all kilowatt hours distributed in Maryland. The amount of the surcharge shall be shown as a separate item on bills rendered to Customers served in Maryland, except wholesale customers.
Adjustments in bills will be made by adding to each bill, as determined by application of the appropriate rate schedule, a tax surcharge. The charge to be added will be determined by the Maryland Public Service Commission as of June 30 each year to be applied the following year.
STATEMENT OF ENVIRONMENTAL SURCHARGE RATES
APPLICABLE TO BILLS FOR ELECTRIC SERVICE SUPPLIED
WITHIN STATE OF MARYLAND UNDER
PROVISIONS OF NATURAL RESOURCES SECTION 3-302
ENVIRONMENTAL TRUST FUND
Effective
Date Location Surcharge Rate
July 1, 2011 State of Maryland $0.000150/Kwh
not to exceed $1,000 per month
This surcharge is applicable to all Rate Schedules. This surcharge is not subject to Maryland Sales Tax or Montgomery County Local Tax. This surcharge shall be set out separately on the customer's bill the same as the two above mentioned taxes and is not subject to late payment charge and is not considered revenue.
ISSUED BY CHARLES E. JONES, PRESIDENT
Issued June 28, 2011 To become effective on
all bills rendered on
or after July 1, 2011
Approved at Public Service Commission Administrative Meeting of July 13, 2011

The savings of a wind turbine occur in the future, and in order to model the future savings correctly it is important to be able to predict how electric prices will escalate over time. To do this the project examined the previous 20 years of retail pricing in the Maryland service area.

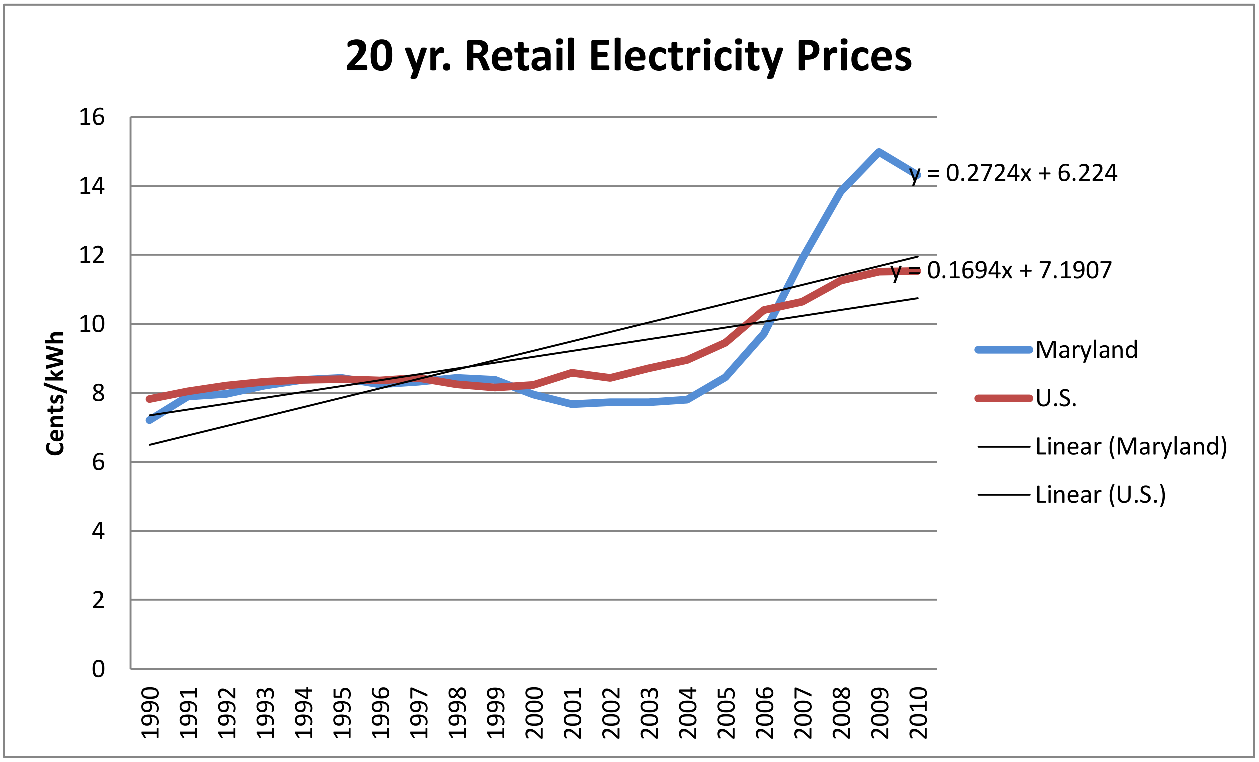
Table 3 and Figure 1 depicts this data and leads to the use of an annual escalator of 2.48%/yr for the state, as opposed to a 1.61% general escalation of rates around the US.

