AD721860

BLANK PAGE

AFWTR-TR-67-1

BNWL-572 VOL 3
UC-53, Meteorology
Special Distribution

TECHNICAL REPORT

THE MOUNTAIN IRON DIFFUSION PROGRAM: PHASE II SOUTH VANDENBERG: VOLUME 3

By

H. G. Daubek, W. L. Dotson,
J. V. Ramsdell and P. W. Nickola

Atmospheric Analysis Section
Environmental and Life Sciences Department

September 1969

BATTELLE MEMORIAL INSTITUTE
PACIFIC NORTHWEST LABORATORIES
RICHLAND, WASHINGTON 99352

[redacted]

THE MOUNTAIN IRON DIFFUSION PROGRAM: PHASE II

H. G. Daubek, W. L. Dotson, J. V. Ramsdell and P. W. Nickola

ABSTRACT

A series of field diffusion experiments conducted at Vandenberg Air Force Base, California are discussed. These tests were designed to provide the necessary data from which an empirical equation, derived by multiple regression analysis, has been developed. This equation is to be used as a range safety tool in support of missile activities on the Air Force Western Test Range at the Sudden Ranch Launch Complex, SLC-6.

The field experiments utilized a fluorescent pigment, zinc sulfide, U. S. Radium Corporation designation No. 2210, as a tracer. Approximately 500 aspirated filters, located at 1.5 m above the ground, were installed along concentric arcs at 500, 800 and 1000 m from the source, and along roadways at greater downwind distances. These samplers provided measurements of the downwind time-integrated distribution of the tracer. These data were supplemented by: ground and aerial air concentration sampling; and, meteorological data from several sites.

The range safety equation that has been derived is:

$$X = 1.9 \times 10^3 \, (\chi/Q)^{-0.41} \, \sigma_\theta^{-0.42} \, \overline{U}^{-0.20} \, (\Delta T_6^{54} + 9)^{0.49}$$

where:

X	=	downwind travel distance, feet
χ/Q	=	normalized concentration, ppm/lb/min
σ_θ	=	standard deviation of source point wind direction, degrees
$\overline{U}$	=	mean wind speed, knots
ΔT_6^{54}	=	temperature difference between 6 and 54 ft, F°

Specific data are archived at the USAF Environmental Technical Applications Center. These data may be available to qualified persons by application to: USAF ETAC(OL-1)
Federal Building
Asheville, North Carolina 28801

CONTENTS

ABSTRACT iii

LIST OF FIGURES vii

INTRODUCTION 1

SUMMARY 3

CHAPTER 1. OPERATIONAL USE OF THE POINT ARGUELLO EQUATION 7

CHAPTER 2. SITE DESCRIPTION AND CLIMATOLOGY . . 13

The Site 13

Local Features 13

Climatology 16

Plume Types 16

CHAPTER 3. EXPERIMENTAL PROCEDURES . . . 19

The Sampling Grid 19

Meteorological Measurements 21

Problems Encountered 21

CHAPTER 4. TURBULENT DIFFUSION IN THE SUDDEN RANCH AREA 25

CHAPTER 5. EQUATION DEVELOPMENT 29

CHAPTER 6. AIRBORNE TRACER MONITORING . . . 37

QARTS Operation 37

Analysis of QARTS Data 42

Overwater Diffusion Equation 49

CHAPTER 7. TRAJECTORY STUDIES 63

CHAPTER 8. SHORT TERM CONCENTRATIONS AT GROUND LEVEL 67

Introduction 67

The Relationship between Time-Integrated and Real-Time Concentrations 67

Experimental Procedures 68

Data Presentation and Analysis 68

Operational Applications at Sudden Ranch . . . 81

ACKNOWLEDGEMENTS 84
REFERENCES 85
APPENDIX A. PLUME PATTERNS FOR MOUNTAIN IRON PHASE II A-1
APPENDIX B. BASIC DATA FROM MOUNTAIN IRON PHASE II . B-1
APPENDIX C. CLIMATOLOGICAL SUMMARY . . . C-1
APPENDIX D. TIME AND DATE OF PHASE II TESTS . . D-1
APPENDIX E. LIST OF ABBREVIATIONS AND TERMINOLOGY . E-1
DISTRIBUTION Distr-1

LIST OF FIGURES

1	Hazard Sector for Straight and Curved Trajectory	10
2	Area Map - Santa Barbara to Santa Maria Valley	14
3	Vicinity Map of South Vandenberg and Sudden Ranch	15
4	Diffusion Sampling Grid, Phase II	20
5	Meteorological Sensor Locations	22
6	A Plot of Phase II Data as E_p/Q_T Versus X, with Best Fit Equation $E_p/Q_T = 1.2 \times 10^2 X^{-2.4}$	32
7	Observed Versus Predicted Time-Integrated Air Concentrations	33
8	Correlation of Measured and Approximated σ_y at Hanford	45
9	Lateral Plume Dispersion as a Function of Distance from the 301 Generation Site	46
10	Decrease in Normalized Time-Integrated Air Concentration as a Function of Distance from the 301 Generation Site	47
11	MI-140 Plume Envelope	51
12	MI-141 Plume Envelope	52
13	MI-142 Plume Envelope	53
14	MI-168 Plume Envelope	54
15	MI-169 Plume Envelope	55
16	MI-171 Plume Envelope	56
17	MI-172 Plume Envelope	57
18	MI-176 Plume Intercepts	58
19	MI-177 Plume Intercepts	59
20	MI-244 Plume Envelope	60
21	MI-245 Plume Envelope	61
22	MI-249 Plume Envelope	62
23	MI-162 Trajectories and Isopleths	64
24	MI-202 Trajectories and Isopleths	65
25	Concentration Versus Time	71
26	Percent of Time 5-Sec-to-Centerline-Mean Concentration Ratio Equals or Exceeds the Indicated Ratio. (Curves are for locations well removed from plume centerline.)	75
27	Percent of Time 5-Sec-to-Centerline-Mean Concentration Ratio Equals or Exceeds the Indicated Ratio. (Curves are for locations near plume centerline.)	76
28	Peak-to-Centerline-Mean Concentration Versus Mean-to-Peak Averaging Interval	78

INTRODUCTION

The Mountain Iron research effort was divided into two separate phases. This document constitutes a report of the Phase II activities, the field studies on Sudden Ranch. It is intended that this report, Volume 3, be supplemental to the first two volumes to avoid redundant publication of material that is essentially identical. Therefore, this volume will contain reference notations to particular sections of the first two volumes in addition to other pertinent literature citations.

As in the preceding study, this research was conducted to develop an empirical diffusion equation that would provide a range safety analysis tool for assessment of the potential hazard area associated with non-routine missile operations. Tracer releases were made from a site very near the Sudden Ranch Launch Complex, SLC-6. Diffusion and meteorological data were collected over the land area by standard techniques. Aerial intercepts of tracer over the ocean were made by a specially equipped aircraft. These data were reduced and analyzed to provide input material for the empirical equations.

The experience gained in Phase I in development procedures for the range safety equation led to employment of the statistical best-fit technique exclusively. This statistical approach to the problem was supplemented with a descriptive narrative for three tests, MI-176, MI-177, and MI-191. These were selected to illustrate some of the complexities introduced to the analysis by meteorological anomalies in the Point Arguello area.

SUMMARY

One hundred and thirty-nine releases of zinc sulfide fluorescent pigment, U. S. Radium Corporation designation No. 2210, were made during the 11 month period, September 1966 to August 1967. The downwind time-integrated air samples of one hundred and fourteen tests provided sufficient detail of the crosswind distribution of the tracer to define a centerline value. The experiments were conducted between the hours of 6:10 a.m. and 10:20 p. m. There is a daytime bias in the experiments which is a reflection of the meteorological conditions at the release site. During the nighttime hours the surface wind flow is off shore approximately 60% of the time. It was not possible to conduct meaningful experiments under these atmospheric conditions because of the close proximity of the coast to the west of the generation site.

The experimental design employed during the Phase II study was a combination of the diffusion gathering techniques used in Phase I and Dry Gulch studies. The relatively flat terrain within 1000 m of the proposed launch site between azimuths of 090 to 200 degrees permitted construction of three concentric sampling arcs about the generation site. The west to east orientation of the coast along the southern border of the reservation and the mountainous terrain of Tranquillon Ridge* forced the remainder of the sampling sites to be placed along existing roads or jeep trails. The Sudden Coast Road was also equipped with samplers even though the general orientation of the road is not normal to expected tracer trajectories. The samplers located on this road did provide measurements of tracer plume reentry to the coast. Approximately 500 tracer collection sites were installed, and used, for this test series.

Meteorological support for the Phase II research program was provided by WIND System sensor sites on South Vandenberg, ten portable wind sensors, three radiosonde systems, and a wiresonde-borne temperature probe.

---

* A change in geographic terminology has been made in this volume. In Volume 1 and 2 the orographic feature south of Honda Canyon was referred to as "Honda Ridge." A check with U. S. Geological Service was made and the nomenclature changed to Tranquillon Ridge.

The recommended range safety equation predicts the dispersion of the gases from a cold, nonbuoyant continuous release at a ground level source at or near the Sudden Ranch Launch Complex, SLC-6. Specifically, this equation is intended to be functional for the Titan II oxidizer gases, and to predict a downwind distance beyond which a critical air concentration will not be exceeded. Statistical best-fit techniques were used in the equation development in the same manner employed in the Dry Gulch and Phase I research. Rigorous application of this technique to a statistically significant group of data produces an expression that minimizes the variance about the line described by the equation. The equation that has been derived is a power function that defines the relationship of downwind travel distance to χ/Q and the meteorological parameters σ_θ, $\bar{U}$ and ΔT. In recognition of the projected range safety application of this equation the least squares regression line has been further adjusted to assure that at the predicted downwind distance values of χ/Q would exceed predicted values less than 5% of the time.

The first equation is presented in the form in which it was derived. The second equation is a reformulation for range safety application.

$$(\chi/Q)_{NO_2} = 1.0 \times 10^8 \, X^{-2.4} \, \sigma_\theta^{-1.0} \, \bar{U}^{-0.48} \, (\Delta T_6^{54} + 9)^{1.2}$$

where

χ/Q = normalized concentration, ppm/lb/min

X = downwind travel distance, feet

σ_θ = standard deviation of source point wind direction, degrees

$\bar{U}$ = mean wind speed, knots

ΔT_6^{54} = temperature difference between 6 and 54 ft, F°

and

$$(X)_{NO_2} = 1.9 \times 10^3 \, (\chi/Q)_{NO_2}^{-0.41} \, \sigma_\theta^{-0.42} \, \bar{U}^{-0.20} \, (\Delta T_6^{54} + 9)^{0.49}$$

Using the conversion factors provided in Chapter 5, the statistical regression equation developed in this study may be applied to diffusion of any chemically stable gas of known molecular weight.

Sampling for the Phase II research was, in general, restricted to relatively close-in distances by the coastline features. Indiscriminate extrapolation of the equations to large downwind distances is discouraged. However, a fitting of the ground based sampler data to that obtained from the airborne sampler does provide a reasonable basis for use of the equation out to distances of about 6.2 statute miles.

Data obtained by aerial sampling were analyzed to provide averaged χ/Q values across the plume as a function of distance. The values found for sampling altitudes of 200 and 500 ft were essentially the same for a given downwind distance. This is attributed to mixing enhanced by flow over the terrain features of the coastline. The subsequent overwater travel was in a more stable atmospheric environment. Based upon these observations and analyses, it may be concluded that the vertical χ/Q distribution up to 500 MSL, is essentially uniform and that ground level concentrations would not exceed those values observed aloft.

BLANK PAGE

CHAPTER 1.

OPERATIONAL USE OF THE POINT ARGUELLO EQUATION

The recommended range safety equation for the assessment of the consequences of an NO_2 release is

$$\chi/Q = 1.0 \times 10^8 X^{-2.4} \sigma_\theta^{-1.0} \overline{U}^{-0.48} (\Delta T_6^{54} + 9)^{1.2} \tag{1}$$

or in terms of X

$$X = 1.9 \times 10^3 (\chi/Q)^{-0.41} \sigma_\theta^{-0.42} \overline{U}^{-0.20} (\Delta T_6^{54} + 9)^{0.49} \tag{2}$$

where

χ/Q	= normalized concentration, ppm/lb/min
χ	= air concentration, ppm
Q	= release rate, lb/min
X	= downwind travel distance, feet
σ_θ	= standard deviation of source point wind direction, degrees
$\overline{U}$	= mean wind speed, knots
ΔT_6^{54}	= temperature difference between 6 and 54 ft, F°

This equation predicts the downwind distance of a plume centerline beyond which a predetermined air concentration from a nonbuoyant and continuous ground based source would not be exceeded in more than 5% of all cases. A critical air concentration value, $\chi = 25$ ppm, has been set by range safety criteria for oxidizer vapors. The effective atmospheric dilution processes are represented in this equation by source point values of: standard deviation of the wind direction; mean wind speed; and temperature difference between 6 and 54 ft. The rate of pollutant release, pounds per minute, to the atmosphere is obtained from an empirical equation, $Q = 0.0242\ \overline{U}^{-0.8} A$, where A is specified as 10,000 ft^2 for wet soil and 3400 ft^2 for dry soil, and $\overline{U}$ is ft/sec.

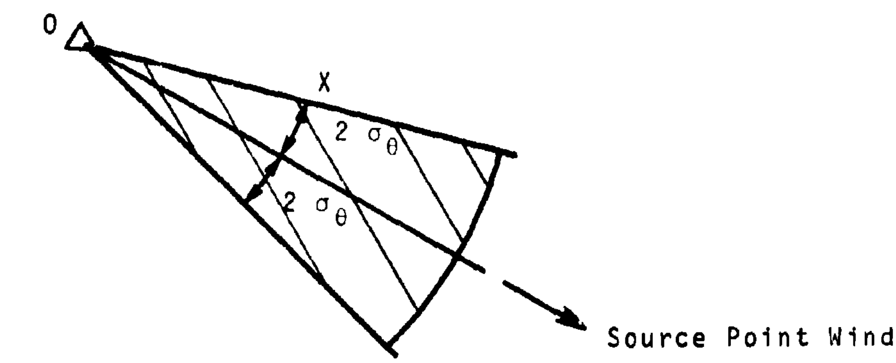
The crosswind spread of pollutant is a function of the lateral meander of the plume in response to the various scales of motion of the atmosphere. This lateral spread of a pollutant plume must be considered in designating a hazard zone. Atmospheric diffusion is a time related process. In the recommended range safety equation, the time required for the diffusion processes to reduce the concentrations at the source to a level designated as safe by a cognizant agency is inherent in "X".

An analysis of Sutton's diffusion equations for a continuous point source indicates that the area enclosed by an isopleth drawn through concentrations of equal value will be "cigar shaped", with the major axis along the direction of the mean wind, and that the maximum crosswind dimension of the isopleth occurs about halfway between the source and the end of the plume.[1] The length of the major axis of an isopleth is a function of source strength and the meteorological parameters in the equation. The ratio of cloud width to cloud length is directly related to the variability of wind direction and varies inversely with respect to atmospheric stability. Stability is the dominant factor over the ranges of downwind distances being considered with decreasing stability resulting in an increase in the width-to-length ratio. Sutton's theoretical works indicate that the width for unstable conditions would be about one-third the length; for neutral conditions, about one-fifth the length; and about one-eighth the length for stable conditions. The atmospheric stability classifications referenced here may be defined: unstable, $\Delta T_6^{54} < -0.5$ F°; neutral, -0.5 F° $< \Delta T_6^{54} > 0.5$ F°; stable, $\Delta T_6^{54} > 0.5$ F°. The width of the plume may be estimated by this technique if the downwind extent of a critical concentration and the atmospheric stability are known, providing that the plume is unimodal and the centerline trajectory is straight. If the plume is curved, the hazard sector will be considerably greater than that indicated by the simple width-to-length ratio considerations. A curved time-mean plume resulting from a change in the wind direction down wind from the source must be associated with a larger hazard sector. A multimodal plume resulting from a shifting mean wind direction during the period of release must also be associated with a larger hazard sector.

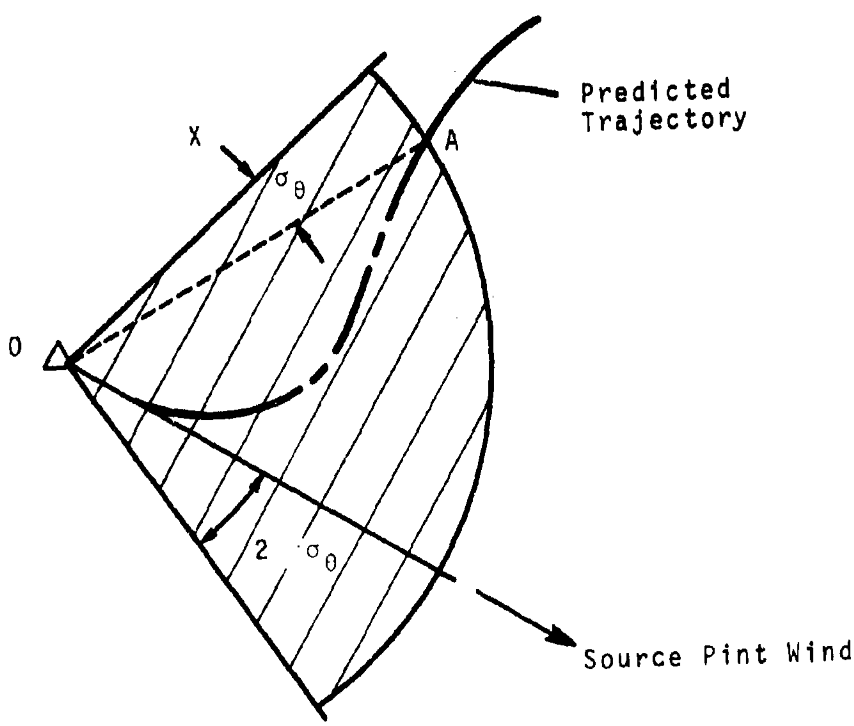
The specification of a hazard sector prior to the release of a pollutant will necessarily be based on forecast winds. The accuracy of the predicted sector is a function of a number of variables such as the length of the forecast period, the meteorological regime prevalent during the forecast period, and many other factors not directly related to measurable meteorological parameters. If a wind direction forecast can be made that will include the spatial and temporal variations that could affect the plume then a hazard sector may be specified.

One method establishing the boundaries of a hazard sector that can be used in cases where a curved plume trajectory is anticipated is presented below. A forecast of the spatial and temporal variations of the wind field in the area surrounding the source must be made and used to predict the probable plume trajectory. The range safety equation will provide the downwind distance that the plume must travel for dilution to a concentration determined to be safe by the range safety officer. This distance is measured radially from the source point and an arc with this radius defines the end of the hazard sector. The lateral extent of the sector is defined by rays with azimuths $2\,\sigma_\theta$ on either side of the mean wind direction. Figure 1a shows a hazard sector defined in this manner. If the forecast trajectory is curved the initial hazard sector estimate must be modified as follows: Determine the two rays defined by $2\,\sigma_\theta$ as before. Then determine two additional rays, one σ_θ on either side of an azimuth defined by the intersection of the plume trajectory and the arc defining the end of the sector. The hazard sector is then completely defined as the sector, containing the plume, between the 2 rays with maximum angular separation. This is shown in Figure 1b where point A is the intersection of the predicted trajectory and the arc with a radius X.

One of the least desirable conditions for injection of toxic gases into the atmosphere is a meteorological regime producing winds of less than three knots. In fact, the equation is not valid for calm winds. This mathematical impasse may be avoided by allowing $\overline{U}$ to approach, but never attain, zero in computer computations. From a range safety view, however, it is very important to recognize that when the winds are less than three knots, two corollary points must be considered. First is that the wind direction is extremely variable and almost unpredictable.



(1a) Straight



(1b) Curved

FIGURE 1. Hazard Sector for Straight and Curved Trajectory

Second, a large amorphous volume of pollutant gases will collect in the immediate area of the spill and the atmospheric diffusion processes will be relatively ineffective. When the wind speed does increase, this ill-defined volume of pollutant gas will move in accordance with the directional component of the freshening wind. A very difficult safety situation may be encountered.

It is recommended that the initial hazard area for light winds, less than three knots, be considered as circular. The dimensions of this area should be large enough to enclose all concentrations greater than the critical value. These dimensions may be determined by using predicted meteorological values. There is yet to be solved the problem of predicting meteorological values at the end of the light wind condition. This can be solved only by exercise of judgment on the part of the responsible official.

The recommended range safety equation is an empirically derived expression relating the diffusive properties of the atmosphere to readily observable meteorological variables. This equation has been derived by multiple regression techniques from data gathered during the on-site experimental series. These factors establish limitations to its use. It may be used with confidence for source points located on Sudden Ranch near the Sudden Ranch Launch Complex, SLC-6, when the plume trajectory remains overland for a distance from the source equal to the distance predicted by the range safety equation. When a significant portion of the predicted plume trajectory is overwater, the inhibited diffusion processes encountered are likely to result in an under-prediction of the distance at which air concentrations would be at or below the established range safety criteria. In the case in which 50% or more of the plume travel is forecast to be over water, it is recommended that the overwater equation discussed in Chapter 6 be used. The source of pollutant gas must be at ground level and the effluent must be essentially nonbuoyant. The source emission period should be within the range of 10 to 60 minutes. The downwind travel distance predictions should not be extended beyond 6.2 miles (10,000 m).

It is intended that the range safety equation be programmed for use in a relatively small general purpose computer. Meteorological measurements from WIND System Site 301 will provide the basis for derivation of values for the right hand member of the equation. Supplementary data from outlying locations, in the form of wind speed and direction, will provide a basis for estimating flow patterns for pollutant material. These will provide a predictive capability for nonroutine situations.

Use of the range safety equations from both Phase I and II studies is not recommended whenever the measured values of the meteorological parameters are outside the following intervals.

- Sigma Theta: $2° \leq \sigma_\theta \leq 45°$
- Delta T: $-8 °F \leq \Delta T \leq +1 °F$
- Wind Speed: 3 knots $\leq \bar{U} \leq$ [illegible]0 knots

Use of the range safety equation during meteorological conditions outside the recommended limitations will result in the degradation of the 95% confidence limit.

CHAPTER 2.
SITE DESCRIPTION AND CLIMATOLOGY

THE SITE

At Point Arguello, the California coast begins changing direction from north-south to east-west (Figure 2). The change is completed 22,000 meters (approximately 14 miles) to the southeast at Point Conception. Mountain ranges in this geographic section are aligned primarily east-west, branching off at nearly 45° to the coast ranges to the north.

The South Vandenberg and Sudden Ranch area may generally be described as rough. The Santa Ynez Mountains start at Point Arguello and follow the coast for some 60 miles to the east of Point Conception. The range is sharply and maturely dissected but has a fairly even crest elevation of 3000 to 4000 ft except in the western portion which is characterized by 1500 ft ridges and 2000 ft peaks.(2) Along the southern base of the mountains is a narrow marine terrace. The terrace varies in width from a few hundred feet to several miles, and in elevation from sea level to several hundred feet (MSL). Cliffs rise from a narrow beach or directly from the ocean to the marine terrace. The southern slopes of this range are steep. In contrast, the Northern slopes gradually decrease to near sea level in the Santa Ynez River Valley.

LOCAL FEATURES

Honda Canyon, 700 to 800 ft deep and generally less than 1-1/2 miles wide, and the ridges adjacent to it are the topographic features having the most influence on diffusion over South Vandenberg and Sudden Ranch (Figure 3). The canyon and ridges create wind shears that change the speed and direction of plume movement. Tranquillon Ridge, culminating in Tranquillon Peak which is the high point of terrain in the South Vandenberg and Sudden Ranch area, is a line across the normal wind flow which produces anomalous wind patterns in its lee.(3) The vegetation is as described previously.(4b) Both farming and grazing take place on the marine terrace south of Tranquillon Ridge (Sudden Ranch).

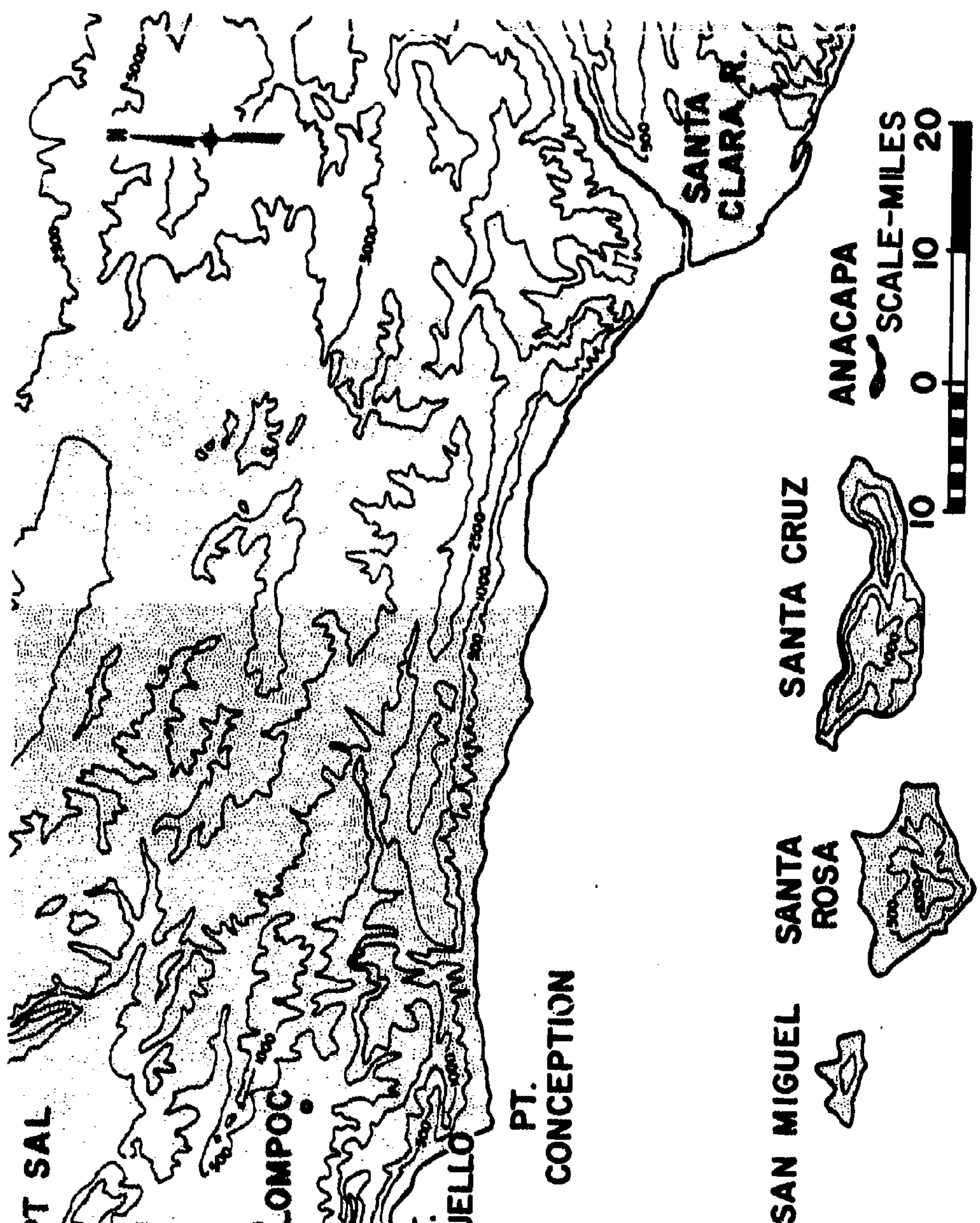


FIGURE 2. Area Map - Santa Barbara to Santa Maria Valley

FIGURE 3. Vicinity Map of South Vandenberg and Sudden Ranch

CLIMATOLOGY

Wind velocity is the most readily observed climatic variation between the 301 source point and VIP-1, Mountain Iron Phase I, Source A. The wind has a more northerly direction and a higher speed at Site 301.[3, 4b] It is felt that the change in wind direction is created by air flow deflected around Tranquillon Ridge or, on a larger scale, around the Santa Ynez Mountains.[5]

A climatological summary of wind observations on Sudden Ranch is included in Appendix C.

PLUME TYPES

Basic plume shapes for the Vandenberg Air Force Base area are discussed in Mountain Iron Phase I,[4b] and Ocean Breeze and Dry Gulch[6] documents which compare some of the plume types deviating from the basic "cigar shape" discussed by Sutton.[1] Mountain Iron Phase I, Volume 1,[4a] labeled typical plume types according to the terrain effect. A grouping can also be made for Mountain Iron Phase II, with descriptive group titles according to plume travel. In general, these titles are south of Tranquillon Ridge, over Tranquillon Ridge, and the hook. These plume patterns may be observed in Appendix A.

The plume types occurring most frequently are those that remain south of Tranquillon Ridge. The plumes that went directly to sea with no further data are characterized by Mountain Iron Tests 180, 181, and 194. The simple cigar shape is a close approximation to the measured data.

The wind structure along the coastline south of Tranquillon Ridge is complex. Plumes were often observed to travel over the sea and return to the shore near Jalama Beach. The plumes that went to sea and were observed to return to Jalama Beach occurred during periods of northerly flow at the source and onshore flow at Jalama Beach (MI-153). When the source winds have a more westerly direction, pollutant plumes are even more affected by the localized onshore wind field and rough terrain on the south side of Tranquillon Ridge. It is hypothesized that this plume type is caused by a helix lying along the south side of Tranquillon Ridge, drawing the plume onshore and spreading it over the entire area south of Tranquillon Ridge (MI 246).

Phase I, Volume 1[4a] discusses the plume type that goes "over Tranquillon Ridge" to the north. A plume type identical to the "canyon low" discussed in Mountain Iron Phase I is "over Tranquillon Ridge." Such a type is characterized by MI Tests 147, 162 and 174.

A curved plume called a "hook" occurs when there is a strong wind shear created by a shallow sea breeze north of Tranquillon Ridge and extending south over Point Arguello while southerly winds exist south of and over Tranquillon Ridge. The plume travels toward the Boathouse and is caught in the wind shears near Cypress Ridge and then turns and passes over Tranquillon Ridge, e.g., MI-174 and 203.

BLANK PAGE

CHAPTER 3.
EXPERIMENTAL PROCEDURES

The basic techniques for the generation of fluorescent pigment zinc sulfide (U. S. Radium Corporation designation No. 2210) and sample assay were not changed significantly for the Phase II study. A complete description of the techniques may be found on pages 15 to 21 of Volume 2 of the Mountain Iron series.[4b]

THE SAMPLING GRID

The decrease of air concentration with increasing downwind distance generally may be expected to follow a power law. As a result, diffusion grids are usually designed as concentric arcs about the source point with logarithmic spacing of the arcs along the radii. In the Phase I study, the terrain features of the experimental area precluded use of this type of sampler array. The Phase II study area was significantly different, within the first 1000 meters to the south and east. The terrain permitted the installation of a logarithmic-spaced concentric-arc sampler array. The 500, 800 and 1000 m sampling lines were very nearly true arcs. At approximately 2000 m, the roughness of the terrain became more pronounced, and it was necessary to vary the sampling arc radius between 2000 and 2200 m. Beyond 2200 m, it was necessary to use whatever roadways or jeep trails were available (Figure 4). A significant departure from the classical grid system was made in placing samplers along the coast road. This was done to provide a capability for the determination of parameters of plumes that had curved overwater trajectories and then had an intersection with the shoreline. Unfortunately, it was not possible to extend this sampling line far enough along the coast to fully define most reentering plumes. As a consequence, centerline concentrations for use in statistical evaluations and crosswind distribution (σ_y) were not determined for plumes of this type beyond Arc 04.

Sampler spacing was established in three separate modes. The three concentric arc sections adjacent to the source point contained samplers at two-degree increments. Arc 04 had a 200 ft separation between samplers. The other road network samplers were deployed by using

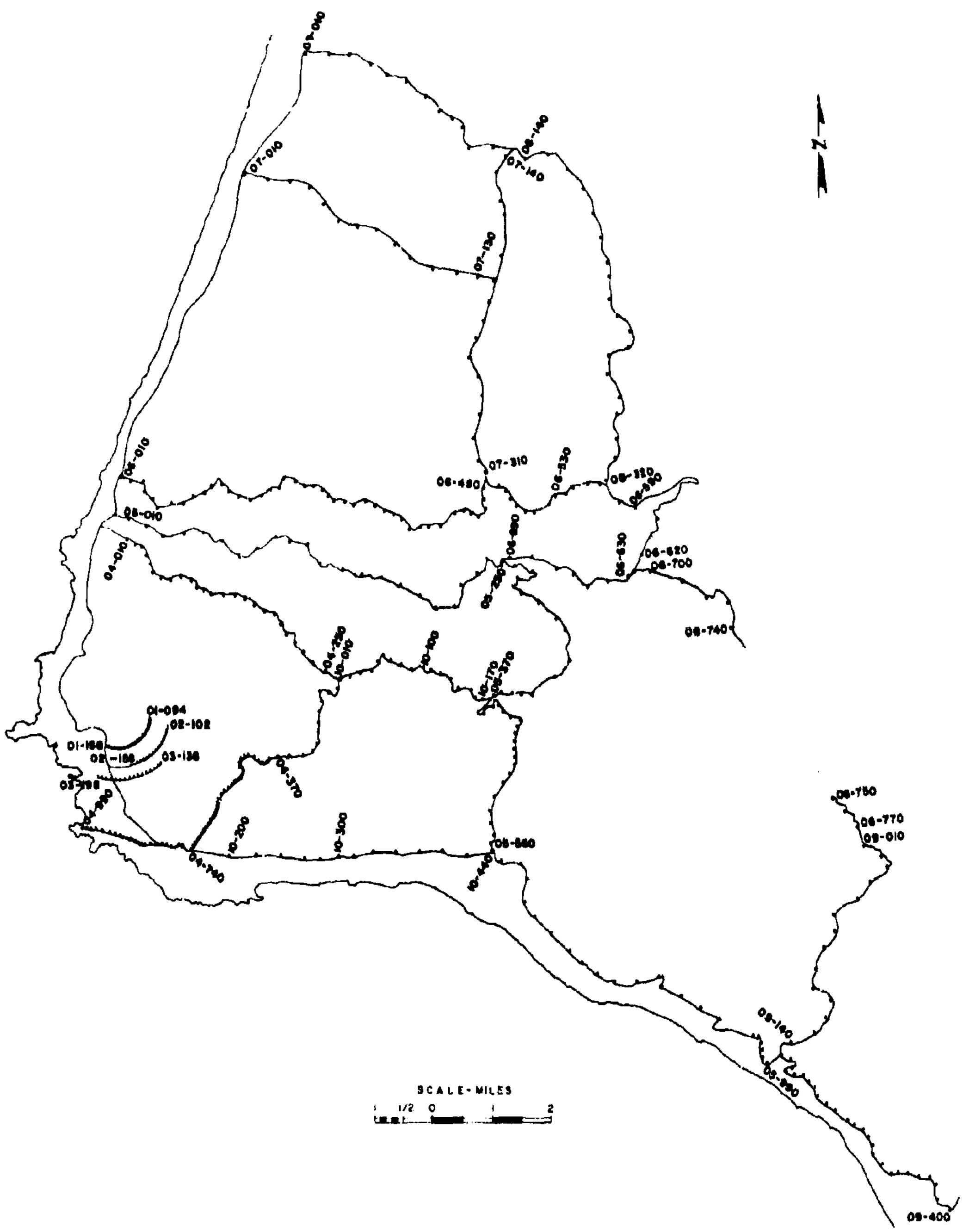


FIGURE 4. Diffusion Sampling Grid, Phase II

elapsed road mileage for spacing. The distance between samplers varied as a function of distance from the source point. There were three spacing increments employed: one-tenth, two-tenths, and four-tenths miles.

For most of the tests in this series, downwind sampling was limited to approximately 2000 m. The net effect of this was to significantly limit the number of data points available at longer distances for statistical analysis. Since the equation derivation techniques employed are statistical in nature, a good data base is necessary to successfully produce a significant result. It has been possible to acquire plume data over the water and outside the ground sampler limits by means of an airborne real time sampler. However, ground-level air concentration values may only be inferred from these samples. Full utilization of all data has been employed to produce the range safety equation recommended in this volume.

METEOROLOGICAL MEASUREMENTS

Diffusion sampling was supplemented by meteorological measurements in the Sudden Ranch-South Vandenberg area. The measurement of surface winds was accomplished by both the WIND System and strip chart recording sensors at the locations indicated in Figure 5. Vertical soundings were taken by wiresonde at the source point and by radiosonde at the Boathouse, Jalama Beach and Honda Canyon at WIND Site 013. Surface weather observations were taken at the source point during test operations.

PROBLEMS ENCOUNTERED

The Phase II research encountered most of the problems that were present in Phase I. In addition, the geographic features of the Phase II site and prevailing meteorological regime combined to create a significant new problem. The zinc-sulfide tracer was carried off shore during a majority of the experimental runs by the prevailing northwesterly winds. It was not possible to acquire ground level air sampler data for the tracer plume during overwater travel. There is some experimental

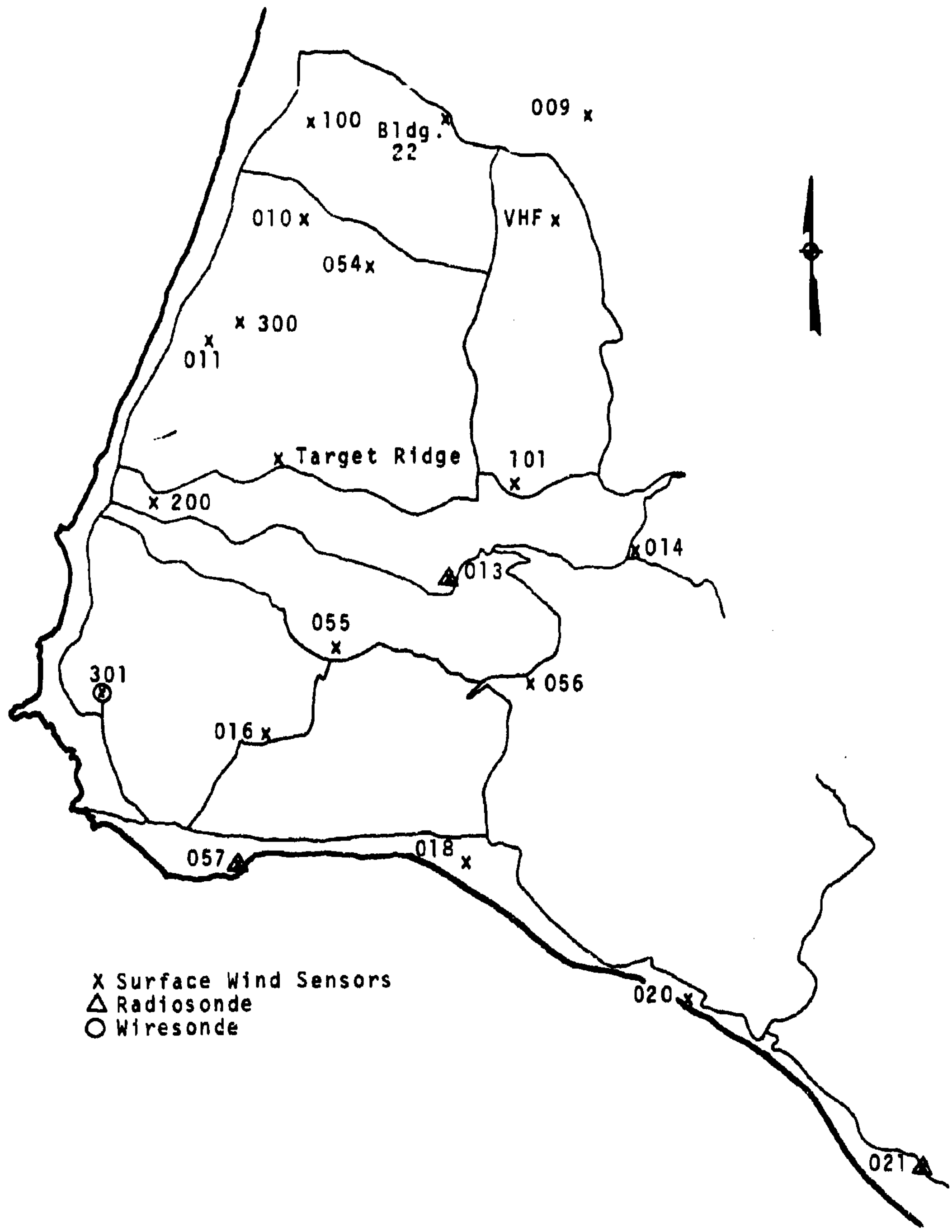


FIGURE 5. Meteorological Sensor Locations

evidence that indicates that plumes curved and intersected the coast downwind. However, full investigation of this phenomena was not possible because the ground air sampling arc could not be extended beyond the limits of the property under Air Force control.

BLANK PAGE

CHAPTER 4.
TURBULENT DIFFUSION IN THE SUDDEN RANCH AREA

The discussion of turbulent diffusion in Volume 2 of the Mountain Iron series[4b] is a concise review of pertinent knowledge of turbulent diffusion processes for overland trajectories.

It has been mentioned earlier that the meteorological conditions at the Sudden Ranch site were, in certain cases, quite different than any of the other locations on Vandenberg Air Force Base.

Figure 3 (Chapter 2) depicts the physical characteristics of the test area. These physical features combine, under a synoptic regime characterized by northwest winds, to produce anomalous local circulations and turbulent diffusion conditions. A study of this figure will point up such significant features as the almost 90° directional change in the orientation of the coastline. A second feature of importance is Tranquillon Ridge, an obstruction to either north or south flow, which acts as a deflector to air flow from the western quadrant. In the cases of north or south flow, this barrier can create anomalous local circulations with many complex flow patterns.

During periods when northerly winds are present in the area, a large eddy is frequently observed in the area south of Tranquillon Ridge. No specific boundary conditions or flow characteristics may be set for this phenomena because of the lack of good observational data. The complex flow patterns downwind of the source point cannot be inferred from source point measurements.

During synoptic periods characterized by westerly winds, convergent/divergent flow patterns are frequently observed. These patterns may carry pollutant material out to sea and then back over the land surface at some point east and south along the coastline. This phenomenon could create an unusually high concentration of vapor which would not ordinarily be forecast.

