HEART BUTTE

PONDERA COUNTY

The Heart Butte site is located over 3 miles west of Heart Butte and about 20 miles south of Browning at 48 17 42 N and 112 53 03 W (Site No. 100 on Map II-1). Elevation at the site is 5,161 feet. This monitoring site was part of the Wind Regional Energy Assessment Program run by Oregon State University for Bonneville Power Administration.

Well exposed and relatively smooth ridge crests abound in the area. The Rocky Mountain Front is less than 5 miles to the west. The site is representative of a large area. Access to the area is reasonable, with a state highway running to the east and a paved secondary road into Heart Butte. A number of dirt roads cut through the area. Winter access is sometimes hampered by drifting snow and severe weather conditions.

The site is located on the Blackfeet Indian Reservation. It is located south of Glacier National Park and near areas still being promoted for wilderness designation. Electrical service in the area is provided by the Glacier Electric Cooperative. One 115 kV line runs into Browning from Cut Bank. The area is at a remote end of the transmission system. The nearest commercial airport is located in Cut Bank, nearly 30 miles to the east. Air traffic generally is light.

Collection of wind data began in October 1981 when a wind-run anemometer was installed. Summaries of this data are printed in Appendix C. A data logger was installed and began collecting data on November 13, 1982. Data collection ran through May 29, 1984. The anemometer height was 35 feet.

Data recovery was fair to excellent, ranging from 68.8 percent in January to 100.0 percent in July through September. Overall data recovery was 92.3 percent.

Average monthly wind speeds ranged from 10.4 miles per hour in June to 27.5 miles per hour in January. Average annual wind speed was 18.0 miles per hour.

Average monthly wind power ranged from 113.9 watts/m^2 in June up to 1,753.8 watts/m^2 in January.

Average seasonal wind speeds were 12.6 miles per hour in the summer, 15.3 miles per hour in the autumn, 25.9 miles per hour in the winter, and 20.2 miles per hour in the spring. In the spring, highest winds happened in the afternoon. Diurnal range of average wind speeds was greatest in the spring, at 5.8 miles per hour and least in the autumn, with a range of 3.2 miles per hour. Highest speeds in winter were during the night.

The wind direction data is incomplete because the wind vane failed January 1, 1984 and was not replaced. The wind speeds during the following five months were particularly high. How this affected the distribution of the wind rose is not known; the wind speeds on the wind rose certainly are below what would have been the average for the eighteen-month monitoring period. The most common wind directions were west-southwest to north-northwest. Winds from the north-northeast through south-southeast were least common.