Table 3 - 20 year Retail Electric Rates

	Maryland	Federal
1990	7.22	7.83
1991	7.9	8.04
1992	7.97	8.21
1993	8.21	8.32
1994	8.39	8.38
1995	8.43	8.4
1996	8.26	8.36
1997	8.33	8.43
1998	8.44	8.26
1999	8.39	8.16
2000	7.95	8.24
2001	7.67	8.58
2002	7.74	8.44
2003	7.73	8.72
2004	7.8	8.95
2005	8.46	9.45
2006	9.71	10.4
2007	11.89	10.65
2008	13.84	11.26
2009	14.98	11.51
2010	14.32	11.54
Overall	49.58%	32.15%
Per year	2.48%	1.61%

(source: US Dept of Energy and Delmarva Power and Light)

Figure 1 – Graph showing 20 Year Retail Electric Rates for Maryland and US



PotomacEdison
A FirstEnergy Company

Billed On: Actual Meter Reading

December 2012
Account Number: 110 086 442 545
Amount Due: $0.00

COPY

Billing Period: Oct 27 to Nov 28, 2012 for 33 days
Bill For: FROSTBURG CITY OF
PINEY DAM WATER PUMP
PINEY CRK
FROSTBURG MD 21532

To report an emergency or an outage, call 24 hours a day 1-888-544-4877 For Customer Service, call 1-800-686-0011. For Payment Options, call 1-800-736-3401. Pay your bill online at www.firstenergycorp.com
Bill issued by: Potomac Edison, PO Box 3615, Akron OH 44309-3615

Messages

Generation, Transmission & Energy Cost Adjustment Price Comparison Information: The current price for Standard Offer Service (SOS) electricity is 5.529 cents/kWh, effective through Nov 30, 2012. SOS electricity will cost 6.512 cents/kWh beginning on Dec. 1, 2012 through Feb 28, 2013. The weighted average price of SOS electricity will be 5.983 cents/kWh through Feb. 28, 2013. The price for SOS from Mar. 1, 2013 through May 31, 2013, will be set in Jan. 2013.

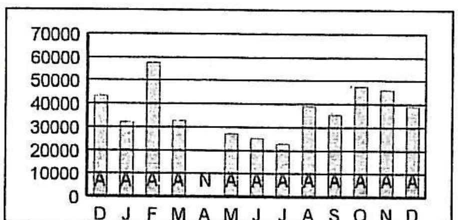
Your next meter reading is scheduled to occur on or about Dec 27, 2012.

Best wishes for a joyous holiday season from all of us at Potomac Edison.

449000 / 11 = 40818
× 12
489,818

Additional messages, if any, can be found on back.

Usage History



Comparisons	Last Year	This Year
Average Daily Use (KWH)	1441	1182
Average Daily Temperature	39	38
Days in Billing Period	30	33
Last 11 Months Use (KWH)		404,921
Average Monthly Use (KWH)		36,811

Account Summary

Account Summary	Amount Due
Previous Balance	-4,540.47
Payments/Adjustments	0.00
Balance at Billing on Dec 13, 2012	**-4,540.47**
Potomac Edison - Consumption	1,437.24
Potomac Edison - Misc. Charges	-1.37
Total Current Charges	**1,435.87**
You have a credit balance of	**-$3,104.60**

Usage Information for Meter Number S58060479

Nov 28, 2012 KWH Reading (Actual)	735.693
Oct 27, 2012 KWH Reading (Actual)	634.088
Difference	101.605
Multiplier	384
KWH used	39,016
Onpeak Load in KW/KVA	218.06976
OffPeak Load in KW/KVA	140.30976
Measured Lagging Reactive Demand	172.6
Billed Load in KW/KVA	218.0
Billed Reactive Demand	118.0

Charges From Potomac Edison

Customer Number: 0804445463 5000922439
Rate: Light and Power Service PE-PH2D

Distribution Charge	579.00
Electric Universal Service Fee	61.77
Administrative Credit	-46.43
Cogeneration PURPA Surcharge	776.18
Franchise Tax	24.19
EmPower MD Surcharge	12.49
Demand Resource Surcharge	24.19
MD Environmental Surcharge	5.85
Current Consumption Bill Charges	**1,437.24**
Security Deposit Interest	**-1.37**
Total Charges	**$ 1,435.87**