Forecasting the occurrence, extent and geometry of the flow patterns is a difficult task. It is often possible, however, to make at least a subjective analysis of the characteristics of the flow by aerial reconnaissance. During periods when the lower atmosphere is characterized by a strong subsidence inversion, curved patterns may be observed in the stratus off shore. Frequently, the eddy flow will be shown by a clear sector whose seaward boundaries are sharp and curved. In the absence of clouds that might serve as indicators, it may be possible to observe air flow over the water by noting the streaked appearance of the water surface. Of course, fixed sensor stations located off shore and automatically reporting to a central location are far more desirable. In any event, it is emphasized that a strict dependence on source point wind direction for projection of the downwind extent of a plume is not advisable under these conditions.

The cliff-like structure of the shoreline imparts another significant feature to the diffusion problem. This is akin to the conditions imposed by flow over ridges, plus the high probability that microscale wind patterns may exist in the immediate lee. The complexity of such a flow regime would require that a special study be undertaken for confirmation and definition. Another consequence of the abrupt transition in the roughness character is to change the effective diffusion mechanisms. It is expected that the local turbulence field would vary in response to the variation in the speed and directional components of the wind field. Pasquill[7] notes that no general formulation is available that accounts for the variability in the turbulence field as a consequence of local changes in roughness character of the surface. In the case of Sudden Ranch, the difficulties inherent in implementing an experimental design to define the characteristics of the changing turbulence field would involve a great many measurements both on and off shore. One significant factor may be gleaned from the general formulations. The lateral dimensions of the plume may be expected to increase after passage over an orographic feature such as the Sudden Ranch shoreline when the wind speeds are at least moderate and approximately normal to the shore. It was not possible to demonstrate this increase in plume dimension from ground observations. However, aircraft observations indicated that the lateral dimensions are larger than would be expected if the plume isopleths were extrapolated out to the point where these data were acquired. Consequently, a corresponding marked decrease in air concentrations through the plume would be expected after passage through this transitional zone. Downwind from this region, the trajectories would be generally over water. It has been shown by other investigators[8, 9] that the diffusive properties of the atmosphere would be inhibited. This has been confirmed by the aircraft observations. Chapter 6 on aerial sampling will cover this facet in more detail.

BLANK PAGE

CHAPTER 5.
EQUATION DEVELOPMENT

Following from the diffusion modeling experiences of Mountain Iron Phase I, only the statistical approach was used to develop the recommended diffusion equation. In general, the statistical technique used is a multiple regression analysis with the time-integrated plume centerline concentration normalized for source strength as the dependent variable. The independent variables are then selected by physical reasoning from among the measured meteorological and physical variables. The specific technique used to derive the recommended prediction equation was suggested for the Ocean Breeze and Dry Gulch diffusion studies[6] and has since been used in Mountain Iron Phase I.

The dependent variable, normalized centerline concentration, may be expressed as either: χ/Q where χ is the concentration and Q is the source release rate, or E_p/Q_T where E_p is the time-integrated concentration and Q_T is the total amount of material released. The two forms of expressing the normalized centerline concentration are considered to be interchangeable.

The independent variables found to have a significant effect on the χ/Q were:

- X, the radial distance from the source
- $\overline{U}$, the mean wind speed
- σ_θ, the standard deviation of the horizontal wind direction fluctuations
- ΔT, the vertical temperature difference.

Each of these variables can be related directly to the normalized centerline concentration of a diffusing plume. The three meteorological variables were evaluated from measurements taken at the source during the period of generation (30 min). The standard deviation of wind direction was determined for the departure of the 10-sec average directions from the 30 min mean direction. The wind sensor was located at a height of 12 ft, while temperatures were measured at 6, 54, and 300 ft.

The mean wind speed is an indicator of the initial dilution of material, emitted at a constant rate, as it leaves the source: the higher the wind speed, the lower the normalized concentration that would be expected at any point downwind.

The wind direction fluctuations are a primary means of spreading the plume in the horizontal. Thus, it is to be expected that the normalized concentration is inversely proportional to the magnitude of the direction fluctuation.

The vertical temperature difference is a measure of atmospheric stability. A positive ΔT corresponds to a stable atmosphere and should be related to inhibited vertical diffusion. In other words, χ/Q should be directly proportional to ΔT.

During plume travel from the source the horizontal and vertical diffusion processes continue to decrease the concentrations within the plume. Therefore, distance is directly related to the total amount of dilution in the plume, and χ/Q is inversely proportional to the distance from the source.

Thus, the independent variables used in the statistical analysis physically represent the initial dilution, the horizontal and vertical dilution rates and the distance over which the dilution rates are applied to a plume. It is, therefore, not surprising that the same variables were used in the prediction equations developed during Mountain Iron Phase I[4] or that all the variables but wind speed were found to be significant in the Ocean Breeze and Dry Gulch Diffusion Programs.[6]

The form of the equation selected for the regression analysis is

$$E_p/Q_T = k\,X^a\,\sigma_\theta^{\,b}\,\overline{U}^c\,\Delta T^d \tag{3}$$

in which parameters k, a, b, c and d are determined statistically to minimize the variance of data about the regression line. As the statistical procedures require taking the logarithms of the variables, a constant was added to the ΔT value to simplify computations.

The following sequence of equations shows the significance of the variables in arriving at the final best-fit equation. An initial equation was derived assuming E_p/Q_T to be a function of downwind distance, as was done in Mountain Iron Phase I. The resulting equation is

$$E_p/Q_T = 1.2 \times 10^2\ X^{-2.4} \tag{4}$$

which predicts E_p/Q_T within a factor of two of the observed value in 62% of the cases observed, and within a factor of four in 92% of the cases. Figure 6 shows the distribution of observed E_p/Q_T versus X, and a plot of Equation (4). The addition of the diffusion rate variables, σ_θ and $(\Delta T_6^{54} + 5)$ as independent variables resulted in the improved predictive equation, Equation (5)

$$E_p/Q_T = 84\ X^{-2.4} \sigma_\theta^{-0.64}\ (\Delta T_6^{54} + 5)^{1.3} \tag{5}$$

($\Delta T_6^{54} = T^{54} - T^6$ where the superscripts on the temperature refer to the height of measurement.) Equation (5) predicted E_p/Q_T within a factor of two in 70% of the cases, and within a factor of four in 94%. The temperature difference between 6 and 300 ft (ΔT_6^{300}) was also used as an independent variable, however, it did not produce as good a statistical fit of the data as did ΔT_6^{54}.

Addition of the final independent variable, wind speed, led to the following equation:

$$E_p/Q_T = 7.8 \times 10^2\ X^{-2.4}\ \sigma_\theta^{-1.0}\ \overline{U}^{-0.48}\ (\Delta T_6^{54} + 5)^{1.2} \tag{6}$$

where

E_p = centerline, time-integrated concentration, g-sec/m^3
Q_T = source strength, grams
X = downwind travel distance, meters
$\overline{U}$ = mean wind speed, knots
σ_θ = standard deviation of source point wind direction, degrees
ΔT_6^{54} = temperature difference between 6 and 54 ft, C°.

Equation (6) predicts the normalized centerline concentration within a factor of two of observed value 69% of the time and within a factor of four, 95% of the time. Figure 7 shows the observed versus the predicted time integrated air concentrations.

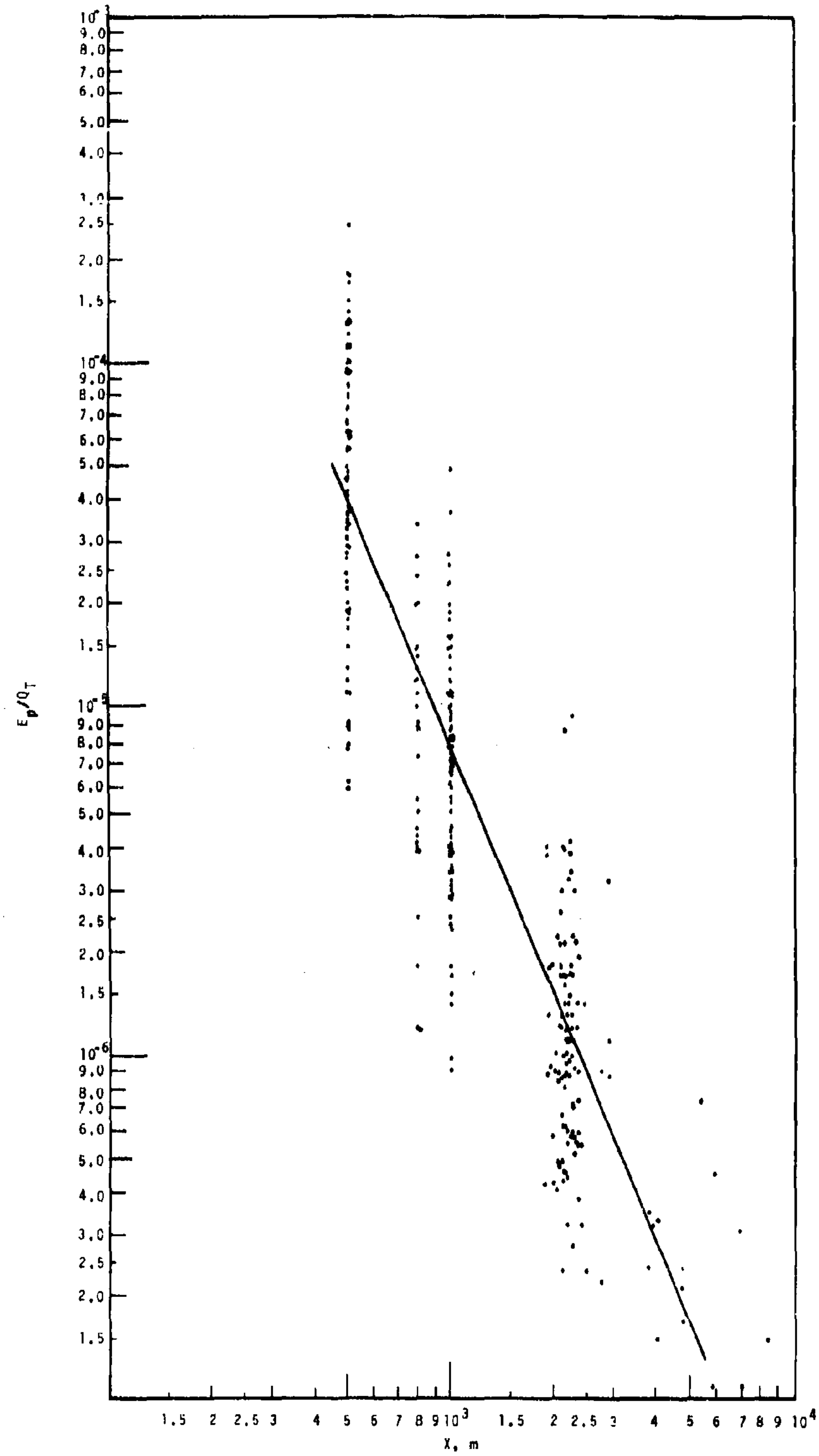


FIGURE 6. A Plot of Phase II Data as E_p/Q_T Versus X, with Best Fit Equation $E_p/Q_T = 1.2 \times 10^2 X^{-2.4}$

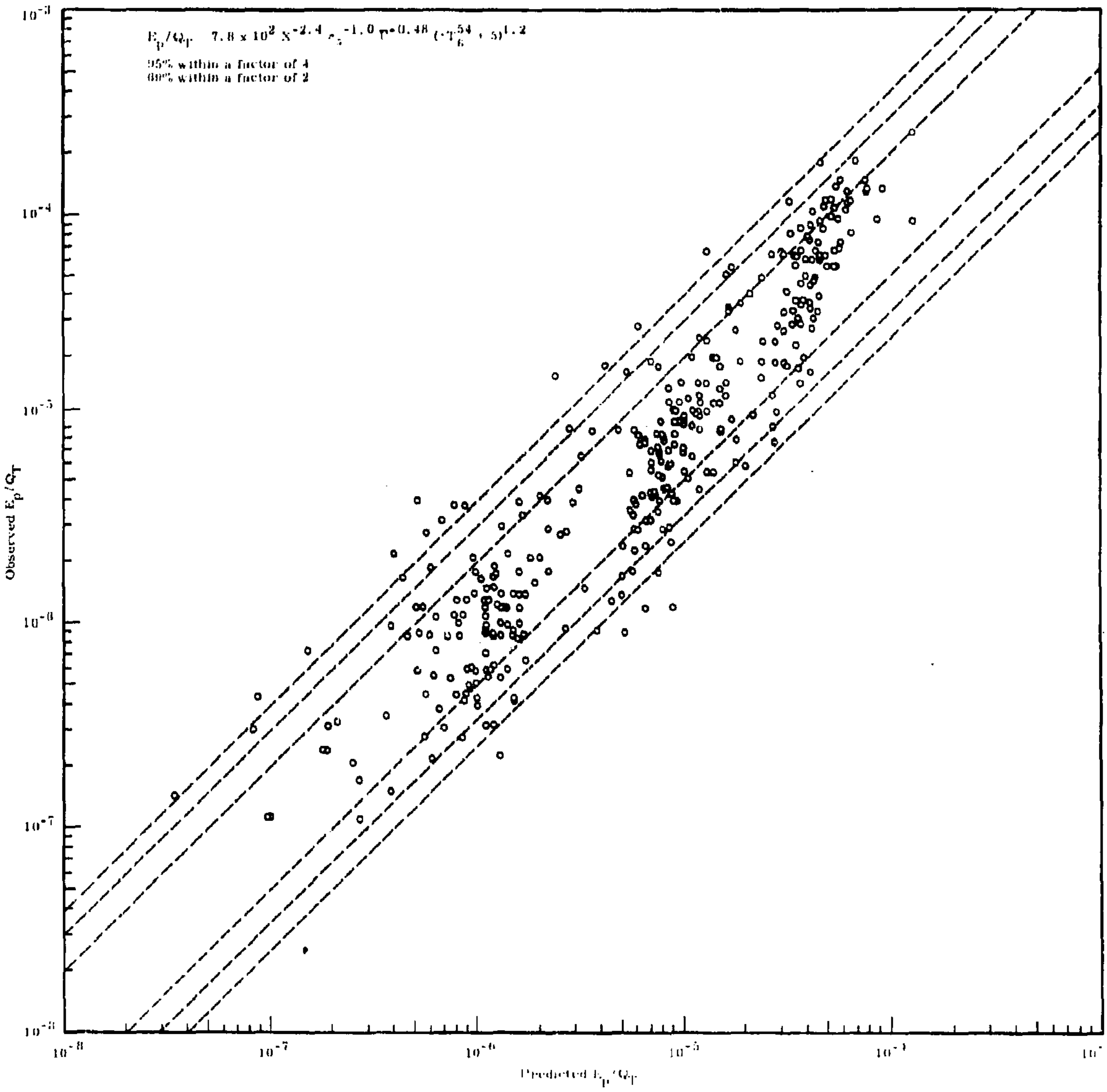


FIGURE 7. Observed Versus Predicted Time-Integrated Air Concentrations

In an attempt to improve the predictive ability of Equation (6), the data were arbitrarily grouped by diffusion rates. Initially, the horizontal diffusion rate variable, σ_θ, was used and the tests were divided at an apparent break in the σ_θ distribution. Tests having σ_θ less than 13° were placed in one group and tests with σ_θ greater than or equal to 13° in another. Each of the data groupings were again arbitrarily subdivided into two groups on the basis of ΔT_6^{54}. The dividing line was ΔT_6^{54} = -1.3 C°; those tests with $\Delta T_6^{54} \leq -1.3$ C° (e.g., -1.4, -1.5, -2.3, etc.) were combined in one group and those with $\Delta T_6^{54} > -1.3$ C° (e.g., -1.2, -0.5, + 1.3, etc) in another. The parameter values for the various data groupings are given in Table 1.

Some improvement in prediction results from using a different equation within each data group. Two or more equations are not recommended, because of the loss of simplicity and the increased uncertainty due to less data within each data group.

The Point Arguello diffusion equation is derived from Equation (6). To change the units of the variables in the equation to engineering units familiar to the range safety officer, the following conversions are necessary:

X in meters is replaced by 0.305 X, where X is now in feet
(ΔT_6^{54} + 5) in Celsius degrees is replaced by 0.55 (ΔT_6^{54} + 9), now in Fahrenheit degrees

with these conversions, Equation (6) becomes

$$E_p/Q_T = 7.0 \times 10^3 X^{-2.4} \sigma_\theta^{-1.0} \bar{U}^{-0.48} (\Delta T_6^{54} + 9)^{1.2} \qquad (7)$$

where X is in feet and ΔT is in Fahrenheit degrees. The conversion of E_p/Q_T from g-sec/m^3/g to ppm/lb/min released for diffusing gases is a function of the molecular weight of the gas. At standard temperature and pressure, 1 ppm/lb/min for a gas is equal to 5.89×10^{-6} g-sec/m^3/g times the gram-molecular weight of the gas. Or, 1 g-sec/m^3/g of the gas is equal to 1.70×10^5 divided by the gram-molecular weight. To convert the E_p/Q_T from Equation (7) into χ/Q for NO_2, the conversion factor is 3.69×10^3. Thus, Equation (7) becomes

$$(\chi/Q)_{NO_2} = 2.6 \times 10^7 X^{-2.4} \sigma_\theta^{-1.0} \bar{U}^{-0.48} (\Delta T_6^{54} + 9)^{1.2} \quad (8)$$

where χ is in ppm of NO_2 and Q is the generation rate of NO_2 in lb/min. The final manipulation of the equation is to convert it from a best fit equation to one that will predict χ/Q values which are exceeded less than 5% of the time. Equation (6) predicted 95% of the observed values of E_p/Q_T within a factor of four, thus multiplication of Equation (8) by four gives the desired result. The final equation is:

$$\chi/Q = 1.0 \times 10^8 X^{-2.4} \sigma_\theta^{-1.0} \bar{U}^{-0.48} (\Delta T_6^{54} + 9)^{1.2} \quad (9)$$

or rearranging to solve for the distance to a predetermined concentration from a source with known emission rate.

$$X = 1.9 \times 10^3 (\chi/Q)^{-0.41} \sigma_\theta^{-0.42} \bar{U}^{-0.20} (\Delta T_6^{54} + 9)^{0.49} \quad (10)$$

It will be noted that Equations (9) and (10) are identical to Equations (1) and (2) in Chapter 1.

TABLE 1. Parameter Values for Regression Equation

$$(E_p/Q_T) = k\, X^a \sigma_\theta^b \bar{U}^c (\Delta T_6^{54} + 5)^d$$

Data Grouping		Data Points in Group: Number	Data Points in Group: Percent of Total	Parameter Values: k	a	b	c	d	Percent Data Within a Factor of: 2	4
All data		349	100	7.8×10^2	-2.4	-1.0	-0.48	+1.2	60	95
$\sigma_\theta < 13°$		278	80	2.1×10^4	-2.7	-1.5	-0.55	+0.78	80	97
$\sigma_\theta \geq 13°$		71	20	8.5×10^{-1}	-1.8	-0.56	-0.12	+1.5	62	97
$\sigma_\theta < 13°$	$\Delta T_6^{54} \leq -1.3$ C°	178	51	3.4×10^4	-2.6	-1.3	-0.41	-0.62	78	99
$\sigma_\theta < 13°$	$\Delta T_6^{54} > -1.3$ C°	100	29	4.2×10^2	-2.7	-1.2	-0.49	+3.2	79	98
$\sigma_\theta \geq 13°$	$\Delta T_6^{54} \leq -1.3$ C°	47	13	1.0×10^{-3}	-1.3	+1.5	-0.36	-1.7	83	100
$\sigma_\theta \geq 13°$	$\Delta T_6^{54} > -1.3$ C°	24	7	2.5×10^{-1}	-2.0	-0.96	-0.35	+4.3	66	96

BLANK PAGE

CHAPTER 6.
AIRBORNE TRACER MONITORING

The northwest winds that prevail in the Point Arguello region carried the tracer offshore approximately two miles southeast of the generation site much of the time. The Battelle-Northwest Queen Air Real Time Sampler (QARTS) described in Volume 2, Appendix B, was used in 24 tracer experiments during Phase II of the Mountain Iron Diffusion Program to determine the plume parameters beyond the coastline. The primary means for determination of the aircraft position was tracking by AFWTR radar. During data analysis it was determined that the radar track provided the only position information sufficiently accurate to make the QARTS data usable. A significant amount of what appeared to be valid QARTS data was unusable due to a lack of adequate positional information. Uneven terrain features and the low level flight path of the aircraft frequently caused the loss of the radar track. Nine of the experimental flights had no radar tracking and an additional six experimental flights had only partial coverage. Table 2 lists the number, date, time, mean wind direction and radar track availability for each of the QARTS sampling flights. For comparison, the relative success or failure of the ground sampling is also listed in Table 2. It should be noted that in five experiments the QARTS was the only source of positive tracer information.

QARTS OPERATION

In QARTS operation during Phase II an emphasis was placed on obtaining data that could be used in conjunction with the data obtained from the ground based sampling network. To meet this goal the aircraft was flown back and forth across the tracer plume several times at a relatively constant distance from the source. When the tracer was no longer intercepted or a sufficient number of intercepts were made at a given distance, the aircraft moved to a new position further from the source and another set of traverses was started. At each distance the aircraft made passes at several altitudes, with flight altitudes over

TABLE 2. List of Diffusion Tests During Which the QARTS was Operated

Release	Date	Time of Start of Generation[a] (PST)	Source Point Mean Wind Direction	Isopleths of Ground Level Data	Radar Track[b]
140	11-4-66	1550	328	Yes	A
141	11-8-66	1416	316	Yes	A
142	11-9-66	1130	183	No	A
144	11-14-66	1251	319	Yes	C
145	11-15-66	1207	310	Yes	C
146	11-18-66	1202	251	No	C
165	1-9-67	1354	323	Yes	C
168	1-11-67	1545	346	No	A
169	1-12-67	1415	353	Yes	A
171	1-13-67	1726	357	No	A
172	1-16-67	1154	353	Yes	A
173	1-17-67	0630	097	No	C
176	1-19-67	0610	150	No	A
177	1-19-67	1216	149	No	A
241	6-28-67	1200	301	Yes	C
242	6-30-67	1145	321	Yes	B
243	7-3-67	1130	128	No	C
244	7-7-67	1245	351	Yes	B
245	7-10-67	1200	331	Yes	B
246	7-12-67	1200	315	Yes	C
247	7-14-67	1220	338	Yes	B
248	7-18-67	1230	327	No	C
249	7-19-67	1220	345	Yes	B
250	7-20-67	1245	345	Yes	B

(a) All tracer releases were 30 min in duration.

(b) Radar track symbol: A - During entire flight
B - During a portion of the flight
C - No radar track

water, generally 200, 500 and 800 ft MSL. No attempt was made to determine the vertical extent of the tracer.

Valid tracer intercepts were made to a distance of 27, 800 m from the source. The range of useful intercepts, however, was generally between 4500 and 16, 500 m from the source. At distances greater than 16, 500 m, the tracer concentrations averaged across the plume were on the order of 10^{-8} g/m^3 and peak concentrations were approximately an order of magnitude higher. Beyond this distance, valid tracer intercepts were chance occurrences, usually encountered near the expected position of the plume centerline.

Intercept altitudes for the overwater plumes varied between 50 and 900 ft MSL. Tracer intercepts at 200 and 500 ft were of a decidedly higher frequency than those at 800; yet, if only successful tracer intercepts are considered, no significant decrease of concentration was apparent with increasing altitude.

Phase II QARTS intercepts were plotted in their entirety; only the mid-points of the intercepts were plotted in Phase I. Plotting the intercepts in their entirety permitted a determination of plume position and an approximate definition of its geometry. A number of pertinent details of the QARTS data and a summary description of the atmospheric thermal stratification for the successful tests are included in Table 3. The temperature profile at the generation site was determined using wiresonde data, while the properties of the air mass in general were determined from rawinsondes released at the Boathouse at approximately the starting time of generation.

The probable tracer envelopes for experiments with successful QARTS operation are presented in Figures 11 through 22, located at the end of this chapter. These envelopes are approximately equivalent to the 2.0×10^{-9} sec/m^3 ground level exposure isopleths which have been included, when available, for comparison with the QARTS probable tracer envelopes. In general, the agreement between the two envelopes is very good. The envelopes of aircraft intercepts also are generally in agreement with the 300 and 600 ft winds as reported by the radiosondes at the Boathouse and Jalama Beach. The wind direction at 300 ft is shown on the map by use of a solid arrow head; the 600 ft winds are indicated with an open arrow head. The Jalama Beach radiosonde was discontinued prior to the final experiments and therefore these data were not available for inclusion in analysis of the 240 series of QARTS data.

The lines within the QARTS tracer envelopes in Figures 11 through 17 and 20 through 22 represent lateral extent and average downwind distance of each series of intercepts. The positions of single, isolated intercepts have not been shown. In Figures 18 and 19 the lines represent individual tracer intercepts and have been numbered in order of occurrence.

TABLE 3. Atmospheric Stability and QARTS Intercept Parameters for Releases with Successful QARTS Operation

Test	Temp. Profile,* 0-300 ft	Base of Inversion Boathouse, ft - MSL	Time of Radiosonde, PST	Number of Intercepts	Time of First Intercept, PST	Time of Last Intercept, PST	Distance To: Closest Intercept, m	Distance To: Furthest Intercept, m	Highest Intercept, ft - MSL	Highest Pass, ft - MSL
140	U	1750	1600	20	1608	1706	4600	21,600	800	900
141	U	--	1530	18	1513	1605	4900	21,400	800	800
142	U	--	1210	9	1200	1233	4750	11,900	800	800
168	U	--	1600	27	1605	1731	4000	27,800	500	800
169	U	560	1410	15	1427	1527	5100	16,500	300	800
171	S	Sfc	1730	10	1739	1825	5500	16,100	600	900
172	U	2150	1300	17	1204	1254	3300	16,300	800	800
176	S	Sfc	0630	13	0636	0724	--	7,300	600	600
177	U	750	1215	6	1236	1259	4600	5,900	500	800
244	U	980	1227	9	1257	1316	5100	19,000	400	400
245	U/S	1600	1200	4	1219	1239	4400	8,800	600	600
249	U/S	460	1229	11	1227	1320	900	7,000	500	500

* U - Unstable - Lapse rate adiabatic or greater
S - Stable (Temperature inversion)
U/S - Unstable layer capped by a stable layer

The plumes from four runs, 142, 169, 176 and 177 deserve comment at this time: the other plumes sampled by the QARTS went to the south and were much as expected.

During Run 142 (Figure 13) the atmosphere was generally unstable as determined from the 301 wiresonde and radiosondes at Honda Canyon, the Boathouse and Jalama Beach. Although the mean wind direction at the source was 183 degrees and all samplers north of generation site on Arcs 04, 05 and 06 were started, the filters of only the western-most samplers received measurable amounts of pigment. The pigment on these filters was just above the background level and could not be isoplethed. The QARTS data indicate that at approximately 1600 m north of Arc 06 the centerline of the plume was over the coastline. By the time the plume reached Bear Creek, the biggest portion of it was over land. The curvature of this trajectory demonstrates the need for examination of winds other than at the source point during hazards appraisal.

Tests 176 and 177 were conducted under light wind conditions. Although a best effort was made to predict the trajectory of the plume and the appropriate ground samplers activated for Test 177, the tracer was not detected on any of the filter media. Figures 18 and 19 depict observations of the zinc sulfide plume by the airborne sensor system.

Test 176 shows that the initial drift of the plume was to the northwest as indicated by Observations 1 through 7. No indications of zinc sulfide were found beyond 7300 m from the source. A search pattern was initiated that revealed that the plume trajectory had changed direction by 180 degrees and was heading back to the source point. Observations 8 through 13 traced the plume back to the vicinity of the generation site. In Test 177 a quite similar situation was observed in that the tracer plume drifted to the northwest as a rather poorly defined entity. Aerial contact was maintained with the plume until 43 min after the start of generation. At that time contact was lost and the run terminated. It is presumed that the remaining plume fragments subsequently moved into the Santa Ynez River Valley. From the lack of zinc sulfide on the exposed filters it can be stated, with confidence, that the plume did not return to land within the sampling grid. It is of interest to note that all of the ground samplers on Arc 08 were activated. This arc follows Mesa Road east from the coast and then south to near Range Operations. None of the samplers indicated any evidence of plume passage.

It is evident from a review of these two tests that the cautionary note relating to the prediction difficulties possible under adverse meteorological conditions in Chapter 1 must be kept in mind. This is particularly so when the synoptic regime is such that the surface winds are light and the subsidence inversion is well developed.

The data, radar track and QARTS were sufficiently complete for six tests to permit detailed analysis. Each of these tests had four or more intercepts at a minimum of two of the standard distances (5, 10 and 15 km). The tests that were analyzed in detail are: 140, 141, 168, 169, 171 and 172. Test 169, one of the group of six tests conducted during northerly winds which received extensive analysis, had a narrow plume well defined by Arcs 01, 03 and 04 and by the QARTS at 10,000 and 16,000 m. At about 5,500 m there were indications of a localized, anomalous circulation that may have spread the tracer over a wider area than that covered by the main plume. The magnitude or extent of the circulation is not known and its cause is assumed to be the confluence of air flow over and around Point Arguello. In the other five tests the plume geometry was much as would be expected.

The QARTS intercepts in experiments 242, 247 and 250 were generally questionable; when plotted the intercepts did not form a recognizable pattern. They were therefore judged to be useless and no further analysis of them was attempted.

ANALYSIS OF QARTS DATA

Little experimental work has been done on the relationship between instantaneous and mean properties of a plume; however, the theoretical relationship between the two has been closely examined. One particularly useful approach to this relationship was published by F. A. Gifford.[10]

According to Gifford, the variance of the distribution of material within a mean plume should be equal to the sum of the variance of the positions of the instantaneous plume centerline about the mean centerline and the average variance of the distribution of the material about the instantaneous plume centerline. This relationship provides a theoretical basis for transforming instantaneous properties of a plume to mean properties.

There have been few diffusion studies in which both instantaneous and mean properties of the same plume have been examined. A recent study conducted at Hanford did measure and compare instantaneous and mean plume properties.[11] By use of techniques derived at Hanford, values of parameters included in Gifford's formulation of the relationship between mean and instantaneous plumes were obtained from diffusion data.

Real Time Sampling (RTS) units mounted on trucks measured the instantaneous plume, while the mean properties of the plume were measured by filters in the usual Hanford manner.[12] Computation of the variance of the positions of the instantaneous plume centerline was straightforward as the RTS charts were directly correlated with positions on the sampling arc through event markers on the charts. The mean centerline was determined by averaging the positions of instantaneous centerline, and the variance about the mean centerline was calculated directly from the definition of variance. The variance of material about the instantaneous centerline was estimated from the trace on the RTS charts using the maximum concentration, the minimum detectable concentration, and the width of each plume intercept. As a first approximation, the distribution of material within the instantaneous plume was assumed to be Gaussian, an assumption also made by Gifford. The two variances determined from the RTS data were then summed to approximate variance of the distribution of material within the mean plume. The variance of the distribution of material in the mean plume was computed directly from the filter exposures.

The two methods for determining σ_y, the standard deviation (variance$^{1/2}$) of the horizontal distribution for a mean plume, are compared in Figure 8.

The same computational techniques used in the Hanford study were used in the analysis of the QARTS data (six diffusion tests conducted during northerly winds) during Phase II. A mean plume σ_y was approximated using QARTS data gathered from intercepts at about 5, 10 and 15 km. These approximated values of σ_y have been compared with the corresponding σ_y values calculated for the 500, 1000 and 2100 ground level sampling arcs.

The growth of σ_y of the mean plume with increasing distance from the source is shown in Figure 9. The growth of the average σ_y over land is much as would be expected from the results of other diffusion studies ($\sigma_y \propto X^{0.8}$). The noticeable decrease in the growth rate of σ_y offshore ($\sigma_y \propto X^{0.4}$) is reasonable and has been reported in the open literature.[8] Of particular interest is the rapid growth of σ_y indicated between 2100 m, the end of the sampling grid, and 5000 m, the beginning of the aircraft sampling area. To better examine this rapid change in σ_y, both growth rates have been projected to a common distance, 3000 m, the approximate distance from the source to the coastline. The σ_y derived from the RTS data is a factor of about 3.5 larger than that computed from the sampling grid, a difference too large to be explained by projection of lines of unequal slopes.

A second parameter associated with a mean plume may be approximated using measurements of an instantaneous plume. That parameter is the exposure to the material in a plume received at a point downwind from the source. In particular, the normalized exposure at the centerline of the mean plume may be approximated. It is possible to determine both the position of the mean plume centerline and the average instantaneous concentration at that point from the QARTS data. This average concentration, normalized to the tracer generation rate, is dimensionally identical with, and approximately equal in value to, the exposure at the point normalized to the total amount of tracer generated. In Figure 10 the QARTS data (transformed to approximate mean plume properties) and

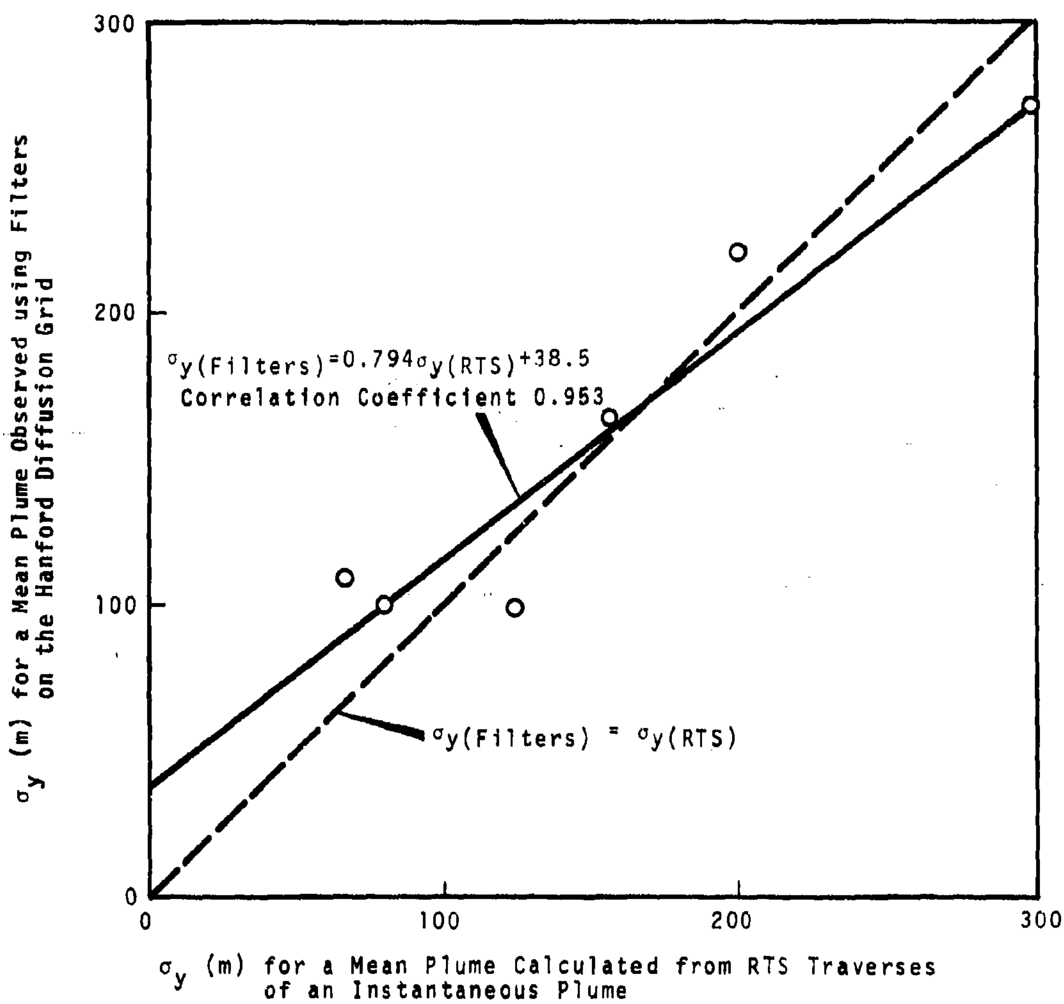


FIGURE 8. Correlation of Measured and Approximated σ_y at Hanford

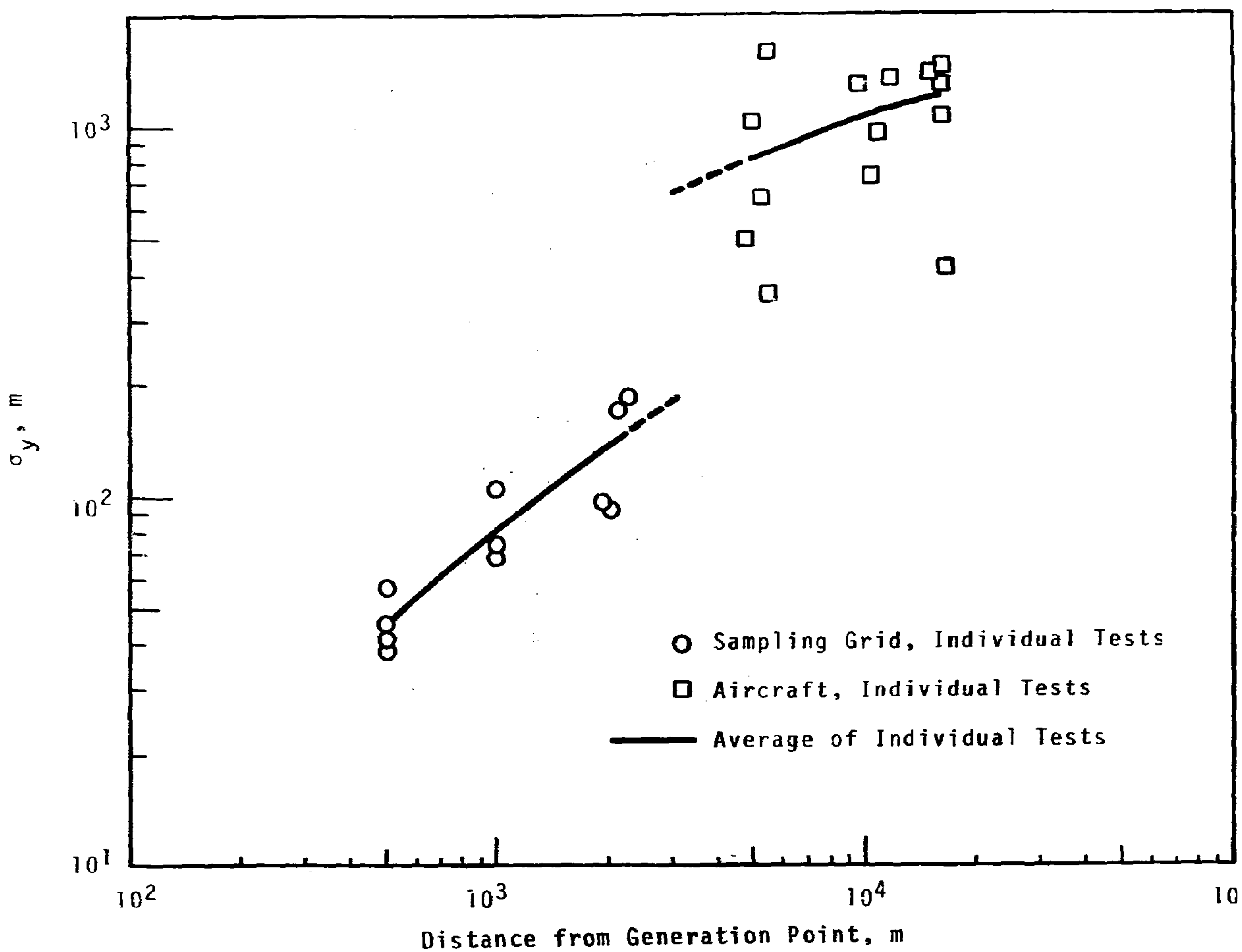


FIGURE 9. Lateral Plume Dispersion as a Function of Distance from the 301 Generation Site

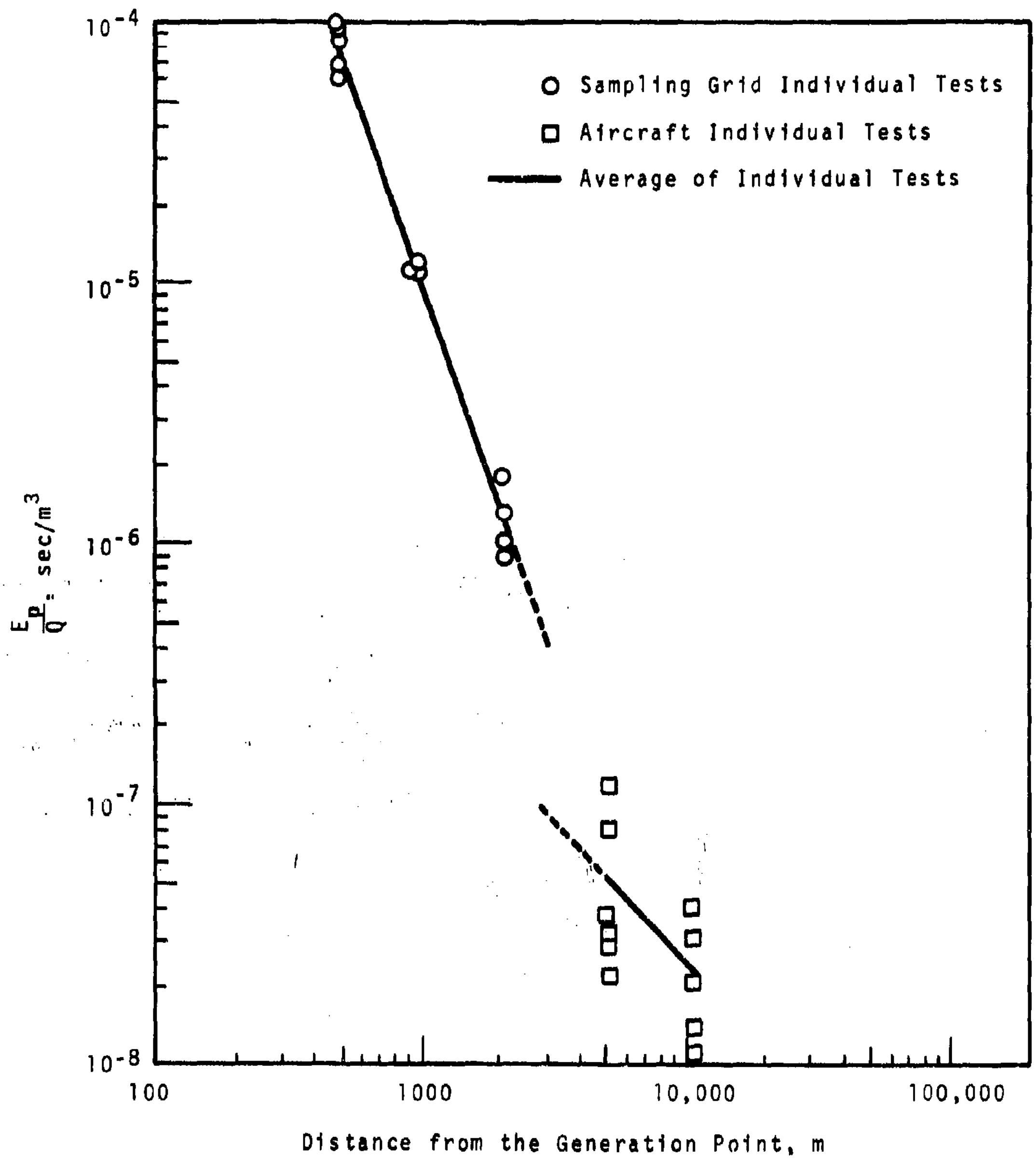


FIGURE 10. Decrease in Normalized Time-Integrated Air Concentration as a Function of Distance from the 301 Generation Site

the sampling grid data show the decrease in maximum exposure with distance. A definite difference in the rate of decrease of exposure between the filter data and the QARTS data indicates that diffusion is more rapid over land than over a body of water. When the slopes of the two curves are again projected to 3000 m, the maximum exposure developed by the extrapolation of the RTS data is about 0.22 of that developed by the extrapolation of the sampling grid data.

