

Plymouth County Sheriff's Department

Joseph D. McDonald, Jr., Sheriff

Wind Energy Project



November 29, 2006



Plymouth County Sheriff's Department

MEMORANDUM

To: Sheriff, Joseph D. McDonald Jr.

From: John Finnerty
Michael T. Cheney

Date: November 29, 2006

Subject: Plymouth County Sheriff's Department Renewable Energy Project

In October of 2005 the Plymouth County Sheriff's Department staff was directed by Sheriff McDonald to conduct a feasibility study on utilizing renewable energy at the Plymouth County Correctional facility in an effort to reduce energy costs at the facility.

Staff first considered solar panel technology. The plan called for solar energy panels to be located on the roof of the Plymouth County Correctional Facility supplying power to the facility. After several meeting with industry experts and considering the capital cost of the energy project, it was determined, by the staff, not to recommend the department move forward with solar panel technology at this time. The staff will continue to monitor this technology as it improves.

The staff then considered wind power technology. After several meetings with representatives of the Commonwealth's Division of Energy Resources, energy consultants and a site visit by representatives of the Renewable Energy Research Laboratory of the University of Massachusetts, we are pleased to report that wind power at the Plymouth County Correctional Facility is possible. We are preparing to move forward with the final test before recommending the installation of a Wind Turbine to be located beside the correctional facility.

The final test consists of installing a free standing 50 – meter, temporary, MET tower (meteorological tower) with an anemometer installed on the tower. The tower will be installed at the Plymouth County Sheriff's Department Farm. The farm was selected as the test site because there is ample room for the support tower guide wires and it is in close proximity to the selected wind turbine site. The data produced by the MET tower will be collected and analyzed. The testing project will take approximately 1 year.

The Plymouth County Sheriff's Department, working with Josh Bagnato, Director of Renewable Energy for the Commonwealth of Massachusetts, has secured a \$40,000.00 grant from the Massachusetts Technology Collaborative Renewable Energy Trust Fund. The Plymouth County Sheriff's Department was notified on November 29, 2006 of the award. This amount represents 100% of the cost of the MET tower testing program.

Please find attached the Report by the Renewable Energy Research Laboratory and the Feasibility Grant Application



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Wind Power at the Plymouth County Correctional Facility: Siting Considerations for a Wind Turbine

Sally Wright, M.S., P.E., Melissa Elkinton

Site visit date: October 5, 2006

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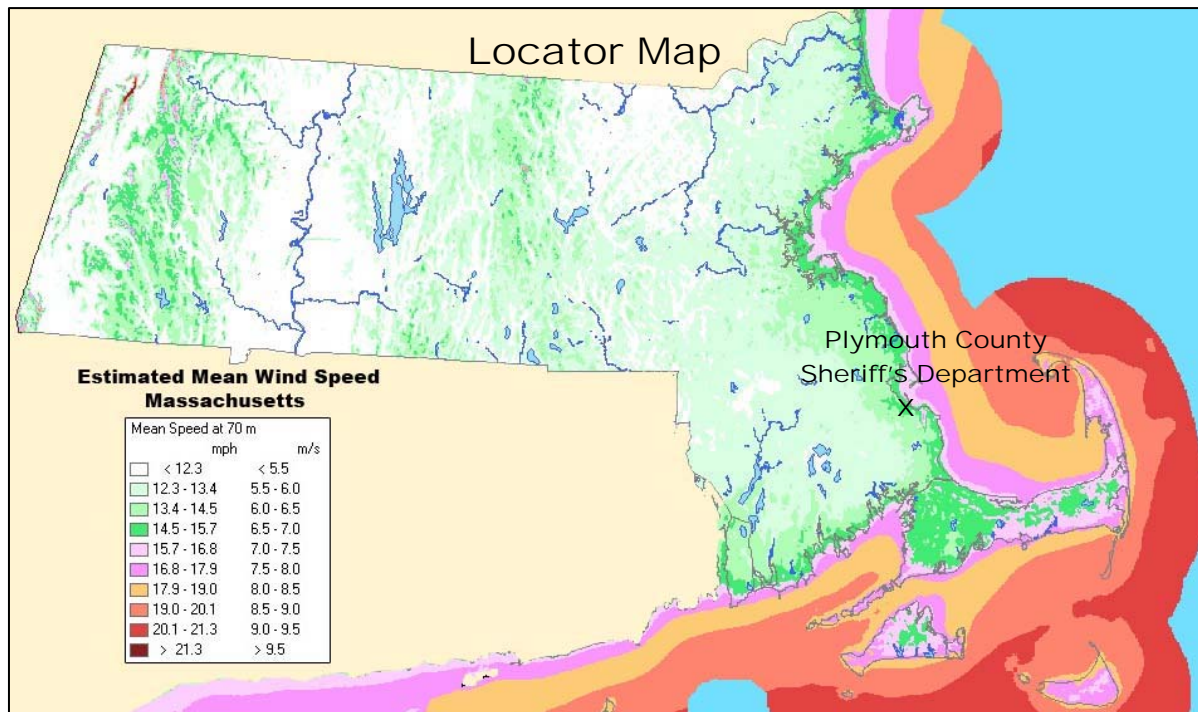
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I. Introduction

At the request of the Commonwealth of Massachusetts and the Massachusetts Technology Collaborative's Renewable Energy Trust, Melissa Elkinton of the UMass Renewable Energy Research Laboratory (RERL) visited potential wind turbine and/or wind monitoring sites at the Plymouth County Sheriff's Department and Correctional Facilities, along with representatives of the Commonwealth, the Sheriff's Department, and the Collaborative (MTC.)

This report provides an initial assessment, that is, a broad "fatal flaw" analysis, of the suitability of potential sites at the Plymouth County Sheriff's Department for potential wind turbine installations.

Appendix B focuses on siting considerations for wind-monitoring towers (met towers) on the Sheriff's Department land; wind monitoring is an important aspect in determining feasibility.

