BRIEFING NOTES

NAME OF GROUP:	PLANNING COMMISSION
DATE, TIME AND PLACE OF MEETING:	Wednesday, October 24, 2018, 1:15 p.m., Council Chambers, County-City Building, 555 South 10th Street, Lincoln, Nebraska.
MEMBERS IN ATTENDANCE:	Tom Beckius, Dick Campbell, Tracy Corr, Tracy Edgerton, Deane Finnegan, Maja Harris, Dennis Scheer and Sändra Washington; (Christy Joy absent).
OTHERS IN ATTENDANCE:	David Cary, Steve Henrichsen, Tom Cajka, Collin Christopher, Rachel Jones and Amy Huffman of the Planning Department.
STATED PURPOSE:	Briefing on **"County Wind Energy Zoning Regulations"** and **"Proposed City Text Amendments Related to Design Standards for Screening"** by Planning Department staff.

Chair Dennis Scheer acknowledged the posting of the Open Meetings Act in the back of the room.

REVIEW OF COUNTY WIND ENERGY ZONING REGULATIONS:

Tom Cajka stated that this briefing is to bring new Commissioners up to date with the approved Wind Energy regulations as of October, 2015. Anything that has happened since that time, including the proposed text changes, will be covered during the Public Hearing of the regular Planning Commission meeting to be held November 28, 2018. These proposed changes related only to the commercial aspect of wind energy, and not to personal use.

In 2014, Volkswind submitted a text amendment and seven special permit applications for wind energy turbines in the southwest part of Lancaster County. Those were very specific proposals involving leases that had been worked out with property owners. The text amendment was met immediately with significant opposition so it was decided a broader review of this topic should take place. Volkswind withdrew their applications in February of 2015. A working group comprised of 12 stakeholders was formed and included both supporting and opposing viewpoints. That group was also joined by eight from Gage County because the applications from Volkswind also extended into their county and they also wanted to update their text related to this topic.

The working group held several public meetings between March and May of 2015, going through various aspects of wind energy in detail including economic factors, environmental impacts, noise and shadow effects, and federal regulations, among others. By summer, various

drafts were available for public comment. Planning Commission voted on the text changes on August 19th, 2015, and County Board voted on October 27, 2015.

Scheer asked what is expected between today's briefing and the public hearing on November 28th. Cajka said Planning has already received some letters on this topic. Henrichsen said that NextEra held both an evening and a morning open house meeting in Hallam and staff was present at both. Planning emailed everyone who was previously involved to let them know this issue has come up again. The text amendment being proposed is not tied to any specific applications, but is meant to amend the overall language. The public process is not anticipated to be as lengthy this time. The Staff Report will be available according to the usual schedule, about one week before the hearing. Henrichsen also noted all information from the past can be found on Planning's webpage.

Corr asked if NextEra is a new iteration of Volkswind, or a different company. Henrichsen said they are a different company who purchased the lease rights from Volkswind. They are present today, though today is not intended to be a public hearing for outside testimony.

Cajka reviewed the current conditions as listed in County Zoning Ordinance 13.048. (See Attachment A).

Finnegan asked if the setbacks have changed. Cajka said he is only discussing the requirements that are in the codes today. Washington asked if any newly established vistas would be included in an updated Comprehensive Plan. Cajka said yes. Scheer asked if there are any guidelines for how far apart turbines need to be from one another; Washington also wondered if there is a professional standard. Cajka said he is not able to answer that. Harris asked about amendments made regarding shadow flicker. Henrichsen said the amount of flicker allowed is no more than 30 minutes in one day.

Chris Schroeder, Heath Department, came forward to review the noise aspect of wind turbines. (See Attachment A). He said that sound and noise are the same, but noise is considered unwanted sound and is related to perception. Sound is measured in in various ways including frequency, type, and strength. Human ears can detect a broad range of sounds. Decibel (dB) levels measure how sound is perceived on a logarithmic scale. Leq is the preferred method for describing sound variances over time. Sound quality affects how sound is perceived; for example, a water drip is an easy sound for the human ear to detect whereas some frequencies are quite neutral, such as white noise, which can even mask other sounds.

Sound from wind turbines is complex and includes swishing from the blades, thumps and pulses, and whirring sounds from the hub. All of these increase with wind speed and change over distance. Multiple turbines can also create modulations in the sounds. Campbell asked if the turbines are shut down at a certain level. Schroeder said he did not know. Most complaints

are related to swishing pulses. It also comes down to perception. Annoyance is at the core of this, as are opinions about the source, control over the noise, and the ability to escape from the disturbances. Annoyance has been linked with health issues. Several studies were reviewed in 2015 for establishing this link. Generally, it was determined that 35 dBs is a tolerable level. Edgerton asked about the dose response to wind noise. Schroeder said that means there is an expected response to a factor at a certain level. A significant increase in annoyance has been measured at 35 dBs. Those exposed to higher than 40 dBs were highly annoyed. Annoyance is generally lower among participants who receive personal benefit.

Scheer asked if there has been more information gathered since 2015. Schroeder said yes and that information will be reviewed. Henrichsen added that new information will be reflected in the recommendation from Staff. This topic differs from the recent chicken farm proposal in that there were a large number of people on both sides of the issue, for and against. There were also more property owners who were participants. Campbell asked if the studies were part of the review by the task force. Henrichsen said they were reviewed. The working group helped to identify issues and to find common ground but did not forward a recommendation because there was not consensus. Staff moved forward with a recommendation that we felt reflected the information and concerns of the time. There are varying standards among different communities; Lancaster County has a relatively high amount of acreage development compared with many others.