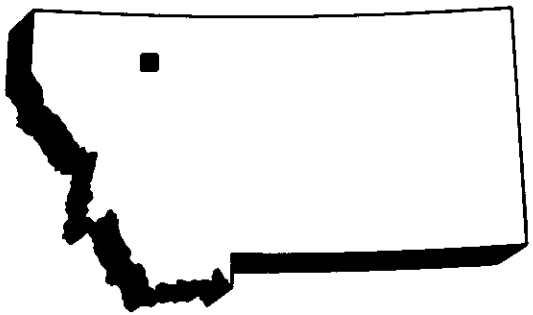


Table IV - 132

Monthly Wind Speed Distribution

PONDERA COUNTY - HEART BUTTE

11/13/82 - 05/29/84

		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR		
	CALM	0.8	1.2	0.0	1.0	0.0	2.5	0.3	0.7	4.4	1.5	3.5	6.7	1.8	CALM	
	0.1-1.0	0.7	1.2	0.0	0.6	0.0	2.0	1.2	1.2	3.3	2.2	2.5	5.0	1.6	0.1- 0.4	
	1.1-2.0	0.0	0.7	0.0	0.4	0.0	4.0	2.6	1.9	1.7	2.1	3.0	3.9	1.5	0.5- 0.9	S
S	2.1-3.0	6.5	7.4	1.5	10.1	7.4	5.6	3.0	2.6	2.6	2.8	3.4	4.4	4.8	1.0- 1.3	P
P	3.1-4.0	0.7	0.5	0.8	1.1	0.0	6.1	3.5	2.8	2.4	3.2	3.4	4.7	2.2	1.4- 1.8	E
E	4.1-5.0	1.4	0.6	1.5	1.9	0.3	6.1	3.8	3.8	1.9	2.7	3.5	4.7	2.4	1.9- 2.2	E
E	5.1-6.0	2.1	0.9	1.1	2.6	0.9	5.6	5.2	5.0	3.3	2.7	3.9	3.6	2.9	2.3- 2.7	D
D	6.1-7.0	1.8	1.3	3.2	2.6	0.6	5.6	3.6	4.4	2.9	3.2	4.0	4.4	3.0	2.8- 3.1	
	7.1-8.0	2.0	1.7	3.5	3.7	0.6	7.6	3.2	6.3	3.2	5.2	3.6	3.9	3.4	3.2- 3.6	M
M	8.1-9.0	1.5	1.6	3.5	3.4	1.3	4.5	4.7	8.1	4.4	4.5	4.9	4.1	3.8	3.7- 4.0	E
I	9.1-10.0	1.9	2.3	4.2	3.2	1.8	6.1	5.9	7.0	4.2	4.8	3.8	4.7	4.0	4.1- 4.5	T
L	10.1-11.0	1.4	2.0	3.2	3.7	2.8	7.1	6.7	7.0	4.0	4.1	3.7	5.0	4.0	4.6- 4.9	E
E	11.1-12.0	1.5	2.6	3.9	4.0	1.5	6.6	5.2	6.9	4.4	4.8	2.7	2.9	3.7	5.0- 5.4	R
S	12.1-13.0	1.5	1.6	3.1	4.4	3.6	3.5	5.8	7.7	5.1	3.8	3.3	3.6	3.9	5.5- 5.8	S
/	13.1-14.0	2.1	1.9	3.8	3.6	3.6	4.0	3.9	5.6	4.7	3.1	3.2	2.3	3.4	5.9- 6.3	/
H	14.1-15.0	1.9	1.7	3.1	4.5	2.4	3.0	4.4	5.6	2.9	4.1	2.2	2.8	3.2	6.4- 6.7	S
O	15.1-16.0	1.4	2.4	3.6	4.2	1.6	2.5	3.6	3.5	2.4	5.5	2.8	2.4	3.0	6.8- 7.2	E
U	16.1-17.0	1.8	1.6	5.0	3.4	2.7	1.5	5.0	4.2	3.5	3.5	3.4	1.1	3.2	7.3- 7.6	C
R	17.1-18.0	1.4	1.7	4.7	3.0	2.7	2.5	3.5	3.6	2.5	4.8	4.1	1.6	3.1	7.7- 8.0	O
	18.1-19.0	2.0	2.1	4.8	3.0	2.1	2.5	3.5	3.2	4.0	4.9	3.0	1.8	3.1	8.1- 8.5	N
	19.1-20.0	1.8	2.6	3.5	2.5	3.6	1.5	2.4	2.3	4.3	4.5	1.8	2.0	2.7	8.6- 8.9	D
	20.1-25.0	7.5	11.5	15.0	13.1	13.5	7.6	9.4	5.1	15.3	13.3	10.3	7.0	10.9	9.0-11.2	
	25.1-30.0	9.3	13.1	10.5	8.7	15.8	1.0	5.1	0.8	6.3	4.8	9.8	5.4	8.1	11.3-13.4	
	30.1-35.0	6.5	13.5	4.7	6.2	11.1	0.5	3.1	0.5	3.1	0.8	5.3	4.9	5.4	13.5-15.6	
	35.1-40.0	5.9	4.8	4.3	2.5	7.1	0.5	0.7	0.1	1.4	0.3	1.5	2.0	2.7	15.7-17.9	
	>40.0	34.2	17.4	7.8	2.7	13.3	0.0	0.7	0.1	1.7	2.9	3.4	5.0	8.1	>17.9	
AVERAGE SPEED (MPH)		27.5	24.2	20.3	16.7	24.4	10.4	13.9	11.8	15.1	15.0	15.7	13.9	18.0		
AVERAGE SPEED (M/SEC)		12.3	10.8	9.1	7.5	10.9	4.7	6.2	5.3	6.7	6.7	7.0	6.2	8.0		
AVERAGE WIND POWER (WATTS/M**2)		1753.8	1196.3	697.6	456.4	1044.8	113.9	235.9	121.4	339.8	368.4	463.3	489.2	649.7		
PERCENT DATA RECOVERY		68.8	81.4	97.1	97.3	98.8	91.7	100.0	100.0	100.0	95.8	98.3	94.8	92.3		

ANEMOMETER HEIGHT = 11 METERS = 35 FEET
NUMBER OF OBSERVATIONS = 8830
PERCENTAGE DATA RECOVERY = 92.3

SOURCE: GEORESEARCH, INC.

Table IV - 133

Percentage Frequency Summary for Wind Speed

PONDERA COUNTY - HEART BUTTE

(WINTER)

