Using Pennsylvania Natural Heritage Program Data for Wind Energy Planning

A Manual for Townships

The Center for Rural Pennsylvania
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Introduction

In Pennsylvania, local governments are responsible for making decisions about the siting of commercial wind energy facilities. Pennsylvania counties and townships with wind energy development potential are currently facing an increased number of proposed facilities. While wind is generally regarded as an environmentally "friendly" source of energy, residents may be opposed to these facilities because of concerns about wildlife impacts, aesthetics, noise, or property values. County and township officials may seek to develop land use regulations to address the siting of wind energy facilities, but find it challenging to determine the most suitable locations for wind energy development.

Currently, Pennsylvania does not have statewide wind energy siting guidelines. While a number of municipalities in Pennsylvania have developed wind energy ordinances that address setbacks from property lines, noise, or decommissioning, very few municipalities have attempted to develop zones specifically for wind energy. Although the Pennsylvania Department of Environmental Protection (DEP) Model Ordinance for Wind Energy Facilities provides a framework for addressing noise, setback, decommissioning, and other non-ecological factors related to wind energy development, it does not provide a mechanism for addressing potential impacts to wildlife.

This manual provides a model for incorporating existing ecological data gathered by the Pennsylvania Natural Heritage Program (PNHP) into the development of a wind energy special purpose zone. The model in this manual is intended for use by townships, although a similar approach may be used at the county level. This manual also provides suggestions on how the PNHP data may be used as part of a wind energy ordinance in townships without a zoning ordinance. This model is intended for use with commercial wind energy developments and does not address small-scale (less than 100 kilowatts) wind turbines.

An overlay zone based on the PNHP data, coupled with DEP's model ordinance, could provide Pennsylvania townships and counties with a comprehensive method for siting wind energy facilities.

Contents

The legal basis for wind energy zoning in Pennsylvania

In Pennsylvania, the Pennsylvania Municipalities Planning Code (MPC) grants the authority to regulate land use to local governments. If a municipality chooses to adopt a zoning ordinance, the MPC requires that no part of the municipality be left unzoned; however, this provision does not apply to counties. This allows counties that do not currently have a countywide zoning ordinance to adopt special purpose zones. For example, Somerset County currently has an Interchange Area Zoning Ordinance to guide land use in the areas surrounding three highway interchange areas near the Borough of Somerset, but has not enacted countywide zoning. In the case of townships, all areas must be zoned.

The MPC includes language permitting counties and municipalities to create zoning ordinances intended to protect ecological features. It also states that any zoning ordinance may contain provisions to protect "environmentally sensitive areas." Zoning ordinances must be designed to "promote, protect and facilitate" the "preservation of the natural, scenic and historic values in the environment and preservation of forests, wetlands, aquifers and floodplains." A county zoning ordinance is superseded by any municipal zoning ordinance.

What is overlay zoning?

Overlay zoning is a regulatory tool that creates a special zoning district, placed over existing base zones, which identifies special provisions in addition to those in the underlying base zone[1]. The overlay district can share common boundaries with the base zone or cut across base zone boundaries. Regulations or incentives are attached to the overlay district to protect a specific resource or guide development within a special area. Overlay districts can manage development in or near environmentally sensitive areas, such as groundwater recharge areas (to ensure water quality and quantity), special habitats (to protect species or features) or floodplains (to prevent flood damage). Common requirements may include building setbacks, density standards, lot sizes, and impervious surface reduction and vegetation specifications.

Wind energy zoning throughout the U.S.

Many counties and municipalities throughout the U.S. have addressed wind energy development in their zoning ordinances, typically as an administrative permit in all zoning districts. Several counties, such as Emmet County, Michigan and Brooking County, South Dakota, specify that any wind energy facility must be constructed within the established agricultural zones. Others, such as Marin and Monterey counties in California, specify a number of agricultural and commercial zones

[1] See Gravin, E. (2001). "Making Use of Overlay Zones." Planning Commissioners Journal, Issue 43, pp. 16-17.

where wind energy development may occur.

