Renewable Energy Research Laboratory
Department of Mechanical and Industrial Engineering

The Hull Wind II Project

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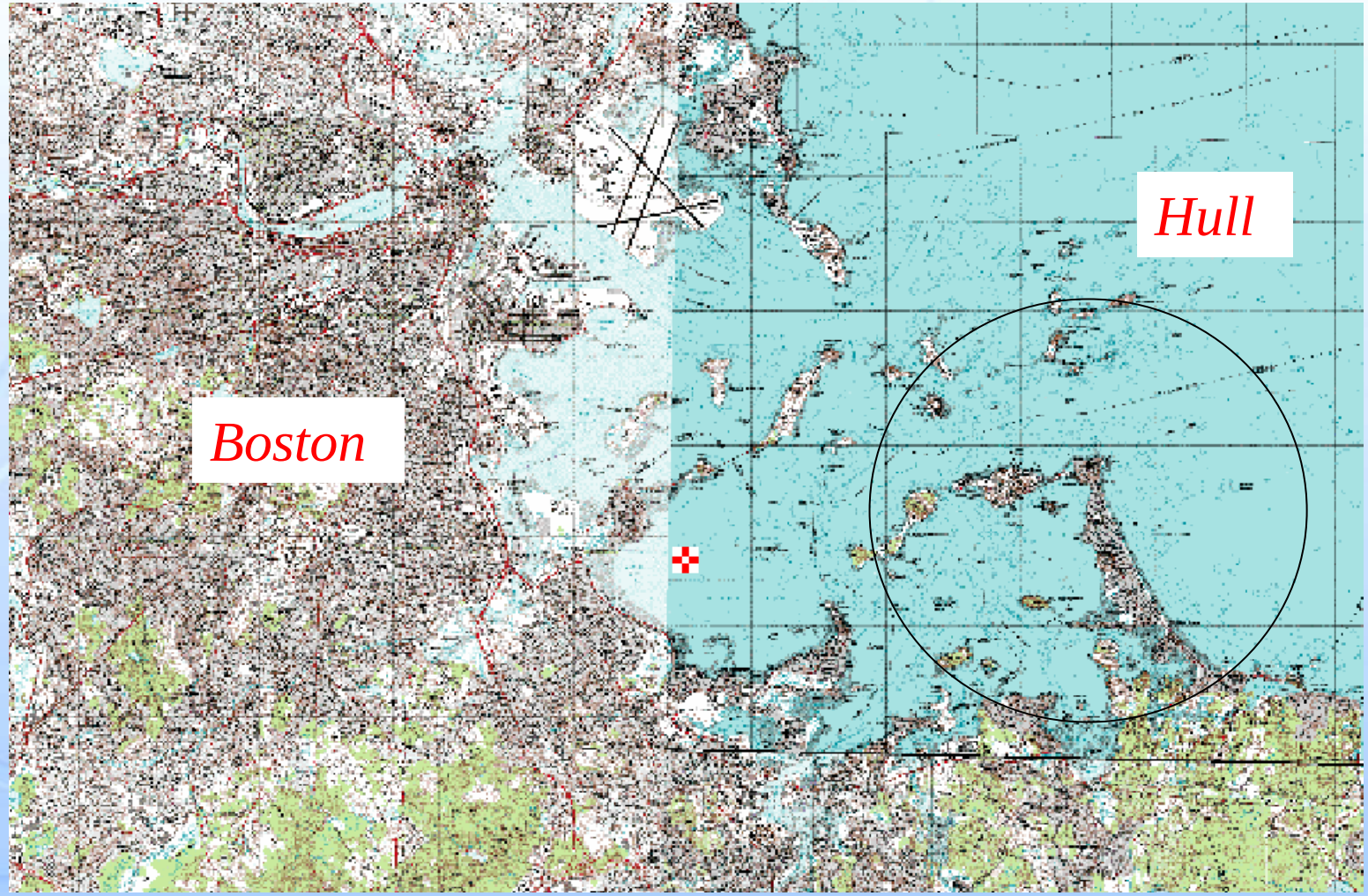
University of Massachusetts

Hull Locator Map



Map: Topozone

Background

- Hull has had a long history of using wind energy
- Hull Wind I, 660 kW, 47 m turbine was installed in 2001
- Planning for Hull Wind II began shortly thereafter

