Wind Resource Summary for Holyoke Site
Final Report
Colorado Anemometer Loan Program

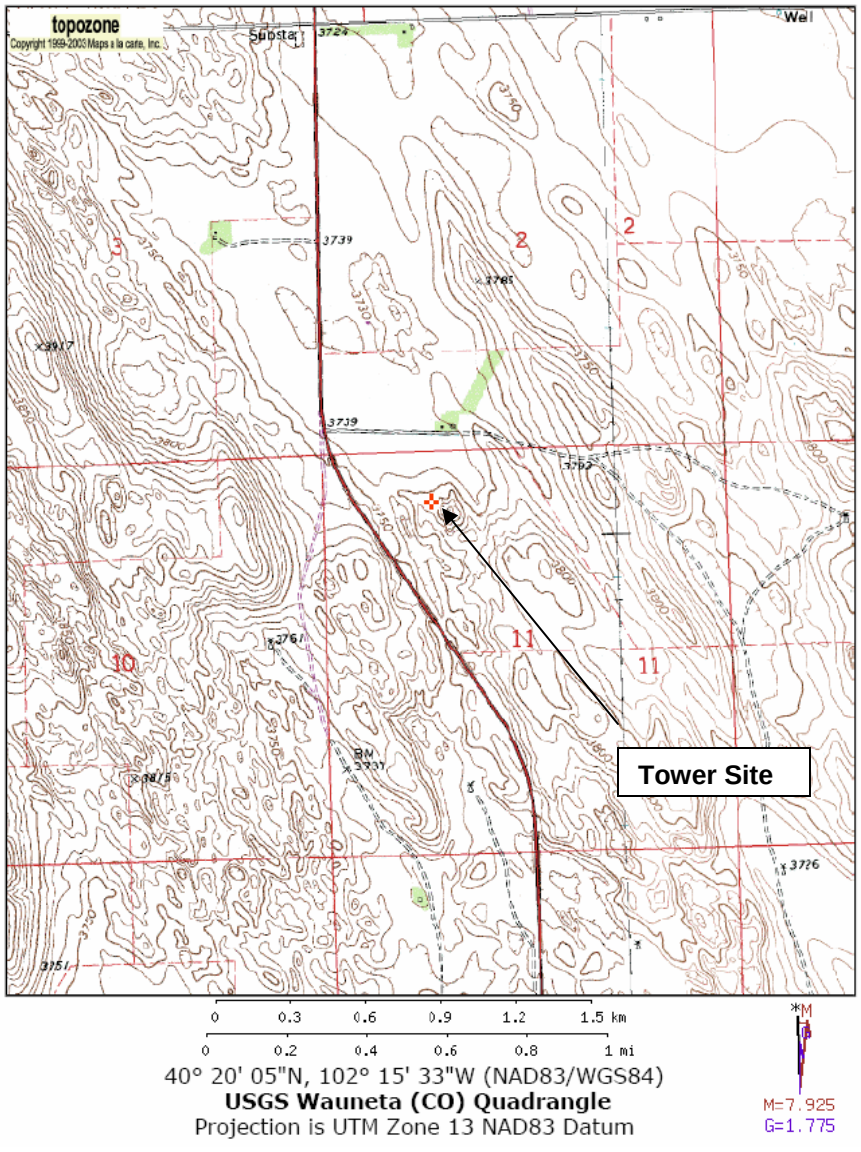
Monitoring Period: 6/21/2006 – 10/06/2007

Report Date: December 2, 2007

Site Description:

The site is 17.4 miles south of the town of Holyoke, Colorado, and it is east of U.S. Highway 385. The terrain is relatively flat, with less than 80 feet of relief over a mile. The tower is located in pasture, but cropland can be found immediately north of the site. A farmstead is located about 1,000 feet north-northeast of the site.

LOCATION DETAILS	
Latitude:	N 40° 20' 05"
Longitude:	W 102° 15' 33"
Township:	4 N
Range:	44 W
Section:	11
Elevation (ft.):	3,776
Tower Type:	NRG Tilt-Up
Tower Height (ft.):	98
Tower Height (m):	30
Vane Offset (deg):	45
Direction Basis:	Mag. North
Mag. Declination:	7.925° E



Report Prepared By:
Michael Kostrzewa, P.E.
Colorado State University
Department of Mech. Eng.
Campus Delivery 1374
Fort Collins, CO 80523-1374
(970) 491-7709
michael@engr.colostate.edu

