



# Land-Based Large-Scale Wind Turbine Siting Guidelines

*February 22, 2016*



STATE OF RHODE ISLAND  
**OFFICE OF  
ENERGY RESOURCES**

# Presentation Overview

1. Background
2. How to Get Started
3. Types of Siting Impacts
4. Addressing Siting Impacts in an Ordinance
  - a. Impact Description
  - b. Standard Recommendations
5. How to Add Flexibility
6. Resources for You
7. Q & A
8. Comments & Feedback



# Background

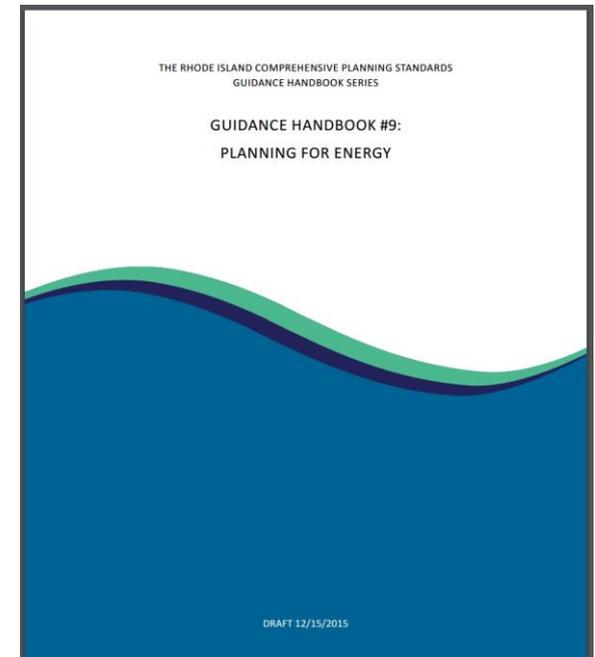
- State law charges the Office of Energy Resources (OER) and the Division of Planning (DOP) with issuing guidelines to assist municipalities as they develop wind siting ordinances (R.I.G.L. 42-140-3, R.I.G.L. 42-11-10)
- In 2012 the DOP issued interim guidelines to assist cities and towns as they develop wind siting ordinances: “Interim Siting Factors for Terrestrial Wind Energy Systems”
- The guidelines presented here are an update to the interim guidelines prepared by DOP in 2012

# Why Wind?

- **Local wind projects can provide energy, economic, and environmental benefits**
  - Diversify RI's electricity supply portfolio
  - Reduce GHG emissions from the power sector
  - Can provide a hedge against future price volatility
  - Can generate in-state investment and economic activity
- **The RI State Energy Plan (adopted Oct 2015) recommends increasing the share of renewable energy (RE) in RI's energy portfolio**
  - The Plan projects the need for over 500MW (nameplate) of local, distributed RE systems by 2035
  - The Plan suggests as much as 70MW (nameplate) of land-based wind could be developed during this time
  - Currently RI has approximately 9MW of wind (nameplate capacity)

# RI Municipalities

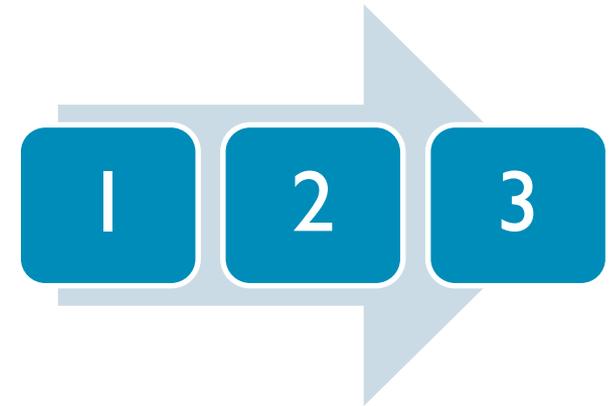
- **RI cities and towns are required to adopt and maintain community comprehensive plans**
  - These plans must address energy issues including the consideration of renewable energy
  - Wind siting ordinances can cover this requirement
  - Towns are currently updating their plans for 2016