Few have developed wind energy overlay zones to delineate specific areas for wind energy development. Development of wind energy overlay zones may be limited due to the lack of established guidelines for geographically delineating areas best suited for wind energy development.

Eveline Township, Michigan and Klickitat County, Washington provide two examples of how local governments have developed their own criteria to make this determination. In both cases, a geographic information system (GIS) was employed for land assessment.

Eveline Township, Michigan

As part of the township's comprehensive plan, Eveline Township planners identified three factors that limit the development of wind energy facilities: forested areas, wetland areas and proximity to airports. Planners scored parcels from one to three negative points based on the quantity of wetlands and amount of forest cover on the parcel. Parcels also received a negative point if they were within four miles of an airport. Three physical attributes that support the development of wind energy were also identified: high elevation, prime agricultural soils, and agricultural future land use. Parcels received one to three points based on elevation, quantity of agricultural soils, and the amount of the parcel that was officially designated for future agricultural use. The planners scored all parcels of land in the township based on these "limiting" and "supporting" factors and calculated a composite score. The five areas of the township with the highest concentration of positive scores were identified as the "wind turbine overlay areas."

Klickitat County, Washington

Rather than use a scoring system, Klickitat County prepared an energy overlay Environmental Impact Statement (EIS) to delineate an overlay district for all future energy projects in the county, including gas-fired, biomass, wind, and solar facilities. The EIS took into consideration the different technologies, their typical environmental impact, and the likelihood of their development within the county. The EIS identified areas of the county that had the highest environmental sensitivity and where energy development could occur without significant environmental impacts. The county determined the boundaries of the overlay district based on the environmental analysis and the location of essential infrastructure.

Wind energy overlay zones in Pennsylvania

In Pennsylvania, as of 2008, only Logan Township, Blair County, had attempted to guide the siting of commercial wind energy facilities through the use of an overlay zone specific to wind energy. Logan Township surrounds the city of Altoona in west-central Pennsylva-

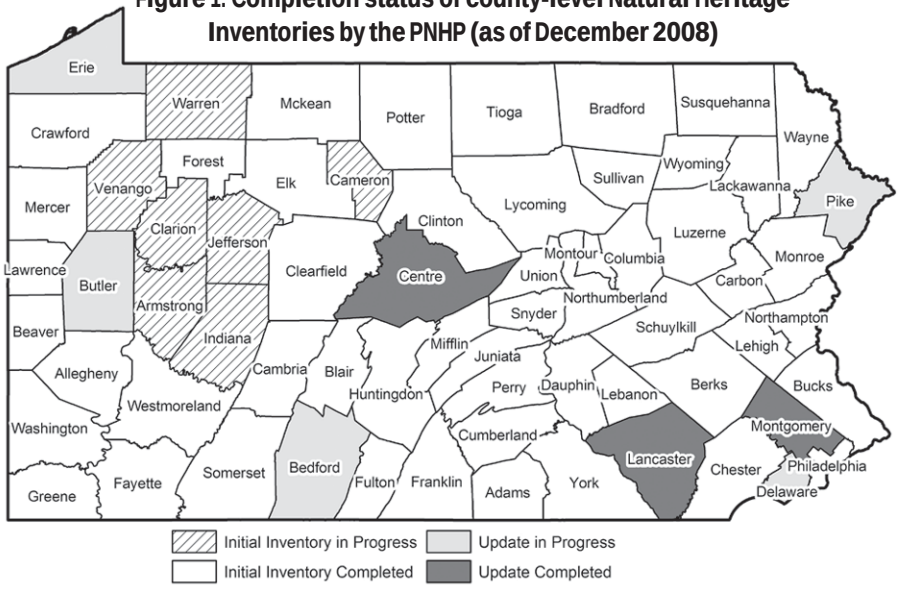
nia. In 2006, the Logan Township supervisors passed an amendment to the township's zoning ordinance that addressed commercial wind energy. The ordinance was based, in part, on the model ordinance developed by DEP.