Charges From UGI Energy Services, Inc

1 Meridian Blvd Suite 2c01, Wyomissing Pa 19610
Customer Service: 1-800-427-8545

The following Supplier is responsible for billing you for your electric generation charges on a separate bill:
UGI Energy Services, Inc

RECEIVED DEC 17 2012

PAID
DEC 19 2012
CITY OF FROSTBURG

PotomacEdison
A FirstEnergy Company

Bill [illegible] On: Actual Meter Reading

January 03, [illegible] 13
Account Number: 110 086 442 545

Amount Due: $0.00

Billing Period: **Nov 29 to Dec 27, 2012 for 29 days**
Bill For: FROSTBURG CITY OF
PINEY DAM WATER PUMP
PINEY CRK
FROSTBURG MD 21532

COPY

To report an emergency or an outage, call 24 hours a day 1-888-544-4877. For Customer Service, call 1-800-686-0011. For Payment Options, call 1-800-736-3401. Pay your bill online at www.firstenergycorp.com
Bill issued by: Potomac Edison, PO Box 3615, Akron OH 44309-3615

Messages

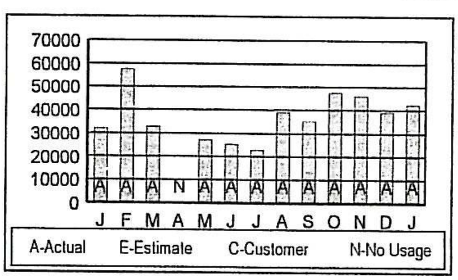
Generation, Transmission & Energy Cost Adjustment Price Comparison Information: The current price for Standard Offer Service (SOS) electricity is 6.593 cents/kWh, effective through Feb 28, 2013. The weighted average price of SOS electricity will be 6.566 cents/kWh through Feb 28, 2013. The price for SOS from Mar 1, 2013 through May 31, 2013 will be set in Jan 2013.

Your next meter reading is scheduled to occur on or about Jan 29, 2013.

Effective January 1, 2013, the Administrative Credit, PURPA Surcharge, and EmPower MD Surcharge have changed. Also, the Energy Cost Adjustment has changed for customers who have not selected an alternate electricity supplier. Please visit www.potomacedison.com, or call 1-800-686-0011 for further details.

Additional messages, if any, can be found on back.

Usage History



Comparisons	Last Year	This Year
Average Daily Use (KWH)	974	1465
Average Daily Temperature	33	39
Days in Billing Period	33	29
Last 11 Months Use (KWH)		415,257
Average Monthly Use (KWH)		37,751

Account Summary

Account Summary	Amount Due
Previous Balance	-3,104.60
Payments/Adjustments	0.00
Balance at Billing on Jan 03, 2013	**-3,104.60**
Potomac Edison - Consumption	1,147.68
Potomac Edison - Misc. Charges	-0.43
Total Current Charges	**1,147.25**
You have a credit balance of	**-$1,957.35**

Usage Information for Meter Number S58060479

Dec 27, 2012 KWH Reading (Actual)	846.327
Nov 29, 2012 KWH Reading (Actual)	735.693
Difference	110.634
Multiplier	384
KWH used	42,483
Onpeak Load in KW/KVA	145.75872
OffPeak Load in KW/KVA	146.61888
Measured Lagging Reactive Demand	102.559
Billed Load in KW/KVA	147.0
Billed Reactive Demand	66.0

Charges From Potomac Edison

Customer Number: 0804445463 5000922439
Rate: Light and Power Service PE-PH2D

Distribution Charge	450.02
Electric Universal Service Fee	61.77
Administrative Credit	-50.55
Cogeneration PURPA Surcharge	613.80
Franchise Tax	26.34
EmPower MD Surcharge	13.59
Demand Resource Surcharge	26.34
MD Environmental Surcharge	6.37
Current Consumption Bill Charges	**1,147.68**
Security Deposit Interest	**-0.43**
Total Charges	**$ 1,147.25**

Charges From UGI Energy Services, Inc

1 Meridian Blvd Suite 2c01, Wyomissing Pa 19610
Customer Service: 1-800-427-8545

The following Supplier is responsible for billing you for your electric generation charges on a separate bill:
UGI Energy Services, Inc

RECEIVED JAN - 7 2013

Previous Bills From 2011 show the actual load from the facility before the application of net metering from the small hydroelectric plant near the water treatment facility. This is the amount of load that should be used to calculate the net metering permissible amount.