[http://www.planning.ri.gov/documents/c omp\\_handbook/9\\_Energy.pdf](http://www.planning.ri.gov/documents/c omp_handbook/9_Energy.pdf)

# Recommended Municipal Process

1. Review municipal zoning use tables
2. Determine which zones in the municipality should allow large-scale land-based wind development
3. Add wind development to municipal use tables, indicating which zones will prohibit, permit, or require special use permits for wind development
4. With legal guidance, a municipality should write a zoning ordinance with explicit wind development standards for all impacts



Illustrative Table

Use	High Density Residential Zone	Low Density Residential Zone	Commercial Zone	Industrial Zone
Land-Based Wind Projects (>100 kW)	Prohibited	Special Use Permit	Special Use Permit	Permitted

# Three Categories of Siting Impacts



- 1. Safety Impacts**
  - I. Tower Collapse
  - II. Blade Throw
  - III. Ice Shedding
- 2. Community Impacts**
  - I. Noise
  - II. Flicker
  - III. Other- visual & signal interference
- 3. Environmental Impacts**

# Safety Impacts: Tower Collapse & Blade Throw

- **What are these impacts?** Tower Collapse describes the failure of a turbine's support structures. Blade Throw describes a scenario in which a blade/piece of a blade becomes detached from the turbine
- **Tower Collapse/Topple can be contained by setbacks slightly larger than the total height of the wind turbine**
- **Blade Throw is harder to predict**
  - Mathematically, throw distance is largely based on release angle, rotor speed, wind speed, and size of dislodged piece
  - Very little information is available about US wind turbine failure rates
  - **THE GOOD NEWS:**
    - There are international certification standards for turbine blades (IEC 61400-23 and 61400-5) which certify blades to operate for 20 years under test conditions
    - Most turbines have redundant systems to stop turbine operation during weather that exceeds rated conditions

# Safety Impacts: Ice Shedding

- **What is Ice Shedding?** During certain weather conditions, ice can accumulate on the blades and tower of a turbine. If turbine blades are spinning, ice can be thrown. If the turbine is stationary, the risk is limited to ice fall.
- **2000 Wind Energy in Cold Climate Final Report** presents an empirically derived equation for maximum throwing distance:  
$$= 1.5 \times (\text{hub height} + \text{rotor diameter})$$
- **The Equation only provides a rough estimate of the risk zone, but it can be paired with conservative operation protocols**



# Setbacks in Other NE States

	Setback Min. to Private or Public Ways	Setback Min. to Property Lines	Setback Min. to Wind Site Structures (buildings, critical electric infrastructure)	Setback Min. to Residential or Commercial Structures	Includes Language for Flexibility in these Setbacks (Waivers)
<b>CT</b>	Not Mentioned	1.5 (for WTs < 65MW) 2.5 (for WTs > 65MW)	Not Mentioned	1.5 (“occupied residential structure”)	Yes
<b>MA*</b>	1.5	1.5	1.5	3.0	Yes
<b>VT</b>	None	None	None	None	None
<b>NH</b>	Not established	Not established	Not established	Not established	Not established
<b>ME</b>	Not Mentioned	1.5	Not Mentioned	Not Mentioned	Yes
<b>Current RI</b>	1.25-1.5	1.5 (2.0 for residential property lines)	None	None	Yes
<b>Recommended for RI</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	<b>None</b>	<b>Yes</b>

\*MA info taken from a 2011 Model Ordinance by Department of Energy Resources, Massachusetts Executive Office of Environmental Affairs- MA Dept of Public Utilities continues to work on regulations

# Safety Impacts: Setback Recommendations

	Setback Min. to Private or Public Ways	Setback Min. to Property Lines	Setback Min to Any Occupied Building	Setback Min. to Wind Site Structures (buildings, critical electric infrastructure)	Includes Language for Flexibility in these Standards
<b>Recommended for RI</b>	1.5	1.5	1.5	None	Yes

