

# Wind Farms and Noise



THE acoustic ecology INSTITUTE



...listen...

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# Wind Farms and Noise

Clear reports of noise problems up to a mile or so  
500 meter / 1500 foot setbacks are often very insufficient





# Wind Farms and Noise

NIMBY: be careful fears aren't based on experiences of others in situations not like yours

WARYDU: don't gloss over noise impacts



# Wind Farms and Noise

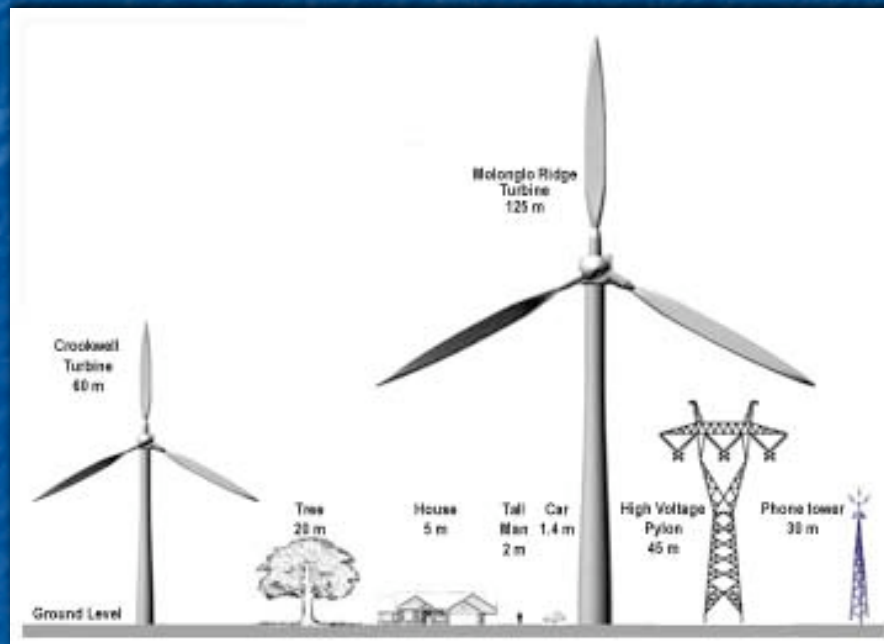


Turbine size and downwind patterns  
Directionality of amplitude modulation  
Atmospheric/nighttime conditions  
What some neighbors are hearing