Allegheny Power

For Emergencies or Outages Call: 1-800-ALLEGHENY (1-800-255-3443)
Contact your Business Account Specialist: 1-866-523-4081 or
myaccountmanager@alleghenypower.com

COPY

Name Service Location: FROSTBURG CITY OF
PINEY CRK
FROSTBURG MD 21532
PINEY DAM WATER PUMP

Meter # 58060479

Mail Payments to:
800 CABIN HILL DRIVE
GREENSBURG PA 15606-0001

Account Number
2 18 22 013 00100 1
Please Use When Calling or Writing

Billing Date: APR 29, 2011 Check Digit 0266 Page 1 of 4

KWH Usage and Demand
For 32 days service, from
MAR 25, 2011 to APR 25, 2011

Energy Used 49,899 KWH
Demand 210 KW

WASHINGTON GAS ENRGY SVC
Generation
Energy Used 49,899 KWH
Demand 210 KW

Usage Date	KWH	KW	Days
04/25/11	49,899	210.0	32
03/24/11	47,227	218.0	29
02/23/11	74,741	231.0	30
01/24/11	69,872	145.0	33
12/22/10	62,606	147.0	30
11/22/10	72,655	214.0	32
10/21/10	62,569	217.0	29
09/22/10	75,620	237.0	30
08/23/10	59,953	212.0	29
07/25/10	62,506	218.0	32
06/23/10	41,457	210.0	30
05/24/10	45,745	131.0	29
04/25/10	49,282	211.0	32
03/24/10	47,659	241.0	29

If you pay by check, you authorize Allegheny to convert your paper check into an electronic debit for the amount of your payment. If you want to cancel this service, call 1-800-ALLEGHENY (1-800-255-3443) and say "I want my checks back".

Your Last Bill

Account Balance Last Bill	5,059.94
Payment Received - APR 10, 2011	5,059.94 CR
Account Balance Remaining	$.00

Allegheny Power Current Charges

Electric Service Charge	1,177.96
Administrative Credit	68.86 CR
Environmental Surcharge	7.58
Electric Universal Service Fee	41.18
Allegheny Power Charges	$1,157.86

WASHINGTON GAS ENRGY SVC Current Charges

Energy Charge	4,121.66
WASHINGTON GAS ENRGY SVC Charges	$4,121.66

Account Balance	$5,279.52
Allegheny Power Balance	$1,157.86
WASHINGTON GAS ENRGY SVC Balance	$4,121.66

TOTAL PAYMENT DUE $5,279.52

RECEIVED MAY - 2 2011
PAID
MAY 1 1 2011
CITY OF FROSTBURG

Billing Date	Total Payment Due After Due Date	Late Payment Charge If Paid After Due Date	Due Date	Total Payment Due
APR 29, 2011	$5,279.52	$.00	MAY 16, 2011	$5,279.52

821,791/yr.
×2
1,643,582

POTOMAC IS THE OLD ALLEGHENY

Allegheny Power

For Emergencies or Outages Call: 1-800-ALLEGHENY (1-800-255-3443)
Contact your Business Account Specialist: 1-866-523-4081 or
myaccountmanager@alleghenypower.co

Name FROSTBURG CITY OF
Service PINEY CRK
Location FROSTBURG MD 21532
PINEY DAM WATER PUMP
Meter # 58060479

Mail Payments to:
800 CABIN HILL DRIVE
GREENSBURG PA 15606-0001

Account Number
2 18 22 013 00100 1
Please Use When Calling or Writing

COPY

Billing Date: MAY 31, 2011 Check Digit 0299 Page 1 of 5

KWH Usage and Demand
For 29 days service, from
APR 26, 2011 to MAY 24, 2011

Energy Used 45,401 KWH
Demand 208 KW

WASHINGTON GAS ENRGY SVC
Generation
Energy Used 45,401 KWH
Demand 208 KW

Usage Date	KWH	KW	Days
05/24/11	45,401	208.0	29
04/25/11	49,899	210.0	32
03/24/11	47,227	218.0	29
02/23/11	74,741	231.0	30
01/24/11	69,872	145.0	33
12/22/10	62,606	147.0	30
11/22/10	72,655	214.0	32
10/21/10	62,569	217.0	29
09/22/10	75,620	237.0	30
08/23/10	59,953	212.0	29
07/25/10	62,506	218.0	32
06/23/10	41,457	210.0	30
05/24/10	45,745	131.0	29
04/25/10	49,282	211.0	32

Your dedicated Business Account Specialist team is available from 8 AM until 5 PM, Monday through Friday. Visit us on-line at www.alleghenypower.com.

