LARGE FILING SEPARATOR SHEET

CASE NUMBER 09-277-EL-BGN

FILE DATE 8/14/09

SECTION PART 3

NUMBER OF PAGES 215

DESCRIPTION OF DOCUMENT

APPLICATION CONTINUED

Table 4. Species of birds observed on proposed Hardin County North Wind Farm.

FAMILY	SPECIES
	Quicalus quicula - Common Grackle
	Molothrus ater - Brown-headed Cowbird
	Fringillidae - Fringilline and Cardueline Finches
	Carpodacus mexicanus - House Finch
	Carduelis tristis - American Goldfinch
Passeridae - Old World Sparrows	*Passer domesticus* - House Sparrow

Table 5. Wildlife species as identified by field observation, landowner interview, and literature search occurring on the Proposed Hardin County North Wind Farm.

FAMILY	SPECIES
Didelphidae - American Opossums	*Didelphis virginiana* - Virginia Opossum
Sciuridae - Squirrels and Allies	*Marmota monax* - Woodchuck
	Tamias striatus - Eastern Chipmunk
	Sciurus carolinensis - Eastern Gray Squirrel
	Sciurus niger - Eastern Fox Squirrel
	Tamiasciurus hudsonicus - Red Squirrel
Muridae - Rats and Mice	*Peromyscus maniculatus* - American Deer Mouse
	Peromyscus leucopus - White-footed Mouse
Arvicolinae - Voles, Muskrats, and Lemmings	*Microyus pennsylvanicus* - Meadow Vole
	Ondatra zibethicus - Common Muskrat
Murinae - Introduced Rats and Mice	*Mus musculus* - House Mouse
	Rattus norvegicus - Norway Rat
Leporidae - Rabbits and Hares	*Sylvilagus floridanus* - Eastern Cottontail
Soricidae - Shrews	*Sorex cinereus* - Masked Shrew
	Blarina brevicauda - Northern Short-tailed Shrew
Vespertilionidae - Vesper Bats	*Pipistrellus subflavus* - Eastern Pipistrelle
	Eptesicus fuscus - Big Brown Bat
Canidae - Wolves and Foxes	*Canis latrans* - Coyote
	Vulpes vulpes - Red Fox
Procyonidae - Raccoons and Relatives	*Procyon lotor* - Northern Raccoon
Mephitidae - Skunks	*Mephitis mephitis* - Striped Skunk
	Mustelidae - Weasels, Otters, and Relatives
	Mustela vison - American Mink
Cervidae - Deer	*Odocoileus virginianus* - White-tailed Deer

Table 6. ODNR species of interest potentially inhabiting Hardin County North Wind Farm Area.

COMMON NAME	SCIENTIFIC NAME
Bald Eagle	*Haliaeetus leucocephalus*
Indiana Bat	*Myotis sodalis*
Clubshell	*Pleurobema clava*
Purple Liliput	*Toxolasma lividus*
Rayed Bean	*Villosa fabalis*
Copper-bellied Watersnake	*Nerodia erythrogaster neglecta*
Eastern Massasauga	*Sistrurus catenatus*

FIGURES

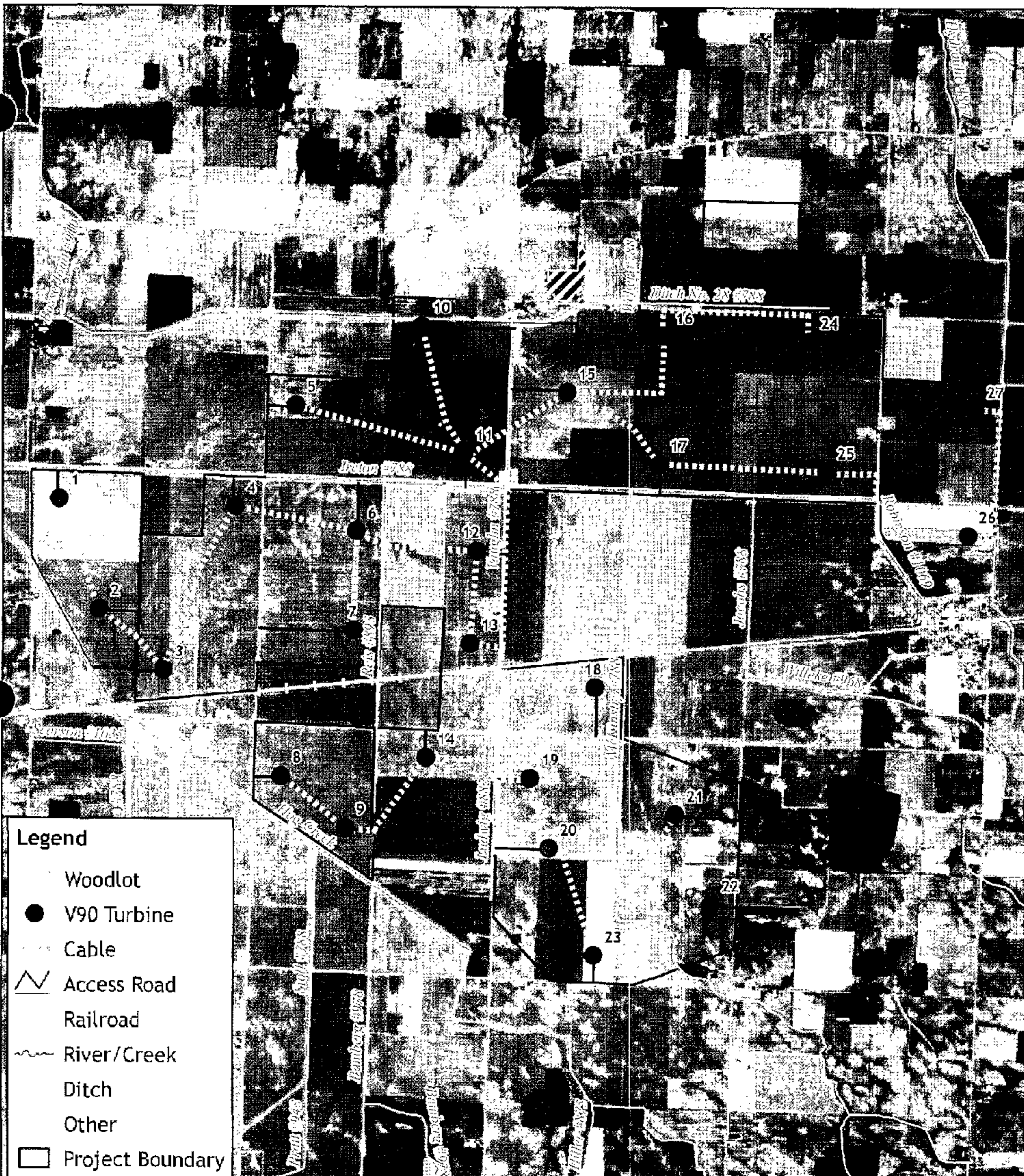


Figure 1. Habitat map with V90 turbine layout for JW Great Lakes Wind, Hardin County North Project, Ohio.

N
W E
S

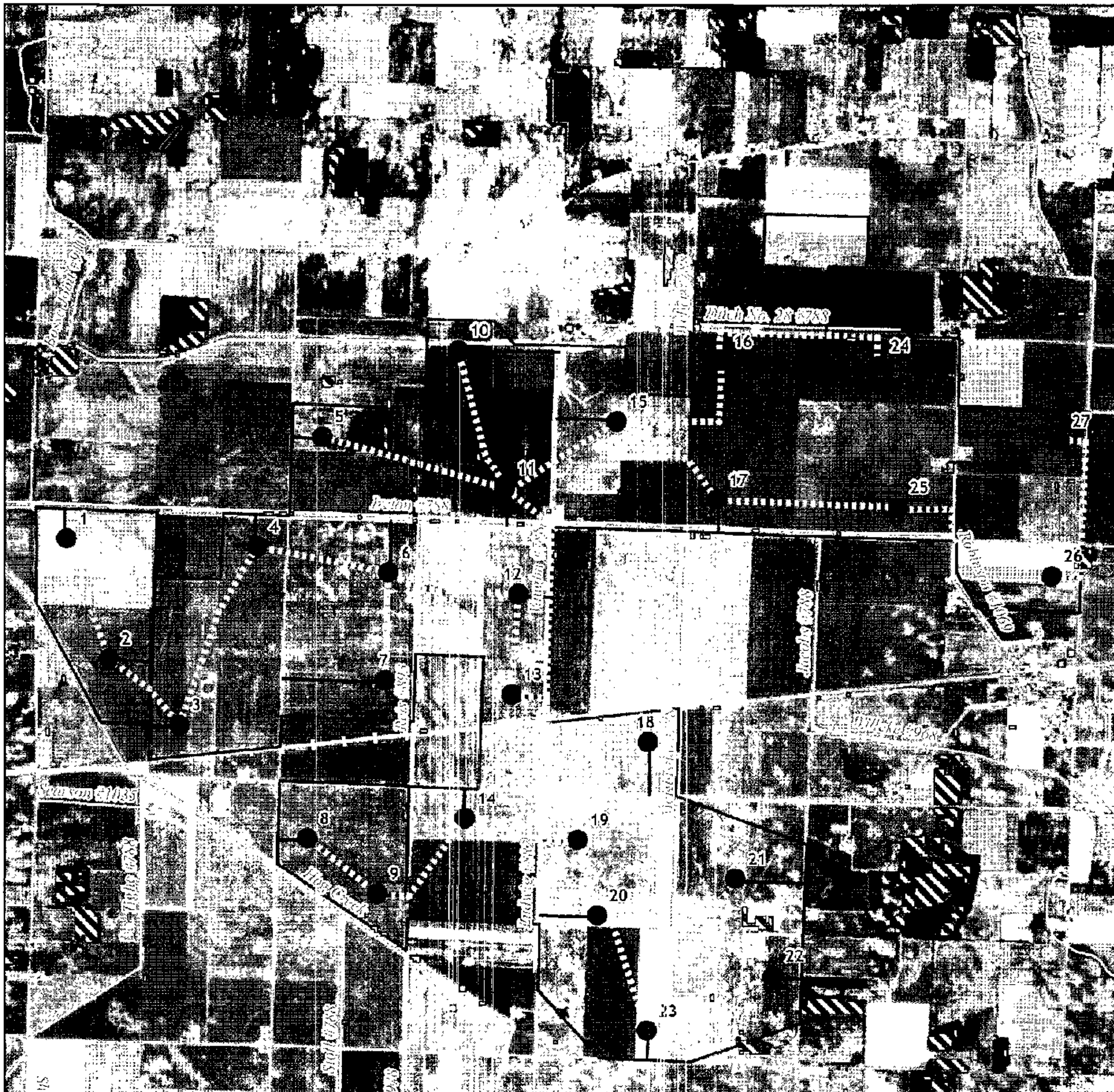
Feet
2,000 0 2,000 4,000

June 2009

BHE ENVIRONMENTAL

Project No. 1865.004

Basemap:
Microsoft Virtual Earth Imagery© 2009



Legend

- ● V90 Turbine
- Cable
- Access Road
- Railroad
- River/Creek
- Ditch
- Other
- Project Boundary

Ohio Wetlands Inventory

- Woods on Hydric Soil
- Shrub/Scrub
- Nonforested Wetland

National Wetlands Inventory

- Palustrine Forested
- Palustrine Scrub-Shrub
- Nonforested Wetland

Figure 2. Ohio Wetlands Inventory with V90 turbine layout for JW Great Lakes Wind, Hardin County North Project, Ohio.

N / W E / S	Feet: 2,000 0 2,000 4,000	June 2009	BHE ENVIRONMENTAL
	Project No. 1865.004	Basemap: Microsoft Virtual Earth Imagery©2009	

APPENDIX A

Photo Log

Photo 1. Looking Northeast from RR crossing on County Route 95

Photo 2. Looking Northwest from RR crossing on County Route 95

Photo 3. Looking west at Fitzhugh Ditch paralleling Town Route 30

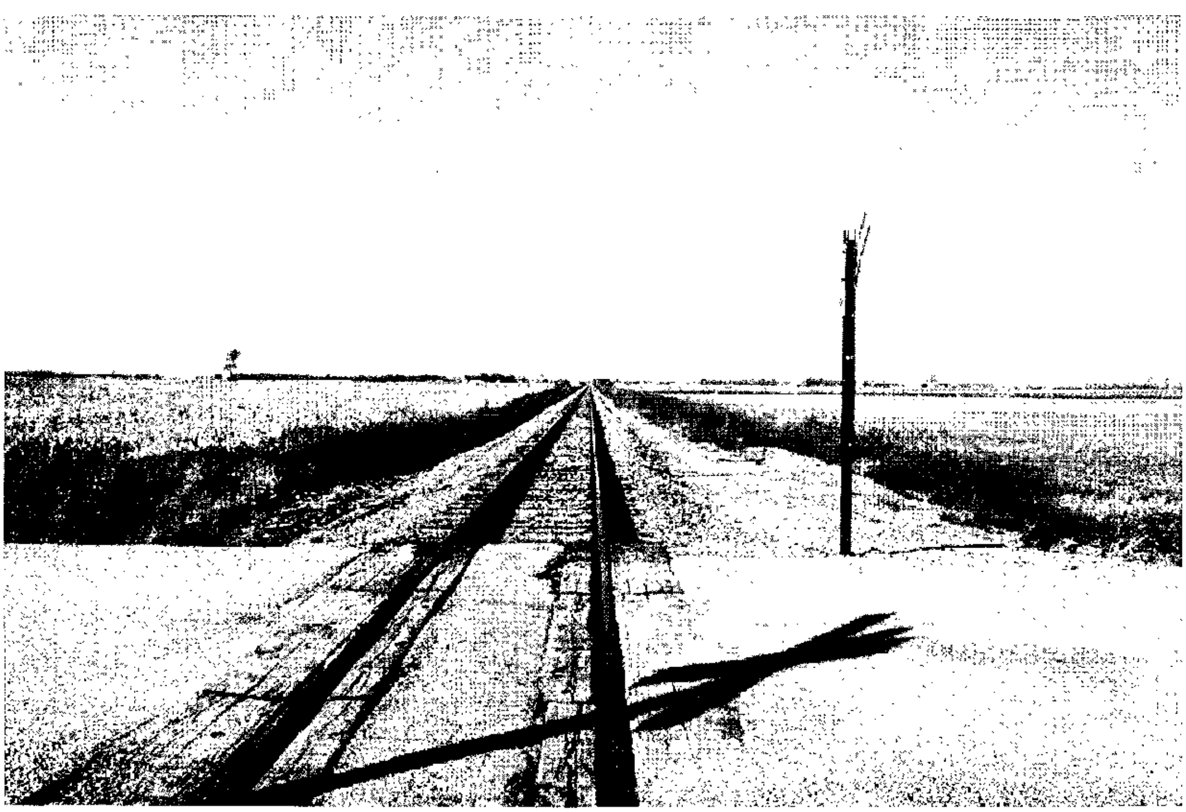


Photo 4. Railroad Crossing on County Route 95 looking west

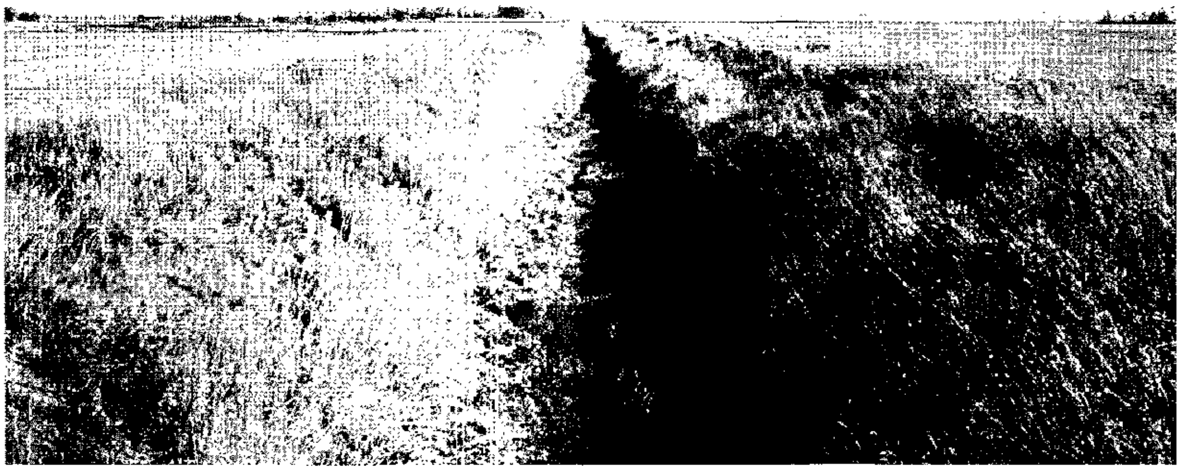


Photo 5. Hog Creek Ditch, looking East from Town Route 85

Photo 6. Hog Creek Ditch looking East from County Route 95

Photo 7. Woodlot looking North along County Route 95

Photo 8. Close-up of Woodlot

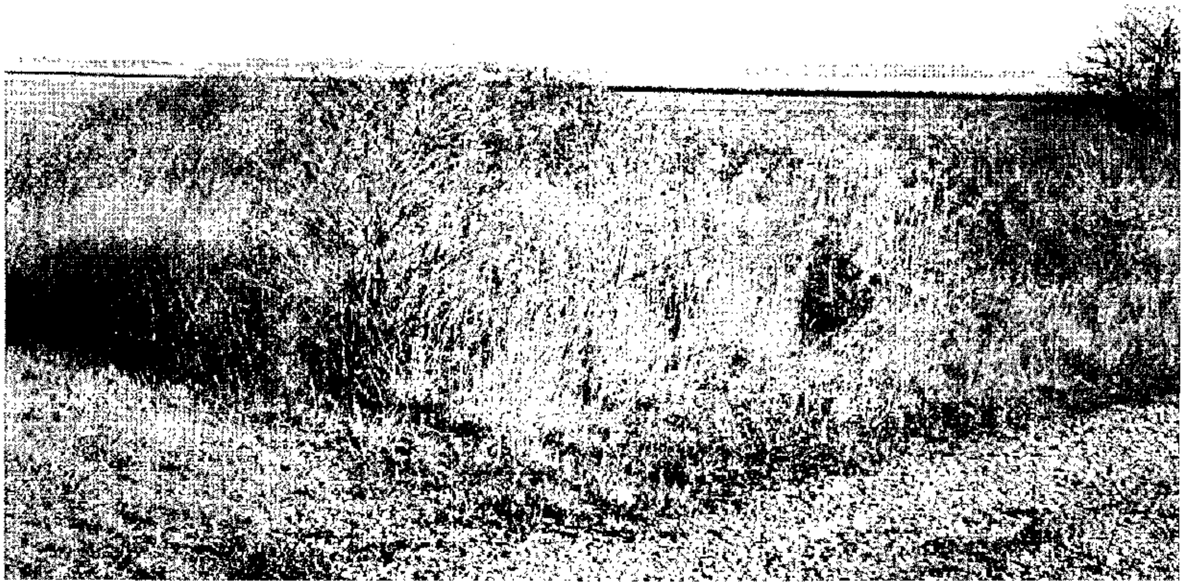


Photo 9. Terrestrial Habitat adjacent to Railroad Tracks at County Route 95

Photo 10. Looking Southeast from State Route 81/County Route 95 Intersection

APPENDIX B

Data Sheets

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: JW Great Lakes Project name: Hardin Co. N Date: 30 Oct 08 Point number: HW1

Survey period: Morning Afternoon Evening Start time: 0800 End time: 1600

Weather Temp (°C): -2.4 Wind speed (m/s): 0 Cloud cover 0 %

Observer: R. White Notes:

Species	#	Time	Age	Observation		Circling (yes/no)	Entered project area (yes/no)	[illegible] within rotor area
				Height	Direction			
RTHA	1	1048	A	1	E	N	Y	
TUVU	1	1242		2	S	N	Y	
RTHA	1	1254	A	1	W	N	Y	
[illegible]	3							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: JW Great Lakes Project name: Hardin Co. N Date: 31 Oct 08 Point number: HW1

Survey period: Morning Afternoon Evening Start time: 0900 End time: 1600

Weather Temp (°C):________ Wind speed (m/s):________ Cloud cover________%

Observer:______________________ Notes:______________________

Species	#	Time	Age	Observation		Circling? (yes/no)	Entered project area? (yes/no)	Estimated time within rotor area
				Height	Direction			
RTHA	2	0915	A	1	W	N	Y	
RTHA	1	1050	A	1	E	N	Y	
AMKE	2	1127	A	1	S	N	Y	
RTHA	1	1130	A	3	S	N	Y	
AMCR	14	1212	A	1	S	N	Y	
NOHA	1	1428	A	1	S	N	Y	
COHA	1	1440	A	1	S	N	Y	
RTHA	1	1450	A	2	S	N	Y	
AMKE	1	1458	A	1	S	N	Y	
	24							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: IW Great Lakes   Project name: Hardin Co. N   Date: 23 oct 08   Point number: HW1

Survey period: Morning   Afternoon   Evening   Start time: 0900   End time: 1600

Weather   Temp (°C): 3   Wind speed (m/s): 1   Cloud cover 0 %

Observer: R. White   Notes:

Species	#	Time	Age	Observation Height	Observation Direction	Circling? (yes/no)	Entered the project area? (yes/no)	Estimated time within rotor area
COHA	1	1024	A	1	W	N	Y	
TUVU	2	1231		1	W	Y	Y	
TUVU	1	1405	A	2	E	N	Y	
TUVU	2	1532		1	S	N	Y	
	6							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: SW Great Lakes Project name: Hardin Co. N Date: 24 Oct 08 Point number: HW1

Survey period: Morning Afternoon Evening Start time: 0900 End time: 1600

Weather Temp (°C): 10.6 Wind speed (m/s): 0 Cloud cover 100 %

Observer: R. White Notes:

Species	#	Time	Age	Observation Height	Observation Direction	Circling? (yes/no)	Entered project area? (yes/no)	Estimated time within rotor area
RTHA	1	0904	A	1	S	N	Y	
NOHA	1	0922	A	1	SW	N	Y	
SSHA	1	0935	A	1	S	N	Y	
AMCR	16	1029		1	S	N	Y	
AMKE	1	1113	A	1	S	N	Y	
NOHA	1	1144	A	1	S	N	Y	
	21							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: AW Great Lakes Project name: Hardin Co. N. Date: 16 oct 08 Point number: HW1

Survey period: Morning Afternoon Evening Start time: 0900 End time: 1600

Weather Temp (°C): 11.5 Wind speed (m/s): 4.5 Cloud cover 100 %

Observer: R, White Notes:

Species	#	Time	Age	Observation		Circling	Entered project area	Estimated time
				Height	Direction	(yes/no)	(yes/no)	within [illegible]
TUVU	2	1118		3	S	Y	Y	
TUVU	1	1248		3	N	N	Y	
RTHA	2	1302	A	2	N	N	Y	
TUVU	3	1302		2	S	N	Y	
RTHA	2	1405	A	3	S	Y	Y	
TUVU	1	1430		1	S	Y	Y	
TUVU	8	1535		3	S	N	Y	
TUVU	366	1545		3	S	Y	Y	
RTHA	1	1545	A	3	S	N	Y	
	386							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: L.W. Great Lakes Project name: Hardin Co. Wind Farm Date: 17 oct 08 Point number: HW1

Survey period: Morning Afternoon Evening Start time: 0900 End time: 1600

Weather Temp (°C): 1[illegible].5 Wind speed (m/s): 2.5 Cloud cover 80 %

Observer: R. White Notes:

Species	#	Time	Age	Observation		Circling (yes/no)	Entered project area (yes/no)	Estimated time within rotor area
				Height	Direction			
COHA	2	0937	A	2	S	N	Y	
TUVU	1	1022		1	E	N	N	
SSHA	1	1114	A	1	SW	N	Y	
TUVU	1	1131		1	S	Y	Y	
TUVU	1	1303		1	S	N	Y	
TUVU	2	1322		1	NW	Y	Y	
Total	8							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: J.D. Great Lakes Project name: Hardin Co. N. Date: 10 oct 08 Point number: 1(w)1

Survey period: Morning Afternoon Evening Start time: 0900 End time: 1600

Weather Temp (°C): 12.2 Wind speed (m/s): 2 Cloud cover 0 %

Observer: R. white Notes:

Species	#	Time	Age	Observation		Circling (yes/no)	Entered project area (yes/no)	Estimated time within rotor area
				Height	Direction			
COHA	1	0925	A	1	S	N	Y	
2USt	23	1015		1	S	N	Y	
TUVU	1	1119		1	N	N	Y	
TUVU	4	1206		2	W	N	Y	
TUVU	2	1213		2	W	N	Y	
TUVU	3	1325		2	S	N	Y	
TUVU	6	1407		2	S	Y	Y	
COHA	1	1552		1	E	N	Y	
[illegible]	41							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

FORM WD03
6/27/08

OHIO DEPARTMENT OF NATURAL RESOURSES
Division of Wildlife

DIURNAL MIGRATION SURVEY FORM

Company: JW Great Lakes Project name: Hardin Co. North Date: 9 Oct 08 Point number: HW 1

Survey period: Morning Afternoon Evening Start time: 0900 End time: 1600

Weather Temp (°C): 17.7 Wind speed (m/s): 2 Cloud cover 0 %

Observer: R. White Notes:

Species	#	Time	Age	Observation		Circling (yes/no)	Entered project area? (yes/no)	Estimated time within inter area
				Height	Direction			
RWBL	9	0945		1	S	N	Y	
MODO	7	0947		1	S	N	Y	
EUST	42	0953		1	S	N	Y	
SSHA	1	1030		1	W	N	Y	
TUVU	2	1157		3	S	Y	Y	
TUVU	1	1208		2	SW	Y	Y	
NOHA	1	1213		2	S	Y	Y	
AMKE	1	1225		1	W	N	Y	
TUVU	1	1408		1	E	Y	Y	
NOHA	1	1452		1	E	N	Y	
Total	66							

#: Number in flock or kettle.
Heights: 1) 0-40m, 2) 40-180m, 3) > 180m.
Direction: Compass direction the bird is heading (e.g. SSW).

Exhibit 08-5. Chiropteran Risk Assessment by BHE.

PN 1865.004-001 July 2009

CHIROPTERAN RISK ASSESSMENT: PROPOSED HARDIN COUNTY NORTH WIND ENERGY GENERATION FACILITY HARDIN COUNTY, OHIO

Prepared for:
JW Great Lakes Wind, LLC
1900 Superior Avenue, Suite 333
Cleveland, OH 44114

Prepared by:
BHE Environmental, Inc.
11733 Chesterdale Road
Cincinnati, OH 45246-3405
www.bheenvironmental.com

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EXECUTIVE SUMMARY

JW Great Lakes, LLC (JW) contracted BHE Environmental, Inc. (BHE) to complete a bat risk assessment for the proposed Hardin County North Wind Farm project near the towns of Ada and Dola, Hardin County, Ohio. JW has proposed to install between 19-27 wind turbines at 100 meter hub height and 90-100 meter diameter rotors on the approximately 3,351 acre site dominated by intensive row crop agriculture production (Figure1). Nearly all of the Project area is cropland.

The Hardin County North Wind Farm site is a privately owned farmland. The terrain on the site is nearly flat. There are paved and gravel section roads throughout the project area and a single set of railroad tracks crosses the property. The area was effectively drained in the 1940s and deep linear drainage ditches cross the property and feed into Hog Creek Ditch, which drains the site to the west. The property is predominantly intensively managed for Soybean and corn agriculture.

Risk to bats is expected to be low.

There are no records of federally threatened or endangered bats in or within 5 miles of the proposed Project planning area.

The Project area is within the range of only one federally listed bat: the endangered Indiana bat (*Myotis sodalis*).

The closest Indiana bat maternity colony recorded is approximately 48 km (30 mi) away from the Project planning area, though closer colonies may be discovered around Wolf Creek approximately 21 km (13 mi) southeast of the Project area.

It is unlikely that Indiana bats will occupy the Project planning area during summer. Habitat conditions in the Project planning area, which is nearly devoid of trees and is composed largely of open fields/agricultural land, is less than suitable for foraging or roosting bats. Indiana bats, even if present, are likely to be very rare at the Hardin County North Project area during summer, and are likely to be active at heights largely below the rotor-swept area. As such, the chance of collisions between Indiana bats and turbine blades during the summer is extremely low. Studies completed to date have documented very low mortality during spring and summer months, even when concurrent mist net surveys and/or ultrasound acoustic detection devices indicate the presence of substantial numbers of bats (Arnett et al. 2008). No effects to Indiana bats during summer are expected.

Furthermore, other bat species that may experience mortality at the Hardin County North Project area are widely dispersed in the U.S. and only a very small minority of each species' population will forage in, roost in, travel through, or migrate over the Hardin County North Project area.

Indiana bats are not likely to be roosting, foraging, or migrating within the Project planning area, due to the poor habitat conditions. Indiana bats are more likely to use the Scioto River and Tymochtee Creek that are 13 and 19 km (8 and 12 mi) away from the planning area and not at risk.

The closest bat hibernaculum is Ohio Caverns in Champaign County over 56 km (35 mi) southeast of the project area.

The closest hibernaculum used by Indiana bats in Ohio, Lewisburg Limestone Mine, is approximately 116 km (72 mi) southwest of the Project area.

It is reasonable to expect that the direction of flight of Indiana bats, and of other species of bats utilizing the Lewisburg Limestone Mine hibernaculum in Preble County or the other nearby hibernacula in Champaign County, is not random. These movements are likely concentrated along the only forested rivers in the vicinity. No contiguous forested tracts link the Hardin County North Project planning area to forested rivers corridors or to any of the hibernacula. Murray and Kurta (2004) found that Indiana bats will choose to travel along forested corridors as opposed to non-forested corridors, even if the distance traveled is greater. This suggests that all of the waterways crossing the Project planning are minimally suitable as travel corridors for Indiana bats. Thus no effects to Indiana bats during spring and fall migration to and from the Lewisburg Limestone Mine in Preble County or the other bat hibernacula in Champaign County are expected.

Habitat loss will be low considering the Project area is nearly all agricultural and only about 4 percent of the area will be disturbed for construction.

1.0 INTRODUCTION

JW Great Lakes Wind, LLC (JWGL) of Columbus, Ohio, proposes construction of the Hardin County North wholesale wind energy generation facility in Hardin County, Ohio (Figure 1). The general location of the Hardin County North facility ("Project planning area") spans 13.5 square kilometers (km^2; 5.2 square miles [mi^2], 1,353 hectares [ha], or 3,351 acres [ac]) of northwestern Hardin County near the towns of Ada and Dola (Figures 1 and 2). The project planning area is approximately 0.2 percent forested, with forested areas restricted to residential yards and those along farm drains and perennial streams. The closest heavily forested areas are along the Scioto River southeast of Kenton in central Hardin County and along Tymochtee Creek near Marseilles in southwestern Wyandot County 13 km (8 mi) and 19 km (12 mi) from the planning area respectively. Land use within the Project planning area is primarily agricultural (Figure 2).

The Project planning area represents the maximum area considered for placement of turbines and facility infrastructure. The actual area occupied by the turbines and access roads that will comprise the facility will be a very small percentage of the Project planning area.

Though number and specific model of turbines has not yet been selected, the Hardin County North facility will consist of 19 to 27 wind turbines located in strings or arrays within the Project planning area. Models and number of turbines under consideration include Kenersys K100 (19 turbines), Siemens SWT 2.3-101 (21 turbines), or Vestas V90 (27 turbines). This risk assessment is applicable to all of the layout options.

The Siemens SWT 2.3-101 model will have a nameplate generating capacity of 2.3 MW, yielding a total nameplate project capacity of 48.3 MW. The proposed hub height is about 100 m (328 ft) agl. Rotor diameter will be approximately 101 m (331 ft) and individual blades will be approximately 50.5 m (166 ft) long. With the rotor tip in the 12 o'clock position, the wind turbines will reach a maximum height of approximately 150.5 m (494 ft) agl. At the 6 o'clock position, the rotor tip will be approximately 49.5 m (163 ft) agl. The turbine rotor will turn at a maximum operating speed of 16 rpm. The turbines have a nominal "cut-in speed" of 4 m/s (8.9 mph). Wind speeds above 4 m/s will result in blade speeds of 6 to 16 rpm, depending upon wind speeds.

The Vestas V90 model will have a nameplate generating capacity of 1.8 MW, yielding a total nameplate project capacity of 48.6 MW. The maximum hub height is about 100 m (328 ft) agl. Rotor diameter will be approximately 90 m (295 ft) and individual blades will be approximately 45 m (145 ft) long. With the rotor tip in the 12 o'clock position, the wind turbines will reach a maximum height of approximately 145 m (476 ft) agl. At the 6 o'clock position, the rotor tip will be approximately 55 m (180 ft) agl. The turbine rotor will turn at a maximum operating speed of 16.6 rpm. The turbines have a nominal "cut-in speed" of 4 m/s (8.9 mph). Wind speeds above 4 m/s will result in blade speeds of 9.3 to 16.6 rpm, depending upon wind speeds. With a 27 turbine layout this layout would disturb the most acreage and is the layout used for the worst case analysis in this report.

The Kenersys K100 model will have a nameplate generating capacity of 2.5 megawatts (MW), yielding a total nameplate project capacity of 47.5 MW. The proposed hub height is about 100 m (328 feet [ft]) above ground level (agl). Rotor diameter will be approximately 100 m (328 ft) and individual blades will be approximately 50 m (164 ft) long. With the rotor tip in the 12 o'clock position, the wind turbines will reach a maximum height of approximately 150 m (492 ft) above ground level (agl). At the 6 o'clock position, the rotor tip will be approximately 50 m (164 ft) agl. The turbine rotor will turn at a maximum operating speed of 14.1 revolutions per minute (rpm). The turbines have a nominal "cut-in speed" of 3.5 meters per second (m/s; 7.9 miles per hour [mph]). That is, winds of 3.5 m/s contain sufficient energy to support the generation of electric power by the turbine. At wind speeds below 3.5 m/s, as measured by an anemometer atop each nacelle, the turbine's "primary brake" is applied (i.e., the turbine blades are feathered by orienting the primary surface of each blade parallel to the wind direction). With the primary brake applied, the blades will not rotate around the hub, or will rotate very slowly (less than 1 rpm). Control systems allow the cut-in wind speed to be set independently at each turbine. Wind speeds above 3.5 m/s will result in blade speeds of 1 to 14.1 rpm, depending upon wind speeds. If wind speeds at an operating (spinning) turbine drop below the cut-in speed, the primary brake is applied and the blades come to a stop within approximately one minute.

BHE assumes turbines will be lit with red strobe-like or incandescent flashing lights. Lighting will be limited to the minimum number required by the Federal Aviation Administration (FAA) for aircraft safety.

Based on other sites using the similar turbine models, BHE assumes each turbine tower will be set upon a concrete pad with an aboveground diameter of approximately 4.5 m (15 ft). Nominally, crops and other vegetation within approximately 55 m (180 ft) of each tower site will be cleared, yielding a maximum of 27, 1.2-ha (2.9-ac) openings (32.4 ha or 78.3 ac of clearing for tower sites). The total cleared area required for erection of turbines will be approximately 0.32 km^2 (0.1 mi^2), or approximately 2.0 percent of the total Project planning area. A 2.5 MW turbine array would require only 19 units so 30% less land would be disturbed. As tree cover is extremely sparse within the planning area and most land use is cropland, little or no tree removal is expected to be necessary for construction of turbines or access roads.

Collisions between bats and other aerial manmade structures are well documented. Numerous impacts with television towers, other communication towers, large buildings, power lines, and fences have been reported (Terres 1956, Timm 1989, Martin et al. 2005). Interactions between wind turbines and birds and bats are a known and documented occurrence as well. Utility-scale wind turbines can directly and indirectly affect bats that occur in or migrate through the wind energy generation facility. In some cases, bat collisions with wind turbine blades appear to occur at higher rates. At this time, such cases of higher fatality rates appear to be limited to sites located on forested Appalachian ridgelines (e.g., the Meyersdale, Pennsylvania, Mountaineer, West Virginia, and Buffalo Mountain, Tennessee wind energy generation facilities discussed later in this document; Arnett et al. 2008; Fiedler et al. 2007).

In evaluating the risk of bat mortality at this site, which is located on primarily flat, agricultural land, it is useful to consider mortalities at other operating utility-scale wind energy generation facilities in the Midwestern United States. Bat mortality studies with statistical corrections for searcher efficiency and scavenger removal have been completed at the following wind development sites in the Midwestern United States. (Figure 3):

- 54.5 MW (33 turbines) Crescent Ridge wind power project, Bureau County, Illinois; located approximately 463 km (287 mi) northwest of the Hardin County North Project planning area;

- 80.1 MW (89 turbines) Top of Iowa wind power development site, Worth County, Iowa; located approximately 791 km (491 mi) northwest of the Project planning area;

- 20.5 MW (31 turbines) wind power development site near Lincoln, Kewaunee County, Wisconsin; located approximately 489 km (304 mi) northwest of the Project planning area; and

- 236 MW (354 turbines) Buffalo Ridge wind power development site, Lincoln and Pipestone counties, Minnesota; located approximately 1,033 km (642 mi) northwest of the Project planning area.

This report documents design and site attributes of the proposed Hardin County North wind energy generation facility, evaluates the avenues by which bats may be affected by the Hardin County North facility, and provides a review of information pertaining to bat mortality at existing wind energy generation facilities. Based upon these data, and upon information provided by state wildlife agencies and the U.S. Fish and Wildlife Service (USFWS), we qualitatively estimate the risk of effects to bats posed by the Hardin County North facility.

2.0 DESCRIPTION OF THE PROJECT AREA

2.1 REGIONAL CONDITIONS

The following text describes the ecological region in which the proposed Hardin County North wind energy generation facility (the "Project") occurs. This description is useful in understanding the nature and important ecological aspects of the area.

The Project lies within the Eastern Broadleaf Forest (Continental) Ecological Province of the United States (USFS 1994). Within this Province, the Project is located in Ecoregion Section 222H—Central Till Plains, Beech-Maple (Figure 4). Of all the wind energy generation facilities at which bat mortality studies have been completed, none are within this same Ecological Province or Ecoregion Section. Ecological aspects of Crescent Ridge, Top of Iowa, Lincoln, and Buffalo Ridge (four Midwestern operating wind energy generation facilities at which bat mortality studies have been completed) are shown in Table 1 for comparison. These wind energy generation facilities occupy areas dominated by agriculture and cropland comparable to the Hardin County North Project planning area.

Ecoregion Section 222H comprises part of the Central Lowlands geomorphic province and is characterized by flat to gently rolling till-plain, broad bottomlands, shallow entrenchment of drainages, and a few major river valleys. Section 222H is predominantly Wisconsinan glacial till and dominant soils include Udalfs and Aqualfs (USFS 1994).

The potential natural vegetation of Section 222H is beech-maple forests with some oak-hickory forests and bluestem prairie. Most of the land in Section 222H is now highly productive farmland, with most forest stands in small, isolated tracts less than 101 ha (250 ac) in size (USFS 1994, Appendix A).

Precipitation averages 900 to 1030 mm (35 to 40 in) per year. Mean annual temperature is approximately 10 to 13 °C (50 to 55°F). The growing season ranges from 155 to 180 days (USFS 1994).

Approximately 28 percent of Hardin County is forested (12 percent coniferous, 11 percent deciduous, 3 percent forested wetlands, and 2 percent mixed forest; USGS 2001).

2.2 SITE-SPECIFIC CONDITIONS

BHE visited the site October 31, 2008, and representative portions were photographed (Appendix A). Topography in the Project planning area is nearly flat, and land use is primarily agricultural (predominantly corn and soybeans). Project area views, from horizon to horizon, are nearly entirely farmland, with small groups of trees, tree lines, or partially treed, narrow riparian strips sometimes visible. Wooded habitat is very uncommon, and occurs primarily in residential yards within the project area and along fencerows and small, isolated woodlots outside the project boundary but within view of the site. The area surrounding the Project planning area is similar, with the majority of the landscape dedicated to row crop production. Many of the watercourses are ditched, or occur in gullies where they are isolated from their floodplains. Active tillage therefore extends in many cases nearly to the ditch's edge.

The planning area lacks significant land features such as ridgelines, river corridors, or forested expanses that may be used as landmarks by migrating bats. The quality of bat habitat at the site is low.

2.3 BATS

Eleven species of bats have been documented in Ohio. Except for the eastern small-footed bat (*M. leibii*) and Rafinesque's big-eared bat (*Corynorhinus rafinesquii*) each of the remaining nine species has potential to occur on the Project area (Table 2).

These nine bat species that occur in Ohio include year-round residents as well as species present only during certain seasons (Table 2). The Indiana bat (*M. sodalis*) is federally listed as endangered. The remaining eight species are not federally listed, are not proposed for listing, and are not candidates for federal listing. The Indiana bat is listed as endangered by the State of Ohio. None of the other bat species potentially present at the Project area is listed by the State of Ohio (ODNR 2009). Descriptions of each species potentially present at the Project area are provided below.

2.3.1 Indiana Bat (*Myotis sodalis*)

The Indiana bat was listed by the federal government as endangered on March 11, 1967 and is listed as endangered by the Ohio Endangered Species Protection Board. Populations across the species range (as recorded from hibernacula counts) have declined since the late 1950s. Recent estimates place the total species population at approximately 468,000 (USFWS 2008a). A principal cause of decline is destruction of hibernacula from collapse, flooding, or vandalism by humans. Suspected contributing factors include loss of suitable summer habitat and contamination by pesticides (USFWS 2007a). A recovery plan for Indiana bats was developed in 1983 (USFWS 1983) and revised in 1999 (USFWS 1999) and in 2007 (USFWS 2007a).

In winter (mid-November through March), Indiana bats hibernate in caves and abandoned underground mines. For the remainder of the year, Indiana bats roost in trees (Barbour and Davis 1969). In April and again in August-September, Indiana bats migrate between winter and summer habitat. Some individuals may travel 483 to 575 km (300 to 357 mi) between summer and winter roosts (USFWS 2007a, Winhold and Kurta 2006). Others, particularly males, may roost in trees near hibernacula in summer. In Pennsylvania and New York, radiotelemetry studies indicate Indiana bats migrate between 16 to 97 km (10 and 60 mi) (USFWS 2007a). Migrating bats have been documented traveling along power line and pipeline rights-of-way, along highways, hedgerows, tree lines, and along stream courses (Murray and Kurta 2004, Johnson and Strickland 2003, USFWS 2007a, Verboom and Huitema 1997). Limited recovery records of banded Indiana bats from the Midwest indicate females and some males migrate north in the spring upon emergence from hibernation (USFWS 2007a).

In spring, Indiana bats migrate from hibernacula to forested habitats. Upon emergence from hibernation, Indiana bats are active near the hibernaculum during a period called staging. Spring staging may occur from approximately mid-April through early May. During staging, Indiana bats emerging from hibernation roost in trees, and forage near their hibernacula. In Missouri, staging male and female Indiana bats traveled between 1.9 and 10.3 km (1.2 and 6.4 mi) from their hibernaculum nightly (Rommé et al. 2002). Females typically leave caves before males (Humphrey 1978, LaVal and LaVal 1980). Following mid-May emergence from hibernation, a single radio-tracked male followed for two weeks traveled 16 km (10 mi) in western Virginia (Hobson and Holland 1995).

Indiana bats typically arrive in summer habitat (primarily upland and riparian forests) in early to mid-May. This species roosts under exfoliating bark or in cavities of trees. Pregnant females form maternity colonies that may contain up to 100 or more adult bats (USFWS 2007a). Male Indiana bats tend to roost singly or in small all-male groups (USFWS 2007a). Males may occur in summer anywhere throughout the range of the species, including near hibernacula (Whitaker and Brack 2002).

Adults of this species feed exclusively on flying insects. Indiana bats forage most frequently in upland and riparian forests, but they also may forage along wooded edges between forests and croplands, and over fallow fields (Brack 1983, LaVal and LaVal 1980). They frequently use open space over streams as travel corridors.

In August, Indiana bats begin to leave summer habitat and migrate back to hibernacula. Autumn swarming occurs from approximately mid-August through September. During swarming, numerous bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in caves during the day (Cope and Humphrey 1977). Indiana bats periodically use tree roosts during fall swarming (Menzel et al. 2001). In Missouri, swarming Indiana bats traveled up to 6.4 km (4 mi) from roost sites (Rommé et al. 2002). In Kentucky, male Indiana bats radio tracked during October traveled up to 2.7 km (1.7 mi) from their roost sites. Kiser and Elliot (1996) found males roosted in trees between 0.8 and 2.4 km (0.5 and 1.5 mi) from the hibernaculum.

The Indiana bat has potential to occur in Ohio year-round (Figure 5; Appendix B). The USFWS assumes the Indiana bat may occur in every county in Ohio (USFWS 2008b). Most counties in Ohio with records of Indiana bats only have summer records. Those few with summer and winter records are located along the in the southern part of the state. Lewisburg Limestone Mine is the closest known Indiana bat hibernaculum, located approximately 116 km (72 mi) southwest of the project area in Preble County, Ohio (Figure 5; Boyer, pers. comm.). The mine is a Priority II Indiana bat hibernaculum based upon the prioritization scheme outlined in the 2007 Indiana Bat Recovery Plan (USFWS 2007a). Though the USFWS and ODNR conducted the most recent census in the hibernaculum in 2009, survey results have not been analyzed (Boyer, pers. comm.). As of 2006, 7,405 Indiana bats were observed (USFWS 2008a). This hibernaculum has been surveyed every other year since 1996. During the course of these surveys, the number of Indiana bats observed has decreased from 9,298 to 7,405 individuals.

Other bat hibernacula in the region include Ohio Caverns, Sanborn's Cave, and an unnamed cave near Sanborn's Cave (Lott, pers. comm.), all found in Champaign County over 56 km (35 mi) from the Project planning area. None of these hibernacula are known to have Indiana bats.

A search of the Ohio Natural Heritage Database in January 2009 revealed that no federal Threatened, Endangered or Candidate bat species have been documented within the Project planning area (Appendix C). Though there are no records of Indiana bats in or within 8 km (5 mi) of the Project planning area, there were two Indiana bats captured along Wolf Creek at least 21 km (13 mi) southeast of the Hardin County North site in south central Hardin County (Boyer, pers. comm.). One of these bats was a lactating female; therefore, it is likely there is a maternity roost near the capture location. The closest confirmed Indiana bat maternity colonies are located southeast of Bellefontaine approximately 48 km (30 mi) south of the Project planning area (Lott, pers. comm.).

2.3.2 Northern Long-Eared Bat (*M. septentrionalis*)

The northern long-eared bat ranges from southern Canada and the central and eastern United States through northern Florida (Appendix B). The northern long-eared bat is migratory (Table 2; Whitaker and Hamilton 1998). In winter (October/November through March/April), this species hibernates in caves and mines. It may hibernate in caves occupied by several other species. Northern long-eared bats occasionally emerge from hibernation and have been observed in flight during winter (Whitaker and Hamilton 1998).

In summer, this species typically roosts in trees (under exfoliating bark or in crevices and hollows) and in manmade structures (Harvey 1992, Foster and Kurta 1999). Foster and Kurta (1999) identified northern long-eared bats roosting singly or in small groups that averaged 17 individuals. This species forages along forested hillsides and ridges, often through dense vegetation (Harvey et al. 1999).

2.3.3 Little Brown Bat (*M. lucifugus*)

The little brown bat is abundant throughout forested areas of the United States as far north as Alaska (Appendix B).

This species often forms nursery colonies in buildings, attics, and other manmade structures (Harvey et al. 1999). These colonies are often close to a lake or stream. Males are likely solitary in the summer months (Harvey et al. 1999). In late August and early September, little brown bats prepare for hibernation, and may swarm at the entrance of caves or mines (Whitaker and Hamilton 1998). Migration between summer and winter roosts may be short distances or several hundred miles (Fenton and Barclay 1980, Whitaker and Hamilton 1998). The timing of migration and hibernation depends upon local weather conditions, with northern populations hibernating from September to early May, and southern populations hibernating from November to March (Fenton and Barclay 1980). Little brown bats typically hibernate in caves and mines, and hibernacula are typically not used as summer roosts (Harvey et al. 1999, Whitaker and Hamilton 1998).

Little brown bats often forage over water where their diet consists of aquatic insects, including mosquitoes, mayflies, midges, and caddisflies. Foraging also occurs over forest trails, cliff faces, meadows, and farmland where they consume a wide variety of insects (Harvey et al. 1999).

2.3.4 Eastern Pipistrelle (*Perimyotis [Pipistrellus] subflavus*)

The eastern pipistrelle occurs in the eastern United States, and ranges throughout Ohio (Appendix B, Barbour and Davis 1969). This species appears abundant throughout its range. Summer and winter ranges are identical. In summer, eastern pipistrelles have been found roosting in foliage and, rarely, in buildings. They may roost singly or in colonies of up to 30 bats (Barbour and Davis 1969). In winter, eastern pipistrelles hibernate in mines, quarries, caves, and rock crevices.

2.3.5 Big Brown Bat (*Eptesicus fuscus*)

The big brown bat is common throughout its range (Appendix B) from Alaska and Canada to Mexico and South America. Big brown bats do not migrate; there appears to be no difference in range from summer to winter (Table 2; Barbour and Davis 1969). They roost in rock crevices, expansion joints of bridges and dams, hollow trees, and manmade structures. Maternity colonies containing several hundred individuals have been recorded from attics, barns, and other buildings (Harvey 1992).

2.3.6 Eastern Red Bat (*Lasiurus borealis*)

The eastern red bat occurs from southern Canada, throughout the United States, to Mexico and Central America (Appendix B, Barbour and Davis 1969). It is common in the Midwest and central states, including Ohio (Harvey 1992, Whitaker and Hamilton 1998). Eastern red bats are migratory; however, migration patterns are poorly understood. In winter, eastern red bats may hibernate in tree foliage for short periods, but arouse and forage during warm winter nights.

Like most lasiurids, *L. borealis* typically roosts in tree foliage. Individual eastern red bats may use several roost sites. Eastern red bats hang from branches or leaf petioles and are camouflaged by leaves. Adults are solitary, but females and young roost together until young become volant.

2.3.7 Hoary Bat (*L. cinereus*)

The hoary bat is widespread throughout the United States, but in eastern regions, the species' distribution varies seasonally (Appendix B, Whitaker and Hamilton 1998). Breeding individuals are known from Canada south to Arkansas, Louisiana, and Georgia (Barbour and Davis 1969). The range of the hoary bat includes Ohio (Harvey et al. 1999).

It appears that the sexes are separate during summer, with females inhabiting the northeast region (Cryan 2003, Whitaker and Hamilton 1998). Reproductive females are found in the northeast as far south as Pennsylvania and Indiana (Whitaker and Hamilton 1998). Female hoary bats give birth between mid-May and early July (Cryan 2003).

In August, this species moves south to winter habitat in southeastern and southwestern states, the Caribbean, and Central and South America (Cryan 2003, Whitaker and Hamilton 1998). In the eastern United States, hoary bats winter in northern Florida and southern Georgia, Alabama, Louisiana, and South Carolina (Whitaker and Hamilton 1998). Hoary bats apparently migrate in groups, with large numbers passing through an area over several nights in spring and fall (Whitaker and Hamilton 1998, Zinn and Baker 1979). Females precede males in spring migration. In the north, some may hibernate rather than migrate (Whitaker 1980). Hoary bats migrate north from March through April (Whitaker and Hamilton 1998).

Hoary bats roost in foliage of deciduous or coniferous trees (Barbour and Davis 1969). The species generally is solitary except during migration and when young accompany females (Mumford and Whitaker 1982).

2.3.8 Silver-Haired Bat (*Lasionycteris noctivagans*)

The silver-haired bat is common in forested areas throughout much of North America, although it is characterized as a northern species (Appendix B, Whitaker and Hamilton 1998). This species typically is found in parts of its range containing stands of coniferous or mixed coniferous and deciduous forests (Whitaker and Hamilton 1998).

Silver-haired bats commonly roost in tree cavities, often switching roosts during the maternity season. Silver-haired bats typically are solitary, but may congregate in small maternity colonies usually numbering fewer than 10 individuals (Whitaker and Hamilton 1998).

Females are thought to migrate farther than males, and it is possible males remain in winter habitat year-round (Whitaker and Hamilton 1998). During migration, silver-haired bats have been found roosting in trees along a ridge (Whitaker and Hamilton 1998). Typical winter roosts for this species include trees, buildings, wood piles, and rock crevices (Harvey et al. 1999). Whitaker and Hamilton (1998) depict the species' winter range as extending as far north as the southern tip of Ohio. Occasionally silver-haired bats will hibernate in caves or mines, especially in northern regions of their range.

