CHAPTER VII

CLIMATOLOGICAL AND AIR QUALITY INFORMATION

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1.0 INTRODUCTION

This Chapter presents a regional and area overview of the climate and air quality and also includes site specific data on meteorological and ambient air quality parameters. The site specific data was collected from an air quality and meteorological monitoring station that was established on the Wishbone Hill mine permit area in October 1988 (see Figure VII-1). The main body of this Chapter presents data that was initially collected from the monitoring station during the period of October 12, 1988 through June 30, 1989. To further assess baseline conditions, the collection of data from the on-site monitoring station continued through October 31, 1991. Air quality data was collected from October 12, 1988 through October 31, 1990 while the collection of meteorological data continued for a full three year period that started on October 23, 1988 and ended October 31, 1991. Addendum 1 contains summary information on the monitoring data that was collected for the entire period of record.

2.0 REGIONAL AND AREA OVERVIEW

2.1 Climate

Five climatological zones have been identified for the state of Alaska: maritime, maritime-continental, transition, continental, and arctic (NOAA 1982). The Matanuska Valley is considered to be in the transition zone between the maritime climate of coastal Alaska and the continental climate of interior Alaska. The transition zone is typified by summer temperatures averaging in the low 60's and winter temperatures averaging near 0 degrees. Maritime zones tend to have more moderate winter temperatures while continental zones tend to have greater temperature extremes.

Precipitation is highly variable within the region depending on topography. Yearly average precipitation in valley areas such as Palmer is about 15 inches including 56 inches of snowfall while precipitation in mountainous areas can be over 80 inches including over 200 inches of snowfall.

Wind direction and velocity are also highly variable depending on local topography. Local winds tend to be oriented in the direction of valleys and rivers. Strong northeast winds exceeding 60 mph periodically blow down the Matanuska River Valley in the fall through spring months. They occur as often as 32 times per year but seldom in the summer. These winds affect a substantial portion of the region depending on exposure. Strong southeast winds often blow down the Knik River Valley

in the summer. The impact of these winds is felt within a limited area in the direct line of exposure.

Long term temperature and precipitation data for Palmer, centrally located in the Matanuska Valley about 8 miles from the Wishbone Hill Mine site, are presented in Table VII-1. Wind speed and direction information is presented in Table VII-2.

Little long-term climatological data exist for portions of the Matanuska Valley area north and east of Palmer; however, the short-term information that does exist suggests that significant differences in temperature and precipitation occur between Palmer and Sutton, near the project area. Sutton (Table VII-3) has significantly greater precipitation and a higher mean temperature than Palmer in spite of its higher elevation.

Wind speed and direction have been monitored in recent years by the Alaska Department of Natural Resources Division of Geological and Geophysical Surveys at a station on Wishbone Hill about 1 mile northeast of the proposed mine permit area, near Wishbone Lake. The results of this monitoring effort are summarized in Table VII-4. The Wishbone Lake area is characterized by moderate east-northeast winds in the fall and winter and light southwest winds in the summer. Although the area is affected by the Matanuska wind phenomenon, maximum wind speed appears to be substantially less than is the case for Palmer and other areas closer to the Matanuska River.

2.2 Air Quality

The Matanuska-Susitna Borough is classified by the Alaska Department of Environmental Conservation as a Class II P.S.D. area which is considered to be clean air (Mat-Su Borough 1981). Few significant sources of air pollution exist in the area. Naturally occurring blowing dust occurs as "Matanuska Winds" pick up glacial sediment from the Matanuska and Knik River floodplains. Dust occurs most often in the spring and fall when high winds correspond with a lack of snow cover.

3.0 SITE CONDITIONS

3.1 Project Monitoring Program

A meteorological and air quality monitoring station was established on the project site in October 1988 with data collection officially beginning on October 12. The station was intended to provide

baseline information regarding background pollutant concentrations and meteorological data for the proposed mine area over a minimum 12 month period. The pollutant monitoring parameters included inhalable particulate (PM-10), and total suspended particulate (TSP). A 10-meter meteorological tower was also established to monitor wind speed, wind direction, ambient temperature, and precipitation.

The monitoring site is located at the Universal Transverse Mercator (UTM) coordinates 2,816,750 north and 559,050 east. The site is immediately south of the proposed mine pit number 1 and about 3000 ft. west of the proposed mine facilities area (Figure VII-1). The site provides meteorological data representative of the mine area, as well as background particulate concentrations.

The particulate data collection was based on the National Sixth-day Sampling Schedule. Additional sampling was required in the spring and late fall to assess particulate concentrations resulting from the entrainment of glacial dust in the Matanuska River basin. Particulate sampling occurred on an every-other-day basis from April 1-May 15 and October 1 through November 30. The other continuously monitored meteorological data were electronically recorded by a microprocessor-based data acquisition system (DAS) yielding hourly averages. The DAS was backed up by a strip chart recorder.

The components of the monitoring station include a TSP high volume sampler, two collocated PM-10 high volume samplers, and a 10-meter meteorological tower. The particulate samplers were placed on a raised platform, with the sampler inlets positioned at approximately 3 meters above ground level. Wind speed, wind direction, and temperature sensors were placed at the 10-meter level on the tower. The propane-heated precipitation gauge was located on a separate platform and protected by a wind screen to minimize the impact of blowing snow. A small shelter to house the DAS, meteorological translator, and backup strip chart recorder was designed and constructed specifically for the extreme weather conditions encountered in the Matanuska Valley. Due to the remote location of the monitoring site, line power is not available. The particulate samplers were powered by a propane fueled generator. The meteorological and data acquisition systems were powered by a 12 volt direct current battery pack.

A listing of the equipment and instrumentation employed during the Wishbone Hill air quality and meteorological monitoring program is presented in Table VII-5.

A field technician provided and trained by Environmental Science and Engineering, Inc. conducted

onsite operations and maintenance at the station. The operator visited the station as necessary to maintain the air quality sampling schedule. During each visit the operator performed routine quality assurance and maintenance procedures to ensure successful data capture.

A station narrative log was maintained by the field technician to document all activities which affected data collection. Such activities included:

Zero checks	Equipment repair
Span checks	Weather conditions
Calibrations	On-site activities
Sample recovery	Equipment maintenance

Quality assurance measures for the Wishbone Hill monitoring program followed EPA "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)", EPA-450/4-87-007, May 1987. Data precision was assessed for the particulate monitors by comparing the data from the two collocated PM-10 samplers. Data accuracy was assessed by conducting independent performance audits on all monitoring systems. The particulate samplers are audited each quarter and the meteorological systems audited semiannually.

The following sections of this baseline report present meteorological and air quality data for three quarters of monitoring from October, 1988 through June, 1989. Detailed presentations of monitoring data are available in Hunter/ESE 1989a, 1989b, and 1989c.

3.2 Climate

The meteorological data collected at the Wishbone Hill site, as expected, were dominated by the movement of air masses down the Matanuska River drainage between the Alaska Range to the north and the Chugach Range to the south.

Data recovery was above 90 percent for all parameters during the last quarter of 1988. During the first quarter of 1989, data recovery for temperature and precipitation was above 90 percent while wind direction and sigma theta were 80 percent and wind speed was 83 percent. Recovery for all meteorological parameters in the second quarter of 1989 was greater than 98 percent.

Summaries of meteorological parameters are presented for each quarterly period in Tables VII-6a

through VII-6c. The temperature data for the last quarter of 1988 indicated normal seasonal variations. The mean ambient temperature for the quarter was -6.4 degrees Celsius, the maximum temperature was 4.9 degrees C. and the minimum was -22.7 degrees C. The temperature data for the first quarter of 1989 indicated unusually cold conditions, especially during January. The mean ambient temperature for the quarter was -9 degrees C., the maximum temperature was 9 degrees C. and the minimum temperature was -40 degrees C. During the second quarter of 1989 temperatures exhibited normal seasonal variations. The quarter was unusually damp with 253 rain events and an accumulation of 3.94 inches of precipitation.

The wind direction data indicated the predominant winds were from the east-southeast during the winter period. This suggests that local topography within the project area may influence the wind direction since winter winds in Palmer and at the Department of Natural Resources Wishbone Lake weather station tend to be from the northeast or north-northeast per the orientation of the Matanuska River valley. The predominant range of wind speed in the October-December period was 6.7-11.2 mph with a percent occurrence of 31 percent. Calm conditions had a frequency of occurrence of 7.3 percent and mean wind speed for the period was 6.7 mph. The highest recorded hourly average wind speed was 23.6 mph on December 2.

During the January-March 1989 period, winds were light with a predominant wind speed range of 1.0-4.5 mph having a frequency of occurrence of 42 percent. Calm conditions had a frequency of occurrence of 26 percent. The quarterly mean wind speed was 3.9 mph. Although light wind predominated most of the quarter, some high wind events were recorded. The highest and second highest 15 minute averages were 24.4 and 23.9 mph; both were recorded on March 3, 1989. A review of the strip chart data indicated peak gusts approaching 50 mph.

In April the predominating wind direction switched from the east-southeast winter condition to a more westerly orientation which is typical of summer conditions. Winds were generally light in the spring months.

Wind rose diagrams for each of the monitored months as well as quarterly wind roses are presented in Figures VII-2 through VII-13.

A quality assurance audit was conducted on April 1, 1989 on the Wishbone Hill meteorological monitoring system. All parameters remained within quality assurance guidelines.

3.3 Air Quality

As previously mentioned, data for both TSP and PM-10 were collected at the Wishbone Hill site. The particulate data for the periods October-December 1988, January-March 1989, and April-June 1989 are presented in Tables VII-7a through VII-7c respectively.

As expected, some elevated particulate levels were observed in October and November. The highest PM-10 value was 49 ug/m^3 observed on November 7, 1989. The mean PM-10 value for the entire sampling period was 13.7 ug/m^3 with a standard deviation of 10.7. The highest TSP value was 324 ug/m^3 recorded November 9, 1989. the mean TSP value was 49.8 ug/m^3 with a standard deviation of 72.3. A cursory review of the data in Table VII-7a indicates several days with elevated particulate concentrations. As expected, these days also showed elevated wind speeds. This is especially true of November 7 and November 9. Hourly wind speeds of over 9 mph were recorded on November 7 and over 16 mph on November 9. Wind gusts during those periods were undoubtedly much higher. The on site technician noted in the field log the presence of visible clouds of dust to the southeast of the site over the Matanuska River valley. He also noted extremely dusty conditions in close proximity to the monitoring site. Although the area is somewhat remote, there is some traffic from recreational vehicles and a local logging operation on a nearby road that traverses the proposed mine area. Apparently, the loggers were utilizing the road for access during these days. From the data and the field records, particulate concentrations at the monitoring site were probably affected by dust generated in the immediate area and from the river basin.

From late November through March particulate levels were low as would be expected during a period of snow cover and light winds. A comparison of the PM-10 data to the TSP data indicate that the largest fraction of the particulate was very fine as is typical of winter conditions with substantial snow cover. Particulate levels were also low during the April to June period because of unusually light winds and high soil moisture.

The National Ambient Air Quality Standard (NAAQS) for particulate was originally based on TSP. In 1987 new regulations were promulgated replacing the TSP standard with a health based standard for PM-10. Since the legislation is in a transitional period, standards for both parameters are presented below.

	PM-10 (ug/m^3)	TSP (ug/m^3)
Primary Standard		
Annual	50	75
24-hour	150	260
Secondary Standard		
Annual	50	60
24-hour	150	150

None of the PM-10 data exceeded the 24-hour standard of 150 ug/m^3 and the quarterly mean of 13.7 ug/m^3 was well below the annual standard. It should be noted that the PM-10 sample from November 9, 1988 was damaged during recovery and subsequently invalidated. Although invalidated, the sample was processed and the PM-10 value estimated at approximately 85 ug/m^3. This value still did not exceed any standard. The TSP data did indicate some exceedances. The TSP value of 324 ug/m^3 for November 9 exceeded the 24-hour values for both primary and secondary standards. The secondary 24-hour standard was also exceeded on November 7, 1988 with a value of 172 ug/m^3.