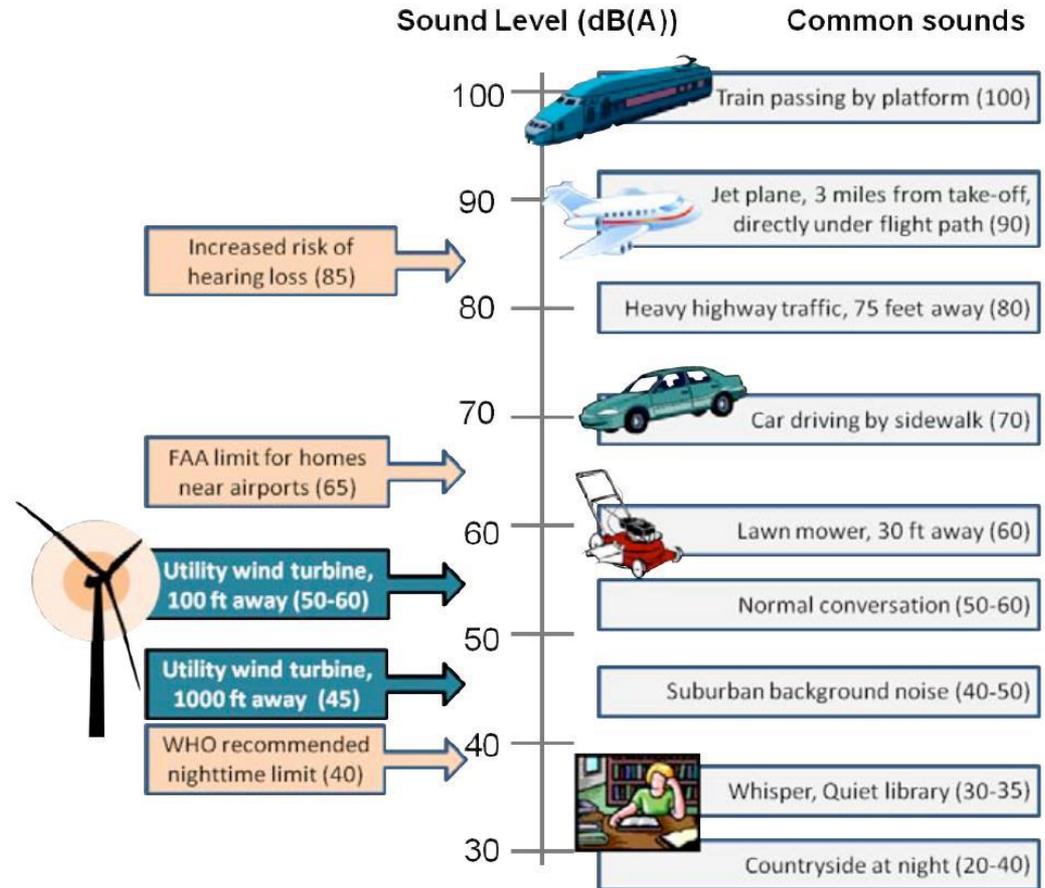
- If a manufacturer’s setback recommendations are larger than the minimums listed above, the manufacturer setback values should be applied to the installation.
- Only turbines meeting IEC or similar certifications should be permitted.
- Temporary shutdown or idling procedures should be required for turbines during ice shedding conditions; waivers for this requirement should be considered for proven de-icing technologies, larger than minimum setbacks, or limited human access to surrounding areas beyond the setback zone.

# Community Impacts: Noise

- **Sound Definition:** Any variation in pressure that the human ear can detect.
- **Noise Definition:** Sounds that are objectionable.
- **Sources of Sound from Wind Turbines:**

**Mechanical & Aerodynamic**

  - Mechanical: caused by mechanical components such as the generator
  - Aerodynamic: caused by the interaction between air and the moving blades