Scott Holmes, Health Department, noted that there was one study from Massachusetts that made a recommendation for a establishing certain noise levels as a “best practice” level. That finding was based on surrounding housing in rural areas. They recommended a higher limit for industrial areas or less densely populated areas. Some areas may have adopted regulations based on economic development rather than on health based recommendations. Campbell wondered if the Canadian studied affirmed this recommended level. Holmes said the Canadian study established annoyance levels and that participants experienced less annoyance. Washington asked for more information on the link between noise levels and health impacts. Holmes said that health effects are associated with annoyance, so if you are not annoyed, you experience less stress. Results from Canadian studies are being reviewed and will be included.

Scheer asked if the text amendment coming forward is from the Planning Department, or the applicant. Henrichsen said it is from the applicant. Planning Commissioners will receive their proposal along with a recommendation from staff, which will include pertinent information from the Health Department. Washington asked if rural areas as defined in the various studies is similar to that of Lancaster County. Schroeder said he will need to look again at density. Harris wondered what the best practice noise level was. She recalled that former Commissioner Cornelius sited a particular recommendation when making his motion for approval by Planning Commission. Schroeder said the study recommended a range of levels based on population density and surrounding uses. Finnegan wondered if the turbines can operate at various

speeds. Schroeder said the rotor speed is tied to wind speed and the size of the rotor. Campbell asked to be provided the height of the towers in Gage County.

PROPOSED CITY TEXT AMENDMENTS RELATED TO DESIGN STANDARDS FOR SCREENING:

Rachel Jones stated the purpose of this proposed text amendment is to balance the required screening with required parking. Feedback from developers helped to identify needs and issues in the application of screening standards. These parking incentives and screening standards are meant to encourage development or redevelopment of sites. The Comprehensive Plan speaks to these goals with mention of shared parking, updating design standards and increasing sense of place. These changes are not a massive overhaul, but are intended to be incremental. The changes have been posted on the Planning website and sent to the development community, and were presented at a Mayor's Neighborhood Roundtable meeting.

The changes to parking include allowing parking in the side yard in the H-2, H-3, and H-4 Districts when not abutting residential. This is currently not allowed in any commercial district. These are also not in use permit districts so there is no typical mechanism to reduce the side yard setback. Minimum parking from restaurants and onsale alcohol establishments in B-2 and B-5 Districts will be reduced to 1 stall per 300. The existing standard is 1/100, which is higher than for the districts, as a whole. We see restaurant sites redeveloping within commercial centers and they have a hard time meeting the existing ratio. This has already been implemented over quite a few use permits issued in the B-2 and B-5 Districts. Parking will also be reduced in the H-2 area, located mostly in the 48th and O Street area. There are mostly restaurants and retail rather than highway commercial uses. Rather than pursuing changes of zone, it will be simpler to reduce the parking in the H-2 to match the uses. Off-site parking will be allowed in the H-4 District. This means parking can be on a site nearby, which is already allowed in all other commercial districts. The distance of the offsite parking should be within 300 feet, which is a reasonable walking distance.

Corr asked how long a typical city block is. Jones said a typical block in the Near South neighborhood, for example, is 300 feet. She added as clarification that not all of the stalls need to be within that 300 feet, as long as the lot is within that distance. She went on to say that joint parking will be allowed for uses considered non-concurrent. A final change is to allow Administrative Amendment approval of minor parking modifications, up to 25% of the total. Harris asked if this will be or all districts. Jones said that is correct.

Collin Christopher, Planning Department, said that all parking located within 100 feet of the property line or road must be screened from the ground up to 3 feet. The intensity varies depending on the property line and is less intense if the use is farther away from that line. There are exceptions and site specific conditions that, when combined, have created an inconsistent application of the standards. In abutting parking lots, you are currently not

required to provide screening. When this occurs over and over again, the cumulative effect is a lack of landscaping and a sea of asphalt. These standards are now clarified, though they will still allow for flexibility in certain circumstances. Corr asked if the buffer would be applied if there is a grade change that prevents connectivity between lots. Christopher said that is correct. Another aspect for this requirement to consider is that there is no guarantee that an adjacent area will always be used for parking.

Christopher went on to say that another exception being eliminated is the screening for shallow lots. They are not currently required to provide screening and the issue comes up frequently. Staff recognizes that there are circumstances where this may be very difficult so a waiver process is being worked out; however, in general, it is our expectation that there is room to do some landscaping and it is worthwhile. Scheer said it will be important to consider that the planting areas are wide enough to support landscaping; it would be worse to require landscaping where it cannot grow. Washington added that there could be property owners who are concerned about space, or who will find this cost prohibitive. Christopher said there is flexibility in the standards and this is being thought of on a city-wide scale. The 6-foot space does work for smaller lots.

Christopher said that the requirement to provide shade trees in parking lots is being increased. There is an expectation that after a certain amount of square footage, internal trees within islands are required. This is an effort to avoid the outdated huge asphalt lots. The proposal is that a minimum 9-foot wide island is installed at the end of each row at a distance of no more than 20 stalls. Beckius asked if that meant 10 stalls if they are within a double row. Christopher clarified it would be 20 in a single row, so potentially 40 stalls in a double row. Campbell commented that it can be difficult to puta shade tree in a lot. Christopher said that has been accounted for by requiring one tree per double row, and working with islands where a light is needed.

