

**MINUTES**  
**LANCASTER COUNTY BOARD OF COMMISSIONERS**  
**COUNTY-CITY BUILDING, ROOM 112**  
**TUESDAY, OCTOBER 20, 2015**  
**4:30 P.M.**

*Advance public notice of the Board of Commissioners meeting was posted on the County-City Building bulletin board and the Lancaster County, Nebraska, web site and emailed to the media on October 16, 2015.*

Commissioners present: Roma Amundson, Chair; Larry Hudkins, Vice Chair; Bill Avery, Deb Schorr and Todd Wiltgen

Others present: Kerry Eagan, Chief Administrative Officer; Gwen Thorpe, Deputy Chief Administrative Officer; David Derbin, Deputy County Attorney; Kristy Bauer, Deputy County Attorney; Dan Nolte, County Clerk; and Kelly Lundgren, County Clerk's Office

*The Chair called the meeting to order at 4:33 p.m., the pledge of allegiance was recited and the location of the Nebraska Open Meetings Act was announced.*

**PUBLIC HEARING:**

**A. Commercial Wind Energy Text Amendment No. 15009.**

The Chair opened the public hearing and the oath was administered to those who wished to testify.

Amundson read a statement outlining the procedures of the public hearing.

**Scott Holmes, Environmental Public Health Division Manager, Lincoln-Lancaster County Health Department (LLCHD)**, gave a PowerPoint presentation on Health-based Noise Standard (Exhibit A), noting the following:

- Existing County Zoning Resolution 13.018 which addresses Commercial Wind Energy Conversion Systems (CWECS)
  - 35 dB(A) at all times measured at the property line
- Proposed noise limits in the text amendment
  - 40 dB(A) measured at 10 min Leq (average noise level over a specified period of time) during daytime hours (7 a.m. to 10 p.m.)
  - 37 dB(A) measured as a 10 min Leq at night
  - Measured at the dwelling unit.
- Wind turbine noise is unique
  - It is different than other types of environmental noise
  - It has unique characteristics, including amplitude modulation and tonality
- Four significant studies were reviewed and given significant credibility
  - 2012 – Massachusetts DEP/DH Expert Panel on Wind Turbine Noise & Health
  - 2014 – Schmidt & Klokker; Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review
  - 2015 – Canadian Health Academies: Understanding the Evidence: The Expert Panel on

## Wind Turbine Noise & Human Health

- 2015 – Health Canada – Wind Turbine Noise and Health (Epidemiological Study)
- Massachusetts DEP/DH study recommends the sound pressure at night be below 40 dB(A) in residential areas
- Schmidt & Klokke study found evidence the tolerable level is around 35 dB(A)
- Canadian Health Academies concluded that wind turbine does cause annoyance, annoyance has many factors, and can lead to sleep disturbance, but the health impacts of wind turbine noise cannot be completely assessed at this time due to the limited quality of available evidence.
- Health Canada found a statistically significant increase in annoyance when levels exceed 35 dB(A), reports of being very or highly annoyed at levels greater than 40 dB(A), annoyance was significantly lower in participants who received personal benefit.
- Conclusions:
  - Percent of annoyance varies by site, increases with noise level and associated with wind turbines
  - Annoyance is a health issue
  - 35 to 40 dB(A) appears to be acceptable level for 80% of people near wind turbines
  - Major data gaps are reason for caution and conservative noise standards.

Avery asked if the noise levels that are recommended would greatly limit the amount of eligible area that could qualify for a turbine and would the project be able to proceed because of this.

Holmes said that he could not answer that question but felt that there were places in Lancaster County that would meet the recommendations.

Schorr asked if Holmes had any recommendations regarding the flicker effect.

Holmes stated the proposal contains the recommendations from the studies that were reviewed.

Hudkins questioned if any information regarding the effects of the warning lights on the towers. He also inquired about the recommended safe depth to remove the concrete if the towers were removed.

Holmes said that no specific correlation to those type of effects were found in the research done by the Health Department and felt that four feet would be a reasonable depth.

Wiltgen inquired if any of the studies had taken into consideration visual annoyance in correlation with the noise.

Holmes said that data reviewed indicates there is a dose response relationship between the noise and annoyance, so not just the presence of the turbine but actually the noise.

**Gregory Schwaninger, 2401 West Hallam Road, Hallam**, stated that he feels the sound limit should be raised to 50 dB(A) and that this is an ag related use of the land. He said his family has farmed in the area for generations. Schwaninger added this could create jobs within Lancaster County and decrease property taxes. Hudkins asked what the taxes were on his property. Schwaninger said approximately \$89 per acre.

**Marilyn McNabb, 1701 W Rose Street, Lincoln**, presented information on the Noise Control Ordinance and a letter to the Commissioners (Exhibit B). She stated that 45 dB(A) is a reasonable range for nighttime limits. McNabb said the regulation for regular agricultural use is 75 dB(A). She added this is an opportunity to take advantage of a natural resource and a positive change for farmers, taxpayers and the environment.

**Ken Haar (State Senator - Legislative District 21), 13901 NW 126<sup>th</sup> Street, Malcolm**, came forward to express support for the wind turbines. He told the Board wind development is a chance for property tax relief. Haar gave examples of property tax revenue from wind farms in a number of Nebraska counties. (Exhibit C) He said there is no peer review study that indicates wind development is a health hazard. Haar stated that wind is a replacement for the well-documented health hazard of burning fossil fuels. He said recently he visited the Steele Flats wind farm and at 968 feet away from the wind turbine could not hear any sound associated with the turbine. Haar urged the Board to adopt a reasonable proposal that lessens the differential between wind and other regulated activities, which have much higher sound limits.

Avery asked where the amounts in the document presented came from.

Haar replied he received the figures from a wind developer that works with those counties. He added that he contacted the counties to verify the information.

Wiltgen inquired as to how the counties benefit in general from the wind development and how the nameplate process works.

Haar referred Wiltgen to page two of the document he submitted comparing Iowa and Nebraska which outlined the economic development of the two states. Haar explained the nameplate capacity tax replaces property taxes that would otherwise be imposed on wind infrastructure.

Schorr asked if the reduction in property value was taken into consideration when arriving at the figures presented.

Haar answered no but referenced a study done in Australia that showed no significant reduction in property tax.

Amundson inquired what the impact is specifically for Lancaster County taxes and revenue.

Haar said the impact depends on the number of wind turbines placed in Lancaster County but could not give specific amounts.

Hudkins questioned if the nameplate tax is assessed by the State of Nebraska.

Haar stated that there is a state tax figure that is much like with farm equipment but he was unsure of the exact number.

**Mary A. Harding, 460 N "F" Street, Milford**, appeared as a Representative of Subdivision 1 of Nebraska Public Power District, which includes all of rural Lancaster County. She presented a card that she gave the rural Lancaster County residents while running for her third term which pictures Harding with wind turbines (Exhibit D). Harding said she does not feel that she would have been re-elected if the opinion of the county was not in favor of renewable energy. She urged the Board to

not block economic development in the county by adopting unreasonable restrictive guidelines. Harding said what the Health Department is recommending would result in a "no build" zone in Lancaster County.

**Cindy Chapman, 1850 Gage Road, Firth**, came forward representing residents of rural Lancaster and Gage County concerned with the effect of turbines, many of whom were in attendance and presented a map with intended wind turbine placement (Exhibit E). She referenced a State Statute that states, as a farmer you cannot cause a nuisance by introducing a new land use that may create an issue with an existing neighbor. Chapman said that wind turbines should not be considered a farming practice. She stated if safe sound limits prevent wind turbines in Lancaster County it just confirms that the population density is too great.

Hudkins asked Chapman if there is a direct difference in industrial use noise and agricultural noise.

Chapman said that when they moved to the area they were aware there would be noise associated with farming and does not mind that. She is concerned about the ability to sell their property due to wind turbines nearby.

Avery and Wiltgen both commented that there has been no real data to support the fact that wind turbines make it more difficult to sell property. Wiltgen noted that there are approximately 38,000 wind turbines in the United States with no studies performed on this issue.

Chapman stated that she had provided information from a study done in Michigan that showed a decrease in the value of homes near the wind turbines.

**Larry Alder, 2498 W Ash Road, Cortland**, came forward stated that he opposed the setbacks that are being proposed because overlapping of property lines and county roads. He stated this is not agricultural; it is commercial wind development and should be zoned appropriately.

Wiltgen asked what Alder thought the setback should be.

Alder said that it should be at least a three-turbine height from the property line.

**Gary Vocasek, 160 N East Street, Hallam**, said the Health Department has done a good job of providing evidence on the effects of wind turbines, but was disappointed that the Planning Commission did not follow all the recommendations. He stated the Board should do what is best for Lancaster County regardless of what Iowa or Kansas does as far as wind energy.

**Curtis Schwaninger, 3750 W Hallam Road, Hallam**, appeared and commented that the wind energy project would decrease the value of property. He voiced concerns of the effects the noise would have on children. Schwaninger said the setback should be a minimum of three-quarters of a mile and the decibel level at 30 dB(A) in more populated areas. He completely opposes the wind energy project.

Hudkins asked what the taxes were on the property he owned.

Schwaninger said approximately \$70 - \$100 per acre.

**Joetta Schwaninger, 3750 W Hallam Road, Hallam,** asked the Board to set the sound levels to 37 dB(A) at night and 40 dB(A) during the day and the sound limits at the property line and not the dwelling. She said health issues can be exacerbated by the wind turbines due to sound and shadow flicker.

**Daniel Clausen, 1215 G Street, #8, Lincoln,** presented a study that the Health Department did not mention (Exhibit F). He stated the findings showed that there was no clear evidence that wind turbines have impact on health but a small percentage of people reported annoyance. Clausen expressed concerns about health related issues that he experiences every day that do not gain as much attention as the wind turbines.

**David Corbin, 1002 N 48<sup>th</sup> Street, Omaha,** currently an Adjunct Professor of Public Health at Creighton, said the evidence of linking public health and wind turbines is not solid. He stated that many of the most respected national medical and public health associations all recommend conversion to renewable energy over fossil fuels, which are far more hazardous than anything demonstrated by wind turbines. Corbin said in visiting with public health officials from Iowa that they report only a handful of health related complaints in a state that has a large number of wind turbines and various sound regulations.

Wiltgen asked if Corbin had reviewed the Canadian Academy conclusion referenced earlier in the meeting.

Corbin stated there are several Canadian studies and they have conflicting results.

**Al Davis (State Senator), 66455 Ponderosa Road, Hyannis,** told the Board a large group of landowners from Cherry County, where his home is located have gone together to consider developing wind energy in their area because of the positive economic impact. He said that the decisions that Lancaster County makes could set a precedent for other counties throughout the state. Davis stated that discussions on how to solve the property tax crisis are ongoing at the Capital particularly related to ag land and wind energy could play a part in property tax relief. He commented on the nameplate capacity tax that is \$3581.00 per megawatt and goes on for the life of the turbine that is sent to the state and then back to the taxing district and a two-hundred megawatt project would provide approximately 1.25 million dollars in property tax relief.

Schorr commented that she has spent time visiting with fellow commissioners through the state and currently twenty-two counties have regulations at 50 dB(A) and five counties at 60 dB(A).

**John Hansen, 1305 Plum Street, Lincoln,** President Nebraska Farmers Union, presented a testimony on the Lancaster County Zoning Ordinance (Exhibit G). He said he has worked with planning and zoning issues for over forty years. Hansen indicated that the Farmers Union has employed Peter Guldborg of Tech Environmental as an expert consultant in wind project issues. He added that Guldborg has worked with wind project issues in more heavily populated areas in the country. Hansen said Guldborg recommendations are 50 dB(A) during the day and 45 dB(A) at night as a reasonable balance that allows for development and protects the health of the residents.

**David Schwaninger, 28500 SW 14<sup>th</sup> Street, Martell,** appeared in support of the project. He stated this is an ag use. Schwaninger said the recommendations set forth by the Health Department will eliminate this project. He noted the high property tax of agriculture land and the rent received from having towers on the property would help offset those taxes.

**Larry Chapman, 1850 Gage Road, Firth,** stated that wind energy developers have not been upfront with landowners. He said that people do not want to live with wind turbines and residential and business growth will stop. Chapman said research shows the wind farms lower the property value and do pose a threat to public health. He asked the Board to abide by the Health Department recommendations.

**Paul Meints, 885 Ashley Avenue, Cortland,** told the Board that he has a housing development in Gage County. He said he has three lots for sale and once he discloses the fact that the wind turbines could be in the area the potential buyers do not return.

**Jeffrey Wagner, 205 SE Spokane Street, Portland, Oregon,** stated that individuals involved in wind energy development are focused on building safe and healthy infrastructures. He said that wind energy is one of the safest and lowest impact forms of energy. Wagner added that it fits well in the agricultural setting by still allowing use of land for crops and economic benefits. He noted that many people live around and work with wind turbines without any adverse health effects. Wagner urged the Board to accept the text language proposed by Volkswind that contains important clarification for site restoration, shadow flicker, setbacks and noise. He said the text prioritizes health and safety as well as property rights. Wagner indicated that he is the Director of Volkswind USA in the United States.

Hudkins asked if after the useful life of the turbine what happens to the concrete bases and what steps are taken to assure they are properly removed.

Wagner stated that Volkswind has uniform lease contract with all participating landowners and for the Hallam project the private contract requires removal down to 40 inches. He added the Planning Commission proposed text is 4 feet, which is acceptable. Wagner noted clarification in the text, which refers to the condition of the land prior to installation.

Wiltgen asked why they chose Lancaster County and what area will be served by the power generated by the wind farm.

Wagner stated that Volkswind looks for agricultural zones for wind farms. He said another consideration is presence of high voltage transmission such as the Sheldon Power Station. The power will be included in the Southwest Power pool that serves Nebraska and many surrounding states.

**Robert O'Neal, 3 Clock Tower Place, Maynard, Massachusetts,** stated he is an acoustical engineer certified by the Institute of Noise Control of Engineers that focus on wind energy. He said acceptable levels are 50 dB(A) night and 45 dB(A) during the day. O'Neal noted that visual impact is a strong correlation to annoyance but does not cause health effects.

The Chair recessed the Public Hearing at 6:35 p.m.

The Public Hearing resumed at 6:55 p.m.

**Judy Daugherty, P.O. Box 193, Hallam,** stated that she will be directly impacted if the proposed text amendment is not changed. She said that twelve wind turbines could be placed within a mile of her home. Daugherty added that the Planning Commission has not performed proper research on the subject. She said she believes there is significant risk to her families health. Daugherty said she

does agree with the recommendations made by Scott Holmes but not the proposed changes made by the Planning Commission.

**Cindy Friesen, 2260 W Pella Road, Hallam**, said that this is not about wind energy but about the right to protect property rights and the health of their family. She said they purchased an eighty-acre farm near Hallam. Friesen stated that ten days after closing that she read in the Lincoln Journal of the proposed wind farm. She added the landowner and realtor did not disclose this information.

**Alan Friesen, 2260 W Pella Road, Hallam**, appeared and presented pictures of the proposed turbine sites located near his farm (Exhibit H). He stated this is not an energy issue but where it is located and the area proposed is too populated for a wind farm. Friesen urged the Board to adopt the Health Department's recommendations.

**Mark Hunzeker, 600 Wells Fargo Center, Lincoln**, appearing on the behalf of Mr. and Mrs. Friesen. He said this is a land use issue, not an environmental or economic development issue. Hunzeker stated industrial scaled wind farms will adversely affect the property value and development of the area. He said the Board should adopt the standards set by the Health Department. Hunzeker added that an amendment should be added to measure setbacks from property lines and not dwellings.

