

NORRIS HILL

MADISON COUNTY

The Norris Hill site is located ten miles north of Ennis at 45°29'⁵⁸42" N and 111°41'57" W (Site No. 157 on Map II-1). Elevation at the site is 5,675⁵⁷⁷⁵ feet. This monitoring site is part of the wind monitoring program of the Montana Department of Natural Resources and Conservation.

The site is located at the crest of Norris Hill on a finger ridge. Norris Hill is at the head of the Madison River valley, which runs more or less due north. A hill to the east and southeast that is approximately 525 feet higher than the site could affect the winds at the site. However, both the ridge on which the site is located and the hill to the east have slopes in the 20 to 50 degree range and the site is otherwise well exposed to the wind. In addition, there is a very evident funneling of winds up the draw where US 287 crests Norris Hill from the south, which could compensate for the hill to the east. The site is representative of a range of hills that runs approximately east and west between the Madison and Jefferson ranges. The range of hills is six to eight miles long, several miles wide and contains many knobs and ridges that would be suitable for the installation of wind generating equipment. The site is just west of state Highway 287, but winter access still can be difficult.

The site is located on private land. Much of the land in the area is held by the Bureau of Land Management; the state also owns some land nearby. Electrical service in the area is provided by the Montana Power Company. A 161 kV line runs south of the site and a 100 kV line runs to the north. Both lines come out of Montana Power's Madison powerhouse in Beartrap Canyon, three miles east of the site. The nearest commercial airport is outside of Bozeman, 35 miles to the northeast. There is a private landing field five miles south of the site in the Madison valley.

Wind data collection began January 10, 1984. Data through March 31, 1986 was available for analysis. Monitoring is scheduled to continue at least through June 1987. A Met One anemometer and a Campbell Scientific data-logger were used. The anemometer height was 33 feet.

Data recovery was poor to excellent, ranging from 45.6 percent in November to 99.9 percent in May, July, and September. Overall data recovery was 85.8 percent.

Average monthly wind speeds ranged from 11.6 miles per hour in July to 22.9 miles per hour in December. Average annual wind speed was 17.0 miles per hour.

Average monthly wind power ranged from 99.3 watts/m² in July to 832.3 watts/m² in December.

Average seasonal speeds were 12.9 miles per hour in the summer, 16.8 miles per hour in the autumn, 21.5 miles per hour in the winter, and 16.4 miles per hour in the spring. In the winter and spring, the highest wind speed occurred in early to late afternoon. High winds in the summer were a little later than in the winter and spring. The highest winds in the autumn were between noon and late afternoon. Diurnal range of average wind speeds was greatest in the summer, least in the winter, and about the same in spring and autumn.

The wind blew most frequently from the south-southeast through the southwest, that is, from directly down the valley. The winds came from the north-northeast and northeast about 20 percent of the time, and otherwise came very infrequently from the other directions. By direction, average wind speeds ranged from 7.5 miles per hour from the east-southeast to 20.0 miles per hour from the south and south-southwest.