For more background information

This report assumes some familiarity with wind resource assessment, wind power siting, and other issues that arise with wind power technology. For an introduction to these areas, please refer to RERL's Community Wind Fact Sheets, which are available on the web at:

http://www.ceere.org/rerl/about_wind/. These sheets include information on the following subjects:

- [Wind Technology Today](#)
- [Performance, Integration, & Economics](#)
- [Capacity Factor, Intermittency, and what happens when the wind doesn't blow?](#)
- [An Introduction to major factors that influence Community Wind economics](#)
- [Impacts & Issues](#)
- [Siting in Communities](#)
- [Resource Assessment](#)
- [Interpreting Your Wind Resource Data](#)
- [Permitting in Your Community](#)

More information on wind turbine technology, policy, and general information can be found at these websites:

- American Wind Energy Association, www.awea.org
- Danish Wind Industry Association, www.windpower.org

II. Site Considered

At the Commonwealth's request, one location at the Plymouth County Sheriff's Department was selected for this evaluation of a wind turbine. This facility, located at 26 Long Pond Road in Plymouth on county land, is comprised of a correctional facility, administrative building, support building, and parking lots.

A field just northwest of the correctional facility was examined for wind turbine placement possibilities. This site is at an elevation of approximately 130 feet and is mostly open and surrounded by 30 to 40 foot trees.

A secure courtyard within the correctional facility's fences was also mentioned during the site visit as potential wind turbine location. This site, however, is not considered in this report because the space is not adequate for a wind turbine.

For this site the following site characteristics were examined:

- A. Predicted Wind Resource
- B. Wind Turbine Component Transportation & Access
- C. Distance to Transmission/Distribution Lines for Power Distribution
- D. Noise
- E. Environmental Issues and Permitting
- F. Proximity to Airports
- G. Potential Electric Loads Offset

The above mentioned characteristics are also summarized with respect to the Sheriff's Department site in the data listing of site characteristics in Appendix A.

III. Wind Turbine Siting Considerations

Purpose

The purpose of this section is to consider whether there are any “fatal flaws” to siting a wind turbine in the site under discussion. Generally, these “fatal flaws” vary as the heights of the specific turbines and their applications vary. For this discussion we assume a “utility-” or “commercial-scale” (600 – 2,500 kW) turbine. The blade-tip height of these turbines ranges between 250 and 400 feet tall. We also address whether wind turbine siting concerns would be reduced if a medium-sized (250 kW or similar) turbine were chosen.

A. Predicted Wind Resource

The economics of wind power at a given site depends on many factors; one of the most important is wind speed. Understanding wind speed and turbulence is critical to estimating the energy that can be produced at a given site. The power in wind is related to its speed, and small changes or inaccuracies in estimated wind speed can mean big changes in annual energy production. For these reasons, wind speed is the first criterion to examine when considering a wind power project.

The primary motivation for understanding the winds at a proposed wind power site is an improved understanding of the project feasibility and returns, and thus a lowering of investment risk. Better, longer, and more site-specific data leads to lower risks.

TrueWind estimates of annual average wind speed

The AWS TrueWind model predicts annual average wind speeds of 6.2 m/s (13.9 mph) at correctional facility field at a height of 50 meters. Because this site has the ability to use power on site, the wind speeds are sufficient to warrant further consideration of a wind power project.

Other available wind data

High-quality wind data from nearby locations can be useful, primarily for correlation with on-site data. *Concurrent*, long-term, nearby data is most useful. Wind resource data collected by RERL are available on the web: http://www.ceere.org/rerl/rerl_resource.html.

RERL installed wind-monitoring equipment in Kingston, about 4.5 miles away from the Sheriff’s Department, and collected wind data for 12 months. This dataset is far enough away that if a utility-scale wind turbine is under consideration, on-site wind monitoring is advisable. If the terrain in Kingston is similar to that at the Sheriff’s Department, however, the Kingston data may be useful in determining the feasibility of a small- to medium-scale turbine installation.

Obstacles to wind flow

Obstacles cause both turbulence and slowing of the wind. If the surrounding landscape is built up, forested, or otherwise rough, turbulence will increase. These are important factors in site selection for a wind turbine because they affect the power production and the longevity of a wind turbine, and may affect the type of turbine that can function reliably at the site.

The primary obstacles to wind flow at the correctional facility field are the correctional facility building and the surrounding trees, especially the 60 foot trees between the field and Route 3. Maps and photos of this site, in addition to TrueWind estimated wind roses, can be found in Appendix C.

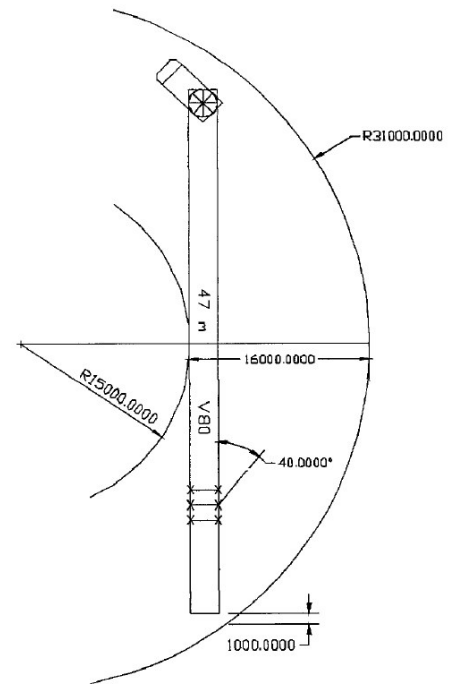
While this site is not ideally clear, obstacles and turbulence should not be fatal flaws.

Additional information regarding the monitoring of wind resources can be found in Appendix B.

B. Wind Turbine Component Transportation & Access

About Transportation and access in general

With blades up to 130 feet long, modern wind turbines require transportation on roads with a fairly large turning radius and only small changes in slope. The example at right shows the set of turning radii (in millimeters) required for transporting one of the 47-meter turbine blades of a Vestas V80, a 1.8 MW machine. Transportation accessibility for turbine installation is an important consideration for a potential wind turbine site.



Transportation and access at the Sheriff's Department

There may be some logistical difficulties in moving wind turbine components into the field by the correctional facility, but site access does not appear to be a fatal flaw for this site at this stage. It will require some planning, and on-site road improvement and/or construction may be necessary. If the Commonwealth and Sheriff's Department proceed with a wind project at this site, a detailed access plan would need to be developed.

C. Distance to Transmission/Distribution Lines for Power Distribution

About power distribution in general

The power generated by any installed wind turbine must be transported to either a load or to the grid. Proximity to utility distribution or transmission lines is an important wind turbine project cost consideration.

Power distribution at the Sheriff's Department

Distribution lines are nearby the correctional facility field. The ratings of these lines are unknown, but interconnection does not appear to be a fatal flaw at this stage. A point of interconnection would be determined later in the project.