Schorr asked if Hunzeker had any specifications with regard to the greater or less than ten acres.

Hunzeker stated that the regulations drafted indicated on ten acres or less the measurement would be from the property line and from the residence on more than ten acres. He said measuring from the property line would be more consistent.

Hudkins asked Hunzeker as one of the leading attorneys in Lincoln on property rights to speak on the Right to Farm Act.

Hunzeker said the Right to Farm Act protects farming operations from being declared a nuisance if the choice is made to locate next to existing farm operations. He stated that the Farm Act applies to any tract of land over 10 acres used for the commercial production of farm products. Hunzeker continued that the Zoning Ordinance defines agricultural in a similar way.

**E Wayne Boles, 128 N 13<sup>th</sup> Street, #506, Lincoln**, commented that electricity is a necessity. He said that the normal speaking volume is about 54 dB(A).

**Ann Devries, 684 E Aspen Road, Cortland**, came forward in support of wind farms. She said she is an acreage owner, but does not qualify for a wind turbine on her property. Devries stated that she supports a high a decibel sound limit.

**Mike Woodward, 2750 SW 14<sup>th</sup> Road, Cortland**, said he is a third generation farmer. He stated that the wind farms will only benefit a few select home owners. Woodward noted that due to pivot irrigation it will require the turbines to be placed closer to homes.

**John Atkeison, 2601 N 44<sup>th</sup> Street, #1, Lincoln**, said he does not feel that there is substantial evidence to show wind farms cause health issues. He stated that a reasonable level would be 50 dB(A) during the day and 45 dB(A) at night.

**Russell Miller, 341 S 52<sup>nd</sup> Street, Lincoln**, presented the Board a statement he prepared (Exhibit I). Miller said that it is important to be concerned about all the residents of Lancaster County and wind energy would replace burning coal. He stated that it is well known that coal is a major cause of air pollution and pollution free air benefits all residents of Lancaster County. Miller said he hopes that the Board will set the decibel level that will make wind farms feasible. He added the revenue generated from the wind farms could be used to repair county roads.

**Julie Dance, 7800 W Hallam Road, Hallam**, commented that she would not have purchased her property had she known there would be wind turbines located so close. Dance said normal farm noises and activities were expected. She added that there are less intrusive forms of safe energy.

**Thomas Schuerman, 2000 W Princeton Road, Martell**, came forward and told the Board that he is a professional engineer and has a responsibility in part to help maintain the health and safety of the public wherever he can. He said that he has concerns with the zoning ordinance as it is proposed. Schuerman stated that it should also take into account the manufacturers recommendations for setbacks. He does support the sound levels suggested by the Public Health Department.

**Trevor L. Lienemann, 26969 Homestead Expressway, Princeton**, told the Board his property will be surrounded by wind turbines. He said they host visitors from around the world in order to promote agriculture but he does not consider wind farms agriculture. Lienemann stated that property values will decrease.

**Lisa Sullivan, NextEra Energy, 700 Universe Boulevard, Juno Beach, Florida**, Director of NextEra Energy, told the Board that NextEra is not looking at developing in Lancaster County but the decision made by the Board could impact regulations in other counties. She presented information outlining how NextEra designed the Steele Flats Wind Project and the factors that were taken into consideration (Exhibit J). The slides also showed how the area available to place wind turbines diminishes as the decibel level is lowered.

Wiltgen asked if there are manufacturer standards.

Sullivan stated that each manufacturer has certain setbacks that they recommend. She said that NextEra has 10,000 operating GE turbines and the recommendations are taken into consideration as NextEra would be liable. Sullivan said NextEra standards are 1400 feet from the residence.

**David Levy, Baird Holm LLP, 1500 Woodmen Tower, Omaha**, appeared before the Board on behalf of Volkswind and NextEra. He stated that his law firm has worked with many of the wind developers active in the state and worked on wind zoning in many counties in the state. Levy said the noise requirements are effectively setbacks. He said the large property line setbacks will not be necessary because of the noise level really will be the driving factor. Levy noted that all of the property taxes paid by wind farms are paid out to the taxing entities within the county in the exact same proportion as real and personal property taxes.

Avery asked Levy why he feels Lancaster County will set the standards.

Levy said that many smaller counties do not have the resources to perform the research and will follow the larger counties lead. He recommended that the Board visit with other counties that have

years of experience of operating wind farms. Levy referenced the Steele Flats wind farm noting that there has not been any documented complaints for the residents in the area.

**Larry Oltman, 899 E Gage Road, Cortland**, appeared in support of the wind farms. He said at a recent meeting regarding Steele Flats and he was informed there has been no reports of property devaluation. Oltman stated he is a dryland farmer and this would be additional income.

**Tori Lienemann, 26969 Homestead Expressway, Princeton**, told the Board annoyance is a subjective term and not easily measurable. She said that there will be eleven turbines surrounding their home. Lienemann stated that their farm will host the Cattleman's Ball in June 2016 which raise funds for cancer research and health initiatives. She added that the visual obstruction from the proposed wind turbines will affect the appealing landscape at their farm.

Hudkins asked how the turbines affect the disabled.

Lienemann said people with sensory disorders the flicker and sensory overload can compound the disabling condition and cause irreparable damage. She stated this is a professional opinion as she has a PhD in Special Education with a focus on Attention Deficit Hyperactivity Disorder (ADHD) and considered an expert in the field by Vanderbilt University.

The Chair closed the Public Hearing.

Amundson indicated that the Board would be making a decision at the Tuesday, October 27, 2015 Board of Commissioners meeting at 9:00 a.m. but would not be accepting any testimony at that time.

Hudkins offered an amendment to the Planning Commission recommendation. He would like for the Board to consider that each tower be removed within a year of decommissioning or revocation of the special permit and upon removal that five feet of soil placed on the average surrounding ground level.

Schorr asked Scott Holmes the reasoning behind the recommendation that the setback is measured at the dwelling unit versus property line. Holmes stated based on data reviewed the majority of complaints relative to health came at nighttime when you are typically in the residence. It was not intended to protect the property line issue.

Avery commended Holmes and the staff of the Health Department for their excellent research.

Schorr made a motion to accept the Health Department regulations at 40 dB(A) during the day and 37 dB(A) at night measured from the dwelling units, the applicable flicker recommendation made by the Planning Commission and to incorporate Hudkins amendment. Schorr would direct the County Attorney to draft the resolution for discussion on Tuesday, October 27, 2015.

Hudkins seconded the motion for discussion. He stated that he does not necessarily agree but it is a start. Hudkins said that he feels 45 dB(A) is preferable but is willing to work together on that. Hudkins expressed concern with the setback being from the dwelling unit and felt it should be from the property line.

Avery stated that he will vote no but that it does not indicate that he is opposed to the project, rather he does not agree with the motion made.

Wiltgen said that he will vote no at this time because more he needs time to review the information presented at the public hearing.

Amundson stated she supports the Health Department's recommendation. She referred to the property tax relief mentioned during the public hearing and said when divided out does not create a great impact. Amundson said when reviewing comments by physicians all over the world there is a complex of symptoms that arise from wind turbines. She also felt as realtor that it does impact property value and said it must be disclosed to potential buyers, which has resulted in loss of interest in purchasing land or homes in the area.

Schorr inquired whether the County Attorney could draft a resolution and the Board make line item changes.

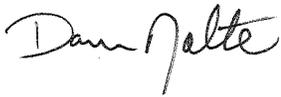
Kristy Bauer, Deputy County Attorney, informed the Board it would not be appropriate to make line item changes on this text amendment. She said clear direction on the Board's intentions is needed before any resolution is drafted.

A vote was taken on Schorr's previous motion.

**ROLL CALL:** Avery, Hudkins, Wiltgen and Amundson voted no. Schorr voted aye. Motion failed 4-1.

## 2) ADJOURNMENT

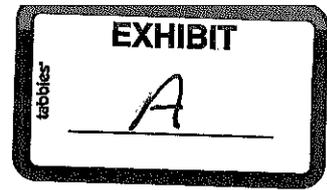
**MOTION:** Schorr moved and Wiltgen seconded to adjourn at 8:30 p.m. Hudkins, Schorr, Wiltgen, Avery and Amundson voted aye. Motion carried 5-0.



---

Dan Nolte, County Clerk





# **Proposed Text Amendment to CR 13.018 Commercial Wind Energy Conversion Systems**

## **Health-based Noise Standard**

**A Presentation to the Lincoln-Lancaster  
County Board of Commissioners**

**Scott E. Holmes, MS, REHS  
Manager, Environmental Public Health**

**October 20, 2015**

# **Existing County Resolution 13.018**

## **Commercial Wind Energy Conversion Systems**

### **Regulates Noise**

- 35 dB(A) at all times
- Measured at the property line
- A noise study may be required

# Proposed Noise Limits in the Text Amendment

- 40 dB(A) measured as a 10 min Leq between 7 am to 10 pm
  - Or 3 dB(A) above background noise level (9 hour Leq)
- 37 dB(A) measured as a 10 min Leq at night (10 pm to 7 am)
  - Or 3 dB(A) above background noise level (15 hour Leq)
- Measured at the dwelling unit

# Definition of Terms

**Noise** is unwanted sound

- Noise annoyance can be defined as “any feeling of resentment, displeasure, discomfort and irritation occurring when a noise intrudes into someone’s thoughts and moods or interferes with activity” (Passchier-Vermeer & Passchier, 2006).
- Annoyance is **correlated** to many factors
  - Loudness
  - Frequency (low or high);
  - Tonality; Modulation
  - Opinions about the source of sound
  - Control over and ability to get away from the sound

# Noise Annoyance Causes Health Impacts

- Physiological reactions include increased heart rate and blood pressure which, among others, may lead to hypertension. (1) (2)

1) T. Lindvall & E. P. Radford. Measurement of annoyance due to exposure to environmental factors(1973). Academic Press Inc.

2) World Health Organisation(WHO). Burden of disease from environmental noise(2011)

# Noise Codes & Annoyance

- Community noise codes are based on:
  - potential for hearing loss
  - projected level of **annoyance** (enjoyment of property)
- Annoyance is subjective, but can be measured objectively
  - Percent of people annoyed
  - Measurable changes in heart rate, blood pressure, and cortisol levels

# What do we know about the sound generated by wind turbines?

- The sound is complex
- The blades slicing through the air can create a **'swish'** sound with a midrange & high frequencies.
- The lack of smooth airflow can create some low frequency **'thump'** sounds and higher frequency **'pulses'**
- The inside the turbine nacelle can create some **'whirr'** sounds with bass and midrange frequencies.
- All of the above tend to increase with wind speed.
- The transformer sub-station can generate some **'hum'** tones as well as sounds from associated cooling systems.

# What do we know about the sound generated by wind farms? (cont.)

- The sound gets lower with **distance**
- **Multiple turbines** can produce modulated sound
- Unique tonal signature
- Wind turbines generate **infrasound** below human hearing range (<20 hz)
- dB(A) sound levels correlate with infra-sound levels (Health Canada, Wind Turbine Noise and Health Study, 2015)

# What do we know about the noise associated with wind turbines?

- Most noise complaints are associated with the **'swishing pulses'**.
  - Modulation and tonality
- Most noise complaints are associated with **night-time** operations.

# Wind Turbine Noise - *It's Unique*

- It is different than other types of environmental noise, such as traffic, railway, or airport noise
- It is not comparable to .....
- It has unique characteristics, including amplitude modulation and tonality

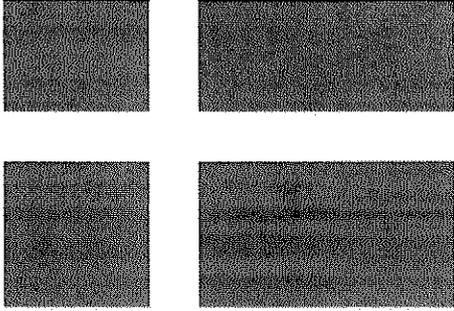
# Some recent studies on Wind Turbine Noise and Health

- 2012 - Massachusetts DEP/DH Expert Panel on Wind Turbine Noise & Health
- 2014 - Schmidt & Klokke; Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review
- 2015 – Canadian Health Academies: Understanding the Evidence: The Expert Panel on Wind Turbine Noise & Human Health
- 2015 – Health Canada – Wind Turbine Noise and Health (Epidemiological Study)



# 2012 Mass DEP/DH Panel Recommendations

Land Use	Sound Pressure Levels (dBs) Nighttime levels
Industrial	70
Commercial	50
Villages, mixed usage	45
Sparsely populated areas, 8m/s wind	44
Sparsely populated areas, 6m/s wind	42
Residential areas, 8m/s wind	39
Residential areas, 6m/s wind	37



# 2014 Schmidt & Klokke

## Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review

- Evidence of a dose response relationship between Wind Turbine Noise and annoyance
- Evidence of a dose response relationship between Wind Turbine Noise and self-reported sleep disturbance
- Tolerable level around 35 dBA Leq



## UNDERSTANDING THE EVIDENCE: WIND TURBINE NOISE

The Expert Panel on Wind Turbine Noise  
and Human Health



Council of Canadian Academies  
Conseil des académies canadiennes

*Science Advice in the Public Interest*

Table 7.1

Overview of Findings with Regard to Adverse Health Effects Addressed in Empirical Population-Based Research on Exposure to Wind Turbine Noise

Condition or Symptom	Level of Evidence (IARC)	Possible Pathways	Knowledge Gaps
Annoyance	Sufficient	Direct – exposure to wind turbine noise can lead to annoyance; however, the effect may be modified by factors such as visual impact and attitudes.	<ul style="list-style-type: none"> <li>• Role of visual impact and attitudes on perception of wind turbines.</li> <li>• Prevalence of annoyance in exposed populations, gravity of effect, and thresholds under different conditions.</li> <li>• Role of specific sound characteristics (amplitude modulation, low frequency noise).</li> </ul>
Sleep Disturbance	Limited	Direct and indirect (via annoyance or stress response or both) pathways are possible; however, wind turbine noise is likely only one among many factors affecting sleep quality.	<ul style="list-style-type: none"> <li>• Nature of the mechanism (direct, indirect, or both) and the relative prevalence and magnitude of the effect for each.</li> <li>• Impacts of specific sound characteristics (including low-frequency sound) of wind turbine noise on sleep.</li> <li>• Long-term effects of wind turbine noise on sleep disturbance.</li> </ul>

# Canadian Academies Conclusions

- Wind turbine noise is associated with annoyance
- Annoyance has many factors
- Annoyance can lead to sleep disturbance
- Both Annoyance and Sleep Disturbance are associated with higher stress levels, which are associated with health outcomes

# Canadian Academies Conclusions

- The Panel stresses that, given the nature of the sound produced by wind turbines and the limited quality of available evidence (small sample sizes, small number of studies available, lack of comprehensive exposure measurement), the health impacts of wind turbine noise cannot be comprehensively assessed at this time.



# Health Canada Study 2015

- One of the largest epidemiological studies of wind turbine noise and potential health impacts
- 1268 residences were grouped into categories based on calculated 24 hour outdoor A-weighted Wind Turbine Noise levels:
  - less than 25 dB;
  - 25 to 30dB;
  - 30 to 35dB;
  - 35 to 40dB;
  - >40 dB\*

\* Only 6 residences were above 45 dB.



