

Zoning and Wind Energy

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Local Experience

- 56, 1.8 MW Vestas Turbines (476' tall) in Mason County
- Consumers Energy: developer, owner, operator

Mason County Lake Winds Energy Park

- 2010-2011:
 - Ordinance Amendment (Citizens Group)
 - Special Land Use (SLU)
 - ZBA, Appeal by Citizens Group
 - Circuit Court appeal- SLU upheld
 - Construction Nov. 2011 to Nov. 2012 (operational, Nov. 25, 2012)

Mason County Lake Winds Energy Park

- 2013 Shadow flicker study
- 2013, 2014 Sound Testing
- 2016 and 2017 Sound Testing (new firm)
 - 2 turbines in mitigated mode (NRO 2)
 - 5 turbines in NRO2 (testing)
- TWO active complaints to resolve

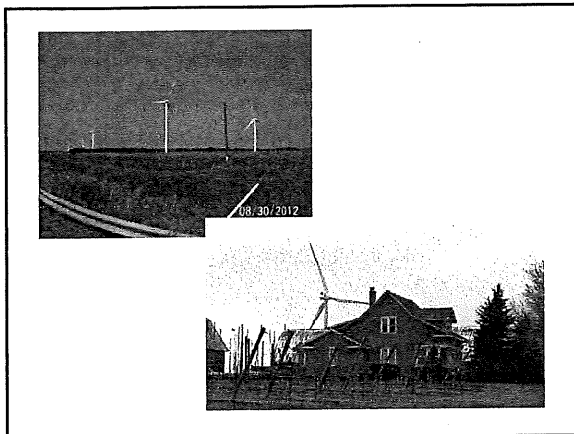
Discussion

1. Common Issues Overview
2. Lessons Learned



Debates

- Economic: taxes, leases, property values
- Efficient form of energy vs. other sources
- Climate Change
- Aesthetics, "rural character"
- Agriculture- is this farming or industry?
- Farmers Vs. Residential Land
- Birds, Bats, Deer, Bees, Fish, etc.



Common Zoning Requirements

- Setback (Dwelling/Property Line)
- Sound
- Shadow Flicker
- Avian-Bat Studies
- Ice Throw
- Performance Guarantee/Abandonment

Other Requirements

- Complaint Resolution
- Paint finish and color (gloss units)
- Height limit
- Signal Interference
- Coordination with state/federal (FAA, MDOT)
- County Roads



Setbacks

- Mason County was 2 X height (952') to dwelling of leased, to property line of non-leased.
- Mason County now, now 4 X height to property line (1904') 3 X height for leased property (1428') .

Setbacks

Leased Properties- not all farmers



Setbacks

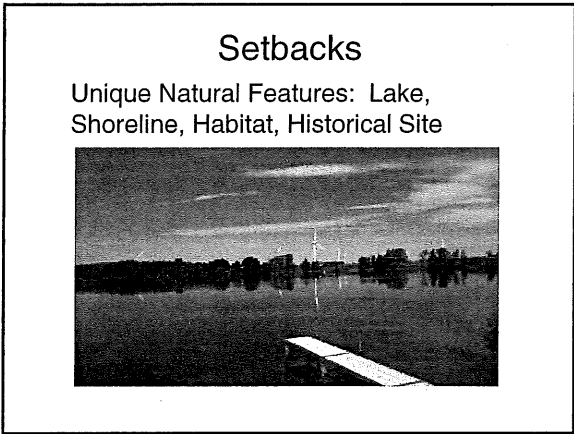
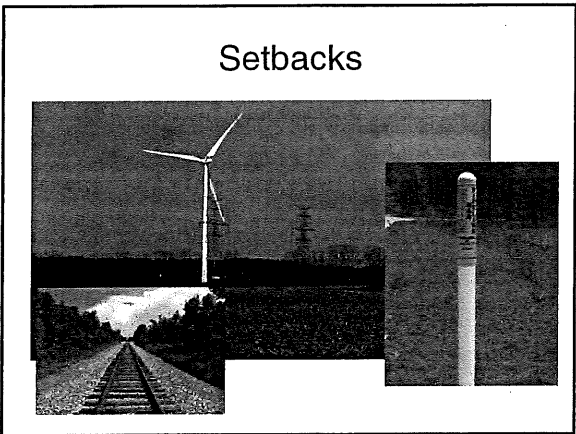
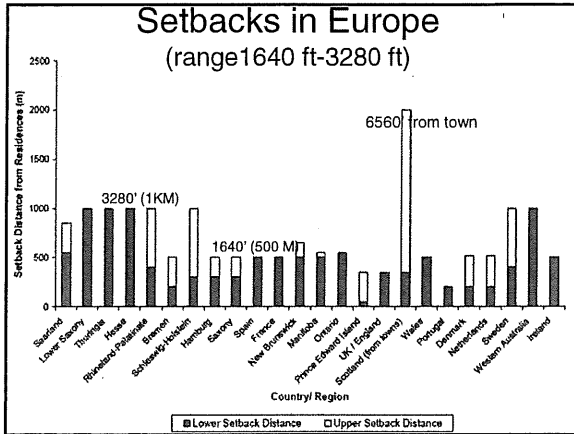
- Huron County: 2 X height or 1000' (whichever is greater) to dwelling or other inhabited building*.
- Huron County current: 1320' for participating (leased)/1640' for non-leased to dwelling.