Data recovery for the PM-10 and TSP data was 90 percent and 80 percent, respectively. The slightly lower percentage for TSP resulted from minor equipment malfunctions during the sampling period. Data recovery for the first quarter of 1989 was 93 percent for both PM-10 and TSP. DAta recovery for the second quarter of 1989 was 94 percent for PM-10 and 64 percent for TSP. A series of mechanical problems with the TSP sampler prevented adequate sampling in late May and June.

4.0 REFERENCES

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5.0 RESPONSIBLE PARTIES

Site meteorology and air quality monitoring were conducted by Environmental Science and Engineering, Inc., Anchorage, Alaska. Principal investigators were:

Robert Morgan – Senior Air Quality Scientist
Raymond DePriest – Field Technician

Regional climatic descriptions and baseline report compilation were conducted by McKinley Mining Consultants, Inc., Palmer, Alaska. The principal investigator was:

John Morsell – Environmental Specialist

TABLES

Table VII-1
Climatological Summary for Palmer, Alaska for the Years 1949-2012

Temperature (F°)													Precipitation (in)								
	Means			Extremes				Mean # Days				Heating Degree Days (Base Temp. 65°F)							Snow		
								Max		Min						M # Days Precip Exceeded ≥					
Month	Max	Min	Mth	Rec Hi	Year	Rec Lo	Year	≥90	≤32	≤32	≤0	Mth Mean	Mean Mtn Total	Max Day	Year	1	0.5	0.1	Mean Mth Tot	Max Depth	Year
Jan	20.6	5.5	13	52	1961	-37	1975	0	23.5	29.8	12.4	1612	0.91	3.45	1981	0	0	3	8.7	25.7	1951
Feb	27	10.4	18.8	54	1980	-32	1993	0	17	26.8	7.7	1305	0.83	2.92	2010	0	0	3	9.5	35.9	1996
Mar	34.7	16.2	25.7	56	1968	-39	2007	0	11	28.7	3.7	1219	0.72	4.02	2011	0	0	2	7.4	22.5	1979
Apr	46.7	28.4	37.5	76	2005	-8	1986	0	1.2	21.5	0.1	824	0.47	2.45	1967	0	0	2	2.9	14.7	1977
May	58.3	38	48.1	88	2011	15	1964	0	0.1	5	0	523	0.67	2.62	1997	0	0	2	0.1	2.5	1972
Jun	65	45.7	55.4	87	1953	33	1960	0	0	0	0	291	1.31	3.13	1962	0	1	4	0	0	1950
Jul	67.1	49.2	58.2	86	2004	32	2010	0	0	0	0	214	2.06	4.37	1959	0	1	6	0	0	1950
Aug	64.7	47.2	56	85	2004	26	1955	0	0	0.3	0	280	2.36	7.83	1959	0	1	6	0	0	1950
Sep	56.6	40	48.3	73	1974	15	1992	0	0	3.7	0	500	2.45	5.08	1965	0	1	6	0	1	1956
Oct	41.9	27	34.5	66	1954	-8	1961	0	4.7	21.3	0.5	947	1.52	3.91	1952	0	1	5	5.3	36.1	1982
Nov	27.5	13.1	20.3	59	1949	-26	1990	0	19.3	28	6.1	1340	1.26	11.02	2010	0	1	4	9.5	34.5	2003
Dec	22.5	8.1	15.3	54	1969	-38	1961	0	22.8	29.7	9.8	1540	1.15	3.5	1976	0	0	4	12.8	32.9	1990
	Ave	Ave	Ave	Rec		Rec		TOT	TOT	TOT	TOT	TOT	TOT	REC		TOT	TOT	TOT	TOT	REC	
Year	44.4	27.4	35.9	88		-39		0	99.4	194.6	40.3	10594	15.73	26.07		1	6	47	56.1	115.1	

TABLE VII-2

Wind Data Summary for the Years 1981-1983, Palmer, Alaska.

Month	Mean Wind Speed (MPH)	Dominant Direction
January	6.8	N
February	12.1	NNE
March	10.3	NNE
April	11.8	SSE
May	12.1	SSE
June	7.9	SSE
July	8.5	SSE
August	7.3	SSE
September	6.1	SSE
October	6.8	NNE
November	6.4	NNE
December	6.8	NNE

Source: Alaska Climate Center, University of Alaska, Anchorage. Compiled from data collected at the Palmer Agricultural and Forestry Experiment Station.

TABLE VII-3

CLIMATOLOGICAL SUMMARY FOR SUTTON, ALASKA FOR THE YEARS 1978-1987

LATITUDE 61 43 N | LONGITUDE 148 53 W | ELEVATION 550 FEET

	TEMPERATURE (DEGREES F)											PRECIPITATION (INCHES)								
	MEANS			EXTREMES				MEAN # DAYS				HEAT DEGREE DAYS							SNOW		
								MAX		MIN			MEAN			MEAN # DAYS					
MTH	MAX	MIN	MTH	REC HI	YR	REC LO	YR	70+	32-	0-	32-	MTH MEAN	MTH TOT	MAX DAY	YR	PRECIP .5	EXCEEDED .25	0.1	MTH TOT	MAX DPTH	YR	DAYS 1.0
JAN	25.9	13.1	19.5	44.0	86	-34.0	82	0.0	22.0	6.0	30.4	1403.6	0.83	0.82	81	0.2		2.9	10.5	26.0	79	27.0
FEB	27.7	13.2	20.5	49.0	86	-29.0	84	0.0	16.5	5.1	27.3	1250.1	1.04	0.81	79	0.7		2.7	10.7	37.0	79	25.1
MAR	38.4	20.2	27.3	55.0	81	-10.0	78	0.0	6.7	1.8	29.6	1078.6	0.73	0.73	79	0.3		2.6	7.4	38.0	85	25.2
APR	46.7	23.6	35.2	68.0	79	12.0	86	0.0	2.0	0.9	25.9	889.1	0.42	0.37	79	0.0		1.7	4.1	25.0	85	7.0
MAY	57.9	31.0	45.5	76.0	81	19.0	80	1.9	0.0	0.0	19.3	598.2	0.68	0.51	80	0.2		2.8	0.4	7.0	85	0.6
JUN	65.4	39.4	52.4	83.0	86	26.0	85	7.0	0.0	0.0	2.8	371.0	1.54	0.51	87	0.1		4.7	0.0			0.0
JUL	67.3	45.5	56.4	82.0	87	29.0	82	9.1	0.0	0.0	0.5	259.6	3.04	1.60	81	1.4		8.5	0.0			0.0
AUG	65.4	42.9	54.2	79.0	78	26.0	84	6.6	0.0	0.0	1.6	328.9	2.83	1.65	84	1.7		7.5	0.0			0.0
SEP	57.2	35.5	46.4	71.0	79	18.0	81	0.2	0.0	0.0	10.9	553.0	3.17	1.87	87	2.1		6.9	0.5	3.0	83	0.3
OCT	42.2	25.9	34.1	60.0	84	-21.0	82	0.0	3.5	0.5	21.6	954.4	2.10	1.69	83	0.9		5.0	9.3	26.0	82	6.5
NOV	29.3	16.1	22.7	48.0	79	-9.0	78	0.0	17.9	3.2	29.0	1261.6	1.43	0.88	79	1.0		3.9	13.5	27.0	81	21.6
DEC	23.7	10.2	17.0	46.0	85	-36.0	80	0.0	23.9	7.3	29.7	1483.2	1.33	0.89	78	0.8		3.9	14.9	34.0	78	26.6
YEAR	AVE 45.8	AVE 26.4	AVE 36.1	REC 83.0		REC -36.0		TOT 24.8	TOT 92.5	TOT 24.9	TOT 228.5	TOT 10451.3	TOT 19.14	REC 1.89		TOT 9.4	TOT	TOT 53.0	TOT 71.3	REC 38.0		TOT 140.6

SOURCE: ARCTIC ENVIRONMENTAL INFORMATION AND DATA CENTER, UNIVERSITY OF ALASKA

TABLE VII-4

Wind Data Summary: Wishbone Hill Wind Station, 1986-1987 Combined.

	Monthly Mean Wind Speed (mph)	Maximum Gust Speed (mph)	Prevailing Direction
Jan.	7.0	33.1	ENE
Feb.	6.8	36.9	ENE
March	6.6	36.9	ENE
April	4.6	33.1	ENE
May	3.3	21.0	SW
June	3.6	17.9	SW
July	2.3	17.0	SW
Aug.	2.6	30.0	SW
Sept.	2.6	21.9	ENE
Oct.	4.3	29.1	ENE
Nov.	7.0	35.8	ENE
Dec.	4.8	31.1	ENE
Annual Av.	4.2	28.7	ENE

Source: Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, Annual Wind Summaries

TABLE VII-5

Equipment list For the Wishbone Hill Coal Project Air Quality and Meteorological Monitoring Program.

Description	Manufacturer	Model No.
TSP Sampler	General Metal Works	2000H
PM-10 Sampler	Anderson Samplers	SAUV-16H
Analytical Balance	Mettler	AE160
Met. Tower	Rohn	---
Wind Direction Sensor	Met One	014A
Wind Speed Sensor	Met One	024A
Temperature Sensor	Met One	060A-2
Radiation Shield	Met One	071A
Precipitation Gauge	Met One	099-3
Translator/Recorder	Met One	109-6
Data Acquisition System	Campbell Scientific Inc.	21X
DAS Software	Met One	---

Source: Environmental Science and Engineering, Inc.

TABLE VII-6a

WISHBONE HILL
METEOROLOGICAL DATA SUMMARY
FOURTH QUARTER 1988
October 23, 1988 thru December 31, 1988

Parameter	Unit	OCT	NOV	DEC	4QTR
Wind Data					
Dominant WD direction	Dir	ESE	ESE	ESE	ESE
occurrence	%	47	33	36	37
Dominant WSP speed range	mph	6.7-11.2	6.7-11.2	6.7-11.2	6.7-11.2
occurrence	%	21	29	35	31
Average Sigma	deg	14.0	21.2	23.5	21.3
Average WSP	mph	5.2	6.4	7.4	6.7
Percent Calms	%	6.0	11.0	4.3	7.3
Temperature Data					
1-Hr maximum	°c	3.5	0.7	4.9	4.9
1-Hr minimum	°c	-11.6	-22.6	-22.7	-22.7
Average TMP	°c	-2.1	-7.2	-6.8	-6.4
Precipitation Data					
No. of hours of recorded PRECP events	hours	4	22	18	44
Accumulation	inch	.05	.54	.36	.95

TABLE VII-6b

WISHBONE HILL
METEOROLOGICAL DATA SUMMARY
FIRST QUARTER 1989
JANUARY 1,1989-MARCH 31,1989

Parameter	Unit	JAN	FEB	MAR	1QTR
Wind Data					
Dominant WD direction	Dir	ESE	ESE	ESE	ESE
occurrence	%	26	22	20	23
Dominant WS speed range	mph	1.0-4.5	1.0-4.5	1.0-4.5	1.0-4.5
occurrence	%	30	53	39	42
Average Sigma	deg	15.4	21.5	24.5	20.3
Average WS	mph	4.8	2.7	4.3	3.9
Percent Calms	%	22.0	27.0	29.0	26.0
Temperature Data					
Maximum	°C	4.0	3.0	9.0	9.0
Minimum	°C	-40.0	-26.0	-22.0	-40.0
Average TMP	°C	-15.1	-7.0	-5.0	-9.0
Precipitation Data					
No. of hours with recorded PRECP events		15	17	39	71
Accumulation	inch	.67	.53	.75	1.95