Silver-haired bats roost in forested areas and feed predominantly in openings such as small clearings and along roadways or streams (Whitaker and Hamilton 1998). The silver-haired bat typically leaves the roost and begins to forage relatively late, with major foraging activity peaks 3, and 7 to 8 hours after sunset (Kunz 1973).

2.3.9 Evening Bat (*Nycticeius humeralis*)

The evening bat occurs throughout the eastern United States, including a large portion of Ohio (Appendix B), and is abundant throughout its range. Evening bats are known to form large maternity colonies, often including up to several hundred individuals. These maternity colonies are generally formed in hollow trees, behind loose bark, or occasionally in buildings and attics. The evening bat is considered a true forest bat and is almost never observed in caves. Little is known about the migration patterns of this species; however, evening bats have been shown to put on high amounts of fat in the fall, a possible indication of a long migration. Banded evening bats have been found up to 547 km (340 mi) south of their initial banding sites. It is believed that evening bats remain active during the winter.

3.0 POTENTIAL EFFECTS TO BATS

Construction and operation of wind energy facilities present potential concerns regarding direct and indirect effects upon bats through three primary avenues:

- Bats may be directly affected by moving turbine blades either through collision or barotrauma .

- Construction of the turbines and associated appurtenances may degrade habitat quality through the removal of trees causing indirect effects.

- Bats may also be indirectly affected through displacement by operating turbines.

3.1 BAT MORTALITY AT WIND ENERGY GENERATION FACILITIES

Much of the information available regarding mortality caused by collisions with moving turbine blades is contained in technical reports completed for wind site owners/developers, is unpublished, and is often difficult to obtain. Anecdotal information can be found in numerous studies intended to address avian impacts, although these data have a bias in that study methods were not designed to detect bat mortality.

A report published in winter 2008 summarized 21 studies of bat mortality at 19 wind energy generation facilities across the United States and one Canadian Province. The 21 studies include five in the Pacific Northwest, one in the Rocky Mountains, three in Alberta, Canada, three in the Midwest, one in south-central United States, and six in the eastern states (Arnett et al. 2008). Average mortality in these 21 studies ranged from 0.1 to 69.6 bat fatalities per turbine per year. Methods used in these studies varied; mortality estimates were adjusted in many cases for the biases presented by searcher efficiency and removal of carcasses by scavengers during mortality monitoring studies. A majority of studies (13 of 21) used bird carcasses as surrogates for bats while conducting searcher efficiency trials and calculating scavenging rates (Arnett et al. 2008). Bat mortality has been recorded both anecdotally and in ongoing studies at other wind energy generation facilities as well.

Documented bat fatalities at North American wind energy generation facilities have been generally highest in the east (Appalachian Mountains), moderate in the Midwest, and lowest in the western states. In most cases, documented mortality was low - less than five bats per turbine per year. Nationwide, more than 93 percent of fatalities documented in the U.S. as of winter 2006 (Arnett et al. 2008) have been of six species, with hoary bats accounting for nearly one-half of all mortality:

- hoary bat (40.7 percent),
- eastern red bat (21.2 percent),
- silver-haired bat (15.4 percent),
- eastern pipistrelle (8.0 percent),
- little brown bat (6.0 percent), and
- big brown bat (2.4 percent).

"Tree bats" (hoary bats, silver-haired bats and eastern red bats) typically roost in trees during summer months and often migrate long distances to southern winter habitat. These migratory bats accounted for the great majority of mortality. Bats that roost (winter and/or summer) in caves, sometimes referred to as "cave bats," comprised the remainder.

Although mortality has been documented in all months when bats are not hibernating, a significant majority of mortality has been documented in mid-July through mid-October during the post-maternity dispersal from summer habitat to winter habitat. At the Buffalo Mountain Windfarm in Tennessee, 70 percent of all bat fatalities occurred between August 1 and September 15 (Fiedler 2004). At Crescent Ridge, 20 of 21 bat fatalities were found in September and October. Overall, mortality appears highest between approximately July 15 and September 15. However, at the Summerview facility in Alberta, Canada, 6 percent of the 272 silver-haired bat fatalities occurred in May and June, suggesting that some mortality does occur during the spring migration period. These findings were supported in Buffalo Mountain, Tennessee, where 84 percent of the 19 silver-haired bat fatalities occurred between mid-April and early June (Arnett et al. 2008). Mortality is very low during the summer maternity period, even when substantial numbers of bats are present at or near wind energy generation facilities (Arnett et al. 2008). In a study in Minnesota at the Buffalo Ridge Wind Power Development, researchers found bat activity as measured by ultrasound detectors during summer was not correlated with bat mortality (Johnson et al. 2003a).

To date only one study has attempted to correlate the timing of fatalities between sites. Kerns et al. (2005) conducted simultaneous fatality searches from August 1 to September 13, 2004 at the Mountaineer and Meyersdale facilities in West Virginia, and Pennsylvania, respectively. The timing of all fatalities, while periodic and highly variable during the study was highly correlated between the two sites. Additionally, the timing of hoary and eastern red bat fatalities were positively correlated for the two sites (Kerns et al. 2005).

The sites at which the highest mortality has been documented occur at approximately 840 m (2,760 ft) above mean sea level (amsl; Meyersdale, Pennsylvania), 1,025 m (3,363 ft) amsl (Mountaineer, West Virginia), and 1,010 m (3,314 ft) amsl (Buffalo Mountain, Tennessee). All three sites are on forested Appalachian Mountain ridgelines. At this time, the greatest risk of bat mortalities is expected at sites on forested Appalachian Mountain ridgelines.

The presence of FAA-approved lighting on towers has been the subject of speculation regarding bat mortality. Studies completed in 2003 at the Mountaineer site (Kerns and Kerlinger 2004), in 2004 at the Mountaineer and Meyersdale sites (Arnett 2005), and in 2005 at the Buffalo Mountain site (Fiedler et al. 2007) found no significant difference in mortality at unlit towers and at towers lit by L-864-type flashing red strobe-like or incandescent lights. Similar results were documented at the Vansycle Ridge site in Oregon (Erickson et al. 2000), in northern Wisconsin (Howe et al. 2002), the Stateline project (Erickson et al. 2003a), the Nine Canyon project in Washington State (Erickson et al. 2003b), the Klondike facility in Oregon (Johnson et al. 2003b), the Summerview project in Alberta (Brown and Hamilton 2006), and the Maple Ridge project in New York (Jain et al. 2007). It also appears that mortality does not vary among the types of lighting used on wind turbines. At the Top of Iowa project, all turbines are lit with FAA lighting: 46 with non-pulsating red beacons, 37 with pulsating red beacons, and six with a combination of flashing white beacons and non-flashing red beacons. Jain (2005) found no significant difference in bat mortality among these towers.

Many of the nine species of bats with potential to be present during some portion of the year at the Hardin County North Project planning area have been fatalities at one or more operating wind energy generation facilities. No fatalities of federally listed bat species have been documented at wind energy generation facilities in the U.S. Based upon results of mortality monitoring completed to date, hoary bats, silver-haired bats, and eastern red bats account for the majority of bat fatalities. These species accounted for approximately 77 percent of the mortality in turbine searches conducted through the end of 2006 (summary of mortality studies contained in Arnett et al. 2008). At the three project sites in the Midwest that were included in Arnett et al. (2008), these species accounted for 84.5 percent of the mortality observed. A study conducted in Bureau County, Ohio, had similar results: all of the bat carcasses recovered during mortality studies were hoary bats, silver-haired bats, or eastern red bats (Kerlinger et al. 2007). Based on these findings, we expect these three species to account for a majority of the mortality associated with the proposed Hardin County North project. Little information exists upon which to base conclusions regarding the biological significance of bat mortality at wind energy generation facilities, because total population estimates do not exist for any of the bat species known to have experienced mortality at wind energy generation facilities.

Reasonably accurate population estimates exist for the federally endangered Indiana bat, one of the most uncommon North American species. In 2007, there were an estimated 468,184 Indiana bats in existence (USFWS 2008a). Although neither this species nor any other federally listed bat species has been identified during bat mortality studies at wind energy generation facilities, we mention the size of the population of this species for context. Populations of species that have experienced fatalities at wind energy generation facilities are much more common than this listed species, and may be an order of magnitude (or more) higher.

3.2 BAT COLLISION MORTALITY

Specific pre-construction techniques/protocols that accurately predict risk of chiropteran mortality at wind sites do not exist. Post-construction mortality monitoring remains the best source for these data. Therefore, comparison of the Hardin County North Project area to nearby similar sites with known mortality is a useful approach.

As discussed above, the highest levels of bat mortality documented to date have occurred at three wind energy generation facilities located in West Virginia (Mountaineer), Pennsylvania (Meyersdale), and Tennessee (Buffalo Mountain). These sites are mountainous with elevated topography (i.e., ridgelines), elevation (i.e., 840 to 1,025 m [2,760 to 3,363 ft] amsl), and geographic location (i.e., eastern U.S.), and are markedly dissimilar to the proposed Project site described herein. Wind energy generation facilities with lower mortality are more similar to the Hardin County North Project planning area (e.g., the Lincoln site in Wisconsin; the Buffalo Ridge site in Minnesota; or the Top of Iowa site in Iowa) are located in Midwestern states, are located on flat terrain, and have been constructed in agricultural areas or other non-forested sites (e.g., short grass prairie/sagebrush, pasture; Table 1). As discussed in Section 2.0, the Hardin County North Project planning area described herein is nearly devoid of tree cover (Appendix A, Figure 2).

Based upon published and unpublished information available at this time, similarities in the projects discussed in Table 1, and anticipated similarity in the behavior of bats at these sites, it is likely that mortality resulting from the Project will be most similar to that at the Crescent Ridge site in Illinois, Top of Iowa site in Iowa, the Lincoln site in Wisconsin, and the Buffalo Ridge site in Minnesota. Annual mortality estimates based upon post-construction monitoring studies was 8.04 bats per turbine per year at Top of Iowa; 4.26 bats per turbine per year at Lincoln; and 1.32 bats per turbine per year at Buffalo Ridge. Post-construction studies at Top of Iowa, Lincoln, and Buffalo Ridge, were all multi-year studies encompassing spring through fall (approximately mid-March through mid-November for each).

Mortality studies at Crescent Ridge were conducted from August through November 2005, March through May 2006, and August 2006, and the total estimate of bat mortality during the whole of the survey was approximately 9 bats per turbine (Kerlinger et al. 2007). Mortality at the Crescent Ridge facility in Illinois was highly seasonal: almost all (20 out of 21) documented bat fatalities occurred in late fall (September and October). A single bat carcass was documented in August, and no bat fatalities were documented in spring. No monitoring was completed in either year during the months of June or July, when it is reasonable to expect some mortality to take place; thus the extrapolated estimate of 9 bat fatalities per turbine may not be as accurate an estimate of annual mortality as might be found in a study that included June and July.

The Hardin County North Project is not proximate to an Indiana bat hibernaculum. The nearest known hibernaculum used by Indiana bats is the Lewisburg Limestone Mine in Preble County, Ohio (Figure 5). The center of the Hardin County North Project planning area is approximately 72 miles (116 km) from the Lewisburg Limestone Mine hibernaculum.

It is reasonable to expect that the direction of flight of Indiana bats, and of other species of bats utilizing the Lewisburg Limestone Mine hibernaculum in Preble County or the other nearby hibernacula in Champaign County, is not random. These movements are likely concentrated along the only forested rivers in the vicinity. No contiguous forested tracts link the Hardin County North Project planning area to forested rivers corridors or to any of the hibernacula. Murray and Kurta (2004) found that Indiana bats will choose to travel along forested corridors as opposed to non-forested corridors, even if the distance traveled is greater. This suggests that all of the waterways crossing the Project planning are minimally suitable as travel corridors for Indiana bats. Thus no effects to Indiana bats during spring and fall migration to and from the Lewisburg Limestone Mine in Preble County or the other bat hibernacula in Champaign County are expected.

The ODNR reports summer records of Indiana bats in south central Hardin County captured along Wolf Creek and in southeastern Logan County near Bellefontaine southeast of the Project planning area. The Ohio Natural Heritage Database has no records of Indiana bats in the Project planning area (Appendix C). The closest know maternity colonies are southeast of Bellefontaine in Logan County. However, the bats captured along Wolf Creek include a lactating female and are currently being tracked to their roost. Though no roost has been identified yet, there is likely a maternity roost along or near Wolf Creek approximately 21 km (13 mi) southeast of the Project planning area. Bats from these colonies are likely to forage along the forested streams and forests connected to such streams. No contiguous forested corridors connect these streams to waterways in the Project planning area. Though bats along such streams may venture out into the open fields, most tend to remain along forested waterways as insects are more abundant and trees provide protection from aerial predators.

It is unlikely that Indiana bats will occupy the Project planning area during summer. Habitat conditions in the Project planning area, which is nearly devoid of trees and is composed largely of open fields/agricultural land, is less than suitable for foraging or roosting bats. Indiana bats, even if present, are likely to be very rare at the Hardin County North Project area during summer, and are likely to be active at heights largely below the rotor-swept area. As such, the chance of collisions between Indiana bats and turbine blades during the summer is extremely low. Studies completed to date have documented very low mortality during spring and summer months, even when concurrent mist net surveys and/or ultrasound acoustic detection devices indicate the presence of substantial numbers of bats (Arnett et al. 2008). No effects to Indiana bats during summer are expected.

Furthermore, other bat species that may experience mortality at the Hardin County North Project area are widely dispersed in the U.S. and only a very small minority of each species' population will forage in, roost in, travel through, or migrate over the Hardin County North Project area. For example, if the range-wide population of hoary bats is assumed to be 5,130,000 (10 times the population of Indiana bats), and if hoary bats comprise 50 percent of expected mortality (0.5 x ~2,343 = 1,172), then annual fatalities of hoary bats would equate to 2 one-hundredths of 1 percent (0.02 percent) of the species' population.

3.3 HABITAT DEGRADATION

The landscape within the Project planning area is dominated by agriculture and tree cover is sparse. Construction of the Project in this agricultural area will have little to no effect upon habitat features important to bats, because few, if any, of these characteristics exist within the thoroughly disturbed and degraded habitat within the Project planning area, e.g. forested area, suitable roost trees, roost structures (e.g., barns), available prey, or other habitat attributes in this area of thoroughly disturbed and degraded habitat.

The USFWS is routinely consulted regarding potential impacts to the Indiana bat associated with a wide variety of projects. Their concerns commonly focus upon habitat modifications near hibernacula and maternity sites, and modification of proximate forested habitat. Where such habitat modifications occur, the USFWS often recommends project-specific consultation and avoidance/conservation measures. However, the Hardin County North Project planning area is almost devoid of trees (Appendix A, Figure 2). Furthermore, tree clearing during construction is unlikely.

3.4 DISTURBANCE AND DISPLACEMENT OF BATS

Speculations have been made concerning the potential disturbance of bats by operating wind energy generation facilities, and the potential for resulting displacement of bats from otherwise suitable habitat. Data do not exist to dismiss the risk of such disturbance or displacement, but preliminary information now available supports the conclusion that wind turbines and their blades do not substantially disturb/displace bats. In 2004 at the Mountaineer and Meyersdale wind energy generation facility sites, bats were commonly observed foraging in forest openings at turbine sites. Thermal imaging equipment was used to investigate bat behavior near wind towers. Bats landed on towers, foraged near rotating blades, pursued rotating blades, and flew in patterns that appeared to indicate purposeful collision avoidance (Horn et al. 2008). The presence of bats near operating turbines was also documented at the Buffalo Ridge site in Minnesota (Johnson et al. 2003a), and the Buffalo Mountain site in Tennessee (Fiedler 2004). Based upon the best available information it appears operating turbines do not significantly disturb or displace bats, and this should especially be the case at the Hardin County North Project planning area because of the lack of roosting and foraging habitat.

4.0 CONCLUSIONS

A summary of the conclusions this bat risk assessment for the proposed Hardin County North wind energy generation facility in Hardin County, Ohio, is listed below.

- Risk to bats is expected to be low.
- There are no records of federally threatened or endangered bats in or within 5 miles of the proposed Project planning area.
- The Project area is within the range of only one federally listed bat: the endangered Indiana bat (*Myotis sodalis*).
- The closest bat hibernaculum is Ohio Caverns in Champaign County over 56 km (35 mi) southeast of the project area.
- The closest hibernaculum used by Indiana bats in Ohio is approximately 116 km (72 mi) southwest of the Project area.

- The closest Indiana bat maternity colony recorded is approximately 48 km (30 mi) away from the Project planning area, though closer colonies may be discovered around Wolf Creek approximately 21 km (13 mi) southeast of the Project area.
- Indiana bats are not likely to be roosting, foraging, or migrating within the Project planning area, due to the poor habitat conditions. Indiana bats are more likely to use the Scioto River and Tymochtee Creek that are 13 and 19 km (8 and 12 mi) away from the planning area and not at risk.
- Habitat loss will be low considering the Project area is nearly all agricultural and only about 4 percent of the area will be cleared for construction.

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TABLES

Table 1. Attributes of the Hardin County North Project area as compared to other Midwestern wind energy generation facilities where post-construction studies of bat mortality have been conducted.

Feature	Hardin County North (Hardin Co., OH)			Crescent Ridge (Bureau Co., IL)	Lincoln (Kewaunee Co., WI)	Buffalo Ridge (Lincoln and Pipestone Cos., MN)	Top of Iowa (Worth Co., IA)
Ecoregion (Section)	Central Till Plains, Beech-Maple Section			Central Loess Plains Section	Northern Great Lakes Section	North-Central Glaciated Plains Section	Minnesota and Northeastern Iowa Morainal, Oak Savannah Section and North-Central Glaciated Plains Section
Position	Towers to be placed in open agricultural areas			Towers located in agricultural areas	Towers located on ridges of glacial till approximately 30-60 m (98-197 ft) above the surrounding lowlands	Towers located on ridge consisting of terminal moraines and stream dissected lands	Towers located in agricultural areas surrounded by grasslands and wetlands
Approximate average elevation (above msl)	284 m (934 ft)			274 m (900 ft)	240-270 m (787-886 ft)	546-610 m (1,791-2001 ft)	366-396 m (1,200 - 1,300 ft)
Vegetative cover	Primarily corn and soybeans			Primarily corn and soybeans	Pasture and agricultural land	Primarily corn, soybeans, pastures, and grasslands	Primarily cropland
No. of turbines	19 (2.5 MW)	21 (2.3 MW)	27 (1.8 MW)	33 (1.65 MW)	31 (0.66-MW)	354 (0.75-MW)	89 (0.90-MW)

Table 1. Attributes of the Hardin County North Project area as compared to other Midwestern wind energy generation facilities where post-construction studies of bat mortality have been conducted.

Feature	Hardin County North (Hardin Co., OH)			Crescent Ridge (Bureau Co., IL)	Lincoln (Kewaunee Co., WI)	Buffalo Ridge (Lincoln and Pipestone Cos., MN)	Top of Iowa (Worth Co., IA)
Turbine string(s)	19 turbines spread across 1,353 ha (3,343 ac) in an irregular array	21 turbines spread across 1,353 ha (3,343 ac) in an irregular array	27 turbines spread across 1,353 ha (3,343 ac) in an irregular array	Irregular array along 9-mile ridge, installed in 2 phases.	14 WPS turbines in 3 rows within 1.5 km (0.9 mi) of one another; 17 MGE turbines in 2 irregular clusters approximately 3.5 km (2.2 mi) apart	Phase 1: 10 turbine strings each with 3 - 20 turbines spaced at 91-183 m (298-600 ft) intervals (73 turbines total) Phase 2: 26 turbine strings each with 2 - 12 turbines spaced at 100-200 m (328-656 ft) intervals (143 turbines total) Phase 3: 36 turbine strings each with 2-13 turbines spaced at 250-500 m (820-1640 ft) intervals (138 turbines total)	89 turbines spread across 865 ha (2,137 ac) in an irregular array
Hub height	100 m (328 ft)	100 m (328 ft)	80 m (262 ft)	78 m (256 ft)	65 m (213 ft)	Phase 1: 36 m (118 ft) Phase 2 and 3: 50 m (164 ft)	72 m (237 ft)
Rotor diameter	100 m (328 ft)	101 m (331 ft)	90 m (295 ft)	82 m (269 ft)	47 m (154 ft)	Phase 1: 33 m (108 ft) Phase 2 and 3: 46 and 48 m (151-157 ft)	52 m (171 ft)
Max. rotor height	150 m (492 ft)	150.5 m (494 ft)	125 m (410 ft)	119 m (390 ft)	89 m (292 ft)	Phase 1: 53 m (174 ft) Phase 2 and 3: 74 m (243 ft) or 73 m (240 ft)	98 m (322 ft)
Min. rotor height	50 m (164 ft)	49.5 m (162 ft)	35 m (115 ft)	37 m (121 ft)	42 m (138 ft)	Phase 1: 19.5 m (70 ft) Phase 2 & 3: 26 m (85 ft) or 27 m (88 ft)	46 m (151 ft)

Table 1. Attributes of the Hardin County North Project area as compared to other Midwestern wind energy generation facilities where post-construction studies of bat mortality have been conducted.

Feature	Hardin County North (Hardin Co., OH)			Crescent Ridge (Bureau Co., IL)	Lincoln (Kewaunee Co., WI)	Buffalo Ridge (Lincoln and Pipestone Cos., MN)	Top of Iowa (Worth Co., IA)
Rotor swept area	7,854 m^2 (84,540 ft^2) per turbine; 149,226 m^2 (1,606,255 ft^2) total	8,012 m^2 (86,240 ft^2) per turbine; 168,249 m^2 (1,811,017 ft^2) total	6,362 m^2 (68,480 ft^2) per turbine; 171,767 m^2 (1,848,885 ft^2) total	5,281 m^2 (56,844 ft^2) per turbine; 174,273 m^2 (1,875,859 ft^2) total	1,735 m^2 (18,675 ft^2) per turbine; 53,785 m^2 (578,937 ft^2) total	Phase 1: 855 m^2 (9,203 ft^2) per turbine; 62,437 m^2 (672,066 ft^2) total Phase 2: 1,735 m^2 (18,675 ft^2) average per turbine; 248,105 m^2 (2,670,580 ft^2) total Phase 3: 1,735 m^2 (18,675 ft^2) average per turbine; 239,430 m^2 (2,577,203 ft^2) total	2,124 m^2 (22,863 ft^2) per turbine; 189,036 m^2 (2,034,767 ft^2) total
Operating rotor rpm	14.1	16	16.6	14.4	28.5	Phase 1: 14 to 50 Phase 2 and 3: 16 to 30	15 or 22
Turbine cut in speed	3.5 m/s (7.9 mph)	4 m/s (8.9 mph)	4 m/s (8.9 mph)	3.5 m/s (7.9 mph)	4.0 m/s (8.9 mph)	Phase 1: 4.0 m/s (9 mph) Phase 2 and 3: 3.6 m/s (8 mph)	Data not available
Lighting	Per FAA regulations	Per FAA regulations	Per FAA regulations	10 of 33 turbines lighted	Data not available	Phase 1: no lighting Phase 2: 6 turbines lighted Phase 3: 69 turbines lighted	46 of 89 towers lighted

Table 1. Attributes of the Hardin County North Project area as compared to other Midwestern wind energy generation facilities where post-construction studies of bat mortality have been conducted.

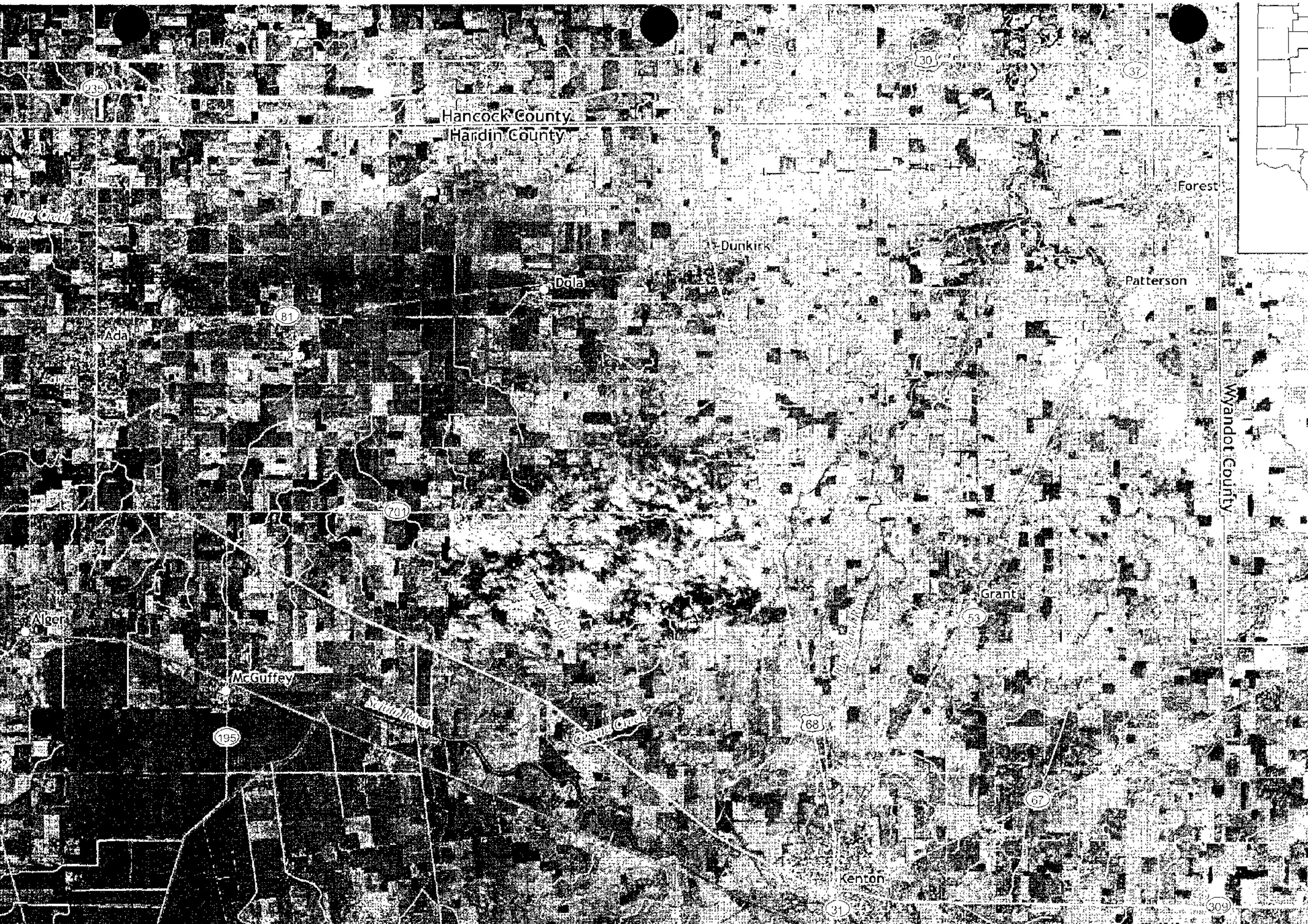
Feature	Hardin County North (Hardin Co., OH)			Crescent Ridge (Bureau Co., IL)	Lincoln (Kewaunee Co., WI)	Buffalo Ridge (Lincoln and Pipestone Cos., MN)	Top of Iowa (Worth Co., IA)
Bat species in the region (bats listed for all sites other than Hardin County North are those species detected in mortality searches. Percent of total detected mortality is indicated).	Big brown Silver-haired Eastern red Hoary Little brown N. long-eared Indiana Evening Eastern pipistrelle	Big brown Silver-haired Eastern red Hoary Little brown N. long-eared Indiana Evening Eastern pipistrelle	Big brown Silver-haired Eastern red Hoary Little brown N. long-eared Indiana Evening Eastern pipistrelle	Hoary (38.1%) Eastern red (28.6%) Silver-haired (28.6%)	Eastern red (37.5%) Hoary (34.7%) Silver-haired (18.1%) *Myotis* spp. (8.3%) Big brown (1.4%)	Hoary (67%) Eastern red (17%) Silver-haired (3%) Big brown (3%) Eastern pipistrelle (2%) Little brown (2%)	Hoary (28%) Eastern red (23.5%) Little brown (23.5%) Silver-haired (11.8%) Big brown (10.5%) Eastern pipistrelle (2.6%)

Table 2. Bats potentially present within the proposed Hardin County North Planning Area during summer, winter, and spring/fall migration.

Species	Status	Potential Seasonal Presence within the Hardin County North Project Planning Area[1]		
		Summer	Winter	Migration
Big brown bat (*Eptesicus fuscus*)	None	Yes	Yes	Yes[2]
Silver-haired bat (*Lasionycteris noctivagans*)	None	Yes	No	Yes
Eastern red bat (*Lasiurus borealis*)	None	Yes	No	Yes
Hoary bat (*Lasiurus cinereus*)	None	Yes	No	Yes
Little brown bat (*Myotis lucifugus*)	None	Yes	No	Yes
Northern long-eared bat (*Myotis septentrionalis*)	None	Yes	No	Yes
Indiana bat (*Myotis sodalis*)	Federal: endangered OH: endangered	Yes	No	Yes
Evening bat (*Nycticeius humeralis*)	None	Yes	No	Yes
Eastern pipistrelle (*Perimyotis subflavus*)	None	Yes	No	Yes

[1]Based upon species range maps and natural history.
[2]Species is not migratory, and may be present during spring and fall.

FIGURES



posed planning area for the Hardin County North wind energy generation facility, Hardin County, Ohio.

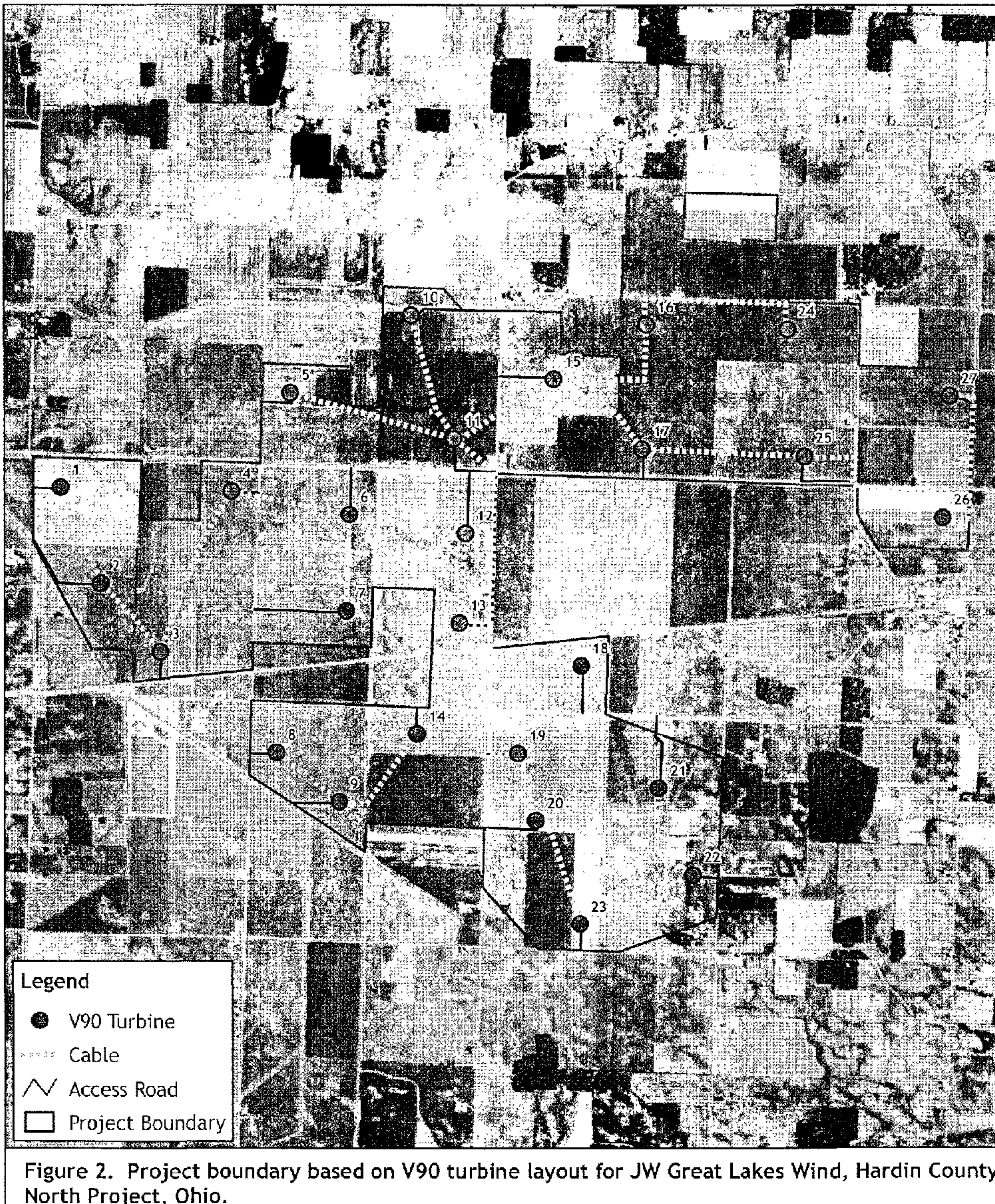


Figure 2. Project boundary based on V90 turbine layout for JW Great Lakes Wind, Hardin County North Project, Ohio.

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	Project No. 1865.004	Basemap: Microsoft Virtual Earth Imagery© 2009	


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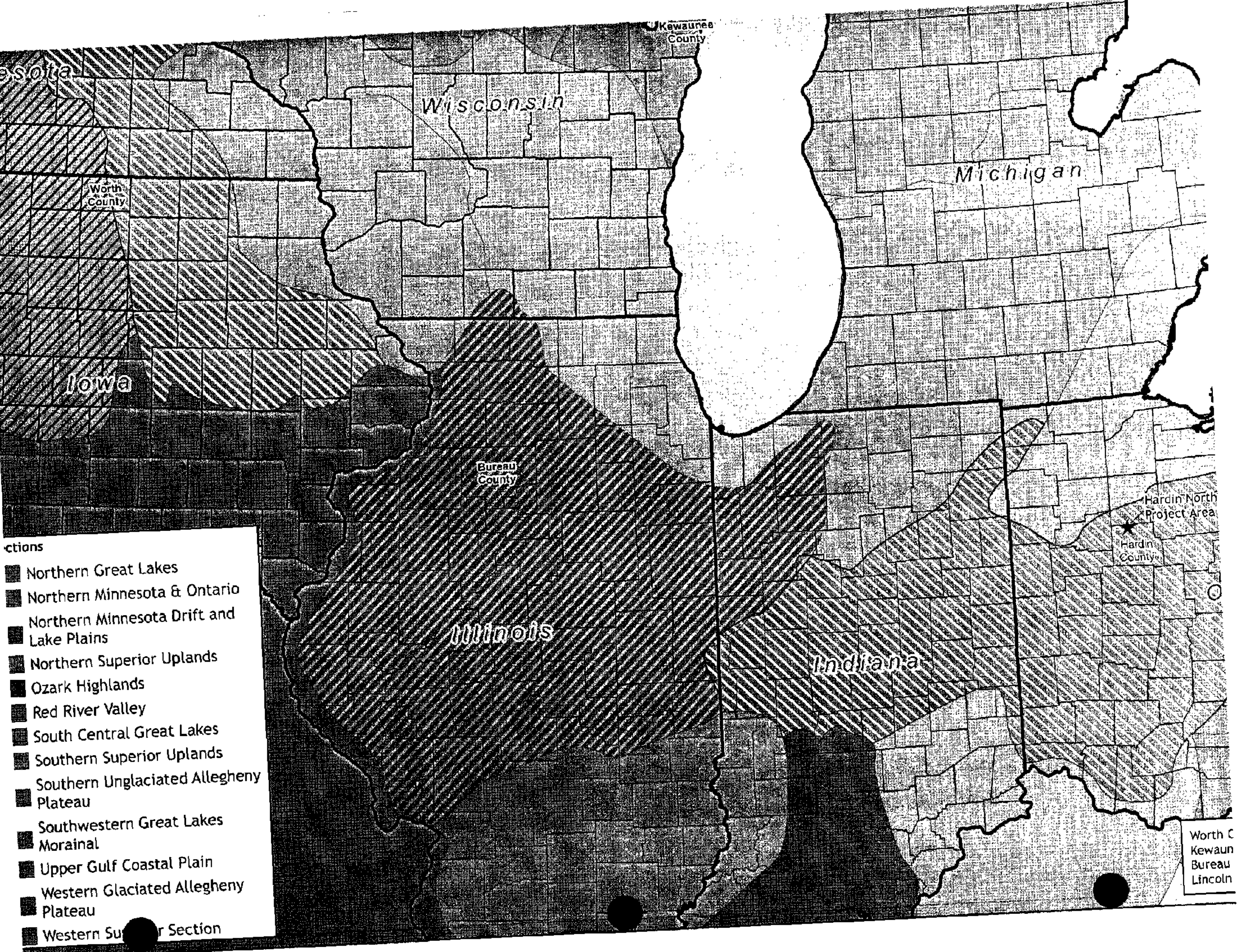
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Northern Minnesota & Ontario
Northern Minnesota Drift and Lake Plains
Northern Superior Uplands
Ozark Highlands
Red River Valley
South Central Great Lakes
Southern Superior Uplands
Southern Unglaciated Allegheny Plateau
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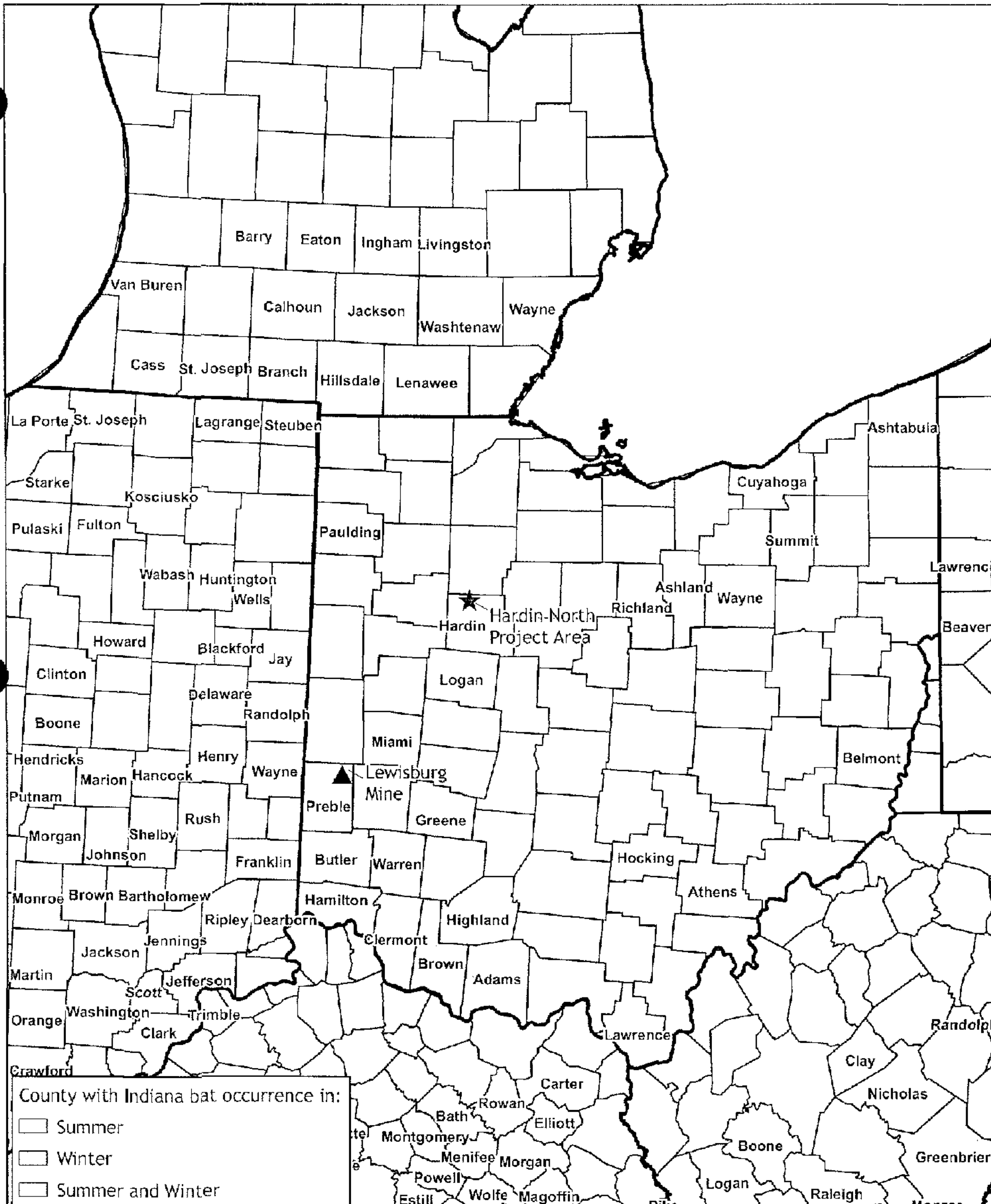

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Figure 5. Counties in which the Indiana bat (*Myotis sodalis*) occurs near the proposed planning area for the Hardin County North wind energy generation facility, Hardin County, Ohio.

Project No. 1865.004

July 2009

BHE ENVIRONMENTAL

APPENDIX A

Photographs of the Hardin County North Project Planning Area

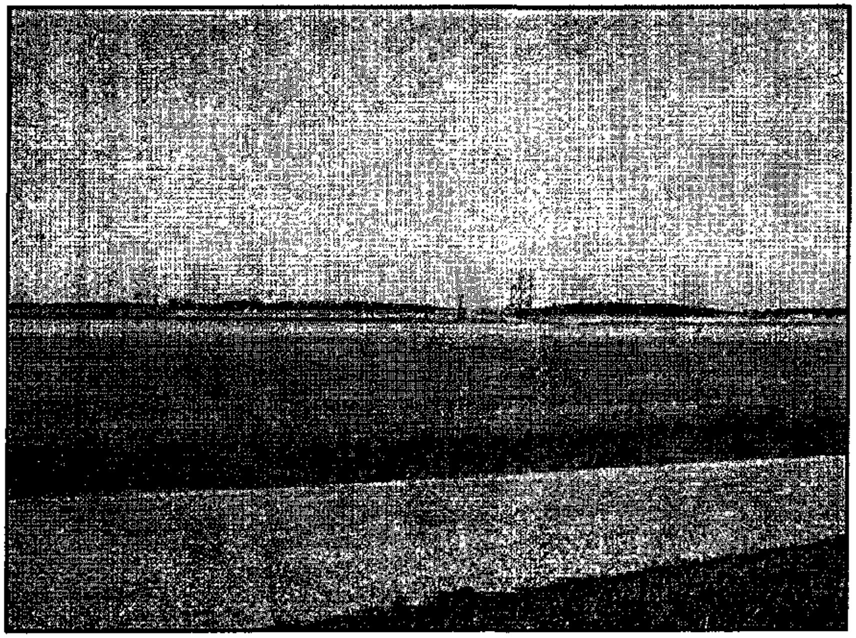


Photo 1. Typical agricultural land use.

Photo 2. Typical agricultural land use.

Photo 3. Grassy vegetation along rail road through the project area.

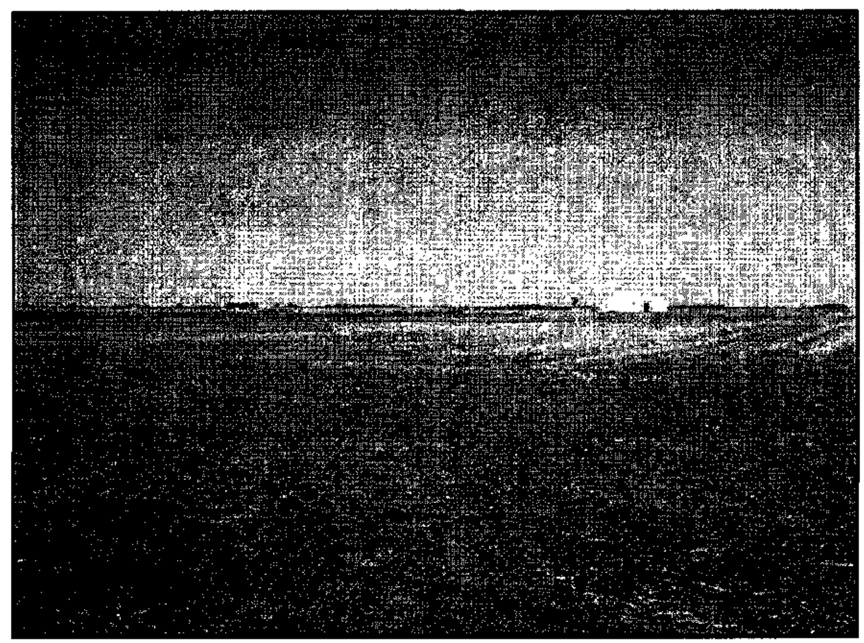


Photo 4. Typical agricultural land use.

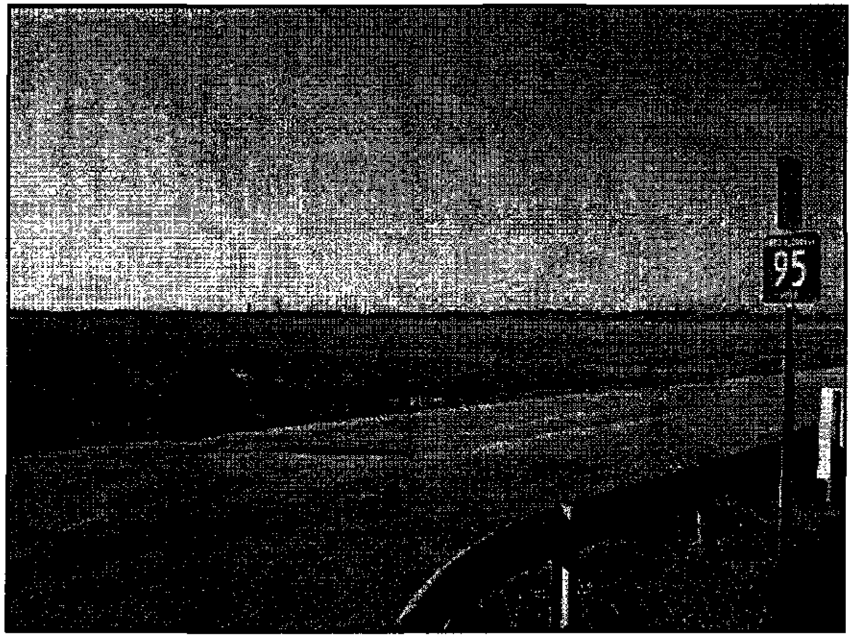


Photo 5. Typical agricultural land use.

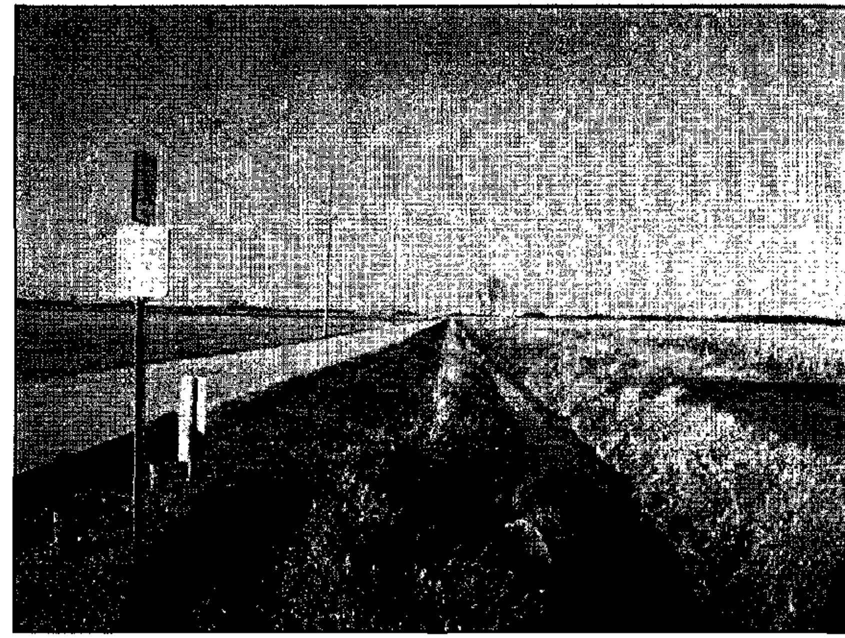


Photo 6. Typical degraded, channeled/grassy watercourse.

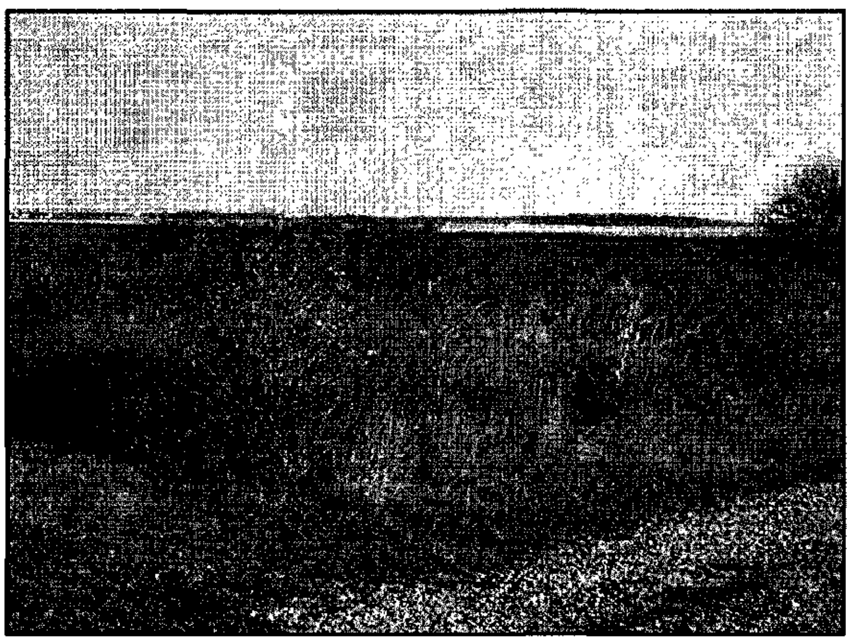


Photo 7. Shrubby vegetation along a road.

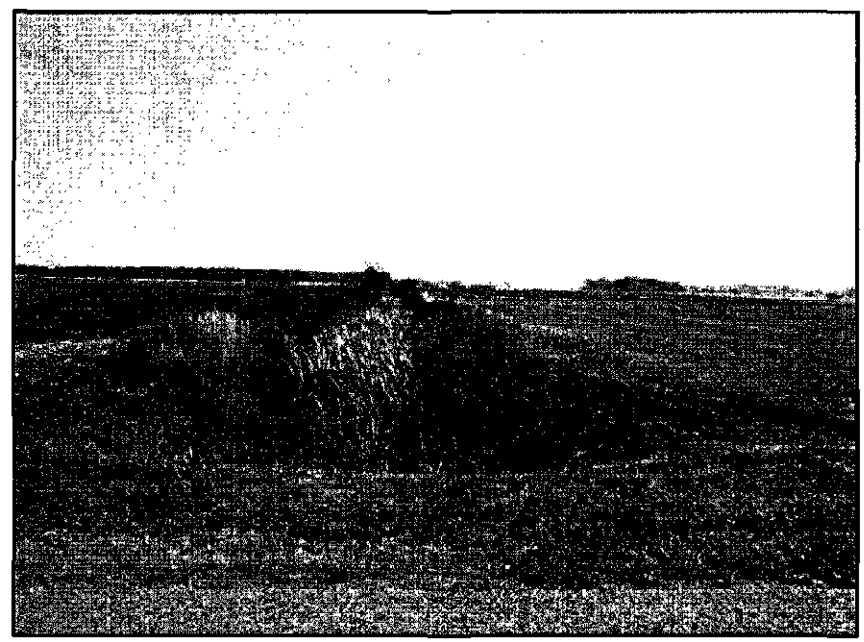


Photo 8. Typical degraded, channeled/grassy watercourse.