D. Noise

About Noise in general

Noise considerations generally take two forms, state regulatory compliance and nuisance levels at nearby residences:

A. *Regulatory compliance:* Massachusetts state regulations do not allow a rise of 10 dB or greater above background levels at a property boundary (Massachusetts Air Pollution Control Regulations, Regulation 310 CMR 7.10).

B. *Human annoyance:* Aside from Massachusetts regulations, residences must also be taken into consideration. Any eventual wind turbine would be sited such that it would be inaudible or minimally audible at the nearest residences. At this stage, to check for fatal flaws, a rule of thumb can be used to minimize possible noise impacts: site wind turbines at least three times the blade-tip height from residences. Distances from mixed-use areas may be somewhat shorter.

For example, this first-pass rule of thumb tells us that a turbine with a 77-meter rotor diameter on a 60-meter tower should be about 300 meters (~1000 feet) from residences. Other turbine sizes would suggest other distances. Note that many factors affect the transmission of sound and that this is a rule of thumb only.

Noise at the Sheriff's Department

Noise may be a siting constraint for a wind turbine at the correctional facility since the building that houses the inmates would likely be within 100 meters of the wind turbine. The road noise from Route 3, however, which is only about 150 meters from the correctional facility, would decrease the noise impact of the wind turbine.

Consideration of the noise at the correctional facility building will be an important factor in sizing and micrositing a wind turbine at the Sheriff's Department. Noise should not be a problem with respect to civilian residences, however, since the closest houses are more than 500 meters (1,600 feet) away.

E. Environmental Issues and Permitting

While there are DEP designated wetlands within the Sheriff's Department's property, they seem to be suitably far from the site under consideration that there is no indication of significant environmentally-based hurdles for the correctional facility field at this preliminary stage.

However, there may other land-use restrictions that RERL is not aware of. It is the Commonwealth's and Sheriff's Department's responsibilities to ensure the environmental appropriateness of the site.

F. Nearby Airports

About airspace in general

The form "7460-1 - Notice Of Proposed Construction or Alteration" must be filed with the FAA before construction of any structure over 200 feet (i.e. all utility-scale wind turbines). The corresponding form for the Massachusetts Aeronautics Commission (MAC form E10, Request for Airspace Review) must also be filed.

These filings are reviewed by the FAA and the DOD for any potential obstruction or interference with air traffic, aircraft navigation/communication systems, military RADAR, etc. This process typically takes about three months for a first response. We recommend these be filed early for any site that is seriously being considered for a wind turbine, to understand whether a wind turbine is a possibility at the site.

While we cannot predict the FAA or DOD response, most sites that are not within about 3-5 miles of a public or military airport are not considered a hazard to air traffic. At this preliminary stage, we look for fatal flaws by considering the distance to public and military runways.

Note that the FAA requires that any structure over 200' be lit; all commercial-scale wind power installations are lit.

Airspace at the Sheriff’s Department

The Plymouth Municipal airport is approximately 4 miles from the correctional facility. This public airport is far enough that the FAA is unlikely to express safety concerns. With no military airports in the vicinity, the DOD is not likely to have any concerns about wind turbines in this area.

G. Potential Electrical Loads Offset

Due to the nature of the Sheriff’s Department’s facilities, a large amount of electricity is consumed on-site. The table below summarizes the electricity used by each of the buildings in FY 2005.

Sheriff’s Department Facility	kWh/year
Support Building	150,840
Administrative Building	859,920
Correctional Facility	4,415,850
Total	5,426,610

In order to maximize the economic benefits of a wind turbine installation at this low wind site, it is helpful for most or all of the electricity produced to be used on-site. Rough estimates of the annual energy productions of a few different size wind turbines hypothetically installed at the correctional facility field are given in the table below. These estimates are based on the following assumptions:

- Estimated mean wind speed of 6.2 m/s at hub height,
- Uniform wind speed over swept area,
- Rayleigh wind speed distribution,
- Standard air density, and
- 10% reduction of energy production due to availability, electrical losses, etc.

Wind Turbine (rated power)	kWh/year
FL 100 (100 kW)	240,000
FL 250 (250 kW)	594,000
V47 (660 kW)	1,330,000
GE 1.5sl (1,500 kW)	3,380,000

A more detailed analysis at a later date could compare the annual and diurnal profiles of electricity production and consumption at the Sheriff's Department.

At this point, we can estimate that most or all of the output of a medium-scale turbine could be used on-site and much of a utility-scale turbine's output might be used on-site.

IV. Conclusions

The Plymouth County Sheriff’s Department and the Commonwealth of Massachusetts are interested in installing a wind turbine in the field northwest of the Plymouth County Correctional Facility. The wind speeds at this site are not ideal and space is limited for a utility-scale wind turbine, but a medium-scale wind turbine is a promising possibility since there is a significant on-site load. Due to the surrounding trees and buildings, it is recommended that any wind turbine be installed on a tall tower in order to get the swept area up and out of the turbulence.

The potential noise impact at the correctional facility could influence micrositing due to the proximity of the inmates. This will be an important consideration when determining the size and specific location for the wind turbine. Noise should not present a problem to civilian residences as they are more than 500 meters from the site.

If the Commonwealth and Sheriff’s Department are interested in pursuing a utility-scale wind turbine installation at the correctional facility, wind-monitoring is recommended. Issues with respect to potential wind-monitoring locations are discussed in Appendix B.

	Plymouth County Correctional Facility
<p>Wind Turbine: Primary constraint(s) <i>If this site is of interest for a utility-scale wind turbine, what factors will most affect feasibility and/or micrositing?</i></p>	<ul style="list-style-type: none"> • Space availability • Possible noise impact on inmates • Obstruction to flow by building and trees
<p>Next step / To be determined <i>To pursue wind power at this site, these items should be explored first (along with wind monitoring and public outreach):</i></p>	<ul style="list-style-type: none"> • Sizing of turbine to meet space constraints and be the best economic fit for the electric loads. • Check on environmental permitting • FAA 7460-1 filing

Appendix A: Site Survey Data

Key:

Green shading: particularly positive aspect that distinguishes this site from the others.

Yellow shading: Significant constraints: these items may force micrositing choices, or may make the site difficult

Red shading: Fatal flaws: these make placement impossible at this site.

Refer to the report “Wind Power at the Plymouth County Correctional Facility: Siting Considerations for a Wind Turbine” for a discussion of these data.

