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September 15, 2016

*Via Electronic Filing*

Ms. Barcy McNeal  
Public Utilities Commission of Ohio  
Administration/Docketing  
180 East Broad Street, 11<sup>th</sup> Floor  
Columbus, OH 43215-3793

**Re: Hardin Wind Energy LLC,  
Case Nos. 09-479-EL-BGN; 11-3446-EL-BGA and 16-469-EL-BGA**

Dear Ms. McNeal:

The March 22, 2010 Opinion, Order, and Certificate (“Certificate”) approving Hardin Wind Energy LLC’s (“Hardin Wind Energy”) Certificate of Environmental Compatibility and Public Need established a set of conditions as part of the Certificate. On April 29, 2011 in Case No. 11-3446-EL-BGA, the Ohio Power Siting Board (“OPSB”) approved an amendment (“Amended Certificate”) to Hardin Wind Energy’s Certificate, which also established an additional set of conditions.

Within these sets of conditions, **Amended Certificate Condition No. 7** requires that:

**At least 30 days prior to construction, Hardin shall assess the potential impacts of the project to WATCH's 2.5 GHz point to multi-point system, Mid-Ohio's 900 MHz omnidirectional system, and any other microwave path or system that was known to operate within the project area at the time of the amendment filed on June 13, 2011. A copy of this study shall be provided to WATCH and Mid-Ohio for review and to Staff for review and acceptance.**

Furthermore, **Amendment Certificate Condition No. 8** also requires:

**That any expected interference or impacts to microwave paths and systems, as identified in the assessment required by Condition 7 of this report and all other communications studies performed for this project, shall be subject to avoidance or mitigation.**

In compliance with Amended Certificate Condition Nos. 7 and 8, and in response to a verbal request from OPSB Staff, attached is a copy of the September 9, 2016 Microwave Study.

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If you have any questions please call at the number listed above.

Sincerely,



Sally W. Bloomfield

Attachment

cc: Andrew Conway (w/Attachment)  
Derek Collins (w/Attachment)  
Mark Bellamy (w/Attachment)

# Wind Power GeoPlanner™

## Microwave Study

### Hardin Wind Energy Project



Prepared on Behalf of  
Invenergy LLC

September 9, 2016



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## 1. Introduction

Microwave bands that may be affected by the installation of wind turbine facilities operate over a wide frequency range (900 MHz – 23 GHz). Comsearch has developed and maintains comprehensive technical databases containing information on licensed microwave networks throughout the United States. 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 the non-federal government microwave systems licensed, applied and proposed at the FCC and the unlicensed microwave system owned by Mid Ohio Energy Cooperative Inc., an electric distribution cooperative located in Kenton, Ohio.

## 2. Project Overview

### Project Information

**Name:** Hardin Wind Energy Project

**County:** Hardin

**State:** Ohio

**Number of Turbines:** 107

**Blade Diameter:** 116 meters

**Hub Height:** 94 or 80 meters



Figure 1: Area of Interest



### 3. Two-Dimensional Fresnel Zone Analysis

#### Methodology

In addition to the microwave data provided by Mid Ohio Energy, our obstruction analysis was performed using Comsearch's proprietary microwave database, which contains all non-government licensed, proposed and applied paths from 0.9 - 23 GHz<sup>1</sup>. First, we determined all microwave paths that intersect the area of interest<sup>2</sup> and listed them in Table 1. These paths and the area of interest that encompasses the planned turbine locations are shown in Figure 2.