Hull Wind II

- 1.8 MW Vestas V80 wind turbine and tower
- Tower height: 60 meters
- Turbine blade rotor diameter: 80 meters
  - Blade length: 40 meters
- Tip of blade to ground: 100 meters
- Turbine placed on town landfill.
  - Height: 60 ft (~20 m)

Hull Wind II

- Foundation built on pilings driven through 60’closed landfill and 20’ into bedrock
- First wind turbine installed on a landfill in US
- Owner is Hull Municipal Lighting Plant, a publicly owned municipal utility
- 100% of electricity will be sold at retail to HMLP customers
- Distribution lines owned by HMLP

Hull Wind II: Important Dates

- Hull Wind I commissioned, 12/2001
- Discussions begin for second turbine, 2/2002
- Poll supports second turbine, 95%, 10/2002
- Possible sites considered, 2003-2004
- Top of closed landfill chosen as site, 10/2004
- Permitting process begun, 12/2004
- Turbine ordered, 4/2005
- Foundation constructed, 12/2005
- Installation completed, 4/2006
- Turbine on line, 5/2006

Hull Wind II Site Options

Pemberton/ Windmill Point

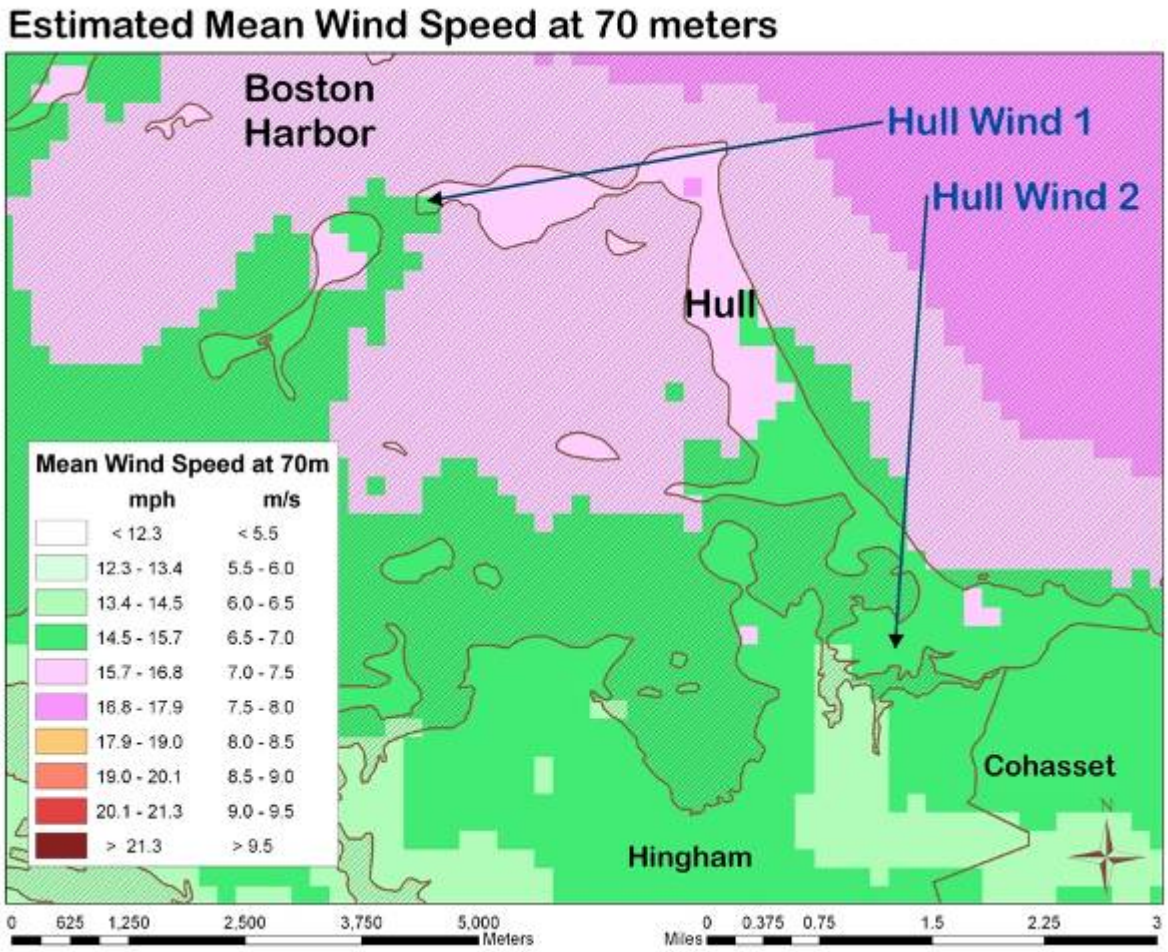
Stony Point

Mariners' Park

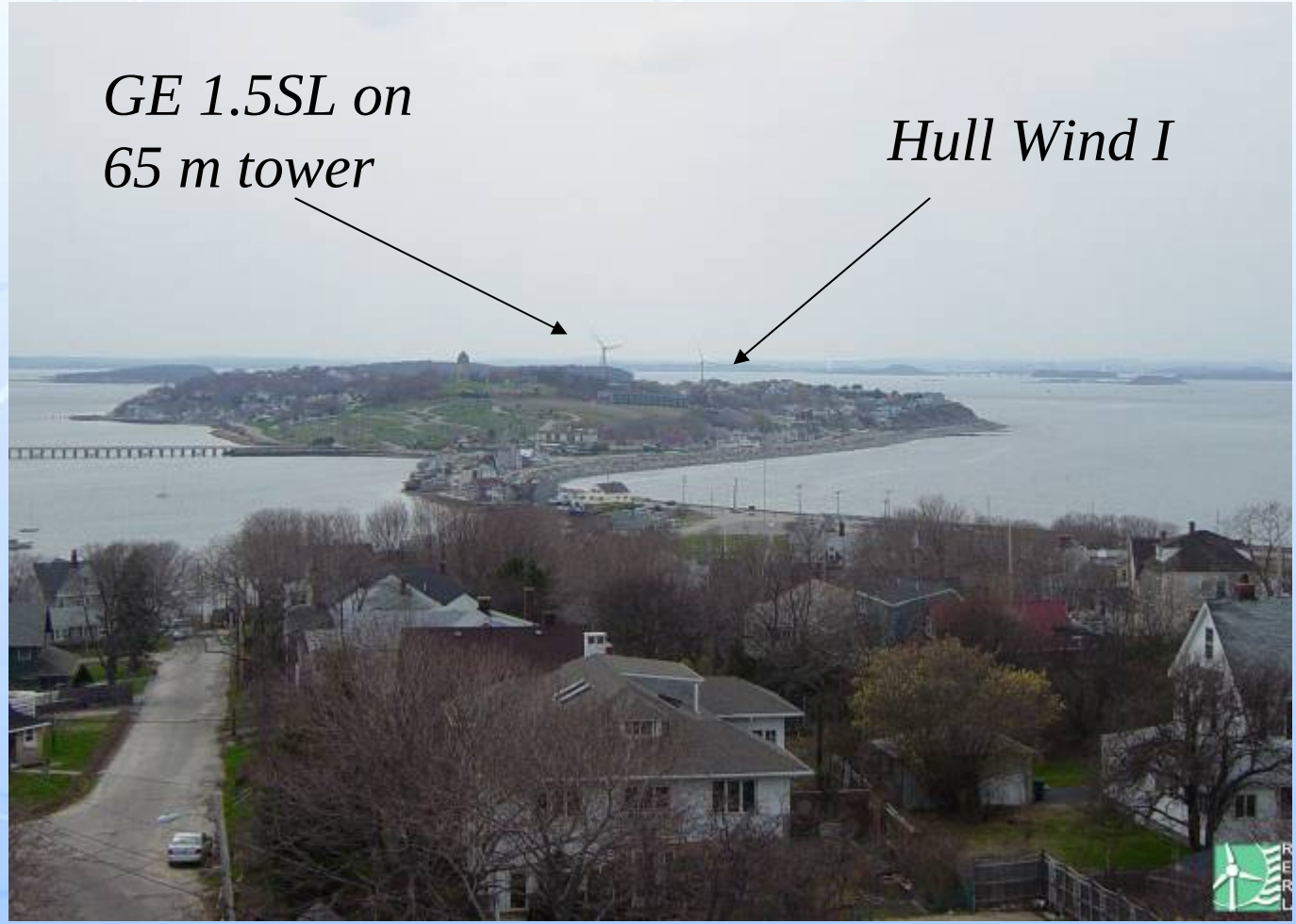
Landfill

Site Assessment

- Wind maps
- Economics
- Data collection
- Public input
- Visualizations



Hull Wind I and Visualization of HWII at Windmill Point (1)



View from Allerton

Hull I and Visualization of HW II at Windmill Point (2)