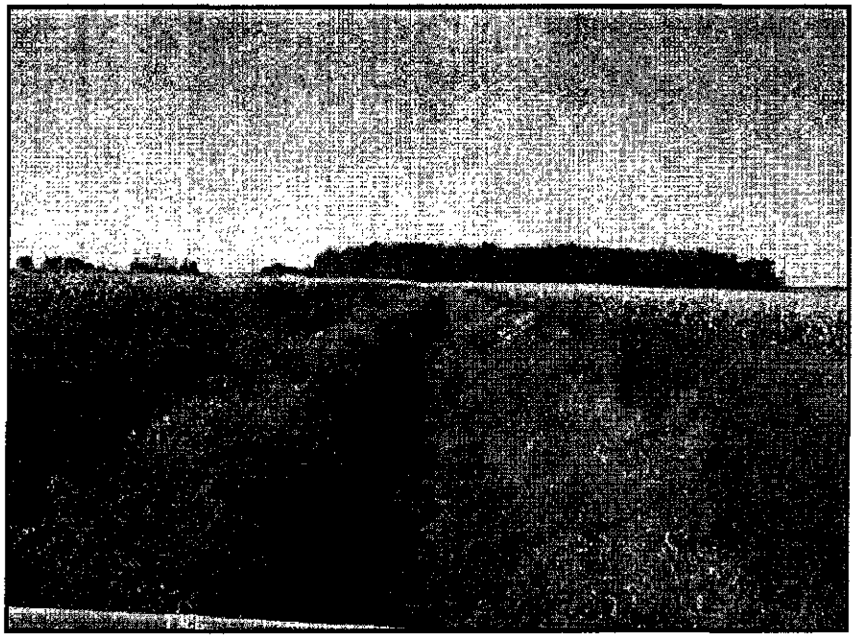


Photo 9. Typical degraded, channeled/grassy watercourse and typical isolated woodlot.

Photo 10. Typical isolated woodlot and trees clustered in a yard.

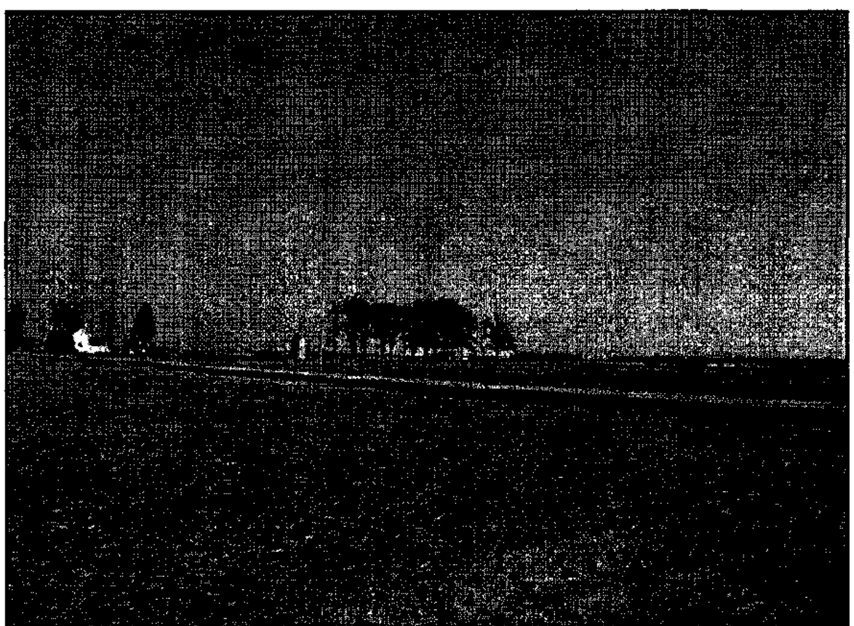
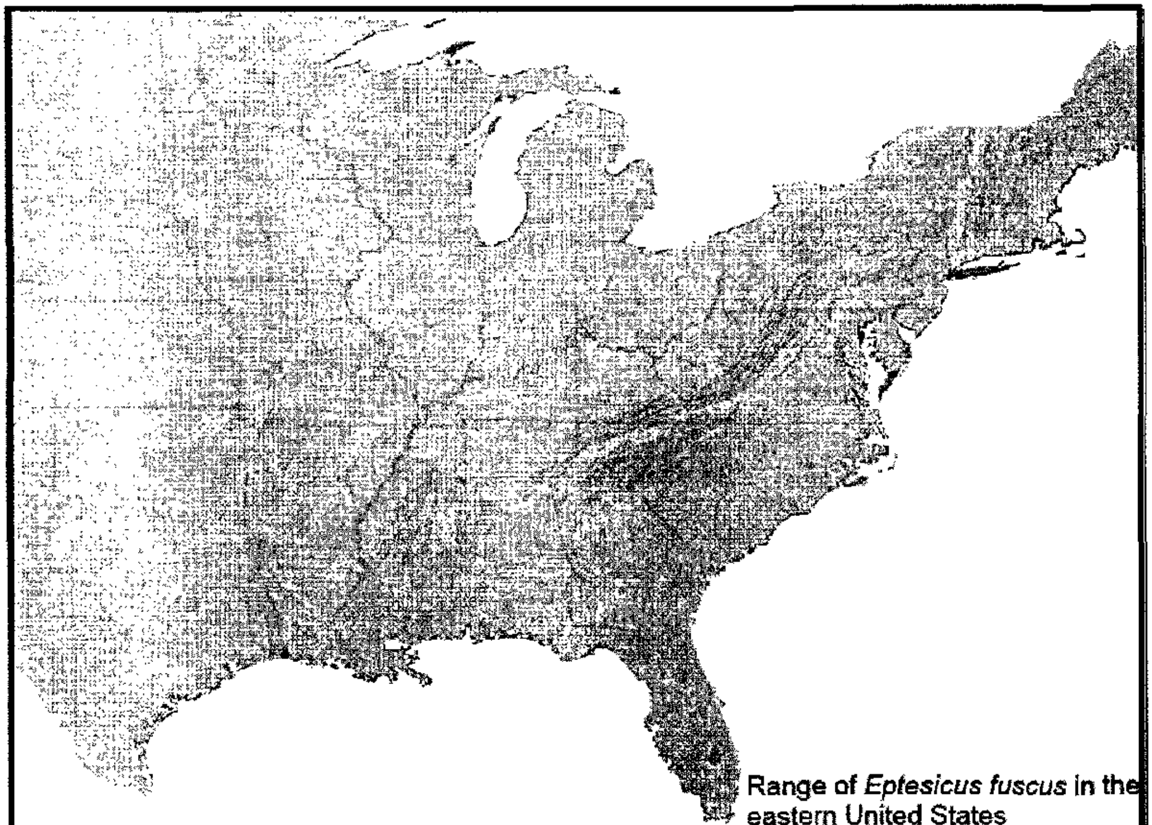


Photo 11. Trees clustered in a yard.

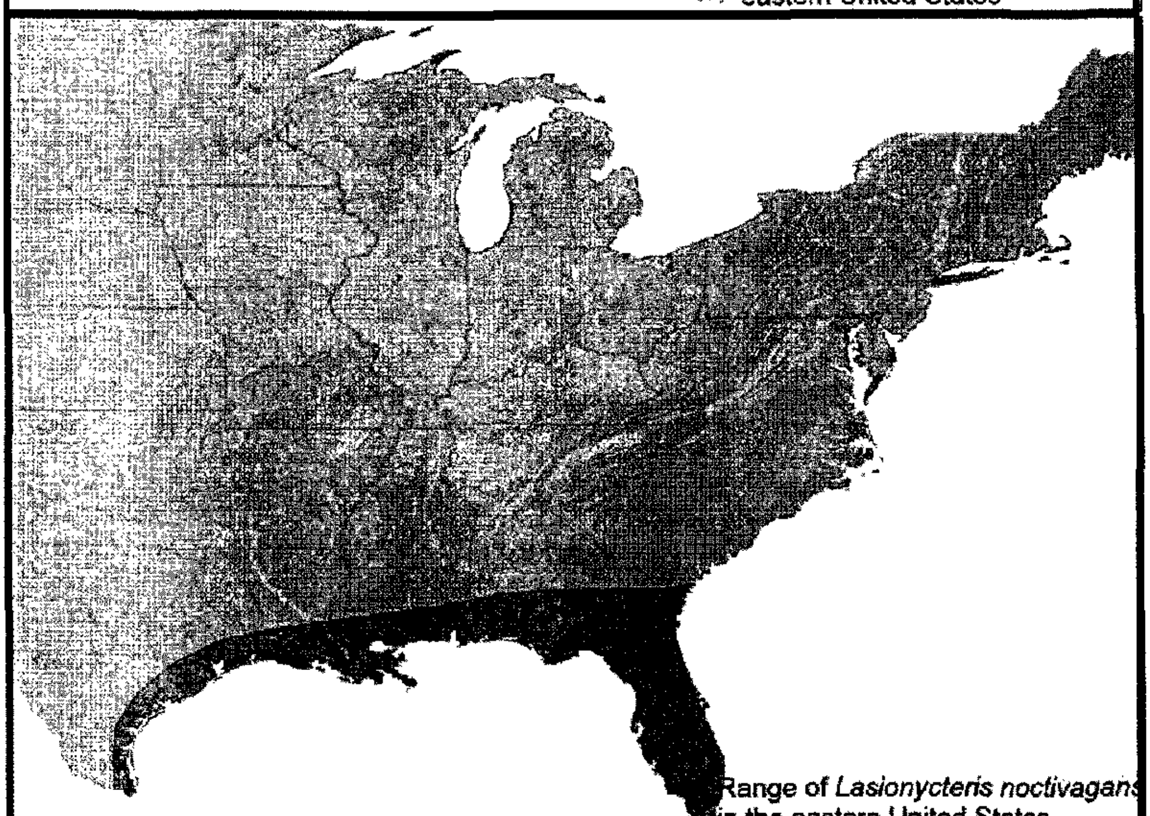
Photo 12. Typical woodlot.

APPENDIX B

Bats of the Hardin County North Project Planning Area:
Range Maps

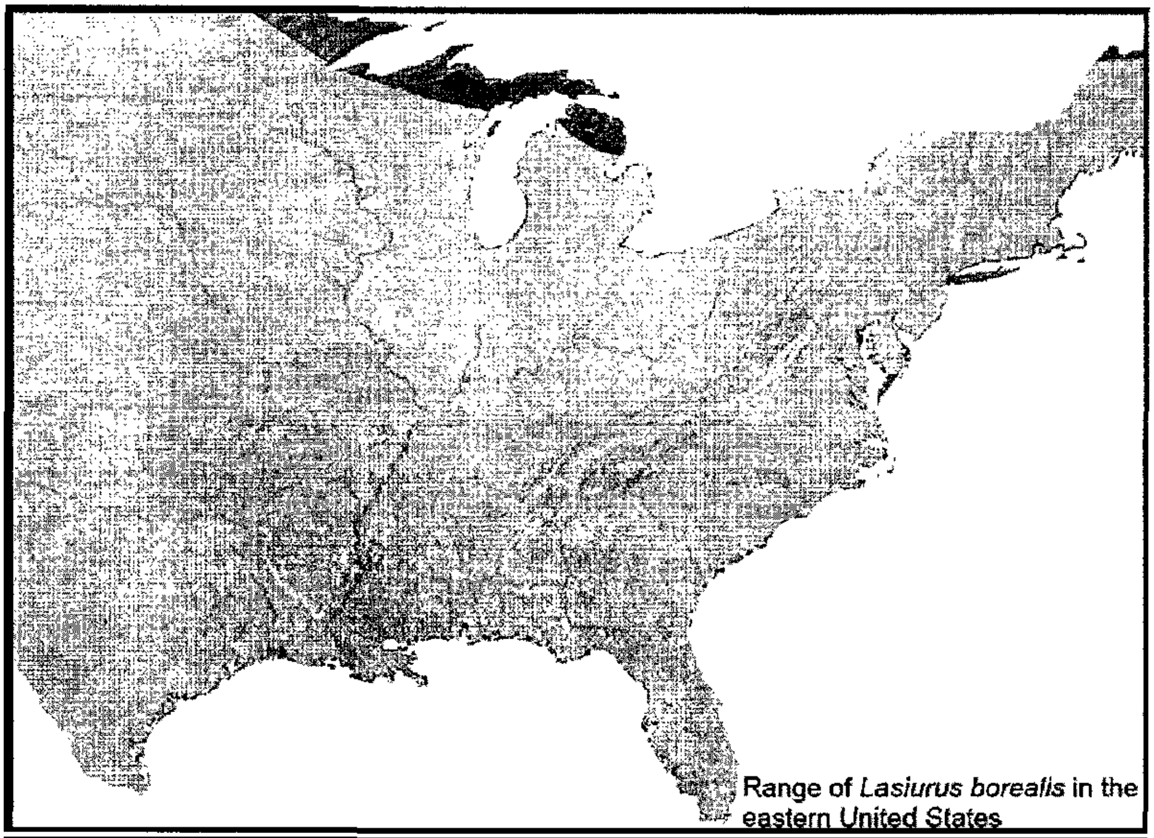


Range of *Eptesicus fuscus* in the eastern United States

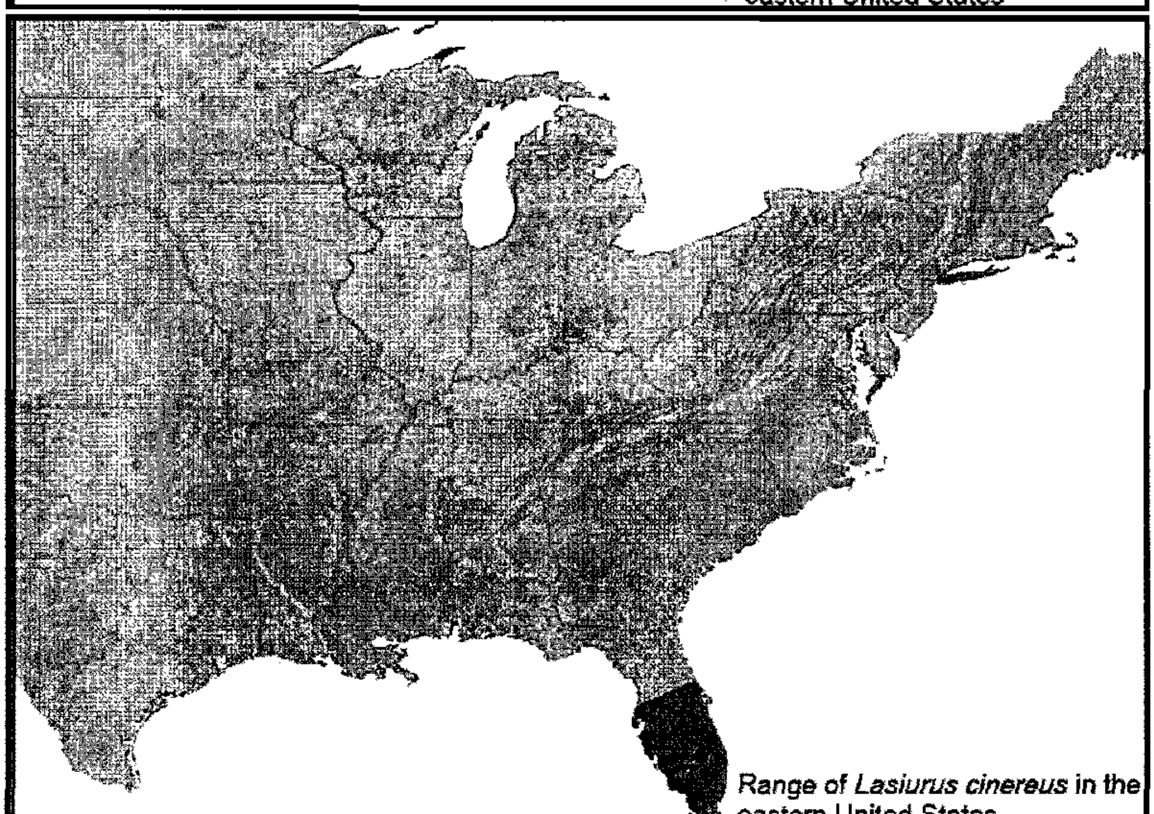


Range of *Lasionycteris noctivagans* in the eastern United States

Bat range data obtained from http://www.natureserve.org/getData/mammalMaps.jsp (06/21/2005)

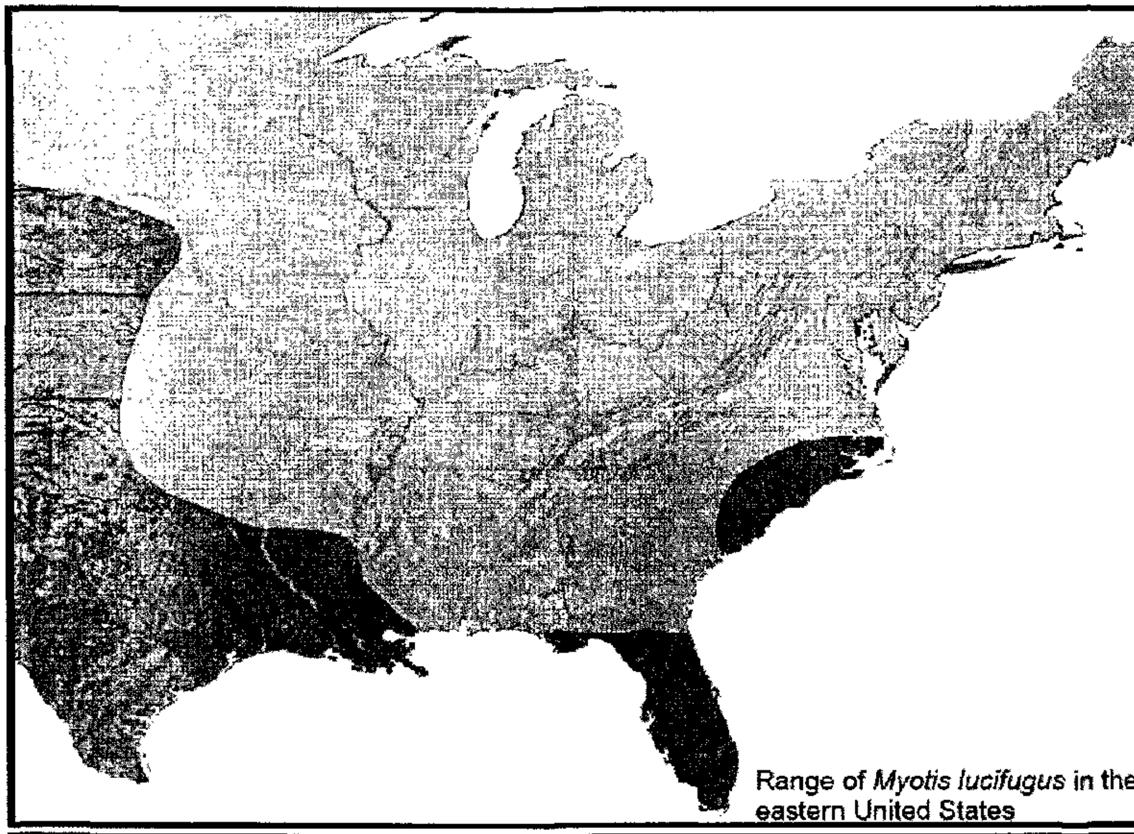


Range of *Lasiurus borealis* in the eastern United States

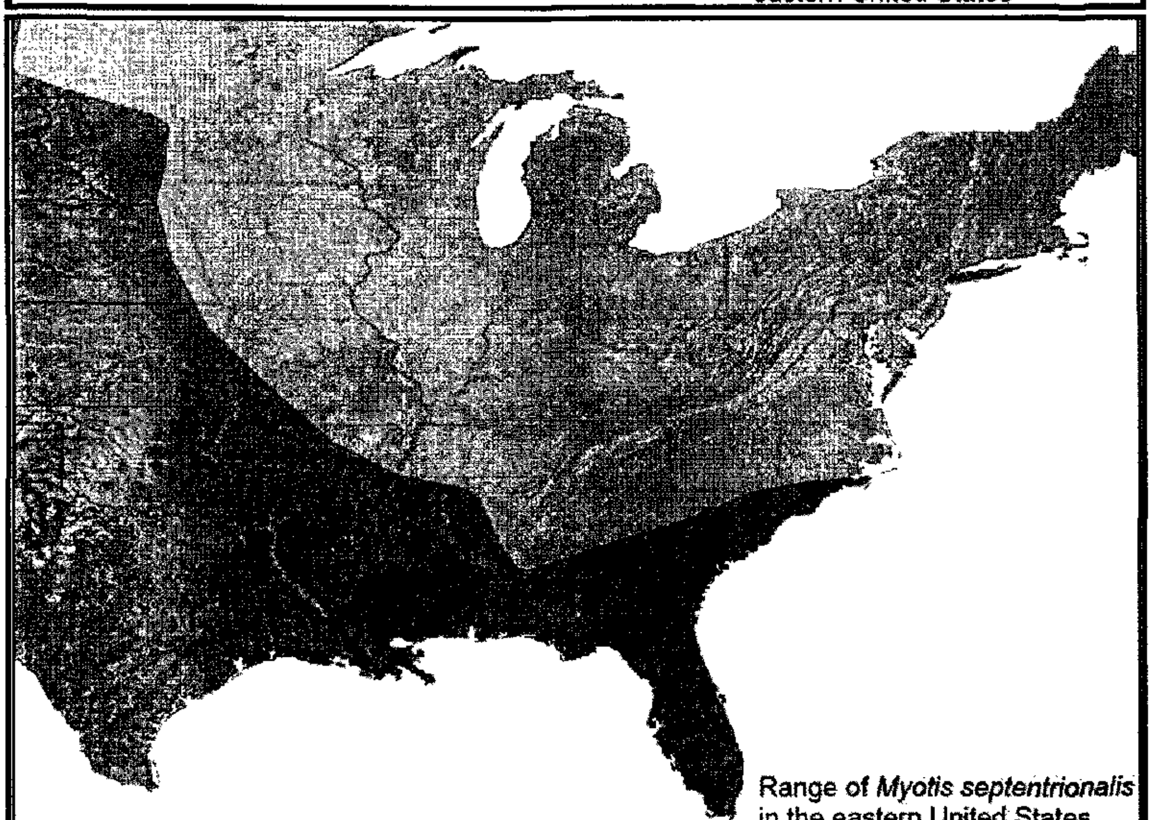


Range of *Lasiurus cinereus* in the eastern United States

Bat range data obtained from http://www.natureserve.org/getData/mammalMaps.jsp (06/21/2005)

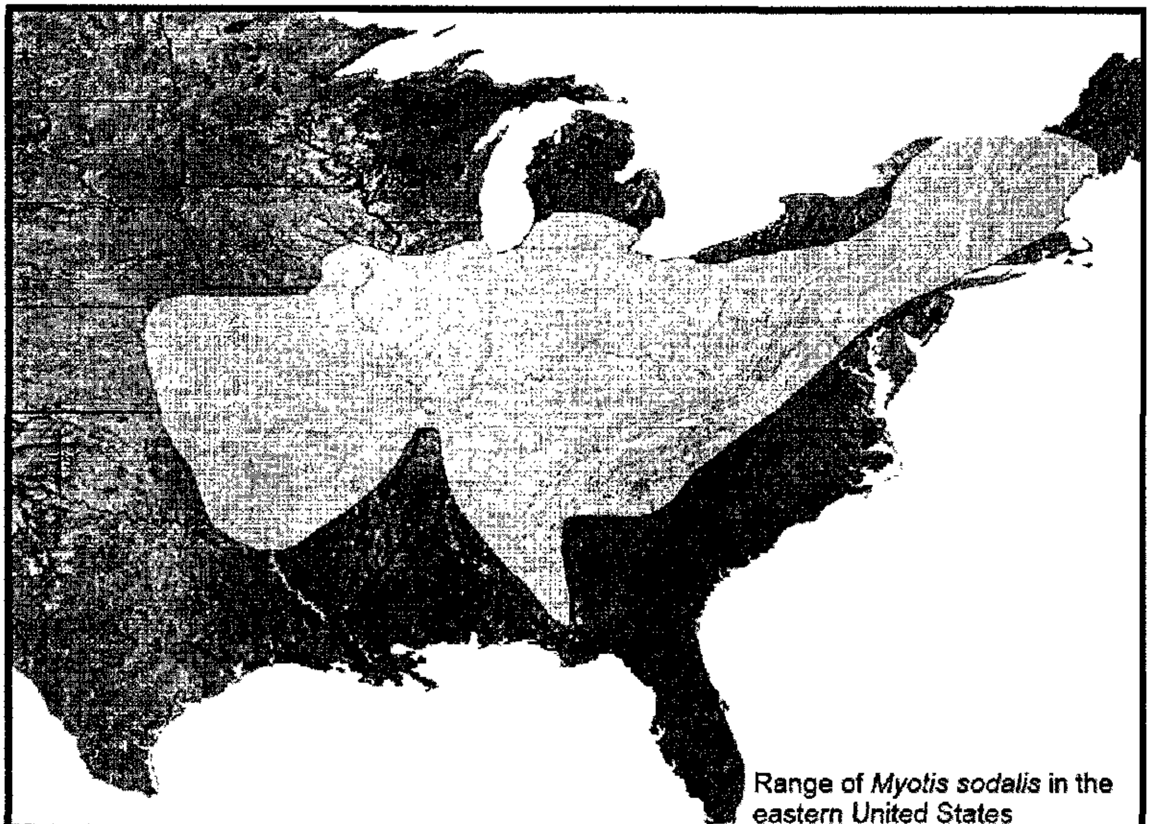


Range of *Myotis lucifugus* in the eastern United States

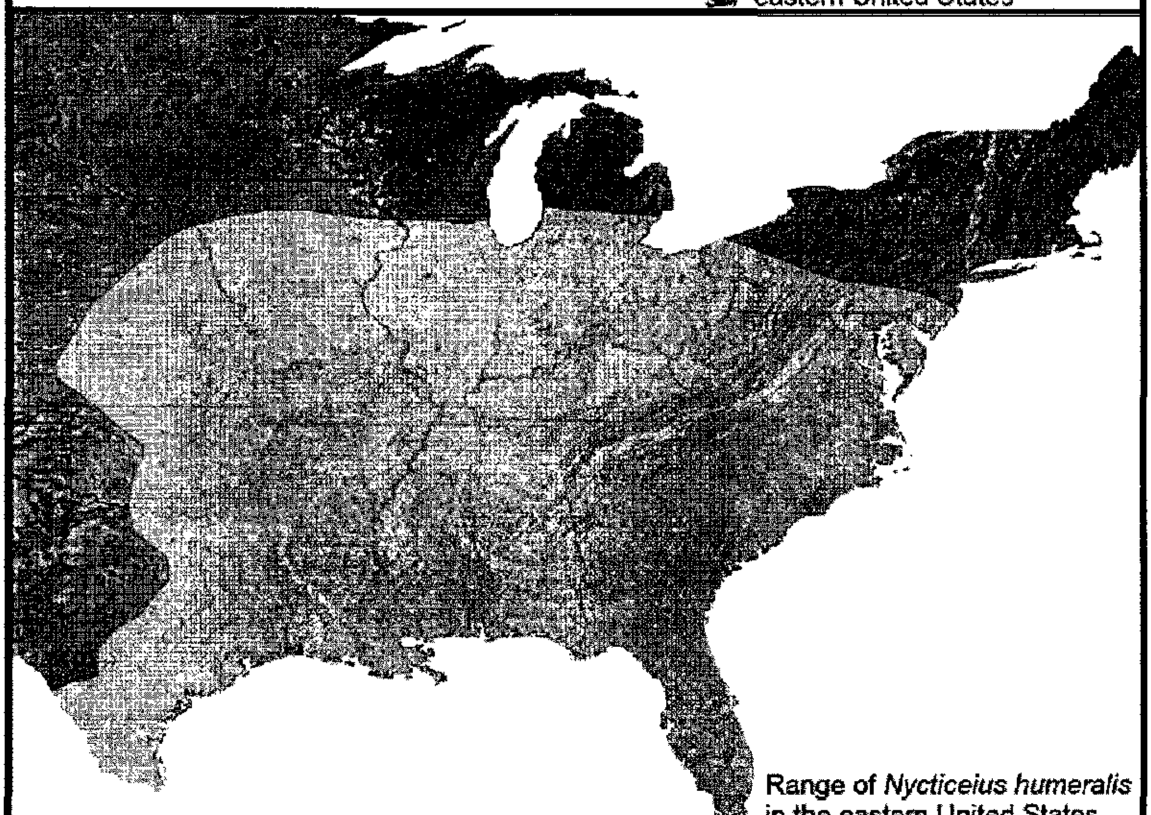


Range of *Myotis septentrionalis* in the eastern United States

Bat range data obtained from http://www.natureserve.org/getData/mammalMaps.jsp (06/21/2005)

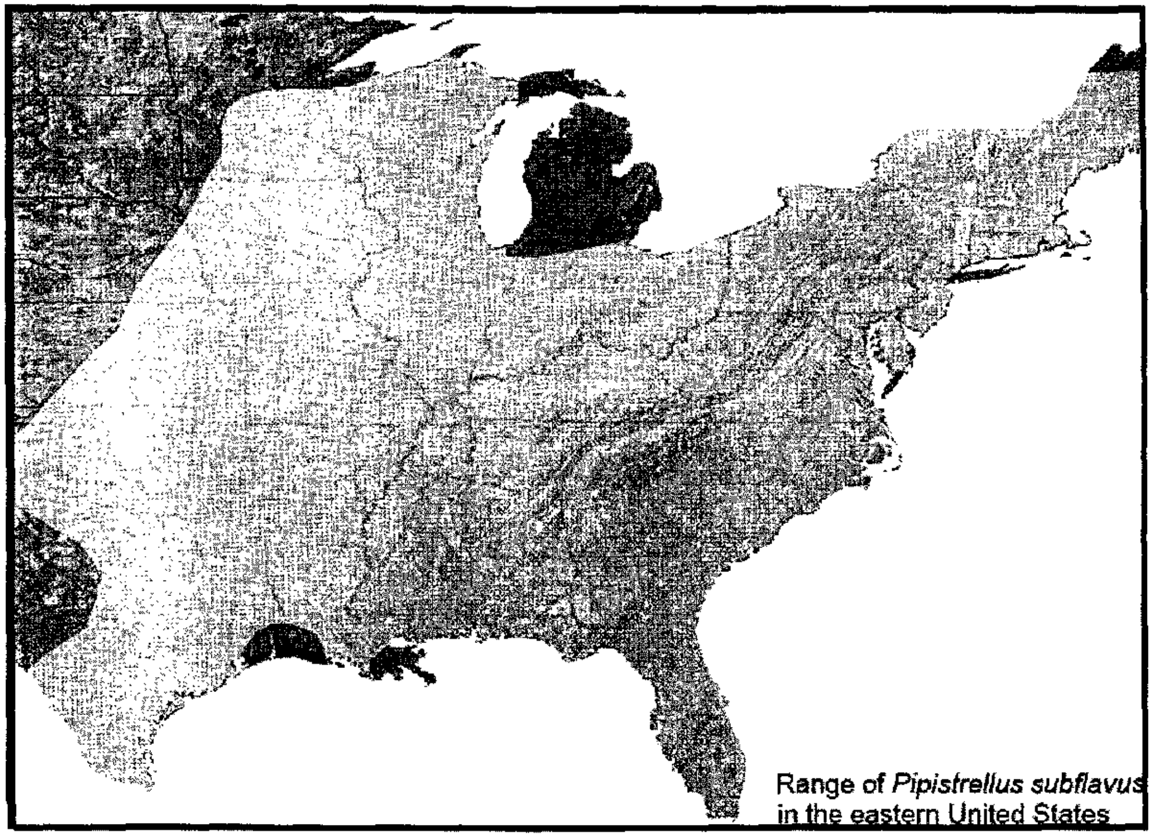


Range of *Myotis sodalis* in the eastern United States



Range of *Nycticeius humeralis* in the eastern United States

Bat range data obtained from http://www.natureserve.org/getData/mammalMaps.jsp (06/21/2005)



Range of *Pipistrellus subflavus* in the eastern United States

Bat range data obtained from http://www.natureserve.org/getData/mammalMaps.jsp (06/21/2005)

APPENDIX C

Agency Queries

Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR SEAN D. LOGAN, DIRECTOR

Division of Natural Areas & Preserves
Steven D. Maurer, Chief
2045 Morse Road, F-1
Columbus, OH 43229-6693
Phone: (614) 265-6453 Fax: (614) 267-3096

July 15, 2009

Mike Sponsler
BHE Environmental, Inc.
5300 E. Main St., Suite 101
Columbus, OH 43224

Dear Mr. Sponsler:

After reviewing our Natural Heritage maps and files, I find the Division of Natural Areas and Preserves has no records of rare or endangered species within 5 miles of the BHE Environmental, Inc. Hardin County North Wind Farm project #1865.004. The site is located in Secs. 8, 9, 10, 16, 17, 18, 20, and 21, Washington Twp., Hardin Co., Ada and Dunkirk Quadrangles.

There are no existing or proposed state nature preserves within 5 miles of the project site. We are also unaware of any unique ecological sites, geologic features, breeding or non-breeding animal concentrations, state parks, state forests, scenic rivers, or wildlife areas within 5 miles of the project area.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although we inventory all types of plant communities, we only maintain records on the highest quality areas.

Please contact me at (614) 265-6409 if I can be of further assistance.

Sincerely,

Butch Grieszmer, Data Specialist
Resource Services Group

Exhibit 08-6. Avian Risk Assessment by BHE.

PN: 1865.004

August 2009

AVIAN RISK ASSESSMENT FOR THE PROPOSED HARDIN COUNTY NORTH WIND FARM, ADA AND DOLA, OHIO

Prepared for:
JW Great Lakes Wind, LLC
1900 Superior Ave., Suite 333
Cleveland, Ohio 44114

Prepared by:
BHE Environmental, Inc.
11733 Chesterdale Rd.
Cincinnati, OH 45246-4131
Phone: 513.326.1500
www.bheenvironmental.com

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EXECUTIVE SUMMARY

JW Great Lakes, LLC (JW) contracted BHE Environmental, Inc. (BHE) to complete an avian risk assessment for the proposed Hardin County North Wind Farm Project near the towns of Ada and Dola, Hardin County, Ohio. This assessment includes a review of appropriate literature and databases; results of agency data base queries; coordination with the Ohio Department of Natural Resources (ODNR), Ohio Power Siting Board (OPSB), and US Fish and Wildlife Service (USFWS); and summary of field investigations conducted in October 2008 and March 2009 by a qualified ornithologist. These data provide an understanding of the species and numbers of birds known or suspected to use the Project area and are used to assess the potential risk to birds, if any, as a result of the proposed wind farm.

The proposed 49.5 megawatts (MW) Hardin County North Wind Farm Project is located near the towns of Ada and Dola in Hardin County, Ohio. JW has proposed to install between 19-27 wind turbine machines at 80-100 meters (m) hub height and 90-100 m diameter rotors on the approximately 3,371 acre (ac) site dominated by intensive row crop agriculture production (Figure1). Over 98% of the Project area is cropland.

The Hardin County North Wind Farm site is privately owned farmland. The terrain on the site is nearly flat. There are paved and gravel section roads throughout the Project area and a single set of railroad tracks crosses the property. The area was effectively drained in the 1940s and deep linear drainage ditches cross the property and feed into Hog Creek Ditch, which drains the site to the west. The property is predominantly intensively managed for soybean and corn agriculture.

During the Fall Raptor Migration survey and Spring Northern Harrier Nest Survey, no federally endangered or threatened species were observed on or within ¼ mile of the Project perimeter. The state endangered Northern Harrier (*Circus cyaneus*) and state species of concern Sharp-shinned Hawk (*Accipiter striatus*) were observed flying through the area well below the height of rotor swept areas. During Spring Raptor surveys, Sharp-shinned Hawks were observed passing through the Project area. Nest searches for Northern Harriers produced no finds. Habitat is not suitable for Sharp-shinned Hawk nesting. A query of the ODNR Natural Heritage Database revealed no records of endangered or threatened species on or within five miles of the Project area.

Nothing in the literature, databases, and examination of the habitats on the site suggest that the property is an important nesting, foraging, or migratory stop-over site for federal or Ohio State endangered, threatened, avian species of concern. There was no indication that the proposed wind farm site harbored large numbers of migrating or wintering birds or that the site is situated along a major migratory pathway.

Due to the intensive agricultural practices, there was no indication of high densities or abundant availability of prey species that could attract raptor species.

The results of the site visits, literature reviews, database searches and survey of the avian species that utilize the site compared with what is known about avian risk factors at wind farms in North America indicate that the risk to avian species at the Hardin County North Wind Farm site is low.

1.0 INTRODUCTION

1.1 PROPOSED PROJECT

JW Great Lakes, LLC (JW) proposes to construct a 49.5 megawatts (MW) wind farm (Hardin County North Wind Farm Project) near the towns of Ada and Dola, Hardin County, Ohio. The Project area represents the maximum area considered for placement of turbines and facility infrastructure. The actual area occupied by the turbines and access roads that will comprise the facility will be a very small percentage (4% during construction; <1% when built) of the Project area. Turbines will be on tubular towers and lighted according to Federal Aviation Administration (FAA) regulations. The proposed 3,351 acre (ac) Project area is dominated (98%) by intensive row crop agriculture (Figures 1 and 2).

Though number and specific model of turbines has not yet been selected, the Hardin County North facility will consist of 19 to 27 wind turbines located in strings or arrays within the Project area. Models and number of turbines under consideration include Kenersys K100 (19 turbines), Siemens SWT 2.3-101 (21 turbines), or Vestas V90 (27 turbines). This risk assessment is applicable to each of the three options.

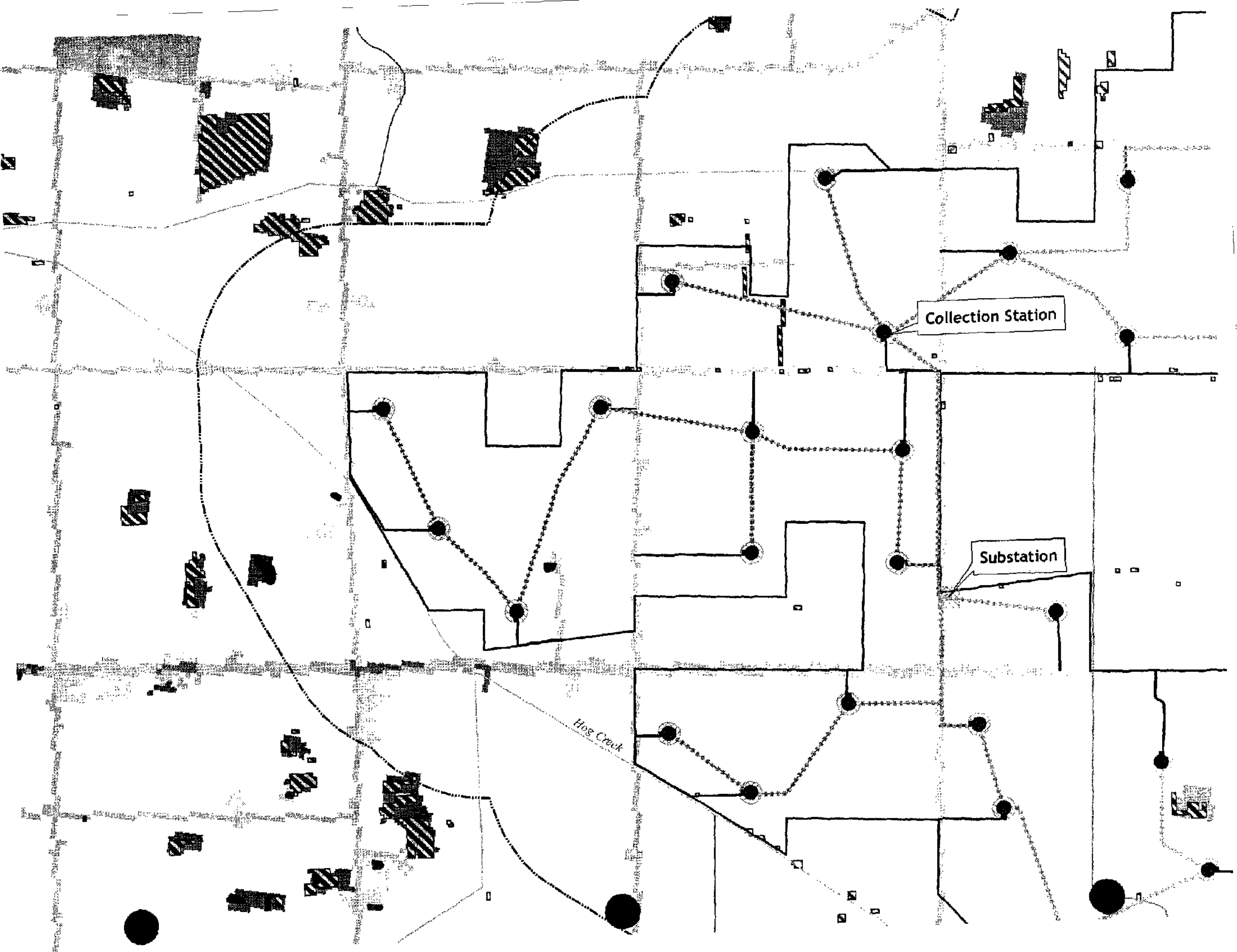
The Siemens SWT 2.3-101 model will have a nameplate generating capacity of 2.3 MW, yielding a total nameplate project capacity of 48.3 MW. The proposed hub height is about 100 meters (m) (328 feet [ft]) above ground level (agl). Rotor diameter will be approximately 101 m (331 ft) and individual blades will be approximately 49 m (160.8 ft) long. With the rotor tip in the 12 o'clock position, the wind turbines will reach a maximum height of approximately 150.5 m (494 ft) agl. At the 6 o'clock position, the rotor tip will be approximately 49.5 m (162 ft) agl. The turbine rotor will turn at a maximum operating speed of 16 revolutions per minute (rpm). The turbines have a nominal "cut-in speed" of 4 m per second (m/s) (8.9 miles per hour [mph]). Wind speeds above 4 m/s will result in blade speeds of 6 to 16 rpm, depending upon wind speeds.

The Vestas V90 model will have a nameplate generating capacity of 1.8 MW, yielding a total nameplate project capacity of 48.6 MW. The proposed hub height is about 80 m (262 ft) agl. Rotor diameter will be approximately 90 m (295 ft) and individual blades will be approximately 44 m (144 ft) long. With the rotor tip in the 12 o'clock position, the wind turbines will reach a maximum height of approximately 125 m (410 ft) agl. At the 6 o'clock position, the rotor tip will be approximately 35 m (115 ft) agl. The turbine rotor will turn at a maximum operating speed of 16.6 rpm. The turbines have a nominal "cut-in speed" of 4 m/s (8.9 mph). Wind speeds above 4 m/s will result in blade speeds of 9.3 to 16.6 rpm, depending upon wind speeds.

The Kenersys K100 model will have a nameplate generating capacity of 2.5 MW, yielding a total nameplate project capacity of 47.5 MW. The proposed hub height is about 100 m (328 ft) agl. Rotor diameter will be approximately 100 m (328 ft) and individual blades will be approximately 48.7 m (160 ft) long. With the rotor tip in the 12 o'clock position, the wind turbines will reach a maximum height of approximately 150 m (492 ft) agl. At the 6 o'clock position, the rotor tip will be approximately 50 m (164 ft) agl. The turbine rotor will turn at a maximum operating speed of 14.1 rpm. The turbines have a nominal "cut-in speed" of 3.5 m/s (7.9 mph). That is, winds of 3.5 m/s contain sufficient energy to support the generation of electric power by the turbine. At wind speeds below 3.5 m/s, as measured by an anemometer atop each nacelle, the turbine's "primary brake" is applied (i.e., the turbine

Figure 1. Project boundary based on V90 turbine layout for JW Great Lakes Wind, Hardin County North Project, Ohio.

N / W / E / S	Feet: 2,000 0 2,000 4,000	May 2009	BHE ENVIRONMENTAL
	Project No. 1865.004	Basemap: Microsoft Virtual Earth Imagery© 2009	


Collection Station
Substation
Hog Creek

blades are feathered by orienting the primary surface of each blade parallel to the wind direction). With the primary brake applied, the blades will not rotate around the hub, or will rotate very slowly (less than 1 rpm). Control systems allow the cut-in wind speed to be set independently at each turbine. Wind speeds above 3.5 m/s will result in blade speeds of 1 to 14.1 rpm, depending upon wind speeds. If wind speeds at an operating (spinning) turbine drop below the cut-in speed, the primary brake is applied and the blades come to a stop within approximately one minute.

As a result of the proposed Project, some existing roads will be improved and new roads constructed to allow access for construction and maintenance of the turbines. Electric lines will be primarily underground.

The ownership of the property is private. No Town, County, State, or Federal property occurs within the Project limits.

1.2 TOPOGRAPHIC/PHYSIOGRAPHIC AND HABITAT DESCRIPTION

Habitat at the Hardin County North Project can be broadly characterized through a review of the ecoregional type. An ecoregion is an area with similar or related physiography, where communities or associations of plants and animals, both common and rare, have adapted to that particular environment. Climate, soils, drainage, and anthropogenic factors all may have an effect on biological communities and ecoregions.

The proposed Hardin County North Wind Farm is located in the Central Till Plains, Beech Maple Section of the Eastern Broadleaf forest Ecoregion (Appendix B). This Section is part of the Central Lowlands geomorphic province, characterized by its flatness and by shallow entrenchment of its drainages. This is a level to gently rolling till-plain (glacial ground moraine), with broad bottom lands along the few major river valleys. Elevation ranges from 200 to 300 m (650 to 1,000 ft). Local relief is mainly a few meters, but in places, hills rise as much as 25 m (80 ft). The topography of the proposed Hardin County North Wind Farm is essentially flat. Topographic changes consist of drainage ditch banks and an elevated railroad track.

1.3 METHODS

Literature and database searches were completed, including a review of relevant printed, published, unpublished, and electronic material including US Geological Survey (USGS) Breeding Bird Surveys, Ohio Breeding Bird Atlas, Audubon Christmas Bird Counts, hawk migration literature, Ohio Natural Heritage Inventory, Ohio Department of Natural Resources (ODNR) information, US Fish and Wildlife Service (USFWS) information, and other sources of information concerning the birds that may nest, migrate through, forage, rest, or use the site as a wintering area.

Coordination was sought from the ODNR and USFWS. Field investigation methods were based upon agency input and the study intensity maps included within the ODNR "On-Shore Bird and Bat Pre- and Post-Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio." Queries of agency databases were conducted (Appendix A).

Vegetation and habitats were surveyed October 30 - 31, 2008. The survey area included the Project area as well as the surrounding one-fourth mile area. Pedestrian surveys of the railroad bed, representative ditches, and the adjacent woodlot identified the dominant vegetation in each habitat type. An automobile survey was conducted throughout the property to assure that no habitat features were excluded and to survey the agricultural areas.

Avian surveys were conducted two days a week from October 9-31, 2008. These surveys were conducted with the aid of 10 magnification binoculars and included periods of stationary observation and automobile surveys. Local residents were interviewed about wildlife species that were nocturnal or seldom seen, but likely occurred on the site. Ditch bottoms were inspected for bird tracks and other identifying signs.

Raptor migration surveys were conducted October 9 - 31, 2008. The counts occurred from 0900 to 1600 hours, two days per week. Estimated raptor flight height above ground level was recorded to assess usage of air space within turbine rotor swept area. Methods used were consistent with Section 2.2 Diurnal Bird/Raptor Migration Monitoring of the *On-Shore Bird and Bat Pre- and Post- Construction Monitoring Protocol for Commercial Wind Energy Facilities in Ohio*, issued by ODNR, except surveys were conducted one less day per week and did not start by the recommended September 1 start up date.

As requested by ODNR, nest searches for the Northern Harrier (*Circus cyaneus*), an Ohio Endangered Species, were conducted March 26-27 and April 28-29, 2009. Due to the distinctive flight patterns during hunting and courtship, observations were conducted from points along public roads where expanses of potentially suitable habitat could be scanned for birds.

A list of birds species detected during these surveys is provided (Table 1).

2.0 LITERATURE REVIEW

2.1 NATIONAL AUDUBON SOCIETY CHRISTMAS BIRD COUNT

Christmas Bird Counts, initiated in 1900, are organized by the National Audubon Society and have been an annual event for 109 years. From the original 25 counts taken in 1900, 124 counts were completed in 2008. The count consists of volunteers attempting to count all of the birds seen or heard in a predetermined, twelve-mile diameter circle.

A Christmas Bird Count was not conducted on the site, but was conducted near Kenton, Ohio, approximately 12 miles (mi) southwest of the Project area. A total of 61 species were identified during the 2008 Hardin County Christmas Bird Count (Table 2).

The lack of habitat diversity limits the occurrence of a diversity of birds using the Project area during the winter. Of the species identified during the Christmas Bird Count, only thirteen species were observed during the surveys of the proposed Project area.

2.2 BREEDING BIRDS

2.2.1 Information from Breeding Bird Survey

The North American Breeding Bird Survey (BBS) is a long-term, international avian monitoring program initiated in 1966 to track the status and trends of North American avian populations. The USGS Patuxent Wildlife Research Center and the Canadian Wildlife Service jointly coordinate the program.

Table 1. Species of birds observed on proposed Hardin County North Wind Farm.

Family	Species
Ardeidae - Herons, Bitterns	*Ardea herodias* - Great Blue Heron
Cathartidae - New World Vultures	*Cathartes aura* - Turkey Vulture
Accipitridae - Hawks, Kites, Eagles	*Circus cyaneus* - Northern Harrier
	Accipiter striatus - Sharp-shinned Hawk
	Accipiter cooperii - Cooper's Hawk
	Buteo jamaicensis - Red-tailed Hawk
	Falco sparverius - American Kestrel
Charadriidae - Lapwings, Plovers	*Charadrius vociferous* - Killdeer *Pluvialis dominica* - American Golden-Plover
Columbidae - Pigeons, Doves	*Columba livia* - Rock Dove
	Zenaida macroura - Mourning Dove
Corvidae - Crows, Jays	*Cyanocitta cristata* - Blue Jay
	Corvus brachyrhynchos - American Crow
Alaudidae - Larks	*Eremophila alpestris* - Horned Lark
Paridae - Chickadees, Titmice	*Baeolophus bicolor* - Tufted Titmouse
	Poecile carolinensis - Carolina Chickadee
Sittidae - Nuthatches	*Sitta carolinensis* - White-breasted Nuthatch
Turdidae - Thrushes	*Sialis sialis* - Eastern Bluebird
	Turdus migratorius - American Robin
Sturnidae - Starlings	*Sturnus vulgaris* - European Starling
Bombycillidae -Waxwings	*Bombycilla cedrorum* - Cedar Waxwing
Parulidae - Wood-Warblers	*Dendroica coronata* - Yellow-rumped Warbler
Emberizidae - Emberizids	*Melospiza melodia* - Song Sparrow
	Melospiza georgiana - Swamp Sparrow
	Zonotrichia albicollis - White-throated Sparrow
	Zonotrichia leucophrys - White-crowned Sparrow *Plectrophenax nivalis* - Snow Bunting
	Junco hyemalis - Dark-eyed Junco
Cardinalidae - Cardinals, Saltators, Allies	*Cardinalis cardinalis* - Northern Cardinal
Icteridae - Blackbirds	*Sturnella magna* - Eastern Meadowlark
	Agelaius phoeniceus - Red-winged Blackbird
	Quicalus quicula - Common Grackle
	Molothrus ater - Brown-headed Cowbird
Fringillidae - Fringilline and Cardueline Finches	*Carpodacus mexicanus* - House Finch
	Carduelis tristis - American Goldfinch
Passeridae - Old World Sparrows	*Passer domesticus* - House Sparrow

Table 2. Christmas Bird Count Results

Common Name	Year	Number	Number Per Hour	Hours
Snow Goose	109	6	0.184615385	32.5
Cackling Goose	109	14	0.430769231	32.5
Canada Goose	109	2808	86.4	32.5
Mute Swan	109	2	0.061538462	32.5
Tundra Swan	109	6	0.184615385	32.5
American Wigeon	109	1	0.030769231	32.5
American Black Duck	109	15	0.461538462	32.5
Mallard	109	854	26.27692308	32.5
Northern Shoveler	109	3	0.092307692	32.5
Northern Pintail	109	62	1.907692308	32.5
duck sp.	109	80	2.461538462	32.5
Canvasback	109	2	0.061538462	32.5
Ring-necked Duck	109	2	0.061538462	32.5
Lesser Scaup	109	1	0.030769231	32.5
Common Merganser	109	14	0.430769231	32.5
Red-breasted Merganser	109	5	0.153846154	32.5
merganser sp.	109	10	0.307692308	32.5
Wild Turkey	109	6	0.184615385	32.5
Great Blue Heron (Blue form)	109	5	0.153846154	32.5
Bald Eagle	109	1	0.030769231	32.5
Cooper's Hawk	109	4	0.123076923	32.5
Accipiter sp.	109	1	0.030769231	32.5
Red-tailed Hawk	109	12	0.369230769	32.5
Buteo sp.	109	1	0.030769231	32.5
American Kestrel	109	14	0.430769231	32.5
Ring-billed Gull	109	169	5.2	32.5
Rock Pigeon	109	32	0.984615385	32.5
Eurasian Collared-Dove	109	13	0.4	32.5
Mourning Dove	109	40	1.230769231	32.5
Belted Kingfisher	109	3	0.092307692	32.5
Red-headed Woodpecker	109	1	0.030769231	32.5
Red-bellied Woodpecker	109	6	0.184615385	32.5
Downy Woodpecker	109	22	0.676923077	32.5
Hairy Woodpecker	109	2	0.061538462	32.5
Northern Flicker	109	1	0.030769231	32.5
Pileated Woodpecker	109	1	0.030769231	32.5
small woodpecker sp.	109	1	0.030769231	32.5
Blue Jay	109	36	1.107692308	32.5
American Crow	109	5	0.153846154	32.5
Horned Lark	109	112	3.446153846	32.5

Table 2. Christmas Bird Count Results

Common Name	Year	Number	Number Per Hour	Hours
Carolina Chickadee	109	24	0.738461538	32.5
Tufted Titmouse	109	6	0.184615385	32.5
White-breasted Nuthatch	109	7	0.215384615	32.5
Brown Creeper	109	2	0.061538462	32.5
Carolina Wren	109	11	0.338461538	32.5
American Robin	109	21	0.646153846	32.5
European Starling	109	1390	42.76923077	32.5
Yellow-rumped Warbler	109	1	0.030769231	32.5
American Tree Sparrow	109	135	4.153846154	32.5
Song Sparrow	109	25	0.769230769	32.5
Swamp Sparrow	109	4	0.123076923	32.5
White-crowned Sparrow	109	1	0.030769231	32.5
sparrow sp.	109	1	0.030769231	32.5
Dark-eyed Junco	109	118	3.630769231	32.5
Lapland Longspur	109	1	0.030769231	32.5
Northern Cardinal	109	47	1.446153846	32.5
Common Grackle	109	2	0.061538462	32.5
Brown-headed Cowbird	109	1	0.030769231	32.5
House Finch	109	38	1.169230769	32.5
American Goldfinch	109	98	3.015384615	32.5
House Sparrow	109	519	15.96923077	32.5

Each year during the height of the breeding season (June for most of the US and Canada), volunteers skilled in avian identification collect breeding bird data along roadside routes. Each survey route is 24.5 mi long with stops at 0.5 mi intervals. At each stop a 3 minute point count is conducted where every bird seen or heard within 0.25 mi is recorded. Surveys begin ½ hour before local sunrise and take approximately 5 hours to complete. Over 4,100 survey routes are located across North America.