## Health Canada Study 2015

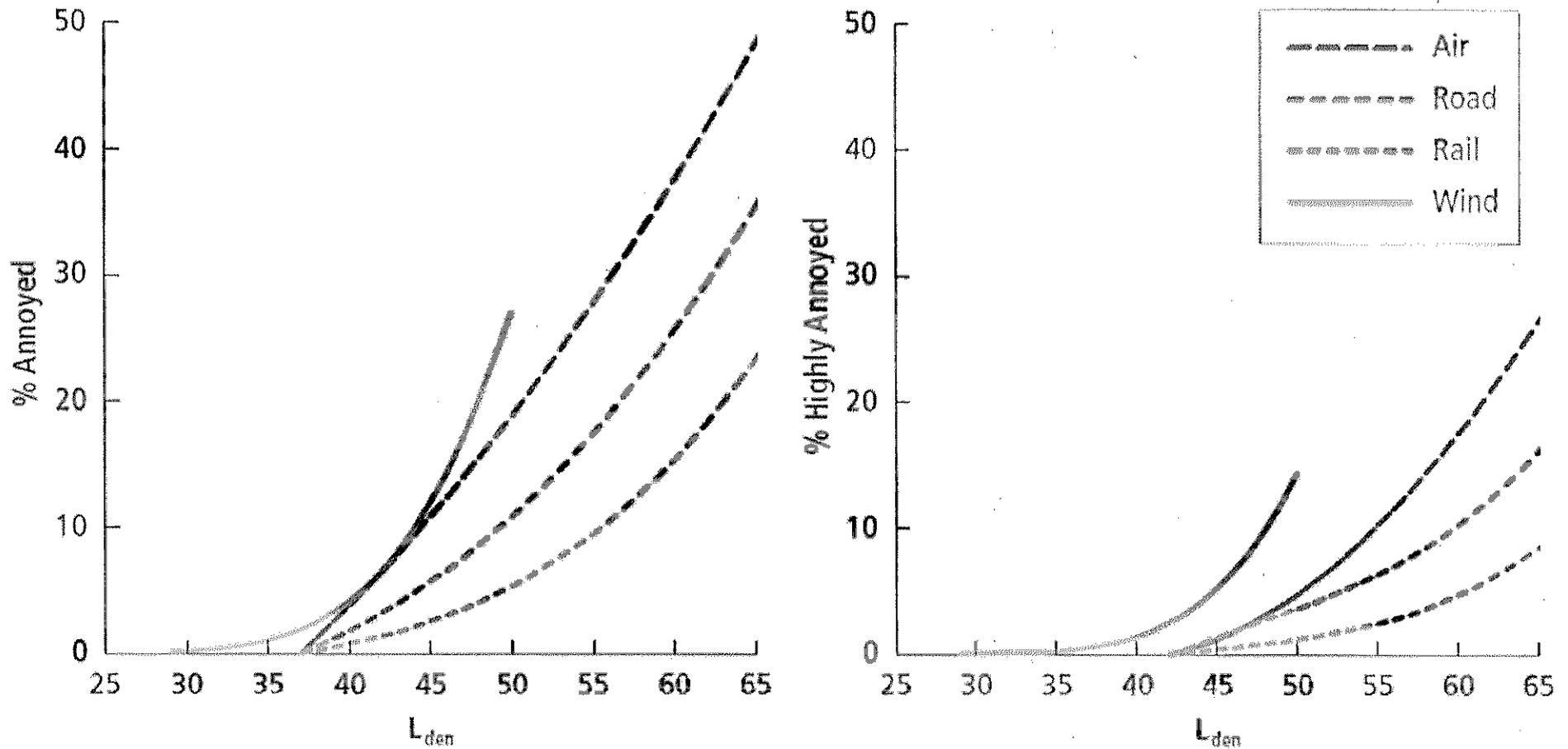
- ***5.2 Community Annoyance Findings***
- A statistically significant increase in annoyance was found when WTN levels exceeded 35 dBA.
- In Ontario, of those exposed to > 40dBA, 16.5% reported being *very or highly annoyed*
- Annoyance was significantly lower among the 110 participants who received personal benefit

Note: *Annoyance* was defined as a long-term response (approximately 12 months) of being "very or extremely annoyed" as determined by means of surveys.



# Health Canada Study 2015

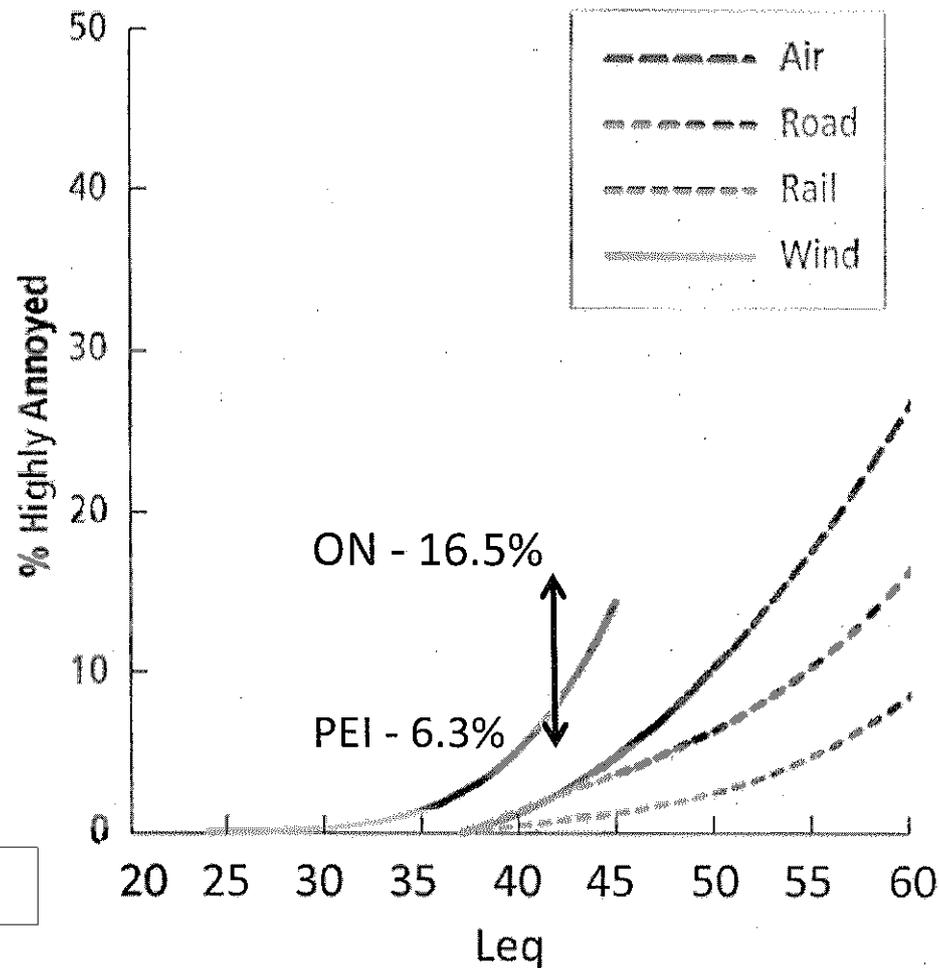
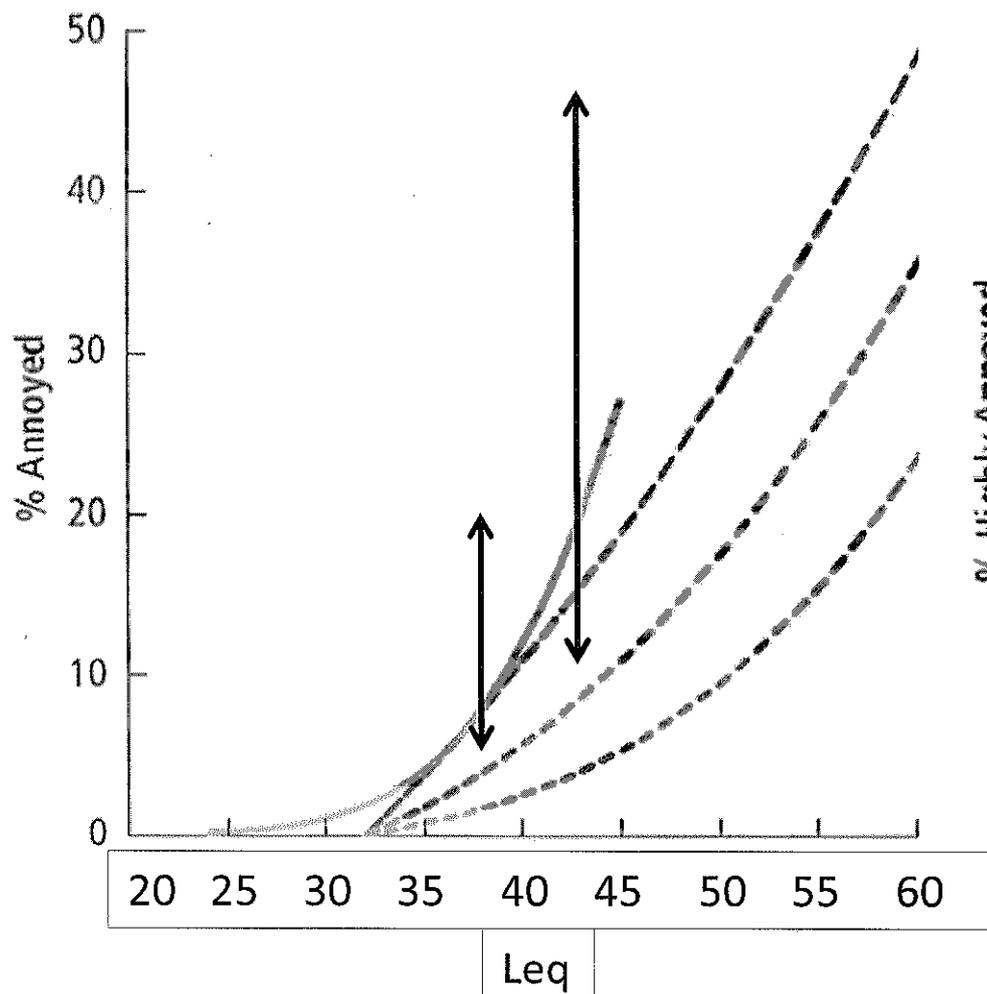
- ***5.3 Annoyance and Health***
- WTN annoyance was found to be statistically related to several self-reported health effects including, but not limited to, blood pressure, migraines, tinnitus, dizziness, scores on the PSQI, and perceived stress.
- WTN annoyance was found to be statistically related to measured hair cortisol, systolic and diastolic blood pressure.
- The above associations were not dependent on the particular levels of noise



Reproduced with permission from Janssen, S. A., Vos, H., Eisses, A. R., & Pedersen, E. (2011). A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources. *The Journal of the Acoustical Society of America*, 130, 3746-3753. Copyright 2015, Acoustical Society of America

Figure 6.1

## Comparison of Annoyance Due to Wind Turbine Noise and Transportation Noise



**LLCHD estimates of Annoyance with Leq in dB(A)**  
**based on Canadian Academies study Figure 6.1**  
**using a 5dB conversion factor for Lden to Leq**  
 - Range estimates  $\updownarrow$  from Pedersen (2011)  
 - Range estimate  $\updownarrow$  from Health Canada (2015) of very  
 or extremely annoyed

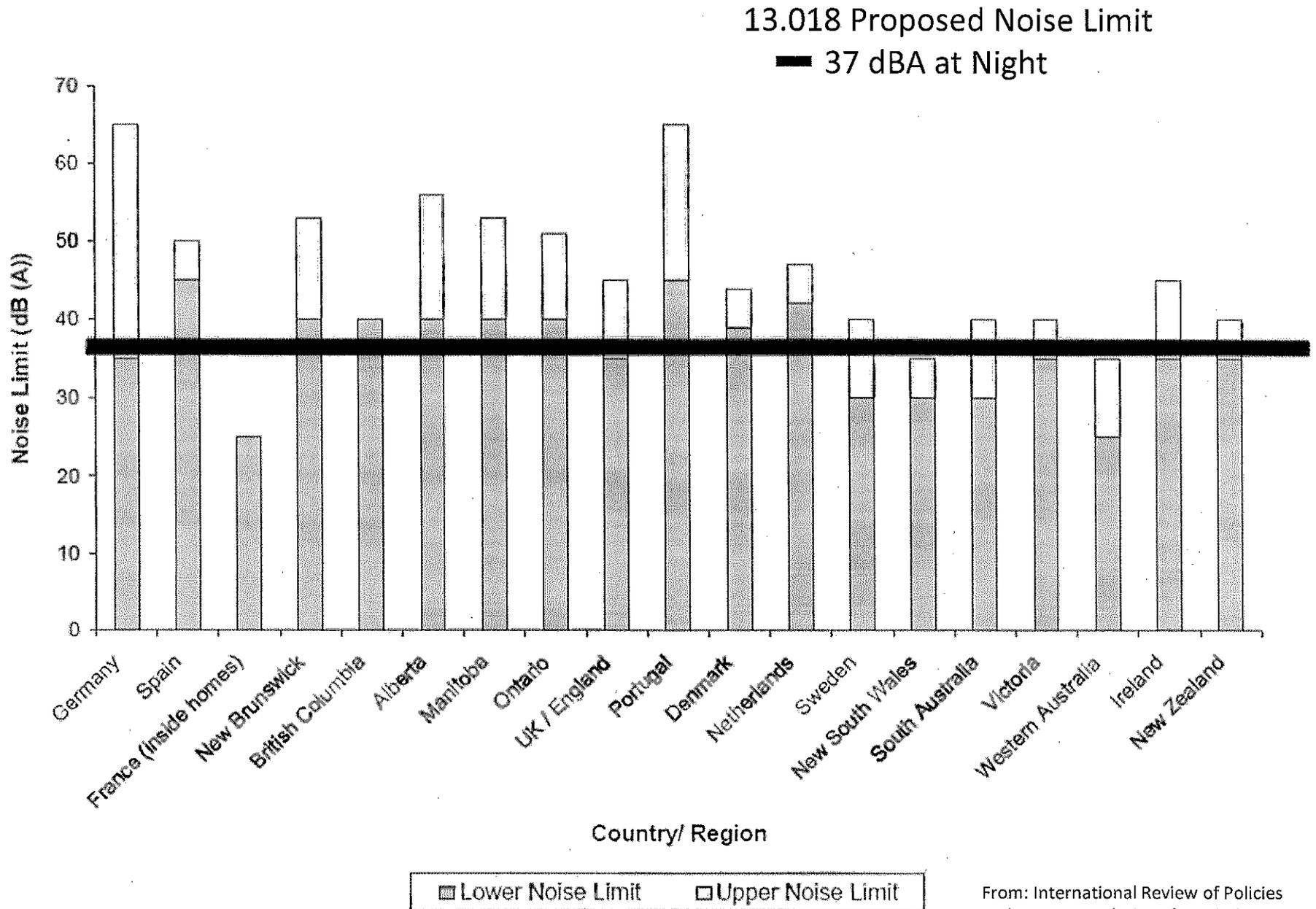


Figure 3: Country Wind Turbine Noise Limits at Residences

From: International Review of Policies and Recommendations for Wind Turbine Setbacks from Residences – MN Dept. of Commerce; 2011

# LLCHD Conclusions

- The percent of annoyed people
  - Varies by site
  - Increases with noise level
  - Is associated with wind turbines being present
- Annoyance is a health issue – sleep disturbance and measurable stress responses (cortisol and blood pressure)
- 35 to 40 dBA Leq appears to be acceptable for about 80% of people near wind turbines



**PUBLIC** | Every One.  
**HEALTH** | Every Day.  
Every Where.

# LLCHD Conclusions

- Major data gaps are reason for caution and conservative noise standards for wind turbines
  - No data on the impact of wind turbine noise on children
    - Studies on other sources of noise have found correlations between noise and lower cognitive performance in children
  - No “chronic” health outcome data
    - Large industrial wind turbine facilities are a “new” phenomena
    - Chronic data (after 20 to 30 years of exposure) is not available

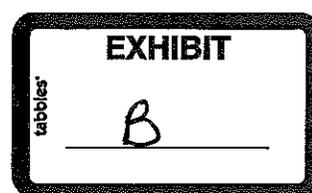


**PUBLIC** | Every One.  
**HEALTH** | Every Day.  
Every Where.

# Proposed Noise Limits in the Text Amendment

13.018 Commercial Wind Energy Conversion System (CWECS).

- 40 dB(A) measured as a 10 min Leq during daytime hours (7 am to 10 pm)
  - Or 3 dB(A) above background noise level (9 hour Leq)
- 37 dB(A) measured as a 10 min Leq at night
  - Or 3 dB(A) above background noise level (15 hour Leq)
- Measured at the dwelling unit



**Subject:** Lancaster County Noise Control Ordinance  
**From:** Marilyn McNabb <mmcnabb1@windstream.net>  
**Date:** 10/19/2015 8:24 PM  
**To:** Marilyn McNabb <mmcnabb1@windstream.net>

Noise Control Ordinance, Chapter 8.24, Section 8.24.090 Noise Disturbance Prohibited

Table 1. Sound Levels by Receiving Land Use

Receiving Land-Use Category	Time	Sound Level Limit in dBA Maximum Ten-Minute Leq Level
Residential	7:00 a.m. to 10:00 p.m.	65
	10:00 p.m. to 7:00 a.m.	55
Noise-sensitive zone, or agricultural residential	7:00 a.m. to 10:00 p.m.	60
	10:00 p.m. to 7:00 a.m.	50
Commercial or business	At all times	70
Industrial At all times	At all times	75
Agricultural	6:00 a.m. to 10:00 p.m.	75
	10:00 p.m. to 6:00 a.m.	50

**Notes:**

\* Unless a different time period has been specified for the specific types of noise disturbances listed under 8.24.090(a).