Logan Township also developed a Wind Energy Overlay Zone that identified areas in the township where commercial wind energy facilities would be considered a "use by right." The township determined the overlay zone through a GIS analysis that overlaid wind speed data onto a topographical map of the township. It examined areas of the township that had sufficient wind for energy development, and, using the Blair County Comprehensive Plan as a guide, excluded undeveloped areas that had been identified for preservation in the comprehensive plan from the wind energy overlay zone. The ordinance also incorporated the Horseshoe Curve National Historic Site as a limiting factor, requiring that any wind energy facility be constructed at least 3,000 feet from the center of the railroad bed that traverses the site.

Pennsylvania Natural Heritage Program data

As of December 2008, the PNHP has completed first-time inventories in 60 of Pennsylvania's 67 counties (Figure 1), and work is progressing in the remaining seven counties. The purpose of the inventories is to provide current, reliable, objective information to help inform environmental decisions. PNHP information can be used to guide conserva-

Figure 1: Completion status of county-level Natural Heritage Inventories by the PNHP (as of December 2008)



(Source: PA Natural Heritage Program, http://www.naturalheritage.state.pa.us/CNAI_Download.aspx)

tion work and land use planning. The data gathered by PNHP provides an opportunity for townships to make land-use decisions based on a centrally managed body of current ecological data. Because of widespread concern over the ecological impacts of wind energy development, as well as legal protections for state and federally listed endangered and threatened species, townships may want to guide wind energy development away from areas of potential ecological impact.

In the PNHP system, field ecologists determine which areas of a county are ecologically significant. These Natural Heritage Areas (NHAs) are determined based on the existence of habitat for plants and animals of special concern, the presence of ecologically significant natural communities, and the landscape context and size of a site. Large, relatively undisturbed areas provide important corridors for plants and animals. The Natural Heritage Inventories include four NHA designations (See box below) that are intended to provide the information needed to plan biodiversity conservation at the species, community, and ecosystem levels.

The PNHP data are well suited as a basis for a wind energy zone for a number of reasons. They represent a

Natural Heritage Area (NHA) designations

- *Biological Diversity Area (BDA)* – BDAs are areas containing plants or animals of special concern at state or federal levels, exemplary natural communities, or exceptional native diversity. BDAs are separated into "core" (essential and highly vulnerable habitats) and "support" (less vulnerable but still ecologically vital areas that often surround or lie adjacent to Core BDAs) areas.
- *Landscape Conservation Area (LCA*) – LCAs are large contiguous areas that are important because of their size, open space, habitats, and/or inclusion of one or more BDAs. Although an LCA includes a variety of land uses, it typically has not been heavily disturbed and thus retains much of its natural character. Its high ecological integrity offers unique capacity to support biodiversity and human health.
- *Important Bird Area (IBA)* – The Pennsylvania Audubon Society administers the state's IBA Program and defines an IBA as "a site that is part of a global network of places recognized for their outstanding value to bird conservation." An IBA must meet one of several criteria developed by the Ornithological Technical Committee of the Pennsylvania Biological Survey.
- *Important Mammal Area (IMA)* – The Important Mammal Areas Project (IMAP) is being carried out by a broad-based alliance of sportsmen, conservation organizations, wildlife professionals, and scientists. Areas nominated must fulfill at least one of five criteria developed by the Mammal Technical Committee of the Pennsylvania Biological Survey.

substantial body of ecological information that is readily available for land use planning applications. Natural Heritage Inventories for most Pennsylvania counties have been completed. Data are updated regularly, and are gathered using a well established protocol that is consistent from one location to another. County inventories are conducted with approval from the county's commissioners and citizen involvement is encouraged, assuring local support and participation. The inventories examine the natural features of each county on a landscape level, determining the needs of individual species and identifying the needs of functioning ecosystems. The PNHP data allow townships to use a consistent, current, and thorough body of data upon which to develop a wind energy zone.

What is a geographic information system?