Washington exited the briefing at 2:48 P.M.

Beckius expressed that there could be concerns with obstructing the view to the business. Christopher said there will be a list of trees to choose from. If the correct tree is chosen, there should not be complaints. This should ultimately help developers to come up with better parking lot designs. Corr asked if a cart corral would count as parking stall. Henrichsen said that would not counts, so the row would be extended to 21 stalls. There is flexibility so trees might be located at one end, near the building, with lights in the center. Many larger centers also have center signs rather than individual signs. He added that Costco is an example of a large business who went above and beyond in their lot design. This impact falls more on larger parcels where visibility of the business sign is not as large a concern. David Cary, Planning Director, noted that this is to create an improved design, overall. This is a minimum amount being requested so it is not pushing developers in an unreasonable way. This also creates a

softer, greener landscape. There is an aesthetic purpose to this. Scheer agreed that the design can improve overall when the circulation is approached as a whole. Smarter design makes pedestrian/vehicle conflicts go away. Connecting this better design to watershed management practices could create better aesthetics and function. Campbell added that he would make a strong recommendation for installation of irrigation in islands. Christopher agreed that the standards may deal with maintenance and enforcement.

Christopher said the final substantive change is to the requirement of street trees. Currently, the standards do not account for these when not part of a subdivision, PUD, CUP or special or use permit. We propose that as part of the traditional commercial building process, street trees are required for new construction or major remodels where investment exceeds 50% of the property's current assessed value. The spacing will fall under current standards which varies based on mph.

In addition to various other clarifications and language clean-up, it made sense to consolidate all of this information into one chapter, so the same information that is located in other chapters will be removed so it is all in one location. The enforcement policy for these regulations will also be updated and procedures will be reinforced since they have generally not been followed. There has been some reformatting and new tables and diagrams added with the goal of making the chapter easier to read and interpret.

Scheer wondered what happens if a public utility destroys trees in the right-of-way or how that type of problem is resolved for commercial. Christopher said that is a good question about a situation that has not been met yet. Cary noted that the majority is on private property, but if there is an easement, public utilities do have the right to go in. There is an expectation that the landscaping is to be replaced, but there is no legal obligation to replant anything within their easement. Scheer wondered where the responsibility would fall. Christopher said if there is an easement in place, then LES would discourage a private landowner from planting in that easement in the first place. Campbell said that in his experience, the utility coming in will be respectful.

There being no further business, the meeting was adjourned at 3:12 p.m.

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Attachment A

13.048. Commercial Wind Energy Conversion System (CWECS)

(Resolution No. R150061, November 24, 2015; Resolution No. R110022, March 29, 2011)

- A Commercial Wind Energy Conversion System (CWECS) may be allowed in the AG District by special permit under the conditions listed below:

13.048. Commercial Wind Energy Conversion System (CWECS)

- a. In cases where CWECS wind turbines are part of a unified plan, parcels which are separated from one another only by the presence of public right-of-way may be combined into one special permit application. When a special permit covers multiple premises, the lease or easement holder may sign the application rather than the lot owner.

13.048. Commercial Wind Energy Conversion System (CWECS)

- b. Turbines shall meet all FAA requirements, including but not limited to lighting and radar interference issues. Strobe lighting shall be avoided if alternative lighting is allowed. Color and finish shall be white, gray or another nonobtrusive, non-reflective finish. There shall be no advertising, logo, or other symbols painted on the turbine other than those required by the FAA or other governing body. Each turbine shall have onsite a name plate which is clearly legible from the public right-of-way and contains contact information of the operator of the wind facility.

13.048. Commercial Wind Energy Conversion System (CWECS)

- c. Each application shall have a decommissioning plan outlining the means, procedures and cost of removing the turbine (s) and all related supporting infrastructure and a bond or equivalent enforceable resource to guarantee removal and restoration upon discontinuance, decommissioning or abandonment. Each tower shall be removed within one year of decommissioning or revocation of the special permit. Upon removal of the tower, there shall be four feet of soil between the ground level and former tower's cement base.

13.048. Commercial Wind Energy Conversion System (CWECS)

- d. Any proposed turbine which is within half mile of any non-participating dwelling shall provide shadow flicker modeling data showing the expected effect of shadow flicker on non-participating properties. Shadow flicker shall not fall upon any non-participating dwelling, or other building which is occupied by humans, for more than a total of 30 hours per any calendar year. If shadow flicker exceeds these limits, measures shall be taken to reduce the effects of shadow flicker on buildings, which may include shutting the turbine down during periods of shadow flicker. If a turbine violates this standard on a non-participating dwelling unit, constructed after the turbine is approved, then the turbine becomes a non-conforming use.

13.048. Commercial Wind Energy Conversion System (CWECS)

- e. Construction and operation shall not adversely impact identified State or Federal threatened or endangered species such as saline wetlands, or rare natural resources such as native prairie and grasslands.

13.048. Commercial Wind Energy Conversion System (CWECS)

- f. No turbine shall obstruct or impair an identified view corridor or scenic vista of public value, as mapped on the Capitol View Corridors map in the Lincoln/ Lancaster County Comprehensive Plan. The views from prominent environmental areas, such as Nine Mile Prairie and Spring Creek Prairie, shall also be protected from adverse visual or noise impacts. Any application which, upon initial review, poses a possible impact to these views will be required to be relocated or provide view shed mapping, and visual simulations from key observation points for review.

