

## ***Bucks Elbow Mountain, VA***

### **Project Summary**

As part of Virginia's State-Based Anemometer Loan Program, an anemometer was placed in Crozet, Virginia to assess the area's wind energy potential. Wind speed and direction were recorded from September 16, 2005 through September 16, 2006; however, wind speed data was faulty for readings after August 4, 2006. Annual average wind speed during the monitoring period (66 ft. [20m] above ground level) was recorded to be 13.86 mph (6.2 m/s). Wind power density is calculated to be 247.0 W/m<sup>2</sup>.

### **Project Location**

The monitoring equipment was installed on private land near Crozet, Virginia at an elevation of 3100 feet. The site is located at N 38° 6.42', W 78° 44.7'.

### **Monitoring Equipment**

The 20-meter NRG-NOW Systems – Wind Explorer kit includes one tower, one Wind Explorer data logger with shelter box, one #40 Maximum anemometer, one #200P wind direction vane, sensor cabling, one lightning rod with copper ground, and two data plugs.

### **Results**

Average annual wind speed	13.86 mph (6.2 m/s)
Average annual wind power density	247.00 W/m <sup>2</sup>
Month with greatest wind resource	January
Average wind speed during month with greatest resource	18.1 mph
Month with least wind resource	August*
Average wind speed during month with least resource	10.8 mph

*\*a full month of data was not recorded for the month of August*

## Monthly Variation

Figure 1 below shows the average monthly wind speed for each month throughout the recorded year. Above average months occur during winter and early spring, while below average months occur during summer.

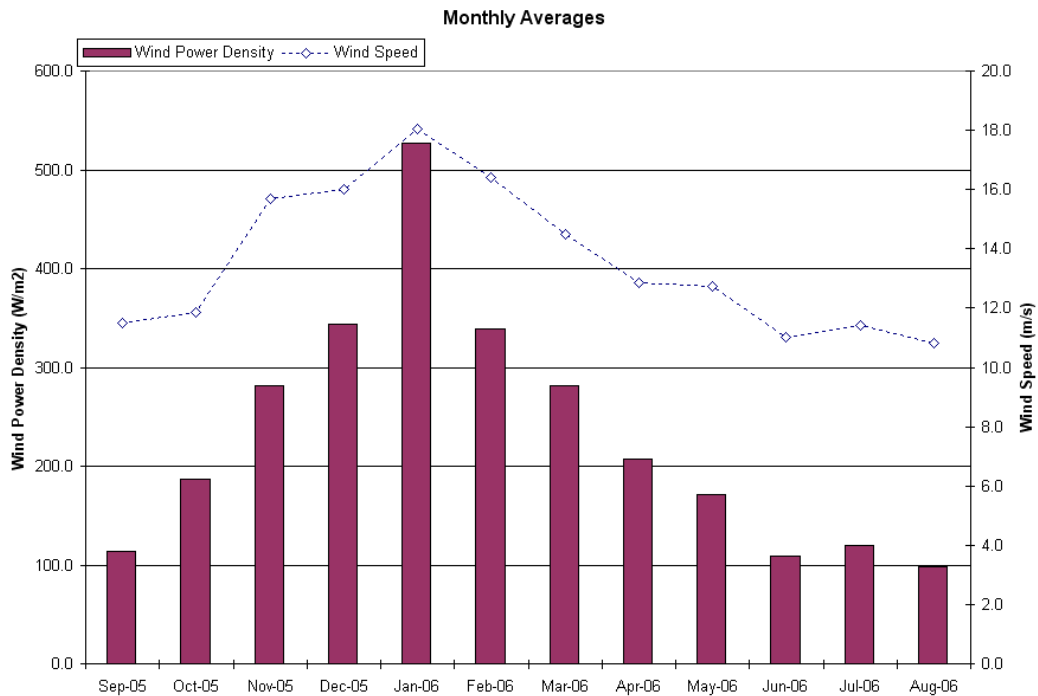


Figure 1. Monthly average wind speeds and power densities throughout the year.

## Diurnal Variation

Figure 2 shows how wind speeds vary on an hourly basis. Typically, stronger winds are more prevalent during afternoon and late evening, early morning hours. At this site, the stronger winds occur late night and early morning.