11/13/82 - 05/29/84

		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		
	1	0.0	2.2	6.7	4.4	3.3	3.3	5.6	5.6	2.2	1.1	5.6	10.0	7.8	14.4	8.9	18.9	25.4	11.3
	2	2.4	2.4	7.3	2.4	2.4	0.0	7.3	6.1	2.4	0.0	7.3	7.3	8.5	12.2	6.1	25.6	25.9	11.6
	3	0.0	1.3	10.3	2.6	3.8	3.8	1.3	3.8	0.0	5.1	5.1	12.8	11.5	6.4	6.4	25.6	26.0	11.6
	4	0.0	2.7	8.0	1.3	5.3	2.7	4.0	1.3	1.3	4.0	1.3	16.0	6.7	17.3	5.3	22.7	26.5	11.8
	5	1.4	0.0	11.4	2.9	2.9	4.3	1.4	0.0	4.3	1.4	0.0	14.3	10.0	11.4	10.0	24.3	26.8	12.0
	6	1.4	4.3	7.2	2.9	1.4	1.4	1.4	1.4	2.9	5.8	4.3	13.0	8.7	8.7	4.3	30.4	26.9	12.0
	7	3.0	1.5	7.6	3.0	1.5	3.0	4.5	1.5	0.0	1.5	6.1	16.7	4.5	10.6	4.5	30.3	27.1	12.1
	8	1.6	1.6	9.4	1.6	4.7	3.1	1.6	1.6	0.0	6.3	6.3	6.3	9.4	12.5	9.4	25.0	26.7	11.9
H	9	0.0	1.6	9.5	4.8	4.8	1.6	1.6	1.6	3.2	7.9	1.6	9.5	9.5	12.7	4.8	25.4	26.0	11.6
	10	1.6	0.0	8.1	3.2	1.6	3.2	1.6	4.8	4.8	3.2	3.2	11.3	14.5	9.7	4.8	24.2	26.4	11.8
O	11	1.6	0.0	9.7	3.2	3.2	3.2	3.2	1.6	4.8	1.6	4.8	11.3	9.7	9.7	9.7	22.6	26.1	11.7
	12	1.6	0.0	6.5	3.2	3.2	3.2	4.8	4.8	1.6	3.2	3.2	11.3	11.3	11.3	3.2	27.4	26.5	11.8
U	13	2.2	1.1	6.7	4.5	10.1	3.4	6.7	3.4	2.2	1.1	3.4	10.1	11.2	10.1	5.6	18.0	22.9	10.2
	14	2.4	3.7	4.9	3.7	2.4	6.1	6.1	4.9	3.7	3.7	2.4	14.6	6.1	7.3	6.1	22.0	24.1	10.8
R	15	1.3	0.0	9.0	1.3	3.8	9.0	3.8	3.8	2.6	3.8	5.1	14.1	6.4	10.3	0.0	25.6	24.3	10.9
	16	1.3	0.0	6.5	1.3	5.2	5.2	2.6	2.6	10.4	5.2	2.6	10.4	7.8	11.7	6.5	20.8	25.1	11.2
	17	0.0	1.4	7.2	1.4	2.9	4.3	4.3	5.8	7.2	2.9	1.4	8.7	8.7	13.0	10.1	20.3	25.8	11.5
	18	1.5	1.5	5.9	0.0	0.0	4.4	1.5	5.9	8.8	1.5	8.8	14.7	8.8	7.4	8.8	20.6	25.8	11.5
	19	0.0	1.5	5.9	2.9	1.5	4.4	1.5	4.4	8.8	2.9	2.9	17.6	7.4	10.3	2.9	25.0	25.8	11.5
	20	0.0	1.5	4.4	4.4	1.5	1.5	4.4	5.9	4.4	2.9	8.8	11.8	8.8	10.3	5.9	23.5	26.2	11.7
	21	0.0	1.5	6.0	3.0	3.0	3.0	4.5	3.0	4.5	4.5	3.0	11.9	10.4	16.4	3.0	22.4	26.0	11.6
	22	0.0	0.0	10.4	1.5	0.0	4.5	4.5	6.0	3.0	3.0	1.5	13.4	11.9	10.4	9.0	20.9	26.4	11.8
	23	0.0	0.0	7.8	0.0	3.1	3.1	4.7	4.7	3.1	4.7	7.8	9.4	9.4	9.4	7.8	25.0	27.1	12.1
	24	0.0	0.0	6.5	0.0	8.1	6.5	4.8	0.0	4.8	3.2	4.8	3.2	9.7	21.0	0.0	27.4	26.8	12.0
ALL HOURS		1.0	1.3	7.6	2.5	3.4	3.7	3.8	3.6	3.8	3.3	4.2	11.7	9.0	11.4	6.0	23.7	25.9	11.6

SOURCE: GEORESEARCH, INC.

Table IV - 134

Percentage Frequency Summary for Wind Speed

PONDERA COUNTY - HEART BUTTE

(SPRING)