TABLE VII-6c

WISHBONE HILL
METEOROLOGICAL DATA SUMMARY
SECOND QUARTER 1989
APRIL 1, 1989-JUNE 30, 1989

Parameter	Unit	APR	MAY	JUN	2QTR
Wind Data					
Dominant WD direction	Dir	SSW	SW	WNW	WNW
occurrence	%	10	11	13	9
Dominant WS speed range	mph	1.0-4.5	1.0-4.5	1.0-4.5	1.0-4.5
occurrence	%	54	63	59	59
Average Sigma	deg	28.8	30.3	32.9	30.7
Average WS	mph	2.6	2.3	2.5	2.4
Percent Calms	%	31.9	27.9	29.4	29.5
Temperature Data					
Maximum	°C	15.0	17.0	23.0	23.0
Minimum	°C	-10.0	-3.0	-3.0	-10.0
Average TMP	°C	3.0	7.0	11.0	7.0
Precipitation Data					
No. of recorded (15 minute) PRECP events		6	158	89	253
Accumulation	inch	.05	2.41	1.48	3.94

TABLE VII-7a

WISHBONE HILL AIR QUALITY &
METEOROLOGICAL MONITORING PROGRAM
PARTICULATE DATA
FOURTH QUARTER 1988
October 12, 1988 thru December 31, 1988

Sample Date	PM-10 Data (ug/m^3)	TSP Data (ug/m^3)
10/12/88	9	NA*
10/14/88	NA	NA
10/16/88	7	NA
10/18/88	NA	NA
10/20/88	7	NA
10/22/88	35	126
10/24/88	17	52
10/26/88	24	57
10/28/88	23	74
10/30/88	5	7
11/01/88	8	24
11/03/88	22	63
11/05/88	14	NA
11/07/88	49	172
11/09/88	NA	324
11/11/88	25	84
11/13/88	15	25
11/15/88	20	57
11/17/88	6	7
11/19/88	5	20
11/21/88	11	10
11/23/88	5	5
11/25/88	2	3
11/27/88	7	26
11/29/88	18	24
12/05/88	7	19
12/11/88	7	4
12/17/88	6	4
12/23/88	13	6
12/29/88	4	2
Mean Particulate Values	13.7	49.8
Standard Deviation	10.7	72.3

* NA = Not Available

TABLE VII-7b

WISHBONE HILL AIR QUALITY &
METEOROLOGICAL MONITORING PROGRAM
PARTICULATE DATA
FIRST QUARTER 1989
January 1, 1989--March 31, 1989

Sample Date	PM-10 Data (ug/m^3)	TSP Data (ug/m^3)
01/04/89	4	3
01/10/89	4	3
01/16/89	4	4
01/23/89	6	9
01/28/89	7	8
02/03/89	4	4
02/09/89	3	2
02/15/89	5	4
02/21/89	5	7
02/27/89	7	11
03/06/89	NA	NA
03/11/89	6	11
03/17/89	8	9
03/23/89	3	3
03/29/89	5	10
Mean Particulate Values	5.1	6.3
Standard Deviation	1.5	3.3

* NA = Not Available

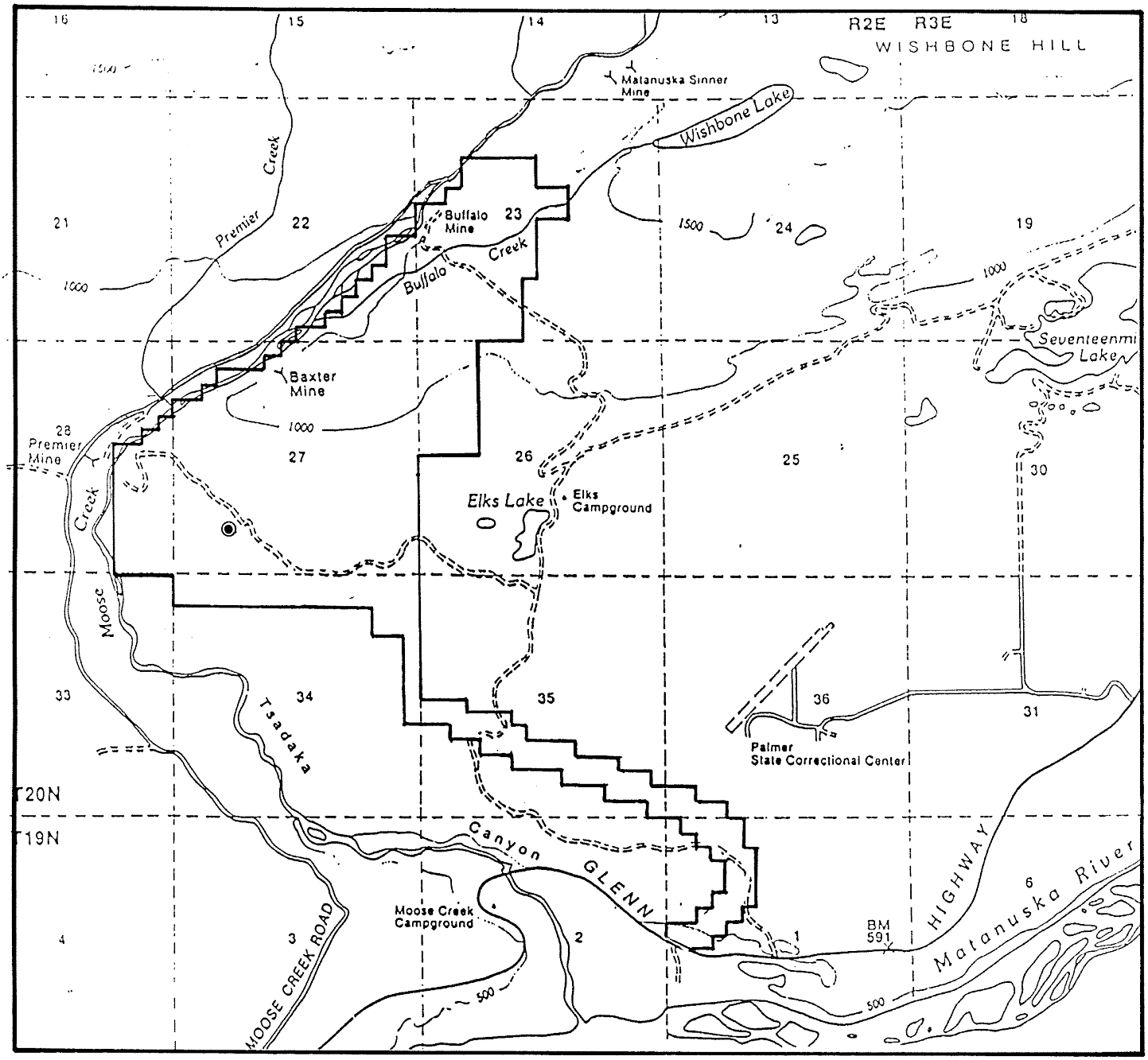
TABLE VII-7c

WISHBONE HILL AIR QUALITY &
METEOROLOGICAL MONITORING PROGRAM
PARTICULATE DATA
SECOND QUARTER 1989
April 1, 1989--June 30, 1989

Sample Date	PM-10 Data (ug/m^3)	TSP Data (ug/m^3)
04/02/89	5	6
04/04/89	8	7
04/06/89	9	5
04/08/89	NA	NA*
04/10/89	8	10
04/12/89	10	7
04/14/89	NA	NA
04/16/89	11	13
04/18/89	9	9
04/20/89	18	18
04/22/89	24	59
04/24/89	13	23
04/26/89	6	4
04/28/89	17	30
04/30/89	9	11
05/02/89	12	10
05/04/89	41	114
05/06/89	22	44
05/08/89	7	8
05/10/89	13	20
05/12/89	9	5
05/14/89	26	31
05/16/89	17	9
05/18/89	15	NA
05/20/89	16	NA
05/22/89	9	NA
05/24/89	16	NA
05/28/89	23	NA
06/04/89	15	NA
06/09/89	17	NA
06/16/89	10	NA
06/21/89	16	NA
06/28/89	12	NA
Mean Particulate Values	14.2	21.1
Standard Deviation	7.3	25.6

* NA = Not Available

FIGURES



◉ Meteorology and Air Quality Monitoring Station

CERTIFICATE

I hereby certify that this drawing has been prepared under my direction and is correct to the best of my knowledge and belief.

David E. Gessner

DESIGN BY:	MONITORING STATION LOCATIONS	WISHBONE HILL MINE	PERMIT No. 01-89-796
DRAWN BY:			
CHECK BY:		FIGURE No. VII-1	REV. 0
DWG FILE:	USIBELLI COAL MINE, INC.		
DATE DRAWN:	P.O. BOX 1000, HEALY, ALASKA 99743 (907) 683-2226	SCALE:	