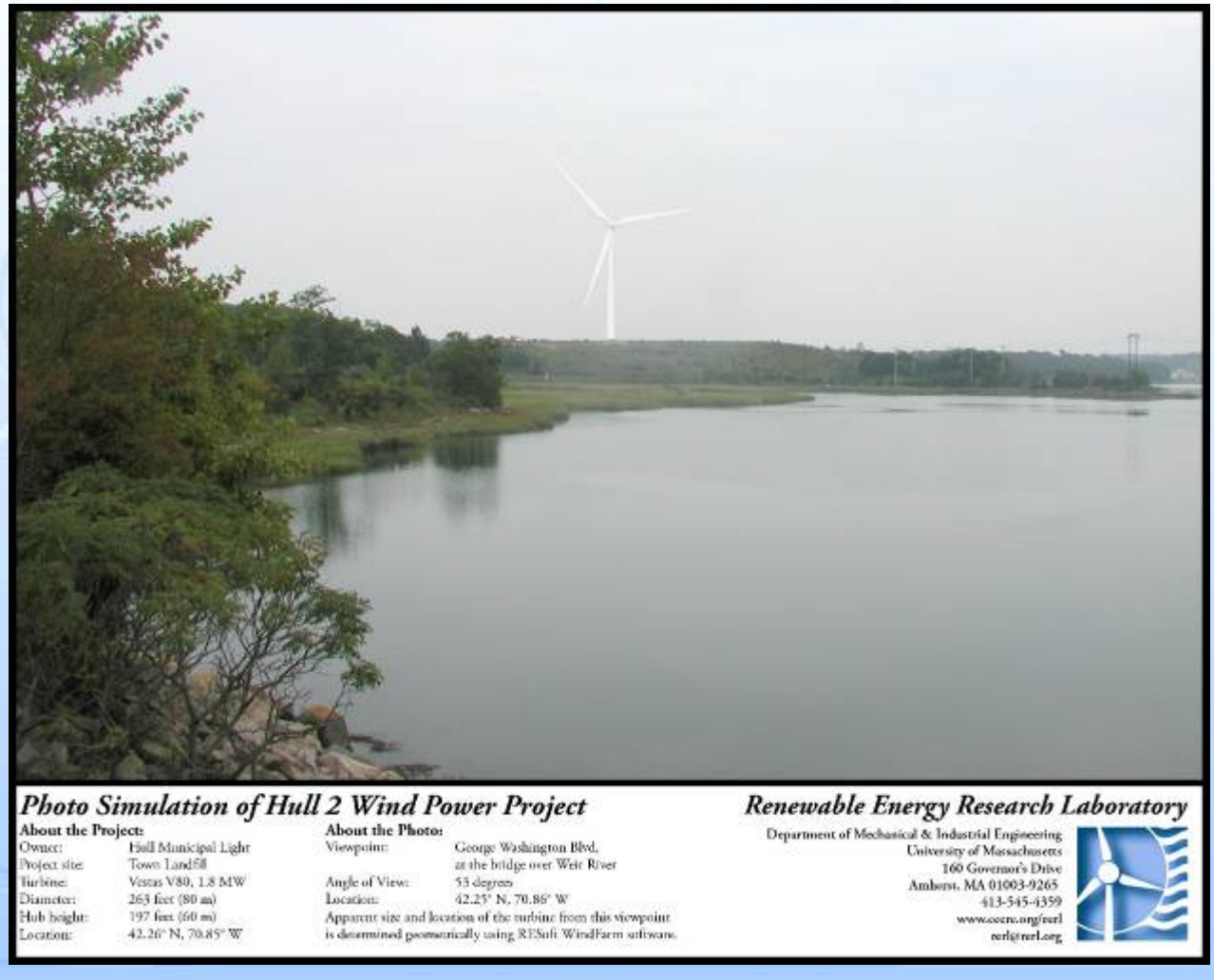
View from Little Brewster

Visualization: Mariner's Park

GE 1.5SL Wind Turbine

View from Ft. Revere

Visualization at Landfill



View from Weir River bridge

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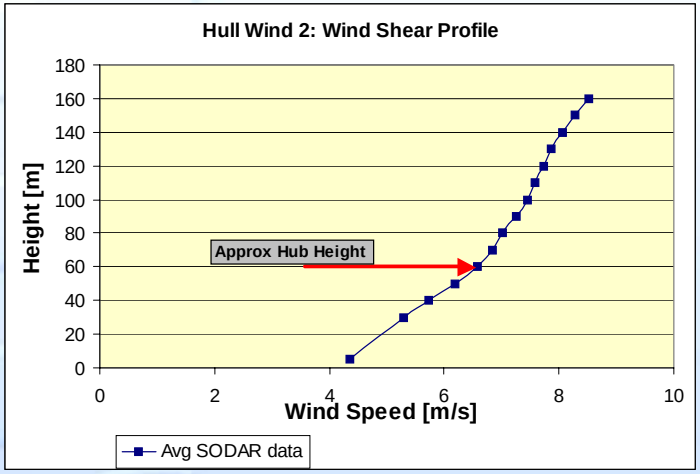
Wind Data Collection

- SODAR at Landfill
  - Uses sound to study wind