# An Intro to Noise

- **Like other generators wind turbines can produce noise impacts**
- **Unfortunately, noise is a difficult thing to measure**
  - Noise varies significantly: night/day, season, weather
  - Different sampling methods can result in very different results: esp. important for ambient noise measurements
- **It is important that wind turbines are not treated differently from other noise-producing developments**
- **To address the complexity of noise impacts, we offer two recommended noise standards**
  - Option 1 is strongly recommended
  - Option 2 is offered as a more conservative method for especially sensitive areas

# Community Impacts: Noise

## Recommended Standards: Two Options

### OPTION 1- Using Pre-Existing Municipal Noise Standards

- Many Cities/Towns already have Noise Standards for zones
- There are means of predicting turbine sound: IEC standards coupled with ISO sound propagation models
- Turbine noise will ADD to ambient sound. So, we need to make sure the SUM will be below municipal standards
- We recommend using conservative methods for predicting turbine sound (make conservative assumptions in the models and use the highest possible sound level produced during operating conditions)
- Then compare the predicted turbine sound (PTS) to municipal maximum sound limits (MMSL).
  - If  $(PTS + MMSL) - MMSL \leq 1 \text{ dB(A)}$  then the turbine noise should be permitted in the area.
  - If  $(PTS + MMSL) - MMSL > 1 \text{ dB(A)}$  then the turbine noise should NOT be permitted in the area.

# Math Explanation

- Decibels add logarithmically
- This means  $50 \text{ dB} + 46 \text{ dB} \neq 96 \text{ dB}$
- It's actually = 51.5 dB

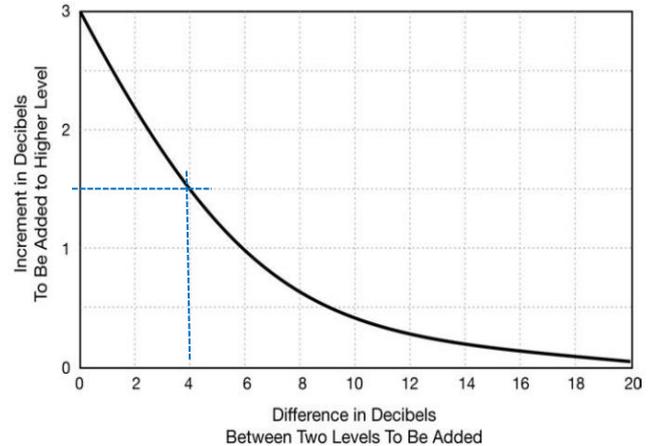


Figure 2-2. Graph for Approximate Decibel Addition

So, if Municipal Max Sound Limit (MMSL) is 40 dB(A)

A turbine must be 6 dB(A) below 40 (i.e. 34 dB(A) or quieter) to meet the siting requirements (total new sound  $\leq 41$  dB(A))

# Community Impacts: Noise

## OPTION 2: Increase in Ambient Noise Standard

- Municipality will determine an allowable increase over ambient sound levels for each zone
- Developer will need to measure ambient noise (pre-construction)- a detailed standard for this will need to be referenced
- Model the turbine sound (IEC standards coupled with ISO sound propagation models)
- Logarithmically sum the two results and determine if the increase in ambient sound is below the municipality's standard

# Community Impacts: Noise

## PROS & CONS of the Two Methods

### **OPTION 1: Existing Municipal Sound Standards**

**PROS:** No need to measure ambient sound.

**CONS:** Compliance could only be tested if the turbine is temporarily shut-off.

### **OPTION 2: Increase over Ambient**

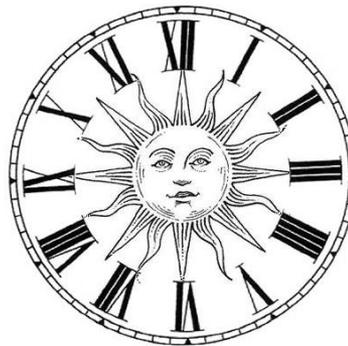
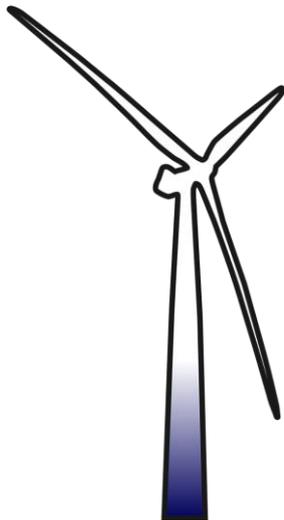
**PROS:** Prevents large increases in ambient sound levels.