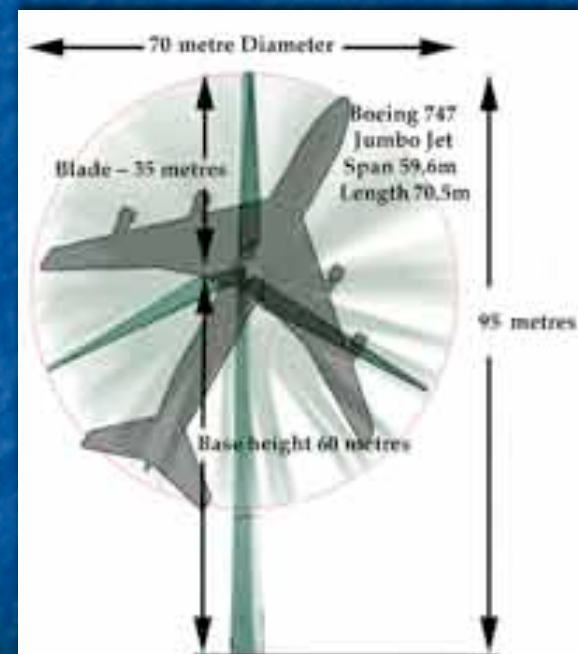
# Size of Turbines



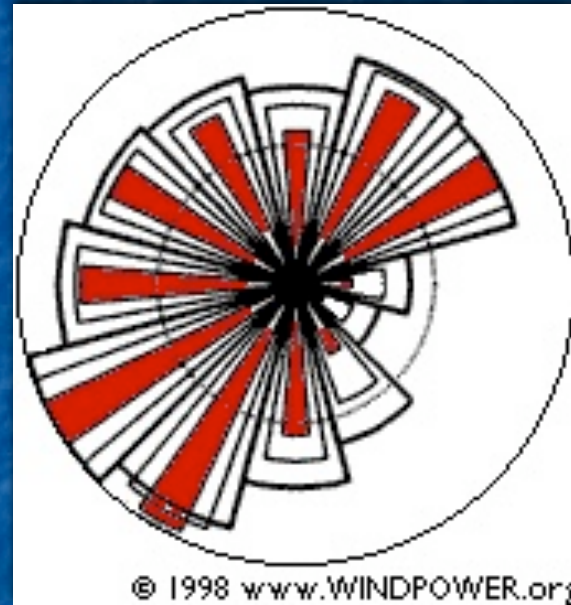
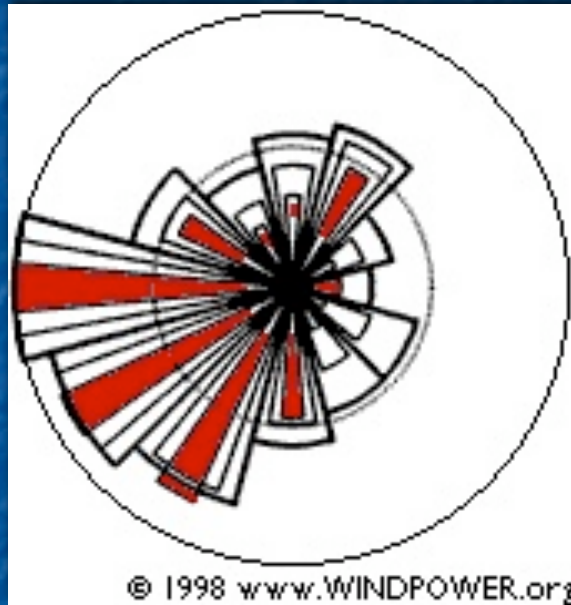
60m  
(200ft)  
High voltage line: 40m

125m  
(410ft)