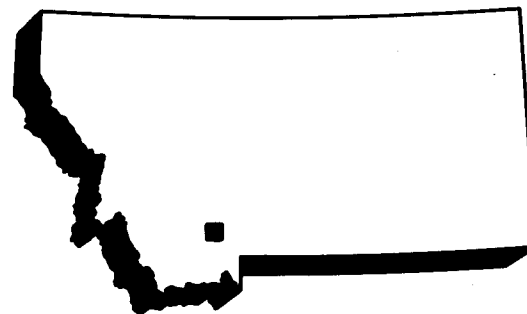


Table IV - 105
Monthly Wind Speed Distribution
MADISON COUNTY - NORRIS HILL

01/10/84 - 03/31/86

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
CALM	1.5	0.0	0.1	0.0	0.0	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.2	CALM
0.1-1.0	0.0	0.3	0.2	0.3	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1- 0.4
1.1-2.0	0.7	0.7	0.7	0.7	0.5	0.6	0.6	0.5	0.9	0.6	0.8	1.0	0.7	0.5- 0.9 S
S 2.1-3.0	1.0	1.3	1.2	0.8	0.7	1.3	1.0	1.6	1.4	0.4	0.9	1.0	1.1	1.0- 1.3 P
P 3.1-4.0	1.2	1.6	2.4	1.6	2.0	2.4	3.0	2.4	2.8	1.8	1.2	1.0	2.0	1.4- 1.8 E
E 4.1-5.0	1.3	1.8	2.6	2.1	2.6	3.2	3.9	3.8	3.2	0.9	1.1	1.6	2.4	1.9- 2.2 E
E 5.1-6.0	2.2	2.3	4.3	4.0	4.6	6.0	6.3	5.1	3.3	2.2	2.3	1.4	3.8	2.3- 2.7 D
D 6.1-7.0	1.4	1.8	2.7	2.5	4.0	4.0	5.9	3.5	4.6	2.7	1.4	1.9	3.1	2.8- 3.1
7.1-8.0	2.0	2.1	4.1	3.6	5.9	6.0	7.1	5.5	6.3	2.2	3.7	1.9	4.2	3.2- 3.6 M
M 8.1-9.0	2.1	2.9	2.9	3.1	5.0	5.3	7.1	5.5	5.6	1.5	3.5	2.6	4.0	3.7- 4.0 E
I 9.1-10.0	3.7	3.8	3.8	3.9	5.7	6.9	7.4	5.9	6.4	2.8	4.3	2.2	4.8	4.1- 4.5 T
L 10.1-11.0	2.3	2.1	3.0	4.3	4.6	5.2	6.6	6.1	4.2	3.2	3.0	1.1	3.8	4.6- 4.9 E
E 11.1-12.0	2.5	3.1	3.8	4.4	6.5	7.2	8.4	7.4	5.8	3.3	5.2	2.3	5.0	5.0- 5.4 R
S 12.1-13.0	2.2	2.4	3.4	4.4	5.3	4.7	5.8	5.3	4.0	2.9	2.7	2.5	3.8	5.5- 5.8 S
/ 13.1-14.0	2.2	3.3	5.1	5.8	6.4	5.7	7.1	8.3	4.4	2.5	5.8	2.3	4.9	5.9- 6.3 /
H 14.1-15.0	2.3	2.0	4.2	4.6	4.9	4.7	4.6	5.9	3.6	2.2	3.3	2.1	3.7	6.4- 6.7 S
O 15.1-16.0	1.9	2.7	4.4	4.8	4.0	4.3	5.2	4.0	4.0	2.9	3.7	1.7	3.6	6.8- 7.2 E
U 16.1-17.0	3.4	3.6	5.6	4.8	4.0	5.6	5.2	5.2	5.4	5.3	4.9	3.3	4.6	7.3- 7.6 C
R 17.1-18.0	2.9	2.9	3.7	3.3	3.4	3.6	2.8	2.6	3.8	4.7	4.4	3.1	3.3	7.7- 8.0 O
18.1-19.0	3.2	4.1	5.1	4.6	3.1	4.3	4.3	2.8	3.9	5.4	6.1	3.3	4.0	8.1- 8.5 N
19.1-20.0	3.5	3.4	4.0	3.9	2.9	2.9	2.3	2.4	3.6	3.4	5.9	2.2	3.3	8.6- 8.9 D
20.1-25.0	19.4	16.7	14.5	16.7	11.7	10.1	4.8	9.5	12.8	20.0	18.3	16.7	14.0	9.0-11.2
25.1-30.0	17.6	14.0	9.1	7.5	6.1	3.4	0.4	3.9	5.3	16.3	9.6	19.4	9.3	11.3-13.4
30.1-35.0	12.4	11.3	5.2	4.3	2.8	1.5	0.0	1.8	2.9	9.4	4.4	11.5	5.7	13.5-15.6
35.1-40.0	4.7	6.0	1.9	2.8	1.9	0.4	0.1	0.6	0.9	2.4	2.9	8.3	2.8	15.7-17.9
>40.0	2.4	3.7	2.0	1.4	1.3	0.7	0.0	0.3	0.6	1.0	0.8	5.5	1.7	>17.9
AVERAGE														
SPEED (MPH)	21.1	20.9	17.1	17.0	15.1	13.6	11.6	13.5	14.5	20.0	17.9	22.9	17.0	
AVERAGE														
SPEED (M/SEC)	9.4	9.3	7.6	7.6	6.8	6.1	5.2	6.0	6.5	8.9	8.0	10.2	7.6	
AVERAGE														
WIND POWER														
(WATTS/M**2)	677.5	688.1	407.4	380.5	297.1	197.3	99.3	187.0	245.0	517.4	400.9	832.3	414.3	
PERCENT DATA														
RECOVERY	93.1	89.1	73.5	95.4	99.9	99.0	99.9	99.8	99.9	53.0	45.6	83.7	85.8	

ANEMOMETER HEIGHT = 10 METERS = 33 FEET
 NUMBER OF OBSERVATIONS = 16743
 PERCENTAGE DATA RECOVERY = 85.8

SOURCE: GEORESEARCH, INC.

Table IV - 106
Percentage Frequency Summary for Wind Speed
MADISON COUNTY - NORRIS HILL
(WINTER)

