OREGON ANEMOMETER LOAN PROGRAM

Wind Resource Evaluation: Sherman County 50m Tower Site

Prepared By:
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1.0 SITE DESCRIPTION

Site Name:	Sherman County 50m
Latitude:	45-31-47 (NAD 27)
Longitude:	120-47-03
Elevation:	2004 ft.
County:	Sherman
Tower Height:	50 meter
Types of Sensors:	NRG Maximum #40 wind speed NRG 200 series2 wind vane
Instrumentation:	50 meters (164 ft). – Wind Speed (2), Wind Direction 40 meters (131 ft). – Wind Speed, Wind Direction 30 meters (99 ft). – Wind Speed
Types of Data:	10 min. average wind speed (mph) 10 min. mean wind direction (deg) 10 min temperature (Deg F) Standard Deviation, maximum and minimum over 10 min. period also available for each data type.
Installation Date:	April 17, 2006
Data Available to:	April 29, 2007

Site Location: The site is located in a fairly level field just north of Gordon ridge, approximately ten miles northwest of the town of Moro in North-Central Oregon. The property has good exposure to the West, North and East but Gordon Ridge to the immediate south has an elevation several hundred feet higher. The tower location is marked on the map included in Appendix A.

Project Description: A group of landowners and interested parties have been evaluating the wind energy potential of the area around the town of Wasco in Sherman County since early 2002. Two additional 30 meter towers have been in place in this area for several years and will also be evaluated in a supplemental analysis. This group was successful in securing funding for a fifty meter monitoring tower that was installed in April 2006 as part of a program to promote a locally owned wind project in the area.

2.0 WIND DATA PROCESSING

NRG equipment was used at this site including #40 anemometers and a Symphony data logger. Data have been provided via NMC card and read at the Energy Resources Research Laboratory. The cards have been swapped out approximately once each month. NRG Symphony software was used to read these files and produce monthly files of wind speed, direction and standard deviation of direction. These files were then converted to hourly averages and converted to an internal ERRL format to accommodate data checking and to perform analysis using existing programs. In this process each level/site combination is assigned a two digit site code. Theses codes are listed in Table 1.

Table 1:Site codes and information for the Sherman County 50m site location.

Site ID	Site Name	Latitude dd-mm-ss	Longitude dd-mm-ss	Elev. (ft)	Sensor Ht (ft)	Period of Record
H1	Sherman 50m	45-31-47	120-47-03	2004	165	April 17 2006 - April 30 2007
H2	Sherman 50m	45-31-47	120-47-03	2004	131	April 17 2006 - April 30 2007
H3	Sherman 50m	45-31-47	120-47-03	2004	98	April 17 2006 - April 30 2007

In addition to the filter available for use with the NRG Symphony software, data files were also scanned manually to identify any additional periods in which ice was might be present and to identify any additional problems. Several significant and sustained icing periods were detected primarily during the months of December 2006 and January 2007. A few isolated periods were also observed in February and March 2007. The end date of data collection is April 29, 2007 rather than the end of the month. The landowner retrieved the data on that day and sent it in order to expedite the completion of the project. This brief missing period is not expected to pose any significant problems. A few data values are also missing in August associated with a site maintenance visit.

Initially, temperature values were not collected at the site. Logging of temperature values began on May 16, 2006. On June 11, 2006 the temperature values began to decrease steadily and were in the negative range within a few days. During the remainder of the observing period these were on the order of -89.0 F. The cause of the problem is not known but is likely a short in the cable of connector. Temperature data from the nearby BPA-Wasco site are available if needed.

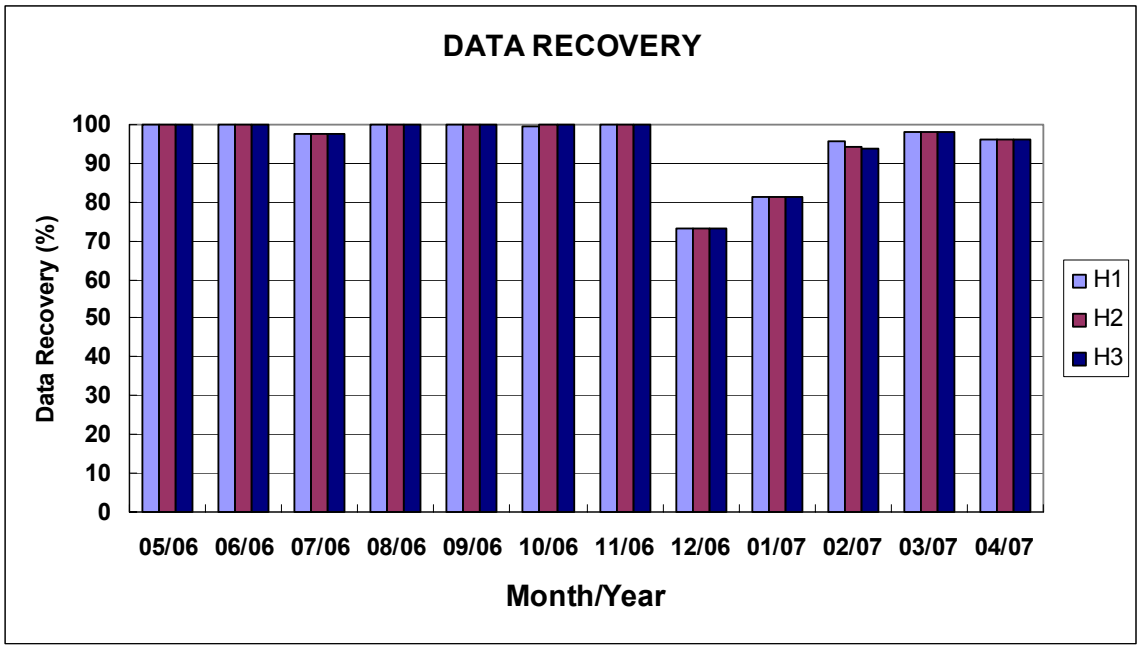


Figure 1: Data recovery for the 3 levels of the Sherman County 50 meter site.

3.0 WIND CHARACTERISTICS

In the following sections, several characteristics of the winds at the Sherman County 50 m site are examined and discussed. The goals are to evaluate the characteristics that can help explain the physical processes at work at the site and to highlight the properties that are important to assessing the wind energy potential. These evaluations are done using hourly averaged means that have been constructed using the 10 minute means recorded at the site. This is done so that existing analysis programs can be used and is not expected to have any appreciable influence on the interpretation of data. Plot of various quantities are included in this section and more complete tables can be found in Appendix B.

This analysis is also confined to a single annual period. This is done so that the results are not biased by the addition of data from only a single season or a portion of a year. ***The period analyzed here is for May 1, 2006 to April 29, 2007.***

Monthly Means:

Table 2: Monthly Mean Wind Speed Values and data recovery rates for the annual study period.

	H1 (165')		H2 (133')		H3 (98')	
Month	Mean (mph)	Rec. (%)	Mean (mph)	Rec. (%)	Mean (mph)	Rec. (%)
MAY	13.7	100.0	13.0	100.0	12.8	100.0
JUN	14.8	100.0	14.0	100.0	13.8	100.0
JUL	15.9	97.7	15.2	97.7	14.9	97.7
AUG	14.7	100.0	14.1	100.0	13.8	100.0
SEP	13.5	100.0	13.0	100.0	12.7	100.0
OCT	12.9	99.3	12.5	100.0	12.2	100.0
NOV	12.2	100.0	12.1	100.0	11.6	100.0
DEC	11.4	73.4	10.8	73.4	10.3	73.3
JAN	11.6	81.2	11.4	81.2	11.0	81.2
FEB	10.8	95.7	10.7	94.0	10.4	93.8
MAR	12.4	98.3	12.1	98.3	11.8	98.3
APR	13.8	96.0	13.3	96.0	13.2	96.0
ANN	13.2	95.3	12.7	95.2	12.4	95.3

Diurnal Means:

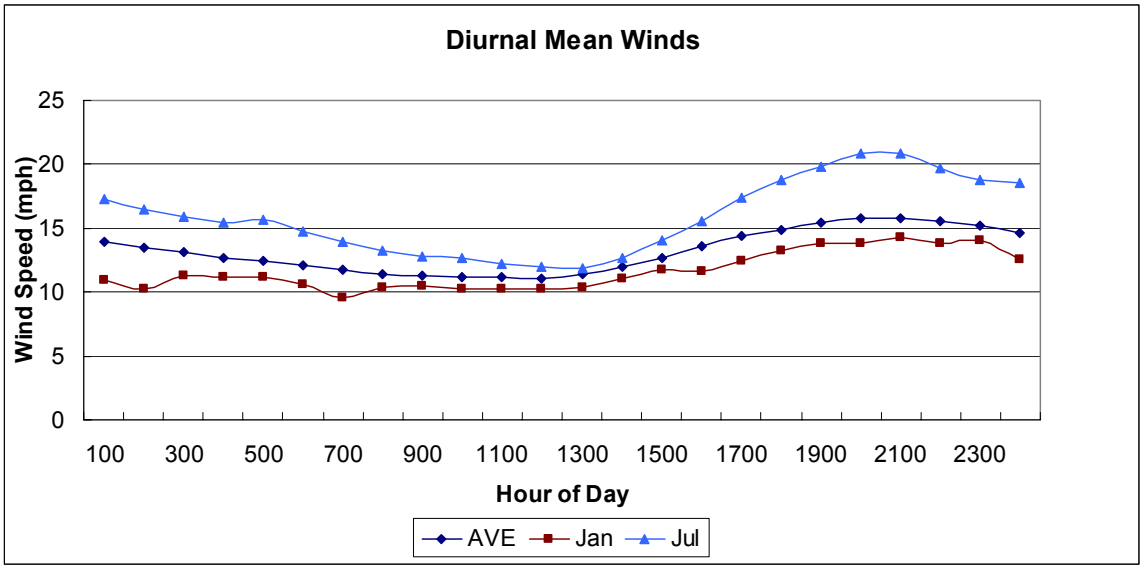


Figure 2: Diurnal mean wind speed values for the 50m (165 ft.) level at the Sherman County 50 meter site.