*allowed for "reduction of setbacks and separation requirements" as part of site plan process
<http://www.co.huron.mi.us/documents/ArticleXWindEnergyOverlayZoningOrdinanceNovember2015.pdf>

Setbacks

- World Health Organization: 6600 feet (1.25 miles)
- Ontario: 550 meters (1804')
- Wisconsin: Lesser of 1250' or 3.1 X height
- Michigan: 1000'-3000'+*

https://docs.legis.wisconsin.gov/code/admin_code/psc/128.pdf#page=3
 *Akron Twp/Tuscola (1000'), Claybanks Twp/Oceana (3000')



Setbacks

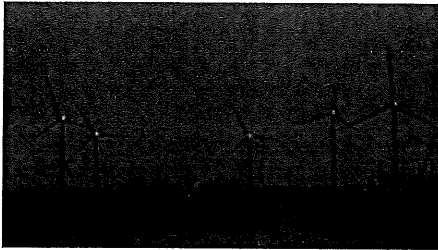
HOW FAR IS THAT?

- Range finder
- Contact GIS professional
- Google Earth
- Travel to another community– ask for a tour (get distances).

Other Aspects of a Wind Farm

- Construction Lay Down Areas
 - Construction Trailers
 - Turbine Components
- Sub-Station
- Operations & Maintenance Building
- Access Roads
- Turn Radius (Road Commission)

Night Sky



SOUND



- Whispering 25 dBA
- Library/Whispering 35 dBA
- Refrigerator 45 dBA
- Average Home 50 dBA
- Normal Conversation 60 dBA
- Clothes Dryer 60 dBA
- Washing Machine 65 dBA
- Vacuum Cleaner 70 dBA

Turbine Sound is Unique

- Changes based on weather, direction, speed, wind shear
- Location and receptor
- Rhythmic and impulsive (if multiple)
- Sound can contribute to **Annoyance**: can cause lack of sleep, leading to health issues*.

*<http://www.hc-sc.gc.ca/ewh-semt/noise-bruit/turbine-eoliennes/summary-resume-eng.php>

Sound Limits

- Range between 35 dBA to 55 dBA
- Mason County 45 dBA at property line (50 dBA leased)
- Model to 40 dBA (Mason)
- 40-45 dBA typical/ 40 dBA in Europe*
- State of Oregon $L_{10} + 10$ dBA/ (26 dBA night)

* International Review of Policies and Recommendations for Wind Turbine Setbacks from Residences: Setbacks, Noise, Shadow Flicker, and Other Concerns Minnesota Department of Commerce: Energy Facility Permitting Kathryn M. B. Haugen October 19, 2011

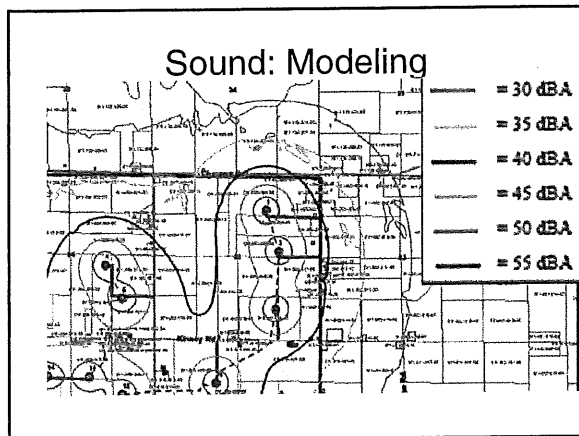
Sound

- Extremely technical– chose expert wisely
- A handheld decibel or an “App” meter WILL NOT work for enforcement
- Sound modeling may have a +/- 3dBA level of error (it did 2014)
- Each turbine has a unique sound profile

Sound/Setback Relationship

Each wind turbine model has its own unique sound signature; for Vestas V100 see below:

Distance from V100 Turbine	Model Predicted Sound Level (dBA)
0	57.5
164 feet	55.6
328 feet	52.9
459 feet	50.9
656 feet	48.3
984 feet	44.8
1312 feet	42.1
1640 feet	39.9




