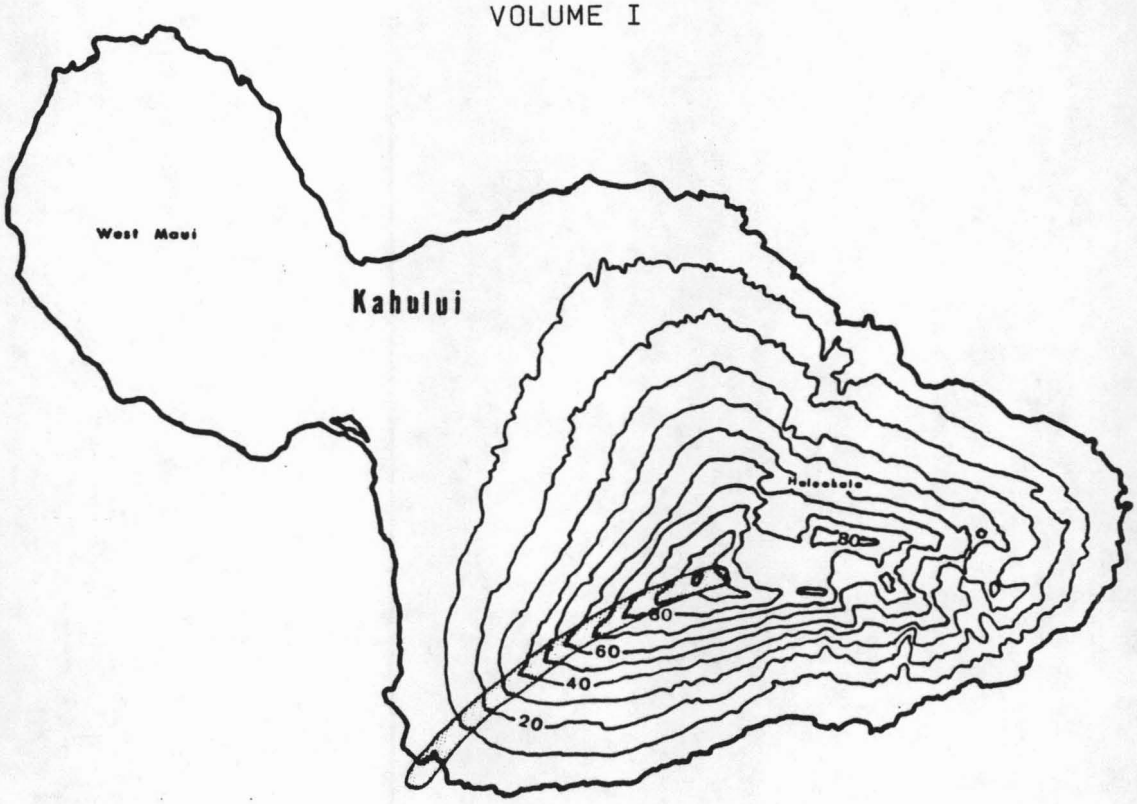
ENVIRONMENTAL BASELINE SURVEY

ULUPALAKUA, MAUI

Final Report
August 1984 - August 1985

VOLUME I



REPORT PREPARED FOR

HAWAII DEPARTMENT OF PLANNING & ECONOMIC DEVELOPMENT
MID-PACIFIC GEOTHERMAL INC
MAUI ELECTRIC COMPANY

By
ENVIRONMENTAL DEPARTMENT
HAWAIIAN ELECTRIC COMPANY, INC.
P. O. BOX 2750
HONOLULU, HAWAII 96840

ACKNOWLEDGMENTS

Hawaiian Electric Company, Inc. wishes to acknowledge the cooperation and assistance of the following individuals and organizations who have contributed to the success of the baseline survey and the preparation of this report:

Mr. Pardee Erdman and Mr. Ed Rice of the Ulupalakua Ranch, Dr. Donald Thomas of the Hawaii Institute of Geophysics, Dr. George Walker of the University of Hawaii Geology and Geophysics Department, and the National Weather Service - Kahului Airport.

ENVIRONMENTAL BASELINE SURVEY

VOLUME I

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ENVIRONMENTAL BASELINE SURVEY

VOLUME II

TABLE OF CONTENTS

ENVIRONMENTAL BASELINE SURVEY
VOLUME II

EXECUTIVE SUMMARY

BACKGROUND

The Southwest Rift of Haleakala, Maui is one of the regions in the State of Hawaii which has long been considered as a potential geothermal resource. In November 1984, 4154 acres along the Haleakala Southwest Rift were designated as a Geothermal Subzone by the State of Hawaii Department of Land and Natural Resource.

In August 1984, a one-year environmental monitoring program was initiated as a joint effort by the State of Hawaii Department of Economic Development (DPED), True/Mid-Pacific Geothermal Venture, and Maui Electric Company (MECO). The purpose of the monitoring program was to:

1) Establish baseline environmental conditions within the region;

2) Collect meteorological data which may be used to perform air pollutant dispersion model studies; and,

3) Satisfy Environmental Protection Agency (EPA) and State of Hawaii Department of Health (DOH) requirements for pre-construction air quality monitoring.

MONITORING PROGRAM DESCRIPTION

A monitoring site was selected in the approximate center of the upper half of the area identified as having geothermal development potential. The topography of the area consists of rolling hills and grass-covered cinder cones. The site selected is typical of the area of potential geothermal interest northeast of the Kula Highway. The general location of the site is shown in Figure 1.

Continuous monitoring was conducted for sulfur dioxide (SO_2) and hydrogen sulfide (H_2S). The meteorological parameters of wind speed and direction, temperature, and precipitation were also measured on a continuous basis. Periodic sampling was performed for total suspended and inhalable particulates, mercury and radon. Periodic samples of rainwater were analyzed for pH, conductance, and elemental and anionic content. Due to the absence of precipitation catchment systems and wells in the area, water samples were taken periodically from a well in the vicinity of La Perouse Bay for constituent analysis.

Data from the analyzers and meteorological systems were recorded using a microprocessor-based data acquisition system. Periodic calibration of the analyzers as well as initiation and termination of the particulate and mercury samplers were also controlled by the data acquisition system. Due to the relative remoteness of the monitoring site and the generally pristine nature of the surrounding area, either large scale or near field significant events are required for a detectable impact to be observed. A log of these events was maintained to the extent they could be identified.

All continuous air monitoring and high-volume particulate sampling was conducted in accordance with the EPA's Prevention of Significant Deterioration (PSD) monitoring guidelines including the performance of periodic quality assurance audits by a third party.

MONITORING PROGRAM RESULTS

Results of the monitoring program are summarized in Table 1 where they may be compared with applicable National and Hawaii Ambient Air Quality Standards.

