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REPORT

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TOWN OF
Falmouth
MASSACHUSETTS

Wind Turbine Relocation Study

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EXECUTIVE SUMMARY

Weston & Sampson Engineers, Inc. (Weston & Sampson), on behalf of the Town of Falmouth, Massachusetts, conducted an analysis of the feasibility of relocating Wind II at the Town's wastewater treatment facility (WWTF) located at 154 Blacksmith Shop Road, Falmouth, MA. The WWTF is situated on approximately 300-acres of contiguous Town-owned land east of Route 28 and south of Thomas B. Landers Road. Construction of Wind I began in 2009 and the commercial operation date was March 23, 2010. The commercial operation date of Wind II was February 14, 2012. The operation of the wind turbines at their existing locations has been the source of various neighborhood complaints for the sights and sounds produced. The operation of both wind turbines has been limited to one degree or another since commercial operation began, while the Town has attempted to mitigate the objectionable conditions. This study is a further attempt to examine the feasibility of implementing actions to decrease the visibility and sound of the turbine in surrounding residential areas.

The objective of this study is to examine the possibility and basic implications of relocating Wind II on the property that would be generally in compliance with or exceed the setback and other relevant requirements of the Town's existing or applicable sections of the Town's wind turbine bylaw. The exercise is first a spatial analysis, to see what alternative on site location(s) would be the most-distant from existing residents and is intended to lessen the impact of the turbine at such an alternate location.

This study uses past data and information from prior studies, assessments and reports to estimate the likely impacts of sound and shadow flicker applied to a possible relocation site and presents an updated opinion of probable construction cost. We have used the past data to apply sight and sound buffers, however, it was not the intent to perform any acoustical measurements or modeling or consider any topographic or terrain effects that may have effects on the turbine. It was beyond the scope of this assessment to document or summarize the history of the project.

Moving Wind II is a technologically feasible task which would simply require dismantling, installation of new infrastructure (roads, foundation and electrical cabling) to support the turbine at a new location. Permitting issues would include a discretionary Special Permit from the Planning Board and 7460-1 obstruction analysis and permit from the Federal Aviation Administration (FAA) for the new location. The utility interconnection service agreement should be updated to reflect the new location of the asset; however, the system characteristics are not expected to change as the same generation equipment that is registered and received prior approval would be used. The direct transfer trip radio transmitter and receiver, which relies upon line of sight to operate, would remain in the same location, with the wiring extended to the alternate turbine location.

The estimated probable cost to relocate Wind II is on the order of $3,025,000.

An economic analysis of the proposed project to relocate Wind II to an alternate location on the WWTF property suggests that the project is financially feasible, if the wind turbine is relocated and permitted to operate without restrictions or curtailment. The analysis suggests that the proposed project to relocate Wind II would have a Net Present Value of $5,789,652 and a benefit to cost ratio of 2.21. The 20-year net cash flow is estimated to be $8,952,415. This is reasonably expected, where the capital cost of the wind turbine was provided in the form of an ARRA grant and assumes that the turbine is expected to be allowed to operate without any scheduled curtailment. If the project was paid for in cash, the IRR would be on the order of 23.3% with a simple payback of five years.

1.0 PROJECT OBJECTIVES

1.1 Introduction

Weston & Sampson Engineers, Inc. (Weston & Sampson), on behalf of the Town of Falmouth, Massachusetts, conducted an analysis of the feasibility of relocating Wind II at the Town's wastewater treatment facility (WWTF). The Site is located at Latitude 41.609324° North, Longitude 70.621562° West in Barnstable County, Massachusetts. The WWTF is located at 154 Blacksmith Shop Road, Falmouth, MA, and situated on approximately 329-acres of Town-owned land.

1.2 Background

The Town's Wastewater Division operates two wastewater systems. The Town's main wastewater treatment facility, located at 154 Blacksmith Shop Road, treats wastewater from the properties connected directly to the sewer, as well as a septage pump out service for individual cesspools and septic systems. The WWTF is currently designed to treat 1.2 million gallons per day of average annual flow. The main WWTF, which was originally constructed in the mid-1980's, was an aerated lagoon plant. Capital improvements to the WWTF were completed in 2005 and 2016. The 2005 upgrades were done to improve effluent discharge quality from the WWTF, which substantially reduced nitrogen load being discharged to the West Falmouth Harbor watershed.

In 2016, the Town completed another wastewater treatment facility improvement project that included the addition of an alkalinity feed system; improvements to the denitrification and sludge handling systems; and construction of an odor control biofilter along the service road. The 2016 improvements are also expected to further increase the consistency of WWTF performance and has already substantially reduced sludge management costs. The sewerage treatment system consists of an operations control building with laboratory, sludge processing building, sequential batch reactor building, aeration lagoons and numerous (15) infiltration beds used to recharge treated water located throughout the site. The recent upgrades added infiltration basins on the northern portion of the site, just south of Thomas B. Landers Road. Figure 3 provides a parcel map depicting the general arrangement of the major system components at the WWTF at the Site.

Construction of Wind I began in 2009 and commercial operation was achieved on March 23, 2010. The construction of Wind II began in 2011 and commercial operation was achieved on February 14, 2012. The present location of Wind I is near a former sludge drying beds at an elevation of 151 feet above mean sea level (AMSL) and Wind II is located between infiltration beds at an elevation of 130 feet AMSL. The location of Wind I and Wind II are depicted in a recent aerial photograph of the Site included as Figure 3.

The operation of the wind turbines at their existing locations has been the source of various neighborhood complaints due to the sights and sounds produced. The operation of both wind turbines has been subject to limited operation, to one degree or another, since commercial operation began, while the Town has attempted to mitigate the objectionable conditions. This study is a further attempt to examine the feasibility of implementing an action (moving the turbine), so as to lessen the impact of the turbine.

1.3 Scope of Analysis

The objective of the project is to provide a dimensional and impact analysis for moving Wind II within the Town-owned parcels at the WWTF and to evaluate compliance with applicable Town bylaws. After evaluating a feasible location that moves the turbine most distant from nearby residents, we then estimate the likely sight and sound of Wind II at the alternate location. These impacts would include safety setback, sound, flicker, wind resource assessment and energy production and provide an opinion of probable cost to move the turbine. We also consider the feasibility of utilizing the existing tower for Wind I as a wireless telecommunication tower, following removal of the wind turbine generation equipment. This analysis would similarly examine the dimensional aspects of using the existing wind tower with respect to applicable Town bylaws regulating telecommunications towers. In summary, the scope of this assessment included the following tasks:

Table 1
Scope of Turbine Relocation Analysis

Task No.	Task Description
1	Evaluate alternate location for Wind II
2	Estimate likely sound impacts for alternate location of Wind II
3	Estimate likely shadow flicker impacts for alternate location of Wind II
4	Estimate wind resource and energy production for alternate location of Wind II
5	Opinion of probable cost for moving Wind II
6	Feasibility of using Wind I for wireless communications
7	Economic analysis for relocation of Wind II

2.0 LOCATION ALTERNATIVES FOR WIND II

The siting of a wind turbine should consider a variety of factors, including the highest ground elevation and access to the best wind resources which are usually the most important factors for energy production. The location analysis may also consider suitability of soil conditions, accessibility and proximity to electrical interconnection. Ideally, the site needs to be accessible by crane, clear of trees, buildings and obstacles that would present an impediment to construction or the wind resources during operation. Other considerations typically include proximity to wetlands, existing habitat of endangered or threatened species and potential impacts to cultural resources. The location should also consider possible airspace restrictions and setback distances to comply with regional and local zoning ordinances with respect to property lines and potential impacts for sound and shadow flicker to residential receptors. Generally, setback distances to minimize sound and flicker impacts would only apply to residential areas which have the potential to be nuisance based on continuous occupation or exposure. A discussion of the siting considerations is given below.

2.1 Permitting Considerations

Federal Permitting

The only federal permit requirements would be through the Federal Aviation Administration (FAA) for structures in excess of 200 feet that are regulated under Title 14, Code of Federal Regulations.

State Permitting

State permit considerations include Natural Heritage and Endangered Species Program Review and Massachusetts Historic Commission Review. Projects which are subject to the state Wetlands Protection Act would be administered through the local Town of Falmouth Conservation Commission, if applicable.

Pursuant to the Massachusetts Endangered Species Act (MESA)(M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00), Weston & Sampson filed a MESA Project Review in 2009 to Natural Heritage and Endangered Species Program (NHESP) for the Wind II project. Based on the NHESP review, the Wind II project location is within the actual habitat of the Eastern Box Turtle which is a state-listed Species of Special Concern. MESA regulations prohibit the "take" of state-listed species (321 CMR 10.01); therefore, the proposed project must be conditioned appropriately to avoid a prohibited "take" of state-listed species. Eastern Box Turtles are attracted to construction sites during the spring and summer nesting seasons because of the open sandy conditions. To avoid the direct harming or killing of turtles, NHESP requires one of the following conditions to be adhered to during the work:

1. Option #1: The proposed work shall only be conducted between November 1st and April 15th, the turtle inactive season.
2. Option #2: If work will occur during the turtle active season, turtle-excluding fencing must encircle the work area and shall be installed before May 1st. NHESP must approve the proposed fence layout prior to installation, and an NHESP approved biologist shall conduct turtle sweeps throughout construction. After construction is complete, site stabilization is achieved and work with heavy machinery is complete, the fencing must be removed and trenches backfilled to not impact wildlife movement.

Regional Permitting
Existing Wind II is not subject to regulation or permitting by the Cape Cod Commission.

Converting Wind I to a Wireless Communication Tower
It is technically feasible to use the tower of Wind I as a wireless communication tower. Antennas are easily attached to many similar structures. Presumably the wind turbine blades, generator, gearbox (entire nacelle) and other internal components integral to the turbine operation would be removed from the tower and the top of the tower would be modified (weatherized) to prevent wind, rain and animals from entering the structure. The top of the tower would likely have a steel plate bolted to cover the opening, or possibly converted to an observation deck or osprey nesting box. The turbine components could be stored and used for spare parts for the other turbine or sold to interested third parties.

The CCC considered wireless communication towers in excess of 35 feet, or monopoles in excess of 80 feet a DRI threshold and therefore, the project would have to be referred to the CCC for DRI review if there is an intent to convert Wind I into a wireless communications tower. There would have to be a need from a wireless communication service provider, or similar user, to improve service in the area with the willingness and desire to enter into an agreement to pay the Town for the use of the monopole structure.

Local Permitting
The parcel acquired from the Steamship Authority, Parcel 4 on LC Conf. Plan 39284A containing 8.86 acres, is held by the town as municipal property. The title reference is Book 28278, Page 156. It is subject to the zoning bylaws of the town, with no other restrictions of record. The wastewater treatment plant is identified as Lot 12 and Lot 16 as shown on LC Plan 31976D. The title reference is Certificate 81906. It is subject to the zoning bylaws of the town.

The Conservation Commission has no record of any conservation restrictions. The town GIS system has no identified areas of restricted use in its database. The certificate of title shows two encumbrances. The first is a Planning Board covenant from 1980, doc. 266,523, which relates to a subdivision which was never built. The second is a notice of the Division of Fisheries and Wildlife that the site is mapped Priority Habitat of the Eastern Box Turtle (*Terrapene carolina)*. The notice focusses on sand beds 14 and 15 but describes "the property" as both the SSA parcel and the wastewater treatment plant parcel.

The Town of Falmouth Zoning Bylaw § 240-166, governs the use of wind turbines. Wind energy systems are allowed with limitations, by Special Permit issued by the Planning Board. The bylaw limits the size of new wind turbine projects to 250 kW; therefore, Wind II would not be permitted under the Town of Falmouth Zoning Bylaw § 240-166 as a new project. Section 240-166D provides that any wind energy system lawfully in existence as of the effective date of this article [adopted in 2013] shall be considered conforming "and may apply for a special permit under this article to … re- locate …." Given Wind II was constructed prior to adoption of the new bylaw, the Special Permit Granting Authority would be the deliberative body to act on an application for a Special Permit to relocate the Wind II under Section 240-166D of the town bylaw.

The project may be subject to review under the Wetlands Protection Act if the project is to be located within a jurisdictional wetland or within the buffer zone of any jurisdictional wetland, bordering vegetative wetland, vernal pools, regulated perineal or intermittent streams or rivers. Based on review of the MassDEP GIS database, there are two small wetland areas on the site: one located in the north-central area of the parcel, and one located near the eastern parcel line. The local Conservation Commission would be consulted if any part of the project was to be located within or close to these areas. Prior to construction, a wetlands survey should be conducted (or at least within the last 3 years) to determine if the project would be located in a wetlands protection area. If the project is not located in a protected area, then a Request for Determination of Applicability (RDA) could be filed with the local Conservation Commission for a written determination as confirmation.

2.2 Siting Considerations

A location which affords the greatest buffer distance between the turbine and nearest residential abutters is the underlying purpose of this assessment and should be of primary consideration. Evaluation of an alternate location for Wind II within the 329-acre parcel would consider required setbacks from property boundaries, which is a minimum of the structure height, plus 10%. This ensures that abutters land and property is protected from damage due to a sudden collapse of the structure. The next consideration should be elevation that also provides the maximum distance buffer from the nearest residential property, where the highest areas generally afford the greatest access to the available wind resources. Accessibility to existing roads and electric utility, amount of clearing and grading needed to support construction are also important factors.

2.3 Alternate Turbine Location AL-1

Given the siting considerations one location onsite was considered. This alternate location called AL-1 is at an elevation of approximately 120 feet AMSL, situated in the northeastern area of the site parcel. The effective ground elevation of 110 feet is estimated once the site clearing and grading have been achieved, as the existing high point is a rather small area which would likely be leveled flat using the high points to fill the lower areas using the onsite cut. The location meets the zoning setback requirements from the nearest parcel boundary and does not appear to encroach into any existing wetland protection areas.