95m (310ft) tower  
70m blades=747



# Wind Direction is Key



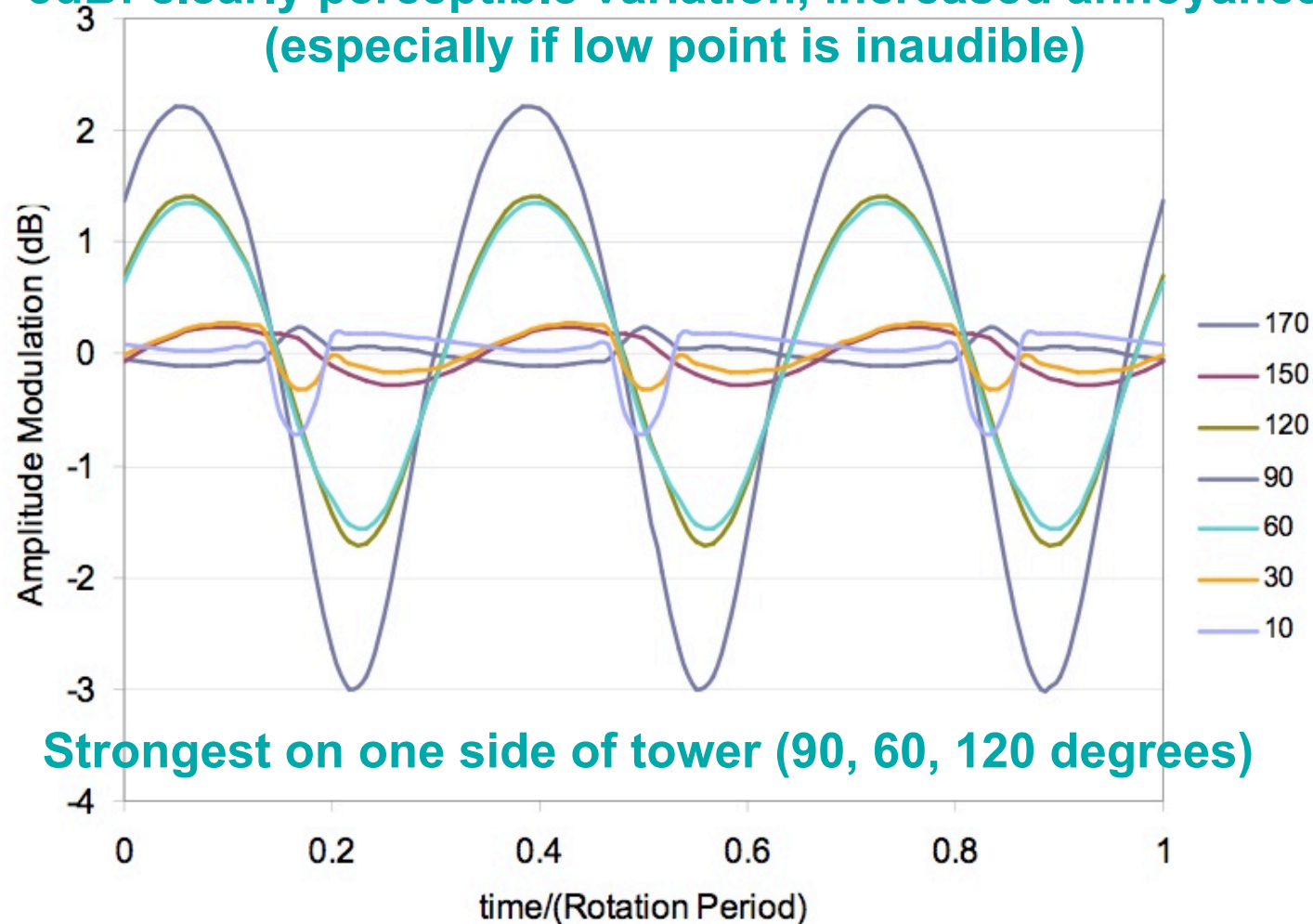
## Wind Rose

Shows wind direction and speed patterns in a given location

Can be close with no noise issues, or far with severe noise

# Amplitude Modulation

5dB: clearly perceptible variation, increased annoyance (especially if low point is inaudible)