Only 0.6% of the hourly average SO_2 values recorded showed any indication of SO_2 presence. The level of SO_2 recorded was within the range of 1 to 6 ppb resulting in 3-hour, 24-hour, annual averages which are all negligible when compared to the National or Hawaii Ambient Air Quality Standards. Of the SO_2 values recorded, 89% were within a range which are primarily attributable to instrument drift or instrument settling following a calibration period.

Approximately 24% of the recorded hourly average H_2S values were recorded as non-zero values having a range of 1 to 7 ppb. However, nearly all of these values can be attributed to analyzer instability or spurious values at instrument zero. No specific cause or event is associated with either the remaining SO_2 or H_2S values.

Total Suspended Particulate (TSP) concentrations were found to be well below existing Federal and State standards. Total Inhalable Particulate (TIP) concentrations, which represent particulates having a size of less than 10 microns, were also well below the Federal standard being proposed by the EPA. Analysis of the total suspended particulate samples by x-ray fluorescence identified chloride, silicon, sulfur, aluminum, and iron as primary constituents.

Both elemental mercury (Hg) vapor and radon were found to be present in low levels. The levels observed were comparable of other background values recorded in Hawaii.

Primary constituents identified in the rainwater analysis were sodium, calcium, silicon, and magnesium. Principle anion components were chlorides and sulfates. As would be expected from the well's relatively close proximity to the ocean, high levels of sodium and chloride were found in the well water samples. Other predominate constituents included magnesium, calcium, potassium, and silicon.

The wind direction frequency distribution (wind rose) for the site exhibits a pattern with two predominate wind directions. One predominate wind was from across the northside of Halekala from a NNW to N direction while the other was from across the southside of Haleakala from an ESE to E direction. Winds from the NNW to NNE sectors generally predominated during the late evening and early morning hours, shifting to either a WNW to NE, or, ESE direction during the day. The average hourly average wind speed for the site was 3.0 mps (6.7 mph). 85% of the wind speed observations were recorded in the 0.4-5.4 mps (0.9-12.1 mph) range. Periods of calms constituted less than 2% of the hourly averages. Maximum wind speeds were recorded during the hours of 0800 and 1800 Local Standard Time (LST) with peak winds occurring during the early afternoon hours.

The diurnal temperature pattern was generally found to be consistent from month to month. During the monitoring period, a low of 11.6 and a high of 24.2 degrees Celsius (52.9 and 75.6 degrees Fahrenheit was recorded.

A total rainfall of nearly 56 cm (22") was recorded during the monitoring period. January was observed to be the wettest month of the monitoring period during which 10.1 cm (4.5") of precipitation were recorded. Approximately 65% of the rainfall was observed during the six-month period of September 1984 through February 1985. August and March were the driest months, averaging less than 1.3 cm (0.5") each.

Known events during the monitoring period which had the potential for impacting the results of the monitoring program were limited to Kilauea volcanic activity on the island of Hawaii and vehicular activity associated with some construction activities up-wind of the monitoring site. However, no causal relationship can be definitively established between these events and any recorded data.

Audits were performed quarterly by an independent third party in accordance with prescribed EPA guidelines for PSD air quality monitoring programs. Results of the audits were satisfactory to excellent, leading the auditor to conclude in the audit reports that the monitoring station was well run.

CONCLUSIONS

The environmental baseline data collected during the one-year monitoring period indicates that there are no significant sources of naturally occurring SO_2 or H_2S in the vicinity of the monitoring site. The values recorded are primarily artifacts of the monitoring system, vehicular activity upwind of the monitoring site, or volcanic activity on the island of Hawaii. It is possible, but improbable, that there are very low levels (less than 5 ppb) of naturally occurring H_2S which are being masked by instrument drift and by the analyzer's slow settling following calibration periods.

The complex terrain, which is characteristic of the area, precludes any specific conclusions regarding the potential impact on air quality which would be associated with the development of a specific geothermal site. It may be generally concluded from the meteorological data of the monitoring period, however, that there is little if any potential for significant impact. This is due to the general predominance of high winds and increased turbulence associated with the day time hours which would provide excellent dispersion of any plant emissions. During the evening and early morning hours, which are characterized by lower wind speeds and more stable conditions, emissions are likely to be carried away from a plant site at an altitude greater than the elevation of the plant thus precluding any surface impact.