FIGURE VII-2

WIND ROSE ANALYSIS FOR 10/23/88 TO 10/31/88

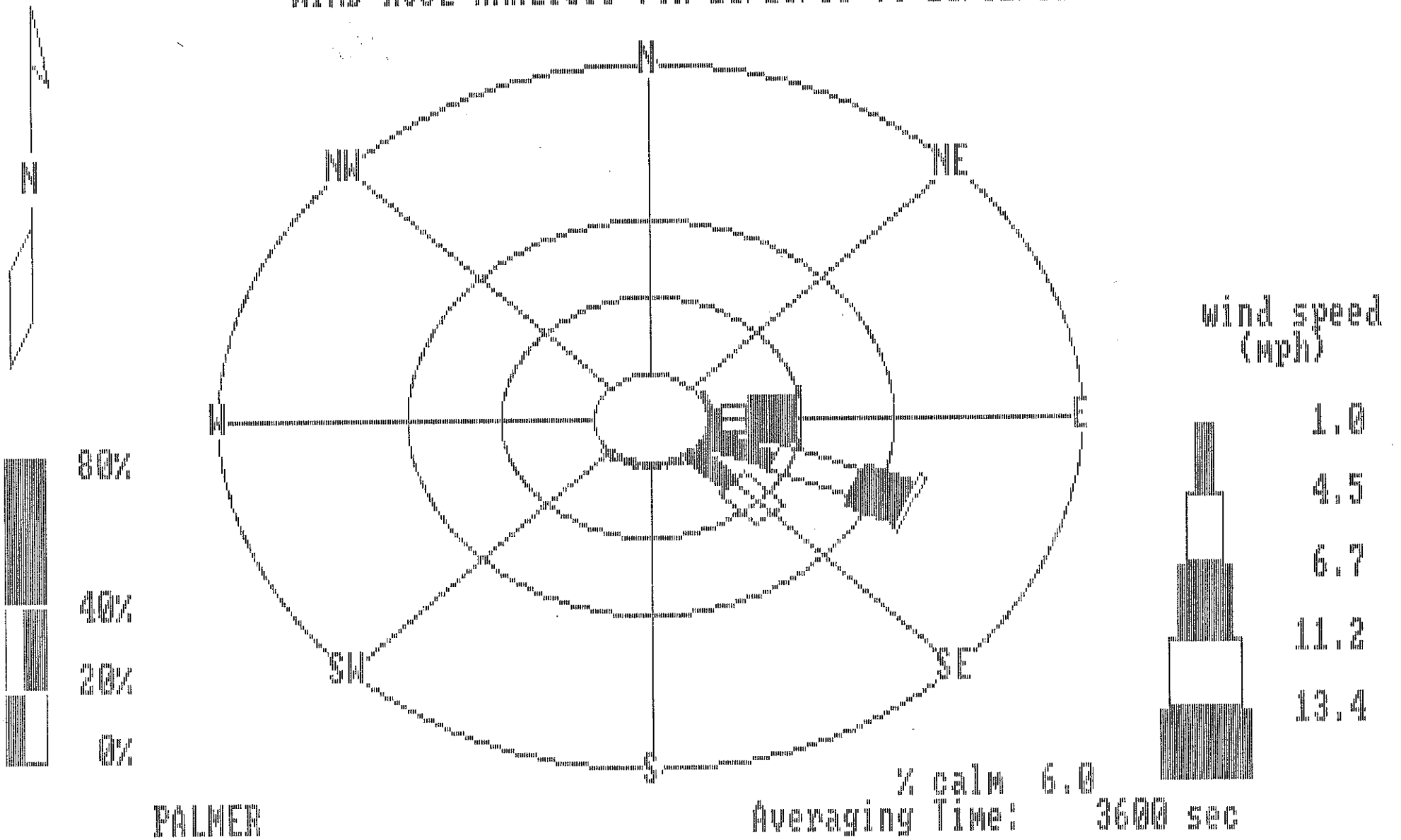


FIGURE VII-3

WIND ROSE ANALYSIS FOR 11/01/88 TO 11/30/88

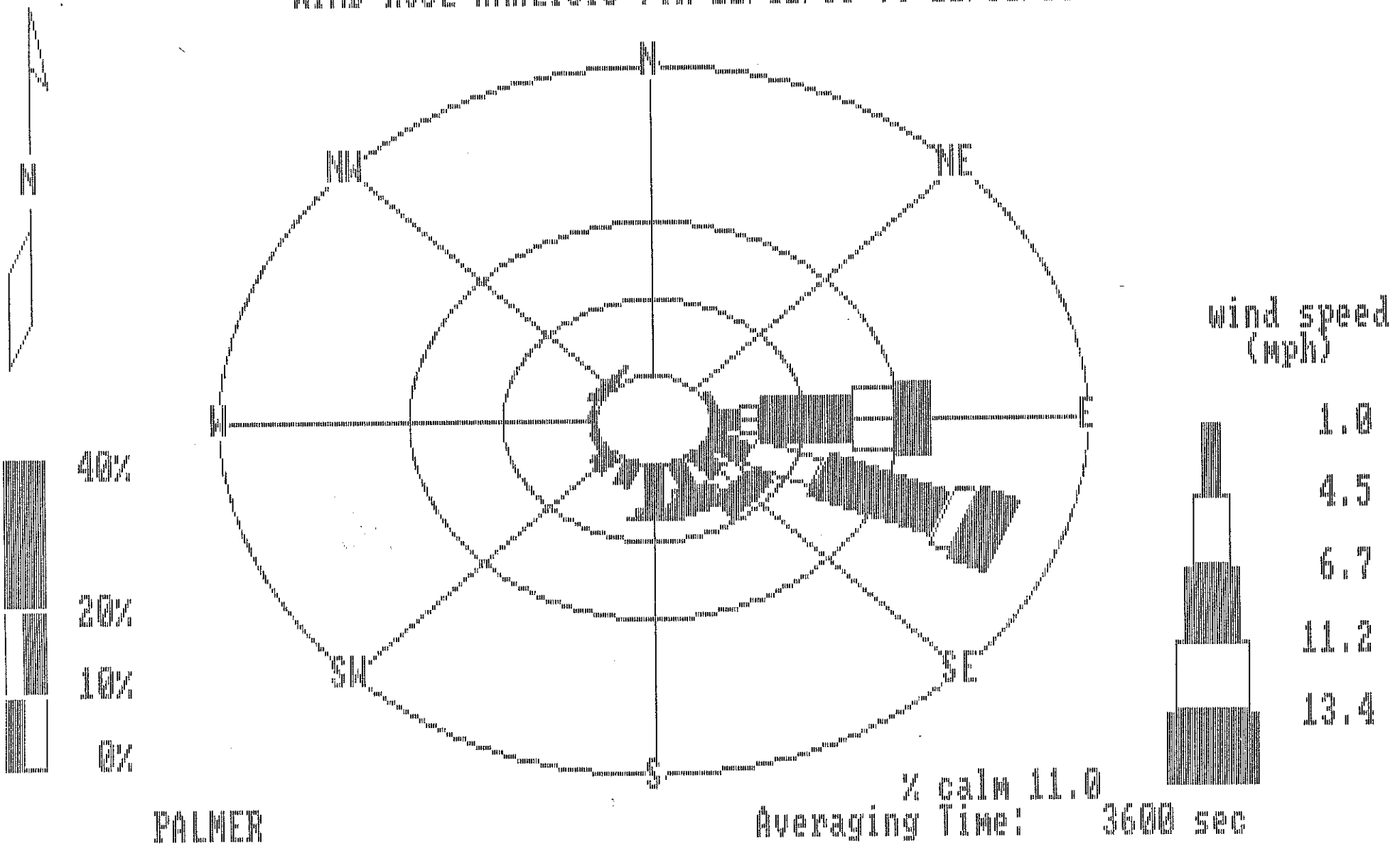


FIGURE VII-4

WIND ROSE ANALYSIS FOR 12/01/88 TO 12/31/88

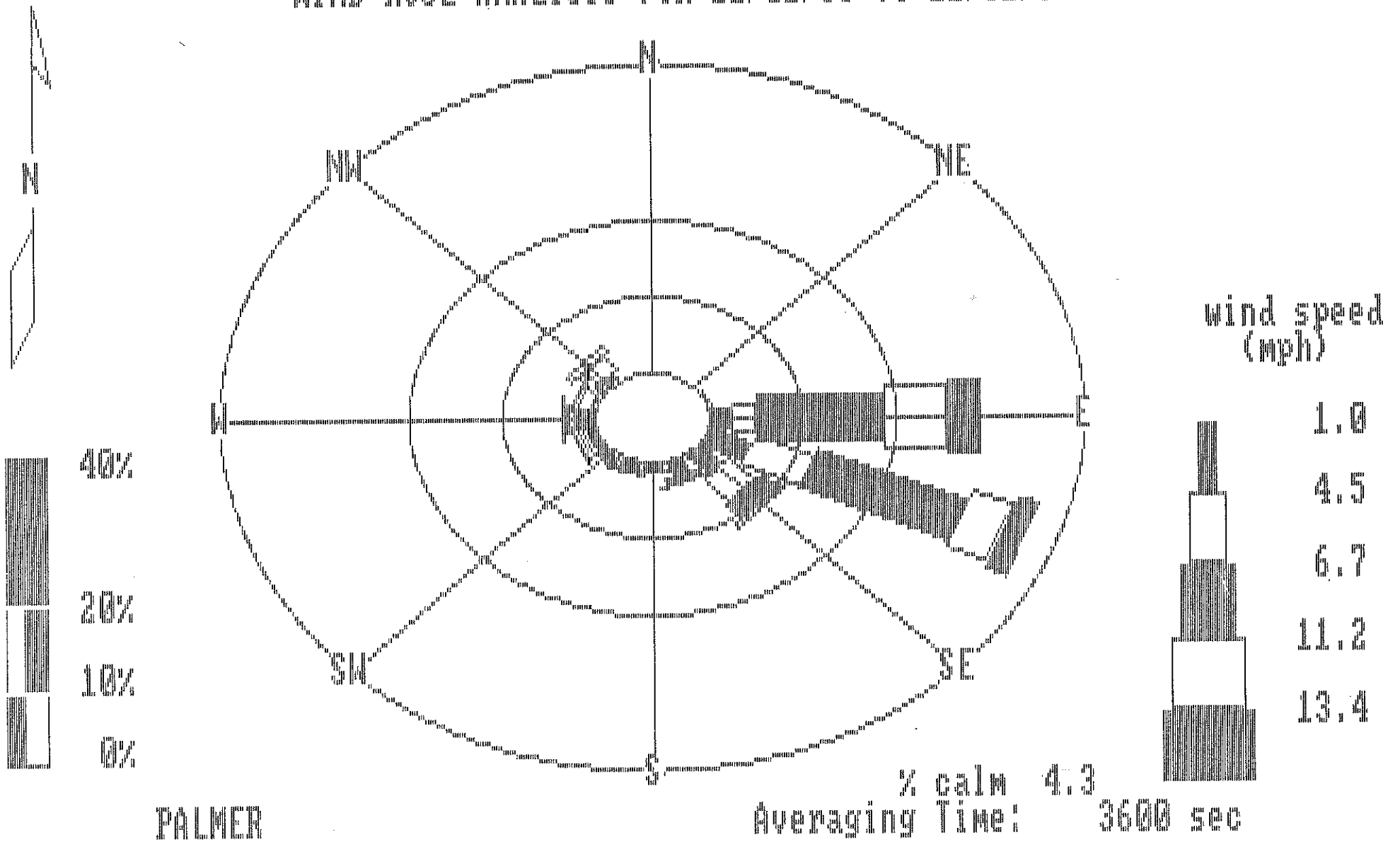


FIGURE VII-5

WIND ROSE ANALYSIS FOR 10/23/88 TO 12/31/88