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Wind Resource Summary

All analysis performed using Windographer 1.13

Data Properties	
Data Set Starts:	6/21/2006 0:00
Data Set Ends:	10/2/2007 7:00
Data Set Duration:	15.5 months
Length of Time Step:	10 minutes
Elevation (ft.):	3,776
Calm threshold (mph):	0
Wind Power Coefficients	
Power Density at 50m:	281 W/m^2
Wind Power Class:	2 (Marginal)
Wind Power Coefficients	
Power Law Exponent:	0.14
Surface Roughness:	0.01 m
Roughness Class:	0.078
Roughness Description:	Rough Pasture

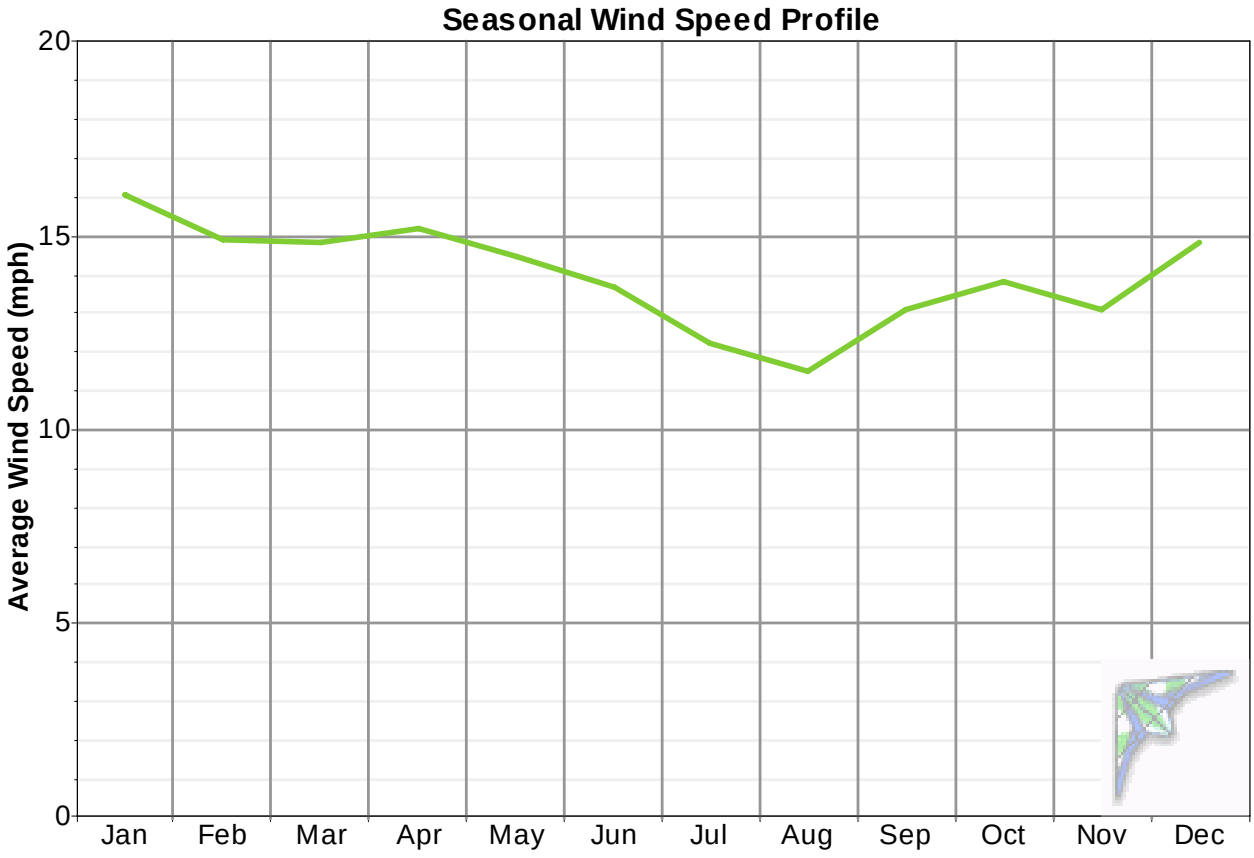
***Note**: Air temperature was not factored into wind calculations*