13.048. Commercial Wind Energy Conversion System (CWECS)

- g. Setbacks to the turbine base:
  - 1. For the purposes of this section, "turbine height" shall be equal to hub height plus the rotor radius.
  - 2. For a nonparticipating lot, the setback shall be 2 times the turbine height measured to the property line, or 3 ½ times the turbine height, measured to the closest exterior wall of the dwelling unit, whichever is greater, but at a minimum 1,000 feet to the property line.
  - 3. For participating dwelling units, the setback shall be 2 times the turbine height measured to the closest exterior wall of the dwelling.
  - 4. The setback to any public right-of-way or private roadway shall be no less than the turbine height.
  - 5. Setbacks to the external boundary of the special permit area shall be no less than as stated above, except that the owner of the adjacent property may sign an agreement allowing that setback to be reduced to the rotor radius plus the setback of the zoning district.

13.048. Commercial Wind Energy Conversion System (CWECS)

- h. The turbine(s) shall not impact a non-participating lot, (vacant or occupied; of any size), to the extent that, because of the location of turbine(s), the lot owner is left with less than 3 acres of land outside of the CWECS setbacks and or the noise impact area in Section (i) below, unless they are part of an agreement with the CWECS owner/operator.

13.048. Commercial Wind Energy Conversion System (CWECS)

i. Noise: No CWECS or combination of CWECS turbine(s) shall be located as to cause an exceedance of the following as measured at the closest exterior wall of any dwelling located on the property. If a turbine violates a noise standard on a dwelling unit, constructed after the turbine is approved, then the turbine becomes a nonconforming use. For both participating and nonparticipating properties:

- **1. From the hours of 7 am to 10 pm:**
  - i. Forty (40) dBA maximum 10 minute Leq or;
  - ii. Three (3) dBA maximum 10 minute Leq above background level as determined by a pre-construction noise study. The background level shall be a Leq measured over a representative 15 hour period.
- **2. From the hours of 10 pm to 7 am:**
  - i. Thirty-seven (37) dBA maximum 10 minute Leq or;
  - ii. Three (3) dBA maximum 10 minute Leq above background level as determined by a pre-construction noise study. The background level shall be a Leq measured over a representative 9 hour period.

13.048. Commercial Wind Energy Conversion System (CWECS)

- j. A professional preconstruction noise study shall be conducted which includes all property within one mile of a tower support base. The protocol and methodology for such studies shall be submitted to the Lincoln-Lancaster County Health Department for review and approval. Such studies shall include noise modeling for all four seasons and include typical and worst case scenarios for noise propagation. The complete results and full study report shall be submitted to the Lincoln-Lancaster County Health Department for review.

13.048. Commercial Wind Energy Conversion System (CWECS)

- k. Prior to the commencement of construction of any turbine, pre-construction noise monitoring may be conducted to determine ambient sound levels in accordance with procedures acceptable to the Lincoln-Lancaster County Health Department.

13.048. Commercial Wind Energy Conversion System (CWECS)

I. Prior to the commencement of construction of any turbine, the applicant shall enter into an agreement with the County Engineer regarding use of County roads during construction.

13.048. Commercial Wind Energy Conversion System (CWECS)

- m. At the discretion of the County Board, post-construction noise level measurements may be required to be performed in accordance with procedures acceptable to the Lincoln-Lancaster County Health Department.

13.048. Commercial Wind Energy Conversion System (CWECS)

- n. All noise complaints regarding the operation of any CWECS shall be referred to the County Board. The County Board shall determine if noise monitoring shall be required to determine whether a violation has occurred.

Sound, Noise & Wind Turbines

A Presentation to the Lincoln/Lancaster Planning Commission

Chris Schroeder, MCRP
Environmental Health Supervisor

October 24, 2018

LINCOLN LANCASTER COUNTY HEALTH DEPARTMENT

Definitions

- Sound is a form of energy that is transmitted by pressure variations which the human ear can detect.

