

MEMORANDUM

Massachusetts Technology Collaborative
Town of Brewster Wind Energy Project
Wind Turbine Addition Impact Summary

B&V Project 137450.0901
September 16, 2009

To: John Cunningham, Town of Brewster

From: Sean Tilley, Black & Veatch

CC: Sonya Mitchell, MTC
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Principal Investigator: Sean Tilley, Black & Veatch

Overview

Town of Brewster has recently verified that structures originally identified via aerial photography near the Commerce Park project site, in fact, do not exist (as discussed in the June 15, 2009 Town of Brewster Feasibility Study). Further, The Town of Brewster has also indicated the likelihood for a Bylaw setback waiver to be granted for the eastern property line bordering the sand & gravel lot/parcel. Together, these developments/clarifications result in supplementary land for the consideration of an additional wind turbine. The Town of Brewster has therefore requested that Black & Veatch (B&V) re-evaluate the potential for an additional wind turbine to be sited within the Commerce Park area.

This memorandum is being presented by B&V as a means of summarizing the potential cost and performance associated with a two-turbine project in the Commerce Park project area.

Summary

B&V conducted a cursory review of the Commerce Park site considering an additional wind turbine. Given the newly available land area and consideration of a property line setback waiver, B&V determined that a second wind turbine could be sited within the Commerce Park area. In addition to Bylaw setback requirements, B&V also considered adequate turbine-to-turbine spacing in the determination of the additional turbine site.

Black & Veatch evaluated the likely performance of a two-turbine project under the same approach as carried out in the June 15, 2009 Town of Brewster Feasibility Study. The analysis indicates that a two-turbine project constructed in the Commerce Park area is estimated to produce a net of approximately 7.412 gigawatt hours (GWh) of electricity per year performing at a 25.66 percent net capacity factor (NCF). The estimates of Annual Energy Production (AEP) or NCF are indicative of a fifty percent probability (P50). A comparison of the annual energy production for each project site is attached.

While a separate budgetary cost estimate or constructability review was not performed, B&V determined the total cost of a two-turbine project at the Commerce Park site to be similar to the total costs associated with the two-turbine project at the Pumping Station Site (as discussed in the June 15, 2009 Town of Brewster Feasibility Study). As discussed in the feasibility study, the budgetary cost estimates are intended for study purposes only and are indicative a plus or minus 30 percent accuracy.

MTC - Town of Brewster
Community Wind Energy Project
 Project Site Annual Energy Production Comparison



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Project Site	Barrows	Commerce Park	Commerce Park	Golf Course	Police Station	Pumping Station	Waste Transfer Station
# Turbines	2	1	2	2	1	2	2
WTG Model	V82	V82	V82	V82	V82	V82	V82
WTG Capacity (MW)	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Site Capacity (MW)	3.3	1.65	3.3	3.3	1.65	3.3	3.3

Exceedance level - 1st Year

P50 [GWh]	7.930	3.838	7.412	8.108	4.353	8.032	8.663
P90 [GWh]	6.419	3.088	5.849	6.570	3.565	6.497	7.097
P95 [GWh]	5.991	2.875	5.406	6.134	3.342	6.062	6.654
P50 [NCF]	27.43%	26.55%	25.64%	28.05%	30.12%	27.78%	29.97%
P90 [NCF]	22.20%	21.36%	20.23%	22.73%	24.67%	22.47%	24.55%
P95 [NCF]	20.72%	19.89%	18.70%	21.22%	23.12%	20.97%	23.02%

Exceedance level - 10th Year

P50 [GWh]	7.930	3.838	7.412	8.108	4.353	8.032	8.663
P90 [GWh]	7.081	3.420	6.439	7.247	3.908	7.173	7.778
P95 [GWh]	6.841	3.302	6.163	7.003	3.782	6.930	7.527
P50 [NCF]	27.43%	26.55%	25.64%	28.05%	30.12%	27.78%	29.97%
P90 [NCF]	24.50%	23.66%	22.27%	25.07%	27.04%	24.81%	26.91%
P95 [NCF]	23.67%	22.84%	21.32%	24.22%	26.17%	23.97%	26.04%