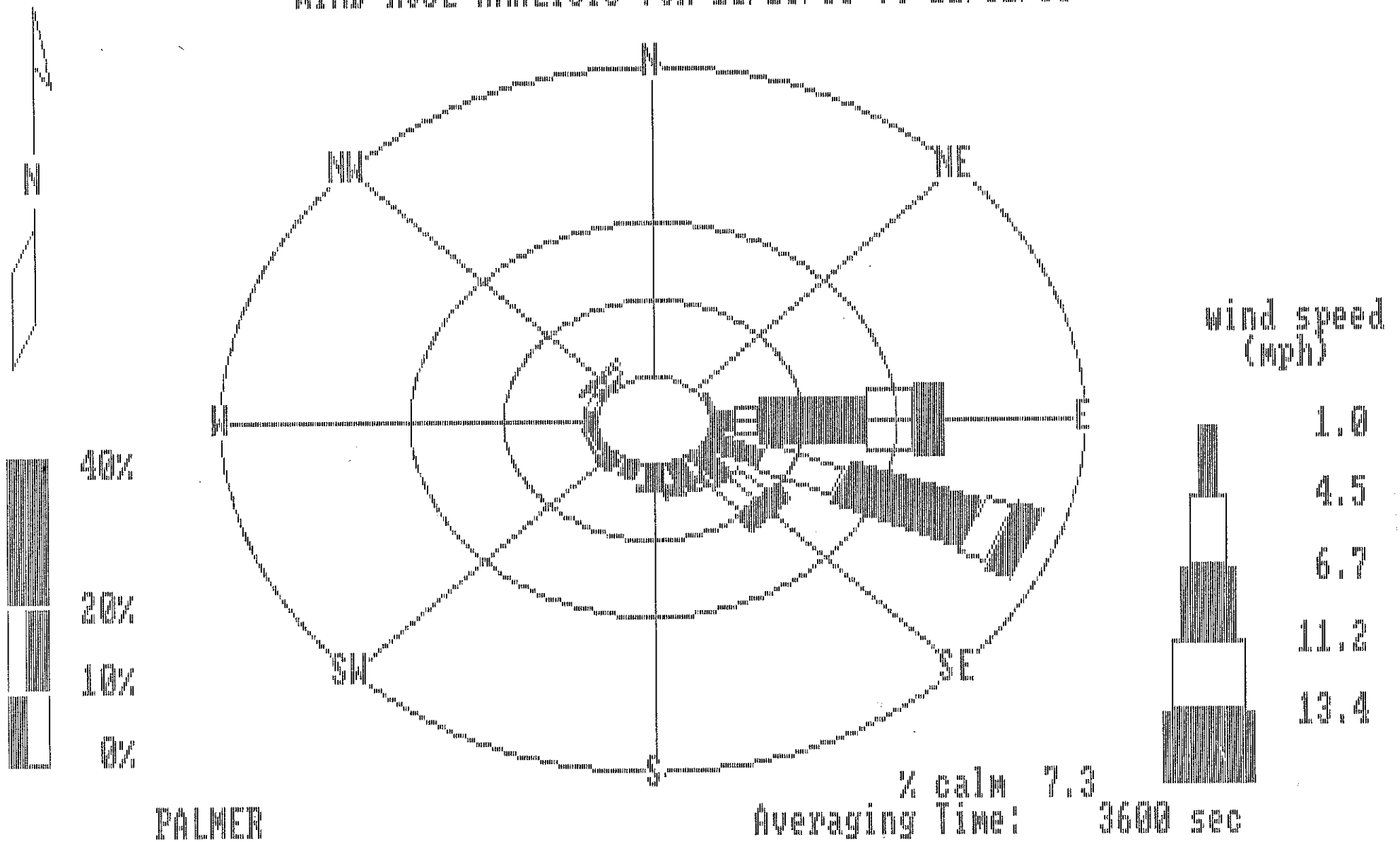


FIGURE VII-6

WIND ROSE ANALYSIS FOR 01/01/89 TO 01/31/89

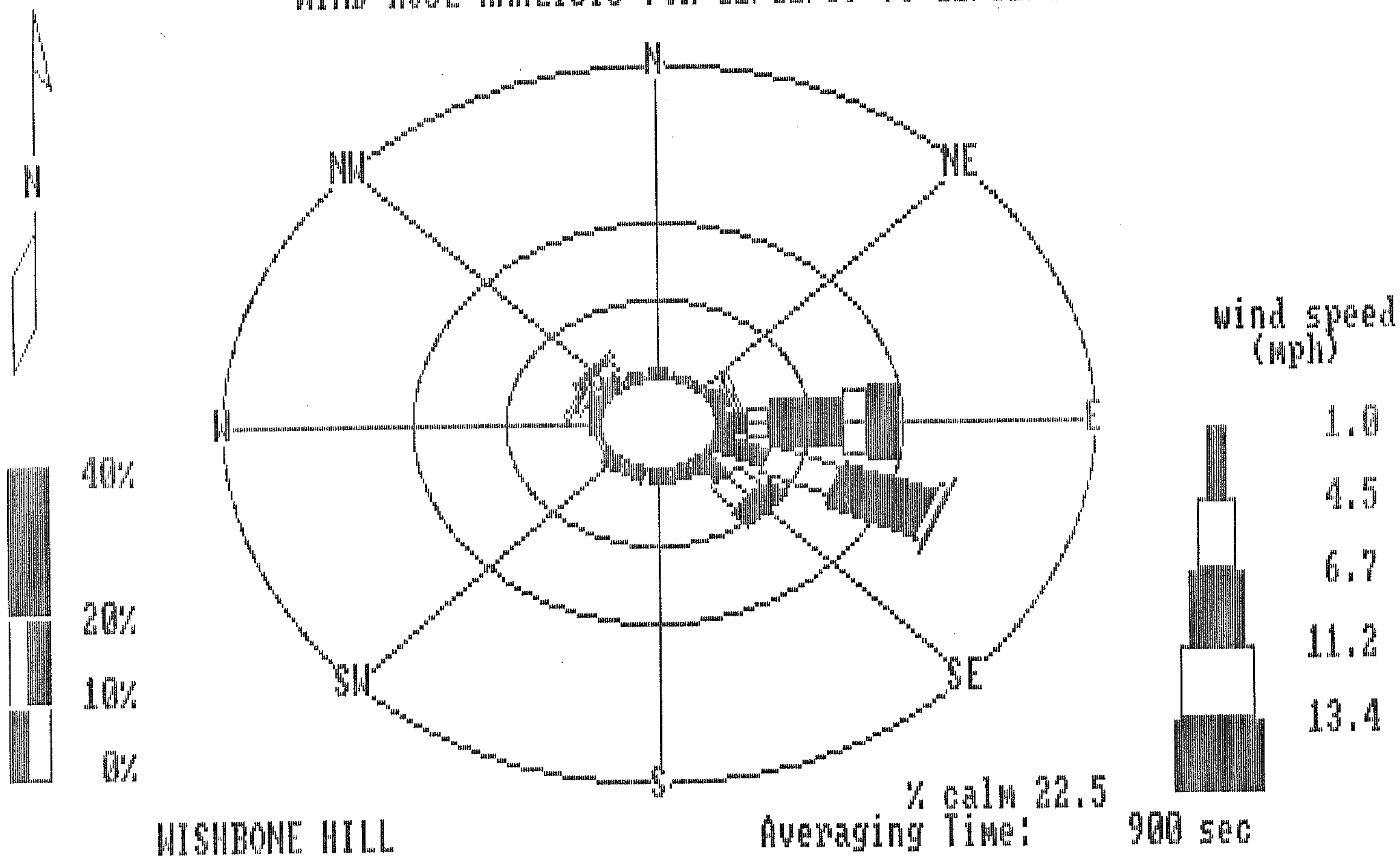


FIGURE VII-7

WIND ROSE ANALYSIS FOR 02/01/89 TO 02/28/89

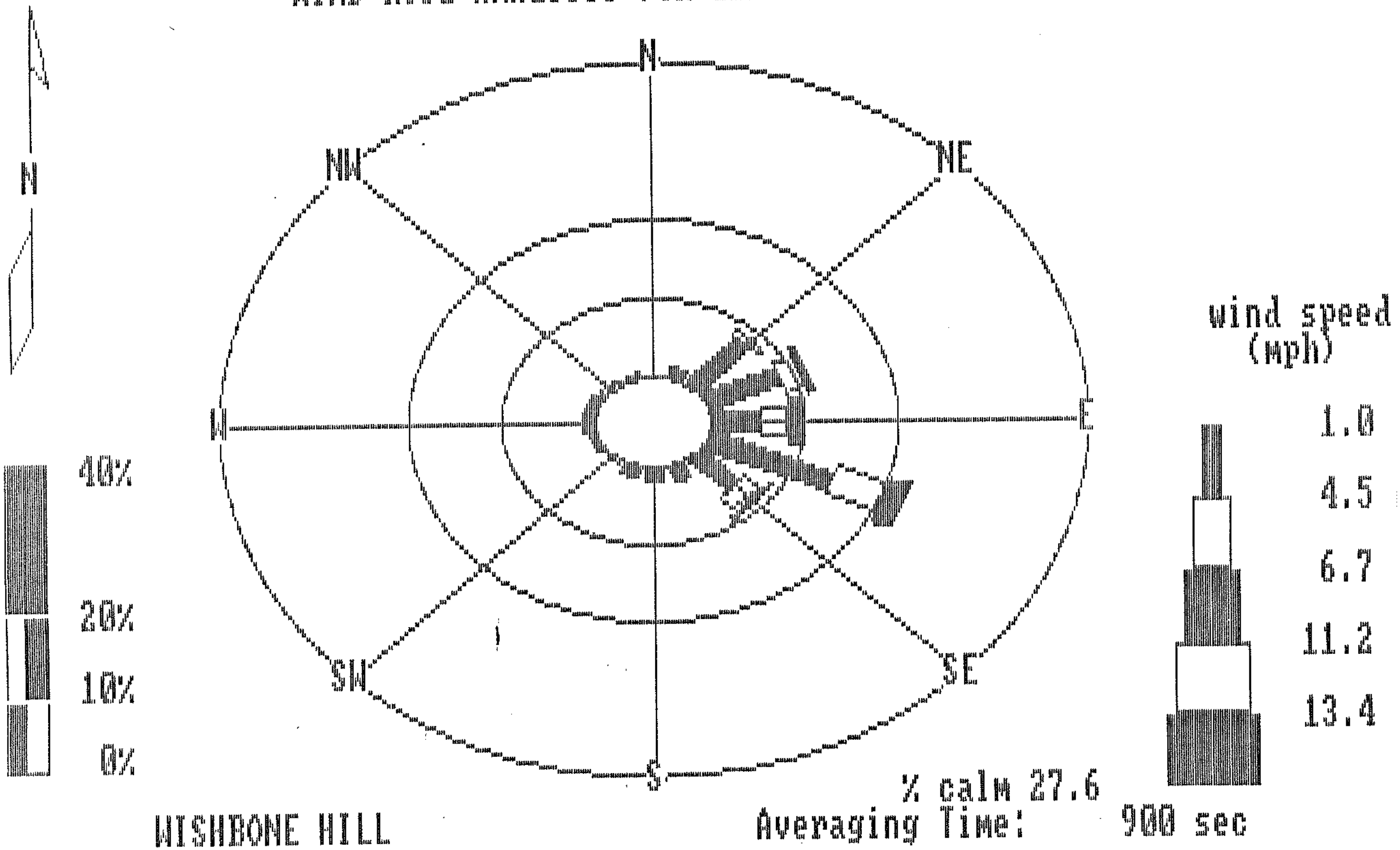


FIGURE VII-8

WIND ROSE ANALYSIS FOR 03/01/89 TO 03/31/89

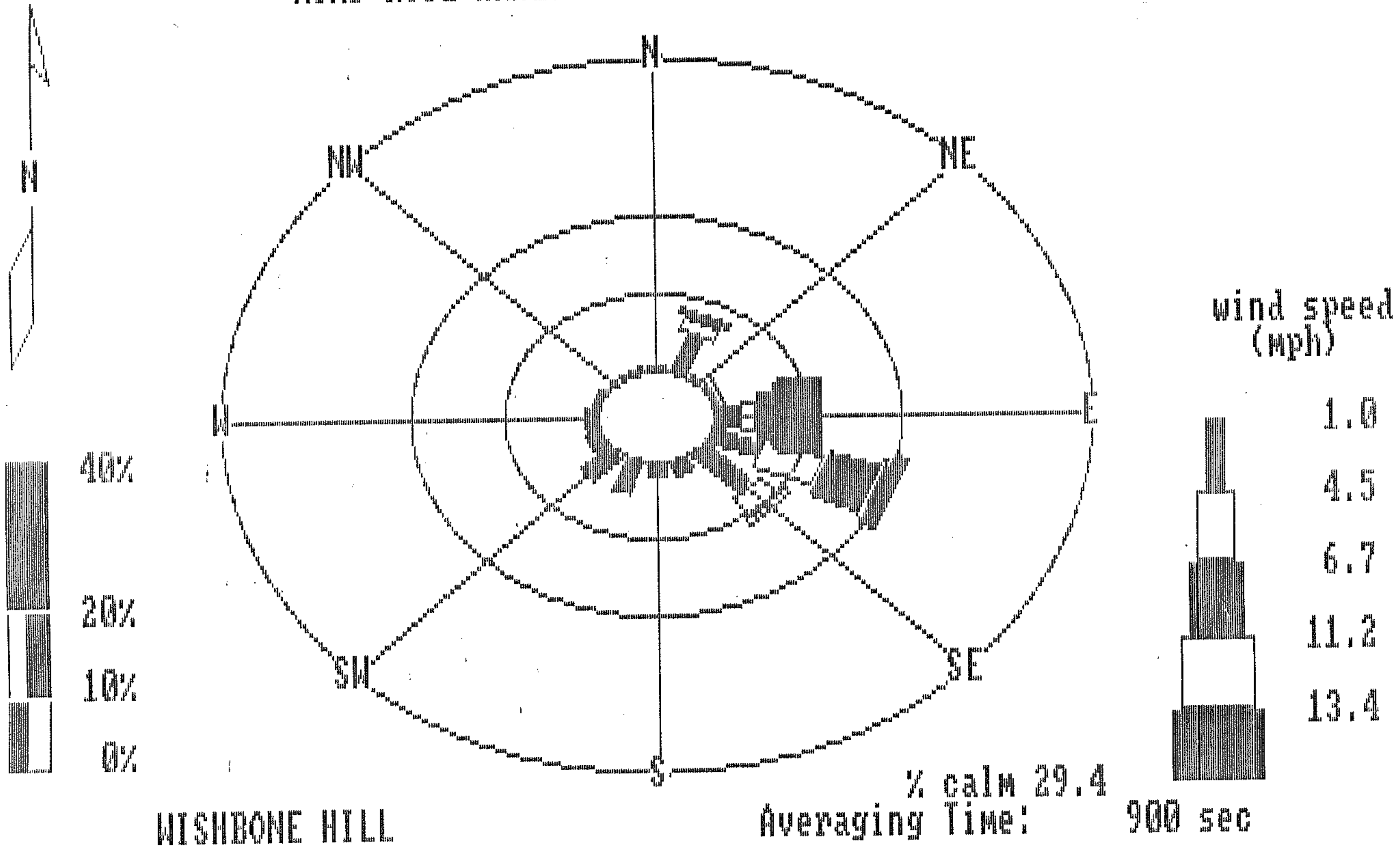


FIGURE VII-9

