

Aurora Wind Project

Tradewind Energy

Divide and Williams Counties, North Dakota

Microwave Path Analysis

April 17, 2018



Capitol Airspace Group

capitolairspace.com

(703) 256 - 2485



Summary

Capitol Airspace conducted a microwave path analysis for the Aurora wind project in Divide and Williams Counties, North Dakota. The purpose for this analysis was to identify licensed and applied coordinated non-federal microwave paths that could limit the placement of wind turbines. At the time of this analysis, individual wind turbine locations had not been identified. As a result, this analysis assessed microwave paths overlying an approximately 290 square mile study area (red outline, [Figure 1](#)) to aid in identifying optimal wind turbine locations.

Point-to-point microwave transmission is a critical component of the national communications infrastructure. Microwave paths enable broadband data transmission that supports telephone, cellular, and personal communication service (PCS) networks, wireless internet providers, audio and video transmission from television studios to transmitter sites, as well as many other industry/utility applications. In order to ensure signal reliability, these paths are sited to avoid any line-of-sight obstructions. Proposed structures that create a line-of-sight obstruction can degrade signal reliability and could require revisions to the microwave system.

Five unique microwave paths overlie the Aurora wind project. Wind turbines within the associated Fresnel zones could cause signal blockage degrading link performance. However, due to the narrow widths of most Fresnel zones, micrositing wind turbines outside of these zones is often a feasible mitigation option.

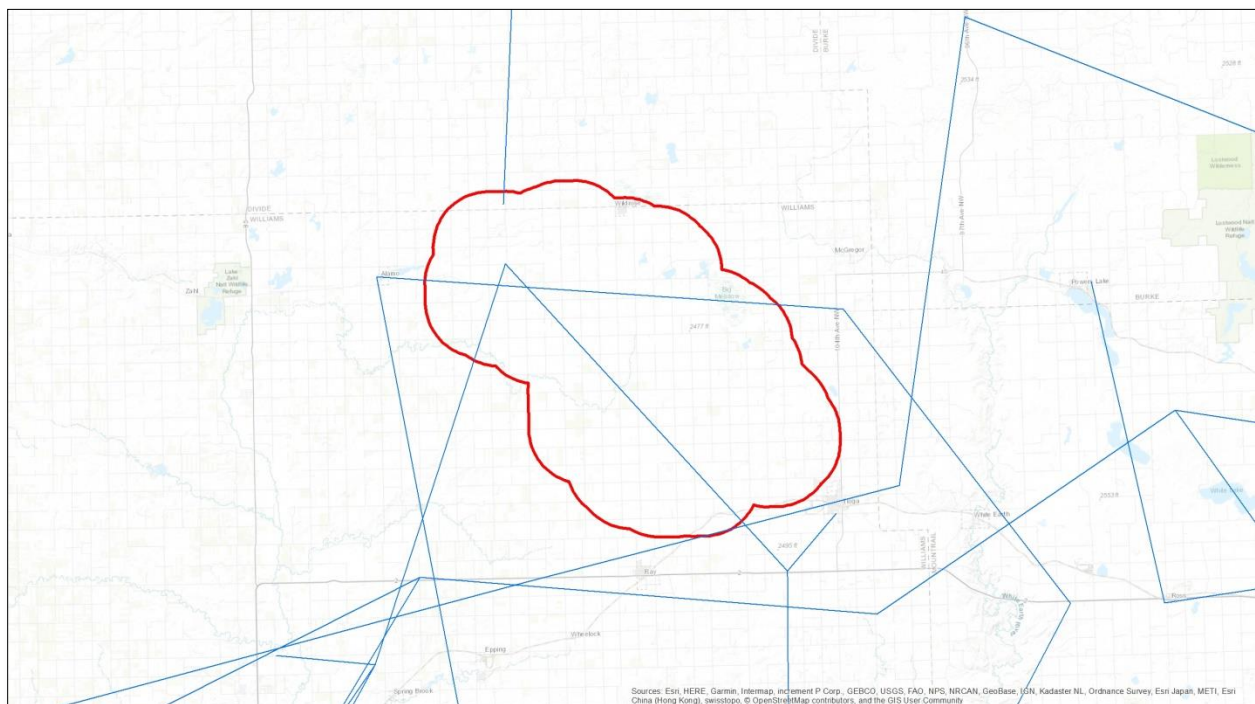


Figure 1: Licensed microwave paths (blue) in proximity to the Aurora wind project



Methodology

Capitol Airspace studied the proposed project based upon location information provided by Tradewind Energy. Using this information, Capitol Airspace used a Geographic Information System (GIS) to determine proximity to both licensed and applied coordinated non-federal microwave paths contained in the Federal Communication Commission (FCC) Universal Licensing System (ULS) database.

This analysis considers impact on microwave paths resulting from the physical blockage of the first Fresnel zone (**Figure 2**). The first Fresnel zone is a three dimensional volume whose radius at a given point is calculated using the path frequency and distance from the transmitting and receiving antennas. The Fresnel zone radius is largest at the path midpoint (where $d_1 = d_2$). Lower frequencies result in larger Fresnel zone radii for a given path and are typically associated with longer paths. Higher frequencies result in smaller Fresnel zone radii for a given path and are typically associated with shorter paths.