Both Figures 9 and 10 indicate the region of rapid diffusion between the end of the sampling grid and the beginning of the aircraft sampling area. This is felt to be a characteristic of the air flow at the coastline rather than a result of the differing methods of determining the mean properties of the diffusing plume. Hewson and Olsson describe downwash and wake effects which could cause the apparent discontinuity in diffusion at the coastline.[9] Low level (250-1250 ft) turbulence measurements indicate a region of relatively strong turbulence at the coastline which lends credence to the existence of the coastal diffusion discontinuity.[3]

The implications of the results of the analysis of the QARTS data on diffusion from the 301 Site are two-fold: first, there is rapid diffusion in the vicinity of the coastline to the south; second, the lower growth rate of σ_y over water will result in a lower diffusion rate over water than over land. The primary effect of the increased diffusion at the coastline will be the reduction of the concentrations or exposures experienced by persons or objects on the water to the south of Sudden Ranch. The concentrations experienced should be approximately one-quarter the expected values. As the plume continues over water, the decreased diffusion rate will cause the concentrations experienced to increase and eventually exceed those expected. On the basis of the information in Figure 10, the distance at which the expected and experienced concentrations would be the same is about 7000 m from Site 301. After approximately 20,000 m of overwater travel, the concentrations would be an order of magnitude higher than at the same distance had diffusion been entirely over land.

OVERWATER DIFFUSION EQUATION

As the diffusion of pollutants over water proceeds at a much slower rate than over land, an overwater prediction equation has been developed from the QARTS data. The general form of the overwater equation is:

$$\chi/Q = k\,X^{-1.1} \tag{11}$$

where

χ = air concentration, ppm

Q = release rate, lb/min

X = downwind travel distance, feet

k = constant of proportionality and is dependent on meteorological conditions (primarily wind direction) and source location.

The parameter -1.1 has been determined from the QARTS data depicted in Figure 10. The overwater equation can be used in extending the range safety equation to account for the decreased rate of diffusion of a plume traveling over water. The constant k, which is determined from the range safety equation, locates a point on the graph of E/Q versus X equal to the distance between the source and the coast. From this distance, diffusion is expected to occur at a rate proportional to $X^{-1.1}$, as determined from the QARTS data. A line describing the diffusion over water is thus determined by a point and slope. The diffusion rate over water is independent of position or wind direction. In the overwater equation, no credit has been taken for increased diffusion at the coastline, although Figure 10 indicates a discontinuity in concentration there. The use of this relationship is recommended any time the distance traveled over water by the plume is greater than the distance traveled over land.

To predict critical downwind distances, Equation (11) is transformed as follows

$$X^{1.1} = \left(\frac{k}{\chi/Q}\right) \tag{12}$$

or

$$X = \left(\frac{kQ}{\chi}\right)^{0.91} \tag{13}$$

In practice, the following procedures are recommended in the solution of Equation (13).

1) Evaluate k by solution of Equation (1) with X equal to the distance between the source point and the coastline and then substituting the resulting (χ/Q) into

$$k = X^{1.1} (\chi/Q_X) \tag{14}$$

where X is the distance between the source and the coast and (χ/Q_X) is the solution of Equation (1).

2) Substitute k, the critical concentration, χ, (25 ppm for NO_2) and the source rate Q from the empirical equation $Q = 0.0242\,\bar{U}^{-0.8} A$ into Equation (13).

A specific confidence limit is not placed on the overwater equation; however, considerably more confidence can be placed in the overwater equation than in an extension of the unmodified range safety equation out to distances as far as Jalama Beach/Point Conception. It is suggested that the WIND System computer could be programmed to provide solutions to the overwater equation directly.

The overwater equation should not be used when the value of any meteorological variable in the range safety equation exceeds its limitations. In addition, the overwater equation should not be extrapolated to distances beyond 25, 000 m from the source.