11/13/82 - 05/29/84

		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)																	
		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	AV SPEED (MPH)	AV SPEED (M/SEC)
	1	0.0	1.0	8.2	4.1	6.2	8.2	7.2	5.2	6.2	10.3	6.2	12.4	6.2	5.2	7.2	6.2	19.1	8.5
	2	0.0	1.0	7.2	4.1	2.1	9.3	13.4	7.2	4.1	4.1	6.2	17.5	7.2	7.2	2.1	7.2	19.1	8.5
	3	1.1	0.0	7.4	4.2	6.3	9.5	8.4	7.4	5.3	4.2	6.3	15.8	8.4	8.4	3.2	4.2	18.4	8.2
	4	1.1	0.0	9.5	5.3	6.3	7.4	4.2	9.5	3.2	10.5	4.2	15.8	8.4	8.4	1.1	5.3	18.1	8.1
	5	1.1	1.1	9.6	4.3	10.6	5.3	4.3	8.5	4.3	7.4	3.2	16.0	8.5	6.4	4.3	5.3	18.3	8.2
	6	2.1	0.0	10.6	9.6	6.4	8.5	2.1	9.6	4.3	3.2	4.3	18.1	6.4	5.3	4.3	5.3	17.5	7.8
	7	2.1	0.0	11.7	8.5	7.4	8.5	4.3	5.3	0.0	10.6	4.3	12.8	7.4	11.7	1.1	4.3	17.3	7.7
	8	1.1	1.1	10.6	3.2	11.7	5.3	8.5	4.3	3.2	7.4	4.3	14.9	9.6	5.3	4.3	5.3	17.9	8.0
H	9	0.0	1.1	9.6	4.3	7.4	7.4	6.4	6.4	6.4	4.3	7.4	16.0	10.6	4.3	0.0	8.5	18.3	8.2
	10	0.0	0.0	8.5	0.0	2.1	9.6	9.6	4.3	7.4	9.6	6.4	20.2	9.6	4.3	2.1	6.4	19.6	8.8
O	11	0.0	0.0	6.5	1.1	4.3	7.5	3.2	7.5	3.2	10.8	7.5	24.7	10.8	2.2	4.3	6.5	20.5	9.2
	12	0.0	0.0	5.4	1.1	2.2	3.3	5.4	7.6	6.5	9.8	6.5	26.1	12.0	7.6	1.1	5.4	21.1	9.4
U	13	0.0	0.0	5.3	1.1	1.1	3.2	6.3	9.5	6.3	3.2	12.6	16.8	14.7	10.5	4.2	5.3	22.1	9.9
	14	0.0	0.0	5.3	1.1	2.1	2.1	5.3	6.3	7.4	5.3	10.5	15.8	16.8	10.5	5.3	6.3	22.8	10.2
R	15	0.0	0.0	6.3	0.0	1.1	2.1	6.3	8.4	6.3	4.2	7.4	17.9	14.7	14.7	2.1	8.4	23.1	10.3
	16	0.0	0.0	6.3	1.1	3.2	0.0	4.2	7.4	10.5	3.2	7.4	21.1	9.5	15.8	3.2	7.4	22.9	10.3
	17	0.0	0.0	5.3	2.1	2.1	1.1	4.2	7.4	9.5	8.4	8.4	14.7	9.5	11.6	7.4	8.4	23.0	10.3
	18	0.0	0.0	4.3	1.1	3.2	2.1	4.3	9.6	9.6	9.6	6.4	16.0	10.6	7.4	10.6	5.3	22.4	10.0
	19	0.0	0.0	5.3	1.1	2.1	6.4	11.7	7.4	6.4	10.6	4.3	10.6	9.6	8.5	9.6	6.4	21.6	9.7
	20	0.0	0.0	4.3	0.0	7.4	4.3	7.4	9.6	12.8	3.2	7.4	10.6	10.6	7.4	9.6	5.3	21.2	9.5
	21	0.0	0.0	5.3	2.1	6.4	5.3	5.3	7.4	13.8	8.5	5.3	9.6	8.5	7.4	8.5	6.4	20.7	9.2
	22	0.0	1.1	5.3	3.2	3.2	6.4	11.7	6.4	9.6	9.6	5.3	5.3	9.6	9.6	3.2	10.6	20.6	9.2
	23	0.0	1.1	6.4	2.1	7.4	8.5	5.3	7.4	5.3	8.5	8.5	12.8	5.3	7.4	5.3	8.5	20.1	9.0
	24	0.0	1.1	6.6	4.4	5.5	11.0	6.6	6.6	7.7	5.5	4.4	15.4	4.4	4.4	7.7	8.8	19.5	8.7
ALL HOURS		0.4	0.4	7.1	2.9	4.9	5.9	6.5	7.3	6.6	7.2	6.5	15.7	9.5	8.0	4.6	6.5	20.2	9.0

SOURCE: GEORESEARCH, INC.

Table IV - 135

Percentage Frequency Summary for Wind Speed

PONDERA COUNTY - HEART BUTTE

(SUMMER)