	Correctional Facility	Sheriff’s Farm: corn field	Sheriff’s Farm: field near Rt. 3
Site overview			
Description, Current land use	Located parallel to Route 3, comprises 75 acres. Land is mostly cleared with buildings, some pine tree forests.	Sheriff’s Department Farm is north of Route 3 and covers 125 acres. Mostly cultivated fields.	
Address	26 Long Pond Road	Obery Street	
Owner	Plymouth County	Plymouth County	
Location			
NAD 83, lat & long	41.932900 N	42.647394 N	42.650494 N
	70.651931 W	70.622450 W	70.609617 W
Degree, minute, second	41° 55' 58.44"N	41° 56' 10.67"N	41° 56' 07.25"N
	70° 39' 06.95"W	70° 38' 59.70"W	70° 39' 00.12"W
Elevation (feet)	132	137	138
Notes	--	--	--

	Correctional Facility	Sheriff's Farm: corn field	Sheriff's Farm: field near Rt. 3
Wind Speeds			
<i>Estimated Mean Speeds* in m/s</i>			
	At height of 100 m	7.2	These sites are not under consideration for a wind turbine.
	At height of 70 m	6.7	
	At height of 50 m	6.2	
	At height of 30 m	5.5	
	Wind Speed Summary:	Suitable for medium- to utility-scale wind power	
	Existing wind data	RERL wind data from Kingston, about 7.4 km (4.6 miles) miles away.	

	Correctional Facility	Sheriff's Farm: corn field	Sheriff's Farm: field near Rt. 3
Wind Turbine Considerations:			
<i>Economic</i>			
	On-site Electric Loads	Yes	
	Electric Loads, kWh/year	Based on FY 2006 for the three meters on the facility: <ul style="list-style-type: none"> • Support Building – 150,840 kWh/year • Administrative Building – 859,920 kWh/year • Correctional Facility – 4,415,850 kWh/year This results in a total of approximately 5.4 million kWh/year.	
	Access for blade transportation**	Some road modifications will be needed, including the removal of one or more lamp/video monitoring posts (see Appendix C). Not a fatal flaw.	
	Distance to Distribution/ Transmission lines**	Nearby	
<i>Obstructions to wind</i>			
	Terrain	Some level terrain surrounded by small, forested hills and dips. A large row of 60' trees are north of the field, south of Route 3.	
	Obstacles to wind	Correctional facility building and trees.	

Noise			
	Nearby residential areas:	No	
	Radius to residences: (m): (ideally >~300m for utility scale†)	> 500 m	
Environmental permitting †			
	Designated by the Natural Heritage & Endangered Species Program as a Core Habitat or a Supporting Natural Landscape?	No	
	Designated by the DEP as Wetlands?	No	
	Designated by the National Audubon Society as an Important Bird Area?	No	
	Is the site a current or former land-fill?	No	
	Other land-use restrictions, e.g. Article 97 †	None known	
Other permitting			
	Distance to airport(s)	Plymouth Municipal airport is about 6.5 km (4 mi) away.	

Wind Turbine: Conclusions				
	<p>Primary constraint(s):</p> <p><i>If this site is of interest for a utility-scale wind turbine, what factors will most affect feasibility and/or micrositing?</i></p>	<ul style="list-style-type: none"> • Space availability • Possible noise impact on inmates • Obstruction to flow by buildings 		
	<p>Next step / To be determined</p> <p><i>To pursue wind power at this site, these items should be explored first (along with wind monitoring and public outreach):</i></p>	<ul style="list-style-type: none"> • Sizing of turbine to meet space constraints and be the best economic fit for the electric loads. • Check on environmental permitting • FAA 7460-1 filing 		
	<p>Recommendation</p> <p><i>Should the town consider this site for a <u>utility-scale</u> wind turbine?</i></p> <p><i>For a smaller wind turbine?</i></p>	<p>Possibly</p> <p>Possibly</p>		
Met Tower Siting Factors				
1.	Space availability & level terrain	<p>While the field is level, there is not enough room for a 50-meter met tower.</p> <p>There is probably enough space for a 40-meter met tower.</p>	Level field. Plenty of space for a 50-meter met tower.	Mostly level field. There is a berm of dirt that would need to be moved. The east side of the field slopes slightly down.
	Power lines or other obstructions to met tower. <i>(Met tower must be set at least 1.5 x the tower height away from power lines.)</i>	None	None	None
	Obstacles to wind	Trees, correctional facility	None	Trees
	Clearing requirements	A few of the surrounding trees may need to be removed	None	A large berm of dirt would need to be moved.

	Soil quality – for met tower anchors	Compacted. Presumably adequate	Tilled soil	Tilled soil
	Road Access – for met tower installation	Good	Good	Good
	Security	Good, near correctional facility	Farm, presumably good	Farm, presumably good
	Existing towers on or near site	There is one sheriff's department radio tower (lattice) located approximately ½ mile away.	No	No
	Distance to AC power if lighting is required	Close	Not nearby	Not nearby
Met Tower: Primary Constraint				
2.	What factors will most affect feasibility and/or siting of a met tower here?	Even for a 40-meter met tower, some trees would need to be cleared. If a 40-meter met tower were installed, the large correctional facility building may affect the measured winds.	None	A large berm of dirt would need to be moved and the slope of the field may make installing a met tower more time-consuming.
Met Tower Recommendation:				
3.	Recommended site:	This is not an ideal site for a met tower. With tree removal, there is only room for a 40-meter met tower.	Yes – This site is appropriate for a met tower.	Yes - This is an appropriate site for a met tower
4.	Recommended met tower height (meters)	Possibly a 40-meter met tower	50-meter	50-meter

Notes:

* Estimated Mean Annual Wind speeds, in m/s: based on the AWS/TrueWind computer models. For more information, see TrueWind Solutions, truwind.teamcamelot.com/ne/

‡ Note that this will vary based on location, turbine size, terrain, ambient noise, etc.

** These items can have significant impacts on installation cost. The intention of this report is not to estimate the costs of these items, but only looks for indications of fatal flaw. However, if one appears to be an issue for the chosen site, it may be advisable to study it further relatively early in the project.

Appendix B: Wind-Monitoring Logistics

Traditionally, wind is monitored for about a year with a met tower. Some sites may be suitable for other types of monitoring in addition to a met tower. This section will concentrate on the siting of a met tower.