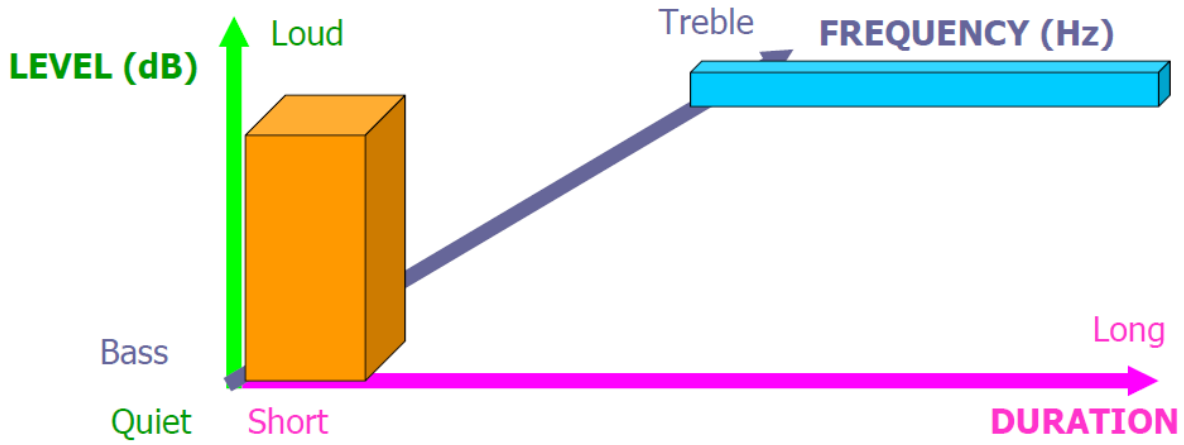
- Noise is unwanted sound - perception

Definitions

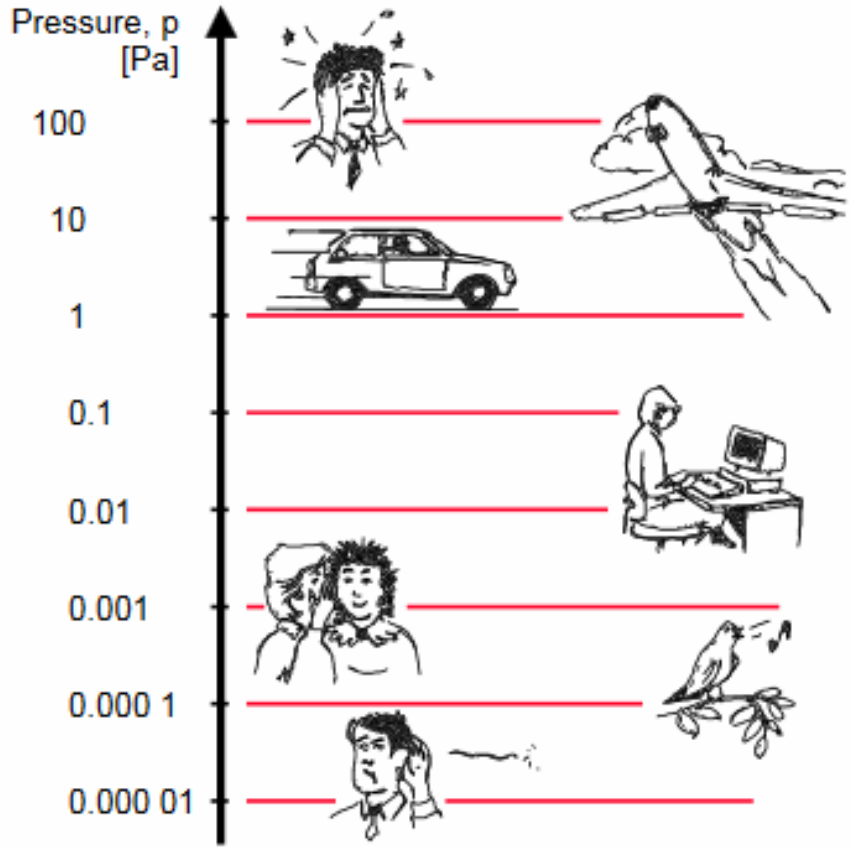
- Sound Level: the "strength" of a sound. It is measured in Decibels (dB). (how loud)
- dB(A): measurement that focuses on frequencies heard by the human ear.
- Frequency: the "pitch" of a sound. It is measured in Hertz (Hz). (how low or high)
- Leq: average noise level over a specified period of time.
- Spectrum: which frequencies are in the sound. The "type" of the sound.

Looking at sound in 3-D

- The **DURATION** can be expressed in seconds, minutes, or even hours
- The **LEVEL** is expressed in **decibels (dB)**
- The **FREQUENCY** is expressed in **Hertz (Hz)**



Range of Sound Pressure



Sound/ Noise Metrics

Decibels

- Measure sound pressure level (SPL)/ Logarithmic scale
- The human ear responds not linearly but logarithmically to sound pressure
- Two (2) times sound energy - increase of 3 dB
- Ten (10) times sound energy – increase of 10 dB
- One-hundred (100) times sound energy – increase of 20 dB
- One-thousand (1000) times sound energy – increase of 30 dB

Perception of dBs

Change in Sound Level (dB)	Change in Perceived Loudness
3	Just perceptible
5	Noticeable difference
10	Twice (or 1/2) as loud
15	Large change
20	Four times (or 1/4) as loud

Sound/ Noise Metrics

Frequency weighting

- A weighted – dB(A) – most common used in noise measurement – audible frequencies – human hearing
- C weighted – dB(C) - can be used for low frequency noise measurements
- G weighted – dB(G) – can be used for infrasound measurements

Sound/ Noise Metrics

Noise Measurements

- *Leq* - Equivalent continuous sound pressure level. A measure of the average sound pressure level during a period of time in dB
- Lden – level day, evening, night – 24 hr. measurement adds dB penalties to evening and night measurements
- L_{A10} - The noise level exceeded for 10% of the measurement period with 'A' frequency weighting calculated by statistical analysis
- L_{A90} - The noise level exceeded for 90% of the measurement period with 'A' frequency weighting calculated by statistical analysis

https://www.cirrusresearch.co.uk/library/glossary-terminology/

Why do some sounds sound louder than others?

- Our hearing system does no have the same **sensitivity** at all frequencies
- The frequencies contained in the sound define its **'quality'**
- Sounds that contain few frequencies are very **'tonal'** and they are easy for the brain to focus on because they are very simple sounds.
- Sounds that contain a lot of frequencies are very **'neutral'** and the brain cannot identify the individual frequencies.
- Sounds that contain a very broad range of frequencies can effectively **'mask'** other sounds with *higher* frequencies.