A BBS has not been conducted on the site due to the intensive agricultural practices which limit nesting habitat. The nearest USGS Breeding Bird Survey occurs near Kenton, Ohio, approximately ten mi to the east. Ninety species were identified during the survey. Seven of the ninety species identified during the USGS Breeding Bird survey were listed as endangered, threatened, or species of concern by federal regulatory agencies or by the State of Ohio. The results of the survey are included in Table 3.

The lack of habitat diversity on the proposed Hardin North Wind Farm precludes breeding of many of the species observed in the Kenton survey.

2.2.2 Breeding Bird Atlas

A Breeding Bird Atlas is a grid-based survey designed to ascertain the status and distribution of all avian species breeding within a country, state or county. For the Ohio Breeding Bird Atlas, the State was divided into 4,437 atlas blocks of approximately 10 square mi. The atlasing field effort began in 2006 and will run through 2010.

Breeding bird data is classified into 4 categories: observed, possible, potential, and confirmed. Birds observed once during "safe dates" (the period of the breeding season that excludes non-breeding migrants or dispersing individuals) is determined to be "observed." Birds seen during "safe dates" and in appropriate breeding habitat are considered "possible." Birds observed exhibiting some indication of breeding activity (territorial disputes, pairs of birds together, etc.) are considered potential. Direct observations of active nests, adults carrying food items or fledglings are classified as confirmed.

The proposed Project area was not included in the 1982-1987 Breeding Bird Atlas project. A survey block adjacent to the Project area was surveyed during the 1982-1987 Atlas and that effort identified ten species as possible breeders, thirty two species as probable and thirty-six species were confirmed as breeding in the area, for a total of seventy eight species.

Of the seventy eight species identified during the five year Breeding Bird Atlas survey, nine species are included in the Federal or Ohio list of endangered, threatened, or species of concern. A summary of the results of the 1982 - 1987 Breeding Bird Atlas is included in Table 4.

Extensive observations of the avian species on the proposed wind farm site compiled a total of only thirty-six species. These surveys were conducted during fall and spring migration and during a portion of the breeding seasons. Available nesting habitat diversity will restrict species richness and diversity. Species such as Song Sparrows (*Melospiza melodia*), Swamp Sparrows (*Melospiza georgiana*), Mallards (*Anas platyrhynchos*), and Common Yellowthroat (*Geothlypis trichas*) may nest in the grasses lining the drainage ditches. The only listed species observed on the proposed wind farm site were Northern Harriers and Sharp-shinned Hawks. Both species were seen migrating through the site at low elevations and did not stop on the property. Preferred breeding habitat for these species is limited or lacking on the site.

Table 3. Results of the Kenton, Ohio Birding Bird Survey Route (66033) from 1966 to 2007. Results are listed in taxonomic order.

Canada Goose	Northern Flicker	Brown Thrasher
Wood Duck	Eastern Wood-Pewee	European Starling
Mallard	Acadian Flycatcher	Cedar Waxwing
Ring-necked Pheasant	Willow Flycatcher	Yellow Warbler
Northern Bobwhite	Eastern Phoebe	Common Yellowthroat
Great Blue Heron	Great Crested Flycatcher	Yellow-breasted Chat
Green Heron	Eastern Kingbird	Scarlet Tanager
Turkey Vulture	White-eyed Vireo	Eastern Towhee
Bald Eagle	Yellow-throated Vireo	Chipping Sparrow
Cooper's Hawk	Warbling Vireo	Field Sparrow
Red-tailed Hawk	Red-eyed Vireo	Vesper Sparrow
American Kestrel	Blue Jay	Savannah Sparrow
Killdeer	American Crow	Grasshopper Sparrow
Upland Sandpiper	Horned Lark	Song Sparrow
Ring-billed Gull	Purple Martin	Northern Cardinal
Black Tern	Tree Swallow	Rose-breasted Grosbeak
Rock Pigeon	Northern Rough-winged Swallow	Blue Grosbeak
Mourning Dove	Barn Swallow	Indigo Bunting
Black-billed Cuckoo	Carolina Chickadee	Dickcissel
Yellow-billed Cuckoo	Black-capped Chickadee	Bobolink
Great Horned Owl	Tufted Titmouse	Red-winged Blackbird
Barred Owl	White-breasted Nuthatch	Eastern Meadowlark
Common Nighthawk	Carolina Wren	Western Meadowlark
Chimney Swift	House Wren	Common Grackle
Ruby-throated Hummingbird	Blue-gray Gnatcatcher	Brown-headed Cowbird
Belted Kingfisher	Eastern Bluebird	Orchard Oriole
Red-headed Woodpecker	Wood Thrush	Baltimore Oriole
Red-bellied Woodpecker	American Robin	House Finch
Downy Woodpecker	Gray Catbird	American Goldfinch
Hairy Woodpecker	Northern Mockingbird	House Sparrow

	Breeding Evdence[1]	Species	Breeding Evidence[1]	Species
)	Confirmed (34)	Eastern Wood-Pewee (Contopus virens)	Probable (23)	Yellow Warbler (Dendroica petechia)
	Confirmed (34)	Acadian Flycatcher (Empidonax virescens)	Possible (10)	Cerulean Warbler (Dendroica cerulea
	Probable (21)	Willow Flycatcher (Empidonax traillii)	Confirmed (34)	American Redstart (Setophaga ruticill
colchicus)	Probable (22)	Eastern Phoebe (Sayornis phoebe)	Possible (10)	Common Yellowthroat (Geothlypis tri
ianus)	Probable (21)	Great Crested Flycatcher (Myiarchus crinitus)	Probable (21)	Yellow-breasted Chat (Icteria virens)
)	Probable (21)	Eastern Kingbird (Tyrannus tyrannus)	Confirmed (34)	Scarlet Tanager (Piranga olivacea)
	Possible (10)	White-eyed Vireo (Vireo griseus)	Probable (21)	Eastern Towhee (Pipilo erythrophthal
isis)	Probable (23)	Red-eyed Vireo (Vireo olivaceus)	Confirmed (31)	Chipping Sparrow (Spizella passerina)
is)	Confirmed (34)	Blue Jay (Cyanocitta cristata)	Confirmed (36)	Field Sparrow (Spizella pusilla)
	Confirmed (34)	American Crow (Corvus brachyrhynchos)	Possible (10)	Vesper Sparrow (Pooecetes gramineu
arius)	Possible (10)	Horned Lark (Eremophila alpestris)	Confirmed (34)	Savannah Sparrow (Passerculus sandw
	Confirmed (39)	Tree Swallow (Tachycineta bicolor)	Probable (26)	Grasshopper Sparrow (Ammodramus s
a)	Confirmed (34)	Northern Rough-winged Swallow (Stelgidopteryx serripennis)	Confirmed (34)	Song Sparrow (Melospiza melodia)
mericanus)	Probable (21)	Barn Swallow (Hirundo rustica)	Confirmed (39)	Northern Cardinal (Cardinalis cardina
ythropthalmus)	Possible (10)	Black-capped Chickadee (Poecile atricapillus)	Probable (21)	Rose-breasted Grosbeak (Pheucticus l
asio)	Probable (23)	Tufted Titmouse (Baeolophus bicolor)	Probable (23)	Indigo Bunting (Passerina cyanea)
ius)	Confirmed (34)	White-breasted Nuthatch (Sitta carolinensis)	Probable (26)	Bobolink (Dolichonyx oryzivorus)
	Possible (10)	House Wren (Troglodytes aedon)	Confirmed (36)	Red-winged Blackbird (Agelaius phoer
a)	Possible (10)	Eastern Bluebird (Sialia sialis)	Confirmed (34)	Eastern Meadowlark (Sturnella magna
hilochus colubris)	Possible (10)	Veery (Catharus fuscescens)	Probable (21)	Common Grackle (Quiscalus quiscula)
yon)	Probable (21)	Wood Thrush (Hylocichla mustelina)	Probable (23)	Brown-headed Cowbird (Molothrus at
rpes erythrocephalus)	Probable (23)	American Robin (Turdus migratorius)	Confirmed (38)	Orchard Oriole (Icterus spurius)
rpes carolinus)	Probable (23)	Gray Catbird (Dumetella carolinensis)	Confirmed (31)	Baltimore Oriole (Icterus galbula)
iescens)	Probable (21)	Brown Thrasher (Toxostoma rufum)	Confirmed (34)	House Finch (Carpodacus mexicanus)
sus)	Probable (23)	European Starling (Sturnus vulgaris)	Confirmed (39)	American Goldfinch (Carduelis tristis)
is)	Confirmed (36)	Cedar Waxwing (Bombycilla cedrorum)	Confirmed (39)	House Sparrow (Passer domesticus)

n possible nesting habitat but no other indication of breeding noted.
eeding season
alls heard) on more than one date in the same place. This is a good indication that a bird has taken up residence if the dates are a week or more apart
tory. In addition to territorial singing, chasing of other individuals of the same species often marks a territory.
tated behavior or anxiety calls from adults suggesting probably presence nearby of a nest or young; well-developed brood patch or cloacal protuberance on trapped adults (for banders)
ilding by wrens and woodpeckers
nole
lock

rs)
et able to fly (including downy young of precocious species). This code should be used only for those birds incapable of sustained flight. Gliding and fledging flights are not considered to be sustained flights.

s. To be used when the presence of eggs or young in a nest cannot be determined due to nest location or presence of incubating adult.
bating eggs, or identifiable egg shells found beneath nest. If you find a cowbird egg in a nest, it is a '38' for the cowbird and a '38' for the identified nest owner
nestling(s). If you fi[illegible]wbird fledgling with other young, it is a '39' for

2.3 MIGRATING BIRDS

2.3.1 Habitat Types Attractive to Migratory Birds

Habitats that attract migrant birds such as forests, wetlands, hedge rows, and shrubby thickets are virtually absent from the Project area (Figure 2). There are a series of drainage ditches within the Project area, but these habitat types are limited in size and will not concentrate migratory birds.

Large farm fields are attractive to Horned Larks (*Eremophila alpestris*), Snow Buntings (*Plectrophenax nivalis*), and other grassland migrants. There is extensive acreage of this habitat type throughout the Midwest, so this habitat within and surrounding the Project area is unlikely to concentrate these migrant species.

2.3.2 Nocturnal Songbird Migration

It is generally accepted that passerine migration occurs along a broad front, not focused into narrow routes. This suggests that any area may be over-flown by migrating songbirds. Passerines also migrate nocturnally. There have been a number of studies concerning the potential risk of wind-energy development on nocturnal migrating songbirds (Kunz et al. 2007; GAO 2005; National Academy of Sciences 2007). Erickson et al. (2001) reviewed 31 studies of bird fatalities at commercial wind energy projects and found that 78% of the avian fatalities were passerines, of which approximately half were nocturnal migrants.

The National Academy of the Sciences (2007) summarized studies up to that time and found that bird mortality averaged 1.98 birds/turbine/year in the Pacific Northwest, 1.5 birds/turbine/year in the Rocky Mountain region, 2.22 birds/turbine/year in the Upper Midwest, and the highest average mortality was recorded in the eastern US in the Appalachian Mountains where the average mortality was 4.27 birds/turbine/year. Eastern forested areas have shown the highest bird mortality, while western and Midwestern farmlands have shown lower mortality.

Songbird habitat is lacking within and near the Hardin North Project area. Songbird or other night migrants would not be expected to be attracted to the area due to its lack of forest, wetlands, and other habitats useful to night migrants that may otherwise utilize the site during migration. Moreover, any night migrant birds flying over the Project area would be expected to fly well above the rotor swept area of the turbines. A radar study by Able (1970) indicates that a mean height for a majority of migratory passerines was between less than 1,900 ft agl and 3,037 ft agl on clear nights during the fall migration. Able's (1970) data shows that overcast skies and heavy cloud cover forces the migrants down to elevations of less than 1,000 ft agl.

2.3.3 Raptor Migration

Throughout the Midwest, hawk migration is normally occurs along a diffuse, broad front. Topographic features, linear ridges, large water bodies, or coastlines sometimes concentrate large numbers of migrating hawks, but these conditions are seldom found in the Midwestern states, with the exception of along and between the Great Lakes. Fall and spring raptor migration pathways may intersect the Project area in the autumn. At the request of ODNR, surveys were conducted weekly of raptor migrations October 9-31, 2008. The results of these surveys are provided in Appendix D.

2.3.4 Waterbirds

A review of wetland inventories and land use land cover data showed water resources on the Project area to be minimal. Water on the proposed Hardin North Wind Farm is restricted to Hog Creek Ditch and the drainage systems (Figure 2). The limited acreage of this habitat type will not attract significant numbers of water fowl or wetland associated bird species.

3.0 IMPORTANT BIRD AREAS, FEDERAL AND STATE WILDLIFE REFUGES, AND PRIVATE PROTECTED AREAS

A query of the ODNR Natural Heritage Database showed no designated conservation or natural resources areas within 5 mi of the Project area.

Two Important Birds Areas are located in the general vicinity of the proposed Hardin County North Wind Farm, the Metzger/Ferguson Reservoirs, approximately 25 mi west near Lima, Ohio and Lawrence Woods, approximately 15 mi southeast of the site. Lawrence Woods is identified as an Ohio State Natural Area under the jurisdiction of the ODNR.

No National Wildlife Refuges are in the vicinity of the Project area.

The Big Darby Nature Reserve is located approximately 30 mi southeast of the proposed Project area. The Reserve is owned and operated by the Nature Conservancy. In conjunction with the Nature Conservancy's Nature Reserve, neighboring properties are also protected.

Natural areas are generally lacking in the Project area.

4.0 SURVEY RESULTS

4.1 HABITAT DESCRIPTIONS AND BIRDS PRESENT

4.1.1 Agricultural Fields

Between 1869 and 1946, a network of drainage ditches was constructed throughout the Project area, effectively dewatering the area for agriculture. As a result, the land use on a vast majority (98%) of the proposed wind farm is the cultivation of corn (*Zea mays*) and soybeans (*Glycine max*) (Figures 1 and 2). These intensive agricultural practices and herbicide application control vegetation diversity. In a study of the effects of wind turbines on upland nesting birds in Conservation Reserve Program (CRP) grasslands, Leddy et. al. (1999) recommends turbines be placed within cropland habitats that support lower densities of grassland passerines than those found in CRP grasslands.

Horned Larks (*Eremophila alpestris*), killdeer (*Charadrius vociferous*), and Red-winged Blackbirds (*Agelaius phoeniceus*) were the birds most commonly observed in the agricultural lands.

4.1.2 Drainage Ditches

The Ohio Wetland Inventory (OWI) Map identified a total of 11.9 ac of wetlands within the Project area (Figure 2). The wetlands were approximately 6 - 8 ft in depth and parallel to the roads and section lines, emptying to the west or southwest into Hog Creek Ditch. They span approximately 10 mi within the Project area. Water quality appeared poor due to the great amount of sediment observed in the water. Presumably, due to channelization and agricultural runoff, stream substrate was mud with no aquatic stream structure such as riffles, sand bars, or gravel bars. Within the drainage ditches, some hydrophytic vegetation existed. The drainage systems resulted in removal of wetlands that historically existed on site and allowed conversion of the land to intensive agricultural, therein limiting habitat types on the property.

Wetland plant and wildlife communities are restricted to these ditches and compose an extremely limited amount of the site. Dominant vegetation along the ditches included reed canarygrass (*Phalaris arundinacea*), narrow-leaf cattail (*Typha angustifolia*), and duckweed (*Lemna minor*). Hydrophytic shrub species and high quality wildlife food species, such as buttonbush (*Cephalanthus occidentalis*) or duck potato (*Sagittaria latifolia*), were entirely lacking within this habitat type.

The ditches within the Project area offer little in terms of wetland habitat. Due to the limited size of this habitat type and seasonality of inundation, aquatic species were also limited. Local residents relayed that a majority of the ditches lack water during the summer months and that Hog Creek Ditch, while perennial, contains few, if any, fish species. Bird species identified using the ditches were Great Blue Heron (*Ardea herodias*), Song Sparrow (*Melospiza melodia*), and Swamp Sparrow (*Melospiza georgiana*) Wood Duck (*Aix sponsa*), and Mallard (*Anas Platyrhynchos*). The two species of waterbirds (Wood Duck and Mallard) were seen in extremely small numbers (1-2 birds) during the migratory season.

4.1.3 Railroad Bed

An active set of railroad tracks transects the property just north of Route 81 (Figure 1). The elevated tracks are the highest area on the property and have been colonized by a variety of upland plant species. Dominant plants along the tracks are common milkweed (*Asclepias syriaca*), giant foxtail (*Setaria faberi*), and tall fescue (*Festuca arundinacea*). Scattered shrubs, such as elderberry (*Sambucus canadensis*) and common cottonwood (*Populus deltoides*), added limited vertical diversity and provided perching, feeding, and nesting opportunities for birds such as Gray Catbirds (*Dumetella carolinensis*) and Brown Thrashers (*Toxostoma rufum*).

Birds identified along the railroad tracks were the Song Sparrow (*Melospiza melodia*), Cooper's Hawk (*Accipiter cooperii*), and Northern Cardinal (*Cardinalis cardinalis*). During migration, the cover and feeding potential offered by this habitat type attracted a few fall migrants such as the White-throated Sparrow (*Zonotrichia albicollis*), White-crowned Sparrow (*Zonotrichia leucophrys*), and Yellow-rumped Warbler (*Dendroica coronata*). These species are transient and migrate to wintering grounds located much further south.

4.1.4 Woodlot

A two-ac woodlot is near the northeast quadrant of the property and is the only location of forest habitat within the property boundary or the ¼ mi buffer zone (Figure 2). This woodlot contains the remnants of an oak/maple forest community. Tree species identified in this habitat type were white oak (*Quercus alba*), American basswood (*Tilia americana*), and American Hackberry (*Celtis occidentalis*). Shrub and understory species in the woodlot were red-panicle dogwood (*Cornus racemosa*), Virginia creeper (*Parthenocissus quinquefolia*), serviceberry (*Amelanchier* sp.), and raspberry (*Rubus* sp.). Bird species identified within the woodlot habitat type were Red-tailed Hawk (*Buteo jamaicensis*), Carolina Chickadee (*Poecile carolinensis*), and White-breasted Nuthatch (*Sitta carolinensis*).

4.2 SPECIES SPECIFIC SURVEYS

4.2.1 Raptor Migration

The most common species observed were Turkey Vultures. The highest count in a single day was 381 Turkey Vultures on October 16, flying at an estimated altitude of 1,000 ft agl). Sightings of Red-tailed Hawks averaged three birds per day for a total of 24 birds. Red-tailed Hawks were observed soaring at heights ranging from approximately 25 ft to 200 ft. They were also observed perched on telephone poles and in the few trees located on the property. Five Northern Harriers were counted for an average of 0.6 birds per day. Average height agl for the harriers was an estimated ten ft. Cooper's Hawks averaged 0.7 birds per day (6 birds observed) and Sharp-shinned Hawks averaged 0.4 birds per day based on a total of 3 birds observed. The Cooper's and Sharp-shinned Hawks were observed flying at low altitudes through the site, less than an estimated 25 ft agl. The other raptor commonly observed on the property was the American Kestrel, with an average of 0.6 birds per day (total of 5 birds) identified during the monitoring period. Kestrels were observed perched on power lines and flying at heights of approximately 50 - 100 ft agl.

This survey indicates that the proposed Hardin North Wind Farm site is not located along an important autumn migratory path. Northern Harriers and Sharp-shinned Hawks, while both are Species of Concern in Ohio, they were observed in very low numbers, with a high of 2 Northern Harriers on October 9. When observed, these species flew low, < 10 m agl, and did not stop on the Project area, but flew directly to the south. Data sheets for this survey are included in Appendix D.

USFWS Hawk Migration Maps show that the Hardin North Wind Farm is not located along a migratory flight path. These maps are included as Appendix D.

4.2.2 Northern Harrier Nesting Survey

No Northern Harriers were observed during these surveys, due to a lack of preferred nesting habitat on-site.

5.0 RISK ANALYSIS FOR THE PROPOSED PROJECT

5.1 REVIEW OF RISKS TO BIRDS AT OTHER WIND POWER PROJECTS

5.1.1 Disturbance and Displacement

<u>Construction Impacts</u>

The footprint of wind turbines typically represents a very small amount of a Project area. For example only 4% of the Hardin North Project area will be disturbed during construction and less than 1% of the land will remain in wind energy production during operation. Construction is often completed in 6-12 months depending on the size of the Project and topography of the site. Construction can have a temporary impact upon avian nesting near a wind energy facility which varies based upon the location and configuration of the facility relative to the quality, location and proximity of the habitat. This effect is typically minor.

Operational Impacts

Displacement of birds due to the presence of turbines has been documented in southwestern Minnesota (Leddy et al. 1999) and in Wyoming (Johnson et al. 2000. Breeding and migrating waterfowl and shorebirds have been displaced by wind turbines Drewitt and Langston (2006).

5.1.2 Collision Risk Factors

Perch Availability

Older lattice tower have demonstrated significantly higher bird fatalities (Orloff and Flannery 1992, 1996). Many birds, especially raptors, use the perches and an energy conserving opportunity or as hunting platforms. Modern turbines are mounted on tubular towers. Any of the turbines to be used at the Project area will use tubular towers, thereby eliminating perch availability and reducing this risk factor

Rotor and Blade Tip Speed

Rotor speed on older wind turbines increases collision rates (Orlander and Flannery 1996); Thelander and Rugge 2001). It has been hypothesized that older turbine designs with higher rotation rates and smaller diameter rotors are less visible and therefore presents increased risk to flying birds (Curry 2006; Tucker 1996). Modern turbines such as those proposed by the Applicant at the Hardin North Project area will rotate at much lower speeds, therein reducing the risk. For example, the Siemens turbine under consideration rotates at only 6-16 rpm compared to 72 rpm for older turbines.

Turbine Number and Spacing

While the highest numbers of fatalities have occurred at sites with large numbers of turbines, available data does not correlate turbine numbers with increased risk. With only 19-27 turbines proposed for the Hardin North Project area this risk factor should be low. Moreover, the spacing of the modern turbine arrays at the over 700 ft apart may allow birds sufficient space to maneuver and avoid collisions.

Rotor height

The lowest height of the rotor sweep (rotor height) has been directly correlated with increased collision risk for birds, especially raptors. Curry and Kerlinger (2006) recorded 65.7% of 571 raptor flights below 10 m and an additional 23.1% ranging from 10 to 30 m, for a total of 88.8% of all raptor flights. They also recorded 98% of 32 different species on the site flew below 30 m agl. Smallwood and Thelander (2004) suggest that rotor heights in excess of 28 m agl could substantially reduce raptor mortality.

The hub heights under consideration for the Facility are 80 - 100 m with 90 m rotor diameter. The rotor swept area will be 35 m agl, which may reduce raptor mortality.

Tower Lighting

At present, there is no evidence that FAA lighting in the form of L-864 or L-810 flashing red lights attract birds or that these lights are a causal factor in large scale fatality events at wind turbines. Kerlinger (2000) documented that flashing red strobe lights (L-864) recommended by the FAA and most often used on wind turbines, do not attract migrants like the combination of this type light with L-810 steady burning red lights.

Communication towers pose a greater risk to nocturnally migrating songbirds due to the common usage of steady burning red lights and guy wires (Avery et al. 1980).

Lighting on the turbines on the Project area will follow FAA recommendations that have been shown to be non-attractant to avifauna.

Topography and Physiography

Topographical aspects of the siting of wind turbines may influence the potential risk for avian collisions. Studies suggest that siting turbines on the edge of steep slopes or within depressions increase collision risk, especially for raptor species; Orloff, S. and R. Flannery 1992, 1996; Smallwood, K.S., and C.G. Thelander 2004; Thelander, C.G. and L. Rugge 2001). The flat and unforested farmland on the Project area is consistent with lower risk topography and physiography.

Availability Prey and Density

Habitats with high densities of prey species are preferred by hunting raptors, leading to increased collision risk is situated near turbines. Densities of small mammals are low in areas subjected to intensive farming practices and cultivation (Smallwood, K.S. and C. G. Thelander 2004; Kerlinger et al. 2006).

Siting locations of the wind turbines for the proposed Hardin County North Wind Farm are in areas currently undergoing intensive farming practices, which reduces this collision risk.

5.1.3 Mortality Studies

In 2001, the National Wind Coordinating Committee (NWCC) commissioned Erickson et al. to produce a resource document entitled *Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to other sources of Avian Collision Mortality in the US* (Table 5). This document reviewed the existing research concerning avian collision mortality, its causes and recommendations. Highlights of this resource document are as follows:
Data collected to date indicate an average of 2.19 avian fatalities/turbine/year in the US for all species combined and 0.033 raptor fatalities/turbine/year.

- Data collected outside California indicate 1.83 avian fatalities/turbine/year and 0.006 raptor fatalities/turbine/year.
- Current estimates of wind plant related avian collision fatalities probably represent from 0.01% to 0.02% (i.e., one out of every 5,000 to 10,000 avian fatalities) of the annual avian collision fatalities in the US.
- Data suggest that while turbines are generally below the flight altitude of most nocturnally migrating birds, weather and other factors that reduce bird flight altitudes may result in collisions with wind turbines as well as other artificial structures.
- For all avian species combined, outside California, estimates of the number of bird fatalities/turbine/year from individual studies have ranged from zero at the Searsburg, Vermont (Kerlinger 1998) and Algona, Iowa sites (Demastes & Trainer 2000) to 4.45 on the Buffalo Ridge, Minnesota Phase III site (Johnson et al. 2000).
- An estimated 488 raptors are killed annually by turbines in the US, nearly all in California, particularly at the Altamont Pass Wind Resource Area.

Table 5. State and Federally Listed Endangered, Threatened and Species of Concern

Common Name	Scientific Name	State Listed[1]	PIF Priority Species
Greater Prairie-Chicken	*Tymnpanuchus cupido*		X
Black Rail	*Latterallus jamaicensis*		X
Henslow's Sparrow	*Ammodramus henslowii*		X
Cerulean Warbler	*Dendrioca cerulea*		X
Dickcissel	*Spiza americana*		X
Red-headed Woodpecker	*Melanerpes erythricephalus*		X
Bell's Vireo	*Vireo belii*		X
Northern Bobwhite	*Colinus virginiaaus*		X
Chimney Swift	*Chaetura pelagica*		X
Field Sparrow	*Spizella pusilla*		X
Yellow-billed Cuckoo	*Coccyzus americanus*		X
Eastern Wood-Pewee	*Contopus virens*		X
Great Crested Flycatcher	*Myarchus crinitus*		X
Grasshopper Sparrow	*Ammodramus savannarum*		X
Northern Harrier	*Circus cyaneus*	E	
Sharp-shinned Hawk	*Accipiter straitus*	SOC	

E = Endangered; SOC = Species of Concern

- Meteorological towers showed estimates of 7.5 bird fatalities/tower/year whereas the turbines showed estimates of 1.8 bird fatalities/turbine/year (Johnson et al. 2001) at Foote Creek Rim, Wyoming. The reason for the difference was the fact that the meteorological towers were guyed as both the towers and wind turbines are approximately 60 m (200 ft) in height.
- Raptor collisions with wind turbines may be more likely to occur while the raptor is concentrating on foraging or stooping towards a prey item. A dense or abundant prey base within a wind resource area may attract a greater number of raptors within the vicinity of wind turbines, and subsequently increasing collision fatality potential among raptor species.
- Water within the vicinity of wind turbines may attract waterfowl, seabirds, and shorebirds, increasing collision potential for these species, although other factors such as adjacent habitat and movement patterns would also greatly influence mortality near these water sources.

The 2005 US Government Accountability Office (GAO) report on Wind Power Impacts on Wildlife and Government Responsibilities for Regulating Development and Protecting Wildlife reviewed bird and bat mortality studies at wind energy facilities around the country. The review states that "studies show that bird and bat mortality from wind power in other parts of the country is comparatively lower than in California or Appalachia."

Overall bird fatalities from wind power ranged from 0 to 7.28 birds/turbine/year. The high rate of 7.28 birds per turbine was found at a facility of only three turbines.
In 2007, the National Academy of Sciences (NAS) released its report titled, *Environmental Impacts of Wind-Energy Projects*. The NAS (2007) reported an average of 2.22

birds/turbine/year fatalities from wind energy facilities in the upper Midwest, which is the region most comparable to the Hardin County North Project area. If the Project area produced similar mortality it may total 60 birds/turbine/year spread among a large number of species, so that any one species would likely realize no more than a few individuals lost to the turbines. To put this number of potential fatalities in context, the NAS (2007) stated:

> "Collisions with buildings kill 97 to 976 million birds annually; collisions with high-tension lines kill at least 130 million birds, perhaps more than one billion; collisions with communications towers kill between 4 and 5 million based on "conservative estimates," but could be as high as 50 million; cars may kill 80 million birds per year; and collisions with wind turbines killed an estimated at 20,000 to 37,000 birds per year in 2003, with all but 9,200 of those deaths occurring in California. Toxic chemicals, including pesticides, kill more than 72 million birds each year, while domestic cats are estimated to kill hundreds of millions of songbirds and other species each year. Erickson et al. (2005) estimate that total cumulative bird mortality in the United States "may easily approach 1 billion birds per year." Clearly, bird deaths caused by wind turbines are a minute fraction of the total anthropogenic bird deaths—less than 0.003% in 2003 based on the estimates of Erickson et al. (2005)."... In a review of bird collisions reported in 31 studies at wind-energy facilities, Erickson et al. (2001) reported that 78% of the carcasses found at facilities outside of California were protected passerines (i.e., songbirds protected by the Migratory Bird Treaty Reform Act of 2005). The remainder of the fatalities included waterfowl (5.3%), waterbirds (3.3%), shorebirds (0.7%), diurnal raptors (2.7%), owls (0.5%), fowl-like (galliform) birds (4.0%), other (2.7%), and non-protected birds (e.g., starling, house sparrow, rock dove or feral pigeon) (3.3%).

Based upon published and unpublished information available at this time, it is likely that mortality resulting from the Project will be most similar to that at the Crescent Ridge site in Illinois, Top of Iowa site in Iowa, the Lincoln site in Wisconsin, and the Buffalo Ridge site in Minnesota. Annual mortality estimates based upon post-construction monitoring studies was 1.3 birds per turbine per year at Top of Iowa, Lincoln and Crescent Ridge. Results from multi-year mortality studies conducted at Buffalo Ridge, Minnesota have ranged from 1.0-4.5 birds/turbine/year. With 33 turbines located amidst intensive agricultural land, the Crescent Ridge, Illinois wind farm site is the most similar to the Hardin County North Project.

5.2 AVIAN RISK ASSESSMENT AT HARDIN NORTH WIND FARM

5.2.1 Disturbance and Displacement Risk

The proposed Hardin North Wind Farm property has minimal nesting habitat and a near absence of grassland birds. The site is currently under intensive agricultural management and has little or no diversity of habitat types. The proposed wind farm will not result in habitat fragmentation, because there is virtually no avian habitat to fragment. These factors indicate these risks to be negligible.

5.2.2 Collision Risk

As found in the previously cited mortality studies, wind power presents at least some collision risk to birds. The proposed Hardin North Wind Farm is located in an area with poor avian habitat, low avian use, and low bird density. The Project will use modern turbine and tower designs that have been demonstrated to reduce collision risk. There is the potential for

Horned Larks fatalities, but the turbine design and low number of turbines planned for the Project area will minimize the impact on this common species. The site most similar to the Hardin county North Project is the Crescent Ridge Wind Farm in central Illinois. Results show 1.3 birds/turbine/year were fatalities at that location. If the same mortality is realized at Hardin County North using the maximum 27 turbine layout, it would result in mortality of 35.1 birds per year. The effect upon birds at this rate would be negligible; especially considering the fatalities would be distributed among several species, therein further reducing the effects upon any one species.

5.2.2.1 *Nocturnal Migrant Passerines*

As the studies cited in this assessment have found, a majority of the fatalities of nocturnal migrant passerines are associated with adverse weather conditions. The lack of suitable stop-over habitat reduces the potential for concentrations of nocturnal migrant passerines occurring on the site. The risk of a large number fatality event for nocturnal migrant passerines is low at the proposed Hardin North Wind Farm.

5.2.2.2 *Raptors*

Few raptors were observed within the Project footprint or in the surrounding area. Some raptors migrate through the site, primarily Turkey Vultures, but they were observed well above the rotor swept area. Northern Harriers, Sharp-shinned Hawks, Cooper's Hawks, and American Kestrels were observed below the rotor swept area of the proposed turbines. Aside from one Red-tailed Hawk nest in the small woodlot in the north central portions of the site, nesting by raptor species is limited. Due to the low use of the Project area by raptors, raptor risk is considered very limited at the proposed Hardin North Wind Farm.

5.2.2.3 *Waterbirds*

Wetland habitat on the proposed Hardin North Wind Farm is restricted to Hog Creek Ditch and the drainage systems. The limited acreage of this habitat type will not attract significant numbers of water fowl or wetland associated bird species. Risk to these species is low at the proposed Hardin North Wind Farm, due to lack of habitat that would attract them to the area.

5.2.2.4 *Wintering Resident Birds*

Ohio agricultural fields are not important avian wintering areas. A majority of the wintering bird species observed on the property were Horned Larks and Snow Buntings. Being predominantly ground dwelling species, the collision risk to wintering and resident species is low at the proposed Hardin North Wind Farm.

5.2.2.5 *Listed Species*

No federally listed species were observed on or near the proposed Project area. No Species of Concern identified by the National Audubon Society Watch List or the Partners in Flight List were identified on the proposed wind farm site. The ODNR has no records of listed species on or within 5 mi of the Project area. Northern Harriers, an Ohio Endangered Species, and Sharp-shinned Hawk, classified as a Species of Concern by ODNR, were observed migrating through the site. Both species were seen flying directly through the property and at heights well below the rotor swept area of the proposed turbines. Collision risk to these species is negligible at the proposed Hardin North Wind Farm.

6.0 CONCLUSIONS

The avian habitat on the Project area is minimal in extent and poor in quality. Few birds would be expected to use the area during anytime of year.

Results of this Risk Assessment indicate that the risks for avian collisions with the proposed turbines are low.

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APPENDIX A

Agency Coordination

BHE ENVIRONMENTAL

July 14, 2009

Ms. Angela Boyer
U.S. Fish and Wildlife Service
6950 American Parkway
Suite H
Reynoldsburg, OH 43068-4127

RE: **Data Update for a Study Area in Hardin County, Ohio.**

Dear Ms. Boyer:

BHE Environmental, Inc.'s client has been completing scoping for a study area located in Hardin County, Ohio as depicted on the attached USGS topographic map (study area is located entirely within Hardin County). BHE's client is considering this area for development of a wind power electric generating plant and associated facilities and will encompass approximately 3,400 acres.

We know that prior coordination and database requests have been made for the project but would like to have the most up to date data. Therefore, we would like to request any data your agency can provide regarding rare/sensitive habitat or natural features and communities within 0.25 miles of the study area. In addition, please provide information regarding federally listed endangered, threatened, and candidate species and critical habitat that may be present within the study area proper or within 0.25 miles of the study area. We understand recent Indiana bat captures have occurred in Ohio as part of wind farm siting studies. Please advise whether this data is relevant to JW's proposed project area.

If possible, please provide us with hard copies as well as latitude/longitude locations so that we may include this information on environmental constraints base maps that will be produced for the project. It would be greatly appreciated if we could get a quick response to this request. I have provided GIS shapefiles of the project boundary to help expedite the process.

Please contact Mike Sponsler at 614-856-4681 or msponsler@bheenvironmental.com if you have any questions about this data request. Thank you in advance for your timely response.

Sincerely,

M Sponsler

Mike Sponsler
Director

11733 Chesterdale Road, Cincinnati, Ohio 45246 513.326.1500 / Fax 513.326.1178

11733 Chesterdale Road, Cincinnati, Ohio 45246 513.326.1500 / Fax 513.326.1178

June 24, 2009

Ohio Department of Natural Resources
Division of Natural Areas and Preserves
Attn: Butch Grieszmer
2045 Morse Road
Building F-1
Columbus, OH 43229

RE: Natural Heritage Database Search update for the Hardin County North Wind Farm

Dear Mr. Grieszmer:

BHE Environmental, Inc.'s client has been completing scoping for a study area located in Hardin County, Ohio as depicted on the attached USGS topographic map (study area is located entirely within Hardin County). BHE's client is considering this area for development of a wind power electric generating plant and associated facilities and will encompass approximately 3,400 acres.

We know that prior coordination and database requests have been made for the project but would like to have the most up to date data to assure any permit applications reflect the most recent information. Therefore, we would like to request a Natural Heritage database search for federally and state-listed species, protected wildlife, unique habitats, natural areas, and other ecologically sensitive resources within 5 miles of the study area. We would also like to request your comments on wildlife species likely to be present within 5 miles of the study area and any other general information about the study area that you feel may be pertinent.

If possible, please provide us with hard copies as well as latitude/longitude locations so that we may include this information on environmental constraints base maps that will be produced for the project. I have also provided GIS shapefiles and a map of the project boundary to help expedite the process.

Please contact Mike Sponsler at 614-856-4681 or msponsler@bheenvironmental.com if you have any questions about this data request. Thank you in advance for your timely response.

Sincerely,

M Sponsler

Mike Sponsler
Director

Cc: P. Endres

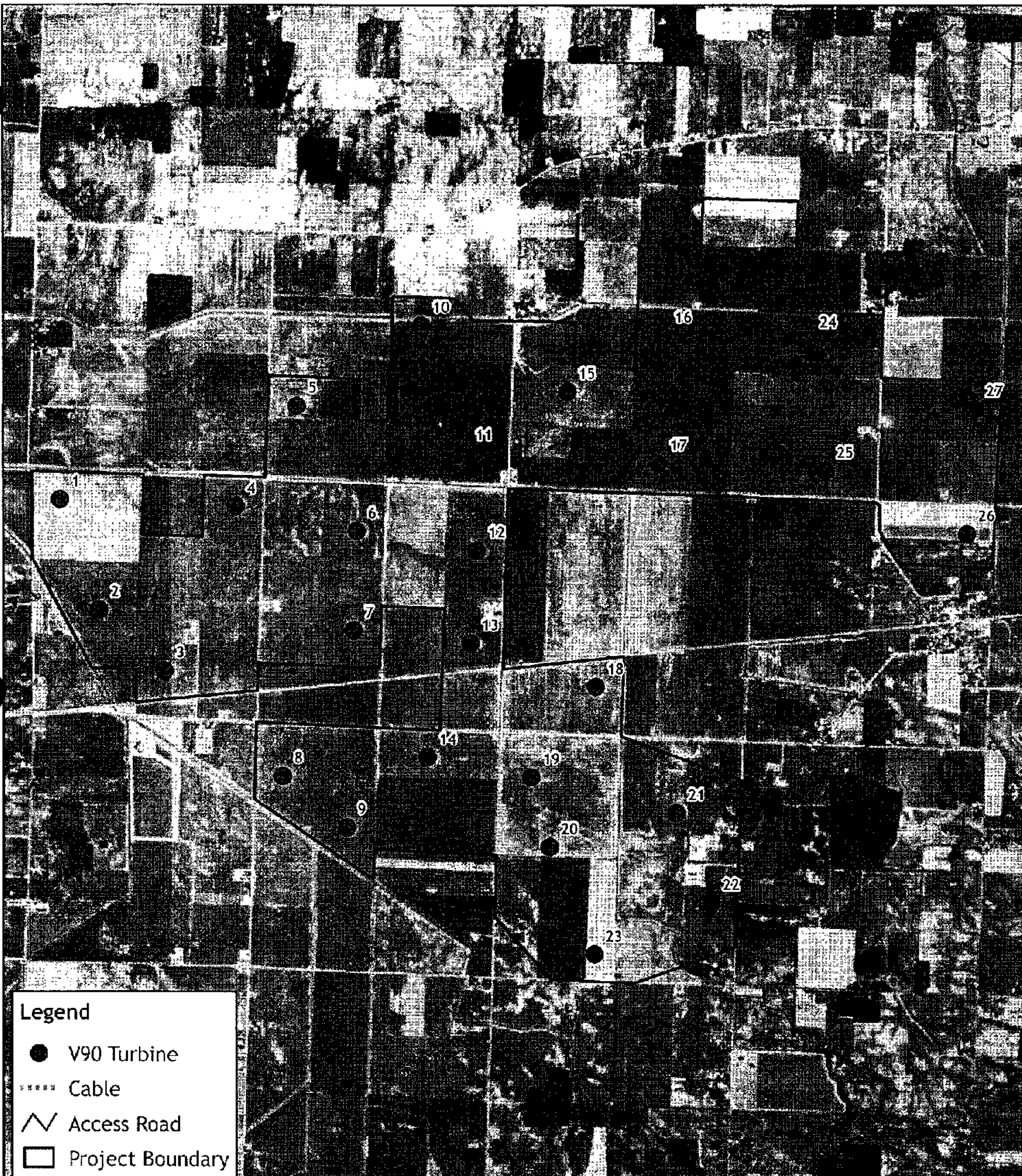


Figure 1. Project boundary based on V90 turbine layout for JW Great Lakes Wind, Hardin County North Project, Ohio.

N W E S	Feet 2,000 0 2,000 4,000	May 2009	BHE ENVIRONMENTAL
	Project No. 1865.004	Basemap: Microsoft Virtual Earth Imagery© 2009	

Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR — SEAN D. LOGAN, DIRECTOR

Division of Natural Areas & Preserves
Steven D. Maurer, Chief
2045 Morse Road, F-1
Columbus, OH 43229-6693
Phone: (614) 265-6453 Fax: (614) 267-3096

July 15, 2009

Mike Sponsler
BHE Environmental, Inc.
5300 E. Main St., Suite 101
Columbus, OH 43224

Dear Mr. Sponsler:

After reviewing our Natural Heritage maps and files, I find the Division of Natural Areas and Preserves has no records of rare or endangered species within 5 miles of the BHE Environmental, Inc. Hardin County North Wind Farm project #1865.004. The site is located in Secs. 8, 9, 10, 16, 17, 18, 20, and 21, Washington Twp., Hardin Co., Ada and Dunkirk Quadrangles.

There are no existing or proposed state nature preserves within 5 miles of the project site. We are also unaware of any unique ecological sites, geologic features, breeding or non-breeding animal concentrations, state parks, state forests, scenic rivers, or wildlife areas within 5 miles of the project area.

Our inventory program has not completely surveyed Ohio and relies on information supplied by many individuals and organizations. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although we inventory all types of plant communities, we only maintain records on the highest quality areas.

Please contact me at (614) 265-6409 if I can be of further assistance.

Sincerely,

Butch Grieszmer, Data Specialist
Resource Services Group

APPENDIX B

Ecoregions of the United States

Ecoregions of the United States
Provinces

M210 Warm Continental Regime Mountains
M212 Adirondack – New England Mixed Forest – Coniferous Forest – Alpine Meadow Province
220 Hot Continental Division
221 Eastern Broadleaf Forest (Oceanic) Province
222 Eastern Broadleaf Forest (Continental) Province
M220 Hot Continental Regime Mountains
M221 Central Appalachian Broadleaf Forest – Coniferous Forest – Meadow Province
M222 Ozark Broadleaf Forest – Meadow Province
230 Subtropical Division
231 Southeastern Mixed Forest Province
232 Outer Coastal Plain Mixed Forest Province
234 Lower Mississippi Riverine Forest Province
M230 Subtropical Regime Mountains
M231 Ouachita Mixed Forest – Meadow Province
240 Marine Division
242 Pacific Lowland Mixed Forest Province
M240 Marine Regime Mountains
M242 Cascade Mixed Forest – Coniferous Forest – Alpine Meadow Province
M244 Pacific Coastal Mountains Forest – Meadow Province
M245 Pacific Gulf Coastal Forest – Meadow Province
250 Prairie Division
251 Prairie Parkland (Temperate) Province
255 Prairie Parkland (Subtropical) Province
260 Mediterranean Division
261 California Coastal Chaparral Forest and Shrub Province
262 California Dry Steppe Province
263 California Coastal Steppe, Mixed Forest, and Redwood Forest Province
M260 Mediterranean Regime Mountains
M261 Sierran Steppe – Mixed Forest – Coniferous Forest – Alpine Meadow Province
M262 California Coastal Range Open Woodland – Shrub – Coniferous Forest – Meadow Province

100 Polar Domain
120 Tundra Division
124 Arctic Tundra Province
125 Bering Tundra (Northern) Province
126 Bering Tundra (Southern) Province
M120 Tundra Regime Mountains
M121 Brooks Range Tundra – Polar Desert Province
M125 Seward Peninsula Tundra – Meadow Province
M126 Ahklun Mountains Tundra – Meadow Province
M127 Aleutian Oceanic Meadow – Heath Province
130 Subarctic Division
131 Yukon Intermontane Plateaus Tayga Province
135 Coastal Trough Humid Tayga Province
139 Upper Yukon Tayga Province
M130 Subarctic Regime Mountains
M131 Yukon Intermontane Plateaus Tayga – Meadow Province
M135 Alaska Range Humid Tayga – Tundra – Meadow Province
M139 Upper Yukon Tayga – Meadow Province

200 Humid Temperate Domain
210 Warm Continental Division
212 Laurentian Mixed Forest Province

300 Dry Domain
310 Tropical/Subtropical Steppe Division
311 Great Plains Steppe and Shrub Province
313 Colorado Plateau Semi-Desert Province
315 Southwest Plateau and Plains Dry Steppe and Shrub Province
M310 Tropical/Subtropical Steppe Regime Mountains
M313 Arizona-New Mexico Mountains Semi-Desert – Open Woodland – Coniferous Forest – Alpine Meadow Province
320 Tropical/Subtropical Desert Division
321 Chihuahuan Semi-Desert Province
322 American Semi-Desert and Desert Province
330 Temperate Steppe Division
331 Great Plains-Palouse Dry Steppe Province
332 Great Plains Steppe Province
M330 Temperate Steppe Regime Mountains
M331 Southern Rocky Mountains Steppe – Open Woodland – Coniferous Forest – Alpine Meadow Province
M332 Middle Rocky Mountains Steppe – Coniferous Forest – Alpine Meadow Province
M333 Northern Rocky Mountains Forest-Steppe – Coniferous Forest – Alpine Meadow Province
M334 Black Hills Coniferous Forest Province
340 Temperate Desert Division
341 Intermountain Semi-Desert and Desert Province
342 Intermountain Semi-Desert Province
M340 Temperate Desert Regime Mountains
M341 Nevada-Utah Mountains Semi-Desert – Coniferous Forest – Alpine Meadow Province

400 Humid Tropical Domain
410 Savanna Division
411 Everglades Province
M410 Savanna Regime Mountains
M411 Puerto Rico Province
M420 Rainforest Regime Mountains
M423 Hawaiian Islands Province

M Mountains with altitudinal zonation. These provinces are named for the spectrum of zone from lower to upper (subnival); e.g., semi-desert – coniferous forest – alpine meadow

ce: R.G. Baile oregions of the United States, USDA Forest Service (scale 1:7,500,000, ed 1994)

APPENDIX C

Site Photographs

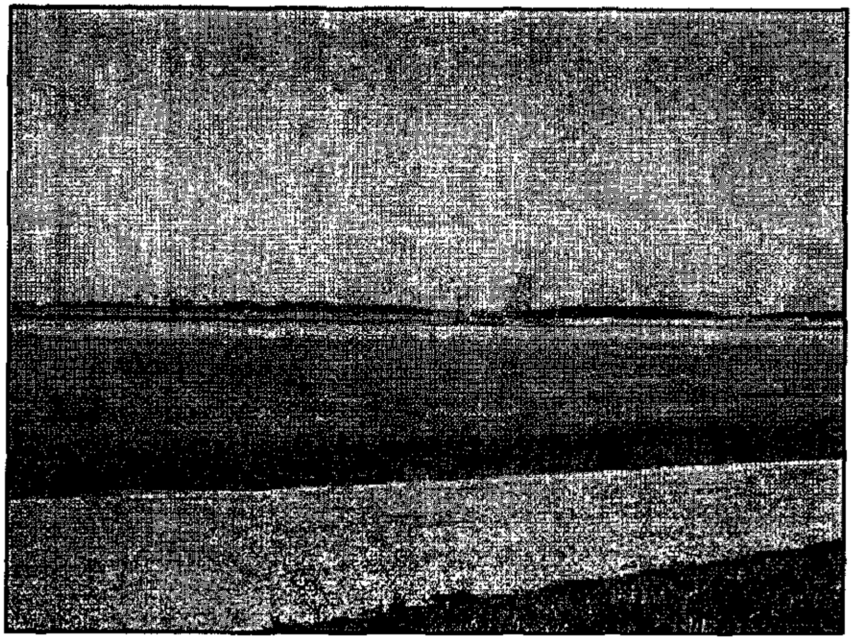


Photo 1. Typical agricultural land use.

Photo 2. Typical agricultural land use.

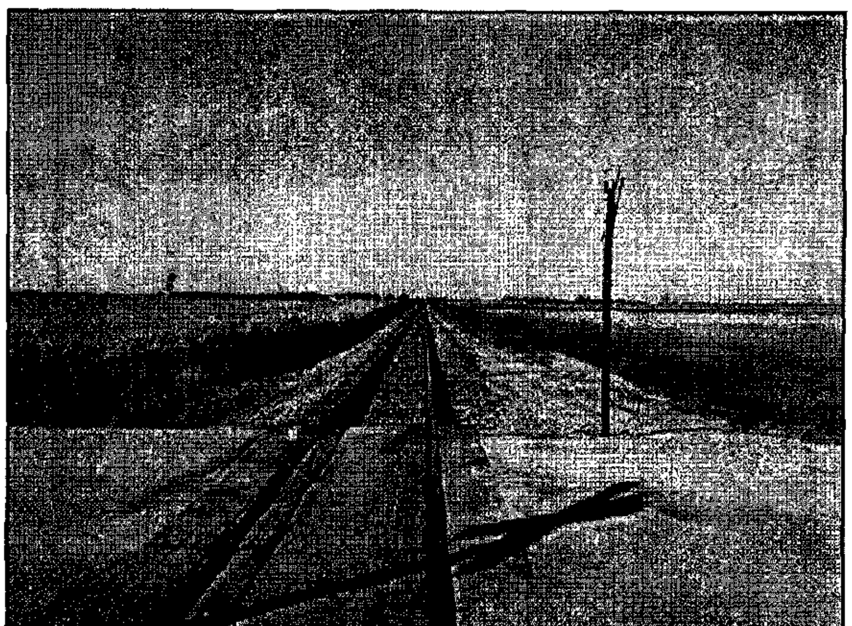


Photo 3. Grassy vegetation along rail road through the project area.