AL-1 would require clearing a minimum of approximately three acres of land and extending the existing electrical and communications service from the present location of Wind II. The distance of Wind II to AL-1 is approximately 2,400 feet. The location of AL-1 is approximately 2,147 feet from the nearest residential receptor to the north and approximately 2,244 feet from the nearest residential areas located south along Blacksmith Shop Road. The location of AL-1 is depicted on Figure 5, Wind II Relocation Site Plan and Figure 6 depicts the nearest residential receptors to AL-1.

3.0 ESTIMATED SOUND AND FLICKER IMPACTS

Based on the alternate location, it is possible to estimate the likely impacts of sound and shadow flicker from the turbine on the surrounding area. We have assessed the likely sound impacts of relocating Wind II to location AL-1. Given the vast amount of study and data collected during prior studies, it is useful to apply the results to the alternate turbine location, given that the characteristics of the turbine are the same and site characteristics in terms of topography, vegetative cover and surrounding area are also virtually the same.

3.1 Sound Impacts

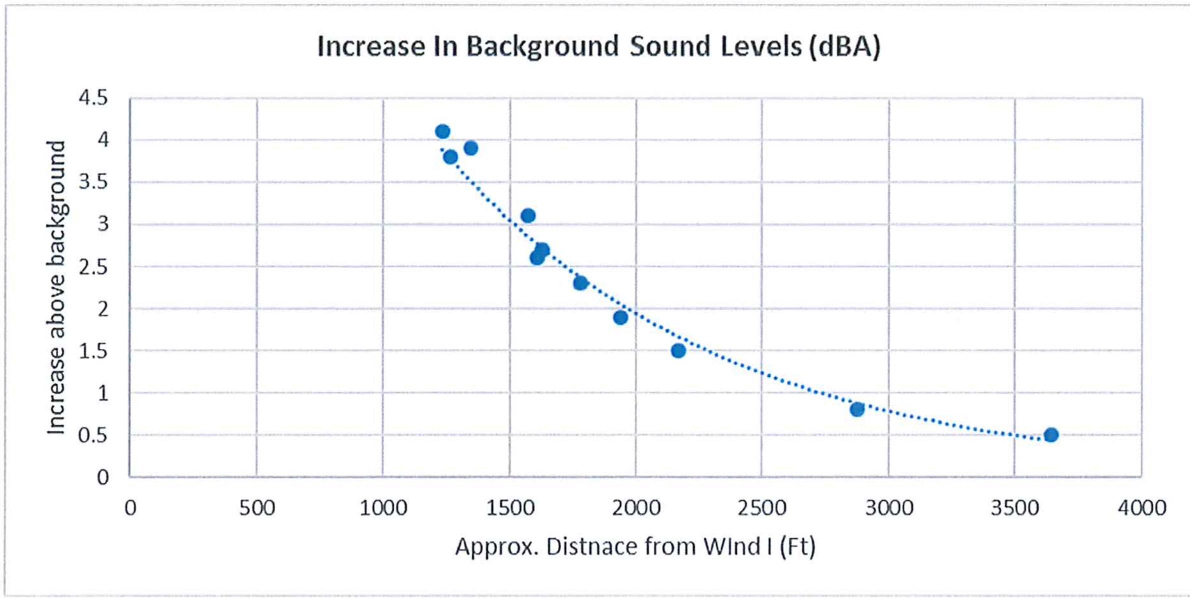
Based on the abundance of available data collected from various studies of the wind turbine sound impacts, we have estimated the likely sound increases. We have taken a simplified approach and used data collected from long and short-term measurement sites by HMMH (HMMH, 2010) during operation of Wind I only, during low (4 meters per second) wind conditions, which most closely represents the "worse-case" increases in background sound levels.

We plotted the values calculated by HMMH for increased background sound level versus the distances the measurements were from the source. A total of 11 measurement sites were collected at various distances from the sound source (Wind I), with only one turbine in operation. The best fit curve can then be used to estimate the increase in sound levels at various distances. A summary of the measurement data and increase in background level are given in the table below:

Table 2
Summary of Wind Turbine Sound Measurements
(HMMH, 2010)

Sound Test Site Location Name	Approximate Sample Distance (feet) from source (Wind I)	Increase In Sound Levels Above Background (dBA)
LT-1	1,347	3.9
LT-2	1,939	1.9
PL-1	1,235	4.1
PL-2	1,264	3.8
PL-3	1,609	2.6
PL-4	2,878	0.8
PL-5	1,629	2.7
ST-1	1,777	2.3
ST-2	1,574	3.1
ST-3	3,643	0.5
ST-4	2,164	1.5

A graph of the sound measurements is provided below. From this graph, we can estimate the likely sound impacts at various distances from the turbine. From prior sound studies, we know that background sound levels increase naturally with wind speed as increased noise is created by wind moving through trees, around buildings and other objects. The estimate of increase in background sound uses a simplified approach that does not involve acoustical modeling that might take into consideration changes in topography or terrain; however, it is based on actual sound measurements and is considered representative of the maximum increases in background sound level during the quietest time periods of the day.



Increase in Sound vs. Distance

3.2 Shadow Flicker Impacts

Shadow flicker is the phenomenon of shadows being cast as the blades rotate, intermittently blocking the sun when the blades are in between the sun and the viewer (receptor). The occurrence of shadow flicker is easily predicted by modeling, based on the height of the turbine, length of the blades, topography, position on the turbine and predictability of the Earth's rotation and orbit around the Sun. The amount of flicker is typically given in maximum hours possible per year given the presumption that every day is bright full sunshine and there are no objects between the receptor and the turbine.

The prior modeling done for this site yielded a predictable "bow tie" shaped flicker pattern that is produced centered just north of the turbine. The concentric bands represent lines of equal hours per year, which diminish as the receptor is moved outward from the turbine. Shadows, even on the brightest of days, also become more and more diffused with distance. The geometric shape created by the model is given in Figure 6. The outlines of the model shape can be superimposed to provide an estimate of the shadow flicker impacts from an alternate turbine location. Some variation due to topography and tree cover should be expected, however, it is a reasonably accurate estimate of the potential impact area given the height of the turbine and similarity in terrain and elevation.

4.0 ESTIMATED WIND RESOURCE

4.1 Methodology and Data Sources

The following section presents an assessment of the expected wind resources based on available published wind data and MET tower data collected at the Site over a 4.5-year period from 2011 through 2015. Meteorological data from an on-Site MET tower was collected through an anemometer located at a height of 45 meters above ground level. A summary of the wind speed sensor data is presented in the table below.

Table 3
Summary of Wind Speed Senor Data

Variable	Value
Start date	6/1/2011 15:40
End date	12/7/2015 18:10
Duration	4.5 years
Length of time step	10 minutes
Calm threshold	0 m/s
Mean temperature	14.8 °C
Mean pressure	100.9 kPa
Mean air density	1.219 kg/m³
Power density at 50m	n/a

4.2 Description of On-Site Wind Resource

The on-site wind measurement program was conducted from June 2011 to December 2012. Below is a table containing the summary of the on-site wind data.

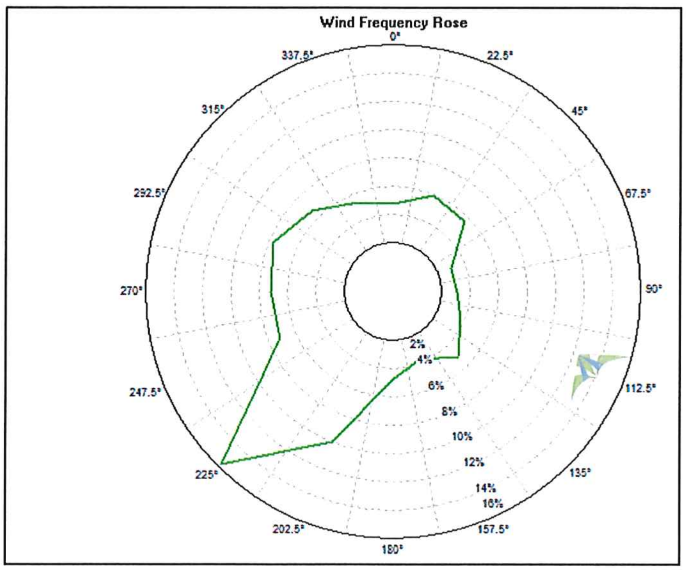
Table 4
Summary of On-Site Wind Data

Variable	T02_Avr.wind speed 2,m/s (3)
Measurement height (m)	80
Mean wind speed (m/s)	6.337
MoMM wind speed (m/s)	6.354
Median wind speed (m/s)	6.000
Min wind speed (m/s)	0.000
Max wind speed (m/s)	22.000
Weibull k	2.294
Weibull c (m/s)	7.155
Mean power density (W/m²)	264
MoMM power density (W/m²)	266
Mean energy content (kWh/m²/yr)	2,311
MoMM energy content (kWh/m²/yr)	2,331

Table 4 Summary of On-Site Wind Data	
Variable	T02_Avr.wind speed 2,m/s (3)
Energy pattern factor	1.699
Frequency of calms (%)	0.07
Possible records	237,615
Valid records	202,161
Missing records	35,454
Data recovery rate (%)	85.08

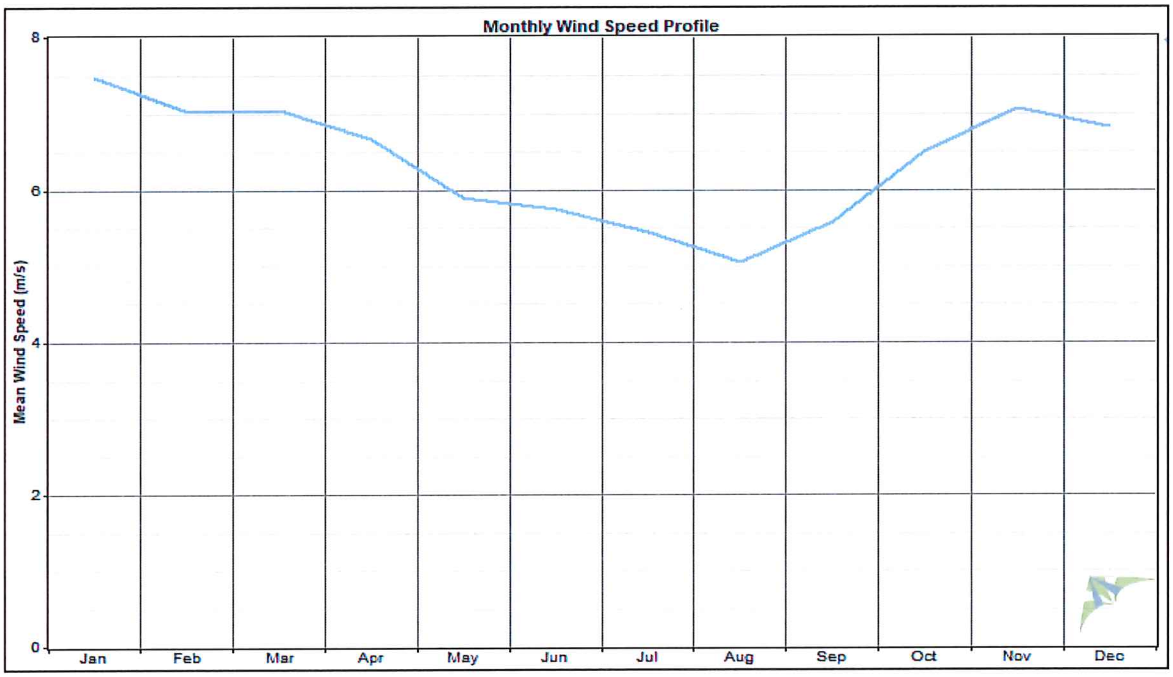
A copy of the Wind Data Report is included in Appendix B.

Weston & Sampson examined the measured wind speed and directional data using commercially available computer software (Windographer and WindPRO) to produce standard statistical wind metrics. A wind rose illustrates graphically the wind direction frequency from the sensor height mounted at 45 meters.



