

# Professional Qualifications

## Michael Hankard



### Education:

B.S., Electrical Engineering  
University of Maine, 1990

### Professional Affiliations:

Institute of Noise Control Engineering  
Acoustical Society of America

### Agency Experience:

Public Service Commissions (various)  
World Bank  
Federal Highway Administration  
Colorado Department of Transportation  
U.S. EPA  
Numerous Cities and Counties

### Background:

Mr. Hankard has been practicing in the fields of acoustics and noise control engineering for the past 23 years. In 1996 he started and remains president of Hankard Environmental Inc. The firm consults in environmental noise and has successfully completed over 400 projects relating to wind turbines, other power generation facilities, oil and gas extraction facilities, highways, mines, entertainment venues, and land development projects.

Mr. Hankard has experience in almost all aspects of environmental noise, including field measurements, predictions, impact assessments, and mitigation design. He has conducted and managed ambient noise surveys lasting from days to years, used a variety of models to predict noise from wind turbines, roadways, and industrial facilities, and designed a wide variety of mitigation measures such as walls, enclosures, baffles, and silencers.

Vibration experience includes the measurement and prediction of ground-borne and structure-borne levels from sources such as rail lines, blasting, and roadways; and the assessment of impact according to internationally accepted methods and standards.

### Wind Turbine Acoustics Experience:

#### Noise Level Compliance Measurements

Mr. Hankard has extensive experience with the measurement of compliance of noise from utility-scale wind turbines as part of state and local regulatory requirements. He has also successfully conducted measurements pursuant to compliance with IEC 61400-11. He is the primary acoustical consultant responsible for the design and execution of one of the most robust and long-term turbine noise compliance studies conducted to date in the U.S. This project has given Mr. Hankard in-depth experience regarding microphone mounting and wind screen selection, concurrent measurement of meteorological conditions, audio and spectral analysis of measurement data, and the application of statistical methods to the determination of compliance.

#### Ambient Noise Measurement Surveys

Mr. Hankard has conducted over 100 ambient sound surveys for the power generation, land development, mining, and other industries. His experience includes the design, execution, and reporting of these studies. Ambient surveys for wind turbine projects are particularly challenging due to the need to measure in a wide variety of windy conditions. A successful study begins with the careful consideration of the project environs, the relative location of turbines and residences, applicable regulations, turbine type, and potential seasonal fluctuations. The selection of the measurements locations is paramount, as is the need to consider measurement for weeks to months at a time, wind screen use, and microphone mounting and placement. Finally, the analysis of the data is complex, needing to separate ambient sounds from those made by the wind and those resulting from microphone-wind interaction.

#### Low Frequency Noise

Low frequency noise (LFN), extending from less than 1 Hertz to 200 Hertz, is often an important consideration on wind turbine projects. Mr. Hankard has experience with LFN in having reviewed much of the latest global research on this subject as lead acoustical consultant on a 100 megawatt turbine project, participation in an international conference addressing this issue, the measurement of LFN as part of a research project, measurement of LFN on a utility scale turbine project, and also as a member of an Acoustical Society of American subcommittee looking into LFN measurement in windy environments.

#### Modeling

Mr. Hankard has an in-depth understanding of the proper way to model wind turbine noise. The size of this source, as well as its distributed nature and other attributes make it a non-traditional source to model. He understands the differences between modeling methods (ISO 9613-2, Nord2000, CONCAWE, etc.), the different settings to be used within these methods (ground type, propagation rate, directivity, low frequency considerations), variation in sound power levels determined using IEC 61400-11, and the different results all of these factors can produce.

#### Representative Projects

Mr. Hankard was the lead consultant for the acoustical aspects of the following projects:  
Willow Creek Energy Center, Oregon: Long-term compliance monitoring (present)  
Highland Wind, Wisconsin: Ambient noise survey, Public Service commission testimony (present)  
Shirley Wind, Wisconsin: Ambient noise measurements and compliance testing (2010 to 2012)  
Forward Energy, Wisconsin: Post construction compliance testing (2008)  
Ledge Wind, Wisconsin: Ambient noise measurements (2009)  
Horn Butte, Oregon: Ambient noise measurements (2009)  
High Sheldon, New York: Compliance noise measurements (2009)