\*\* Slow meter response or use meter with Leq function.

**Subject:** Wind Turbine Noise Zoning and Health  
**From:** Marilyn McNabb <mmcnabb1@windstream.net>  
**Date:** 10/13/2015 10:10 AM  
**To:** commish@lancaster.ne.gov

Dear Lancaster County Board of Commissioners:

Thank you for the opportunity for the public to voice views at the hearing next Tuesday on the zoning rules for wind turbines in our county. Because I have been a member of the Wind Energy Text Amendment Working Group, I have done some reading on this subject and would like to share my thoughts in writing. I write as a citizen who has sorted through a lot of information, but not as an expert on sound or statistics. However, I think I--and you--can understand what is important about the recently published studies on the effects of wind noise on the nearby public, and what the implications are for regulation.

The Lancaster County Health Department's recommendations for regulation of noise levels for Wind Turbine Noise (WTN) are considered by the applicant wind company to eliminate the prospects of development of wind in the county. They are far more restrictive than those of other Nebraska counties, neighboring states, or most other locations in the country. I have read the studies the Health Department cited as the basis for its recommendations with an eye to understanding what has been learned recently that calls for higher wind noise controls than adopted elsewhere. I find, on the contrary, that the best of the new studies gives a great deal of reassurance that people living near wind turbines will not suffer negative health impacts from turbine noise. The exceptionally tough standards proposed by the Health Department appear to me to be unwarranted by current research.

In its "Recommendation for Noise Levels from Commercial Wind Energy Conversion Systems," the Department says that in reaching its conclusion, "[o]f particular importance to the updated recommendations were findings in studies published in late 2014 and early 2015. These studies expanded and improved the knowledge of the potential health risk posed by wind turbine noise. . ." The five studies listed on pages 3 and 4 of the "Recommendations" will be referred to here as 1) the Massachusetts report, 2) Schmidt and Klokker, 3) the WHO paper (World Health Organization), 4) the Expert Panel Review and 5) the Health Canada Study. We add a sixth, published in Nov. 2014, called here the MIT Review ("Wind Turbines and Health, a Critical Review of the Scientific Literature, Journal of Occupational and Environmental Medicine, Vol 56, issue 11) We agree with the Health Department that the analyses published in the last year advance knowledge in important ways.

This discussion is divided into two parts, the first about objectively-measurable health risks such as high blood pressure or sleep disturbance. The second is about levels of "annoyance,"

defined by WHO as an subjective experience that may include anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation or exhaustion. Annoyance is self-reported, not objectively measured.

### 1. Objectively measured health effects of Wind Turbine Noise (WTN)

The Lancaster County Health Department correctly called the Health Canada Wind Turbine Noise and Health Study "a very well designed epidemiological study." There are important reasons to credit it as the best one so far. It is more comprehensive than previous reports in a number of ways. In two Canadian provinces, it surveyed more people (1238 households) over more time (4000 hours) and gathered objectively measured information on health effects and also used self-reports. It recorded actual measurements of blood pressures, a chemical indicator of stress over time found in hair, and several aspects of quality of sleep using a wrist-worn monitor. It also made actual measurements of sound rather than relying only on modelling, as almost all previous studies have done.

The results: wind turbine noise (WTN) was found not to be related to blood pressure or stress. Wind turbine noise levels "near the participants' home was not found to be associated with sleep efficiency, the rate of awakenings, duration of awakenings, total sleep time, or how long it took to fall asleep." As for self-reported sleep disturbance and difficulties, illnesses (dizziness, tinnitus, prevalence of frequent migraines and headaches) and chronic health conditions (e.g., heart disease, high blood pressure and diabetes), "the prevalence was not found to change in relation to WTN levels." The health issues that Health Canada examined are a compilation of essentially all of the health issues alleged to be the results of WTN in previous studies. All these health issues were found not to be related to exposure to wind turbine noise.

Of the five documents the Health Department lists as the basis for its recommendations, only Health Canada conducted its own, original study. The WHO paper did not address the specific subject of wind noise. The others are studies of studies. Health Canada is the most important new study and its conclusion that the prevalence of health effects was not found to change in relation to WTN levels, the most important finding.

### 2. Subjectively-reported annoyance of WTN

Health Canada also studied annoyance, which is subjective and self-reported. While annoyance is not included in the International Classification of Diseases, it has been used in noise studies for many decades. Health Canada found "support for a potential link between long term high annoyance and health." It found WTN annoyance to be "statistically related" to several self-reported health effects as well as several measured indicators of stress, but they "were not dependent on the particular levels of noise or particular distances from the turbines. . ."

Reasons for reported annoyance, Health Canada found, can be matters other than noise, including the visual appearance of the turbines or their blinking lights. As with other studies,

Health Canada found that those who benefited from payments for land use were significantly less annoyed. Health Canada has pointed out that "it is not clear if those receiving economic benefit experience lower WTN annoyance because they gain financially, or if they began with a lower annoyance and, therefore, were more likely to become participating receptors in the first place. Similarly, the interaction between visual annoyance and noise annoyance is equally difficult to disentangle. In both cases, it is difficult to make causal statements about the relationship between exposure to WTN and community annoyance and, therefore, to set science-based sound level limits." (Health Canada, "Research Design and Noise Exposure Assessment," p. 3)

The MIT review discussed a number of ways that annoyance study results can be distorted. One is a "nocebo response" resulting from negative expectations, also "selection bias," with individuals with complaints more likely to volunteer for the study, "information bias" with respondents simply overestimating or under estimating health effects—and "confounding bias," the mixing of possible effects of other risk factors because of correlation with exposure. It said, "In most surveyed populations, some individuals (generally a small proportion) report some degree of annoyance with wind turbines; however, further evaluation has demonstrated. . .[f]actors such as attitude toward visual effect of wind turbines on the scenery, attitude toward wind turbines in general, personality characteristics, whether individuals benefit financially from the presence of wind turbines, and duration of time wind turbines have been in operation have all been correlated with self-reported annoyance; and annoyance does not correlate well or at all with objective sound measurements or calculated sound pressures." (p. 117)

In discussing the largest epidemiological study of wind turbine noise before Health Canada's, the MIT review looked at non-acoustical factors associated with annoyance and concluded, "Logistic regression showed that sound levels, noise sensitivity, attitudes toward wind turbines and visual effect were all significant independent predictors of annoyance. Visual effect was found to have an effect size in the medium to large range." Overall, "Our review suggests that these other risk factors play a more significant role than noise from wind turbines in people reporting annoyance." (p. 126)

Also indicating that there are problems in assessing the significance of annoyance are what certainly appear to be contradictions with the results of other factors. Health Canada found measures associated with stress—hair chemistry concentrations and blood pressure measurements—as well as self-reported stress, not to be affected by exposure to WTN. The Massachusetts report concluded "the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems," (p. 6) Health Canada found that WTN was not associated with any significant changes in reported quality of life in any of the four WHO domains: physical, environmental, social and psychological. And yet annoyance is defined in terms that would seem to affect individual stress, mental health problems and social and psychological domains of quality of life. The very definition of annoyance addresses psychological distress and mental health problems, including "anger, disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety,

distraction, agitation or exhaustion."

Clearly self-reported annoyance is a slippery concept, yet it appears to be the main basis for the Health Department's call for tough standards. In its "Recommendations," (pp. 2 and 3), two of the four points are based on annoyance, one cites uncertainty about health impacts and one refers to the possibility of a sensitive subset of the population. None discusses the Health Canada findings of no evidence to support a link between exposure to WTN and health effects reported by people living near the turbines.

My recommendation to the Board is to consider the wisdom of the impressively-credentialed authors of the Massachusetts report who urged their policy makers to consider "trade-offs between environmental and health impacts of different energy sources, national and state goals for energy independence, potential extent of impacts, etc." in setting sound levels (p. 60). In other words, it is important to look at the broad public policy implications of the decision. In our situation public policy considerations also include benefits to farmers who want to harvest wind energy from their land and to county taxpayers, who would welcome sharing the load with a new wind development.

Thank you for considering my views.

Sincerely,

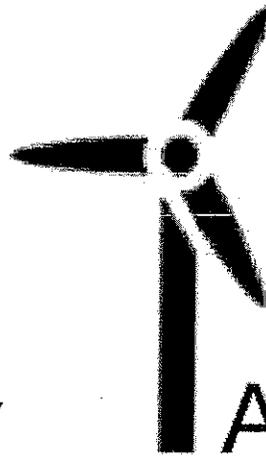
Marilyn McNabb

[mmcnabb1@windstream.net](mailto:mmcnabb1@windstream.net)

402-476-7463

1701 W. Rose St.

Lincoln, NE 68522



REAL PROPERTY TAX RELIEF

through Wind Development

*Approximate yearly property tax revenue from  
wind farms in a number of counties...*

Boone - \$800,000/year

Custer - \$1 million/year

Gage - \$200,000/year

Jefferson - \$260,000/year

Knox - \$800,000/year

Webster - \$860,000/year

Handwritten notes: ~~Handwritten~~ #21

Economic Development <i>Direct, Indirect, Induced</i>	Benchmark	Iowa 2014	Nebraska 2014
Wind Expansion	1,000 MW	6,000 MW	900 MW
Total Project Investment	\$1.7 billion	\$10.2 billion	\$1.5 billion
Annual State Personal Income Tax Increase	\$550,000	\$3,300,000	\$495,000
Annual Property Tax Increase	\$1,495,000	\$8,970,000	\$1,345,500
Annual Nameplate Capacity Tax Revenue (replaces property taxes that would otherwise be imposed on wind infrastructure).	\$3,518,000	\$21,108,000	\$3,166,200
Total Annual Revenue Increase	\$5,563,000	\$33,378,000	\$5,006,700
20 Year Nebraska Tax Revenue Increase	\$111,260,000	\$667,560,000	\$100,134,000
Additional New Jobs for Rural Nebraska	480	2880	432
+ manufacturing		-wind turbines	-parts
+ indirect & induced impacts			

#### What are DIRECT, INDIRECT and INDUCED EFFECTS?

Most approaches for quantifying local economic impacts characterize economic impacts based on direct, indirect, and induced effects. The same terms are used in computable general equilibrium and hybrid macroeconomic models.

**DIRECT** effects are changes in sales, income, or jobs associated with the on-site or immediate effects created by an expenditure or change in final demand; for example, the employment and wages for workers who assemble wind turbines at a manufacturing plant.

**INDIRECT** effects are changes in sales, income, or jobs in upstream-linked sectors within the region. These effects result from the changing input needs in directly affected sectors; for example, increased employment and wages for workers who supply materials to the turbine assemblers.

**INDUCED** effects are changes in sales, income, or jobs created by changes in household, business, or government spending patterns. These effects occur when the income generated from the direct and indirect effects is re-spent in the local economy; for example, increased employment and wages for workers at the local grocery store because turbine assemblers use their increased wages to buy groceries.

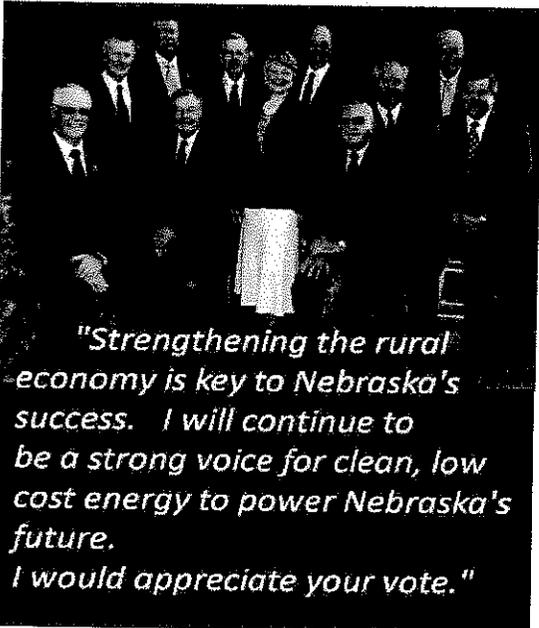
Source: *Assessing the Economic Benefits of Clean Energy Initiatives*, US Environmental Protection Agency

EXHIBIT  
tabbles®  
D



RE-ELECT  
Mary  
Harding

NEBRASKA PUBLIC POWER DISTRICT  
CLEAN LOW COST ENERGY



*"Strengthening the rural economy is key to Nebraska's success. I will continue to be a strong voice for clean, low cost energy to power Nebraska's future. I would appreciate your vote."*

**Committed to low rates**

I will continue to work for efficient, cost effective energy options for the customer, to build a strong economy for Nebraskans.

**12 Years Experience at NPPD**

I currently chair the Budget Committee, and was Corporate Secretary for 7 years. I served two terms on the Board of Southeast Community College and have more than 25 years experience protecting the public interest and balancing budgets.

**Focused on the Future**

Wind energy creates local jobs for young families, provides new sources of farm income and protects our natural resources for our children and grandchildren.

I will continue to advocate for balanced investment including renewable energy.

RE-ELECT  
Mary  
Harding

NEBRASKA PUBLIC POWER DISTRICT  
CLEAN LOW COST ENERGY

Paid for by Mary Harding for NPPD  
4316 S 48 #1, Lincoln NE 68516





Daniel Clausen  
Wind Energy Meeting Testimony  
Oct. 20, 2015



*an honor  
to be a part of this*

Hello. Thank you for holding this meeting on such important issues. It's good to see that deliberative democracy is still strong in Nebraska.