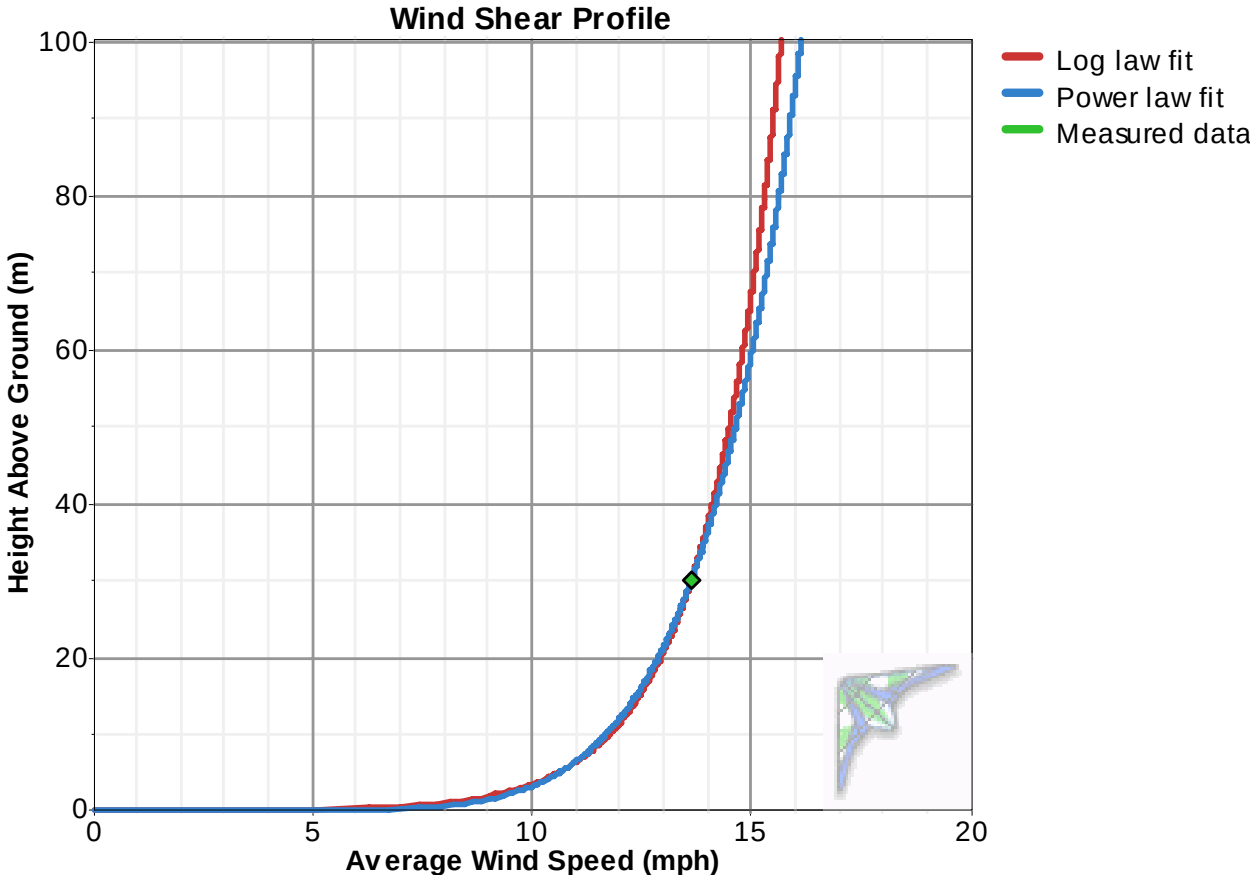
Wind Resource Statistics

Variable	Wind Speed *at 30m*
Height above ground (m)	30
Mean wind speed (mph)	13.64
Median wind speed (mph)	12.92
Min wind speed (mph)	0
Max wind speed (mph)	50.87
Mean power density (W/m²)	227
Mean energy content (kWh/m²/yr)	1,990
Energy pattern factor	1.83
Weibull k	2.097
Weibull c (mph)	15.36
1-hr autocorrelation coefficient	0.825
Diurnal pattern strength	0.062
Hour of peak wind speed	15
Mean turbulence intensity	0.144
Standard deviation (mph)	6.76
Coefficient of variation (%)	49.6
Frequency of calms (%)	0.45
Actual observations	67,934
Missing observations	76
Data completeness (%)	99.9