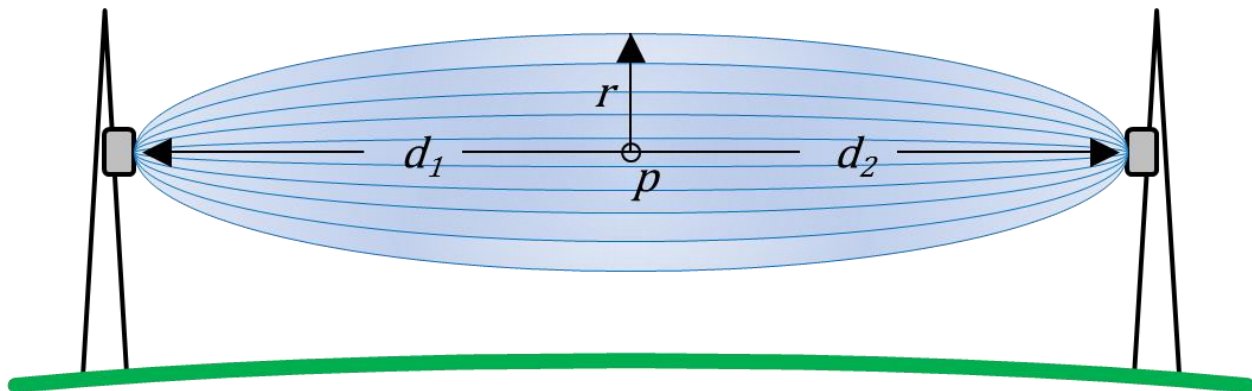


Figure 2: Fresnel zone example

In many cases, ULS database microwave transmitter and receiver antenna locations are inaccurate. Available aerial imagery including United States Geological Survey (USGS) Orthoimagery was used to improve the coordinates for locations associated with microwave paths in proximity to the defined study area.



Figure 3: Example of using USGS Orthoimagery to correct erroneous ULS database antenna location



Study Findings

Nine microwave path Fresnel zones overlie the Aurora wind project ([Table 1](#) & [Figure 4](#)). These Fresnel zones are associated with five common paths used by Basin Electric Power Cooperative, Continental Resources, Inc., Infrastructure Networks, Inc., and Prairie Broadcasting, Inc.

Licensee	Call Sign	Path	Status	Transmitter	Receiver	Frequency (MHz) ¹
Basin Electric Power Cooperative	WQQW846	2	Licensed	NESET	WHEELLOCK	6256.54
	WQRB986	1	Licensed	WHEELLOCK	NESET	6004.50
Continental Resources, Inc.	WQRU770	1	Licensed	CORINTH	SPRINGBROOK	10735.00
		2	Licensed	CORINTH	NEMONT	10775.00
	WQRU773	3	Licensed	NEMONT	CORINTH	11265.00
	WQRU779	1	Licensed	SPRINGBROOK	CORINTH	11225.00
Infrastructure Networks, Inc.	WQTP889	2	Licensed	ALAMO	McGREGOR	6330.67
	WQTP891	1	Licensed	McGREGOR	ALAMO	6078.63
PRAIRIE PUBLIC BROADCASTING, INC.	WPJB257	1	Licensed	Location 1	Location 2	944.25

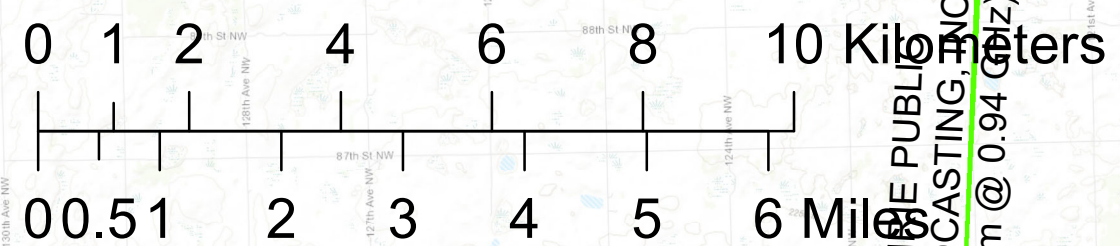
Table 1: Microwave paths with Fresnel zones overlying the study area

Conclusion

The results of this analysis indicate that nine Fresnel zones (green, [Figure 4](#)) associated with five unique microwave paths overlie the Aurora wind project. Wind turbines should be sited outside of the lateral boundaries of the Fresnel zones associated with these paths in order to avoid the likelihood of signal blockage. Due to the relatively narrow size of most microwave path Fresnel zones, it is likely that impact on these paths can be avoided through micrositing. However, wind turbines (including the rotor-swept area) could be sited within the lateral boundaries of Fresnel zones provided they do not penetrate the three dimensional Fresnel zones

If you have any questions regarding the findings of this study, please contact [Rick Coles](#) or [Tim Connolly](#) at (703) 256-2485.