What do we know about the sound generated by wind farms? (I)

- The sound is fairly 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 that also **'pulses'** the higher frequencies.
- The elements inside the 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? (II)

- The sound changes with **distance**
  - The midrange and high frequency components tend to fall below the range of audibility fairly rapidly.
  - The low frequency (bass) components can still be noticeable at much greater distances.
- The absorption of the **ground** is not a factor for low frequency sounds
- **Multiple turbines** can yield to modulation effects in the sound at some locations.
- Turbines can influence each other when it comes to the 'smoothness' of the air surrounding them.
- Wind turbines generate acoustic waves that are below the audible range (**infrasound**).

What do we know about the noise associated with wind farms?

- Most complaints are associated with the **'swishing pulses'.**
- Many complaints are associated with **night-time** operations.
- **Infrasound-related** complaints are problematic to assess.
  - Interfering factors
  - Equipment limitations
  - Incorrect test methodology
- It is difficult to come up with an effective **regulation** for it.
  - Weather and other factors vary between time of complaint and time of inspection.
  - Implementing **Best Practices** can be expensive.

Does sound becomes noise when it's intermittent or modulated?

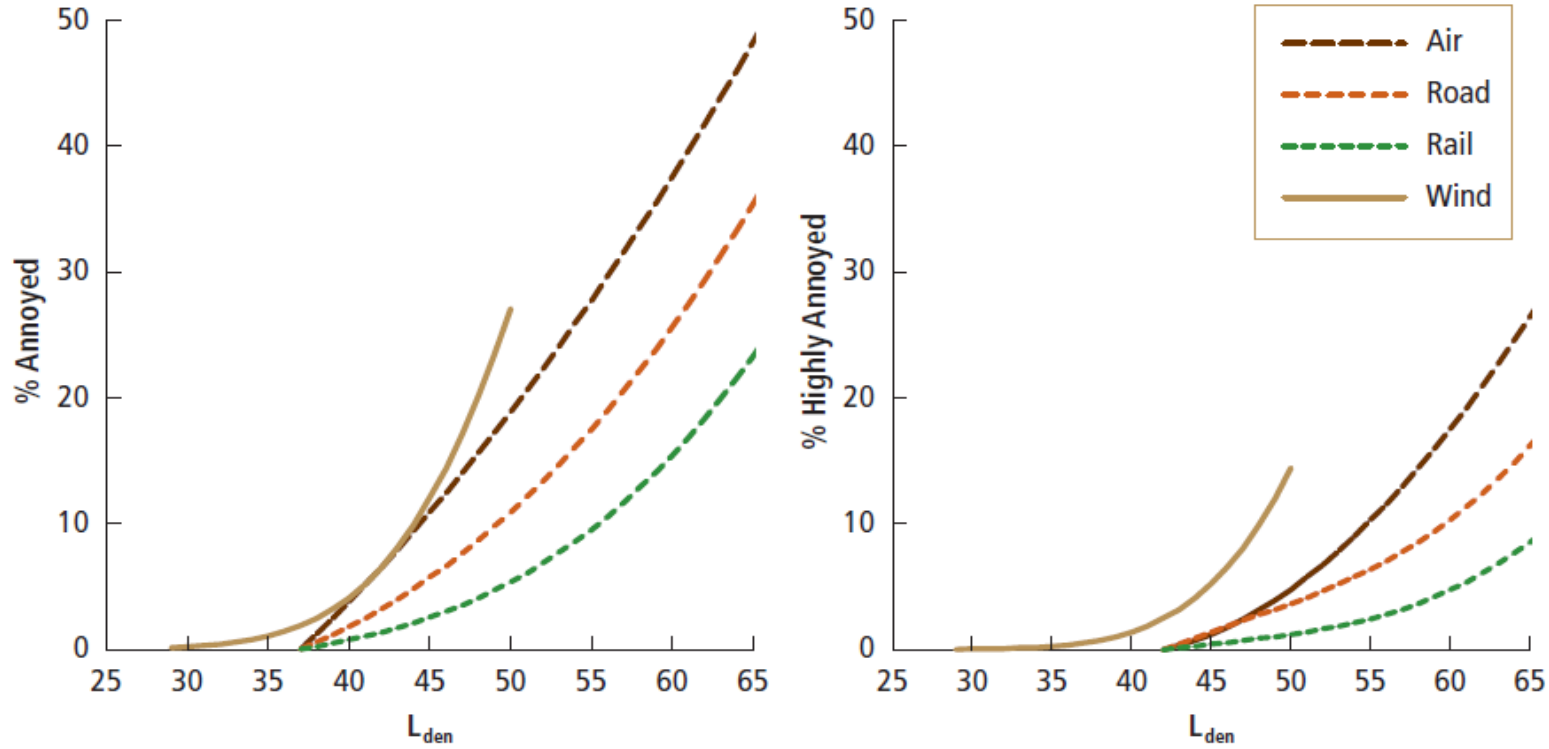
- Music is intermittent and modulated.
  - What's music to some is noise to others.
- Annoyance is **correlated** to many factors when it comes to noise…
  - The level of the sound,
  - The frequency content of the sound,
  - Opinions about the source of sound,
  - Control about the source of sound,
  - Ability to get away from the sound,
  - And **many** other factors…

WTN > Annoyance > Health

ANNOYANCE:

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).