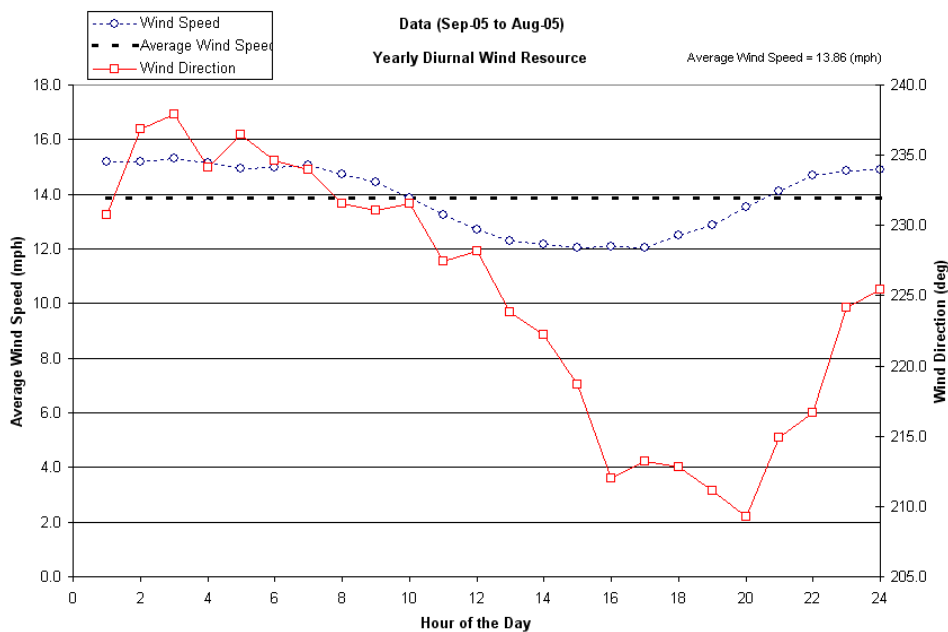


Figure 2. Average hourly wind speeds and directions throughout the year.

### Monthly Diurnal Variations

Figure 3 shows the diurnal (hourly) variations of the wind speed over each month. The trends of each month closely follow one another.

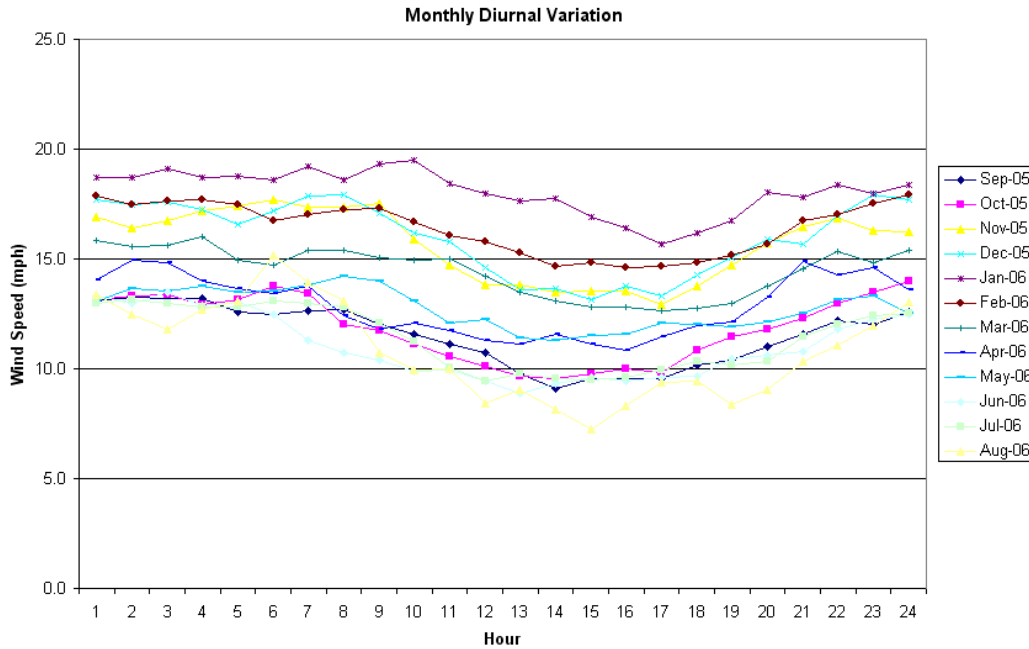


Figure 3. Average hourly wind speeds for each month.

### Wind Speed Histogram

Figure 4 shows the occurrence in number of hours that each wind speed occurs. Typically this falls under what is called the Weibull distribution, with a high peak early, and a tailing off at higher wind speeds.