Frequency Distribution:

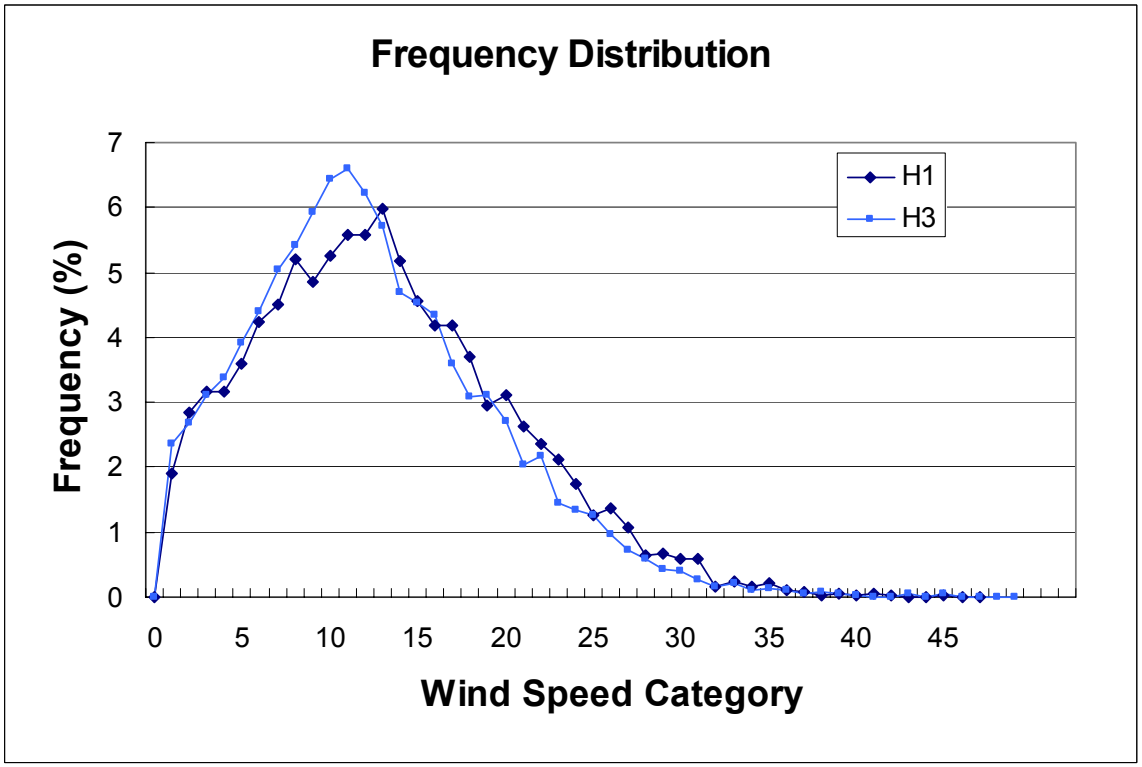


Figure 3: Wind speed frequency distribution for the 50 meter (165 ft.) and 30 meter levels at the Sherman County 50 meter Site.

Wind Rose:

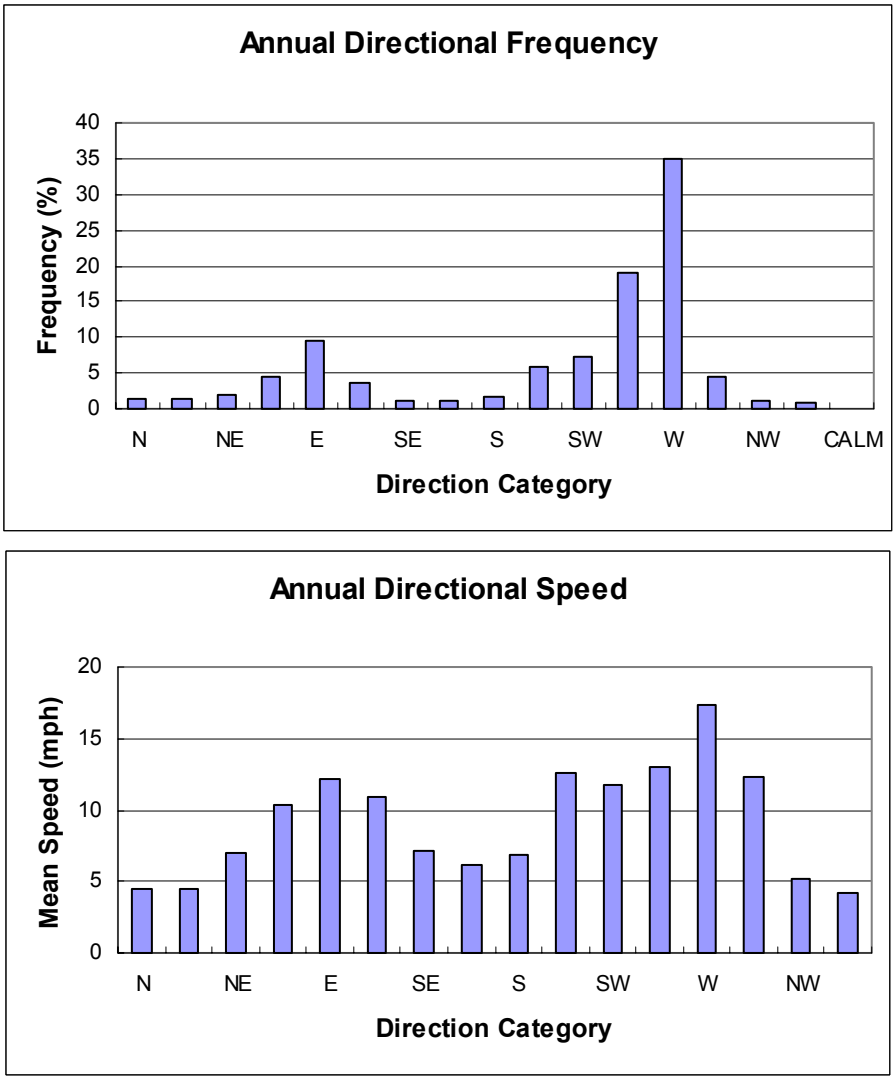


Figure 4a-b: Frequency (%) and average wind speed (mph) for each of 16 wind direction categories from the 50 meter (165 ft.) level of the Sherman County 50 meter site.

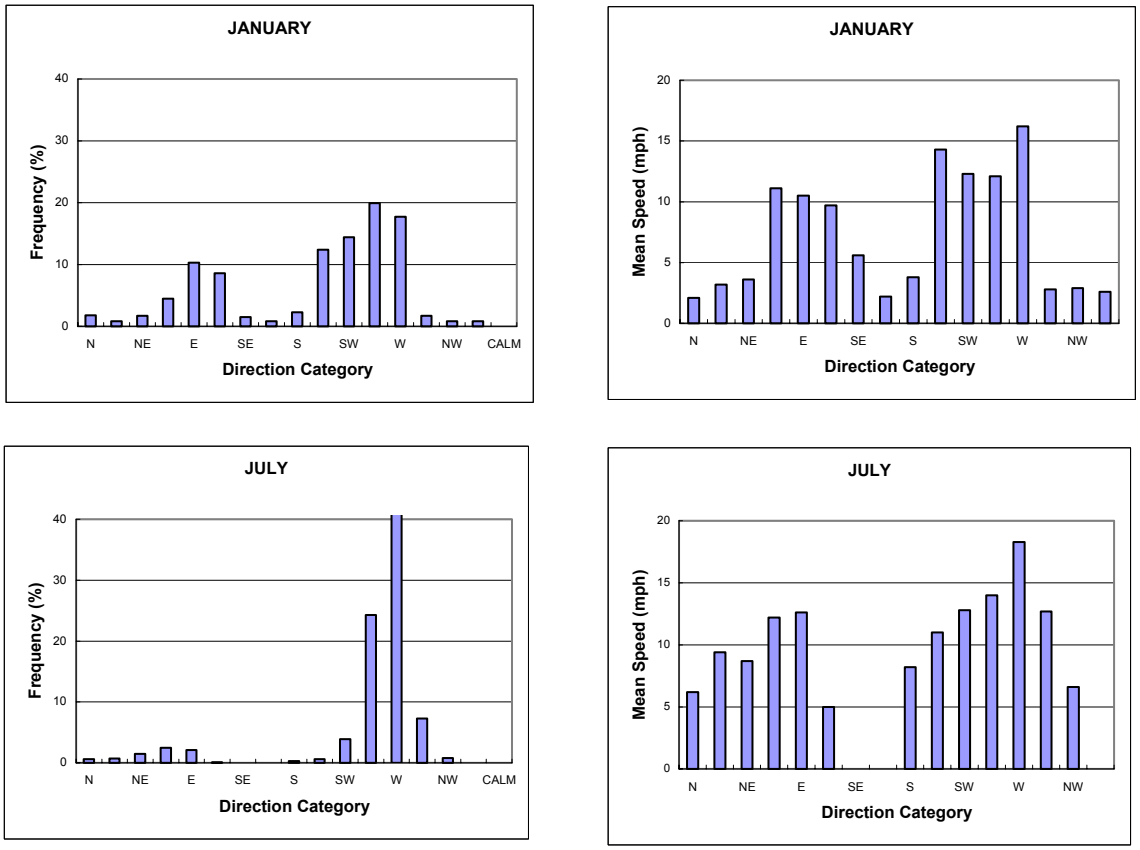


Figure 5a-d: Frequency (%) and average wind speed (mph) for each of 16 wind direction categories for the months of January and July from the 50 meter (165 ft.) level of the Sherman County 50 meter site.

4.0 CLIMATOLOGICAL ANALYSIS

Measurements taken over a single one-year period can provide a good estimation of the winds and wind energy potential of a site. However, this is a fairly limited period and is only meaningful if we can place the period into a larger climatological context. There are three long-term wind sites in the area surrounding the Sherman County site that can be used for various comparisons. All of these are owned and maintained by the Bonneville Power Administration as part of its long-term wind monitoring network. The location and site information for these sites is shown in Table 5.

Table 5: Information about long-term BPA monitoring sites:

Site ID	Site Name	Latitude dd-mm-ss	Longitude dd-mm-ss	Elev. (ft)	Sensor Ht (ft)	Period of Record
SL	Sevenmile Hill	45-38-56	121-16-20	1880	50	Oct. 1978 - Present
WO	Wasco	45-30-58	120-46-40	2391	100	Sept. 2005 – Present
GU	Goodnoe Hills	45-47-31	120-33-46	2540	195	May 1980 - Present

Comparison with BPA- Wasco

Since the BPA-Wasco site has been active for a limited time it cannot be used to determine the climatological significance of the current monitoring period. However a comparison of the monthly means with the Sherman County site is useful (Table 6). This comparison show the two sites are in general agreement except during a few isolated months. The biggest difference was during November when the BPA-Wasco site had a much higher observed monthly mean. This is likely due to the direction from which storms approach the area and the orientation of the ridge that the BPA site is located on. The Sherman County tower did show slightly higher wind during July when the winds are typically from the west. Overall, the two sites are in general agreement. Linear correlation of hourly averages is on the order of 0.68 for this annual period.

