Rhode Island
Land-Based Wind Siting Guidelines

Applicable to proposed turbines ≥ 200 feet in height or rated to produce ≥ 100 kW of power

January 2017

This document provides information and helpful guidance for Rhode Island municipalities interested in establishing new (or revising existing) terrestrial wind turbine siting ordinances for their community. The information within this document is based on best practices in other New England, national, and international jurisdictions; input from the public, state agencies, and industry stakeholders; previous wind siting guidance documents created for Rhode Island; and a literature review of scientific, peer-reviewed journals. The information and recommendations presented within should not be deemed mandates by the Rhode Island Office of Energy Resources (OER). For more information, please contact OER at (401) 574-9100 or energy.resources@energy.ri.gov.

Table of Contents

Glossary of Terms

A-weighted decibel level (dB(A))	The decibel is a unit used to measure the intensity of sound. Specifically, it is a logarithmic measure of sound pressure levels. An A-weighted decibel measurement has been filtered to better represent how humans sense sound. It discounts frequencies near the top and bottom of the human range of hearing.
Capacity Factor	A capacity factor is a ratio or percentage that represents a wind turbine's actual energy output versus its maximum potential energy output. The value is typically reported as an annual figure, not monthly, hourly or instantaneously. The maximum potential energy output assumes the turbine can operate at its nameplate capacity continuously throughout one year.
Cut-in speed	The minimum wind speed needed for a wind turbine to begin generating electricity.
Hub	The hub is part of the turbine's rotor. It is where the blades attach to the turbine.
Nacelle	The housing component located at the top of the tower that contains much of the turbine's mechanical systems. It is connected to the turbine's rotor.
Noise	Any sound that is objectionable, loud, unpleasant, or that causes disturbance.
Octave Band	A frequency band encompassing a range of frequencies, the highest of which is twice the frequency of the lowest. For example, the 1kHz octave band (named for its center frequency) will encompass frequencies from 707Hz to 1,414Hz.
Pure tones	Often defined as when an octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.
Rotor	The rotating assembly consisting of a wind turbine's blades and connecting hub, located at the top of the tower.
Short Duration Repetitive Sounds	For wind turbines, this phenomenon is defined as a sequence of repetitive sounds that occur within a 10-minute measurement interval. Each sound must be clearly discernible as an event resulting from the wind development and must cause an increase on the fast meter response of 5 dBA or greater above the sound level observed immediately before and after the event. Each event is typically ±1 second in duration, and must be inherent to the process or operation of the wind development. Please see Maine's No Adverse Environmental Effect Standard of the Site Location Law, Section I:

	Sound Level Standards for Wind Energy Developments[1] for more information.
Sound	Any variation in pressure that the human ear can detect. Sounds that are objectionable or unpleasant are referred to as "noise."
Total height	The distance from the base of the turbine to the tip of a turbine blade when the blade is pointed at the 12 o'clock position.

[1] http://www.maine.gov/sos/cec/rules/06/096/096c375.doc

Introduction

Wind development in Rhode Island dates back over a decade, when the first commercial-scale wind turbine was installed in 2006 at the Portsmouth Abbey. Since then, over 22 MW of wind – representing 21 systems 100 kW or larger – have been installed in the state. Now, policy initiatives, such as the Renewable Energy Growth Program (REG Program) and net metering, are expected to generate increased demand in Rhode Island's growing wind energy market.

Local wind energy projects can provide important energy, economic, and environmental benefits to the people and communities of Rhode Island. Wind projects offer the potential to diversify Rhode Island's electricity supply portfolio while reducing greenhouse gas emissions from the power sector. Local wind projects can also help reduce energy purchase costs, provide a hedge against future price volatility, support distributed generation, and generate in-state investment and economic activity. For individual cities and towns, wind projects may provide tax or lease revenues, preservation of open space, price stability, diversified electricity sources, and local jobs.

On the other hand, wind projects may pose certain types of public safety, community and environmental impacts. These potential impacts can include turbine collapse/topple, blade throw, ice shedding/throw, noise, shadow flicker, environmental impacts such as bird and bat mortalities, and visual and signal interference. However, proper siting of wind turbines can mitigate or avoid such impacts. This document reviews major siting considerations for wind projects in Rhode Island and provides recommended (non-mandated) standards for communities to consider when addressing potential impacts.

In Rhode Island, individual municipalities hold the authority to regulate the siting of wind turbines through zoning ordinances. State law charges the Office of Energy Resources (OER) and Division of Planning (DOP) with issuing guidelines to assist cities and towns as they develop wind siting ordinances.[2] In 2012, DOP issued a technical report, "Interim Siting Factors for Terrestrial Wind Energy Systems,"[3] which put forth guidelines for siting wind turbines in municipalities. This document, prepared by OER, is an update to the interim draft guidelines prepared by DOP in 2012.

Rhode Island cities and towns are required to adopt and maintain community comprehensive plans. These plans must include a section addressing energy issues, including the consideration of renewable energy.[4] However, there is no specific requirement on individual Rhode Island municipalities to pursue wind projects.

This document contains the following sections and appendices:

- **Background** – This section contains background information on wind energy in Rhode Island; policies and programs related to wind; and past wind siting initiatives in the state.

- **Zoning Considerations for Municipalities** – This section outlines the process and steps for municipalities as they embark on developing wind siting ordinances.

---

[2] http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-11/42-11-10.HTM
http://webserver.rilin.state.ri.us/Statutes/TITLE42/42-140/42-140-3.HTM
[3] http://www.planning.ri.gov/statewideplanning/land/energy.php
[4] http://www.planning.ri.gov/documents/comp_handbook/0_Standards.pdf
http://www.planning.ri.gov/documents/comp_handbook/9_Energy.pdf
http://www.planning.ri.gov/documents/LU/energy/energy15.pdf

- **<u>Siting Impacts and Recommended Standards</u>** – This section identifies the major potential siting impacts of wind projects and provides recommended standards for addressing impacts.

- **<u>Municipal Development Proposal Checklist</u>** – This section contains a checklist for municipal officials to reference as they consider development proposals for wind projects.

- **<u>Rhode Island Wind Turbine Case Studies</u>** – This section provides case studies of existing wind turbines in Rhode Island, including background information and project details.

- **<u>Sample Wind Ordinance</u>** – This section contains a sample wind ordinance from Massachusetts for municipal officials to reference as they develop zoning ordinances for wind projects.

- **<u>Example Waiver Language</u>** – This section contains waiver language used in the state of Connecticut for wind turbine siting. The language illustrates the need for flexibility in wind siting standards and procedures.

- **<u>Increased Impact Special Use Permit Procedure</u>** – This section provides a sample remonstrance procedure for wind turbine special use permits. The procedure was created by modifying South Kingstown's Liquor License remonstrance process.

Background

This section contains background information on wind energy in Rhode Island; policies and programs related to wind; and past wind siting initiatives in the state.

Overview of Wind Energy in Rhode Island

Wind turbines use the energy of moving air to generate electricity.[5] Turbines produce more power at higher wind speeds, which are typically found in areas with higher elevation relative to surrounding terrain and low surface roughness. In Rhode Island, the most significant wind energy resources are concentrated in areas along the coast and offshore in ocean waters. However, some modern day commercial scale wind turbines are designed to perform more effectively at low wind speeds and these turbines can be economically viable throughout portions of the state.

The use of wind to generate electricity is a relatively new undertaking in Rhode Island. The first modern commercial-scale wind turbine was installed in 2006 at the Portsmouth Abbey. However, a large wind turbine with a 100ft tower did operate on Block Island as early as 1979 [1]. As a small and densely populated state, Rhode Island does not lend itself to large land-based wind farms of the type seen in the Midwestern and Western states. Instead, Rhode Island's wind power potential lies in the opportunity to develop multiple municipal or small-scale commercial projects consisting of one or a few wind turbines, and in offshore wind farms.

As of December 2014, the Ocean State had an installed nameplate wind capacity of approximately 22 MW, with 21 systems 100 kW or larger (Figure 1). In 2016, Deepwater Wind LLC completed construction on the nation's first offshore wind installation, a five-turbine, 30 MW wind farm in state waters off the coast of Block Island. A much larger offshore wind project – up to 1,000 MW – is planned for development in federal waters off of Rhode Island and Massachusetts. In addition, ten 1.5 MW land-based wind turbines are currently in construction in the Town of Coventry..

Figure 1. Rhode Island Wind Turbines

Name	Location	System Size	Height	Date Installed
Portsmouth Abbey	Portsmouth	660 kW	240 ft.	2006
Aquidneck Corporate Park	Middletown	100 kW	157 ft.	2009
New England Tech	Warwick	100 kW	157 ft.	2009
Portsmouth High School*	Portsmouth	1.5 MW	336/414 ft.	2009/2016
Fishermen's Memorial Campground	Narragansett	100 kW	157 ft.	2011
Hodges Badge	Portsmouth	225 kW	158 ft.	2011
Shalom Housing	Warwick	100 kW	157 ft.	2011
Narragansett Bay Commission #1	Providence	1.5 MW	365 ft.	2012
Narragansett Bay Commission #2	Providence	1.5 MW	365 ft.	2012
Narragansett Bay Commission #3	Providence	1.5 MW	365 ft.	2012
Sandywoods Farm	Tiverton	275 kW	231 ft.	2012
North Kingstown Green	North Kingstown	1.5 MW	402 ft.	2013
Coventry Turbine #1	Coventry	1.5 MW	414 ft.	2016

[5] For more information on how wind technology works, visit: http://energy.gov/eere/wind/how-do-wind-turbines-work or http://energy.gov/articles/how-wind-turbine-works

Coventry Turbine #2	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #2A	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #2B	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #3	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #4	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #6	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #6A	Coventry	1.5 MW	414 ft.	2016
Coventry Turbine #6B	Coventry	1.5 MW	414 ft.	2016

*Two values are displayed in the Height and Date Installed columns for this turbine because it was shut down in June of 2012 due to a gearbox failure and replaced with a direct drive turbine in July of 2016.

FAQ's

1. How much wind power potential exists in Rhode Island?

The State's most significant wind energy resource from a power production standpoint is offshore wind. The 2007 RIWINDS study, commissioned by the Rhode Island Economic Development Corporation (now the Rhode Island Commerce Corporation, or Commerce RI), concluded that over 95 percent of the wind energy resources available to Rhode Island are located offshore. Subsequent renewable energy resource assessments conducted in 2012 through the Renewable Energy Siting Partnership (RESP) helped further quantify the resource opportunities for land-based wind. Overall, land-based wind energy resources are modest in Rhode Island compared to other regions of the country. However, important in-state opportunities exist for developing land-based wind energy.

2. How many wind turbines are there in Rhode Island?

As of December 2014, the Ocean State had an estimated installed wind capacity of approximately22 MW, with 21 systems 100 kW or larger. See Appendix B "Rhode Island Wind Turbine Case Studies" to learn more about existing wind turbines in the state.

3. How much of Rhode Island's electricity needs does wind energy provide?

As of 2014 Rhode Island consumes approximately 8,000 GWh of electricity each year. Assuming a 20% capacity factor (see question 4 below), existing Rhode Island wind turbines generate a total of about 16,000 MWh per year. Therefore, in-state wind turbines currently offer enough supply to meet roughly 0.2% of Rhode Island's electricity needs. For perspective, wind energy provided 10.5% of U.S. electricity in 2014.

4. What is a capacity factor and what does it mean for wind power?

Because the wind doesn't always blow and wind speeds often vary, wind turbines don't produce power at their maximum capacity all of the time. A capacity factor is a ratio or percentage that represents a wind turbine's actual energy output versus its maximum potential energy output. Wind turbines located in areas with more wind resources have higher capacity factors. In Rhode Island, onshore wind turbines typically see capacity factors around 20%. Because the wind blows more strongly off the coast, offshore wind turbines in Rhode Island are expected to achieve capacity factors approaching 50%.

5. How many homes can a wind turbine power?

A typical 1.5 MW onshore wind turbine in Rhode Island can power the equivalent of approximately 440 homes annually, assuming a 20% capacity factor and an average monthly household use of 500 kWh. A 6 MW offshore wind turbine in Rhode Island can power the equivalent of more than 4,000 homes annually, assuming a 48% capacity factor and an average monthly household use of 500 kWh.

6. How much carbon dioxide does a wind energy turbine offset?

A typical 1.5 MW onshore wind turbine in Rhode Island can offset approximately 870 metric tons of carbon dioxide annually, assuming a 20% capacity factor and a New England carbon dioxide emissions rate of 730 lb/MWh. Eliminating 870 metric tons of carbon dioxide is the same as preventing the annual emissions of about 180 vehicles.

Policy Context

Energy 2035, the Rhode Island State Energy Plan, adopted in October 2015, demonstrated that renewable and other no-to-low carbon energy resources will play an important role in helping Rhode Island achieve its energy, economic, and environmental goals. The Plan recommends increasing the share of renewable energy in Rhode Island's electricity supply through a mix of clean energy imports, distributed renewable generation, and in-state, utility-scale projects. Local renewable energy projects, such as land-based wind, are part of this multi-tiered approach to promoting renewable energy.