I wasn't born in Nebraska, but my grandparents were. I grew up rooting for the Huskers, and since I had privilege of coming here to attend UNL, I've come more and more to appreciate why "The Good Life" is a such a fitting motto for this great state. The rich cultural and political heritage, the strong family oriented communities, and the virtues of self sufficiency, responsibility, and community spirit that we see everyday in Nebraska are all too rare in the world today.

But now we are all faced with a new problem, and a large problem. We know from our scholars and scientists that our energy-hungry way of life is endangering the places we live, both directly and indirectly, and so endangering the lives—the good lives—in those places. But we are also doing what we can to make positive changes. Lancaster County, of course, can only deal with only one small part of a global problem. But if we don't take care of our place, no one else will.

The current situation is that Lancaster county is finally going to have a wind farm—something that surrounding states have long since embraced. This project can provide electricity for Lincoln and the surrounding areas, and a windfall to landowners. But now that wind farm seems to be in jeopardy due to legitimate worries about health impacts.

Last year, a team of six doctors and researchers from MIT and other institutions published "a critical review and synthesis of the evidence available from the eight study populations studied to date (and reported in 14 publications)". They concluded they were able to "provide some insights into the hypothesis that wind turbine noise harms human health in those living in proximity to wind turbines."

Their findings were clear, and not in contradiction of the studies provided by the planning commission. Here are the most important findings:

- \* No clear or consistent association is seen between noise from wind turbines and any reported disease or other indicator of harm to human health.
- \* In most surveyed populations, some individuals (generally a small proportion) report some degree of annoyance with wind turbines; however, further evaluation has demonstrated:
- \* Factors such as attitude toward visual effect of wind turbines on the scenery, attitude toward wind turbines in general, personality characteristics, whether individuals benefit financially from the presence of wind turbines, and duration of time wind turbines have been in operation all have been correlated with self-reported annoyance; and
- \* **Annoyance does not correlate well or at all with objective sound measurements or calculated sound pressures.** //

The studies these scholars examined were located around the world, from Scandinavia and Poland to the US. In all cases, the only time that people reported increased annoyance and stress was when they were already negatively disposed toward wind turbines.

I am not opposed to regulating industry to protect public health, in fact, I heartily support it. Part of our duty is to protect the weak and vulnerable from the excesses of the powerful—that is nothing more than equality before the law. But in determining the threshold level of noise which we can accept from a wind farm, we must make decisions based on facts and on fairness.

*Wind Turbines & Health: A critical Review of the Scientific Literature*  
*Journal of Occupational & Environmental Medicine*  
*McConney et al*  
*Nov. 14*

*study*

*do not directly agree with earlier*

Daniel Clausen  
Wind Energy Meeting Testimony  
Oct. 20, 2015

F

Those who wish to restrict the wind farm's noise argue that the noise causes annoyance, annoyance causes stress, and stress causes ill health effects. <sup>over</sup> Even if this were true, any perceived ill health effects are at best three steps removed from the wind farm, and could have a wide variety of other contributing factors.

But we don't even have to go that far. As the MIT researchers showed, annoyance is *not* related to the objective sound measurements. It is related to how people think of the turbines, and the longer the turbines are there, the less people complain. Given a chance, the turbines become a part of the landscape, just as the windmills of the homesteaders did 100 years ago (I'm sure those were quite an annoyance to the Pawnee and the Omaha). <sup>one</sup>

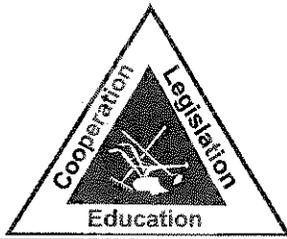
I know that many people here today are worried about the destruction of a "good life" that they found on an acreage outside of town. Granted, there will be some change, some decline from a romantic ideal. <sup>an original</sup>

I understand that ideal. I hope to find it too someday. But I am also annoyed with threats to my own good life every day. I am annoyed by aggressive drivers who threaten me on my bicycle commute. I am annoyed with, <sup>drunk driving, driving at night</sup> pollution, drunk driving, and litter on game days. I am annoyed that this state imports most of its electricity in the form of coal from Wyoming. All of these annoyances have more direct health impacts than the subtle noise from proposed wind farms, and yet we don't hear complaints about these in the same way.

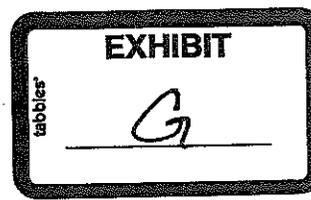
<sup>an</sup> And we should also remember those Nebraska virtues: self-sufficiency, responsibility, and community. We should put wind farms where the energy will be used, and where the ecosystems and landscapes are already dominated by development—not "out of sight" in places like the ecologically fragile Sandhills, or out of reach of transmission in the grandly empty landscapes of the West. Wind energy helps create local jobs, it keeps more money in the state, and is far healthier than coalsmoke or radioactive waste. <sup>not 45</sup> encourage the county to remain with the balanced and reasonable noise ordinance of 50 dba, rather than creating one of the strictest regulations in the country based on the prejudices of a small group despite <sup>desires</sup> 80% of area residents support of wind energy.

~~My great uncle claims that the ammonia stink of hogs is the smell of money. I just can't bring myself to agree—but I know the sound of a wind turbine is the sound of a healthier future.~~

Thank you. <sup>to me</sup>



# Nebraska Farmers Union



Office: 402-476-8815  
Fax: 402-476-8815  
1305 Plum Street  
Lincoln, NE 68502

[www.nebraskafarmersunion.org](http://www.nebraskafarmersunion.org)

October 20, 2015

Lancaster County Commissioners  
555 South 10<sup>th</sup> Street, Room 110  
Lincoln, NE 68508

Testimony on Lancaster County Zoning Ordinance Public Comment Process

From: John K. Hansen, President, Nebraska Farmers Union, 1305 Plum Street, Lincoln, NE 68502

Chairman Roma Amundson,  
Commissioner Bill Avery  
Commissioner Larry Hudkins  
Commissioner Deb Schor  
Commissioner Tod Wiltgen

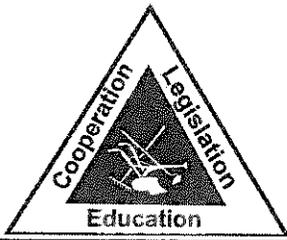
Thank you for this opportunity to testify before you on this issue today. I am John Hansen, President of Nebraska Farmers Union, our state's second largest general farm organization, representing over 5,671 farm and ranch families and rural communities. We are very big supporters of local control. I believe this to be the first time in over 25 years that I have testified on behalf of my organization before any County Commissioners.

I am here tonight because I firmly believe that what Lancaster County decides on the issue before you will have either positive or negative repercussions that will reach far beyond the boundaries of Lancaster County relative to wind energy development in our state. Harvesting our world class wind resources, ranked third in the nation, is a new and exciting agricultural activity that provides our farmers with new opportunities for steady additional farm income, and rural communities with new ways to bring badly needed new tax bases and good paying jobs to rural Nebraska.

This issue, like all siting issues, is a matter of striking the proper balance between competing interests of production agriculture, landowners, rural residents, wind developers, and the general public. In order to help my organization help you find that proper balance, we have retained the services of a nationally recognized expert on wind noise and flicker issues, Peter Guldberg, of Tech Environmental from Waltham, MA. The consulting firm he heads works for both communities and wind developers. We thought his firm was objective, experienced, and used to working with wind project issues in more heavily populated areas of the country, although his firm has worked a good deal in the Midwest.

We are enclosing the short letter from Peter Guldberg to you with our written testimony. His recommendations are for 50 dBAs for daytime and 45 dBAs for nighttime for noise. Mr Guldberg believes that these levels strike the proper balance that still allows commercial wind development to take place while protecting the health of the wind farm neighbors.

*Fighting for Nebraska's family farmers and ranchers since 1913.*



# Nebraska Farmers Union

Office: 402-476-8815  
Fax: 402-476-8815  
1305 Plum Street  
Lincoln, NE 68502

[www.nebraskafarmersunion.org](http://www.nebraskafarmersunion.org)

Wind development is a big deal for Nebraska agriculture, and our state as a whole. Renewable energy is overwhelmingly supported by the public, including rural residents as witnessed by the recent University of Nebraska Rural Poll, that we have highlighted for you in our handouts that show that 75% of rural Nebraskans, including 80% of rural residents from southeast Nebraska want more wind energy developed.

By the end of 2016, Nebraska will have 1,324 megawatts of electrical generation built and on line. At an estimated annual rate of \$4,000 per MW, that amounts to \$5.296 million of additional farm income. At an estimated annual rate of \$6,500 per MW, that amounts to \$8.606 million of new additional tax revenues. At an estimated cost of \$1.75 million per MW, that is a capital investment in rural communities of \$2.3 billion. At a minimum, this wind development will bring at least 130 good paying jobs with benefits. These are the kinds of jobs that keep rural kids in rural communities to raise their families.

Nebraska Farmers Union firmly believes wind development to be an agricultural activity. As you consider setting noise and siting standards for wind energy development, we feel you also need to consider what those standards would mean for other agricultural activities. For example, if the 37 dBAs at night and 42 dBAs for daylight operation recommendations were adopted and applied to other agricultural activities, Lancaster County farmers could not plant, harvest, haul or dry crops, wean calves, or raise hogs.

In the past 8 years, my organization has made over 600 presentations across the state of Nebraska bringing them the latest and most current information on renewable energy. Nebraskans want our state to find a way forward with responsible wind development. The Guldberg recommendations that we have provided you with this evening square with our own 11 years of experience in helping rural communities strike the proper balance between competing interests to move forward with wind energy development. We hope they are helpful and useful to you in your deliberations.

A final thought. We support zoning standards that protect the public health. We believe it is not possible or proper to use zoning standards to eliminate all annoyances. After all, the perception of annoyance, like the perception of art is in the eye of the beholder. The only sure way to prevent annoyance is to prevent business development and operation. If that standard were to be applied to all other areas that cause annoyance for some people, our entire business structure would collapse. No more roads, airports, railroads, etc.

Thank you for your time and attention. We are glad to be of assistance to you as your deliberations move forward.

*Fighting for Nebraska's family farmers and ranchers since 1913.*



**TECH environmental**

FOCUSED KNOWLEDGE. REAL SOLUTIONS.

October 16, 2015

Lancaster County Commissioners  
City-County Building  
555 South 10<sup>th</sup> Street, Room 110  
Lincoln, NE 68508

Ref 4049

***Re: Lancaster County – Proposed Wind Turbine Sound Limits***

Dear Board of Commissioners:

On behalf of the Nebraska Farmers Union, Tech Environmental, Inc. (TE) is pleased to provide comments on, and recommendations for, the proposed sound level limits for wind turbines in Lancaster County, Nebraska.

**Qualifications**

I am a Full Member of the Institute of Noise Control Engineering (INCE) and a Certified Consulting Meteorologist (CCM), with 40 years of experience as an acoustic and environmental consultant. I have testified in court on cases involving wind turbines and noise, and have been certified as an expert on the subject. I have completed acoustic studies for 85 wind turbines in 15 States, from Oklahoma to Maine. While my practice involves work on behalf of developers, I also provide independent peer-review consulting to the Maine Department of Environmental Protection (DEP) for all utility-scale wind projects in that State and have provided similar peer-review consulting to municipalities in several other States.

**Proposed Sound Limits**

From my review of all current studies and expert-panel reviews, I can attest that a sound level limit of 45 dBA  $L_{eq}$  (equivalent sound level) at night will protect nearby residents from adverse health effects and annoyance, while allowing some form of wind farm development. This is the reasonable balance the County Commissioners should seek. Both the US EPA and World Health Organization (WHO) have published residential noise guidelines recommending a nighttime, outdoor  $L_{eq}$  sound limit of 45 dBA to prevent sleep disturbance (with the window open for air).

Sound limits can be 5 dBA higher in the daytime and still prevent interference with outdoor, daytime activities. Thus, I recommend the Commissioners adopt daytime outdoor sound limits of 50 dBA  $L_{eq}$  for wind farms in Lancaster County. At this level, wind farms can be pursued as a viable agricultural activity.

I understand others have put forth a 42 dBA or lower for the nighttime limit. In acoustics, halving the sound power of discrete sound sources, by halving the number of sources in a fixed area, causes the sound pressure level heard at a distance to drop by 3 dBA.<sup>1,2</sup> Thus, reducing the nighttime sound limit from 45 dBA to 42 dBA will have the effect of halving the number of allowable turbines on any section of land and will generally make a project economically infeasible. The 37 dBA limit recommended by the Planning Department is effectively a “back-door” ban on wind farms as an agricultural activity, given the typical location of occupied structures along the boundaries of sections and quarter-sections of agricultural land.

### **Review of the Cooper Study**

I understand the Lancaster County Planning and Health Departments have received comments about a study of the Cape Bridgewater Wind Farm in Australia (the “Cooper study”), from a member of the Wind Energy Working Group, who claims it shows wind turbines cause adverse health effects. The Cooper study demonstrates nothing of the sort.

The Cooper study has six fatal flaws and does not qualify as objective research:

1. Self-selection bias. Only a small group of six people were selected, who are complainants and have admitted to having strong anti-wind attitudes.
2. No control group was used, as required in all scientific studies.
3. Nothing was done to control for confounding variables, specifically the fact that turbine operations follow wind speed and wind gusts closely, and natural wind-turbulence low-frequency sound is highest during high wind speeds and wind gusts.
4. No control was made for the Nocebo Effect, the belief based on fear that something unmeasurable will bring harm.
5. Use of a non-objective measure. Cooper had participants record in a diary their “sensations” such as “feeling of heaviness, or heart racing”.
6. The study was not peer-reviewed.

Cooper notes on page ii of the Executive Summary: “For one resident, sensation, noise and vibration were observed with the wind farm shutdown”. That is, the participants were trying so hard to feel “sensations” that they felt them even when the wind farm was not operating. This fact helps illustrate why the Cooper study is not a credible piece of research.

---

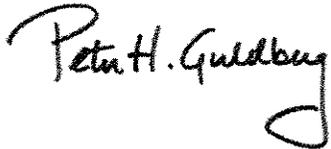
<sup>1</sup> Beranek, Leo, Noise and Vibration Control, published by the Institute of Noise Control Engineering, 1988, p. 41.

<sup>2</sup> And, similarly, doubling the sound power of discrete sources by doubling the number of them in a fixed area increases the sound pressure level heard at a distance by 3 dBA.

Thank you for the opportunity to provide my comments and recommendations.

Sincerely yours,

TECH ENVIRONMENTAL, INC.

A handwritten signature in black ink that reads "Peter H. Guldberg". The signature is written in a cursive style with a large, looped initial "P" and a distinct "G" at the end.

Peter H. Guldberg, INCE, CCM  
Senior Principal  
4049/Letter Oct 16 2015

# Public Opinion In Rural Nebraska

## The 2015 UNL Nebraska Rural Poll- Selected Results

**Most rural Nebraskans agree that more should be done to develop solar or wind energy as well as ethanol or biodiesel energy in Nebraska.**

80% of rural Nebraskans agree or strongly agree that more should be done to develop solar or wind energy in Nebraska.

59% agree or strongly agree that more should be done to develop ethanol or biodiesel energy in Nebraska.

**Most rural Nebraskans believe Nebraska should invest more in wind and solar energy over the next several years. Approximately three-quarters of rural Nebraskans believe the state should invest much more or somewhat more in both wind and solar energy. 80% of the residents of the South-east region believe the state should spend more on wind energy over the next several years, compared to 68% of the residents of the North Central region.**

**Most rural Nebraskans have undertaken various energy conservation projects on their current home**, including: purchased fluorescent or LED light bulbs; purchased more energy-efficient appliances; sealed air leaks around windows and/or doors; up-graded insulation, windows or doors in the home; and purchased a more energy-efficient air conditioner, water heater or furnace.