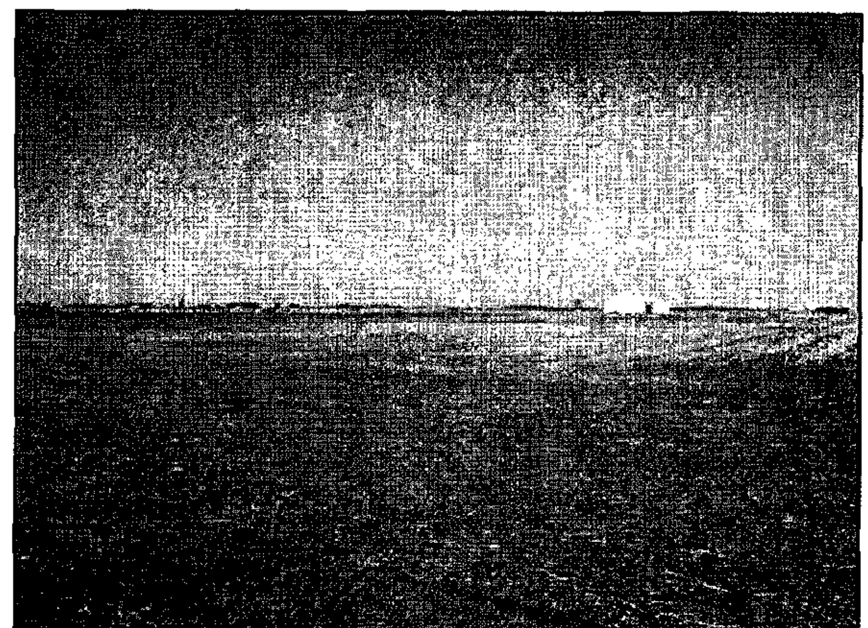


Photo 4. Typical agricultural land use.

Photo 5. Typical agricultural land use.

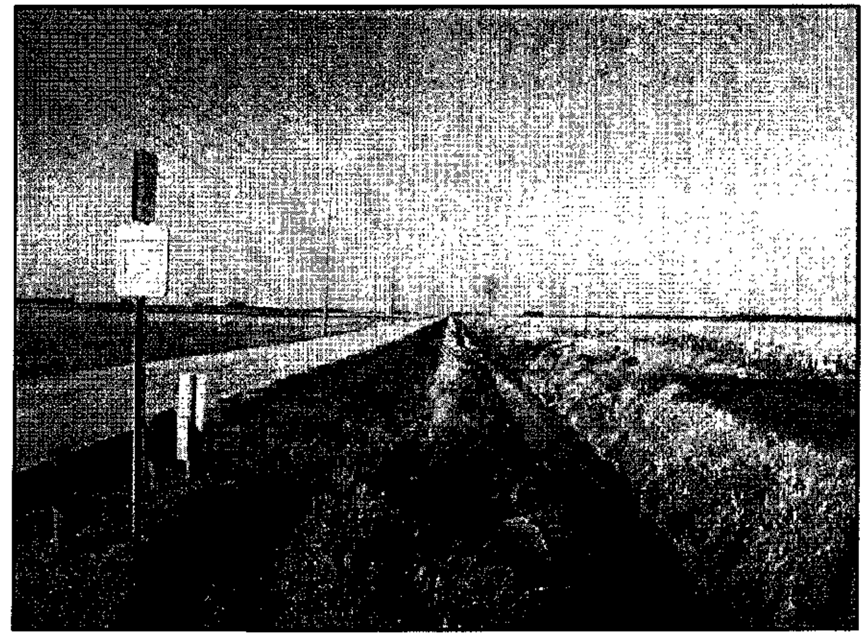


Photo 6. Typical degraded, channeled/grassy watercourse.

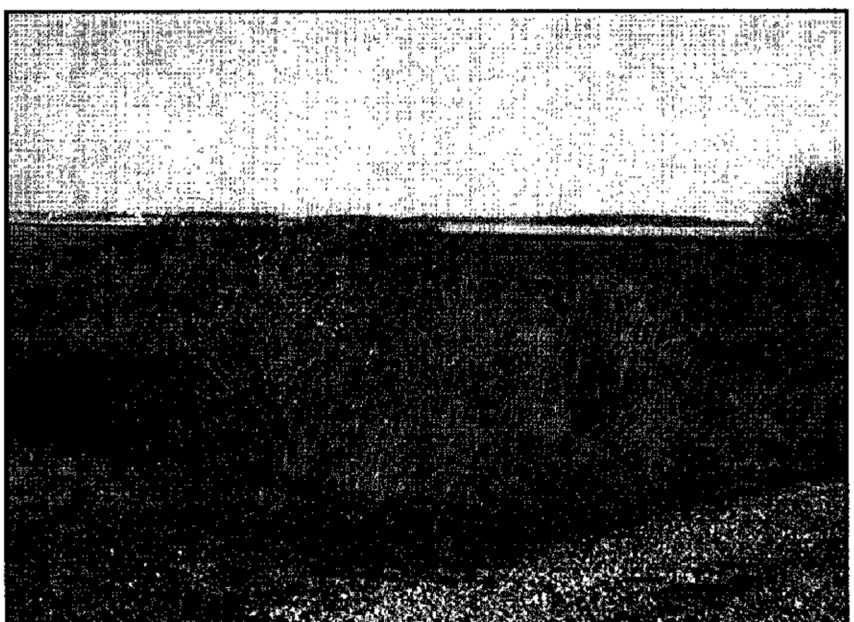


Photo 7. Shrubby vegetation along a road.

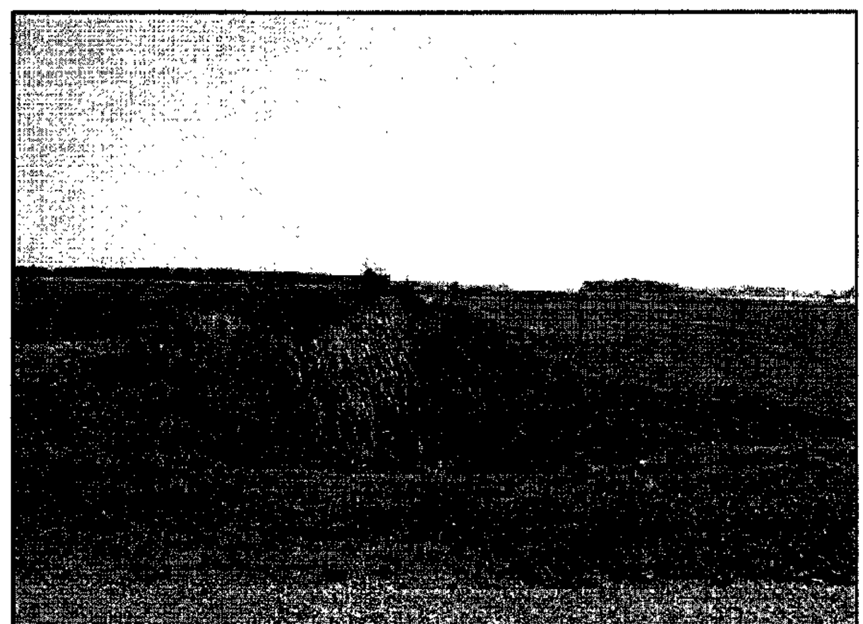


Photo 8. Typical degraded, channeled/grassy watercourse.

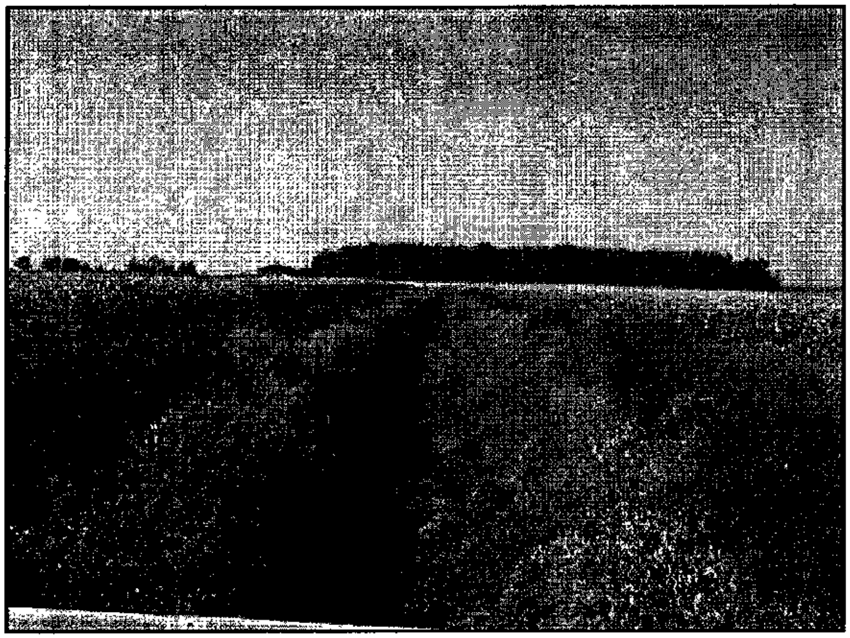


Photo 9. Typical degraded, channeled/grassy watercourse and typical isolated woodlot.

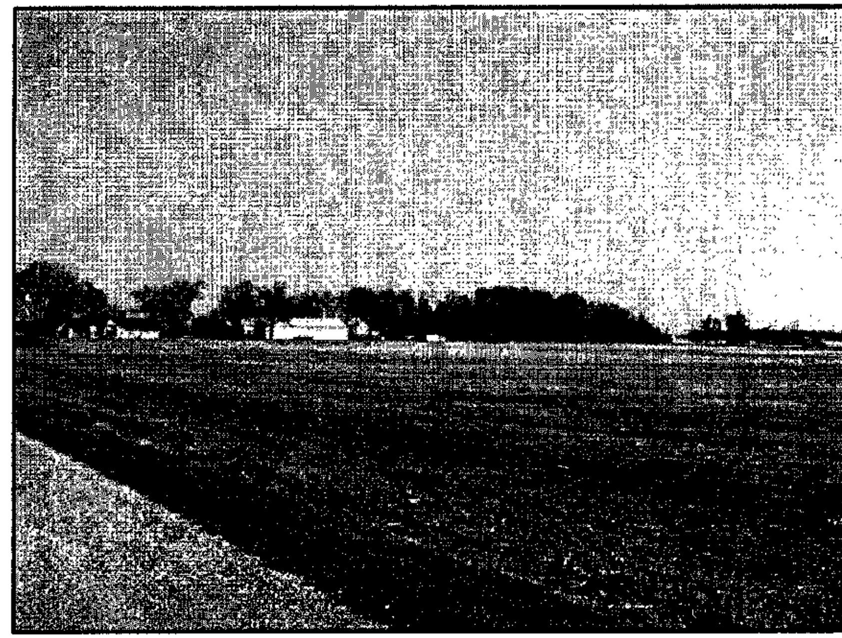


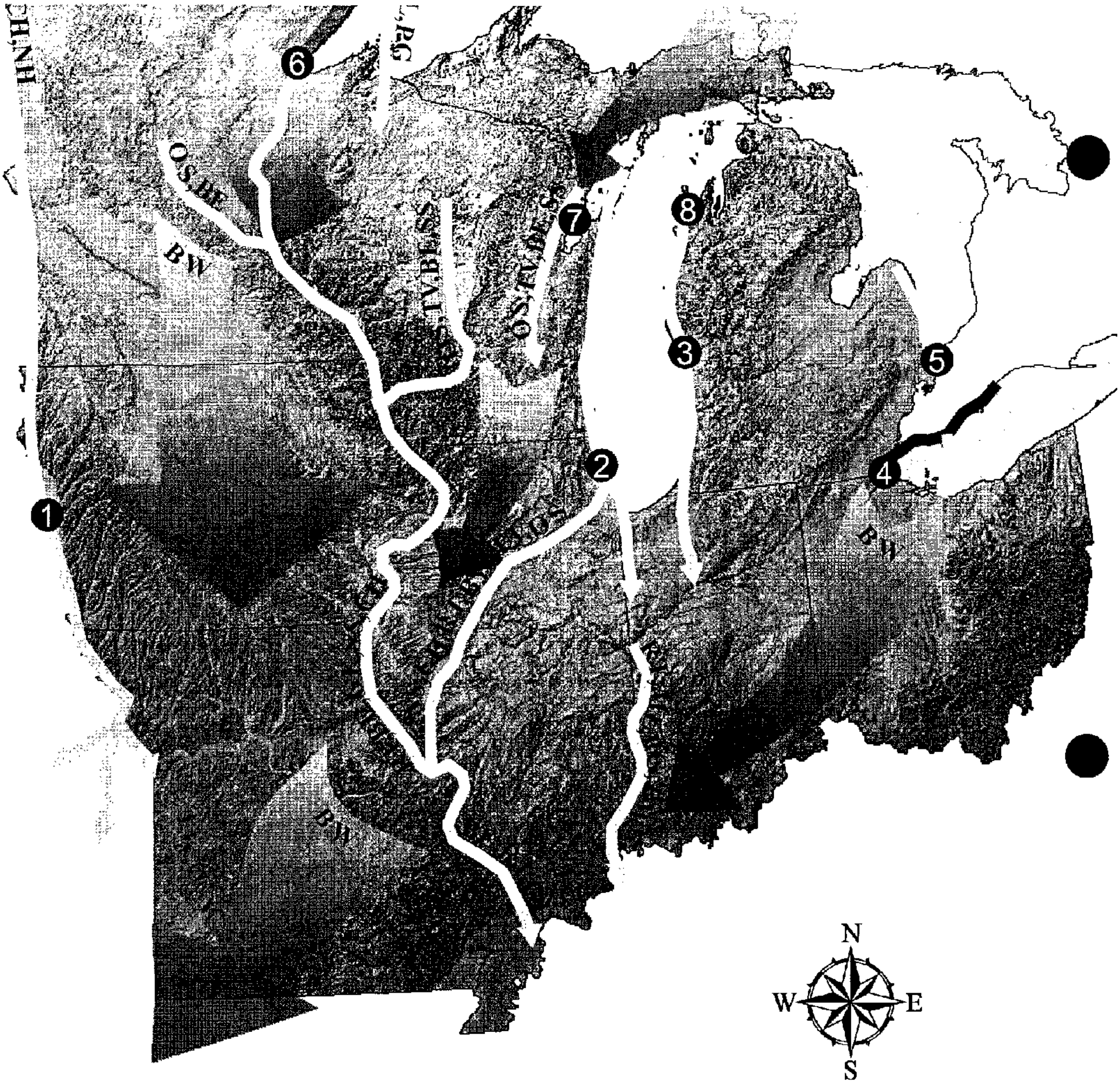
Photo 10. Typical isolated woodlot and trees clustered in a yard.

Photo 11. Trees clustered in a yard.

Photo 12. Typical woodlot.

APPENDIX D

Ohio Raptor Migration Maps



FALL RAPTOR MIGRATION ROUTES

COMMON NAME
American Kestrel
Bald Eagle
Boreal Owl
Broadwing
Cooper's Hawk

Major Raptor Migration Observation Sites

1. Hitchcock Nature Area (CH,RT,SS,TV,SW,NH)
2. Illinois Dunes State Park (ML,NH,PG,SEO)
3. Muskegon State Park (SS,RL,RT)

Legend
Number of B

2,500 -
25,000 -

SPRING RAPTOR MIGRATION ROUTES

MON NAME
nerican Kestrel
ald Eagle
oreal Owl
roadwing
ooper's Hawk

Major Raptor Migration Observation Sites

1. **West Skyline Observatory, Duluth (TV,OS,BE,SS, BW,RT,RL,GE)**
2. **Chequemegon Bay, Ashland (TV,SS,BW,RT,GE,BE)**

Legend
Number of Bi

2,500 - 5

5,000 - 1

Exhibit 08-7. History/Architecture and Archaeological Literature Review

PN: 1865.004

June 1, 2009

HISTORY/ARCHITECTURE AND ARCHAEOLOGICAL LITERATURE REVIEW FOR THE JW GREAT LAKES WIND, LLC, PROPOSED HARDIN COUNTY NORTH WIND FARM WASHINGTON TOWNSHIP, HARDIN COUNTY, OHIO

Prepared for:
JW Great Lakes Wind, LLC
Tower Press Building
1900 Superior Avenue
Suite 333
Cleveland, Ohio 44114-4420

by

BHE Environmental, Inc.
11733 Chesterdale Rd.
Cincinnati, OH 45246-4131
Phone: 513.326.1500
www.bheenvironmental.com

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ACKNOWLEDGEMENT

Research, field review and preliminary mapping for this report were prepared under a subcontract
by
Hardlines Design Company
4608 Indianola Avenue
Columbus, Ohio 43214
614.784.8733

ABSTRACT

A cultural resources service project was completed in association with the Hardin County North Wind Farm development proposed by JW Great Lakes Wind, LLC, to be located in Washington Township, Hardin County, Ohio. The proposed wind farm will involve the construction of 19-27 turbines and associated service roads, crane pads, a substation, and inter-turbine cabling. Ohio Power Siting Board regulations require that impacts on cultural and historical landmarks be considered, in terms of the continued meaningfulness of the landmarks. These landmarks include archaeological sites and historical structures or districts that are recognized as significant on the local level or the national level (the National Register of Historic Places [NRHP]). Because such landmarks may be present within the wind farm boundary or within visual range of the wind farm, cultural resources surveys are required to identify these landmarks and estimate the impact of the proposed wind farm on them.

The report contains the following items:

- A cultural and historical context for the project area
- A literature review to record the existing resources
- A history/architecture photo log that records all buildings listed in the National Register of Historic Places and that shows representative types of existing structures in the area
- An archaeological photo log that documents typical land use and vegetation cover within the wind farm boundaries

For this investigation, the footprint of the proposed construction activities for the wind farm serves as the base area—for archaeological resources, the literature review includes a 1-mile (1.6-km) buffer zone extending out from the boundary of the footprint; the study area for history/architecture resources also considers indirect impacts and is therefore defined as the footprint plus an area extending 5 miles (8-km) out from the boundary of the footprint.

Findings from the History/Architecture Investigation: This investigation revealed that one property within the history/architecture study area is listed in the NRHP:

- The Ada Pennsylvania Passenger Station and Railroad Park, 112 East Central Avenue, listed in the NRHP in 1998

This property lies within the 5-mile (8-km) buffer zone around the wind farm footprint, about 3 miles west of the wind farm footprint in the town of Ada. The project as currently planned will not physically encroach on the property.

A total of 136 properties with Ohio Historic Inventory (OHI) forms are within this same 5-mile buffer zone; no OHI properties are situated within the boundaries of the wind farm footprint itself. During the field visit, a number of structures were observed within the study area from the late nineteenth to early twentieth centuries. Most of these structures have undergone recent renovations including replacement siding, doors, windows, and roofing materials. Several properties had entranceways and windows covered or bricked in.

Findings from the Archaeological Investigation: Three archaeological sites were identified within a 1-mile (1.6-km) buffer around the wind farm boundary:

- 33HR15 (the Demier Kame)
- 33HR16 (the Wilkie Kame)
- 33HR17 (the Candler Kame)

All appear to be located outside the boundary of the wind farm footprint. However, the record for 33HR15 shows it to be in a location about 800 feet from the boundary and the record for 33HR 15 shows it in a location adjacent to the project boundary. Proposed disturbances are approximately 3000 (33HR15) and 1300 feet (33HR16) from the recorded locations. Site 33HR17 appears to have been completely destroyed through gravel-mining operations associated with railroad construction.

Most of the wind farm area lies within the former extent of the Hog Creek Marsh and is currently under agricultural production. A portion of the eastern section of the wind farm footprint features some rises in the otherwise flat landscape. The overall archaeological potential within the wind farm foot print appears low, with the exception of the low rises in the eastern section, which would have been good locations for short-term resource extraction camps focused on the Hog Creek Marsh. Additional Glacial Kame burial sites may be present on the low rises as well.

1.0 PROJECT OVERVIEW

1.1 PROJECT DESCRIPTION

A literature review of cultural resources was completed in April 2009 for the JW Great Lakes Wind, LLC, proposed Hardin County North Wind Farm development in Washington Township, Hardin County, Ohio. The project area is superimposed on the appropriate USGS topographic quadrangle maps in Figure 1.

The proposed wind farm will involve the construction of 19-27 turbines and associated service roads, crane pads, a substation, and inter-turbine cabling. Ohio Power Siting Board regulations require that impacts on cultural and historical landmarks be considered in terms of the continued meaningfulness of the landmarks. These landmarks include archaeological sites and historical structures or districts that are recognized as significant on the local level or the national level (the National Register of Historic Places [NRHP]). Because such landmarks may be present within the wind farm boundaries or within visual range of the wind farm, cultural resources surveys can identify these landmarks and estimate the impact of the proposed wind farm on them.

1.2 SUMMARY OF INVESTIGATION

The purpose of this investigation is to provide a cultural resources literature review (including a reconnaissance-level field visit and photo log) to supply information necessary for the Project Summary Form that the OHPO requires to begin the consultation process. The following items were completed and contained in this report:

- A cultural and historical context for the project area
- A literature review to record the existing history/architecture and archaeological resources
- A history/architecture photo log that records all buildings listed in or determined eligible for the NRHP, as well as the representative types of existing structures in the area
- An archaeological photo log that documents the typical land use and vegetation cover within the wind farm boundaries

For this investigation, two study areas were defined to serve as the areas to be searched for previously identified structures and sites in and near the wind farm:

- **History/architecture resources**: The study area for the history/architecture resources also considers visual and noise impacts and is therefore defined as the footprint of the proposed construction activities for the wind farm, plus a larger area extending out 5 miles (8-km) from the boundary of the footprint (Figure 1).

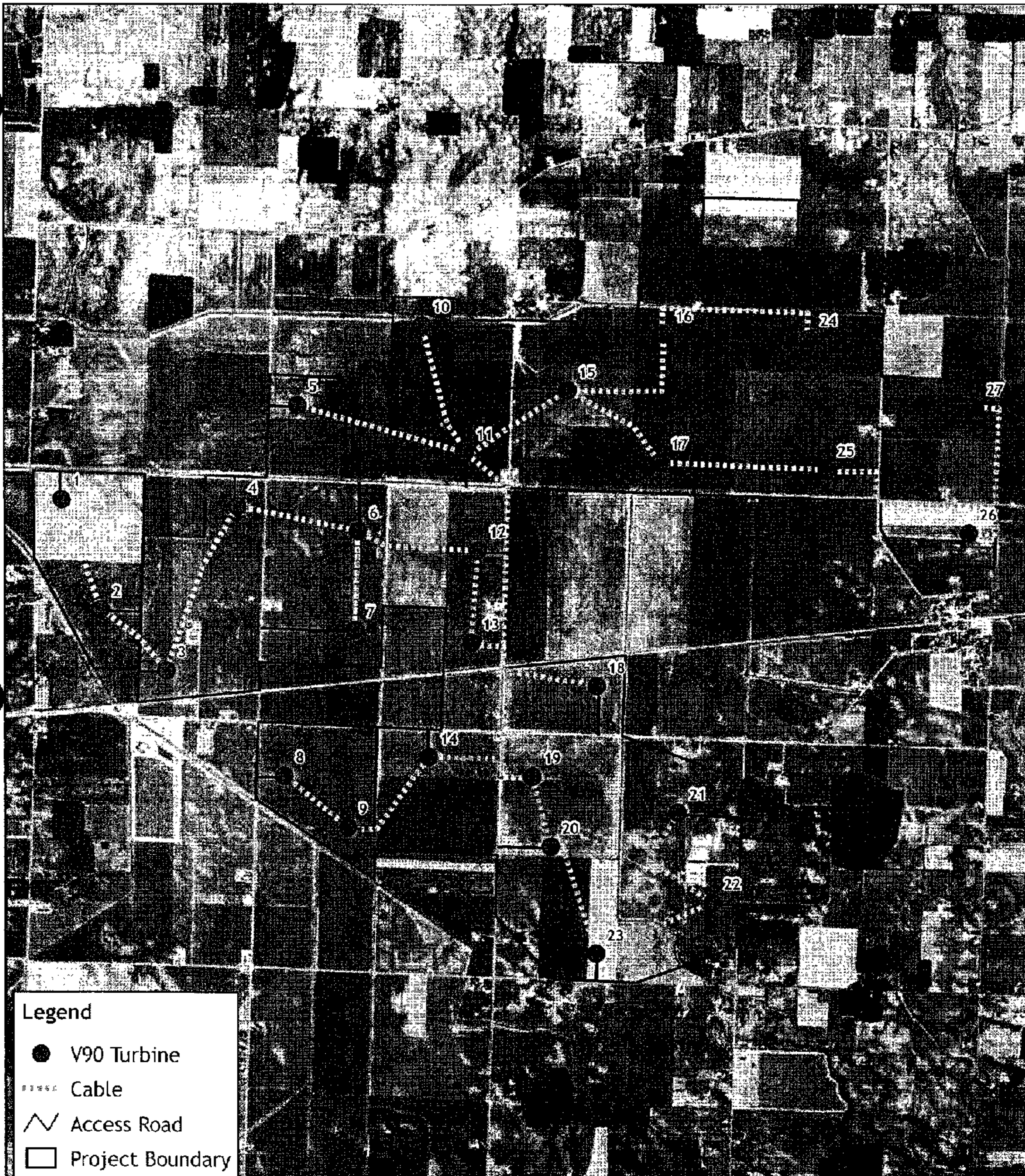


Figure 1. Project boundary based on V90 turbine layout for JW Great Lakes Wind, Hardin County North Project, Ohio.

N W E S	Feet 2,000 0 2,000 4,000	May 2009	BHE ENVIRONMENTAL
	Project No. 1865.004	Basemap: Microsoft Virtual Earth Imagery © 2009	

Findings: The field visit revealed that the NRHP-listed Ada Pennsylvania Station and Railroad Park is within the 5-mile (8-km) buffer zone. The project as currently planned will not physically encroach on this historic district. A total of 136 buildings listed in the Ohio Historic Inventory (OHI) are within the 5-mile buffer zone. During the field visit, a number of late nineteenth to early twentieth century structures were observed within the 5-mile buffer; most of these structures have undergone recent renovations including replacement of siding, doors, windows, and roofing materials. Several properties had entranceways and windows covered or bricked in. None of the OHI-listed properties are situated within the actual wind farm boundaries. For a full listing of the 136 OHI buildings, please see Appendix A.

- **Archaeological resources:** The study area for archaeological resources is the footprint of the proposed construction activities, plus a 1-mile (1.6-km) buffer around the wind farm boundary (Figure 1).

  Findings: Three archaeological sites were identified within a 1-mile (1.6-km) buffer around the wind farm boundaries: 33HR15 (the Demier Kame), 33HR16 (the Wilkie Kame), and 33HR17 (the Candler Kame). These archaeological sites are located close to the wind farm footprint, but none are within the project limits and none are in an area to be disturbed. Site 33HR17 (Candler Kame) was not located within the footprint, and appears to have been completely destroyed through gravel-mining operations associated with railroad construction. Based upon the field visit, there appears to be elevated landforms near the probable locations of 33HR15 (Demier Kame) and 33HR16 (Wilkie Kame). Proposed disturbances are no closer than 800 feet from the kame locations shown in the historical records. The majority of the proposed wind farm lies within the former extent of the Hog Creek Marsh, and is currently under agricultural production. Portions of the southern and eastern sections of the wind farm feature some rises in an otherwise flat landscape. The overall archaeological potential within the wind farm boundary appears low, with the exception of the low rises in the eastern and southern sections, which would have been good locations for short-term resource extraction camps focused on the Hog Creek Marsh. Additional Glacial Kame burial sites may be present on the low rises as well.

Report Organization

Chapter 1 of this report includes the project description, a summary of the investigations, and this description of how the report is organized.

Chapter 2 features a cultural and historical context to provide a framework for the recommendations generated from the field visit and any subsequent field investigations for this project.

Chapter 3 provides a literature review of the history/architecture resources within the history/architecture study area and the known archaeological resources in the archaeological study area.

Chapter 4 summarizes the results of the reconnaissance-level field visit.

Chapter 5 presents recommendations and conclusions.

The References section lists all sources that were cited in the report.

Appendix A contains a table with information on the 136 buildings in the history-architecture study area that have OHI forms.

Appendix B contains a table with information on the archaeological resources located in the archaeological study area.

Appendix C provides historical maps for the wind farm area.

2.0 CULTURAL CONTEXT

2.1 INTRODUCTION

The culture history section provides a broad prehistoric and historical context within which to discuss the project results. Synthetic works on the prehistory of the Eastern Woodlands by Griffin (1967) and Ford (1974) are the primary sources for this discussion; the publications of other scholars are drawn upon for additional detail (Dancey et al. 1987; Dragoo 1976; Prufer and Baby 1963; Stoltman 1978; Yerkes 1988). For convenience, this report uses the Midwestern Taxonomic System developed by McKern (1939) and modified by Griffin (1946, 1952, 1967) to structure the prehistory discussion. The authors have attempted, however, to incorporate the idea of continuity presented by the temporal models developed by Stoltman (1978) and used by Yerkes (1988), rather than the compartmentalization of traits inherent in the Midwestern Taxonomic System. This report also provides a brief overview of the proto-historic and historical Native American occupations in the Ohio Region, along with the early Euro-American history of Hardin County and Washington townships.

2.2 PREHISTORIC OCCUPATION

2.2.1 The Peopling of the Americas

The first people likely reached North America no earlier than 30,000 years ago. Although definitive archaeological evidence dating the arrival of North America's populations is scant, the earliest accepted date for the diagnostic artifacts of the Clovis Culture, generally considered the earliest culture in the New World, is 9500 B.C. (Anderson et al. 1996). However, recent research undertaken at numerous North American sites strongly suggests the possibility of earlier arrival and occupation dates (Dillehay and Meltzer 1991). Numerous sites have been put forward as evidence for a pre-Clovis human occupation in eastern North America, including the Meadowcroft rock shelter in Pennsylvania, Page-Ladson and Little Salt Springs in Florida, Saltville and Cactus Hill in Virginia, and Topper in South Carolina (Anderson et al. 1996; Begley and Murr 1999). These claims, however, are subject to debate (Dincauze 1984; Begley and Murr 1999). Research by Seeman and Prufer (1982) suggests that by 9500 B.C., Paleoindians could have entered Ohio from any direction. By this time, the glacial front that once covered Ohio had retreated into Ontario.

2.2.2 The Paleoindian Period

The first well-documented evidence of human occupation in eastern North America is associated with the Paleoindian period (9500-8000 B.C.), which is characterized primarily by its lithic assemblages. Fluted projectile points, usually produced from high-quality chert, are generally considered the diagnostic marker of the time period. Other tools include end scrapers, side scrapers, bifacial knives, gravers, drills, choppers, awls, and abraders (Meltzer 1988:34). The lithic assemblages also provide an important base for building theories about settlement patterns, hunting practices, and other aspects of Paleoindian life. For example, Custer et al. (1983) suggest a cyclical model of Paleoindian settlement that repeatedly brought groups back to chert outcrops. These lithic sources functioned as preferred quarry sites, and they were regularly used for the easy procurement of suitable lithic resources (Lepper 1986:357-358).

In an update of Prufer and Baby's *Paleo-Indians of Ohio* (1963), Seeman and Prufer (1982) comment on the distribution of Paleoindian fluted points across the Ohio landscape. Although the majority of the projectile points were isolated surface finds, they were recovered from counties that are home to portions of major Ohio river systems, including the Scioto, Miami, and Upper Muskingum. Furthermore, a higher number of Paleoindian fluted points were found in those counties where the river systems form broad valleys and open flood plains, and are bordered by elevated uplands. A total of 13 fluted points was reported for Hardin County by Prufer and Baby in 1963, but that number had increased to 14 by the time of Seeman and Prufer's 1982 publication.

2.2.3 The Archaic Period

The Archaic period is the longest documented temporal segment of prehistory in eastern North America. It is typically divided into the three periods of the Early Archaic (8000-6000 B.C.), the Middle Archaic (6000-3000 B.C.), and the Late Archaic (3000-1000 B.C.), based on the marked differences in subsistence and settlement patterns (Ford 1974:393). The Archaic period is characterized by dramatic climatic change that included a shift from coniferous to temperate forests due to a drying, warming trend. Technological innovation is also characteristic of the Archaic period, as is subsistence diversification. Early archaeological research in the Eastern Woodlands suggested a complete discontinuity between the people of the Paleoindian and Archaic periods, a conclusion likely based on scanty material remains from the Early Archaic (Dragoo 1976:10). A greater consensus has emerged in more recent years for the theory that developments in the Archaic are the result of an unbroken sequence of gradual change that started in the Paleoindian period (Dragoo 1976:10; Ford 1974; Prufer and Baby 1963:4; Prufer and Long 1986:3).

2.2.3.1 The Early Archaic Period (8000-6000 B.C.)

Small bands of Early Archaic hunter-gatherers appear to have been highly mobile and may have traveled across large territorial ranges and a variety of landforms (Jefferies 1990:150). Evidence for this mobility is based on the distribution of projectile points that are diagnostic of the time period (such as Kirk, LeCroy, and Kanawha) but that are made of non-local cherts. Although projectile point styles exhibit a high degree of similarity across the Mid-continent, regional differences in subsistence and settlement practices probably existed (Brown 1985; Jefferies 1990). These differences are simply a function of the diversity of post-Pleistocene environments, from the formerly glaciated regions south of the Great Lakes down to the Florida peninsula. As Smith (1986:10) notes, "an accurate assessment of the character and degree of regional and temporal variation in early Holocene adaptive patterns is not yet possible." Other tools within Early Archaic assemblages include knives, gravers, drills, a few bone awls, hammer stones, choppers, and chipped stone adzes (Griffin 1967:178).

Stafford (1994) conducted one of the few systematic surface surveys undertaken for Archaic sites in the region. More than 22,339 acres (9,000 ha) of land located in the lower Wabash Drainage system of adjacent Indiana were surveyed to identify and understand Archaic-period land use change. Based on a collection of diagnostic bifaces, Stafford determined that Early Archaic materials were found primarily in upland settings (67 percent) followed by terraces along smaller drainages (21 percent), and minimally on the flood plains of major drainages (12 percent). Stafford (1994) explains this biface distribution by suggesting that the early part of the Holocene was characterized by an environmental homogeneity that allowed Early Archaic foragers to exploit resource patches from residential camps that frequently moved within and between drainages. As a result, Archaic groups seemed to favor the tributaries of major drainages and the upland areas next to them. Stafford's settlement model for the Archaic period in Indiana appears to hold true as well for the Scioto River Valley of Ohio. Many Archaic sites in Ohio are located in the uplands along the tributaries of the Scioto, rather than in the main Scioto River Valley itself (Blank 1970). In the Till Plains region, Keener et al. noted that Early Archaic sites tend to focus mainly on the Uplands (79.52 percent of the sites in their study), followed by Upland Flats (13.25 percent) and very minor uses of Glacial Lake Margins, Valley Floors, and Ridges (2.41 percent each) (Keener et al. 2008:37).

2.2.3.2 The Middle Archaic Period (6000-3000 B.C.)

Several technological innovations took place between the Early and Middle Archaic periods. Projectile point types of this time period varied regionally; representative styles of the Midwest included Eva, Morrow Mountain, Big Sandy II, Raddatz, and Godar (Justice 1995; Nance 1988:138; Jefferies 1996:47; Duerksen and Bergman 1998:3-4). Ground stone tools such as axes, pitted stones, pestles, and grinding stones first appeared at this time (Jefferies 1996:48). In addition, archaeological evidence indicates that Middle Archaic people were also familiar with the atlatl, or spear thrower (Jefferies 1996:48).

By the Middle Archaic, populations had shifted their movement strategies from high mobility to reduced mobility (Stafford 1994). Middle Archaic sites appear closer to major river systems than sites from the Early Archaic, a change that corresponds to the hypothesis that there was an increase in biodiversity in the Middle Archaic. This evidence indicates that Middle Archaic settlement patterns had shifted to a processor-based strategy, which included reduced mobility and increased sedentism (Brown 1985; Jefferies 1996). The appearance of ground stone tools and the related implication of increased plant usage also support the idea that Middle Archaic populations were somewhat more sedentary than those living in the region before them.

The Middle Archaic period also saw the use of cemetery sites. The individuals and the materials interred with them reflect no social stratification other than for age and gender. The repeated use of some cemetery sites intensified in the region during the Late Archaic period. The use of designated cemeteries, along with the sedentism and the regional differentiation of settlement systems, suggests that Middle Archaic groups were organized into bands of foragers, and that formal foraging territories had been established (Brown 1985). Regional trade systems also appeared during the Middle Archaic, as indicated by the appearance of exotic materials. Trade networks were organized regionally along the major river valleys throughout the eastern United States, and were oriented primarily around copper and other non-local lithic materials that originated from distant locales, including the Great Lakes and the Gulf and Atlantic coasts (Jefferies 1996).

2.2.3.3 The Late Archaic Period (3000-1000 B.C.)

The Late Archaic period began after the Hypsithermal climatic episode. At this time, streams established their current channels, and the climate became similar to modern conditions.

Trends first seen in the Middle Archaic, such as the increased use of plant resources, increased sedentism, and the use of cemeteries, continued into the Late Archaic period. The Late Archaic lithic assemblage is dominated by a variety of side-notched and corner-notched point types, such as the Brewerton group, as well as hafted scrapers and ground stone tools, including celts and adzes (Prufer and Long 1986; Dragoo 1976). Some evidence from sites in the southeastern United States indicates that Late Archaic populations began to experiment with fired clay. Sites along the Atlantic coast, for example, show evidence of fiber-tempered pottery beginning around 2500 B.C. (Sassaman 1993; Milanich 1994).

Settlement-pattern data for the Late Archaic period demonstrate reduced mobility and settlements restricted to the lower reaches of drainage systems. Archaeological evidence indicates that residential base camps were located primarily along stable terraces of large streams and positioned to exploit heterogeneous environmental patches. For example, in southwestern Indiana, terminal Late Archaic flood-plain settings account for 19 percent of diagnostic Archaic materials on river valley landforms, as compared to 12 percent during the Middle Archaic (Stafford 1994:229). However, regional Late Archaic settlement data sorely lack any evidence of Late Archaic structures. Yerkes (1988:318) points out that permanent domestic structures are rarely encountered for the time period, and when discovered, they are highly variable. Evidence from the Koster site in Illinois indicates the remains of a rectangular structure covering approximately 5 square meters, while data from Massachusetts demonstrates the remains of a slightly larger rectangular structure (Yerkes 1988:318). Archaeological evidence from Vermont indicates that structures there were circular and large enough to house a nuclear family (Ford 1974:396), and circular and ovoid structures were uncovered in northern Ohio that ranged from 41 feet (12.5 m) in diameter to 9.8 feet (3 m) long by 3.3 feet (1 m) wide (Yerkes 1988:318).

The Late Archaic period is also known for the emergence of several mortuary complexes. A mortuary complex is defined as a group of observed traits, "such as preferred burial locations, ritual treatment of the dead, and distinctive kinds of artifacts [that] cannot be assigned specifically to a recognized cultural system" (Penney 1985:28). The Old Copper Complex, found in portions of the Upper Great Lakes, dates from approximately 3000 to 500 B.C.; distinctive copper tools, projectile points, blades, knives, beads, and bracelets are characteristic of this mortuary complex. Copper extraction consisted of mining free, float, or vein copper, and the objects were fashioned into shape by beating and annealing. The Glacial Kame Mortuary Complex dates from 1500 to 500 B.C. and is principally found in the lower Great Lakes region. A sandal-sole gorget of marine shell is one of the most distinctive Glacial Kame artifacts. The Red Ocher Complex also dates from 1500 to 500 B.C. and is centered in the western Great Lakes region. The Red Ocher Complex is characterized by large ceremonial knives made from fine white chert, caches of ovate or triangular points, and turkey-tail points made from Hornstone found in Harrison County, Indiana. Both Glacial Kame and Red Ocher Complex burials were covered with red ocher and typically contained copper beads, tubular pipes, and atlatl weights, which are locally known as birdstones (Tuck 1978).

When the draft version of the Late Archaic study unit for northeastern Ohio was prepared in the mid 1980s by Lee and Brose (n.d.), little was known about the Archaic Period, particularly the Late Archaic in this region of Ohio. Lee and Brose (n.d.) report that at the time of their writing, there were 208 known Late Archaic sites in northeastern Ohio, with 50 percent of those being located on upland landforms, particularly at stream confluences. Lee and Brose (n.d.) recognized that site location was not random, but they could find no reason for the pattern described above. The authors cited reporting bias and inconsistencies, as well as a lack of subsurface data, as causes that limited further interpretation of the existing data. In 2001, Prufer published a more in-depth examination of the Archaic Period data from the region and found that, despite more than 15 years of additional research, the pattern originally identified by Lee and Brose (n.d.) still held true. Prufer (2001:184) found that nearly every elevated glacial landform in the region possessed some evidence of occupation during the Archaic Period. He also found that open Archaic Period sites, particularly of the Late Archaic, were typically located in the "immediate vicinity of rivers and contemporary bogs," which in the Archaic, Prufer proposes, would have been open, shallow bodies of water (Prufer 2001:185). Rockshelters were also utilized but remain understudied, although data from Krill Cave in Summit County suggests that rockshelters may have been utilized in the summer and fall (Prufer 2001:185, 189; Prufer et al. 1989).

Keener et al. (2008) noted that the landform distribution of all Archaic sites in the Till Plains of North-Central Ohio feature a distribution heavily favoring the uplands, with 79 percent of the sites in their study located in uplands. Furthermore, Keener et al. also noted a difference in landform selection between the Early and Late Archaic periods, with a marked decrease in the use of upland flats in the Late Archaic (4.80 percent) as compared to the Early Archaic (13.25 percent). Late Archaic site occurrence on Ridges and Valley Floors (4.00 percent each of total Late Archaic sites) increased slightly over the Early Archaic on the same landforms (2.41 percent each of total Early Archaic sites), while use of Glacial Lake Margins increased significantly in the Late Archaic (8.80 percent of all Late Archaic sites versus 2.41% of all Early Archaic sites) (Keener et al. 2008:37).

2.2.4 The Woodland Period

Originally termed "basic cultures," the Woodland and Mississippian units were first articulated within the McKern Taxonomic System (McKern 1939; Stoltman 1978:708). The Woodland period is divided into three temporal units: the Early Woodland (1000-200 B.C.), the Middle Woodland (200 B.C.-A.D. 400), and the Late Woodland (A.D. 400-1000). The publication of Griffin's work in 1952 solidified the Woodland as three distinct periods (Stoltman 1978:708). This system is in use today, although there is great variability in the archaeological record, especially in the later periods. The main problem is that the original terminology was based on the initial ceramic and mound-building traits, and subsequent research has demonstrated that these traits varied greatly in regional timing. Additionally, plant domestication and the use of domesticated animals also varied greatly across the landscape and through time in eastern North America.

2.2.4.1 The Early Woodland Period (1000-200 B.C.)

In the Midwest, the Woodland period is characterized by the appearance of ceramic vessels by 1000 B.C. Ceramics dating to this time are generally thick walled and either cordmarked, plain, or fabric-impressed. Ceramic paste consisted of heavy grit tempering. Stemmed projectile points indicate Midwestern Adena populations; the Adena complex has been dated to as early as 500 B.C., primarily on the basis of construction of earthen burial mounds in the central Ohio Valley (Seeman 1992:25).

In some areas of the Midwest, settlement patterns resembled those of the Late Archaic, with larger base camps situated in flood plain settings. Although there was probably some level of sedentism, sedentary "hamlets" most likely did not occur in the Midwest until the Middle Woodland period (Yerkes 1988:319). In fact, Early Woodland populations may have been more sedentary than is currently acknowledged. Yerkes (1988:318) notes that Early Woodland structural remains are rarely found in the Midwest. Seasonal movement between summer base camps located on larger flood plains to upland winter camps may also have occurred (Yerkes 1988:319). Some of these locales may have been used over long periods of time, similar to Late Archaic practices.

Cemetery construction is best documented in the central Illinois, Mississippi, and Ohio River valleys, where this behavior first appeared in the late Middle Archaic period. In west-central Illinois, cemeteries contained flexed burials, bundle burials, cremations, and evidence of mound building (Charles and Buikstra 1983). Artifacts associated with some burials included items made of exotic raw materials, such as copper and galena, indicating long-distance, regional trade. The exchange networks established during the Archaic were apparently also operating in the Early Woodland, at least in some form (Seeman 1992:18). Toward the end of the Early Woodland period, ca. 500-150 B.C., the Early Adena people of the central Ohio Valley directed their surplus energy into building numerous mounds within mortuary contexts. Early researchers believed that the positioning of burials and differentiation of grave goods indicated a tribal social organization for the Adena (Clay 1992:77). More recent work, however, has lent credence to the claim that Adena populations were relatively egalitarian, semi-sedentary hunter-gatherers (Clay 1992:80). Other Early Woodland mounds that lacked mortuary contexts were also built, and these possibly functioned as territorial markers or aggregation loci (Yerkes 1988:317).

2.2.4.2 The Middle Woodland Period (200 B.C. - A.D. 400)

The Middle Woodland period is characterized by a sedentary hamlet or farmstead settlement system in the Midwest. People relied increasingly on domesticated crops, and there is evidence that trade for exotic resources spanned the continent. The time period is characterized by a dramatic increase in mound construction, including burial mounds and large geometric earthworks. In the past, researchers have equated the Middle Woodland period with the Hopewellian Interaction Sphere (Caldwell 1964). The two major manifestations of Hopewell in the Midwest are the Havana and Scioto traditions, centered in Illinois and Ohio, respectively. Distinctive markers of the Hopewell culture include bladelet technology, exotic artifacts in burial contexts, "special purpose ceramics," and cordmarked and stamped, surface-treated ceramics (Asch and Asch 1985).

Ohio Hopewell is noted for its elaborate mortuary ceremonialism, and for ideological expression in the material culture associated with burials. Exotic artifacts from all over North America were interred in the mounds; materials included obsidian from the Yellowstone area, marine shell from the Gulf and Atlantic Coasts, mica from the southern Appalachian region, and copper from the upper Great Lakes. Crops, usually maize, also sometimes appeared in very small amounts in sub-mound contexts. At the Edwin Harness Mound in Central Ohio, carbonized maize was dated to the Middle Woodland period (Smart and Ford 1983:58).

Dancey and Pacheco (1997:3-40) proposed a dispersed sedentary model for Middle Woodland settlement in the Central Ohio Valley region. Archaeological evidence indicates that Middle Woodland populations consisted of sedentary farming groups that lived in dispersed hamlets, used the same locale year-round, and engaged in the construction of local earthworks. The results of excavations at the Murphy site in Central Ohio suggest that these hamlets were relatively stable, enduring, self-sufficient household units (Dancey 1991). Within the vicinity of the Murphy site, several Middle Woodland earthworks are located at Yost, Glenford, and Brownsville. Carskadden and Morton (1996) have identified similar but later types of Middle Woodland occupations that also appear to follow Dancey and Pacheco's dispersed settlement model.

2.2.4.3 The Late Woodland Period (A.D. 400-1000)

The Late Woodland period is marked by complex social change. Around A.D. 400, the elaborate Hopewell culture of the Middle Woodland period dramatically changed into so-called "Dark Age" cultures in many portions of the Eastern Woodlands, especially Ohio. As Yerkes (1988:328) observes, the early Late Woodland assemblages are "known more for what they lack than for what they are." The elaborate artifacts and mound constructions that marked the previous period were no longer evident. Late Woodland ceramics are plain with little decoration, the lithics are generally used flakes or plain bifaces, and the exotic materials so characteristic of the Middle Woodland Hopewell phase are virtually absent (Yerkes 1988:328). Late Woodland populations in the region probably adopted the bow and arrow sometime after A.D. 700, but certainly by A.D. 900 (Seeman 1992).

Immediately following the disappearance of the Hopewell culture, a move toward nucleated, fortified settlements began, which eventually ended with the emergence of maize-based agricultural groups by A.D. 1000 (Griffin 1967). This shift from a dispersed to an aggregated settlement pattern was the major change in the Ohio Valley region during the Late Woodland phase (Church 1987). Household units formed larger settlements of approximately 2.47 acres (3 ha) for defensive purposes. Some of these communities were located in defensible topographic settings and were surrounded by defensive architecture in the form of ditches and stockades. Defensive community architecture represents a major shift in household-level social organization, and this change happened rather quickly, over a period of approximately 200 years at most. Evidence indicates that by the terminal Late Woodland (ca. A.D. 900), a hierarchical settlement pattern was emerging in the Mississippi drainage; this pattern acted as a precursor for the village hierarchy settlement pattern of later Mississippian times (Dancey 1992).

Interpretation of the last 300 years of the Late Woodland period (ca. A.D. 700-1000) is somewhat problematic. Seeman (1992:36) describes this time as a period of "accelerated cultural change." Radical changes likely increased household and intra-community social complexity. The adoption of the bow and arrow and the extensive domestication of maize varied spatially and temporally throughout the Midwest. However, these developments are very clear in the east and the west with the emergence of the Fort Ancient and Mississippian cultures, respectively.

2.2.5 The Late Prehistoric Period

The Late Prehistoric period spans roughly 650 years, from approximately A.D. 1000 to A.D. 1650. By A.D. 1000 along the Mississippi and Ohio Valleys, a number of distinct regional variants emerged from the Late Woodland period. Mississippian populations were organized into highly stratified, maize-based agricultural communities with large-scale public architecture and an elite ruling class. In other parts of the Midwest, different social systems appeared. At Fort Ancient villages, for example, distinct autonomous entities emerged. In these villages, Philo societies occupying the eastern Muskingum drainage shared similar settlement and procurement traits with both the Fort Ancient and Monongahela cultures of the same period (Eberhard and Herr 1993:9).

Early Fort Ancient villages emerged in the central Ohio Valley by approximately A.D. 1000, independent tribal societies whose main characteristics included the following:

- A circular village with a central plaza, usually surrounded by a palisade (Griffin 1943; Kime and Immel 1981:21)
- Kinship-based organization of households within the village
- Population sizes that averaged 200-400 people
- Agriculturalists relying on eight-row maize, squash, and beans
- Exchange with Mississippian groups, as indicated by marine shell gorgets and masks
- Little apparent social stratification

The great influx of Mississippian material culture into the Ohio Valley is reflected by marine shell gorgets and ceremonial masks found at Fort Ancient sites. Mississippian influence is also evident in innovative ceramic production, most notably shell tempering, and in large landscaping efforts such as the construction of plazas and temple mounds at Fort Ancient sites (Murphy 1975:9).

Despite extensive findings that suggest a widespread acceptance of some aspects of Mississippian technology, Muller (1986:254) argues that the minute size of Mississippian villages in the Ohio Valley makes a mass migration into the region highly unlikely. The Caborn-Welborn phase in the lower Ohio Valley is the only truly established Late Mississippian phase of this time. Radiocarbon assays for the Caborn-Welborn phase in the Ohio Valley establish a beginning date of approximately A.D. 1500. This phase, however, stretches into the proto-historic and historical periods, as evidenced by the recovery of certain historical trade goods, including musket balls and gunflints at Caborn-Welborn sites (Muller 1986).

2.3 PROTO-HISTORIC AND HISTORICAL NATIVE AMERICAN OCCUPATION IN OHIO

A definitive beginning to the proto-historic period in Ohio is difficult to establish, since so little is known about the early 1600s. Europeans had at least indirect contact with Late Prehistoric Native American populations in the Ohio Valley, as indicated by European trade goods recovered at two Fort Ancient sites (Drooker 1997). But Knepper (1997:14) states that the Ohio country was "uninhabited" from the demise of the Fort Ancient people until the early 1700s. Others believe that the only truly indigenous historical groups are the Shawnee in the southern Ohio region and the Erie in the extreme northeastern portion, of what is now the state of Ohio (Hunter 1978). Scholars have established, however, that many indigenous populations were pushed westward, out of Ohio, during the Beaver Wars of 1654-1700. For example, the Seneca, an Iroquois group, invaded what is now Ohio, expelled the Erie, and used the area for hunting territory to acquire furs for trade with the British and French.