Table 6: Comparison of monthly means from two levels of the Sherman County site and the nearby BPA-Wasco site.

Month	Sherman CO. 50m Mean (mph) 2006-2007	Sherman CO. 30m Mean (mph) 2006-2007	Wasco-BPA Mean (mph) 2006-2007	50m - Wasco Difference (mph)	30m - Wasco Difference (mph)
May	13.7	12.8	12.9	0.8	-0.1
Jun	14.8	13.8	13.4	1.4	0.4
Jul	15.9	14.9	14.2	1.7	0.7
Aug	14.7	13.8	13.4	1.3	0.4
Sep	13.5	12.7	12.7	0.8	0.0
Oct	12.9	12.2	12.1	0.8	0.1
Nov	12.2	11.6	15.1	-2.9	-3.5
Dec	11.0	10.0	11.4	-0.4	-1.4
Jan	11.6	11.0	11.5	0.1	-0.5
Feb	10.8	10.4	11.8	-1.0	-1.4
Mar	12.4	11.8	12.1	0.3	-0.3
Apr	13.8	13.2	12.8	1.0	0.4
ANN	13.2	12.4	12.8	0.4	-0.4

Comparison with Sevenmile Hill and Goodnoe Hills:

It appears that the Sherman County site has similar wind characteristics to those at both Sevenmile Hill and Goodnoe Hills. Linear correlation of hourly values are 0.6742 between the 50 meter level and the upper level (195') of Goodnoe Hills and 0.6534 for the 50' level at Sevenmile Hill. Sevenmile Hill is a bit more protected from the south and southwest and the influence of storm generated winds. What is desired at this point is to evaluate the current annual study period to determine to what degree it might be considered normal. Table 7 shows the long-term normals, the monthly means for the study period and the departure of these means. For the period as a whole the records from both sites show the wind were very close to normal (+3.3% at Sevenmile Hill and +0.9% at Goodnoe Hills). Several of the months show variability greater than this but as a whole this is a good indication that the annual period for which winds have been observed at the Sherman County site should be representative of the long-term mean conditions at the site.

Table 7: Monthly mean and departures for winds at the 195' level at Goodnoe Hills and the 50' level at Sevenmile Hill.

GOODNOE HILLS 195'			
Month	Normal (mph) 1980-2007	Mean (mph) 2006-2007	Departure (%)
May	16.7	15.2	-9.0
Jun	17.1	16.2	-5.3
Jul	16.6	17.1	3.0
Aug	15.5	14.9	-3.9
Sep	13.9	13.8	-0.7
Oct	13.3	14.3	7.5
Nov	13.3	15.8	18.8
Dec	11.6	10.9	-6.0
Jan	12.9	11.8	-8.5
Feb	12.6	12.9	2.4
Mar	14.1	15.5	9.9
Apr	16.0	16.7	4.4
ANN	14.5	14.6	0.9

SEVENMILE HILL 50'			
Month	Normal (mph) 1978-2007	Mean (mph) 2006-2007	Departure (%)
May	18.9	15.8	-16.4
Jun	20.0	19.0	-5.0
Jul	21.3	23.3	9.4
Aug	19.7	21.1	7.1
Sep	15.8	17.5	10.8
Oct	12.6	15.3	21.4
Nov	10.0	10.2	2.0
Dec	9.9	9.4	-5.1
Jan	10.2	10.1	-1.0
Feb	10.1	10.0	-1.0
Mar	13.0	14.4	10.8
Apr	15.6	16.8	7.7
ANN	14.8	15.2	3.3

5.0 SITE POWER CHARACTERISTICS

In order to evaluate the wind power potential at this site a number of quantities were computed using the collected wind data. As with the wind characteristics, hourly wind data was used to complete this work. The power density calculation requires air density. This is estimated assuming a standard atmosphere and the site elevation. The computed quantities include the mean and standard deviation of the hourly values, the recovery rate, the maximum one hour average, the available power, the frequency that the wind was observed within a wind speed range (12 mph to 60 mph) and the shear coefficient (alpha). These quantities are shown in Table 2 and reveal a number of things about the potential for generating energy at the site.

Table 3: Observed and computed power quantities for the Sherman County 50 meter site. Values shown are for the 50 meter (165 ft.) level. The shear factor is for the e 30 meter (98 ft.) to 50 meter (165 ft.) levels.

Month	Mean	Std.	Recovery	Max 1-Hr	Time in Range (12-60)	Available Energy	Shear Factor	Shape	Scale
	(mph)	(mph)	Rate (%)	(mph)	mph (%)	KWh/m**2		Factor	Factor
May	13.7	6.9	100.0	35.7	56.5	177	0.127	2.11	15.5
Jun	14.8	7.2	100.0	34.8	65.6	208	0.124	2.17	16.7
Jul	15.9	6.3	97.7	35.5	70.8	231	0.119	2.71	17.9
Aug	14.7	7.0	100.0	37.6	62.5	209	0.118	2.24	16.6
Sep	13.5	7.5	100.0	48.0	54.7	186	0.124	1.91	15.2
Oct	12.9	6.9	99.3	39.4	52.6	157	0.109	1.98	14.5
Nov	12.2	7.0	100.0	36.6	44.6	147	0.097	1.66	13.7
Dec	11.4	7.8	73.4	50.7	40.8	159	0.188	1.50	12.6
Jan	11.6	8.3	81.2	42.2	40.2	177	0.102	1.45	12.8
Feb	10.8	7.1	95.7	44.5	33.1	117	0.075	1.57	12.0
Mar	12.4	7.4	98.3	36.0	46.9	163	0.097	1.76	14.0
Apr	13.8	6.3	96.0	31.5	57.6	161	0.094	2.36	15.6
ANN	13.2	7.3	95.1	50.7	52.7	2101	0.113	1.91	14.9

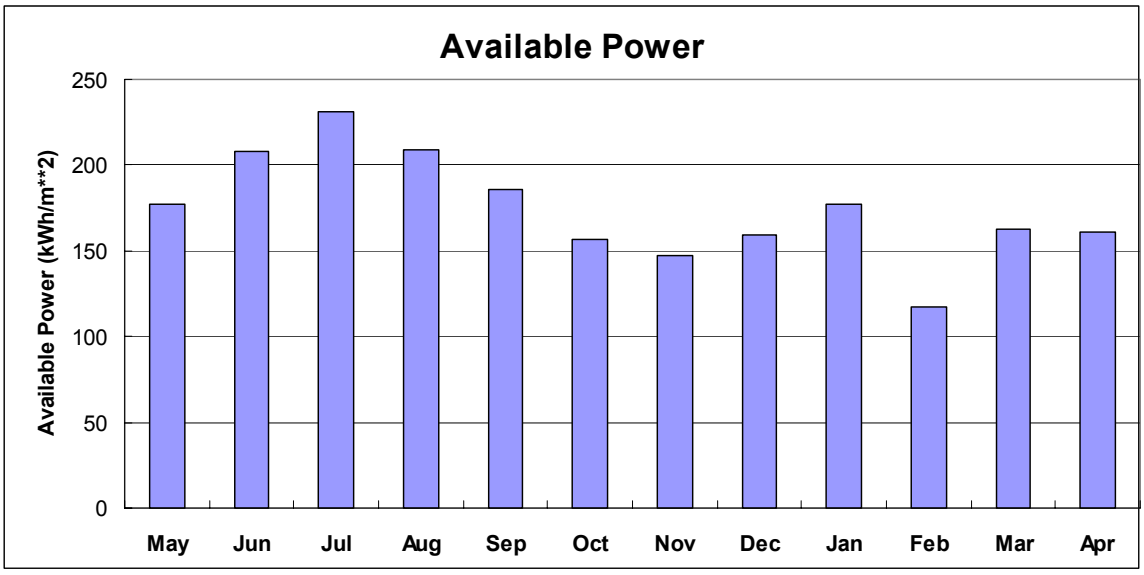


Figure 6: Monthly available power for the 50 meter (165 ft.) levels at the Sherman County 50 meter Site.

An analysis program was run to evaluate the energy that could be produced by two separate wind turbine types. To do this an analysis program was run that adjusts the site Weibul distribution using the shear coefficient (alpha) calculated from the hourly values (from 98 ft. to 165 ft.). Density variations are approximated using the site elevation and a standard atmosphere. Two wind turbine types are shown for reference, a moderate sized Vestas 660 kW and a larger GE 1.5 MW. Table 4 compares the gross capacity factors for each month for the two wind turbines. Net capacity factor estimates would account for array losses, availability losses electric line and transmission losses, yaw, turbulence, control, blade soiling, icing and high wind cycling. While these losses would be dependent upon the design of the wind farm, a general estimate is that these losses could be in the range of eleven to fifteen percent. Using fifteen percent, the annual net capacity factor for the GE 1.5 MW would be 0.19 and the Vestas 660 kW would be 0.175.