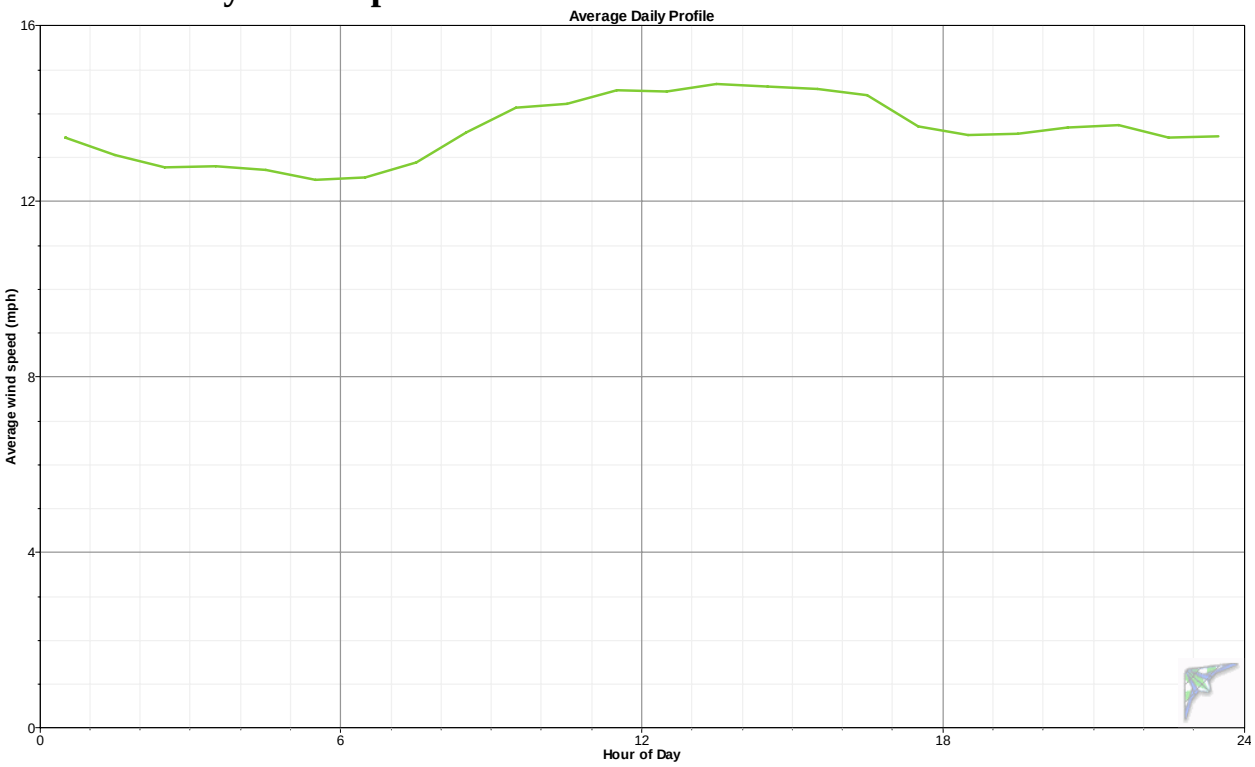
Hour of Day	Average Wind speed *mph*
0.5	13.458
1.5	13.060
2.5	12.794
3.5	12.809
4.5	12.717
5.5	12.485
6.5	12.562
7.5	12.903
8.5	13.573
9.5	14.135
10.5	14.219
11.5	14.543
12.5	14.508
13.5	14.689
14.5	14.620
15.5	14.553
16.5	14.438
17.5	13.715
18.5	13.513
19.5	13.547
20.5	13.700
21.5	13.753
22.5	13.475
23.5	13.502

Direction Sector Midpoint *degrees*	Frequency *percent*
0	7.6515
10	0
20	6.8655
30	0
40	0
50	6.5681
60	0
70	4.6369
80	0
90	3.4239
100	0
110	4.2527
120	0
130	0
140	3.9789
150	0
160	5.9999
170	0
180	8.8483
190	0
200	12.9508
210	0
220	0
230	9.3782
240	0
250	4.4087
260	0
270	3.2811
280	0
290	4.048
300	0
310	0
320	6.0515
330	0
340	7.2026
350	0