Your Last Bill

Account Balance Last Bill	5,279.52
Payment Received - MAY 12, 2011	5,279.52 CR
Account Balance Remaining	$.00

Allegheny Power Current Charges

Electric Service Charge	1,128.62
Administrative Credit	62.65 CR
Environmental Surcharge	6.90
Electric Universal Service Fee	41.18
Allegheny Power Charges	$1,114.05

WASHINGTON GAS ENRGY SVC Current Charges

Energy Charge	3,750.12
WASHINGTON GAS ENRGY SVC Charges	$3,750.12

Account Balance	$4,864.17
Allegheny Power Balance	$1,114.05
WASHINGTON GAS ENRGY SVC Balance	$3,750.12

TOTAL PAYMENT DUE $4,864.17

PAID RECEIVED JUN - 2 2011
JUN - 8 2011
CITY OF FROSTBURG

Billing Date	Total Payment Due After Due Date	Late Payment Charge If Paid After Due Date	Due Date	Total Payment Due
MAY 31, 2011	$4,864.17	$.00	JUN 15, 2011	$4,864.17

UGI Energy services provides the electricity generation services to the facility under a separate invoice:

UGI EnergyLink

Page 1

UGI Energy Services, Inc.
dba UGI EnergyLink
One Meridian Blvd., Suite 2C01
Wyomissing, PA 19610
(800) 427-8545

Invoice Number: E194514
Invoice Date: 02/19/2013
Salesperson: Pricing Desk
Elec. Utility: Potomac Edison

RECEIVED FEB 2 2 2013

City of Frostburg
59 E Main Street
Frostburg, MD 21532

Summary Billing Information
Outstanding Bal. $0.00
Current Charges $2,557.82

Piney Crk
30.330/16.310

Customer No: FROS108 Facility: City of Frostburg
Month: Feb-2013 12/28/2012 - 01/28/2013 32 days
Account Number: 08044454635000922439

Metered Usage 44,882.00 kWh

Energy Charges

Month	Type	Swing	Volume (kWh)	Price ($/kWh)	Amount ($)
Dec-12	Full Req.		5,610.25	$0.05699	$319.73
Jan-13	Full Req.		39,271.75	$0.05699	$2,238.09

Net Invoice: $2,557.82

Total UGI Energy Services, Inc. Charge: $2,557.82

Total Amount Due: $2,557.82

PAID
FEB 2 7 2012
CITY OF FROSTBURG

Questions about your bill please call UGI Energy Services, Inc. at
1-800-427-8545 or 610-373-7999
Make Checks Payable to UGI Energy Services, Inc.

UGI EnergyLink

Page 1

UGI Energy Services, Inc.
dba UGI EnergyLink
One Meridian Blvd., Suite 2C01
Wyomissing, PA 19610
(800) 427-8545

Invoice Number: E177594
Invoice Date: 01/07/2013
Salesperson: Pricing Desk
Elec. Utility: Potomac Edison

RECEIVED JAN - 9 2013

City of Frostburg
59 E Main Street
Frostburg, MD 21532

Summary Billing Information Pd 1-2-13 50415 ck#
Outstanding Bal. ~~$2,223.52~~
Current Charges $2,421.10

Piney Creek 30.330/16.310

Customer No:FROS108 **Facility:** City of Frostburg
Month: Jan-2013 11/29/2012 - 12/26/2012 28 days
Account Number: 08044454635000922439

Metered Usage 42,483.00 kWh

Energy Charges

Month	Type	Swing	Volume (kWh)	Price ($/kWh)	Amount ($)
Nov-12	Full Req.		3,034.50	$0.05699	$172.93
Dec-12	Full Req.		39,448.50	$0.05699	$2,248.17

Net Invoice: $2,421.10

Total UGI Energy Services, Inc. Charge: **$2,421.10**

Total Amount Due: ~~$4,644.62~~ 2,421.10

PAID
JAN 1 6 2013
CITY OF FROSTBURG

Questions about your bill please call UGI Energy Services, Inc.
1-800-427-8545 or 610-373-7999
Make Checks Payable to UGI Energy Services, Inc.

✓

Appendix K

FAA and Related Issues

FAA and Related Issues

Wind turbines are tall structures and as such must be studied for the impact they would have on airspace and other issues such as long range radar and other Department of Defense issues.