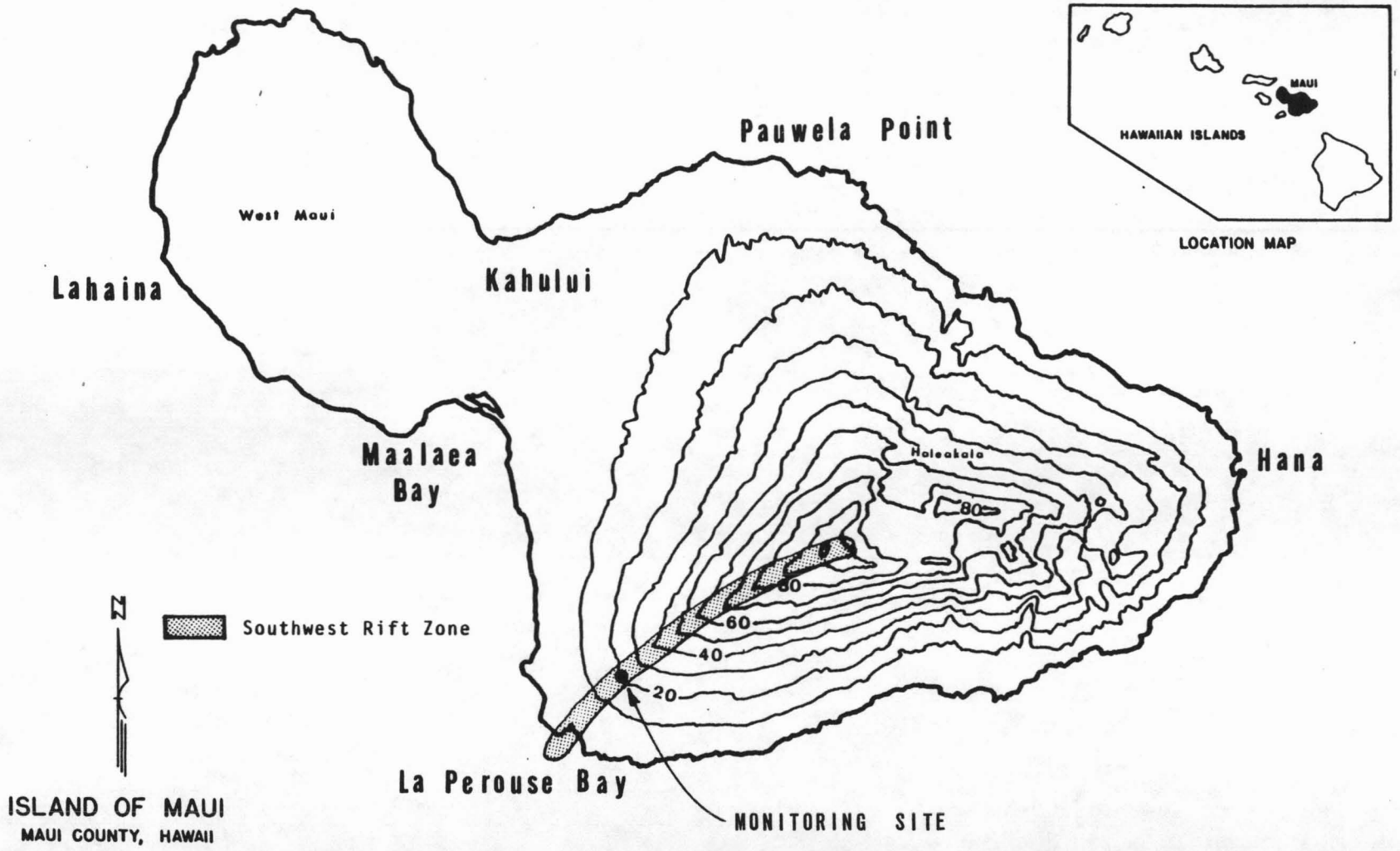

Pauwela Point
West Maui
Lahaina
Kahului
Maalaea Bay
Haleakala
Hana
80
60
40
20
Southwest Rift Zone
N
ISLAND OF MAUI
MAUI COUNTY, HAWAII
La Perouse Bay
MONITORING SITE
MAUI
HAWAIIAN ISLANDS
LOCATION MAP

FIGURE 1

TABLE 1

AIR QUALITY STANDARDS AND MAXIMUM MEASURED VALUES
SITE 241 - ULUPALAKUA
AUGUST 1984 - August 1985

POLLUTANT	STANDARD	STANDARD CONCENTRATION LIMITS	MAXIMUM MEASURED VALUE
SO_2	Annual Primary NAAQS (1)	140 ppb	0 ppb
SO_2	24hr Primary NAAQS	30 ppb	1 ppb
SO_2	3hr Secondary NAAQS	494 ppb	4 ppb
H_2S	1hr Hawaii AAQS (Proposed)	100 ppb	7 ppb
TSP	24hr Primary NAAQS	260 ppb	45 ug/m^3
TSP	24hr Secondary NAAQS	150 ug/m^3	45 ug/m^3
TSP	Annual Primary NAAQS	75 ug/m^3	18 ug/m^3
TSP	Annual Secondary NAAQS	60 ug/m^3	18 ug/m^3
TIP	24hr Primary NAAQS (Proposed)	150-250 ug/m^3	21 ug/m^3
HG	DOSH[2]	1 ug/m^3	157 ug/m^3
RADON	NRC[3]	3 pCi/l	0.24 pCi/l

Unless otherwise indicated, the standards reflected are the most stringent federal standard. A Hawaii State Standard is provided in the absence of an appropriate federal standard.

1. NAAQS - National Ambient Air Quality Standard

2. This value is 1/100 of the Hawaii Department of Occupational Safety & Health (DOSH) Permissable Exposure Level for an 8-hour period.

3. Nuclear Regulatory Commission (NRC) Continuous 7-day Exposure Limit.

1.0 INTRODUCTION

The Southwest Rift of Haleakala, Maui is one of the regions in the State of Hawaii which has long been considered as a potential geothermal resource. A land area of 4154 acres along the Haleakala Southwest Rift was recommended in 1984 for designation as a Geothermal Resource Subzone by the State of Hawaii Department of Land and Natural Resource. Designation of the area as a Geothermal Resource Subzone was made in November 1984.

An environmental monitoring program was conducted from August 7, 1984 through August 18, 1985 as a joint effort by the State of Hawaii Department of Economic Development (DPED), Mid-Pacific Geothermal, and Maui Electric Company (MECO). The objectives of the monitoring program were to:

1) Establish baseline environmental conditions within the region prior to any geothermal exploration, development, or usage for power production or other purposes;

2) Collect one year of meteorological data which could be used to perform air pollutant dispersion model studies of the environmental impact of proposed developments, and for Environmental Protection Agency (EPA) and State of Hawaii Department of Health (DOH) permit applications; and

3) Satisfy EPA/DOH requirements for pre-construction air quality monitoring in the vicinity of proposed geothermal developments for which permits must be obtained.

2.0 FIELD MONITORING

2.1. Monitoring Sites

A monitoring site for the collection of baseline environmental data was selected in the approximate center of the upper half of the area identified as having potential for geothermal development. It is designated as Site 241. Considerations entering into the selection of the site included:

1) Proximity to the area of possible initial geothermal development,

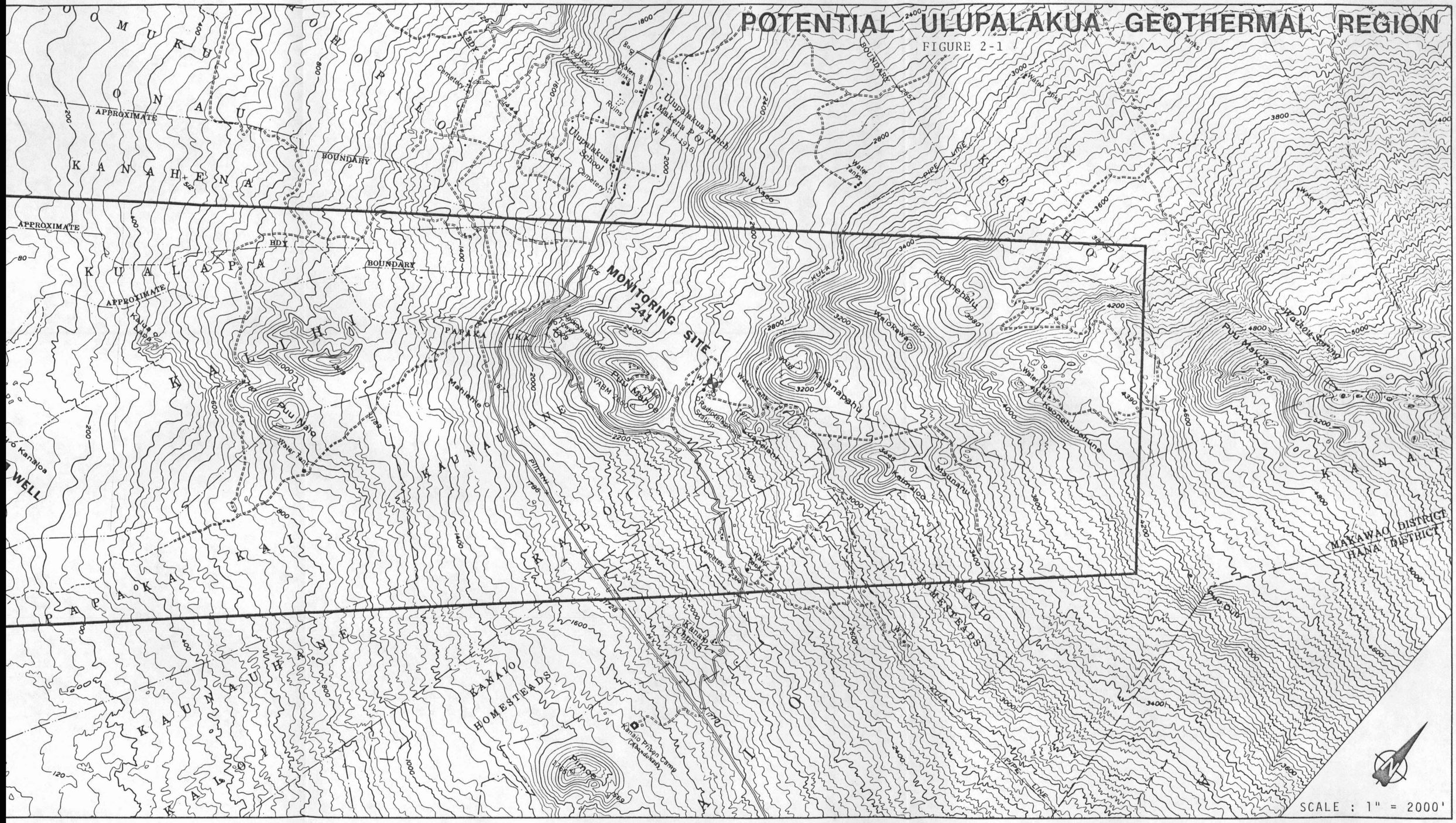
2) Avoidance of unusual air flows caused by terrain features, trees, or structures, and