01/10/84 - 03/31/86

		WIND SPEED (MPH)																	
		CALM	0.1- 2.0	2.1- 4.0	4.1- 6.0	6.1- 8.0	8.1- 10.0	10.1- 12.0	12.1- 14.0	14.1- 16.0	16.1- 18.0	18.1- 20.0	20.1- 25.0	25.1- 30.0	30.1- 35.0	35.1- 40.0	>40.0		
		WIND SPEED (METERS/SECOND)																AV SPEED (MPH)	AV SPEED (M/SEC)
		CALM	0.1- 0.9	0.9- 1.8	1.8- 2.7	2.7- 3.6	3.6- 4.5	4.5- 5.4	5.4- 6.3	6.3- 7.2	7.2- 8.0	8.1- 8.9	9.0- 11.2	11.2- 13.4	13.5- 15.6	15.7- 17.9	>17.9		
H O U R	1	0.5	0.9	1.9	4.2	6.0	4.2	3.3	4.7	5.1	8.4	7.9	19.5	12.6	11.6	6.0	3.3	21.2	9.5
	2	0.5	0.9	2.8	2.8	4.2	5.1	5.1	4.2	6.5	4.7	8.8	20.0	12.1	14.0	6.0	2.3	21.4	9.6
	3	0.9	1.4	1.4	3.3	4.2	5.2	5.6	5.6	5.6	4.7	8.5	17.8	11.3	18.3	4.2	1.9	21.2	9.5
	4	1.0	1.0	2.4	1.9	3.4	6.3	3.9	6.3	5.3	9.2	8.7	17.9	11.6	15.0	3.4	2.9	21.1	9.4
	5	1.0	0.5	2.9	3.9	1.5	6.3	3.9	5.3	4.9	10.7	8.7	19.4	11.2	13.1	4.4	2.4	21.0	9.4
	6	1.0	1.5	1.5	4.4	1.5	7.3	4.4	3.9	4.4	8.7	7.8	20.4	13.1	14.1	3.4	2.9	21.1	9.4
	7	1.0	1.0	2.4	1.0	2.9	6.8	5.3	5.8	3.4	7.3	7.8	25.2	9.2	14.6	3.9	2.4	21.4	9.5
	8	1.0	0.0	2.5	4.9	2.9	4.9	5.4	2.0	6.4	7.4	9.3	18.6	12.7	14.7	4.4	2.9	21.5	9.6
	9	0.5	0.5	2.0	3.4	3.9	6.9	4.9	6.4	2.5	6.9	6.4	23.2	10.8	14.8	5.9	1.0	21.3	9.5
	10	0.5	0.0	2.0	4.5	1.0	7.4	5.4	4.5	5.0	7.4	6.4	20.8	14.4	12.9	5.0	3.0	21.5	9.6
	11	0.5	2.0	1.5	3.0	3.0	4.5	5.5	5.0	3.5	6.0	7.0	25.0	12.0	14.0	5.5	2.0	21.7	9.7
	12	0.5	2.0	3.6	1.5	3.1	4.1	5.6	5.6	2.6	5.6	5.1	26.0	14.8	13.3	5.1	1.5	21.5	9.6
	13	0.5	0.9	3.2	0.5	3.2	5.5	4.6	5.1	2.3	5.5	7.8	21.2	12.9	17.5	5.5	3.7	22.8	10.2
	14	0.5	0.5	1.4	2.3	4.6	4.2	5.6	4.6	5.1	5.6	6.5	18.1	15.3	18.5	3.2	4.2	22.7	10.1
	15	0.5	0.5	0.9	2.4	4.7	6.2	4.3	3.3	4.3	8.1	6.6	16.6	17.1	14.2	6.2	4.3	22.6	10.1
	16	0.5	0.5	0.5	4.8	3.8	6.7	2.9	5.2	5.2	3.3	8.6	20.0	13.3	13.8	7.1	3.8	22.3	10.0
	17	0.5	0.0	1.9	5.3	3.8	6.7	5.3	4.3	3.8	4.8	4.3	23.0	12.9	15.3	5.3	2.9	21.8	9.7
	18	0.5	0.5	2.9	4.8	3.8	7.2	4.8	3.8	3.8	4.8	4.3	21.5	16.7	11.0	7.7	1.9	21.5	9.6
	19	0.5	1.0	3.4	3.8	5.8	7.2	3.4	5.3	3.4	5.3	5.8	18.3	17.3	12.0	5.3	2.4	21.1	9.4
	20	0.5	1.0	2.9	4.9	5.3	8.3	6.8	4.9	2.9	4.9	3.4	20.4	16.0	9.7	5.3	2.9	20.5	9.2
	21	0.5	1.0	2.5	4.4	3.9	7.4	4.4	6.9	3.9	5.4	2.5	23.0	16.2	10.3	4.9	2.9	21.2	9.5
	22	0.0	1.5	4.5	3.5	4.5	4.0	4.5	6.9	3.0	5.0	5.9	24.3	14.9	9.4	4.5	4.0	21.3	9.5
	23	0.0	2.0	3.0	5.5	4.0	3.5	2.5	6.0	5.0	5.5	7.5	24.5	10.5	14.0	3.5	3.0	21.1	9.4
	24	0.5	1.0	3.6	6.6	3.1	5.6	3.1	4.6	4.6	9.7	5.1	21.4	12.8	12.8	3.6	2.0	20.2	9.0
ALL HOURS		0.6	0.9	2.4	3.6	3.7	5.9	4.6	5.0	4.3	6.4	6.7	21.0	13.4	13.7	5.0	2.8	21.5	9.6

SOURCE: GEORESEARCH, INC.

Table IV - 107
 Percentage Frequency Summary for Wind Speed
MADISON COUNTY - NORRIS HILL
(SPRING)
 01/10/84 - 03/31/86