FAA Issues

According to the FAA web site:

The requirements for filing with the Federal Aviation Administration for proposed structures vary based on a number of factors: height, proximity to an airport, location, and frequencies emitted from the structure, etc. For more details, please reference CFR Title 14 Part 77.9.

You must file with the FAA at least 45 days prior to construction if:

- *your structure will exceed 200ft above ground level*
- *your structure will be in proximity to an airport and will exceed the slope ratio*
- *your structure involves construction of a traverseway (i.e. highway, railroad, waterway etc...) and once adjusted upward with the appropriate vertical distance would exceed a standard of 77.9(a) or (b)*
- *your structure will emit frequencies, and does not meet the conditions of the FAA Co-location Policy*
- *your structure will be in an instrument approach area and might exceed part 77 Subpart C*
- *your proposed structure will be in proximity to a navigation facility and may impact the assurance of navigation signal reception*
- *your structure will be on an airport or heliport*
- *filing has been requested by the FAA*

If you require additional information regarding the filing requirements for your structure, please identify and contact the appropriate FAA representative using the Air Traffic Areas of Responsibility map for Off Airport construction, or contact the FAA Airports Region / District Office for On Airport construction.

Because of this project's height above ground level of 302' to the tip of the turbine blades, the project exceeds the 200' limitation above by 102' and therefore a filing of a form 7460-1 is required before construction.

During the course of this study the FAA recently suspended the use of 7460-1 filings for the purpose of feasibility studies, therefore no such filing has been made during this study. (A filing WAS made for the met tower which will be placed on the site).

Instead of such a filing therefore, the study has examined the traditional reasons as to why a 'Determination of Hazard' might be issued for wind turbine projects to see if there was any 'red flags' that would preclude the site from being considered as feasible in terms of airspace at this time.

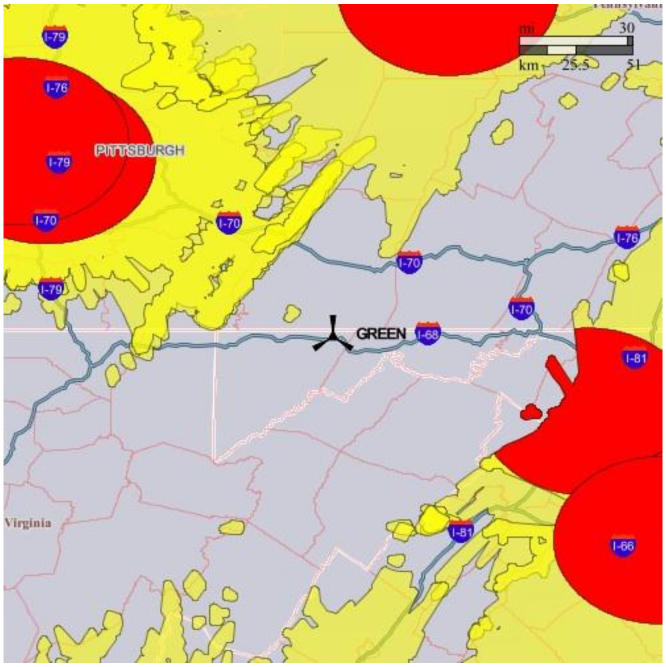
In our experience, very few conflicts are incurred with FAA airspace for turbines that are located more than 3 miles from an airport. For this site, the FAA on-line siting tool indicates that **NO** airports are located within **5** miles of the proposed turbine location. Therefore in our opinion, although a 7460-1 will need to be filed for construction, the project site meets the 'feasible' criteria.

DOD Issues

The study investigated the following issues using the FAA's DoD Screening tool (https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp)

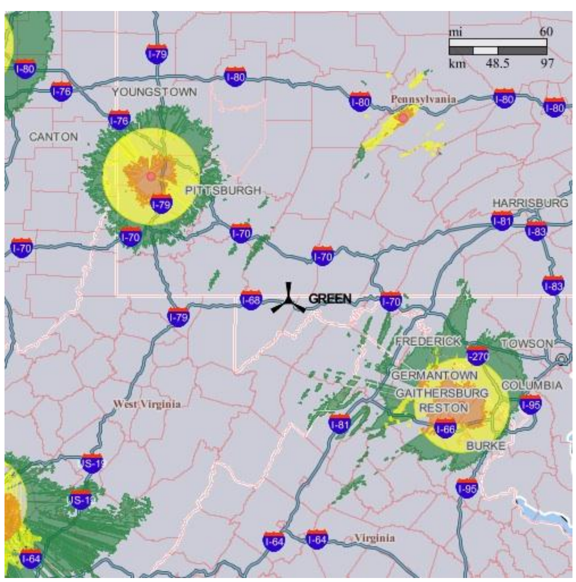
Long Range Radar (Air Defense and Long Range Security):

The screening tool places the project in a 'green' area designation, which indicates no effects on Long Range Radar.