11/13/82 - 05/29/84

		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		
	1	0.0	4.2	2.8	7.0	8.5	19.7	18.3	7.0	9.9	8.5	4.2	7.0	0.0	1.4	1.4	0.0	12.5	5.6
	2	0.0	4.2	5.6	4.2	12.7	19.7	15.5	8.5	7.0	2.8	5.6	8.5	2.8	2.8	0.0	0.0	12.5	5.6
	3	0.0	7.0	7.0	14.1	8.5	9.9	12.7	14.1	4.2	8.5	2.8	7.0	0.0	4.2	0.0	0.0	11.8	5.3
	4	0.0	7.0	8.5	9.9	9.9	8.5	16.9	16.9	1.4	4.2	4.2	7.0	2.8	1.4	1.4	0.0	11.9	5.3
	5	1.4	5.7	5.7	10.0	14.3	11.4	11.4	11.4	4.3	4.3	8.6	8.6	0.0	0.0	1.4	1.4	11.9	5.3
	6	1.4	5.8	10.1	17.4	4.3	10.1	8.7	11.6	10.1	7.2	1.4	7.2	1.4	1.4	0.0	1.4	11.6	5.2
	7	1.4	13.0	7.2	11.6	14.5	8.7	8.7	8.7	5.8	5.8	2.9	7.2	1.4	1.4	1.4	0.0	10.9	4.9
	8	1.4	10.1	11.6	15.9	11.6	7.2	13.0	4.3	4.3	4.3	4.3	7.2	1.4	1.4	1.4	0.0	10.4	4.7
H	9	2.9	1.4	17.4	15.9	15.9	10.1	7.2	2.9	7.2	4.3	2.9	7.2	1.4	1.4	1.4	0.0	10.3	4.6
	10	0.0	2.9	13.0	15.9	11.6	7.2	11.6	7.2	7.2	5.8	8.7	7.2	0.0	1.4	0.0	0.0	11.2	5.0
O	11	0.0	2.9	10.1	14.5	8.7	13.0	4.3	4.3	8.7	13.0	4.3	13.0	1.4	1.4	0.0	0.0	12.4	5.6
	12	1.4	1.4	8.7	10.1	10.1	14.5	4.3	13.0	5.8	10.1	5.8	11.6	0.0	2.9	0.0	0.0	12.6	5.6
U	13	0.0	4.2	5.6	8.5	8.5	8.5	14.1	9.9	8.5	7.0	14.1	9.9	1.4	0.0	0.0	0.0	13.1	5.8
	14	0.0	1.4	4.2	8.5	9.9	8.5	14.1	4.2	9.9	9.9	9.9	14.1	5.6	0.0	0.0	0.0	14.3	6.4
R	15	2.8	1.4	5.6	8.5	7.0	9.9	8.5	2.8	5.6	14.1	12.7	15.5	5.6	0.0	0.0	0.0	14.4	6.4
	16	0.0	1.4	7.0	9.9	8.5	2.8	4.2	16.9	14.1	15.5	7.0	11.3	1.4	0.0	0.0	0.0	13.8	6.2
	17	1.4	0.0	8.5	1.4	8.5	9.9	14.1	7.0	21.1	11.3	4.2	9.9	2.8	0.0	0.0	0.0	13.6	6.1
	18	1.4	1.4	1.4	4.2	4.2	14.1	16.9	16.9	14.1	8.5	7.0	5.6	1.4	2.8	0.0	0.0	13.8	6.2
	19	1.4	1.4	2.8	5.6	4.2	19.7	12.7	19.7	12.7	9.9	1.4	1.4	4.2	2.8	0.0	0.0	13.1	5.9
	20	0.0	1.4	1.4	2.8	11.3	16.9	22.5	14.1	8.5	4.2	2.8	7.0	2.8	4.2	0.0	0.0	13.6	6.1
	21	0.0	1.4	5.6	5.6	4.2	15.5	23.9	11.3	7.0	7.0	4.2	5.6	1.4	7.0	0.0	0.0	13.8	6.2
	22	0.0	5.7	1.4	8.6	7.1	14.3	15.7	20.0	5.7	8.6	4.3	4.3	1.4	1.4	1.4	0.0	12.7	5.7
	23	0.0	0.0	4.3	8.6	11.4	21.4	14.3	12.9	7.1	5.7	5.7	5.7	0.0	1.4	1.4	0.0	12.5	5.6
	24	0.0	4.3	2.9	2.9	8.6	20.0	17.1	18.6	7.1	2.9	2.9	10.0	0.0	2.9	0.0	0.0	13.0	5.8
ALL HOURS		0.7	3.7	6.6	9.2	9.3	12.6	13.0	11.0	8.2	7.7	5.5	8.3	1.7	1.8	0.5	0.1	12.6	5.6

SOURCE: GEORESEARCH, INC.

Table IV - 136

Percentage Frequency Summary for Wind Speed

PONDERA COUNTY - HEART BUTTE

(AUTUMN)