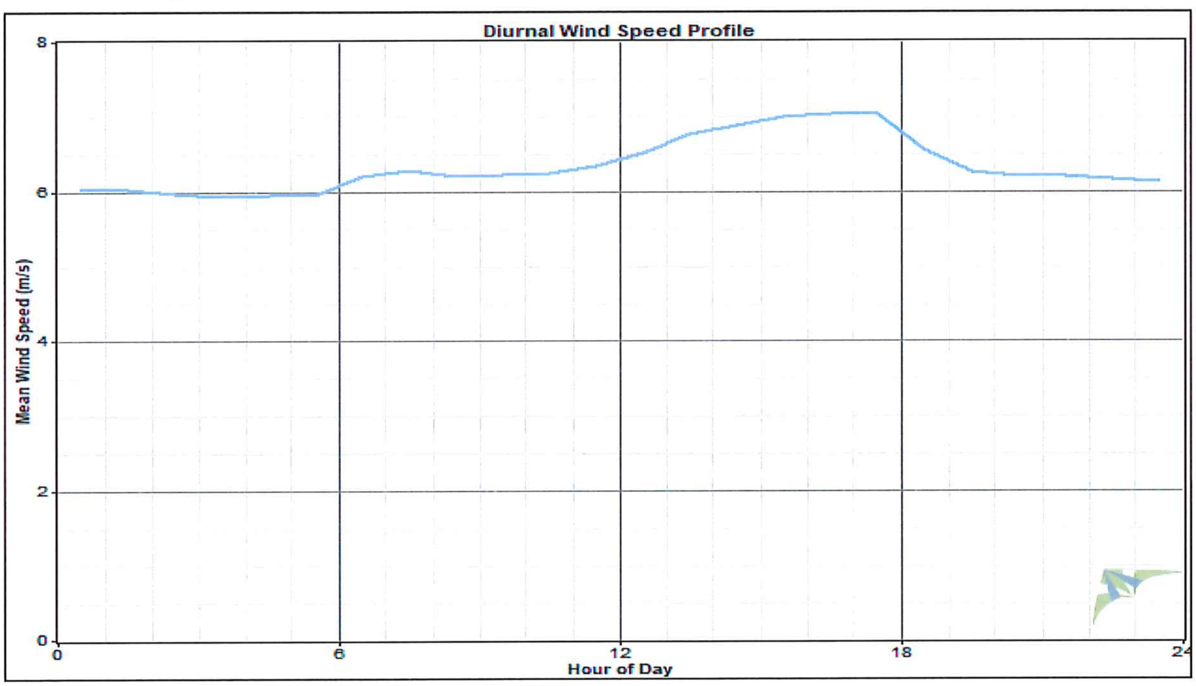
Wind Rose

The monthly wind speed profile for the Site is similar to other locations in Massachusetts, where the average wind speeds are greatest during the winter months and lowest during the summer months. A graph of the monthly wind speed profile for the wind sensor is given below:

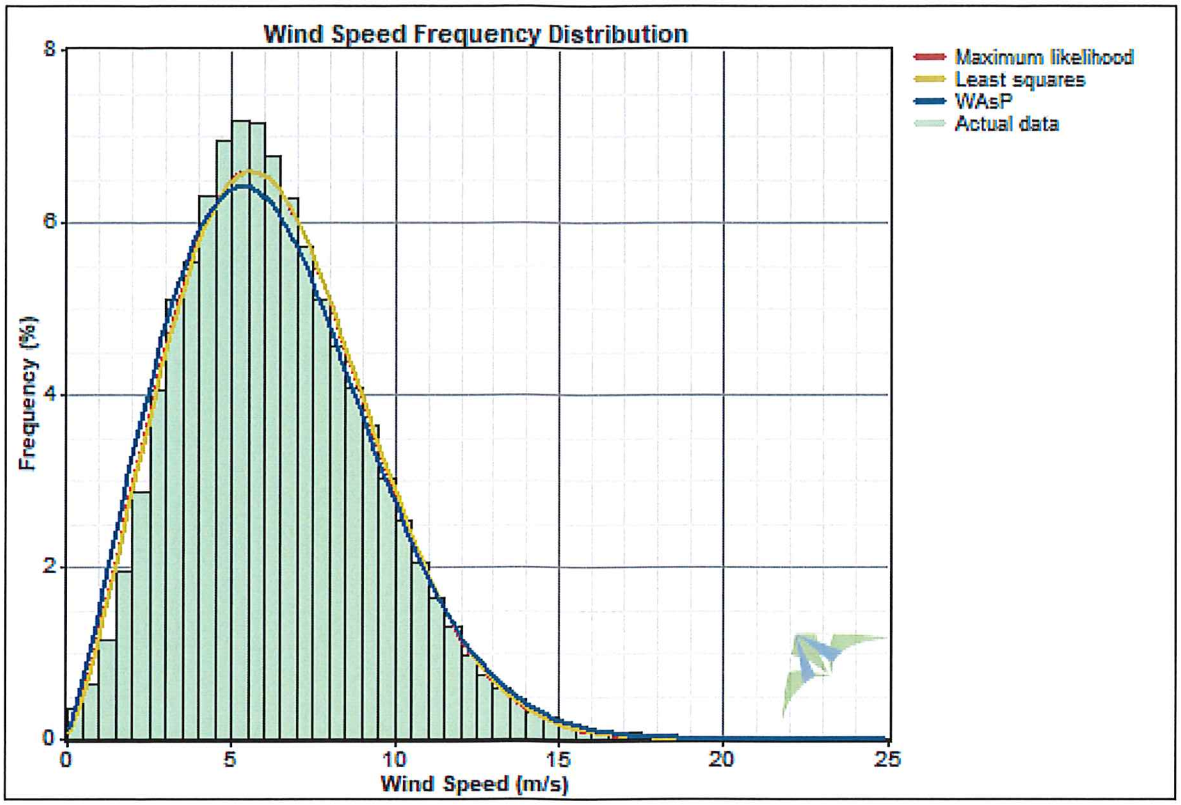


Monthly wind speed profile

There are also predictable diurnal wind speed patterns, where the higher average wind speeds occur between 11:00 and 16:00 on a daily basis and tend to diminish in the evening and are lowest on average during the early morning hours around 06:00 hours. The diurnal wind speed and wind speed frequency distribution is given below.



Diurnal wind speed profile



Wind Speed Frequency Distribution

Wind shear refers to the change in wind speed with height above the ground. The wind speeds tend to increase with height above ground. The variation in the wind speed with height above ground is referred to the as the "wind shear profile." In the field of wind resource assessment, two mathematical relations are generally used to characterize the wind shear profile: a logarithmic profile or log law and the power law profile or power law. The vertical wind shear profile provides a method of extrapolating measured wind speeds at known reference heights, to greater hub heights.

4.3 Obstruction and Their Impact on Wind Resources

Nearby physical obstructions, such as trees, buildings, structures and topographic features can disrupt wind flow and have a negative effect on wind turbine performance. Siting of the turbine away from these objects is desirable. The location of AL-1 modeled for the wind turbine is located away from existing buildings, however there are existing trees in this vicinity. The elevation of this area is approximately 120 feet above mean sea level, near the highest are elevation on and around the site and would provide for the most unobstructed access to the wind at the site.

4.4 Impact on Energy Production

The wind power class is a number indicating the mean energy content of the wind resource. Wind power classes are based on the mean wind power density at 50 meters above ground. The degree of certainty with which the wind power class can be specified depends on three factors: the abundance and quality of wind data; the complexity of the terrain; and the geographical variability of the resource.

The impact on wind turbine energy production as a result of relocating the existing Wind II to Alternate Turbine Location AL-1 is expected to be minimal. The ground elevation at the existing location is 131 feet. The ground elevation at AL-1 is 110 feet. A wind turbine energy production estimate was modeled for the alternate location AL-1. This estimate indicates that annual energy production could be on the order of 3,511,274 kWh per year at the alternate turbine location. This is in the same expected range of energy production for the current Wind II turbine.

5.0 OPINION OF PROBABLE CONSTRUCTION COST

One of the main objectives of this analysis was to develop an opinion of probable construction cost for relocating Wind II. The cost was developed based on schedule of value information from prior contracts and cost estimates from informal queries of several contractors and service providers with experience completing similar projects. The Town of Falmouth has already completed two exceptionally similar projects in procuring and constructing two Vestas V-82 1.65 MW wind turbines at the WWTF. Both projects used the same make and model wind turbine, using the same size 80-meter tall steel tubular tower, with nearly identical foundation systems and underground cabling, etc. Each Wind I and II were procured through an open and public competitive bid process and completed in 2010 and 2012, respectively; therefore, the analysis of the probable cost begins with data from these two projects.

5.1 Review of prior wind project costs

The total final contract values for Wind I and Wind II were very similar $4,365,933 and $4,330,606, for essentially the same project, using the same turbine, delivered to the same location in Falmouth, MA. The balance of plant basically represents all other work involved with constructing both projects and is similar in nature to the work that is contemplated in relocating one of the wind turbines on the same site, excluding some of the permitting, geotechnical, design and dismantling requirements that would be necessary; but similar nonetheless for comparison purposes here. A summary of the prior wind turbine projects is given below:

Table 5
Summary of Prior Wind Turbine
Project Contract Values

Description	Wind I	Wind II
Completion Date	2010	2012
Original Contract Value	$ 4,332,000	$ 4,288,500
Change Orders	$ 33,933	$ 42,106
Total Contract Value	$ 4,365,933	$ 4,330,606
Wind Turbine (capital cost)	$ 2,800,000	$ 2,546,150
Balance of Plant	$ 1,565,933	$ 1,784,456

The balance of plant project costs provides an initial estimate of the value or cost of the proposed relocation project costs. Further review of the balance of plant schedule of values from the prior completed projects to identify other similar project features is appropriate, as well as identification of other project costs. The relocation project would have similar civil site work requirements as the prior wind turbine projects. The major civil site work includes: the clearing, access road and earthwork to improve ground such that it is suitable to support the large crane. The crane is required for turbine erection; foundation installation; and extending underground electric and communications duct bank to the new turbine location.

5.2 Geotechnical, Engineering Design, and Permitting

A soil exploration would be required for roadway and foundation design. Additional engineering design and survey is required for stormwater, grading, roadways, crane pad, fencing, and other site features for permitting. Permitting would include Planning Board, NHESP, MHC, FAA, Conservation Commission, building and electrical approvals. The Special Permit required from the Planning Board is a discretionary permit and therefore it may be prudent to perform only those tasks which are required in order to seek approval for this permit before investing in additional survey and design work. Based on the value of the work, the project would have to be publicly advertised for bid.

The geotechnical, engineering design, and permitting is estimated to cost on the order of $200,000.

5.3 Civil Site Improvements

Use of the existing access roads on site could be used to the greatest extent possible, with clearing, embankment and subgrade improvements made where needed. The proposed relocation spot for Wind II is some 2,400 feet from its current position on site, requiring 2,400 feet of underground electrical duct bank, three acres of tree clearing, 1,200 linear feet of new access roads and embankments, plus ground improvements required for crane pad and construction staging. The civil site work would also include installation of temporary and permanent erosion and sedimentation control and any needed stormwater drainage features, clearing of trees, grubbing of soil for the removal of organic materials from the topsoil, installation and compaction of subgrade and embankment materials and finished grading of final cover systems. Figure 5 provides a conceptual layout for Wind II turbine relocation plan.

The civil site work is estimated to cost on the order of $350,000.

5.4 Structural Site Improvements

A similar wind turbine foundation as used in Wind I and II is expected to be suitable for the alternate location. A geotechnical investigation must be done in the proposed location to verify soil conditions and provide data required for foundation design. The exiting turbines utilize a patented proprietary tensionless pier foundation design developed by Patrick & Henderson (P&H) to provide structural support for the wind turbines. The foundation systems are approximately 32-feet deep "ring beam" consisting of stay-in-place corrugated metal pipes that are 10 feet in diameter to form the inner ring and 14 feet diameter to form the outer ring of the concrete pier. A series of 32-foot long post-tensioned anchor bolts are set inside the rings to ensure the concrete that comprises the pier remains in compression, even when the structure is subjected to extreme wind loads. A one-foot topping slab covers the pier foundation system.

The installed cost of the wind turbine foundation system is on the order of $850,000.

5.5 Electrical and Communications Installation

An underground duct bank of electrical and communications wiring are used to connect the turbine to the electric grid and control its operation. The primary power cabling for the turbine would call for 25 kV class wire installed within two four-inch conduits, extending the line from the pad-mounted transformer location to the new transformer location. There would be two new two-inch conduits installed for communications of the turbine controllers and direct transfer trip used by the utility. Secondary cabling is needed from the transformer to the base of the new turbine foundation. Setting and wiring of pad mounted equipment, manholes used pull poxes at regular intervals along the conduit duct bank and other miscellaneous items, such as concrete covering (in roadways) and site restoration are also expected.

The cost of the electrical and communications work is on the order of $415,000.

5.6 Rigging to Dismantle, Move and Erect Turbine

A 300-foot tall crawler crane is needed to dismantle and erect the turbine. A smaller helper crane is used to assist and assemble the larger crane, which is delivered to the site in multiple pieces. It takes about one week to assemble a crane of this size to perform the work. The crane may be capable of traversing the access road from the location of Wind II to AL-1, if the road is designed wide enough to accommodate the assembled crane. If not, the crane would likely need to be at least partially disassembled and then re-assemble to erect the turbine in the new alternate location. There will be specialized delivery equipment needed to move the turbine components from one location to the other on site.

The cost of the rigging to dismantle, move and reassemble Wind II on site is on the order of $1,060,000.

5.7 Balance of Plant

There are costs for developing bid documents, surveying, testing and inspection. Additional costs should be carried for contingencies and unexpected site conditions. There could also be costs for additional detailed studies for sound, sightlines, legal support which may be required or otherwise requested.

The cost of the balance of plant is on the order of $150,000.

The overall probable cost to relocate Wind II to AL-1 is on the order of $3,025,000.

Table 6
Summary of Probable Cost

Description	AL - 1
Geotechnical, Design and Permitting	$200,000
Civil Site Improvements	$350,000
Structural Site Improvements	$850,000
Electrical and Communications Installation	$415,000
Rigging to Dismantle, Move and Erect Turbine	$1,060,000
Balance of Plant	$150,000
TOTAL	$3,025,000

A more detailed estimate of probable cost for these items is included in Appendix C.

6.0 PROJECT ECONOMICS

6.1 Cost and Benefit Analysis

A cost benefits analysis was conducted using updated project information to evaluate the relocation of Wind II within the wastewater treatment facility property. The cost to benefit ratio is a standard economic figure of merit used to analyze the financial value of the project. This analysis does not attempt to recreate the past work done in this area by Sustainable Energy Advantage, Inc. (SEA, 2014), and Weston & Sampson (WSE, 2012) where financial implications of operating Wind I and Wind II under varying curtailment scenarios and increasing electrical loads were evaluated. Suffice to say that limiting the operational hours of any wind turbine has a significantly negative impact on the financial performance of the project. The findings of the prior economic studies suggest that limiting turbine operation creates a negative net present value, a benefit-cost ratio of less than 1.0 and costs more money to own than the turbine can produce under many of scenarios where the turbine(s) are limited at 32% of the time or more. It is noted that an identical Vestas V-82 model wind turbine has been permitted and operating on a 24/7 basis on an adjacent parcel for multiple years (Webb turbine).