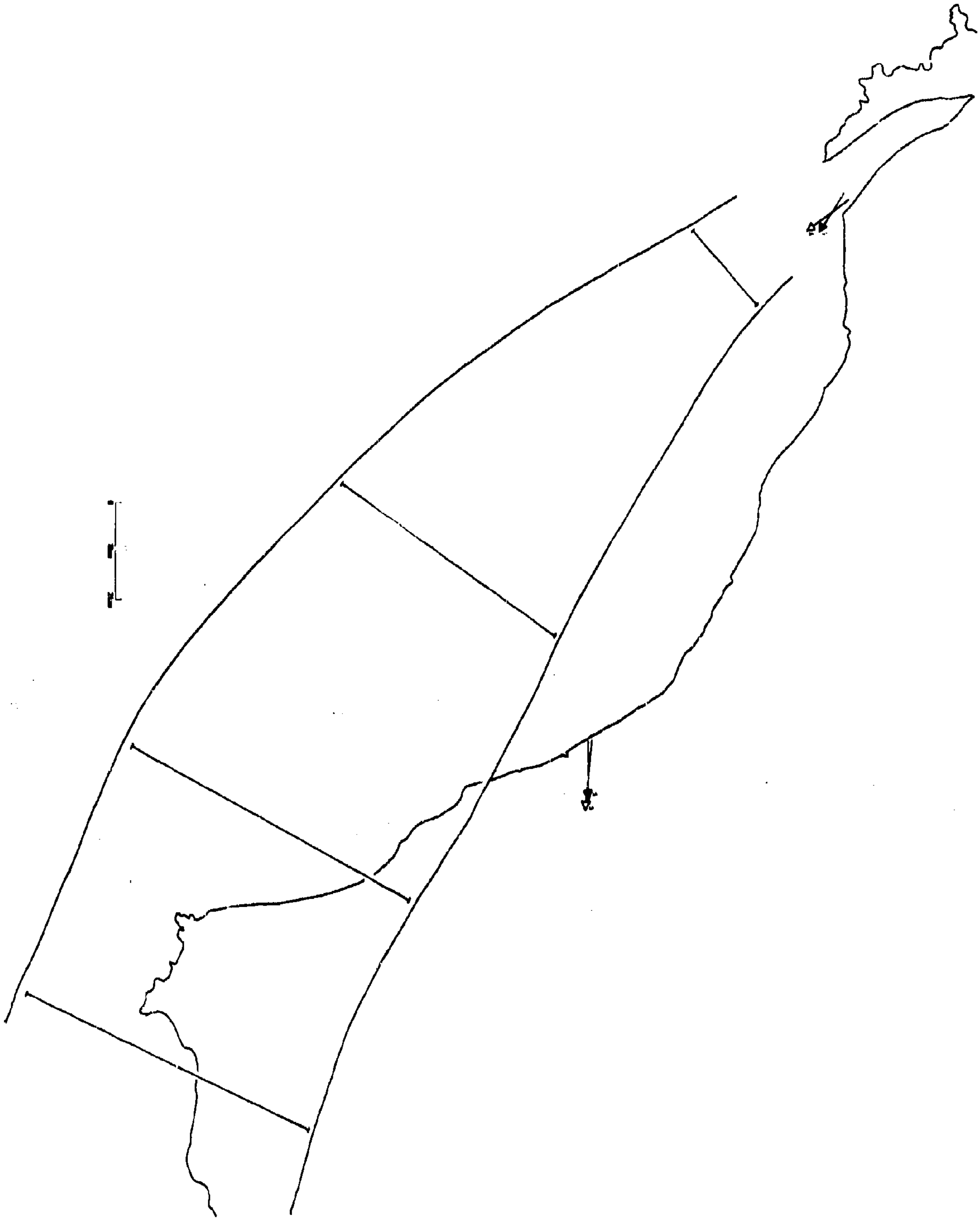


FIGURE 11. MI-140 Plume Envelope

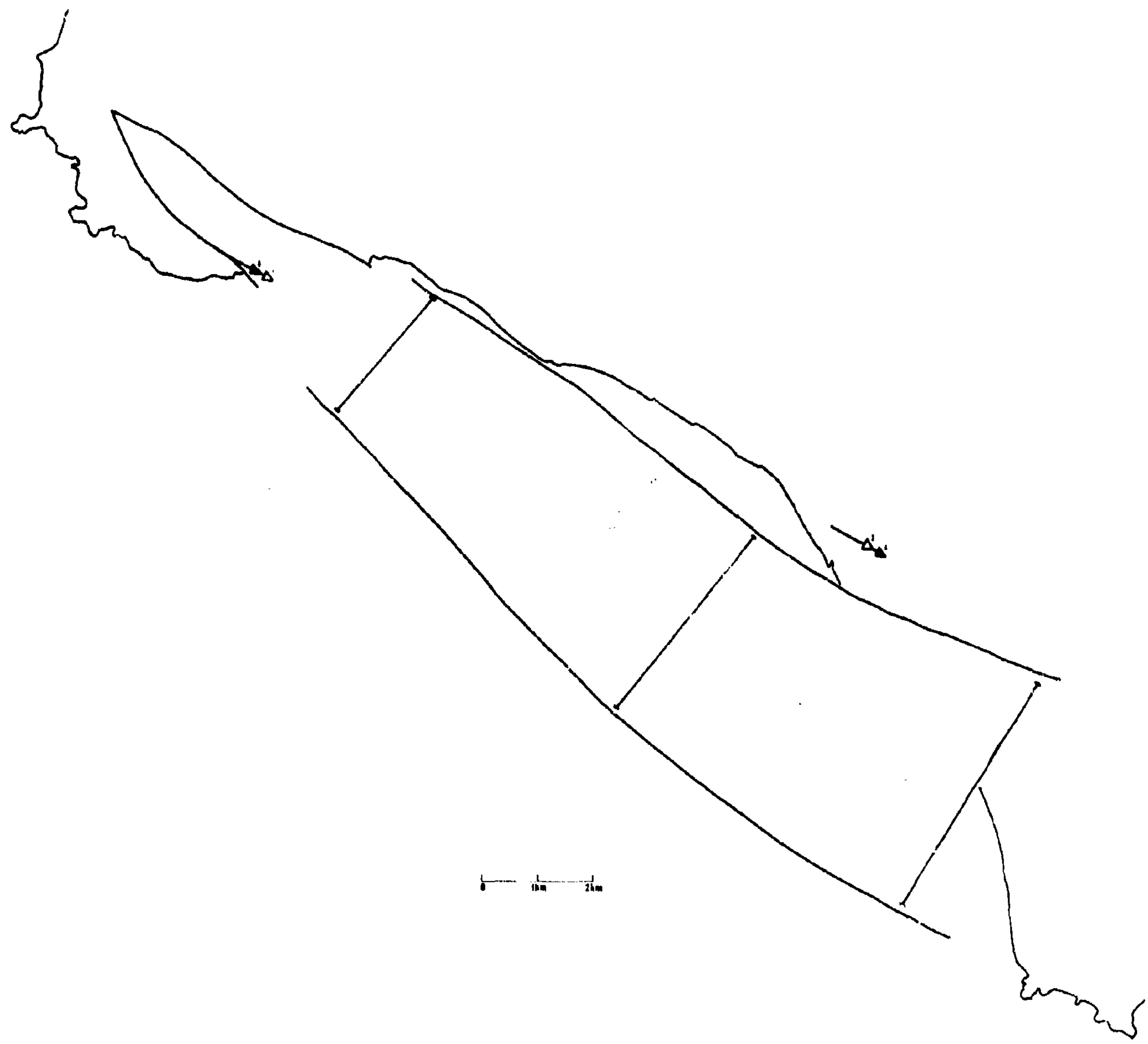


FIGURE 12. MI-141 Plume Envelope

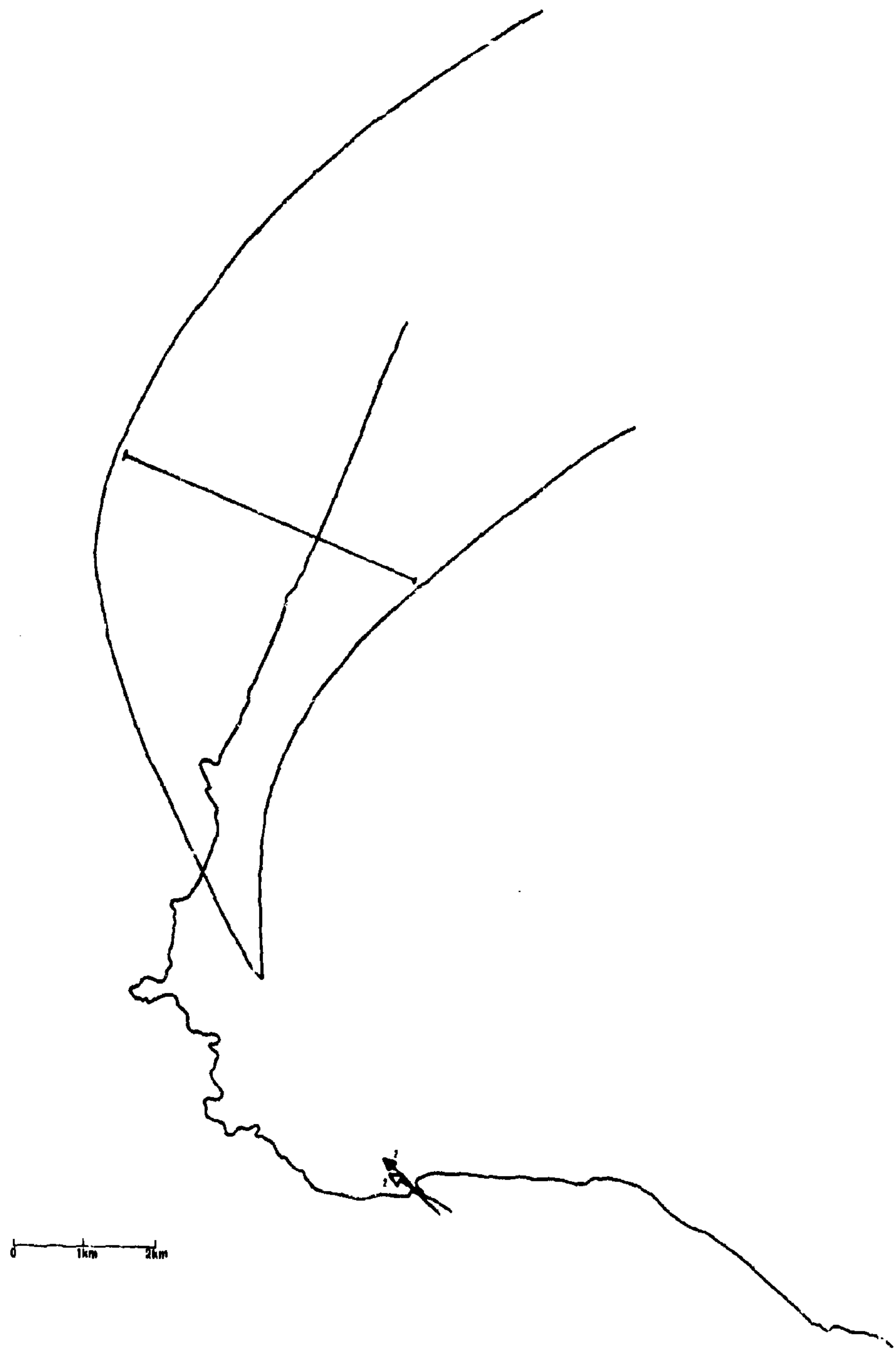


FIGURE 13. MI-142 Plume Envelope

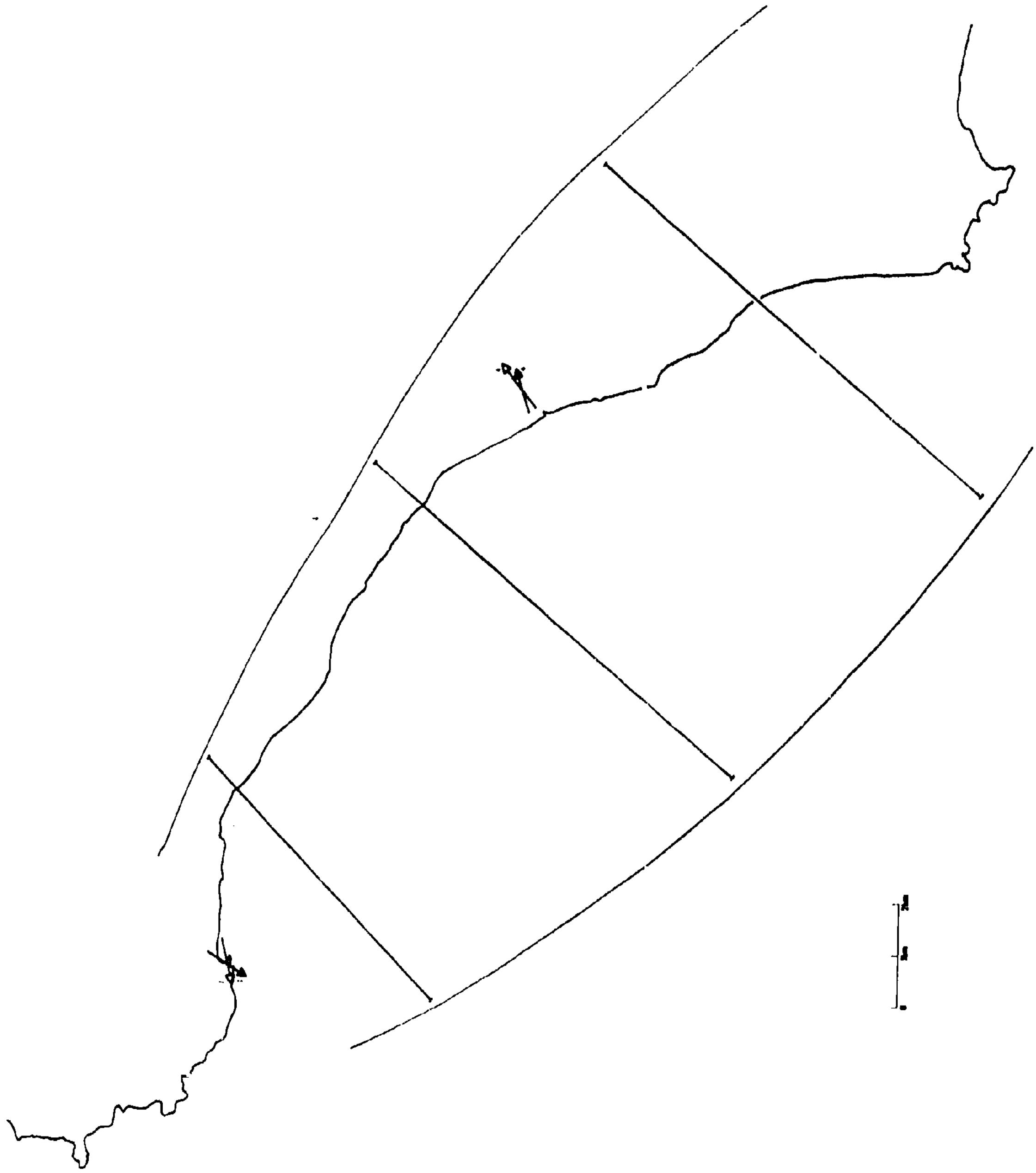


FIGURE 14. MI-168 Plume Envelope

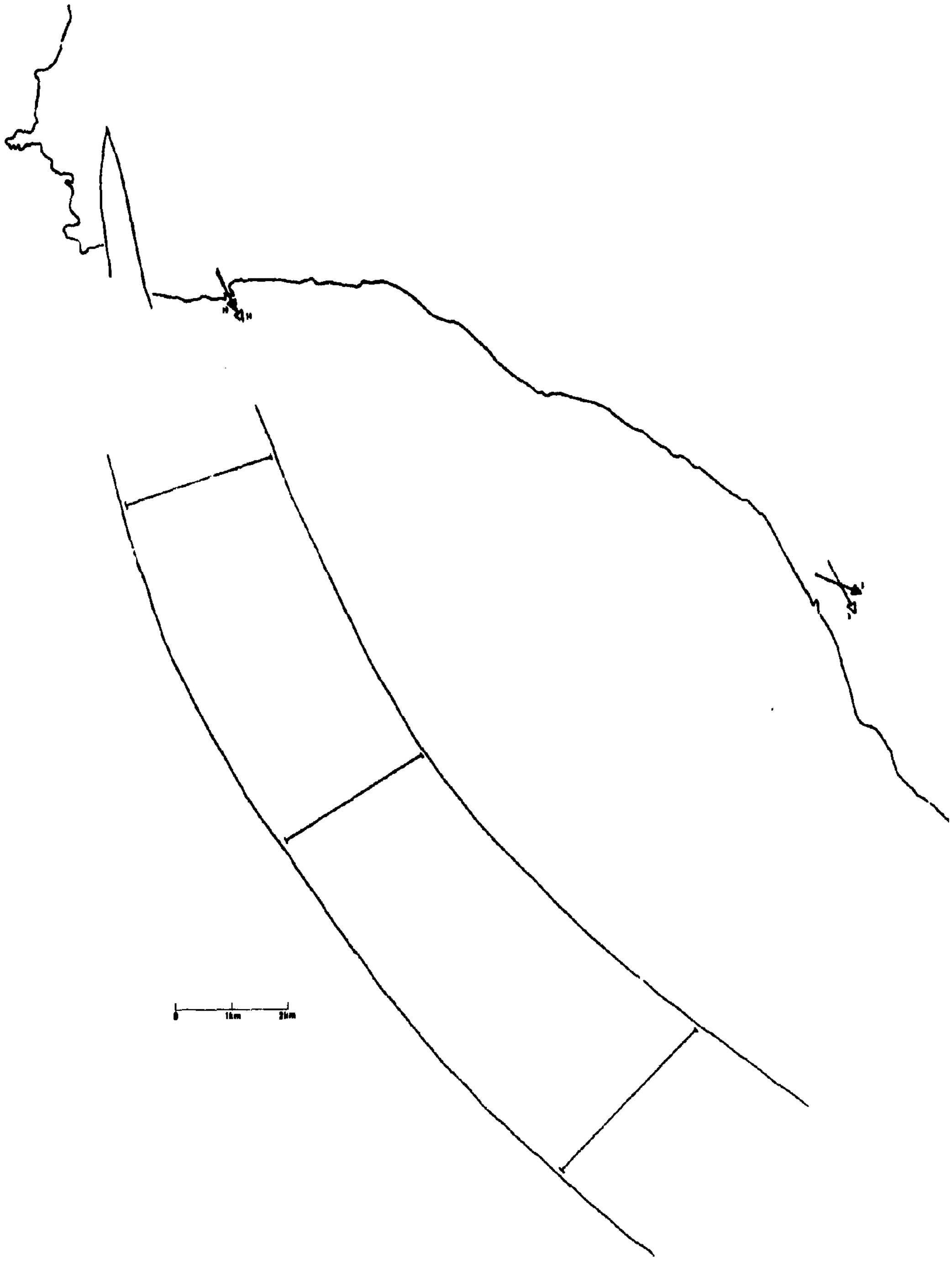


FIGURE 15. MI-169 Plume Envelope

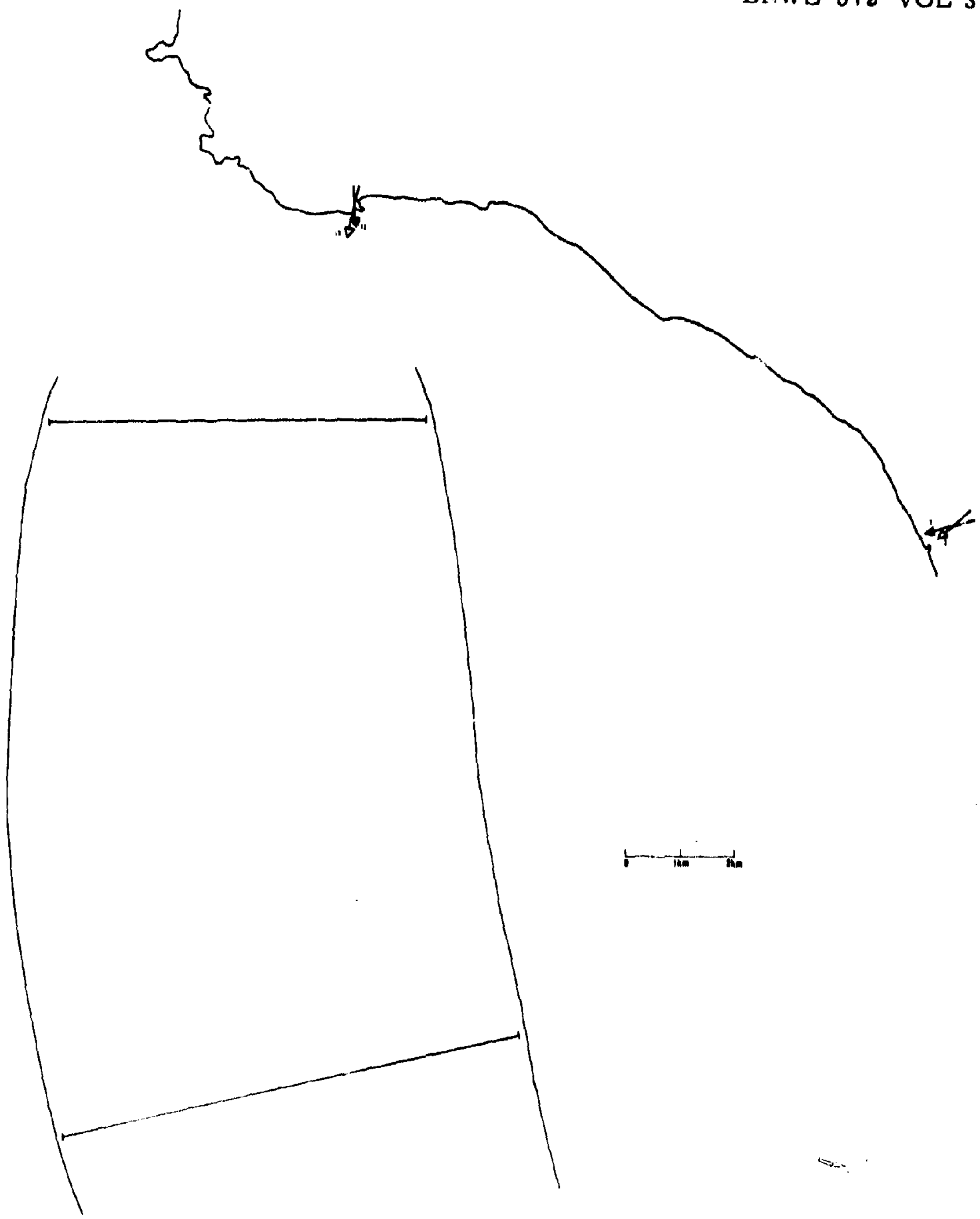


FIGURE 16. MI-171 Plume Envelope

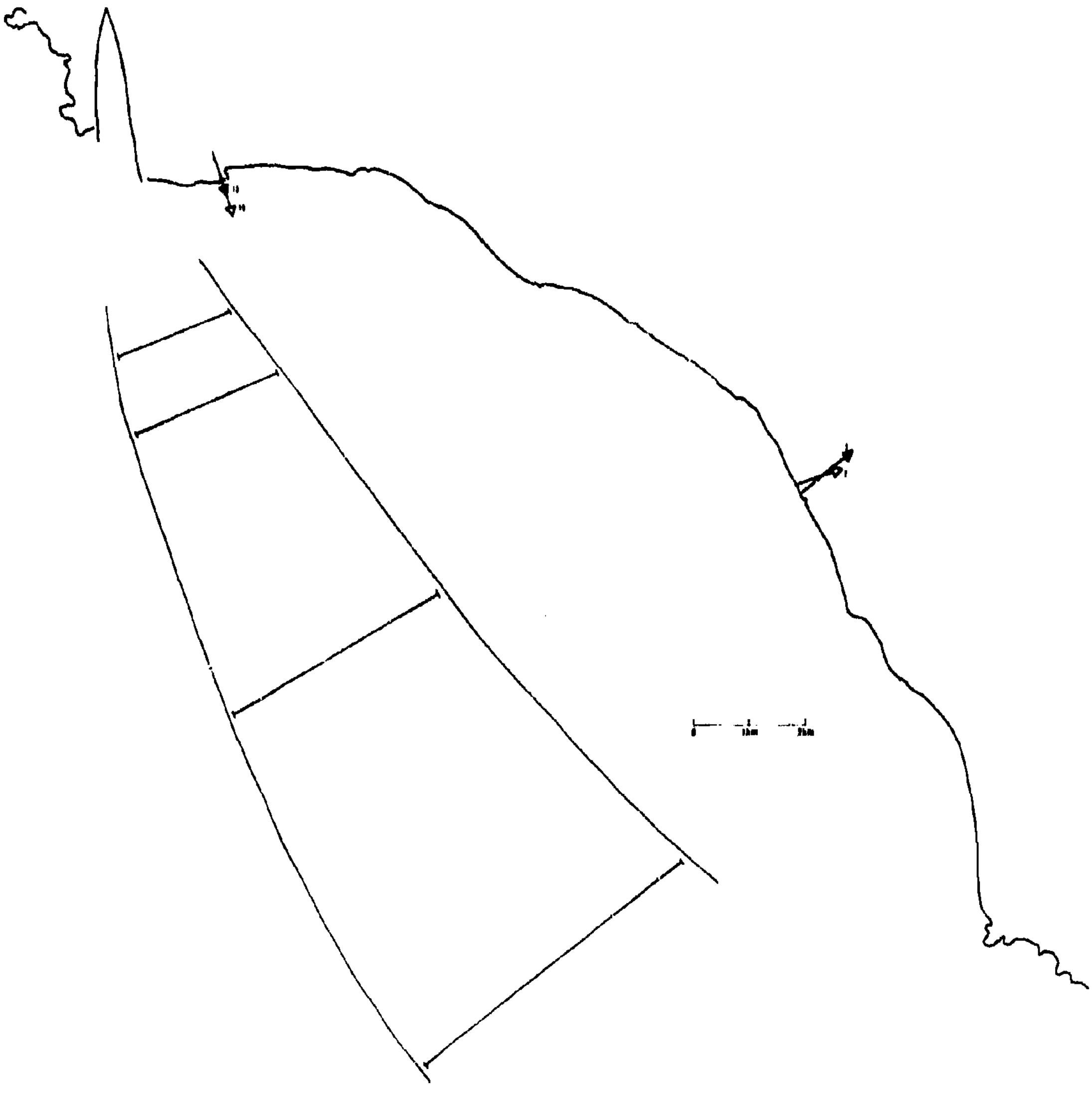


FIGURE 17. MI-172 Plume Envelope

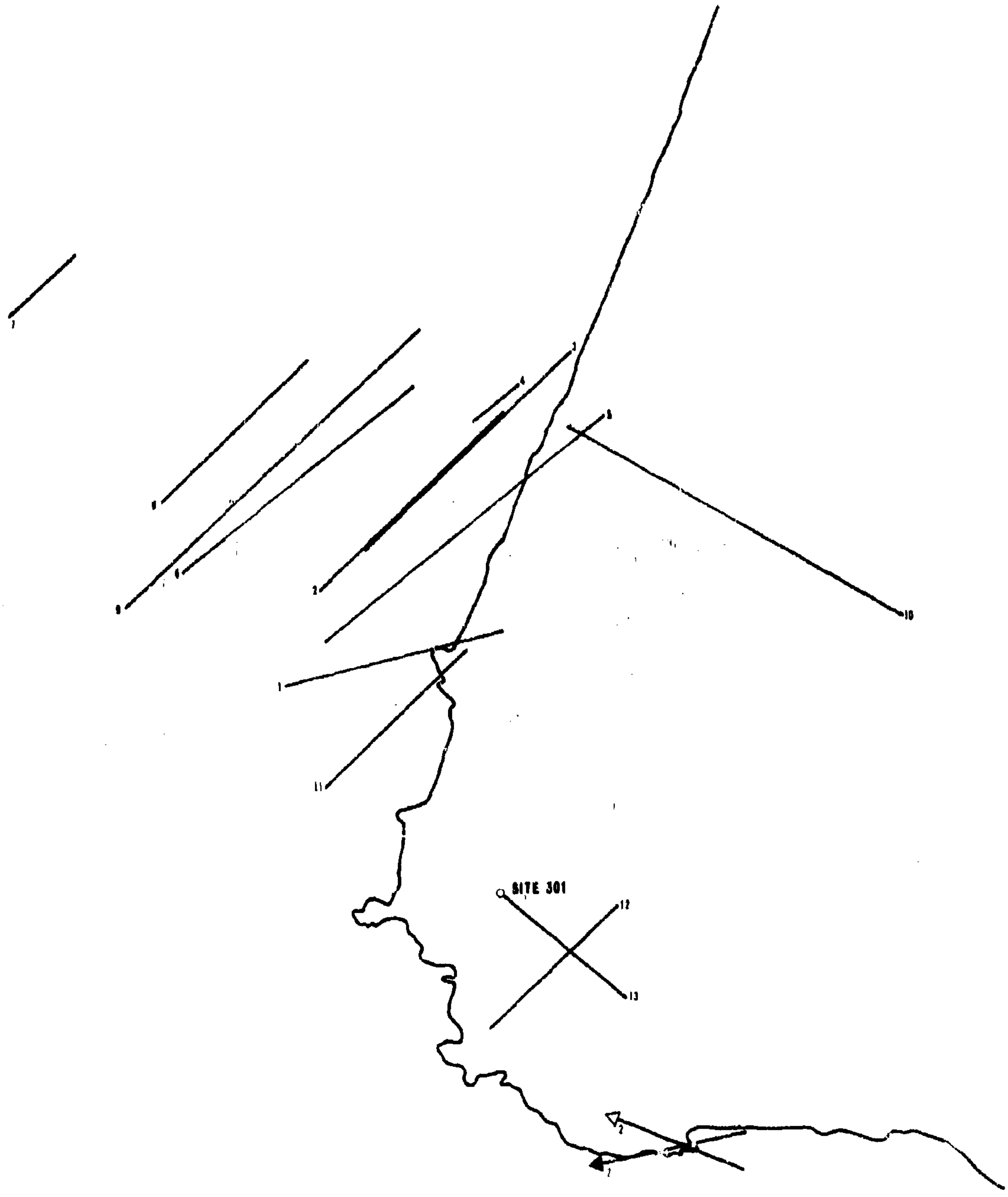


FIGURE 18. MI-176 Plume Intercepts

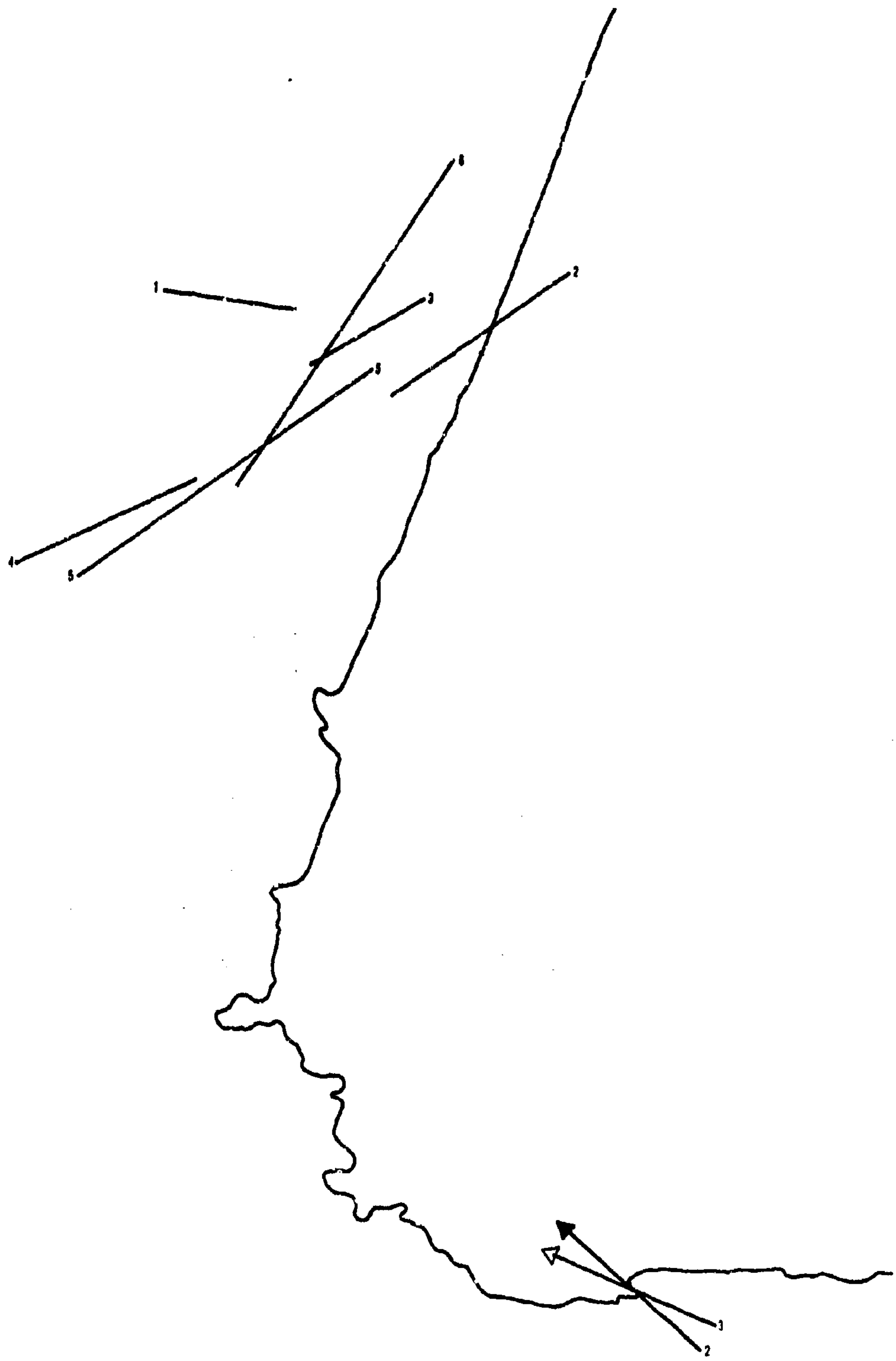


FIGURE 19. MI-177 Plume Intercepts

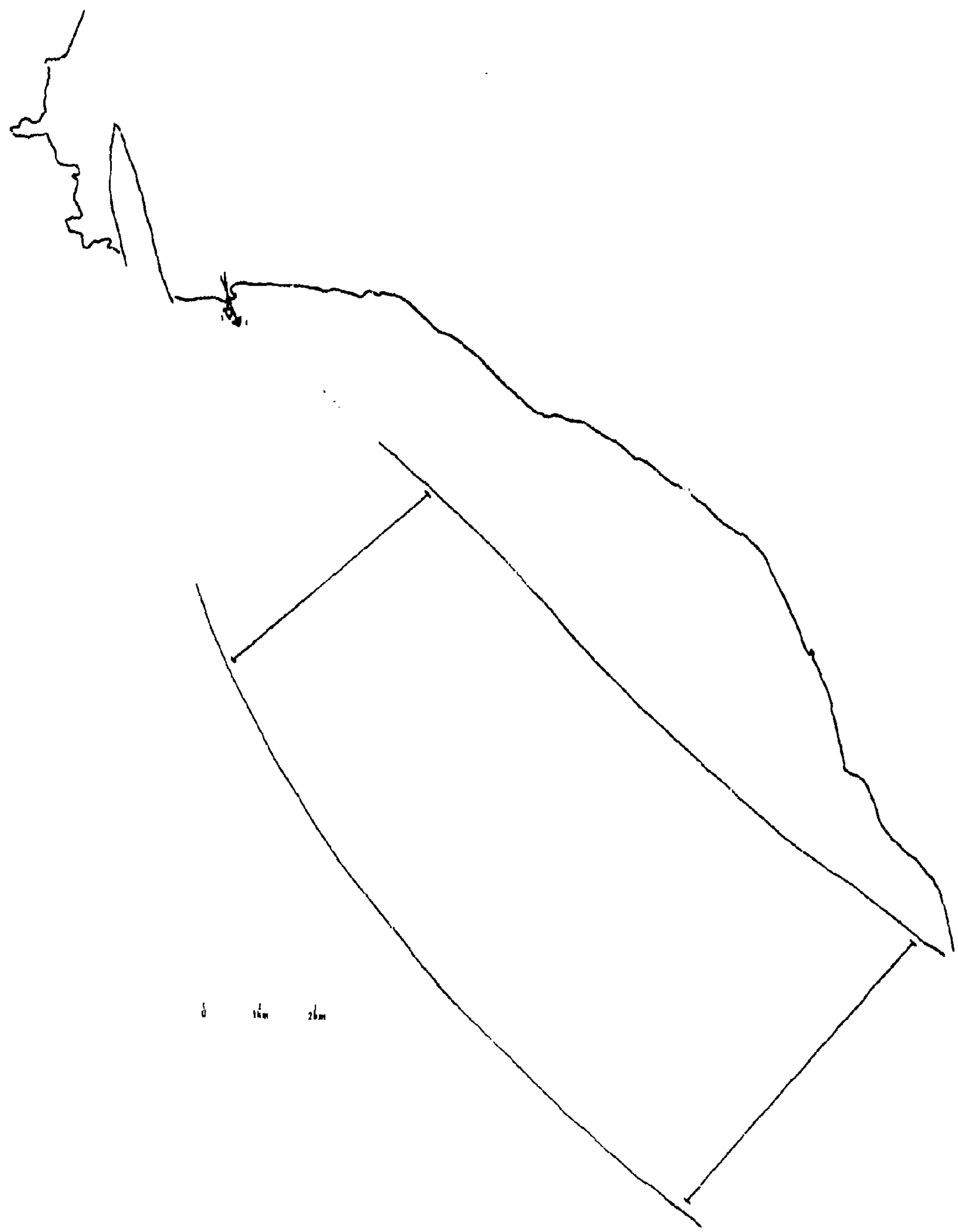


FIGURE 20. MI-244 Plume Envelope

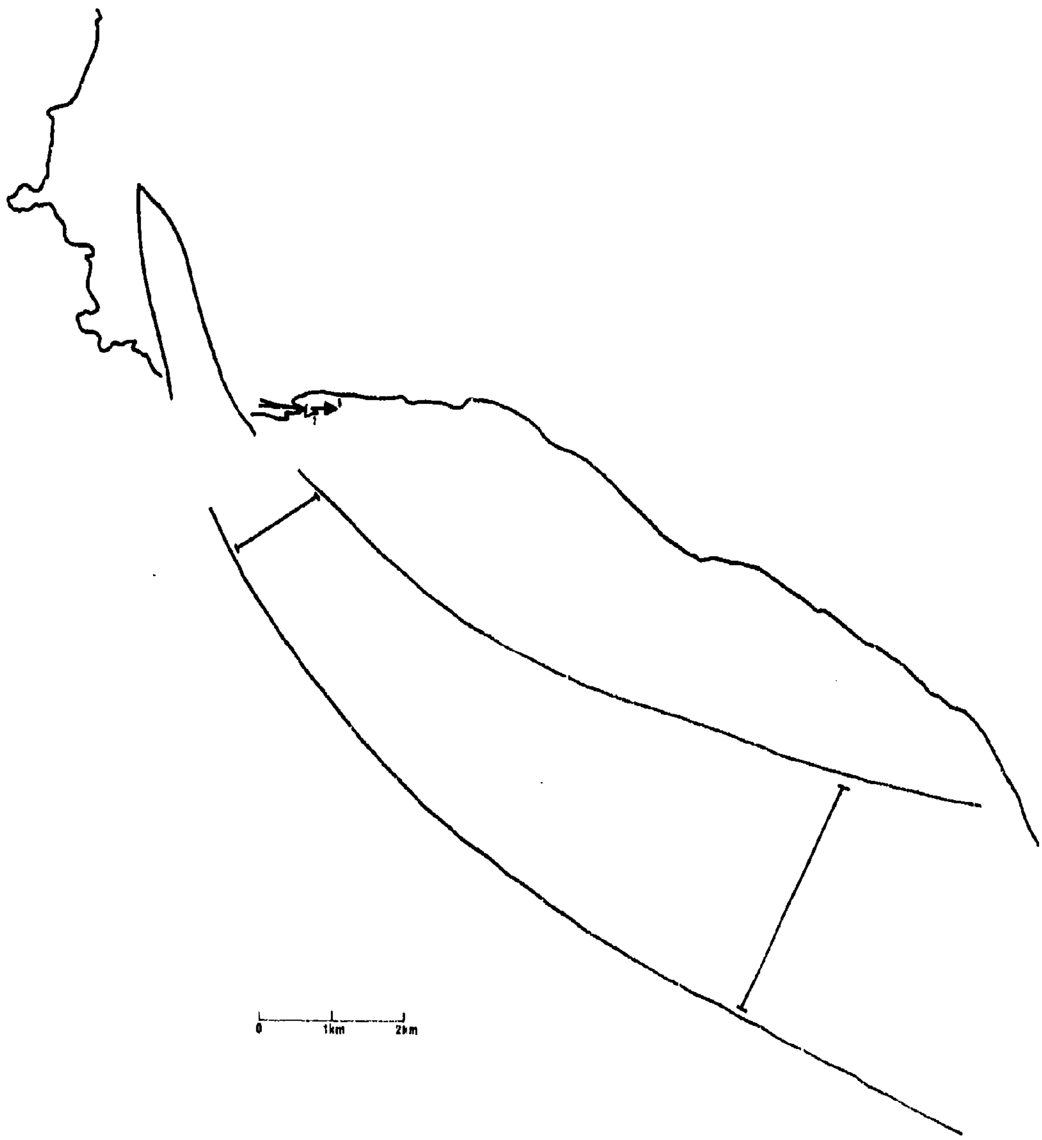


FIGURE 21. MI-245 Plume Envelope

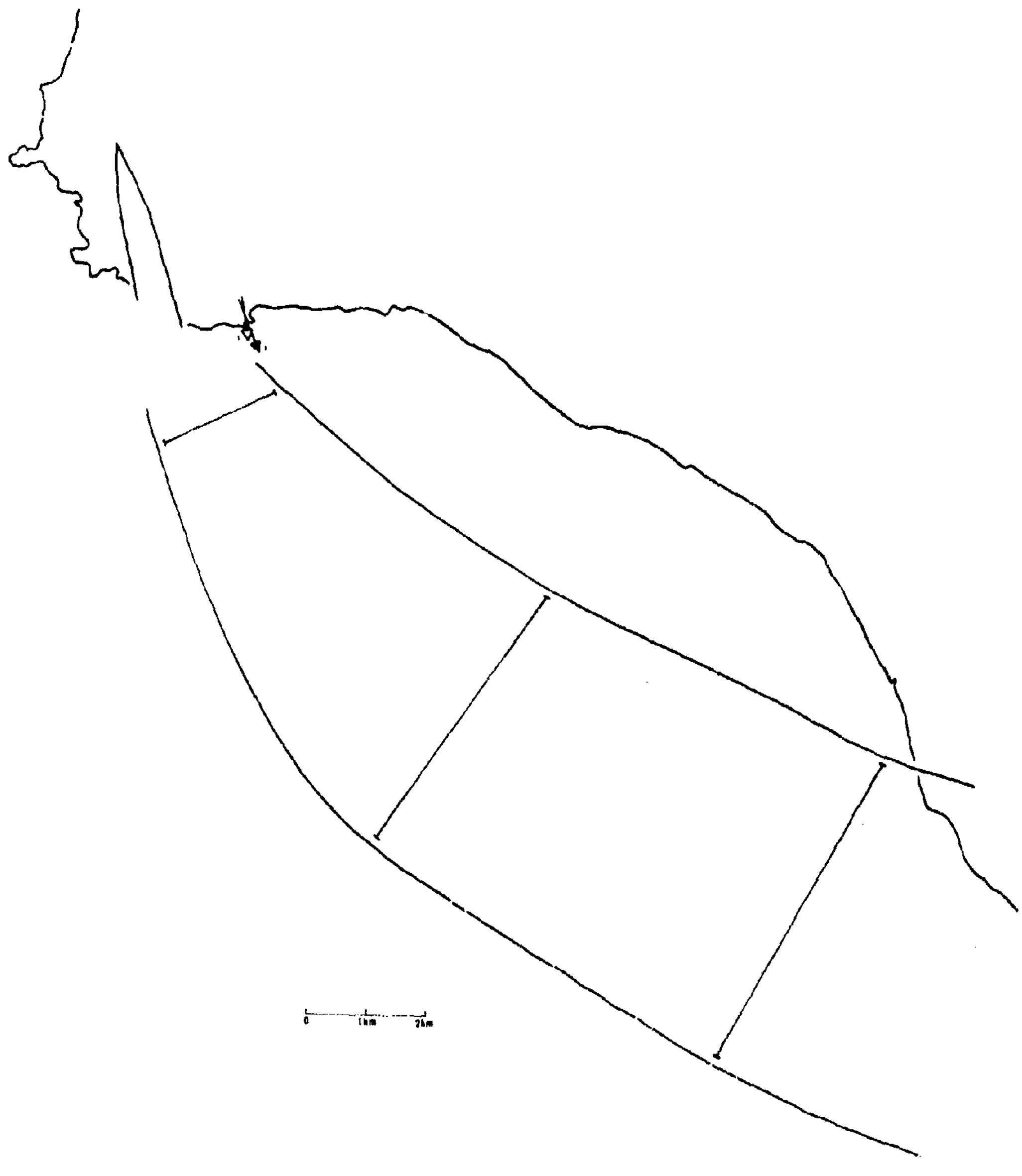


FIGURE 22. MI-249 Plume Envelope

CHAPTER 7.
TRAJECTORY STUDIES

The properties of a diffusing plume are essentially Lagrangian, that is, they are dependent upon the motions of the air parcels containing the diffusing material as the parcels travel downwind from the source. These Lagrangian motions may be approximated by trajectories based upon streamline analysis of the wind field in the region of expected plume passage. The accuracy of this approximation is dependent on both the detail with which the wind field is known and the frequency of the streamline analyses. Use of wind information from a single sensor leads to decidedly less accurate trajectories than does the use of wind field data from an array of sensors.

Trajectory studies in both Phase I and Phase II indicate that trajectories drawn from streamline analyses based upon consecutive five minute averages of the wind field are a good approximation of the diffusion pattern of a plume when the start of first averaging period for the wind field and the start of generation coincide. The discrepancies between the plume patterns and the positions of the trajectories in these studies were primarily due to an inadequate description of the wind field. An attempt was made in Phase II to pinpoint regions where the definition of the wind field was not adequate. Streamline analyses were drawn to exactly fit the wind field as defined by the WIND system sensors; orographic effects on the wind field, not measured, were not estimated. The recommended changes in the array of wind sensors for the WIND system were determined by noting the reappearing discrepancies between plume patterns and trajectories.

Figures 23 and 24 show examples of the most consistent discrepancies between the trajectories and the plume patterns. Trajectories drawn for those cases in which the tracer was carried to the northeast were consistently displaced to the north of the plume after crossing Honda Canyon. This displacement is typified in the comparison of trajectories and plume concentration isopleths in Figure 23. The other consistent discrepancy between trajectories and the plume patterns occurred during northwest

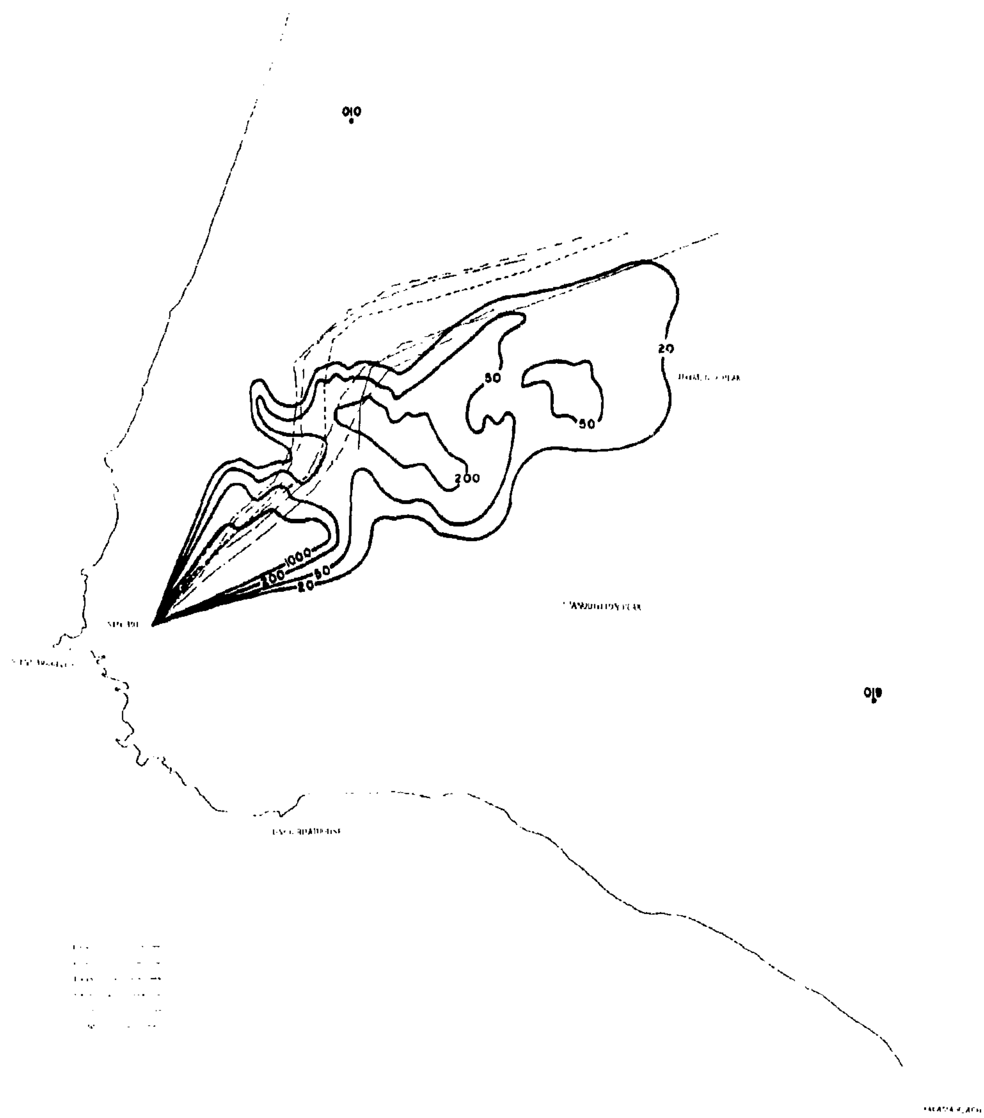


FIGURE 23. MI-162 Trajectories and Isopleths

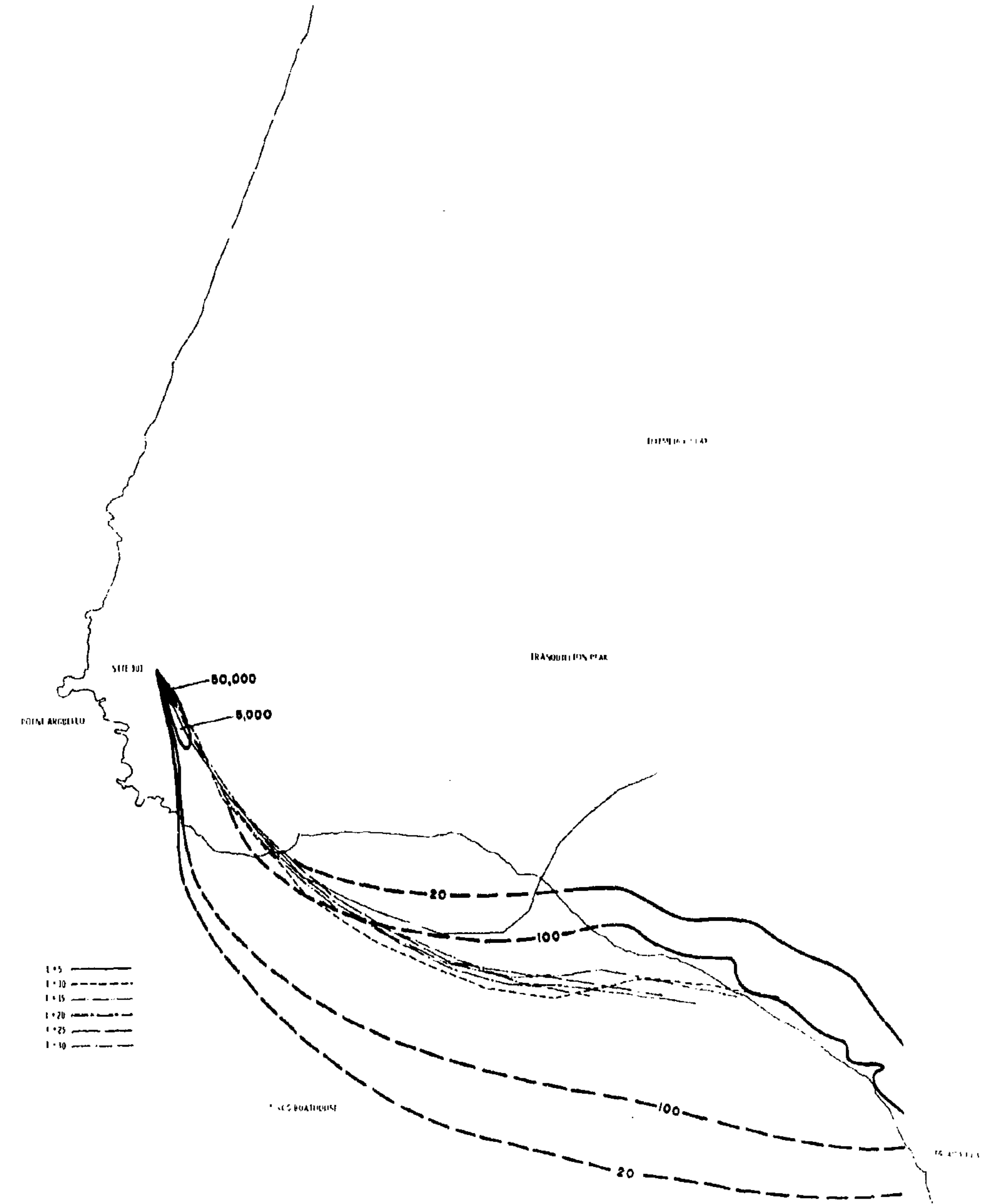


FIGURE 24. MI-202 Trajectories and Isopleths

winds at Site 301. The easterly displacement of the trajectories from the plume near the coastline south of Sudden Ranch shown in Figure 24 is typical of this discrepancy.

The cause of the northerly displacement for trajectories crossing Honda Canyon was determined to be the influence of the data from the Target Ridge wind sensor on the streamline analyses. The data suggest that the wind measured by this sensor is not representative of the airflow carrying material northeast from the Sudden Ranch-Point Arguello region. It is therefore recommended that the Target Ridge wind be disregarded in determining probable plume trajectories from sources located in the Sudden Ranch-Point Arguello region.

The easterly displacement of the trajectories during northwesterly winds is largely caused by the influence of Cypress Ridge on the wind field. To determine the extent of this influence and to provide a complete description of the wind field for the Sudden Ranch-Point Arguello region it is recommended that an additional wind sensor for the WIND system be located in the vicinity of a point 4200 ft from Site 301 on true bearing of 170 degrees.

CHAPTER 8.
SHORT TERM CONCENTRATIONS AT GROUND LEVEL

INTRODUCTION

Maximum air concentrations of a pollutant to which an individual may safely be exposed are dependent upon the duration of his exposure to that pollutant. Therefore, it is necessary to know not only the average concentration of the pollutant over a relatively long period of time, but also maximum shorter term concentrations within the long period. Filters used during Mountain Iron provided a great volume of information on 30-minute mean or time-integrated air concentrations. A ground-based device(13) capable of monitoring atmospheric concentrations of zinc sulfide tracer on a real time scale was employed during a number of field tests in Mountain Iron Phase II. Although the volume of data generated is much less than from the filter samplers, these data do offer a means to investigate and estimate the magnitude of short-term concentrations.

THE RELATIONSHIP BETWEEN TIME-INTEGRATED AND REAL-TIME CONCENTRATIONS

The real time concentration samplers employed during Mountain Iron Phase II were calibrated in terms of air concentration, χ, the mass of tracer per unit volume of air sampled. In this study, filter sampling resulted in time-integrated air concentrations with units of mass of tracer sampled divided by filter sampling rate. Division of the time-integrated concentration by the tracer generation duration gives a mean concentration, $\overline{\chi}$, with units of mass of tracer per unit volume of air sampled. It is possible to compare concentrations derived by the above two methods in the form of a dimensionless ratio. Conversion of both concentration units from mass per unit volume to ppm does not alter the validity or value of the comparison ratio.

Perhaps it should be mentioned that in a strict sense the time-integrated concentrations cannot be converted to mean concentrations in the manner specified in the preceding paragraph. The discrepancy involves ignoring the plume end effects--the stretching of a finite length plume with time.

However, in relatively constant meteorological conditions, the difference between the true mean concentration of a continuous plume and the mean computed by the prescribed technique is negligible. Thus, in this chapter the real time concentration sampler records were employed to determine concentrations averaged over periods varying between five seconds and ten minutes, while the 30-minute mean concentration for the entire test was computed from filter exposures.

EXPERIMENTAL PROCEDURES

Two real time sampler (RTS) units were employed to measure tracer concentrations during Phase II. The RTS sensors with accompanying vacuum supplies, recorders, and power supplies were truck-mounted. This mounting permitted movement of the samplers into areas where the tracer plume was expected to pass. One or both of the RTS units were operated during 36 routine field experiments commencing with Test MI-167 and ending with Test MI-216.

During 31 field tests, the truck-mounted RTS's were "rovers." In this situation the samplers roamed in areas where tracer was expected. If a high concentration was encountered, the truck sometimes was brought to a momentary halt, but generally the procedure was to continue driving slowly through the plume, to turn around, and then to attempt to traverse across the plume in the opposite direction. Although useful data were generated during 18 of these roving tests, problems associated with truck movement introduced some signal noise into the RTS system.

There were five field experiments in which an RTS unit was operated as a stationary sampler. It is from these five experiments that the most useful data were generated. Under these conditions, electronic noise was at a minimum. Further, the entire history of the tracer concentration at the selected site was defined.

DATA PRESENTATION AND ANALYSIS

The signals generated by the RTS units were recorded on strip charts moving at the rate of six in./min. For the fixed location RTS data, it was decided to reduce the concentration analog signal to digital form as a series of end-to-end 5-sec mean concentrations (χ_5). For the moving RTS's the charts were scanned for maximum signal levels. Only the maximum 5-sec concentration (χ_{p5}) observed in an area during each test was recorded.

The choice of a 5-sec data averaging interval was based on the facts that:

- The 5-sec time increment approximates the breathing rate of man.
- This time increment approaches the smallest time increment to which the strip chart data could be reduced without becoming concerned about the influence of the RTS system time constant.
- Time divisions on the strip chart facilitated use of this increment.

Figure 25 gives the history of concentration for specific locations during tests MI-185 and MI-190. The mean 5-sec concentrations are plotted as points and these points are joined, sequentially by straight lines, for graphical clarity. These selected tests are the two in which the stationary RTS's were located closest to the plume centerline (see Columns G and H of Table 4). During MI-185, the mean concentration for the entire test observed at the RTS location, $\bar{\chi}_{RTS}$, was 0.85 of the plume centerline mean concentration, $\bar{\chi}_{CL}$. During MI-190, the ratio $\bar{\chi}_{RTS}/\bar{\chi}_{CL}$ was 0.95. Despite their near centerline exposure, there are considerable differences in the character of these RTS distributions of tracer concentration with time. During MI-185, the plume was detectable at the RTS location (Station 04-910) for about 21 consecutive minutes, or 70% of the time. During MI-190 when the RTS was at Station 03-180, the plume was in evidence only 43% of the time and on a much more sporadic basis. These graphs point out that even near the plume centerline the tracer concentration is far from a constant value.

Similar fluctuations from the mean concentration were observed during the other three tests where the RTS equipment was operated at fixed locations. During test MI-167, both RTS's were operated in a relatively flat field at a distance of about 800 m. A fixed RTS was operated at Station 04-340 during test MI-181. During test MI-183, the RTS location was fixed at Station 04-830.

TABLE 4. Meteorological and Concentration Data for Tests Involving RTS Units

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	
							Location of RTS with respect to plume centerline		Observed (a)		Ratio of predicted to observed values						
MI Test No.	x, meters	σ_θ, degrees	$T_6^{54}-T_6^{5}$, C°	$\bar{u}$ knots	$\bar{u}$ mps	t, sec	$\bar{y}_{RTS}/$℄	y/σ_y	$\bar{\chi}_{℄}/Q$	$\bar{\chi}_{p5}/\bar{\chi}_{℄}$	$\bar{\chi}_{℄}$	χ_p (10 min)	χ_p (5 min)	χ_p (3 min)	χ_p (1 min)	χ_{p5} (5 sec)	MI Test No.
167(b)	800	23.7	4.4	3.1	1.6	590	0.20	-	96(c)	1.5	4.0	29	29	31	31	34	167(b)
181	2150	3.6	4.6	3.2	4.2	500	0.55	0.59	87	4.5	1.6	2.4	3.0	3.7	5.2	8.8	181
183	2150	4.0	4.9	16.6	8.6	250	0.54	1.18	21	3.3	3.8	7.6	7.6	7.6	11	28	183
185	1880	10.0	1.4	6.0	3.1	620	0.85	0.43	40	7.0	5.0	7.2	10	11	14	7	185
190	1000	9.5	4.0	9.6	4.9	200	0.95	0.42	56	14	5.0	5.6	6.0	6.0	4.8	8.8	190
170	1970	10.7	4.1	11.2	5.8	340	1.00		13	12	3.4					6.4	170
179	3640	17.8	4.4	6.2	3.2	1100	0.80		4.6	12	5.6					10	179
179	9060	17.8	4.4	6.2	3.2	2900	~0.9		~4.6	30	0.56					0.44	179
179	11600	17.8	4.4	6.2	3.2	3600	~0.6		~1.5	-27	1.1					0.92	179
180	2340	5.9	4.4	13.3	6.9	340	0.38		14	9.5	12					[illegible]	180
184	2240	12.4	3.1	14.0	7.2	310	0.52		8.6	5.8	2.1					8.8	184
187(b)	9910	4.3	4.4	9.8	4.9	2000	0.56		0.25	5.4	88					310	187(b)
189(b)	2670	8.2	4.5	6.9	3.6	740	0.41		5.5	14	8.0					14	189(b)
191	1000	10.9	4.3	5.4	2.8	360	0.61		140	4.1	2.4					14	191
192	2250	7.2	4.0	17.2	8.9	250	0.36		12	15	3.3					5.2	192
193	2000	5.4	4.1	19.3	9.9	200	0.90		8.3	21	8.0					9.2	193
194	2230	3.1	4.2	17.3	8.9	250	0.37		9.3	9.5	10					15	194
196(b)	2880	6.9	3.4	5.4	3.0	960	0.67		8.6	7.2	2.5					8.4	196(b)
199(b)	2380	9.2	3.3	5.5	2.8	850	0.69		3.2	15	11					17	199(b)
199	3630	9.2	3.3	5.5	2.8	1300	0.85		3.4	12	3.6					7.2	199
200	1880	7.5	3.8	10.1	5.2	360	0.85		12	12	5.2					10	200
201	2280	6.8	4.2	10.9	5.6	410	0.52		8.2	9.1	6.4					16	201
202	2220	8.2	4.6	8.0	4.1	540	0.35		39	6.9	1.4					4.8	202
213	6890	26.0	3.6	3.3	1.7	4000	0.39		1.0	16	1.3					1.8	213
215	2230	5.5	3.1	15.3	7.9	280	0.31		5.2	17	7.2					10	215
216	2280	8.0	3.6	10.2	5.3	430	~0.6		6.0	17	6.4					3.2	216

(a) Units are "$\times 10^{-7}$ sec/m^3" or "$\times 10^{-7}$ g/m^3/g/sec"
(b) Northward trajectory
(c) Computed from "recommended equation" since no filters near this location during MI 167

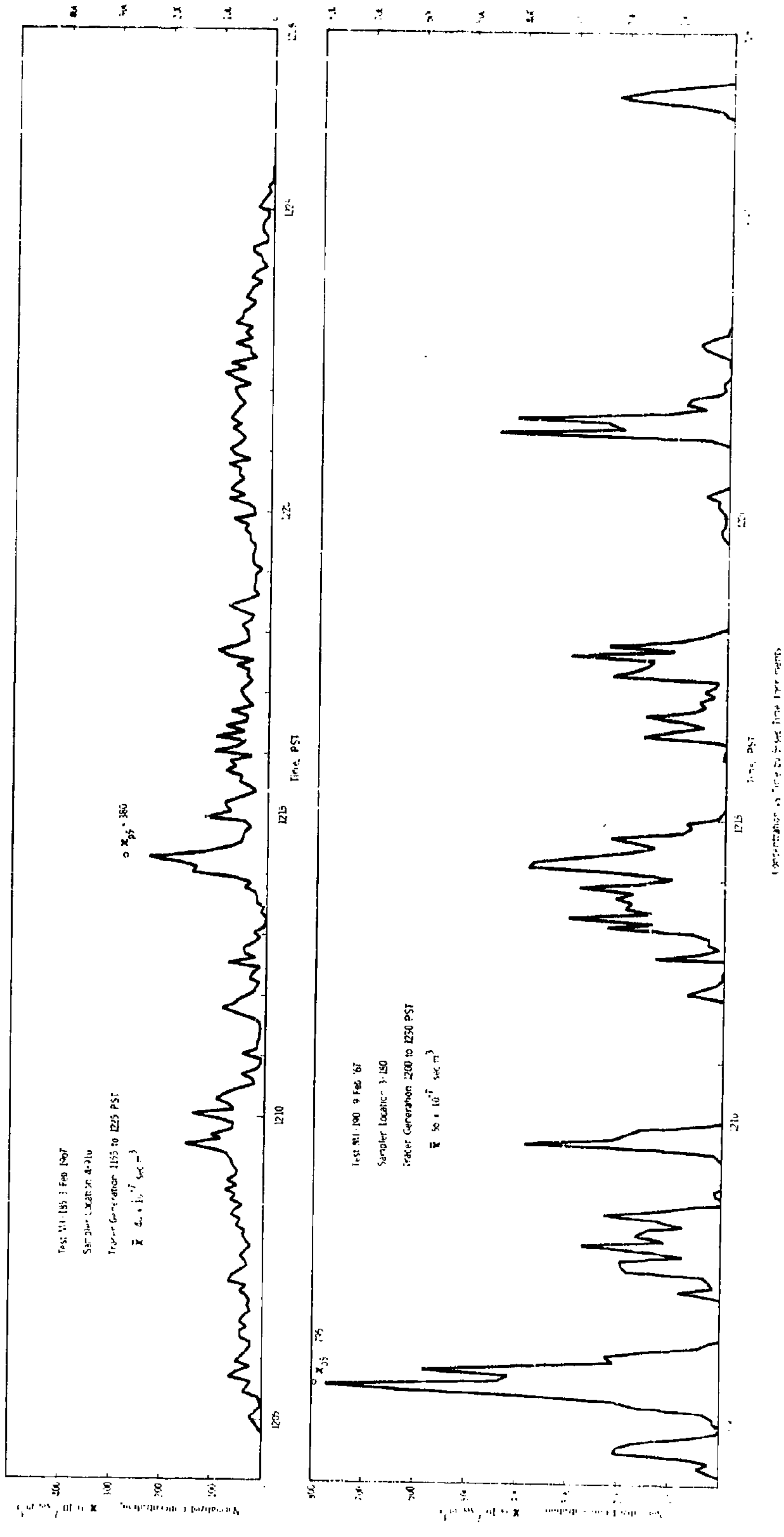


FIGURE 25. Concentration Versus Time

One way of investigating the vagaries of the fluctuating plume concentration is to relate short term concentration, χ_s, to concentrations averaged over considerably longer time increments, $\overline{\chi}_L$, if the χ_s value chosen is the highest concentration, χ_{ps}, observed for the specific short term interval, then the $\chi_{ps}/\overline{\chi}_L$ ratio may be referred to as a peak-to-mean concentration ratio. Generally, the $\overline{\chi}_L$ employed in forming this ratio is that measured at the same location as the χ_{ps}. However, since a parameter of prime interest in the Mountain Iron study is the plume centerline concentration, $\overline{\chi}_{CL}$, resulting from a 30-min tracer release, $\overline{\chi}_{CL}$ has been chosen as the standard long period concentration with which to compare. Thus, in this study, the ratio $\chi_{ps}/\overline{\chi}_{CL}$ is referred to as the peak-to-mean concentration ratio.

The nomenclature χ_{p5} indicates peak value for a 5-sec increment. Column J of Table 4 gives $\chi_{p5}/\overline{\chi}_{CL}$ values for the five stationary RTS tests as well as for the 18 roving RTS tests. First consider the five stationary RTS tests. Since the mean plume centerline is the location where the instantaneous plume would be expected to appear most frequently, it is the point where there is the greatest probability of observing high χ_s values. Although it is no doubt partially fortuitous, note that the peak-to-mean values in Column J of Table 4 order perfectly with respect to their proximity to the plume centerline as is indicated in Columns G and H. In these columns, $\overline{\chi}_{RTS}$ is the mean concentration at the RTS location, y is the crosswind distance of the RTS from the mean plume centerline, and σ_y is the standard deviation of the crosswind plume distribution.

For its specific location, the fixed RTS will always detect the maximum χ_s values. In the case of the roving RTS, no such situation is assured. If the roving RTS were to stay continually near plume centerline, the probability of intercepting maximum χ_s values would be at least equal to that of the fixed RTS. Roving in areas where minimal or no tracer could be found would, of course, give the reverse probability. The previously mentioned signal perturbations associated with the moving RTS make it more difficult to specify a maximum χ_s. In fact, spurious signals add to the danger of overestimating the peak value. Nonetheless, it is subjectively concluded that reasonable use of a roving RTS would result in about the same probability of intercepting high χ_s values as would the use of a fixed RTS which is physically positioned prior to tracer release.

Examination of the peak-to-mean values in Column J for the roving RTS's (tests MI-170 to 216) reveals seven tests in which peak-to-mean ratios are greater than the χ_{p5} of 14 observed in test MI 190. Test MI 179 shows the highest ratios. (The sampler was moving along the coast, and hence concentrations were obtained at more than one location.) The ratios listed for MI 179 are approximate since the plume centerline was projected to be offshore where it could not be measured. Since the $\overline{\chi}_{CL}$ values used are estimates, it is entirely possible that the peak-to-mean ratio here could be higher.

The possibility of relating the observed peak-to-mean ratio to such simple parameters as distance from source (X), wind direction standard deviation (σ_θ), thermal stability (ΔT_6^{54} + 5), mean wind speed ($\overline{U}$), or travel time (t) was investigated. These parameters are listed in Columns A through F of Table 4. Minimal or no statistical correlation was observed.

The random nature of the very short term peak concentrations, such as those of 5-sec duration, no doubt tends to mask correlations even if they do exist. For instance, a glance at the concentration distributions on Figure 25 reveals that if the observed half-minute peak concentration period had somehow failed to appear, the next highest peak short period concentrations would have been about 30% lower in magnitude. In other words, in using a single observation location (even if it be near the plume centerline) there is no assurance that on a given experiment one will observe the peak short term concentration possible under the existing meteorological conditions.

Although there is particular concern with peak 5-sec concentrations (χ_{p5}), it is also of interest to know the distribution of 5-sec duration concentrations (χ_5) of lesser magnitude. Here the higher sample density permits the drawing of conclusions with more confidence than is the case with those based on the single value of χ_{p5}. Figures 26 and 27 give cumulative frequency distributions of $\chi_5/\bar{\chi}_{CL}$ for the five fixed-location RTS tests. It cannot be stated that these are "typical" but they are a least rough guides to these distributions at locations both near the plume centerline (MI-185 and 190) and nearer the plume edge (MI-167). Columns G and H in Table 4 quantitatively specify these locations. The distributions assume a possible 30-min total plume passage.

Some example uses of these graphs may be in order. For this purpose, consider the curve for test MI-190 as the applicable distribution. The sampler was exposed at a distance of 1000 m from the source and at $\bar{\chi}_{RTS}/\bar{\chi}_{CL}$ of 0.95. What percentage of the χ_5 values were equal to or greater than the centerline mean concentration? To answer, read the ordinate of 24% above the value $\chi_5/\bar{\chi}_{CL}$ of 1.0. What percentage were at least five times the mean? Above $\chi_5/\bar{\chi}_{CL} = 5.0$, the answer is read as 4.4%. What 5-sec-to-mean concentration ratio was exceeded only 1% of the time? The abscissa at the cumulative percentage of 1% indicates an answer of 8.4 for this short-term-to-mean ratio.

Examination of these graphs gives some indication of the random nature of the χ_{p5} value. The continuous portions of the curves were generated by computing χ_5 values for a series of end-to-end, 5-sec time increments. The selection of the first increment, and hence all succeeding, was dictated merely by a timing division on the strip chart record. It would, of course, be quite unlikely that the χ_{p5} value for <u>any</u> 5-sec time increment on the chart would coincide with one of the specified end-to-end increments. Thus the χ_{p5} for a test will be equal to or greater than the largest χ_5 value generated from the end-to-end reduction. The χ_{p5} values are indicated by circles on Figures 25, 26, and 27.

If the choice of timing increment for reduction of the strip chart had been based on the χ_{p5} increment instead of being of an arbitrary nature as was the fact, it is unlikely that the curves on Figures 26 and 27 would have been altered except at the extreme bottom. In fact, it is doubtful if the second highest χ_5 value, again irrespective of time but not overlapping the χ_{p5} increment, would significantly differ from the second highest

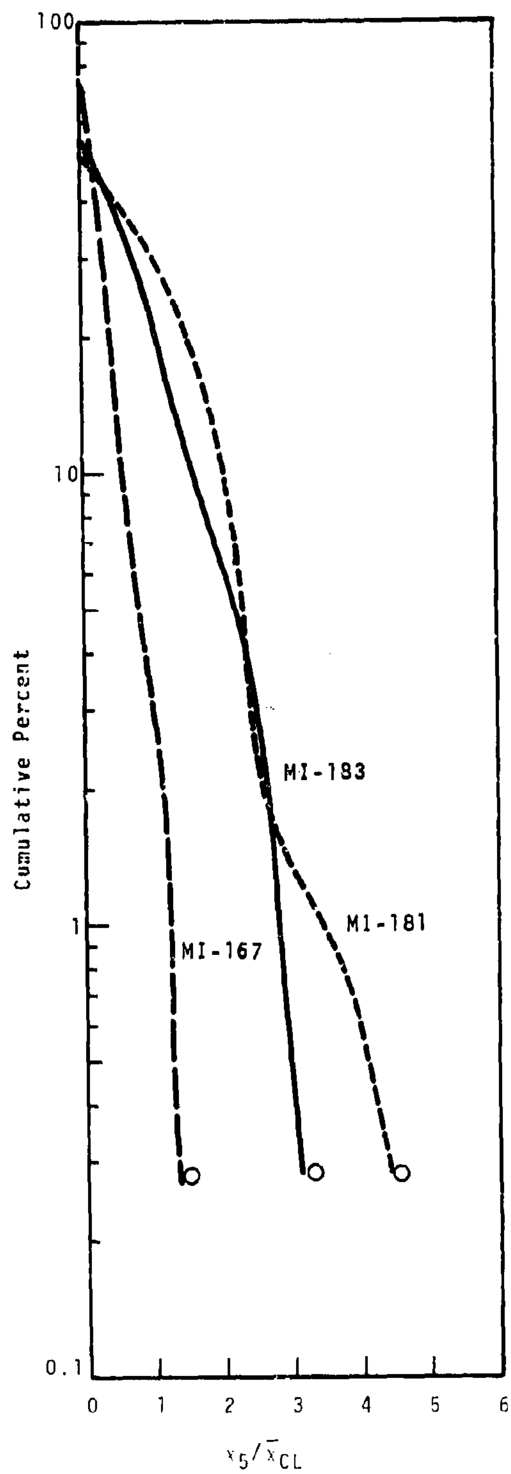


FIGURE 26. Percent of Time 5-Sec-to-Centerline-Mean Concentration Ratio Equals or Exceeds the Indicated Ratio. (Curves are for locations well removed from plume centerline.)

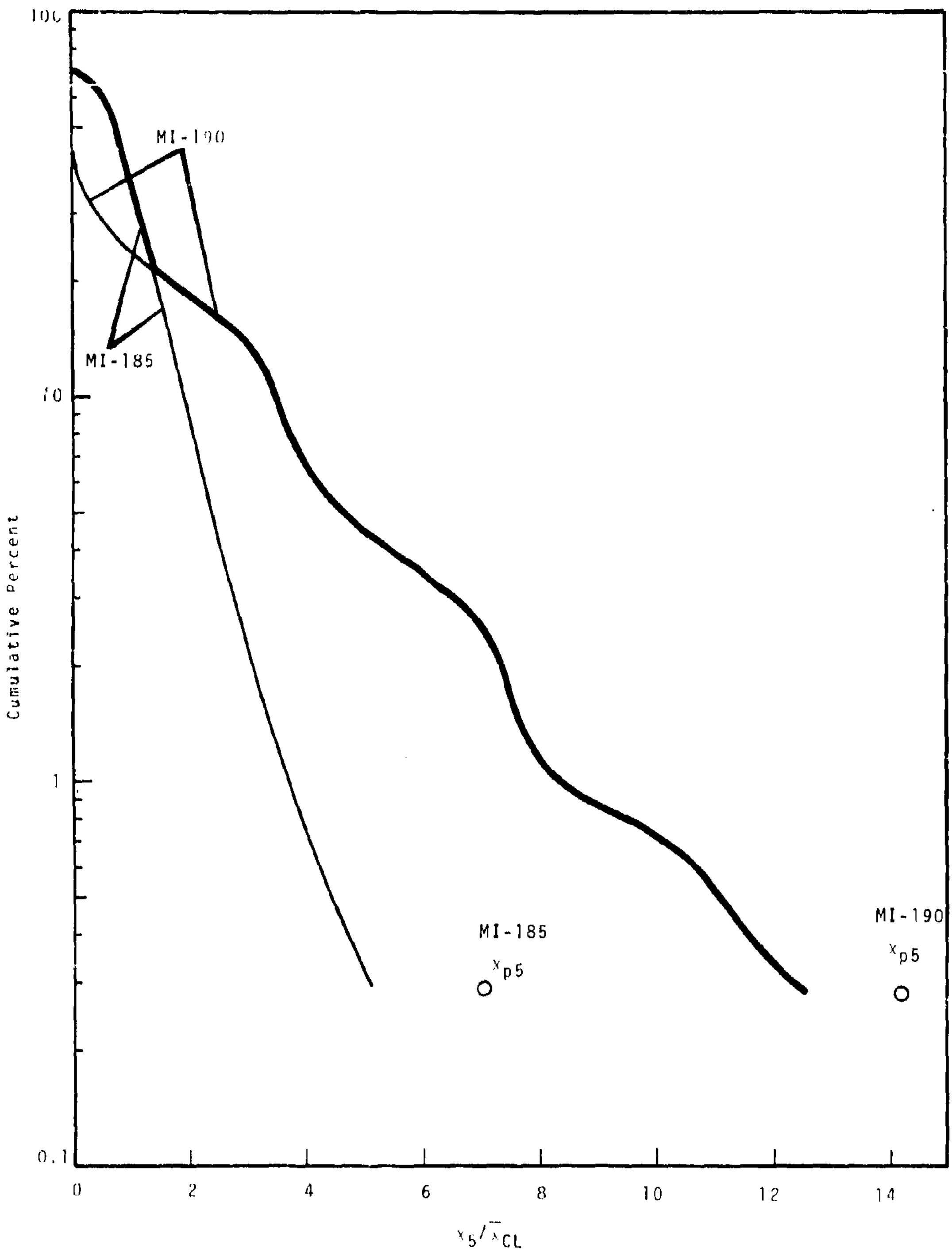


FIGURE 27. Percent of Time 5-Sec-to-Centerline-Mean Concentration Ratio Equals or Exceeds the Indicated Ratio. (Curves are for locations near plume centerline.)