Wind projects can help diversify Rhode Island's electricity supply portfolio, which is currently dominated by natural gas both in-state and regionally. Local wind generation can reduce costs and power losses associated with transporting electricity long distances. It can also reduce the demands on the grid during periods of peak electricity use. By reducing the need to burn fuel, local wind projects can provide health and environmental benefits, price predictability and a hedge against volatile fossil fuel and electricity prices. In-state investment, economic growth, and job creation can also be spurred through the construction and operation of local wind projects.

Land-based wind is anticipated to play a supportive role in helping Rhode Island achieve the goals established in the State Energy Plan. The Plan projects the need for over 500 MW of local, distributed renewable energy systems developed by 2035.

As of 2016, the state has two primary policy initiatives for supporting the development of in-state, land-based wind projects: the Renewable Energy Growth Program (REG Program) and net metering. The two programs are further described below. For more information on Rhode Island's major energy laws, please visit www.energy.ri.gov or see Appendix A of *Energy 2035, Rhode Island State Energy Plan* "Rhode Island Energy Laws."

The REG Program will support the development of 160 MW of new renewable energy projects in Rhode Island between 2015 and 2019. The REG Program is the successor program to the 40 MW Distributed Generation Standard Contracts Program (DG Program) that was in place from 2011 to 2014. The REG Program replaced the contract-based DG Program with a new system of performance-based incentives set in tariffs filed at and approved by the Public Utilities Commission. Eligible technologies include wind, solar, hydropower, and anaerobic digestion.

Net metering requires electric distribution companies to credit energy produced by small renewable energy systems (under 5 MW) installed on the customer's side of the electric meter. Eligible systems must be sized to meet on-site loads, based on a three-year average of electricity consumption at the property. Customers receive credit at the electric distribution company's avoided cost rate for excess generation produced by a net-metered system, up to 125 percent of the customer's own consumption during a billing period. To participate in net metering, a renewable energy system must be sited on the customer's premises, with certain exceptions for public sector projects, farms, affordable housing, and residential projects.

Wind Siting in Rhode Island

Siting wind energy projects involves a careful consideration of both the available wind resource and the potential impacts a project may pose to the surrounding area. A number of public-private partnerships and state initiatives have evaluated siting considerations associated with offshore and onshore wind in Rhode Island:

Ocean Special Area Management Plan (SAMP)

The Ocean Special Area Management Plan (SAMP)[6] was a planning and regulatory development process conducted by the Coastal Resources Management Council (CRMC) to promote, protect, enhance, and honor existing human uses and natural resources in the coastal waters of Rhode Island, while encouraging economic development, creating renewable energy siting zones, and facilitating the coordination of state and federal decision making bodies. Adopted October 19, 2010, the Ocean SAMP informed the siting of Rhode Island's first offshore wind farm in state waters off Block Island and will direct the future siting of utility-scale wind farms in Rhode Island Sound.

Division of Planning Wind Siting Guidelines

In 2012, the Division of Planning (DOP) released a technical report, "Interim Siting Factors for Terrestrial Wind Energy Systems," which put forth guidelines for siting wind turbines in municipalities. DOP produced this report as part of an overarching statutory charge to develop siting guidance for the location of renewable energy facilities in the state. The law directed the DOP to consider standards and guidelines for the location of eligible renewable energy resources and facilities with consideration for the location of such resources and facilities in commercial, industrial, and agricultural areas, areas occupied by public and private institutions, and property of the State, and in other areas of the state as appropriate. For more information on the DOP Wind Siting Guidelines, please visit: www.planning.ri.gov/statewideplanning/land/energy.php.

Renewable Energy Siting Partnership (RESP)

In response to questions about the effects that the increased development of renewable energy may have on the people and communities of Rhode Island, the State initiated the Renewable Energy Siting Partnership (RESP) in 2011. The RESP spearheaded a statewide conversation among residents, municipalities, and other stakeholders about the benefits and impacts of renewable energy development in the state. The RESP evaluated impacts of land-based wind turbines on birds and bats, scenery, cultural values, property values, and public safety, as well as acoustic, shadow flicker, and electromagnetic

[6] http://seagrant.gso.uri.edu/oceansamp/

interference impacts. The RESP also performed an analysis of modeled wind speed values and confirmed modeled estimates with data collected at specific sites. Drawing on analysis of impacts and wind resource data, the RESP performed a siting analysis to visualize the distribution of wind energy opportunities and constraints around the state. For more information on the RESP, please visit: www.crc.uri.edu/projects_page/rhode-island-renewable-energy-siting-partnership-resp/.

Property Values & Acoustic Impacts Studies

The Rhode Island Office of Energy Resources (OER) commissioned two follow-up studies to the RESP: a property values study and an acoustics study. The purpose of the property values study was to assess the effect that existing onshore wind turbines have on nearby residential property values in Rhode Island. The report concluded that "across a wide variety of specifications, the results indicate that wind turbines have no statistically significant impact on house prices…. Our principle finding is that the best estimate is that there is no price effect, and we can say with 90% level of confidence if there is a price effect, it is roughly 5.2% or less." To see the full report, please visit: www.energy.ri.gov/documents/Onshore%20Wind/Final%20Property%20Values%20Report.pdf.

Another report conducted by the University of Connecticut and the Lawrence Berkeley National Laboratory in 2014 studied wind turbines and property values in Massachusetts. This study analyzed 122,198 single-family home sales, occurring between 1998 and 2012, within 5 miles of 41 wind turbines. The results of the study were very similar to the findings reported in the Rhode Island property value study above. In particular, the study states, "The results of this study do not support the claim that wind turbines affect nearby home prices."[2]

The purpose of the acoustics study commissioned by OER was to advance an understanding of the acoustic impacts of wind turbines in Rhode Island. The study recorded and analyzed radiated sound from wind turbines currently installed in Rhode Island. It also discusses the variability of both ambient sounds and sounds emanating from the wind turbines. The full report can be found here: www.energy.ri.gov/documents/Onshore%20Wind/FINAL_REPORT_RIOER%2020140711.pdf

DEM Terrestrial Wind Turbine Siting Report

In 2009, the Rhode Island Department of Environmental Management (DEM) created a Terrestrial Wind Turbine Siting Report. Although several years old, this report still offers some valuable insight related to siting wind turbines in environmentally sensitive, coastal areas. To access the report, please visit: www.dem.ri.gov/cleannrg/pdf/terrwind.pdf.

Zoning Considerations for Municipalities

This section outlines the process and steps for municipalities to consider as they embark on developing wind siting ordinances. The following is a recommended process based on best practices.

Municipalities should use the existing structure built into their zoning to direct wind development to ideal areas and away from controversial areas. This requires two steps:

1. Municipalities should review their "use tables" and identify whether wind turbines should be a permitted use, special (or "conditional") use, or prohibited use in different types of zoning districts. Use tables allow municipalities to steer potential development activities to locations well-suited for wind projects relative to existing or planned land use activities, and away from areas that a municipality may view as less suitable for wind development. Figure 2 displays an illustrative example of wind projects in a use table.

Figure 2. Illustrative Municipal Use Table

Use	**High Density Residential Zone**	**Low Density Residential Zone**	**Commercial Zone**	**Industrial Zone**
Wind Projects (≥100 kW)	Prohibited	Special Use Permit	Special Use Permit	Permitted

2. Municipalities should then identify the required standard for each siting impact in each zone. The "Siting Impacts and Recommended Standards" section provides recommended standards for several categories of siting impacts: public safety impacts, community impacts, and environmental impacts. Public safety standards should not vary by zone. Community impact and environmental impact standards, however, may vary by zone.

3. Figure 3 displays an example of illustrative municipal wind siting standards for different zones. For more details regarding each standard, please see the Setback, Noise, and/or Shadow Flicker sections of this document.

Figure 3. Illustrative Municipal Wind Siting Standards

Siting Impact	**High Density Residential Zone**	**Low Density Residential Zone**	**Commercial Zone**	**Industrial Zone**
Setback	1.5x	1.5x	1.5x	1.5x
Noise	40 dB(A)	40dB(A)	65 dB(A)	75 dB(A)
Shadow Flicker	Max 30 hrs/yr at occupied structures or sites permitted for occupied structure construction at time of wind project permitting (using **worst-**	Max 30 hrs/yr at occupied structures or sites permitted for occupied structure construction at time of wind project permitting (using **worst-**	Max 30 hrs/yr at occupied structures or sites permitted for occupied structure construction at time of wind project permitting (using	Max 30 hrs/yr at occupied structures or sites permitted for occupied structure construction at time of wind project permitting (using

Least Restrictive	(green)
Less Restrictive	(yellow)
Most Restrictive	(red)

	case scenario modeling)	**case scenari**o modeling)	**realistic** modeling)	**realistic** modeling)

Siting Impacts and Recommended Standards

This section identifies the major potential siting impacts of wind projects and provides recommended standards for addressing impacts. All recommended standards should be applied at the time of project permitting. Table 1 displays a summary of the wind siting impacts considered and the recommended standards:

Table 1. Summary of Rhode Island Wind Siting Impacts and Recommended Standards

Category	**Siting Impact**	**Recommended Standard**
Public Safety Impacts	Setbacks to Prevent Personal Injury and/or Property Damage (turbine collapse/topple, blade throw, and ice shedding/throw)	Setbacks equal to 1.5 x total turbine height from the closest point of property lines, public or private ways, and occupied buildings, or manufacturer's specifications, whichever is largest.
Community Impacts	Noise	Option 1 relies on existing municipal maximum sound levels Option 2 is based on measured levels of ambient noise (see Noise section).
	Shadow Flicker	No more than 30 hours per year at occupied structures or sites permitted for occupied structure construction at time of wind project permitting (using worst-case scenario modeling).
	Other Impacts (Visual & Signal Interference)	Require a viewshed analysis and photographic renderings. Also require turbine developers to notify nearby communication towers prior to construction. If communication issues arise additional transmitter masts should be installed at the wind developer's expense or the developer should be responsible for finding another, mutually agreeable solution.
Environmental Impacts	Environmental Impacts	Require pre- and potentially post-construction site characterization visits and/or surveys as outlined by the USFWS's voluntary guidelines. Also engage with RI DEM, USFWS, and other appropriate environmental groups for comments and recommendations.

As municipalities set standards for the following wind siting impacts, the following considerations should be kept in mind:

- Recommended standards should be applied at the time of project permitting.
- It is recommended that municipalities consider options for less stringent standards for community impacts where applicable and appropriate. Specifically, municipalities may choose to propose less stringent standards for community impacts in zones with fewer sensitive receptors, for example—commercial or industrial zones.

- It is recommended that municipalities do not propose less stringent standards for public and environmental safety impacts within their ordinances.
- It is recommended that municipalities measure most standards with respect to abutting property lines, not just at occupied buildings, as a property owner may wish to develop an undeveloped part of his/her lot in the future. Shadow flicker standards are a critical exception to this rule.
- Expert reviewers or consultants may be needed by a municipality to evaluate the technical aspects of a wind turbine project proposal. It is recommended that municipalities set a limit or negotiate a maximum cost to the wind developer for these services prior to a proposal review. OER is able and willing to provide assistance to municipalities as they navigate issues related to hiring third party consultants.
- Projects with impacts reaching across town lines should be required to work with each town. The developer should comply with the siting standards of each impacted area's governing municipality.
- Providing flexibility in siting standards is an essential part of any wind siting ordinance. Blanket standards do not allow regulations to be molded to the needs of different sites and different project neighbors. If landowners are willing to assume greater risk or exposure to siting impacts, they should be allowed to do so within reason. Other states such as Connecticut use waivers to provide this flexibility within their siting standards (See Appendix D for Connecticut's waiver language). However, Rhode Island's Zoning Enabling Act differs from Connecticut's zoning laws and the use of waivers in Rhode Island may be legally prohibited. We recommend that municipalities obtain legal counsel with expertise in zoning prior to finalizing their wind siting ordinances. As an alternative to waivers, it is recommended that Rhode Island municipalities create two types of special use permits for terrestrial wind turbine projects. The first type of permit or special use permit should be granted for wind turbine projects meeting a municipality's specified siting standards and located within a wind-permitting zone (i.e. within a zone that allows wind turbines as a 'permitted' or 'special' use). The second type of special use permit should be granted if a project exceeds the impact levels allowed by the municipality but the municipality's Zoning Board still wishes to permit the development after having heard the opinions of all landowners who will experience the increased impacts. In order to differentiate between special use permits granted for projects meeting siting standards versus those granted due to a lack of opposition/individual Zoning Board decisions, this document will refer to them as 'special use permits' and 'increased impact special use permits' (IISUPs) respectively.
- Clearly written IISUPs and IISUP notification letters are an essential part of wind siting guidelines as they allow regulations to be better molded to the needs of different sites. However, reviewing these types of special use permit requests can require extensive technical expertise and a comprehensive understanding of site details. Therefore, it is encouraged that municipalities reach out to appropriate departments and agencies during IISUP reviews. In general, the Rhode Island Office of Energy Resources is well equipped to provide IISUP guidance and decision-making support. Please see Appendix E for a sample review procedure.

* * * * *

Setbacks

<u>Description of Impacts</u>

There are three main safety concerns associated with proximity to large scale wind turbines: turbine collapse/topple, blade throw, and ice shedding/throw. These concerns are usually tied to extreme weather events[3][4]. Although both tower collapse/topple and blade throw events are rare, they have the potential to be catastrophic due to the size and location of the equipment.