6.2 Updated Economic Analysis

For a wind energy project of this nature, the viability is generally based on the wind resource, the value of the energy created (or displaced) and the capital cost of the project. In this analysis, we considered a wind resource probability of 90% (P90) and the historical values from the actual turbine operation in Falmouth (without curtailment). Given the average wind speed of 6.4 m/s at an 80-meter hub height and historical data, the wind turbine should produce on average approximately 3,517 MWh of electricity per year. It should be noted that a lower probability, P50 for example, would result in a higher expected wind speed average, and thus higher expected turbine output. A variety of risk tolerances and variables can be considered as part of any economic analysis. Predicting future values of energy prices, values of related commodities such as RECs, and future costs to operate and maintain the turbine, has inherent uncertainty.

6.3 Financial Figures of Merit

One industry-standard economic metric for a wind turbine project is the net present value (NPV). The NPV can be defined as the present value of the initial investment, plus all future cash flows. For a wind turbine, cash flows are evaluated over the useful life of the equipment, usually 20 years, but sometimes 25 to 30 years, depending upon the manufacturer and care taken during the maintenance of the equipment. Naturally, the cost of operation and maintenance increases with age of the equipment.

Another useful measure is a time-adjusted benefit-cost ratio (BCR). The BCR is the present value of cash inflows divided by the present value of cash outflow. An investment which has BCR which is greater than 1.00 predicts a positive return on the investment and anything less than 1.00 costs more than the benefit of the investment. A project with a BCR of 1.00 is considered breakeven.

The Internal Rate of Return (IRR) is also used to judge the economic merits of an investment. If the IRR exceeds the opportunity cost of capital, the investment is attractive. If the IRR equals the cost of capital, the investment is marginal. The IRR is a capital budgeting metric typically used by private firms to decide whether they should make investments. It is an indicator of the efficiency or quality of an investment, as opposed to net present value (NPV), which indicates value or magnitude. The IRR is the annualized effective compounded return rate which can be earned on the invested capital, i.e., the yield on the investment. A project is a good investment proposition if its IRR is greater than the rate of return that could be earned by alternate investments of equal risk (investing in other projects, buying bonds, even putting the money in a bank account). In general, if the IRR is greater than the project's cost of capital, or hurdle rate, the project would add value for the Town. Formally, the IRR of an investment is equal to the discount rate at which the investment's NPV equals zero (Higgins, 1998). Both IRR and Simple Payback assumes that the investment is paid for up front with cash. If there is debt brought to complete the project, such as a general obligation bond, these figures of merit simply do not apply. It is often useful to examine IRR and Simple Payback if the project was built with cash, as a point of comparison.

Project cash flow is based upon the amount of retail power which can be off-set by the turbine, sale of any excess energy which may be produced and the sale of renewable energy certificates (REC) which have a marketable value. The amount of retail power which can be off-set is also a function of coincidence factor. The coincidence factor, a measure of the percentage of time power is being created and used on the site at the same time, in that the value of electricity is instantaneous. If energy is not being used when it is produced, then it is net metered and sold back to the grid. We have reviewed and used current values for energy, operation and maintenance based on the current age of the asset. A summary of the recent annual energy use at the WWTF is provided as follows:

Table 7
Falmouth Wastewater Treatment Facility
Eversource Electric Bill: 9/29/2018
13-Month Billing History
Account 5119548

Bill Date	Peak (kWh)	Low A (kWh)	Low B (kWh)	Total (kWh)	Demand (kW)
8/27/2018	28,971	16,855	54,494	100,320	254
7/27/2018	31,452	18,860	52,048	102,360	272
6/27/2018	28,942	16,307	47,151	92,400	288
5/29/2018	27,630	15,386	48,904	91,920	243
4/27/2018	29,109	17,330	49,441	95,880	235
3/28/2018	19,346	20,178	46,156	85,680	236
2/27/2018	13,826	29,463	48,751	92,040	189
1/29/2018	14,919	32,133	56,268	103,320	220
12/27/2017	13,421	29,667	45,952	89,040	190
11/28/2017	17,219	26,975	52,046	96,240	211
10/27/2017	28,837	16,135	44,668	89,640	241
9/27/2017	29,377	16,088	43,575	89,040	244
8/28/2017	32,685	17,933	56,662	107,280	287
Average	24,287	21,024	49,701	95,012	239
Annual	283,049	255,377	589,454	1,127,880	288

The recent energy data was used to estimate the value of the retail energy credits and net metering credits based on the current rate structure, and is given in the table below:

Table 8 Falmouth Wastewater Treatment Facility Account 5119548				
Existing Power Use and Cost Basis:		Rate 5084	Demand	372 kW
Description	Units	Rate	Month	Annual
Customer Charge	month	$ 370.00	$ 370.00	$ 4,440.00
Distribution Demand	kVA	$ 1.510000	$ 383.54	$ 5,218.56
Transmission Demand	kVA	$ 8.160000	$ 2,072.64	$ 28,200.96
Distribution Peak	kWh	$ 0.025710	$ 744.84	$ 7,277.19
Distribution Low A	kWh	$ 0.022900	$ 385.98	$ 5,848.13
Distribution Low B	kWh	$ 0.017670	$ 962.91	$ 10,415.65
Transition Peak	kWh	$(0.000610)	$ (17.67)	$ (172.66)
Transition Low A	kWh	$ (0.000610)	$ (10.28)	$ (155.78)
Transition Low B	kWh	$ (0.000610)	$ (33.24)	$ (359.57)
Transmission Peak	kWh	$ 0.002770	$ 80.25	$ 784.05
Transmission Low A	kWh	$ 0.002770	$ 46.69	$ 707.39
Transmission Low B	kWh	$ 0.002770	$ 150.95	$ 1,632.79
Renewable Energy	kWh	$ 0.000500	$ 50.16	$ 563.94
Energy Efficiency	kWh	$ 0.007800	$ 782.50	$ 8,797.46
Basic Service	kWh	$ 0.102940	$ 10,326.94	$116,103.97
Primary Service Discount (3%)		3%	$ (167.98)	$ (2,062.74)
Primary Metering Discount (2%)		2%	$ (111.99)	$ (1,375.16)
Total Electric Cost		0.15965	$ 16,016.24	$185,864.18
Estimated Value of Retail Offset		$ 0.15965	kWh	
Estimated Value of Net Metering Credit		$ 0.12861	kWh	

6.4 Financial Modeling Variables

The economic modeling herein assumes that the relocation project will be paid for with a general obligation bond with no penalties or repayment demands of the original America Recovery and Reinvestment Act (ARRA) grant used to finance the original Wind II project. The project grant was administered by the MassDEP Water Abatement Trust (now re-named the Massachusetts Clean Water Trust) under the assumption that the project would be a useful renewable energy project that would be a financial benefit to the Town of Falmouth. Simple payback estimates, as the name implies, generally do not consider the time value of money or scenarios where debt is used to finance the project. It also does not consider inflation and is simply based on the full year average net revenue divided by the project cost. The cost estimates do not include the cost of decommissioning, nor do they include the residual value of the installation. In this case, these figures are assumed to be of equal value and therefore would have a net zero impact on the analysis.

In order to perform an economic analysis for the alternatives presented, the benefits and costs of the project were evaluated. The project costs include costs for design and permitting, installation and interconnection, operation and maintenance, insurance and estimated legal expenses, which are summarized herein. The benefits of the project include the value of offset retail energy purchases, net metering credits and sale of Class I renewable energy certificates. The value of the avoided cost was calculated based on the sum of the estimated value of default service, distribution, transmission and transition kilowatt-hour charges. The value of the sale of Renewable Energy Certificates (REC) was estimated in the short term at $25 per MWh. The cost and benefits are normally estimated over the useful life of the project and are then factored into a simple economic model (discounted cash flows) which estimates the Net Present Value and other financial metrics described above. For this study, we have modeled the cost and benefits using a bond term of 20 years at 4% and an energy escalation value of 3.5%. The Green Communities Act of 2008 suggests an energy escalation rate of 3.5% for estimating the value of energy efficiency or renewable energy project and our own research has suggested the average retail electricity prices in MA have an approximate 30-year average increase of 3.5%.

To estimate values of REC, we reviewed New England Power Pool Generator Information System (NEPOOL GIS) data, for recent (2017) Alternative Compliance Payment (ACP) Rates for the six Renewable & Alternative Energy Portfolio Standards (RPS & APS). The ACP Rates for Massachusetts RPS and APS published February 1, 2017 included the following:

- RPS Class I = $67.70 per MWh
- RPS Class I Solar Carve-Out = $448.00 per MWh
- RPS Class I Solar Carve-Out II = $350.00 per MWh
- RPS Class II Renewable Energy = $27.79 per MWh
- RPS Class II Waste Energy = $11.12 per MWh
- APS = $22.23 per MWh

The wind turbine would be eligible to produce and sell Class I REC for sale into the market, which would provide revenue to the Town. Historically, the Class I REC rates for the wind turbine generation have ranged from $25 to $40 MWh. Based on the ACP data, we have used $40 MWh for the near term (Year 1 to 10) and $25 for the long (Year 11- 20) forecast in the financial model. The table below provides a summary of the economic model variable assumptions:

Table 9
Economic Model Variable Input

Project Term	20 years
Project Cost	$3,025,000
Value of Net Metering Credit	$128 MWh
Value of Renewable Energy Certificates	$25 MWh
Discount/Loan Rate	4.0%
Interest Rate on Principal Debt, if applicable	4.0%
Operation and Maintenance	$40 kW
Energy Escalation Rate	3.5%
Inflation Escalation Rate	2.0%

6.5 Financial Modeling Results

The analysis suggests that the proposed project to move Wind II is financially attractive with a substantially positive Net Present Value of $5,789,652 and a benefit to cost ratio of 2.21. The 20-year net cash flow is estimated to be $8,952,415. This is reasonably expected, where the capital cost of the wind turbine was provided in the form of an ARRA grant and assumes that the turbine is expected to be allowed to operate without any scheduled curtailment (as is the case with an identical Vestas V-82 model wind turbine which has been operating on an adjacent parcel for multiple years). If the project was paid for in cash, the IRR would be on the order of 23.3% with a simple payback of five years. A summary of the modeling results with input variables used in the analysis is provided below:

Table 10 Modeling Input Variables		
Wind Turbine	Vestas V-82	Units
Turbine Size	1,650	kW
Capacity Factor	24.3%	
Tower Height	80	meters
Average Wind Speed	6.4	m/s at 80 m
Project Term	20	years
Annual Energy Production	3,516,658	kWh
Estimated Project Cost	$3,025,000	
Financing Method	General obligation bond	
Bond Rate	4.0%	
Energy Inflation	3.5%	
General Inflation	2.0%	
Annual Energy Use	1,127,880	kWh/year
Value of Retail Off Set	$0.1597	kWh
Value of Excess Power	$0.1286	kWh
REC value Y1-Y10	$0.0400	kWh
REC value Y11-Y20	$0.0250	kWh
Coincidence factor	100.0%	
O&M ($/kW)	$42.50	
20-Y Energy Production	70,333,164	kWh
Financial Results		
Unit Cost of Energy	$0.10	kWh
Net Present Value	$5,789,652	
Net Cash Flow	$8,952,415	
Present Value Benefit	$10,577,693	
Present Value Cost	$4,788,041	
Benefit Cost Ratio	2.21	
Internal Rate of Return	NA	%
Simple Payback	NA	years
Residual Value	$0	

We note that small changes in projected energy rates and using more conservative energy escalation rates can have a rather significant impact on the financial performance and figures of merit when examining the performance over the 20-year term of the project. For example, if energy rate escalates at only 1.5%, instead of 3.5%, the NPV of the project is reduced by $1.4M (from $5.7M to $4.3M); however, even if the price of energy escalates only at 0.5%, the project is still substantially positive and financially attractive. A summary of results to an energy inflation sensitivity is presented below:

Table 11
Energy Inflation Sensitivity Analysis

Figure of Merit	3.5%	2.5%	1.50%	0.50%
NPV	$5,789,652	$5,026,163	$4,344,963	$3,736,576
Net Cash Flow	$8,952,415	$7,619,669	$6,439,948	$5,394,933
Present Value Benefit	$10,577,693	$9,814,204	$9,133,005	$8,524,617
Present Value Cost	$4,788,041	$4,788,041	$4,788,041	$4,788,041
Benefit Cost Ratio	2.21	2.05	1.91	1.78

A review of the year over year project costs and project expenses is expected to produce net annual cash flows ranging from $295,808 to $642,533. Year over year project benefits are summarized below:

Table 12
Project Benefits

Year	Value of Retail Offset	Net Metering Credit	Sale of RECs	Annual Revenue
1	$180,068	$307,221	$140,666	$627,955
2	$186,370	$317,973	$140,666	$645,010
3	$192,893	$329,103	$140,666	$662,662
4	$199,644	$340,621	$140,666	$680,932
5	$206,632	$352,543	$140,666	$699,841
6	$213,864	$364,882	$140,666	$719,412
7	$221,349	$377,653	$140,666	$739,668
8	$229,096	$390,871	$140,666	$760,633
9	$237,115	$404,551	$140,666	$782,332
10	$245,414	$418,710	$140,666	$804,791
11	$254,003	$433,365	$87,916	$775,285
12	$262,893	$448,533	$87,916	$799,343
13	$272,095	$464,232	$87,916	$824,243
14	$281,618	$480,480	$87,916	$850,014
15	$291,475	$497,297	$87,916	$876,688
16	$301,676	$514,702	$87,916	$904,295
17	$312,235	$532,717	$87,916	$932,868
18	$323,163	$551,362	$87,916	$962,441
19	$334,474	$570,659	$87,916	$993,050
20	$346,180	$590,632	$87,916	$1,024,729

Year over year project costs are summarized below:

Table 13 Project Costs					
Year	Principal	Interest	O&M	Administrative, Legal, Insurance	Total Annual Cost
1	$101,585	$121,000	$70,125	$39,438	$332,147
2	$105,648	$116,937	$71,528	$40,226	$334,339
3	$109,874	$112,711	$72,958	$41,031	$336,574
4	$114,269	$108,316	$74,417	$41,851	$338,853
5	$118,840	$103,745	$75,906	$42,688	$341,179
6	$123,593	$98,991	$77,424	$43,542	$343,551
7	$128,537	$94,048	$78,972	$44,413	$345,970
8	$133,679	$88,906	$80,552	$45,301	$348,438
9	$139,026	$83,559	$82,163	$46,207	$350,955
10	$144,587	$77,998	$83,806	$47,131	$353,522
11	$150,370	$72,214	$85,482	$48,074	$356,141
12	$156,385	$66,200	$87,192	$49,036	$358,812
13	$162,641	$59,944	$88,935	$50,016	$361,537
14	$169,146	$53,439	$90,714	$51,017	$364,316
15	$175,912	$46,673	$92,528	$52,037	$367,150
16	$182,948	$39,636	$94,379	$53,078	$370,041
17	$190,266	$32,318	$96,267	$54,139	$372,991
18	$197,877	$24,708	$98,192	$55,222	$375,999
19	$205,792	$16,793	$100,156	$56,326	$379,067
20	$214,024	$8,561	$102,159	$57,453	$382,197

Table 14 Project Net Annual Cash Flow				
Year	Total Annual Revenue	Total Annual Cost	Net Annual Cash Flow	Cumulative Cash Flow
1	$627,955	$332,147	$295,808	$295,808
2	$645,010	$334,339	$310,671	$606,479
3	$662,662	$336,574	$326,088	$932,567
4	$680,932	$338,853	$342,078	$1,274,646
5	$699,841	$341,179	$358,662	$1,633,308
6	$719,412	$343,551	$375,862	$2,009,169
7	$739,668	$345,970	$393,698	$2,402,868
8	$760,633	$348,438	$412,196	$2,815,064
9	$782,332	$350,955	$431,377	$3,246,441
10	$804,791	$353,522	$451,268	$3,697,709
11	$775,285	$356,141	$419,144	$4,116,854

Table 14 Project Net Annual Cash Flow				
Year	Total Annual Revenue	Total Annual Cost	Net Annual Cash Flow	Cumulative Cash Flow
12	$799,343	$358,812	$440,531	$4,557,384
13	$824,243	$361,537	$462,706	$5,020,091
14	$850,014	$364,316	$485,699	$5,505,789
15	$876,688	$367,150	$509,537	$6,015,327
16	$904,295	$370,041	$534,253	$6,549,580
17	$932,868	$372,991	$559,877	$7,109,457
18	$962,441	$375,999	$586,442	$7,695,900
19	$993,050	$379,067	$613,983	$8,309,882
20	$1,024,729	$382,197	$642,533	$8,952,415

Excluded from the project economics are the costs of dismantling and long-term storage and maintenance of Wind I. Irrespective of the future of Wind II, it has been determined that Wind I must be decommissioned and dismantled. Wind I could be used for spare parts for Wind II and potentially significantly reduce the future O&M cost of Wind II. The turbine components, such as the blades, hub, tower sections and nacelle should be stored in such a manner as to protect them from the basic elements of sun, rain and snow. These components could be stored in a Quonset hut or outdoor storage shed structure near its present location. There are long term storage and preventative maintenance requirements set forth by the manufacturer which should be followed in order for them to retain their value and be useful at a future date. Equipment that might be susceptible to degradation due to high humidity includes sensitive electrical equipment that are associated with the electronic controllers and related SCADA equipment. The cost of dismantling, with long term storage and care would need to be considered and was beyond the scope of this study.

7.0 REFERENCES

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\\wse03.local\WSE\Projects\MA\Falmouth MA\Wind Turbine Relocation Study\Wind Turbine Relocation Analysis Report.docx

APPENDIX A

Figures

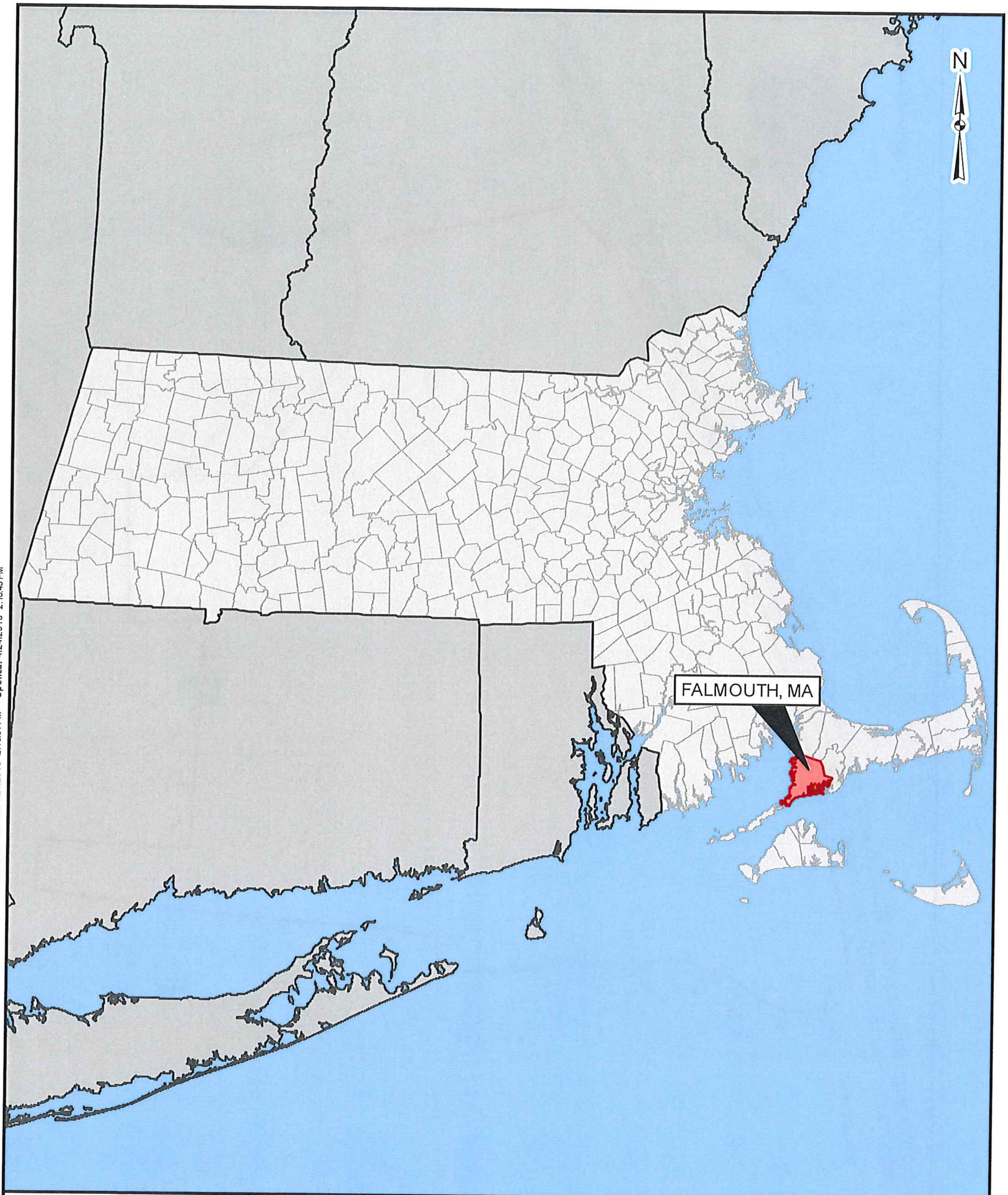

FIGURE 1
TOWN OF FALMOUTH, MASSACHUSETTS

LOCUS MAP

Weston & Sampson

Path: \\gisdatasrv\GIS\DataStore\Client\Falmouth MA\Project\WIND TURBINE RELOCATION\Locus Map.mxd User: OzerekoZ Saved: 4/24/2018 2:16:31 PM Opened: 4/24/2018 2:16:43 PM

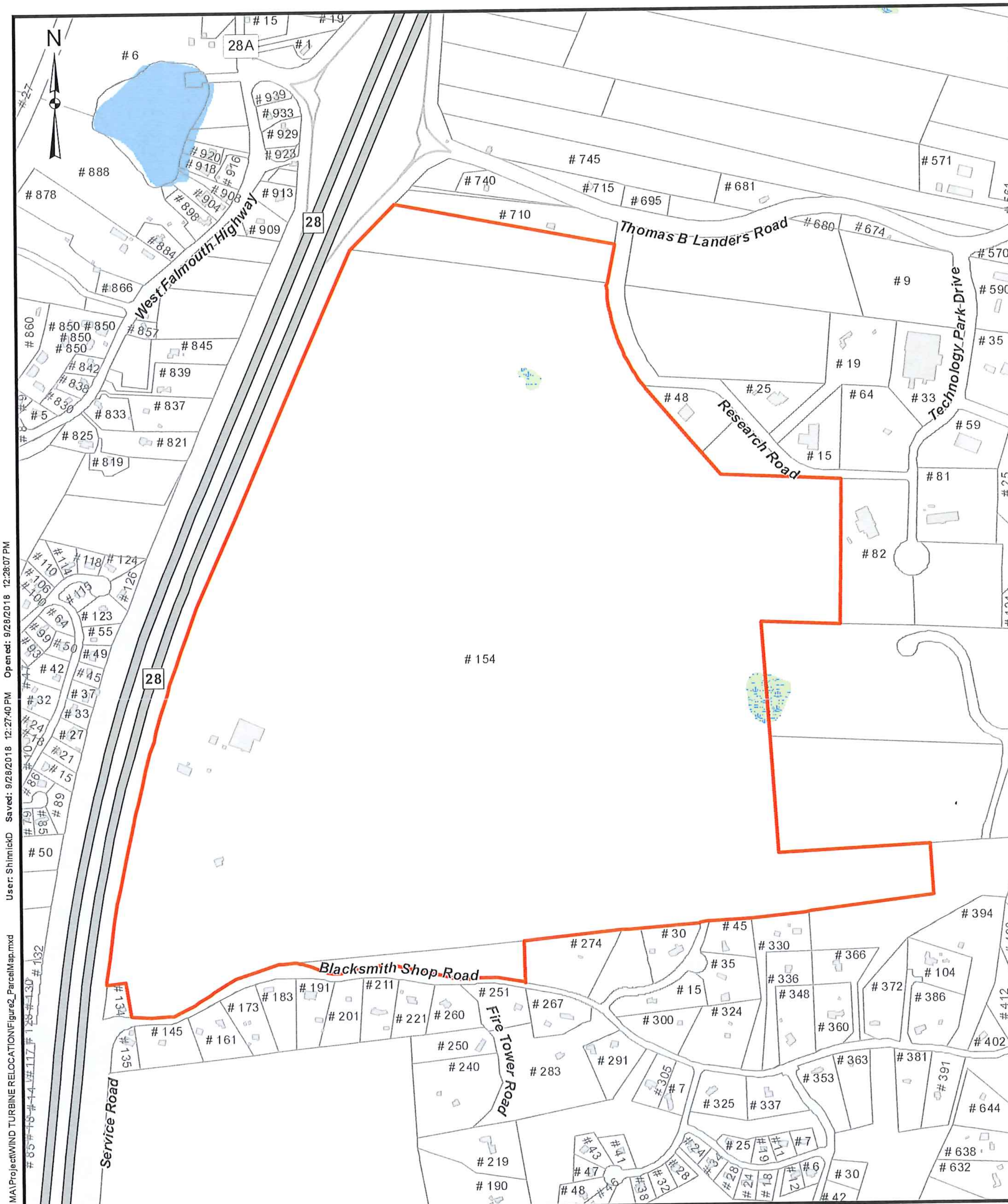

FIGURE 2
TOWN OF FALMOUTH, MASSACHUSETTS

PARCEL MAP

Site Parcel
Buildings
Parcels
Wooded marsh
Open Water

800 0 800
Scale In Feet

Weston & Sampson

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FIGURE 3
TOWN OF FALMOUTH, MASSACHUSETTS

PARCEL MAP

Buildings
Site Parcel
Parcels

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Scale In Feet

Weston & Sampson

Path: \\gisdatasrv\gis\DataStore\Client\Falmouth MA\Project\WIND TURBINE RELOCATION\Figure3_ParcelMapAerialImage.mxd User: ShinnickD Saved: 9/28/2018 4:27:45 PM Opened: 9/28/2018 4:27:56 PM