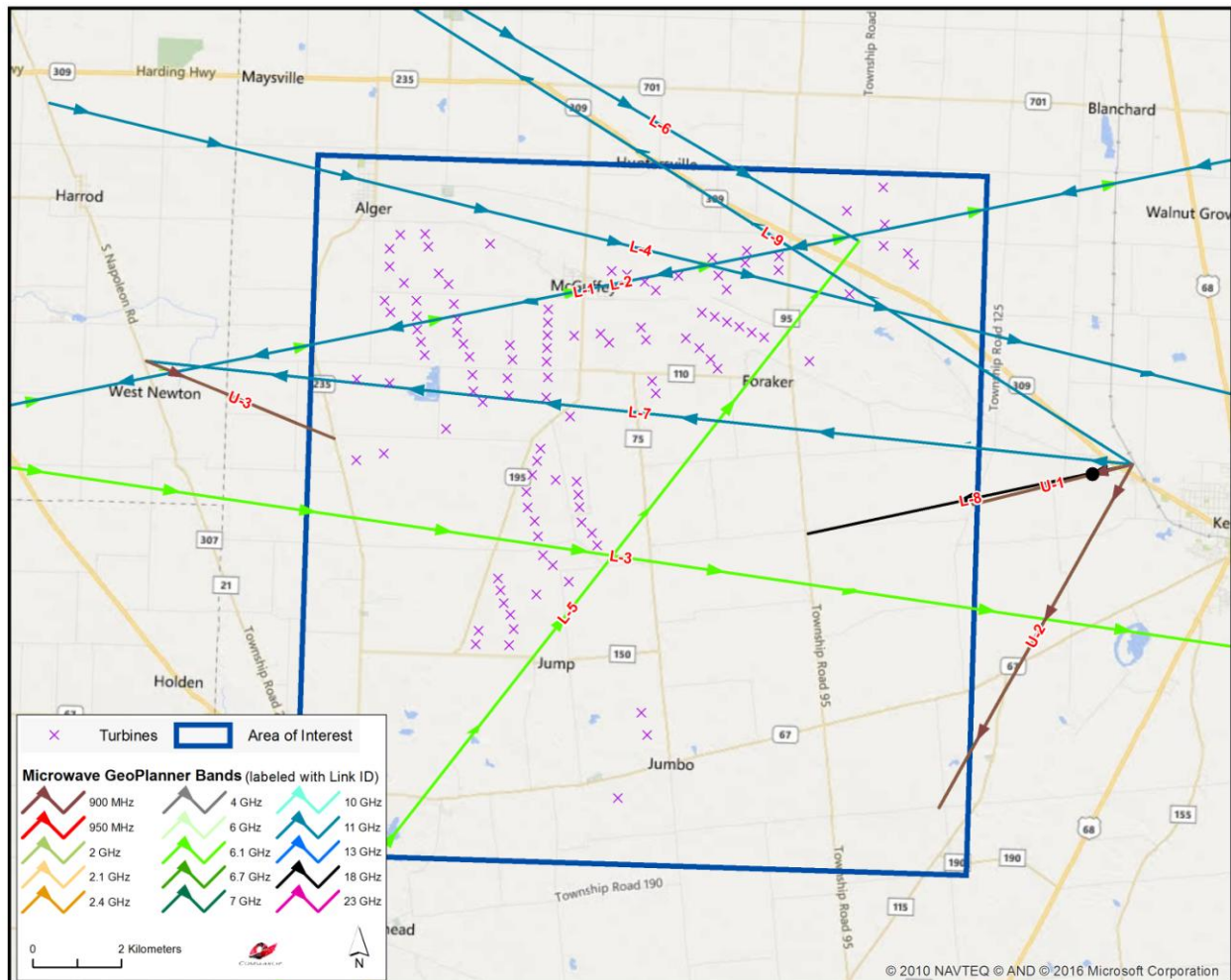


Figure 2: Microwave Paths that Intersect the Area of Interest

<sup>1</sup> Please note that this analysis does not include unlicensed microwave paths or federal government paths that are not registered with the FCC.

<sup>2</sup> We use FCC-licensed coordinates and coordinates provided by Mid Ohio Energy to determine which paths intersect the area of interest. It is possible that as-built coordinates may differ slightly from these coordinates.