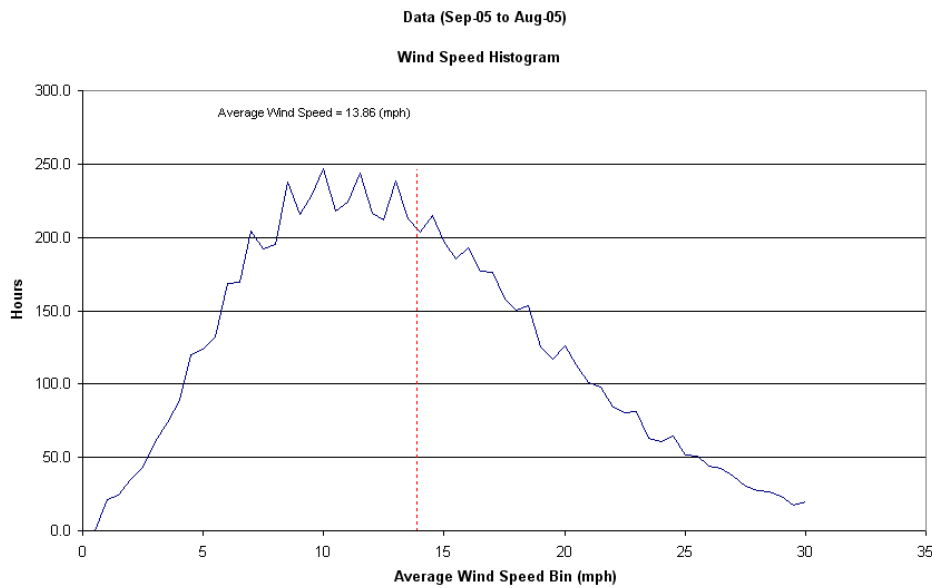


Figure 4. Wind speed frequency over the year by # of hours.

## Wind Speed and Direction Trace

Figure 5 shows the wind speed and wind direction reading for every ten-minute average over the course of the data. The wind speed data is the blue line, and the directional data are the red lines.

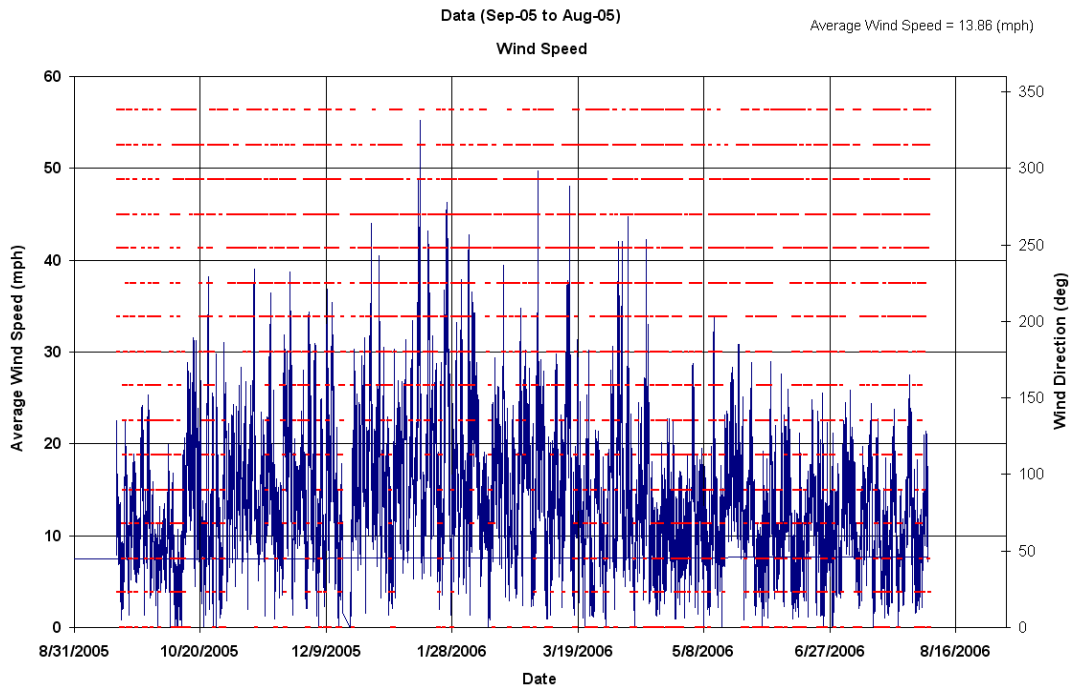


Figure 5. Wind speed and direction readings throughout the year.