After a peace treaty between the Iroquois and other groups was signed at Montreal in 1701, many different non-indigenous Native American cultures repopulated the Ohio Valley area.

These cultures fall within two major language groups: (1) the Algonquian, which includes the Shawnee, Miami, Ottawa and Delaware; and (2) the Iroquoian, which includes the Erie, Wyandot (reformulated), and Seneca. By the time Europeans began to settle in the Ohio area, it was not unusual for different populations with different life ways and material cultures to congregate within a single village, banding together for protection from Europeans and hostile Native American groups (Hunter 1978).

The French began to search for a river called the "Ohio" in the 1670s after they learned of its likely existence from Native American groups in the Great Lakes region. France subsequently claimed all of the Ohio territory. However, only in the 1750s and 1760s did Europeans begin to settle the Upper and Middle Ohio Valley in larger numbers. A long struggle between the French and British for control of the Ohio lands culminated in France forfeiting all official claims to North America in the 1763 Peace of Paris. At the same time, European encroachment sparked Pontiac's Rebellion in 1763-1764, an uprising of Native American groups in the Great Lakes region who intended to end British settlement and push the Europeans out of the Great Lakes and Ohio Valley areas (Knepper 1997:24-46).

During the American Revolutionary War (1776-1783), most Native American groups allied with the British and fought against the Americans and French. The Treaty of Paris in 1783 ended the American Revolutionary War. Great Britain retained Canada, but the Northwest Territory, which included all land west of the Ohio River, became part of the new American nation. The United States government gave plots of land in the Northwest Territory to veterans of the American Revolution as compensation for their efforts. Many Native American groups signed treaties with the United States in which they relinquished all claims to vast tracts of land. Such was the case in the Treaty of Fort McIntosh, signed in 1785.

The Northwest Ordinance of 1787 established a procedure through which territories could become states, provided a guide for how a state should be governed, and allowed for the surveying of the Northwest Territories (Dean and Speas 2001:37-38). However, despite a statement in the Northwest Ordinance protecting Native American land claims and various treaties, tension continued in Ohio country. In 1789, another series of hostilities began between Native Americans and Europeans in the Northwest Territory, culminating in 1794 when General Anthony Wayne defeated a confederation of tribes at the Battle of Fallen Timbers. The following year, the Treaty of Greenville was signed by representative tribes in Ohio, who ceded the southern two-thirds of the state to the United States.

Ohio became a state in early 1803 (Dean and Speas 2001:70; Knepper 1997:95) and expanded its borders through treaty negotiations with Native American populations. The north-central portion of Ohio was ceded to the United States in 1805 with the Treaty of Fort Industry, while the Treaty of Fort Detroit in 1807 ceded the Toledo area and parts of Michigan. In 1817, Native Americans relinquished the northwest portion of Ohio, and in 1818, the Miami ceded the last large tract of Native American land, located west of Wapakoneta. After 1818, Native Americans resided only on small reservations in northwestern Ohio. The Wyandot relinquished the last official Native American reservation in Ohio in 1842 near Upper Sandusky. After this time, all Ohio tribes were relocated to reservations west of the Missouri River to the present states of Oklahoma, Kansas, and Nebraska (Dean and Speas 2001:77-78; Hunter 1978).

2.4 EURO-AMERICAN HISTORY OF HARDIN COUNTY AND WASHINGTON TOWNSHIP

The proposed wind farm area is located within Washington Township, Hardin County. Although the 5-mile history/architecture buffer zone does extend into other townships and to the north into Hancock County, this historic context focuses on the footprint of the wind farm. Historical map coverage of the project area is limited, but maps and atlases from 1879 and 1907 are provided in Appendix C.

2.4.1 Hardin County

The northwestern corner of the state of Ohio was not readily open for settlement by Euro-Americans until the early 1800s. As part of the 1795 Treaty of Greenville, Native Americans lost their rights to land across much of Ohio, but they were able to keep the land that includes present-day Hardin County. In 1817, however, the Treaty of the Maumee Rapids (also known as the Treaty of the Wyandot and the Fort Meigs Treaty) opened most of northwest Ohio to Euro-American settlement. A few years later, in 1820, Hardin County was established from land that formerly belonged to Logan County. The county was not formally organized until 1833, with the county seat located at Kenton. The county was named after Colonel John Hardin, a Revolutionary War veteran who was killed in 1792 while on a mission of peace in what is now Shelby County (Howe 1888).

Settlement in the area was hindered somewhat by the heavy timber that covered much of the land area of the new county, and three large marshes. In 1840, the population of the county was 4,538 (Howe 1888). The entry of the railroad into the county in the late 1840s spurred the development of several communities, including Dola (originally North Washington) and Dunkirk in 1852, and Ada (originally Johnston) in 1853. By 1880, the population had increased to 27,023; according to the Ohio Department of Development, Hardin County's population has remained at a level between 27,000 and 32,000 people.

Hardin County has remained rural in nature throughout its existence. Cropland accounts for 80 percent of current land use. The population as of 2007 was 31,650, with nearly 44 percent of the population living in the towns of Kenton and Ada (Ohio Department of Development 2007). Kenton is the county seat for Hardin County, while Ada is home to Ohio Northern University, founded in 1871.

2.4.2 Washington Township

Washington Township was organized in late 1835 or early 1836 with 36 one-mile square sections. Much of Washington Township was covered by the Hog Creek Marsh, a large, 8,000-acre marsh in the western portion of the township, while the rest of the original land cover was woodland. The current landscape of Washington Township can be characterized as flat and dominated by agricultural fields, with scattered farmsteads located along the county roads. This landscape has probably changed little in appearance since the drainage of Hog Creek Marsh in the late 1800s.

The first settlers in the township arrived between 1832 and 1840 and included several German immigrants. The only community in Washington Township is the village of Dola, originally platted in 1852 as North Washington. The name was changed to Dola in 1907 to avoid confusion with the town of New Washington in Crawford County. The Pittsburgh, Fort Wayne

& Chicago Railroad (later the Pennsylvania Railroad) was constructed in the township beginning in 1852, but it was not truly finished until about 1862, when the sections of the railroad grade in the Hog Creek Marsh were finally stabilized enough that the tracks no longer sank into the marsh. The Hog Creek Marsh itself was subject to drainage beginning in 1868, which opened up the 8,000 acres of the former wetland to cultivation. Before it was drained and converted to cropland, the Hog Creek Marsh served as a source of flags for cooperage, marsh grass for hay, and cranberries (Warren, Beers & Co. 1883:688). In 1840, the population of Washington Township was 203 people; it increased to 1,291 people by 1880 (Howe 1888).

Early German settlement in Washington Township appears significant to local history. According to Warren, Beers & Co. (1883), nine out of 30 early settlers in ca. 1830-1840 in Washington Township were German immigrants (30 percent). The German surnames recorded include Orth, Wagoner, Griner, Kraft, Reifenstein, Kahler, Markley, Wejount, and Smith. By the end of 1880, 738 German immigrants were present in Hardin County, accounting for 2.7 percent of the total population (Warren, Beers & Co 1883:693).

3.0 LITERATURE REVIEW

3.1 INTRODUCTION

A literature review was conducted in April 2009 to identify previously documented history/architecture or archaeological resources located within their respective study areas (defined below) and previous history/architecture or archaeological investigations that had taken place in the vicinity of the proposed wind farm. This research provides information on the expected types and settings of any properties and archaeological sites in the region..

Literature Review Study Areas, Defined

Two study areas were defined for this project, one for history/architecture resources and one for archaeological resources. These study areas delineate the areas investigated for previously identified structures and sites. The literature review included properties or sites falling completely or partially within the study areas.

For **history/architecture resources**, the study area was defined as the footprint of the proposed construction activities for the wind farm, plus a buffer zone extending 5 miles (8-km) from the boundary of the footprint. This buffer zone takes into account the visual impacts that the wind farm might have on surrounding properties.

For **archaeological resources**, the study area was defined as the footprint of the proposed construction activities for the wind farm, plus a buffer zone extending 1-mile (1.6 km) from the boundary of the footprint.

The boundaries of the wind farm footprint and the two study areas are shown superimposed on USGS quadrangle maps in Figure 1.

Sources Reviewed

The literature review entailed researching the following sources:

- Ohio Historic Preservation Office (OHPO)
- Ohio Archaeological Inventory (OAI) forms
- Ohio Historical Inventory (OHI) forms
- National Register of Historic Places (NRHP) nominations (completed, active, and inactive nominations) and questionnaires
- National Historic Landmarks list
- Determination of Eligibility files
- Cultural Resource GIS Data Base
- *Archaeological Atlas of Ohio* (Mills 1914)
- USGS 7.5- and 15-minute series topographic maps
- Ohio Department of Transportation (ODOT) Historic Bridge Inventory
- Ada Public Library
- Cemetery records
- Hardin County atlases and histories

3.2 PREVIOUSLY DOCUMENTED HISTORY/ARCHITECTURE RESOURCES

A literature review of records held at the OHPO was completed for the history/architecture study area in April of 2009. This section of the report discusses the previously documented resources found (from the above-listed sources) to be located within the study area.

Figure 2 shows the location of these resources.

3.2.1 National Register of Historic Places (NRHP)

The history/architecture study area contains one property that is listed in the NRHP, the Ada Pennsylvania Passenger Station and Railroad Park, located at 112 East Central Avenue. This property is situated along the western edge of the history/architecture study area (see). Built in 1887 by the Pennsylvania Railroad, the Ada station is a two-story gabled building measuring 26 feet by 76 feet and constructed of white pine. The track-side canopy retains its original standing seam metal roof. There are three corbelled chimneys, with the easternmost chimney decorated with cast red architectural brick scroll work. In 1902, the Grand Army of the Republic Association added a large iron siege gun or cannon from Fort Mifflin as a Civil War monument and park associated with the Ada station; this small park later became known as the Railroad Park.

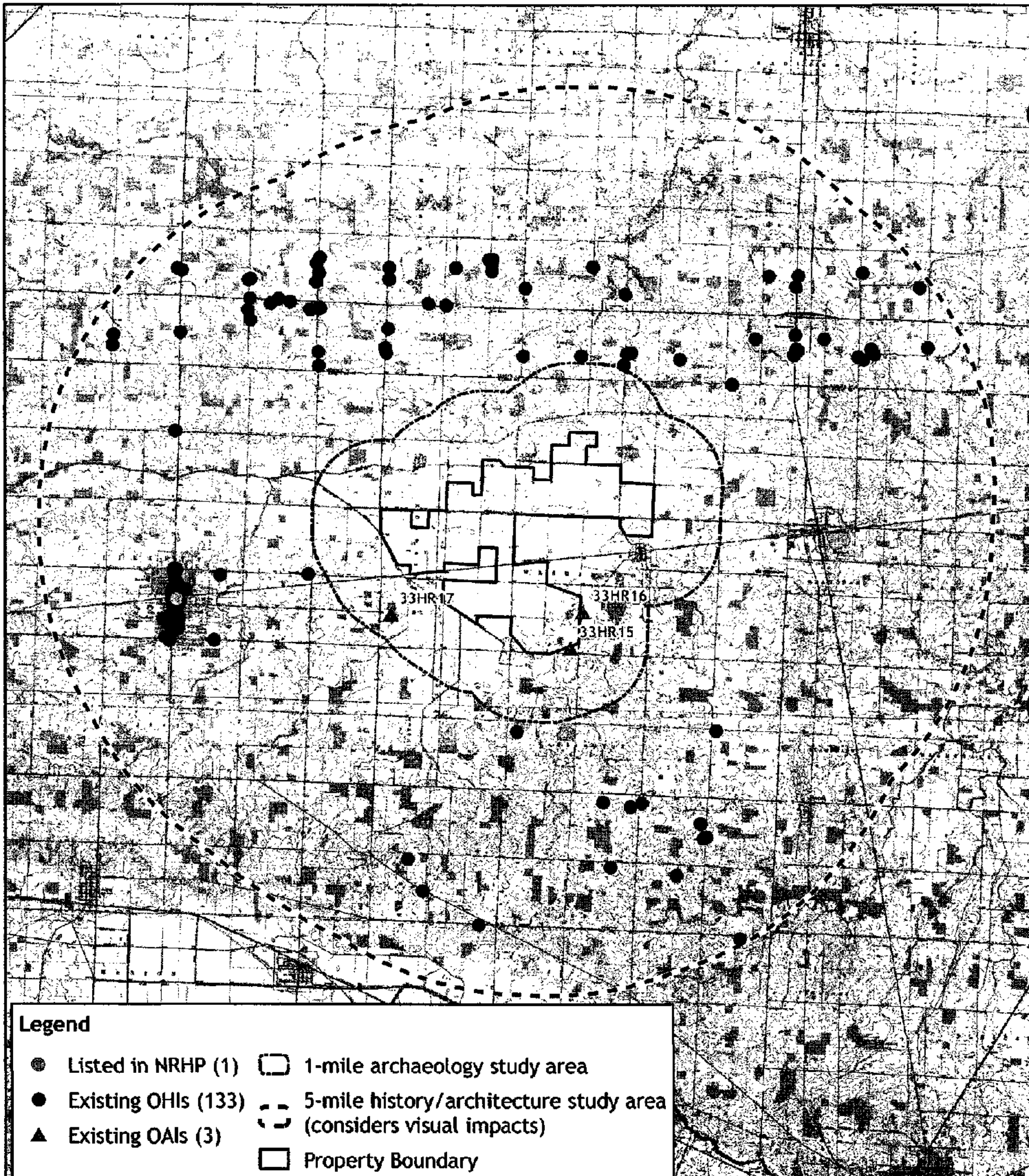


Figure 2. Location of previously recorded history/architecture and archaeological resources.

N W E S	Miles 1.5 0 1.5 3	May 2009	BHE ENVIRONMENTAL
	Project No. 1865.004	Basemap: USGS 7.5' Topographic Map	

The Ada station (at right) is a good example of a wood-frame passenger station constructed in the Stick Style, a late nineteenth-century architectural style that contains adaptations of Medieval English architectural forms. The Stick Style is not a common architectural style in Ada, and the Ada station is one of only a few surviving Stick Style railroad depots in Ohio. See other sections for additional photographs of the station.

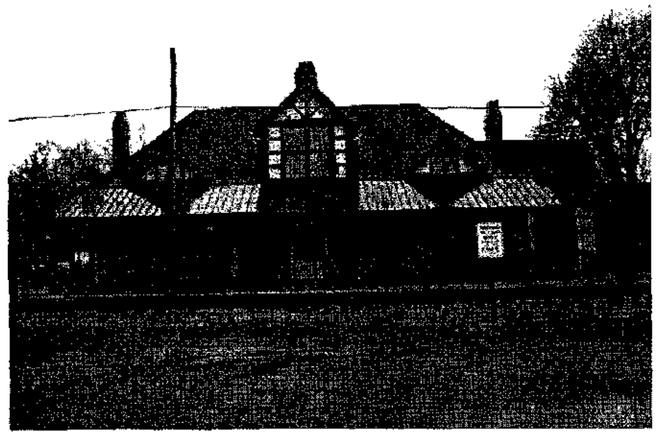


Photo 1. The Ada Pennsylvania Passenger Station and Railroad Park

The Ada passenger station and park was listed in the NHRP on August 8, 1998, under Criterion A and Criterion C—under Criterion A for its association with events that have made a significant contribution to the broad patterns of our history; and under Criterion C for embodying distinctive characteristics of a type, period, and method of construction in the Stick Style. This property also reflects the broad patterns of industry and transportation in northwestern Ohio.

3.2.2 Historic Bridges

No historic bridges are located within the history/architecture study area.

3.2.3 Historic Cemeteries

A review of the Ohio Historic Inventory (OHI) revealed that no cemeteries were located within the boundaries of the wind farm. However, numerous historic cemeteries were found to be within the history/architecture study area. A brief listing is provided including the Ohio Genealogical Society's (OGS) numerical identification number (Table 1).

Table 1. Historic cemeteries in the history/architecture study area.

Portion of the study area	Historic cemeteries
Northern portion	An American Indian Burial Ground (unsubstantiated) (OGS 14630) The McEroy Cemetery (OGS 4900) The Jones-Helms-Krider Cemetery (OGS 4936), The Eagle Creek Cemetery (OGS 4847) The Williamstown Cemetery (OGS 4825)
Western portion, near the town of Ada	The Ada Mausoleum (OGS 4896) The Old Washington Cemetery (OGS 4901) The Woodlawn-Old Washington Cemetery (OGS 4904)
Southern portion	The Hunterville Cemetery (OGS 4870) The Obenour Cemetery (OGS 4872) The Foit-Gramlick Cemetery (OGS 14612) The Smith Cemetery (OGS 4939)
Central portion, near the unincorporated community of Dola	The Wagoner Cemetery (OGS 4940) The Dola-Washington Township Cemetery (OGS 4937)
Eastern portion, near the town of Dunkirk	The Waggoner Cemetery (OGS 14633) The Fry Farm-Lynch Cemetery (OGS 4860) The Dunkirk Cemetery (OGS 4859) The Sorgen Cemetery (OGS 4863)

3.2.4 Determinations of Eligibility

No properties in the study area have received a determination of NRHP eligibility, except for the aforementioned NRHP-listed Ada Pennsylvania Passenger Station and Railroad Park.

3.2.5 Cultural Resource GIS Database

The OHS online Cultural Resource database was initially consulted to get a preliminary count of NRHP and Ohio Historical Inventory-listed properties, and Ohio Archaeological Inventory-listed sites within the study areas. Detailed information on the identified properties is not available online so the records at the Ohio Historic Preservation Office (OHPO) were consulted.

3.2.6 Ohio Historic Inventory (OHI)

OHI records indicate that no previously documented OHI properties are located within the footprint of the wind farm. However, the 5-mile (8-km) extended buffer zone contains 136 previously inventoried historic properties (Figure 2), including the NHRP-listed Ada Pennsylvania Passenger Station and Railroad Park. Many of the OHI properties (57 resources) were clustered in the town of Ada. Another concentration occurred as the result of field investigations that were conducted for the US Route 30 project in northern Hardin and southern Hancock counties. Some of the architectural styles include: vernacular (62), Italianate/Italian Villa (43), Colonial Revival (9), Gothic Revival (5), Queen Anne (6), Romanesque (4), Bungalow (3), Greek Revival (1), Prairie (1), Eastlake (1) and Stick (1). Most of the OHI properties were of late nineteenth to early twentieth century vernacular construction. The dominant discernable architectural style was Italianate, which was popular during the period from 1850 to 1880. Much of the study area was settled at approximately this same time, when the Hog Creek Marsh was drained.

For a full listing of the previously documented OHI resources, please see Appendix A. Due to the number of OHI properties encountered for this area, the discussion of these resources is a general characterization of the types of buildings encountered.

3.3 PREVIOUSLY DOCUMENTED ARCHAEOLOGICAL RESOURCES

3.3.1 Mills's (1914) Archaeological Atlas of Ohio

Mills's *Archaeological Atlas of Ohio* (1914) identifies 44 prehistoric sites in all of Hardin County: 20 mounds, 20 burials, 2 enclosures, 1 village site, and 1 cemetery. Mills's Hardin County map is reproduced in Figure 3. Of the prehistoric sites identified by Mills, one mound is located in Washington Township within the study area, but outside of the project boundary, in the vicinity of OAI 33HR17 (Candler Kame).

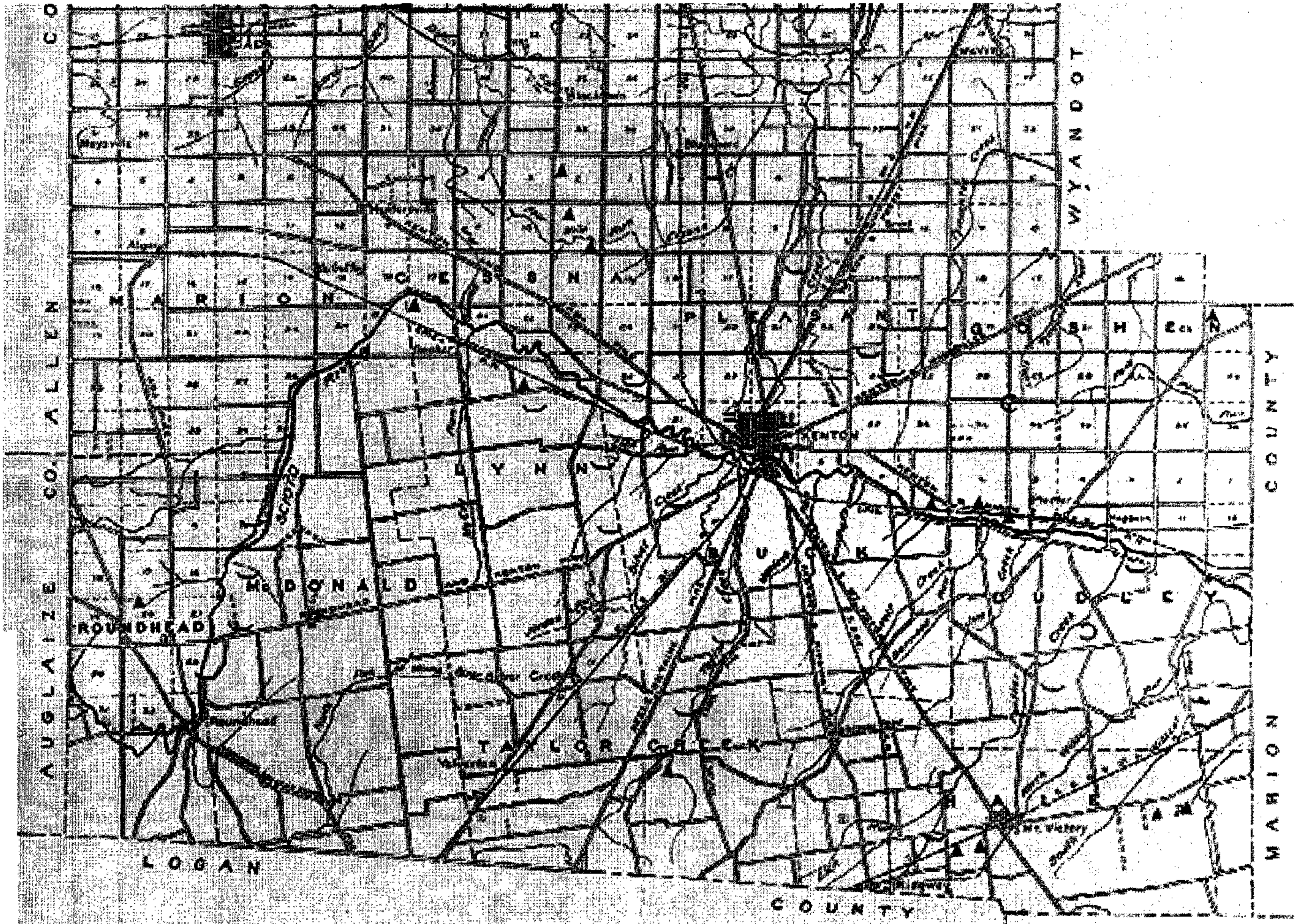
Sites recorded by Mills were not professionally documented, and the locations of many remain unconfirmed. Aboveground evidence of other sites recorded by Mills, particularly mounds and earthworks, may have been obliterated by historical Euro-American farming practices and development. While Mills's spatial data is less than perfect, care should be taken in areas where Mills reported prehistoric remains because subsurface signatures, such as the base of earthwork walls or the footprint of a mound, may still exist.

3.3.2 Previous Archaeological Surveys and the Ohio Archaeological Inventory (OAI)

No archaeological surveys were identified as having been conducted within the archaeological study area. A review of the USGS 7.5-minute topographic maps, the Ohio Archaeological Inventory (OAI) files, the NRHP files, and the contract reports at the OHPO identified three previously reported archaeological sites within the 1-mile (1.6-km) study area; all are within Washington Township:

- 33HR15 (the Demier Kame)
- 33HR16 (the Wilkie Kame)
- 33HR17 (the Candler Kame)

The basic characteristics of these sites are summarized in an archaeology literature review table in Appendix B, and their locations are mapped (Figure 2). Based on preliminary project boundaries, all of these archaeological sites are located close to the footprint of the wind farm, and two may fall within the boundary; information contained in the OAI inventory forms for Sites 33HR15 (Demier Kame) and 33HR16 (Wilkie Kame) offer only minimal locational data about these prehistoric resources, which were likely never professionally investigated.



4) Hardin County map sheet, with the wind farm boundary superimposed in red (Map is not to scale. Wind farm boundary and

According to OAI data, the Demier Kame (33HR15) is located in Township 3 South, Range 10 East, in the southeast quarter of Section 21. The Wilkie Kame (33HR16) is situated in Township 3 South, Range 10 East, west of the center of Section 22. 33 HR16 is adjacent to the project boundary, but the closest disturbance is over 800 feet away. 33HR15 is about1300 feet from the project boundary with the closest disturbance is greater than 3000 feet distant from the archaeological site.

The Candler Kame (33HR17) was located in Township 3 South, Range 10 East, in the southwest quarter of Section 19; this site is located to the west of the proposed wind farm boundary and appears to have been completely destroyed in 1897 by gravel-mining operations associated with construction of the Pennsylvania Railroad (Converse 1980:136). During these quarrying operations, numerous burials were removed, including the primary interment that was encountered at a depth of 14 feet (4.2 meters) below the surface of the kame. Based on the field visit, there appears to be elevated landforms in the vicinity of the probable locations of both Sites 33HR15 (Demier Kame) and 33HR16 (Wilkie Kame), but no discernable glacial landforms were in the immediate vicinity of the plotted location of 33HR17 (Candler Kame), supporting the hypothesis that the kame was completely removed in the late nineteenth century.

No archaeological resources of any kind have been conclusively documented within the wind farm footprint boundary. No archaeological sites or archaeological districts within the literature review study area are listed in the NRHP or have been determined officially eligible for the NRHP.

3.4 HISTORICAL MAPS AND ATLASES

The literature review yielded three historical maps—two USGS topographic maps from 1907 and one 1879 atlas map of Washington Township. These maps are presented in Appendix C.

For the most part, the maps show a sparsely inhabited landscape, with scattered farmsteads along the section line roads. The exceptions include the towns of Ada, North Washington (now Dola), and Dunkirk, and a fairly high number of farmsteads along modern County Highway 14. Within the wind farm boundary, 18 farmsteads appear on the 1879 atlas map, but only nine appear to correlate with currently existing farms. The 1907 USGS maps show a total of 30 structures within the wind farm boundaries, of which 23 appear to still be present. Structures located within the wind farm boundary that overlap with the community of Ada are not included in the above totals.

4.0 RESULTS OF THE FIELD VISIT

4.1 INTRODUCTION

This section of the report presents the results of the reconnaissance-level field visits for the history/architecture and archaeological investigation conducted on April 29, 2009. During this fieldwork, representative buildings and representative overview landscape scenes were photographed. The purpose of the photos is to show the general nature of the structures within the history/architecture study area and to characterize the existing ground conditions, observed disturbances, and archaeological potential within the archaeological study area.

4.2 HISTORY/ARCHITECTURE RECONNAISSANCE SURVEY

Due to the preliminary nature of this work, photographs were taken of representative samples of the types of buildings present and not of all individual properties; this work represents a characterization of the built environment surrounding the proposed Hardin County Wind Farm history/architecture study area. The photographs show the typical property types encountered within the study area, and the photographs of Ada, Dola, and Dunkirk are representative of streetscapes from these towns.

For ease of discussion, the results here are divided into four sections: Ada, Dola, Dunkirk, and outlying properties.

4.2.1 The Town of Ada

The only community in Liberty Township is the town of Ada, originally platted in 1853 as Johnston, and located in the western part of the township. The population of Liberty Township in 1840 was 170 people, which increased dramatically to 3,295 people by 1880, likely because of the town of Ada and the 1871 establishment of Ohio Northern University (Howe 1888). Ada is a town of approximately 3,500 people located near the western edge of the history/architecture study area. This town features a high percentage of surviving Victorian architecture and is home to Ohio Northern University. A total of 57 previously documented OHIs were listed for the town of Ada, including the NHRP-listed property Ada Pennsylvania Passenger Station and Railroad Park (Photo 1), Dukes Memorial Hall at Ohio Northern University (HAR-155-1) (Photo 2), the Presbyterian Church (HAR-165-1) (Photo3), and the First Methodist Church (HAR-166-1) (Photo 4). While the town of Ada does possess a number of relatively unmodified historic structures, including the Ada station and most of its churches, most of the built environment has been heavily altered. A streetscape photograph of Main Street (Photo 5) demonstrates that nearly all of the first-story levels of the commercial structures in downtown Ada have been heavily modified. Many of the single-family dwellings on the secondary streets have been subjected to typical replacement of doors, windows, and siding. However, it appears that many brick structures in the town have survived relatively unmodified. The dominant architectural style of the previously documented 57 OHI properties in Ada is Italianate, accounting for 23 of the 57.

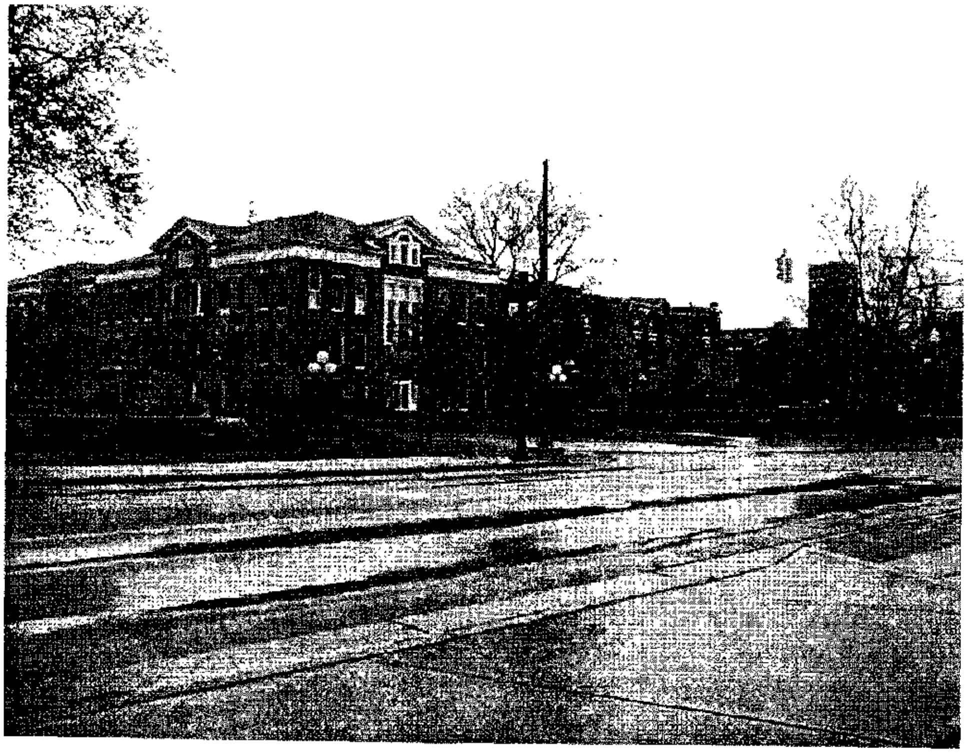


Photo 2. Dukes Memorial Hall, Ohio Northern University campus (OHI HAR-155-1), facing northwest

Photo 3. Main Street, Ada, Presbyterian Church (OHI HAR-165-1) facing northwest

Photo 4. First Methodist Church (OHI HAR-166-1), Main Street, Ada, facing northwest

Photo 5. Main Street, Ada, facing southeast from First Methodist Church

4.2.2 The Unincorporated Community of Dola

Dola, Ohio, is a small unincorporated settlement with a population of 456, located near the eastern terminus of the proposed Hardin County Wind Farm footprint. The skyline of Dola is dominated by a series of large concrete grain elevators that are situated near the center of town (Photo 6). No previously documented OHI properties for Dola were found. Most of the structures appear to date from the late nineteenth to early twentieth century and are of vernacular construction. These structures exhibit a moderate to severe amount of alteration including replacement doors, windows, siding, and roofing. A few surviving single-family dwellings were observed that appear to be relatively unmodified. One notable example of a standing structure in Dola is a late nineteenth-century wood-frame church that had survived relatively unscathed until it was recently converted to a garage/storage facility (Photo 7).

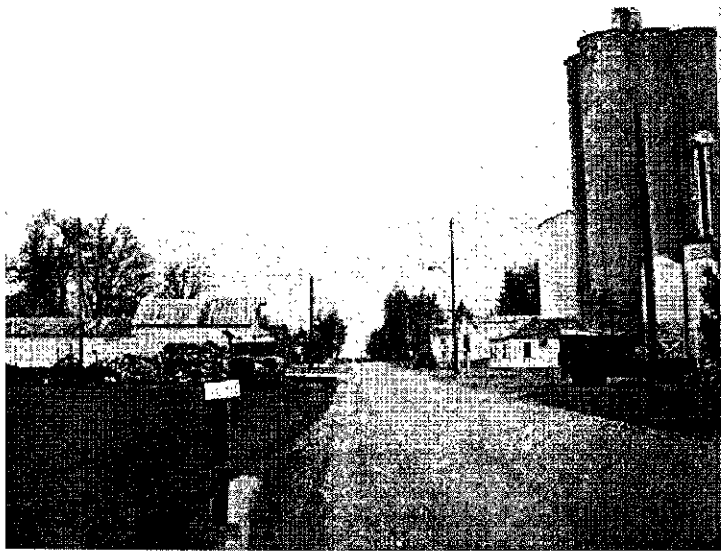


Photo 6. Main Street, Dola, facing south

Photo 7. Former church on Anthony Street, Dola, facing northwest

4.2.3 The Town of Dunkirk

The town of Dunkirk, Ohio, is situated near the eastern periphery of the history/architecture study area around the Hardin County Wind Farm. As of the 2000 census, Dunkirk had a population of 952. No previously documented OHIs were on file at the OHPO for properties in this town. Dunkirk retains a high percentage of mid-to late-nineteenth century buildings, many of which are brick Italianate structures. The downtown commercial district of Dunkirk features several late nineteenth century examples of Italianate and Romanesque Revival storefronts (Photo 8). Some of these structures have been heavily altered, including replacement windows and doors. Some of the observed modifications to these structures included the alteration of window and door placements. While most of Dunkirk is dominated by structures of vernacular style, there are several examples of high style late Victorian architecture (Photo 9).

Photo 8. Main Street, Dunkirk, facing northeast

Photo 9. Edgar and Main streets, Dunkirk, facing southeast

4.2.4 Outlying Areas in the Townships

In keeping with the scope for this investigation, this section of the report provides a reconnaissance-level overview of the resources in Washington townships that fall outside city or town boundaries; the results here characterize the types of resources expected within the history/architecture study area, and do not attempt to provide a complete survey of standing structures.

The study area contains a high number of frame homes of vernacular buildings from the late nineteenth to early twentieth centuries. Some of the more common recognizable architectural styles observed include Italianate, Colonial Revival, and Four Square variants. Most of the wood-frame structures observed have been heavily altered with replacement doors, windows, roofing, and siding. Examples of typical standing structures within the study area are provided below:

4.2.4.1 2530 Township Road 85 (No OHI)

The structure located at 2530 Township Road 85 is situated near the center of the history/architecture study area. This building is an early twentieth-century two-story wood-frame Colonial Revival building with a concrete-block foundation; it is a modest example in the folk four-square style complete with a half columned supported front porch (Photos 10 and 11). There is a small concrete-block outbuilding located to the rear of the main structure, and a large recently built metal clad pole barn. This structure is a typical farmhouse for the study area in that it features replacement windows, doors, and siding.

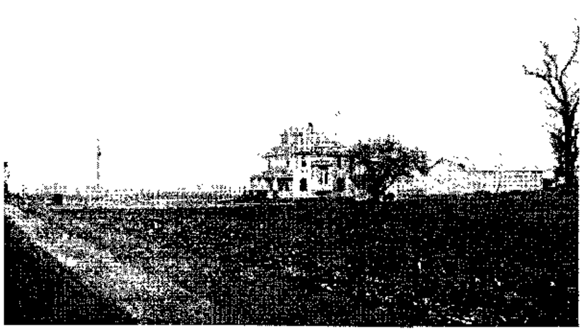


Photo 10. Typical farmhouse, located at 2530 Township Road (TR) 85, facing northeast

Photo 11. Front of farmhouse at 2530 TR 85, facing east

4.2.4.2 1701 County Road 113 (No OHI)

The structure at 1702 County Road 113 is two-story frame single-family dwelling that was probably at one time Italianate in architectural style. The house is located to the north of Dola, Ohio, and lies within the footprint boundary of the proposed wind farm. This building features an original standing-seam metal roof with replacement windows, doors, siding, and porch (Photo 12). The foundation appears to have been recently replaced with modern concrete block. Two outbuildings are associated with this house, including an old timber framed wood-clad barn and a newer steel-clad pole barn.

Photo 12. Farmhouse at 1702 County Road (CR) 113, facing east

4.2.4.3 9224 County Road 14 (No OHI)

The structure at 9224 County Road 14 is located to the north of Dola, Ohio. This two-story brick single-family dwelling features a low-pitched hipped roof capped with standing seam metal roofing (Photo 13). There appears to be a small flat area of the peak that may have at one time supported a small cupola. This Italianate building has segmentally arched window tops and appears to have a brick foundation. Observed alterations include replacement windows and doors, as well as at least one blocked window or door on the second story of the north elevation.

Photo 13. Farmhouse at 9224 CR 14, facing southeast

4.2.4.4 9389 County Road 14 (No OHI)

The single-family dwelling located at 9389 County Road 14 is a large two-story Queen Anne/Colonial Revival farmhouse (Photo 14). This two-story wood-frame structure with a gabled-ell floor plan; it features Palladian windows flanked by textured shingles in the gable ends that serve as attic windows. This structure has undergone extensive renovations including replacement doors, windows, siding, and roofing, as well as a significant one-and-a-half story addition to the rear. The front porch has been removed recently and is most likely in the process of being replaced.

Photo 14. Farmhouse at 9389 CR 14, facing northwest

4.2.4.5 *2257 CR113 (No OHI)*

The building at 2257 County Road 113 is situated to the north of Dola, Ohio, and is a prominent example of a cross-gabled Italianate farmhouse complete with bracketed drip molds and decorative brick work (Photo 15). The east elevation features a large projecting three-light bay window with a mansard-like roof. This bay may have at one time supported a tower or cupola. Also conspicuously absent are the bracketed cornices that would almost certainly have accompanied a structure of this magnitude. Alterations to this structure include replacement windows and roofing.

Photo 15. Farmhouse at 2257 CR 113, facing west

4.2.4.6 Charles Kahler Farm (HAR-11-2)

The Charles Kahler Farm is a two-story wood-frame structure with a gabled-ell floor plan and Eastlake design elements on the front porch (Photo 16). At least two outbuildings are associated with this house: a large timber-frame barn and a smaller wood structure. The Kahler Farm house is in a state of ruin. The building is shrouded by a dense undergrowth of weeds and saplings. When observed, this structure was missing all of its windows and doors. Other damage included holes in the roof and some missing siding.

Photo 16. Ruin of Charles Kahler Farm (OHI HAR-11-2), south of CR 60 and CR 96, facing southeast

4.2.4.7 *Dale Warmbrod House (HAR-87-6)*

The Dale Warmbrod House is located along the west side of Township Road 115 south of State Route 701. This single-family dwelling is a two-story wood-frame side-gabled house of vernacular construction (Photo 17). As many as five outbuildings may be associated with the main house, including three large timber-frame barns and two smaller wood structures. Alterations to this structure include replacement windows, doors, siding, and roofing. There is also an early twentieth-century porch addition on the east elevation.

Photo 17. Dale Warmbrod House (OHI HAR-87-6), located at 6403 TR 115, facing west

4.3 ARCHAEOLOGY RECONNAISSANCE SURVEY

This section presents the typical surface conditions, observed disturbances, and a preliminary assessment of the potential for cultural resource discovery for the area within the boundary of the proposed wind farm footprint. For ease of discussion, the findings are organized according to the township section numbers. The wind farm area is located in 16 sections of Washington Township as shown in Figure 4.

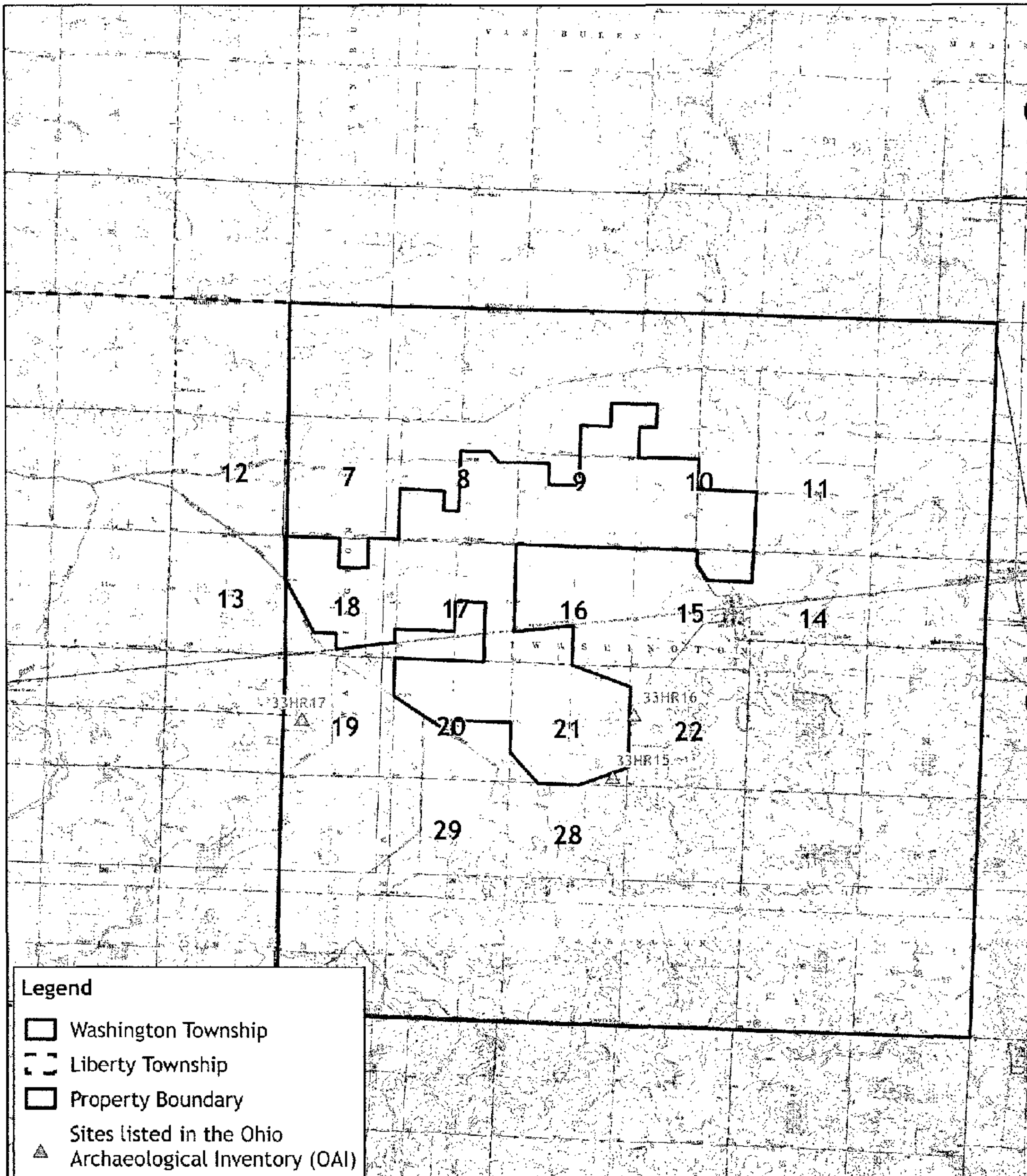


Figure 4. Section numbers for Washington and Liberty townships, with wind farm area.

N W E S	Miles 1 0 1 2	May 2009
	Project No. 1865.004	Basemap: USGS 7.5' Topographic Map

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4.3.1 Washington Township Sections

The area of the wind farm footprint in Washington Township covers the following 16 sections (15 partially and 1 completely): Sections 7-10, 15-18, and 20-21.

The southern half of **Section 7** is situated at the western terminus of the wind farm footprint, with the Fitzhugh Ditch as the southern border. The ground cover in Section 7 is light bean stubble with at least 80 percent surface visibility. The terrain in this area is dead flat with extremely dark Brookston-Crosby soil series formerly associated with the Hog Creek Marsh. No obvious signs of disturbance were observed with the exception of the installation of drainage tile. Expectations for cultural resource discovery in this portion of Section 7 would be extremely low given the poorly drained and low lying terrain.

Section 8 is located immediately to the east of Section 7 along the northern edge of the project area, with the Fitzhugh Ditch forming the southern boundary. The observed ground cover in this area was corn stubble with 50 to 60 percent surface visibility. The construction of the Ftizhugh Ditch would have caused some disturbance along the extreme southern boundary of this section. The topography was extremely flat and low with poorly drained soils. The potential for the discovery of cultural resources in this vicinity is extremely low.

Section 9 is situated immediately east of Section 8 and is bounded on the south by the Fitzhugh Ditch and on the east by County Road 95. Ditch No. 28 also cuts through the northern third of Section 9 on an east-west axis. The majority of Section 9 is included in the project area as it is currently defined. Ground cover for the majority of Section 9 is corn stubble affording 60 percent surface visibility. Expected disturbances in this area would include the construction of the Ftizhugh and No. 28 ditches, as well as the installation of drainage tile. Expectations for cultural resource discovery in this portion of Section 9 would be extremely low given the poorly drained and low-lying terrain.

Section 10 lies to the east of Section 9 and is bounded to the south by Township Road 30 and to the east by Township Road 115. Most of Section 10 falls within the footprint of the wind farm, with the exception of the extreme northeastern corner. Ground cover for most of this section is bean stubble with 80 percent surface visibility. The remaining portion of Section 10 is covered with corn stubble with at least 50 percent surface visibility. No other obvious signs of disturbance were observed, with the exception a ditch built along the eastern boundary. The potential for the recovery of cultural resources within Section 10 appear to be low given the low-lying and previously wet soils in this portion of the wind farm footprint.

Section 15 is located to the south of Section 10 in Washington Township. Only the north eastern quarter this section contains any wind farm project area. This area is covered with bean stubble affording 80 to 90 percent surface visibility. A few discernable slight rises were observed within this portion of Section 15 indicating that there is a low to moderate potential for cultural resource discovery.

Section 16 lies to the west of Section 15 and is bounded on the north by Township Road 30 and on the west by County Road 95. A little more than half of Section 16 falls within the wind farm boundary, with the exception being the southeastern corner. Ground cover for most of this section is bean stubble with 80 percent surface visibility (Photos 18 and 19). The southern portion of Section 16 is covered with corn stubble with at least 50 percent surface visibility. No obvious signs of disturbance were observed except for a raised railroad bed constructed within the southern one-third of this section. The potential for the recovery of cultural resources within Section 16 appears to be low given the low lying nature of the landscape and previously wet soils in this vicinity. This portion of the project area was formerly part of the Hog Creek Marsh.

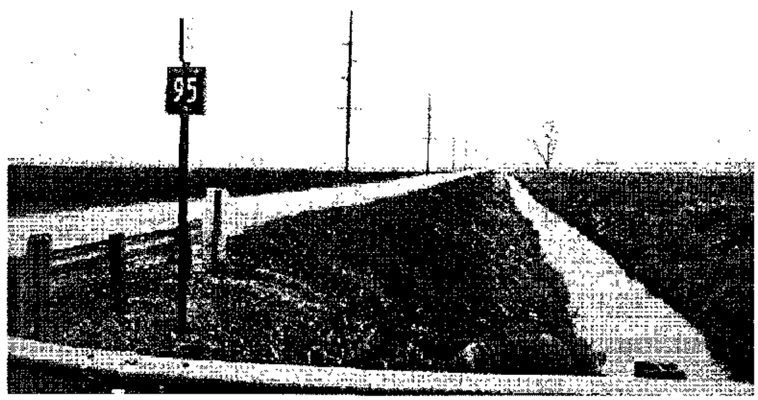

Photo 18. Fitzhugh Ditch along CR 95 at TR 30, facing west

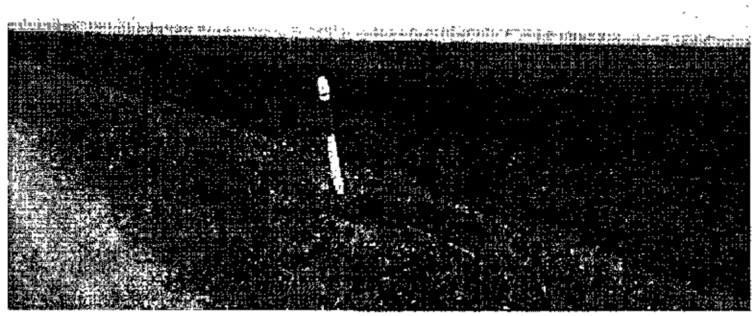

Photo 19. Ground conditions at TR 30 and CR 95, facing southeast

Section 17 is situated to the west of Section 16 and is bordered by Township Road 30 on the north, Township Road 85 to the west, State Road 81 to the south, and County Road 95 to the east. A raised railroad bed cuts through the southern third of Section 17 on an east-west axis. All of Section 17 is included in the wind farm footprint. Ground cover for the northern three-quarters of Section 17 is bean stubble affording 80 percent surface visibility. The southern quarter of this section was covered in corn stubble with 50 percent surface visibility. Expected disturbances in this area would include the construction of the railroad as well as the installation of drainage tile. Expectations for cultural resource discovery in this portion of Section 17 would be extremely low given the poorly drained and low-lying terrain. This portion of the wind farm area was formerly within the boundaries of the Hog Creek Marsh.

Section 18 is situated immediately west of Section 17 and is bound on the north by Township Road 30, on the west by County Road 75, to the south by State Highway 81, and to the east by Township Road 85. The Hog Creek Ditch cuts through the southern third of Section 18 on a northwest-to-southeast axis. Some discernable rises on the terrain indicate the potential for better drained soils. The majority of Section 18 is included in the wind farm footprint, with the exception of the extreme southwestern corner. Ground cover for the majority of Section 18 is corn stubble affording 40 to 50 percent surface visibility. Expected disturbances in this area include the construction of the Hog Creek Ditch and the raised railroad bed, as well as the installation of drainage tile. Expectations for cultural resource discovery in this portion of Section 18 would be moderate given the location of the Hog Creek. The former location of the 33HR17 (Candler Kame) was located nearby just south in Section 19 (Photo 20).

Photo 20. Former location of site 33HR17 (Candler Kame) on SR 75 east of CR 44, facing east

Section 20 is situated south of Section 17 and is bordered by State Highway 81 to the north, Township Road 85 on the west, County Road 95 to the east and Township Road 50 to the south. Most of Section 20 is located within the wind farm area with the exception of the southwesternmost corner. Some slight rises were observed across the landscape. Ground cover included corn stubble with 90 percent surface visibility. Observed disturbances in this area include the construction of the Hog Creek Ditch, as well as the installation of drainage tile. Expectations for cultural resource discovery in this portion of Section 20 would be moderate to high given the presence of Hog Creek and the proximity of the Candler Kame (33HR17) that was situated in nearby Section 19, according to OAI records.

Section 21 is located east of Section 20 and is bounded on the north by State Highway 81, County Road 95 on the west, Township Road 50 on the south, and Township Road 105 on the east. The majority of Section 21 is situated within the wind farm project area with the exception of the northeastern corner. Much of this area was flat and low; however, a long moderate rise was observed running through the center of Section 21 (Photo 21), which may correspond to 33HR15 (Demier Kame). There was very little information recorded about this site in OHPO files, but the identification as a kame indicates the presence of Glacial Kame burials. No apparent disturbances were observed within Section 21. Ground cover in this area was winter wheat with no surface visibility in the western portion and bean stubble in the eastern section with 90 percent surface visibility. The potential for the recovery of cultural resources within Section 21 appears to be moderate to high given the proximity of this area to the Hog Creek Ditch, 33HR15 (Demier Kame), 33HR16 (Wilkie Kame) and the presence of elevated well drained soils in this area Photos 21 and 22).