Low Frequency Sound

- Rely on an expert– research is ongoing
- Low frequency sound travel: 3+ miles
- Effects some and not others
- Amplitude modulation research (2015) (characteristic sound of the swoosh)

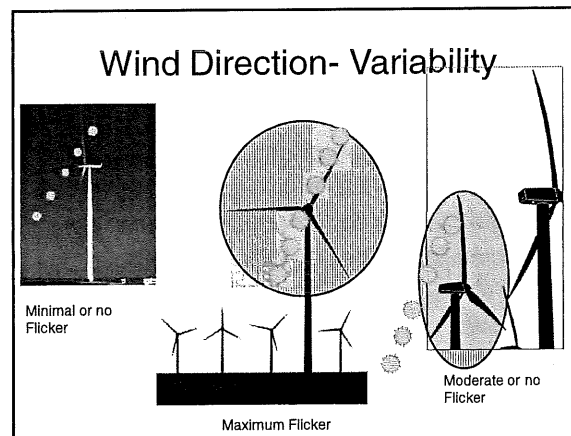
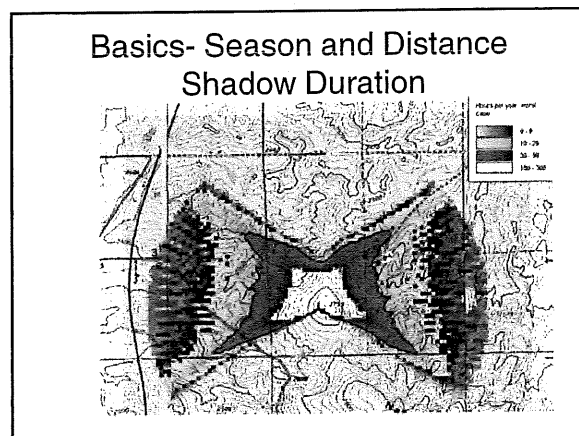
Shadow Flicker

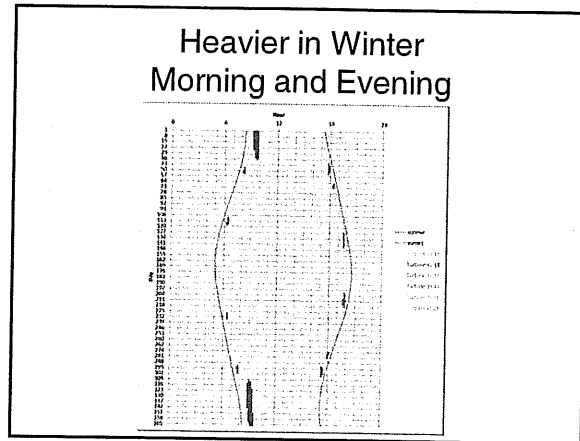
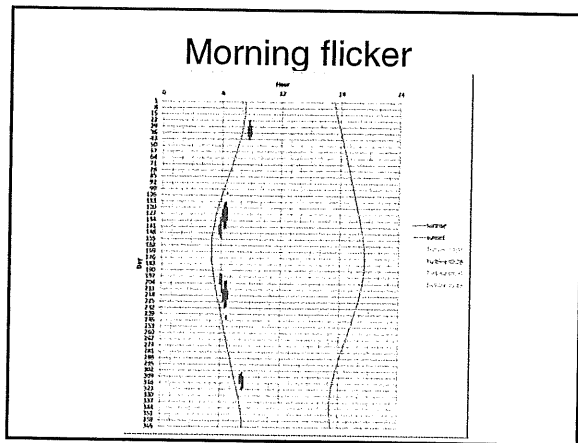
- Shadow Flicker is the rhythmic change in light intensity caused when the blade of a turbine is spinning between a receptor (dwelling) and the sun.


 anthony rd 11-18.MOV

Basics: Location of Sun in Sky

- Sun location is based on earth's rotation (season)
- Flicker events are always changing-based on time of day, season.



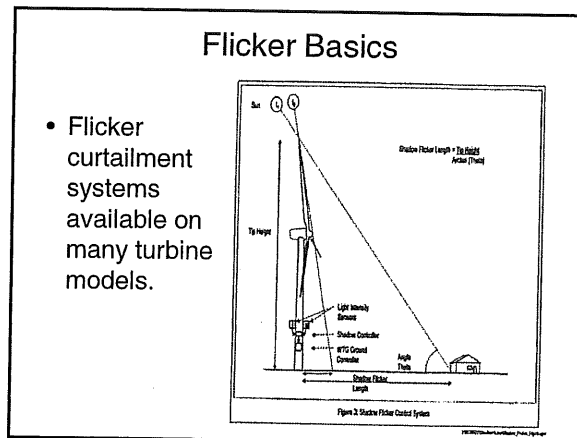


HOW MUCH FLICKER IS OCCURRING COMPARED TO THE MODEL?