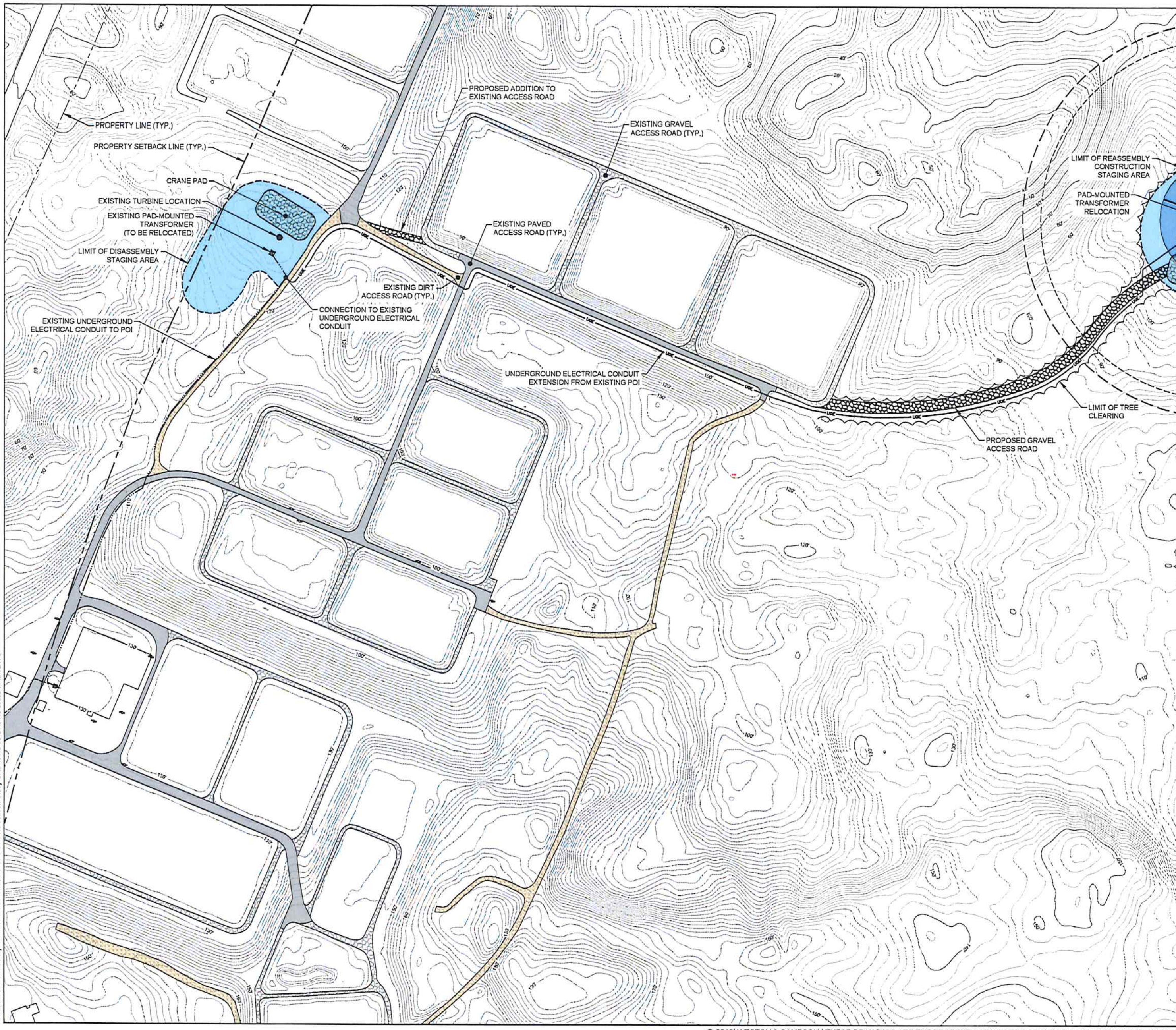
FIGURE 4

TOWN OF FALMOUTH, MASSACHUSETTS

EXISTING SITE CONFIGURATION

OCTOBER 2018 SCALE: NOTED

Weston & Sampson



NOTES:

1. LAYOUT IS CONCEPTUAL, ALL QUANTITIES AND DIMENSIONS SHOWN ARE APPROXIMATE. FINAL COMPONENTS AND CONFIGURATION TO BE DETERMINED BASED ON DESIGN CRITERIA, PERMITTING REQUIREMENTS AND EXISTING SITE CONDITIONS.
2. DEVELOPER TO VERIFY SITE CONDITIONS PRIOR TO DESIGN.
3. PROPOSED ACCESS ROAD TO MEET REQUIRED SPECIFICATIONS FOR TURBINE TRANSPORTATION.
4. EXISTING ACCESS ROAD(S) TO BE UPGRADED AS NEEDED TO MEET REQUIRED SPECIFICATIONS FOR TURBINE TRANSPORTATION.
5. CONSTRUCTION STAGING AREA FOR REASSEMBLY TO BE GRADED SUCH THAT IT IS FLAT AND UNIFORM.
6. EXISTING PAD-MOUNTED TRANSFORMER CONNECTED TO WIND TURBINE TO BE DISCONNECTED, RELOCATED AND RECONNECTED AT NEW TURBINE LOCATION.
7. TOPOGRAPHY AND PROPERTY LINES FROM THE MASSACHUSETTS BUREAU OF GEOGRAPHIC INFORMATION (MASSGIS).
8. TOPOGRAPHIC CONTOURS IN 2-FOOT INTERVALS.

100 50 0 100 200 300
GRAPHIC SCALE 1"= 100'

WIND TURBINE SPECIFICATIONS	
WIND TURBINE MODEL	1.65 MW VESTAS V-82
ROTOR DIAMETER	269.00 FT.
TOWER HEIGHT	257.31 FT.
HUB HEIGHT	262.00 FT.
OVERALL TURBINE HEIGHT	369.98 FT.
FEASIBILITY METRICS	
TREE CLEARING AREA	109,850 SQ. FT. (2.52 ACRES)
PROPOSED ACCESS ROAD AREA	20,485 SQ. FT. (0.47 ACRES)
DISASSEMBLY STAGING AREA	54,980 SQ. FT. (1.26 ACRES)
REASSEMBLY STAGING AREA	77,885 SQ. FT. (1.79 ACRES)
CRANE PAD DIMENSIONS	66 FT. X 132 FT.
PROPOSED UGE EXTENSION LENGTH	2,390 LINEAR FT.

Project:

TOWN OF FALMOUTH, MA

WWTF WIND TURBINE II RELOCATION PROJECT

154 BLACKSMITH SHOP ROAD, EAST FALMOUTH, MA 02536

Weston & Sampson

Weston & Sampson Engineers, Inc.
5 Centennial Drive Peabody, Massachusetts
(978) 532-1900 (800) Sampson
www.westonandsampson.com

Revisions:

Rev	Date	Description

Seal:

JOB NO. 2180187.A
CONCEPTUAL LAYOUT

Date:	10.12.18
Scale:	AS SHOWN
Designed By:	NLN
Reviewed By:	SPW
Checked By:	SPW
Approved By:	-

Drawing Title:

FIGURE 5
WIND II TURBINE RELOCATION PLAN

Project:
Town of Falmouth Wind Turbine Project

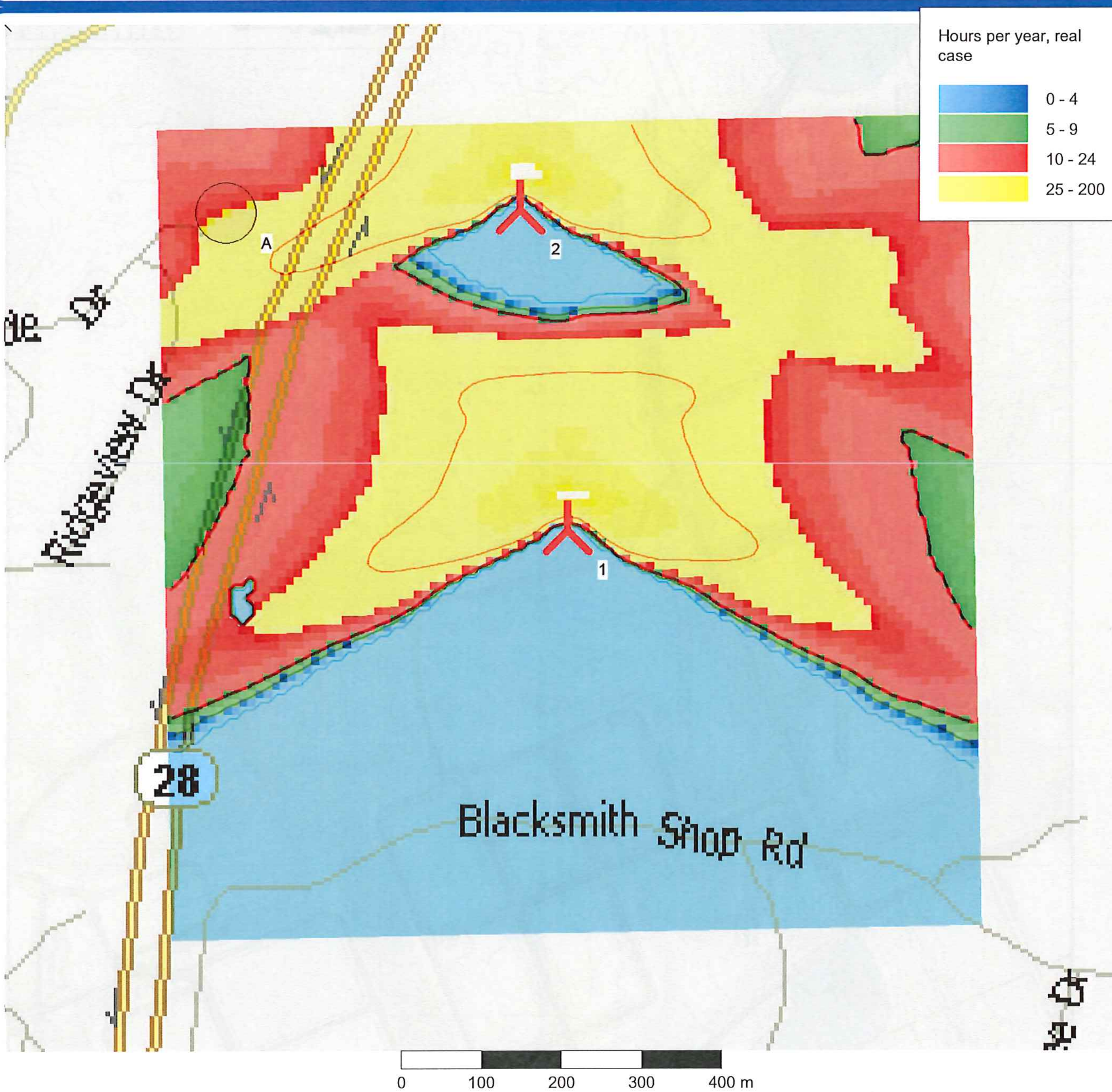
Printed/Page
6/14/2011 11:34 AM / 1

Licensed user:
Weston & Sampson Engineers Inc.
Five Centennial Drive
US-PEABODY, MA 01960
+1 978 532 1900
WindPro / tomlinsons@wseinc.com

Calculated:
6/14/2011 11:33 AM/2.7.486

SHADOW - Map

Calculation: Omnidirectional - lawn -real case



Map: WindPRO map , Print scale 1:7,500, Map center UTM NAD 83 Zone: 19 East: 364,950.00 North: 4,607,300.00

New WTG Shadow receptor

Isolines showing shadow in Hours per year, real case

0 5 10 50

FIGURE 6

TOWN OF FALMOUTH, MASSACHUSETTS

PROPOSED SITE CONFIGURATION

OCTOBER 2018 | SCALE: NOTED

Weston & Sampson

APPENDIX B

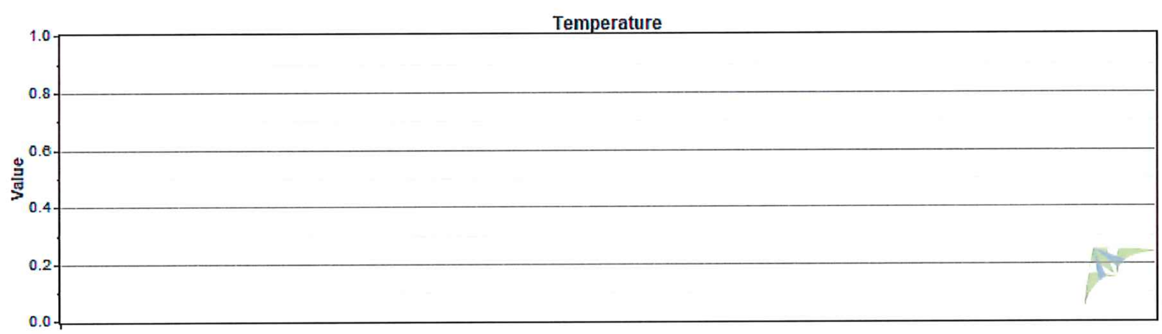
Wind Data Reports

Summary Report: Alternate Turbine Location AL - 1

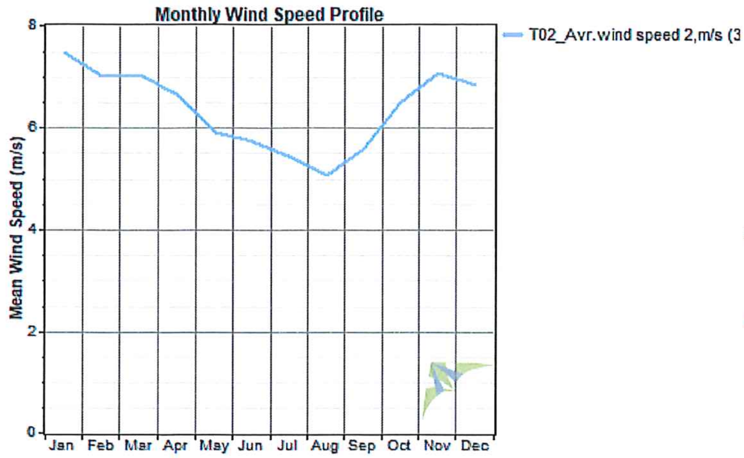
Data Set Properties

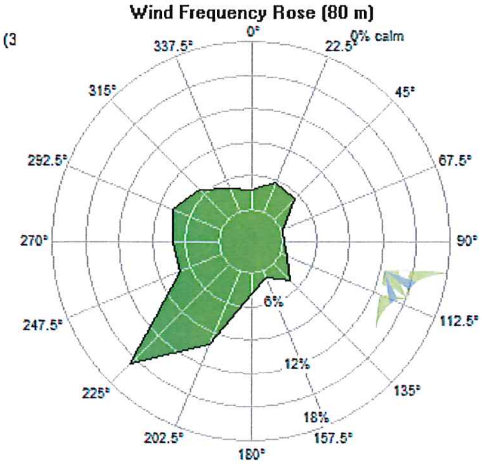
Report Created: 5/11/2018 15:30 using Windographer 2.4.13
Filter Settings: <Unflagged data>