χ_5 computed in the end-to-end timing actually used. So the discontinuous nature of the cumulative distribution would remain at the extreme lower end.

Gifford[14] presented peak-to-mean ratios as a function of the total time of data collection, τ_L, divided by the period of averaging of the relatively short period peak, τ_s. Hinds[15] and Ramsdell[16] also have presented peak-to-mean data in this fashion.

The mean concentrations in the cited studies were measured at the same location as the peak short-term concentrations, χ_{ps}, and not at the plume centerline as in the Mountain Iron study. This difference in the reference to which χ_{ps} is compared results in different ratios (except for locations at the plume centerline where the references are identical). In either case, the presentation of peak-to-mean ratios as a function of τ_L/τ_s is convenient. This technique does not prescribe the τ_L or τ_s intervals over which the concentration data must be averaged, so that the τ_L/τ_s ratio is applicable to a variety of peak and mean averaging intervals.

The χ_{ps} values for each field test were chosen in a manner analogous to the method of choosing χ_{p5}. They are the result of systematic elimination of periods of obviously high concentration until only the highest, χ_{ps}, remained for a given τ_s. τ_s averaging increments of 1, 3, 5, and 10 minutes were used, resulting in τ_L/τ_s abscissa values of 30, 10, 6 and 3. Figure 28 presents data from the five stationary RTS tests plotted in the described fashion.

χ_{p5} values for both the fixed and roving RTS tests were also employed. The resulting peak-to-mean values are plotted at τ_L/τ_s of 360. χ_{ps} values other than χ_{p5} are not obtainable from the roving RTS tests. Values generated by the roving RTS's are plotted as triangles. The values plotted at τ_L/τ_s of 1 reflect the mean plume concentration at the RTS location with respect to the same parameter at the plume centerline, i.e., $\overline{\chi}_{RTS}/\overline{\chi}_{CL}$.

Some theory and observations support the hypothesis that at "intermediate" values of τ_L/τ_s, the peak-to-mean ratio increases at a rate proportional to the square root of the τ_L/τ_s ratio. The solid straight line at

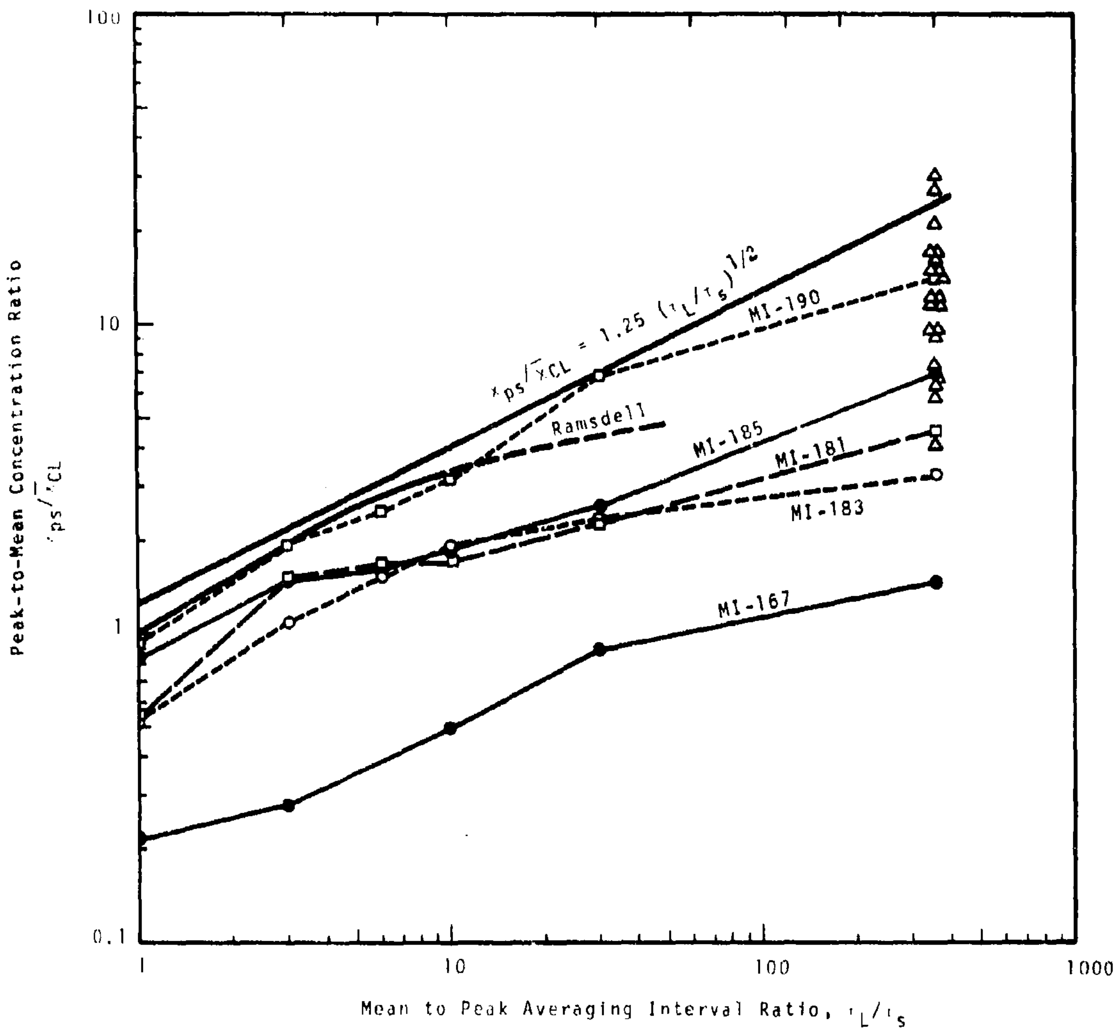


FIGURE 28. Peak-to-Centerline-Mean Concentration Versus Mean-to-Peak Averaging Interval

the top of Figure 28 reflects this relationship. The line labeled "Ramsdell" is Ramsdell's estimate of the typical peak-to-mean relationship for locations near plume centerline. His work was based on real-time concentration measurements of a diffusing radioactive inert gas plume. His τ_L values ranged from 10 to 20 min.

The curve for test MI-190, the test carried out closest to the plume centerline, has a slope approximating the slope of one-half suggested by theory and shown by the solid line. The MI-190 curve is in good agreement with Ramsdell's curve throughout the "confident" portion of his data. The slopes on the other tests average between one-half and one-third.

If the mean concentration at the plume centerline is known, the solid line with the equation

$$\frac{\chi_{ps}}{\overline{\chi}_{CL}} = 1.2 \left(\frac{\tau_L}{\tau_s}\right)^{1/2} \tag{15}$$

is suggested as a reasonable curve for estimating the peak-to-mean ratio. It was chosen mainly because it embraces all of the $\chi_{ps}/\overline{\chi}_{CL}$ data for the stationary RTS's and data from all but one test from the roving RTS's. (The two triangular data points above the recommended line at $\tau_L/\tau_s = 360$ are both from test MI-179, a test with a partially overwater trajectory.)

Of course, in the usual situation, the plume centerline concentration is not known but must be predicted. The final equation as developed in Chapter 5 for predicting the centerline concentration or exposure is

$$\frac{\overline{\chi}_{CL}}{Q} = \frac{E_p}{Q_T} = 7.8 \times 10^2 \quad X^{-2.4} \quad \sigma_\theta^{-1.0} \quad \overline{U}^{-0.48} \quad (\Delta T_6^{54} + 5)^{1.2} \; . \tag{6}$$

To assure that at least 95% of the centerline concentrations are less than the predicted value, the intercept of Equation (6) is multiplied by four, and predicting equation becomes

$$\frac{\overline{\chi}_{CL}}{Q} = \frac{E_p}{Q_T} = 3.1 \times 10^3 \quad X^{-2.4} \quad \sigma_\theta^{-1.0} \quad \overline{U}^{-0.48} \quad (\Delta T_6^{54} + 5)^{1.2} \; . \tag{16}$$

The question then arises as to whether the safety factor built into Equation (16) is sufficient to permit continued use of Equation (15) in combination with the $\overline{\chi}_{CL}$ predicted by Equation (16) to forecast limiting peak-to-mean ratios.

Column K in Table 4 gives the ratio of the predicted value of $\overline{\chi}_{CL}$ [from Equation (16)] to the mean centerline concentration actually observed. There is one test, MI-179 again, in which the predicted is less than the observed. Columns L through P give the predicted-to-observed ratios for peak concentrations averaged over several different time increments. As before, only the χ_{p5} values are available for the roving RTS tests. The fact that the predicted-to-observed χ_s ratios (in Columns L through P) are larger than the predicted-to-observed $\overline{\chi}_{CL}$ ratios (in Column K) indicates that the peak short period concentration forecasts are at least as conservative as the centerline predictions. The only exception to the just stated conclusion concerning the conservative nature of the forecasting technique occurs during test MI-179 which shows two predicted χ_{p5} values smaller than the observed. Conversely, for test MI-187 Columns K and P of Table 4 show extremely conservative forecasts of both $\overline{\chi}_{CL}$ and χ_{p5} with overestimates of 88 and 320 times the observed, respectively. These overestimates result from drastic changes in wind during the course of the experiment. Samplers were exposed at a location north of the source point. Winds were southerly during tracer generation, but switched abruptly to northerly, minutes after generation ended. Apparently only the extreme leading portions of the plume reached the sampling location, thus reducing the originally expected mean and peak concentrations. The forecasts are based on the plume continuing to move under essentially the same meteorological conditions that occurred during tracer generation. In fact, the deteriorating meteorology caused this test to be eliminated from those considered in the developing of equations in Chapter 5. MI-187 is, incidentally, the only test tabled in these short term concentration considerations that was not employed in the general equation development.

Does the Equation (15) and (16) combination give too conservative an estimate? Perhaps. Yet Column P shows the predicted χ_{p5} for test MI-213 was only 1.8 times the observed value. Further, considering the random nature of χ_{p5} values, the number of tests sampled was none too high. Finally, the philosophy in this report is that the concentrations desired are biased toward the "maximum possible" type, and are not of the "expected value" type. It is recommended that Equations (15) and (9) be employed to estimate peak concentrations. Equation (9) is equivalent to Equation (16) with the appropriate conversions for use with NO_2 and the system of units used in the range safety equation.

OPERATIONAL APPLICATIONS AT SUDDEN RANCH

Although constants in the following prediction equations were developed using the assumption that the total release period of a pollutant was 30 min, these equations can reasonably be used to estimate peak short period concentrations (5-sec to 10-min duration) resulting from releases of 15 to 45 min duration. The equations apply to distances in the range of 200 to 10,000 m (0.1 to 6.2 miles) from a ground based pollutant source.

The peak short period atmospheric concentration of a pollutant that can be expected can be estimated from the relationship

$$\chi_{ps} = 2.1 \times 10^4 Q \tau_s^{-0.5} X^{-2.4} \sigma_\theta^{-1.0} \bar{U}^{-0.48} (\Delta T_6^{54} + 5)^{1.2} \qquad (17)$$

where

χ_{ps} = maximum short period concentration for time interval τ_s, mass/m^3

Q = pollutant source generation rate with mass units the same as used for χ_{ps}, mass/sec

τ_s = selected short-period averaging increment, minutes

X = distance from pollutant source, meters

σ_θ = wind direction standard deviation, degrees

$\bar{U}$ = mean wind speed, knots

ΔT_6^{54} = temperature at height of 54 ft minus temperature at 6 ft, C°.

After transformation of Equation (17) to a form more compatible with anticipated Sudden Ranch application, parts per million of NO_2 for short periods can be estimated from the equation

$$\chi_{NO_2} = 6.8 \times 10^8 \, Q_{NO_2} \, \tau_s^{-0.5} \, X^{-2.4} \, \sigma_\theta^{-1.0} \, \bar{U}^{-0.48} \, (\Delta T_6^{54} + 9)^{1.2} \tag{18}$$

where

Q_{NO_2} = generation rate of the NO_2 source, lb/min
τ_s = selected short period averaging increment, minutes
X = distance from NO_2 source, feet
σ_θ = wind direction standard deviation, degrees
$\bar{U}$ = mean wind speed, knots
ΔT_6^{54} = temperature at height of 54 ft minus temperature at 6 ft, F°.

If an estimate of mean plume centerline concentration, $\bar{\chi}_{CL}$, has been made [for example, from Equation (9)] then the peak short period concentration, χ_{ps}, can be estimated from the relationship

$$\chi_{ps} = 6.85 \, \tau_s^{-1/2} \, (\bar{\chi}_{CL}) \tag{19}$$

where τ_s, in minutes, is the short period of interest. The units of χ_{ps} are determined by and are identical to the units of $\bar{\chi}_{CL}$.

For computational convenience, Table 5 lists several values of $6.8 \, \tau_s^{-1/2}$ for corresponding values of τ_s.

TABLE 5. Multipliers for Converting Centerline Mean Concentration to Estimated Peak Concentration

τ_s, min	$6.8 \, \tau_s^{-1/2}$
10	2.2
5	3.1
3	4.0
1	6.8
1/2	9.7
1/12 (5-sec)	24.0

A rough estimate of the distribution of 5-sec increments of concentration, χ_5, with respect to the mean plume centerline concentration, $\bar{\chi}_{CL}$, can be obtained from the composite curve on Figure 27. These graphed distributions apply to near centerline locations. (The $\chi_5/\bar{\chi}_{CL}$ ratios are lower at locations farther removed from the plume centerline--as in Figure 26.) A number of points from the limiting curve (emphasized by the heavier line) in Figure 27 are tabled in Table 6. Note that the concern here is the distribution of all 5-sec duration increments of concentration resulting from a single pollutant release, and not just the single peak 5-sec value. Example readings from the table are, "Near plume centerline, the 5-sec duration concentrations exceed one-half the mean centerline concentration no more than 60% of the time." "The 5-sec duration concentrations exceed 10 times the mean centerline concentration no more than 0.71% of the time."

TABLE 6. Percent of Time the Five-Second-to-Centerline-Mean Concentration Ratio Equals or Exceeds the Indicated Ratio

Data Apply to Near-Centerline Locations

Cumulative Percent	$\chi_5/\bar{\chi}_{CL}$ Equalled or Exceeded
60	0.5
50	0.8
37	1.0
25	1.3
20	1.7
18	2.0
14	3.0
10	3.5
6.8	4.0
5.0	4.7
4.5	5.0
3.5	6.0
2.5	7.0
1.1	8.0
1.0	8.4
0.87	9.0
0.71	10.0
0.52	11.0
0.36	12.0

ACKNOWLEDGEMENTS

During the test period, Detachment 30, 6th Weather Wing, under the command of Col. R. F. Durbin was most helpful and provided coordination, meteorological support, and cooperation in the forecast effort. Col. J. M. Tyndall, Commander, and Lt. J. F. Anderson, Detachment 30, have given assistance and counsel concerning the contents of the document. Extensive upper air sounding was ably performed by the 6th Weather Squadron (Mobile), 6th Weather Wing, and by the U.S. Weather Bureau at Vandenberg Air Force Base, under the direction of N. J. Asbridge.

Battelle-Northwest personnel have provided invaluable assistance in the program. Continuing direction and support of the program were provided by C. L. Simpson, C. E. Elderkin and E. C. Watson. Assistance by E. W. Lusty and O. B. Abbey during the data gathering effort contributed greatly to the program's success. Many of the Atmospheric Analysis Section contributed at one time or another to the data reduction and document preparation effort; special recognition is given B. N. Nelson, Jr. and Delores McKee for their sustained efforts in analysis of volumes of data and to Judy Nielson for her tireless effort in typing.

Gerald Marzyck, Graphics Section, provided consultation which improved graphics representation within the document and did an excellent rendering of the base map for South Vandenberg Air Force Base and Sudden Ranch.

REFERENCES

1. O. B. Sutton. Micrometeorology. McGraw-Hill Book Co., Inc., New York, N.Y., 1953.

2. N. M. Fenneman. Physiography of Western United States. McGraw-Hill Book Co., Inc., New York and London, 1931.

3. T. B. Smith, E. K. Kauper, S. Berman, and F. Vukovich. Micro-meteorological Investigation of Naval Missile Facility, Point Arquello, California, Vol. I. Meteorology Research, Inc., 2420 North Lake Avenue, Altadena, California, 1964.

4a. W. T. Hinds and P. W. Nickola. The Mountain Iron Diffusion Program: Phase I; South Vandenberg: Volume 1, BNWL-572 Vol. 1. Battelle-Northwest, Richland, Washington, November 1967.

4b. W. T. Hinds and P. W Nickola. The Mountain Iron Diffusion Program: Phase I; South Vandenberg: Volume 2, BNWL-572 Vol. 2. Battelle-Northwest, Richland, Washington, January 1968.

5. G. A. Demarrais, G. C. Holzworth, and C. R. Hosler. Meteorological Summaries Pertinent to Atmospheric Transport and Dispersion Over Southern California, Tech. Paper 54, Weather Bureau (ESSA), Dept of Commerce, Washington, D.C., 1965.

6. D. A. Haugen and J. H. Taylor. The Ocean Breeze and Dry Gulch Diffusion Programs. Air Force Cambridge Research Laboratories, 1963.

7. F. Pasquill. Atmospheric Diffusion. Van Nostrand, London, 1962.

8. I. Van der Hoven. "Atmospheric Transport and Diffusion at Coastal Sites," Nucl. Safety, vol. 8, no. 5, pp. 490-499. September-October 1967.

9. E. W. Hewson and L. E. Olsson. "Lake Effects on Air Pollution Dispersion," J. Air Pollution Control Assoc., vol. 17, no. 11, pp. 757-761. November 1967.

10. F. A. Gifford. "Statistical Properties of a Fluctuating Plume Dispersion Model," Advances in Geophysics. Academic Press, New York, 1959. vol. 6, pp. 117-137.

11. J. V. Ramsdell. "The Use of Instantaneous Plume Measurements to Approximate a Mean Plume," Pacific Northwest Laboratory Annual Report for 1967 to the USAEC Division of Biology and Medicine, Vol. II: Physical Sciences, Part 3. Atmospheric Sciences, BNWL-715-3, pp. 12-18. Battelle-Northwest, Richland, Washington, October 1968.

12. J. J. Fuquay, C. L. Simpson, and W. T. Hinds. "Prediction of Environmental Exposures from Sources near the Ground Based on Hanford Experimental Data," J. Appl. Meteorol., vol. 3, no. 6, pp. 761-770. December 1964.

13. P. W. Nickola, M. O. Rankin, M. F. Scoggins, and E. M. Sheen. "A System for Recording Air Concentrations of Zinc Sulfide Fluorescent Pigment on a Real Time Scale," J. Appl. Meteorol., vol. 6, no. 2, pp. 430-433. 1967.

14. F. Gifford. "Peak to Average Concentration Ratios According to a Fluctuating Plume Dispersion Model," Inter. J. Air Pollution, vol. 3, no. 4, pp. 253-260. 1960.

15. W. T. Hinds. On the Variance of Concentration in Plumes and Wakes, BNWL-SA-1435. Battelle-Northwest, Richland, Washington, 1967.

16. J. V. Ramsdell, Jr. Unpublished Data. Battelle-Northwest, Richland, Washington. (Preliminary work relating to peak-to-mean relationships derived from a diffusing plume of ^{85}Kr gas).

APPENDIX A

PLUME PATTERNS FOR MOUNTAIN IRON PHASE II

BLANK PAGE

APPENDIX A

PLUME PATTERNS FOR MOUNTAIN IRON PHASE II

Isopleths of normalized time-integrated concentration for each of the tests used in development of the statistical regression equation for Mountain Iron Phase II, except test 168, are included in Appendix A. No concentration isopleths were drawn for MI-168 because time-integrated concentrations were available from only the 500 m sampling arc. (A general idea of the plume pattern for MI-168 can be gained from Figure 12 in Chapter 6.) The physical units for the time-integrated concentration isopleths are g-sec/m^3/g, and the labeled values must be multiplied by 10^{-9} to obtain actual time-integrated concentrations.

The wind field for each test, determined from the WIND System and other wind sensors, is shown by arrows aligned with the airflow. The wind speed, in knots, for each location is shown at the head of the arrow; the letter M is used to indicate missing wind speeds. The wind data shown represent averages for the 30 min period of tracer generation.

In a number of tests, time-integrated concentrations well above background levels were obtained along the coastal road near Jalama Beach. The isopleths for this area have been connected with the corresponding isopleths in the Point Arguello-Sudden Ranch area by dashed lines to show the continuity between them (e.g. MI-122, 153 and 202). These dashed lines do not indicate actual plume boundaries and no attempt has been made to indicate the coastal region of rapid lateral plume growth discussed in Chapter 6.

In many of the plume patterns (e.g., MI-118, 148 and 229) the isopleths have been extended a short distance beyond the most distant sampling arc having time-integrated concentrations above background. This was done to facilitate identification and labeling of the isopleths.

There are several tests in which isopleths end abruptly, e.g., 125, 158, 165 and 191. This can be explained in every case but one by the fact that measurements were not taken at the next arc. The lack of data at the next arc for one test, i.e., MI-191, can not be explained. A thorough check of the records indicate that all downwind sampler engines on the next arc were operating.

The time-integrated concentration for each sampler for these tests may be made available to qualified persons by application to the USAF Environmental Technical Applications Center.

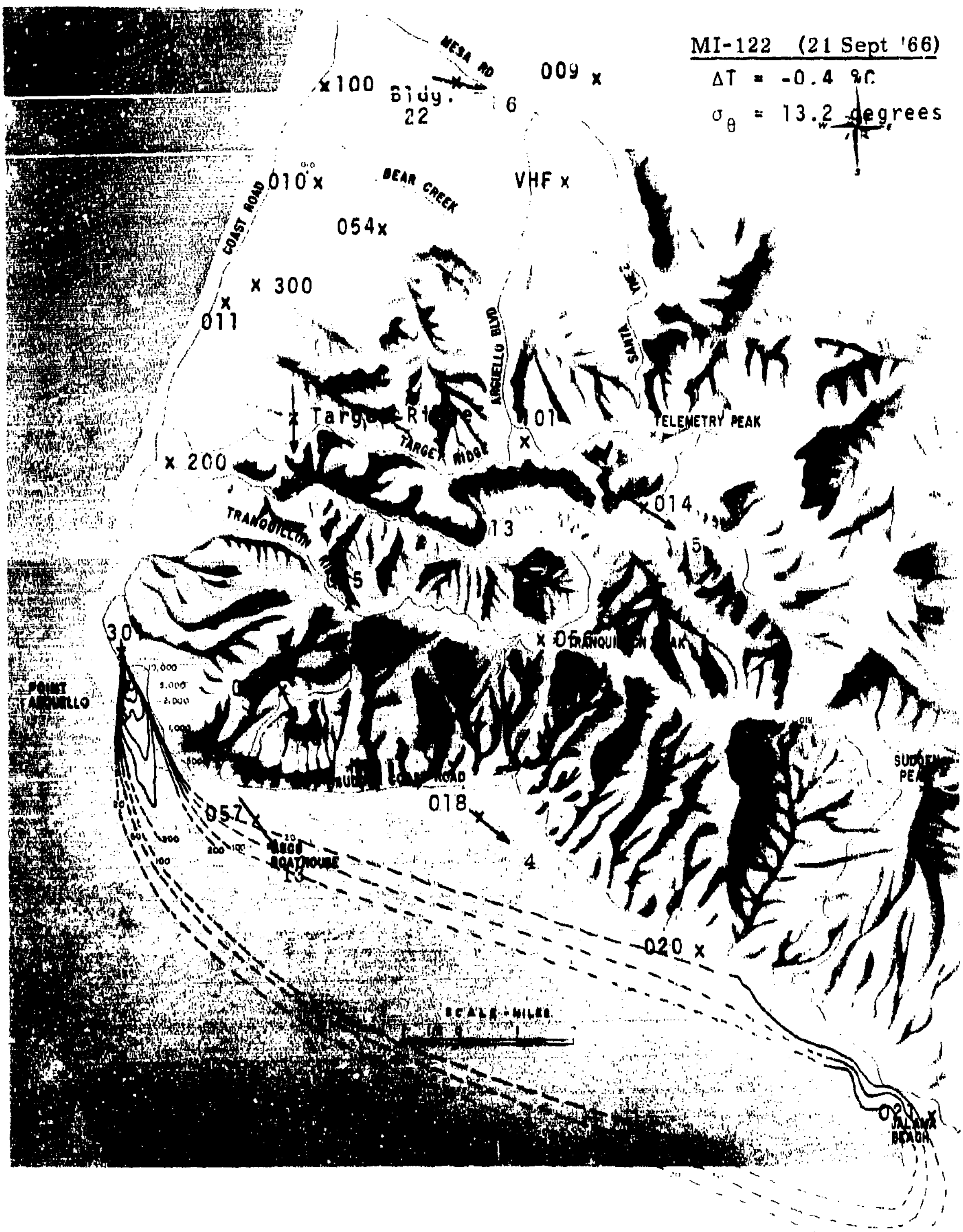

MI-114 (7 Sept '66)
ΔT = -2.1 °C
σθ = 12.5 degrees
x100
Bldg. 22
009 x
MESA RD
010
BEAR CREEK
COAST ROAD
054
5
VHF
10
300
011
5
5
SANTA
ARGUELLO BLVD
Target Range
TARGET RIDGE
TELEMETRY PEAK
200
014
013
5
9
018
11
057
020 x
021
13


MI-115 (8 Sept '66)
ΔT = -2.4 °C
σθ = 9.6 degrees
MESA RD
009 x
x100
Bldg. 22
10
COAST ROAD
010
BEAR CREEK
VHF
11
19
054
300
7
011
11
TELEMETRY PEAK
x 200
TRANQUILLON
13
014
057 x
018
15
020 x
021
8

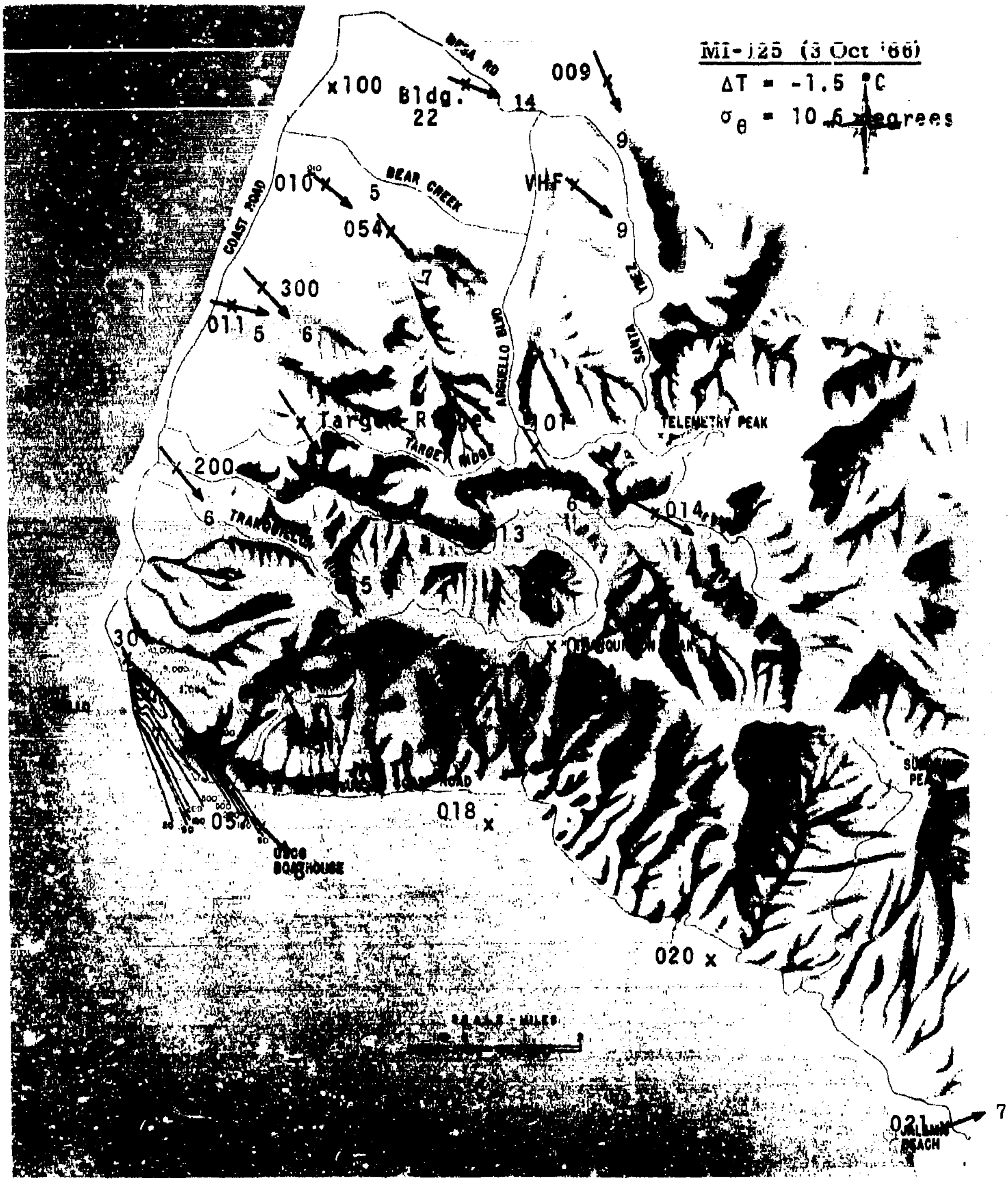

MI-116 (9 Sept '66)
ΔT = -1.0 °C
σ_θ = 7.3 degrees
x 100 Bldg. 22
8
009 x
BEAR CREEK
010 x
6
054 x
VHF x
10
COAST ROAD
x 300
7
011
7
3
ARGUELLO BLVD
Target Ridge
TARGET RIDGE
01
TELEMETRY PEAK
x 200
x 014
13
5
057 x
018
10
USCG BOATHOUSE
020 x
021
BEACH
4


MI-117 (14 Sept '66)
ΔT = -2.0 °C
σθ = 15.5 degrees
MESA RD
009 x
x100
Bldg. 22
13
BEAR CREEK
COAST ROAD
010
054
8
VHF
15
300
18
011
7
1
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
x 200
14
014
TRANQUILLON
13
5
30
POINT ARGUELLO
018
087
USCG BOATHOUSE
19
12
020 x
021
13


MI-118 (15 Sept '66)
ΔT = -2.4 °C
σ_θ = 10.6 degrees
MESA RD
009 x
x100
Bldg. 22
11
BEAR CREEK
010
COAST ROAD
VHF
11
054
5
7
300
011
6
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
x 200
9
014
13
5
7
057
018
4
020 x
6

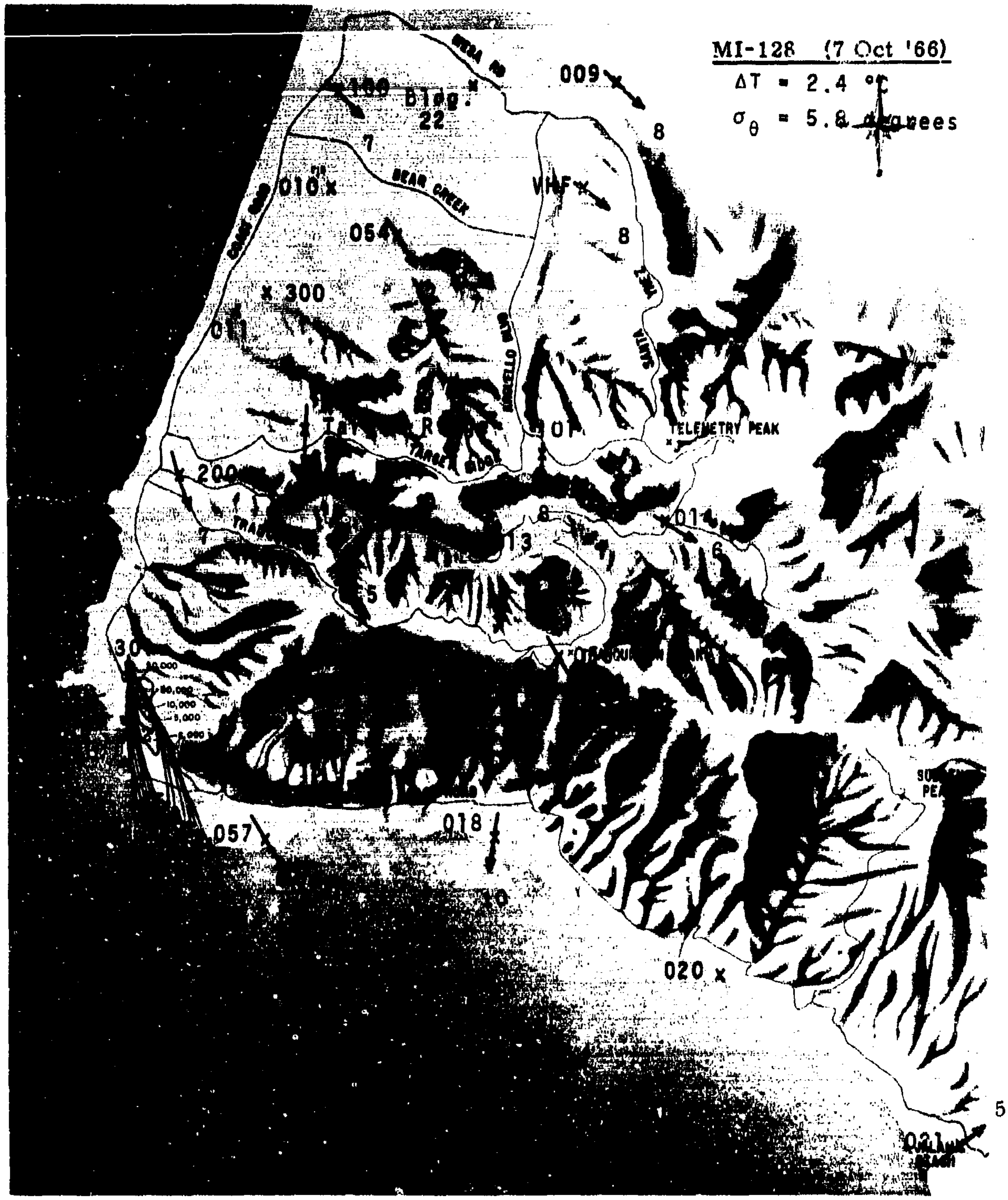

MI-122 (21 Sept '66)
ΔT = -0.4 °C
σθ = 13.2 degrees
MESA RD
009 x
x100
Bldg. 22
6
010 x
BEAR CREEK
VHF x
COAST ROAD
054x
x 300
011
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
01
TELEMETRY PEAK
x 200
TRANQUILLON
014
13
5
5
30
POINT ARGUELLO
TRANQUILLON PEAK
COAST ROAD
018
052
BOATHOUSE
4
020 x
SCALE - MILES
JALAMA BEACH


MI-124 (22 Sept '66)
ΔT = -1.3 °C
σ_θ = 6.6 degrees
MESA RD
009
11
x100 Bldg. 22
010
5
BEAR CREEK
VHF
9
COAST ROAD
054
8
300
011
6
2
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
10
x 200
10
12
014
TRANQUILLON
13
7
55
TRANQUILLON PEAK
301
057
018
19
USCG BOATHOUSE
020 x
SCALE - MILES
021
JALAMA BEACH


MI-125 (3 Oct '66)
ΔT = -1.5 °C
σθ = 10.6 degrees
x100 Bldg. 22
14
009
9
010
5
BEAR CREEK
VHF
9
054
7
COAST ROAD
300
011
5
6
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
6
13
014
5
018 x
020 x
USCG BOATHOUSE
021
7


MI-126 (4 Oct '66)
ΔT = -1.2 °C
σ_θ = 11.3 degrees
Bldg. 22
BEAR CREEK
VBF
TELEMETRY PEAK
TARGET RIDGE
010
054
300
011
200
013
014
018
020
021
10
6
7
5
3


MI-127 (6 Oct '66)
ΔT = -2.4 °C
σθ = 7.5 degrees
x100 Bldg. 22
009
11
010
4
BEAR CREEK
VHF
054
7
300
011
4
2
COAST ROAD
TELEMETRY PEAK
x 200
8
014
13
5
018
057
020 x
021


MI-128 (7 Oct '66)
ΔT = 2.4 °C
σθ = 5.8 degrees
009
8
100
Bldg. 22
7
BEAR CREEK
010
VHF
8
054
x 300
011
TELEMETRY PEAK
200
8
014
6
13
5
30
057
018
020
021
5


MI-129 (13 Oct '66)
ΔT = -1.4 °C
σ_θ = 4.3 degrees
Bldg. 22
100
009
010
BEAR CREEK
VHF
054
13
30
300
011
COAST ROAD
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
200
11
TRANQUILLON
20
013
014
018
21
020
14
021
BEACH
057
22
12
MESA RD


MI-130 (14 Oct '66)
009
100
Bldg. 22
010
BEAR CREEK
VRF
054
300
200
TELEMETRY PEAK
014
13
057
018
020
USGS BOATHOUSE
SCALE - MILES
021


MI-131 (17 Oct '66)
ΔT = -1.3 °C
σθ = 7.3 degrees
100
Bldg. 22
4
009
10
010
BEAR CREEK
VHF
8
054
4
COAST ROAD
300
3
011
4
TELEMETRY PEAK
TARGET RIDGE
200
4
014
5
13
5
30
057
018
USCG BOATHOUSE
020
3
021
JALAMA BEACH

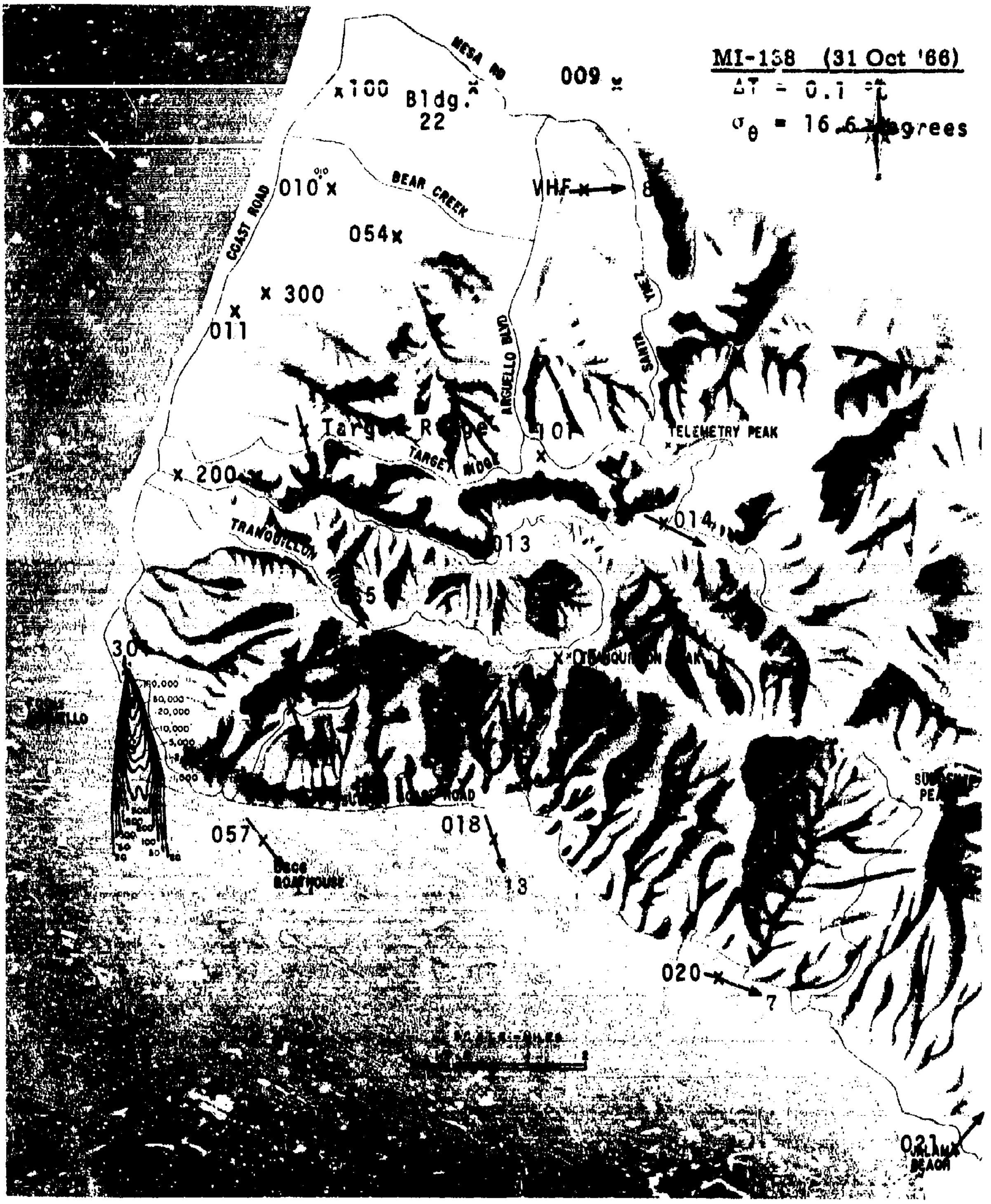

MI-132 (19 Oct '66)
ΔT = -0.6 °C
σ_θ = 10.1 degrees
Bldg. 22
BEAR CREEK
VHF
TELEMETRY PEAK
TARGET ROAD
057
018
020
021
USGS BOATHOUSE
SCALE MILES
BEACH


MI-133 (21 Oct '66)
ΔT = -1.4 °C
σθ = 6.5 degrees
100
Bldg. 22
9
009
010
7
054
BEAR CREEK
VHF
14
COAST ROAD
300
011
10
TELEMETRY PEAK
200
8
013
014
018
16
057
020
12
021
JALAMA BEACH
7