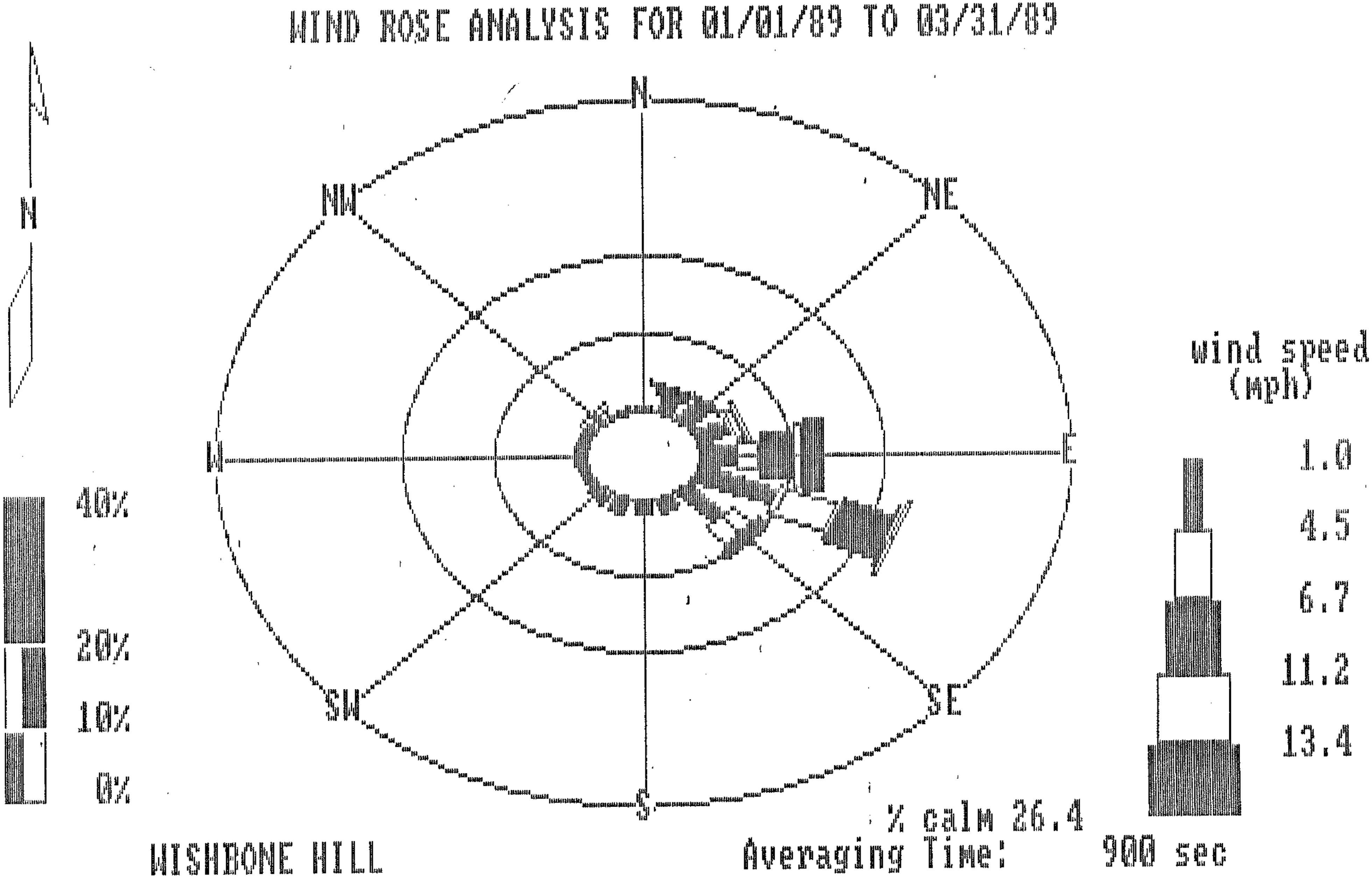

WIND ROSE ANALYSIS FOR 01/01/89 TO 03/31/89
N
N
NW
NE
W
E
SW
SE
S
40%
20%
10%
0%
wind speed
(mph)
1.0
4.5
6.7
11.2
13.4
% calm 26.4
WISHBONE HILL
Averaging Time: 900 sec

FIGURE VII-10

WIND ROSE ANALYSIS FOR 04/01/89 TO 04/30/89

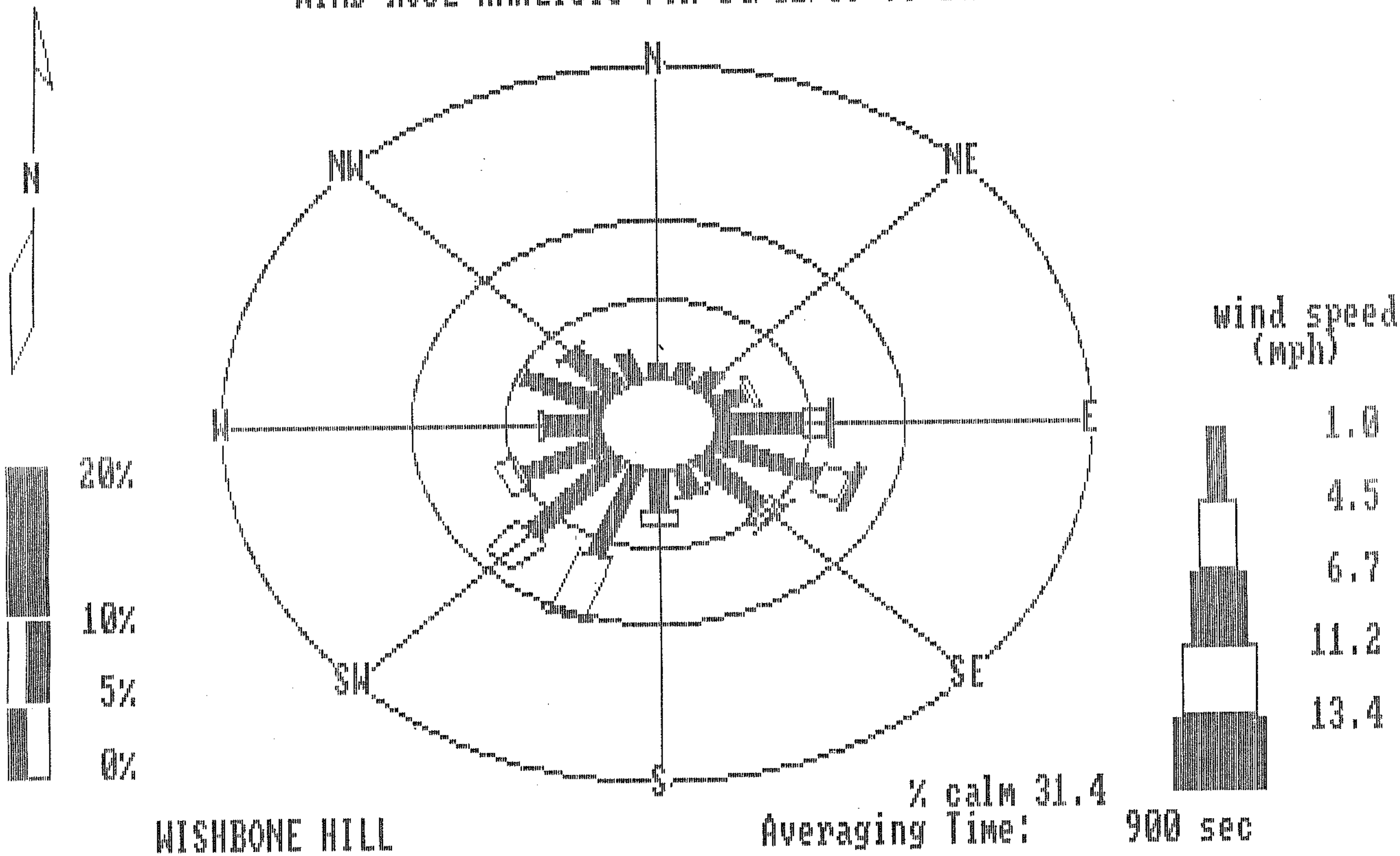
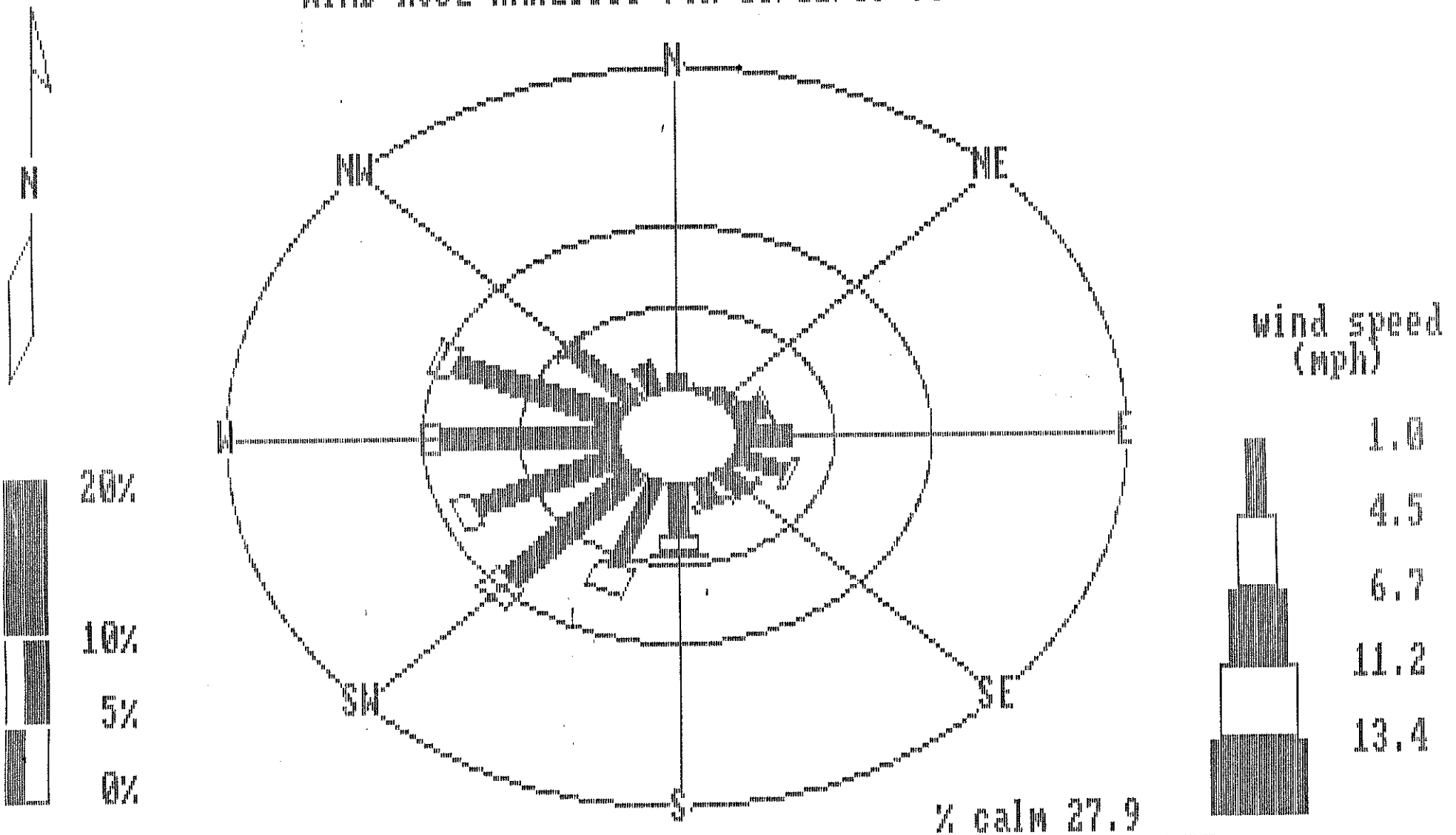