3) Reasonable accessibility and availability of power.

The topography of the area consists of grass covered cinder cones and rolling hills. The site selected may be considered typical of the area of potential geothermal interest northeast (mauka) of the Kula Highway. The region southwest of the Kula Highway changes dramatically as one progresses down the mountain in the direction of La Perouse Bay. Site 241 cannot be considered representative of this lower area from a topographic standpoint, but can be considered representative for baseline air quality and meteorological considerations. The geographic location of the monitoring site has been identified from the topographic map in Figure 2-1 as having coordinates 20° 38' 56"N, 156° 23' 05"W at an elevation of 2610 feet.

An effort to include the analysis of water samples as part of tne baseline survey was handicapped by the general absence of both precipitation catchment systems and wells in the area of potential geothermal interest. Consequently, water sampling has been limited to precipitation collected at Site 241 and periodic samples from the one well in the area located just inland of the north end of La Perouse Bay. The location of this well is also identified in Figure 2-1.

Of interest during the survey period are those events, conditions, or activities which may have an impact on the parameters being monitored. Due to the relative remoteness of the monitoring site and generally pristine nature of the surrounding area, large scale or near field phenomena will generally be required for any detectable impact to be observed. Phenomena which may have such an impact include: volcanic activity, severe weather conditions, and local area construction upwind of the monitoring site. When such phenomena can be identified, it has been documented in Appendix E as a significant event.


POTENTIAL ULUPALAKUA GEOTHERMAL REGION
FIGURE 2-1
MONITORING SITE 241
WELL
APPROXIMATE BOUNDARY
KAHIKINUI
KAUPO
KANAIO HOMESTEADS
MAKAWAO DISTRICT
HANA DISTRICT
SCALE : 1" = 2000'

2.2. Monitoring Parameters

All continuous air monitoring and hign-volume particulate sampling was conducted in accordance with Environmental Protection Agency (EPA) Prevention of Significant Deterioration (PSD) monitoring guidelines. Continuous air monitoring instrumentation and sampling equipment was installed in or mounted on an 8'x8'x15' shelter having a temperature controlled internal environment.

A Radian DART II data acquisition system was used to collect data from the air quality analyzers and meteorological sensors. Several quality assurance related sensors such as station temperature and AC line voltage were also monitored. Data in the form of six minute averages were computed from the five second samples and recorded on a floppy disk for subsequent processing. A hard copy printout of all data is also produced and serves as backup to the floppy disk. Strip chart recorders serve as a third level backup for all analyzers and meteorological sensors except precipitation. A summary of the parameters monitored, their sampling frequency, and averaging time or sampling period are provided in Table 2-1.

Continuous monitoring was conducted for sulfur dioxide (SO_2) and hydrogen sulfide (H_2S) using flame photometric analyzers. Periodic sampling was also performed for total suspended and total inhalable particulates (TSP & TIP), mercury (Hg), and radon.

High-volume TSP and TIP samples were taken at approximate five day intervals. Inhalable particulates were sampled using a size selective inlet that allowed for the collection of particulates 10 microns and smaller.

Low-volume (40 liter/min [lpm]) particulate sampling was performed at approximately two-week intervals for elemental analysis of ambient particulates. The filter media used in high-volume sampling is unsatisfactory for this purpose.

Air samples for the analysis of elemental mercury vapor were taken approximately monthly. Sampling for the presence of radon was conducted for a three-month period using Terradex Corporation Type F Etch Track Detectors which are sensitive to alpna particles.

All air sampling was performed under the control of the DART II data acquisition system which initiated and terminated the sampling periods. All sampling periods were 24 hours, midnight to midnight.

The meteorological parameters of horizontal wind speed and direction, temperature, and precipitation were measured on a continuous basis. The six-minute wind direction variance was also calculated from wind direction observations taken at five second intervals.

Precipitation samples were collected for elemental, anionic and pH analysis. Water samples were drawn quarterly from the well located inland of La Perouse Bay for constituent analysis.

Details of the monitoring and sampling methodologies and procedures are contained in Appendix D of Volume II.

TABLE 2-1

SUMMARY OF MONITORING PARAMETERS

Parameter	Sampling Frequency	Averaging/ Sampling Period
Sulfur Dioxide	5 Second	Six Minute Ave.
Hydrogen Sulfide	5 Second	Six Minute Ave.
Wind Speed	5 Second	Six Minute Ave.
Wind Direction	5 Second	Six Minute Ave.
Wind Direction Variance	5 Second	Six Minute Ave.
Temperature	5 Second	Six Minute Ave.
Precipitation	5 Second	Six Minute Ave.
HI-VOL TSP	5 Day Interval	24 Hours
HI-VOL TIP	5 Day Interval	24 Hours
LO-VOL TSP	10 Day Interval	24 Hours
Radon	Quarterly	3 Months
Mercury	Monthly	24 Hours
Precipitation	*	*
Well Water	Quarterly	Instantaneous

* The frequency and period of collection for precipitation samples were a function of rainfall.