About met towers

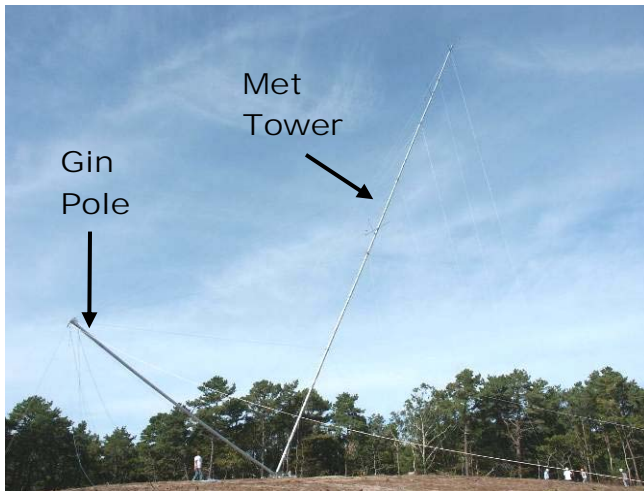
Most met towers are temporary structures that do not require a foundation and are supported by guy wires in 4 directions. Towers are usually 40 meters (131') or 50 meters (164') tall. In most cases, standard utility anchors are used to anchor the guy wires. The number and type of anchors required depends on the particular site. They will likely be proof-tested at installation to make sure they can hold enough load.

Typically, a tower is raised using a winch; no crane is required. The tower consists of a set of 6" diameter pipes that stack together; the whole set-up can be brought in on a pick-up truck.

The pictures on this page give an idea of what this equipment looks like.



A met tower base-plate sits directly on the ground.



A met tower in the process of being raised. The "gin pole" gives the winch leverage to lift the tower.



Typical 6-foot-long utility screw-in anchor



RERL's truck loaded with the sections of a 50-meter met tower

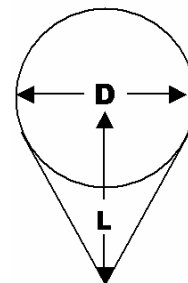


An anchor, installed, with 2 guy wires attached

Space required for a met tower

Clearing is necessary both for met tower installation and to reduce ground effect disturbance during data collection. The cleared area is shaped like a circle for the guy wires, with an additional “wedge” in which the tower is assembled before raising. An additional buffer is then cleared around that area to leave some area to work. The **minimum** cleared areas for guyed towers are:

Tower Height	D (Guy Diam.)	L (Space to lay the tower down)	Approximate total envelope to be cleared
40 meter (131')	160 feet	135 feet	240 x 190 feet
50 meter (164')	240 feet	165 feet	310 x 270 feet
<i>Dimensions of a football field, for comparison:</i>			<i>300 x 160 feet</i>



In general, a larger cleared area reduces the disturbances seen by the instruments, and improves data quality. Therefore, **a cleared area larger than the minimum size is preferred.**

While it is not necessary to pull stumps, removing as much obstruction and underbrush as possible will facilitate the raising of the tower. Guy-wires will be pulled across this field, and any obstacles that entangle the wires make the job more difficult.

It is also essential that there not be any electric or telephone wires within 1.5 times the height of the tower, i.e. 200 feet of a 40 m tower, or 250 feet of a 50 m tower.

Trees must be cleared at least the height of the trees away from the anchors to eliminate the danger of a falling tree hitting the guys. For example, a 50-foot-tall tree within less than 50 feet of an anchor must be cut down.

Note that it is possible to use some of this cleared area after the met tower has been installed; in other words, after installation, the space is left largely open.

Met Tower Siting Considerations

Generally speaking, wind speed and turbulence should be monitored at, or as close as possible to, the preferred wind turbine site. However, met tower siting involves certain additional considerations, and it may not always be possible to monitor wind at the proposed turbine site. This section provides an overview of the feasibility of placing a met tower at correctional facilities and Sheriff’s Department farm.

Space Availability for the Sheriff’s Department Sites

Correctional Facility field: Even if some of the trees and brush are cleared, there is still only room for a 40-meter met tower at this site.

Sheriff’s Farm corn field: There is plenty of room at this site for a 50-meter met tower.

Sheriff’s Farm field near Route 3: There is a large berm of dirt that would need to be moved in order to have enough room for a 50-meter met tower. This field also has a slight slope that may make installing a met tower somewhat more time-consuming.

Clearing requirements

Correctional Facility Field: Some trees and shrubs would need to be cleared along the edges of the field.

Sheriff's Farm corn field: No clearing required.

Sheriff's Farm field near Rt. 3: No tree clearing required. The berm of dirt would need to be moved.

Soil quality & anchor requirements

These sites have either compacted or tilled dirt, which should present no difficulties for anchoring, although longer or larger anchors are probably required.

Accessibility for met tower installation

The three available sites have good accessibility.

Permitting: Local approval process

The Commonwealth and Sheriff's Department is responsible for any local permits (e.g. building permits, zoning variances, DigSafe, etc.) that are required for the temporary met tower.

Nearby airports & FAA restrictions for met towers

Most met towers are shorter than 200 feet and do not require registration with the FAA.

Lighting

The FAA does not require met tower lighting at these sites.

Met tower size recommendation

There are usually two size options for met towers: 40-meter and 50-meter. The choice of a met tower depends on the site.

A 50-meter met tower is recommended for the Sheriff's Department corn field. If this site is not available, then the field near Route 3 is a second choice for a 50-meter met tower.

There is not enough space at the correctional facility field for a 50-meter tower, so it may be necessary to accept a 40-meter tower if this site is chosen.

Conclusion: met tower siting recommendations

Because wind-monitoring should be put near a proposed wind turbine site, the Commonwealth and Sheriff's Department should consider turbine siting options in order to decide on a met tower site. However, since wind turbines have different siting criteria than met towers, a site that is preferred for the former may not be as easy for the latter.

Wind-monitoring options should be discussed further depending on the size of turbine considered. If the Commonwealth and Sheriff's Department are interested in installing a utility-scale wind turbine at the correctional facility, then wind-monitoring is recommended.

The installation of a 50-meter met tower is recommended in the Sheriff's Farm corn field, where there is plenty of room. The winds at this site should be sufficiently similar to the winds at the correctional facility.

If a small- to medium-scale turbine is considered, wind-monitoring may not be essential.

Appendix C: Maps & Photos

Refer to the report “Wind Power at the Plymouth County Sheriff’s Department: Siting Considerations for a Wind Turbine” for a discussion of these maps and photos.