- SODAR used to investigate wind shear and provide basis for correlations

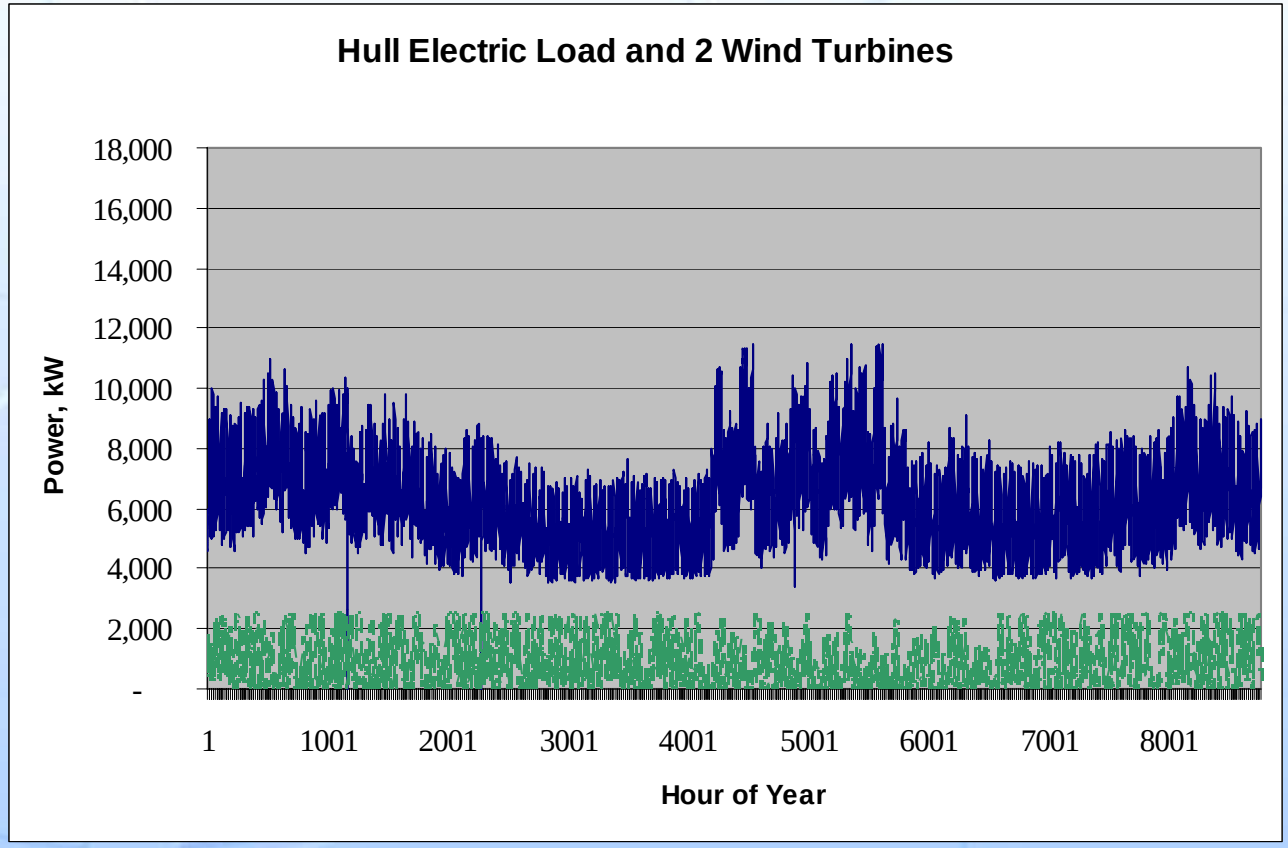
Wind Data/Turbine Power Analysis

- Short term wind speed and wind shear
- Correlations with long term sites ("MCP")
- Capacity factor should be similar to Hull Wind I's (approximately 0.27)
- Will produce ~ 9% of Hull's electricity