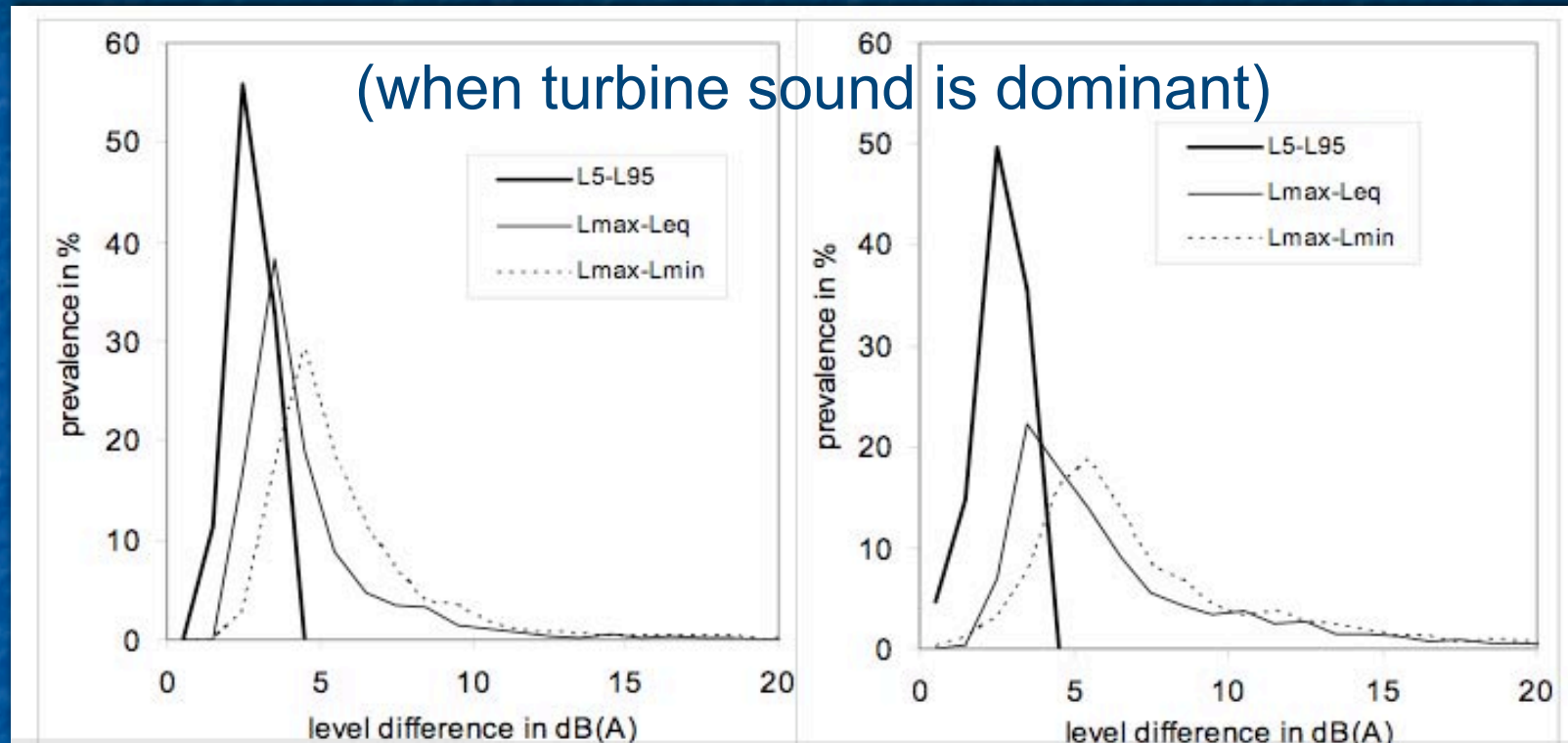


Strongest on one side of tower (90, 60, 120 degrees)

Fig. 9. Amplitude modulation of radiated sound for a complete three bladed rotor.