SAMPLE DATA SHOWING TURBINE,
HOURS PER TURBINE and TOTAL

Turbine ID	Turbine Name	Model ID	Hours	Clearness Index	Total
322	THOMAS DONALD L	011009-015-10	18	0.7	13.5
322	THOMAS DONALD L	011009-015-10	19	0.7	13.5
322	THOMAS DONALD L	011009-015-10	23	2.8	13.5
322	THOMAS DONALD L	011009-015-10	24	0.9	13.5
227	WILLIAMS RAMON C & ALICE	011016-002-00	22	1.2	13.4
227	WILLIAMS RAMON C & ALICE	011016-002-00	25	1.9	13.4
227	WILLIAMS RAMON C & ALICE	011016-002-00	26	7.5	13.4
227	WILLIAMS RAMON C & ALICE	011016-002-00	29	0.7	13.4
227	WILLIAMS RAMON C & ALICE	011016-002-00	31	2.1	13.4
199	PETERSEN GARY L & ALTA	014018-024-00	33	11.8	13.2
199	PETERSEN GARY L & ALTA	014018-024-00	41	1.4	13.2
437	MARTZ LARRY D & BONNIE JEAN	014112-001-00	11	2.3	13.0
437	MARTZ LARRY D & BONNIE JEAN	014112-001-00	12	0.7	13.0
437	MARTZ LARRY D & BONNIE JEAN	014112-001-00	13	10.0	13.0
356	PADRON ARMANDO & MODESTA	011002-013-10	3	7.8	12.9
356	PADRON ARMANDO & MODESTA	011002-013-10	9	5.1	12.9

Note: Total flicker in model derived from multiplying "worst case" cumulative total in graphs shown by .3 blade pass across the sun and .4 clearness index or .12-.15 was used to account for variability in climatic conditions.



- ### Flicker Basics
- ORDINANCE MAXIMUM: If limit "X hours" per year, how is it enforced or calculated?
 - Mason County was 10 hours per year
 - Common standard is 30 hours per year with mitigation at 20 hours
 - Mason County is now 0 hours

- ### Lessons Learned
- Flicker model: increased to 5400 feet
 - Flicker at 9000+ feet- very faint
 - Flicker maximums are enforceable- but time consuming (for staff/property owner)
 - Model works well-(most of the time)
 - Trees, topography, obstructions (buildings) play a significant role.

Lessons Learned

- Flicker model is reliable (but not perfect)
- Flicker may be modeled, but not exist (due to obstructions)
- High variation of flicker impact
- Curtailment system works well
 - Can be human error in programming
 - Issues with shadows on light sensors

30-hour flicker standard

- 30 hour standard comes Germany
- 30 hour maximum is based on an astronomical maximum for modeling, not actual flicker*
- Flicker maximum in Germany is 8 hours of ACTUAL FLICKER*

* International Review of Policies and Recommendations for Wind Turbine Setbacks from Residences: Setbacks, Noise, Shadow Flicker, and Other Concerns Minnesota Department of Commerce: Energy Facility Permitting Kathryn M. B. Haugen October 19, 2011

Ice Throw

- Ice can be thrown depending speed, thickness of ice, etc.
- Ice sensors on turbines and other towers
- Operator must be vigilant!
- Community decides how to regulate



Avian & Bat Studies

- Endangered and Threatened species survey from DNR.
- US Fish and Wildlife Guidelines
- Variation between birds/bats/raptors
- Local areas of significance?
- Post-construction monitoring for mortality



Performance Guarantee

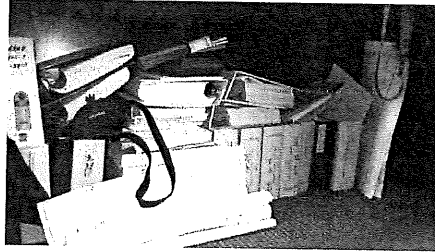
- ABANDONMENT
 - Cost of bond adjusted for inflation
 - Adjust for construction costs against common index
 - Assign time period to adjust (every 3 years)
 - What if just one wind turbine?
 - Long term maintenance issue?



Lessons Learned

- 1) The best way to control sound is through setbacks (be conservative +3 dBA)
- 2) Model shadow flicker to 5000'-6000'
- 3) Escrow account for application process
- 4) Escrow for life of the project (attorney, special studies, complaint resolution)

The application



Lessons Learned

- Social impacts
- Neutral
- Professional
- Declare conflicts publicly



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