Results from MCP		
Long-term Data used:	Thompson Island **Nov 26 2004 to Nov 25 2005** Avg Speed: 5.98 m/s	
Concurrent Data: Increased Sodar wind speeds by 0.5 m/s prior to MCP	Oct 17 to Nov 17 2005	
To reflect long-term Logan data, Mean Wind Speed increased by factor:		1.026
Hull 2 Predictions (at 60m)		
	Avg Speed:	**7.03 m/s**
	k	**2.52**
	c	**7.92**

Hull's Electricity Use and Contributions from its First Two Wind Turbines



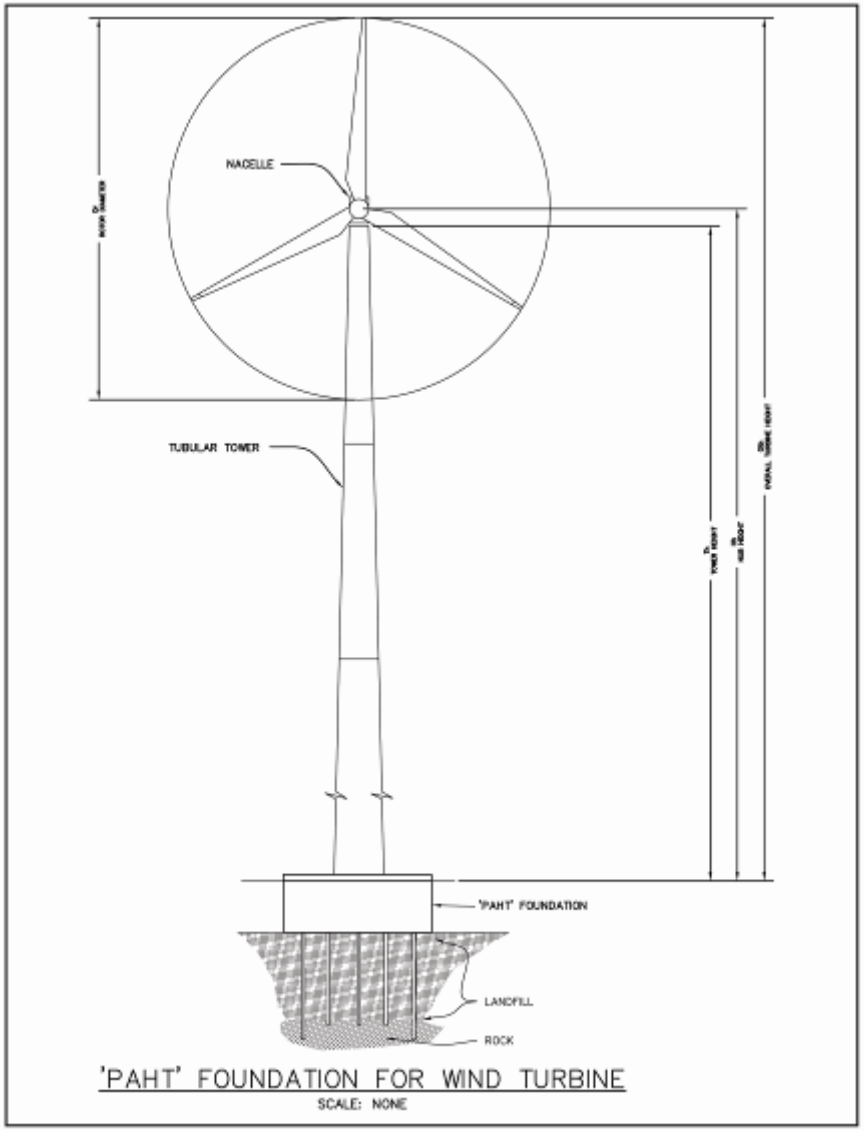
- Fraction from wind approximately 12%

Environmental Impacts

- Close proximity to houses primary concern
- Common issues, such as noise and avian impacts, of secondary importance to Hull residents
- Certain percentage of REC income to be given to Weir River Association
- HMLP agreed to a voluntary 1 year bird study- performed by Mass Audubon
- Objections from neighboring town (Hingham), based on visual, found to be w/out merit