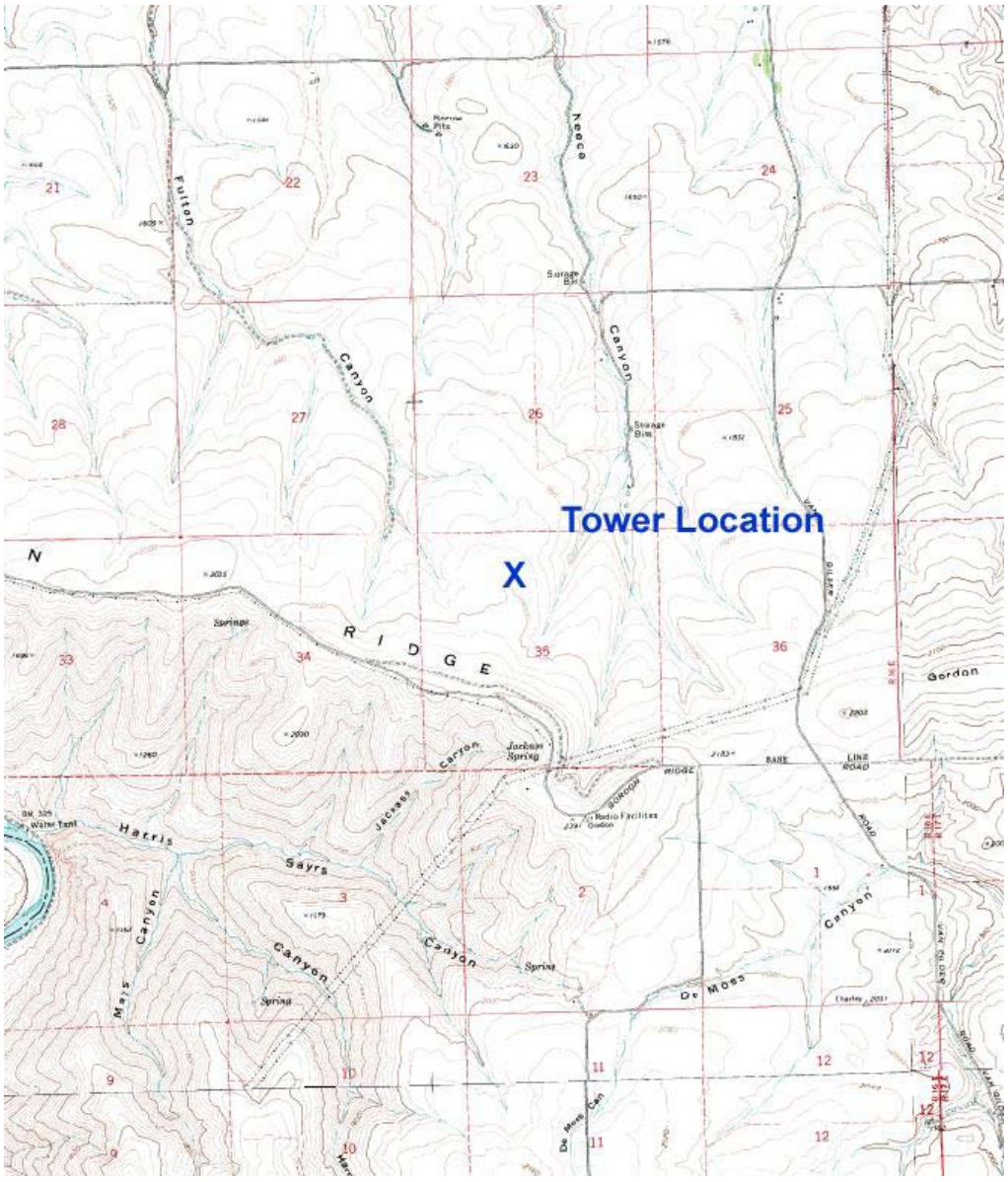
Table 4: Gross monthly and annual capacity factors for two wind turbine types.

Turbine	Vestas 47	GE Wind 70.5
Size (kW)	660	1500
Hub Ht. (ft.)	131	210
May	0.219	0.246
Jun	0.261	0.289
Jul	0.280	0.311
Aug	0.253	0.281
Sep	0.213	0.237
Oct	0.196	0.215
Nov	0.162	0.175
Dec	0.157	0.188
Jan	0.167	0.182
Feb	0.130	0.138
Mar	0.185	0.201
Apr	0.216	0.233
ANN	0.206	0.227

Summary,

1) The annual mean wind speed at this site was found to be 13.2 mph at the 50 meter level and 12.4 mph at the 30 meter level.
2) The measured shear coefficient between the 98 ft. and 165 ft. levels was 0.113.
3) Winds at the site were observed to be seasonal with light winds in the winter and somewhat stronger winds in the summer. Stronger winds tend to occur from the south and from the west.
4) Computed gross capacity factors for two sample wind turbine types were found in a range between 20 % and 23 %. Estimates of the net capacity factors are 17 % to 19 %.

Appendix A: Topographic map of the Sherman County Wind site.



Appendix B: Miscellaneous analysis Tables.

STATION - Sherman Co. 50 m (165' - H1)
WIND SPEED FREQUENCY DISTRIBUTION WITH NORMALIZED AVAILABLE ENERGY
DATA PERIOD OF RECORD - 5/2006 - 4/2007
NORMALIZATION PERIOD - ONE YEAR
AVERAGE WIND SPEED FOR PERIOD: 13.2 MPH
NORMALIZED AVAILABLE ENERGY: 2098.9 KWH/M2/YEAR**
TOTAL HOURS OBSERVED: 8351

SPD MPH	HOURS/ PERIOD	RELFREQ	CUMHRS	CUMRELFREQ	NORMALIZED AVAIL. ENERGY KWH/M**2/YEAR
0	0	0.00	8351	100.00	0.0
1	167	2.00	8351	100.00	0.0
2	245	2.93	8184	98.00	0.1
3	267	3.20	7939	95.07	0.4
4	264	3.16	7672	91.87	0.9
5	299	3.58	7408	88.71	2.0
6	356	4.26	7109	85.13	4.2
7	375	4.49	6753	80.86	7.0
8	434	5.20	6378	76.37	12.0
9	404	4.84	5944	71.18	15.9
10	437	5.23	5540	66.34	23.6
11	464	5.56	5103	61.11	33.4
12	465	5.57	4639	55.55	43.5
13	497	5.95	4174	49.98	59.1
14	431	5.16	3677	44.03	64.0
15	380	4.55	3246	38.87	69.4
16	348	4.17	2866	34.32	77.1
17	349	4.18	2518	30.15	92.8
18	309	3.70	2169	25.97	97.5
19	245	2.93	1860	22.27	90.9
20	260	3.11	1615	19.34	112.5
21	220	2.63	1355	16.23	110.2
22	197	2.36	1135	13.59	113.5
23	176	2.11	938	11.23	115.9
24	144	1.72	762	9.12	107.7
25	104	1.25	618	7.40	87.9
26	115	1.38	514	6.15	109.4
27	89	1.07	399	4.78	94.8
28	53	0.63	310	3.71	63.0
29	57	0.68	257	3.08	75.2
30	48	0.57	200	2.39	70.1
31	49	0.59	152	1.82	79.0
32	13	0.16	103	1.23	23.0
33	19	0.23	90	1.08	36.9
34	13	0.16	71	0.85	27.6
35	18	0.22	58	0.69	41.8
36	10	0.12	40	0.48	25.2
37	6	0.07	30	0.36	16.4
38	3	0.04	24	0.29	8.9
39	4	0.05	21	0.25	12.8
40	3	0.04	17	0.20	10.4
41	5	0.06	14	0.17	18.6
42	3	0.04	9	0.11	12.0
43	1	0.01	6	0.07	4.3
44	1	0.01	5	0.06	4.6
45	2	0.02	4	0.05	9.9
46	0	0.00	2	0.02	0.0
47	0	0.00	2	0.02	0.0
48	1	0.01	2	0.02	6.0
49	0	0.00	1	0.01	0.0
50	0	0.00	1	0.01	0.0
51	1	0.01	1	0.01	7.2

STATION - Sherman Co. 50 m (165' - H1)
MONTHLY WIND SPEEDS (MPH)
DATA PERIOD OF RECORD - 5/2006 - 4/2007

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	# OBS
2006	0.0	0.0	0.0	0.0	13.7	14.8	15.9	14.7	13.5	12.9	12.2	11.0	5682
# OBS	0	0	0	0	744	720	727	744	720	739	720	568	
2007	11.6	10.8	12.4	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2669
# OBS	604	643	731	691	0	0	0	0	0	0	0	0	

STATION - Sherman Co. 40 m (' - H2)
MONTHLY WIND SPEEDS (MPH)
DATA PERIOD OF RECORD - 5/2006 - 4/2007

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	# OBS
2006	0.0	0.0	0.0	0.0	13.0	14.0	15.2	14.1	13.0	12.5	12.1	10.5	5685
# OBS	0	0	0	0	744	720	727	744	720	744	720	566	
2007	11.4	10.7	12.1	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2658
# OBS	604	632	731	691	0	0	0	0	0	0	0	0	

STATION - Sherman Co. 30 m (98' - H3)
MONTHLY WIND SPEEDS (MPH)
DATA PERIOD OF RECORD - 5/2006 - 4/2007

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	# OBS
2006	0.0	0.0	0.0	0.0	12.8	13.8	14.9	13.8	12.7	12.2	11.6	10.0	5691
# OBS	0	0	0	0	744	720	727	744	720	744	720	572	
2007	11.0	10.4	11.8	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2656
# OBS	604	630	731	691	0	0	0	0	0	0	0	0	

STATION - Sherman County 50 m (165 ft.) (H1)
DIURNAL WIND SPEEDS (MPH)
DATA PERIOD OF RECORD - 5/2006 - 4/2007

MON	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	AVG SPD
JAN	11.0	10.2	11.3	11.2	11.2	10.6	9.6	10.4	10.5	10.3	10.3	10.2	10.4	11.1	11.7	11.6	12.5	13.2	13.8	13.8	14.3	13.8	14.0	12.6	11.6
FEB	10.6	10.9	11.7	11.5	11.1	10.8	10.1	9.4	10.0	9.9	10.1	8.7	9.7	9.6	9.7	10.9	11.5	11.9	11.1	11.1	11.6	11.5	12.3	12.1	10.8
MAR	12.5	11.7	11.4	11.6	11.4	11.0	11.7	11.4	11.5	11.6	10.2	9.6	10.0	10.7	12.2	13.0	13.5	14.7	16.0	14.6	14.8	15.1	14.7	13.6	12.4
APR	13.4	14.1	13.3	12.0	11.8	12.0	11.8	11.8	12.2	11.5	11.3	11.4	12.5	13.9	14.1	15.2	16.1	17.1	17.2	17.2	16.6	15.8	15.6	14.0	13.8
MAY	15.2	14.3	13.0	11.1	10.5	10.2	10.6	10.7	10.3	11.3	11.5	11.9	12.1	13.2	14.2	15.4	15.7	16.4	17.8	18.3	16.9	16.5	16.2	15.5	13.7
JUN	16.1	15.6	15.3	13.9	13.4	13.9	12.5	11.7	11.1	11.0	12.0	12.6	12.6	13.0	14.0	15.8	16.8	17.3	18.3	19.3	17.6	17.3	16.7	16.6	14.8
JUL	17.3	16.5	15.9	15.4	15.7	14.8	13.9	13.2	12.8	12.7	12.2	12.0	11.9	12.7	14.0	15.6	17.4	18.8	19.8	20.8	20.8	19.7	18.8	18.6	15.9
AUG	16.5	15.5	15.2	14.8	13.6	13.3	12.9	12.5	12.3	11.0	10.8	11.2	12.1	12.8	14.0	14.9	15.5	16.6	17.8	17.9	17.7	18.2	18.2	17.9	14.7
SEP	14.5	13.1	12.3	12.2	11.9	11.9	11.6	10.7	11.0	10.9	10.7	10.9	11.9	12.7	13.6	14.2	15.8	15.9	15.3	16.0	17.4	17.5	16.5	15.8	13.5
OCT	14.4	13.9	13.6	13.4	13.1	13.4	12.3	12.0	11.9	11.8	11.1	10.6	10.8	11.5	11.4	11.9	12.7	13.1	12.9	14.7	15.0	14.9	14.9	13.9	12.9
NOV	12.7	12.8	12.0	11.7	11.1	11.2	11.8	11.1	10.8	11.2	11.5	11.5	11.3	12.2	12.5	13.1	13.3	13.0	12.8	13.5	13.9	12.8	12.5	11.6	12.2
DEC	10.7	10.8	10.6	12.6	12.3	11.3	11.7	10.9	9.8	10.6	11.6	11.6	11.2	10.2	10.1	10.8	10.6	10.0	10.4	11.4	11.8	11.6	11.0	11.4	11.0
AVG SPD	13.9	13.4	13.1	12.7	12.3	12.1	11.8	11.4	11.2	11.2	11.1	11.0	11.4	12.0	12.7	13.6	14.4	14.9	15.4	15.8	15.8	15.5	15.2	14.6	13.2