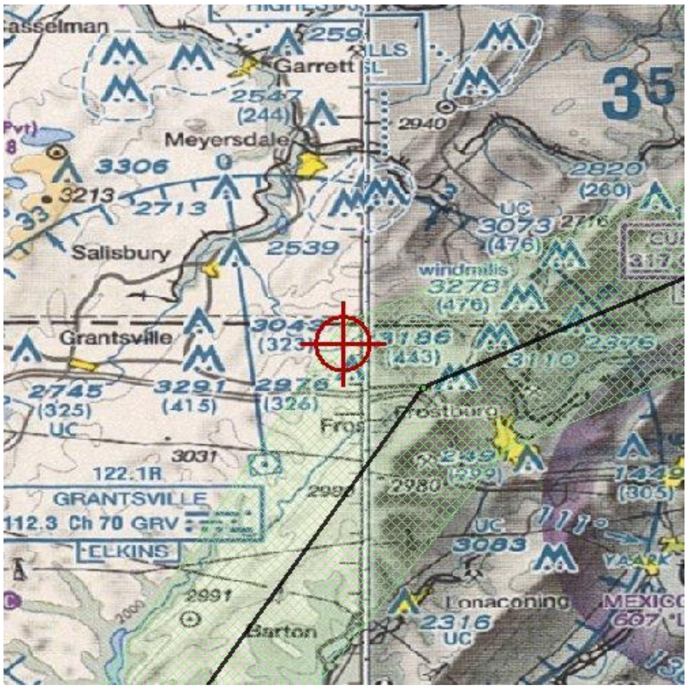
NEXRAD (Weather Surveillance and Doppler Radars):

The screening tool places the project in a 'green' area designation, which indicates no effects on NEXRAD.



Military Operations:

The screening tool shows that the project site falls within the confines of SR808. A detailed review is recommended; contact Chief Rick Alderton at (304)-616-5021.



Appendix L

Capabilities and Bios of Associated Wind Developers, LLC

Associated Wind Developers

"Consultants and Developers for Renewable Energy Projects Worldwide"

Feasibility Studies	Development	Financing
AWD is a leading expert in wind energy generation and understands each necessary component for development.	AWD designs, engineers, and develops renewable energy projects and solutions internationally.	AWD models project financials, arranges and secure debt and equity financing on renewable energy projects.

Representation Projects

Anderson Bogs	Wind	.75MW	USA
Camelot Wind	Wind	2 MW	USA
Kingston Wind	Wind	6 MW	USA
Santa Cruz	Hybrid	6 MW	Cape Verde
Santiago North	Wind	10 MW	Cape Verde
Ngong Hills	Wind	25 MW	Kenya

AWD Overview

AWD designs, engineers, and permits commercial/industrial and utility-scale renewable energy projects worldwide. From our core competency at wind site analysis we have expanded our offerings through our "Essential Utilities" consortium partners to include Thermal Backup Generation, Grid Stabilization, Water Desalinization, and Solar PV systems. We offer these services on a 'Develop- to-Own' and 'Develop-for-Hire' basis.

From desktop appraisals to full feasibility studies, and from project design through construction, AWD can help your project. We can also broker and arrange financing on renewable energy projects worldwide, and act as 'Owner's Representatives' for your development project. As a U.S. company, we have access to a large spectrum of wind project financing sources for projects around the world.

Wind4Water

Wind-Powered Desalinization

AWD has the ultimate solution for developing and island nations worldwide that lack a significant water resource. AWD has partnered with Water Management Group to create Cape Verde's first wind powered desalinization plant module.

This module will produce over 750,000 gallons of fresh water daily at a lower cost than fossil-fuel powered desalinization plants. This module is designed to be implemented worldwide.

Associated Wind Developers, LLC 11 Resnik Rd. Plymouth, MA 02360 info@AssociatedWindDevelopers.com +1 888-800-2381

Professional Bio – Brian D. Kuhn/ Primary Investigator

Brian D. Kuhn

Founder and Principal

Associated Wind Developers, LLC
Developers Marketing Services, Inc.
Aeronautica Windpower, LLC

Professional Bio:

Brian Kuhn is the Founder and a principal member of a number of renewable energy and real estate development related companies. Mr. Kuhn offers the perspective of over 30 years of project, product and service development in the fields of Wind, Solar, Heat Recovery, Real Estate development and permitting and general marketing.