		WIND SPEED (MPH)																	
		CALM	0.1-2.0	2.1-4.0	4.1-6.0	6.1-8.0	8.1-10.0	10.1-12.0	12.1-14.0	14.1-16.0	16.1-18.0	18.1-20.0	20.1-25.0	25.1-30.0	30.1-35.0	35.1-40.0	>40.0		
		WIND SPEED (METERS/SECOND)																AV SPEED (MPH)	AV SPEED (M/SEC)
		CALM	0.1-0.9	0.9-1.8	1.8-2.7	2.7-3.6	3.6-4.5	4.5-5.4	5.4-6.3	6.3-7.2	7.2-8.0	8.1-8.9	9.0-11.2	11.2-13.4	13.5-15.6	15.7-17.9	>17.9		
H O U R	1	0.0	1.1	1.6	5.9	6.4	12.2	13.3	9.6	8.5	5.9	8.0	15.4	6.4	3.7	1.6	0.5	15.8	7.1
	2	0.0	0.0	4.3	6.9	6.9	10.1	10.6	12.8	6.9	6.4	7.4	16.0	5.3	5.3	0.5	0.5	15.7	7.0
	3	0.0	1.6	5.3	6.4	4.8	8.5	13.8	5.9	10.1	10.1	5.3	16.5	6.4	4.3	0.5	0.5	15.6	7.0
	4	0.0	2.1	2.7	10.1	9.0	6.4	8.0	11.7	8.5	5.9	8.5	16.0	5.9	4.3	0.5	0.5	15.4	6.9
	5	0.0	1.6	2.7	8.0	12.2	6.9	6.4	10.1	8.0	9.6	10.6	11.7	5.3	3.7	3.2	0.0	15.4	6.9
	6	0.0	1.6	3.7	6.4	8.0	10.7	8.6	9.1	7.0	11.2	9.1	12.3	5.3	5.9	1.1	0.0	15.5	6.9
	7	0.0	1.1	4.3	7.5	8.0	8.0	10.7	10.2	8.6	7.0	5.9	18.7	5.9	2.7	1.1	0.5	15.4	6.9
	8	0.5	2.1	2.1	10.2	5.9	3.7	12.3	13.4	11.8	7.0	5.9	13.4	6.4	3.2	1.1	1.1	15.4	6.9
	9	0.0	2.1	4.8	6.4	4.8	8.0	12.8	9.1	9.6	11.2	5.3	13.4	4.8	4.3	1.6	1.6	15.7	7.0
	10	0.0	1.1	3.2	5.9	8.0	8.0	8.0	11.2	8.0	8.6	10.7	14.4	3.7	5.3	2.7	1.1	16.4	7.3
	11	0.0	0.0	3.2	8.6	5.9	10.2	4.8	10.2	11.2	8.6	7.5	13.4	7.0	5.3	1.6	2.7	16.8	7.5
	12	0.0	0.5	2.2	8.1	5.9	8.1	4.3	11.8	10.2	9.7	8.1	16.1	5.9	3.8	2.7	2.7	17.3	7.7
	13	0.0	0.5	1.6	8.5	7.4	6.3	5.8	3.7	10.6	9.0	6.9	21.2	9.5	3.7	3.2	2.1	18.1	8.1
	14	0.0	0.5	2.1	4.8	6.9	6.3	6.3	9.0	6.3	11.1	10.6	17.5	7.4	4.2	4.8	2.1	18.3	8.2
	15	0.0	0.5	0.5	5.8	6.9	7.4	7.4	9.5	6.9	6.3	13.2	13.8	9.0	5.8	2.6	4.2	18.5	8.3
	16	0.0	0.0	3.7	3.2	7.4	6.3	7.9	8.5	6.3	9.5	8.5	19.0	7.4	6.9	3.7	1.6	18.3	8.2
	17	0.0	0.0	2.1	3.2	6.9	6.3	5.3	14.8	10.1	5.3	6.3	20.6	6.3	7.4	3.2	2.1	18.3	8.2
	18	0.0	0.0	2.1	4.8	6.9	9.5	6.3	10.6	11.6	7.9	6.9	14.3	8.5	6.3	3.2	1.1	17.7	7.9
	19	0.0	0.5	4.3	6.4	4.8	6.9	8.0	13.3	6.4	8.0	8.0	18.1	5.9	6.4	2.1	1.1	17.0	7.6
	20	0.0	0.5	2.7	7.0	9.1	8.0	12.3	8.6	9.6	7.0	6.4	16.0	4.3	5.9	1.6	1.1	16.1	7.2
	21	0.0	0.5	2.1	11.8	8.6	9.1	5.9	10.7	7.0	8.6	8.6	17.6	4.3	4.3	1.1	0.0	15.3	6.8
	22	0.0	1.1	1.6	7.5	11.2	8.6	10.7	9.1	9.1	10.2	5.3	17.6	3.2	3.2	1.1	0.5	15.1	6.7
	23	0.0	0.5	3.8	4.8	10.2	10.2	12.9	8.6	10.2	6.5	8.6	15.6	3.2	2.7	1.6	0.5	15.1	6.8
	24	0.0	1.6	3.8	3.8	9.2	9.2	9.2	10.3	12.0	9.8	7.1	14.1	4.3	3.8	0.5	1.1	15.3	6.8
ALL HOURS		0.0	0.9	2.9	6.7	7.6	8.1	8.8	10.1	8.9	8.3	7.9	16.0	5.9	4.7	2.0	1.2	16.4	7.3

SOURCE: GEORESEARCH, INC.

Table IV - 108
Percentage Frequency Summary for Wind Speed
MADISON COUNTY - NORRIS HILL
(SUMMER)
01/10/84 - 03/31/86