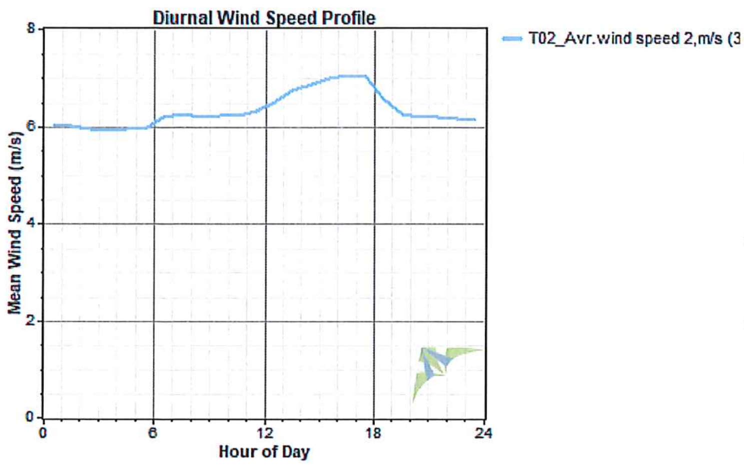
Variable	Value
Latitude	N -70.614000
Longitude	W 41.609400
Elevation	110 ft
Start date	6/1/2011 15:40
End date	12/7/2015 18:10
Duration	4.5 years
Length of time step	10 minutes
Calm threshold	0 m/s
Mean temperature	14.8 °C
Mean pressure	100.9 kPa
Mean air density	1.219 kg/m³
Power density at 50m	n/a
Wind power class	n/a
Power law exponent	n/a
Surface roughness	n/a
Roughness class	n/a
Roughness description	n/a

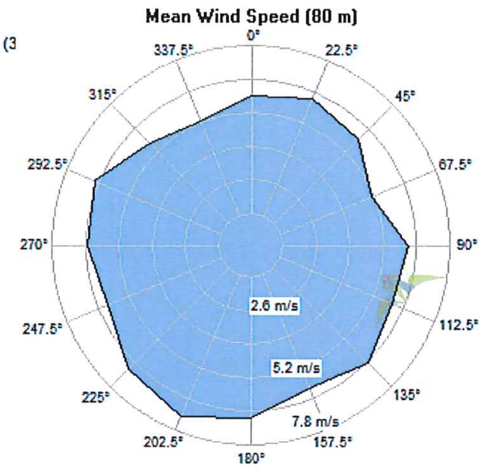


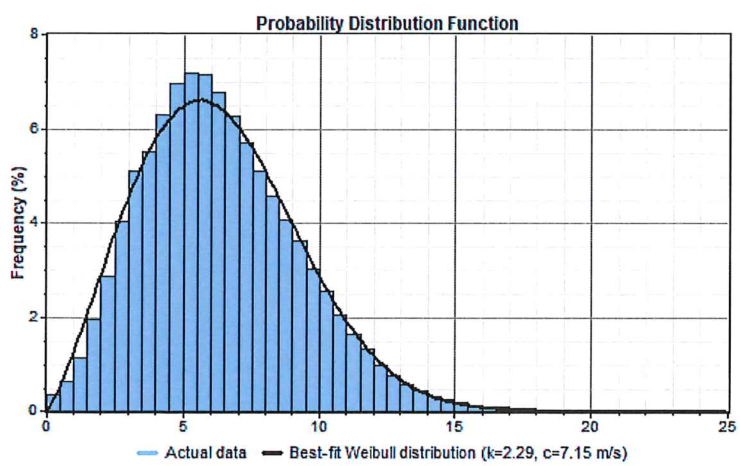
Wind Speed and Direction

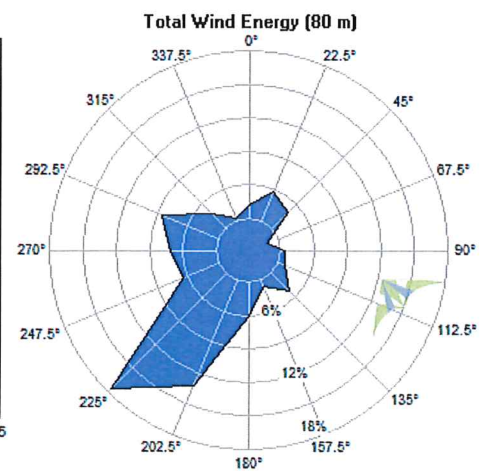












Data Column Properties

Number	Label	Units	Height	Possible Records	Valid Records	Recovery Rate (%)	Mean	Min	Max	Std. Dev
1	Year			237,615	237,615	100.00	2,015	2,011	2,015	3
2	Month			237,615	237,615	100.00	6.76	1.00	12.00	3.37
3	Day			237,615	237,615	100.00	15.69	1.00	31.00	8.81
4	T02_Avr.wind speed 2,m/s (3)	m/s	80 m	237,615	202,161	85.08	6.34	0.00	22.00	2.92
5	T02_Avr.nacelle pos.° (4)	°	80 m	237,615	202,161	85.08	242.2	0.0	359.0	97.2
6	Vestas V82 - 1.65 MW Power Output	kW		237,615	202,161	85.08	487	0	1,650	501
7	Air Density	kg/m³		237,615	237,615	100.00	1.219	1.221	1.221	0.002
8	T02_Avr.wind speed 2,m/s (3) WPD	W/m²		237,615	202,161	85.08	264	0	6,499	378

APPENDIX C

Detailed Cost Estimates

Falmouth - Relocate Wind II

Description	Quantity	Units	Unit Cost	Amount
Topographic survey	1	Each	$25,000	$25,000
Geotechncial investigation	1	Each	$20,000	$20,000
Structural design	1	Each	$50,000	$50,000
Civil design	1	Each	$25,000	$25,000
Electrical design	1	Each	$25,000	$25,000
Specifications	1	Each	$12,500	$12,500
Bid documents	1	Each	$7,500	$7,500
Public bidding	1	Each	$4,500	$4,500
Construction administration	1	Each	$75,000	$75,000
Testing (CMT, Electrical)	1	Each	$35,700	$35,700
Permit coordination	1	Each	$7,500	$7,500
Utility coordination	1	Each	$5,500	$5,500
Wetland Survey and RDA	1	Each	$11,500	$11,500
Special Permit	1	Each	$30,000	$30,000
FAA	1	Each	$5,000	$5,000
ISO-NE	1	Each	$5,000	$5,000
Mobilization	1	Each	$200,000	$200,000
General conditions	1	Each	$50,000	$50,000
Insurance	1	Each	$25,000	$25,000
Bonds	1	Each	$25,000	$25,000
Clearing, grubbing	1	Each	$19,500	$19,500
Embankment, subgrade	1	Each	$30,000	$30,000
Foundation	1	Each	$350,000	$350,000
Crane mobilization	1	Each	$100,000	$100,000
Rigging	1	Each	$100,000	$100,000
Dismantle turbine	1	Each	$280,000	$280,000
Move turbine	1	Each	$125,000	$125,000
Re-assemble turbine	1	Each	$455,000	$455,000
Electrical work	1	Each	$415,000	$415,000
Commissoning	1	Each	$100,000	$100,000
Fencing (around WTG)	1	Each	$15,000	$15,000
Contract close out	1	Each	$15,000	$15,000
Sub-Total				$2,649,200
General Conditions	0.1	10.00%	$2,649,200	$264,920
Contingency	0.05	5.00%	$2,649,200	$132,460
Total Estimate				$3,046,580

BALDWIN ENERGY
232 Andover Street
Wilmington, MA 01887

PH: 978 657-7555 FAX: 978 657-5647

April 27, 2018

Mr. Stephen Wiehe
Weston & Sampson
wiehes@wseinc.com

Falmouth Wind II Turbine Relocation Project
Falmouth, MA

RE: Falmouth Wind II Turbine Relocation
BALDWIN JOB NO. 18106

Dear Mr. Wiehe,

The following information was developed as an aid for Weston & Sampson and the Town of Falmouth in developing indicative pricing and an RFP for the above referenced project:

Typically, for new construction the following categories would be included prior to the turbine installation on the RFP:

1. Civil
2. Collection
3. Substation
4. Foundation *(removal of the old foundation and\or construction of the new foundation)*

Each of these categories would have a breakdown of specific tasks that are individually priced out. As I am not sure what work is needed or what your intentions are regarding including any of these areas in the RFP, my focus is on the dismantle, relocation and install. The following are potential categories and estimated costs:

WTG Dismantle- $480,500

Provide all necessary labor and equipment required to disassemble the complete WTG including the following components:

- Tower Wiring as needed for turbine disassembly and relocation
- Rotor (Hub and Blades)
- Nacelle
- Tower Sections

- DTE Equipment

- Price must include all related Labor and Equipment Including:
  - Main Crane
  - Tailing Crane
  - *NOTE: Creation of Crane Pad would typically be part of a civil contract*
  - Crane Mats and Plates
  - Rigging- All specialty rigging for the aforementioned mentioned components
  - Tooling

<u>WTG Load Out and Transport</u>- $125,000

Provide all necessary Labor and Equipment required to relocate the complete WTG from Site-1 to Site-2 including the following:

- Cranes
- Riggers
- Rigging
- Transportation Equipment

<u>Crane Relocation</u>- $TBD ($20,000 - $150,000 depending on civil plan)

NOTE: Depending on the finalized civil plan, the main crane relocation can be performed in one of three ways: 1. Complete break-down and reassembly, 2. Partial break-down and reassembly, 3. Full breakdown and reassembly. Each of these three methods has considerable cost differences. Which one is required is dependent on the width and conditions of the roads between the sites as well as the type of crane being used by the erector.

<u>WTG Install</u>- $305,000

Provide all necessary labor and equipment required to install the complete WTG including the following components:

- DTE Equipment
- Tower Sections
- Nacelle
- Rotor
- Tower Wiring

- The following services must be included in the WTG Install pricing:
  - Complete Installation according to the Vestas Installation Manual
  - Tower wiring
  - Pressure Washing of all components including the Tower Sections, Nacelle, Blades and Hub.
  - Torqueing and Tensioning where required using certified equipment
  - MCC (Mechanical Completion)- To be verified by Owner Rep and OEM

Please let me know if you have any questions.

Sincerely,

Mark Baldwin

FALMOUTH WWTF WIND TURBINE
RELOCATION OF WIND TURBINE NO. 2

PROPOSED ELECTRICAL INTERCONNECTION
MATERIALS AND CONSTRUCTION COST ESTIMATE

Item Description	Quantity	Units		Unit Cost		Total Cost
Excavation, Backfill and Compaction for Primary Cable Ductbank (2-4")	2,400	Feet	$	45.00	$	108,000.00
Additional excavation & backfill for 2-2" communications conduits	2,400	Feet	$	18.00	$	43,200.00
Installation of Primary and Communications Conduits	4,800	Feet	$	11.00	$	52,800.00
Concrete Encasement of conduits	2,400	Feet	$	20.00	$	48,000.00
Installation of Primary Cable, 25kV class	2,400	Feet	$	35.00	$	84,000.00
Concrete Pad for New Padmount Transformer	1	Ea	$	2,500.00	$	2,500.00
Grounding of Transformer	1	Ea	$	1,000.00	$	1,000.00
Installation of Secondary Conduits from Trans to Turbine 6-4" w/2-2" Comm	50	Feet	$	125.00	$	6,250.00
Installation of Secondary Cable to Turbine, 5 sets 4W-600MCM	50	Feet	$	170.00	$	8,500.00
Installation of New Electric Manholes	5	Ea	$	7,000.00	$	35,000.00
Installation of New Communication Handholes (10"x18"x20")	5	Ea	$	900.00	$	4,500.00
Control Cable, Installed	2,400	Feet	$	1.50	$	3,600.00
Padmount Transformer, removed and relocated on new pad	1	Ea	$	1,800.00	$	1,800.00
Cable Junction Pedestal on existing Transformer Pad, installed and Wired	1	Ea	$	6,500.00	$	6,500.00
Padmount Transformer 25kVA 1-phase on box pad installed, grounded, etc.	1	Ea	$	3,000.00	$	3,000.00
New Distribution Panel for Aux Equipment, installed and wired	1	Lot	$	1,500.00	$	1,500.00
Site Restoration - Loaming and Seeding (Manhole / Trench area only)	1	Lot	$	4,000.00	$	4,000.00

SUBTOTAL - CONSTRUCTION			**$**	**414,150.00**
Contractor Markup, Insurance, Permits, etc.	10%	of subtotal	$	41,415.00
Additional Electrical Equipment and Testing	5%	of subtotal	$	20,707.50
(Control Wiring, Cable Terminations, Start-up, etc.)				
Contingency	10%	of subtotal	$	41,415.00
TOTAL ESTIMATE			**$**	**517,687.50**

NOTES:
1. Cost Estimate is budgetary for planning purposes and does not include permitting, legal, financing and other costs beyond those listed above.

APPLICATION AND CERTIFICATE FOR PAYMENT

28-190

TO: Town of Falmouth
Department of Public Works
59 Town Hall Square
Falmouth, Massachusetts 02540

Wind Energy Facility
Falmouth, Massachusetts

APPLICATION NO. 11

PERIOD TO: 12/31/2010

Distribution to:
- [ ] OWNER
- [X] ENGINEER
- [ ] CONTRACTOR

FROM (CONTRACTOR): D&C Construction Company, Inc.
Post Office Box 415
Rockland, Massachusetts 02370-0415

VIA ENGINEER: Weston & Sampson Engineers, Inc.
5 Centennial Drive
Peabody, Massachusetts 01960

CONTRACTOR'S APPLICATION FOR PAYMENT

CHANGE ORDER SUMMARY		ADDITIONS	DEDUCTIONS
Change Orders approved in previous months by Owner TOTAL		23,586.18	-0-
Approved this Month			
Number	Date Approved		
2	05-04-2010	10,346.52	
		10,346.52	-0-
Net change by Change Orders		33,932.70	-0-

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that the current payment shown herein is now due.