ID	Status	Site Name 1	Site Name 2	Callsign 1	Callsign 2	Band	Path Length (km)	Licensee/Owner
L-1	Licensed	LIMA	KENTON	WPUG339	WPUG341	Lower 6 GHz	34.79	W.A.T.C.H. TV Company Inc.
L-2	Licensed	KENTON	LIMA	WPUG341	WPUG339	11 GHz	34.79	W.A.T.C.H. TV Company Inc.
L-3	Licensed	0-1011941	6-25318	WQNA532	WQNA533	Lower 6 GHz	59.06	AB Services LLC
L-4	Licensed	SBAOH03357-B	ATC81629	WQQT246	WQQI778	11 GHz	27.76	Comprehensive Wireless LLC
L-5	Licensed	INDIAN CREEK	KENTON	WQVZ662	WQVZ800	Lower 6 GHz	24.19	Agile Network Builders LLC
L-6	Licensed	OHIO NORTH	KENTON	WQWC965	WQVZ800	11 GHz	16.19	Agile Network Builders LLC
L-7	Licensed	KENTON TWR	W NEWTON SUB	WQXL304	WQLH337	11 GHz	22.48	Mid Ohio Energy Cooperative Inc.
L-8	Licensed	KENTON TWR	LYNN SUB	WQXL304	WQNK932	18 GHz	7.52	Mid Ohio Energy Cooperative Inc.
L-9	Licensed	KENTON TWR	ADA SUBSTN	WQXL304	WQXJ440	11 GHz	23.91	Mid Ohio Energy Cooperative Inc.
U-1	Unlicensed	KENTON TWR	N KENTON-LYNN Tie Pt	N/A	N/A	900 MHz	3.73	Mid Ohio Energy Cooperative Inc.
U-2	Unlicensed	KENTON TWR	LYNN-Rt 31 Tie Pt	N/A	N/A	900 MHz	8.94	Mid Ohio Energy Cooperative Inc.
U-3	Unlicensed	W NEWTON SUB	LYNN-W NEWTON Tit Pt	N/A	N/A	900 MHz	4.61	Mid Ohio Energy Cooperative Inc.

Table 1: Summary of Microwave Paths that Intersect the Area of Interest

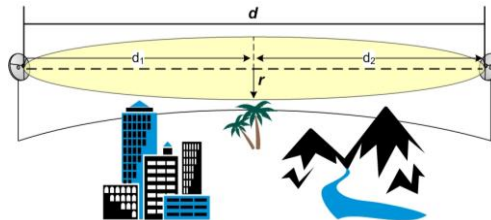
(See enclosed mw\_geopl.xlsx for more information and  
GP\_dict\_matrix\_description.xls for detailed field descriptions)

### Verification of Coordinate Accuracy

It is possible that as-built coordinates may differ from those on the FCC license. For this project, path IDs L1-4, L7 and L9 cross within close proximity of the proposed turbines and the tower locations for these paths will have a critical impact on the result. Therefore, we verified these locations using aerial photography. Some of the towers were found to be slightly off and were moved to their locations based on the aerial photos or the coordinates provided by Mid-Ohio Energy<sup>3</sup>.

Next, we calculated a Fresnel Zone for each path based on the following formula:

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

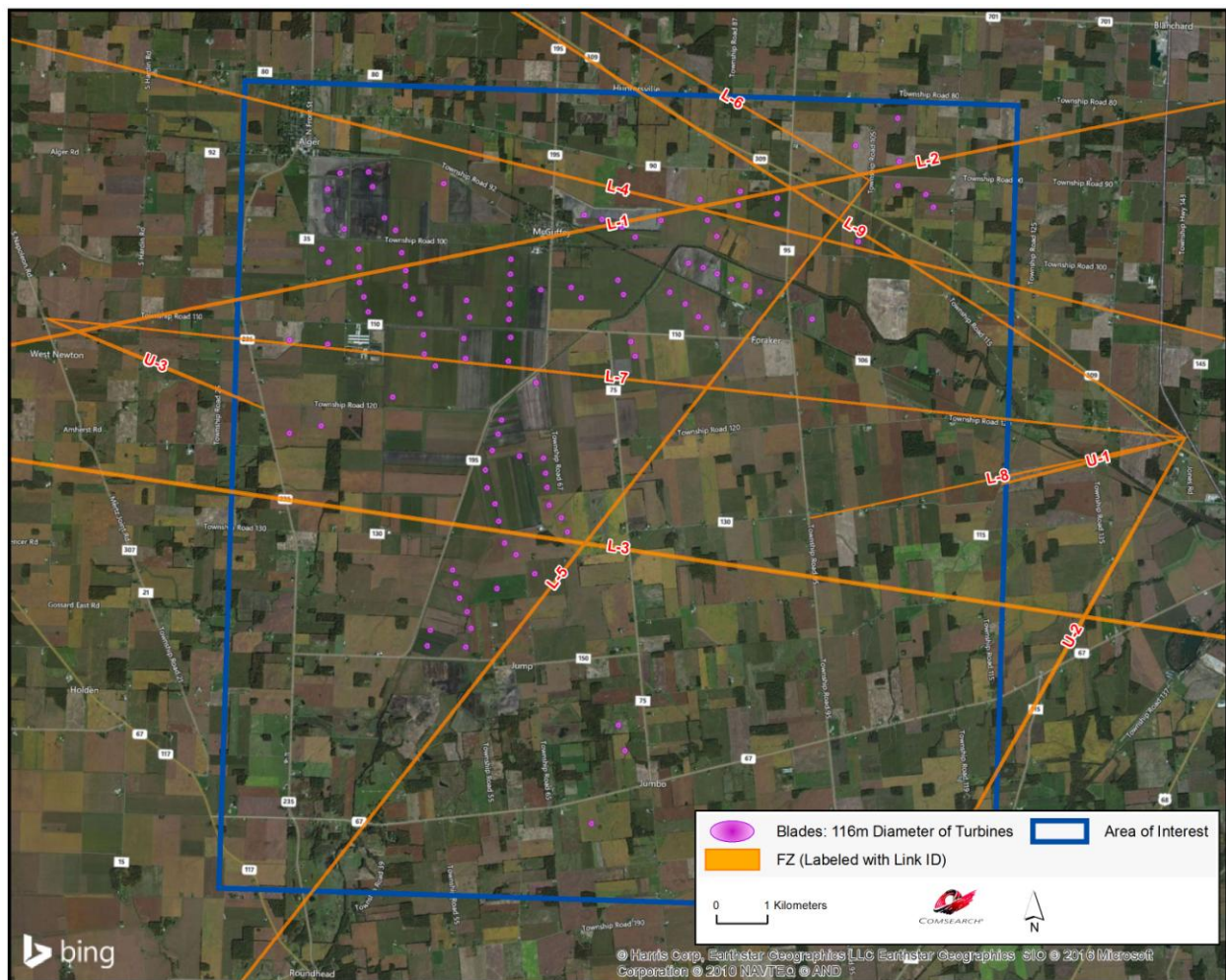


Where,

<sup>3</sup> See enclosed mw\_geopl.shp and mw\_geopl\_fcc.shp for details.

- $r$  = Fresnel Zone radius at a specific point in the microwave path, meters  
 $n$  = Fresnel Zone number, 1  
 $F_{\text{GHz}}$  = 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

In general, this is the area where the planned wind turbines should be avoided, if possible. A depiction of the Fresnel Zones for each microwave path listed can be found in Figure 3 through Figure 6, and is also included in the enclosed shapefiles<sup>4,5</sup>.