Turbine collapse or topple describes the failure of a turbine's support structures, such as the foundation or tower. The failure of such support structures can result in the turbine tumbling to the ground. In this situation, setbacks slightly larger than the total turbine height are likely sufficient to protect the public from turbine collapse or topple.

Blade throw describes a failure scenario in which a blade or section of a blade becomes detached from the turbine structure. Due to the rotation of the blades, these detached pieces can be thrown away from the turbine base. The distance thrown can vary significantly depending on variables such as turbine rotor speed, blade release angle, wind velocity, mass of detached piece, and turbine height [5].

A final safety concern is ice throw or shedding. During certain weather conditions, it is possible for ice to accumulate on the blades and tower of a turbine. If the turbine rotor is not rotating, ice fall risk is similar to that of other tall stationary structures such as communication towers and buildings. However, if turbines continue to operate during icing conditions, spinning blades may throw ice debris a significant distance from the tower base. An empirically derived equation presented in the 2000 Wind Energy in Cold Climate Final Report, defines a maximum throwing distance as 1.5 times the sum of the turbine's hub height and rotor diameter [6]. This equation only provides a rough estimate of a risk zone, but when coupled with conservative operation protocols and/or modern ice-sensing technologies it can actively prevent dangerous ice throw scenarios.

Proper siting and operational practices can effectively mitigate all three of these safety concerns. Connecticut and Maine have set a precedent for using 1.5 times the total turbine height as a public safety setback. Massachusetts also calls for this setback value in their model zoning ordinances created by the Massachusetts Department of Energy Resources and the Massachusetts Executive Office of Environmental Affairs.

Recommended Standards

	Minimum Setback to Private or Public Ways not located on the property being developed	**Minimum Setback to Property Lines**	**Minimum Setback to Any Occupied Building not located on the property being developed**	**Include Language for IISUPs**
Recommended for Rhode Island	1.5 x Total Turbine Height	1.5 x Total Turbine Height	1.5 x Total Turbine Height	Yes

- Total turbine height is defined as the distance from the base of the turbine to the tip of a turbine blade when the blade is pointed at the 12 o'clock position.
- Setback distances should be measured from the closest edge of the turbine base to the closest point of the occupied building, property line, or private or public way.
- If a private or public way or occupied building located on the property being developed will not have a 1.5x setback, the developer should notify the land owner and submit an acknowledgement of the lessor setback signed by the land owner to the municipality.
- 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 International Electrotechnical Commission (IEC) or similar certifications should be permitted.
- Signage should be considered as a means of providing extreme weather warnings to the public. Phrases such as "stay clear if wind is over ## mph or if ice is visible on blades or towers" may be advisable along the outer perimeter of a wind development's setback distance.
- Temporary shutdown or idling procedures should be required for turbines during ice shedding conditions unless proven de-icing technologies, larger than minimum setbacks, or limited human access to surrounding areas can be demonstrated.
- Increased impact special use permits (IISUPs) for lesser setback distances should be granted if all landowners who will experience smaller setback distances do not object.

FAQ's

1. What setbacks do other states recommend?

Below is a summary table of wind turbine setbacks employed by other New England states in 2015.

	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 Setback Waivers
CT[7]	Not Mentioned	1.5 (for WT facility < 65MW) 2.5 (for WT facility > 65MW) Or manufacturer recommendations, whichever is larger	Not Mentioned	1.5 ("occupied residential structure")	Yes
MA[8]	1.5	1.5	1.5	3.0	Yes
VT[9]	None	None	None	None	None
NH[10]	Not established	Not established	Not established	Not established	Not established
ME[11]	Not Mentioned	1.5 Or setback requirements for local zoning classification, whichever is larger	Not Mentioned	Not Mentioned	Yes
RI 2012[12]	1.25-1.5	1.5 (2.0 for residential property lines)	None	None	Yes

---

[7] http://www.cga.ct.gov/aspx/CGARegulations/CGARegulations.aspx?Yr=2014&Reg=2012-054&Amd=E http://www.ct.gov/csc/lib/csc/regulations/final_clean_copy_wind_regs.pdf

[8] http://www.mass.gov/eea/docs/doer/gca/wind-not-by-right-bylaw-june13-2011.pdf and http://www.mass.gov/eea/docs/doer/gca/as-of-right-wind-bylaw-june-2011.pdf and http://www.mass.gov/eea/energy-utilities-clean-tech/renewable-energy/wind/wind-energy-model-zoning-by-law.html

[9] http://psc.wi.gov/renewables/documents/windSitingReport2014.pdf (summary of all state guidelines from Oct 2014)

[10] http://www.nh.gov/oep/energy/programs/documents/sb99-rulemaking-final-deliverable.pdf

[11] http://www.maine.gov/dep/land/sitelaw/windpower/ and http://www.maine.gov/dep/land/sitelaw/application_text.pdf

[12] http://www.planning.ri.gov/documents/LU/energy/Wind_Energy_FacilityGuidelines_June-2012_.pdf

2. Why should a turbine be certified by the IEC or other certification body?

Third party certification can help to verify a turbine's capabilities and safety. For example, international standards such as the IEC 61400-23 and IEC 61400-5 are available for wind turbine blades. If a turbine meets these blade-specific standards, the blade is certified to operate for a 20 year lifespan under testing conditions. Meeting these standards can help to lessen blade throw risks, especially when paired with redundant systems to stop turbine operation during severe weather or wind events. These types of certifications are intended to provide for public safety while ensuring manufacturers meet design, performance and reliability standards. It is important that wind developments meet the most current standards at the time of construction.

3. Is there failure rate data for modern, U.S. wind turbines?

Unfortunately, U.S. turbine failure data is very limited. There are no requirements or incentives for U.S. turbine manufacturers or operators to publicly report turbine failures. The U.S. also lacks a regulatory body charged with compiling and verifying failure events. Therefore, failure risk data specific to U.S. turbines and climate conditions is not currently available.

4. How far away can a blade or piece of a blade be thrown?

Due to the lack of U.S. turbine failure data, there is little empirical evidence to define how far a turbine blade, or part of a blade, could be thrown. A 2005 study of German and Denmark wind turbine failures occurring between the years of 1984 to 2001, identified a maximum throw distance of 500 meters. However, this data is unlikely to reflect modern turbine blade throw risks [3].

5. Why are increased impact special use permits (IISUPs) important for setback requirements?

Special use permits provide flexibility in the siting standards. They allow the standards to be molded on a case-by-case basis. For example, consider the following scenario: a developer wishes to build a turbine closer to a neighbor's property line than allowed by the setback standards. However, the property within the required setback contains wetlands where development can't occur. In this case, the property owner might encourage the Zoning Board to accept the increased risk on his wetlands by not objecting to issuance of an IISUP. IISUPs may play an important role in turbine siting, especially in more densely developed areas.

6. How often do icing weather conditions occur in Rhode Island?

According to the 2012 Rhode Island Renewable Energy Siting Partnership report, Rhode Island usually experiences wind turbine icing conditions 0-2 times per year.

7. What are mitigation strategies for ice throw?

If icing is expected to be a problem, operation protocols can be established to prevent blade rotation during icing conditions. Sensors and visual observations can help identify when operation should be halted due to ice buildup. Multiple blade de-icing technologies are also in different stages of research and development. In the future, there will likely be viable technologies to prevent the buildup of ice on wind turbine blades.

* * * * *

Noise

Description of Impact

Noise is generally considered the point at which sound becomes bothersome due to intensity (loudness) or tonal quality (frequency). Reducing the noise emanating from wind turbines that will negatively impact people in the surrounding area should be the objective of siting standards.

There are several critical sound parameters to bear in mind in developing ordinances:

- Sound pressure level (dB) at the source.
- Distance from the sound source to the impacted parties.
- Sound propagation from source to impacted parties. Sound propagation varies depending on wind direction and speed, wind shear, turbulence, terrain vegetation, atmospheric conditions (humidity, rain, snow, etc.). For example, the impact can vary significantly going "with the wind" vs. "against the wind."
- Ambient noise levels in the area surrounding the wind turbine. Ambient noise levels vary throughout the day and can likewise change the perception of noise emanating from a wind turbine.

When operating, wind turbines produce both mechanical and aerodynamic sound. Mechanical sound is largely generated by turbine components, such as the generator or gearbox, located in the turbine nacelle. This sound is relatively easy to mitigate via nacelle sound insulation.

Aerodynamic sound, on the other hand, comes from the interaction between the air, the rotating turbine blades and the tower. This sound is often complex and can vary with weather, wind speed, blade angle and other parameters. Together, both sound sources radiate sound away from the turbine and can increase the sound levels of the surrounding area.

Recommended Standards

Municipalities are encouraged to choose between two recommended options for establishing noise standards for wind turbine development. Option 1 is based on existing municipal maximum sound levels; Option 2 is based on levels of ambient sound. Both options consider sound levels at abutting property lines. Both options should also include language for increased impact special use permits (IISUPs); should require complaint collection, disclosure, and investigation procedures; and should establish a pre-set limit on the frequency and/or total number of times compliance testing can be required. It is recommended that municipalities begin with Option 1 as it is the easiest to implement and the least burdensome to wind turbine developers. However, if zones are expected to be sensitive to changes in sound levels, Option 2 can provide a more conservative standard.

Option 1: This approach uses existing municipal maximum sound levels (dB(A)) set for each zone – these values are often described in municipal noise ordinances.

The turbine developer will need to predict the turbine's sound pressure level via modeling at the points of interest. It is recommended that the most up-to-date IEC standards for sound power levels (IEC 61400-11 ed 3 as of 2015) be used for the proposed turbines and any additional anticipated sound emitting equipment (for example, substation transformers). These sound power levels should then be used in the most current ISO outdoor sound pressure propagation methods (ISO 9613-2 as of 2015) to develop a sound contour map of the project and to predict turbine sound at surrounding property lines. Other accurate sound modeling options, such as NORD200 software, should also be accepted. All efforts to be reasonably conservative in this modeling should be taken. The predicted sound levels should include one scenario that is based on the maximum turbine sound power level with a typical vendor uncertainty (e.g. +2 dB(A)) using mixed or hard ground conditions (i.e., ISO 9613-2 Ground Absorption factor (G) for fully absorptive ground (G=1) should not be relied on).

The predicted project sound levels or sound contours are representative of project-only sound levels. The total sound level that one would hear or measure after project completion is the acoustic sum of the project sound level and the existing, background sound level. Therefore, L_{EQ} values in dB(A) should be predicted by the modeling efforts for each abutting property line. The L_{EQ} metric is a common way to describe sound levels that vary over time. It is a single A-weighted decibel value which takes into account the total sound energy over the period of time of interest (please see the Glossary of Terms for an explanation of A-weighted decibel level). All efforts to be conservative in modeling this L_{EQ} value for wind developments should be taken—i.e. worst case scenarios should be applied where appropriate.

The resulting conservative L_{EQ} value(s) that represent project-only sound levels, should be compared to the municipal maximum sound limits (MMSL). If the logarithmic sum of MMSL + L_{EQ} is less than or equal to 1 dB(A) above MMSL, then the turbine should be permitted with respect to noise. If the logarithmic sum of MMSL + L_{EQ} is greater than 1dB(A) above MMSL, then the turbine would be considered too loud for the abutting property(ies) unless increased impact special use permits (IISUPs) are obtained.

> PROs of Option 1: The time, costs, and uncertainties associated with measuring ambient sound can be avoided.
>
> CONs of Option 1: If noise complaints are received, this method can add a layer of difficulty to post-construction compliance monitoring. If post-construction monitoring shows sound levels greater than 1 dB(A) above the MMSL, the turbine will need to be shut-down for ambient sound measurements. Without knowing the ambient sound levels, it is impossible to determine if the turbine is at fault for increasing the sound level above the permitted level.

Option 1 is based on the fact that sound levels add logarithmically, not linearly. For example, 50 dB(A) + 46 dB(A) ≠ 96 dB(A). Rather, 50 dB(A) + 46 dB(A) = 51.5 dB(A). The following chart can be used to approximate the logarithmic addition of sound levels.

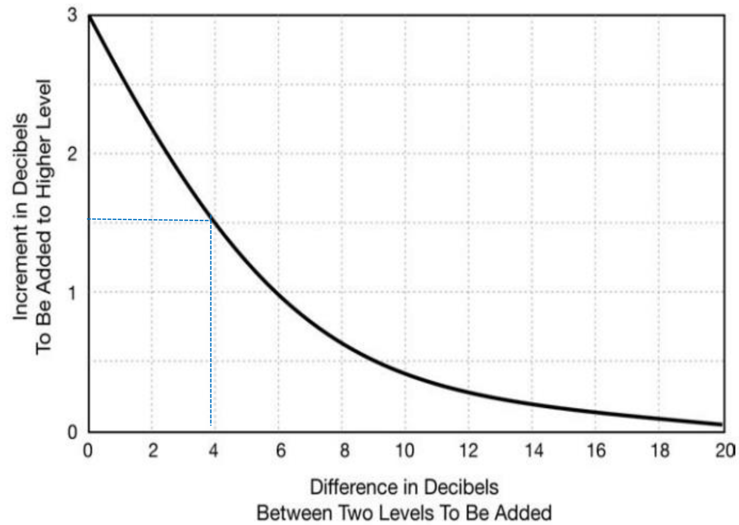


Figure 4: Approximate Decibel Addition Graph[7]

Option 2: This method requires the measurement of a site's pre-construction ambient sound. It is common to define ambient as a L_{A90} value. L_{A90} is the A-weighted decibel level (dB(A)) that is exceeded 90% of the time (please see the Glossary of Terms for an explanation of A-weighted decibel level). Often, the lowest ambient sound levels are measured at night during the winter. A pre-defined, technically detailed method for measuring sound should be selected by the municipality. See Maine's No Adverse Environmental Effect Standard of the Site Location Law, Section I: Sound Level Standards for Wind Energy Developments[13] or the MassCEC Acoustic Study Methodology for Wind Turbine Projects[14] for example sampling methods. Often, a wind developer will need to fund a third party with acoustic expertise to conduct this pre-construction sound monitoring.

