Land-Based Large-Scale Wind Turbine Siting Guidelines

February 22, 2016
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
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

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

<table>
<thead>
<tr>
<th>Use</th>
<th>High Density Residential Zone</th>
<th>Low Density Residential Zone</th>
<th>Commercial Zone</th>
<th>Industrial Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land-Based Wind Projects (&gt;100 kW)</td>
<td>Prohibited</td>
<td>Special Use Permit</td>
<td>Special Use Permit</td>
<td>Permitted</td>
</tr>
</tbody>
</table>
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

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

*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

- 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
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 ≤ 1 dB(A) then the turbine noise should be permitted in the area.
  - If (PTS + MMSL) - MMSL > 1 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 $= 51.5 \text{ dB}$

So, if Municipal Max Sound Limit (MMSL) is $40 \text{ dB(A)}$

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

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

- **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**

![Image of a bat](https://via.placeholder.com/150)

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

- **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**

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**Fig. 1.** Annual avian mortality in the USA [8–11]. Numbers show the lowest values when a range of estimates is given.
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/](http://www.energy.ri.gov/renewable/landwind/)
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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:

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  RI Office of Energy Resources
  Attn: Becca Trietch
  One Capitol Hill, 4th Floor
  Providence, RI 02908
Q & A

Feel free to ask any technical or clarifying questions

Comments will be heard immediately after
Comments