**CONS:** Must select a detailed ambient sound measurement method- ambient sound is difficult to measure.

- **Both Methods can be made more conservative by modeling  $L_{DEN}$  instead of  $L_{EQ}$  sound levels**

# Community Impacts: Shadow Flicker

- **What is shadow flicker?** When a turbine is located between the sun and an observer, the rotating blades can cast moving shadows on the observer's location
- **This is a widely recognized annoyance factor for people living near wind turbines**
- **It is relatively easy to model and accurately predict (WindPRO)**



# Community Impacts: Shadow Flicker Recommended Standard

- **Based on Germany's Guidelines: WEA-Schattenwurf-Hinweise-Germany**
  - Maximum of 30 hours per year
  - Maximum of 30 minutes per day
- **For any portion of a nearby property**
- **Realistic Modeling (realistic shadow predictions)**
- **Can set less stringent standards (next slide), but all occupied buildings should require the 30 hrs/yr and 30 min/day limit**

# Can Adjust Stringency of Noise & Flicker Standards

- **Noise:** Select  $\Delta$ dB(A) over ambient or dB(A) limit per zone
- **Flicker:** Can adjust stringency with realistic versus worst-case scenario modeling

Illustrative Table

Siting Impact	Residential Zone	Commercial Zone	Industrial Zone
<b>Setback</b>	1.5x	1.5x	1.5x
<b>Noise</b>	40 dB(A)	65 dB(A)	75 dB(A)
<b>Shadow Flicker</b>	Max 30 hrs/yr & 30 min/day on any part of a nearby property (using realistic modeling)	Max 30 hrs/yr & 30 min/day at occupied structures (using worst-case scenario modeling)	Max 30 hrs/yr & 30 min/day at occupied structures (using realistic modeling)

Least Restrictive	
Less Restrictive	
Most Restrictive	

# Community Impacts: Signal Interference

- Historically, large-scale wind turbines were primarily composed of metal
- Today, composite materials are used
- New synthetic materials have minimal impacts on broadcast signal transmission
- Recommendation: notify nearby communication towers. Owner will need to install additional transmitter masts if issues are shown to arise.



# Community Impacts: Visual

- **Assessing the visual impacts of any development is highly subjective. Therefore we don't recommend a standard for assessing visual impacts.**
- **However, we do recommend a viewshed/sightline analysis be included in a project proposal along with accurately-scaled photographic renderings for areas with the greatest expected visual impacts (day and night if nighttime lighting is required)**
- **If a municipality has already established visual standards for other types of developments, wind should need to meet the same requirements**
- **Otherwise the viewshed/sightline analyses & photographic renderings are simply meant to be educational- a good public engagement strategy**

# Environmental Impacts

- Birds & Bats**



nbc15.com, "US gives threatened status to northern long-eared bat"