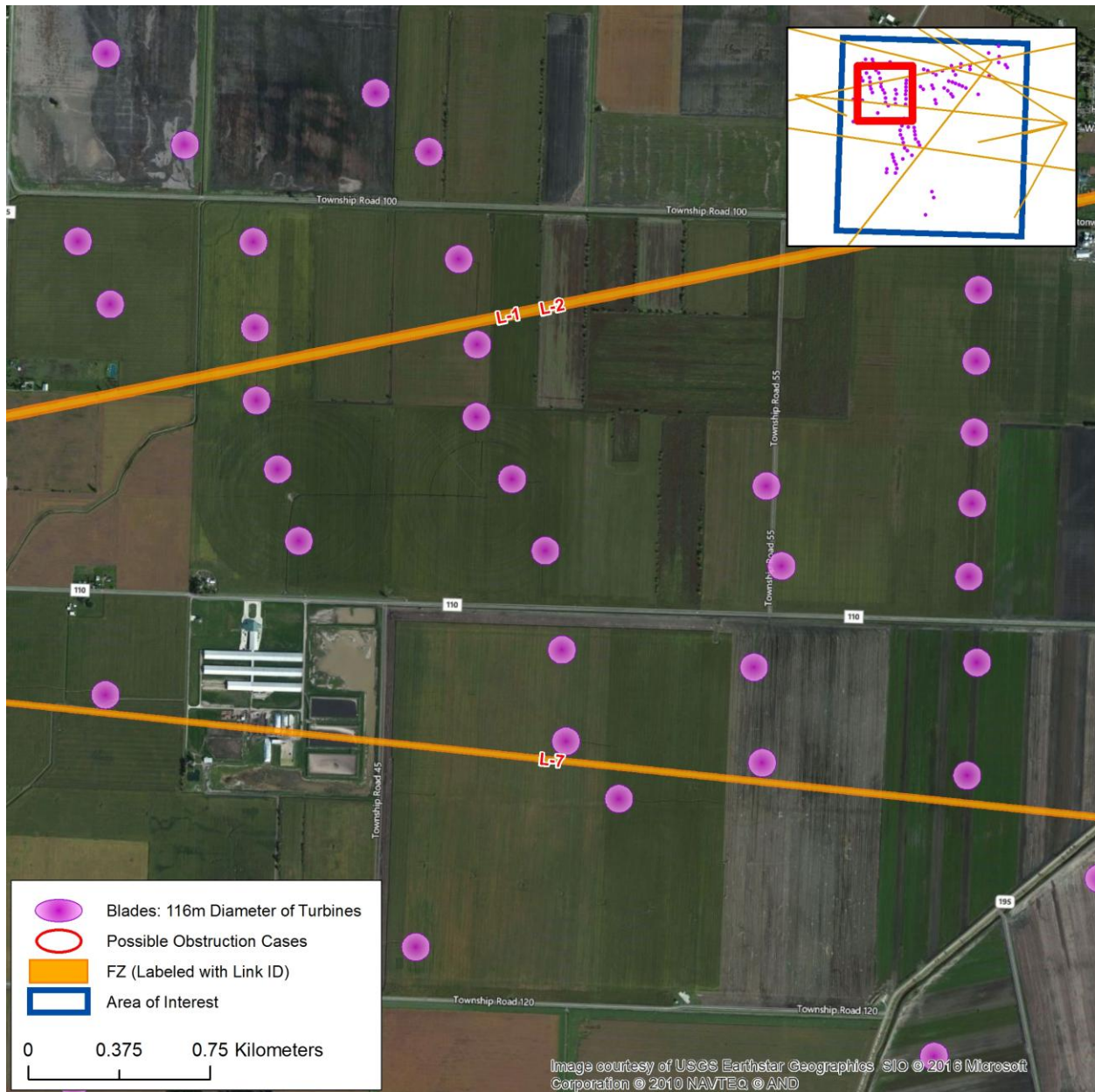


**Figure 3: Fresnel Zones in the Area of Interest**

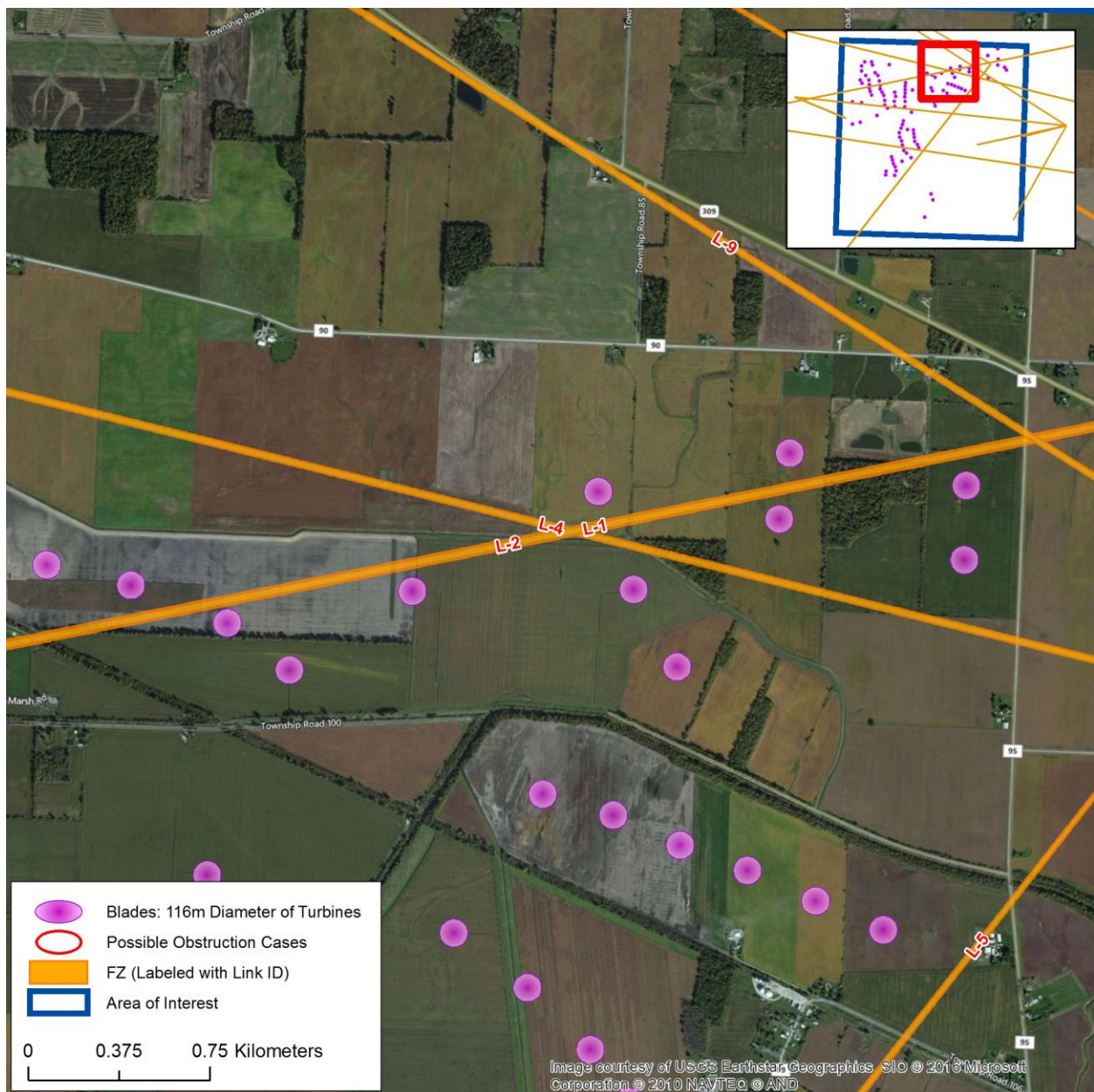
<sup>4</sup> The ESRI® shapefiles enclosed are in NAD 83 UTM Zone 17 projected coordinate system.

<sup>5</sup> Comsearch makes no warranty as to the accuracy of the data included in this report beyond the date of the report. The data provided in this report is governed by Comsearch's data license notification and agreement located at [http://www.comsearch.com/files/data\\_license.pdf](http://www.comsearch.com/files/data_license.pdf).





*Figure 4: Fresnel Zones in the Area of Interest*



*Figure 5: Fresnel Zones in the Area of Interest*





Figure 6: Fresnel Zones in the Area of Interest

## 4. Conclusion

Total Microwave Paths	Paths with Affected Fresnel Zones	Total Turbines	Turbines intersecting the Fresnel Zones
12	0	107	0

*Table 2: Fresnel Zone Analysis Result*

Our study identified a total of twelve microwave paths intersecting the Hardin Wind Energy Project area of interest. Six of these microwave paths were owned by Mid Ohio Energy Cooperative Inc, three of which were licensed at the FCC.

The Fresnel Zones for these microwave paths were calculated and mapped in order to assess the potential impact from the turbines. A total of 107 turbines were considered in the analysis, each with a blade diameter of 116 meters and a hub height of 94 or 80 meters. Of those turbines, none were found to have potential obstruction with the microwave systems in the area.

## 5. Contact

For questions or information regarding the Microwave Study, please contact:

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Summary: Correspondence of Hardin Wind Energy LLC in Compliance with Amended Certificate Condition Nos. 7 and 8 - Updated Microwave Study electronically filed by Teresa Orahod on behalf of Sally W. Bloomfield