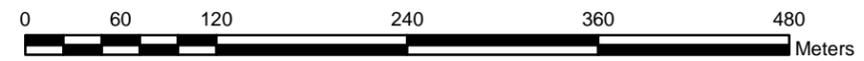
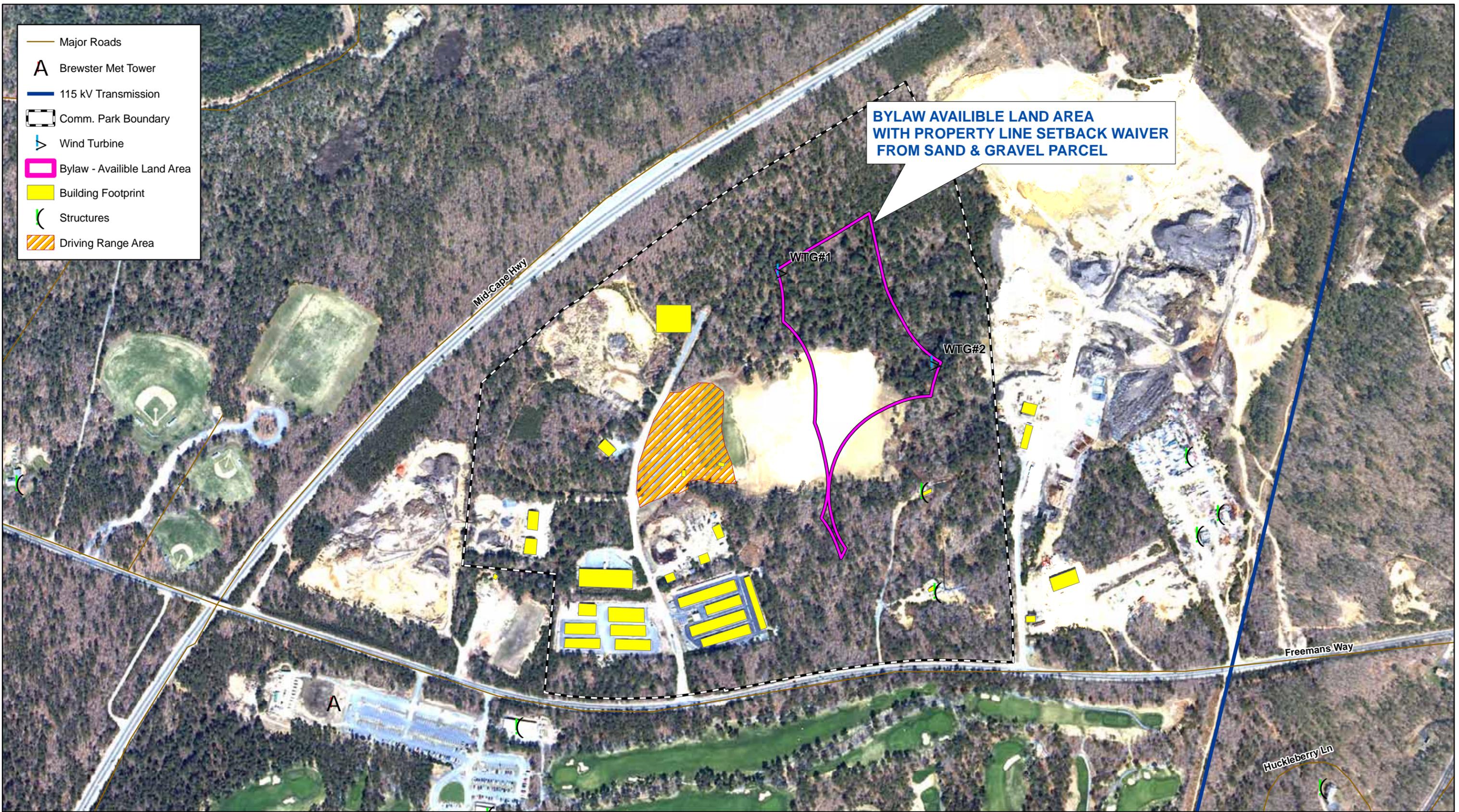
Exceedance level - 20th Year

P50 [GWh]	7.930	3.838	7.141	8.108	4.353	8.032	8.663
P90 [GWh]	7.134	3.447	6.483	7.301	3.936	7.227	7.832
P95 [GWh]	6.909	3.336	6.219	7.072	3.817	6.999	7.597
P50 [NCF]	27.43%	26.55%	24.70%	28.05%	30.12%	27.78%	29.97%
P90 [NCF]	24.68%	23.84%	22.42%	25.26%	27.23%	25.00%	27.09%
P95 [NCF]	23.90%	23.08%	21.51%	24.46%	26.41%	24.21%	26.28%

Note: NCF is the net capacity factor

Site Production Loss Factors

Array efficiency [%]	94.84	100.00	97.18	99.47	100.00	98.34	98.13
Availability [%]	95.00	95.00	95.00	95.00	95.00	95.00	95.00
Electrical efficiency [%]	98.00	98.00	98.00	98.00	98.00	98.00	98.00
Hysteresis [%]	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Icing and blade degradation [%]	98.00	98.00	98.00	98.00	98.00	98.00	98.00
Other Factors [%]	97.00	97.00	97.00	97.00	97.00	97.00	97.00
Power curve turbulence variation [%]	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Sector Management [%]	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Substation maintenance [%]	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Topographic efficiency [%]	100.64	92.40	91.81	98.12	104.81	98.31	106.26
Utility downtime [%]	98.00	98.00	98.00	98.00	98.00	98.00	98.00
Total Losses [%]	17.22	19.86	22.62	15.35	9.10	16.15	9.56



MTC - Town of Brewster
 Community Wind Energy Project Sites
 Commerce ParK Project Site Layout - **PRELIMINARY**



Drawn By:	Sean Tilley
Date:	09/16/2009
PROJECT	137450.0901