After quantifying the ambient sound levels at the abutting property lines, the turbine developer will need to predict the turbine's sound via modeling. It is recommended that the most up-to-date IEC standards for sound power levels (IEC 61400-11 ed 3 as of 2015) be used in conjunction with the most current ISO sound pressure propagation methods (ISO 9613-2 as of 2015) to predict turbine sound at surrounding property lines. Other accurate sound modeling options, such as NORD200 software, should also be accepted. L_{EQ} values in dB(A) should be predicted by the modeling efforts for each abutting property line. L_{EQ} is a single A-weighted decibel value that represents the total sound energy over the period of time of interest. It is a common means of representing a time-averaged sound level for sounds that vary.

The logarithmic summation of the L_{EQ} values plus the corresponding pre-construction ambient sound levels is the resulting noise level (RNL) at each property line. The RNL values should not exceed zone-specific A-weighted decibel increases over ambient. In other words, the non-logarithmic difference between RNL and ambient must be less than or equal to the allowed dB(A) increase over ambient.

---

[13] http://www.maine.gov/sos/cec/rules/06/096/096c375.doc

[14] http://images.masscec.com/uploads/attachments/MassCEC_Acoustic_Study_Methodology_for_Wind_Turbine_Projects_12-9-11.pdf

Increases over ambient should be limited based on zone. For example, a residential zone may only allow a 10 dB(A) increase while an industrial zone could allow for a 15 dB(A) increase. A municipality may also set maximum dB(A) values for each zone type. Some municipalities may already have such maximum dB(A) sound levels defined in their noise ordinances. If this is done, it is recommended that the more restrictive limit (maximum limit versus increase over ambient limit) be applied for permitting.

PROs of Option 2: This method prevents turbine neighbors from experiencing a large increase in ambient sound levels. There will not be a large change in sound levels for the surrounding properties.

CONs of Option 2: A method must be chosen for measuring ambient sound. Requiring the measurement of ambient sound levels may increase siting costs and the time needed for site analyses. Ambient sound levels can also vary depending on season, time of day, weather, and other factors. For this reason, ambient sound is often very difficult to accurately quantify.

Similar to Option 1, if noise complaints are received, this method can add a layer of difficulty to post-construction compliance monitoring. If post-construction monitoring shows sound levels greater than the allowed dB(A) above documented ambient levels, the turbine will need to be shut-down for further ambient sound measurements. Without knowing if the ambient sound levels have changed since the original measurements, it is impossible to determine if the turbine is at fault for increasing the sound level above the permitted level.

Both Options: To make either option more conservative a L_{DEN} value with dB(A) penalties for pure tones or short duration repetitive sounds can be predicted via modeling (instead of a L_{EQ} value). L_{DEN} refers to a day-evening-night A-weighted decibel value. Similar to an L_{EQ} value, a L_{DEN} value is a time-averaged value used to represent variable sound. However, it is more conservative than L_{EQ} values because it penalizes sound levels that occur between certain hours. Specifically, the sound measurement occurs over 24 hours with 10 dB penalties added to the sound levels between 23:00 and 7:00 and 5 dB penalties added to the sound levels between 19:00 and 23:00. The penalties are meant to reflect people's extra sensitivity to sound during night and evening hours. See the Glossary of Terms for the definitions of pure tones and short duration repetitive sounds. Both standards should include language for increased impact special use permits (IISUPs); should require a complaint collection, disclosure and investigation procedure; and should establish a pre-set limit on the frequency and/or total number of times compliance testing can be required.

FAQ's

1. How can compliance be enforced?

To accurately measure complex sounds and sound levels, specialized equipment is required. The costs of procuring, maintaining, calibrating, and deploying this equipment is often a barrier to municipal compliance testing. Therefore, it is common for a third party acoustics expert to be hired if noise complaints are submitted. Often, the turbine operator will be required to fund the third party noise analysis. Detailed sound sampling procedures, such as the ones described in Maine's No Adverse Environmental Effect Standard of the Site Location Law, Section I: Sound Level Standards for Wind

Energy Developments[15] or the MassCEC Acoustic Study Methodology for Wind Turbine Projects[16], should be specified to ensure the comparability of measurements. A municipality should also establish a pre-set limit on the number of times compliance testing can be required.

2. What are potential mitigation strategies for noise?

Mechanical noise emitted from the nacelle can often be controlled by additional nacelle insulation or the selection of quieter mechanical devices. However, aerodynamic noise is less easily mitigated. If a turbine is noncompliant with respect to its noise production, operational modification and/or curtailment during weather conditions that cause excessive noise generation may be required.

3. Why are increased impact special use permits (IISUPs) important for noise requirements?

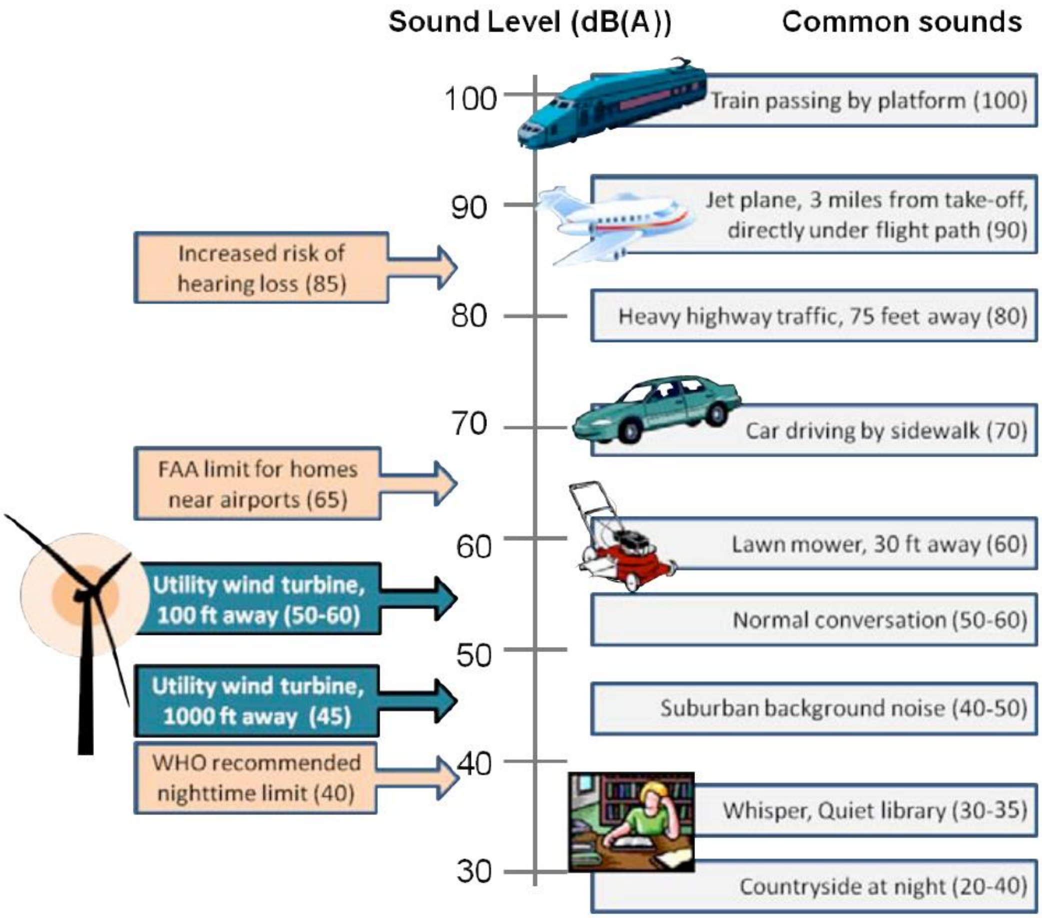
In general, special use permits can allow siting standards to be better molded to the needs of a specific site. For example, consider a scenario of a wind turbine located near a farm with sold development rights. Although the noise at the farm property line may exceed the limits chosen by the municipality, the farmer's house may be located some distance away. If the farmer feels that the potential for increased noise over his/her fields will not disturb his/her operation and he/she cannot develop the land near the turbine, then the benefits of the turbine's development may outweigh any increased noise impacts. By allowing the Zoning Board to consider the desire of nearby property owners to accept differing levels of noise on their property, the standards become adaptable on a case-by-case basis.

4. What does 45 dB(A) or 50 dB(A) equate to?

The graphic below was used in a 2010 West Michigan Wind Assessment Issue Brief. [8]

[15] http://www.maine.gov/sos/cec/rules/06/096/096c375.doc

[16] http://images.masscec.com/uploads/attachments/MassCEC_Acoustic_Study_Methodology_for_Wind_Turbine_Projects_12-9-11.pdf



5. What noise level is appropriate for sleeping?

According to the World Health Organization (WHO), a $L_{night,outside}$ of 40 dB should be the target limit for night noise guidelines. This value protects the general public, including vulnerable groups such as children, the chronically ill, and the elderly. L_{night} is defined according to the European Union (EU) definition in Directive 2002/49/EC: "L_{night} is the A-weighted long-term average sound level as defined in ISO 1996-2: 1987, determined over all the night periods of a year."[9]

6. What is infrasound? Is it generated by wind turbines and does it pose a health concern?

Infrasound (IS), often interchanged with the term low frequency noise (LFN), is defined by the Webster-Merriam online dictionary as "a wave phenomenon of the same physical nature as sound but with frequencies below the range of human hearing." The threshold for human hearing is 20 Hz. Any sound wave with a frequency below this level is classified as infrasound.

Both natural and man-made sources of infrasound exist in our environment. Ocean waves are a common example of a natural source, wind turbines are an example of a man-made source. At this time there is no evidence of physiological effects caused by the levels of infrasound emitted from wind turbines. [10][11]

Moreover, a 2015 Frontiers in Public Health article states "…the results from the current investigation indicate that increases in LFN associated with wind turbine operation are correlated with increases in overall sound levels. These results, in conjunction with those of previous reports, suggest that controlling for overall sound levels produced by normally operating wind turbines will inherently control for LFN. The results reported here are in agreement with a recent report issued by Health Canada, which concluded that following over 4,000 h [hours] of wind turbine noise measurements, there was "*no additional benefit in assessing LFN as C- and A-weighted levels were so highly correlated (r=.94) that they essentially provided the same information*". Given the low levels of IS and the correlation between LFN and overall sound levels from wind turbines, the development and enforcement of suitable outdoor guidelines and limits, based on dB(A), provide an effective means to evaluate, monitor, and protect potential receptors."[12]

7. **What are the general health impacts of sound?**

Different levels of sound exposure have been linked with certain physiological effects in humans. Loud, impulse sounds such as a close proximity gun shot, and long-term sound levels greater than 75-85 dB(A) can induce hearing loss. In addition, studies have linked noise exposure with annoyance, sleep disturbance, decreased patient and staff performance in hospitals, decreased cognitive performance in schoolchildren, and higher occurrence of hypertension and cardiovascular disease. The scientific literature has only connected wind turbine noise with increased self-reported annoyance and sleep disturbance [13]. The World Health Organization (WHO) suggests an average night-time outside noise level of 40 dB(A) to prevent all noise-induced health effects.[14][15]

* * * * *

Shadow Flicker

Description of Impact

When an operating wind turbine is positioned between the sun and an observer, the rotating blades can cast moving shadows on an observer's location. This phenomenon is called shadow flicker and it is widely recognized as a potential annoyance factor for people living and working near large scale wind turbines. Fortunately, shadow flicker is relatively easy to model and predict as it is based on the sun's daily and seasonal pathways across the sky. Therefore, appropriate site selection should be able to control for shadow flicker effects. It should be noted that shadow flicker only occurs on sunny days when a turbine is spinning. In stormy, overcast, or cloudy conditions, if the sun is not bright enough to cast shadows, it will not bright enough to cause shadow flicker.

Recommended Standard

Shadow flicker should be limited to no more than 30 hours per year at occupied structures or sites permitted for occupied structure construction at the time of wind project permitting. This limit should be based on worst-case scenario modeling, which assumes flat, open land, constant sunshine during the day and constant wind turbine operation. Appropriate modeling software such as WindPro should be used for these analyses. This standard should only be applied to occupied structures not located on the wind development property. If an occupied structure located on the property being developed will experience shadow flicker in excess of the standard, the developer should notify the land owner and submit an acknowledgement of the higher shadow flicker impact signed by the land owner to the municipality. Increased impact special use permits (IISUPs) for higher shadow flicker exposure on occupied structures located outside of the wind development property should be allowed. In addition, a standard should require complaint collection, disclosure, and investigation procedures, and should establish a pre-set limit on the frequency and/or total number of times compliance testing can be required.