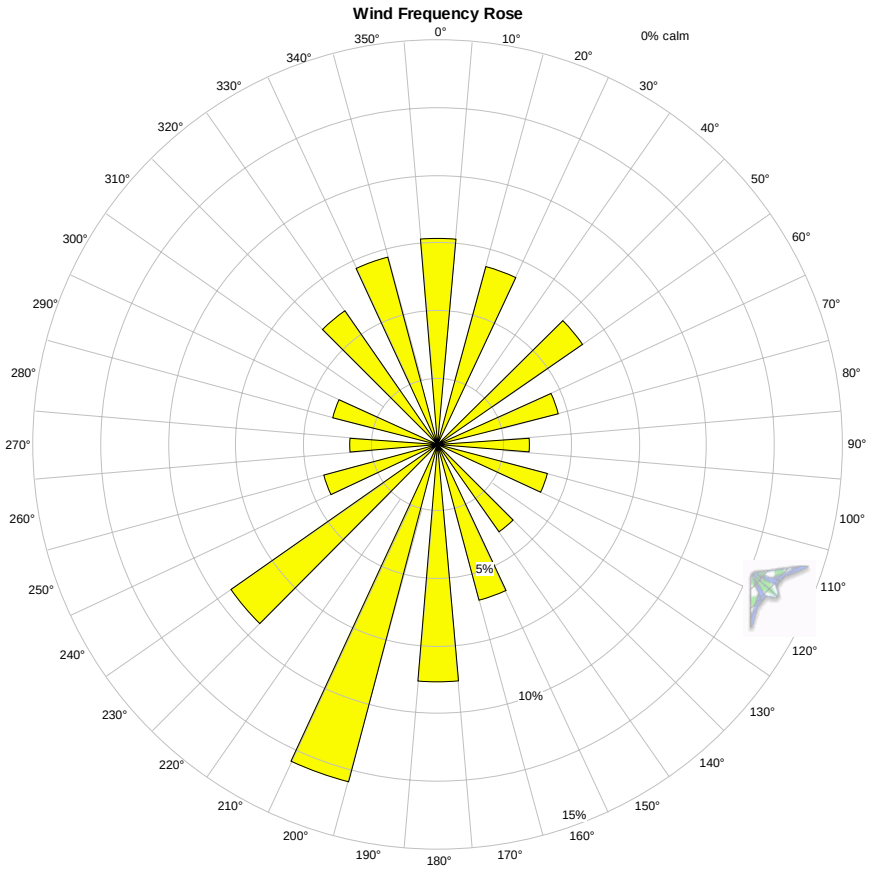

Seasonal Wind Speed Profile
Average Wind Speed (mph)
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Wind Shear Profile
Height Above Ground (m)
100
80
60
40
20
0
0
5
10
15
20
Average Wind Speed (mph)
Log law fit
Power law fit
Measured data

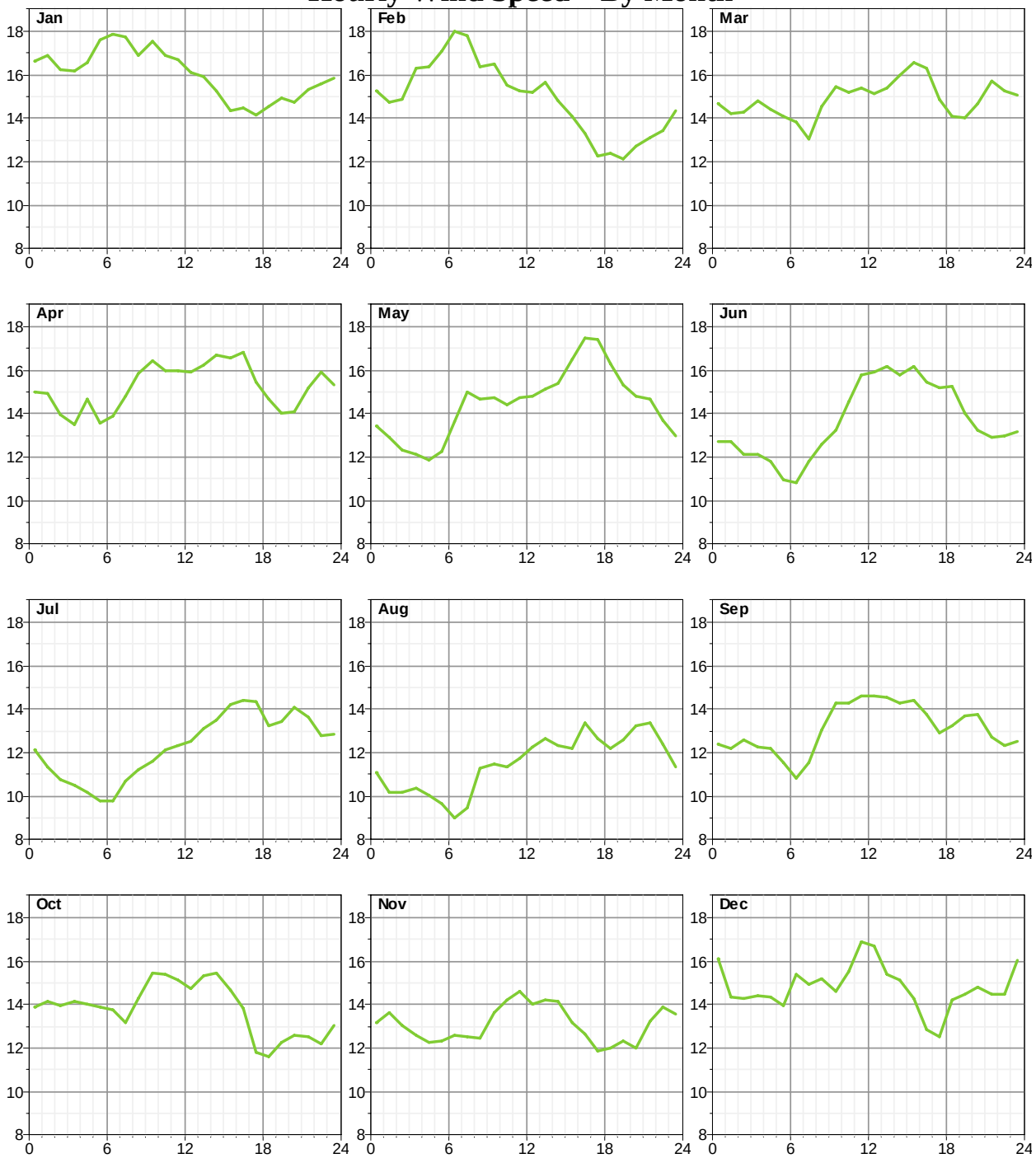
Daily Wind Speed Profile – Total For Measurement Period