**Most rural Nebraskans believe the state should develop a plan for adapting to climate change** in order to reduce its impact on agriculture, rural communities, forestry and natural resources. Over six in ten rural Nebraskans (61%) agree or strongly agree that Nebraska should develop a plan for adapting to climate change in order to reduce its impact on agriculture, rural communities, forestry and natural resources. Fewer than two in ten (17%) disagree with the statement. Almost seven in ten persons age 19 to 29 (69%) agree with this statement, compared to 58% of persons age 65 and older.

**Many rural Nebraskans are concerned about more severe droughts or longer dry periods in their area**, insect-borne diseases like West Nile Virus, and more extreme summer temperatures in their area. Almost one-half (48%) of rural Nebraskans are concerned or very concerned about more severe droughts or longer dry periods. Just over four in ten rural Nebraskans (41%) are concerned or very concerned about insect-borne diseases and 39% are concerned or very

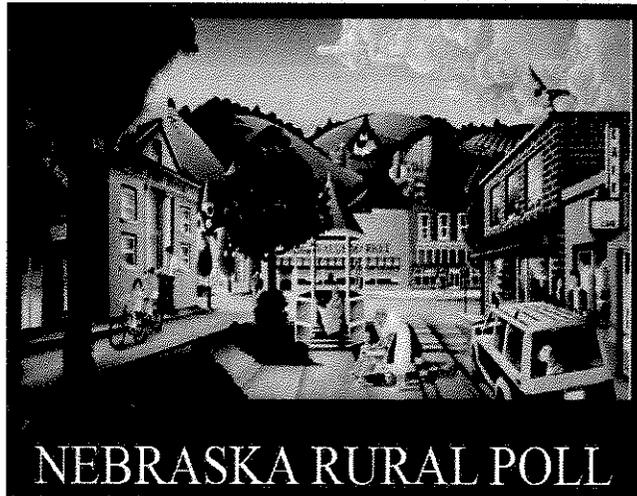
concerned about more extreme summer temperatures. Less than one-quarter of rural Nebraskans are concerned about the availability of water for their community or home or more frequent extreme rains or floods.

**Most rural Nebraskans trust experts regarding information about climate change and its potential impacts**, such

as University of Nebraska experts, scientists in general, and doctors and other public health experts. Seventy percent of rural Nebraskans somewhat or strongly trust University of Nebraska experts, 61% trust scientists in general and 55% trust doctors and other public health experts as sources of information about climate change.

For the Climate and Energy section of the Poll, see this page: <http://bit.ly/UnlRuralsReadyForClimateActionPlan>

For the entire Poll, see this PDF file: <http://bit.ly/RuralPoll15ClimateAndEnergy>



**Nebraska Farmers Union**  
1305 Plum Street, Lincoln, NE 68502  
(402) 476-8815 ~ [NebraskaFarmersUnion.org](http://NebraskaFarmersUnion.org)

# Growing the Rural Economy With Wind

## A Dollars and Cents Look at What 1,324MW of Wind Power Means

- \$5.296 million of new annual income for Nebraska farmers and landowners.
- \$8.606 million of new local tax revenues annually.
- 130 new jobs that are good jobs in rural Nebraska.
- \$2.3 billion of capital investment.

**That** is what Nebraskans will benefit from every year for the next 20 years, just from the wind farms that will be complete and operating by the end of 2016.

And Nebraska has the potential for far more wind power development. This state ranks third of our 50 states for wind power potential and so could reap even more than the substantial benefits that are already committed to our state.

Some other states are taking advantage of their wind resources more than Nebraska is, and they are taking advantage of the revenue as well.

### ***Let's take a closer look at the numbers.***

Nebraska utilities have contracted for the electricity from several new wind farms and when they are all completed in 2016, the total capacity for Nebraska wind farms will total 1,324 MegaWatts (MW).

At a rate of \$4,000 per MW, 1,324 MW's of wind development in Nebraska will yield \$5,296,000 million of new annual revenue for project landowners and farmers.

The 2013 Baird Holm Bluestem study pegged the new property tax revenue realized by local governments at \$6,500 per MW per year for 20 years. These same wind farms will produce \$8,606,000 of new local tax revenues per year.

About 130 new good paying jobs with benefits will be there for the young people who want to stay close to home. With real jobs and a more prosperous community Nebraska can look forward to having more young families again.

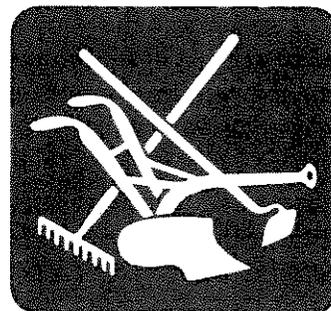
At an estimated \$1.75 million per MW, wind represents over \$2.3 billion of capital investment.

Nebraska has the third most wind energy development *potential* in the nation, yet is tied for 18th in *actual* development with states that have much less potential. As of today, Iowa has 7 times the wind developed as does Nebraska, yet Iowa has substantially less wind capacity and has 3

million people compared to Nebraska's 1.8 million. If Iowa can find a way to balance the interests of wind energy development with their rural residents, so can Lancaster and other Nebraska Counties.

Wind is an essential element of the clean renewable power systems that will make it possible to stop using fossil fuels. This will save us a lot of money in saved doctor and hospital bills because the air will be less polluted. The biggest savings of all will be the bills we do not have to pay to cope with the worst of the coming climate changes like more intense droughts and overall less soil moisture.

Wind development makes good practical sense.

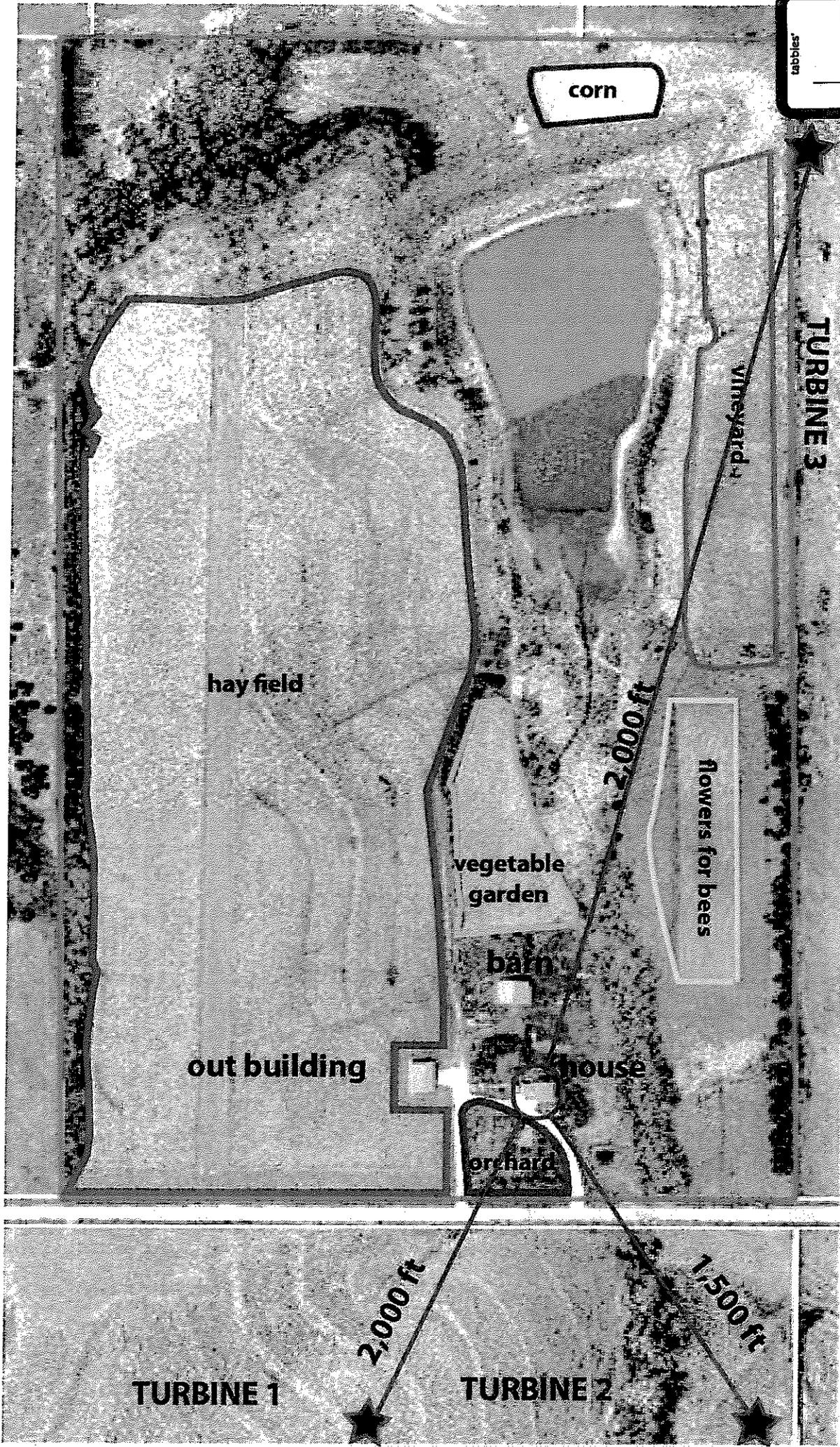


(402) 476-8815

[www.NebraskaFarmersUnion.org](http://www.NebraskaFarmersUnion.org)  
1305 Plum Street, Lincoln, NE 68502

tabbies

H



corn

hay field

vineyard

flowers for bees

vegetable garden

barn

out building

house

orchard

TURBINE 3

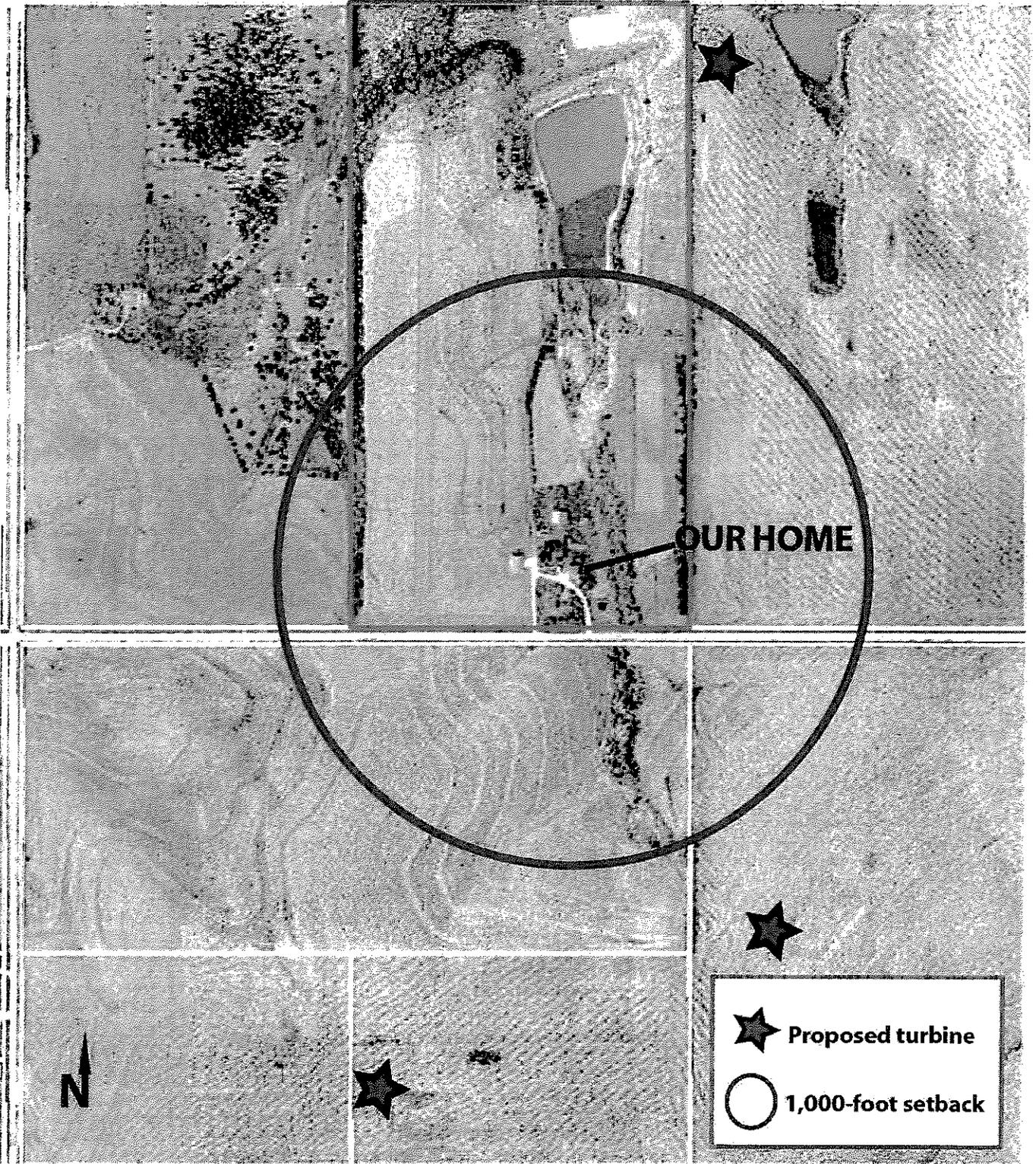
TURBINE 1

TURBINE 2

2,000 ft

2,000 ft

1,500 ft



**OUR HOME**

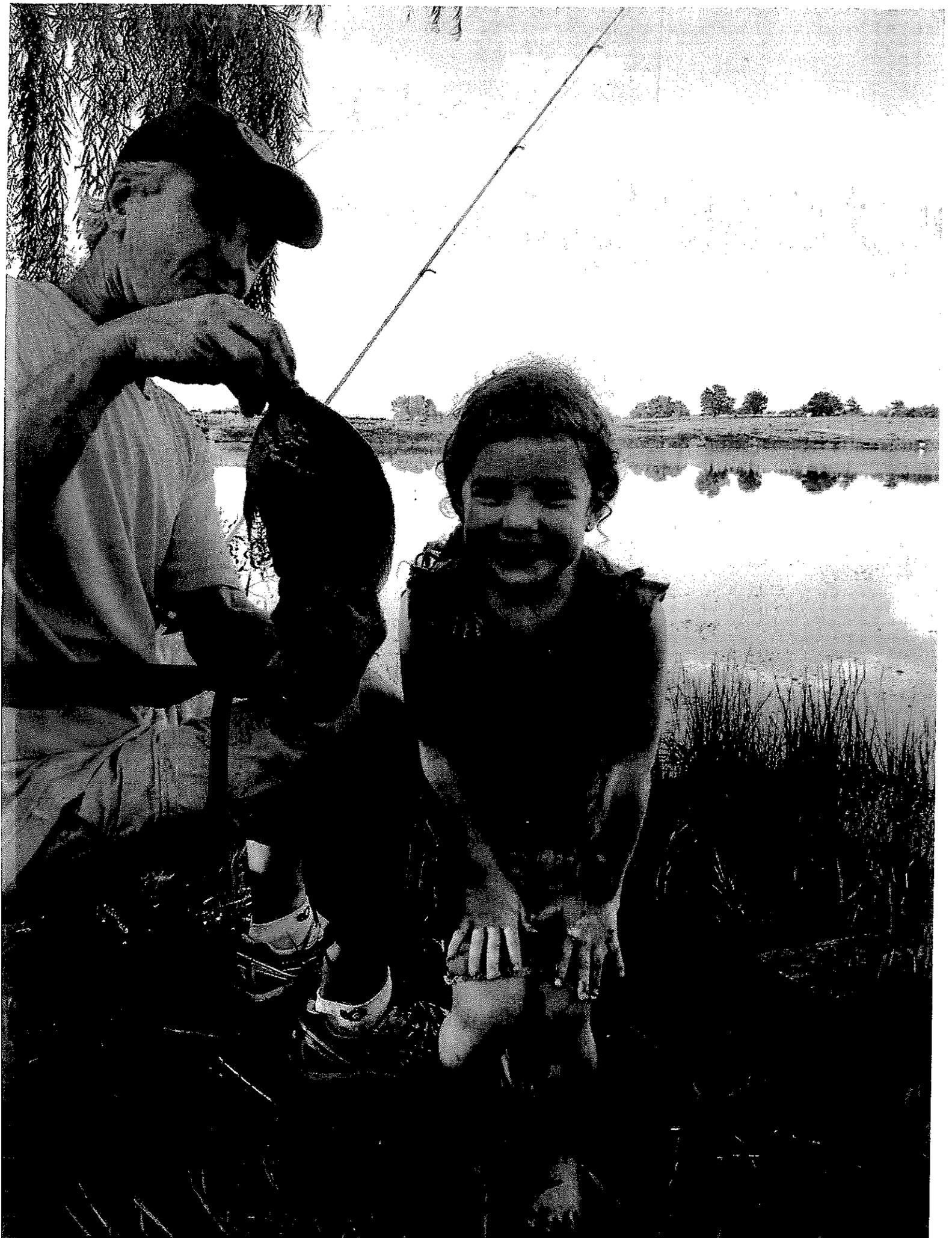


**Proposed turbine**



**1,000-foot setback**

**N**





To : Lancaster County Commissioners

From : Russell Miller  
341 S. 52  
Lincoln, NE 68510

Subject : Wind turbine noise

Hello,

I attended all but one of the Working Group information meetings conducted by Lincoln/Lancaster Planning Dept. that started on 12 March 2015. It was apparent from the beginning that the acreage owners were opposed to the project. At the first meeting the opposition was due to the visual aspects of the towers. At later meetings the opposition focused on the noise which could be a health problem.