CONTRACTOR: D&C Construction Company, Inc.

By: [signature] Date: December 31, 2010
Duncan S. Peterson, Vice President

Application is made for Payment, as shown below, in connection with the Contract. Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM	$	4,332,000.00
2. Net change by Change Orders	$	33,932.70
3. CONTRACT SUM TO DATE (Line 1 ± 2)	$	4,365,932.70
4. TOTAL COMPLETED & STORED TO DATE	$	4,365,932.70
5. RETAINAGE:		
a. Punch List	$	-0-
b.	$	-0-
c.	$	-0-
Total Retainage (Line 5a+5b+5c)	$	-0-
6. TOTAL EARNED LESS RETAINAGE (Line 4 less Line 5 Total)	$	4,365,932.70
7. LESS PAID TO DATE	$	4,345,932.73
8. CURRENT PAYMENT DUE (NET 30 DAYS)	$	19,999.97
9. BALANCE TO FINISH	$	-0-

State of: Massachusetts County of: Plymouth
Subscribed and sworn to before me this 31st day of December, 2010
Notary Public: [signature]
My Commission Expires: January 19th, 2012

OWNER Town of Falmouth Department of Public Works

By: ______ Date: ______

AMOUNT CERTIFIED 19,999.97
(Attach explanation if amount certified differs from the amount applied for.)

ENGINEER'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising the above application, the Engineer certifies to the Owner that to the best of the Engineer's knowledge, information and belief, the Work has progressed a indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

ENGINEER
By: [signature] Date: 1/20/11
Stephen Wiehe, PG

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the CONTRACTOR named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

D&C Construction Company
Application and Certificate for Payment #11
Town of Falmouth Department of Public Works
Wind Energy Facility
For Period through December 31, 2010

A #	B Description of Work	C Qty	D Unit	E Cost per Unit	G Itemized Scheduled Value	H Qty Comp'd This Period	I Qty Stored This Period	J $ This Period	K Qty Comp'd Previous Periods	L Qty Stored Previous Period	M $ Previous Periods	N Total Qty Comp'd (H+I+K+L)	O Total $ Comp'd (J+M)	P % Comp'd [O/G]	Q Balance to Finish [G-O]
1 .00	Install Wind Turbine														
1 .01	Mobilization	1	LS	216,600.00	216,600.00	-0-	-0-	-0-	1.00	-0-	216,600.00	1.00	216,600.00	100.00	-0-
1 .10	Site Erosion Control	1	LS	15,000.00	15,000.00	-0-	-0-	-0-	1.00	-0-	15,000.00	1.00	15,000.00	100.00	-0-
1 .11	Excavation and Backfill Turbine Foundation	1	LS	175,000.00	175,000.00	-0-	-0-	-0-	1.00	-0-	175,000.00	1.00	175,000.00	100.00	-0-
1 .12	Fill Sludge Bed	1	LS	150,000.00	150,000.00	-0-	-0-	-0-	1.00	-0-	150,000.00	1.00	150,000.00	100.00	-0-
1 .13	Gravel Road	1	LS	10,000.00	10,000.00	-0-	-0-	-0-	1.00	-0-	10,000.00	1.00	10,000.00	100.00	-0-
1 .14	Pavements	1	LS	3,400.00	3,400.00	-0-	-0-	-0-	1.00	-0-	3,400.00	1.00	3,400.00	100.00	-0-
1 .15	Site Drains	1	LS	3,000.00	3,000.00	-0-	-0-	-0-	1.00	-0-	3,000.00	1.00	3,000.00	100.00	-0-
1 .16	Excavate & Backfill Electrical Duct Bank	1	LS	70,000.00	70,000.00	-0-	-0-	-0-	1.00	-0-	70,000.00	1.00	70,000.00	100.00	-0-
1 .17	Fencing and Guard Rails	1	LS	20,000.00	20,000.00	-0-	-0-	-0-	1.00	-0-	20,000.00	1.00	20,000.00	100.00	-0-
1 .18	Widen Site Entrance	1	LS	4,000.00	4,000.00	-0-	-0-	-0-	1.00	-0-	4,000.00	1.00	4,000.00	100.00	-0-
1 .19	Loam and Seed	1	LS	15,000.00	15,000.00	-0-	-0-	-0-	1.00	-0-	15,000.00	1.00	15,000.00	100.00	-0-
1 .20	Concrete Foundation	1	LS	300,000.00	300,000.00	-0-	-0-	-0-	1.00	-0-	300,000.00	1.00	300,000.00	100.00	-0-
1 .22	Erect Turbine	1	LS	225,000.00	225,000.00	-0-	-0-	-0-	1.00	-0-	225,000.00	1.00	225,000.00	100.00	-0-
1 .23	Electrical Duct Bank	1	LS	125,000.00	125,000.00	-0-	-0-	-0-	1.00	-0-	125,000.00	1.00	125,000.00	100.00	-0-
1 .24	Transformers and Switch Gear	1	LS	50,000.00	50,000.00	-0-	-0-	-0-	0.33	0.67	50,000.00	1.00	50,000.00	100.00	-0-
1 .25	Electrical Connection at Turbine	1	LS	25,000.00	25,000.00	-0-	-0-	-0-	1.00	-0-	25,000.00	1.00	25,000.00	100.00	-0-
1 .26	Electrical Connection at Utility	1	LS	25,000.00	25,000.00	-0-	-0-	-0-	1.00	-0-	25,000.00	1.00	25,000.00	100.00	-0-
1 .27	Turbine Start-Up	1	LS	100,000.00	100,000.00	-0-	-0-	-0-	1.00	-0-	100,000.00	1.00	100,000.00	100.00	-0-
CO .1	Additional Revenue Meter	1	LS	23,586.18	23,586.18	-0-	-0-	-0-	1.00	-0-	23,586.18	1.00	23,586.18	100.00	-0-
CO .2	Relocate SCADA, Install Relay, Credit Compı	1	LS	10,346.52	10,346.52	-0-	-0-	-0-	1.00	-0-	10,346.52	1.00	10,346.52	100.00	-0-
1 .00	Totals				1,565,932.70			-0-			1,565,932.70		1,565,932.70	100.00	-0-
2 .00	Turbine Procurement														
2 .01	Turbine Order	1	LS	700,000.00	700,000.00	-0-	-0-	-0-	1.00	-0-	700,000.00	1.00	700,000.00	100.00	-0-
2 .02	Turbine Purchase	1	LS	1,400,000.00	1,400,000.00	-0-	-0-	-0-	1.00	-0-	1,400,000.00	1.00	1,400,000.00	100.00	-0-
2 .03	Turbine Purchase	1	LS	560,000.00	560,000.00	-0-	-0-	-0-	1.00	-0-	560,000.00	1.00	560,000.00	100.00	-0-
2 .04	Turbine Purchase	1	LS	140,000.00	140,000.00	-0-	-0-	-0-	1.00	-0-	140,000.00	1.00	140,000.00	100.00	-0-
2 .00	Totals				2,800,000.00			-0-			2,800,000.00		2,800,000.00	100.00	-0-
	Grand Totals				4,365,932.70			-0-			4,365,932.70		4,365,932.70	100.00	-0-

APPLICATION AND CERTIFICATE FOR PAYMENT

Similar to AIA G702

PROJECT: 477 - Falmouth WWTF Wind Energy Facility II "Wind II"

FROM (CONTRACTOR)
Lumus Construction, Inc
1 Jewel Drive, Suite 321
Wilmington, MA 01887

APPLICATION #:	SEVENTEEN	Distribution:	OWNER
APPLICATION DATE:	8/31/2012		ARCHITECT
PERIOD:	3/1/12 - 8/31/12		CONTRACTOR
CONTRACT #:	3297		
CONTRACT DATE:	January 5, 2010		

CONTRACTORS APPLICATION FOR PAYMENT

CHANGE ORDER SUMMARY		ADD	DEDUCT
Change Orders approved in previous months by Owner			
	TOTAL	42,105.99	0
Approved this Month			
Number	Date approved		
	TOTAL THIS MONTH	0.00	0
	PROJECT TOTALS	42,105.99	0
Net change by Change Orders			42,105.99

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR: LUMUS CONSTRUCTION

By: ____________________ Date: 8/31/2012
Bruce Mabbott, Project Manager

Application is made for payment, as shown below, in connection with the Contract Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM	$4,288,500
2. NET CHANGE BY CHANGE ORDERS	$42,106
3. CONTRACT SUM TO DATE (Line 1+2)	$4,330,606
4. TOTAL COMPLETED & STORED TO DATE *(Column G on G703)*	4,330,606
5. RETAINAGE:	
a. 0.00% of Completed Work *(Column D+E on G703)*	-
b. 0% of Stored Material *(Column F on G703)*	-
c. Total Retainage *(Line 5a+5b or Total in Column I of G703)*	-
6. TOTAL EARNED LESS RETAINAGE *(Line 4 - Line 5 Total)*	4,330,606
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT *(Line 6 from prior Certificate)*	$4,271,361
8. CURRENT PAYMENT DUE	59,245
9. BALANCE TO FINISH, PLUS RETAINAGE *(Line 3 - Line 6)*	$0

State of: MASSACHUSETTS County of: MIDDLESEX
Subscribed and sworn to before me this day of:

Notary Public: 15D16

My Commision expires:

BRADLEY D. ESLINGER
Notary Public
COMMONWEALTH OF MASSACHUSETTS
My Commission Expires
April 21, 2017

OWNER: Town of Falmouth Department of Public Works

By: ____________________ Date: ____________________

AMOUNT CERTIFIED 16,100.00
(Attach explaination if amount certified differs from the amount applied for.)

ENGINEER:
By: ____________________ Date: 9/12/12
Stephen Wiehe, PG

ENGINEER'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising the above application, the Engineer certifies to the Owner that to the best of the Engineer's knowledge, information and belief, the Work has progressed as indicated, the quality of the work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

CONTINUATION SHEET

PROJECT: 477 - Falmouth WWTF Wind Energy Facility II "Wind II"

In tabulations below, amounts are stated to the nearest dollar.

APPLICATION #: SEVENTEEN
APPLICATION DATE: 8/31/2012
PERIOD: 3/1/12 - 8/31/12
OWNER'S PROJECT #: 3297

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G/C)	BALANCE TO FINISH (C - G)	RETAINAGE 0.00%
			FROM PREVIOUS APPLICATION (D+E)	THIS PERIOD					
001	General Conditions	182,400	182,400	-	-	182,400	100%	-	-
002	Bond	38,500	38,500	-	-	38,500	100%	-	-
003	Foundation Design	35,600	35,600	-	-	35,600	100%	-	-
004	WTG Material	2,546,150	2,546,150	-	-	2,546,150	100%	-	-
005	WTG Transportation	177,742	177,742	-	-	177,742	100%	-	-
006	WTG Commissioning	127,308	127,308	-	-	127,308	100%	-	-
007	Three Year Service Contract	195,000	195,000	-	-	195,000	100%	-	-
008	Sitework & Excavation - Erosion Control	8,600	8,600	-	-	8,600	100%	-	-
009	Sitework & Excavation - Site Prep	7,200	7,200	-	-	7,200	100%	-	-
010	Sitework & Excavation - Foundation E&B	121,200	121,200	-	-	121,200	100%	-	-
011	Sitework & Excavation - Ductbank	39,300	39,300	-	-	39,300	100%	-	-
012	Manholes, Frames & Covers - Material	19,000	19,000	-	-	19,000	100%	-	-
013	Manholes, Frames & Covers - Installation	7,500	7,500	-	-	7,500	100%	-	-
014	Gravel Pad & Laydown Area	28,000	28,000	-	-	28,000	100%	-	-
015	Road Cuts & Asphalt Patching	12,000	12,000	-	-	12,000	100%	-	-
016	Fencing	11,900	-	11,900	-	11,900	100%	-	-
017	Final grading and site restoration	9,200	5,000	4,200	-	9,200	100%	-	-
018	Anchors Bolts & Rebar - Material	49,000	49,000	-	-	49,000	100%	-	-
019	Anchors Bolts & Rebar - Labor	18,000	18,000	-	-	18,000	100%	-	-
020	CMP Material	12,000	12,000	-	-	12,000	100%	-	-
021	Concrete Foundation	39,700	39,700	-	-	39,700	100%	-	-
022	Unload WTG & Tower	30,000	30,000	-	-	30,000	100%	-	-
023	WTG & Tower Installation	392,500	392,500	-	-	392,500	100%	-	-
024	Transformer & Switch - Material	66,400	66,400	-	-	66,400	100%	-	-
025	Transformer & Switch - Installation	10,500	10,500	-	-	10,500	100%	-	-
026	Primary Ductbank Conduit & Cable	75,200	75,200	-	-	75,200	100%	-	-
027	Communication Cabling	7,900	7,900	-	-	7,900	100%	-	-
028	Pad & Tower Grounding	7,900	7,900	-	-	7,900	100%	-	-
029	Testing & Commissioning (Non Mfg Work)	12,800	12,800	-	-	12,800	100%	-	-
030	Change Order#1	9,504	9,504	-	-	9,504	100%	-	-
031	Change Order#2	32,602	32,602	-	-	32,602	100%	-	-
	Total of Above	4,330,606	4,314,506	16,100	-	4,330,606	100%	-	-