MI-135 (26 Oct '66)
ΔT = -1.1 °C
σ_θ = 8.0 degrees
MESA RD
009
8
100
Bldg. 22
7
8
BEAR CREEK
010
VHF
11
054
5
6
COAST ROAD
300
6
011
2
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
9
014
5
013
5
5
301
057
BOATHOUSE
15
018
020
SCALE - MILES
BEACH


MI-136 (27 Oct '66)
ΔT = -1.6 °C
σθ = 9.1
100
Bldg. 22
009
BEAR CREEK
COAST ROAD
010
054
VHF
x 300
011
TARGET RIDGE
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
200
014
TRANQUILLON
057
USCG BOATHOUSE
018
020
BEACH


MI-137 (28 Oct '66)
ΔT = -1.0 °C
σθ = 16.2 degrees
MESA RD
009
8
100
Bldg. 22
6
010
BEAR CREEK
VHF
10
054
5
6
COAST ROAD
300
011
9
3
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
TARGET RIDGE
200
6
TRANQUILLON
6
014
13
30
057
BOATHOUSE
018
020
SCALE - MILES
BEACH

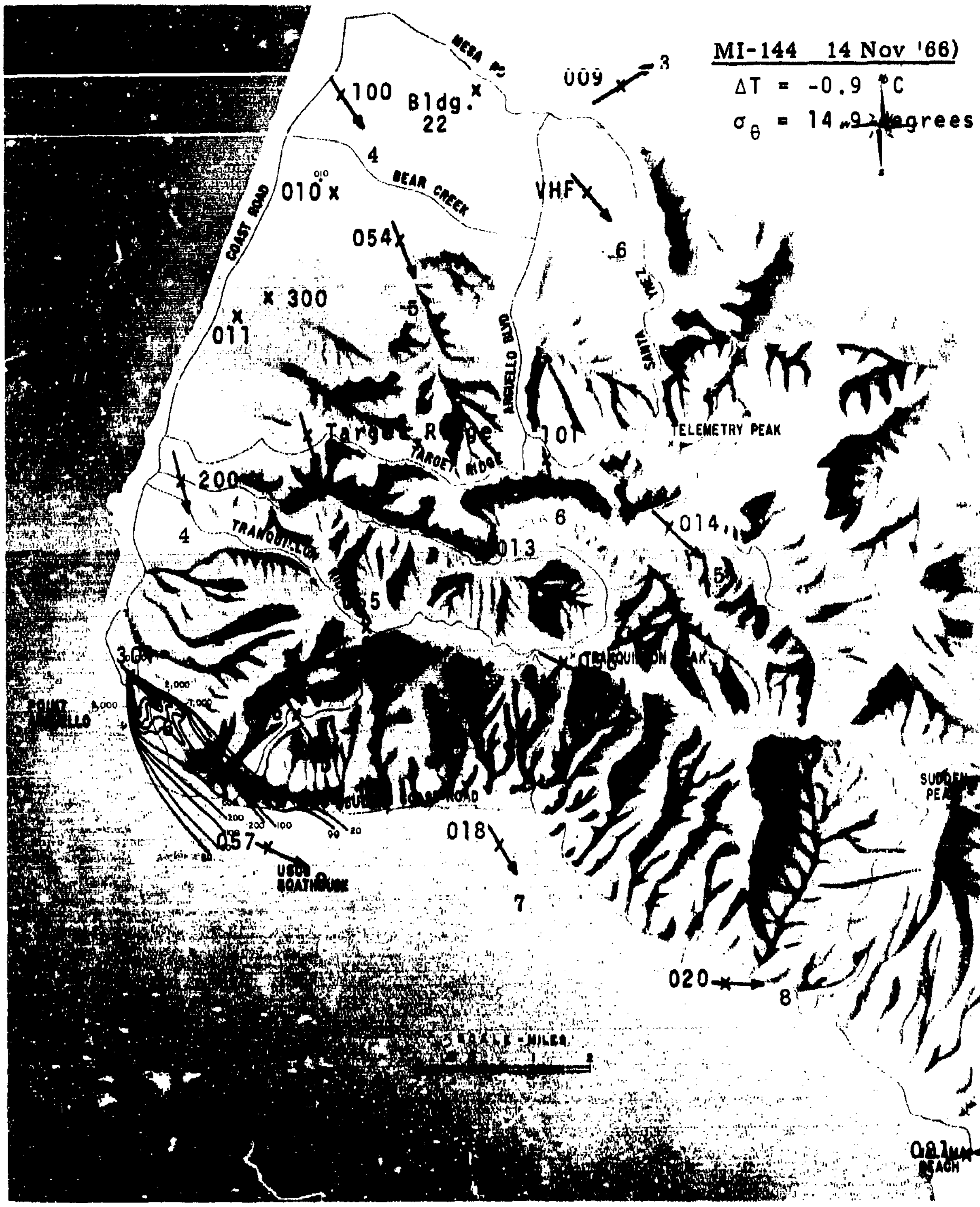

MI-138 (31 Oct '66)
ΔT = 0.1 °C
σ_θ = 16.6 degrees
MESA RD
x100
Bldg. 22
009
010 x
BEAR CREEK
VHF
8
COAST ROAD
054x
x 300
x 011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
101
x 200
014
TRANQUILLON
013
5
30
057
018
BOATHOUSE
13
020
7
10
021
BEACH


MI-139 (2 Nov '66)
ΔT = -0.6 °C
σ_θ = 14.9 degrees
MESA RD
009
100
Bldg 22
BEAR CREEK
VHF
010
COAST ROAD
054
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
101
014
013
057
USCG BOATHOUSE
018
020
021


MI-140 (4 Nov '66)
ΔT = -0.4 °C
σθ = 9.7 degrees
Bldg. 22
MESA RD
BEAR CREEK
COAST ROAD
VHF
TARGET RIDGE
TELEMETRY PEAK
TRANQUILLON
009
100
010
054
300
011
200
014
018
020
021
057
13
11
9
7
6
4
3
5

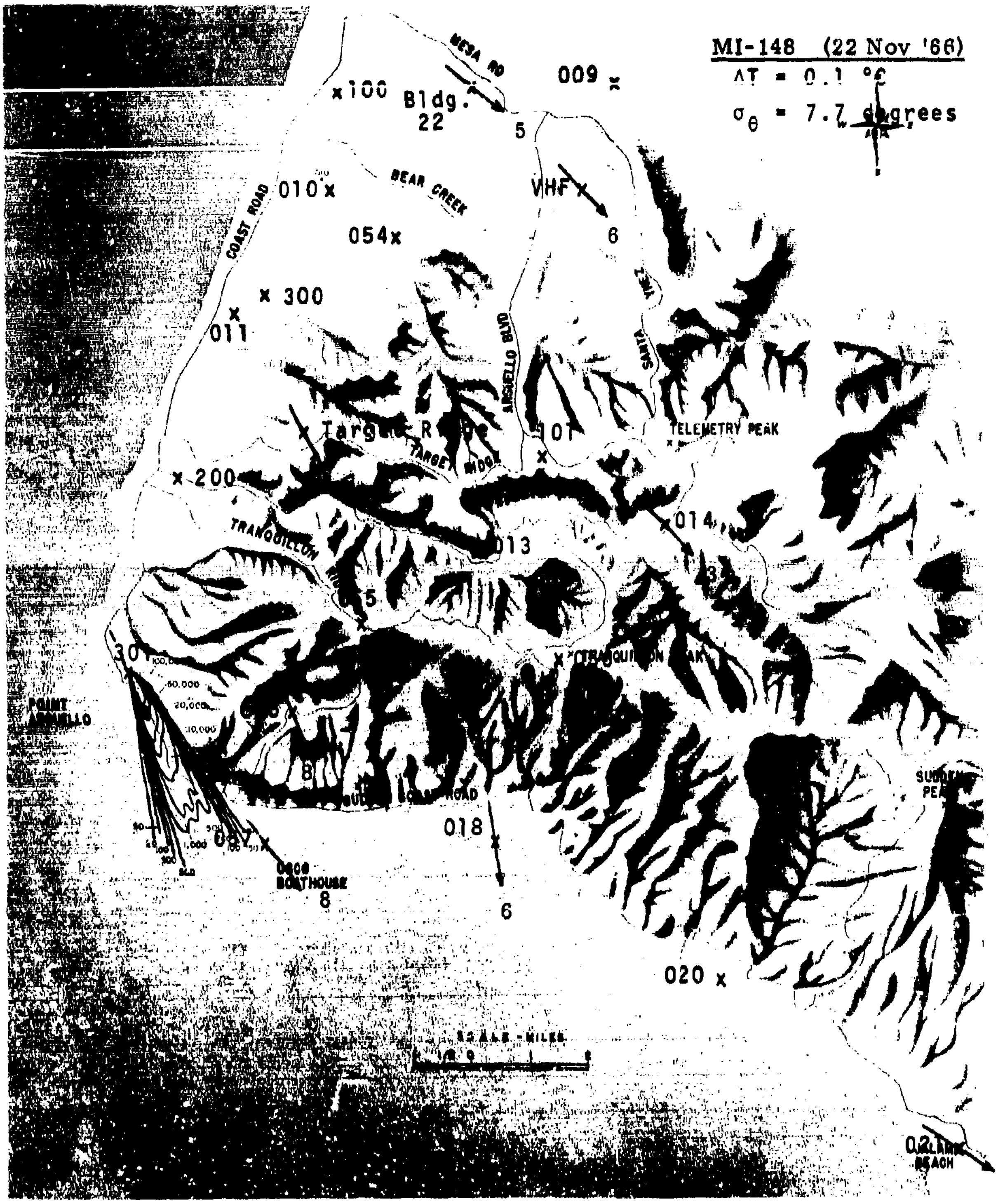

MI-141 (8 Nov '66)
ΔT = -0.8 °C
σθ = 8.3 degrees
MESA RD
009 x
x100 Bldg. 22
010 x
BEAR CREEK
COAST ROAD
054x
VHF
6
x 300
011
SANTA YNEZ
ARGUELLO BLVD
TARGET RIDGE
TELEMETRY PEAK
x 200
014
TRANQUILLON
TRANQUILLON PEAK
018
6
057
USCG BOATHOUSE
020
6
021
JALAMA BEACH
5


MI-143 (10 Nov 68)
ΔT = -1.6 °C
σθ = 6.5 degrees
MESA RD
009
x100
Bldg. 22
010
BEAR CREEK
VHF
054
COAST ROAD
x 300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
x 200
TRANQUILLON
013
014
018
15
020
12
021
USCG BOATHOUSE

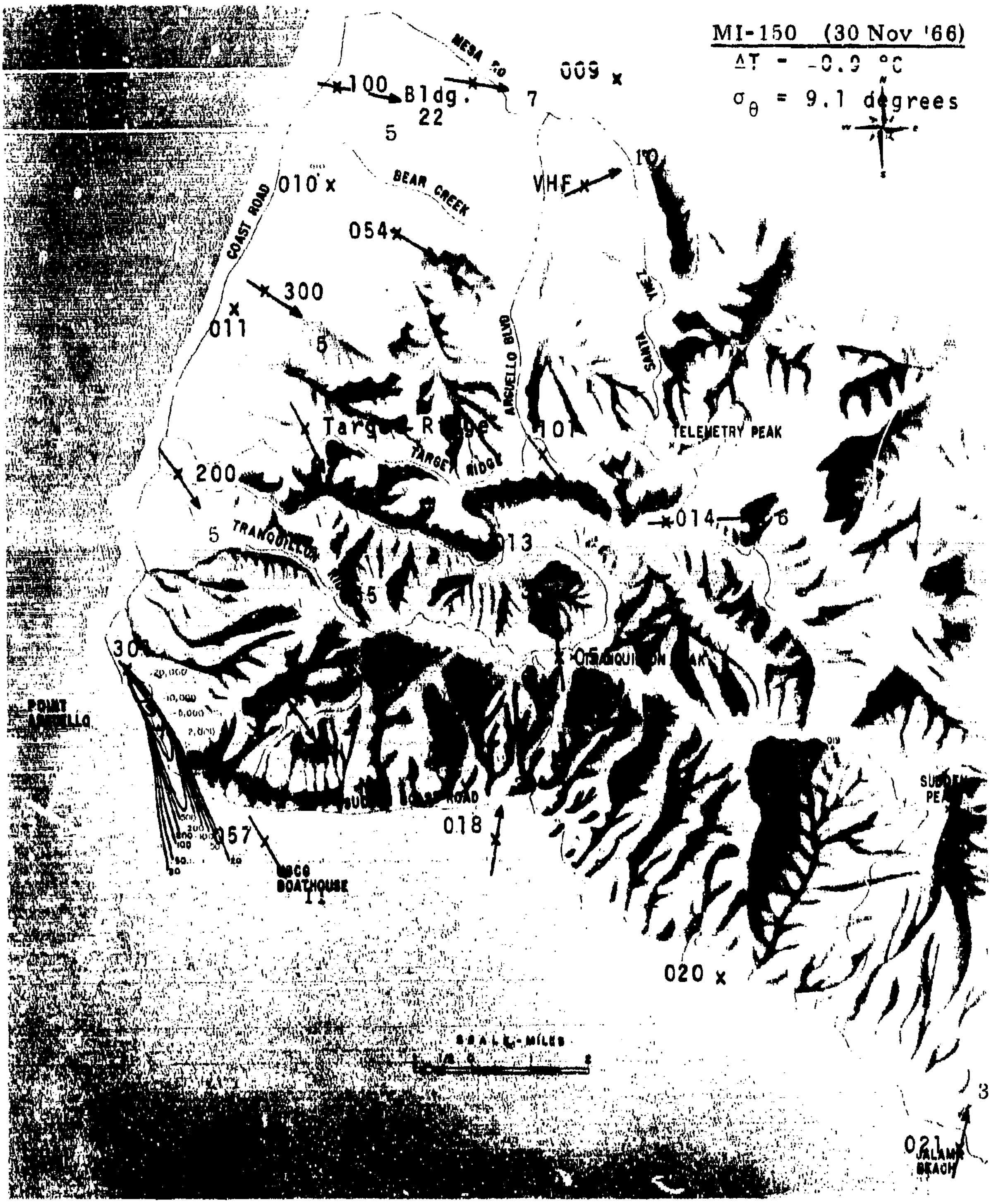

MI-144 14 Nov '66)
ΔT = -0.9 °C
σθ = 14.9 degrees
009
3
100
Bldg. 22
4
BEAR CREEK
010
VHF
6
COAST ROAD
054
300
011
ARGUELLO BLVD
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
101
200
4
TRANQUILLON
6
014
013
5
TRANQUILLON PEAK
POINT ARGUELLO
057
USCG BOATHOUSE
018
7
020
8
8


MI-145 (15 Nov '66)
ΔT = -0.8 °C
σ_θ = 14.2 degrees
MESA RD
x 100 Bldg. 22
009
5
BEAR CREEK
COAST ROAD
010 x
VHF
8
054
x 300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
101
x 200
2
TRANQUILLON
013
014
4
5
30
057
018
USGS BOATHOUSE
020
7
021
4

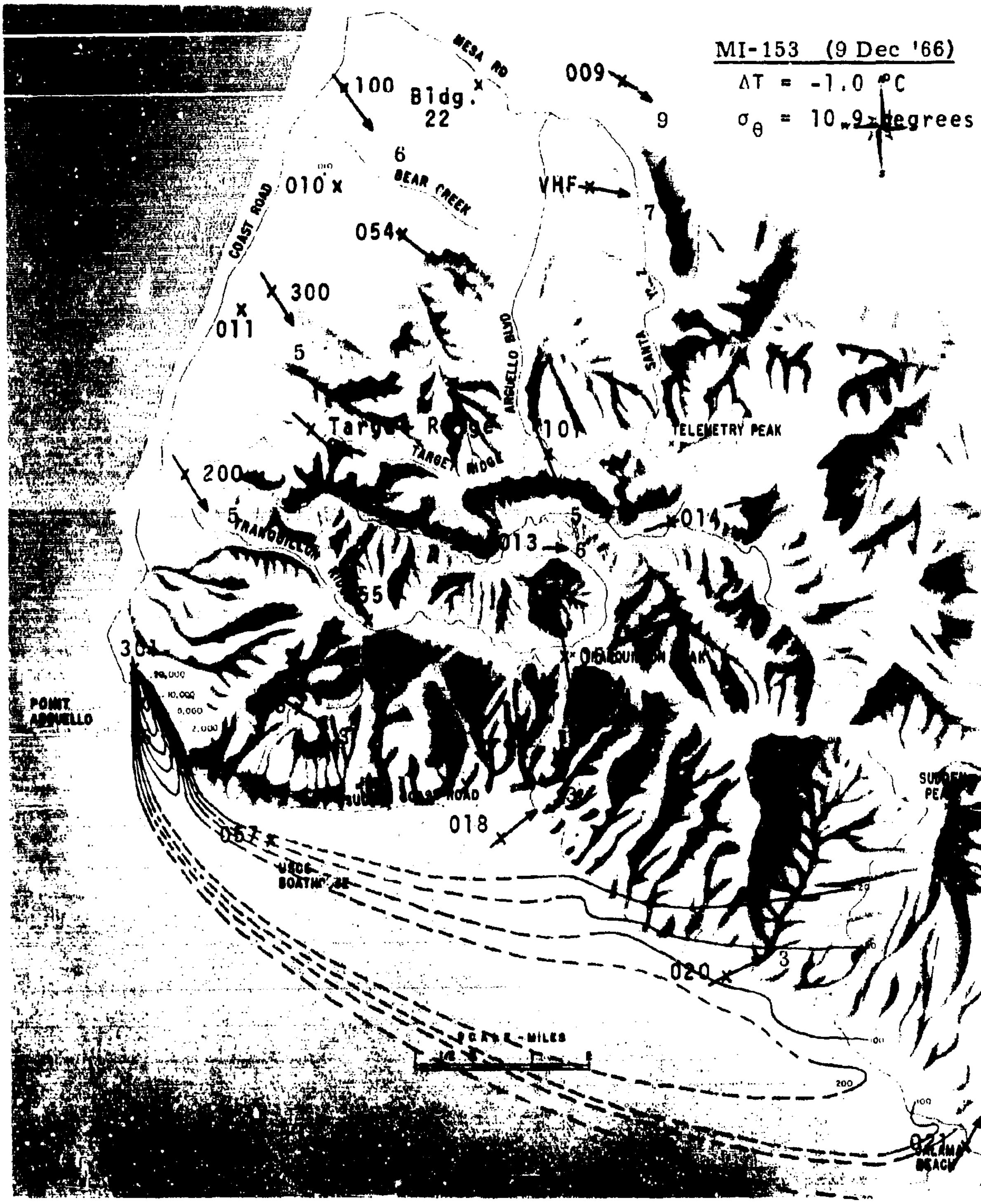

MI-147 (21Nov '66)
ΔT = 0.2 °C
σθ = 18.5 degrees
100
Bldg. 22
MESA RD
009
2
5
VHF
010
BEAR CREEK
054
4
300
011
Target Range
TARGET RIDGE
2
200
101
4
TELEMETRY PEAK
014
13
5
30
057
4
018
2
USCG BOATHOUSE
020
5
021
BEACH
5

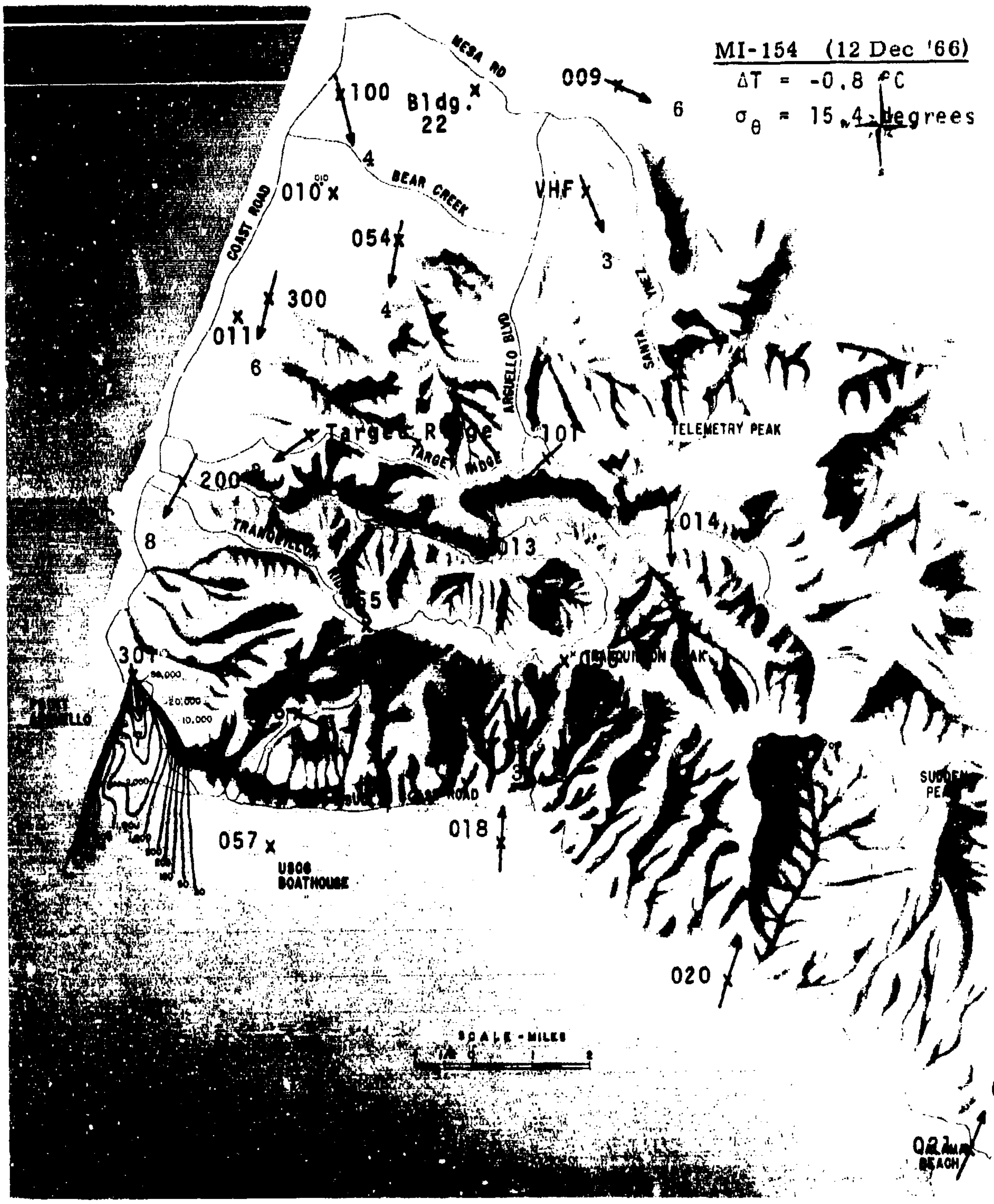

MI-148 (22 Nov '66)
ΔT = 0.1 °C
σ_θ = 7.7 degrees
MESA RD
009
x 100
Bldg. 22
5
010 x
BEAR CREEK
VHF
6
054x
COAST ROAD
x 300
011
SANTA YNEZ
ARGUELLO BLVD
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
101
x 200
TRANQUILLON
014
013
5
3
TRANQUILLON PEAK
301
100,000
50,000
20,000
10,000
POINT ARGUELLO
SUDDEN PEAK
018
BOATHOUSE
8
6
020 x
SCALE-MILES
BEACH
4


MI-149 (29 Nov '66)
ΔT = -0.7 °C
σθ = 4.5 degrees
MESA RD
009
100
Bldg. 22
11
13
010
BEAR CREEK
VHF
COAST ROAD
054
300
011
12
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
101
014
TRANQUILLON
11
14
013
057
BOATHOUSE
22
018
20
020
SCALE-MILES
021
BEACH
12

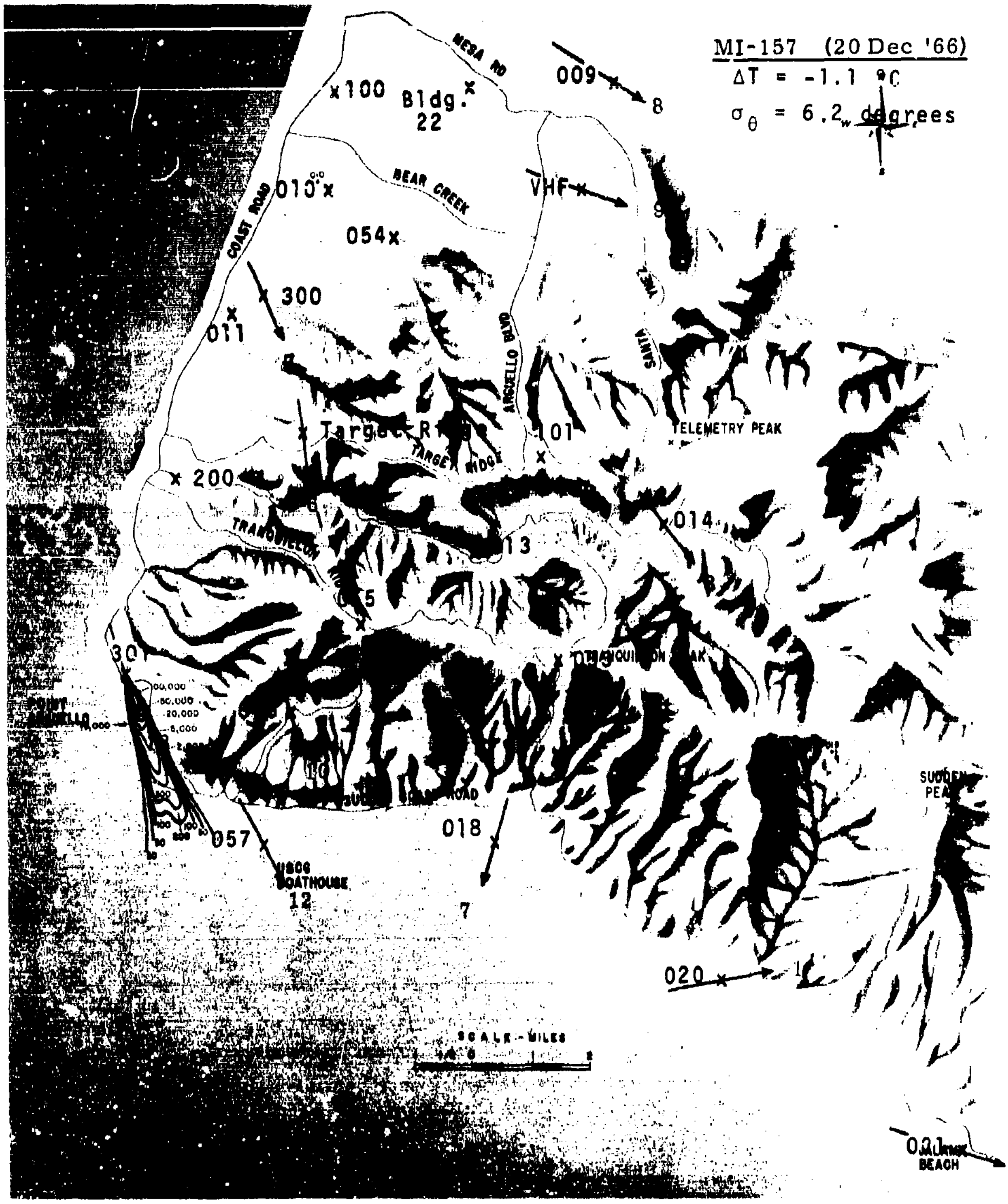

MI-150 (30 Nov '66)
σθ = 9.1 degrees
MESA RD
100
Bldg. 22
009
VHF
BEAR CREEK
COAST ROAD
010
054
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
TRANQUILLON
014
013
POINT ARGUELLO
057
BOATHOUSE
018
020
SCALE - MILES
021
JALAMA BEACH


MI-152 (8 Dec '66)
ΔT = -0.7 °C
σ_θ = 5.4 degrees
MESA RD
009
14
100
Bldg. 22
18
13
010 x
BEAR CREEK
VHF
16
054
COAST ROAD
300
011
15
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
13
TRANQUILLON
18
014
013
055
VII
GRANQUILLON PEAK
301
POINT ARGUELLO
SUDDEN ROAD
018
14
057 x
USCG BOATHOUSE
020
7
SCALE - MILES
SUDDEN PEAK
021
JALAMA BEACH

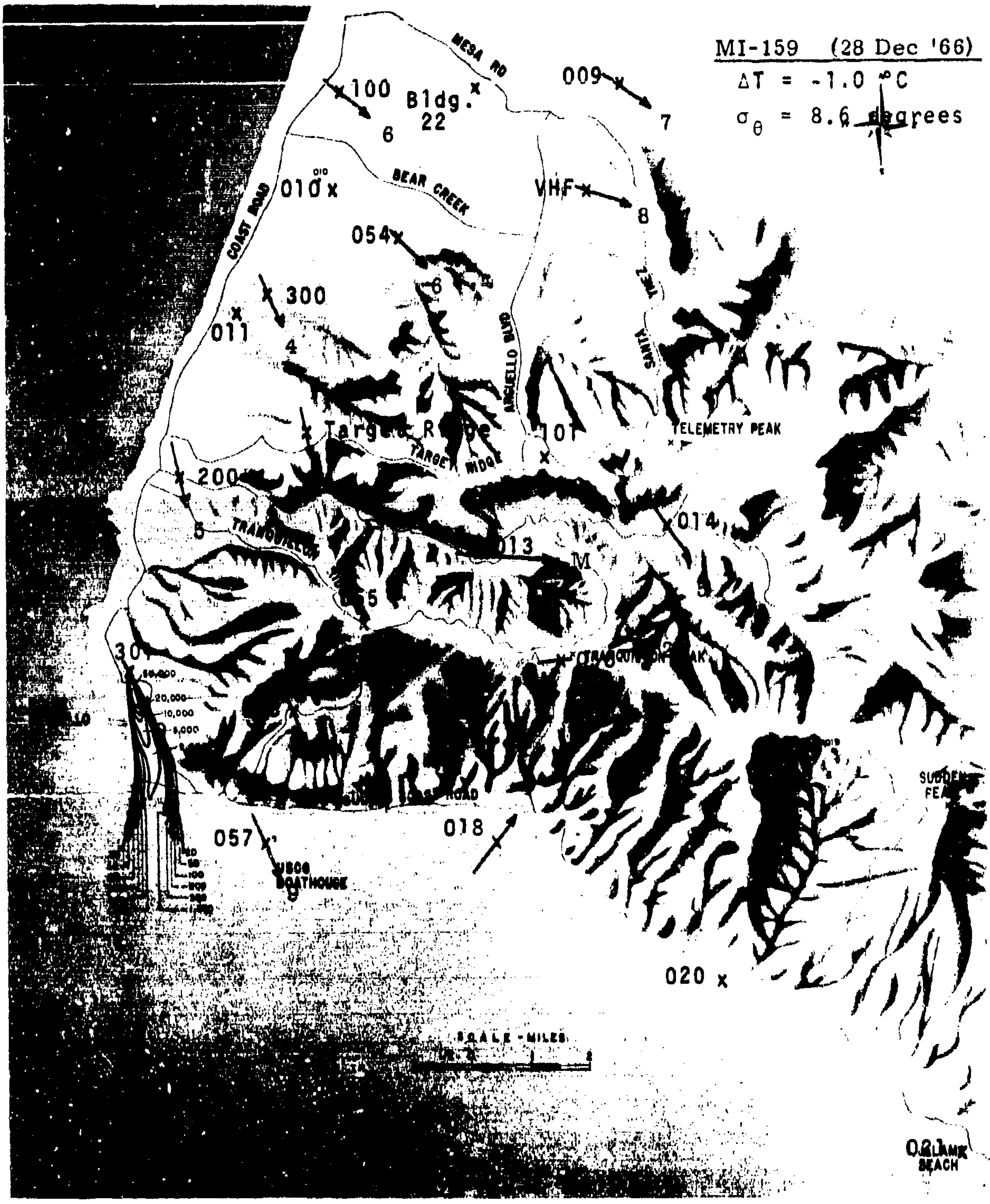

MI-153 (9 Dec '66)
ΔT = -1.0 °C
σ_θ = 10.9 degrees
100
Bldg. 22
MESA RD
009
9
6
010
BEAR CREEK
VHF
7
054
COAST ROAD
300
011
5
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
10
TELEMETRY PEAK
200
5
TRANQUILLON
013
6
014
55
301
POINT ARGUELLO
018
057
SCALE - MILES
020
3
200
4
021

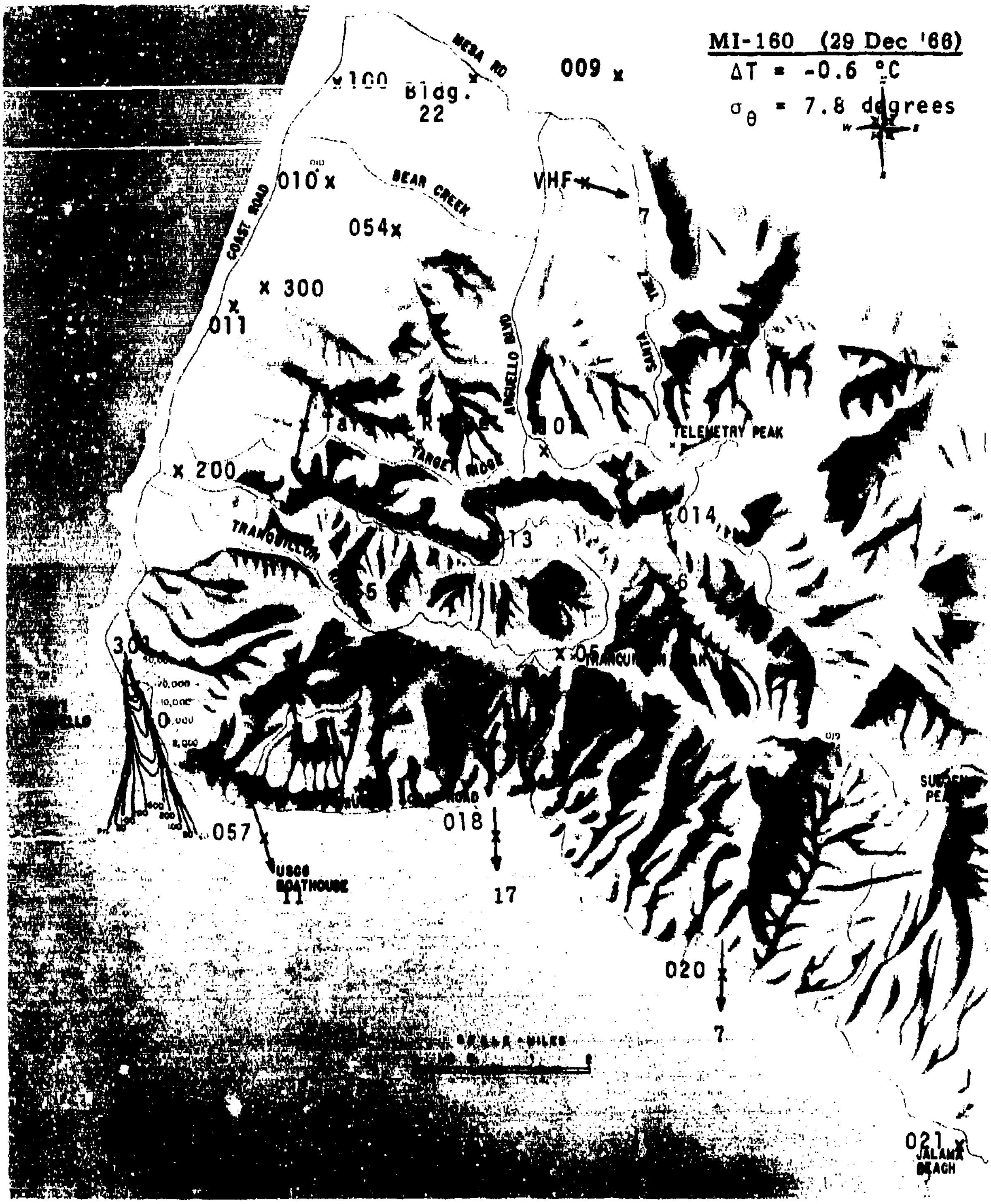

MI-154 (12 Dec '66)
ΔT = -0.8 °C
σ_θ = 15.4 degrees
MESA RD
009
6
100
Bldg. 22
4
BEAR CREEK
COAST ROAD
010 x
VHF
054
3
300
4
011
6
SANTA YNEZ
ARGUELLO BLVD
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
8
TRANQUILLON
014
013
055
301
TRANQUILLON PEAK
20,000
10,000
3
018
057 x
USCG BOATHOUSE
020
SCALE - MILES
6
BEACH


MI-155 (13 Dec '66)
ΔT = -0.4 °C
σθ = 6.7 degrees
009
7
100
1
Bldg.
22
010
BEAR CREEK
VHF
COAST ROAD
054
300
6
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
7
014
9
13
7
TRANQUILLON
30
POINT ARGUELLO
018
7
057
BOATHOUSE
14
020
2
SCALE - MILES
021
SURF
BEACH
4

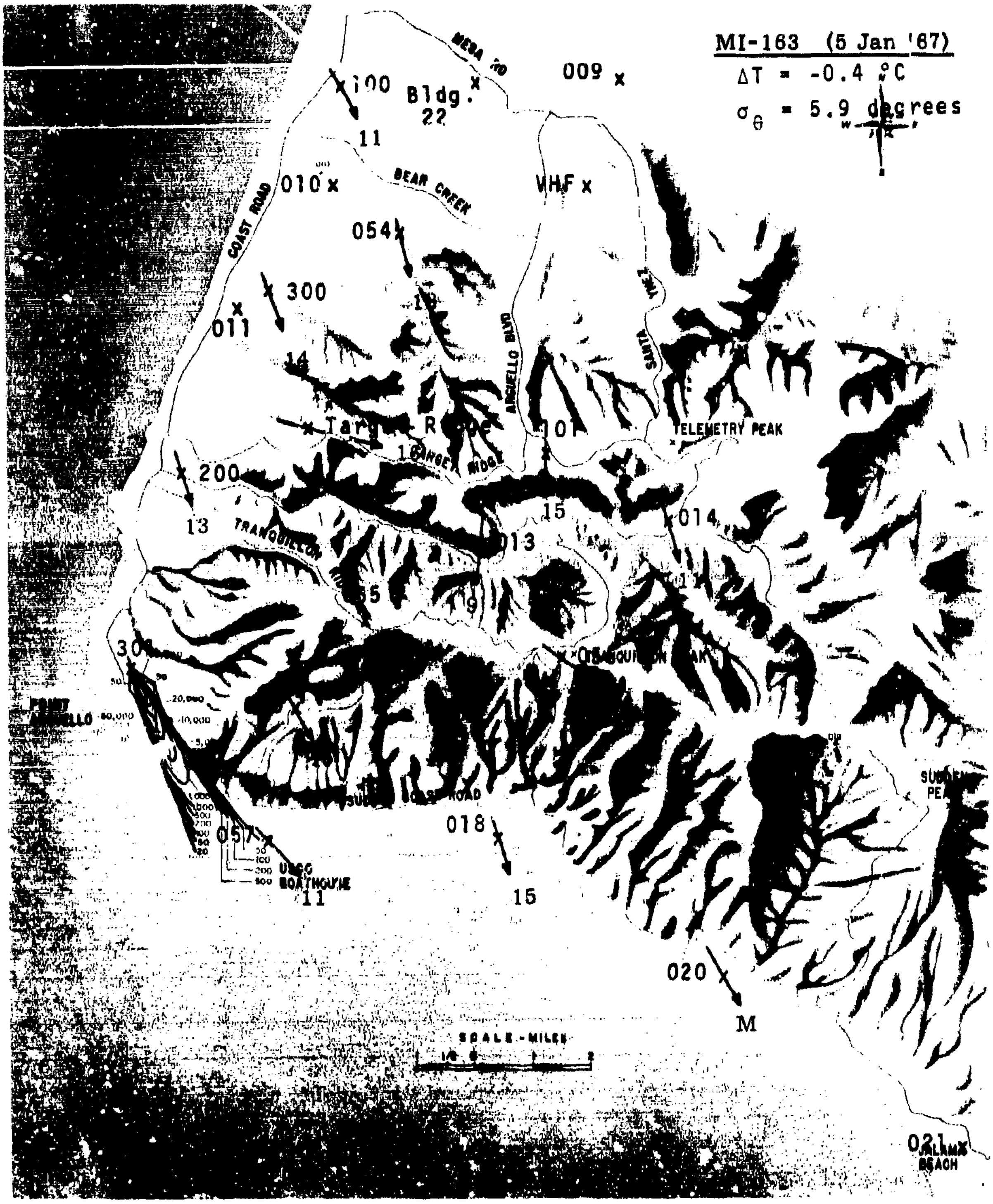

MI-157 (20 Dec '66)
ΔT = -1.1 °C
σ_θ = 6.2 degrees
MESA RD
009
8
x100 Bldg.
22
BEAR CREEK
010 x
VHF
9
COAST ROAD
054x
300
011
SANTA
ARGUELLO BLVD
Target R
TARGET RIDGE
101
TELEMETRY PEAK
x 200
TRANQUILLON
014
13
5
TRANQUILLON PEAK
30
018
057
USCG
BOATHOUSE
12
7
020
SCALE - MILES
BEACH


MI-158 (22 Dec '66)
ΔT = -0.2 °C
σθ = 17.5 degrees
MESA RD
100
5
Bldg. 22
009
7
010
BEAR CREEK
VHF
7
COAST ROAD
054
4
300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
TARGET RIDGE
200
TRANQUILLON
13
014
5
018
057
USCG BOATHOUSE
020
3
SCALE - MILES
021


MI-159 (28 Dec '66)
ΔT = -1.0 °C
σθ = 8.6 degrees
MESA RD
100
Bldg. 22
6
009
7
010 x
BEAR CREEK
VHF
8
COAST ROAD
054
6
300
4
011
TELEMETRY PEAK
TARGET RIDGE
101
200
5
014
013
M
5
30
057
018
020 x
SCALE - MILES