Council of Canadian Academies, 2015. Understanding the Evidence: Wind Turbine Noise. Ottawa(ON): The Expert Panel On Wind Turbine Noise and Human Health, Council of Canadian



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

Council of Canadian Academies, 2015. Understanding the Evidence: Wind Turbine Noise. Ottawa(ON): The Expert Panel On Wind Turbine Noise and Human Health, Council of Canadian

WTN > Annoyance > Health

- Almost all community noise codes are built around:
  - potential for hearing loss
  - projected level of annoyance (enjoyment of property)

- Annoyance is subjective, but can be measured objectively
  - Percent of people are annoyed
  - Physiological, neurological, biochemical responses

WTN > Annoyance > Health

- Impacts may include physiological responses, central nervous system reactions, and biochemical changes. (2)

- Physiological reactions to sound annoyance include increased heart rate and increased blood pressure which, among others, may lead to hypertension. (1) (2) Hearing impairment, such as increased hearing threshold, and tinnitus are considered as another possible consequence of sound annoyance.(2) (3)

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)

3) W. Passchier-Vermeer & W.F. Passchier. Noise Exposure and public health (2000). Environmental Health Perspectives, Vol 108, Supplement 1

In 2015, Health reviewed Four Key Studies on Wind Turbine Noise and Health

- 2012 - Massachusetts DEP/DH Expert Panel Review Study
- 2014 - Schmidt & Klokker; Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review
- 2015 – Canadian Health Academies Expert Panel Review Study
- 2015 – Health Canada – Wind Turbine Noise and Health Epidemiological Study

2014 Schmidt & Klokker 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

Purpose: assess the scientific evidence on the question of wind turbine noise and human health in order to provide a foundation of knowledge to support governments, policy-makers, communities, and the industry.

Canadian Academies Conclusions

- Wind turbine noise is associated with annoyance
- Annoyance has many factors, not all of which are related to noise
- Annoyance can lead to sleep disturbance
- Sleep Disturbance can lead to annoyance
- Both Annoyance and Sleep Disturbance are associated with higher stress levels, which are associated with some health outcomes

Council of Canadian Academies, 2015. Understanding the Evidence: Wind Turbine Noise. Ottawa(ON): The Expert Panel On Wind Turbine Noise and Human Health, Council of Canadian Academies.

Health Canada Study 2015

- One of the largest epidemiological studies of wind turbine noise and potential health impacts
- 1238 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*
- Everyone in the study was exposed to WTN.

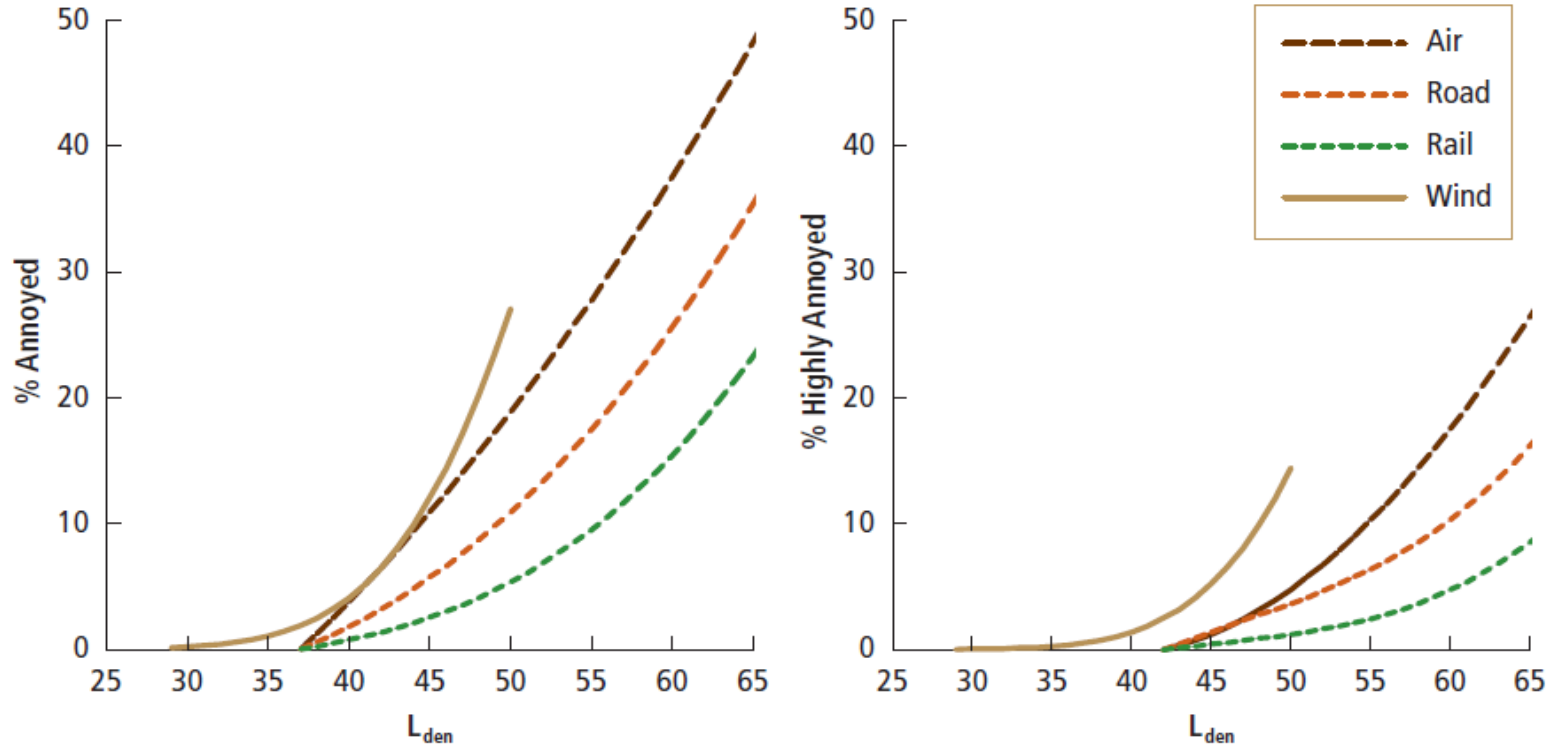
* Only 6 residences were above 45 dB.