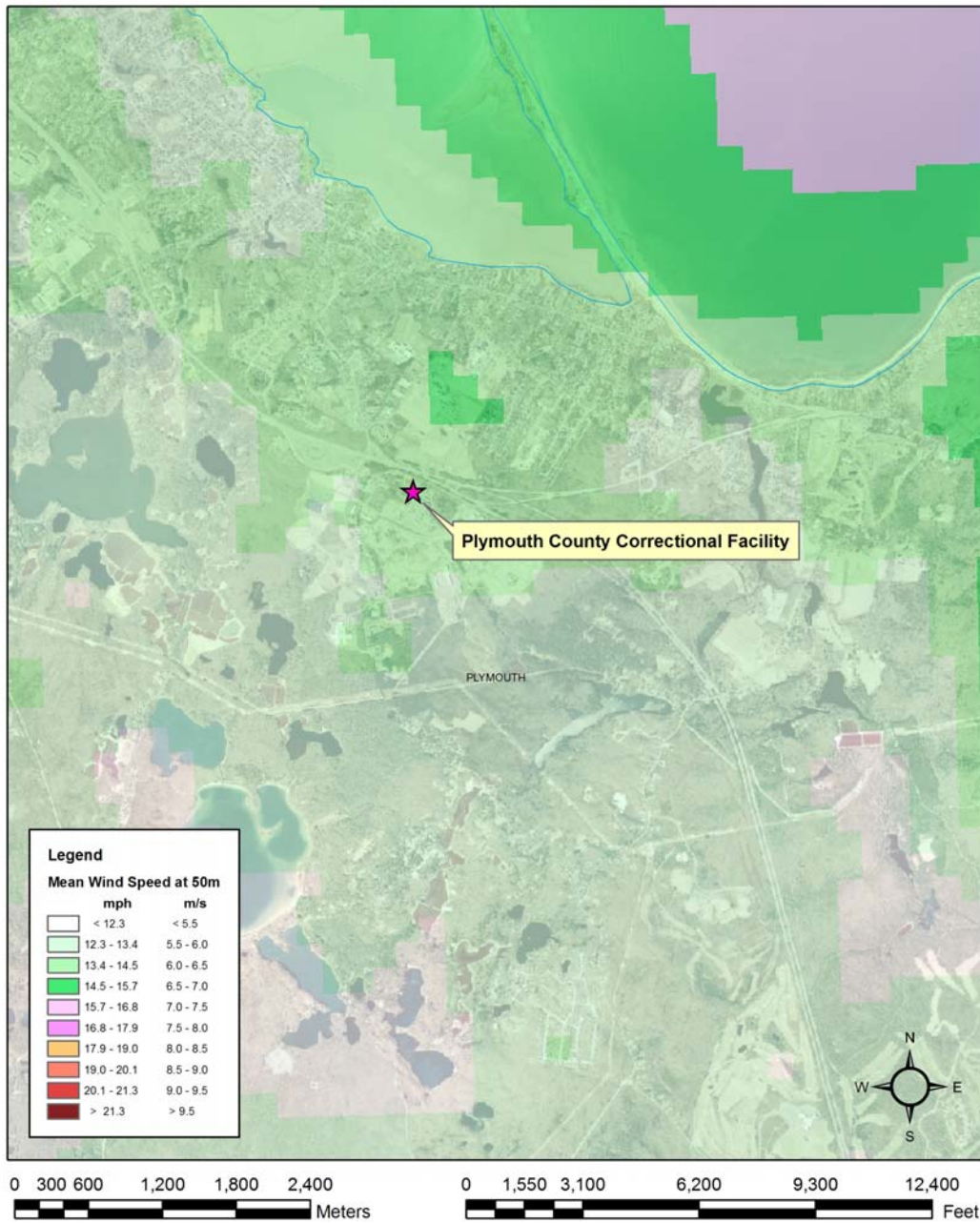
Source for base maps:

Ortho (aerial photographs) are from the MassGIS website, www.mass.gov/mgis/dwn-imgs.htm. The mainland was photographed in April 2001, so much of the recent construction projects in the Plymouth area are not visible in these orthophotos.

Roads and town boundaries are also from MassGIS.

Mean wind speeds are AWS-TrueWind’s estimates for New England, 2003. For more information, see TrueWind Solutions, truewind.teamcamelot.com/ne/.