A realistic modeling standard that accounts for topology, obstacles, and normal weather and wind patterns could be used by a municipality to lessen the shadow flicker requirement on occupied structures in non-residential zones. Figure 3 on page 12 of this document provides an example of how realistic versus worst-case scenario modeling can be applied to adjust the conservativeness of the shadow flicker standard. It is recommended that a municipality work with a developer to determine which variables and data should or should not be used in a realistic model. All assumptions made in a realistic model should be carefully reviewed by a municipality.

FAQ's

1. What are the potential health impacts of shadow flicker?

Previously, the main concern regarding health and shadow flicker has been the risk of inducing seizures in individuals with photosensitive epilepsy. However, seminal studies published in the peer-reviewed medical journal Epilepsia[16][17] have investigated this relationship and have found that rotation frequencies of 3 Hz or greater are needed for wind turbines to pose a risk to the photosensitive population. A 3 Hz frequency translates into a 60 rotations per minute (rpm) speed for a three-bladed wind turbine. This rpm is well above the rotation speeds of most modern, large-scale wind turbines. Common rpms range from 6 to 17 rpm for today's large-scale turbines. Other health concerns are tied to annoyance. At this time, further studies are needed to determine the exact relationship between shadow flicker and annoyance.[18]

2. What are some mitigation strategies for flicker?

If shadow flicker limits are exceeded, operational curtailment during flicker-producing conditions is a potential mitigation strategy. The installation of blinds, the planting of vegetation, and/or the installation of other screening measures by the turbine operator/developer can also help to decrease the effects of shadow flicker. It is important that the mitigation strategy most acceptable to the affected property owner be selected.

3. Why are increased impact special use permits (IISUPs) important for flicker requirements?

Special use permits are an important part of adapting standards on a case-by-case basis. In the case of shadow flicker, certain sites may only experience shadow flicker during limited periods of the day and only during certain times of the year. For example, flicker may only occur in the early morning hours for a particular household during the winter. If members of this household are rarely awake during these hours or are already at work, the property owner and Zoning Board may feel the benefits of the turbine's development outweigh the shadow flicker nuisance. In such a scenario, IISUPs allow the siting standards to be better molded to the needs of a specific site.

* * * * *

Environmental Impacts

Description of Impact

There are several environmental impacts that are specific to large scale wind turbines. These include avian and bat fatalities and wildlife displacement and/or behavioral change due to turbine operation and maintenance activities.

Birds & Bats: Today's wind turbines can pose a risk to birds and bats though the exact impact has yet to be accurately quantified [19][20][21]. In comparison to other U.S. human activities and structures, current total avian mortality due to wind turbines has been shown to be relatively low [20].

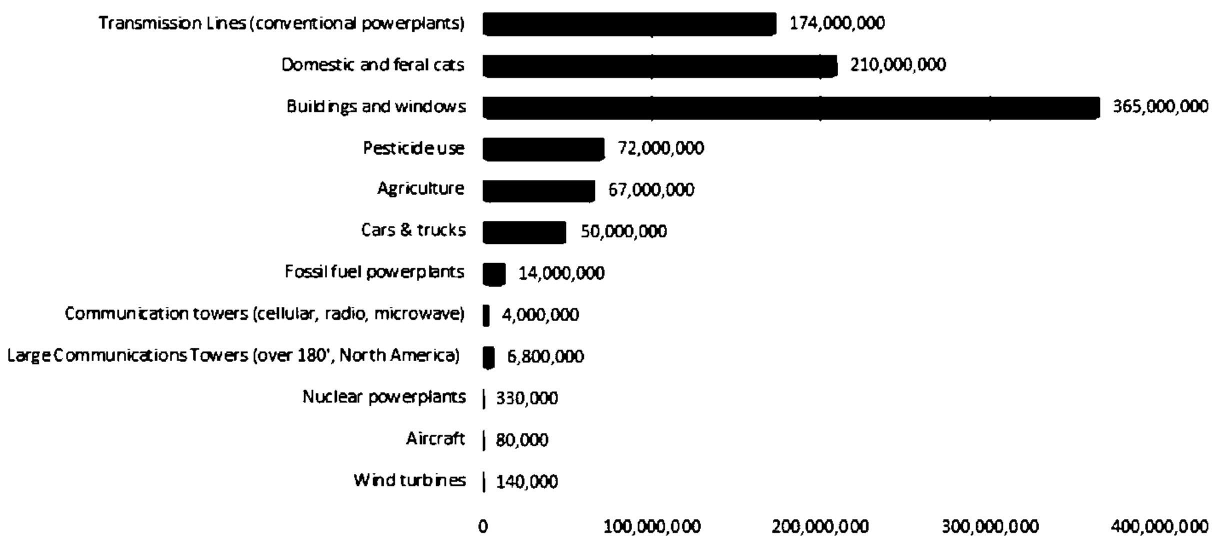


Fig. 1. Annual avian mortality in the USA [8–11]. Numbers show the lowest values when a range of estimates is given.

Figure 5: Annual avian mortality in the USA [20].

However, the relatively small number of documented avian deaths from wind turbines does not mean that the mortality rates should be ignored. It is important to note that the number of wind turbines compared to the number of domestic cats, transmission lines, buildings and windows, and other categories shown in the above figure is extremely low. In addition, low reported mortality rates could be due to a lack of consistent or standardized monitoring or reporting and/or various factors affecting fatality detection rates. As the number of turbines increases, negative avian and bat effects will likely increase. Of particular importance are the type of birds represented by the mortality rates and the potential for effective mitigation strategies. Even a small increase in mortality rates can be harmful to some populations, especially for long-lived species such as bats, with slow maturity and low reproductive rates [6][7]. More research is also needed to determine if bats are disproportionately affected by wind turbines compared to birds.

Several species likely impacted by wind turbine development are also protected by the U.S. Fish and Wildlife Service. Specifically, Bald and Golden Eagles are federally protected under the Bald and Golden Eagle Protection Act (16 USC 668-668d); many migratory bird species are protected under the Migratory Bird Treaty Act (16 USC 703-712); and endangered or threatened species are protected by the

Endangered Species Act (16 U.S.C. 1531–1544; ESA). The April 2015 addition of the Northern Long-Eared Bat to the federal list of threatened species should be of particular concern to Rhode Island wind developers.

<u>All Fauna</u>: Questions remain regarding wind turbines and their effects on all types of surrounding fauna. Further studies regarding species displacement and predator-prey balances are needed to explain species-specific effects [22][23][24].

<u>Recommended Standard</u>

Due to the current, limited scientific understanding, it is recommended that the scale of a proposed project be considered in regards to potential environmental impacts. All project proposals should consider the available literature and history, current habitat types, and potential presence and activities of fauna near the proposed site. This may require both pre- and post-construction monitoring via visual, acoustic, netting, and/or other appropriate surveying methods. Mitigation strategies may also need to be identified if significant potential for adverse environmental effects exists. The costs of environmental surveys and monitoring activities should be weighed against the usefulness of the data to be collected, the severity of potential environmental impacts, and the need for further information.

In general, it is recommended that areas that serve as important migratory layovers, pathways, or concentration points be avoided, as should endangered or protected species nesting, breeding, or feeding sites. At minimum, a literature review should be conducted as well as a basic site characterization visit. During a site characterization visit, an expert will identify surrounding habitat types and their potential for attracting or supporting species of concern. The potential for a project to displace or attract enough fauna to significantly affect local predator-prey balances should also be considered.

The level of consideration for these environmental affects should reflect the scale of potential impact. Detailed analyses should be reserved for wind farms sited near important wildlife habitats, within migratory pathways, or where endangered or protected species are present. For a more in depth decision making process, the U.S. Fish and Wildlife Service (U.S. FWS) has put together voluntary guidelines that can be accessed online.[17] To accompany these wind siting guidelines, an eagle conservation guide was released in 2013.[18] The Rhode Island Natural Heritage Program, overseen by the Rhode Island Department of Environmental Management (RI DEM), is also a good resource regarding Rhode Island's rarest and most vulnerable natural landscapes.[19] This program has created Geographic Information Systems (GIS) layers based on observation densities of rare, threatened, and endangered species that can be found on the RIGIS website.[20]

Another source of peer-reviewed wind and environmental impact studies is the American Wind and Wildlife Institute (AWWI).[21] AWWI maintains a website with a mapping tool for impacted species identification.[22] The tool also has links to mapped information such as The Nature Conservancy Priority Areas and Audubon Important Bird Areas.

---

[17] http://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf

[18] http://www.fws.gov/migratorybirds/Eagle_Conservation_Plan_Guidance-Module%201.pdf

[19] http://www.dem.ri.gov/programs/bpoladm/plandev/heritage/

[20] http://www.edc.uri.edu/rigis/data/data.aspx?ISO=biota

[21] https://awwi.org/

[22] http://www.wind.tnc.org/#app=1db9&5362-selectedIndex=1&509c-selectedIndex=0

Wind turbine developers should be required to engage the U.S. FWS, the RI DEM, and other appropriate environmental advisory groups as early in the proposal process as possible. In general, the environmental impacts of wind turbines are best handled at the state and federal levels. Therefore, project guidance from the U.S. FWS, and when possible RI DEM and other appropriate environmental advisory groups, should be obtained prior to a municipality's project review. All relevant recommendations and comments from these environmental groups/agencies should be addressed in a project proposal and considered by a municipality during the permitting process. Mitigation strategies should be identified and included in plans prior to construction approval in case post-construction monitoring indicates an unacceptable level of environmental impact. Post-construction monitoring data, if deemed necessary to collect, should be shared with the municipality. If federal (and state, if received) environmental recommendations are met by a proposal, a municipality should not retain the right to reject a proposal for environmental reasons.

FAQ's

1. **How many important migratory bird/bat pathways are in Rhode Island? Where are they? And are wind turbines likely to adversely affect them?**

   In general, birds and bats do not tend to follow a particular line or pathway until they encounter the ocean. However, particularly in the fall, they tend to concentrate near the coastline and follow the coast south. Most migrate at night with the timing of their migratory movements coinciding with certain weather events. Unfortunately, little more is well understood about migratory pathways. Many questions regarding how and when they are used remain unanswered. A lack of information regarding current population levels can also prevent an accurate understanding of the effects of turbine-caused mortalities. Therefore, post-construction monitoring is important to ensure the real-life impacts are close to those predicted by the pre-construction survey(s). In addition, known concentration areas and ground resting or roosting places along the coast should generally be avoided by wind turbine development.

2. **Who can help to identify if an area is an important bird/bat habitat or if there are endangered or protected species present?**

   It is recommended that a developer engage the U.S. Fish and Wildlife Service and the Rhode Island Department of Environmental Management as early in the development process as possible. Both of these agencies can offer expertise in floral and faunal identification and site evaluations.

3. **What are potential mitigation strategies for birds/bats?**

   If significant adverse avian impacts are likely to occur, another site should be considered. Mitigation strategies such as tubular tower construction, operation curtailment, limited lighting (must be in compliance with the Federal Aviation Agency (FAA), see Code of Federal Regulations here: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=61302bd90d79271a583474ad2f9dcd7e&rgn=div5&view=text&node=14:2.0.1.2.9&idno=14#14:2.0.1.2.9.2.1.3), and/or avian detection technologies can also be incorporated into construction and operation plans [25]. To specifically reduce mortality risks for the threatened Northern Long-Eared Bat, it is recommended that increased wind turbine cut-in speeds be considered. Since these bats are thought to be less active during high winds, increased cut-in speeds can significantly reduce the risk to this species. This may be an important operation restriction if a turbine is likely to affect Northern Long-Eared Bats [26].

4. What costs are associated with pre- and post-construction environmental surveys?

In general, environmental studies can be relatively expensive for wind farms consisting of only one or a few wind turbines. Due to equipment, expert time, and analysis costs, most environmental surveying techniques such as radar, acoustic studies, raptor surveys, and mist netting with radio transmitter placement, require investments well above $10,000 per study. These costs must be weighed against the usefulness of the data collected and the need for further information. In general, collecting pre- and post-construction data, though costly, is likely the best way to improve and simplify future environmental impact standards.

* * * * *

Other Impacts

Description of Impacts

Visual Impacts: Due to the height and siting needs of large scale wind turbines, they may have significant visual impacts on the surrounding landscape. Whether they improve or detract from the landscape is highly subjective. In either case, it is important to understand the change that will result from turbine construction. To get a sense as to the visual impact, a viewshed/sightline or other visual impact analysis should be included in a project proposal. In addition, accurately-scaled, photographic renderings should be produced for areas with the greatest expected visual impact(s). Daytime and nighttime renderings should be submitted if lighting requirements are likely to impact the nighttime scenery. It is advisable that visual impacts to recognized historic, cultural, archeological, or scenic sites be minimized.

In general, unless pre-existing visual impact standards are violated, a turbine project proposal should not be rejected on the basis of visual impacts. Wind development should not be treated differently from other types of development with respect to visual impacts. If a municipality has pre-existing visual impact standards, wind development should be required to abide by those standards. However, if no visual impact standards exist in a municipality at the time of an application submittal, none should be applied to the review of a wind development proposal.