STATION - Sherman Co. 50 m (165' - H1)
WIND ROSE FOR ALL DATA - 8351 OBSERVATIONS
DATA PERIOD OF RECORD - 5/2006 - 4/2007

SPEED CATEGORIES(MPH)

DIR	0 TO 10	10 TO 13	13 TO 16	16 TO 19	19 TO 22	22 TO 25	25 TO 28	28 TO 31	31 TO 34	34 TO 37	37 TO 40	40 TO 43	43 TO 46	46 TO 49	49 TO 52	52 TO 55	>= 55	TOTAL %	MEAN SPEED (MPH)
N	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	4.4
NNE	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	4.5
NE	1.5	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	6.9
ENE	2.3	0.9	0.6	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	10.0
E	4.0	2.0	1.7	1.3	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.1	11.7
ESE	1.7	0.8	0.6	0.4	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	10.7
SE	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	7.1
SSE	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	6.1
S	1.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	6.8
SSW	3.1	1.0	0.5	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	12.5
SW	3.3	1.8	0.9	0.4	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	11.7
WSW	5.3	4.6	4.1	2.6	1.0	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.7	12.9
W	5.4	4.0	5.4	5.8	5.5	3.7	2.6	1.3	0.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	34.7	17.3
WNW	1.9	0.9	0.5	0.2	0.2	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	12.3
NW	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	5.2
NNW	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	4.1
CALM																		0.0	
TOTAL %	36.4	16.7	14.6	11.4	8.5	5.6	3.4	1.8	0.8	0.5	0.1	0.1	0.0	0.0	0.0	0.0	0.0	100.0	13.2

NOTE: MEAN SPEED OF THE TOTAL IN A WIND ROSE MAY DIFFER FROM THE SPEED FREQUENCY DISTRIBUTION FOR A GIVEN PERIOD DUE TO DATA SELECTION. SPEED FREQUENCY DISTRIBUTIONS REQUIRE ONLY A WIND SPEED OBSERVATION BE PRESENT. WIND ROSES, ON THE OTHER HAND, REQUIRE BOTH SPEED AND DIRECTION BE PRESENT FOR EACH OBSERVATION.

STATION - Sherman Co. 50 m (165' - H1)
ENERGY ROSE (TOTALS ARE NORMALIZED AVAILABLE ENERGY (KWH/M2)**
DATA PERIOD OF RECORD - 5/2006 - 4/2007

MON	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	OBS.	NORM.
JAN	0.0	0.0	0.0	5.9	7.1	4.8	0.2	0.0	0.1	45.1	25.2	27.0	62.4	0.0	0.0	0.0	178.0	604	744
FEB	0.0	0.0	0.0	0.4	8.0	6.5	1.1	0.6	0.9	32.7	9.2	17.8	39.8	0.2	0.0	0.0	117.3	643	672
MAR	0.0	0.0	0.1	2.0	7.9	0.8	0.0	0.1	0.3	0.7	25.1	14.5	101.7	10.0	0.2	0.1	163.5	731	744
APR	0.0	0.0	0.3	4.9	11.7	1.3	0.2	0.1	0.0	0.2	1.4	17.2	106.3	18.3	0.2	0.0	162.0	691	720
MAY	0.3	0.1	3.7	9.5	11.2	3.5	0.2	0.8	0.1	0.5	1.9	11.3	107.8	25.4	0.1	0.4	176.9	744	744
JUN	0.1	0.1	0.2	3.2	8.4	0.5	0.4	0.0	0.2	0.2	0.6	10.9	173.8	9.1	0.3	0.1	208.0	720	720
JUL	0.1	0.5	0.4	1.9	2.1	0.0	0.0	0.0	0.1	0.8	4.0	34.4	177.8	8.9	0.1	0.0	230.9	727	744
AUG	0.3	0.3	1.2	2.5	4.8	0.7	0.0	0.0	0.0	0.1	2.9	36.7	158.0	2.0	0.3	0.1	210.0	744	744
SEP	0.3	0.2	0.4	6.1	13.8	1.0	0.1	0.0	0.0	0.9	1.5	32.1	125.3	5.0	0.1	0.1	186.9	719	720
OCT	0.0	0.1	1.4	4.4	24.9	2.3	0.4	0.2	0.1	1.9	4.8	34.3	81.2	1.5	0.0	0.0	157.5	739	744
NOV	0.0	0.0	0.0	0.7	6.1	4.1	0.9	0.5	2.9	69.0	18.8	21.1	22.5	0.9	0.1	0.0	147.7	719	720
DEC	0.0	0.0	0.0	0.1	19.1	17.2	0.6	0.7	2.2	10.6	41.4	25.2	35.7	0.1	0.0	0.0	153.0	568	744
TOT	1.1	1.4	8.0	41.6	125.0	42.6	4.3	3.1	7.0	162.6	137.0	282.5	1192.2	81.4	1.4	0.7	2091.8	8349	8760

NOTE: AVAILABLE ENERGY IN AN ENERGY ROSE MAY DIFFER FROM THE SPEED FREQUENCY DISTRIBUTION FOR A GIVEN PERIOD DUE TO DATA SELECTION. SPEED FREQUENCY DISTRIBUTIONS REQUIRE ONLY A WIND SPEED OBSERVATION BE PRESENT. ENERGY ROSES, ON THE OTHER HAND, REQUIRE BOTH SPEED AND DIRECTION BE PRESENT FOR EACH OBSERVATION.

Supplemental Analysis
Sherman County Wind Sites
March 15, 2007

A group of landowners and interested parties have been evaluating the wind energy potential of the area around the town of Wasco in Sherman County since early 2002. This group was successful in securing funding for a fifty meter monitoring tower that was installed in April 2006. This evaluation is meant to supplement the evaluation of the 50 meter tower and to provide additional information about the winds in the region of interest.

Existing Sherman County Sites:

1. McCoy Home:

Latitude: 45-35-18.28 Longitude: 120-43-37.49 Elevation: 1326 ft.

This site is located about 1.5 miles west of the town of Wasco. The area consists mostly of rolling hills used for dry wheat production. Some subtle variation in terrain elevation exists and there are a few deep gullies or canyons that bisect the region. A thirty meter tower was installed at the site on May 2002 with speed sensors at the 10m and 30m levels and a single direction sensor at the 30m level.

2. McCoy Ridge:

Latitude: 45-31-58.34 Longitude: 120-45-34.39 Elevation: 1921 ft.

This site is located further south and west on what is labeled Gordon Ridge. The terrain appears similar to the McCoy Home site but with a slightly higher elevation and more variation in terrain. A thirty meter tower was installed at the site on May 2002 with speed sensors at the 10m and 30m levels and a single direction sensor at the 30m level.

New Sherman County Site:

1. Sherman 50m:

Latitude: 45-31-47 Longitude: 120-47-03 Elevation: 2004 ft.

This site is located just to the west of the McCoy Ridge site, just below Gordon Ridge. The tower was installed at the site on April 17, 2006 with instrumentation at three levels (30m 40m and 50m). The ERRL was not involved in the placement or installation of this tower.

Data Processing and Checking:

All of these data sites used NRG equipment including Maxium #40 anemometers and Symphony data loggers. Raw Symphony data files were provide for this analysis from the McCoy sites. Data from the 50m site were extracted from MMC cards mailed to the ERRL by the landowner. NRG Symphony software was used to read these files and produce monthly files of wind speed, direction and standard deviation of direction. These files were then converted to an internal ERRL format to accommodate data checking and to perform analysis using existing program. In this process each level/site combination is assigned a two digit site code. Theses codes are listed in Table 1.

Data were also scanned manually to identify sustained periods in which ice was believed to be present. Periods lasting over a day or so were removed from the records (values set to missing). This was done for the speed and standard deviation of speed only. Other, shorter periods likely exist in the data but the identification of all periods is beyond the scope of the work to be conducted here.

Table 1: Information about Sherman County wind monitoring sites.

Site ID	Site Name	Latitude dd-mm-ss	Longitude dd-mm-ss	Elev. (ft)	Sensor Ht (ft)	Period of Record
M1	McCoy Home	45-35-18	120-43-38	1326	99	May 15 2002 - Dec 31, 2006
M2	McCoy Home	45-35-18	120-43-38	1326	33	May 15 2002 - Dec 31, 2006
M3	McCoy Ridge	45-31-59	120-45-35	1921	99	May 15 2002 - Dec 31, 2006
M4	McCoy Ridge	45-31-59	120-45-35	1921	33	May 15 2002 - Dec 31, 2006
H1	Sherman 50m	45-31-47	120-47-03	2004	165	April 17 2006 - April 29,2007
H2	Sherman 50m	45-31-47	120-47-03	2004	133	April 17 2006 - April 29,2007
H3	Sherman 50m	45-31-47	120-47-03	2004	98	April 17 2006 - April 29,2007

Site Wind Summaries:

In order to gain a basic understanding of the overall wind resource in these areas, some basic wind statistics have been computed and can be used to characterize the winds and the wind resources in this area. This characterization is done using data from the 30 meter levels at the McCoy Home and McCoy Ridge sites only. Data have been collected at these sites for several years and can be used to characterize the winds in this area better than using the limited period over which winds are available at the new 50 meter tower.