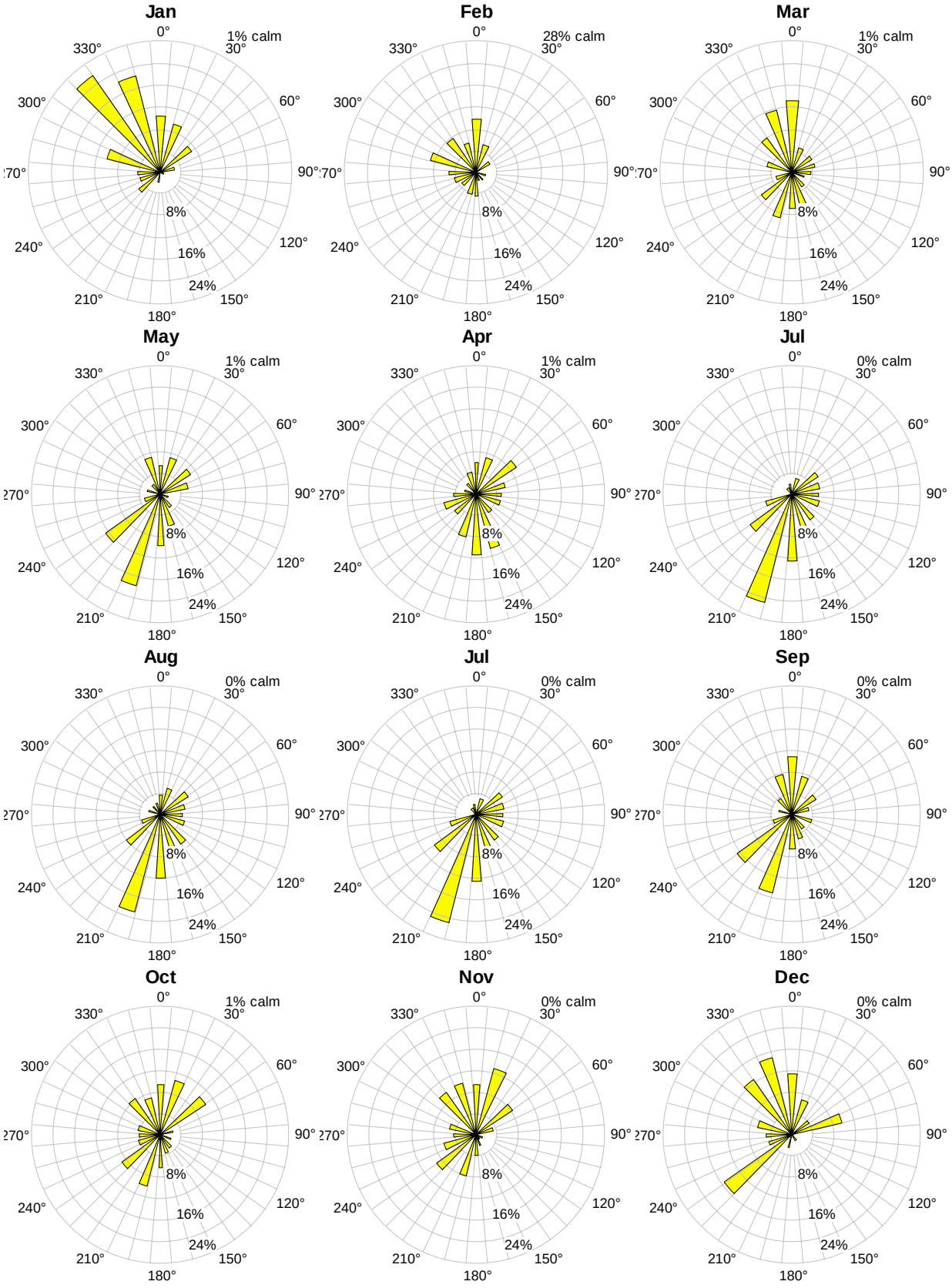
Wind Direction – For Total Measurement Period