3.0 RESULTS

Monitoring commenced at Site 241, Ulupalakua, Maui, the evening of August 6, 1984. At that time, all continuous monitoring systems were in operation and producing valid data. Two radon samplers were also installed the same date. High-volume particulate samplers for TSP and TIP were placed in operation the following week. Low-volume particulate sampling, precipitation sample collection, and mercury sampling were initiated in October due to a delay in equipment arrival.

3.1. Air Quality Data

Monthly reports of SO_2 and H_2S hourly averages are provided in Appendix A of Volume II. The highest 3-hour, 24-hour, and annual averages are all negligible compared to the National Ambient Air Quality Standards (NAAQS) provided in Table 3-1 and the present Hawaii Ambient Air Quality Standards (AAQS). Only 0.6% of the SO_2 hourly average values (53 of 8494) showed any indication of SO_2 presence. The range of hourly SO_2 values were between 1 ppb and 6 ppb with 1 ppb representing over 64% of the non-zero values. There was only one occurrence of a 6 ppb hourly average.

The non-zero SO_2 values recorded can generally be characterized as having very low values (1-2 ppb) (89%) and occurring between 2200 and 0800 Local Standard Time (LST) (83%). Most of the SO_2 values in the 1-2 ppb range can be attributed to instrument drift or instrument settling following the one-hour daily auto-calibration cycle which occurs at 2000 (LST). Other non-zero SO_2 observations may be related to construction activity upwind of the monitoring site during November and December and the presence of vehicular equipment at other times. Volcanic activity at Kilauea on the island of Hawaii is also a possible, but remote source.

As nearly 90% of all recorded non-zero SO2 values are within EPA accepted limits of instrument performance for drift and accuracy, it can be concluded that there is no apparent naturally occurring source of SO_2 in the vicinity of the monitoring site. The SO_2, which was recorded, is attributed primarily to instrument zero drift, vehicular activity upwind of the site, with possible, but unlikely contributions from Kilauea volcanic activity.

Of the 8310 H_2S values recorded during the monitoring period, 2006 or 24.1% were non-zero values ranging from 1 ppb to 7 ppb. 86% of these values were in the 1-3 ppb range. There were only six periods during which 5 ppb was exceeded. The highest 1-hour value of 7 ppb compares to a proposed 100 ppb AAQS.

The non-zero H_2S values can generally be characterized as having very low values (1-5 ppb) (99.7%) and occurring between 2100 and 2200 (LST) (77%). All of the values in the 1-5 ppb range can generally be attributed to instrument drift or instrument settling following the 2000 (LST) daily auto-calibration. Instrument zero drift and instability in the 1-5 ppb range is not uncommon for the type of analyzer (flame photometric) and full scale range used. The 100 ppb full scale range used for the H_2S analyzer contrasts with a 500 ppb full scale range on the SO_2 analyzer. This and the higher reactivity of H_2S gas will frequently result in spurious low level values, particularly following instrument calibration when the analyzer has experienced nearly full scale levels of H_2S.

Experience at the Lake County, California Air Pollution Control District indicates some very low levels (1-5 ppb) of H_2S may be naturally present from animal waste due to livestock grazing in the immediate vicinity of the monitoring site. The significance of this source, however, would be very difficult to quantify. Consequently, it can be concluded that there are no significant sources of H_2S in the vicinity of the monitoring site and, if low naturally occurring levels are present, they are less than 5 ppb.

Total Suspended Particulate (TSP) 24-hour concentrations varied from a low of 2.1 to a high of 44.6 ug/m^3. These concentrations are well below the secondary TSP NAAQS of 150 ug/m^3 and the State 24-hour Standard of 100 ug/m^3. The annual average (geometric mean) of 18 ug/m^3 is also well below the secondary annual NAAQS of 60 ug/m^3 and the State annual average of 55 ug/m^3. Total Inhalable Particulate (TIP) concentrations varied from 1.5-21.3 ug/m^3, averaging (geometric mean) 8.7 ug/m^3. These concentrations are well below the 150-250 ug/m^3 range which EPA has proposed for a primary 24-hour TIP NAAQS. Inhalable particulates having a range size of 10 microns and smaller represented approximately 53% of the total suspended particulates. There was no apparent correlation between particulate concentrations and either high or low wind speeds. The detailed results of the high-volume particulate sampling are provided in Appendix A of Volume II.

The measurements of airborne elemental mercury ranged from 36 ng/m^3 to 121 ng/m^3 with a mean value of 68 ng/m^3. As has been shown in studies of elemental mercury on the island of Hawaii and other areas of the world, high levels of mercury emissions are associated with volcanic sources. In contrast, the atmosphere over open oceans are very low in mercury content. The moderate trade wind conditions typically present at the monitoring site would tend to minimize the impact of any mercury emissions which may be present. Further, the absence of

any volcanic or geothermal activity in the vicinity further suggests that relatively low levels of mercury would be observed.

With the exception of two observations which exceeded 100 ng/m^3, generally low levels of mercury emissions were observed. The two observations which exceeded 100 ng/m^3 are believed to be aberrations of the sample analysis process rather than representative of actual conditions. Detailed results of the elemental mercury monitoring are provided in Table A-4 of Volume II.

The Radon-222 levels observed at the site ranged from 100 pCi/m^3 to 240 pCi/m^3. Radon is a radioactive gas naturally formed from the decay of radium contained in geological materials. Radon-222 has a half-life of 3.8 days and decays via an energetic alpha particle. Two of its daughter products (Polonium-218 and Polonium-214) have very short lives (3.0 minutes and 1.6×10^{-4} seconds respectively), and also decay by energetic alpha particles. Due to radon's radioactivity and presence as a gas which can be inhaled, high radon levels may be injurious to human health. As with atmospheric mercury, high radon emission rates are associated with volcanic and geothermal areas. Conversely, open ocean air associated with the trade winds has a very low radon content. The measured range of 100 to 240 pCi/m^3 indicates relatively low outdoor levels and are typical of other radon measurements in Hawaii. Results of the monitoring for Radon-222 are provided in Table A-5 of Volume II.

3.2. Meteorological Data

Detailed tabulations of the meteorological data for wind speed, wind direction, temperature and precipation are presented in Appendix B of Volume II. The following discussion summarizes the data.

As shown in Figure 3-4 and Table 3-2, winds of greatest frequency and speed occurred in the NNW-N (22.6%) and ESE-E (24.8%) sectors. Wind from the ESE-E sectors represents flow across the southside of Haleakala while winds from the NNW-N sectors represents flow across the northside of the mountain. During the late evening and early morning hours (1900-0600), winds from the NNW-NNE sectors occurred most frequently. During daytime hours (0700-1800) winds were predominate from either the WNW-NW sectors (25.3%) or ESE sector (18.4%).