Signal Interference: Previously, when wind turbines were predominately made with metal, they had the potential to cause signal variations due to signal deflection. However, modern turbines are now made with synthetic materials that have minimal impacts on broadcast signal transmission [26][27]. If broadcast issues do arise after turbine installation, additional transmitter masts can be installed at relatively low cost to the wind turbine developer [26]. Prior to construction, it is recommended that wind turbine developers notify any nearby communications towers.

References

[1] R. M. Downie, “This Week in Block Island’s History: 124 years of electric power on Block Island,” *The Block Island Times*, 29-Aug-2012.

[2] C. Atkinson-Palombo and B. Hoen, “Relationship between Wind Turbines and Residential Property Values in Massachusetts: A Joint Report of University of Connecticut and Lawrence Berkeley National Laboratory,” Boston, MA, 2014.

[3] L. W. M. M. Rademakers and H. Braam, “ANALYSIS OF RISK-INVOLVED INCIDENTS OF WIND TURBINES,” *Energy Res. Cent. Netherlands Publ. as Append. A Guid. Risk‐ Based Zo. Wind Turbines (handb. Risicozonering Wind.*, 2005.

[4] AWEA and ASCE, “Recommended Practice for Compliance of Large Land-based Wind Turbine Support Structures,” Washington, DC & Reston, Virginia, 2011.

[5] G. Carbone and L. Afferrante, “A novel probabilistic approach to assess the blade throw hazard of wind turbines,” *Renew. Energy*, vol. 51, pp. 474–481, 2013.

[6] H. Seifert, A. Westerhellweg, and J. Kröning, “Risk analysis of ice throw from wind turbines,” *Pap. Present. Boreas VI*, no. April 2003, 2003.

[7] C. E. Hanson, D. A. Towers, and L. D. Meister, “Transit Noise and Vibration Impact Assessment,” 2006.

[8] E. (Grand V. S. U. Nordman, “Wind Power and Human Health: Flicker, Noise and Air Quality,” 2010.

[9] World Health Organization, “Night Noise Guidelines for Europe,” Copenhagen, Denmark, 2009.

[10] Australia Department of Health, “Wind farms, sound and health,” Melbourne, Australia, 2013.

[11] T. Evans, J. Cooper, and V. Lenchine, “Infrasound levels near windfarms and in other environments,” 2013.

[12] R. G. Berger, P. Ashtiani, C. a. Ollson, M. Whitfield Aslund, L. C. McCallum, G. Leventhall, and L. D. Knopper, “Health-Based Audible Noise Guidelines Account for Infrasound and Low-Frequency Noise Produced by Wind Turbines,” *Front. Public Heal.*, vol. 3, no. February, pp. 1–14, 2015.

[13] J. H. Schmidt and M. Klokker, “Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review,” *PLoS One*, vol. 9, no. 12, p. 28, 2014.

[14] M. Basner, W. Babisch, A. Davis, M. Brink, C. Clark, S. Janssen, and S. Stansfeld, “Auditory and non-auditory effects of noise on health,” *Lancet*, vol. 383, no. 9925, pp. 1325–1332, 2014.

[15] J. M. Ellenbogen, S. Grace, W. Heiger-Bernays, J. F. Manwell, D. A. Mills, K. A. Sullivan, M. G. Weisskopf, and S. L. Santos, “Wind Turbine Health Impact Study: Report of Independent Expert Panel January 2012,” 2012.

[16] G. Harding, P. Harding, and A. Wilkins, “Wind turbines, flicker, and photosensitive epilepsy: Characterizing the flashing that may precipitate seizures and optimizing guidelines to prevent them,” *Epilepsia*, vol. 49, no. 6, pp. 1095–1098, 2008.

[17] A. R. D. Smedley, A. R. Webb, and A. J. Wilkins, “Potential of wind turbines to elicit seizures under various meteorological conditions,” *Epilepsia*, vol. 51, no. 7, pp. 1146–1151, 2010.

[18] L. D. Knopper, C. a. Ollson, L. C. McCallum, M. L. Whitfield Aslund, R. G. Berger, K. Souweine, and M. McDaniel, “Wind Turbines and Human Health,” *Front. Public Heal.*, vol. 2, no. June, pp. 1–20, 2014.

[19] M. M. P. Huso and D. Dalthorp, “A comment on bats killed in large numbers at united states wind energy facilities,” *Bioscience*, vol. 64, no. 6, pp. 546–547, 2014.

[20] S. Wang, S. Wang, and P. Smith, “Ecological impacts of wind farms on birds: Questions, hypotheses, and research needs,” *Renew. Sustain. Energy Rev.*, vol. 44, pp. 599–607, 2015.

[21] a. Tabassum, M. Premalatha, T. Abbasi, and S. a. Abbasi, “Wind energy: Increasing deployment, rising environmental concerns,” *Renew. Sustain. Energy Rev.*, vol. 31, pp. 270–288, 2014.

[22] J. W. Pearce-Higgins, L. Stephen, A. Douse, and R. H. W. Langston, “Greater impacts of wind farms on bird populations during construction than subsequent operation: Results of a multi-site and multi-species

analysis," *J. Appl. Ecol.*, vol. 49, no. 2, pp. 386–394, 2012.

[23] T. K. Stevens, a. M. Hale, K. B. Karsten, and V. J. Bennett, "An analysis of displacement from wind turbines in a wintering grassland bird community," *Biodivers. Conserv.*, vol. 22, no. 8, pp. 1755–1767, 2013.

[24] V. L. Winder, L. B. Mcnew, A. J. Gregory, L. M. Hunt, S. M. Wisely, and B. K. Sandercock, "Effects of wind energy development on survival of female greater prairie-chickens," *J. Appl. Ecol.*, vol. 51, no. 2, pp. 395–405, 2014.

[25] R. Saidur, N. a. Rahim, M. R. Islam, and K. H. Solangi, "Environmental impact of wind energy," *Renew. Sustain. Energy Rev.*, vol. 15, no. 5, pp. 2423–2430, 2011.

[26] D. Al Katsaprakakis, "A review of the environmental and human impacts from wind parks. A case study for the Prefecture of Lasithi, Crete," *Renew. Sustain. Energy Rev.*, vol. 16, no. 5, pp. 2850–2863, 2012.

[27] K. Dai, A. Bergot, C. Liang, W.-N. Xiang, and Z. Huang, "Environmental issues associated with wind energy – A review," *Renew. Energy*, vol. 75, pp. 911–921, 2015.

APPENDICES

A. Municipal Development Proposal Checklist

The following checklist is meant to serve as a reference for municipalities as they draft their project proposal guidelines and zoning ordinances. The list is in no particular order.

All wind turbine proposals and/or ordinances should address the following topics:

1. Check if the development will meet safety, community, and environmental standards—setbacks, noise, shadow flicker, visual impacts, signal interference, and environmental impacts
2. Noise analysis(es)
3. Shadow flicker analysis
4. Visual impact study and photographic renderings
5. Copy of communication tower notification
6. Environmental literature review, results of site characterization visit(s), and comments from RI DEM, U.S. FWS and/or other environmental groups
7. Results of further environmental studies (if required)
8. Decommissioning plan, including funding considerations
9. Turbine visual appearance—such as advertising, color, lighting, and appropriate safety signage
10. Construction issues—such as erosion, water quality, noise, habitat loss and/or fragmentation, and component transportation. All applicable permits should be sought by the developer
11. Turbine certifications
12. Mitigation strategies applicable for potential project impacts
13. Compliance/enforcement protocols
14. Safety protocols—who operates the machine(s), how are different weather scenarios handled, are fire safety protocols in place?
15. Turbine specifications
16. Application fees
17. Grid interconnection documentation
18. Complaints—collection, disclosure and investigation procedures
19. Public hearings, public notices, and/or notifying neighbors
20. Professional Engineer (P.E.) certified foundation
21. Applicable local and state building codes
22. Compliance with the Federal Aviation Administration (FAA). See Code of Federal Regulations here: http://www.ecfr.gov/cgi-bin/text-idx?c=ecfr&SID=61302bd90d79271a583474ad2f9dcd7e&rgn=div5&view=text&node=14:2.0.1.2.9&idno=14#14:2.0.1.2.9.2.1.3. Or use their Notice Criteria Tool here: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showNoNoticeRequiredToolForm
23. Compliance with the Department of Defense (DOD). Since radar systems can be affected by wind turbines as return signals may give the appearance of a moving aircraft on a 2-dimensional radar screen. The DOD has a preliminary "wind siting tool" that helps identify potential areas of interference: https://oeaaa.faa.gov/oeaaa/external/gisTools/gisAction.jsp?action=showLongRangeRadarToolForm
24. Bonding for owner/operator default or bankruptcy situations
25. Liability insurance

26. Signed acknowledgements from land owner(s) of the property to be developed if impacts greater than the standards set by the municipality are likely to occur
27. A description of tangible project benefits to the municipality

B. Rhode Island Wind Turbine Case Studies*

Wind turbine installation	Setback from homes (ratio of setback to turbine height)	Setback from public roads and right of ways (ratio of setback to turbine height)	Height of turbine (ft)	Setback from closest property line (ratio of setback to turbine height)	Closest property line type	Formal flicker complaints	Flicker study completed	Ice shedding events documented	Wildlife study(ies) completed	Total recorded bird or bat mortalities over all years of operation	Years in operation
Sandywoods	3.04	1.04	231	-	-	-	-	-	-	-	~3
Hodges Badge	2.85	1.49	158	1.1	Residential (Agriculture)	None	Yes	No	No	None	~4
Portsmouth High School	1.2	0.8	414	0.1	Open Space/School	None	Yes	No	No	-	~4 months
Portsmouth Abbey	1.66	2.66	240	3.1	Residential	None	Yes	No	Yes	2	~9
Aquidneck Corporate Park in Middletown	7.55	0.52	157	0.3	Traffic sensitive office business (OBA)-Commercial	None	No	No	No	1	~6
DEM Fishermen's Memorial State Park	2.05	1.82	157	-	Residential	None	Yes	No	Yes	1	~4
New England Tech	N/A	1.32	157	-	-	None	-	No	-	-	~6
Shalom Housing	N/A	1.31	157	0.1	-	1	No	No	No	None	~4
Narragansett Bay Commission #1 (A)	2.83	0.37	365	0.6	Industrial	None	Yes	No	No	~11	~3
Narragansett Bay Commission #2 (B)	5.10	0.37	365	0.6	Industrial	None	Yes	No	No	~11	~3
Narragansett Bay Commission #3 (C)	3.59	0.81	365	0.7	Industrial	None	Yes	No	No	~11	~3
North Kingstown Green	0.7	0.4	414	-	Residential	None	Yes	No	No	1	~4
WED Coventry 1	2.4	3.8	414	1.1	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 2	4.5	2.6	414	1.1	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 2A	3.7	1.2	414	0.6	Residential	None	Yes	No	No	-	~6 Months

WED Coventry 2B	3.5	1.3	414	0.4	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 3	1.2	2.4	414	1.1	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 4	3.2	5.7	414	1.1	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 6	6.6	4.2	414	0.3	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 6A	3.0	0.2	414	0.2	Residential	None	Yes	No	No	-	~6 Months
WED Coventry 6B	1.5	1.1	414	0.6	Residential	None	Yes	No	No	-	~6 Months

*All information was provided by persons knowledgeable of one or more listed turbines. All information is provided to the best of these persons' knowledge and is not guaranteed as accurate. "–" means data was not provided.

C. Sample Wind Ordinance

DISLCAIMER: Please note that this sample ordinance is governed by Massachusetts law which differs from Rhode Island law and should be used for informational purposes only. Municipal officials should obtain legal counsel with expertise in zoning before finalizing their wind ordinances.

Revised March 2012

Model As-of-Right Zoning Ordinance or Bylaw: Allowing Use of Wind Energy Facilities

Prepared by:
Department of Energy Resources
Massachusetts Executive Office of Environmental Affairs

This Model By-Law was prepared to assist cities and towns in establishing reasonable standards for wind power development. The by-law is developed as a model and not intended for adoption without specific review by municipal counsel.

1.0 Purpose

The purpose of this bylaw is to provide standards for the placement, design, construction, operation, monitoring, modification and removal of wind facilities that address public safety, minimize impacts on scenic, natural and historic resources and to provide adequate financial assurance for the eventual decommissioning of such facilities.

The provisions set forth in this bylaw shall take precedence over all other bylaws when considering applications related to the construction, operation, and/or repair of land- based wind energy facilities.

1.1 Applicability

This section applies to all utility-scale and on-site wind facilities proposed to be constructed after the effective date of this section. This section also pertains to physical modifications to existing wind facilities that materially alter the type, configuration, location or size of such facilities or related equipment.

This section does not apply to off-shore wind systems.

2.0 Definitions

As-of-Right Siting: As-of-Right Siting shall mean that development may proceed without the need for a special permit, variance, amendment, waiver, or other discretionary approval. As-of-right development may be subject to non-discretionary site plan review to determine conformance with local zoning bylaws as well as state and federal law. As-of-right development projects that are consistent with zoning bylaws and with state and federal law cannot be prohibited.