		WIND SPEED (MPH)																	
		0.1- CALM	2.1- 2.0	4.1- 4.0	6.1- 6.0	8.1- 8.0	10.1- 10.0	12.1- 12.0	14.1- 14.0	16.1- 16.0	18.1- 18.0	20.1- 20.0	25.1- 25.0	30.1- 30.0	35.1- 35.0	40.1- 40.0	>40.0		
		WIND SPEED (METERS/SECOND)																AV SPEED (MPH)	AV SPEED (M/SEC)
		CALM	0.1- 0.9	0.9- 1.8	1.8- 2.7	2.7- 3.6	3.6- 4.5	4.5- 5.4	5.4- 6.3	6.3- 7.2	7.2- 8.0	8.1- 8.9	9.0- 11.2	11.2- 13.4	13.5- 15.6	15.7- 17.9	>17.9		
H O U R	1	0.0	1.6	6.5	9.2	10.9	14.7	13.0	15.8	6.0	12.0	5.4	4.3	0.5	0.0	0.0	0.0	11.5	5.1
	2	0.5	1.6	5.4	14.1	10.9	14.1	15.8	9.8	8.7	6.5	4.9	7.6	0.0	0.0	0.0	0.0	11.1	5.0
	3	0.0	0.5	6.5	16.3	12.5	13.0	14.7	10.3	9.8	5.4	4.3	4.9	1.6	0.0	0.0	0.0	10.9	4.9
	4	0.0	0.5	8.2	10.3	16.3	12.5	13.6	12.5	6.0	7.6	6.5	4.9	1.1	0.0	0.0	0.0	11.1	5.0
	5	0.5	0.5	4.3	11.4	12.0	11.4	18.5	12.5	12.0	7.1	4.3	5.4	0.0	0.0	0.0	0.0	11.5	5.1
	6	0.5	0.5	4.3	12.0	10.3	14.7	17.4	12.0	8.2	5.4	8.2	6.0	0.5	0.0	0.0	0.0	11.5	5.1
	7	0.5	1.6	2.7	7.1	15.8	13.6	15.8	13.0	10.9	6.5	6.0	5.4	1.1	0.0	0.0	0.0	11.7	5.2
	8	0.0	1.1	4.3	6.0	13.6	12.5	15.8	12.5	10.3	9.8	7.6	6.0	0.5	0.0	0.0	0.0	12.1	5.4
	9	0.0	0.0	5.4	3.8	12.0	13.6	16.3	16.8	11.4	5.4	7.6	6.5	1.1	0.0	0.0	0.0	12.4	5.5
	10	0.0	0.0	5.5	7.1	10.9	10.9	12.6	16.9	9.3	11.5	4.4	8.2	1.6	1.1	0.0	0.0	12.9	5.8
	11	0.0	0.5	3.8	8.8	9.9	12.1	15.4	12.6	6.6	11.0	5.5	8.8	3.8	0.5	0.0	0.5	13.2	5.9
	12	0.0	0.0	3.3	9.4	10.5	10.5	15.5	11.6	11.6	6.1	5.0	9.9	3.3	1.7	1.7	0.0	13.7	6.1
	13	0.0	0.0	1.1	12.5	12.0	6.0	14.1	17.9	7.6	7.1	2.2	12.0	2.7	3.8	0.5	0.5	14.0	6.3
	14	0.0	0.0	1.6	6.5	7.6	18.5	7.6	14.1	11.4	6.0	3.8	14.7	3.3	3.8	0.0	1.1	14.8	6.6
	15	0.0	0.0	0.0	6.5	10.3	13.0	12.5	10.9	12.5	5.4	10.9	10.3	1.6	3.8	1.1	1.1	15.0	6.7
	16	0.0	0.0	0.5	4.9	4.3	14.7	12.5	12.0	9.8	10.3	8.7	12.5	3.3	5.4	0.5	0.5	15.8	7.0
	17	0.0	0.0	0.0	8.7	7.1	7.1	10.9	9.8	12.5	13.6	7.1	15.2	5.4	1.6	0.5	0.5	15.6	7.0
	18	0.0	0.0	1.1	4.9	9.3	9.8	10.9	8.7	13.7	13.7	7.7	12.6	3.3	2.7	1.1	0.5	15.3	6.9
	19	0.0	0.0	1.6	7.7	8.7	12.6	9.3	11.5	8.7	12.0	9.8	12.0	3.3	1.6	0.5	0.5	14.5	6.5
	20	0.0	0.0	4.9	8.8	8.2	12.1	11.0	11.5	7.7	11.5	8.2	12.1	1.6	1.6	0.0	0.5	13.6	6.1
	21	0.0	0.5	6.0	9.9	8.8	13.7	17.0	8.8	9.3	7.7	7.1	7.1	1.6	1.1	1.1	0.0	12.6	5.6
	22	0.0	2.2	6.0	15.4	7.7	13.7	14.3	8.8	11.0	4.4	3.8	12.1	0.5	0.0	0.0	0.0	11.6	5.2
	23	0.0	1.6	3.8	12.1	13.2	15.4	15.4	8.2	9.3	8.2	3.8	8.2	0.5	0.0	0.0	0.0	11.5	5.1
	24	0.0	1.1	6.7	12.2	13.3	13.9	8.3	17.2	6.1	5.6	8.3	7.2	0.0	0.0	0.0	0.0	11.3	5.0
ALL HOURS		0.1	0.6	3.9	9.4	10.7	12.7	13.7	12.3	9.6	8.3	6.3	8.9	1.8	1.2	0.3	0.3	12.9	5.8

SOURCE: GEORESEARCH, INC.

Table IV - 109
Percentage Frequency Summary for Wind Speed
MADISON COUNTY - NORRIS HILL
(AUTUMN)
01/10/84 - 03/31/86