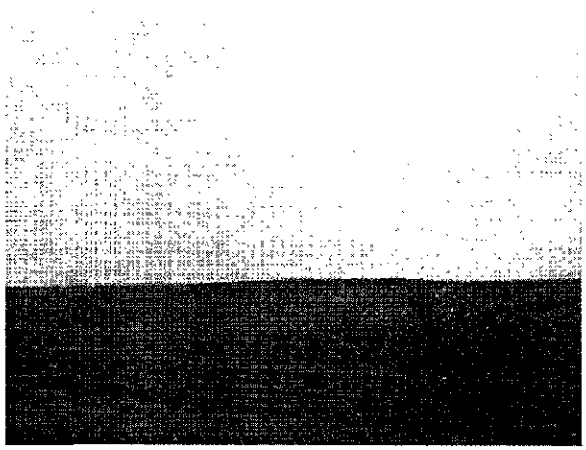

Photo 21. Probable location of site 33HR15 (Demier Kame) on TR 50, facing southwest

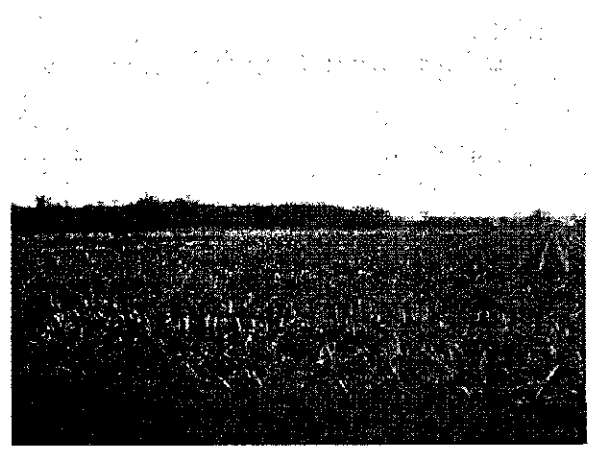

Photo 22. Probable location of site 33HR16 (Wilkie Kame), in woodlot on TR 105, facing northeast

5.0 RECOMMENDATIONS

The following information summarizes recommendations derived from the April 2009 literature review and reconnaissance-level field visit.

5.1 HISTORY/ARCHITECTURE RECOMMENDATIONS

The NRHP-listed Ada Pennsylvania Station and Railroad Park is located within the history/architecture study area (the wind farm footprint plus a 5-mile [8-km] buffer zone). The project as currently planned will not physically encroach on this property.

No properties with OHI forms are located within the footprint of the wind farm. A total of 136 OHI properties fall within the history/architecture study area. However, hundreds of unevaluated structures are present within the study area. During the field visit, a fairly large number of late nineteenth and early twentieth century residences and farmsteads were observed in a variety of architectural styles, with Italianate being the most common. Also observed were a fairly large number of vernacular dwellings with few or no high-style features. Most of the structures demonstrated a significant amount of physical alterations that do not complement the original building designs. Recent renovations include replacement siding, doors, windows, and roofing materials, and several properties had entranceways and windows covered or bricked in. The extent of the alterations varied greatly from structure to structure. Additional study would need to be performed to determine if these structures have sufficient integrity and historic significance to be eligible for the NRHP or any other type of historic designation

The communities of Dola and Dunkirk appear to have never undergone a history/architecture survey.

5.2 ARCHAEOLOGICAL RECOMMENDATIONS

The archaeological potential within the wind farm footprint appears to be relatively low, with the exceptions of areas exhibiting elevation changes in the topography. The former Hog Creek Marsh would have been an attractive resource for prehistoric groups, and any low rise around the former location of the marsh could have served as a temporary encampment. Areas within the actual marsh itself would have very low potential for prehistoric sites.

In addition, at least three Glacial Kame burial sites (listed below) have been recorded in proximity to the wind farm, raising the likelihood of the presence of undocumented Glacial Kame burials on similar land forms within the wind farm footprint.

- 33HR15 (the Demier Kame)
- 33HR16 (the Wilkie Kame)
- 33HR17 (the Candler Kame)

As such, special consideration should be given to kames and topographic rises that will be impacted by construction activities related to the wind farm.

Historical archaeological resources are also likely present within the wind farm footprint, but these sites will be located mainly along the township roads, and the likelihood of the wind farm construction affecting such sites is judged to be lower than for prehistoric sites.

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APPENDIX A

Ohio Historic Inventory Properties

Appendix A. below summarizes information derived from records on file at the Ohio Historic Preservation Office (OHPO); it contains all the properties that have Ohio Historic Inventory (OHI) forms that are located within the history/architecture study area, which includes the footprint of the proposed Hardin County Wind Farm plus a 5-mile (8-km) buffer extending out from the footprint boundary.

UTM coordinates are in NAD 27 meters. Please note that the UTM coordinates furnished in this table are taken from the OHI records; they are from previous cultural resource surveys and may not necessarily be accurate. For future work, the locations of these properties will need to be verified.

Existing OHI properties within the history/architecture study area

Abbreviations: TR - Township Road; CR= County Road; SR=State Route; Z=Zone; N,S,E,W = North, South, East, West

OHI Number / Property Name		UTM Coordinates	Address	Style	Date of Construction	Previous NRHP Recommendation
HAR-93-6	Frank Kahler House	Z 17 E 267240 N 4510810	SR 309 W	Queen Anne	1900	Not assessed
HAR-98-6	Gerald Potter House	Z 17 E 267240 N 4510060	SR 309 W, near TR 85	Italianate	1880	Not assessed
HAR-95-6	J W Ralston House	Z 17 E 268590 N 4509260	TR 90, near SR309	Queen Anne	1905	Not assessed
HAR-88-6	Don Warmbrod House	Z 17 E 271840 N 4512140	9408 SR 701	Vernacular	1850	Not assessed
HAR-89-6	Madison House	Z 17 E 272020 N 4510620	9614 T-80	Italianate	1883	Not assessed
HAR-87-6	Dale Warmbrod House	Z 17 E 272490 N 4512040	SR 701, near CR 115	Vernacular	1850	Not assessed
HAR-86-6	John Smith House	Z 17 E 272760 N 4512120	6120 CR 115	Italianate	1885	Not assessed
HAR-92-6	Dwight Hassen House	Z 17 E 273590 N 4510420	TR 80, near TR 115	Italianate	1880	Not assessed
HAR-96-6	George and Mary Gerlach House	Z 17 E 274160 N 4511640	6403 TR 125	Vernacular	1870	Not assessed
HAR-90-6	Allyne Humphrey House	Z 17 E 272230 N 4511290	6661 TR 125	Vernacular	1850	Not assessed
HAR-97-6	Allyne Humphrey House	Z 17 E 274300 N 4511320	6582 TR 125	Italianate	1880	Not assessed
HAR-110-2	Charles Kahler House	Z 17 E 269820 N 4513800	10103 SR 701	Eastlake	1875	Not assessed
HAR-111-2	Eibling House	Z 17 E 274530 N 4513820	11066 County Hwy 60	Italianate	1880	Not assessed
HAR-153-1	Lehr-Kennedy House	Z 17 E 261480 N 4516440	404 S Union St	Queen Anne	1902	Not assessed
HAR-163-1	Sigma Phi Epsilon House	Z 17 E 261525 N 4516000	821 Gilbert St	Colonial Revival	1915	Rec. not eligible

OHI Number / Property Name		UTM Coordinates			Address	Style	Date of Construction	Previous NRHP Recommendation
HAR-156-1	Presser Hall	Z 17	E 261540	N 4516360	S Gilbert near College Av	Neoclassical Revival	1929	Not assessed
HAR-157-1	ONV President's House	Z 17	E 261625	N 4515930	W Lima Av	Georgian Revival	1937	Rec. not eligible
HAR-152-1	Lehr Memorial	Z 17	E 261640	N 4516380	S Main	Neoclassical Revival	1915	NHRP district potential
HAR-155-1	Dukes Memorial	Z 17	E 261640	N 4516340	NWC S Main St & College Av	Italianate	1880	Rec. eligible
HAR-154-1	John Wesley Hill Memorial	Z 17	E 261660	N 4516420	SWC University Av & S Main St	Romanesque Revival	1879	Not assessed
HAR-194-1	Ansley House	Z 17	E 261680	N 4516100	723 S Main St	Italianate	1880	Rec. eligible
HAR-151-1	Huber Building	Z 17	E 261680	N 4516500	NWC S Main St & University Av	Neoclassical Revival	1923	Not assessed
HAR-149-1	ONU Apts.	Z 17	E 261690	N 4511320	403 S Main St	Italianate	1875	Not assessed
HAR-166-1	1st United Methodist Church	Z 17	E 261695	N4517130	301 S Main St	High Victorian Gothic	1897	Not assessed
HAR-473-1	US Post Office	Z 17	E 261695	N 4517130	131 S Main St	Colonial Revival	1938	Rec. not eligible
HAR-172-1	Bisque Basket	Z 17	E 261700	N 4516830	117 S Main St	Italianate	1886	Not assessed
HAR-173-1	Dr. Robert Love Office	Z 17	E 261700	N 4516840	115 S Main St	Commercial	1886	Not assessed
HAR-174-1	Reichert's Shoes & Clothing	Z 17	E 261700	N 4516850	113 S Main St	Colonial Revival	1900	Rec. eligible
HAR-175-1	Yankee Peddler	Z 17	E 261700	N 4516860	105-107 S Main St	Italianate	1885	Not assessed
HAR-176-1	Baker Hardware	Z 17	E 261700	N 4516880	103 S Main St	Vernacular	1886	Not assessed
HAR-177-1	Deglar Building	Z 17	E 261700	N 4516940	101 N Main St	Italianate	1880	Not assessed
HAR-170-1	Gardner's Rexall Drugs	Z 17	E 261700	N 4516815	125 S Main St	Italianate	1884	Not assessed
HAR-171-1	Orders Construction	Z 17	E 261700	N 4516820	121 S Main St	Italianate	1885	Not assessed
HAR-178-1	Regal Beagle	Z 17	E 261700	N 4516950	105 N Main St	Romanesque Revival	1893	Not assessed
HAR-179-1	American Legion Hall	Z 17	E 261700	N 4516955	109 N Main St	No information	1889	Not assessed
HAR-180-1	Village Hardware	Z 17	E 261700	N 4516960	111 N Main St	Italianate	1876	Not assessed
HAR-165-1	Presbyterian Church	Z 17	E 261705	N 4516745	Main St	High Victorian Gothic	1890	Not assessed
HAR-183-1	The Art Place	Z 17	E 261710	N 4517070	221 N Main St	Italianate	1882	Rec. eligible
HAR-184-1	IOOF Building	Z 17	E 261710	N 4517080	227-229 N Main St	Vernacular	1905	Not assessed

OHI Number / Property Name	UTM Coordinates	Address	Style	Date of Construction	Previous NRHP Recommendation
HAR-185-1 Ludwig's Corner Market	Z 17 E 261710 N 4517090	231 N Main St	Vernacular	1914	Not assessed
HAR-181-1 Village Hardware	Z 17 E 261710 N 4516970	115-117 N Main St	Italianate	1880	Not assessed
HAR-182-1 John & Tom's Tavern	Z 17 E 261710 N 4517040	209-211 N Main St	Romanesque Revival	1878	Not assessed
HAR-199-1 Ahlebeld House	Z 17 E 261720 N 4517520	533 N Main St	Italianate	1875	Not assessed
HAR-193-1 Terry Lyons House	Z 17 E 261725 N 4517610	607 N Main St	No information	1880	Rec. eligible
HAR-192-1 McCrurdy Estate Apts.	Z 17 E 261740 N 4516825	SR 235	Italianate	1885	Not assessed
HAR-195-1 Kenneth Failor House	Z 17 E 261745 N 4517400	508 N Main St	Queen Anne	1900	Rec. eligible
HAR-186-1 Star Furniture	Z 17 E 261745 N 4517080	232 N Main St	Italianate	1890	Not assessed
HAR-196-1 Masonic Temple	Z 17 E 261750 N 4517200	322 N Main St	Italian Villa	1885	Not assessed
HAR-190-1 Dales Barbershop	Z 17 E 261750 N 4516960	110 N Main St	Italianate	1885	Not assessed
HAR-191-1 Parshall's Clothing	Z 17 E 261750 N 4516940	102-108 N Main St	Italianate	1890	Rec. eligible
HAR-168-1 Ada Church of Christ Disciples	Z 17 E 261750 N 4516600	316 N Main St	Shingle	1893	Not assessed
HAR-187-1 Vandemark Real Estate	Z 17 E 261760 N 4517040	208 N Main St	Italianate	1890	Not assessed
HAR-188-1 UmPhress Jewelry	Z 17 E 261760 N 4517020	202-204 N Main St	Italianate	1873	Rec. eligible
HAR-164-1 Robert Allen House	Z 17 E 261770 N 4517550	548 N Main St	Vernacular	1910	Not assessed
HAR-161-1 Zimmer Motor Sales	Z 17 E 261770 N 4517610	602 N Main St	No information	1878	Not assessed
HAR-89-1 Jerry's Hair Port	Z 17 E 261780 N 4517020	108 E Buckeye Av	Romanesque Revival	1880	Rec. eligible
NHRP 98001014 Ada Depot	Z 17 E 273590 N 4510420	112 E Central Av	Stick Style	1880	Listed in NHRP on 8-8-98
HAR-147-1	Z 17 E 261810 N 4517270	421 N Main St	Italianate	1880	Not assessed
HAR-198-1 Steve Reese House	Z 17 E 261820 N 4516400	513 S Johnson St	Colonial Revival	1900	Not assessed
HAR-150-1 Bob Pitts House	Z 17 E 261820 N 4516210	621 S Johnson St	Italianate	1890	Not assessed
HAR-158-1 Alpha Xi Delta Sorority House	Z 17 E 261820 N4516290	125 E College St	Colonial Revival	1890	Not assessed
HAR-162-1 St. Mark's Lutheran Church	Z 17 E 261825 N 4516800	125 S Johnson St	Late Gothic Revival	1928	Not assessed
HAR-159-1 Delta Zeta House	Z 17 E 261830 N 4516750	125 E Lincoln Av	Greek Revival	1860	Not assessed
HAR-148-1 Steve Cole House	Z 17 E 261830 N 4517230	118 E Monford Av	Queen Anne	1900	Not assessed

OHI Number / Property Name	UTM Coordinates	Address	Style	Date of Construction	Previous NRHP Recommendation
HAR-160-1 Sigma Theta Epsilon Fraternity	Z 17 E 261855 N 4516455	502 S Johnson St	Queen Anne	1895	Not assessed
HAR-197-1 McCurdy Estate House	Z 17 E 261870 N 4516840	118 S Johnson St	Italian Villa	1880	Not assessed
HAR-167-1 Our Lady of Lourdes Church	Z 17 E 262000 N 4517120	NEC Highland & Simon Sts.	Gothic Revival	1874	Rec. eligible
HAR-169-1 James Bowden House	Z 17 E 262660 N 4515940	905 S Main St	Prairie	1915	Not assessed
HAR-200-1 Priscilla Davis House	Z 17 E 262800 N 4517465	3670 SR 81	Second Renaissance Revival	1925	Not assessed
HAR-129-1 Sugar Grove Church	Z 17 E 264890 N 4517490	4945 SR 81	Italianate	1898	Not assessed
HAR-97-6 Allyne Humphrey House	Z 17 E 274300 N 4511320	6582 TR 125	Italianate	1920	Not assessed
HAN-450-15 Frederick Crible House	Z 17 E 264017 N 4523801	4315 US 30	Vernacular	1900	Not assessed
HAN-439-15 Evans House	Z 17 E 264211 N 4523916	4432 US 30	Vernacular	1900	Not assessed
HAN-504-15 Daft House	Z 17 E 264485 N 4523847	4599 US 30	Vernacular	1885	Not assessed
HAR-126-1 Liberty Grange #2526	Z 17 E 261760 N 4520840	TR 115, S of SR 309	Italianate	1880	Not assessed
HAN-434-15	Z 17 E 261825 N 4524625	22596 SR 235	Vernacular	1900	Not assessed
HAN-447-15	Z 17 E 261880 N 4523130	23517 SR 235	Vernacular	1900	Not assessed
HAN-435-15	Z 17 E 261925 N 4524585	22591 SR 235	Vernacular	1900	Not assessed
HAN-448-15	Z 17 E 263470 N 4523650	23154 TR 56	Vernacular	1910	Not assessed
HAR-437-15	Z 17 E 263491 N 4524353	22730 TR 56	Vernacular	1875	Not assessed
HAN-449-15 Forest Gudakunst House	Z 17 E 263515 N 4523429	23287 TR 56	Vernacular	1900	Not assessed
HAN-436-15 Bethel Church of Christ	Z 17 E 263529 N 4523928	4014 US 30	Gothic Revival	1912	Not assessed
HAN-438-15	Z 17 E 263542 N 4524377	22715 TR 56	Bungalow/Craftsmen	1925	Not assessed
HAN-503-15 Criblez House	Z 17 E 264947 N 4523660	23118 CR 12	Italianate	1885	Not assessed
HAN-440-15 J N Gallant House	Z 17 E 265105 N 4524320	22694 CR12	Vernacular	1890	Not assessed
HAN-441-15 James Gallant House	Z 17 E 265117 N 4524743	22436 CR12	Italianate	1875	Not assessed
HAN-454-15 J Robert Daft House	Z 17 E 265129 N 4522675	23721 CR 12	Vernacular	1875	Not assessed
HAN-455-15 J Robert Daft Barn	Z 17 E 265140 N 4522357	23721 CR 12	Vernacular	1940	Not assessed
HAN-552-15 Carl Wagner House	Z 17 E 265149 N 4523684	23099 CR 12	Vernacular	1870	Not assessed

OHI Number / Property Name	UTM Coordinates	Address	Style	Date of Construction	Previous NRHP Recommendation
HAN-900-6 Mark Montgomery House	Z 17 E 265169 N 4524523	22569 CR 12	Bungalow	1925	Not assessed
HAN-553-15 Carl Wagner Barn	Z 17 E 265187 N 4523707	23099 CR 12	Vernacular	1870	Not assessed
HAN-452-15 Warren House	Z 17 E 265191 N 4524875	7102 US 30	Vernacular	1885	Not assessed
HAN-456-15 Kenneth Redd House	Z 17 E 266700 N 4522780	TR 59	Gothic Revival	1890	Not assessed
HAN-457-16 Wolber House	Z 17 E 266740 N 4522660	23669 TR 59	Vernacular	1895	Not assessed
HAN-458-16 Loren Redd House	Z 17 E 266780 N 4523220	22319 TR59	Vernacular	1880	Not assessed
HAN-507-16 J Harmon House	Z 17 E 266810 N 4524370	CR 12, N of US 30	Vernacular	1885	Not assessed
HAN-459-16 Johnson House	Z 17 E 266820 N 4524640	Box 91; TR 59	Italianate	1875	Not assessed
HAN-460-16 Riegle House	Z 17 E 266820 N 4524380	22615 TR 59	Vernacular	1880	Not assessed
HAN-509-16 Paul Kurt House	Z 17 E 267740 N 4523800	7102 US 30	Vernacular	1885	Not assessed
HAN-508-16 Harold Raush House	Z 17 E 268160 N 4523760	US 30, W of TR 60	Italianate	1885	Not assessed
HAN-461-16 Baumgaroners House	Z 17 E 268400 N 4524640	TR 60, N of US 30	Vernacular	1880	Not assessed
HAN-510-16 Hicks House	Z 17 E 269180 N 4524840	22908 TR 61	Vernacular	1870	Not assessed
HAN-511-16 Cheney Chicken House	Z 17 E 269240 N 4524740	7514 US 30	Vernacular	1910	Not assessed
HAN-463-16 Bosser House	Z 17 E 269240 N 4524560	22457 TR 61	Vernacular	1875	Not assessed
HAN-462-16 Rausch House	Z 17 E 269260 N4524840	22291 TR 61	Italianate	1875	Not assessed
HAN-465-16 Jarmon Kliesch House	Z 17 E 270040 N 4524160	SR 698, S of US 30	Vernacular	1885	Not assessed
HAN-467-16 Rodabaugh House	Z 17 E 271340 N 4522580	23654 TR 54	Vernacular	1893	Not assessed
HAN-464-16 Horsh House	Z 17 E 271620 N 4524660	22294 TR 65	Vernacular	1870	Not assessed
HAN-468-16 Cliff Hinkle House	Z 17 E 272340 N 4522380	23748 CR 9	Vernacular	1880	Not assessed
HAN-469-16 Kent McMillen House	Z 17 E 272380 N 4524020	22756 CR 9	Italianate	1875	Not assessed
HAN-470-16 Claude Neiswan House	Z 17 E 272420 N 4522620	23609 CR 9	Vernacular	1940	Not assessed
HAN-518-16	Z 17 E 272520 N 4522660	US 30 &CR 9	Vernacular	1895	Not assessed
HAN-585-17 Windmill Site 611	Z 17 E 273680 N 4522500	US 30, near CR 9	Vernacular	1900	Not assessed
HAN-111-2 Fort Necessity Historic Marker	Z 17 E 274910 N 4521920	CR 21, W of SR 68	No info	1915	Not assessed
HAN-471-17 Ray Worstein House	Z 17 E 275460 N 4522980	TR 69, S of US 30	Vernacular	1895	Not assessed

OHI Number / Property Name	UTM Coordinates	Address	Style	Date of Construction	Previous NRHP Recommendation
HAR-472-17 Swank House	Z 17 E 274300 N 4511320	6582 TR 125	Italianate	1880	Not assessed
HAN-473-17 Hodge & Riggs House	Z 17 E 276380 N 4522600	US 68, S of US 30	Vernacular	1875	Not assessed
HAN-476-17 Wilbur Garlinger House	Z 17 E 276420 N 4523080	23234 US 68	Vernacular	1870	Not assessed
HAN-478-17 Hollinger House	Z 17 E 276440 N 4524200	US 68, N of US 30	Vernacular	1890	Not assessed
HAN-474-17 Michael Franks House	Z 17 E 276440 N 4522740	23445 US 68	Vernacular	1940	Not assessed
HAN-475-17	Z 17 E 276480 N 4522710	23445 US 68	Vernacular	1865	Not assessed
HAN-477-17 Dean Benjamin House	Z 17 E 276500 N 4524460	22435 US 68	Vernacular	1905	Not assessed
HAN-486-17 Main House	Z 17 E 277100 N 4522980	23287 TR 176	Vernacular	1875	Not assessed
HAN-480-17 Dennis Essinger House	Z 17 E 277900 N 4522560	TR 177 S US 30	Vernacular	1880	Not assessed
HAN-481-17 Baughman House	Z 17 E 278020 N 4522500	23583 TR 177	Vernacular	1875	Not assessed
HAN-479-17 Joseph Conley House	Z 17 E 278020 N 4524520	22341 TR 177	Vernacular	1875	Not assessed
HAN-482-17 Rex & Cheryl Gallant House	Z 17 E 278200 N 4522740	13152 TR 146	Vernacular	1875	Not assessed
HAN-483-17 Clarence Jolliff House	Z 17 E 278280 N 4522620	13676 TR 146	Vernacular	1900	Not assessed
HAN-485-17 Tim Graydon House	Z 17 E 279360 N 4524160	13865 TR 148	Vernacular	1875	Not assessed
HAN-487-18 Crabill House	Z 17 E 279560 N 4522760	23375 TR 181	Vernacular	1890	Not assessed
HAR-91-6 Douglas Ziegler House	Z 17 E 272410 N 4507320	TR 115, S of SR 309	Italianate	1880	Not assessed
HAR-92-6 Dwight Hassen House	Z 17 E 273590 N 4510420	TR 80, near TR 115	Italianate	1880	Rec. not eligible
HAR-96-6 George and Mary Gerlach House	Z 17 E 274160 N 4511640	6403 TR 125	Vernacular	1870	Not assessed
HAR-90-6 Allyne Humphrey House	Z 17 E 272230 N 4511290	6661 TR 125	Vernacular	1850	Not assessed
HAR-97-6 Allyne Humphrey House	Z 17 E 274300 N 4511320	6582 TR 125	Italianate	1880	Not assessed
HAR-94-6 Dennis Comstock House	Z 17 E 275080 N4508930	TR 90, near CR 135	Italianate	1885	Rec. not eligible

APPENDIX B

Existing Archaeological Resources Table

PROJECT NAME: HARDIN COUNTY WIND FARM SURVEY
Data Collector's Name(s): Patrick M. Bennett (HDC)
Collection Date(s): April 23, 2009

Existing archaeological resources within the archaeological study area

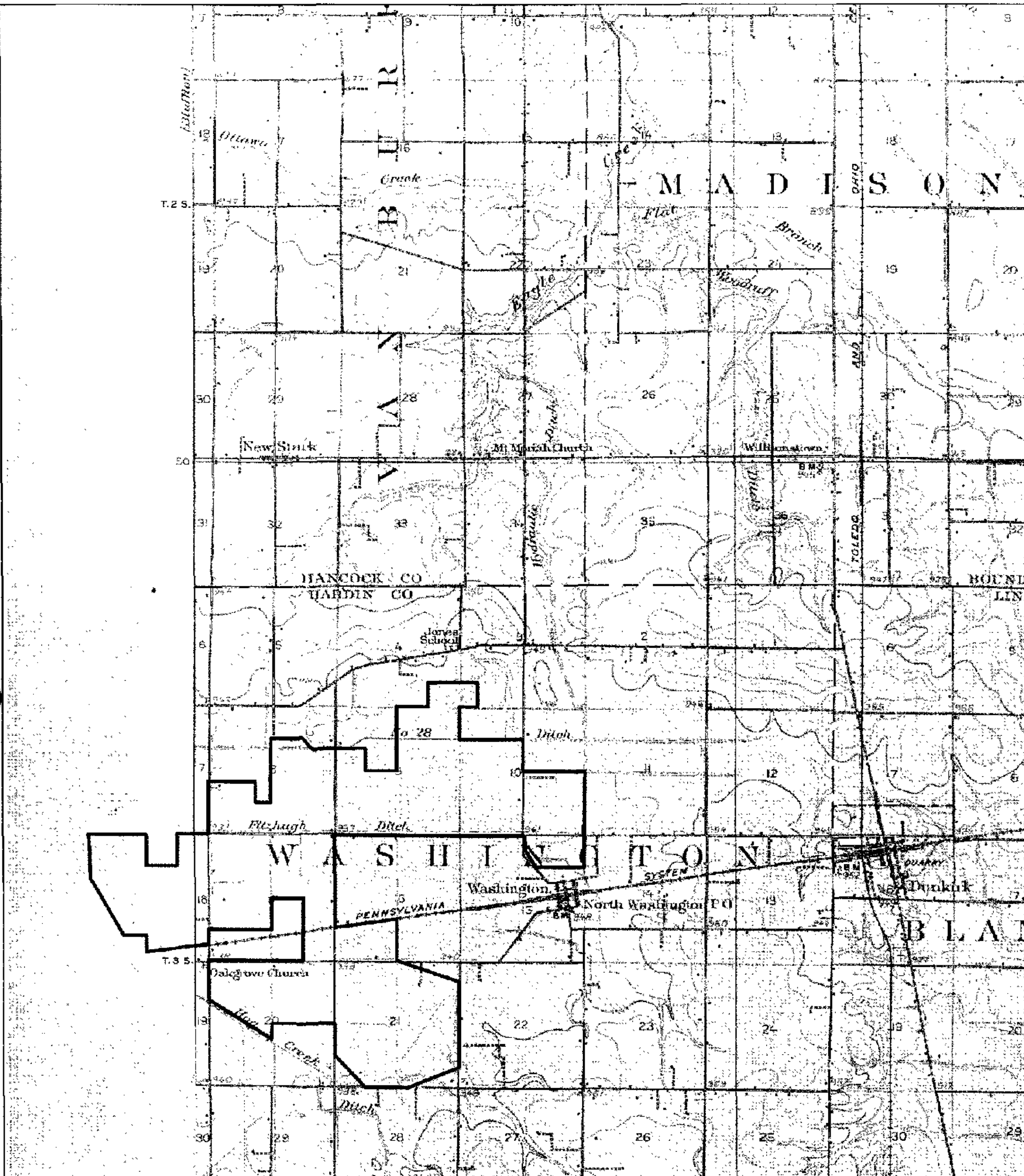
The archaeological study area covers the footprint of the proposed wind farm plus a 1-mile [1.6-km] buffer zone extending out from the boundary of the footprint.

Site Identifier	UTM Coordinates[1]	Temporal Period and Site Type	Landform	Site Dimensions (ft/m)	NRHP Criteria Status / (Reference / Date) / Condition
33HR15 Demier Kame	Z 17 E 271080 N 4515750	Unknown period, unknown site type	Glacial kame	Unknown	Not applied/Unknown
33HR16 Wilkie Kame	Z 17 E 271380 N4516600	Unknown period, unknown site type	Glacial kame	Unknown	Not applied/Unknown
33HR17 Candler Kame	Z 17 E 266830 N4516540	Unknown prehistoric, numerous flexed, bundle and extended burials	Glacial kame	Unknown	Not applied/Destroyed

[1] UTM coordinates are in NAD 27 meters.

APPENDIX C

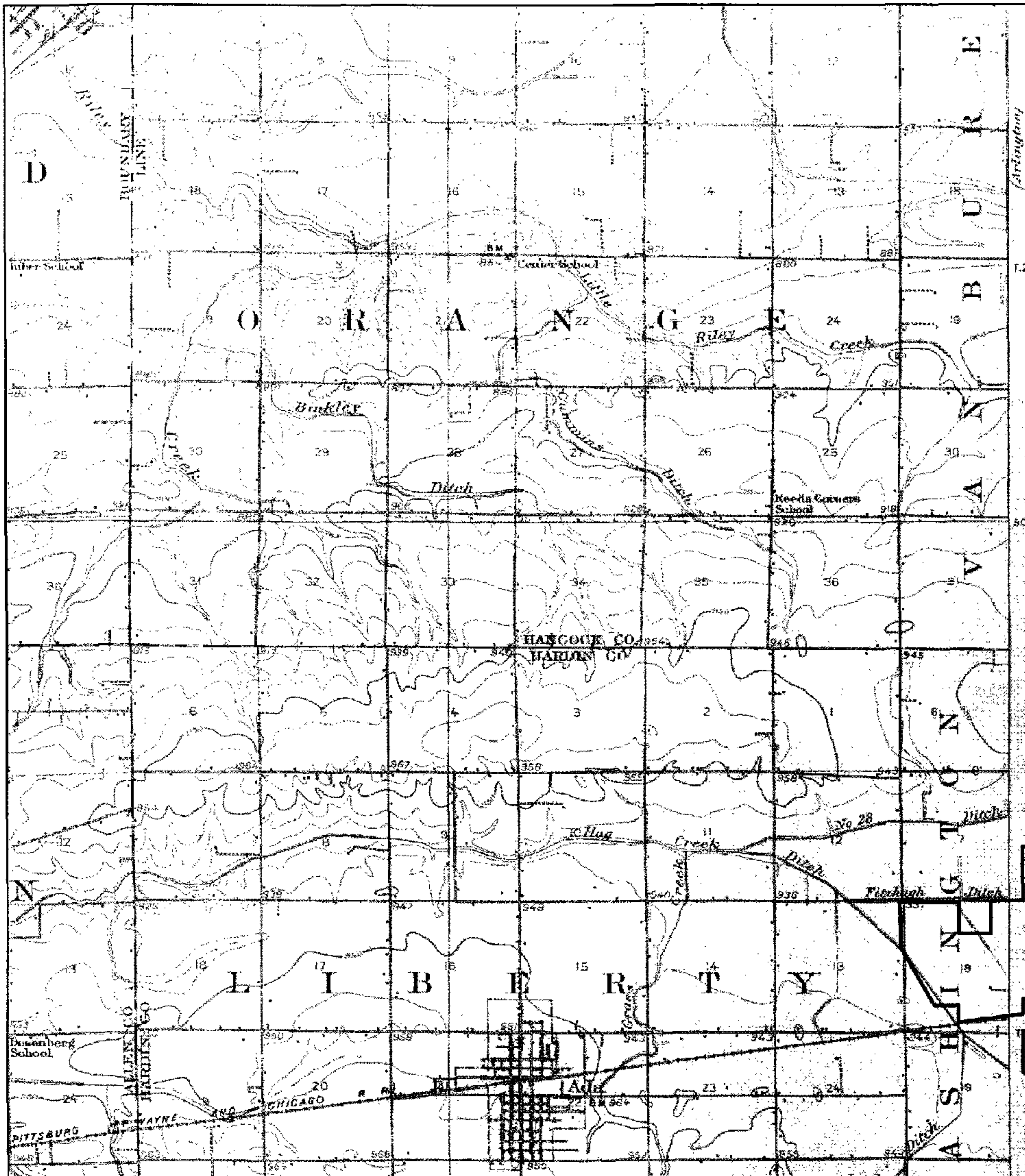
Historical Maps



Map 1. 1907 15-minute Arlington, Ohio, USGS topographic map, southwestern quadrant. (Wind farm footprint in red, added)

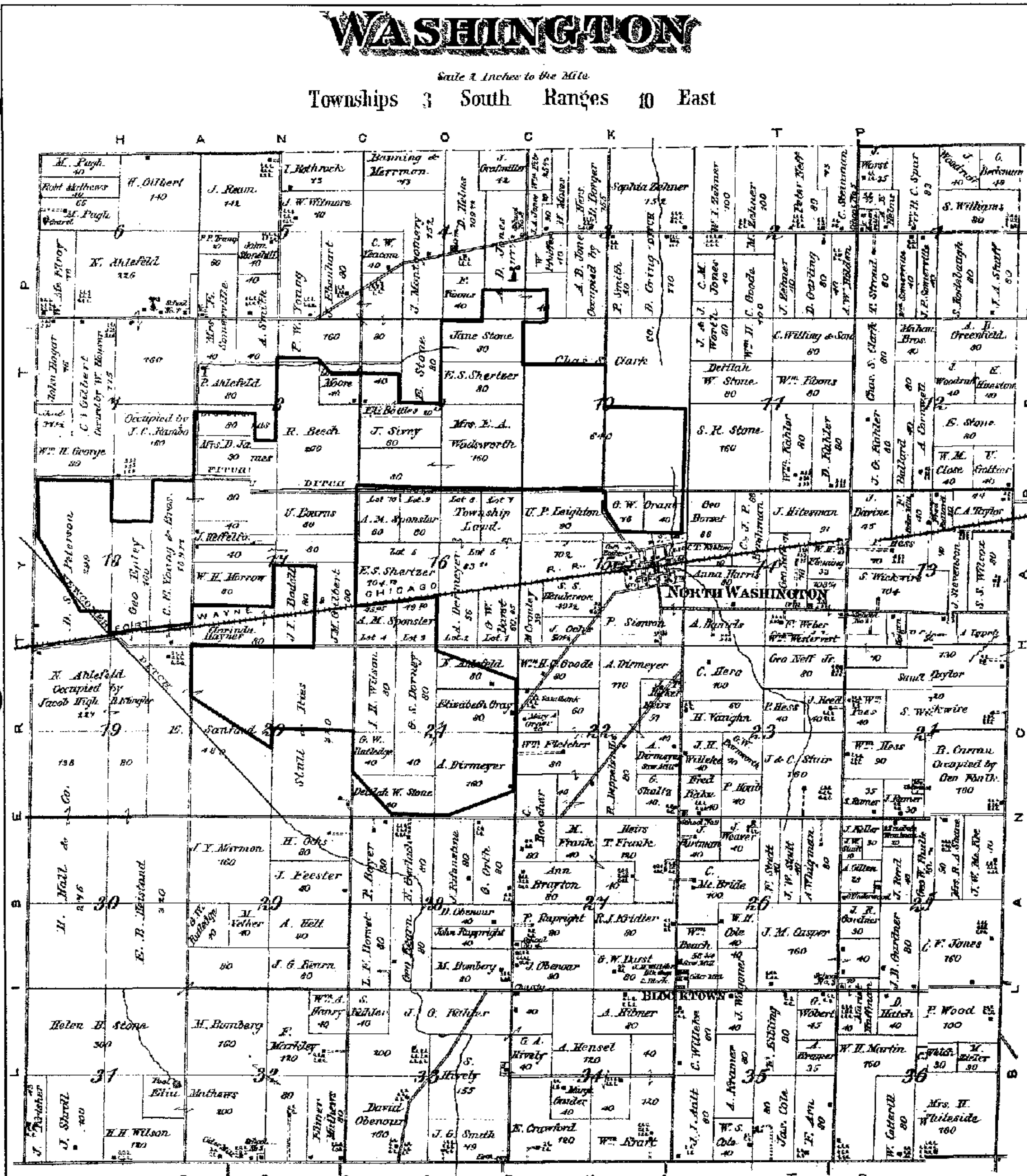
N W E S	Miles 1 0 1 2	May 2009
	Project No. 1865.004	Basemap: USGS 15' Topographic Map (1907)

BHE ENVIRONMENTAL



Map 2. 1907 Bluffton, Ohio, USGS topographic map, southeastern quadrant. (Wind farm footprint in red, added)

N / W / E / S	Miles: 0.5 0 0.5 1	May 2009	BHE ENVIRONMENTAL
	Project No. 1865.004	Basemap: USGS Topographic Map (1907)	



Map 3. 1879 Washington Township Atlas map, published by R. Sutton & Co. (Wind farm footprint in red, added)

N W E S	Miles 0.5 0 0.5 1	May 2009	
	Project No. 1865.004	Basemap: Washington Township Atlas Map (1879)	

Exhibit 08-8. Wind Power GeoPlanner Licensed Microwave Report by Comsearch.

Wind Power GeoPlanner™

Licensed Microwave Report

Hardin County North Wind Farm

Prepared on Behalf of
JW Great Lakes Wind
LLC

June 29, 2009

COMSEARCH
A CommScope Company

Table of Contents

1. Introduction

The use of wind energy, one of the oldest forms of harnessing a natural energy source, is now one of the world's fastest growing alternative energy sources. The United States is committed to the use of wind energy, and over the next several years billions of dollars will be spent on wind power projects. However, as new wind turbine generators are installed around the country, it is important to note that they may pose an interference threat to existing microwave systems and broadcast stations licensed to operate in the United States.

Wind turbines can interfere with microwave paths by physically blocking the line-of-sight between two microwave transmitters. Additionally, wind turbines have the potential to cause blockage and reflections ("ghosting") to television reception. Blockage is caused by the physical presence of the turbines between the television station and the reception points. Ghosting is caused by multipath interference that occurs when a broadcast signal reflects off of a large reflective object—in this case a wind turbine—and arrives at a television receiver delayed in time from the signal that arrives via direct path.

Many states and other jurisdictions recognize the need for regulations addressing interference to radio signal transmissions from the wind turbine installations. Specifically, local planning authorities typically require project developers to ensure wind turbines will not cause interference. In some cases they require developers to notify the telecommunication operators in the area of the proposed wind turbine installation. Other factors prompting developers to undertake proactive investigation into potential interference include the need to prevent legal and regulatory problems and the desire to promote goodwill within the community—a good neighbor approach.

Comsearch has developed and maintains comprehensive technical databases containing information on licensed microwave networks throughout the United States. Microwave bands that may be affected by the installation of wind turbine facilities operate over a wide frequency range (900 MHz – 23 GHz). These systems are the telecommunication backbone of the country, providing long-distance and local telephone service, backhaul for cellular and personal communication service, data interconnects for mainframe computers and the Internet, network controls for utilities and railroads, and various video services.

This report focuses on the potential impact of wind turbines on licensed non-federal government microwave systems. Comsearch provides additional wind energy services, a description of which can be found at the end of this report.

2. Summary of Results

An overall summary of results appears below.

Number of Microwave Paths	Number of Turbines	Number of Potential Obstructions
2	27	3

Methodology
Our obstruction analysis was performed using Comsearch's proprietary microwave database, which contains all non-government licensed paths from 0.9 - 23 GHz[1]. First, we determined all microwave paths that intersect the area of interest. The area of interest was defined by the client and encompasses the planned turbine locations. Next, for each microwave path that intersected the project area, we calculated a Worst Case Fresnel Zone (WCFZ). The mid-point of a full microwave path is the location where the widest (or worst case) Fresnel zone occurs. Fresnel zones were calculated for each path using the following formula.

$$Rn \cong 17.3\sqrt{\frac{n}{F_{GHz}}\left(\frac{d_1 d_2}{d_1 + d_2}\right)}$$

Where,

- R_n = Fresnel Zone radius at a specific point in the microwave path, meters
- n = Fresnel Zone number, 1
- F_{GHz} = Frequency of microwave system, GHz
- d_1 = Distance from antenna 1 to a specific point in the microwave path, kilometers
- d_2 = Distance from antenna 2 to a specific point in the microwave path, kilometers

For worst case Fresnel zone calculations, $d_1 = d_2$

The calculated WCFZ radius, giving the linear path an area or swath, buffers each microwave path in the project area. See the Tables and Figures section for a summary of paths and WCFZ distances. In general, this is the two-dimensional area where the planned wind turbines should be avoided, if possible. A depiction of the WCFZ overlaid on topographic basemaps can be found in the Tables and Figures section, and is also included on the enclosed CD[2].

[1] Please note that this analysis does not include unlicensed microwave paths or federal government paths that are not registered with the FCC.

[2] The ESRI® shapefiles contained on the enclosed CD are in NAD 83 UTM Zone 17 projected coordinate system.

Discussion of Potential Obstructions
For this project, 27 turbines were considered in the analysis, each with a blade diameter of 101 meters and turbine height of 101 meters. Of those turbines, 3 were found to have a potential conflict with 2 microwave paths. The next section contains a detailed depiction of the potential obstruction scenario(s) and a tabular summary of the affected turbines and microwave paths.

When turbines fall within the two-dimensional WCFZ, Comsearch offers and recommends a detailed clearance study, which considers the vertical Z-height clearance objectives. The results of the detailed study may clear the potential conflict without requiring turbine relocation. Please contact Denise Finney at (703) 726 – 5650 to request a detailed study.

3. Tables and Figures

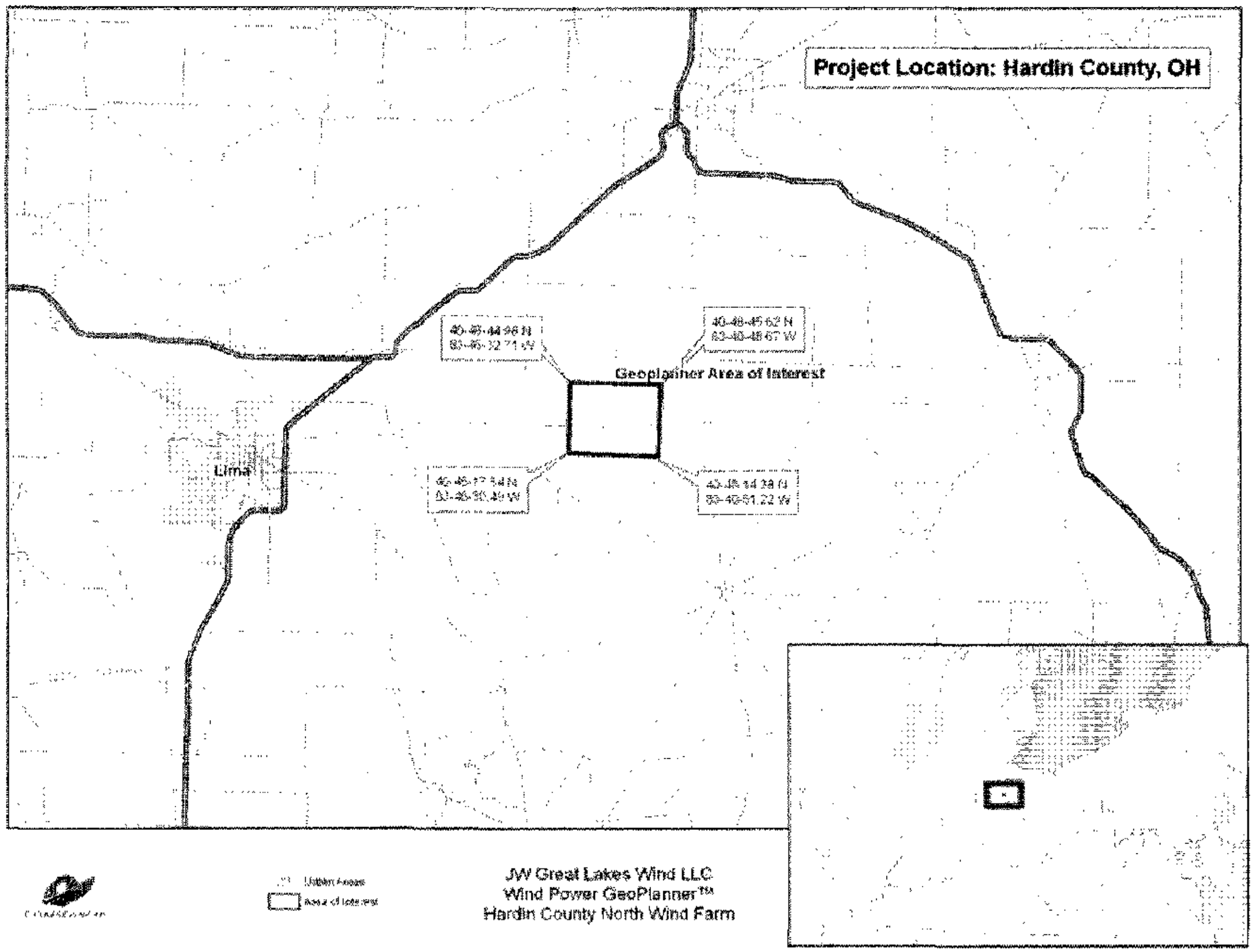


Figure 1: Area of Interest

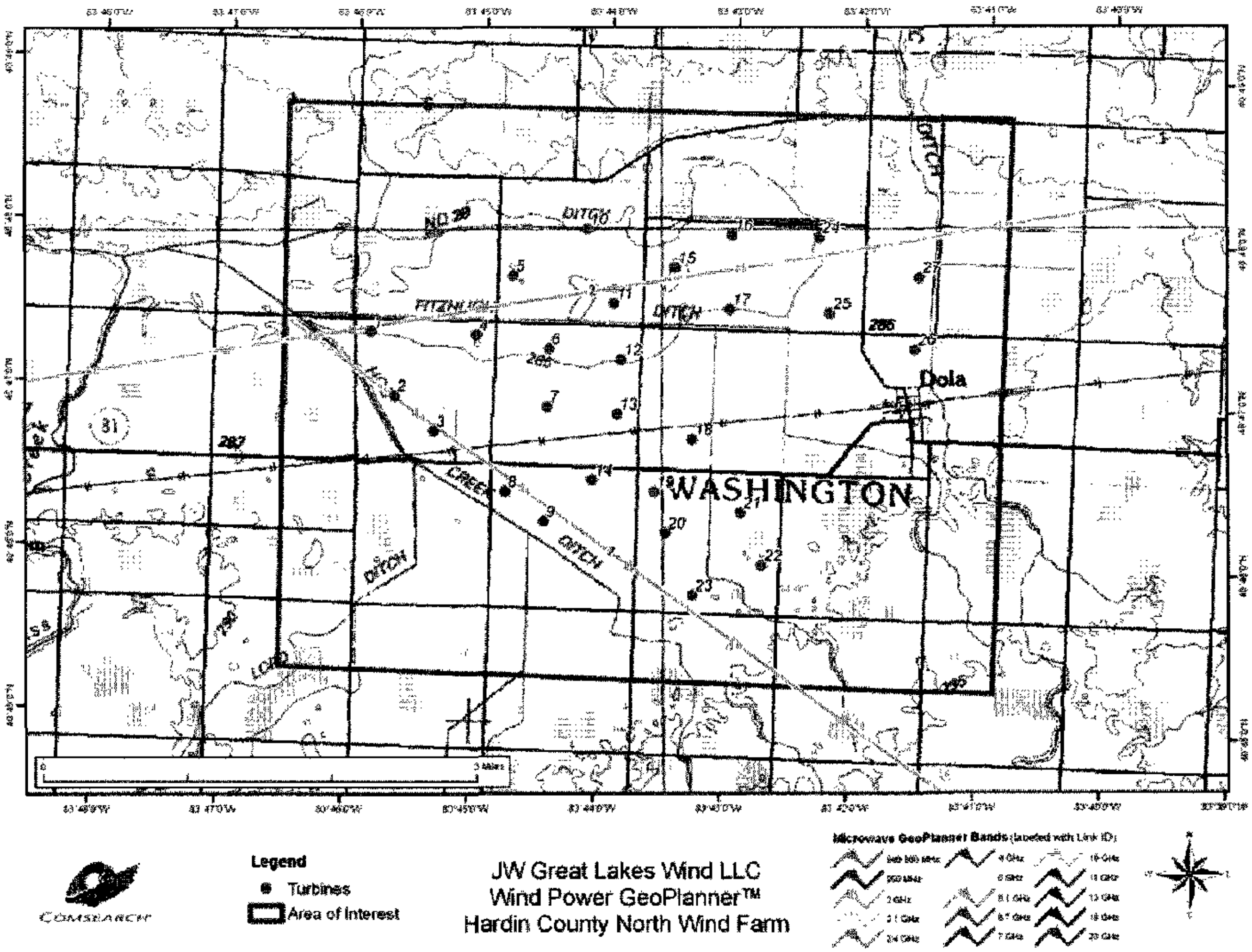


Figure 2: Microwave Paths that Intersect the Area of Interest

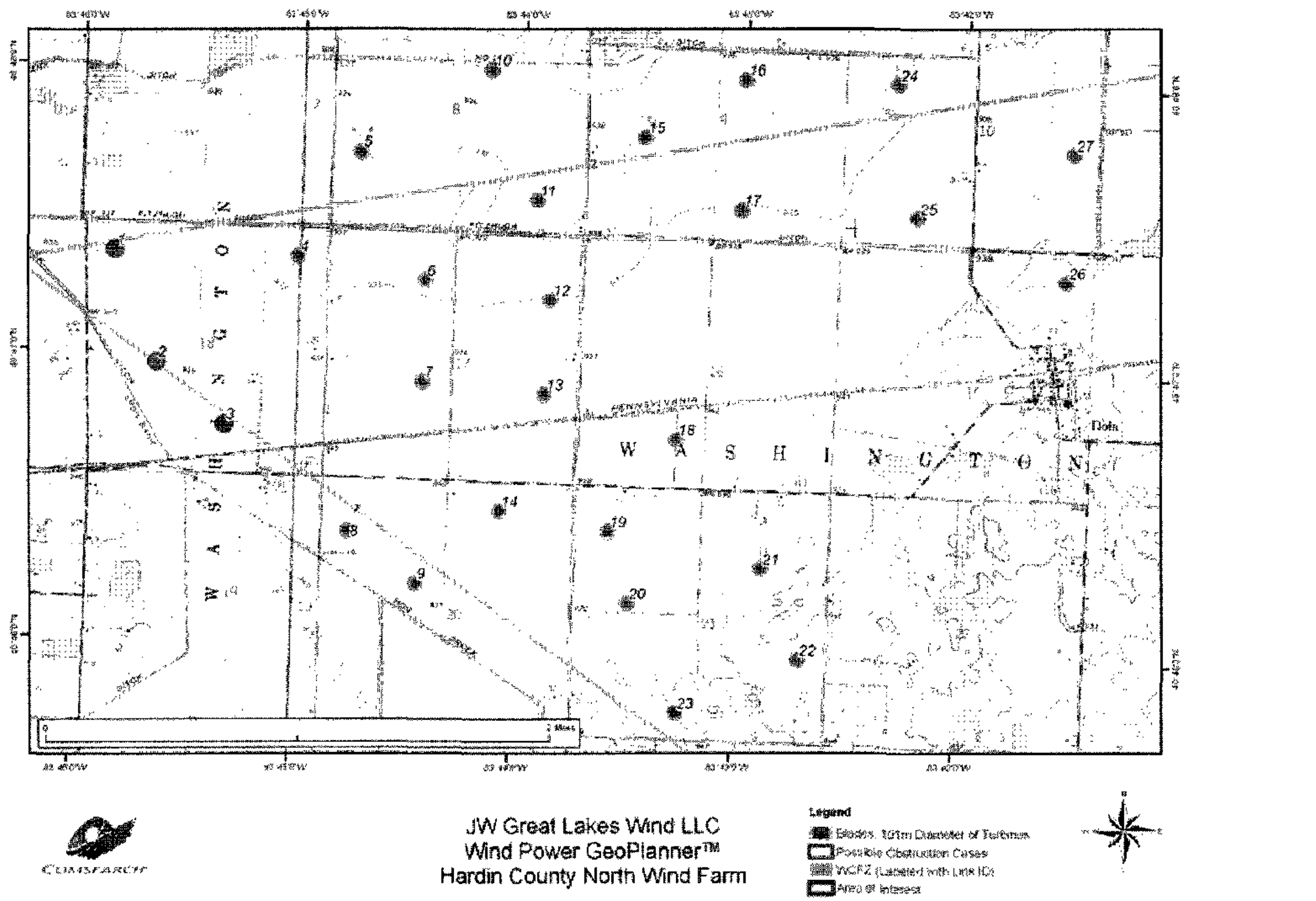


Figure 3: Microwave Paths with WCFZ Buffers

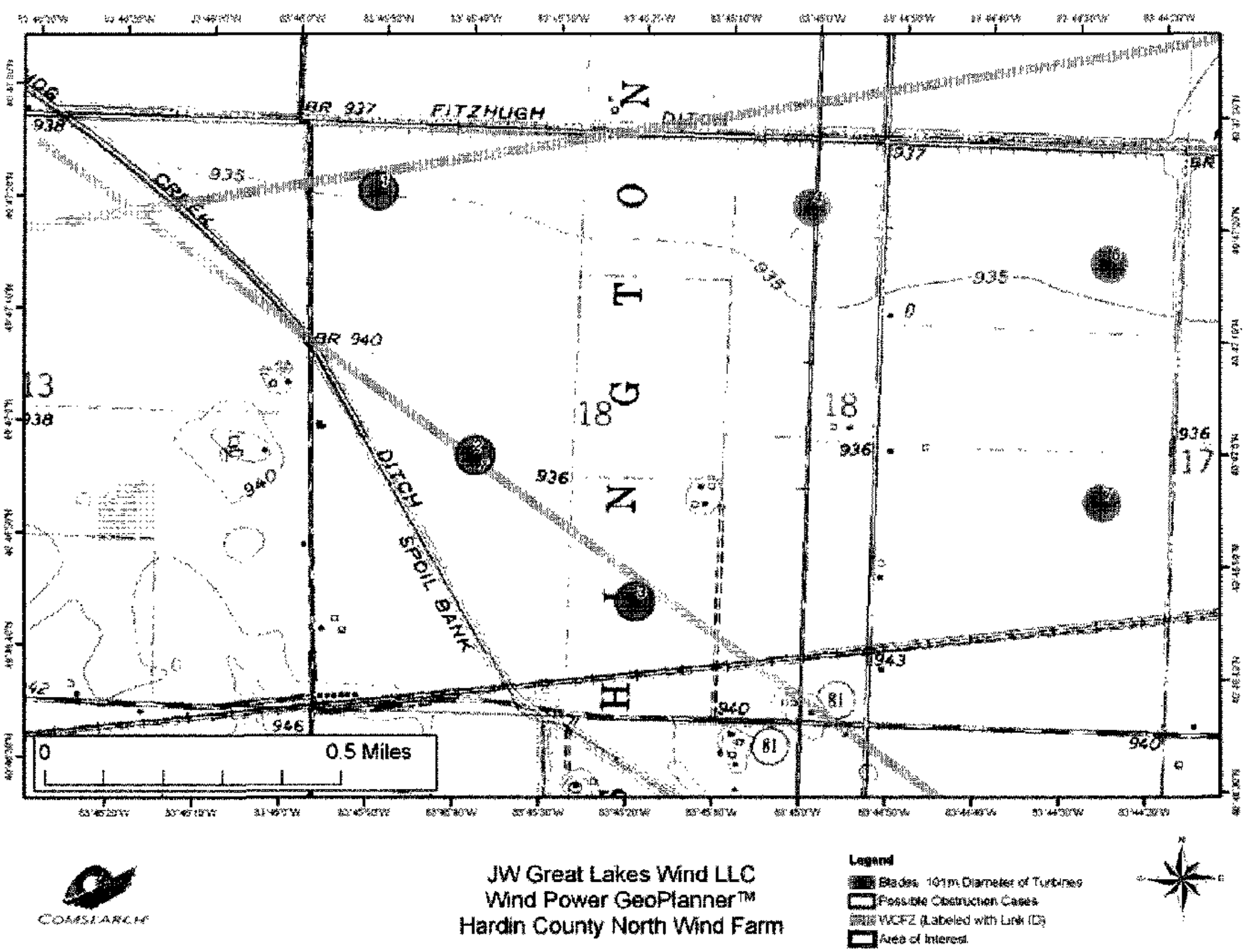


Figure 4: Potential Obstruction Scenario

(Turbine #1-3)

ID	Site Name 1	Site Name 2	Callsign 1	Callsign 2	Band	Licensee	WCFZ (m)
1	ADA	KENTON	WPSJ364	WPNN226	Lower 6 GHz	Ohio RSA 5 Limited Partnership	13.31
2	DUNKIRK 672	LIMA EAST 76	WPXD876	WPSK794	Lower 6 GHz	Cellco Partnership - Ohio	15.13

Table 1: Microwave Paths that Intersect the Area of Interest

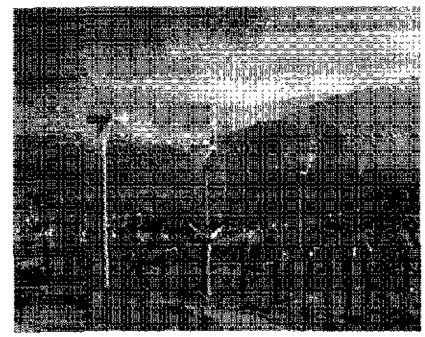
(See enclosed mw_geopl.xls for more information and
GP_dict_matrix_description.xls for detailed field descriptions)

Turbine ID	Latitude (WGS84)	Longitude (WGS84)	Affected Microwave Link IDs
1	40°47'21.35"	-83°45'50.24"	2
2	40°46'58.01"	-83°45'38.01"	1
3	40°46'45.46"	-83°45'19.10"	1

Table 2: Turbines that Cause Potential Obstructions

4. Recommended Ancillary Reports

Comsearch offers the following wind energy services.