11/13/82 - 05/29/84

		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		
	1	4.6	5.5	4.6	6.4	9.2	11.0	8.3	9.2	7.3	7.3	1.8	12.8	4.6	4.6	0.9	1.8	14.5	6.5
	2	2.8	5.5	6.4	8.3	10.1	7.3	8.3	8.3	6.4	5.5	4.6	13.8	6.4	3.7	0.9	1.8	14.6	6.5
	3	3.7	3.7	6.4	6.4	12.8	7.3	7.3	7.3	5.5	6.4	6.4	15.6	4.6	4.6	0.9	0.9	14.6	6.5
	4	5.5	2.8	8.3	6.4	8.3	11.9	4.6	5.5	4.6	9.2	7.3	14.7	5.5	2.8	0.9	1.8	14.6	6.5
	5	5.5	3.7	8.3	2.8	10.1	11.0	5.5	3.7	11.9	4.6	7.3	15.6	7.3	1.8	0.0	0.9	14.3	6.4
	6	2.8	6.5	6.5	9.3	8.3	10.2	10.2	7.4	2.8	3.7	7.4	13.0	6.5	2.8	0.9	1.9	14.2	6.4
	7	3.7	6.5	8.3	11.1	6.5	10.2	13.0	2.8	8.3	4.6	1.9	8.3	8.3	3.7	0.9	1.9	13.7	6.1
	8	6.5	9.3	7.4	7.4	7.4	5.6	2.8	12.0	5.6	5.6	3.7	16.7	5.6	1.9	0.9	1.9	13.7	6.1
H	9	2.8	9.3	11.2	5.6	4.7	5.6	10.3	8.4	0.9	10.3	7.5	13.1	1.9	5.6	0.0	2.8	14.2	6.4
	10	4.7	6.6	3.8	6.6	7.5	6.6	6.6	9.4	7.5	8.5	9.4	12.3	5.7	1.9	0.9	1.9	14.8	6.6
O	11	1.0	5.7	6.7	4.8	4.8	10.5	7.6	7.6	6.7	12.4	4.8	12.4	8.6	3.8	1.0	1.9	15.8	7.1
	12	0.0	6.0	8.0	3.0	5.0	13.0	5.0	7.0	7.0	12.0	6.0	19.0	1.0	3.0	2.0	3.0	15.8	7.1
U	13	0.9	3.7	6.5	4.6	6.5	6.5	8.3	10.2	6.5	6.5	7.4	21.3	4.6	3.7	0.9	1.9	16.1	7.2
	14	1.9	4.6	4.6	6.5	4.6	9.3	5.6	5.6	9.3	7.4	13.0	14.8	5.6	4.6	0.9	1.9	16.2	7.2
R	15	0.9	2.8	6.5	6.5	5.6	6.5	4.6	6.5	9.3	7.4	18.5	13.9	3.7	4.6	0.9	1.9	16.4	7.4
	16	0.9	2.8	4.6	4.6	3.7	5.6	9.3	10.2	5.6	13.0	16.7	11.1	3.7	4.6	0.9	2.8	16.9	7.6
	17	0.9	3.7	1.9	1.9	10.2	9.3	11.1	9.3	10.2	9.3	6.5	13.9	3.7	4.6	0.0	3.7	16.3	7.3
	18	1.9	1.9	1.9	5.6	9.3	11.1	11.1	12.0	4.6	9.3	4.6	13.0	6.5	1.9	0.9	4.6	16.2	7.2
	19	0.0	2.8	6.5	11.1	5.6	13.9	7.4	6.5	6.5	3.7	8.3	12.0	4.6	5.6	0.9	4.6	16.0	7.1
	20	4.6	5.6	8.3	7.4	5.6	8.3	10.2	2.8	3.7	5.6	7.4	15.7	1.9	6.5	0.9	5.6	15.9	7.1
	21	5.6	5.6	7.4	2.8	11.1	5.6	6.5	7.4	2.8	6.5	2.8	18.5	5.6	4.6	1.9	5.6	16.4	7.3
	22	4.7	4.7	5.6	7.5	6.5	9.3	7.5	4.7	5.6	5.6	5.6	16.8	8.4	4.7	0.0	2.8	15.7	7.0
	23	5.9	5.9	2.9	8.8	5.9	9.8	3.9	7.8	6.9	4.9	4.9	14.7	9.8	2.9	2.0	2.9	15.9	7.1
	24	6.2	6.2	3.1	4.1	8.2	6.2	9.3	9.3	7.2	6.2	5.2	15.5	7.2	3.1	1.0	2.1	15.2	6.8
ALL HOURS		3.2	5.0	6.1	6.2	7.4	8.8	7.7	7.5	6.4	7.3	7.1	14.5	5.5	3.8	0.9	2.6	15.3	6.9

SOURCE: GEORESEARCH, INC.