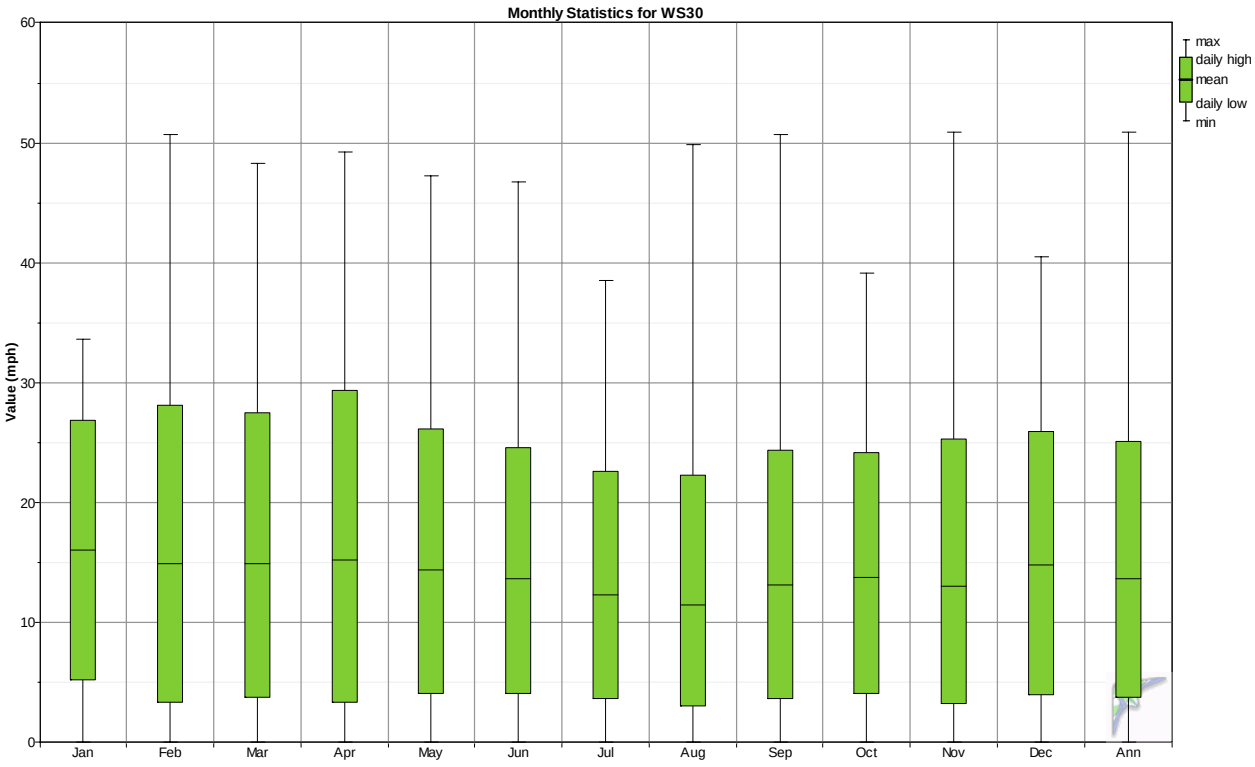
Hourly Wind Speed – By Month



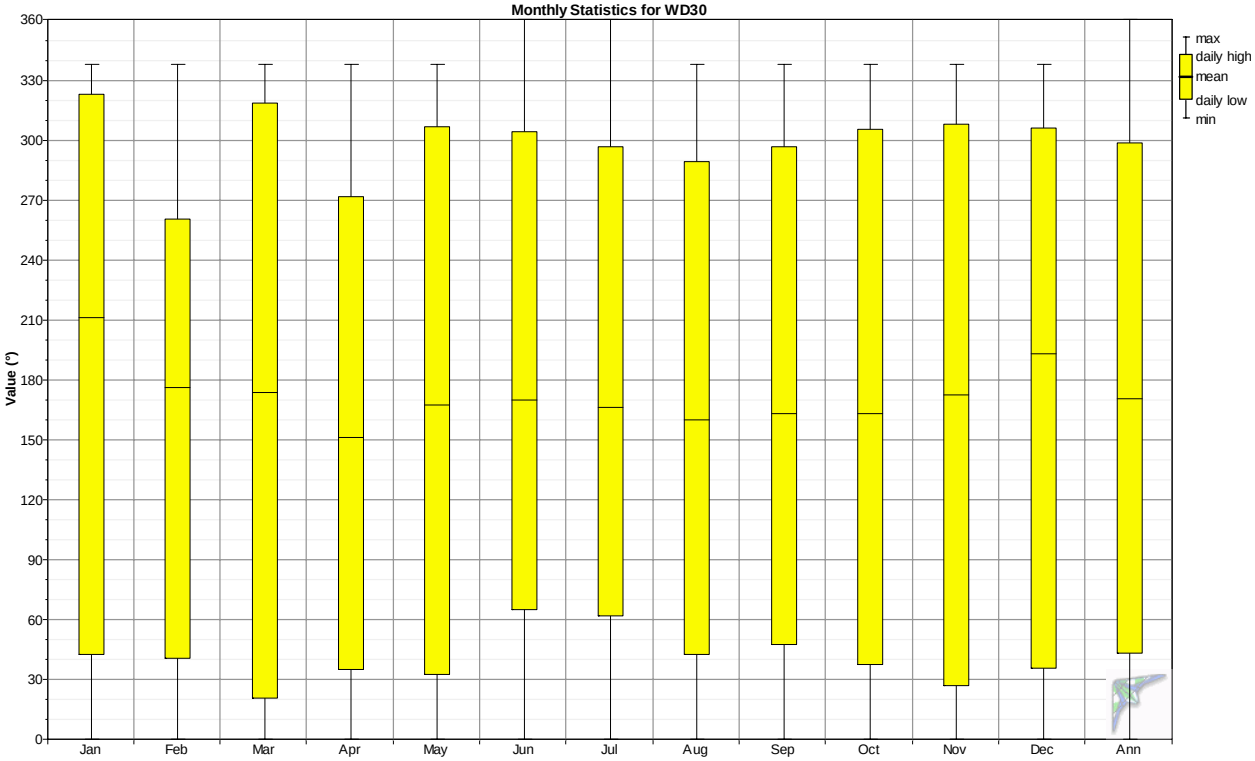
Wind Direction – By Month (All Years)



Box Plot for Wind Speed – By Month



Box Plot for Wind Direction – By Month



Estimated Wind Turbine Performance

The wind resource data from this site was compared against typical small wind turbines at 30m tower height to project the total energy production potential. The table below lists the turbines considered, the estimated turbine costs and the expected turbine performance:

Turbine	Estimated Turbine Cost *(w/o tower)*	Rotor Diameter *meters*	Rotor Power *kW*	Hub Height *meters*	Hub Height Wind Speed *mph*	Time At Zero Output *percent*	Time At Rated Output *percent*	Average Net Power Output *kW*	Average Net Energy Output *kW*	Average Net Capacity Factor *kW*
Bergey Excel-R/120V	$16,560	6.7	7.5	30	13.64	15.11	4.31	1.76	15,458	23.5
Bergey Excel-S/60	$20,610	6.7	10	30	13.64	7.35	1.83	1.89	16,576	18.9
Bergey XL.1	$2,650	2.5	1	30	13.64	2.66	6.01	0.264	2,316	26.4
Southwest Skystream 3.7	$8,999	3.7	1.8	30	13.64	13.86	0	0.495	4,337	27.5
Southwest Whisper 500	$6,062	4.5	3	30	13.64	15.06	5.22	0.856	7,501	28.5

Note that the costs do *not* include the costs for the tower or labor for installation.

These turbines are not recommended or endorsed. Landowners interested in installing a turbine are encouraged to contact a wind equipment dealer or a wind developer for design assistance and equipment recommendations.

The costs shown above were obtained from publicly available costs on the Internet. For reference, the costs for these turbines were obtained from the following vendor:

Earth Solar Group
6315 Canyon Dr.
Amarillo, TX 79110
1.800.329.3283
http://www.earthsolar.com/