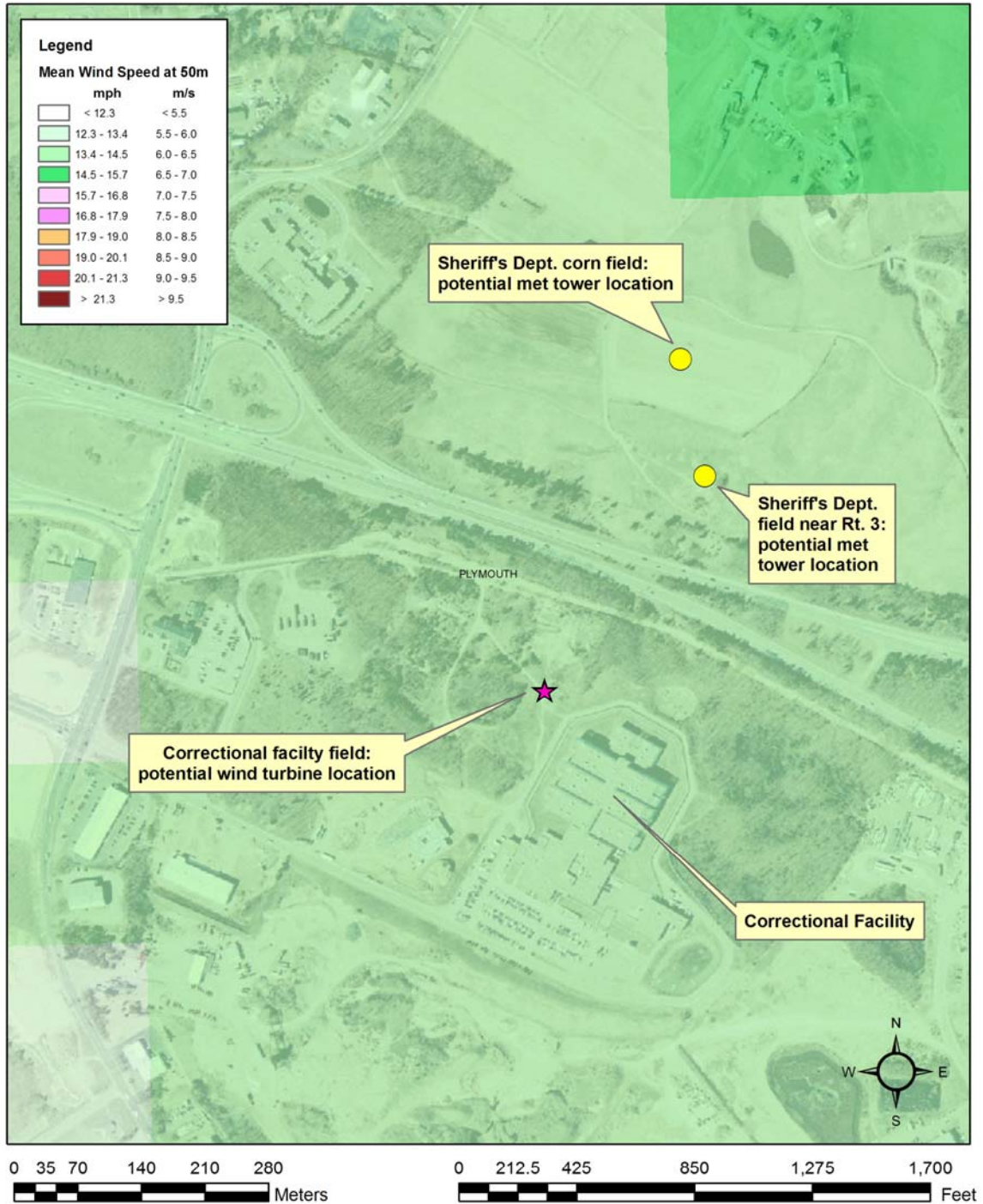
Estimated Mean Wind Speeds at 50 meters



Map 1: Aerial photograph, overlaid with TrueWind's estimated wind speeds at a height of 50 meters. The correctional facility, which is the proposed wind turbine site, is marked with a pink star.

Sites of primary interest for utility-scale wind power have a mean wind speed of 6.5 m/s or greater. On this map, these places are shown in dark green or pink. The estimated mean wind speed at the correctional facility is 6.2 m/s at a height of 50 meters.

Estimated Mean Wind Speeds at 50 meters



Mean wind speeds are AWS-TrueWind's estimates for New England, 2003. For more information, see TrueWind Solutions, truwind.teamcamelot.com/ne/.

Map 2: This is a zoomed-in map of the Plymouth County Sheriff's Department land. The pink star marks the proposed wind turbine location at the field and the two yellow circles mark possible met tower sites at the Sheriff's Department Farm.

Sheriff's Department wind turbine and met tower locations



Map 3: This map shows 50-meter met tower layouts at the sheriff's farm fields.

Photographs 1-3:

Looking southwest, a 150° view of the correctional facility field.





Photographs 4-5: Correctional facility field

4) View looking northwest

5) Road access to the field, view looking north.

Photographs 6-8:

Sheriff's department farm, the field near Route 3.

- 6) View looking northeast. This mound of dirt would need to be moved for a met tower installation.
- 7) View looking east.
- 8) View looking southeast



Photographs 9-11:

Looking east, a 150° view of the harvested corn field at the sheriff's department farm.





Plymouth County Sheriff's Department

Wind power revenues

A wind turbine/operator is considered an independent producer (IP) of electricity. As such he is protected and regulated by state and federal laws.

The state of Massachusetts has enacted legislation requiring that all publicly owned utilities purchase electricity from IPs, as long as it conforms to the technical interconnection requirements of the utility. The utility must purchase the power at "Avoided cost" or the cost to the utility to replace the same power. Since the establishment of the New England Power Pool, avoided cost is determined by the spot price according to the open market. The purchase price from the utility is usually two to three times less than the retail price to the customer.

An owner of a wind turbine realizes revenues in six ways.

- 1) Power purchases from the utility
- 2) Federal Production tax credit
- 3) Offsetting retail purchases
- 4) Renewable energy credits
- 5) Grants
- 6) Other tax incentives

Power purchases from the utility: As explained above, this is a direct price/kWh purchase of power by the utility to an IP. It is determined by a revenue meter that simply accumulates kWh when power is delivered from the turbine to the power grid.

Federal Production Tax Credit: In order to increase the value of wind generated electricity, Congress enacted the "Federal Production Tax Credit" as a part of the Energy Policy Act of 1992. Every kWh of electricity sold to a public utility will receive a tax credit of \$0.015 (adjusted for inflation to the present value of \$0.019). Every kWh of electricity sold to the utility by the Plymouth County Sheriff's Department turbine will receive this federal tax credit. The production tax credit expires on December 31, 2007. <http://www.irs.gov/pub/irs-pdf/f8835>.

Retail power purchases offset: The bulk of the revenue from the Plymouth Sheriff's Department turbine will be realized by the offsetting of retail purchase by the Plymouth County Correctional Facility. Whenever the load of the prison is greater than the production of the turbine (most, if not all of the time) the power generated by the turbine will simply offset the power purchased by the facility.

Envision a tank that has to be kept at a constant level because of a tube removing water from the tank (the load). There are two other tubes keeping the tank filled. One is

metered and every gallon of water supplied to fill the tank is paid for (utility feed). As the water level falls, the utility feeder tube replenishes the water. The other tube fills the tank when water is available (the wind turbine). So every gallon (kWh) of water supplied from the wind turbine means that a gallon (kWh) of electricity does not have to be purchased from the utility. This is called a “Behind the meter” system since power is supplied on the customer side of the meter offsetting the power needed to be purchased from the utility.

This power is valued at the retail rate since it is offsetting the purchase of power from the utility at retail costs.

Renewable Energy Credits or Certificates (RECs): Many organizations, private and public, have decided, for environmental reasons, to purchase a portion of their energy use from renewable (non greenhouse gas producing) sources. In most cases, it is impractical for them to install their own generators, so they are willing to pay a premium to have renewable producers virtually deliver them “green” power. This virtual system eliminates the transmission charges imposed by power companies to “wheel” electricity from an independent producer to a customer across their lines. These Renewable Energy Credits, or Certificates (RECs) are traded on the open market and are bound by short term or long term contracts. This system results in a premium paid for renewable electric generation.

Historically, RECs have had prices as high as 7-8 cents/kWh. Recently hydro electricity has been included in the mix and prices have fallen in the 4 cents/kWh range. It appears that the market for RECs will remain strong into the future.