Table IV - 137

Annual Wind Rose Distribution

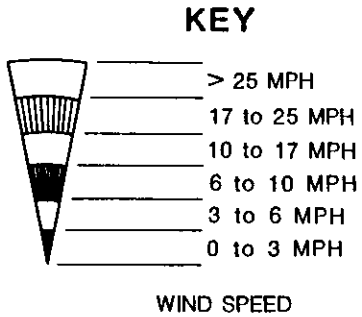
PONDERA COUNTY - HEART BUTTE

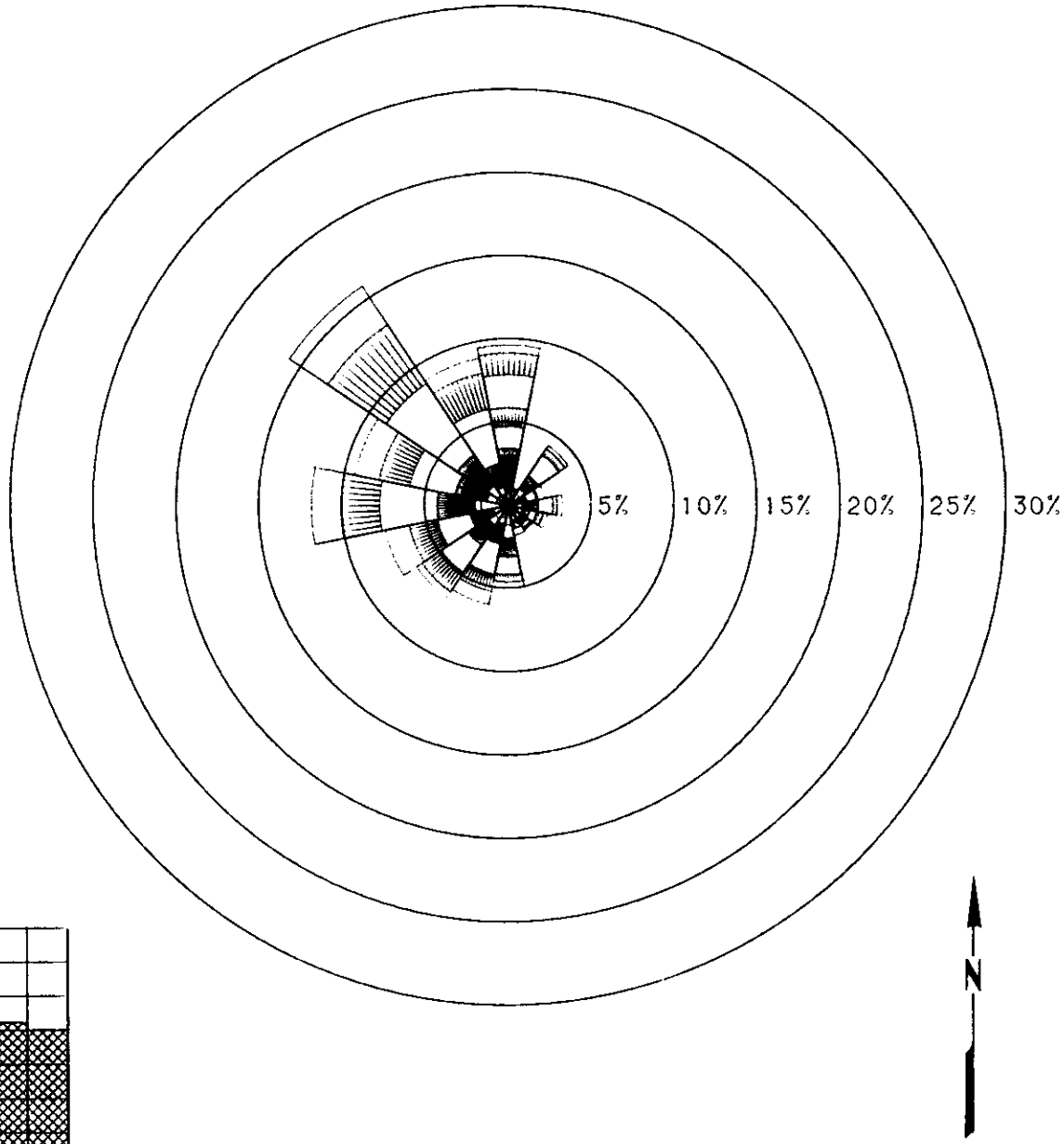
11/13/82 - 05/29/84

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	0.2	0.1	0.2	0.2	0.3	0.2	0.1	0.1	0.3	0.1	0.2	0.2	0.1	0.2	0.2	0.1	2.7	0.1- 0.4
1.1- 2.0	0.2	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.2	2.6	0.5- 0.9
2.1- 3.0	0.4	0.1	0.2	0.1	0.1	0.2	0.2	0.1	0.3	0.3	0.2	0.2	0.4	0.2	0.2	0.2	3.3	1.0- 1.3 S
3.1- 4.0	0.2	0.1	0.2	0.1	0.1	0.2	0.3	0.1	0.3	0.2	0.3	0.2	0.4	0.2	0.2	0.2	3.3	1.4- 1.8 P
S 4.1- 5.0	0.3	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.5	0.2	0.3	0.2	3.4	1.9- 2.2 E
P 5.1- 6.0	0.4	0.1	0.3	0.1	0.2	0.1	0.2	0.2	0.5	0.3	0.3	0.1	0.5	0.3	0.3	0.2	4.0	2.3- 2.7 E
E 6.1- 7.0	0.3	0.0	0.2	0.1	0.2	0.0	0.1	0.1	0.3	0.3	0.3	0.3	0.5	0.3	0.3	0.3	3.8	2.8- 3.1 D
E 7.1- 8.0	0.2	0.0	0.2	0.0	0.3	0.2	0.1	0.1	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.3	4.3	3.2- 3.6
D 8.1- 9.0	0.4	0.0	0.3	0.2	0.1	0.2	0.1	0.2	0.3	0.2	0.5	0.3	0.5	0.4	0.6	0.4	4.9	3.7- 4.0 M
9.1-10.0	0.3	0.0	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.6	0.7	0.6	0.5	4.8	4.1- 4.5 E
M 10.1-11.0	0.2	0.1	0.4	0.2	0.2	0.0	0.1	0.1	0.2	0.2	0.4	0.3	0.8	0.6	0.7	0.4	4.8	4.6- 4.9 T
I 11.1-12.0	0.3	0.0	0.2	0.1	0.1	0.1	0.0	0.1	0.2	0.3	0.3	0.3	0.5	0.3	0.7	0.6	4.3	5.0- 5.4 E
L 12.1-13.0	0.3	0.1	0.2	0.2	0.2	0.1	0.0	0.1	0.2	0.3	0.3	0.4	0.5	0.4	0.8	0.6	4.6	5.5- 5.8 R
E 13.1-14.0	0.4	0.0	0.3	0.1	0.1	0.1	0.0	0.1	0.1	0.2	0.3	0.3	0.2	0.3	0.9	0.4	3.9	5.9- 6.3 S
S 14.1-15.0	0.3	0.0	0.1	0.0	0.2	0.1	0.0	0.0	0.1	0.3	0.2	0.2	0.5	0.3	0.7	0.5	3.5	6.4- 6.7 /
/ 15.1-16.0	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.2	0.4	0.3	0.5	0.5	0.7	0.4	3.4	6.8- 7.2 S
H 16.1-17.0	0.2	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.4	0.3	0.7	0.5	3.4	7.3- 7.6 E