A geographic information system (GIS) integrates computer hardware, software, and data for capturing, managing, analyzing, and displaying various forms of geographically referenced information. GIS mapping involves layering information to develop maps. These maps may be used to show the location of geographic features or perform complex analyses. For example, GIS can be used to calculate the amount of forest within a municipality, locate the steepest slopes, or identify parcels of land within flood plains. GIS has become an important tool for land use planning throughout the world.

How the maps were developed

The researchers generated the township-level maps for land use planning. They assessed the risk to ecological features due to wind energy development through the creation of an index that assigned ranks to different classes of NHAs and added the intersections of these different areas in locations featuring Class 4 or higher wind speeds. They employed data analysis and map creation ArcGIS 9.2 GIS software, produced by the Environmental Systems Research Institute (ESRI) and licensed to the Indiana University of Pennsylvania Department of Geography and Regional Planning SEAL Laboratory.

Wind speed data

The U.S. Department of Energy classifies wind speed on a scale of 1 through 7. At 164 feet (50 meters) above ground level, wind speeds of Class 4 and above (15.7 mph or greater) can be used for generating wind power with large turbines and are considered good wind energy resources. With advances in technology, some locations in Class 3 areas (wind speeds of 14.3 to 15.7 mph) may be suitable for utility-scale wind development. For the model in this manual, however, the researchers only considered Class 4 and above wind speeds (hereon referred to as "Class 4" for convenience).

Private consulting firm AWS

Truewind, LLC first developed the wind speed data used in this manual for the U.S. Department of Energy in 2002 and revised it in 2006. Wind speeds were predicted based on geophysical and meteorological information. It is important to emphasize that, while the wind speed model has an error of 7 percent or less, actual wind speed at a particular site may differ from the predicted value shown on the maps.

Conflict index

The researchers combined township boundaries with NHAs and Class 4 wind speeds to determine where overlaps occurred. Of the resulting 235 townships, many possessed relatively small amounts of Class 4 areas (100 acres or less), yet all were mapped. (While existing large wind facilities in Pennsylvania can cover thousands of acres, the turbines themselves occupy a relatively small percentage of the area[2].) They then developed a "conflict index" based on these overlaps. Higher values represent a greater concentration of ecological resources, and corresponding risk if developed for wind energy. They edited the maps to remove portions of NHAs that did not fall on the commercially desirable wind areas, and calculated the acreages of the remaining overlapped areas for the townships. They processed wind speed and NHA data in a "raster" GIS format, which represents features as clusters of gridded cells; hence, edges of areas ranked by the conflict index appear "jagged."

The merits of specific species are not readily comparable, and information about which species inhabit the NHAs is restricted and was not included among the data used in the research. It is important to note that the information contained in the NHA layers and the qualities they represent may allow one to assign higher priority to some categories than others, but they do not allow for the true assessment of how much more significant one area is than another.

Because of their importance to many species and their often undisturbed character, Biological Diversity Areas (BDAs) were considered to represent the highest conservation priority. Also, critical Important Bird Areas (IBAs) and Important Mammal Areas (IMAs) are often captured in BDAs. In this model, the presence of a BDA outweighed any other ecological consideration when developing the township conflict maps (Table 1). The researchers assigned a value of 1 to areas belonging to Landscape Conservation Areas (LCAs), IBAs, and IMAs. They assigned values of 10 and 100 to Support BDAs and Core BDAs, respectively. The summed layer values represent the number of overlapping conservation areas and the presence or absence of BDAs. For example, a map area

[2] The National Renewable Energy Laboratory online Windfarm Area Calculator assumes an individual turbine footprint of between 0.25 and 0.5 acre (http://www.nrel.gov/analysis/power_databook/calc_wind.php).