		WIND SPEED (MPH)																	
		0.1- CALM	2.1- 2.0	4.1- 4.0	6.1- 6.0	8.1- 8.0	10.1- 10.0	12.1- 12.0	14.1- 14.0	16.1- 16.0	18.1- 18.0	20.1- 20.0	25.1- 25.0	30.1- 30.0	35.1- 35.0	40.0- 40.0	>40.0		
		WIND SPEED (METERS/SECOND)																AV SPEED (MPH)	AV SPEED (M/SEC)
		0.1- CALM	0.9- 0.9	1.8- 1.8	2.7- 2.7	3.6- 3.6	4.5- 4.5	5.4- 5.4	6.3- 6.3	7.2- 7.2	8.1- 8.1	9.0- 9.0	11.2- 11.2	13.4- 13.4	15.6- 15.6	17.9- 17.9	>17.9		
H O U R	1	0.0	1.7	3.3	8.3	7.4	9.9	8.3	6.6	7.4	10.7	9.1	16.5	5.8	4.1	0.8	0.0	15.6	7.0
	2	0.0	1.7	5.0	2.5	8.3	8.3	6.6	8.3	8.3	10.7	12.4	17.4	7.4	2.5	0.8	0.0	16.0	7.1
	3	0.0	2.5	1.7	5.0	6.6	7.4	6.6	12.4	9.1	10.7	9.9	16.5	7.4	3.3	0.0	0.8	16.1	7.2
	4	0.0	0.0	5.0	3.3	6.6	8.3	5.8	14.0	7.4	10.7	11.6	18.2	5.8	2.5	0.8	0.0	16.1	7.2
	5	0.0	0.8	1.7	7.5	8.3	10.0	9.2	5.8	5.0	13.3	12.5	15.8	5.0	4.2	0.0	0.8	16.0	7.2
	6	0.0	1.7	1.7	4.2	10.0	6.7	11.7	10.0	6.7	5.8	11.7	18.3	5.8	5.8	0.0	0.0	16.2	7.2
	7	0.8	1.7	0.8	4.2	9.2	7.5	15.0	8.3	5.0	10.0	5.0	17.5	10.0	3.3	1.7	0.0	16.2	7.2
	8	0.8	1.7	4.2	6.7	5.8	7.5	11.7	6.7	6.7	10.8	6.7	18.3	9.2	3.3	0.0	0.0	15.8	7.1
	9	1.7	1.7	0.8	5.0	10.8	8.3	8.3	7.5	8.3	7.5	8.3	16.7	11.7	3.3	0.0	0.0	16.0	7.2
	10	0.8	1.7	2.5	8.3	5.8	6.7	10.0	6.7	8.3	8.3	7.5	22.5	2.5	7.5	0.8	0.0	16.4	7.3
	11	0.8	0.0	4.2	3.3	7.5	7.5	10.8	9.2	5.8	6.7	6.7	20.8	5.8	8.3	1.7	0.8	17.3	7.7
	12	0.0	0.0	5.8	4.2	6.7	7.5	5.8	10.0	5.8	6.7	7.5	16.7	10.8	9.2	1.7	1.7	18.3	8.2
	13	0.0	0.0	5.8	5.0	4.1	9.1	5.8	5.8	7.4	8.3	6.6	15.7	10.7	9.9	3.3	2.5	19.1	8.5
	14	0.0	0.8	1.7	2.5	9.1	7.4	9.1	5.8	5.0	5.8	5.8	20.7	10.7	11.6	1.7	2.5	19.3	8.6
	15	0.0	0.0	2.5	3.3	5.8	11.6	6.6	5.0	5.0	8.3	7.4	19.8	9.9	9.9	3.3	1.7	19.1	8.6
	16	0.0	0.0	1.7	3.3	5.8	10.7	9.1	5.8	4.1	8.3	9.1	21.5	8.3	9.1	2.5	0.8	18.8	8.4
	17	0.0	0.0	0.8	1.7	9.1	10.7	5.8	6.6	7.4	9.1	8.3	21.5	8.3	9.9	0.8	0.0	18.3	8.2
	18	0.0	0.8	1.7	2.5	9.2	7.5	10.0	8.3	8.3	11.7	9.2	13.3	8.3	8.3	0.8	0.0	17.2	7.7
	19	0.0	0.8	3.3	4.2	6.7	15.0	8.3	2.5	6.7	11.7	11.7	15.8	7.5	5.0	0.8	0.0	16.4	7.3
	20	0.0	0.0	4.2	3.3	12.5	8.3	9.2	10.0	5.8	10.8	8.3	13.3	8.3	5.0	0.8	0.0	15.8	7.1
	21	0.0	0.8	5.0	5.0	8.3	14.2	5.0	5.8	8.3	10.8	10.0	14.2	6.7	5.0	0.0	0.8	15.8	7.1
	22	0.0	0.8	5.9	6.7	5.0	8.4	10.9	5.9	6.7	10.9	10.9	17.6	4.2	4.2	0.8	0.8	15.8	7.0
	23	0.0	0.8	4.2	10.9	8.4	7.6	5.9	8.4	5.9	9.2	11.8	16.8	5.9	1.7	2.5	0.0	15.4	6.9
	24	0.0	0.8	2.5	5.9	11.9	8.5	11.0	7.6	7.6	8.5	5.9	20.3	5.1	4.2	0.0	0.0	15.4	6.9
ALL HOURS		0.2	0.9	3.2	4.9	7.9	8.9	8.6	7.6	6.8	9.4	8.9	17.7	7.6	5.9	1.1	0.6	16.8	7.5

SOURCE: GEORESEARCH, INC.