# Amplitude Modulation



400m/quarter mile

1500m/1 mile

5dB variation about  
30% of time

5dB variation about  
20% of time



# Atmospheric effects

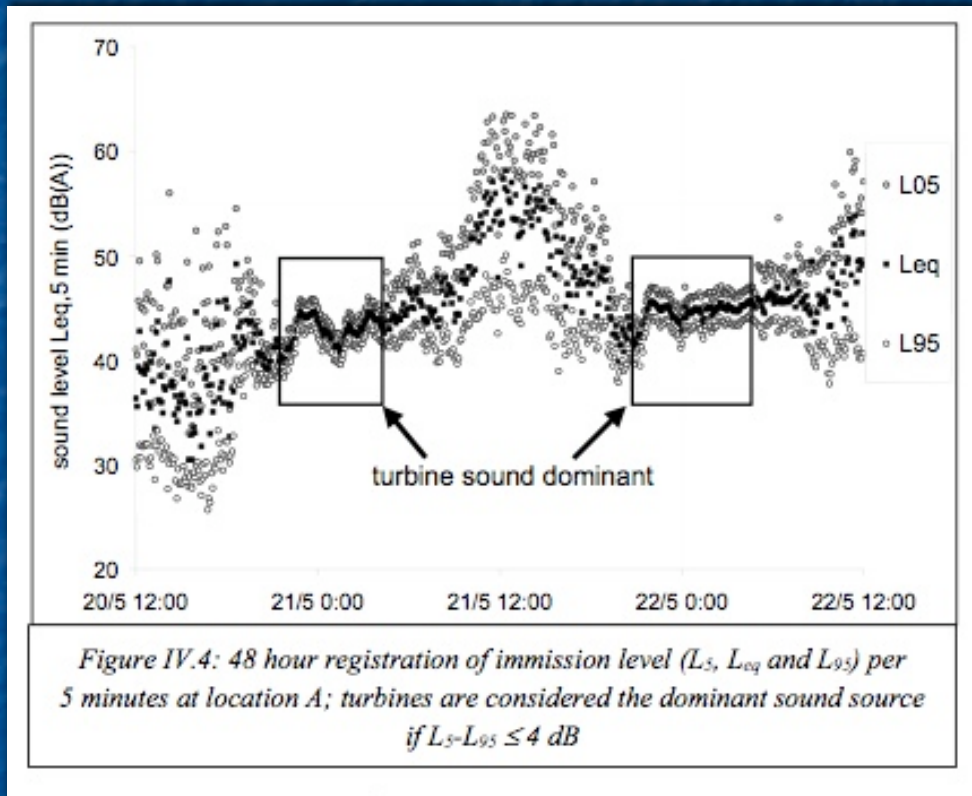


Wind up high > turns blades  
Still at ground > very low ambient noise  
**Night-time: quite at house, turbines  
audible further away than normal**

Inversion layer above turbine  
**Early morning as air warms: noise  
Accentuated at ground level**