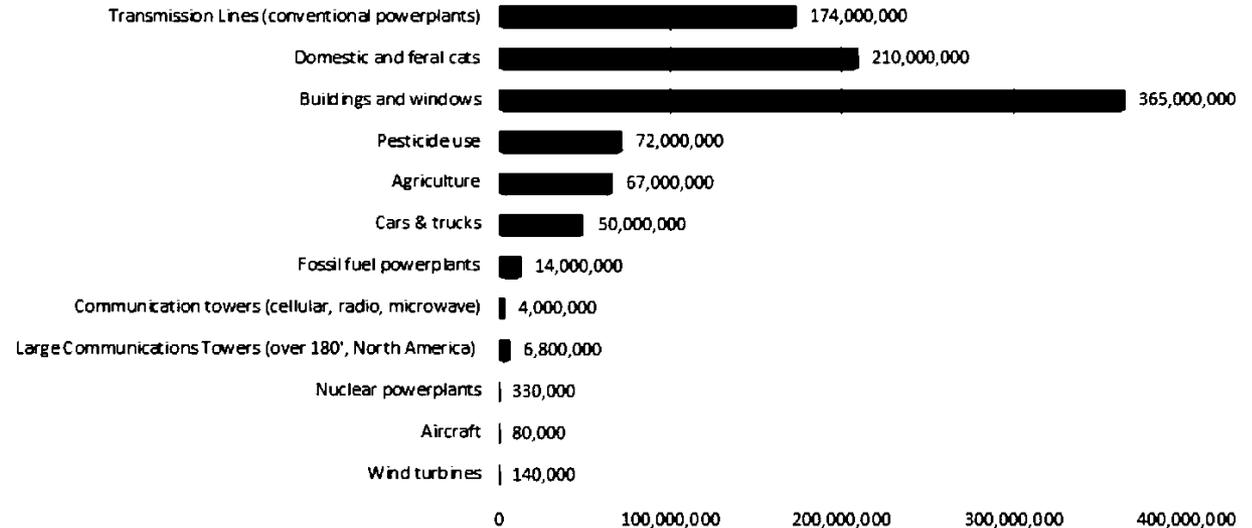


Fig. 1. Annual avian mortality in the USA [8–11]. Numbers show the lowest values when a range of estimates is given.

- Note: In 2015, the Northern Long-Eared Bat was added to the federal list of threatened species**
- Other species: species displacement and predator-prey balances may be affected, though more studies are needed**
- Overall, there is limited scientific understanding**

# Environmental Impacts Recommended Standard



- In general, env. impacts are best regulated at the state and federal level
- Developers should engage the U.S. Fish & Wildlife Service (USFWS) and the RI Department of Environmental Management (RI DEM) and other appropriate environmental groups as early in the proposal process as possible

# Environmental Impacts Recommended Standard

- **Developers should follow the voluntary guidelines put together by the USFWS**
  - These guidelines, at minimum, require a literature review & a site characterization visit- an expert is to identify surrounding habitat types and their potential for attracting or supporting species of concern
  - They also offer a decision-making process for requiring or not-requiring further environmental studies
  - In general, if a site avoids important migratory layovers/concentration points, and endangered or protected species nesting, breeding, or feeding sites, only the minimum work explained above is required
- **All questions/comments from the USFWS and RI DEM should be addressed in the project's proposal. If state and federal recommendations are met, a municipality should accept the proposal w.r.t. its env. impacts**

# Adding Flexibility: Two-Tiers of Special Use Permits

- **All recommended standards need to be flexible. One-size does not fit all.**
- **How to add flexibility?**
  - Two-tiered special use permit structure!
    - Tier 1: If the development meets the previously discussed zoning standards ➡ Then development should receive a special use permit
    - Tier 2: If the development does not meet previously discussed standards (setbacks, noise, flicker) ➡ Then all impacted nearby landowners should be notified. A remonstrance procedure can then occur. If no impacted landowners object, the development should receive a special use permit
- **Why is this important?**
  - Setback/Flicker/Noise example: adjacent wetlands or farm with sold development rights

# Additional Resources

- Page 31 of Proposed Guidelines: Proposal Checklist
- Page 46: Two-tier Special Use Permit Procedure Explanation
- Pages 10-11: Renewable Energy Siting Partnership, Property Values & Acoustic Impacts Studies
- Where to view the proposed Guidelines:  
<http://www.energy.ri.gov/renewable/landwind/>

# Contact Us

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# Next Steps

- In the interest of collaboration and public input, OER will be accepting written comments, thoughts, and suggestions for the next 30 days
- We will consider all received comments as we work to finalize the document
- All comments must be received by 5pm EST on March 23, 2016
- Please email or mail all comments to:

[becca.Trietch@energy.ri.gov](mailto:becca.Trietch@energy.ri.gov)

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# Q & A

**Feel free to ask any technical or clarifying questions**

**Comments will be heard immediately after**

# Comments