FIGURE VII-11

WIND ROSE ANALYSIS FOR 05/01/89 TO 05/31/89



% calm 27.9

WISHBONE HILL

Averaging Time: 900 sec

FIGURE VII-12

WIND ROSE ANALYSIS FOR 06/01/89 TO 06/30/89

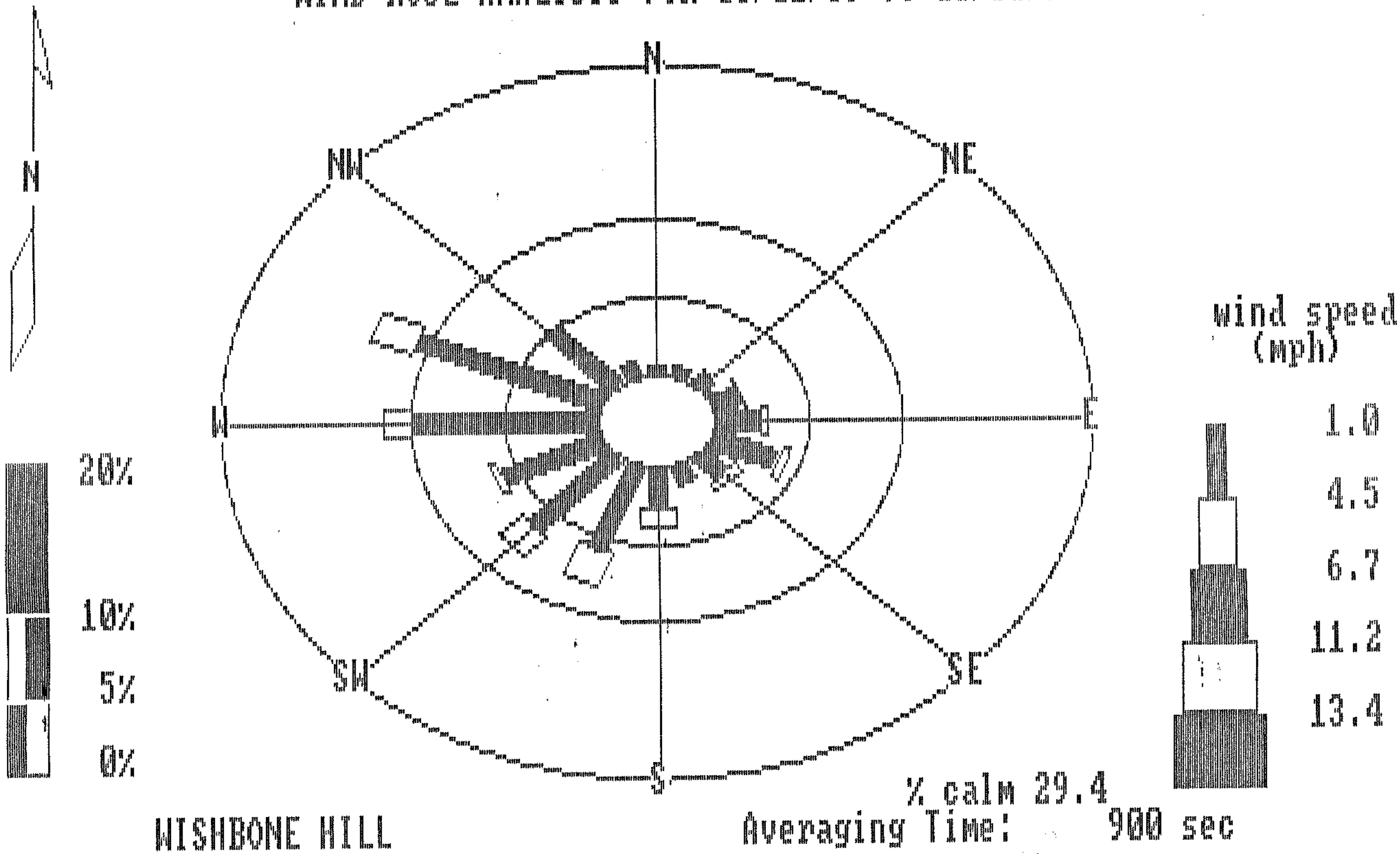
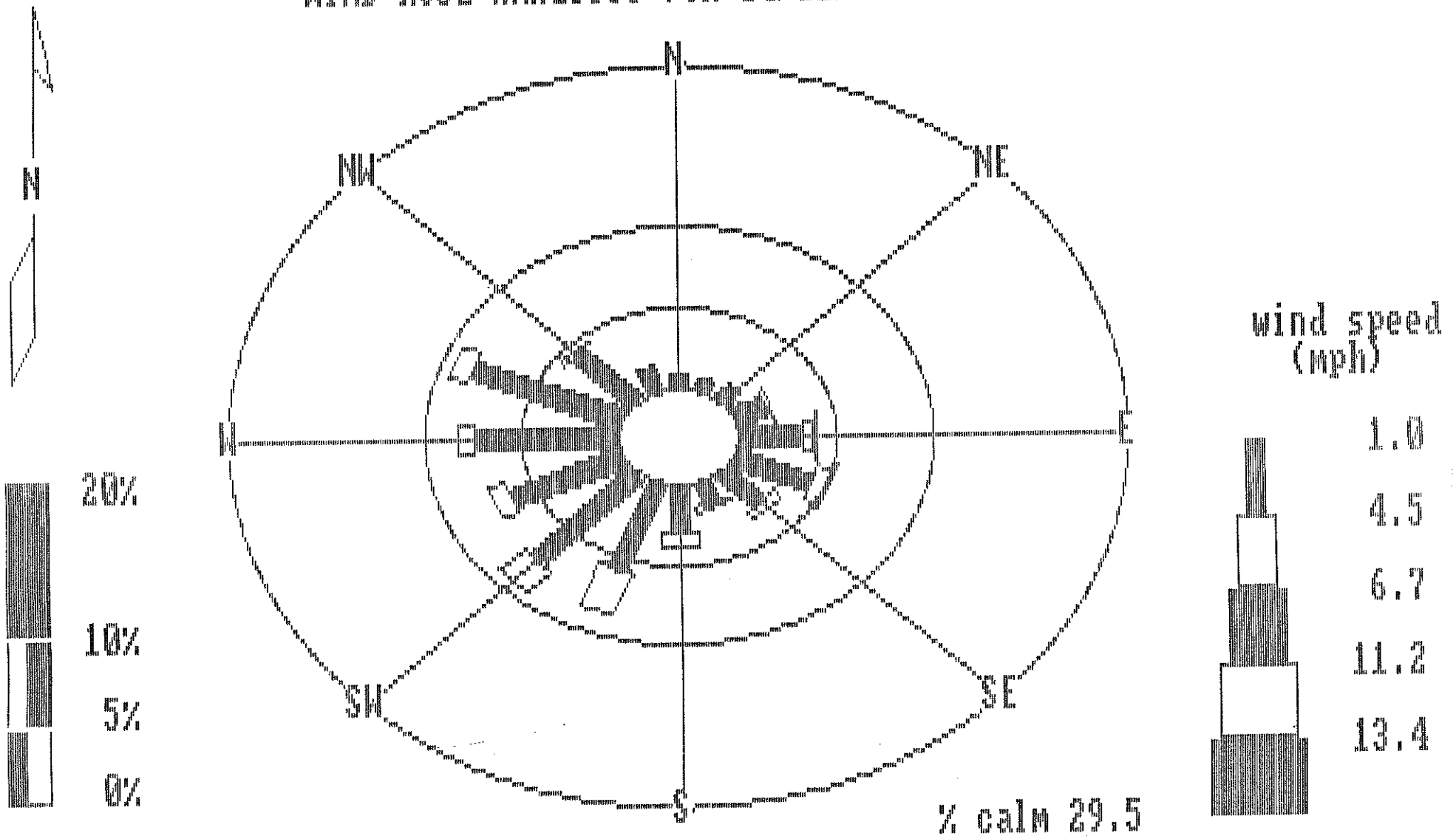


FIGURE VII-13

WIND ROSE ANALYSIS FOR 04/01/89 TO 06/30/89



WISHBONE HILL

ADDENDA

ADDENDUM 1

AIR QUALITY AND METEOROLOGICAL DATA FROM THE ON-SITE MONITORING STATION FOR THE PERIOD OF OCTOBER 12, 1988 – OCTOBER 31, 1991

AIR QUALITY DATA – TWO YEAR SUMMARY

WISHBONE HILL PARTICULATE DATA
10/12/88 - 10/31/90

	PM-10 ($\mu g/m^3$)	TSP ($\mu g/m^3$)
Highest Observed	197	623
Second Highest Observed	107	324
Mean Value	12.9	30.0
Standard Deviation	19.9	58.2

Seasonal trends were also examined by graphing particulate sample values by date. The graphic also compares the PM-10 data to the TSP data. Because of the amount of data collected over the two year period, the graphic was separated into individual years. These are presented in Figures 2-1 and 2-2. As noted in earlier quarterly reports, the months of October, November, April, and May, were periods with high wind episodes. Corresponding high particulate levels were observed during these periods.

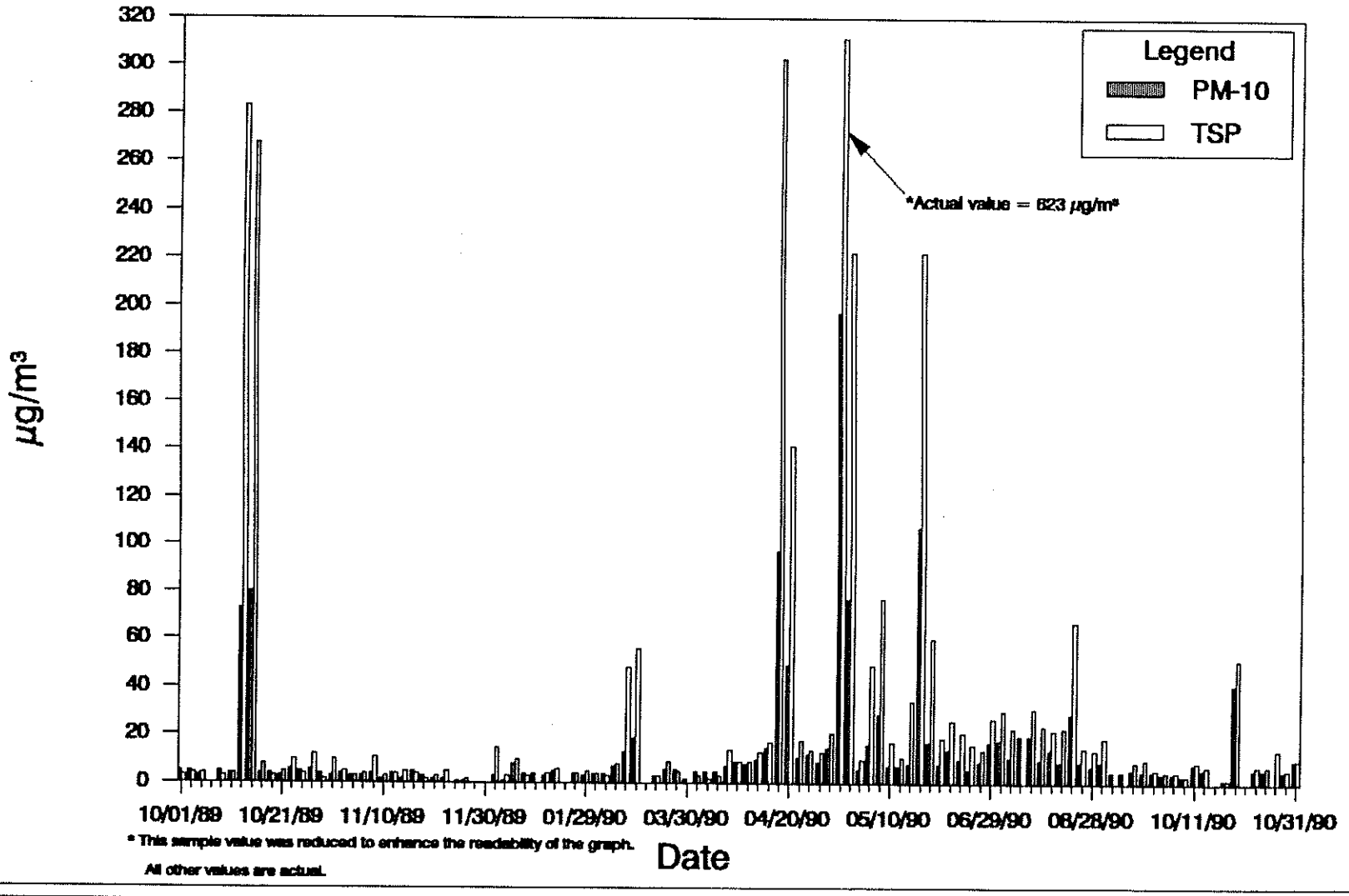


Figure 2-2 Graph of PM-10 and TSP Data
October 1989 to October 1990

ENVIRONMENTAL SCIENCE
AND ENGINEERING, INC.