# Atmospheric effects



Turbine sound dominant

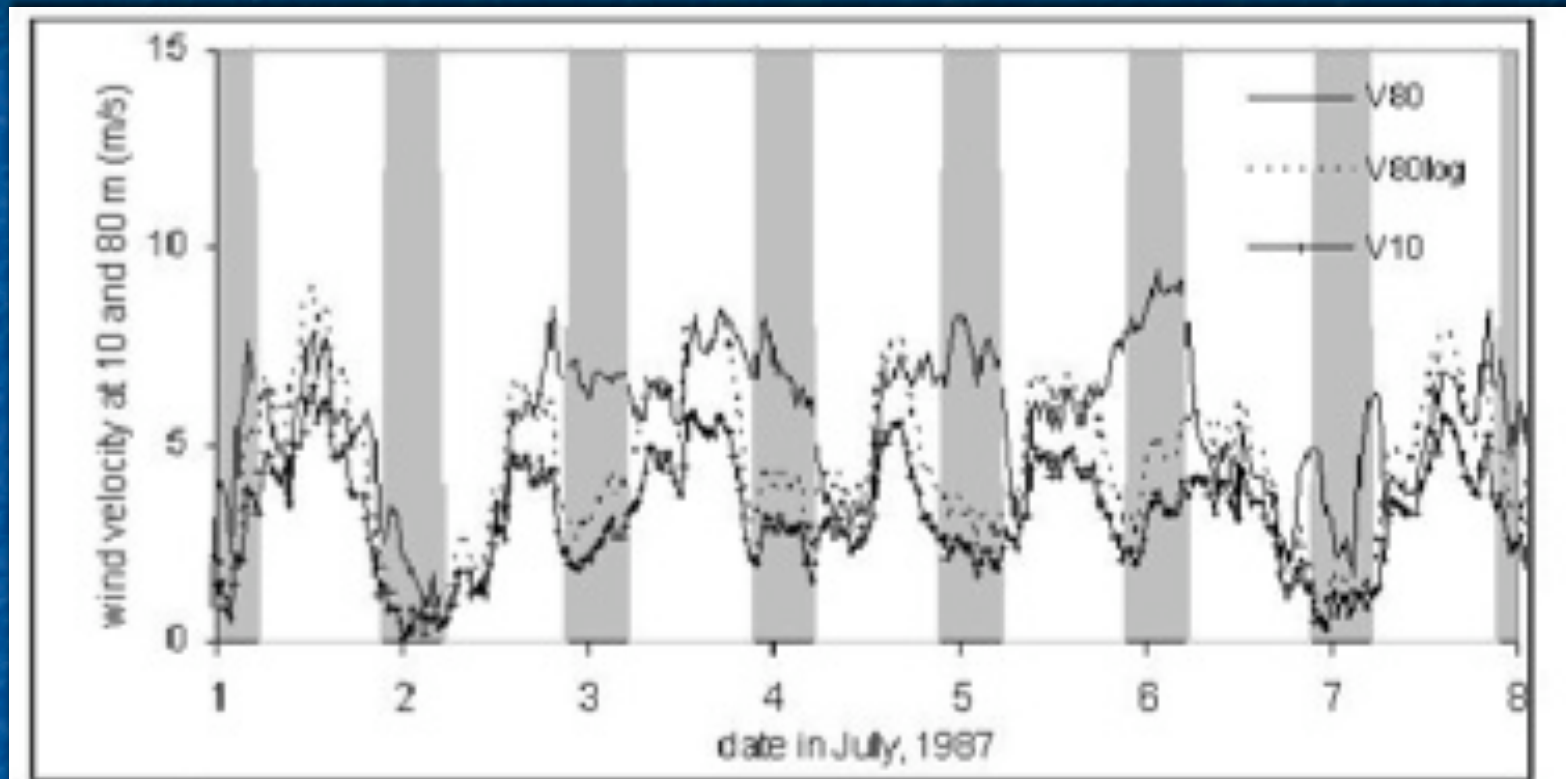
Day:  
not at all

Night:  
72% of time at 400m  
/quarter mile

38% of time at 1500m  
/1mile



# Atmospheric effects



Summer nights

More common to have low speed at ground  
With higher wind speed at 80m

# Reports from neighbors

Are those who complain just  
persnickety people?  
(sensitive or crotchety?)

**NO!**

Bajdek 2007 report to NOISECON:

Under a half mile (mostly quarter to half):  
44-50% “highly annoyed” by noise  
(45-55 dB)

Under 40dB, rates start dropping

At 1 mile (35dB) it's down to 4%



*Remember this is just one location; threshold of minimal impact could be more or less than 1 mi*



# Reports from neighbors

Elmira, Prince Edward Island  
1 - 2km (.6-1.25 mi) from wind farm



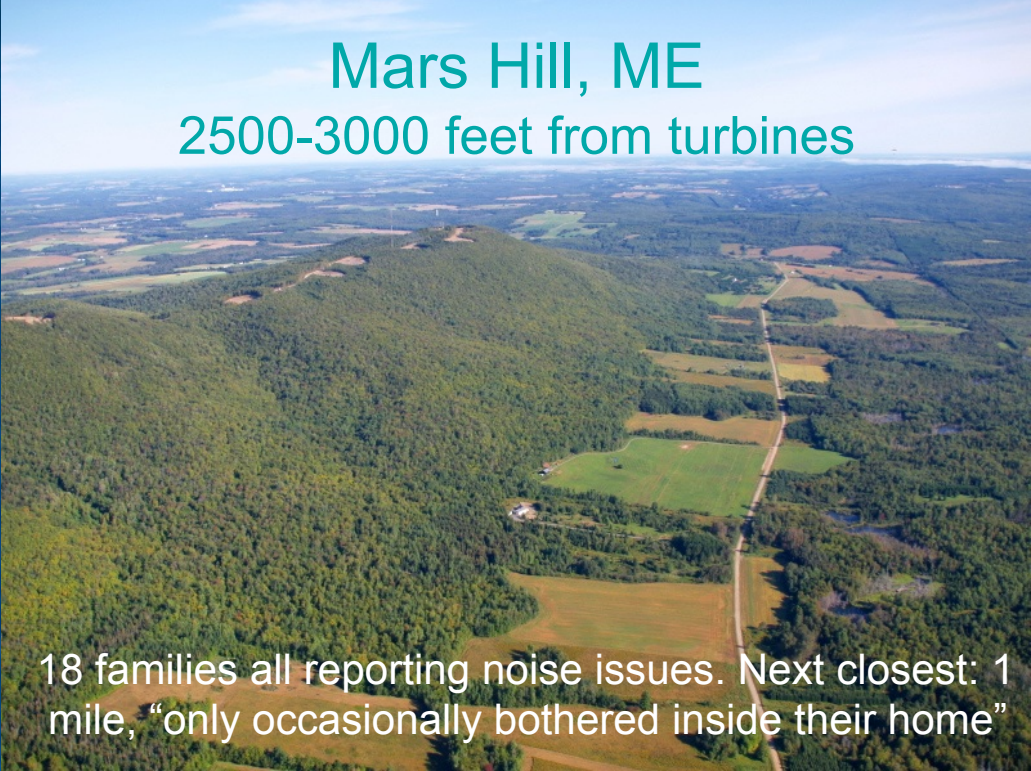
"My idea of noise is a horn blowing or a tractor - it disappears. This doesn't disappear. Your ears ring. That goes on continuously."