Building Inspector: the inspector of buildings, building commissioner, or local inspector charged with the enforcement of the state building code.

Building Permit: The permit issued in accordance with all applicable requirements of the Massachusetts State Building Code (780 CMR).

Critical Electric Infrastructure (CEI): electric utility transmission and distribution infrastructure, including but not limited to substations, transmission towers, transmission and distribution poles, supporting structures, guy-wires, cables, lines and conductors operating at voltages of 13.8 kV and above and associated telecommunications infrastructure. CEI also includes all infrastructure defined by any federal regulatory agency or body as transmission facilities on which faults or disturbances can have a significant adverse impact outside of the local area, and transmission lines and associated equipment generally operated at voltages of 100 kV or higher, and transmission facilities which are deemed critical for nuclear generating facilities.

Designated Location: The location[s] designated by [the community's local legislative body] in accordance with M.G.L. c. 40A, section 5, where wind energy facilities may be sited as-of right. Said location[s] [is/are] shown on a Zoning Map [insert title of map]. This map is hereby made a part of this Zoning Bylaw and is on file in the Office of the [Town/City] Clerk.

Note: *The "designated location" refers to the location within a community where wind power generation is permitted as-of-right. Establishment of a designated location for wind power generation is an integral part of the process of adopting an As-of-Right Wind Energy Facility Bylaw.*

Legal Requirements: *The process of designating the location must comport with the requirements of Section 5 of Chapter 40A of the Massachusetts General Laws which sets out the requirements for adopting and amending zoning bylaws.*

Communities should keep in mind the requirements of the Green Communities Program. To qualify for designation as a Green Community, the designated area must provide a realistic and practical opportunity for development of wind power generation. An average wind speed of six meters per second at 50 meters elevation is considered the minimum wind speed for *commercial scale wind generation, however, the potential for power generation increases exponentially with increased average wind speeds.*

To satisfy the as-of-right zoning requirement contained in the Green Communities Act, the as-of-right bylaw must allow for wind energy facilities that utilize at least one turbine with a rated nameplate capacity of 600 kW or more.

Methods of Designating a Location: *Communities may designate locations by reference to geographically specific zoning districts. In the alternative, communities may create an overlay district consisting of all or portions of multiple preexisting zoning districts, where wind power generation is permitted by right. In designating a location, it is important for the community implementing the zoning bylaw to consider the availability of wind and particular characteristics of the local community.*

Height: The height of a wind turbine measured from natural grade to the tip of the rotor blade at its highest point, or blade-tip height. This measure is also commonly referred to as the maximum tip height (MTH).

Note: *The height of the wind energy facility will have a direct impact on the amount of power it generates. While actual outputs vary, a wind turbine that is 250 feet tall will have an average nameplate capacity of roughly 660 kW, whereas a turbine that is 450 feet will have an average nameplate capacity of roughly 1.5 to 2.0 MW.*

As previously mentioned, to satisfy the as-of-right zoning requirement contained in the Green Communities Act, the as-of-right bylaw must allow for the construction and operation of wind generation facilities that utilize at least one turbine with a rated nameplate capacity of 600 kW or more.

Actual generating capacity must be considered not only in terms of tower height, but also in light of average wind speeds at a given location.

Rated Nameplate Capacity: The maximum rated output of electric power production equipment. This output is typically specified by the manufacturer with a ―nameplate‖ on the equipment.

Site Plan Review Authority: Refers to the body of local government designated by the municipality to review site plans.

Utility-Scale Wind Energy Facility: A commercial wind energy facility, where the primary use of the facility is electrical generation to be sold to the wholesale electricity markets.

Wind Energy Facility: All of the equipment, machinery and structures together utilized to convert wind to electricity. This includes, but is not limited to, developer-owned electrical equipment, storage, collection and supply equipment, service and access roads, and one or more wind turbines.

Wind Monitoring or Meteorological Tower: A temporary tower equipped with devices to measure wind speed and direction, to determine how much electricity a wind energy facility can be expected to generate.

Wind Turbine: A device that converts kinetic wind energy into rotational energy to drive an electrical generator. A wind turbine typically consists of a tower, nacelle body, and a rotor with two or more blades.

Zoning Enforcement Authority: The person or board charged with enforcing the zoning bylaws.

Note: *By state statute, this may be the "inspector of buildings, building commissioner or local inspector, or if there are none, in a town, the board of selectmen, or person or board designated by local ordinance or by-law". MGL 40A § 7. In many communities, the building inspector is the person charged with enforcing both the state's building code and local zoning bylaws.*

3.0 General Requirements for all Wind Energy Facilities

The following requirements are common to all wind energy facilities to be sited in designated locations.

3.1 Compliance with Laws, Ordinances and Regulations

The construction and operation of all such proposed wind energy facilities shall be consistent with all applicable local, state and federal requirements, including but not limited to all applicable safety, construction, environmental, electrical, communications and aviation requirements.

3.2 Building Permit and Building Inspection

No wind energy system shall be erected, constructed, installed or modified as provided in this section without first obtaining a building permit.

Note: *Under the state building code, work must commence within six (6) months from the date a building permit is issued, however, a project proponent may request an extension of the permit and more than one extension may be granted.*

3.3 Fees

The application for a building permit for a wind energy system must be accompanied by the fee required for a building permit.

3.4 Site Plan Review

No wind energy facility shall be erected, constructed, installed or modified as provided in this section without first undergoing site plan review by the Site Plan Review Authority.

Purpose: *The purpose of the site plan review is to determine that the use complies with all requirements set forth in this zoning by-law and that the site design conforms to established standards regarding landscaping, access, noise and other zoning provisions.*

Additional Considerations: *As part of the implementation of an as-of-right wind energy bylaw, communities should consider amending their existing site plan review provisions in order to incorporate site plan review conditions that apply specifically to wind energy facilities.*

3.4.1 General

All plans and maps shall be prepared, stamped and signed by a professional engineer licensed to practice in Massachusetts.

Pursuant to the site plan review process, the project proponent shall provide the following documents:

(a) A site plan showing:

- **i.** Property lines and physical dimensions of the site parcel and adjacent parcels within 500 feet of the site parcel;
- **ii.** Outline of all existing buildings, including purpose (e.g. residence, garage, etc.) on site parcel and all adjacent parcels within 500 feet of the site parcel, including distances from the wind facility to each building shown;
- **iii.** Location of the proposed tower, foundations, guy anchors, access roads, and associated equipment;
- **iv.** Location of all existing and proposed roads, both public and private, and including temporary roads or driveways, on the site parcel and adjacent parcels within 500 feet of the site parcel;
- **v.** Location of all existing above ground or overhead gas or electric infrastructure, including Critical Electric Infrastructure, and utility rights of way (ROW) and easements, whether fully cleared of vegetation or only partially cleared, within 500 feet of the site parcel;
- **vi.** Existing areas of tree cover, including average height of trees, on the site parcel and any adjacent parcels within a distance, measured from the wind turbine foundation, of 3.0 times the MTH.;
- **vii.** Proposed changes to the landscape of the site, grading, vegetation clearing and planting, exterior lighting (other than FAA lights), screening vegetation or structures;
- **viii.** Tower foundation blueprints or drawings signed by a Professional Engineer licensed to practice in the Commonwealth of Massachusetts;
- **ix.** Tower blueprints or drawings signed by a Professional Engineer licensed to practice in the Commonwealth of Massachusetts;

x. One or three line electrical diagram detailing wind turbine, associated components, and electrical interconnection methods, with all National Electrical Code and National Electrical Safety Code compliant disconnects and overcurrent devices;
xi. Documentation of the wind energy facility's manufacturer and model, rotor diameter, tower height, tower type (freestanding or guyed), and foundation type/dimensions;
xii. Name, address, phone number and signature of the applicant, as well as all co-applicants or property owners, if any;
xiii. The name, contact information and signature of any agents representing the applicant; and
xiv. A maintenance plan for the wind energy facility;

(b) Documentation of actual or prospective access and control of the project site (see also Section 3.5), together with documentation of all applicable title encumbrances (e.g. utility ROW easements);
(c) An operation and maintenance plan (see also Section 3.6);
(d) A location map consisting of a copy of a portion of the most recent USGS Quadrangle Map, at a scale of 1:25,000, showing the proposed facility site, including turbine sites, and the area within at least two miles from the facility. Zoning district designation for the subject parcel should be included; submission of a copy of a zoning map with the parcel identified is suitable for this purpose;
(e) Proof of liability insurance, in amounts commensurate with the risks;
(f) Certification of height approval from the FAA;
(g) A statement that evidences the wind energy facility's conformance with Section 3.10.6, listing existing ambient sound levels at the site and maximum projected sound levels from the wind energy facility; and
(h) Description of financial surety that satisfies Section 3.12.3.
(i) A public outreach plan, including a project development timeline, which indicates how the project proponent will meet the required site plan review notification procedures and otherwise inform abutters and the community.

The Site Plan Review Authority may waive documentary requirements for good cause shown.

Additional Consideration (expedited site plan review for smaller wind energy facilities):
The extensive site plan review documentation set forth in Section 3.4.2 of this model bylaw may not be appropriate for smaller wind energy facilities, such as those utilizing turbines under 150 feet in height. Accordingly, communities should consider incorporating a provision in their bylaw that allows smaller wind energy projects to undergo a site plan review with fewer required documents. One of the key goals underpinning the Green Communities Program is the development of renewable and alternative energy capacity. Communities should shape their bylaws to enable both large and small wind energy projects to proceed without undue delay.

3.5 Site Control

The applicant shall submit documentation of actual or prospective access and control of the project site sufficient to allow for installation and operation of the proposed wind energy facility. Control shall include the legal authority to prevent the use or construction of any structure for human habitation, or inconsistent or interfering use, within the setback areas.

3.6 Operation & Maintenance Plan

The applicant shall submit a plan for maintenance of access roads and storm water controls, as well as detailed procedures for operational maintenance of the wind facility that are in accordance with manufacturer's recommendations for the period of expected operation of such facility. A facility that is not being maintained in accordance with the submitted plan and manufacturer's recommendations shall cease operation until such time as the facility is brought into compliance with the maintenance plan and manufacturer's recommendations.

3.7 Utility Notification

No site plan for the installation of a wind energy facility shall be approved until evidence has been given that the electric utility company that operates the electrical grid where the facility is to be located has been informed of the customer's intent to install an interconnected customer-owned generator, and copies of site plans showing the proposed location have been submitted to the utility for review. No installation of a wind energy facility should commence and no interconnection shall take place until an

–Interconnection Agreement pursuant to applicable tariff and consistent with the requirements for other generation has been executed with the utility. Off-grid systems shall be exempt from this requirement, unless they are proposed to be located within setback distance from the sideline of an existing utility ROW.

3.8 Temporary Meteorological Towers (Met Towers)

A building permit shall be required for stand-alone temporary met towers. No site plan review shall be required for met towers. Met towers shall not be located within setback distance from the sideline of any utility ROW.

Note: *Under the state building code, work must commence within six (6) months from the date a building permit is issued, however, a project proponent may request an extension of the permit and more than one extension may be granted.*

3.9 Design Standards

3.9.1 Appearance, Color and Finish

Color and appearance shall comply with Federal Aviation Administration (FAA) safety requirements.

3.9.2 Lighting

Wind turbines shall be lighted only if required by the FAA. Lighting of other parts of the wind energy facility, such as appurtenant structures, shall be limited to that required for safety and operational purposes, and shall be reasonably shielded from abutting properties. Except as required by the FAA, lighting of the wind energy facility shall be directed downward and shall incorporate full cut-off fixtures to reduce light pollution.

3.9.3 Signage

Signs on wind energy facilities shall comply with the Town's sign by-law. The following signs shall be required:

(a) Those necessary to identify the owner, provide a 24-hour emergency contact phone number, and warn of any danger.

(b) Educational signs providing information about the facility and the benefits of renewable energy.

Wind turbines shall not be used for displaying any advertising except for reasonable identification of the manufacturer or operator of the wind energy facility.

3.9.4 Utility Connections

Reasonable efforts, as determined by the Site Plan Review Authority, shall be made to place all developer-owned utility connections from the wind energy facility underground, depending on appropriate soil conditions, shape, and topography of the site and any requirements of the utility provider. Utility owned electrical equipment required for utility interconnections may be above ground, if required by the utility provider.

3.9.5 Appurtenant Structures

All appurtenant structures to wind energy facilities shall be subject to applicable regulations concerning the bulk and height of structures, lot area, setbacks, open space, parking and building coverage requirements. All such appurtenant structures, including but not limited to, equipment shelters, storage facilities, transformers, and substations, shall be architecturally compatible with each other and contained within the turbine tower whenever technically and economically feasible. Whenever reasonable, structures should be shaded from view by vegetation and/or located in an underground vault and joined or clustered to avoid adverse visual impacts.

> ***Note:*** *Regulations governing appurtenant structures are typically contained in a town's zoning bylaw.*

3.9.6 Height

The height (MTH) of wind energy facilities shall not exceed 450 feet in height.