O 17.1-18.0	0.2	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.3	0.4	0.4	0.4	0.8	0.4	3.4	7.7- 8.0 C
U 18.1-19.0	0.2	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.2	0.4	0.2	0.5	0.2	0.8	0.4	3.3	8.1- 8.5 O
R 19.1-20.0	0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.4	0.7	0.3	2.8	8.6- 8.9 N
20.1-25.0	0.6	0.1	0.2	0.1	0.2	0.2	0.0	0.0	0.2	0.8	0.6	1.1	1.2	1.1	2.4	1.3	10.0	9.0-11.2 D
25.1-30.0	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.0	0.2	0.6	0.2	0.6	0.7	0.8	1.3	0.4	5.8	11.3-13.4
30.1-35.0	0.2	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.6	0.6	0.4	0.6	0.3	3.3	13.5-15.6
35.1-40.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2	0.4	0.1	1.4	15.7-17.9
>40.0	0.1	0.0	0.0	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.6	0.3	0.1	0.1	0.3	2.1	>17.9
CALM																	3.0	CALM
TOTAL	6.7	1.2	4.4	2.8	3.3	2.5	1.8	1.8	5.0	6.0	6.6	8.1	12.1	9.5	16.0	9.3	100.0	TOTAL
AV SPEED (MPH)	13.4	12.4	11.3	19.7	11.5	13.2	8.2	7.1	10.6	13.9	12.7	18.5	15.7	15.6	16.9	16.1	14.4	AV SPEED (MPH)
AV SPEED (M/SEC)	6.0	5.5	5.1	8.8	5.2	5.9	3.7	3.2	4.7	6.2	5.7	8.3	7.0	7.0	7.6	7.2	6.4	AV SPEED (M/SEC)

SOURCE: GEORESEARCH, INC.

Figure IV - 15
Annual Wind Rose
PONDERA COUNTY - HEART BUTTE
(1982 - 1984)





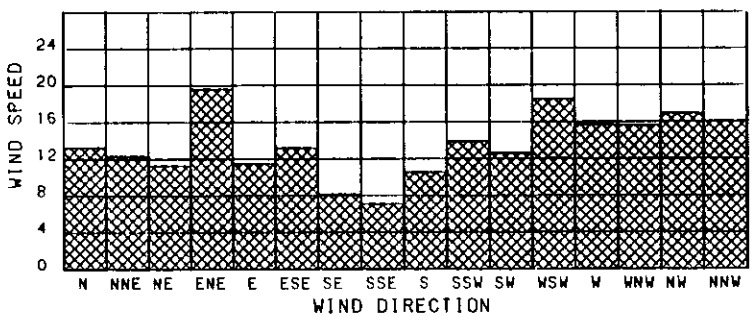


Table IV - 138

Coefficients of Weibull Distribution

PONDERA COUNTY - HEART BUTTE

11/13/82 - 05/29/84

MONTH	SCALE FACTOR (C) (M/SEC)	SHAPE FACTOR (K)
JANUARY	16.7163	1.4883
FEBRUARY	13.8343	1.6648
MARCH	9.6070	1.9676
APRIL	8.5469	1.5470
MAY	12.9609	2.0039
JUNE	5.1221	1.5909
JULY	6.8428	1.7648
AUGUST	5.8349	2.2495
SEPTEMBER	8.0830	1.7133
OCTOBER	7.5162	1.8382
NOVEMBER	8.1650	1.3627
DECEMBER	6.8367	1.1526
YEAR	8.9803	1.4585

SOURCE: GEORESEARCH, INC.