Monthly Mean Wind Speeds:

The monthly mean wind speed values are shown in Figure 1 for both the 30 meter levels of the McCoy Home (M1) and McCoy Ridge (M3) sites for the entire time period over which measurements have been collected. Full tables of the values can be found in the Appendix. Several characteristics are apparent. First, there is a regular and defined seasonal pattern of stronger winds during the summer months and weaker winds during winter. In addition, the McCoy Home site appears to have slightly stronger winds during the summer peak months. It also has a slightly higher mean wind speed overall (13.7 mph for M1 and 13.0 mph for M3)

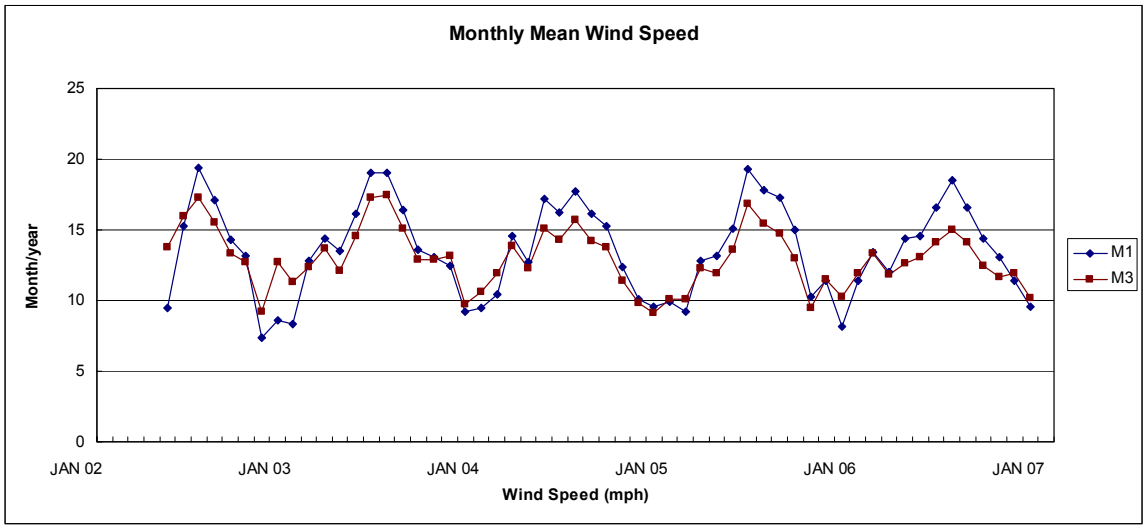


Figure 1: Monthly mean wind speed from 30 meter levels of two existing sites in Sherman County, the McCoy Home (M1) and McCoy Ridge (M3) sites

Wind Rose:

The frequency and mean wind speed at the 30 meter tower sites for each of 17 wind direction categories are shown in Figures 2a-b. It is clear that the winds come most often from the west at both of these sites and that are only slight differences between the two locations. The McCoy Home site (M1) has a slightly higher mean wind in the West category and a slightly higher mean wind speed (17.8 mph for M1 and 15.8 mph for M3). This likely explains the slightly higher overall mean wind speed and is likely a result of the more southerly location of the McCoy Ridge site. During the peak summer wind periods this site is just enough south to get slightly lower winds.

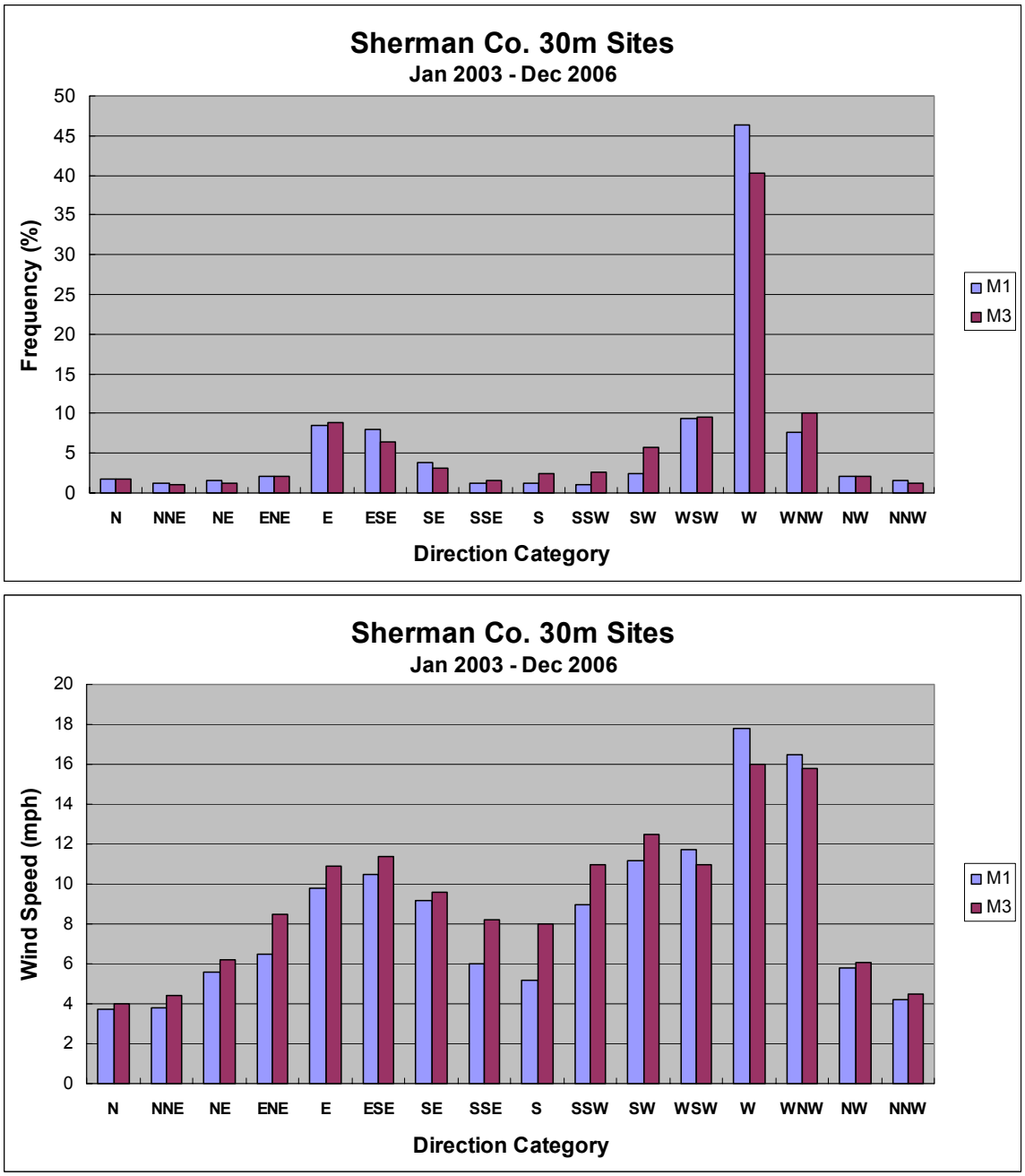


Figure 2a-b: Wind rose showing the frequency (a) and wind speed (b) of 17 wind categories for the 30 meter levels of two existing sites in Sherman County, the McCoy Home (M1) and McCoy Ridge (M3) sites

Frequency Distributions:

The biggest difference between the two sites can be seen in the frequency distributions (Figure 3). The McCoy Home site (M1) has a much broader distribution and higher frequencies for the higher wind speed categories. The McCoy Ridge site has a more defined peak in the distribution between 8 mph and 12 mph and somewhat lower frequencies for the higher wind speed categories. The interesting part is the higher frequencies at the McCoy Home site in the lowest categories, suggesting the site experiences more periods of near calm winds.

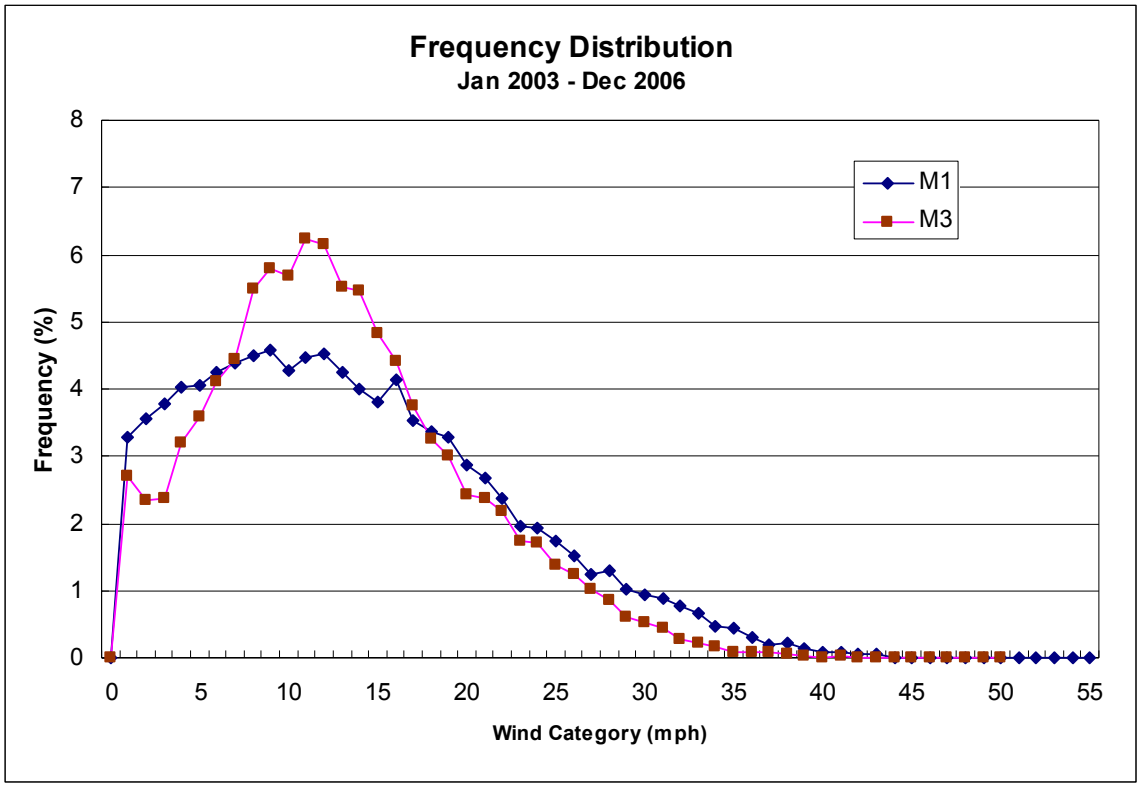


Figure 3: Frequency distribution for the 30 meter levels of two existing sites in Sherman County, the McCoy Home (M1) and McCoy Ridge (M3) sites

50 Meter Tower Comparison:

In the previous section it was clear that the existing sites for which multiple year of data are available are fairly similar to one another but show a few potentially important differences. In this section data from the new 50 meter are compared to the existing sites to gage its relevance. After a visual comparison, the wind characteristics from the 30m level of the new 50m site appear to be very similar to those at the McCoy Ridge site.