Table 1: Values used in conflict index rankings

Layer	Value
Core Biological Diversity Area + Class 4 wind area	100
Supporting Biological Diversity Area + Class 4 wind area	10
Landscape Conservation Area + Class 4 wind area	1
Important Bird Area + Class 4 wind area	1
Important Mammal Area + Class 4 wind area	1
Class 4 wind area only	0

possessing a value of 102 represents the overlap of a Core BDA and two lower-ranked areas (LCA, IMA, or IBA). A map area with a value of 13 represents the overlap of Support BDA cells with cells of the LCA, IMA, and IBA categories. A value of 0 indicates the presence of Class 4 or higher winds but not NHAs.

NHAs that contain endangered or threatened species (federal or state listing) are also shown on the maps wherever they occur (they were not edited to exclude areas outside locations of Class 4 winds). However, the presence or absence of endangered or threatened species was not factored into the scoring.

Using the maps

The maps, which are included in the accompanying CD, are not intended as a substitute for more detailed site analyses once a development proposal has actually been submitted. They can, however, serve more proactive purposes. For townships with zoning ordinances, the areas shown on the maps could be used to delineate a wind overlay zone. For example, township planners could designate wind energy as a permitted land use within areas with an index score of 0; as a conditional land use where scores of 1 through 13 appeared; and as a prohibited land use within areas possessing a score of 100 through 103. Such a structure would remove the highest conflict areas from wind energy development while allowing case-by-case review within areas of moderate conflict.

For example, applying this structure to Shade Township, Somerset County would prohibit wind energy development in the Class 4 portions of the township containing the areas of greatest ecological significance, including an area harboring an endangered species. This area would encompass 608 acres (representing index values 100 and 101). For the conditional use area, 966 acres (index values 1, 2, 10, and 11) would be potentially available for wind energy development. In the permitted area, 2,240 acres would be included.

Should a township choose to develop a wind energy overlay zone as described above, it should keep in mind that financial resources and technical abilities are needed to develop and update the zone with a GIS. Incorporating a conditional use area would require a review process to be established, raising questions about how the process would be structured and who would conduct the reviews of proposed wind energy facilities. Because Pennsylvania has not yet developed wind

energy siting guidelines, planners would need to use the U.S. Fish and Wildlife Service guidelines[3], use guidelines from another state, or develop their own. Planners would also need to consider if they would require post-construction wildlife impact studies, once again raising the issues of format and review process.

For townships without zoning ordinances, the maps could be incorporated into wind energy ordinances by establishing setbacks from conflict areas. For example, an ordinance could require that any wind energy development occur not less than 1,000 feet from conflict areas with a score of 100 through 103, thus assuring protection of the highest conflict areas. Perhaps a lesser setback, such as 500 feet, could be required for areas of moderate conflict (scores of 1 through 13). No setback would be required in areas with an index score of 0.

Tyrone Borough in Blair County, as part of its wind energy ordinance, incorporated a similar structure by requiring that wind energy facilities be setback 2,000 feet from various natural resource areas, including NHAs.

The maps do not address noise, visual impact, "shadow flicker" (the strobe effect created by turbine blades passing in front of sunlight), proximity to historical features, or other non-ecological factors related to wind energy development. Township planners may want to consider these factors when developing a wind overlay zone. The potential ecological impacts could be overlaid with other GIS data layers to create a more comprehensive wind overlay zone.

Statewide ecological benefits of using the maps

Throughout Pennsylvania, as the number of proposed wind energy facilities increases, more townships may seek to develop wind energy zones, yet no model exists for such an endeavor. This could result in widely varying methods applied to develop wind energy zones due to factors such as a county's or township's funding availability, GIS capabilities, understanding of wind energy issues, or other circumstances. A PNHP-based model would allow townships across Pennsylvania to develop wind energy zones using a common, consistent body of data that is readily available. And because areas of ecological significance often cross political boundaries, adjacent governments using the PNHP data for wind energy planning purposes would benefit from landscape-level ecological protection. This would allow townships to enhance the existing DEP model ordinance by addressing the ecological as well as non-ecological impacts of wind energy, ultimately serving a broad range of public interests.

[3] U.S. Fish and Wildlife Service (2003). Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines. Washington, DC: USFWS.