## Wind Daily Averages

Figure 6 shows the average wind speed and direction by day of the month. Notice there is no particular trend here.

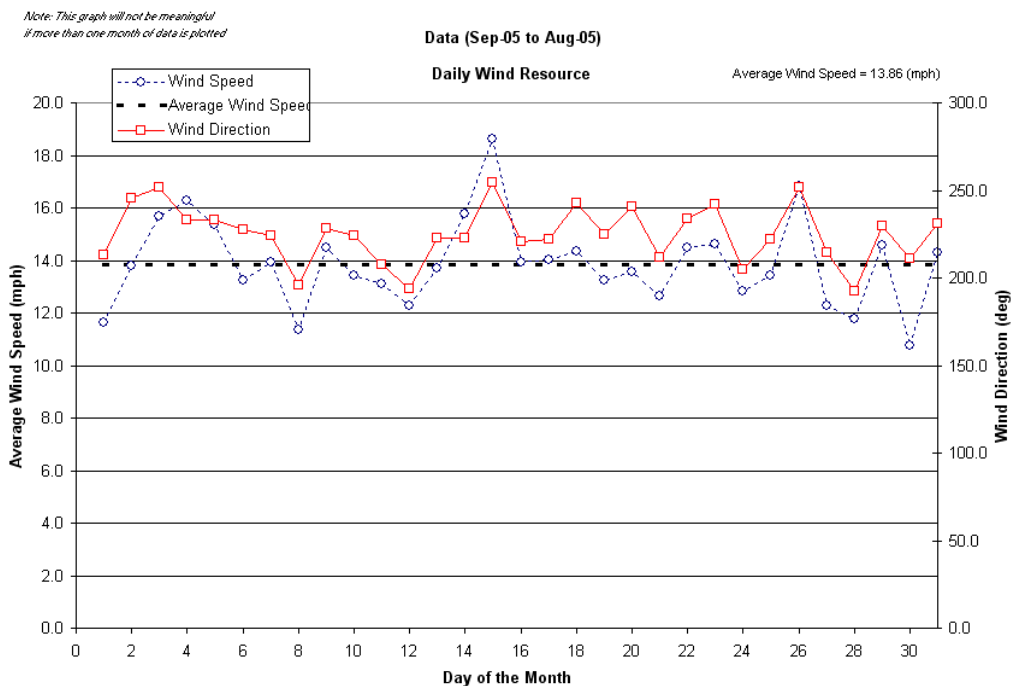
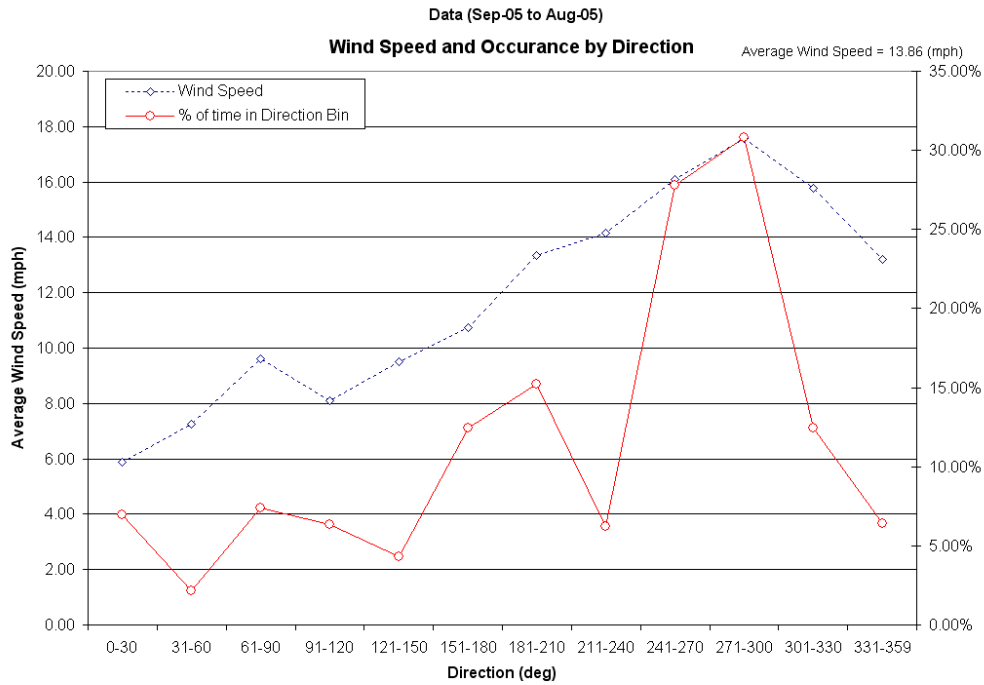


Figure 6. Wind speed and direction averages by day of the month.