Originally, I was in favor of the project because of the project's expected \$700,000 in yearly taxes to be paid to Lancaster County. I think those taxes should be ear-marked for County roads and I think those tax revenues should be part of your decision.

Today, I think the health issues of air pollution from coal fired power generation should be considered. That air pollution affects all 300,000 Lancaster County residents.

After it became a health issue, I started examining various health aspects of electricity generation ; especially coal fired electricity. The Sierra Club website has a page (<http://vault.sierraclub.org/coal/map/>) listing the annual Sheldon power plant pollutants. Scott Holmes (County Health) states those Sierra Club numbers are wrong and the correct or current numbers as accepted by our health department are : 36 pounds of **mercury** (can cause brain damage, heart problems and birth defects), 1.5 million tons of **carbon dioxide** (linked to global warming), 3,200 tons of **sulfur dioxide** (cause lung damage, breathing problems, acid rain), and 2,800 tons of **nitrogen oxides** (breathing problems, more susceptible to chronic lung disease).

In regards to the noise issue I will refer you to Denmark and their national wind turbine system that generated 140% of their electrical needs on 9 July 2015. (Guardian Newspaper 10 July 2015) It was a very unusual,

windy day because normally Denmark produces about 40% of their electricity from wind.

My point is that here is a country that is about 1/5 the size of Nebraska with 3 times Nebraska's population that is using wind turbines successfully. A more pertinent fact is that Lancaster County's population density is 351 persons per sq. mile and Denmark's is essentially the same at 341 per square mile.

Denmark's noise ordinance ( [http://eng.mst.dk/media/mst/66206/engelsk\\_vindmoellebekendtgorelse.pdf](http://eng.mst.dk/media/mst/66206/engelsk_vindmoellebekendtgorelse.pdf) ) in section 4 states :

**"SECTION 4.** The total noise impact from wind turbines may not exceed the following limit values:

- 1) 1) At the most noise-exposed point in outdoor living area no more than 15 metres from dwellings in **open countryside**:
  - (a) 44 dB(A) at a wind speed of 8 m/s.
  - (b) 42 dB(A) at a wind speed of 6 m/s.
- 2) 2) At the most noise-exposed point in areas with noise-sensitive land use:
  - (a) 39 dB(A) at a wind speed of 8 m/s. (b) 37 dB(A) at a wind speed of 6 m/s

RM note : 8 m/s = 17.9 mph, 6 m/s = 13.4 mph I bold print "open country side."

Since Denmark's plan is successfully working, it would seem reasonable to copy their noise regulation BUT I think the noise levels should be 50 dB(A) daytime and 42 dB(A) nighttime.

My reason for the 50dB(A) is that wind generated electricity will replace the pollution from the coal power plants. That benefits the health of all 300,000 County residents and especially approximately 20,000 children under 5 years of age and 33,000 elderly over 65. According to EPA those age group are especially susceptible to air pollution. Their health must be considered in any calculation in permitting the Hallam Wind Project.

Please support the 50 dD(A) daytime and 42 dD(A) nighttime standards.

Thank you,

Russell Miller

402-499-2611 emailed 14 Oct. 15

To : Lancaster County Commissioners

19 October 2015

From : Russell Miller  
341 S. 52  
Lincoln, NE 68510

Subject : Wind turbine noise

This is a copy of my op-ed piece to the Lincoln Journal-Star that was published 3 October 2015. My email to you of 14 October 2015 provided information about Denmark's noise standards. This email is concerned with Lancaster County farmers' expenses, air pollution or health and taxes.

The Journal Star editorial of 31 August 2015 about the noise from the potential Hallam wind-farm omitted several key considerations.

First the County Commissioners, just like the City-County Planning Commission, represent all of the approximately 300,000 persons living in the County. That includes the 265,000 Lincolntes and the true farmers that make their living from the use of their land plus the acreage dwellers considered in the editorial.

The Editorial correctly stated the acreage owners will suffer lost visibility and added noise. The dilemma is where does one person's enjoyment stop and your neighbor's enjoyment start.

The wind turbine's tower is expected to be as high as 450 feet with some type of aircraft hazard light. Some acreage owners are stating that will spoil what they expect an agricultural view should be. With today's farming economics, wind farms and solar fields are becoming the new norm and should be expected.

Many affected acreage owners are concerned with turbine noise and the Editorial explained that topic at length. Again it is because the sound is interfering with what acreage owners expect 'country living' is supposed to be like.

The farmers can have some complaints also. Granted acreage owners have an investment but it pales to nothing in relation to the investment that farming requires. A tractor could cost \$100,000 and a combine with a corn-picker head is approximately \$250,000. When you consider the other costs of land (very significant), housing, fences, etc., farming landowners have to take advantage of every financial opportunity that is available. The only source of income they have is their use of their land and the question becomes should the farmers' income be restricted by their non-farming neighbors?

In other words the farmer's only source of income is tied to the use of his land. Should the desires of a few acreage owners and their small amount of land restrict his use of his land and his potential wind income? All of the land is zoned AG including the acreages which means wind farms are permitted.

The County Health Department information has put considerable emphasis upon the health of nearby occupants to turbine noise. However, all 300,000 Lancaster County residents and society in general benefit from clean air that results from wind generated electrical power.

At this moment in time the Sheldon coal fired plant yearly emits into the atmosphere 36 pounds of **mercury** (can cause brain damage, heart problems and birth defects), 1.5 million tons of **carbon dioxide** (linked to heart attacks, asthma and global warming), 3,200 tons of **sulfur dioxide** (cause lung damage, breathing problems, acid rain), and 2,800 tons of **nitrogen oxides** (breathing problems, more susceptible to chronic lung disease).

These numbers will be reduced by about half when Monolith Materials completes their project of converting one of Sheldon's two boilers from coal to hydrogen.

According to EPA, children and the elderly are very susceptible to air pollution. According to U.S. Census data, Lancaster County has approximately 20,000 children under 5 years of age and 33,000 elderly over 65. Their health must be considered in any calculation of permitting the Hallam Wind Project.

Air pollution literally blows in the wind which means there are days when the 300,000 people living in Lancaster County have no air pollution and other days we get all of it. The health and welfare of those 53,000 susceptible seniors and children must receive equal consideration that the acreage owners receive.

All 300,000 Lancaster residents will benefit from the expected \$700,000 annual taxes that the Hallam wind project is expected to pay. Many Lincolniters do not realize that Lincoln property taxes pay 90% of the County taxes.

Unfortunately, the Hallam wind project will have an impact on the neighboring acreage owners BUT fortunately it will also have major positive financial impact on the farmers, help County taxpayers, and help clean the region's air by providing needed electricity without burning coal.

All of our energy decisions have consequences that we may not see from day to day but that add up over time. If we don't develop a wind industry, we're doomed to keep making electricity from coal, with all of its damages to our health.

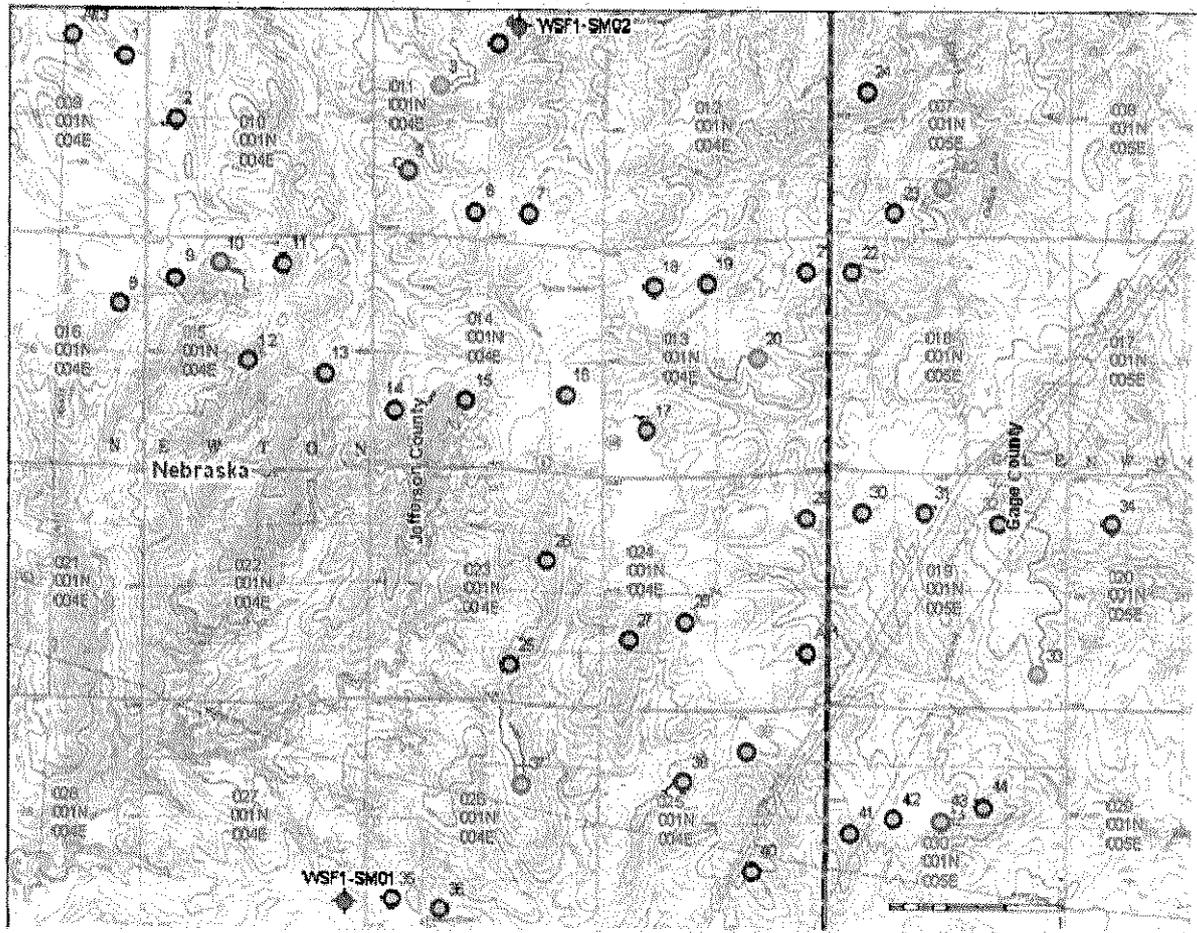
Hopefully, the County Commissioners understand the benefits to the whole County and will increase the noise limits to 50 db daytime and 45 db nighttime.

Thank you,  
Russell Miller

emailed 19 oct 15

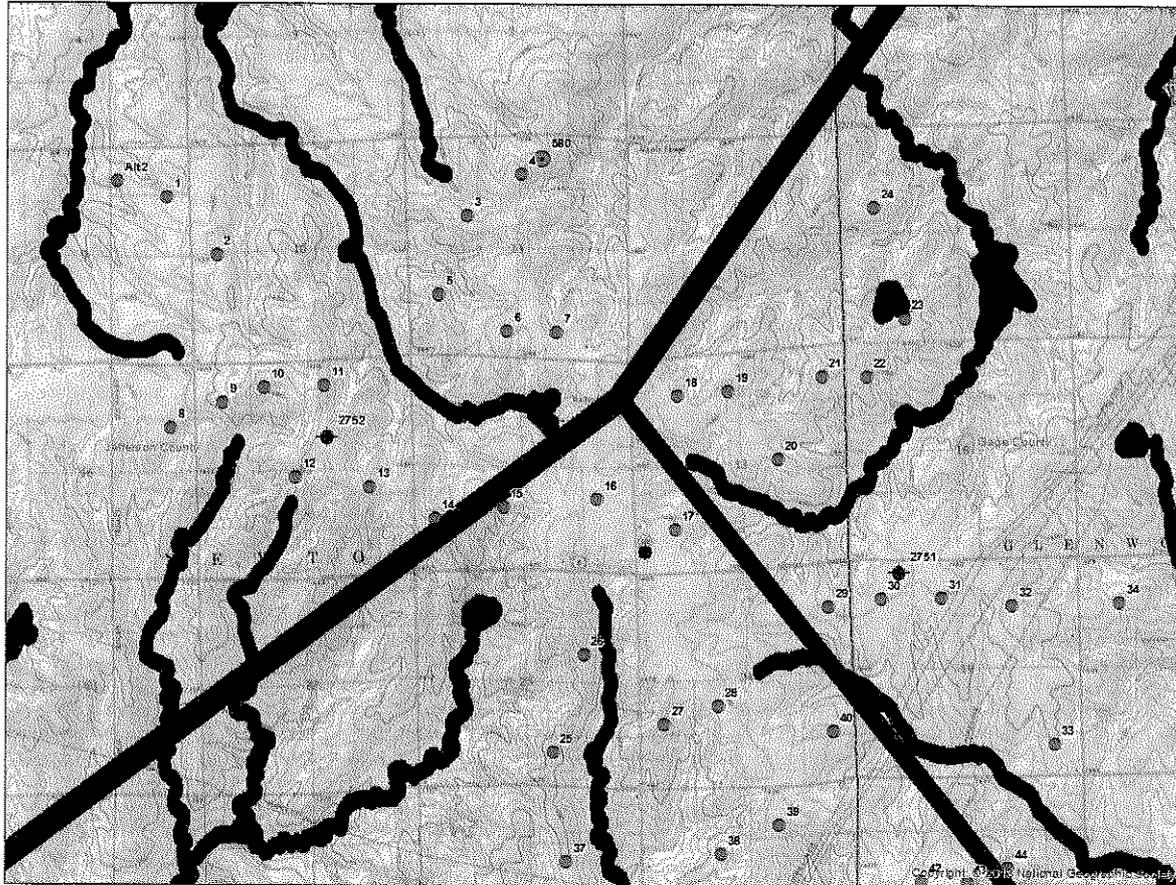
The design of the Steele Flats Wind Project was an iterative process that considered many factors