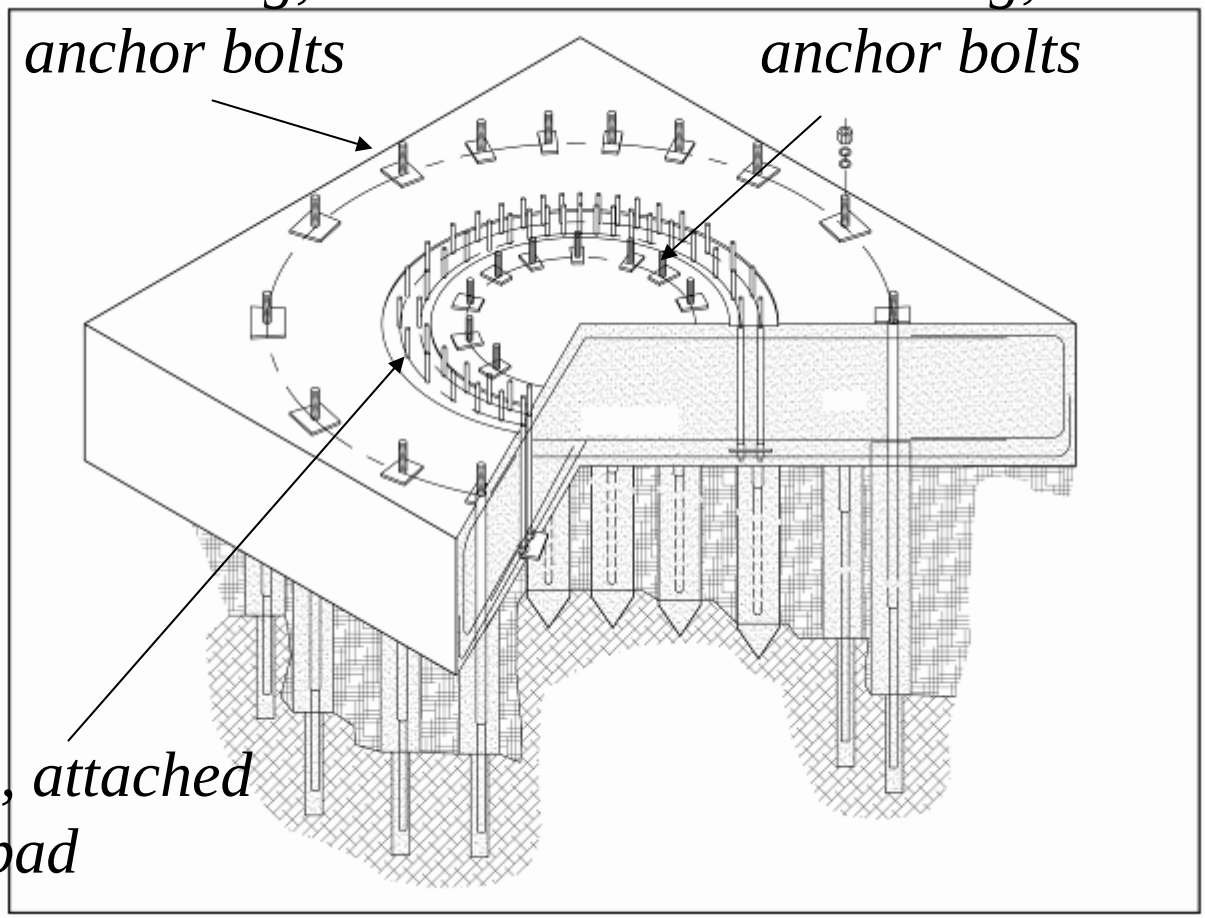
Foundation Design

- Turbine bolted to reinforced concrete pad (20’x 20’x 6’) on top of landfill
- Pad connected to bedrock via long, hollow anchor bolts, drilled and grouted in place



Foundation Design (2)

- Piles driven through landfill to bedrock provide conduit for anchor bolts



Economics: Costs

- Turbine: $1,800,000
- Foundation: $850,000
- Other: $350,000
- Total: $3,000,000
  - Cost per kW, installed: $1,666
- Annual recurring costs:
  - O&M: $25,000/yr
  - Insurance: $16,000/yr

Economics: Benefits

- Energy: 4,250,000 kWh/yr
- Value of displaced power: $0.10/kWh
- Simple Payback: 7.5 yrs
  - Less than 5 yrs, when RECs considered
- Cost of Energy: $0.045-0.056/kWh
- Net annual savings to Town:

  $250,000 - $425,000

  (depends on assumptions regarding financial factors, inflation, incentives such as REC's, REPI etc.)