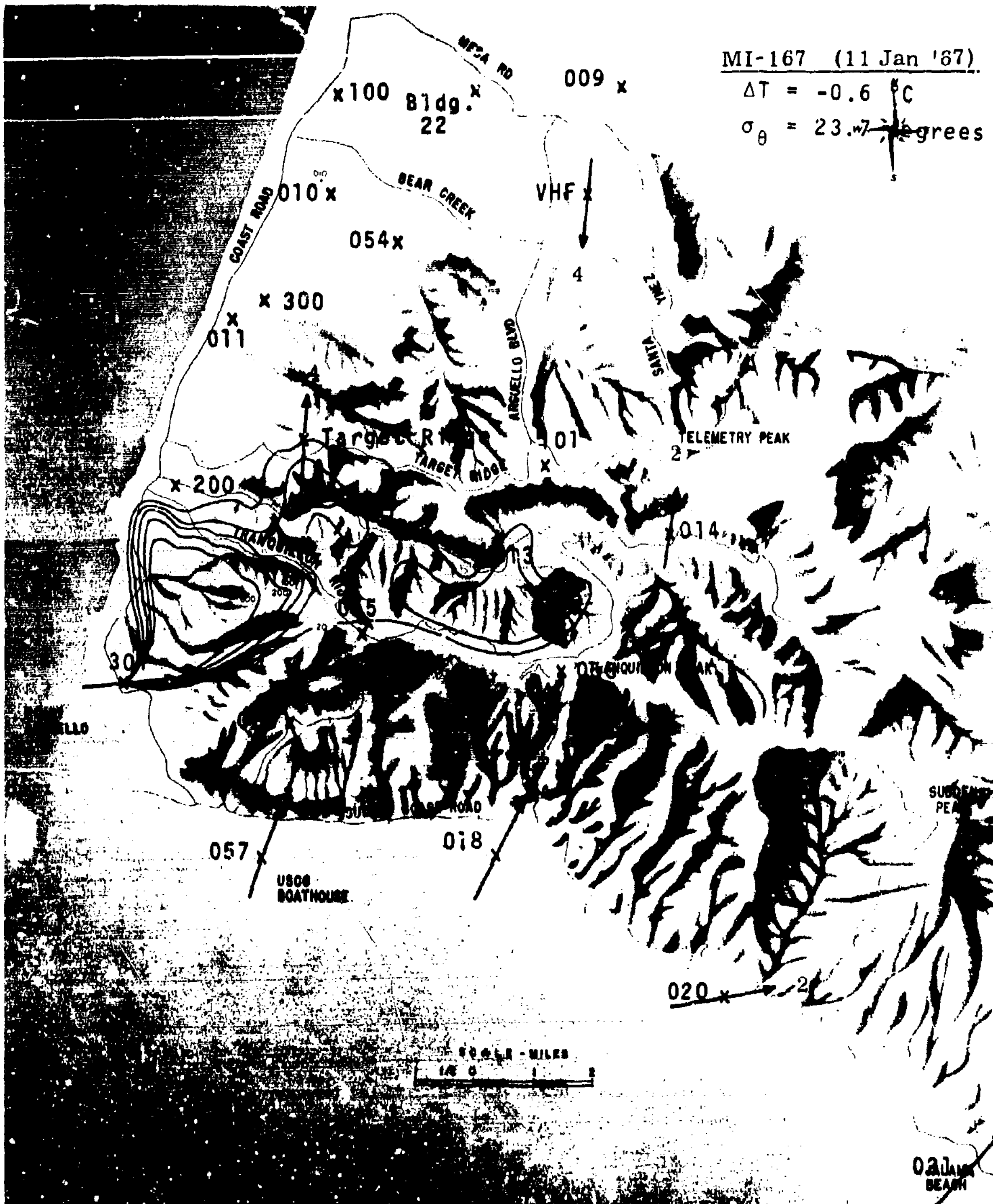

MI-160 (29 Dec '66)
ΔT = -0.6 °C
σθ = 7.8 degrees
MESA RD
009
100
Bldg. 22
010
BEAR CREEK
VHF
7
054
COAST ROAD
300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
TARGET RIDGE
200
014
TRANQUILLON
13
5
6
05
057
018
USCG BOATHOUSE
11
17
020
7
021
JALAMA BEACH

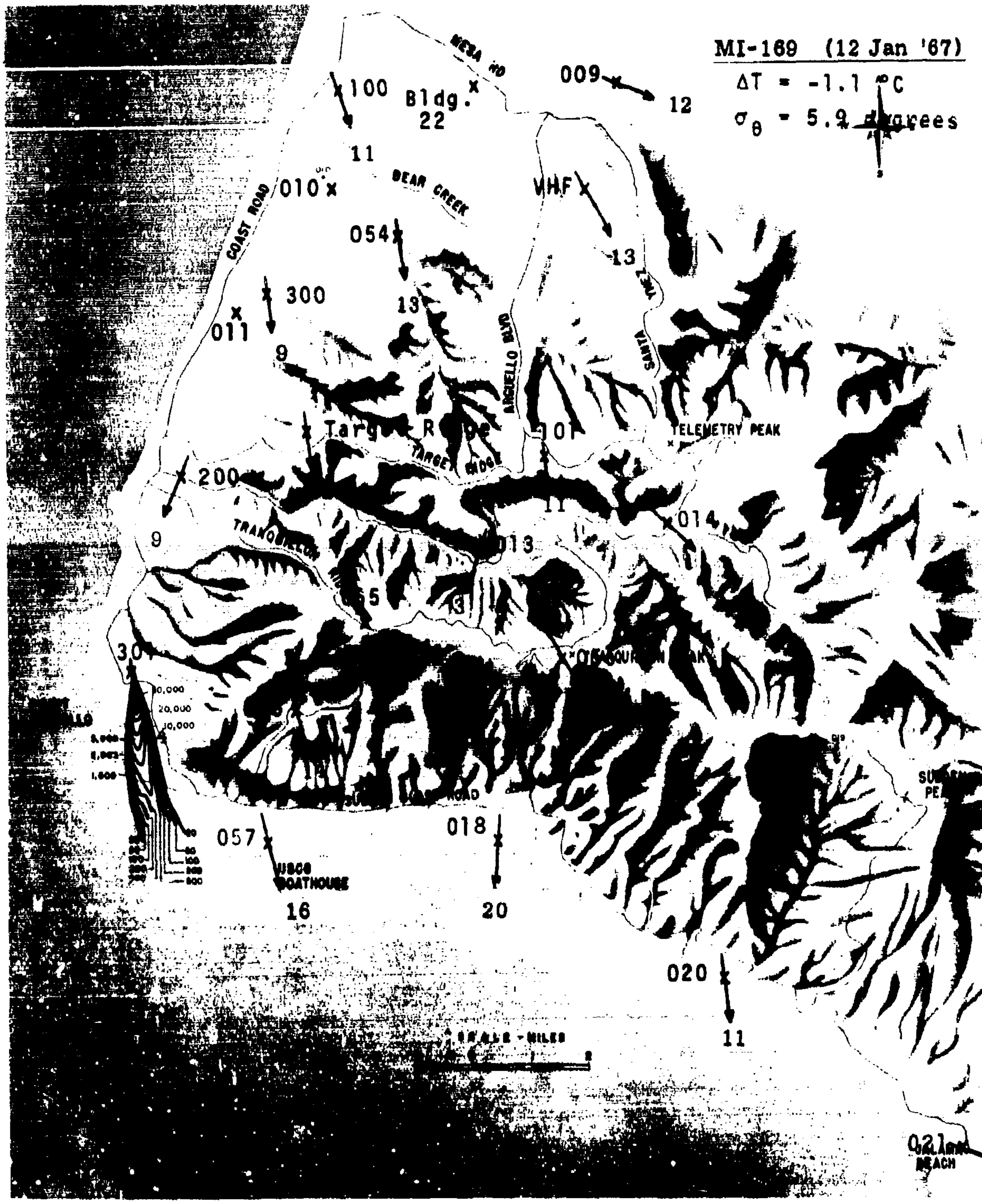

MI-162 (4 Jan '67)
ΔT = -1.2 °C
σθ = 8.7 degrees
MESA RD
100
6
Bldg. 22
009
BEAR CREEK
010
VHF
8
054
COAST ROAD
300
6
011
ARGUELLO BLVD
5
TELEMETRY PEAK
3
200
6
014
13
1,000
5
3
4
SUDDEN PEAK
057
018
USCG BOATHOUSE
020
SCALE - MILES
021
JALAMA BEACH


MI-163 (5 Jan '67)
ΔT = -0.4 °C
σθ = 5.9 degrees
MESA RD
009 x
100 Bldg. 22
11
010 x
BEAR CREEK
VHF x
COAST ROAD
054
300
11
011
14
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
200
13
TRANQUILLON
15
013
014
5
9
018
15
USCG BOATHOUSE
11
020
M
SCALE-MILES

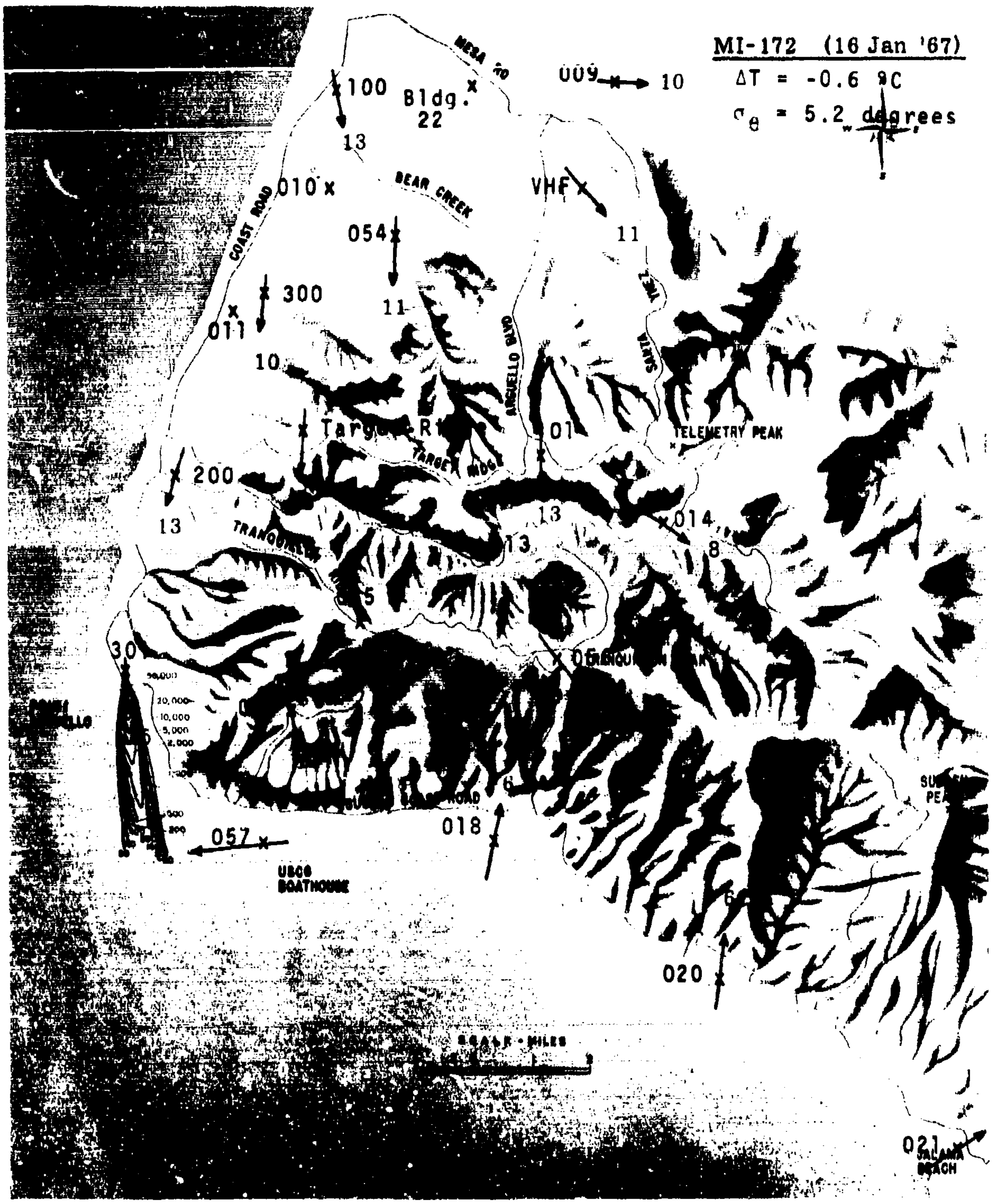

MI-165 (9 Jan '67)
ΔT = -0.6 °C
σθ = 16.2 degrees
MESA RD
100
6
Bldg.
22
009
8
BEAR CREEK
010
VHF
6
COAST ROAD
054
6
300
C11
4
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
101
4
200
4
014
013
5
TRANQUILLON PEAK
057
5
018
6
020
3
SCALE - MILES
SUDDEN PEAK
BEACH


MI-166 (10 Jan '67)
ΔT = -0.9 °C
σθ = 18.3 degrees
MESA
009 x
100
Bldg. 22
4
BEAR CREEK
VHF
8
COAST ROAD
010 x
054x
5
300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
4
TARGET RIDGE
200
TRANQUILLON
014
13
6
5
30
POINT ARGUELLO
057
USCG BOATHOUSE
018
020
SCALE - MILES
3
021
BEACH

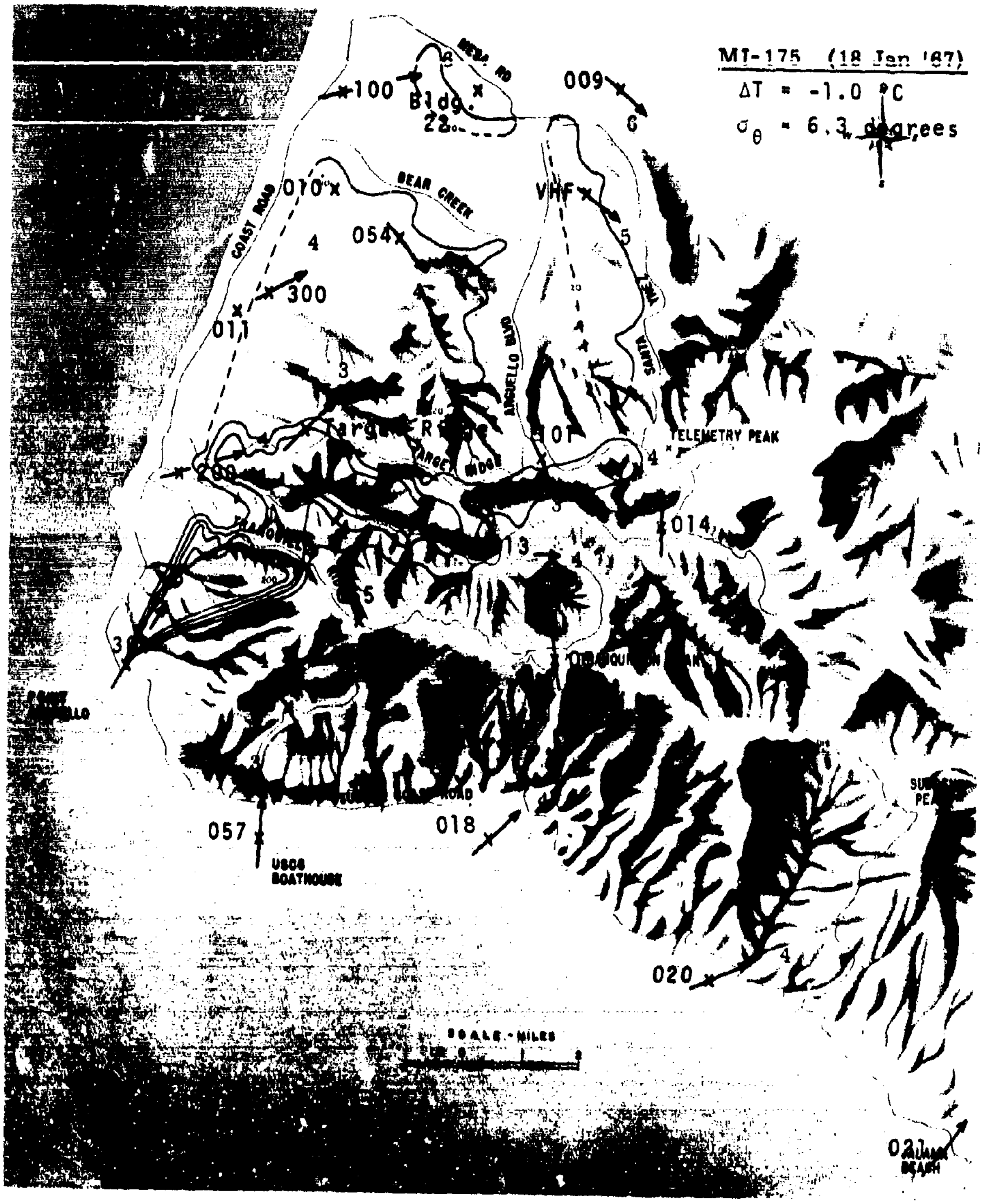

MI-167 (11 Jan '67)
ΔT = -0.6 °C
σθ = 23.7 degrees
MESA RD
009 x
x100
Bldg. 22
010 x
BEAR CREEK
VHF x
COAST ROAD
054x
4
x 300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
2
x 200
TARGET RIDGE
014
30
USCG BOATHOUSE
057
018
020
2
SCALE - MILES
3
021
BEACH


MI-169 (12 Jan '67)
ΔT = -1.1 °C
σθ = 5.9 degrees
MESA RD
Bldg. 22
100
11
009
12
010
BEAR CREEK
COAST ROAD
VHF
13
054
13
300
011
9
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
9
TRANQUILLON
013
11
014
057
USCG BOATHOUSE
16
018
ROAD
20
020
11
SCALE - MILES
021
BEACH
M


MI-170 (13 Jan '67)
ΔT = -0.9 °C
σθ = 10.7 degrees
MESA RD
009
13
100
Bldg. 22
10
BEAR CREEK
010
COAST ROAD
VHF
054
14
300
15
011
ARGUELLO BLVD
SANTA
101
TELEMETRY PEAK
200
TARGET RIDGE
19
014
013
5
30
057
018
18
020
4
8


MI-172 (16 Jan '67)
ΔT = -0.6 °C
σθ = 5.2 degrees
100
Bldg. 22
13
009
10
010
BEAR CREEK
VHF
11
054
11
COAST ROAD
300
011
10
Target R
TARGET RIDGE
ARGUELLO BLVD
SANTA
01
TELEMETRY PEAK
200
13
13
TRANQUILLON
13
014
8
5
057
USCG BOATHOUSE
018
6
020
SCALE - MILES
021
SALAMA BEACH
5

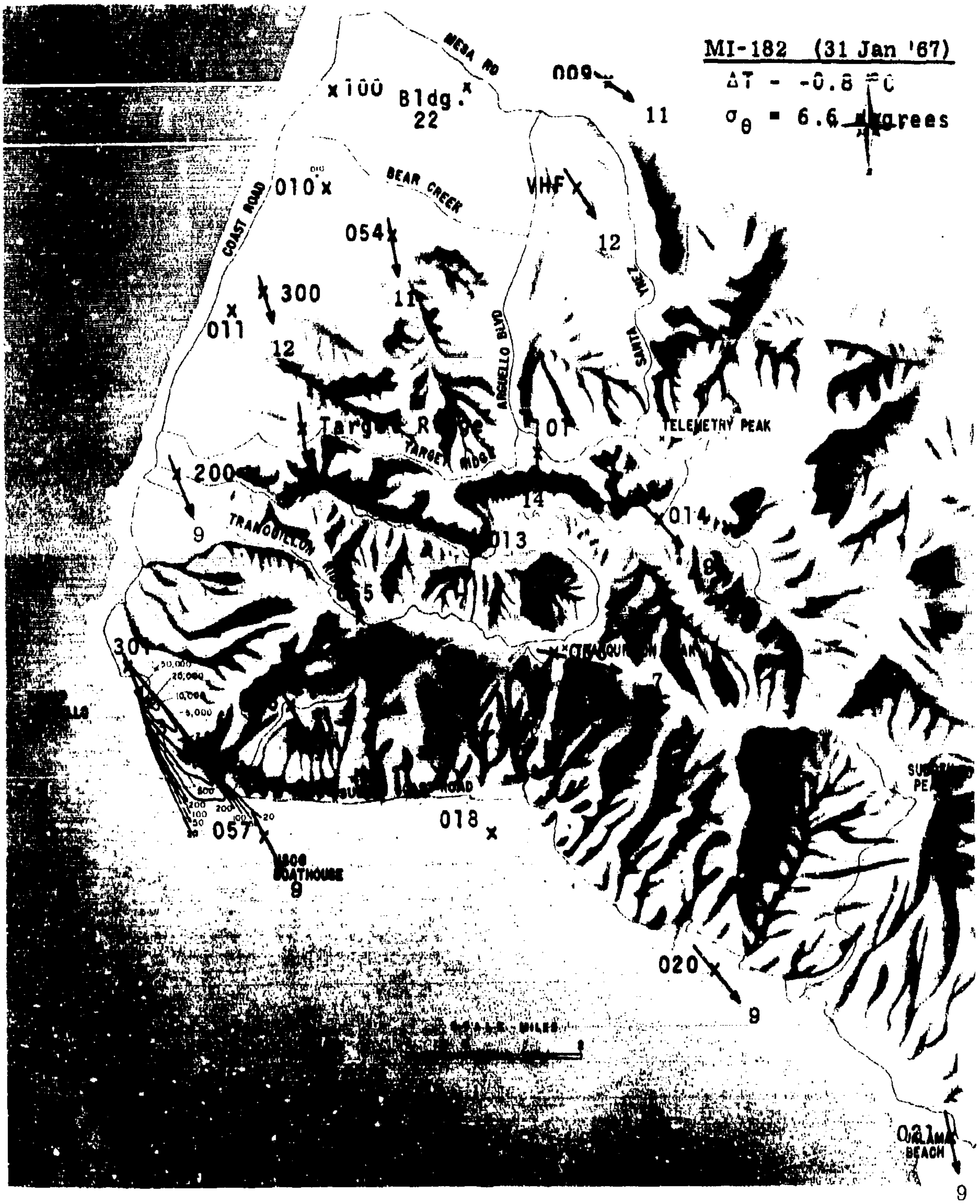

MI-174 (17 Jan '67)
ΔT = -0.4 °C
σ_θ = 26.1 degrees
009
9
100
Bldg 22
010
BEAR CREEK
COAST ROAD
VHF
6
054
4
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
014
13
200
30
057
USCG BOATHOUSE
018
020
021
3


MI-175 (18 Jan '67)
ΔT = -1.0 °C
σ_θ = 6.3 degrees
100
Bldg. 22
009
6
010
BEAR CREEK
VHF
5
COAST ROAD
4
054
300
011
3
Target Ridge
101
TELEMETRY PEAK
4
014
13
5
3
057
USCG BOATHOUSE
018
020
4
SCALE - MILES
4
021

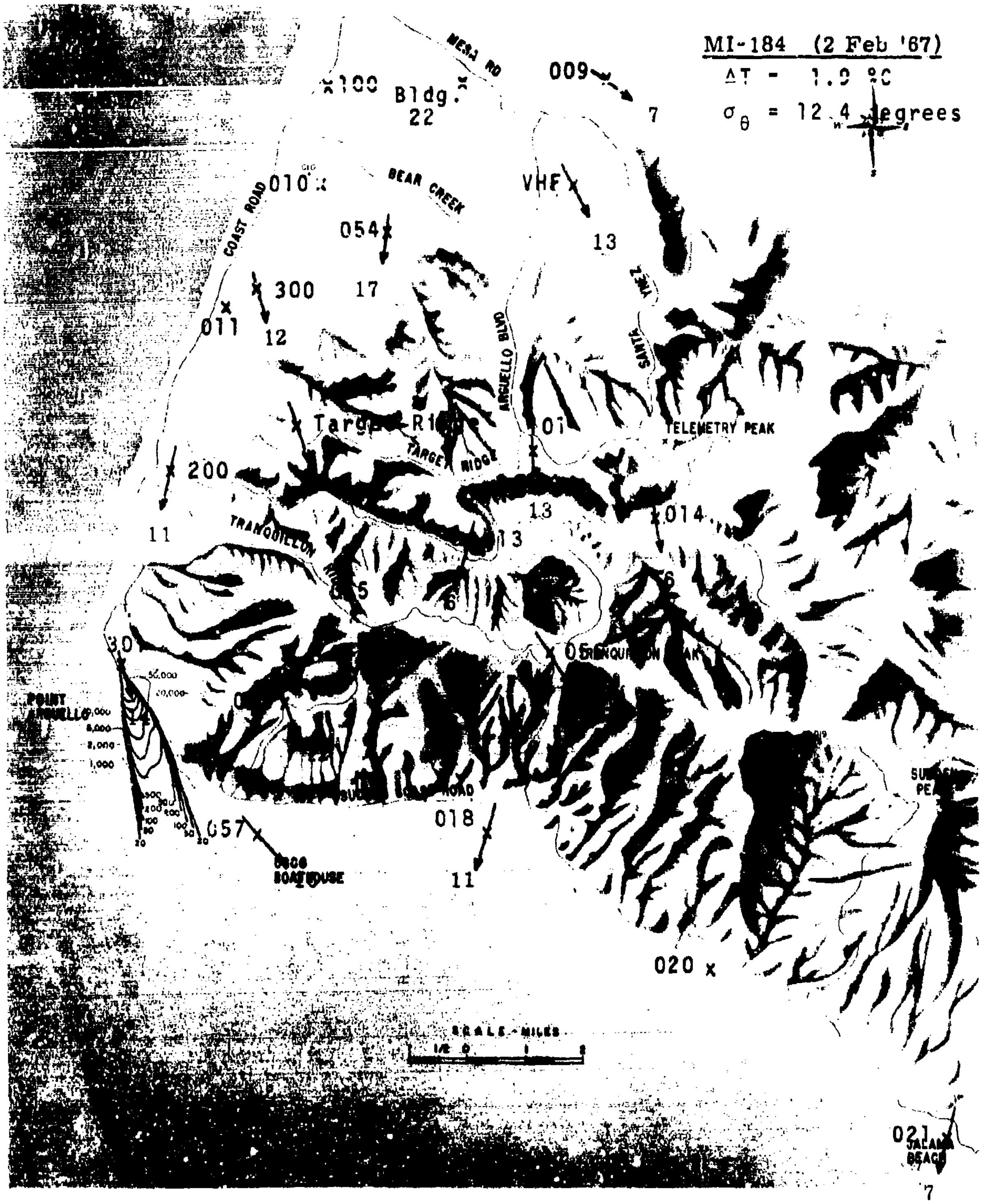

MI-179 (23 Jan '67)
ΔT = -0.6 °C
σθ = 17.8 degrees
009
3
100
Bldg.
7 22
010
BEAR CREEK
VHF
1
COAST ROAD
054
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
101
8
200
014
6
013
15
TRANQUILLON PEAK
057
018
9
200
020
13
11


MI-180 (25 Jan '67)
ΔT = -0.6 °C
σ_θ = 5.9 degrees
MESA RD
x 100
Bldg. 22
009
11
010 x
BEAR CREEK
VHF
14
054
COAST ROAD
300
011
13
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
200
12
TRANQUILLON
15
014
13
018
14
08
BOATHOUSE
020
13
021
BEACH
11

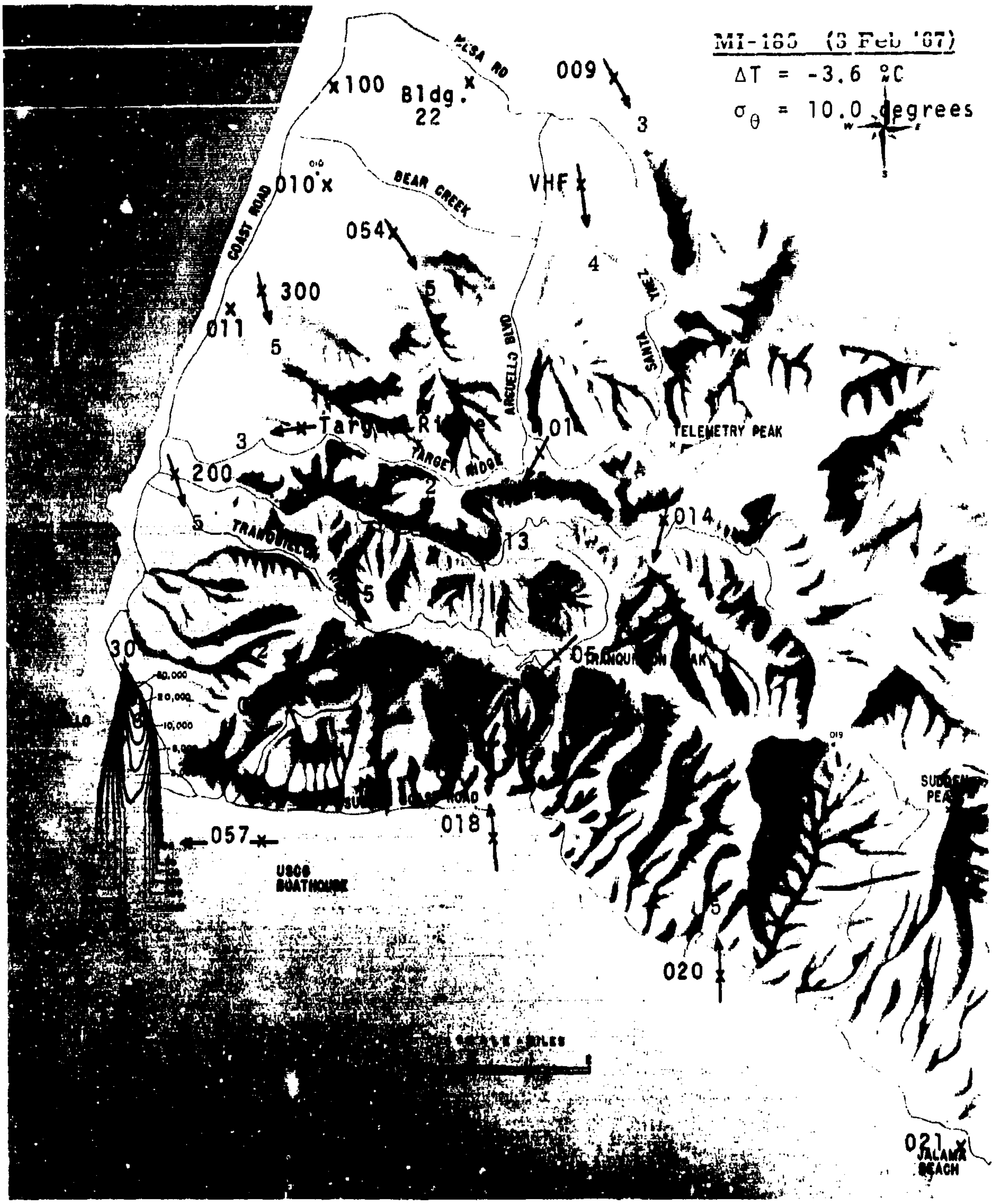

MI-181 (27 Jan '67)
ΔT = -0.4 °C
σθ = 3.6 degrees
MESA RD
009
2
100
Bldg.
22
1
BEAR CREEK
010
VHF
2
COAST ROAD
054
300
011
4
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
101
TARGET RIDGE
200
6
5
014
13
30
057
USCG
BOATHOUSE
018
10
020
SCALE - MILES
4


MI-182 (31 Jan '67)
ΔT = -0.8 °C
σ_θ = 6.6 degrees
MESA RD
x100
Bldg. 22
009
11
BEAR CREEK
COAST ROAD
010 x
VHF
12
054
11
300
011
12
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
200
9
TRANQUILLON
14
013
014
8
7
30
50,000
20,000
10,000
5,000
057
018 x
BOATHOUSE
9
020
9
BEACH
9


MI-183 (1 Feb '67)
ΔT = -1.0 °C
σ_θ = 4.1 degrees
009
13
x100
Bldg. 22
010 x
BEAR CREEK
COAST ROAD
VHF
15
054
15
300
011
14
ARGUELLO BLVD
SANTA YNEZ
Target Range
TARGET RIDGE
101
TELEMETRY PEAK
200
15
16
014
013
055
19
30
100,000
60,000
20,000
10,000
057
USCG BOATHOUSE
018
10
020
14
021
BEACH
5



MI-184 (2 Feb '67)
ΔT = 1.9 °C
σθ = 12.4 degrees
MESA RD
009
7
100
Bldg. 22
010
BEAR CREEK
VHF
13
COAST ROAD
054
17
300
12
011
SANTA YNEZ
ARGUELLO BLVD
TELEMETRY PEAK
TARGET RIDGE
200
11
13
13
014
TRANQUILLON
6
POINT ARGUELLO
SUDDEN COAST ROAD
018
11
057
USCG BOATHOUSE
020 x
SCALE - MILES
021
JALAMA BEACH
7

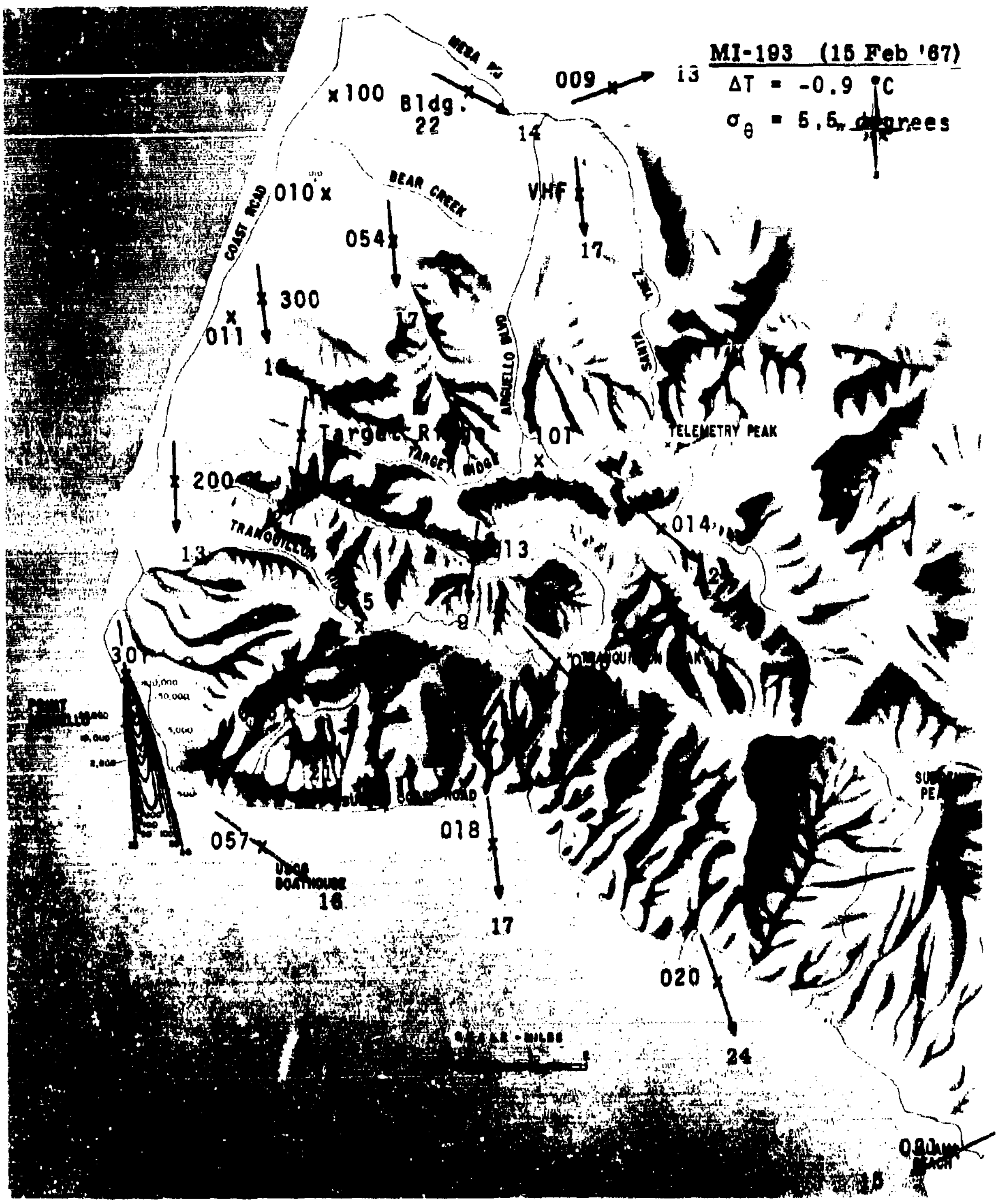

MI-185 (3 Feb '67)
ΔT = -3.6 °C
σ_θ = 10.0 degrees
x100 Bldg. 22
009
3
MESA RD
010 x
BEAR CREEK
VHF
054
4
COAST ROAD
300
5
011
5
SANTA YNEZ
ARGUELLO BLVD
3
TARGET RIDGE
01
TELEMETRY PEAK
200
2
014
5
13
5
30
2
TRANQUILLON PEAK
057
018
USCG BOATHOUSE
5
020
021 x
JALAMA BEACH


MI-189 (8 Feb '67)
ΔT = -0.5 °C
σθ = 8.2 degrees
x100
Bldg. 22
8
009
7
MESA RD
BEAR CREEK
COAST ROAD
010 x
VHF
054
6
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
014
13
5
3
057
018
USCG BOATHOUSE
020
SCALE - MILES


MI-190 (9 Feb '67)
ΔT = -1.0 °C
σθ = 9.5 degrees
x100
Bldg. 22
009 x
10
010 x
BEAR CREEK
COAST ROAD
VHF
054
300
011
6
Target Range
TARGET RIDGE
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
200
7
3
9
014
8
13
55
10
TRANQUILLON
20,000
10,000
5,000
2,000
057
018
16
020
10
021
10
SCALE - MILES


MI-191 (10 Feb '67)
ΔT = -0.7 °C
σθ = 10.9 degrees
x100
Bldg. 22
009
9
010 x
BEAR CREEK
VHF
8
COAST ROAD
054
7
300
011
5
ARGUELLO BLVD
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
200
7
10
13
014
TRANQUILLON
30
057
BOATHOUSE
018
020
021
5

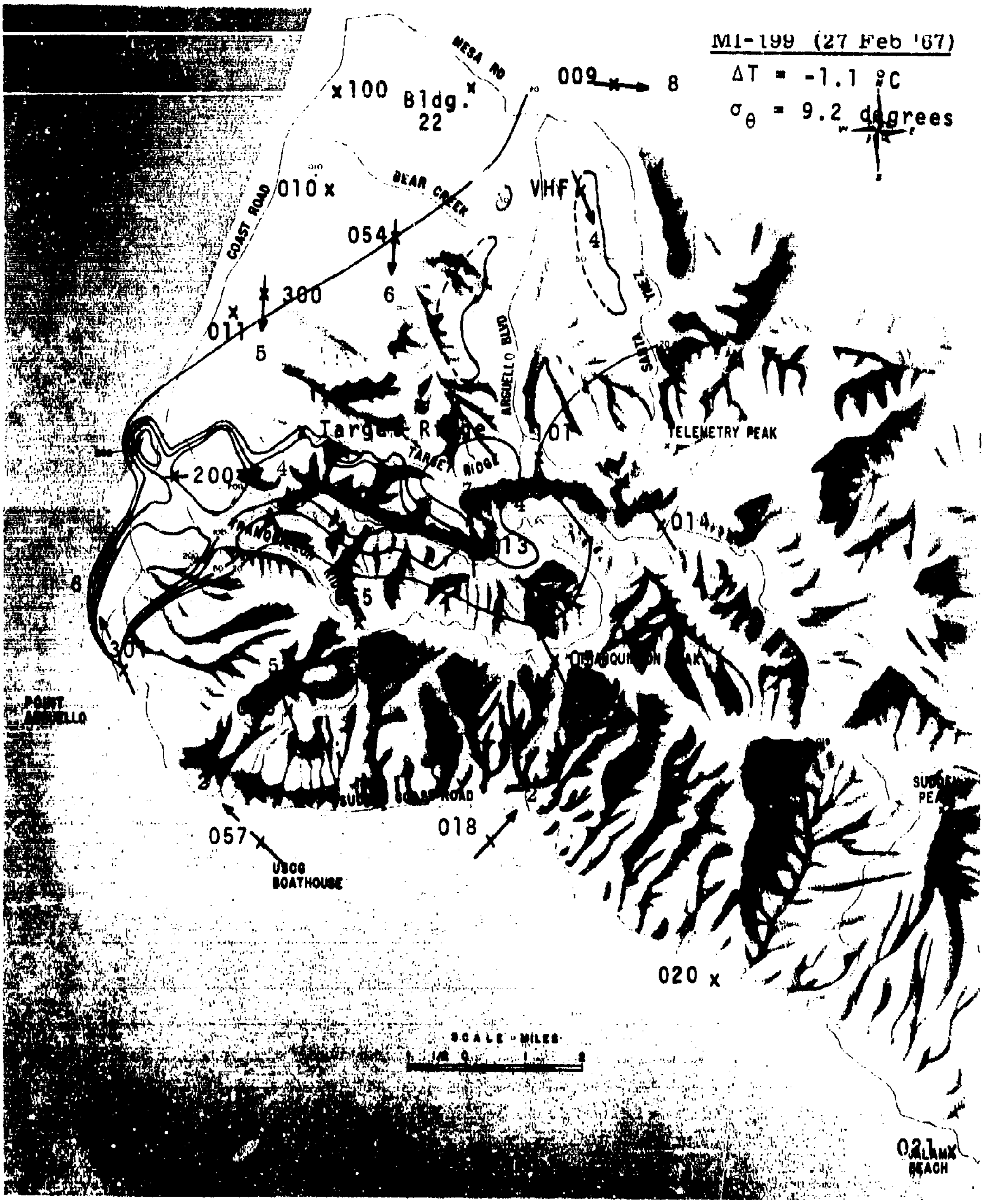

MI-192 (14 Feb '67)
ΔT = -1.0 °C
σθ = 7.2 degrees
009
16
x100
Bldg. 22
14
010 x
BEAR CREEK
VHF
18
054
16
COAST ROAD
300
x
011
16
ARGUELLO BLVD
TELEMETRY PEAK
Target Range
TARGET RIDGE
10
200
15
014
013
057
USCG BOATHOUSE
018
16
020
15
021
SCALE - MILES
14


MI-193 (15 Feb '67)
ΔT = -0.9 °C
σ_θ = 5.5 degrees
009
13
x100
Bldg.
22
14
BEAR CREEK
010 x
COAST ROAD
VHF
054
17
300
011
ARGUELLO BLVD
TELEMETRY PEAK
101
200
TARGET RIDGE
TRANQUILLON
014
13
13
30
057
USCG
BOATHOUSE
16
018
17
020
24


MI-104 (16 Feb '67)
ΔT = -0.8 °C
σθ = 3.1 degrees
x100 Bldg. 22
009
12
010 x
054
17
VHF
15
300
011
13
Target Ridge
TARGET RIDGE
10
TELEMETRY PEAK
200
19
014
8
013
5
15
30
057
11
018
18
020
24
021
12
COAST ROAD
BEAR CREEK
SANTA