List of Townships

Following is a list of townships possessing conflicts between Class 4 or greater winds and PNHP conservation areas. The maps for these townships are included on the attached CD.

ADAMS: Franklin, Hamiltonban

BEDFORD: Colerain, Cumberland Valley, East Providence, Hopewell, Juniata, Kimmel, Liberty, Lincoln, Londonderry, Monroe, Napier, Pavia, Snake Spring, Southampton, South Woodbury, West St. Clair, Woodbury

BERKS: Albany, Upper Bern

BLAIR: Antis, Blair, Catharine, Frankstown, Freedom, Greenfield, Huston, Juniata, Logan, North Woodbury, Snyder, Taylor, Tyrone, Woodbury

BRADFORD: Armenia, Monroe

CAMBRIA: Adams, Cresson, Gallitzin, Jackson, Lower Yoder, Portage, Reade, Summerhill, Upper Yoder, Washington, West Taylor

CAMERON: Grove

CARBON: Banks, East Penn, Kidder, Packer

CENTRE: Gregg, Haines, Harris, Miles, Potter, Rush, Spring, Union, Walker, Worth

CLINTON: Beech Creek, Chapman, Lamar, Noyes, Porter

COLUMBIA: Conyngham, Jackson, Locust, Roaring Creek, Sugarloaf

CUMBERLAND: Dickinson, Hopewell, Lower Frankford, Lower Mifflin, South Middleton, Southampton, Upper Frankford, Upper Mifflin

DAUPHIN: Halifax, Jackson, Jefferson, Lower Paxton, Lyken, Middle Paxton, Reed, Rush, Wayne, Williams, Wisconisco

FAYETTE: Georges, Henry Clay, North Union, Saltlick, South Union, Springfield, Springhill, Stewart, Wharton

FRANKLIN: Fannett, Greene, Hamilton, Letterkenny, Lurgan, Metal, Montgomery, Peters, Quincy, Southampton, St. Thomas, Warren

FULTON: Ayr, Belfast, Brush Creek, Dublin, Licking Creek, Thompson, Todd, Union, Wells

HUNTINGDON: Brady, Cass, Clay, Cromwell, Dublin, Franklin, Jackson, Logan, Miller, Shirley, Spruce Creek, Tell, Union, West

JUNIATA: Beale, Delaware, Fayette, Lack, Milford, Spruce Hill, Turbett, Tuscarora, Walker

(continued on next page)

LACKAWANNA: Carbondale, Jefferson

LEBANON: Cold Spring

LEHIGH: Washington

LUZERNE: Bear Creek, Butler, Dorrance, Hanover

LYCOMING: Armstrong, Limestone, Washington

MIFFLIN: Armagh, Bratton, Brown, Decatur, Derry, Granville, Menno, Union, Wayne

MONROE: Eldred, Jackson, Pocono, Ross

NORTHUMBERLAND: Coal, West Cameron, Zerbe

PERRY: Jackson, Northeast Madison, Southwest Madison, Spring, Toboyne, Tyrone

PIKE: Blooming Grove

POTTER: Hector

SCHUYLKILL: Barry, Delano, East Union, Hegins, Mahanoy, North Union, Porter, Tremont, Union

SNYDER: Beaver, Spring, West Beaver, West Perry

SOMERSET: Addison, Allegheny, Black, Brothers Valley, Conemaugh, Elk Lick, Fairhope, Greenville, Jefferson, Jenner, Larimer, Lincoln, Lower Turkeyfoot, Middlecreek, Northampton, Ogle, Shade, Somerset, Stoney Creek, Southampton, Summit

SULLIVAN: Cherry, Colley, Davidson

SUSQUEHANNA: Clifford

TIOGA: Elk, Sullivan

UNION: Hartley, West Buffalo, White Deer

WAYNE: Canaan, Preston

WESTMORELAND: Cook, Derry, Donegal, Fairfield, Ligonier, St. Clair

WYOMING: Forkston, Monroe, North Branch, Noxen

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