## Steele Flats Wind Project Setbacks



The design of the Steele Flats Wind Project was an iterative process that considered many factors

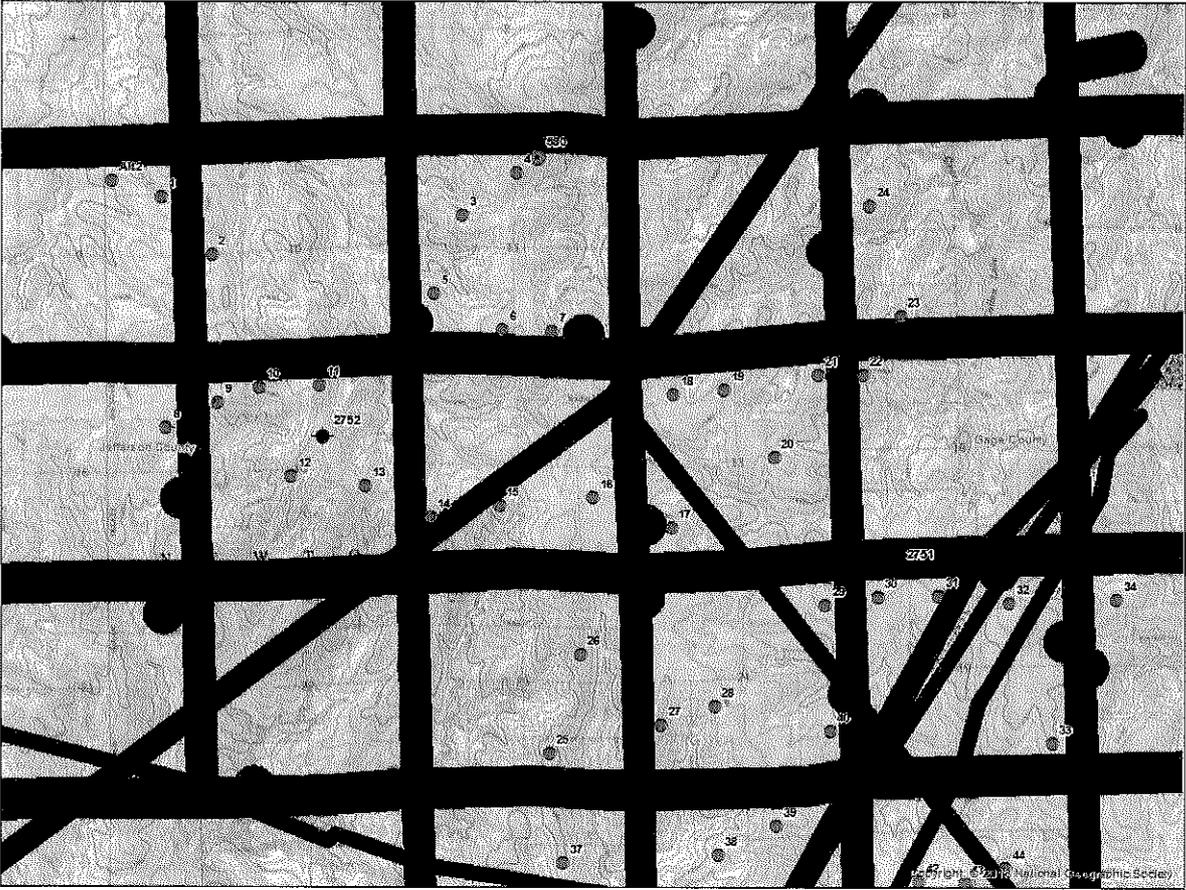
## Steele Flats Wind Project Setbacks (cont)



The wind farm design avoids beam paths, rivers, and water features

The design of the Steele Flats Wind Project was an iterative process that considered many factors

### Steele Flats Wind Project Setbacks (cont)

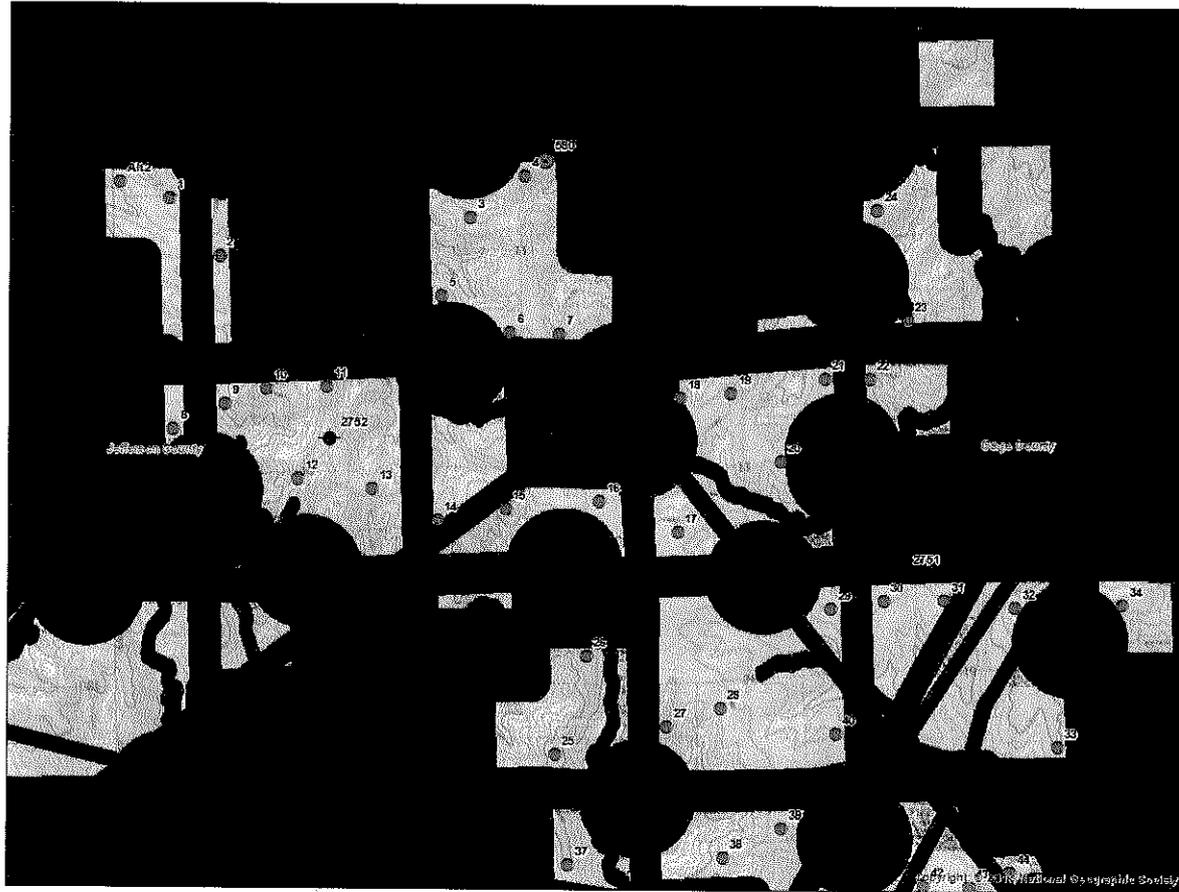


The wind farm design also avoids roads, pipelines, and existing structures



The design of the Steele Flats Wind Project was an iterative process that considered many factors

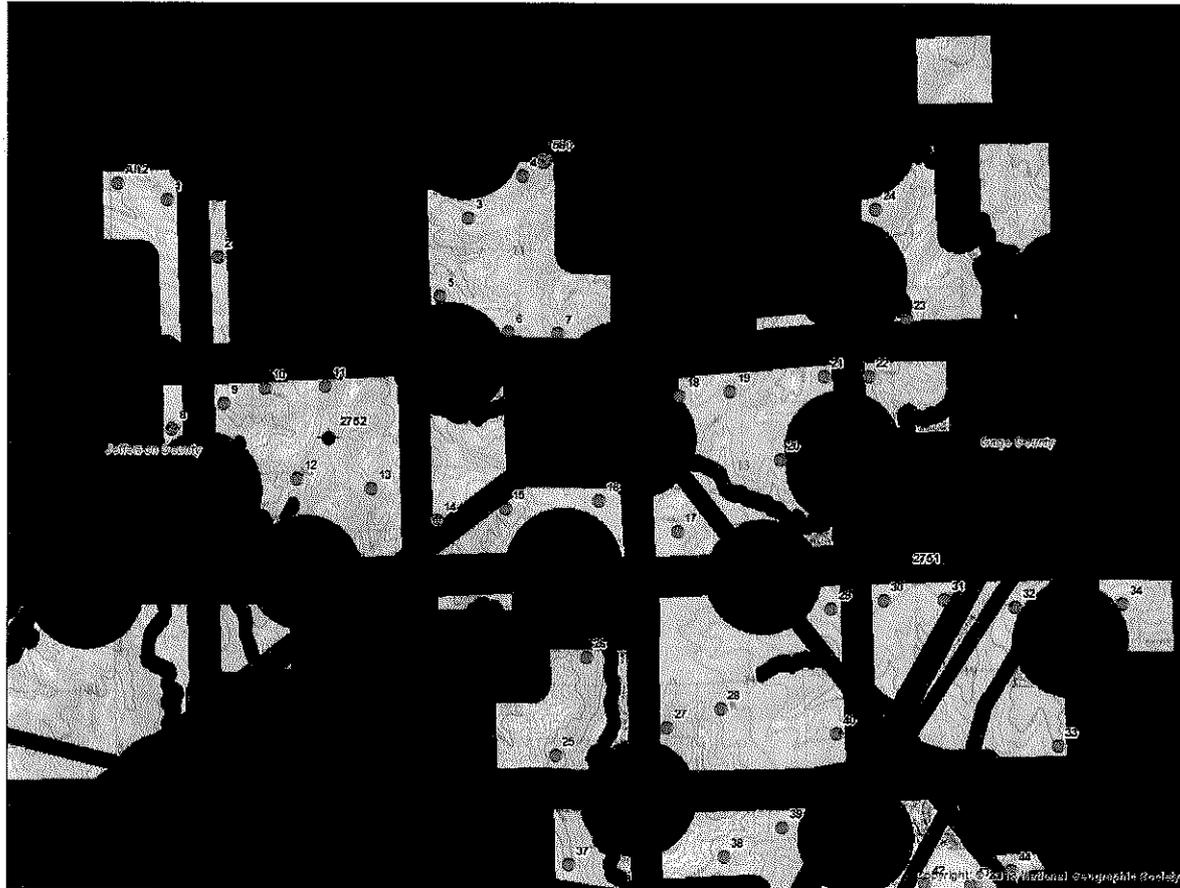
## Steele Flats Wind Project Setbacks (cont)



The wind farm design includes setbacks from homes and non-participating property owners

The design of the Steele Flats Wind Project was an iterative process that considered many factors

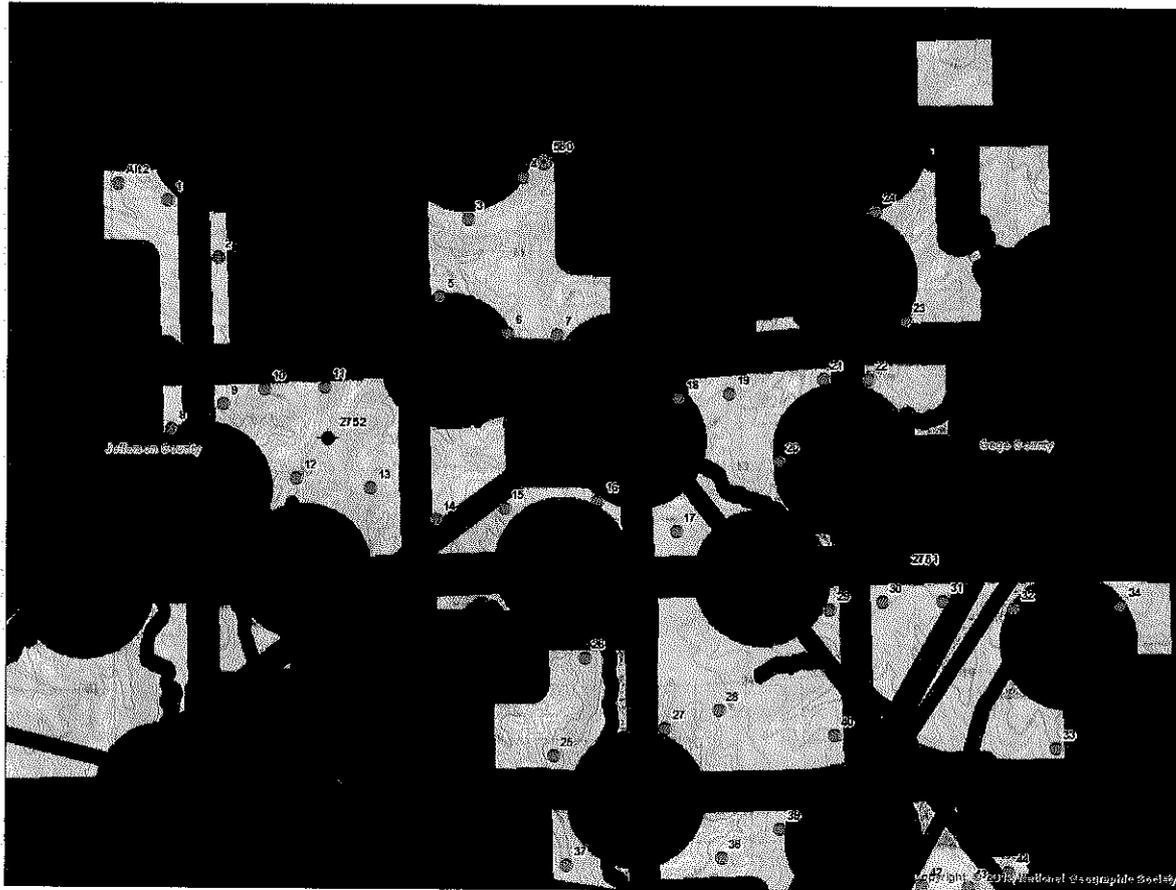
## Steele Flats Wind Project Setbacks (cont)



Once setbacks are met, the array is refined to minimize sound (50dBA limit) and shadow effects and reviewed by the turbine manufacturer for warranty requirements

The design of the Steele Flats Wind Project was an iterative process that considered many factors

## Steele Flats Wind Project Setbacks (cont)



Once setbacks are met, the array is refined to minimize sound (45dBA limit) and shadow effects and reviewed by the turbine manufacturer for warranty requirements

The design of the Steele Flats Wind Project was an iterative process that considered many factors

## Steele Flats Wind Project Setbacks (cont)



Once setbacks are met, the array is refined to minimize sound (42dBA limit) and shadow effects and reviewed by the turbine manufacturer for warranty requirements

The design of the Steele Flats Wind Project was an iterative process that considered many factors

## Steele Flats Wind Project Setbacks (cont)



Once setbacks are met, the array is refined to minimize sound (37dBA limit) and shadow effects and reviewed by the turbine manufacturer for warranty requirements