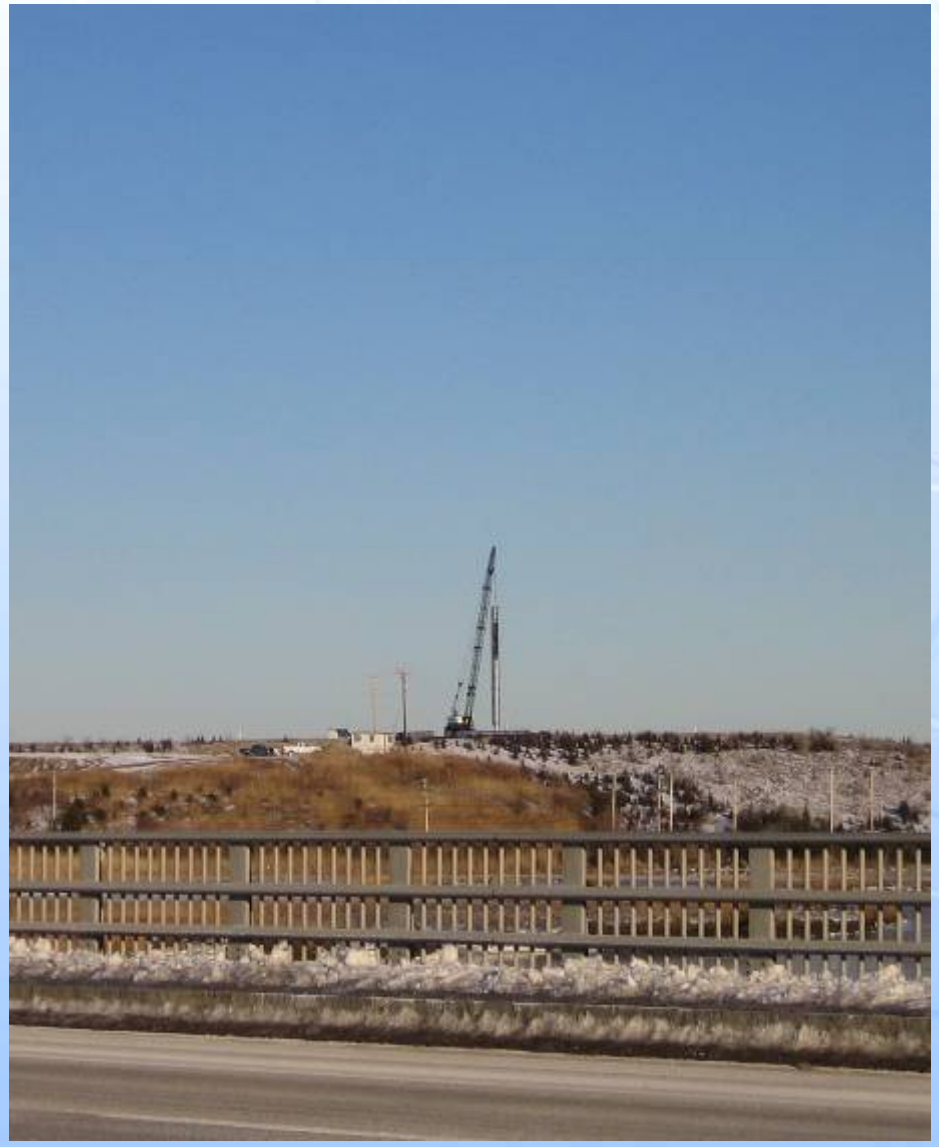
Blades Arriving by Ship

Nacelle Arriving in Quincy

Nacelle Being Unloaded

Blades on Site

Pile Driving for Foundation



Foundation Pilings

Completed Turbine

Keys to Success

- Qualified and experienced partners
  - Municipal electric company ideal host
- Adequate wind resource
  - Sufficient height above ground
- Guaranteed value of energy
- Clear public benefit
  - Non-restrictive regulations
- Opportunities for meaningful public input
- Reputable and responsive turbine supplier
- Contract details

Next Steps

- Monitor initial operation of Hull II
- Formal dedication this summer
- Install small turbine (Southwest 1.8 kW) at Weir River Assoc. visitors center
- Pursue development of Hull Offshore Wind Energy Project