The average hourly wind speed average for the monitoring period was 3.0 mps. Figure 3-2 shows the average hourly wind speed generally reaching a maximum at about 1400 daily. Table 3-2 shows 85% of the wind observations were in the range of 0.4-5.4 mps. Periods of calm constituted less than 2% of the observations.

Wind speeds are maximum during the day at the same time the wind direction variation, as reflected by the standard deviation of the wind direction, is greatest. Maximum wind speeds and wind direction standard deviations occurred between 0800 and 1800 (LST). The wind direction standard deviation is a reflection of the variation in horizontal wind direction and is indicative of turbulence conditions at the site.

The diurnal temperature pattern was generally consistent month to month. During the monitoring period a low of 11.6 and a high of 24.2 degrees Celsius were recorded. The maximum, minimum, and average hourly temperatures are summarized in Figure 3-3.

Nearly 56 cm of rainfall averaging 4.6 cm per month were recorded during the monitoring period. The months of August and March were the driest, averaging less than 1.3 cm each. January was recorded as the wettest month with a total of 11.4 cm. The two wettest periods of the year were the six-month period from September through February and May-June when approximately 65% and 20%, respectively, of the rainfall occurred.

3.3. Laboratory Analysis

3.3.1 Well Water and Precipitation Data

The analytic results of rainwater samples collected are provided in Appendix C of Volume II. The first two samples show decidedly different characteristics from the succeeding three with regards to pH and conductance. No explanation is available for this difference. Primary constituents of the rainwater are sodium, calcium, silicon, and magnesium. Chlorides and sulfates were the principle anion constituents.

The results of the analysis on the well water samples are provided in Appendix C of Volume II. Results of all three samples indicate the water is non-acidic and has an average pH of 8.1. As might be expected due to the well's close proximity to the ocean, high levels of sodium were analyzed. Relatively high levels of hard water constituents including magnesium, calcium, potassium, and silicon were also present. Chlorides and sulfates were the predominate anions present in the one sample for which these constituents were analyzed. No radiochemical components (Gross Alpha/Beta or Radium 226) exceeding detection limits were found.

3.3.2 Low-Volume Particulate Data

The analytical results of the low volume particulate sampling are also provided in Appendix C of Volume II. On the average, the low-volume particulate concentrations were slightly higher (10%) than the concentrations recorded by the high-volume sampling. The analysis, using x-ray fluorescence, identified the following constituents as the most prominent components on the average for all samples.

Average

Constituent	Composition (%)
Chloride	9.5
Silicon	4.6
Sulfur	3.6
Aluminum	2.7
Iron	2.2

3.4 Significant Events

Known events which may have an impact on the results of the monitoring program have been chronologically noted in Appendix D of Volume II. These events consist primarily of Kilauea volcanic activity on the island of Hawaii and adverse weather conditions, typically high winds or rainfall as observed by the National Weather Service at the Kahului Airport. Known occurrences of vehicular activity associated with construction activities upwind of the monitoring site have also been identified.

While the possibility exists that the air quality data could have been impacted by the events listed, no direct cause and effect relationship can be established. There was, however, about a 50% correlation between high trade wind conditions observed bythe National Weather Service at Kahului

International Airport and periods of high winds at the monitoring site. No unusually high winds, however, were observed at the site during the one high wind warning period issued by the National Weather Services.

3.5 Independent Audits

As part of a PSD air quality monitoring program, periodic audits of the monitoring system are required. During the monitoring period, four audits were performed at approximately quarterly intervals. Included in the audit were SO_2 and H_2S analyzers, wind speed, wind direction, temperature, and precipitation measurement systems, high-volume samplers, data acquisition system, and station operating procedures and documentation. All audits were conducted in accordance with prescribed EPA guidelines by Environmental Monitoring & Services, Inc.

During all audits, the SO_2 and H_2S analyzers met the criteria for satisfactory to excellent performance. Checks performed on their associated calibration systems also yielded excellent results. Results of the audits of all the meteorological systems were excellent except for a wind vane orientation which was found to be in error by five degrees during the first audit. The vane was realigned at the time of the audit. Results of the data acquisition system audits were excellent in each audit. Audits of the high-volume samplers also provided satisfactory to excellent results except for one sampler which differed from the audit flow by 9.6% during the fourth audit.

An evaluation of the general station condition, operation, and maintenance was also conducted by the auditor. Generally, all procedures used were found to be consistent with EPA guidelines for PSD monitoring and all documentation was found complete, concise, and up-to-date. The auditor concluded the station was a well run monitoring station.

TABLE 1

AIR QUALITY STANDARDS AND MAXIMUM MEASURED VALUES
SITE 241 - ULUPALAKUA
AUGUST 1984 - August 1985

POLLUTANT	STANDARD	STANDARD CONCENTRATION LIMITS	MAXIMUM MEASURED VALUE
SO_2	Annual Primary NAAQS (1)	140 ppb	0 ppb
SO_2	24hr Primary NAAQS	30 ppb	1 ppb
SO_2	3hr Secondary NAAQS	494 ppb	4 ppb
H_2S	1hr Hawaii AAQS (Proposed)	100 ppb	7 ppb
TSP	24hr Primary NAAQS	260 ppb	45 ug/m^3
TSP	24hr Secondary NAAQS	150 ug/m^3	45 ug/m^3
TSP	Annual Primary NAAQS	75 ug/m^3	18 ug/m^3
TSP	Annual Secondary NAAQS	60 ug/m^3	18 ug/m^3
TIP	24hr Primary NAAQS (Proposed)	150-250 ug/m^3	21 ug/m^3
HG	DOSH[2]	1 ug/m^3	157 ug/m^3
RADON	NRC[3]	3 pCi/l	0.24 pCi/l

Unless otherwise indicated, the standards reflected are the most stringent federal standard. A Hawaii State Standard is provided in the absence of an appropriate federal standard.

1. NAAQS - National Ambient Air Quality Standard

2. This value is 1/100 of the Hawaii Department of Occupational Safety & Health (DOSH) Permissable Exposure Level for an 8-hour period.