¹ Microwave paths may be licensed to operate using more than one frequency. For the purposes of calculating Fresnel zone radii, the lowest frequency was used to create the largest Fresnel zone.

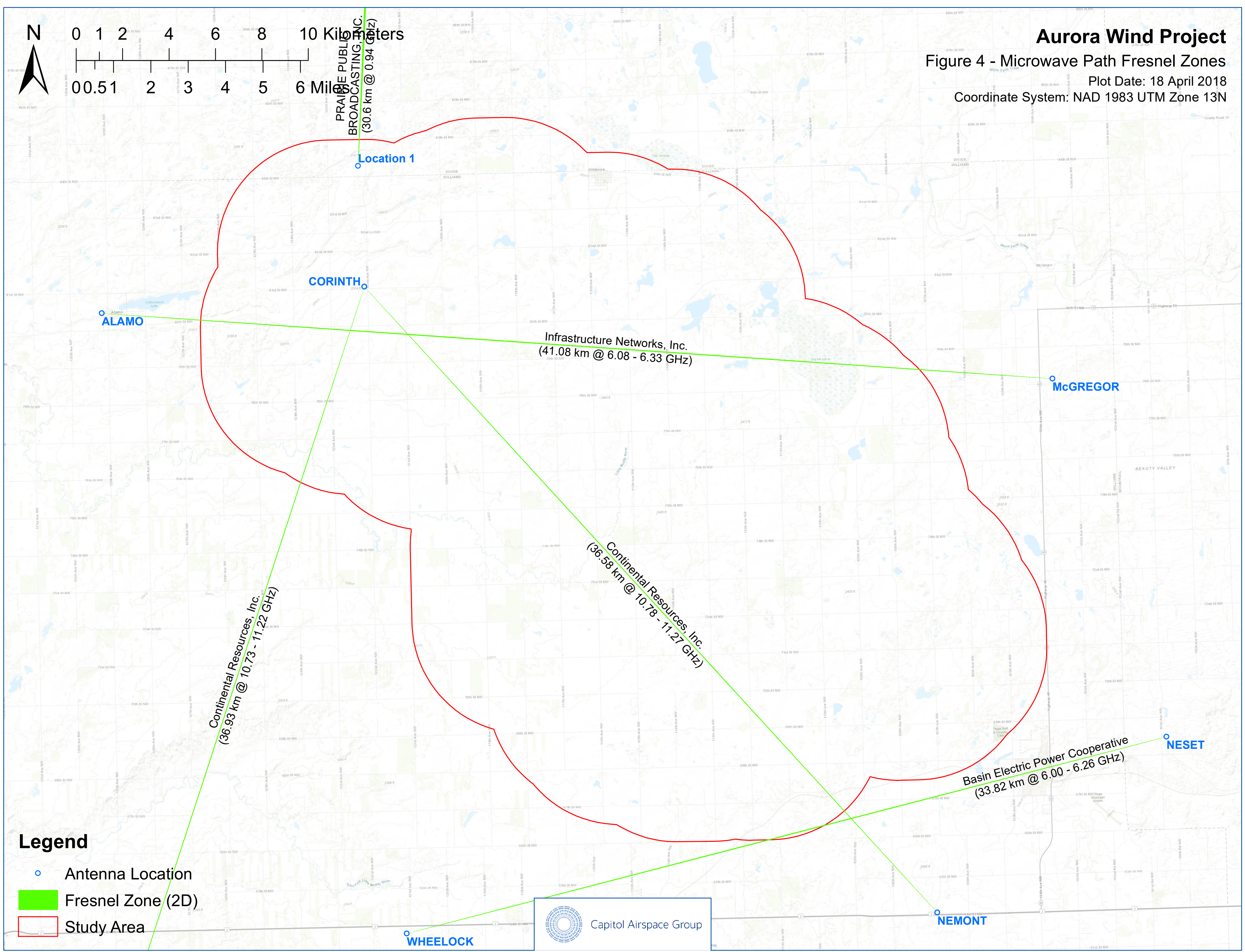


Aurora Wind Project

Figure 4 - Microwave Path Fresnel Zones

Plot Date: 18 April 2018

Coordinate System: NAD 1983 UTM Zone 13N



PRAIRIE PUBLIC BROADCASTING, INC.
(30.6 km @ 0.94 GHz)

Location 1

CORINTH

ALAMO

Infrastructure Networks, Inc.
(41.08 km @ 6.08 - 6.33 GHz)

McGREGOR




Continental Resources, Inc.
(36.93 km @ 10.73 - 11.22 GHz)

Continental Resources, Inc.
(36.58 km @ 10.78 - 11.21 GHz)

Basin Electric Power Cooperative
(33.82 km @ 6.00 - 6.26 GHz)

NESET

Legend

-  Antenna Location
-  Fresnel Zone (2D)
-  Study Area

WHEELOCK



Capitol Airspace Group

NEMONT