Distances from 1 to 1.5 kilometers were the areas of the most annoying sounds. This spring the winds created constant misery.

"When you are outside working and absorbed in what you are doing, you are OK. If inside, resting or reading, it's a problem. Forget about sleeping at night. The repetitions would go away, you think that it is gone, and it comes back again."

# Reports from neighbors

Mars Hill, ME  
2500-3000 feet from turbines



18 families all reporting noise issues. Next closest: 1 mile, “only occasionally bothered inside their home”

There are many times when winds are high on the ridge but near calm at our homes. The noise and vibrations penetrate our homes; at times there is no escape from it...the noise ranges from the sound of a high jet to a fleet of planes that are approaching but never arrive... When it's really bad it takes on a repetitive, pulsating, thumping noise that can go on for hours or even days. ”

Nick Archer, Regional Director, Maine Dept of Environmental Protection:  
“I thought you were crazy at first, but you are not...the quality of life behind the mountain has changed. We need to figure out what is going on with these things before we go putting any more of them up.”



# Reports from neighbors

Allegheny Ridge, PA  
600m/2000ft from turbines



I'm not going to jump on the 'I hate windmills' bandwagon because I don't. I'm just tired of nobody listening. My point is what is your peace of mind worth? I can't play outside with my kids back at the pond in the woods because it gives me a headache."

I know it's going to make some noise, but a lot of times, it sounds like a jet.

"On a calm day, you come outside and try to enjoy a nice peaceful day, and all you hear is the noise all the time and you can't get away from it. The first time they started them up, I didn't know what it was. I was like man, that's a weird noise. It was that loud."

# Reports from neighbors

Cohocton, NY  
1000-2000ft from turbines



**Cohocton Town Justice Hal Graham signed a lease to allow a turbine on his land:**

We thought we were going to do something good - that these things made good, clean, green energy. We said from day one, we don't want noise and we were constantly assured that at 900 feet, the noise would only be like the hum of a refrigerator. We believed that. Don't let them buffalo you.

**Now, they realize they made a mistake:**

It's a constant grinding, whining noise. You walk outside the house and it sounds like planes are in the sky all the time. And now I can't sleep at night, in the winter, with the windows closed. You wake up at two or three in the morning, and it's impossible to get back to sleep.



# Setback Standards

**300-450 m**

**1000-1500 feet**

Industry favors this range

Canada: 400m from buildings

Wisconsin: 440ft from property line, 1000 ft from homes

Very often not enough (all our examples)

**2500 feet / half mile / 750m**

Becoming a common “happy medium”

Not always enough (eg Elmira, Mars Hill)

**1.5-2 km**

**1-1.25 miles**

National Academy of Medicine (France)

Rick James (acoustic consultant)

National Wind Watch

Not always inaudible; may not address health effects for residents with vestibular conditions:

2 miles or more is suggested



# Setback Standards

Elmira PEI, from 3km

## Industry Responding to Concerns

Shear Wind, Canada

Redesigned project to stay 1.4km (3300ft) from homes  
“We’ve taken every single concern to heart and engaged folks on the issues”

Invenergy Wind, Illinois

Ten towers removed from proposed project  
in settlement with neighbors  
(secret to avoid setting precedent)

E.on Energy, Wales

Canceled 8-turbine project when it became apparent  
that it would have to be downsized  
to avoid noise issues

“As a responsible developer, we simply wouldn’t be willing to build a scheme that we thought had the potential to exceed acceptable noise limits.”



# Setback Standards

**Such relative responsibility by industry is not yet common**

“Refrigerator”

“Traffic at 100 feet”

“Morning birdsong”

Playing with noise models to  
make them “work” at the site

Pushing for state regs when localities  
set limits beyond 1500 ft

Painting all concerns as NIMBY







“If setbacks had been done properly, none of this would have happened.”



“If they had used just a little foresight and moved these back just a little farther....but they didn't”