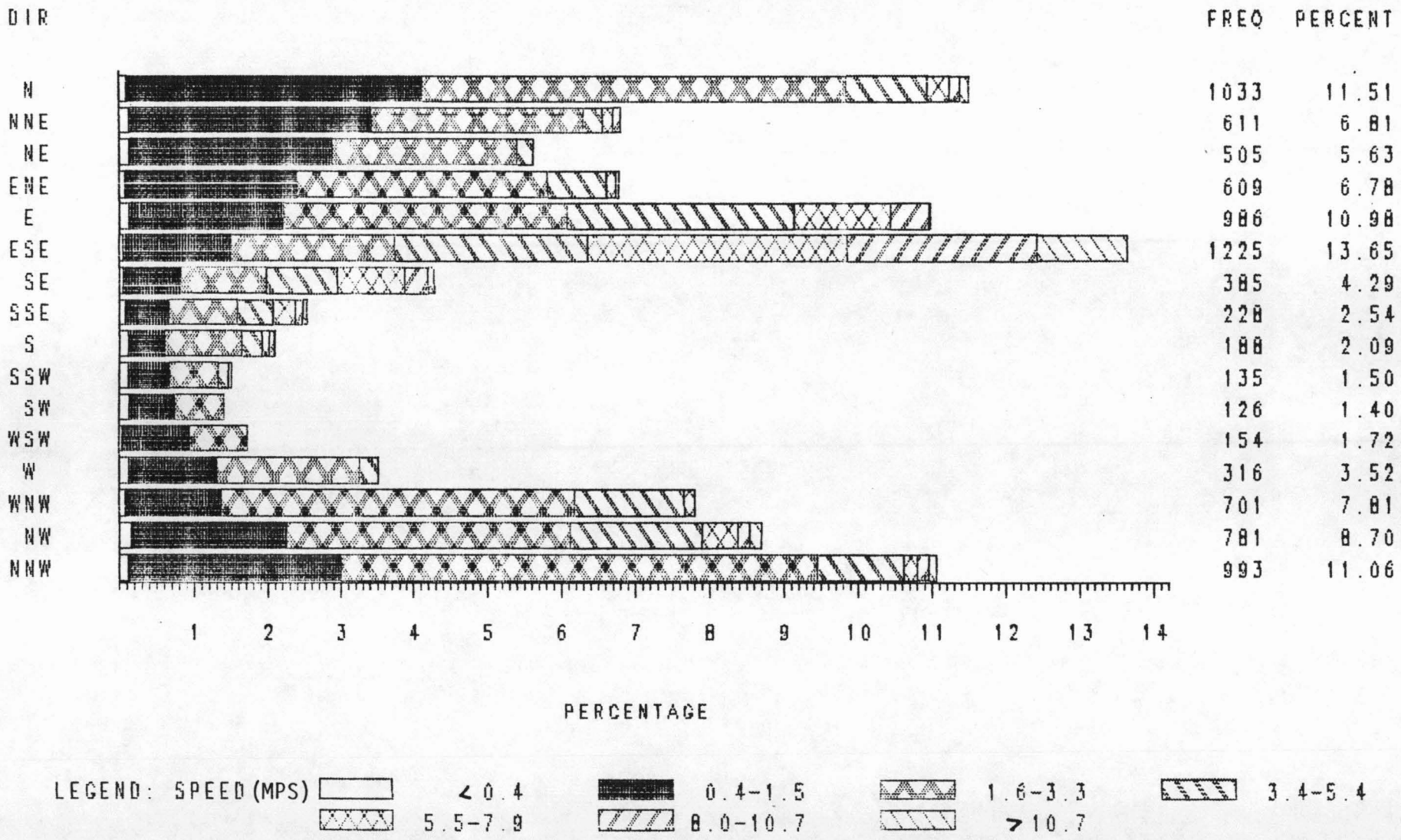
3. Nuclear Regulatory Commission (NRC) Continuous 7-day Exposure Limit.

FIGURE 3-1

AIR QUALITY MONITORING PROGRAM

WIND SPEED/DIRECTION FREQUENCY DISTRIBUTION (%)

SITE 241 - ULUPALAKUA AUGUST 1984 - AUGUST 1985



11/25/85

TABLE 3-2

AIR QUALITY MONITORING PROGRAM
WIND SPEED/DIRECTION FREQUENCY DISTRIBUTION (%)
SITE 241 - ULUPALAKUA AUGUST 1984 - AUGUST 1985

TABLE OF DIR BY SPEED

	SPEED (M/S)							
DIRECTION	<0.4	0.4-1.5	1.6-3.3	3.4-5.4	5.5-7.9	8.0-10.7	>10.7	PERCENT
N	0.10	4.01	5.74	1.09	0.30	0.14	0.12	11.51
NNE	0.14	3.28	2.87	0.26	0.14	0.11	0.00	6.81
NE	0.14	2.73	2.53	0.21	0.01	0.00	0.00	5.63
ENE	0.09	2.31	3.43	0.80	0.11	0.04	0.00	6.78
E	0.13	2.08	3.85	3.07	1.29	0.52	0.02	10.98
ESE	0.07	1.44	2.23	2.62	3.51	2.55	1.24	13.65
SE	0.06	0.77	1.15	0.98	0.94	0.31	0.09	4.29
SSE	0.08	0.59	0.90	0.50	0.31	0.09	0.07	2.54
S	0.12	0.48	1.04	0.29	0.10	0.06	0.01	2.09
SSW	0.11	0.55	0.66	0.14	0.04	0.00	0.00	1.50
SW	0.13	0.60	0.67	0.00	0.00	0.00	0.00	1.40
WSW	0.04	0.90	0.77	0.00	0.00	0.00	0.00	1.72
W	0.14	1.15	1.96	0.27	0.00	0.00	0.00	3.52
WNW	0.08	1.28	4.81	1.48	0.16	0.00	0.00	7.81
NW	0.16	2.11	3.87	1.77	0.48	0.17	0.16	8.70
NNW	0.11	2.89	6.46	1.16	0.19	0.16	0.10	11.06
TOTAL HRS	154	2437	3854	1315	681	373	162	8976
PERCENT	1.72	27.15	42.94	14.65	7.59	4.16	1.80	100.00

11/20/85

FIGURE 3-2

AIR QUALITY MONITORING PROGRAM
MAXIMUM, MINIMUM AND AVERAGE WIND SPEED BY HOUR
STATION 241 - ULUPALAKUA AUGUST 1984 - AUGUST 1985