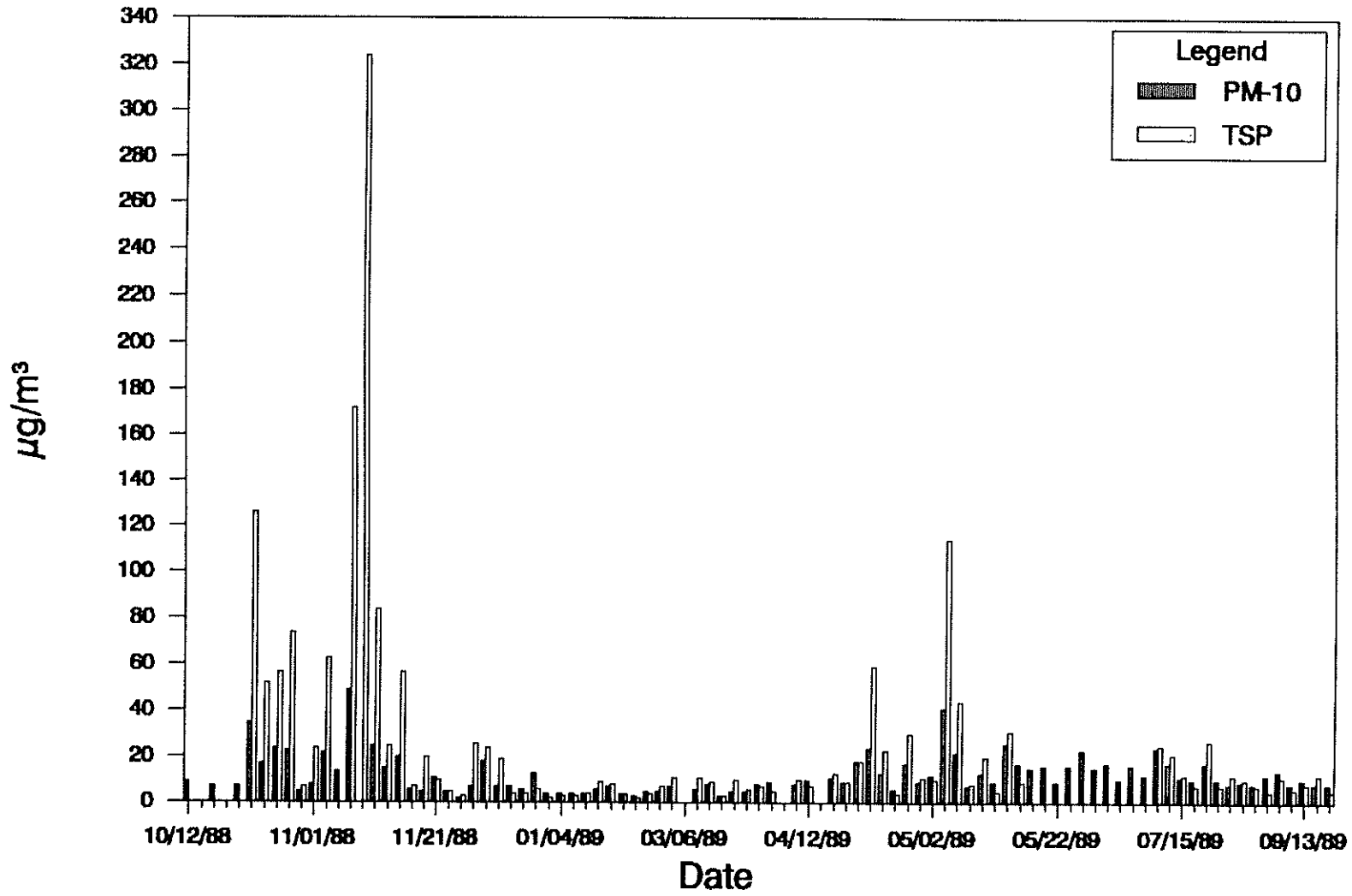


Figure 2-1 Graph of PM-10 and TSP Data
October 1988 to September 1989

ENVIRONMENTAL SCIENCE
AND ENGINEERING, INC.

METEOROLOGICAL DATA – THREE YEAR SUMMARY

WISHBONE HILL

AIR QUALITY AND METEOROLOGICAL MONITORING PROGRAM

METEOROLOGICAL DATA SUMMARY
OCTOBER 23, 1988 - OCTOBER 31, 1991

Prepared for:

IDEMITSU ALASKA, INC.
Palmer, Alaska

Prepared by:

ENVIRONMENTAL SCIENCE & ENGINEERING, INC.
Anchorage, Alaska

January, 1992

WISHBONE HILL AIR QUALITY AND METEOROLOGICAL MONITORING PROGRAM

Percent Data Recovery
Meteorological Monitoring Data
October 23, 1988 - October 31, 1991

PARAMETER	88-89	89-90	90-91	COMBINED
Wind Direction (WD)	73	96	92	87
Sigma Theta (SIGMA)	73	94	92	87
Wind Speed (WS)	83	93	92	86
Temperature (TEMP)	87	95	92	91
Precipitation (PRECP)	87	95	92	92

WISHBONE HILL METEOROLOGICAL MONITORING PROGRAM
DATA SUMMARY 1988 -1991
WIND PARAMETERS

Parameter	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
October 23, 1988-September 30, 1989													
Dominant WD	ESE*	ESE*	ESE*	ESE	ESE	ESE	SSW	SSW	WSW	SW	WNW	na	ESE
Avg Sigma deg	14.0	21.2	23.5	15.4	21.5	24.5	28.8	30.3	32.9	25.7	16.1	na	24.2
Dominant WS mph	6.7-11	6.7-11	6.7-11	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	na	1-4.5
Avg WS mph	5.2	6.4	7.4	4.8	2.7	4.3	2.6	2.3	2.5	2.3	2.3	3.3	3.7
% Calms	6.0	11.0	4.3	22.0	27.0	29.0	31.9	27.9	29.4	27.6	22.1	na	25.5
October 1, 1989-September 30, 1990													
Dominant WD	E	E	E	E	E	E	E	W	W/SW	W/SW	WNW	ESE	ESE
Avg Sigma deg	13.2	14.8	29.7	27.2	37.8	27.5	28.3	31.7	33.6	31.8	30.6	33.7	27.8
Dominant WS mph	1-4.5	6.7-11	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	na	1-4.5
Avg WS mph	2.9	6.3	4.9	4.5	4.2	4.6	3.5	2.4	2.2	2.4	2.1	2.3	3.3
% Calms	40	21	28	25	23	13	26	30	33	31	34	31	26
October 1, 1990-September 30, 1991													
Dominant WD	E	ESE	E	E	E	E	E	W	WNW	WNW	E	E	na
Avg Sigma deg	27.1	8.7	21.1	30.0	25.6	27.5	29.5	33.3	32.3	34.0	32.7	35.7	28.1
Dominant WS mph	1-4.5	1-4.5	<1.0	<1.0	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	1-4.5	na
Avg WS mph	4.1	5.5	4.7	4.1	5.5	2.8	3.6	2.8	2.4	2.0	3.2	2.6	3.6
% Calms	22	21	35	39	16	27	18	19	15	20	17	18	22
October 1, 1990-October 31, 1991													
Dominant WD	E												
Avg Sigma deg	28.8												
Dominant WS mph	1-4.5												
Avg WS mph	3.9												
% Calms	18												

* For the months of October through December 1988 the meteorological data was compiled as 1-hour averages. In January of 1989 the data logger program was changed to record 15-minute averages.

na = not available

WISHBONE HILL METEOROLOGICAL MONITORING PROGRAM
DATA SUMMARY 1988 -1991
TEMPERATURE DATA

Parameter	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
October 23, 1988-September 30, 1989													
Maximum Temp °c	3.5*	0.7*	4.9*	4.0	3.0	9.0	15.0	17.0	23.0	27.0	23.0	22.0	27.0
Minimum Temp °c	-11.6	-22.6	-22.7	-40.0	-26.0	-22.0	-10.0	-3.0	-3.0	4.0	2.0	-1.0	-40.0
Avg. Temp °c	-2.1	-7.2	-6.8	-15.1	-7.0	-5.0	3.0	7.0	11.0	14.0	13.0	9.0	1.0
October 1, 1989-September 30, 1990													
Maximum Temp °c	11.8	2.8	4.7	2.8	5.1	10.5	14.0	20.0	24.8	25.8	24.6	17.5	25.8
Minimum Temp °c	-16.6	-28.8	-31.0	-31.3	-32.5	-17.9	-8.6	-3.6	3.4	4.0	0.5	-2.9	-32.5
Avg. Temp °c	0.5	-8.6	-5.2	-10.6	-16.0	-1.5	4.5	8.8	12.8	13.7	12.6	7.6	2.4
October 1, 1990-September 30, 1991													
Maximum Temp °c	9.3	6.7	1.1	6.8	5.1	10.5	12.3	21.0	19.3	21.0	19.9	17.4	21.0
Minimum Temp °c	-15.6	-27.6	-30.7	-27.2	-32.5	-17.9	-6.7	-4.6	2.8	1.4	0.5	-1.9	-32.5
Avg. Temp °c	-0.9	-9.6	-9.3	-9.1	-5.7	-4.5	3.1	7.7	11.2	11.8	11.1	8.3	1.2
October 1, 1990-October 31, 1991													
Maximum Temp °c	11.0												
Minimum Temp °c	-13.2												
Avg. Temp °c	0.6												

* For the months of October through December 1988 the meteorological data was compiled as 1-hour averages. In January of 1989 the data logger program was changed to record 15-minute averages.

na = not available

WISHBONE HILL METEOROLOGICAL MONITORING PROGRAM
DATA SUMMARY 1988 -1991
PRECIPITATION DATA

Parameter	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
October 23, 1988-September 30, 1989													
# of 1-hr events*	4	22	18	15	17	39	6	158	89	76	187	117	748
Accumulation inch	0.05	0.54	0.36	0.67	0.53	0.75	0.05	2.41	1.48	1.73	5.47	3.21	17.25
October 1, 1989-September 30, 1990													
# of 15-min events	218	472	265	243	137	136	15	60**	70**	23	213	388	2240
Accumulation inch	3.03	5.11	3.12	2.73	1.43	1.58	0.17	1.66	1.81	0.35	4.69	5.82	31.50
October 1, 1990-September 30, 1991													
# of 15-min events	37	182	274	76	58	110	27	25	32	281	69	132	1303
Accumulation inch	0.46	2.00	3.46	0.80	0.96	1.56	0.28	0.32	0.35	5.05	1.15	2.30	18.69
October 1, 1990-October 31, 1991													
# of 15-min events	82												
Accumulation inch	1.03												

* For the months of October through December 1988 the meteorological data was compiled as 1-hour averages. In January of 1989 the data logger program was changed to record 15-minute averages. To calculate the annual statistics all 15-minutes values were converted to 1-hours values.

** Because of problems digitizing the strip charts, the number of recorded events were approximated.