Brian holds a *Bachelor of Science* degree in '*Renewable Energy Systems and Business',* from the University of Massachusetts, in Amherst, MA ('77). This special (BDIC) degree was a 4 year mix of Mechanical Engineering and Business studies. During his time at UMass he studied under Professor *William Heronemus*, a noted naval architect and world renowned primary investigator for off-shore wind systems. He was a member of a small team of engineers that designed and built the first *UMass Solar Habitat and Wind Furnace* for the Department of Energy. This wind turbine introduced many innovations, including the use of a 3 bladed, variable pitch rotor and the use of a monopole tower – features that are now standard in today's modern wind turbine designs. The *Wind Furnace* turbine is currently heading to a new home at the Smithsonian Institute in Washington. The wind turbine and solar habitat later went on to become the highly respected *Renewable Energy Research Laboratory* at UMass.

In the 1980's Mr. Kuhn served as National Solar Specialist to Rheem Water Heaters, Inc., the world's largest manufacturer of water heaters. Mr. Kuhn was responsible for training Rheem's dealers and distributors on the proper design and installation of the company's solar hot water systems.

More recently, Mr. Kuhn founded and is actively involved in the management of 3 companies which provide services and products to the Renewable Energy market space.

- Associated Wind Developers, LLC, of Plymouth, MA offers development and financing services to wind energy project developers across the USA. AWD provide these services in a 'Developer-for-Hire' or 'Develop-to-Own' scenarios. The company is currently putting together a number of distributed generation wind energy sites which will be owned in $20Million portfolios. AWD has provided design, development and marketing services for more than 150 projects, including Wind Appraisals, Feasibility Studies, Development Services and more to Landowners, Industry, Municipalities and County Governments around the world.

- *Developers Marketing Services* of Plymouth, MA, which offers consulting services and product and project development expertise in the Renewable Energy and Real Estate industries. Mr. Kuhn also offers the unique perspective of over 20 years of experience as a real estate broker licensed in 8 different states with involvement in land procurement and development projects across the Northeast. Clients have included landowners, builders, developers, financial institutions, the Resolution Trust Company, FDIC, Freddie Mac, and many more.

- Aeronautica Windpower, a company designed to bring the manufacture and commercialize mid-scale wind turbines in the United States. Mr. Kuhn's responsibilities at Aeronautica currently include product and project development, new business development and R&D efforts.

From 2006 to 2008 Mr. Kuhn served as Chairman for the *Plymouth Energy Committee* (PEC), a volunteer advisory group which reports to the Board of Selectmen of Plymouth, Massachusetts. He is the principal author of *'Plymouth 2020'*, a plan which calls for virtually all of Plymouth's Municipal electricity to be produced by renewable sources in time for the town's 400th anniversary.

He has had several articles published about solar and wind power. Brian is an Adjunct Professor at Cape Cod Community College, where he teaches Wind and Solar Energy courses. He is a member of *AWEA*, the *Distributed Wind Energy Association (DWEA)*, the *National Association of Home Builders* and the *Northeast Sustainable Energy Association*. He is also a past member of the *National Association of Realtors*, and is licensed as a real estate broker involved in land procurement and development projects across the Northeast.

Civic Projects and Experience:

Chairman, *Plymouth Energy Committee,* (2006-2008) Plymouth, MA. (www.PlymouthEnergyCommittee.com)

President, *Center for Renewable Energy and Sustainable Living, Inc*. (2007-Present) (non-profit formed to create learning and exhibition centers in Plymouth.

Chairman, Loring Library Reconstruction Project, (2000-2004) Plymouth, MA

President, Zion Lutheran Church, (1999-2001) Plymouth, MA

Awards and Publications:

Gold Medal Award, National Association of Home Builders, *'Climate Tempered Communities'*. Developed novel design for senior housing using green energy (largely passive heating in central solariums) www.CrystalPalaces.com

'Wind Power – Highest and Best Use of Land?' - New England Real Estate Journal, June, 2007

Author of *'Plymouth 2020 – A clear vision of energy use in the future'*. Developed comprehensive plan to supply all of Plymouth's Municipal electrical requirements from renewable energy sources, largely wind) www.PlymouthEnergyCommittee.com

'Solar Energy Across America' – Solar Today Magazine, 1983 – A 6 issue series about solar and other renewable development efforts across the country.

Assorted other articles in various magazines.