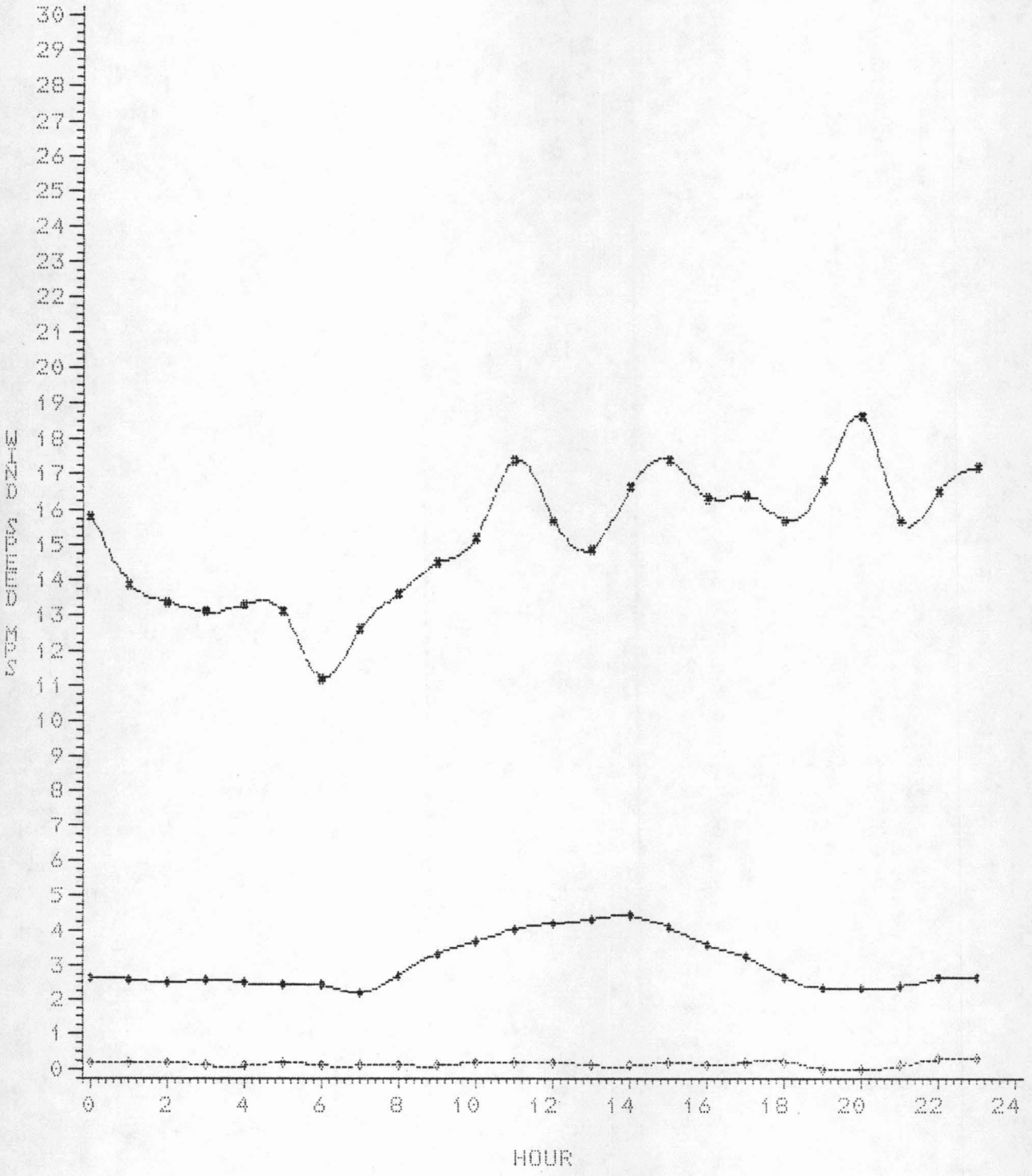
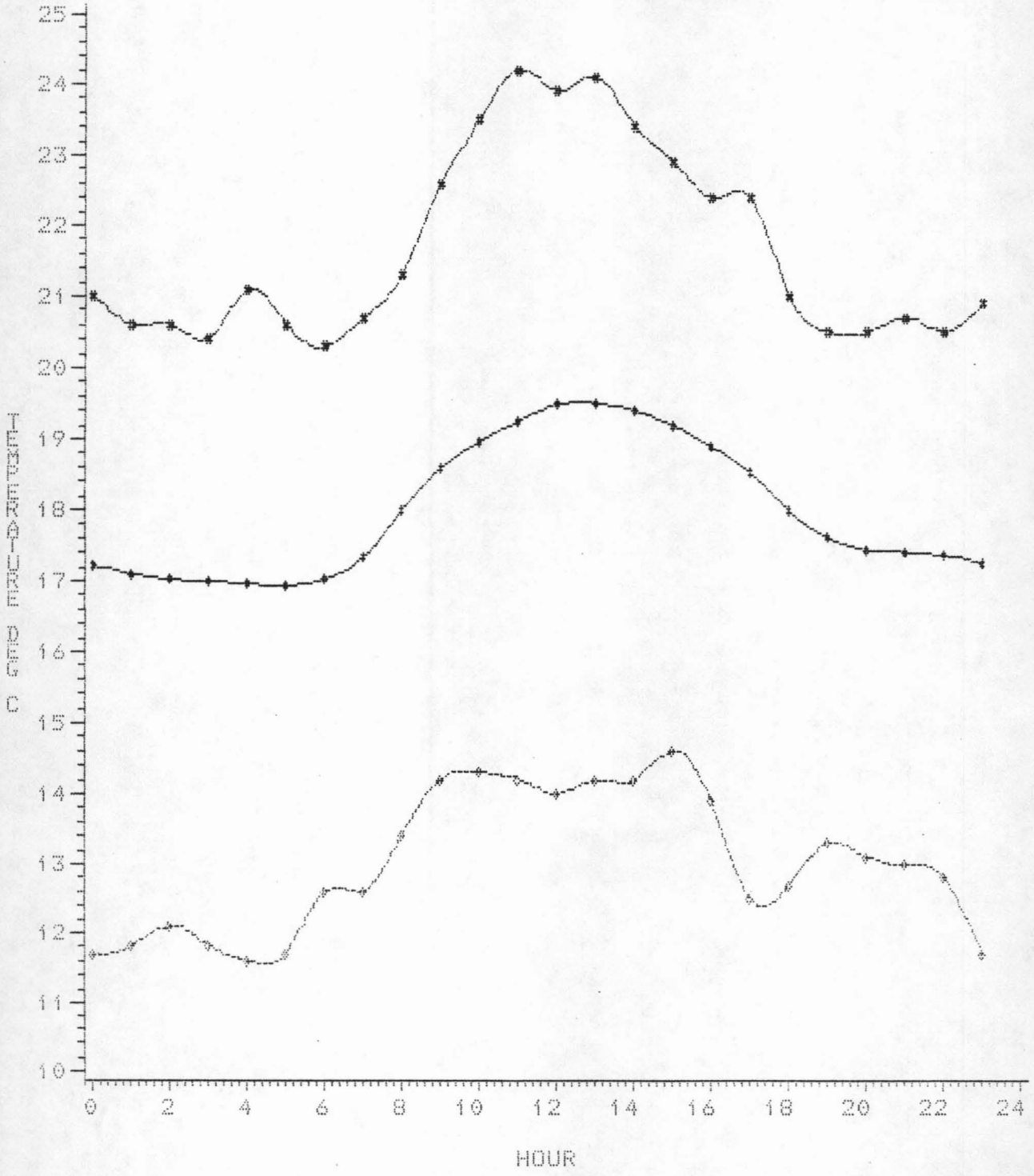


FIGURE 3-3

AIR QUALITY MONITORING PROGRAM
MAXIMUM, MINIMUM AND AVERAGE TEMPERATURE BY HOUR
SITE 241 - ULUPALAKUA AUGUST 1984 - AUGUST 1985



11/25/85