This was expected due to the closeness of the sites. To examine this further, the frequency distribution of the 30m levels have been plotted together (Figure 4) for the period May 2006 to December 2006 when both sites were exposed to the same conditions. Although some variation exists the two curves are essentially identical and will allow us data from the McCoy Ridge to characterize conditions in the area. The longer record of the McCoy Ridge site will be useful in characterizing long-term variations at the site.

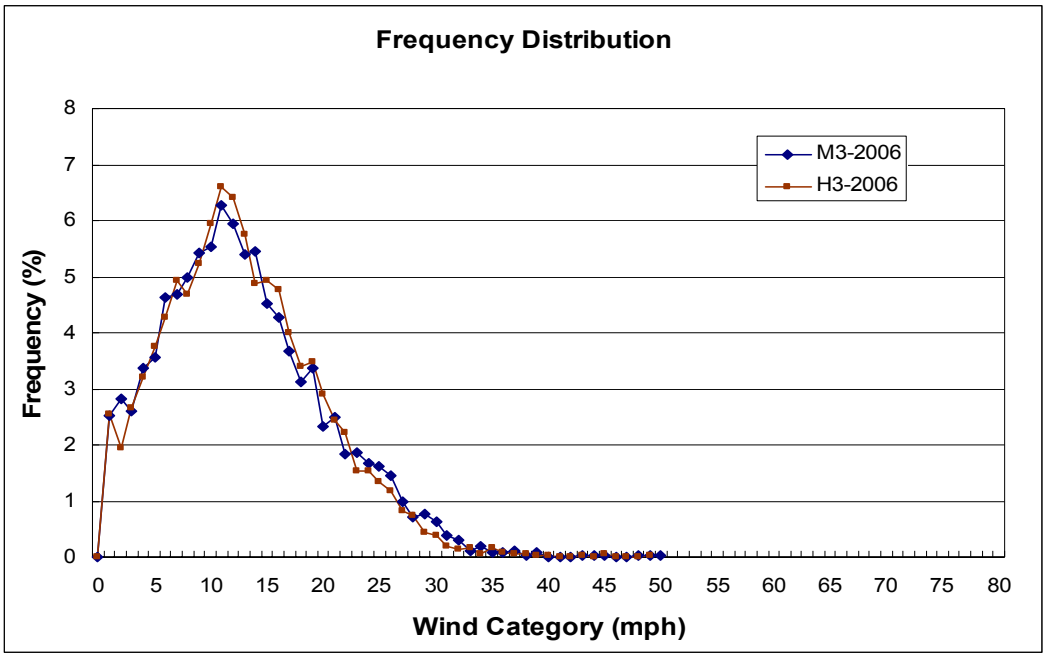


Figure 4: Frequency distribution of 30 meter levels at McCoy Ridge (M3) and the 30 meter level of the new 50m Tower for the period May 2006 to December 2006.

It is also of interest here to compare the wind characteristics at 50 meters with those at the 30 meter level. The frequency distribution for both the 30 meter and 50 meter levels of the 50 meter tower are shown in Figure 5. The relationship between the two levels is about what would be expected from a site with moderate shear. In figure 6a-b is the

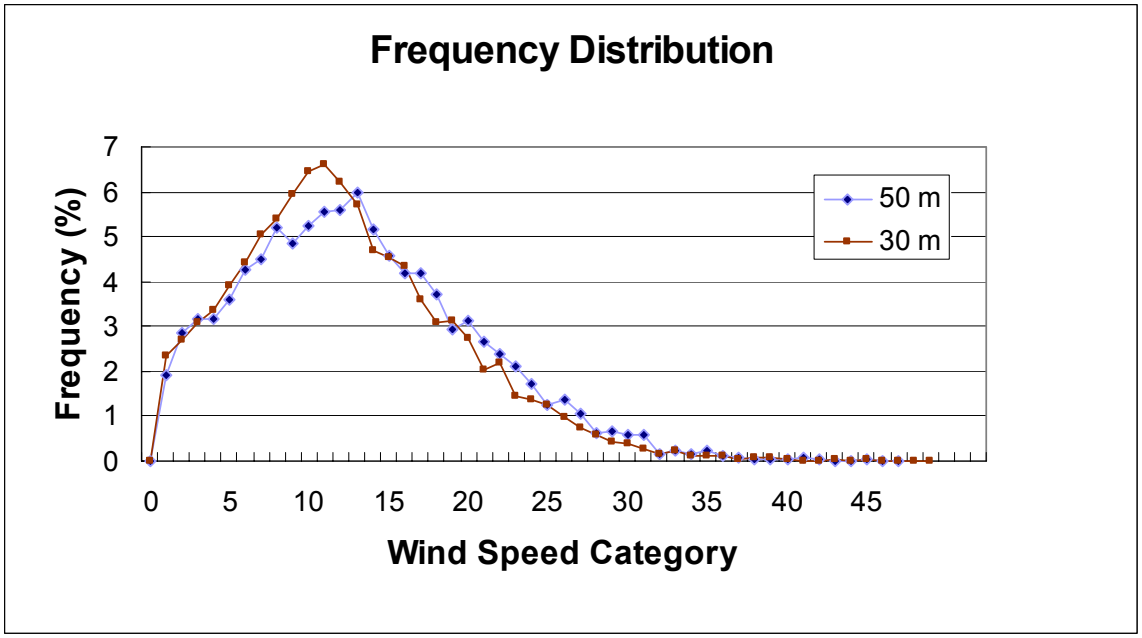


Figure 5: Frequency distribution of 30 meter level (H3) and 50 meter level of the 50m Tower for the period May 2006 to April 2007.

We can also compare the wind rose from these two sites to see if there is any significant variation with height. The frequency portion is shown in Figure 6. It appears that at higher levels the wind is straight West more often while at lower levels winds from the SW and WSW occurred more often.

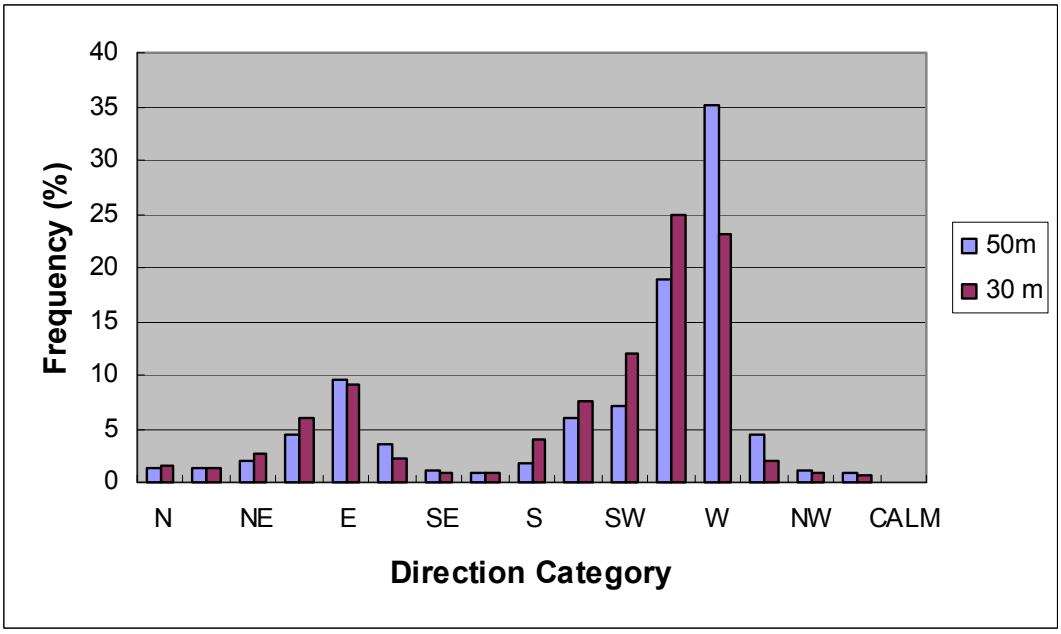


Figure 6: Frequency of winds from 17 direction categories for the 30 meter level (H3) and 50 meter level of the new 50m Tower for the period May 2006 to April 2007.

Climatological Context:

The frequency distribution in the previous section will allow power estimates to be made as well as estimates of capacity factors for specific wind turbines (with the proper assumptions. One of the important questions is how well the observations used to this point represent the long-tem conditions at the site. What we essentially seek to do is use the variability at one of a number of sites with longer data records to answer several questions about the winds at in this area. There are several sites in the area that could be used for this process. These are part of a network operated and managed by the Bonneville Power Administration.

Table 2: location and information for BPA long-term monitoring sites.

Site ID	Site Name	Latitude dd-mm-ss	Longitude dd-mm-ss	Elev. (ft)	Sensor Ht (ft)	Period of Record
SL	Sevenmile Hill	45-38-56	121-16-20	1880	50	Oct. 1978 - Present
WO	Wasco	45-30-58	120-46-40	2391	100	Sept. 2005 – Present
GU	Goodnoe Hills	45-47-31	120-33-46	2540	195	May 1980 - Present
KZ	Kennewick	46-06-15	119-07-43	2200	86	June 1976 - Present

To narrow this list down, monthly means from the two 30 meter sites were correlated to monthly means at the sites in table 4. The linear correlation provides an indication of how well variations in one variable relate to variations in another. By using Monthly means we are essentially examining the relationships between seasonal variations at the different sites. Results for the two best sites are provided below and suggest that Sevenmile Hill would represent this variation better than Goodnoe Hills.

Correlation	GU	SL
M1	0.7679	0.9633
M3	0.7046	0.8759

A comparison of the four year period for which data is available at the 30 meter sites with the long-term conditions at Sevenmile Hill shows that at Sevenmile Hills the winds for this period were 2.1 % below normal. Individual months may show differences but this suggests that the current period of analysis adequately represents long-term conditions in the area. If this value was large an adjustment might be warranted but these levels are likely within any margin of error of observations.

SEVENMILE HILL 50'		
Normal (mph) 1978-2007	Mean (mph) 2003-2006	Departure (%)
14.5	14.2	-2.1

Shear Analysis:

The purpose of the new 50 meter tower is to provide better estimates of the shear in the region. Using the 30 meter towers an estimation of the shear could be obtained using the 10 meter and 30 meter winds. The problem with this is that there can be a great deal of turbulence and fluctuation of the winds at 10m. Shear values computed in this lower layer are not always a good indication of the shear at upper levels.