Table IV - 110
Annual Wind Rose Distribution
MADISON COUNTY - NORRIS HILL
01/10/84 - 03/31/86

DIRECTION>	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	TOTAL	<DIRECTION
SPEED (MPH)																		SPEED (M/SEC)
0.1- 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	0.0	0.0	0.1	0.1- 0.4
1.1- 2.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.5- 0.9
2.1- 3.0	0.0	0.1	0.2	0.1	0.0	0.0	0.0	0.1	0.0	0.2	0.3	0.0	0.0	0.0	0.0	0.0	1.1	1.0- 1.3 S
3.1- 4.0	0.0	0.1	0.4	0.2	0.1	0.0	0.1	0.1	0.1	0.3	0.5	0.0	0.0	0.0	0.0	0.0	2.0	1.4- 1.8 P
S 4.1- 5.0	0.1	0.2	0.6	0.2	0.1	0.0	0.0	0.1	0.2	0.4	0.4	0.0	0.0	0.0	0.0	0.0	2.4	1.9- 2.2 E
P 5.1- 6.0	0.1	0.3	0.9	0.2	0.1	0.1	0.1	0.1	0.4	0.6	0.7	0.0	0.0	0.0	0.0	0.0	3.8	2.3- 2.7 E
E 6.1- 7.0	0.1	0.4	0.8	0.1	0.0	0.0	0.0	0.1	0.4	0.4	0.5	0.0	0.0	0.0	0.0	0.0	3.1	2.8- 3.1 D
E 7.1- 8.0	0.1	0.6	0.8	0.2	0.0	0.0	0.0	0.2	0.7	0.8	0.6	0.0	0.0	0.0	0.0	0.0	4.2	3.2- 3.6
D 8.1- 9.0	0.1	0.6	0.7	0.1	0.0	0.0	0.1	0.2	0.6	0.8	0.6	0.1	0.0	0.0	0.0	0.0	4.0	3.7- 4.0 M
9.1-10.0	0.1	0.8	0.7	0.1	0.1	0.0	0.1	0.3	0.9	1.0	0.5	0.0	0.0	0.0	0.0	0.0	4.8	4.1- 4.5 E
M 10.1-11.0	0.2	0.6	0.6	0.1	0.0	0.0	0.0	0.3	0.7	0.7	0.5	0.0	0.0	0.0	0.0	0.0	3.8	4.6- 4.9 T
I 11.1-12.0	0.1	0.9	0.3	0.1	0.0	0.0	0.1	0.3	1.2	1.0	0.7	0.1	0.0	0.0	0.0	0.0	5.0	5.0- 5.4 E
L 12.1-13.0	0.2	0.6	0.3	0.0	0.0	0.0	0.1	0.3	0.9	0.7	0.5	0.1	0.1	0.0	0.0	0.0	3.8	5.5- 5.8 R
E 13.1-14.0	0.1	0.7	0.4	0.1	0.0	0.0	0.1	0.4	1.4	0.7	0.8	0.1	0.0	0.0	0.0	0.0	4.9	5.9- 6.3 S
S 14.1-15.0	0.1	0.4	0.3	0.1	0.0	0.0	0.0	0.4	1.1	0.6	0.5	0.1	0.1	0.0	0.0	0.0	3.7	6.4- 6.7 /
/ 15.1-16.0	0.1	0.5	0.2	0.1	0.0	0.0	0.0	0.3	1.2	0.6	0.4	0.1	0.0	0.0	0.0	0.0	3.6	6.8- 7.2 S
H 16.1-17.0	0.1	0.7	0.3	0.0	0.0	0.0	0.0	0.4	1.5	0.8	0.7	0.1	0.0	0.0	0.0	0.0	4.6	7.3- 7.6 E
O 17.1-18.0	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.3	1.3	0.5	0.3	0.1	0.0	0.0	0.0	0.0	3.3	7.7- 8.0 C
U 18.1-19.0	0.0	0.4	0.3	0.0	0.0	0.0	0.0	0.4	1.6	0.8	0.3	0.1	0.0	0.0	0.0	0.0	4.0	8.1- 8.5 O
R 19.1-20.0	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.3	1.3	0.7	0.3	0.1	0.0	0.0	0.0	0.0	3.3	8.6- 8.9 N
20.1-25.0	0.1	0.8	0.7	0.1	0.0	0.0	0.0	1.9	5.8	2.7	1.4	0.2	0.1	0.0	0.0	0.1	14.0	9.0-11.2 D
25.1-30.0	0.1	0.3	0.1	0.1	0.0	0.0	0.0	1.5	3.7	2.5	0.6	0.3	0.0	0.0	0.0	0.0	9.3	11.3-13.4
30.1-35.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.8	2.4	1.9	0.4	0.1	0.0	0.0	0.0	0.0	5.7	13.5-15.6
35.1-40.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	1.2	1.6	0.1	0.0	0.0	0.0	0.0	0.0	3.2	15.7-17.9
>40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	1.3	>17.9
CALM																	0.2	CALM
TOTAL	1.9	10.0	9.4	2.1	0.6	0.4	0.9	9.0	29.1	21.4	11.8	1.6	0.7	0.3	0.3	0.4	100.0	TOTAL
AV SPEED (MPH)	12.7	13.7	10.8	9.4	7.8	7.5	10.2	19.9	20.0	20.0	14.2	18.0	13.9	10.8	9.9	11.7	17.0	AV SPEED (MPH)
AV SPEED (M/SEC)	5.7	6.1	4.8	4.2	3.5	3.3	4.6	8.9	8.9	9.0	6.3	8.1	6.2	4.8	4.4	5.2	7.6	AV SPEED (M/SEC)

SOURCE: GEORESEARCH, INC.