Note: *A turbine height of 450 feet is used for illustration purposes only. Communities may set a height limit that is less than 450 feet, provided that the limit selected allows for the as-of-right construction and operation of turbines with a rated nameplate capacity of 600 kW or more.*

Currently, a land-based turbine that is 450 feet in height is considered a large turbine. Periodically, communities may wish to revisit their siting criteria to ensure that they reflect industry standards as well as Green Communities Act requirements.

3.10 Safety and Environmental Standards

3.10.1 Emergency Services

The applicant shall provide a copy of the project summary, electrical schematic, and site plan to the police and fire departments, and/or the local emergency services entity designated by the local government, as well as the local electrical utility company. Upon request the applicant shall cooperate with local emergency services in developing an emergency response plan. All means of disconnecting the wind energy facility shall be clearly marked. The applicant or facility owner shall identify a responsible person for public inquiries or complaints throughout the life of the project.

3.10.2 Unauthorized Access

Wind energy facilities shall be designed to prevent unauthorized access. For instance, the towers of wind turbines shall be designed and installed so that step bolts or other climbing features are not readily accessible to the public and so that step bolts or other climbing features are not installed below the level of 8 feet above the ground. Electrical equipment shall be locked where possible.

3.10.3 Setbacks

A wind turbine may not be sited within:
(a) a distance equal to one and one-half (1.5) times the maximum tip height (MTH) of the wind turbine from buildings, critical infrastructure—including Critical Electric Infrastructure and above-ground natural gas distribution infrastructure—or private or public ways that are not part of the wind energy facility;
(b) a distance equal to three (3.0) times the maximum tip height (MTH) of the turbine from the nearest existing residential or commercial structure; or
(c) a distance equal to one and one-half (1.5) times the maximum tip height (MTH) of the turbine from the nearest property line, and private or public way.

3.10.5 Shadow/Flicker

Wind energy facilities shall be sited in a manner that minimizes shadowing or flicker impacts. The applicant has the burden of proving that this effect does not have significant adverse impact on neighboring or adjacent uses.

Educational Note: Shadow flicker is caused by sunlight passing through the swept area of the wind turbine's blades. As sunlight passes through the spinning blades, it is possible to have a stroboscopic effect that can, under the right conditions, affect persons prone to epilepsy. In general, these conditions require varying light intensity at frequencies of 2.5-3 Hz. Large commercial turbines are typically limited to a frequency of less than 1.75 Hz. Furthermore, the impacts of shadow flicker diminish rapidly with distance and should be minimal at 10 or more rotor diameters. Though the RPM for smaller turbines is generally higher (up to 350 RPM, for some turbines), the small size of the rotor swept area, combined with the shorter tower heights, support a negligible shadow flicker impact from these types of facilities. In any case, the effects of shadow flicker are a seasonal and/or diurnal impact, requiring that the sun be at the right position in the sky to generate a line of sight with the affected building and the wind turbine rotor. As such, the impacts of shadow flicker will generally only be felt for a few hours per year.

3.10.6 Sound

The operation of the wind energy facility shall conform with the provisions of the Department of Environmental Protection's, Division of Air Quality Noise Regulations (310 CMR 7.10).

Educational Note: According to the Division of Air Quality Control Policy, a source of sound will be considered to be violating 310 CMR 7.10 if the source:

- **(a)** Increases the broadband sound level by more than 10 dB(A) above ambient, or
- **(b)** Produces a ―pure tone‖ condition – when an octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by 3 decibels or more.

These criteria are measured both at the property line and at the nearest inhabited structure. Ambient is defined as the background A-weighted sound level that is exceeded 90% of the time measured during equipment hours. The ambient may also be established by other means with consent from the DEP.

3.10.7 Land Clearing, Soil Erosion and Habitat Impacts

Clearing of natural vegetation shall be limited to that which is necessary for the construction, operation and maintenance of the wind energy facility or otherwise prescribed by applicable laws, regulations, and bylaws, and subject to existing easements, restrictions and conditions of record.

3.11 Monitoring and Maintenance

3.11.1 Wind Energy Facility Conditions

The applicant shall maintain the wind energy facility in good condition. Maintenance shall include, but not be limited to, painting, structural repairs, emergency braking (stopping) and integrity of security measures. Site access shall be maintained to a level acceptable to the local Fire Chief and Emergency Medical Services. The project owner shall be responsible for the cost of maintaining the wind energy facility and any access road(s), unless accepted as a public way.

3.11.2 Modifications

All material modifications to a wind energy facility made after issuance of the required building permit shall require approval by the Site Plan Review Authority.

3.12 Abandonment or Decommissioning

3.12.1 Removal Requirements

Any wind energy facility which has reached the end of its useful life or has been abandoned shall be removed by the licensee. The owner/operator shall physically remove the facility no more than 150 days after the date of discontinued operations. The applicant shall notify the Site Plan Review Authority by certified mail of the proposed date of discontinued operations and plans for removal. Decommissioning shall consist of:

(a) Physical removal of all wind turbines, structures, equipment, security barriers and transmission lines from the site.

(b) Disposal of all solid and hazardous waste in accordance with local, state, and federal waste disposal regulations.

(c) Stabilization or re-vegetation of the site as necessary to minimize erosion. The Site Plan Review Authority may allow the owner to leave landscaping or designated below-grade foundations in order to minimize erosion and disruption to vegetation.

3.12.2 Abandonment

Absent notice of a proposed date of decommissioning or written note of extenuating circumstances, the wind energy facility shall be considered abandoned when the facility fails to operate for more than one year without the written consent of the Site Plan Review Authority. If the applicant fails to remove the facility in accordance with the requirements of this section within 150 days of abandonment or the proposed date of decommissioning, the town may enter the property and physically remove the facility

3.12.3 Financial Surety

Applicants for utility-scale wind energy facilities shall provide a form of surety, either through escrow account, bond or otherwise, to cover the cost of removal or failure to maintain, in the event the town must maintain or remove the facility and remediate the landscape, in an amount and form determined to be reasonable by the Site Plan Review Authority, but in no event to exceed more than 125 percent of the cost of removal and compliance with the additional requirements set forth herein, as determined by the applicant. Such surety will not be required for municipally or state- owned facilities. The applicant shall submit a fully inclusive estimate of the costs associated with removal, prepared by a qualified engineer. The amount shall include a mechanism for calculating increased removal costs due to inflation.

D. Example Waiver Language

DISLCAIMER: Rhode Island's Zoning Enabling Act differs from Connecticut's zoning laws and the use of waivers in Rhode Island may be legally prohibited. Accordingly, the following is meant to illustrate the flexibility of wind siting standards accommodated by another New England state. Municipal officials should obtain legal counsel with expertise in zoning prior to finalizing their wind ordinances.

The Connecticut Siting Council uses the following language in their 2015 wind turbine waiver provisions.

"GENERAL WAIVER PROCEDURE

(j) Waivers.

(1) Agreements. Pursuant to Section 16-50o of the Connecticut General Statutes, the applicant or petitioner shall submit any agreements entered into with any abutting property owner of record to waive the requirements under subsections (a) and (c) of section 16-50j-95 of the Regulations of Connecticut State Agencies.

(2) Requests. The applicant or petitioner shall submit to the Council any request for a waiver of the requirements under subsections (a) and (c) of section 16-50j-95 of the Regulations of Connecticut State Agencies at the time an application or petition is filed with the Council. If the Council finds good cause for a waiver of the requirements under subsections (a) and (c) of section 16-50j-95 of the Regulations of Connecticut State Agencies during a public hearing, the applicant or petitioner shall provide notice by certified mail to the abutting property owner of record that includes, the following:

(A) notice of the requirements under subsections (a) and (c) of section 16-50j-95 of the Regulations of Connecticut State Agencies;
(B) notice of the criteria considered for a good cause determination to waive the requirements under subsections (a) and (c) of section 16-50j-95 of the Regulations of Connecticut State Agencies;
(C) notice of the wind turbine manufacturer's recommended setback distances; and
(D) notice that the abutting property owner of record is granted a 30-day period of time from the date notice by certified mail is sent to an abutting property owner of record to provide written comments on the proposed waiver of the requirements under subsections (a) and (c) of section 16-50j-95 of the Regulations of Connecticut State Agencies to the Council or to file a request for party or intervenor status with the Council pursuant to Sections 16-50j-13 to 16-50j-17, inclusive, of the Regulations of Connecticut State Agencies.

SPECIFIC TO SETBACKS

(2) Waiver of requirements. The minimum required setback distances for each of the proposed wind turbine locations and any alternative wind turbine locations at the proposed site and any alternative sites may be waived, but in no case shall the setback distance from the proposed wind turbines and any alternative wind turbines be less than the manufacturer's recommended setback distances from any occupied residential structure or less than 1.5 times the wind turbine height from any occupied residential structure, whichever is greater:

(A) by submission to the Council of a written agreement between the applicant or petitioner and abutting property owners of record stating that consent is granted to allow reduced setback distances; or

(B) by a vote of two-thirds of the Council members present and voting to waive the minimum required setback distances upon a showing of good cause, which includes consideration of:

(i) land uses and land use restrictions on abutting parcels;

(ii) public health and safety;

(iii) public benefit and reliability;

(iv) environmental impacts;

(v) policies of the state; and

(vi) wind turbine design and technology.

SPECIFIC TO SHADOW FLICKER

(2) Waiver of Requirements. The maximum total annual hours of shadow flicker generated by the operation of each of the proposed wind turbines and any alternative wind turbines at the proposed site and any alternative sites may be waived:

(A) by submission to the Council of a written agreement between the applicant or petitioner and property owners of record stating that consent is granted to allow excess total annual hours of shadow flicker; or

(B) by a vote of two-thirds of the Council members present and voting to waive the total annual hours of shadow flicker requirements upon a showing of good cause, which includes consideration of:

(i) land uses and land use restrictions on abutting parcels;

(ii) public health and safety;

(iii) public benefit and reliability;

(iv) environmental impacts;

(v) policies of the state; and

(vi) wind turbine design and technology."

E. Increased Impact Special Use Permit Language & Procedure

The following procedure is a modified version of the Town of South Kingstown's Liquor License Policies and Procedures[23]. It has been modified to support land-based wind turbine projects seeking increased impact special use permits (IISUPs). Municipal officials should obtain legal counsel with expertise in zoning prior to finalizing their wind special use permit procedures.

New Increased Impact Special Use Permit Applications

A. Application

1. An application form must be obtained from the Town Clerk, fully completed, and returned to the Town Clerk with the application processing fee and all required documentation to include:
    a. Site Plan
    b. Special Use Permit Application
    c. Master Plan Amendment Approval for locations in Special Management Districts (if applicable).
2. The application forms to be used are available in the Office of the Town Clerk and are specifically made part of these rules and regulations.
3. The non-refundable application processing fee is $##.
4. The application must contain a description of the project sufficient to identify the specific location, on the property and/or nearby properties, where increased impacts above zoning standards could occur. A site plan, drawn to an acceptable engineering scale and accurately presenting all required data must be submitted with, and as part of, the increased impact special use permit application. The site plan shall contain:

    Parcel identification (Tax Assessor's Map and Lot.)

    Property ownership.

    Zoning Classification.

    Identification of all special use permits, variances, and other legally authorized deviations from the Zoning Ordinance with dates of authorization, including special use permits granted for the expansion of existing uses.

    Identification of exact locations where increased impacts in excess of those permitted by zoning standards could occur.

    Identification of all property owners who may experience increased impacts in excess of those permitted by current zoning standards.

B. Notice

Notice of the application must be given by regular mail to all owners of property who may experience increased impacts in excess of those permitted by applicable zoning standards. The notice is to follow a standard format set by the Town, and will be reviewed and mailed by the Town. Costs shall be paid by the applicant. The notice must state that impacted residents have a right to be heard and state the time and place of the hearing. In addition, each notice must specify the impact(s) that will be in excess of the

[23] http://www.southkingstownri.com/town-government/policies-and-procedures/licenses/liquor-license-rules-and-regulations

Town’s siting standards, where the increased impact(s) will occur on an owner’s property, what land development restrictions could result from the wind turbine development, and how much greater the impact(s) will be compared to the Town’s siting standards.

C. Advertising

The Town must advertise the hearing once a week for two weeks in a newspaper of local circulation. The initial advertisement must appear 30 days or more before the scheduled hearing date.

D. Basis for Denial

1. All available increased impact special use permits authorized under the limits established by these rules and regulations have been issued and no increased impact special use permit is currently available.
2. Objection is made by at least one owner of a property likely to experience impacts in excess of the Town’s siting standards and the Zoning Board determines that the increased impact(s) pose(s) health, or safety concerns or are incompatible with Town zoning goals or plans.
3. The Zoning Board has general discretionary authority to deny an increased impact special use permit based upon criteria which it has established and fairly applies. The following criteria have been established by the Town Council:
    a. Compliance with all Town Ordinances;
    b. Impact on existing municipal services and requirement, if any, for new municipal services;
    c. Compliance with all wind siting requirements included in the Town’s wind siting ordinance except siting impact standards and zoning requirements;
    d. Such other health and safety factors as each individual application may present.
4. Failure of applicant to comply with the requirements of State law

E. Special Use Permit

Wind turbine impacts in excess of the Town’s wind siting standards are permitted under the Zoning Ordinance only by special use permit. Prior to filing the application for an increased impact special use permit, the applicant must demonstrate that an application for a special use permit has been filed with the Zoning Board.