Shear values were computed using wind speed values from the 50 meter and 30 meter levels of the tower. The shear values are shown in table 2. For the most part the months are fairly consistent except for a few notable exceptions. A further look at the wind observations indicated that the high value during December is likely associated with a high frequency of East winds. During December the winds came from the east on the order of 35 % of the time compared to about 1-15 % for other months. The other months had lower values and were in general agreement. When averaged over the whole period the shear value is 0.113.

Table 3: Wind and shear information from the Sherman County 50 meter Tower.

Month	50 m	Std.	30 m	Std.	Shear Factor
	(mph)	(mph)	(mph)	(mph)	
May	13.7	6.9	12.8	6.5	0.127
Jun	14.8	7.2	13.8	6.7	0.124
Jul	15.9	6.3	14.9	5.9	0.119
Aug	14.7	7.0	13.8	6.5	0.118
Sep	13.5	7.5	12.7	6.9	0.124
Oct	12.9	6.9	12.2	6.3	0.109
Nov	12.2	7.0	11.6	7.3	0.097
Dec	11.4	7.8	10.3	7.4	0.188
Jan	11.6	8.3	11.0	8.1	0.102
Feb	10.8	7.1	10.4	6.9	0.075
Mar	12.4	7.4	11.8	6.9	0.097
Apr	13.8	6.3	13.2	5.7	0.094
ANN	13.2	7.3	12.5	6.9	0.113

Estimated 80 meter winds:

The shear values identified above are used to obtain estimates of the near hub-height winds (80 meter) at the nearby sites with longer term data record. Using the mean alpha coefficient of 0.113, hourly values from the 30 meter winds at the McCoy Home (M1) and McCoy Ridge (M3) sites are adjusted to produce a frequency distribution for the period January 2003 through December 2006. Data only from complete years are used so that no seasonal bias is introduced. The results can be found in Table 4 showing the frequency and annualized frequency for each site. This can be compared to turbine power curves to obtain estimates of power that can be produced on an annual basis. ***Elevation and density consideration have not been accounted for in this process.***

Frequency Distribution: Annualized
Site = Sherman Co. - Estimated 80m Speed, McCoy Home (M6), McCoy Ridge (M7)
Period: January 2003 to December 2006
From Hourly Averages. Adjustments made using alpha = 0.113

Speed (mps)	Frequency M6	Annualized M6	Frequency M7	Annualized M7
0	0.02010	176.11	0.01837	160.92
1	0.07135	625.05	0.04672	409.24
2	0.07835	686.35	0.06141	537.98
3	0.08701	762.22	0.08295	726.64
4	0.08761	767.50	0.10610	929.44
5	0.09137	800.41	0.12124	1062.10
6	0.08658	758.45	0.11865	1039.33
7	0.07987	699.66	0.10473	917.39
8	0.07864	688.86	0.08704	762.49
9	0.06582	576.57	0.06461	565.98
10	0.05968	522.81	0.05117	448.23
11	0.04617	404.48	0.04185	366.59
12	0.03616	316.80	0.03178	278.41
13	0.03029	265.30	0.02458	215.35
14	0.02363	207.01	0.01562	136.85
15	0.01939	169.83	0.01096	96.03
16	0.01460	127.87	0.00588	51.54
17	0.00995	87.18	0.00284	24.86
18	0.00594	52.01	0.00161	14.13
19	0.00373	32.66	0.00108	9.42
20	0.00195	17.08	0.00039	3.40
21	0.00112	9.79	0.00015	1.31
22	0.00023	2.01	0.00012	1.04
23	0.00026	2.26	0.00003	0.26
24	0.00009	0.75	0.00006	0.53
25	0.00006	0.50	0.00006	0.53
26	0.00003	0.25	0.00000	0.00
27	0.00003	0.25	0.00000	0.00
28	0.00000	0.00	0.00000	0.00
29	0.00000	0.00	0.00000	0.00
30	0.00000	0.00	0.00000	0.00
Sum	1.00	8760.0	1.00	8760.0

Cold Temperature Analysis:

A request was made to examine temperature influences and to characterize the winds and potential power production during periods of cold temperatures. Cold temperatures are considered to be anything at or below 15 deg. F. The temperature records from the 50 meter tower were not working so records from the BPA-Wasco site will be used. This will be limited to the winds observed at the 50 meter tower site due to its proximity.

For the period between September 2005 and April 2007, there were 168 hourly observations of winds that correspond to temperatures at or below 15F. Of these, all but a few involved winds from the east. The highest hourly mean wind speed observed was 44.8 mph. The cold periods appear to occur in episodes and were not observed during several of the winter months.

To try and estimate the influence this might have on energy production, frequency distributions similar to those in the previous section were produced using data from the 50 meter tower. This table shows the distribution of winds adjusted to 80 meters, the distribution of the adjusted winds during the cold periods (100 cases) and the difference between the two. When used in conjunction with a power curve this would provide an estimate of the amount of power that could be generated during these cold conditions. However, this is specific only to this period. Although there appear to be relatively few hours in such conditions during other years may be substantially different.

Frequency Distribution
Site = Sherman Co. - Estimated 80m Speed from 50m level of 50m tower (H1)
Period: May 1, 2006 - April 29, 2007
From Hourly Averages. Adjustments made using alpha = 0.113

Speed (mps)	All Data			Temp <= 15.0F			Difference		
	Number	Frequency	Annualized	Number	Frequency	Annualized	Number	Frequency	Annualized
		N= 8646			N=100			N=8546	
0	63	0.0073	63.83	1	0.0001	1.01	62	0.0072	62.82
1	531	0.0614	538.00	6	0.0007	6.08	525	0.0607	531.93
2	600	0.0694	607.91	5	0.0006	5.07	595	0.0688	602.84
3	799	0.0924	809.54	8	0.0009	8.11	791	0.0915	801.43
4	914	0.1057	926.05	19	0.0022	19.25	895	0.1035	906.80
5	1014	0.1173	1027.37	23	0.0027	23.30	991	0.1146	1004.07
6	1047	0.1211	1060.80	29	0.0034	29.38	1018	0.1177	1031.42
7	827	0.0957	837.90	7	0.0008	7.09	820	0.0948	830.81
8	766	0.0886	776.10	2	0.0002	2.03	764	0.0884	774.07
9	575	0.0665	582.58	0	0.0000	0.00	575	0.0665	582.58
10	477	0.0552	483.29	0	0.0000	0.00	477	0.0552	483.29
11	366	0.0423	370.83	0	0.0000	0.00	366	0.0423	370.83
12	248	0.0287	251.27	0	0.0000	0.00	248	0.0287	251.27
13	157	0.0182	159.07	0	0.0000	0.00	157	0.0182	159.07
14	112	0.0130	113.48	0	0.0000	0.00	112	0.0130	113.48
15	69	0.0080	69.91	0	0.0000	0.00	69	0.0080	69.91
16	28	0.0032	28.36	0	0.0000	0.00	28	0.0032	28.36
17	28	0.0032	28.36	0	0.0000	0.00	28	0.0032	28.36
18	6	0.0007	6.08	0	0.0000	0.00	6	0.0007	6.08
19	9	0.0010	9.12	0	0.0000	0.00	9	0.0010	9.12
20	5	0.0006	5.06	0	0.0000	0.00	5	0.0006	5.06
21	3	0.0003	3.04	0	0.0000	0.00	3	0.0003	3.04
22	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00
23	1	0.0001	1.02	0	0.0000	0.00	1	0.0001	1.02
24	1	0.0001	1.02	0	0.0000	0.00	1	0.0001	1.02
25	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00
26	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00
27	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00
28	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00
29	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00
30	0	0.0000	0.00	0	0.0000	0.00	0	0.0000	0.00

Appendix: Monthly Mean Tables

STATION – McCoy Home M1 30 m
MONTHLY WIND SPEEDS (MPH)
DATA PERIOD OF RECORD - 1/2003 - 12/2006

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	# OBS	AVG
2003	8.2	12.9	14.3	13.5	16.0	19.0	18.9	16.5	13.7	13.0	12.5	9.1	8759	13.97
# OBS	744	672	744	720	744	720	744	744	720	744	720	743		
2004	9.3	10.5	14.5	12.8	17.1	16.2	17.6	16.0	15.6	12.4	10.0	9.6	8696	13.53
# OBS	705	696	744	720	744	720	744	744	720	744	720	695		
2005	9.9	9.3	12.7	13.3	14.9	19.3	17.8	17.4	14.9	10.4	11.2	8.3	8673	13.37
# OBS	731	672	744	720	744	720	744	744	720	744	720	670		
2006	11.4	13.4	12.0	14.4	14.6	16.6	18.5	16.6	14.4	13.1	11.4	9.6	8741	13.84
# OBS	744	672	744	720	744	720	744	744	720	744	720	725		
AVG	9.7	11.5	13.4	13.5	15.7	17.8	18.2	16.6	14.7	12.2	11.3	9.2	34869	13.67
SD	1.3	1.9	1.2	0.6	1.2	1.6	0.6	0.6	0.8	1.3	1.0	0.6		

STATION – McCoy Ridge M3 30 m
MONTHLY WIND SPEEDS (MPH)
DATA PERIOD OF RECORD - 1/2003 - 12/2006

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	# OBS	AVG
2003	11.3	12.4	13.7	12.1	14.6	17.3	17.5	15.1	12.9	12.9	13.2	9.7	7815	13.84
# OBS	56	560	744	720	744	720	744	744	720	744	720	599		
2004	10.6	11.9	13.9	12.3	15.1	14.3	15.7	14.2	13.8	11.4	9.8	9.1	8666	12.70
# OBS	627	696	744	720	744	720	744	744	720	744	720	743		
2005	10.1	10.1	12.3	11.9	13.6	16.8	15.4	14.7	13.0	9.5	11.5	10.3	8376	12.54
# OBS	657	672	744	720	744	720	744	744	720	744	574	593		
2006	11.9	13.3	11.8	12.6	13.1	14.1	15.0	14.1	12.5	11.7	11.9	10.2	8621	12.73
# OBS	744	672	744	720	744	720	744	744	720	744	720	605		
AVG	10.9	11.9	12.9	12.2	14.1	15.6	15.9	14.5	13.1	11.4	11.6	9.8	33478	12.93
SD	0.8	1.3	1.0	0.3	0.9	1.6	1.1	0.5	0.5	1.4	1.4	0.6		