Figure IV - 12
Annual Wind Rose
MADISON COUNTY - NORRIS HILL
(1984 - 1986)

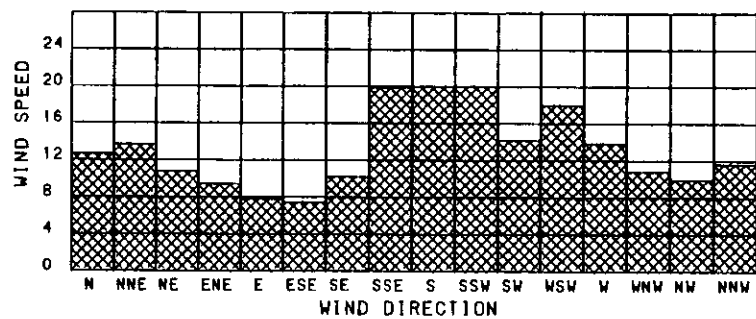
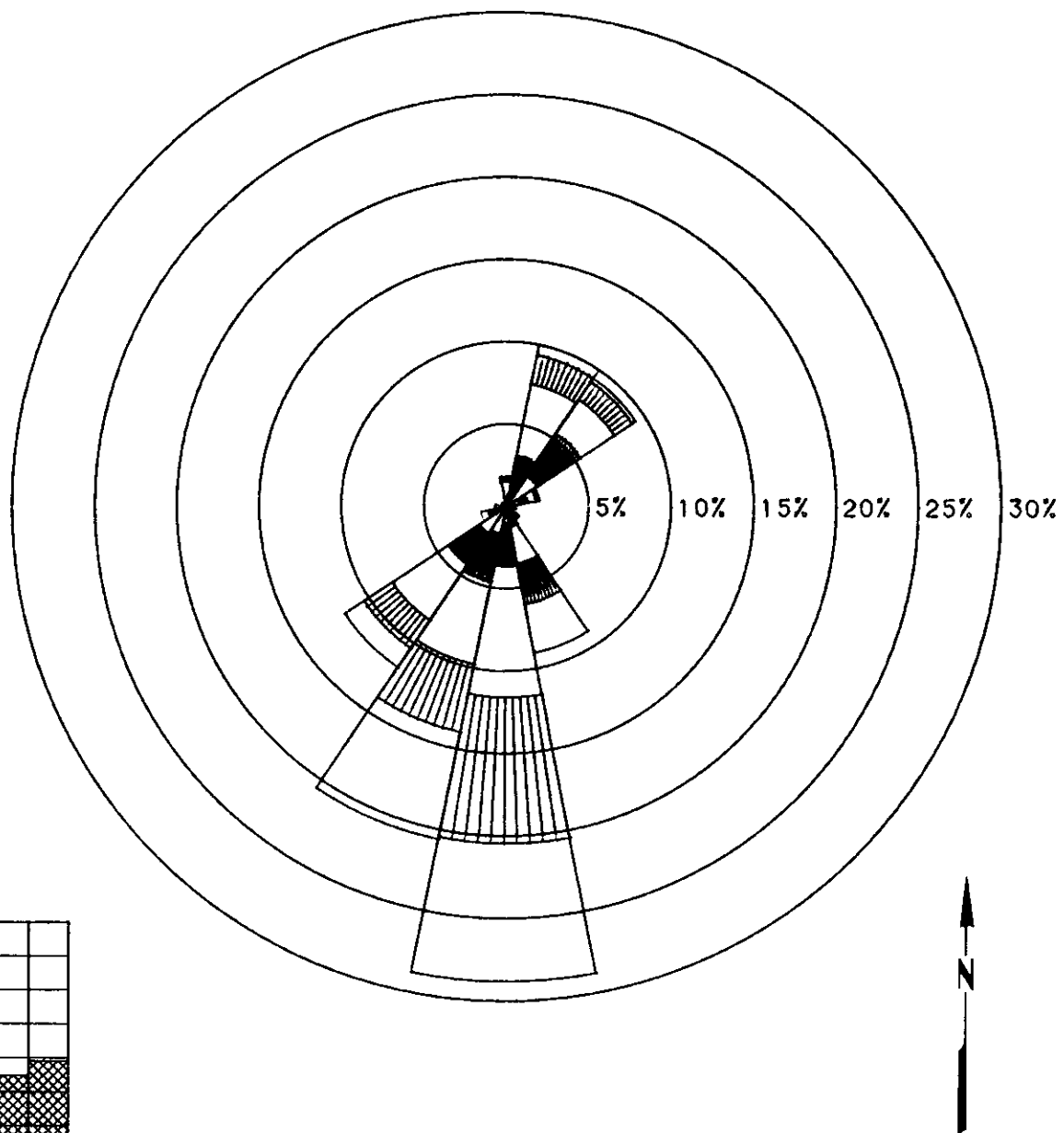
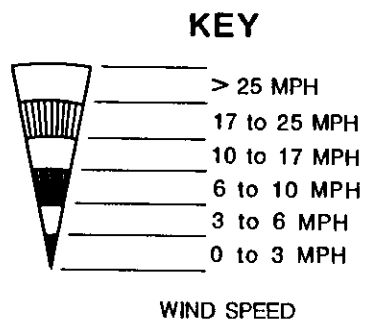


Table IV - 111
 Coefficients of Weibull Distribution
MADISON COUNTY - NORRIS HILL
 01/10/84 - 03/31/86

MONTH	SCALE FACTOR (C) (M/SEC)	SHAPE FACTOR (K)
JANUARY	11.3258	2.3120
FEBRUARY	11.1553	2.0144
MARCH	8.6541	1.9453
APRIL	8.4476	2.0909
MAY	7.0567	2.0074
JUNE	6.5672	2.0709
JULY	5.7501	2.3289
AUGUST	6.4320	2.1890
SEPTEMBER	7.1492	1.9162
OCTOBER	10.5452	2.4754
NOVEMBER	8.9925	2.3193
DECEMBER	12.5081	1.9372
YEAR	8.4924	1.8549

SOURCE: GEORESEARCH, INC.