Grants and incentives from the Commonwealth of Massachusetts:

Plymouth County Sheriff’s Department has applied for and received a grant from the Massachusetts Renewables Fund LORI grants and anemometer loan program from the Massachusetts Technology Collaborative and the University of Massachusetts (respectively).

Other tax incentives/credits from the Commonwealth and federal governments:

Federal MACRS:

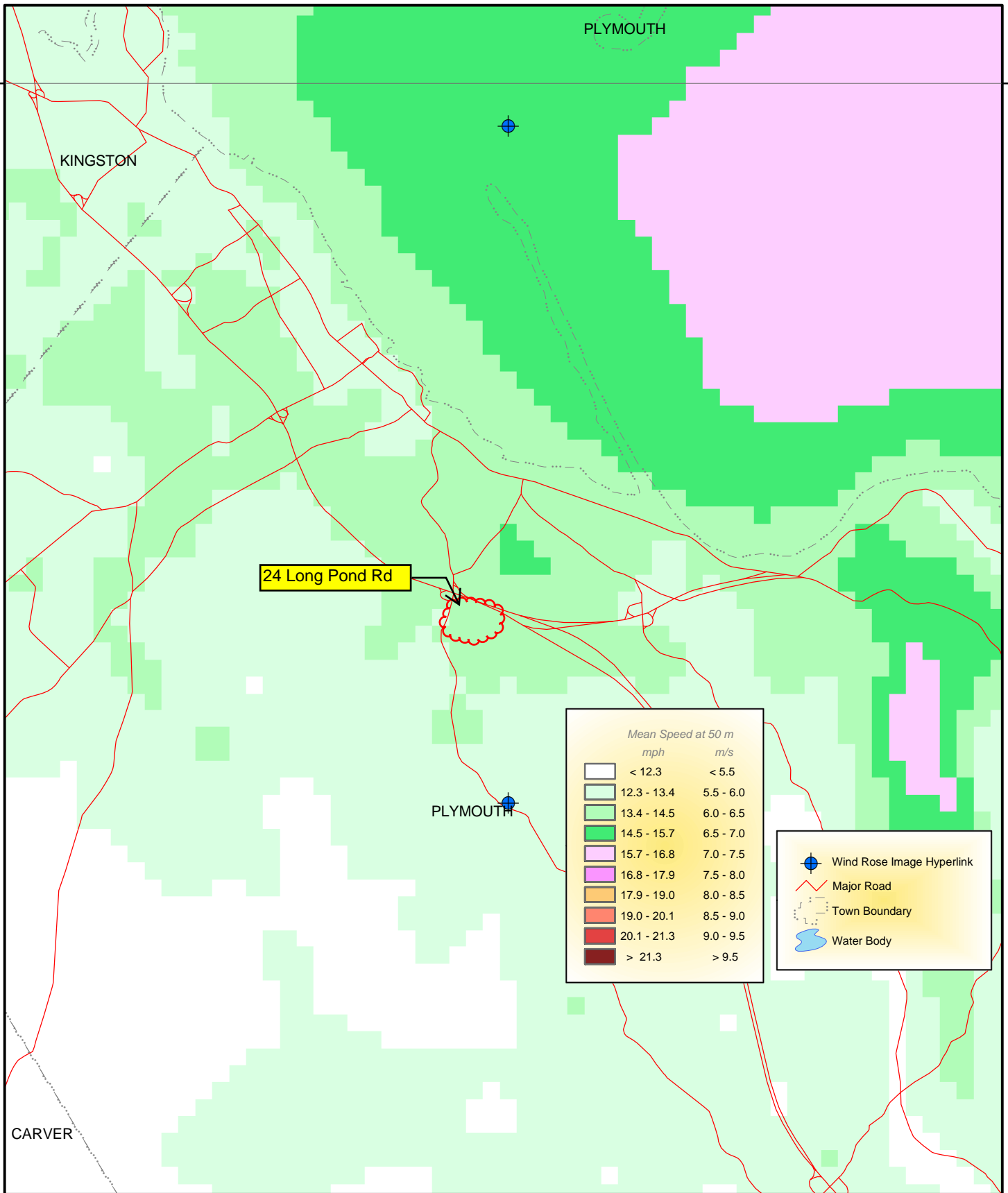
Under the Modified Accelerated Cost-Recovery System (MACRS), businesses can recover investments in certain property through depreciation deductions. The MACRS establishes a set of class lives for various types of property, ranging from three to 50 years, over which the property may be depreciated. For solar, wind and geothermal property placed in service after 1986, the current MACRS property class is five years. With the passage of the Energy Policy Act of 2005, fuel cells, micro turbines, and solar hybrid lighting technologies are now classified as 5-year property as well. 26 USC § 168 references 26 USC § 48(a)(3)(A) with respect to classifying property as “5-year property” and EPA 2005 added these technologies definition of energy property in § 48 as part of the business energy tax credit expansion. For more information, see IRS Publication 946, IRS Form 4562: Depreciation and Amortization, and Instructions for Form 4562.

Massachusetts Excise Tax Deduction and Exemption

Businesses may deduct from net income, for state excise tax purposes, costs incurred from the installation of any "solar or wind powered climatic control unit and any solar or wind powered water heating unit or any other type unit or system powered thereby." The installation must be located in Massachusetts and used exclusively in the trade or business of the corporation. A system or unit that qualifies for this deduction will not be taxed under the tangible property measure of the state's corporate excise tax. The exemption is in effect for the length of the equipment's depreciation period. Go to web site: <http://www.state.ma.us/doer/programs/renew/renew.htm#taxcred>

A working example of the benefits of wind energy can be found in the Town of Hull.

Hull can generate a kilowatt of electricity for 3.4 cents, but because of production tax credits and tradable renewable energy certificates (RECs), it takes in 6.3 cents. The electricity generated goes straight into the town's own grid, replacing power that would cost eight cents per kilowatt hour if it were purchased in the energy market.

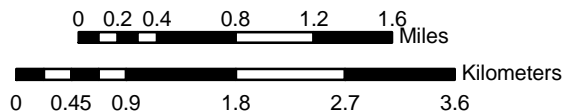


Wind Resource of New England

Sponsors:



Contractors:



Projection: Transverse Mercator, Zone 19, Spatial Resolution of Wind Resource Data: 200m

This map was created by TrueWind Solutions using the MesoMap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement. The map has been validated by the National Renewable Energy Laboratory (NREL) and consulting meteorologists using surface wind data.