## Wind Speed Occurrence by Direction

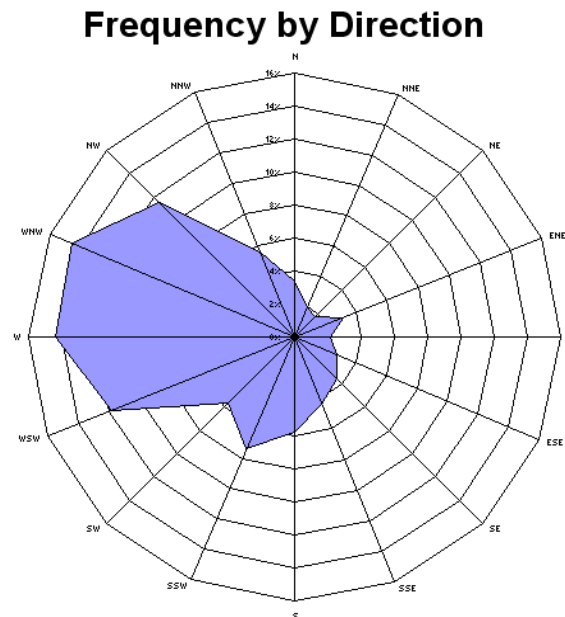
Figure 7 displays the average wind speed for each direction the wind comes from. It also shows the percent of time in that direction bin. For this site the higher wind speeds came from the west northwest.



**Figure 7.** Average wind speed for each direction bin and % time in that bin.

## Frequency Wind Rose

Figure 8 displays a frequency wind rose. It can be seen that the majority of the wind comes from the west and west-northwest directions.

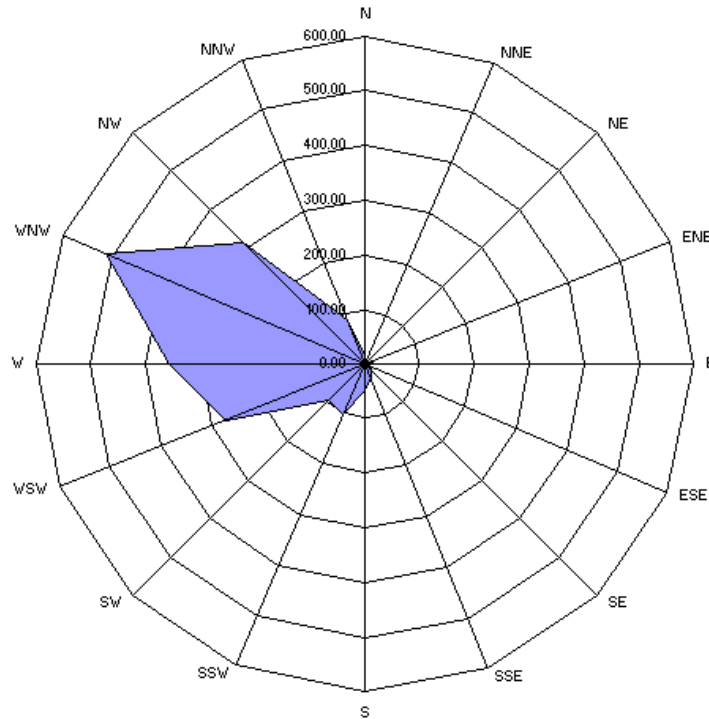


**Figure 8.** Wind rose displaying wind direction frequency.

## Energy Rose

Figure 9 is an energy wind rose, showing the number of kWh/m<sup>2</sup> available from 16 compass-point directions. The majority of energy comes from the west-northwest. This is due to the high frequency of occurrence of these winds along with relatively high wind speeds.

### Energy by Direction



**Figure 9.** Energy wind rose with units in kWh/m<sup>2</sup>.