Health Canada Study 2015

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.

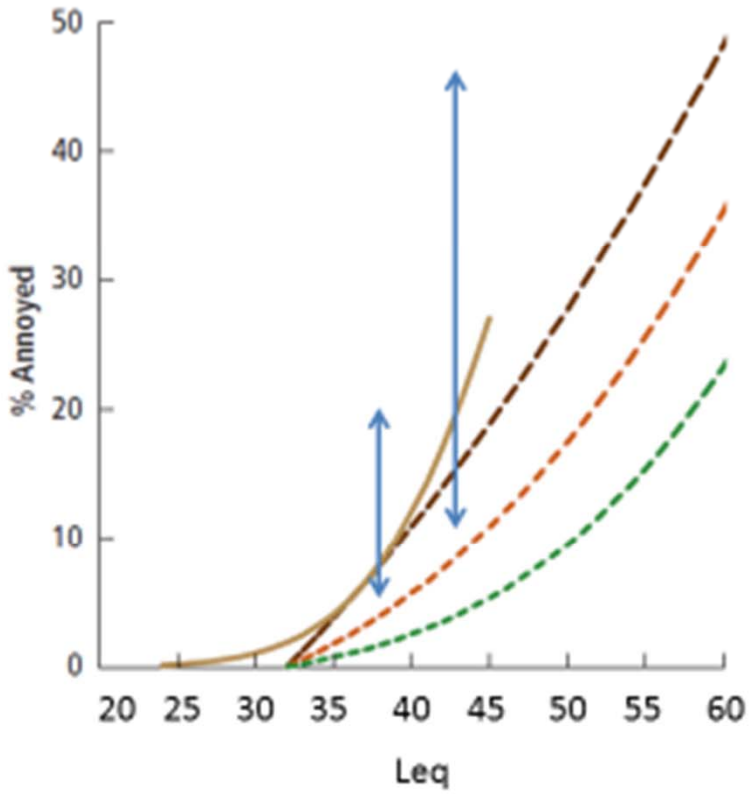


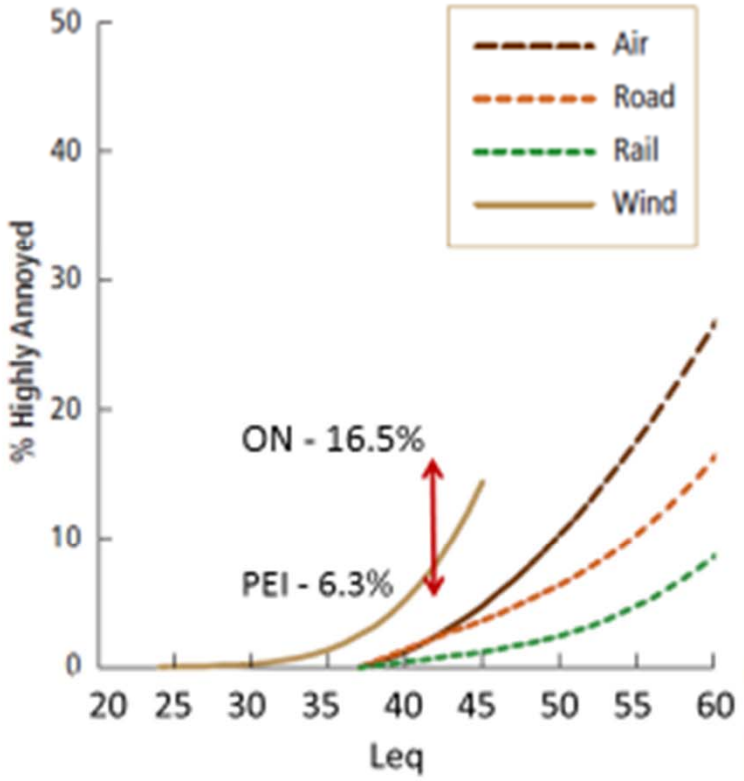
Reproduced with permission from Janssen, S. A., Vos, H., Eisses, A. R., & Pedersen, E. (2011). A comparison between exposure-response relationships for wind turbine annoyance and annoyance due to other noise sources. The *Journal of the Acoustical Society of America*, 130, 3746-3753. Copyright 2015,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

Figure 6.1

Comparison of Annoyance Due to Wind Turbine Noise and Transportation Noise

Council of Canadian Academies, 2015. Understanding the Evidence: Wind Turbine Noise. Ottawa(ON): The Expert Panel On Wind Turbine Noise and Human Health, Council of Canadian





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 ↕ from Pedersen (2011)**
- **Range estimate ↕ from Health Canada (2015) of very or extremely annoyed**

2015 LLCHD Conclusions

- The percent of annoyed people
  - Varies by site
  - Increases with louder dB(A)
  - 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 dB(A) Leq appears to be acceptable for >80% of people near wind turbines

In Progress

- Review NextEra/Ollson "white paper" and referenced studies
- Review additional information already requested from NextEra/Ollson
- Review other pertinent studies on wind turbine noise and health impacts

LINCOLN LANCASTER COUNTY HEALTH DEPARTMENT