- **Licensed Microwave Report** – Assess all licensed non-Federal Government microwave paths and worst case Fresnel Zones that intersect the wind energy project area. If any potential obstructions exist, perform a **Detailed Fresnel Zone Analysis** to consider the actual horizontal and vertical Fresnel Zone clearances.

- **Coordination with Federal Government Systems** - Coordinate with NTIA, the agency that manages government spectrum, to determine if the proposed wind energy project will impact Federal Government links.

- **TV Analysis** - Plot off-air TV stations within 100 miles of the project area to identify which communities may have signal reception issues.

- **Ancillary Telecommunication Studies** – Conduct obstruction studies of other potentially-affected wireless telecommunication systems. This includes:
  - Land Mobile Sites
  - AM and FM Broadcast Stations
  - Advanced Wireless and Mobile Phone Carriers
  - Cable Facilities
  - Radio Astronomy Sites

- **Tower Structures** - Identify and map tower structures owned by the top five tower companies and those found in the FCC's Antenna Structure Registration database.

- **TV Baseline Measurements** - Perform baseline measurements of off-air TV stations in the vicinity of the wind energy facility. The measurements will be performed at various locations in population centers and at locations where the potential for signal blockage, multipath and electromagnetic noise degradation is probable.

- **Measurements to Identify Government and Unlicensed Operators** – Identify all commercial and government signals in the area, including unlicensed operators. Frequency range of this measurement will be from 400 MHz – 12,000 MHz.

- **Post Installation Measurements and Consultation** - Perform measurements after the installation of the wind energy facility. The measurements will be made at all sites where signal blockage, multipath and/or electromagnetic noise is reported and/or suspected. If the measurements and analysis verify signal blockage, multipath or electromagnetic noise due to the wind turbines, provide consulting services to mitigate the conditions. Perform radiation hazard compliance measurements.

- **Regulatory Support** - Complete and file FAA forms on behalf of the wind energy developer.

5. Contact Us

For questions or information regarding the Licensed Microwave Report, contact:

Contact person:	Denise Finney
Title:	Account Manager
Company:	Comsearch
Address:	19700 Janelia Farm Blvd., Ashburn, VA 20147
Telephone:	703-726-5650
Fax:	703-726-5595
Email:	dfinney@comsearch.com
Web site:	www.comsearch.com

Exhibit 08-9. AM/FM Broadcast Station Operations Report by Comsearch.

COMSEARCH

19700 Janelia Farms Blvd
Ashburn, VA 20147
703-726-5500

Analysis of AM and FM Broadcast Station Operations in the Vicinity of the Hardin County North Wind Farm Project in Hardin County, Ohio

Comsearch was contracted by JW Great Lakes Wind, LLC to determine if there would be any degradation to the operational coverage of AM and FM Radio Broadcast Stations located in the vicinity of the proposed Hardin County North Wind Farm Project in Hardin County, Ohio.

Comsearch determined that there were two licensed AM stations within a search radius of (20 miles) of the center of the Project site. The two entries for the two stations are for two different transmit powers. For certain stations the FCC requires a lower transmit power after sundown.

Table 1 AM Radio Stations in the Vicinity of the Hardin County North Wind Farm Project

Location		Call Sign	Frequency	Tx-Power	Distance
LIMA	OH	WCIT	940 kHz	0.25 kW	19.13 mi
LIMA	OH	WCIT	940 kHz	0.006 kW	19.13 mi
FINDLAY	OH	WFIN	1330 kHz	1.0 kW	16.25 mi
FINDLAY	OH	WFIN	1330 kHz	0.079 kW	16.25 mi

OH = Ohio
kHz = kilohertz
kW = kiloWatt
mi = mile
Tx-Power = transmit effective radiated power

Figure 1 is a map that shows the location of the AM transmit antennas with respect to the Project site. No degradation of AM broadcast coverage will occur due to the presence of the wind turbines as long as the separation distance to the nearest wind turbine is greater than 2 miles. Potential problems with broadcast coverage are only anticipated when AM broadcast stations with directive antennas are within 2 miles of turbine towers and AM broadcast stations with non-directive antennas are within 0.5 mile. Since the AM transmit antenna is outside the project area and more than 2 miles from the planned wind turbines no problems with degradation is anticipated.

Comsearch determined that there were twenty-three data entries for FM stations within a 20 mile search radius of the center of the Project site. All of the stations are outside of the Project area-of-interest and at distances greater than 3 miles from any of the planned wind turbines. At distances of 3 miles or more from the wind turbines, the effects to the FM coverage for the FM Stations will be very minimal to non-existent. Therefore, all of the stations outside of the Project area-of-interest will be unaffected. The FM Stations are listed in Table 2 of this report. Figure 2 is a map that shows the location of the FM transmit antennas with respect to the Project site.

Table 2 FM Radio Stations in the Vicinity of the Fairwind Wind Power Project

Location		Call Sign	Status	Frequency	Tx-Power	Distance
FINDLAY	OH	WLFC	LIC	88.3 MHz	0.155 kW	18.99 mi
FINDLAY	OH	WTKC	LIC	89.7 MHz	0.125 kW	18.50 mi
LIMA	OH	880407ME	USE	93.1 MHz	NA	19.71 mi
FINDLAY	OH	W231AJ	LIC	94.1 MHz	0.05 kW	16.94 mi
ADA	OH	WONB	LIC	94.9 MHz	3. kW	5.86 mi
ADA	OH	880615MG	USE	94.9 MHz	NA	5.59 mi
KENTON	OH	WKTN	LIC	95.3 MHz	3.5 kW	12.80 mi
KENTON	OH	WKTN	USE	95.3 MHz	NA	12.80 mi
BAIRD	OH	NEW	APP	95.5 MHz	0.12 kW	17.93 mi
BAIRD	OH	NEW	APP	95.5 MHz	0.12 kW	17.93 mi
FINDLAY	OH	NEW	APP	97.5 MHz	0.08 kW	17.68 mi
VAN BUREN	OH	NEW	APP	97.5 MHz	0.08 kW	17.93 mi
BLUFFTON	OH	WBWH-LP	LIC	99.3 MHz	0.066 kW	12.05 mi
FINDLAY	OH	NEW	APP	99.5 MHz	0.12 kW	17.93 mi
FINDLAY	OH	NEW	APP	99.5 MHz	0.055 kW	18.43 mi
FINDLAY	OH	WKXA-FM	LIC	100.5 MHz	20. kW	11.49 mi
FINDLAY	OH	WKXA-FM	USE	100.5 MHz	NA	11.49 mi
FINDLAY	OH	WKXA-FM	CP	100.5 MHz	20. kW	11.49 mi
LIMA	OH	WEGE	LIC	104.9 MHz	3. kW	19.18 mi
LIMA	OH	WEGE	USE	104.9 MHz	NA	19.18 mi
KENTON	OH	W286AB	LIC	105.1 MHz	0.05 kW	12.27 mi
OTTAWA	OH	WBUK	LIC	106.3 MHz	1.4 kW	15.29 mi
OTTAWA	OH	WBUK	USE	106.3 MHz	NA	15.29 mi

OH = Ohio
NA = Not applicable
MHz = kilohertz
kW = kilowatt
mi = mile
Tx-Power = transmit effective radiated power

LIC = Licensed and Operational
CP = Construction Permit Issued but station is not operational
USE = Frequency Assigned awaiting license
NA = Not Applicable

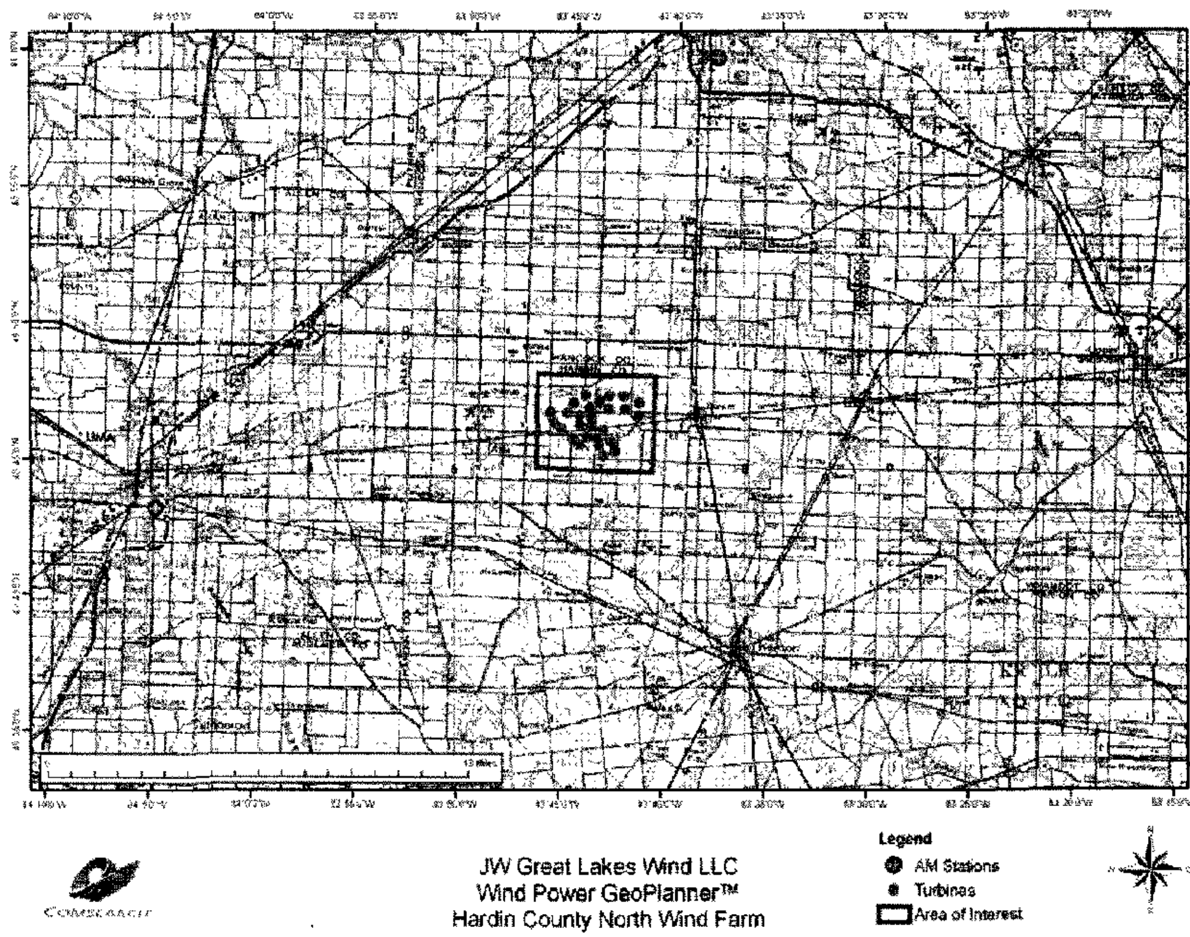


Figure 1 AM Stations in the Vicinity of the Hardin County North Wind Farm Project

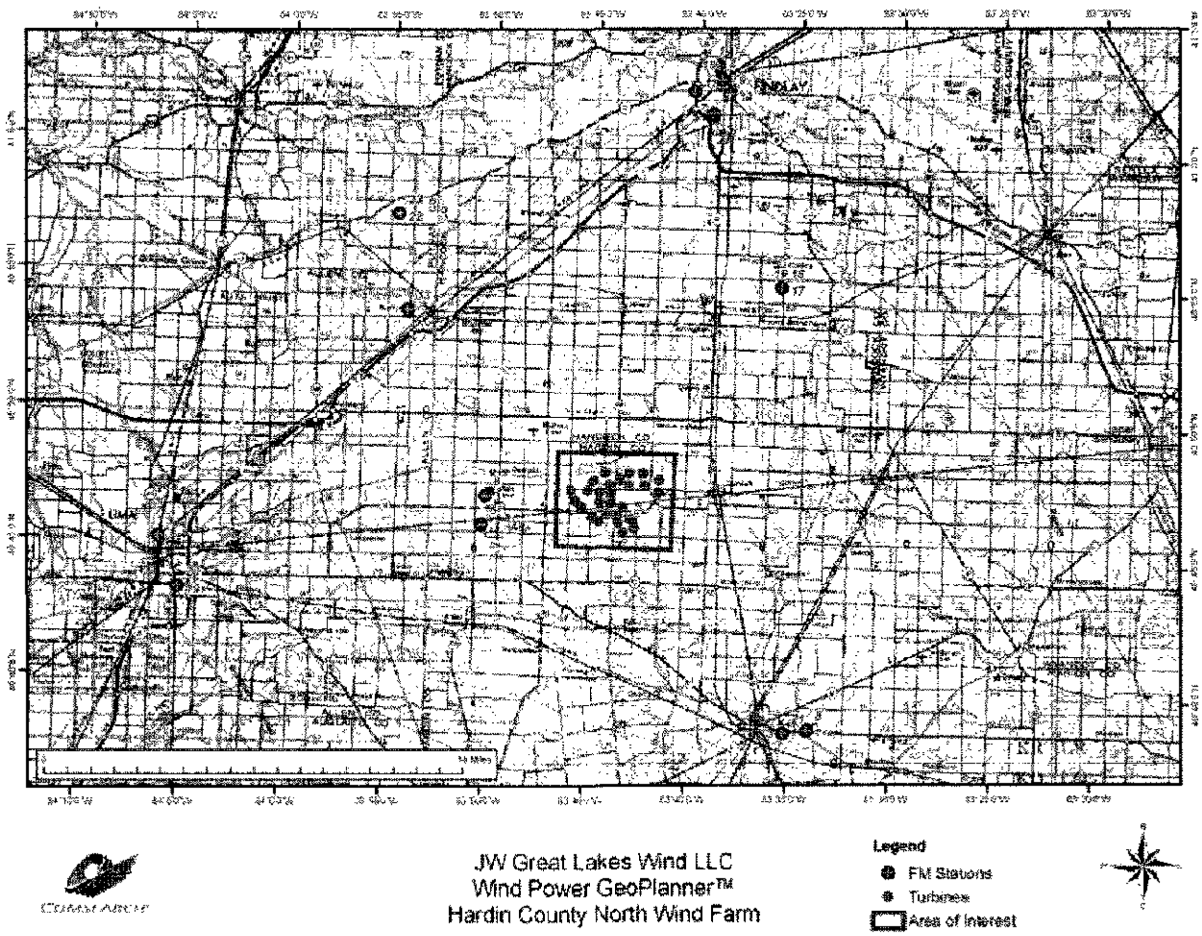


Figure 2 FM Stations in the Vicinity of the Hardin County North Wind Farm Project

Exhibit 08-10. Off-Air TV Reception Analysis by Comsearch.

COMSEARCH

19700 Janelia Farms Blvd
Ashburn, VA 20147
703-726-5500

Off-Air TV Reception Analysis at the Hardin County North Wind Farm Project Area in Hardin County, Ohio

Comsearch was contracted by JW Great Lakes Wind, LLC to identify all of the off-air television stations within a 100-mile radius of the Hardin County North Wind Farm Project (the Project) in Hardin County, Ohio. Off-air television stations are broadcasters that transmit signals that can be received directly on a television receiver from terrestrially located broadcast facilities. Comsearch examined the coverage of the off-air TV stations and the communities in the area that could potentially have degraded television reception because of the location of the Project's wind turbines. The proposed wind energy facility boundaries and local communities are shown in Figure 1 of this memorandum. Table 1 lists the off-air television stations within 100 mile radius of the Project and Table 2 lists the off-air television stations within 40 miles of the Project. Figure 2 shows the location of the off-air TV channel broadcast antennas with respect to the Project.

Table 1 Off-Air TV Stations within 100 Miles of the Hardin county North Wind Farm Project

Location		Call Sign	Channel	Service	Status	Distance
TOLEDO	OH	WLMB	5	DT	LIC	68.02 mi
COLUMBUS	OH	WSYX	6	TV	LIC	69.27 mi
AUBURN	IN	W07CL	7	TX	LIC	78.90 mi
COLUMBUS	OH	WGCT-CA	8	CA	LIC	67.14 mi
LIMA	OH	WLIO-DR	8	DR	GRANT	21.34 mi
LIMA	OH	WLIO	8	DS	STA	21.34 mi
LIMA	OH	WLIO	8	DS	STA	21.33 mi
COLUMBUS	OH	WGCT-CA	8	CA	APP	64.42 mi
LIMA	OH	WLIO	8	DT	CP MOD	21.34 mi
LIMA	OH	WLIO	8	DS	APP	21.34 mi
COLUMBUS	OH	WGCT-CA	8	DC	CP	64.42 mi
FINDLAY	OH	W09CG	9	TX	LIC	22.97 mi
FORT WAYNE	IN	WFWC-LD	10	LD	CP	77.28 mi
TOLEDO	OH	WTOL	11	DT	CP MOD	63.98 mi
ANGOLA	IN	WINM	12	DT	LIC	72.71 mi
MANSFIELD	OH	WMFD-TV	12	DT	LIC	58.25 mi
MANSFIELD	OH	WMFD-TV	12	DT	CP	58.25 mi
COLUMBUS	OH	WSYX	13	DS	STA	69.30 mi
COLUMBUS	OH	WSYX	13	DT	LIC	69.30 mi
TOLEDO	OH	WTVG	13	DT	CP MOD	64.20 mi
COLUMBUS	OH	WCMH-TV	14	DS	STA	67.14 mi
COLUMBUS	OH	WCMH-TV	14	DS	STA	67.14 mi
COLUMBUS	OH	WCMH-TV	14	DT	LIC	67.14 mi
DAYTON	OH	WPTD	16	DT	CP MOD	78.34 mi
DAYTON	OH	WPTD	16	DS	APP	78.34 mi
COLUMBUS	OH	WDEM-CA	17	CA	LIC	67.14 mi

CELINA	OH	W17AA	17	TX	LIC	44.23 mi
LIMA	OH	-	17	TA	-	39.36 mi
TOLEDO	OH	WTOL	17	DS	STA	63.98 mi
TOLEDO	OH	WTOL	17	DT	LIC	63.98 mi
CELINA	OH	W17AA	17	LD	CP	44.22 mi
COLUMBUS	OH	WDEM-CA	17	DC	LIC	67.14 mi
FORT WAYNE	IN	WISE-DR	18	DR	APP	79.34 mi
FORT WAYNE	IN	WISE-TV	18	DT	APP	79.33 mi
LIMA	OH	WLQP-LP	18	TX	LIC	27.24 mi
SPRINGFIELD	OH	WBDT	18	DT	LIC	78.22 mi
LEXINGTON	OH	W32AR	18	LD	APP	58.25 mi
TOLEDO	OH	W22CO	18	LD	CP	61.98 mi
LIMA	OH	WLQP-LP	18	LD	APP	19.93 mi
FORT WAYNE	IN	WISE-TV	19	DS	STA	78.78 mi
FORT WAYNE	IN	WISE-TV	19	DS	APP	78.78 mi
FORT WAYNE	IN	WISE-TV	19	DT	LIC	78.78 mi
FORT WAYNE	IN	WISE-TV	19	DS	APP	78.78 mi
COLUMBUS	OH	WCLL-CA	19	CA	LIC	68.40 mi
TOLEDO	OH	WTVG	19	DT	LIC	64.20 mi
SPRINGFIELD	OH	W20CL	20	TX	LIC	57.13 mi
FINDLAY	OH	NEW	20	LD	APP	19.93 mi
COLUMBUS	OH	WBNS-TV	21	DS	STA	67.14 mi
COLUMBUS	OH	WBNS-TV	21	DT	LIC	67.14 mi
COLUMBUS	OH	WBNS-TV	21	DT	APP	67.14 mi
BUCYRUS	OH	WBKA-CA	22	CA	LIC	43.46 mi
DAYTON	OH	WKEF	22	TV	LIC	78.56 mi
FINDLAY	OH	WFND-LP	22	TX	LIC	22.97 mi
FINDLAY	OH	WFND-LP	22	TX	CP	13.40 mi
FINDLAY	OH	WFND-LP	22	LD	APP	22.97 mi
MUNCIE	IN	WIPB	23	DT	CP MOD	99.83 mi
MUNCIE	IN	WIPB	23	DS	APP	99.83 mi
COLUMBUS	OH	W23BZ	23	TX	LIC	71.30 mi
LIMA	OH	W23DE-D	23	TX	CP	27.24 mi
COLUMBUS	OH	W23BZ	23	LD	CP	71.30 mi
LIMA	OH	W23DE-D	23	LD	LIC	27.24 mi
FORT WAYNE	IN	WPTA	24	DT	LIC	79.33 mi
NEWARK	OH	WSFJ-TV	24	DS	STA	90.38 mi
NEWARK	OH	WSFJ-TV	24	DS	STA	73.01 mi
NEWARK	OH	WSFJ-TV	24	DT	LIC	73.01 mi
SPRINGFIELD	OH	W24DG-D	24	LD	CP	57.13 mi
LIMA	OH	WOHL-CA	25	CA	LIC	27.24 mi
LIMA	OH	WOHL-CA	25	DC	APP	27.24 mi
COLUMBUS	OH	WCPX-LP	25	LD	CP	64.75 mi
COLUMBUS	OH	WCPX-LP	25	LD	APP	64.75 mi
AUBURN	IN	W26DH-D	26	LD	CP	78.90 mi
DEFIANCE	OH	WDFM-LP	26	TX	STA	54.93 mi
DEFIANCE	OH	WDFM-LP	26	TX	LIC	54.93 mi
SPRINGFIELD	OH	WBDT	26	DT	CP MOD	78.22 mi

MARION	IN	WSOT-LP	27	TX	CP	99.90 mi
MARION	IN	WSOT-LP	27	LD	CP	99.90 mi
BOWLING GREEN	OH	WBGU-TV	27	DT	CP MOD	26.09 mi
MIILLERSBURG	OH	W69AO	27	LD	APP	81.10 mi
BOWLING GREEN	OH	WBGU-TV	27	DS	APP	26.09 mi
DEFIANCE	OH	W52CO	28	TX	APP	54.93 mi
TOLEDO	OH	W28DH-D	28	LD	CP	60.05 mi
TOLEDO	OH	WGTE-TV	29	DT	LIC	62.22 mi
DAYTON	OH	WRGT-TV	30	DT	CP	78.22 mi
DAYTON	OH	WRGT-TV	30	DS	STA	78.22 mi
FORT WAYNE	IN	WANE-DR	31	DR	GRANT	78.95 mi
FORT WAYNE	IN	WANE-TV	31	DS	STA	78.95 mi
FORT WAYNE	IN	WANE-TV	31	DS	APP	78.95 mi
FORT WAYNE	IN	WANE-TV	31	DS	APP	78.95 mi
FORT WAYNE	IN	WANE-TV	31	DT	CP MOD	78.95 mi
FORT WAYNE	IN	WANE-TV	31	DS	APP	78.95 mi
NEWARK	OH	W31AA	31	TA	-	85.84 mi
NEWARK	OH	W31AA	31	TX	LIC	84.50 mi
TOLEDO	OH	W59DC	32	TX	APP	60.74 mi
LEXINGTON	OH	W32AR	32	TX	LIC	58.25 mi
XENIA	OH	960722KP	32	TV	APP	73.29 mi
XENIA	OH	960722KP	32	TA	-	72.74 mi
COLUMBUS	OH	WCSN-LP	32	TX	LIC	64.75 mi
DAYTON	OH	WWRD-LP	32	TX	LIC	78.42 mi
CENTERVILLE	OH	WWRD-LP	32	TX	APP	78.42 mi
MAPLEWOOD	OH	W63AH	32	LD	APP	32.18 mi
LIMA	OH	W55CH	33	TX	APP	27.24 mi
ASHLAND	OH	W33BW	33	TX	LIC	74.17 mi
COLUMBUS	OH	WCSN-LD	33	LD	CP	64.75 mi
TOLEDO	OH	WBTL-LP	34	TX	LIC	60.71 mi
COLUMBUS	OH	WCLL-LD	35	LD	CP	68.40 mi
LIMA	OH	WOHL-CA	35	DC	APP	21.34 mi
LIMA	OH	WOHL-CA	35	LD	APP	21.34 mi
FORT WAYNE	IN	WFFT-TV	36	DS	STA	79.98 mi
FORT WAYNE	IN	WFFT-TV	36	DT	CP MOD	79.98 mi
COLUMBUS	OH	WTTE	36	DT	CP	69.30 mi
COLUMBUS	OH	WTTE	36	DS	STA	69.30 mi
COLUMBUS	OH	WTTE	36	DS	STA	69.30 mi
FORT WAYNE	IN	W38EA-D	38	LD	LIC	79.68 mi
COLUMBUS	OH	WOSU-TV	38	DT	LIC	60.46 mi
LIMA	OH	WLMO-LP	38	TX	LIC	27.24 mi
TOLEDO	OH	W38DH	38	TX	LIC	59.91 mi
LIMA	OH	WLMO-LP	38	LD	APP	19.93 mi
COLUMBUS	OH	WOSU-TV	38	DT	CP	60.46 mi
RICHMOND	IN	WKOI-TV	39	DS	STA	100.03 mi
RICHMOND	IN	WKOI-TV	39	DT	LIC	100.03 mi
RICHMOND	IN	WKOI-TV	39	DT	CP	100.03 mi
MARION	OH	WOCB-CA	39	CA	LIC	33.40 mi

MARION	OH	WOCB-CA	39	DC	LIC	33.54 mi
FORT WAYNE	IN	WFWA	40	DT	LIC	79.68 mi
FORT WAYNE	IN	WFWA	40	DT	APP	79.68 mi
DAYTON	OH	WRCX-LP	40	TX	LIC	78.22 mi
DAYTON	OH	WRCX-LP	40	LD	CP	78.22 mi
SANDUSKY	OH	W41AP	41	TX	LIC	70.35 mi
DAYTON	OH	WHIO-TV	41	DS	STA	77.48 mi
DAYTON	OH	WHIO-TV	41	DT	LIC	77.48 mi
DAYTON	OH	WHIO-TV	41	DT	CP	77.48 mi
DAYTON	OH	WHIO-TV	41	DS	APP	77.48 mi
DELAWARE	OH	WXCB-CA	42	CA	LIC	49.06 mi
SANDUSKY	OH	WGGN-TV	42	DS	STA	64.63 mi
SANDUSKY	OH	WGGN-TV	42	DS	APP	69.74 mi
DELAWARE	OH	WXCB-CA	42	DC	CP	48.21 mi
DELAWARE	OH	WXCB-CA	42	CA	APP	48.21 mi
DELAWARE	OH	WXCB-CA	42	DC	CP	48.20 mi
SANDUSKY	OH	WGGN-TV	42	DT	CP MOD	69.77 mi
COLUMBUS	OH	W43BZ	43	TX	LIC	67.14 mi
LIMA	OH	WTLW	44	DT	CP MOD	23.92 mi
LIMA	OH	WTLW	44	DS	APP	23.92 mi
FORT WAYNE	IN	WFWC-CA	45	CA	LIC	77.30 mi
LIMA	OH	WLQP-LP	45	LD	APP	21.34 mi
CHILLICOTHE	OH	WWHO	46	DT	LIC	88.64 mi
TOLEDO	OH	WUPW	46	DT	LIC	61.98 mi
TOLEDO	OH	WUPW	46	DT	APP	61.98 mi
MANSFIELD	OH	W47AB	47	TA	-	63.49 mi
LIMA	OH	WTLW	47	DS	STA	23.92 mi
MANSFIELD	OH	W47AB	47	TX	LIC	65.34 mi
LIMA	OH	WTLW	47	DT	LIC	23.92 mi
MANSFIELD	OH	W47AB	47	LD	CP	65.34 mi
COLUMBUS	OH	W47DI-D	47	LD	CP	63.98 mi
MANSFIELD	OH	W47AB	47	LD	APP	65.36 mi
LIMA	OH	WLMO-LP	47	LD	APP	21.34 mi
BOWLING GREEN	OH	W50CD	48	TX	APP	26.09 mi
TOLEDO	OH	WMNT-CA	48	CA	LIC	60.91 mi
COLUMBUS	OH	WCPX-LP	48	LD	APP	60.46 mi
COLUMBUS	OH	WCPX-LP	48	TX	LIC	64.75 mi
COLUMBUS	OH	WSYX-DR	48	DR	APP	69.30 mi
TOLEDO	OH	WNWO-TV	49	DT	LIC	63.99 mi
MANSFIELD	OH	WOHZ-CA	50	TX	LIC	58.25 mi
DAYTON	OH	WDTN	50	DS	STA	78.61 mi
DAYTON	OH	WDTN	50	DT	LIC	78.61 mi
TOLEDO	OH	NEW	50	LD	APP	60.71 mi
DAYTON	OH	WKEF	51	DS	STA	78.22 mi
DAYTON	OH	WKEF	51	DT	LIC	78.22 mi
FINDLAY	OH	W09CG	51	LD	APP	22.97 mi
DAYTON	OH	WKEF	51	DT	APP	78.22 mi
LOUDONVILLE	OH	WIVX-LP	51	LD	APP	81.10 mi

MUNCIE	IN	WIPB	52	DS	STA	99.83 mi
DEFIANCE	OH	NEW	56	DN	APP	26.09 mi
BOWLING GREEN	OH	WBGU-TV	56	DS	STA	26.09 mi
BOWLING GREEN	OH	WBGU-TV	56	DT	LIC	26.09 mi
DAYTON	OH	WPTD	58	DT	LIC	78.34 mi
MAPLEWOOD, ETC.	OH	W63AH	63	TX	LIC	32.18 mi
LOUDONVILLE	OH	WIVX-LP	65	TX	LIC	81.12 mi
SPRINGFIELD	OH	-	66	TA	-	59.25 mi
DAYTON	OH	W66AQ	66	TX	APP	78.56 mi
DAYTON	OH	W66AQ	66	TX	LIC	78.56 mi
TOLEDO	OH	W22CO	68	TX	LIC	60.74 mi
MILLERSBURG	OH	W69AO	69	TX	LIC	94.88 mi

TV –Normal Broadcast Station
DS-Digital Service Television, Temporary Operation, STA Operation
DT-Digital Television Broadcast Station
DR- Indicates Station has Applied for FCC Rule Making
GRA-Indicates Rule Making was granted by FCC
LP-Low Power Television Broadcast Station
TX-Translator Television Broadcast Station
LIC – Licensed and operational station
CP – License approved construction permit granted
APP – License application, not yet operational
STA – Special transmit authorization, usually granted by FCC for temporary operation
CA – Class A Television, Low-power
LD - Digital Low power
TA – Vacant channel

The most likely TV stations that will produce off-air coverage to the area near the Project will be those stations at a distance of 40 miles or less. Of the stations listed in Table 1 there are a total of 39 stations registered within this range and they are listed in Table 2 below. Fifteen of the twenty-eight stations are presently licensed and operational. Of these fifteen stations two are full-power digital stations. Four are full-power digital stations operating under a special transmit authority granted by the FCC. The remaining nine stations are low-power stations. One is a low-power-digital station and two are full-service low-power stations. One is a full-service low power digital station. There are also five low-power translator stations in the area. The low-power translators and full-service stations are probably still utilizing analog modulation as they were not required to switch to digital modulation by the FCC on the June 12, 2009 cut-off date for analog modulation for full-power television broadcast stations..

Table 2 Off-Air TV Stations within 40 Miles of the Hardin North Wind Farm Project

Location		Call Sign	Channel	Service	Status	Distance
FINDLAY	OH	WFND-LP	22	TX	CP	13.40 mi
LIMA	OH	WLQP-LP	18	LD	APP	19.93 mi
FINDLAY	OH	NEW	20	LD	APP	19.93 mi
LIMA	OH	WLMO-LP	38	LD	APP	19.93 mi

LIMA	OH	WLIO	8	DS	STA	21.33 mi
LIMA	OH	WLIO-DR	8	DR	GRANT	21.34 mi
LIMA	OH	WLIO	8	DS	STA	21.34 mi
LIMA	OH	WLIO	8	DT	CP MOD	21.34 mi
LIMA	OH	WLIO	8	DS	APP	21.34 mi
LIMA	OH	WOHL-CA	35	DC	APP	21.34 mi
LIMA	OH	WOHL-CA	35	LD	APP	21.34 mi
LIMA	OH	WLQP-LP	45	LD	APP	21.34 mi
LIMA	OH	WLMO-LP	47	LD	APP	21.34 mi
FINDLAY	OH	W09CG	9	TX	LIC	22.97 mi
FINDLAY	OH	WFND-LP	22	TX	LIC	22.97 mi
FINDLAY	OH	WFND-LP	22	LD	APP	22.97 mi
FINDLAY	OH	W09CG	51	LD	APP	22.97 mi
LIMA	OH	WTLW	44	DT	CP MOD	23.92 mi
LIMA	OH	WTLW	44	DS	APP	23.92 mi
LIMA	OH	WTLW	47	DS	STA	23.92 mi
LIMA	OH	WTLW	47	DT	LIC	23.92 mi
BOWLING GREEN	OH	WBGU-TV	27	DT	CP MOD	26.09 mi
BOWLING GREEN	OH	WBGU-TV	27	DS	APP	26.09 mi
BOWLING GREEN	OH	W50CD	48	TX	APP	26.09 mi
DEFIANCE	OH	NEW	56	DN	APP	26.09 mi
BOWLING GREEN	OH	WBGU-TV	56	DS	STA	26.09 mi
BOWLING GREEN	OH	WBGU-TV	56	DT	LIC	26.09 mi
LIMA	OH	WLQP-LP	18	TX	LIC	27.24 mi
LIMA	OH	W23DE-D	23	TX	CP	27.24 mi
LIMA	OH	W23DE-D	23	LD	LIC	27.24 mi
LIMA	OH	WOHL-CA	25	CA	LIC	27.24 mi
LIMA	OH	WOHL-CA	25	DC	APP	27.24 mi
LIMA	OH	W55CH	33	TX	APP	27.24 mi
LIMA	OH	WLMO-LP	38	TX	LIC	27.24 mi
MAPLEWOOD	OH	W63AH	32	LD	APP	32.18 mi
MAPLEWOOD, ETC.	OH	W63AH	63	TX	LIC	32.18 mi
MARION	OH	WOCB-CA	39	CA	LIC	33.40 mi
MARION	OH	WOCB-CA	39	DC	LIC	33.54 mi
LIMA	OH	-	17	TA	-	39.36 mi

There are enough off-air television stations available to the Project's local communities that they have to be considered as the primary source of television programming in the area. It should be expected that some off-air television channels will be affected at certain homes and businesses in the area once the wind turbines are installed. The other delivery modes of television programming to the area are via cable, where available, and direct broadcast satellite. These services will be unaffected by the presence of the wind turbine facility. These modes of TV service delivery can be offered by the wind energy facility developer to those area residents who can show that their off-air TV reception is disrupted by the presence of the wind turbines after they are installed. Another mitigation technique for degraded reception would be to improve the television reception system at the home or business where degradation is experienced. This mitigation involves the use of a rotatable high gain antenna installed at a height above local terrain and trees. It also utilizes low-loss coaxial cable and amplifiers to overcome the signal attenuation caused by the presence of the wind turbines. Because of the location of some homes and businesses this mitigation may not be a solution for all degradation cases.

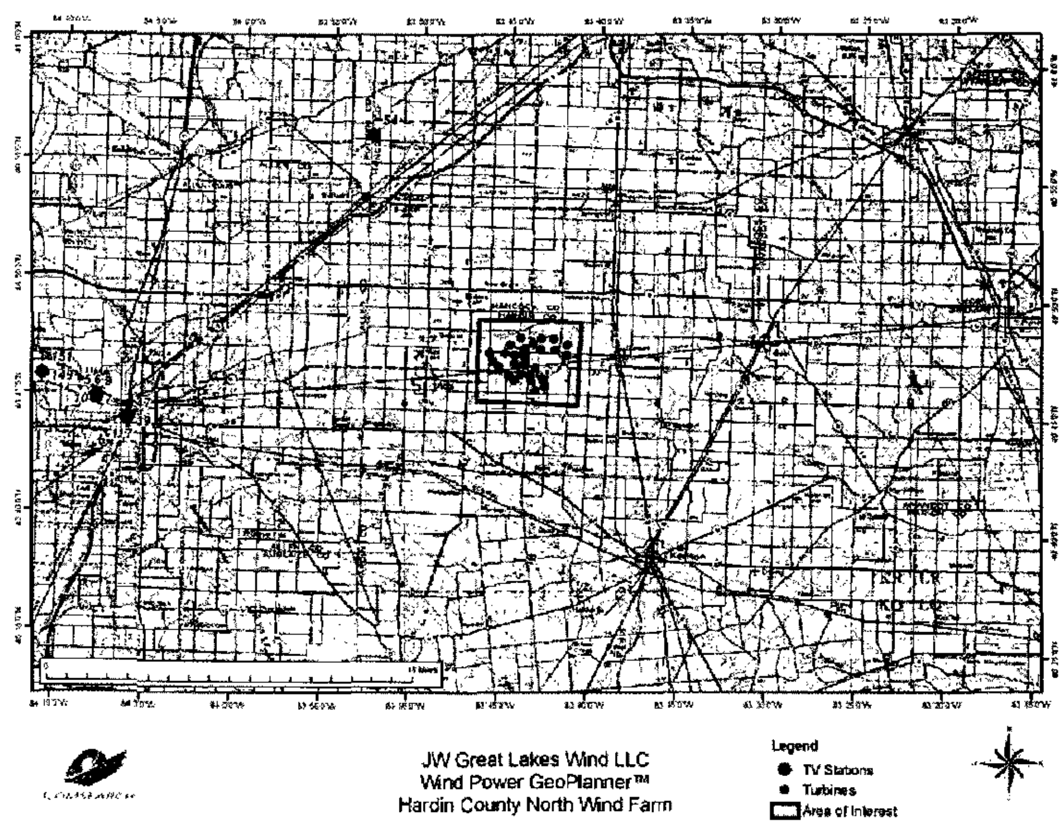


Figure 1 Map of Off-Air TV Stations near the Hardin County Wind Farm Project Area and Local Communities

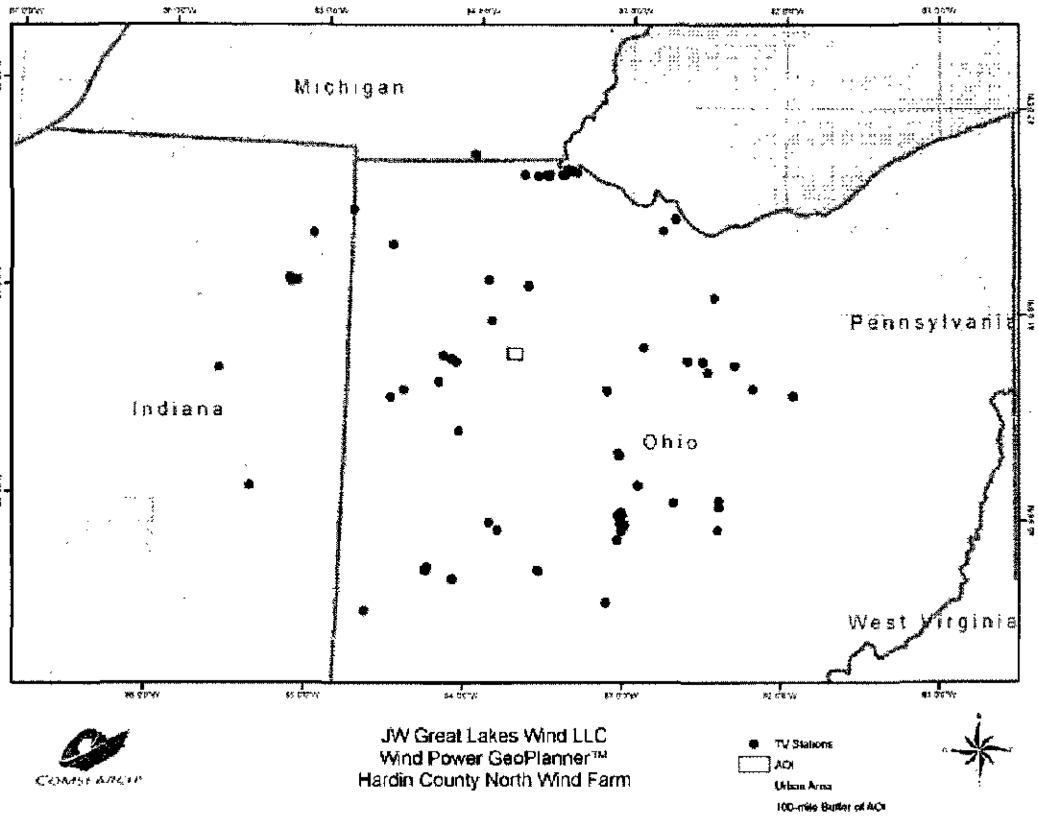
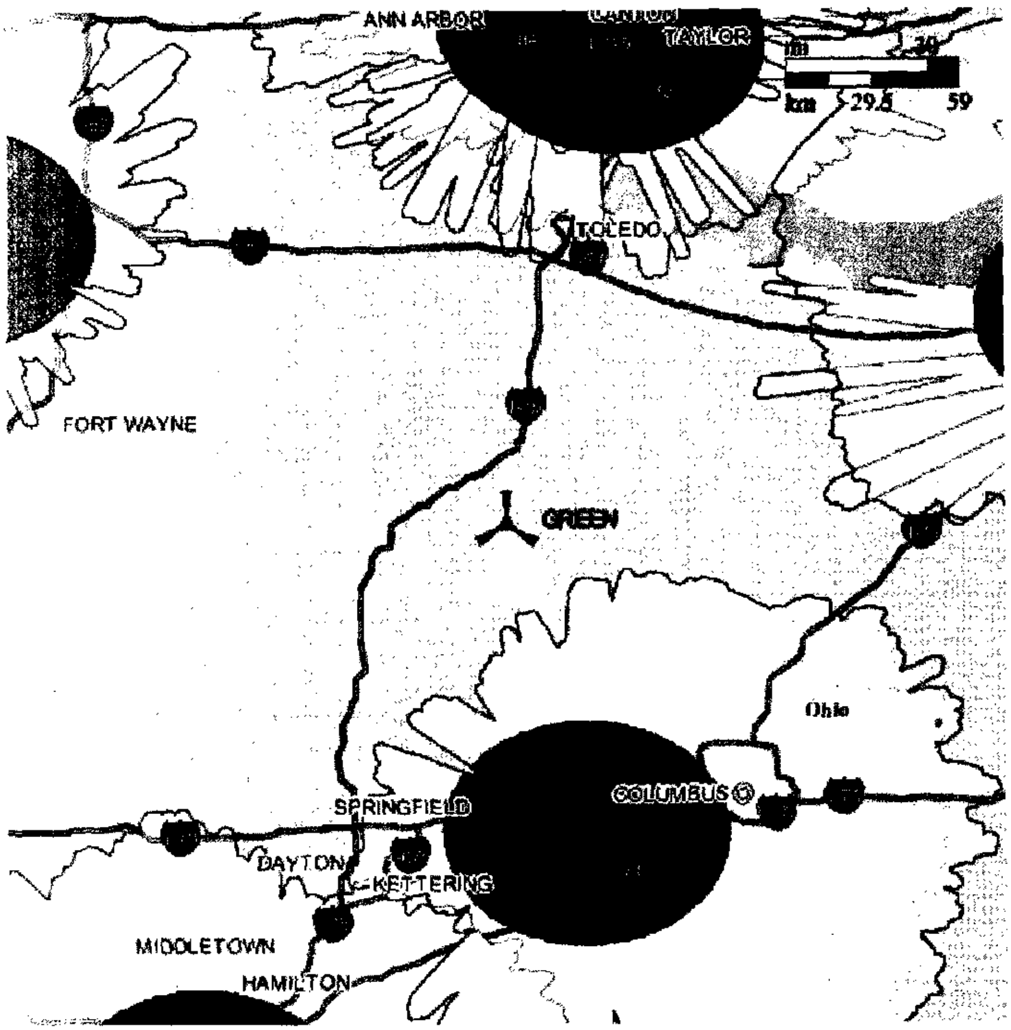


Figure 2 -TV Stations within 100 Miles of the Hardin County Wind Farm Project Area

Exhibit 08-11. FAA Military Radar Screening Tool.

FAA Military Radar Screening Tool

https://oeaaa.faa.gov/oeaaa/external/portal.jsp



Symbol represents Hardin County North Wind Farm site

"Green" indicates no predicted impact on air defense or military radar

Exhibit 08-12. Letter of Notification to NTIA by JWGL.

Tower Press Building
1900 Superior Avenue, Suite 333
Cleveland, OH 44114-2148
Office: 216.344.9305

JWGL
JW Great Lakes Wind LLC

July 13, 2009

Mr. Ed Davison
U.S. Department of Commerce
1401 Constitution Avenue N.W. Rm 4099A
Washington DC 20230

RE: Notification of the Hardin County North Wind Farm in Hardin County, OH.

Dear Mr. Davison:

This letter and its attachments will serve as notification to the government that JW Great Lakes Wind LLC plans to install a wind energy facility in Hardin County, OH. The installation is currently named Hardin County North Wind Farm.

Enclosed are maps and tables that describe the location of the project.

- Table 1 is a list of the coordinates of the turbine locations using the coordinate system: WGS 1984.
- Figure 1 is a map of the project area showing the turbine locations in reference with the city of Dunkirk, OH.

The dimensions of the wind turbines to be installed at this facility are:

- Turbine Hub Height AGL: 100 meters (328 feet)
- Turbine Blade Diameter: 101 meters (331.3 feet)
- Blade Tip Height AGL: 151.5 meters (497 feet)

If you have any questions with regard to this notification, or if you need further information, please call or email.

Sincerely,

Peter K. Endres
Project Manager
juwi / JW Great Lakes Wind
Office: 216.344.9305
endres@juwi.com

Table 1: Turbine Coordinates, WGS 1984

Turbine Number	Longitude	Latitude
1	-83°45'50.05"	40°47'20.73"
2	-83°45'37.31"	40°46'59.86"
3	-83°45'19.49"	40°46'45.22"
4	-83°45'00.14"	40°47'21.06"
5	-83°44'43.85"	40°47'43.14"
6	-83°44'25.53"	40°47'16.76"
7	-83°44'25.55"	40°46'55.45"
8	-83°44'44.60"	40°46'23.84"
9	-83°44'25.95"	40°46'13.32"
10	-83°44'09.05"	40°48'01.05"
11	-83°43'55.62"	40°47'34.17"
12	-83°43'51.27"	40°47'13.42"
13	-83°43'52.38"	40°46'53.65"
14	-83°44'03.60"	40°46'28.93"
15	-83°43'27.00"	40°47'47.98"
16	-83°43'00.12"	40°48'00.54"
17	-83°43'00.37"	40°47'33.24"
18	-83°43'16.32"	40°46'45.06"
19	-83°43'33.94"	40°46'25.32"
20	-83°43'28.21"	40°46'10.48"
21	-83°42'52.46"	40°46'18.52"
22	-83°42'41.84"	40°45'59.57"
23	-83°43'14.41"	40°45'47.91"
24	-83°42'18.86"	40°48'00.54"
25	-83°42'12.78"	40°47'32.73"
26	-83°41'31.95"	40°47'20.20"
27	-83°41'30.90"	40°47'46.91"

Figure 1: Map of Wind Farm

Hardin County
North Wind Farm

Legend

- • Wind Turbines
- Public Roads

07-13-09