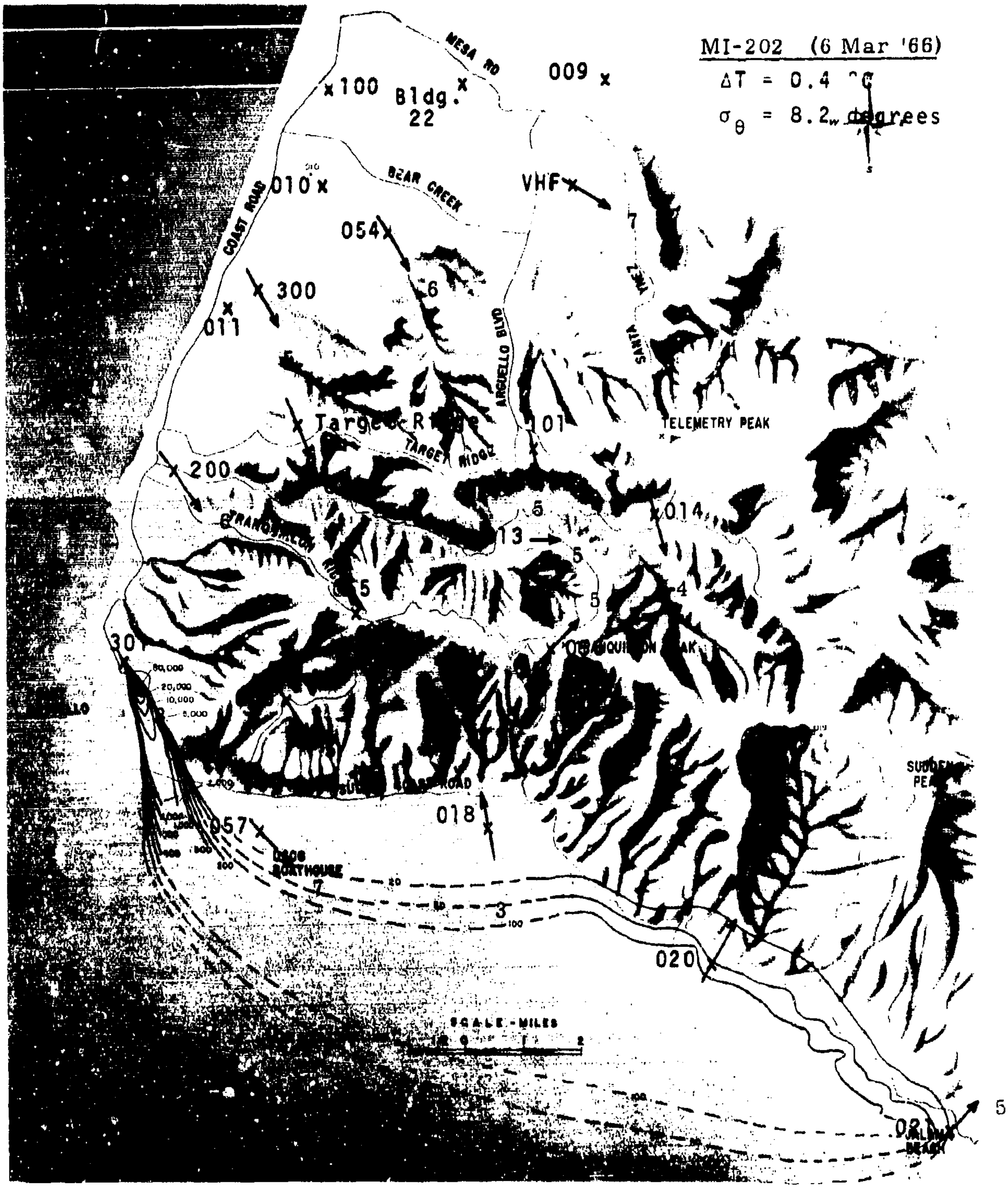

MI-108 (20 Feb '67)
ΔT = -1.6 °C
σθ = 8.9 degrees
MESA RD
009
7
x100 Bldg. 22
BEAR CREEK
010 x
VHF
9
COAST ROAD
054
12
300
5
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
01
TARGET RIDGE
200
6 TRANQUILLON
014
13
8
30
018
020
6
021


MI-197 (21 Feb '67)
ΔT = -1.7 °C
σ_θ = 9.8 degrees
MESA RD
009
2
x100
Bldg. 22
010 x
BEAR CREEK
VHF
4
054x
COAST ROAD
300
011
6
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
5
TRANQUILLON
13
014
5
5
8
TRANQUILLON PEAK
30
057
018
4
BOATHOUSE
020
5
SCALE - MILES
021
JALAMA BEACH
5


MI-199 (27 Feb '67)
ΔT = -1.1 °C
σ_θ = 9.2 degrees
x100
Bldg. 22
MESA RD
009
8
010 x
BEAR CREEK
COAST ROAD
VHF
054
6
4
x 300
011
5
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
200
4
014
13
5
30
POINT ARGUELLO
057
USCG BOATHOUSE
018
2
020 x
021
BEACH
SCALE - MILES


MI-200 (2 Mar '67)
ΔT = -1.2 °C
σθ = 7.5 degrees
MESA RD
009 x
x100 Bldg. 22
BEAR CREEK
010 x
COAST ROAD
VHF
054
300
011
TELEMETRY PEAK
200
TRANQUILLON
013
014
055
301
POINT ARGUELLO
057
USCG BOATHOUSE
018
020 x
SCALE - MILES
GUDDEN PEAK
BEACH


MI-201 (3 Mar '67)
ΔT = -0.8 °C
σθ = 6.8 degrees
x100
Bldg. 22
009 x
010 x
BEAR CREEK
VHF
12
054
10
300
9
011
COAST ROAD
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
101
200
8
TRANQUILLON
11
13
014
8
5
301
POINT ARGUELLO
20,000
10,000
5,000
2,000
018
12
057
USCG BOATHOUSE
020
10
021
JALAMA BEACH
10


MI-202 (6 Mar '66)
ΔT = 0.4 °C
σθ = 8.2 degrees
MESA RD
009 x
x100 Bldg. 22
010 x
BEAR CREEK
VHF
COAST ROAD
054
300
011
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
014
13
301
018
057
020
SCALE - MILES

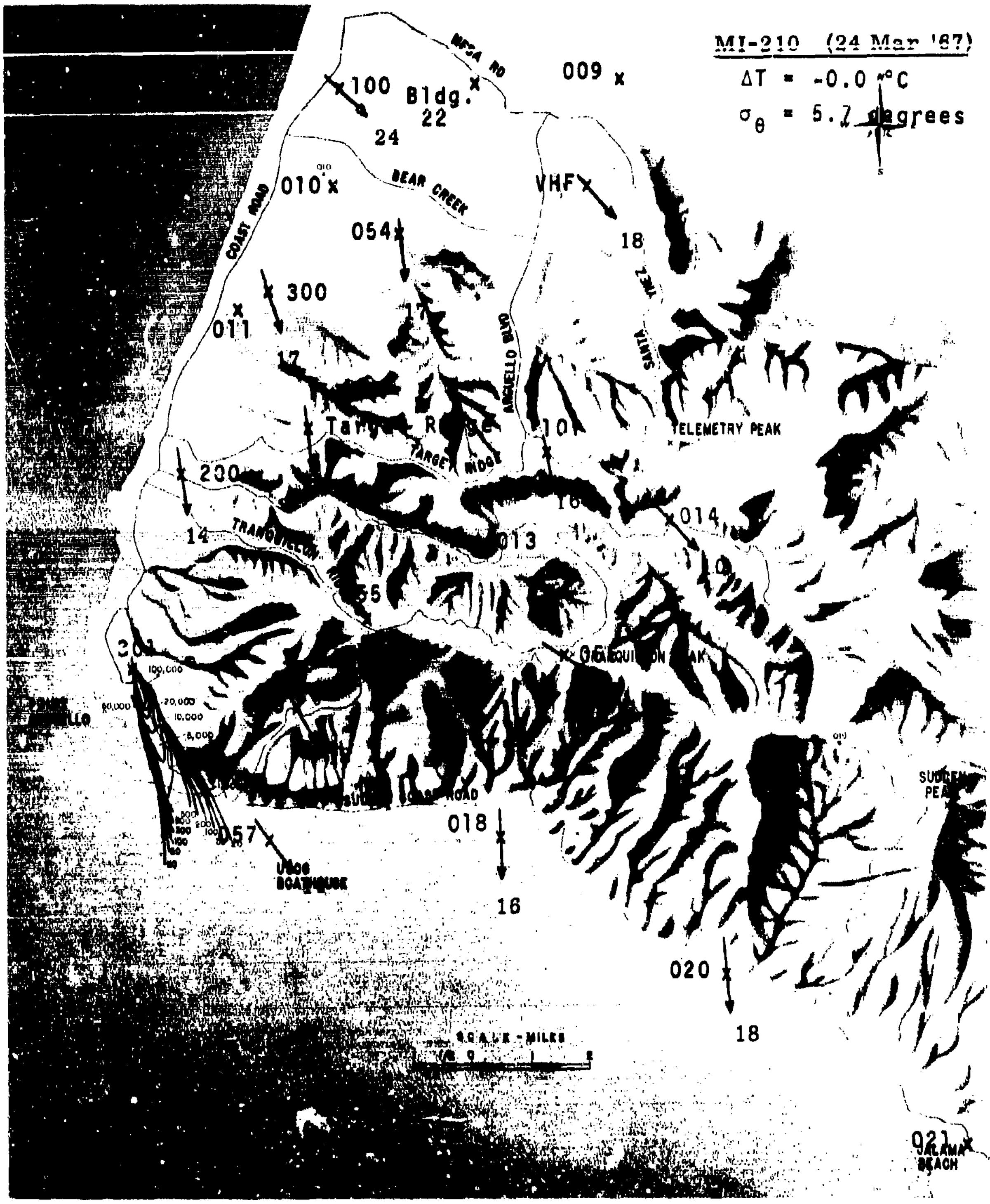

MT-203 (8 Mar '67)
ΔT = -1.0 °C
σθ = 33.9 degrees
MESA RD
x100
Bldg. 22
009
010
COAST ROAD
BEAR CREEK
VHF
054
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
TRANQUILLON
014
13
8
5
6
4
30
057
018
USCG BOATHOUSE
020
021
JALAMA BEACH
7


MI-204 (9 Mar '67)
ΔT = -0.7 °C
σ_θ = 12.3 degrees
MESA RD
009
x100
Bldg. 22
10
BEAR CREEK
010
COAST ROAD
VHF
4
054
300
011
ARGUELLO BLVD
SANTA YNEZ
TARGET RIDGE
01
TELEMETRY PEAK
6
TRANQUILLON
014
13
8
5
057
018
020
9
SCALE - MILES

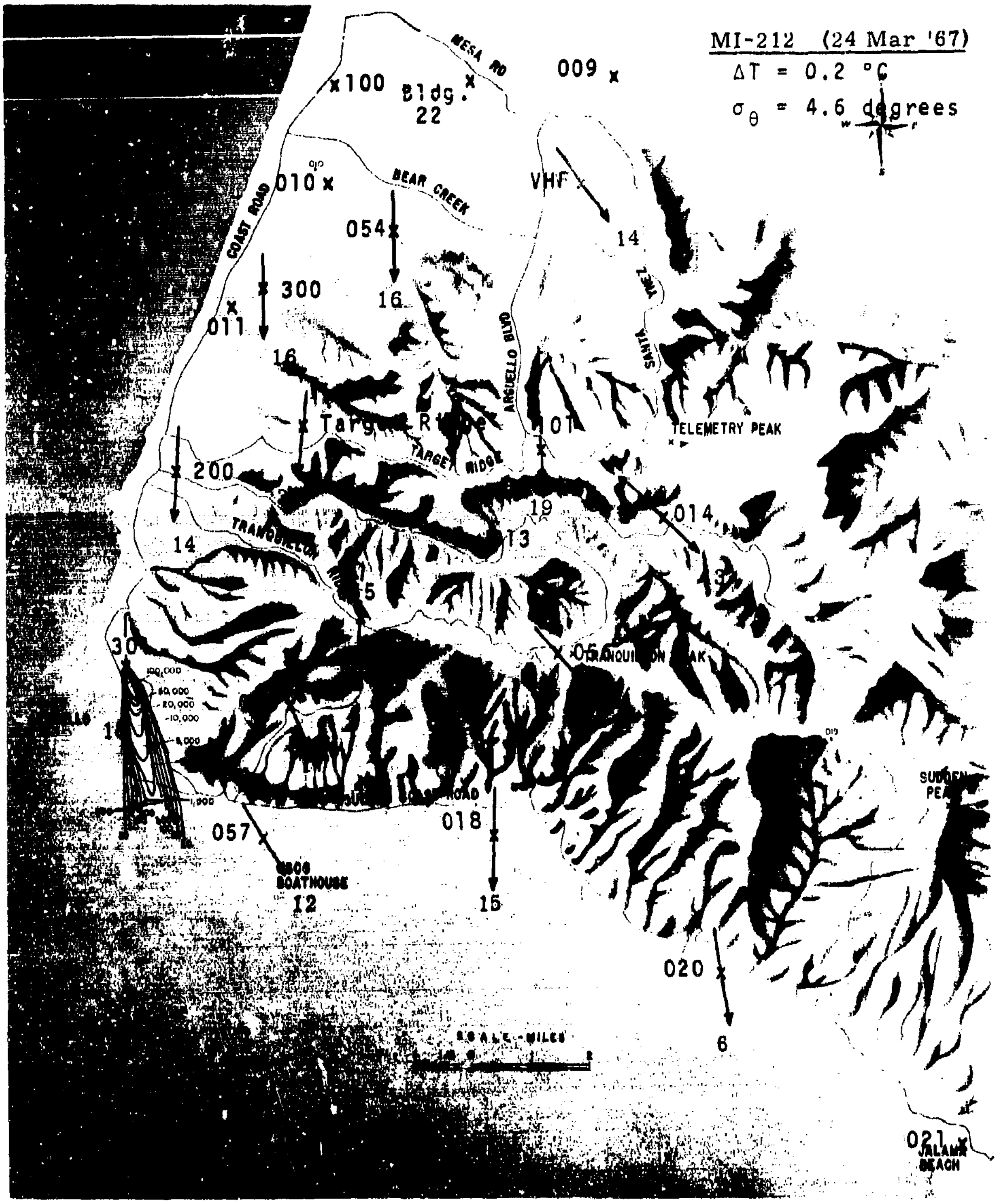

MI-205 (21 Mar '67)
ΔT = -2.0 °C
σθ = 7.0 degrees
100
Bldg.
6
009 x
010 x
BEAR CREEK
VHF
8
054
COAST ROAD
300
011
5
6
TELEMETRY PEAK
200
6
TARGET RIDGE
014
5
TRANQUILLON
13
5
30
100,000
057
USCG BOATHOUSE
17
018
10
020
16
10
021
JALAMA BEACH


MI-208 (23 Mar '67)
ΔT = -0.7 °C
σθ = 9.6 degrees
MESA RD
009
100 Bldg.
6 22
BEAR CREEK
010
VHF
COAST ROAD
054
300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
7
TRANQUILLON
014
13
6
018
020
10
021
8


MI-209 (24 Mar '67)
ΔT = -1.6 °C
σθ = 5.5 degrees
100
Bldg. 22
17
009
010
BEAR CREEK
VHF
18
COAST ROAD
054
300
011
15
16
ARGUELLO BLVD
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
200
13
TRANQUILLON
21
13
014
5
POINT ARGUELLO
018
14
057
USCG BOATHOUSE
020
16
021
JALAMA BEACH
15


MI-210 (24 Mar '67)
ΔT = -0.0 °C
σθ = 5.7 degrees
100 Bldg.
22
24
009 x
MESA RD
BEAR CREEK
010 x
COAST ROAD
VHF
18
054
300
011
17
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
10
200
14
TRANQUILLON
16
013
014
10
55
301
100,000
20,000
10,000
8,000
057
018
16
USCG BOATHOUSE
020
18
SCALE - MILES
021 x
JALAMA BEACH

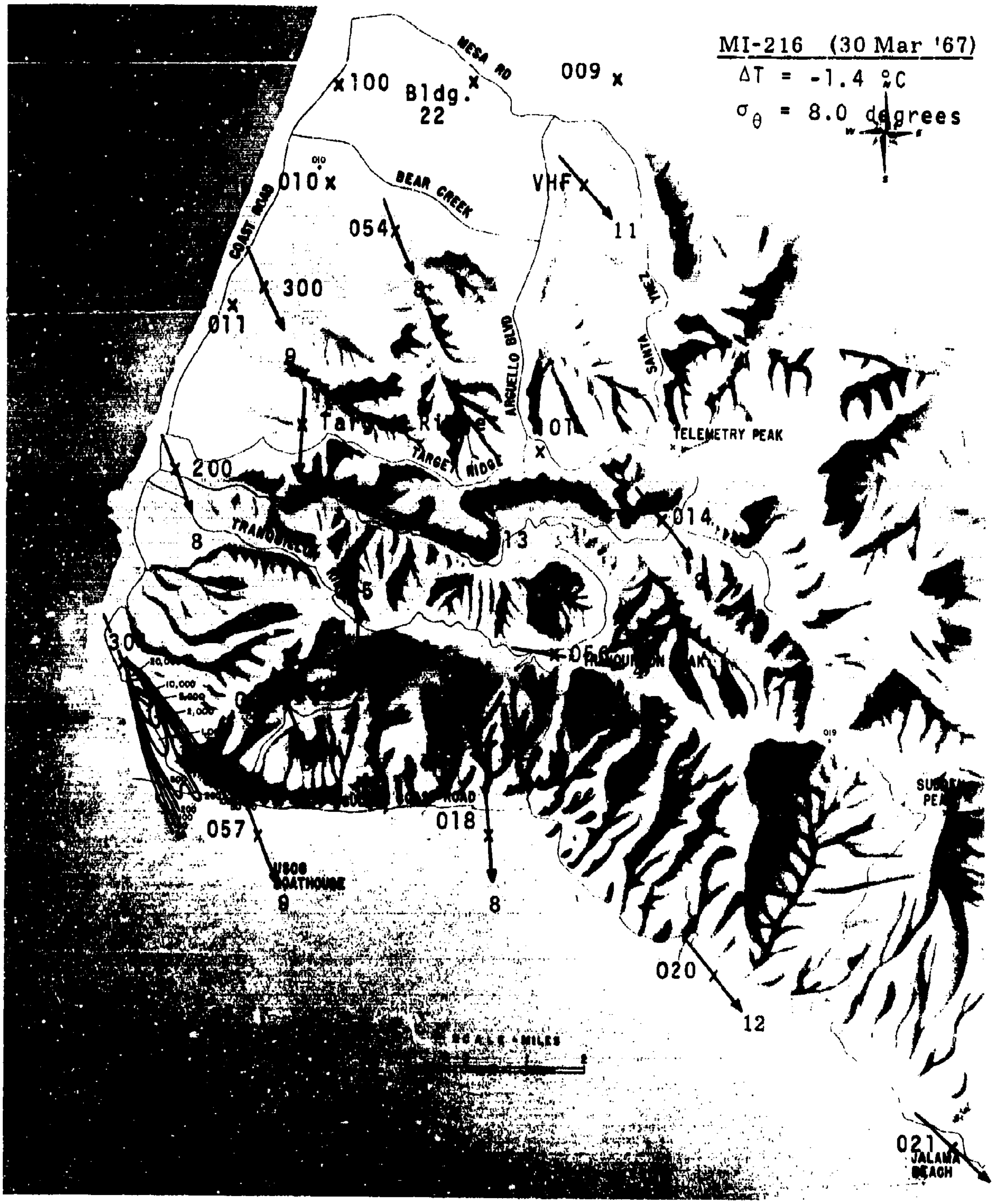

MI-211 (24 Mar '67)
ΔT = -0.0 °C
σθ = 4.8 degrees
x100
Bldg. 22
009 x
MESA RD
010 x
BEAR CREEK
VHF
054
COAST ROAD
300
17
15
011
15
TELEMETRY PEAK
200
TARGET RIDGE
19
014
11
13
TRANQUILLON
30
057
018
17
020
23
021
JALAMA BEACH
SANTA YNEZ


MI-212 (24 Mar '67)
ΔT = 0.2 °C
σθ = 4.6 degrees
MESA RD
009
x100
Bldg. 22
010
BEAR CREEK
VHF
14
054
COAST ROAD
300
16
011
16
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
101
200
19
014
14
TRANQUILLON
13
30
100,000
60,000
20,000
10,000
5,000
1,000
018
057
BOATHOUSE
12
15
020
6
SUDDEN PEAK
021
JALAMA BEACH
SCALE - MILES

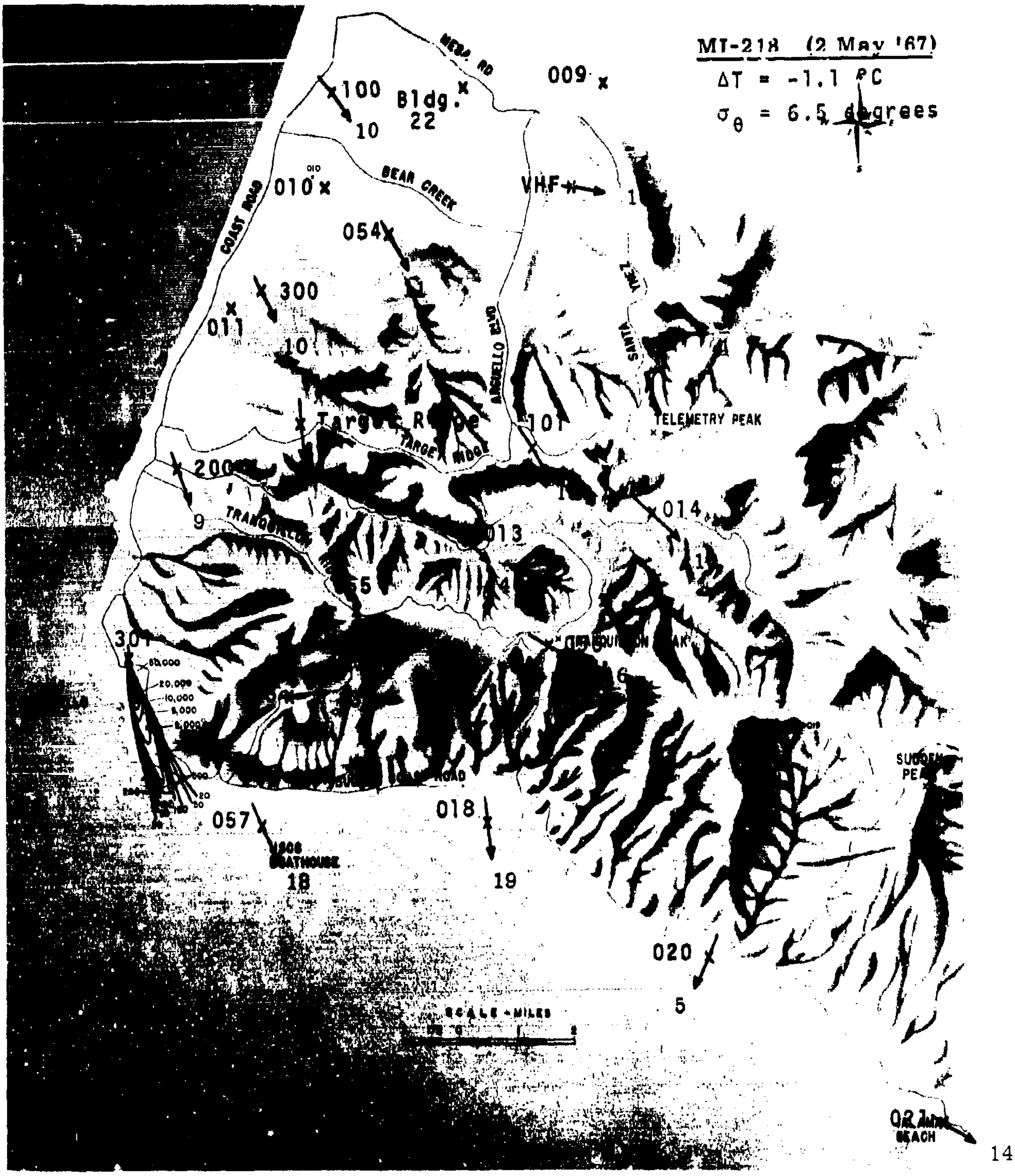

MI-213 (27 Mar '67)
ΔT = -1.4 °C
σθ = 26.0 degrees
x100
Bldg. 22
009 x
MESA RD
BEAR CREEK
010 x
VHF x
COAST ROAD
054
7
300
011
4
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RDG
101
TELEMETRY PEAK
200
TRANQUILLON
4
013
014
5
30
4
2
TRANQUILLON PEAK
POINT ARGUELLO
057
5
018
USCG BOATHOUSE
020
SCALE - MILES
5
021
BEACH


MI-214 (28 Mar '67)
ΔT = -0.6 °C
σθ = 5.6 degrees
x100
Bldg. 22
009
MESA RD
010
BEAR CREEK
VHF
8
054
COAST ROAD
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
TRANQUILLON
014
13
018
7
BOATHOUSE
020
11
8


MI-215 (29 Mar '67)
ΔT = -1.9 °C
σθ = 5.5 degrees
MESA RD
100
Bldg. 22
13
009
BEAR CREEK
010
VHF
15
054
15
COAST ROAD
300
011
14
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
14
TRANQUILLON
13
17
014
USCG BOATHOUSE
13
057
018
11
020
15
021
JALAMA BEACH
15


MI-216 (30 Mar '67)
ΔT = -1.4 °C
σ_θ = 8.0 degrees
100
Bldg. 22
MESA RD
009
010
BEAR CREEK
VHF
11
054
COAST ROAD
300
011
9
8
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
8
TRANQUILLON
13
014
5
057
USCG BOATHOUSE
9
018
8
020
12
021
JALAMA BEACH
SCALE - MILES


MI-217 (1 May '67)
ΔT = -1.0 °C
σθ = 11.5 degrees
MESA RD
009 x
100
Bldg. 22
10
010 x
BEAR CREEK
VHF
13
054
COAST ROAD
300
011
10
Target Ridge
TARGET RIDGE
SANTA
TELEMETRY PEAK
101
200
14
TRANQUILLON
13
014
7
5
8
30
10,000
5,000
2,000
1,000
057
USCG BOATHOUSE
13
018
6
020
6
6
021


MT-218 (2 May '67)
ΔT = -1.1 °C
σθ = 6.5 degrees
100
10
Bldg.
22
009
010
BEAR CREEK
COAST ROAD
VHF
054
300
011
10
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
9
TRANQUILLON
013
014
5
4
301
057
USGS BOATHOUSE
18
018
19
020
5
SCALE - MILES
SUDDEN PEAK
BEACH
14


MI-219 (3 May '67)
ΔT = -1.3 °C
σθ = 9.5 degrees
MESA RD
009
100
Bldg.
6
22
010
BEAR CREEK
VHF
11
COAST ROAD
054
8
300
7
011
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
200
7
TRANQUILLON
014
13
5
5
057
USCG
BOATHOUSE
018
9
020
021
BEACH
5


MI-220 (4 May '67)
ΔT = -1.2 °C
σθ = 8.8 degrees
MESA RD
009
100
Bldg.
5
22
010
BEAR CREEK
VHF
9
054
COAST ROAD
300
011
5
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
TARGET RIDGE
101
200
5
014
8
13
5
30
018
8
057
USCG BOATHOUSE
020
7
021
8

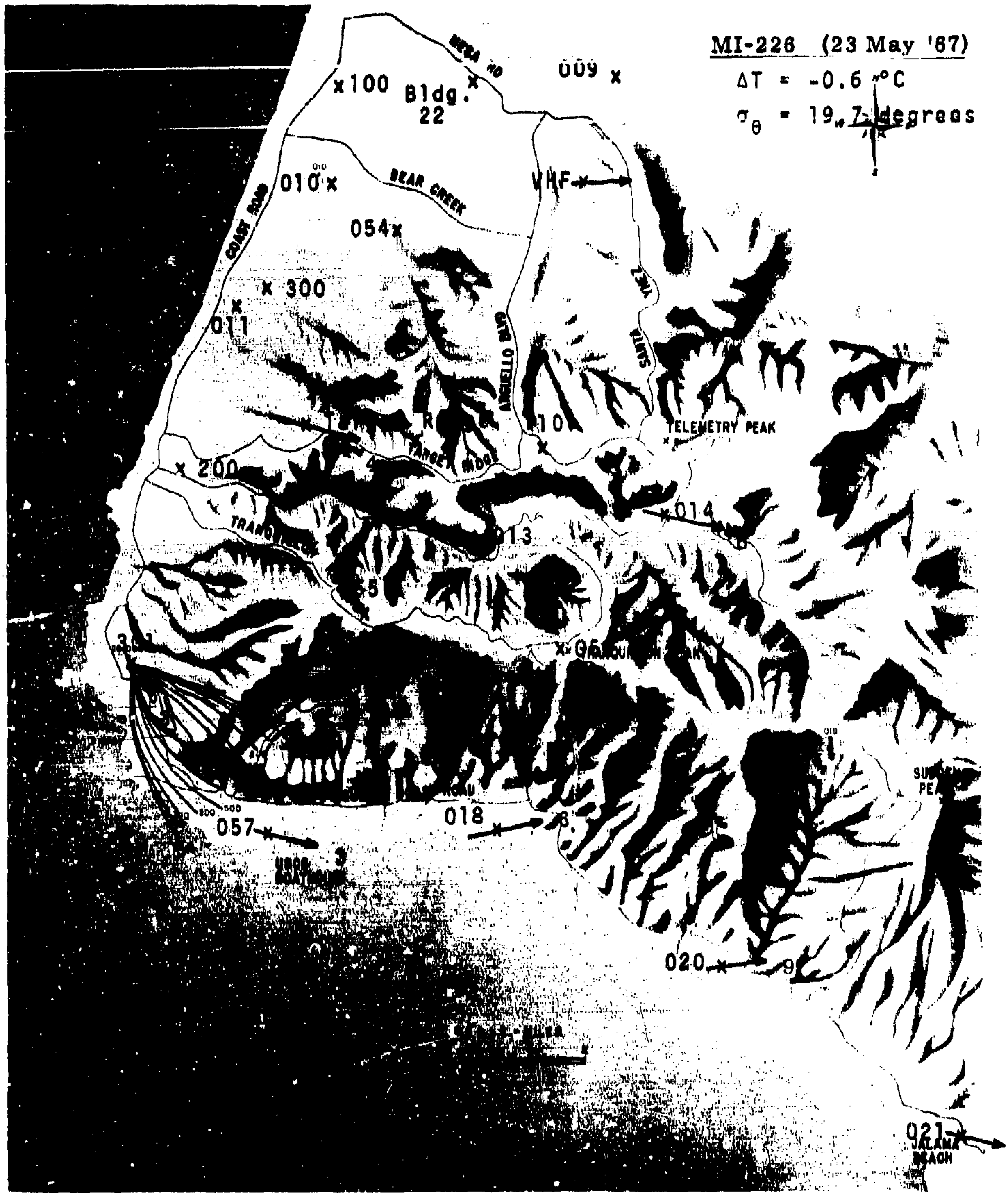

MI-221 (4 May '67)
ΔT = -1.2 °C
σθ = 12.2 degrees
MESA RD
009 x
100
Bldg. 22
8
010 x
BEAR CREEK
COAST ROAD
VHF x
12
054
300
011
7
SANTA YNEZ
AGUELLO BLVD
101
TELEMETRY PEAK
TARGET RIDGE
200
6
TRANQUILLON
014
13
9
5
5
30
USCG BOATHOUSE
057 x
018
9
020
14
021
11
SCALE - MILES


MI-222 (4 May '67)
ΔT = -1.5 °C
σθ = 6.7 degrees
100
9
Bldg. 22
009
MESA RD
010
BEAR CREEK
054
VHF
14
COAST ROAD
300
011
9
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
8
014
013
5
30
018
9
057
020
13
021
12
BEACH


MI-223 (4 May '67)
ΔT = -0.7 °C
σ_θ = 4.4 degrees
MESA RD
009
100
Bldg.
22
8
010
BEAR CREEK
VHF
11
054
9
COAST ROAD
300
011
9
SANTA YNEZ
ARGUELLO BLVD
TELEMETRY PEAK
01
200
7
12
TARGET RIDGE
TRANQUILLON
13
11
014
8
30
50,000
20,000
10,000
5,000
POINT ARGUELLO
057
USCG BOATHOUSE
018
8
020
12
SCALE - MILES
021
JALAMA BEACH
10


MI-224 (4 May '67)
ΔT = -0.0 °C
σθ = 3.6 degrees
MESA RD
009 x
100
Bldg.
22
4
BEAR CREEK
010 x
VHF
7
054
COAST ROAD
300
011
6
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
8
TRANQUILLON
11
014
13
5
05
TRANQUILLON PEAK
30
018
7
020
8
021
JALAMA BEACH
5

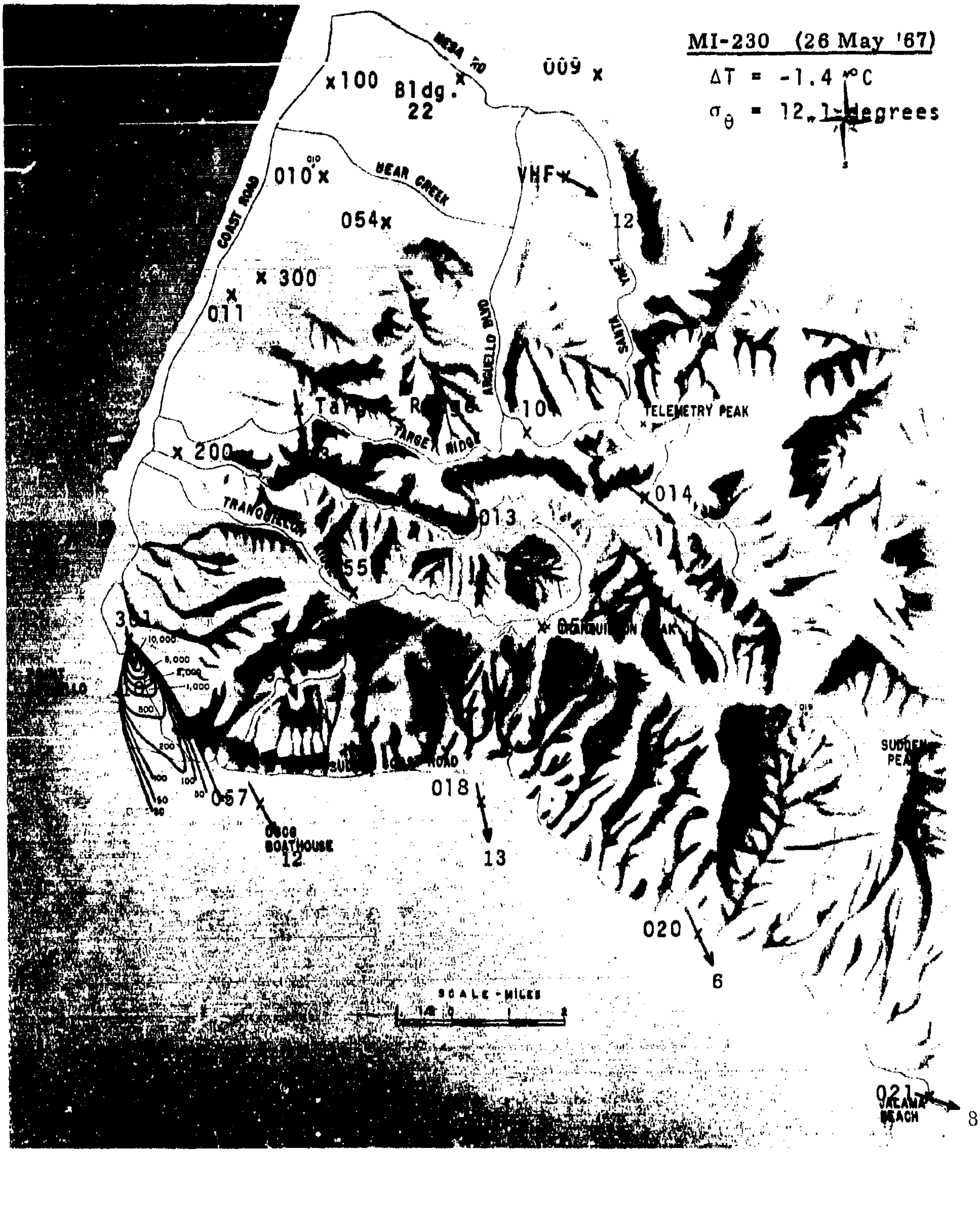

MI-225 (5 May '67)
ΔT = -1.4 °C
σθ = 9.1 degrees
100
Bldg. 22
009
010
BEAR CREEK
COAST ROAD
VHF
054
300
011
10
ARGUELLO BLVD
TELEMETRY PEAK
200
TRANQUILLON
014
057
USCG BOATHOUSE
018
12
020
11
SCALE - MILES


MI-226 (23 May '67)
ΔT = -0.6 °C
σ_θ = 19.7 degrees
009 x
x100 Bldg. 22
010 x
BEAR CREEK
054 x
COAST ROAD
x 300
011
VHF
TELEMETRY PEAK
TARGET RIDGE
x 200
014
013
018
057
020
021
JALAMA BEACH


MI-227 (23 May '67)
ΔT = -1.6 °C
σθ = 16.5 degrees
MESA RD
x100
Bldg. 22
009 x
010 x
BEAR CREEK
VHF
054x
COAST ROAD
x 300
011
SANTA YNEZ
ARGUELLO BLVD
Target Range
TARGET RIDGE
TELEMETRY PEAK
x 200
x014
TRANQUILLON
013
TRANQUILLON PEAK
POINT ARGUELLO
057
018
USCG BOATHOUSE
020
021
JALAMA BEACH
6


MI-228 (24 May '67)
ΔT = -1.3 °C
σθ = 6.5 degrees
x100 Bldg. 22
009 x
MESA RD
010 x
BEAR CREEK
VHF
9
054x
COAST ROAD
x 300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
10
TARGET RIDGE
x 200
014
TRANQUILLON
13
6
55
TRANQUILLON PEAK
3
057
018
COAST ROAD
BOATHOUSE
11
020
13
13
021
SALAMA BEACH

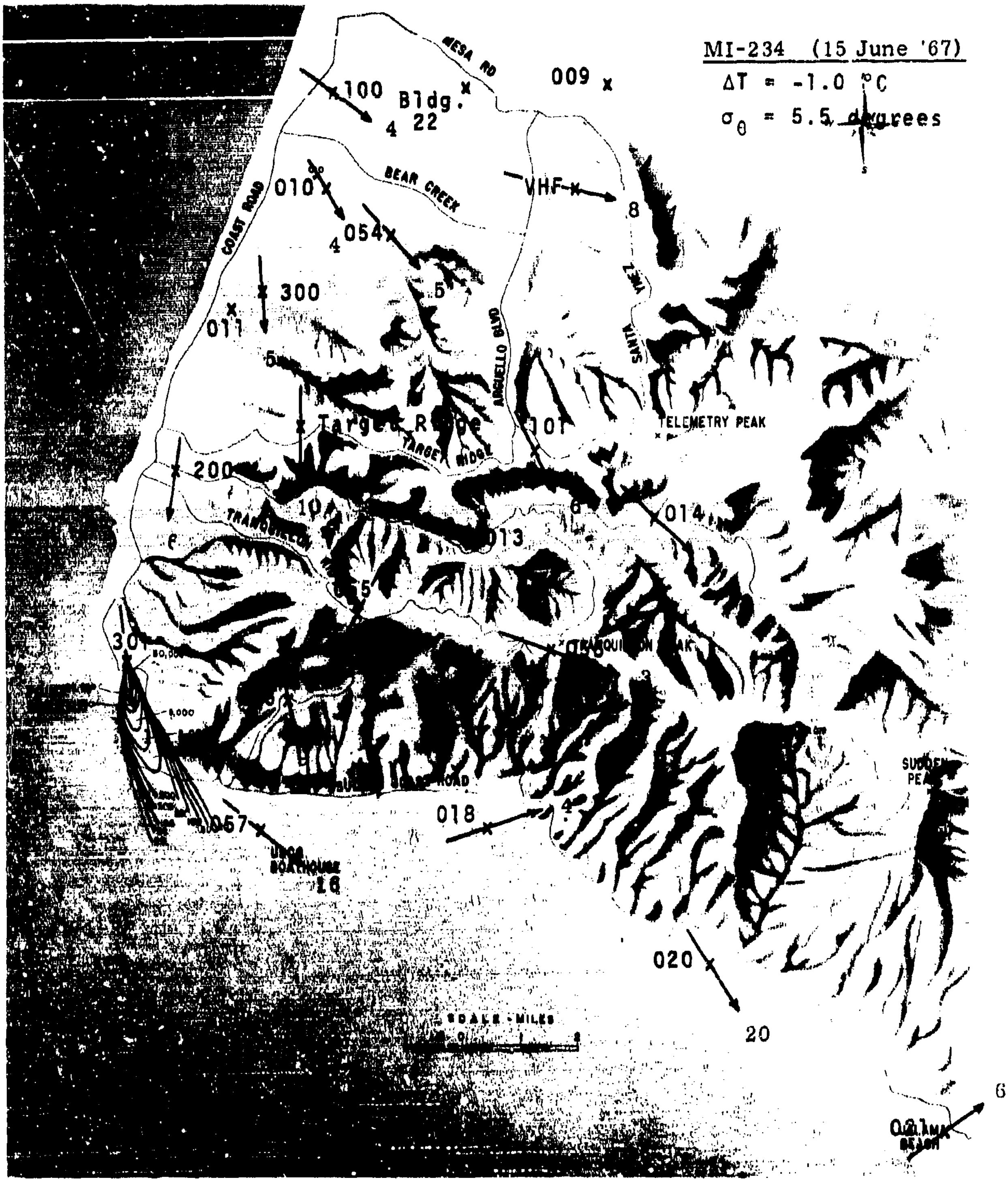

MI-229 (25 May '67)
σθ = 8.3 degrees
MESA RD
009
100 Bldg. 22
010
BEAR CREEK
VHF
9
054
COAST ROAD
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
10
200
TARGET RIDGE
TRANQUILLON
013
014
057
USCG BOATHOUSE
7
018
12
020
10
5

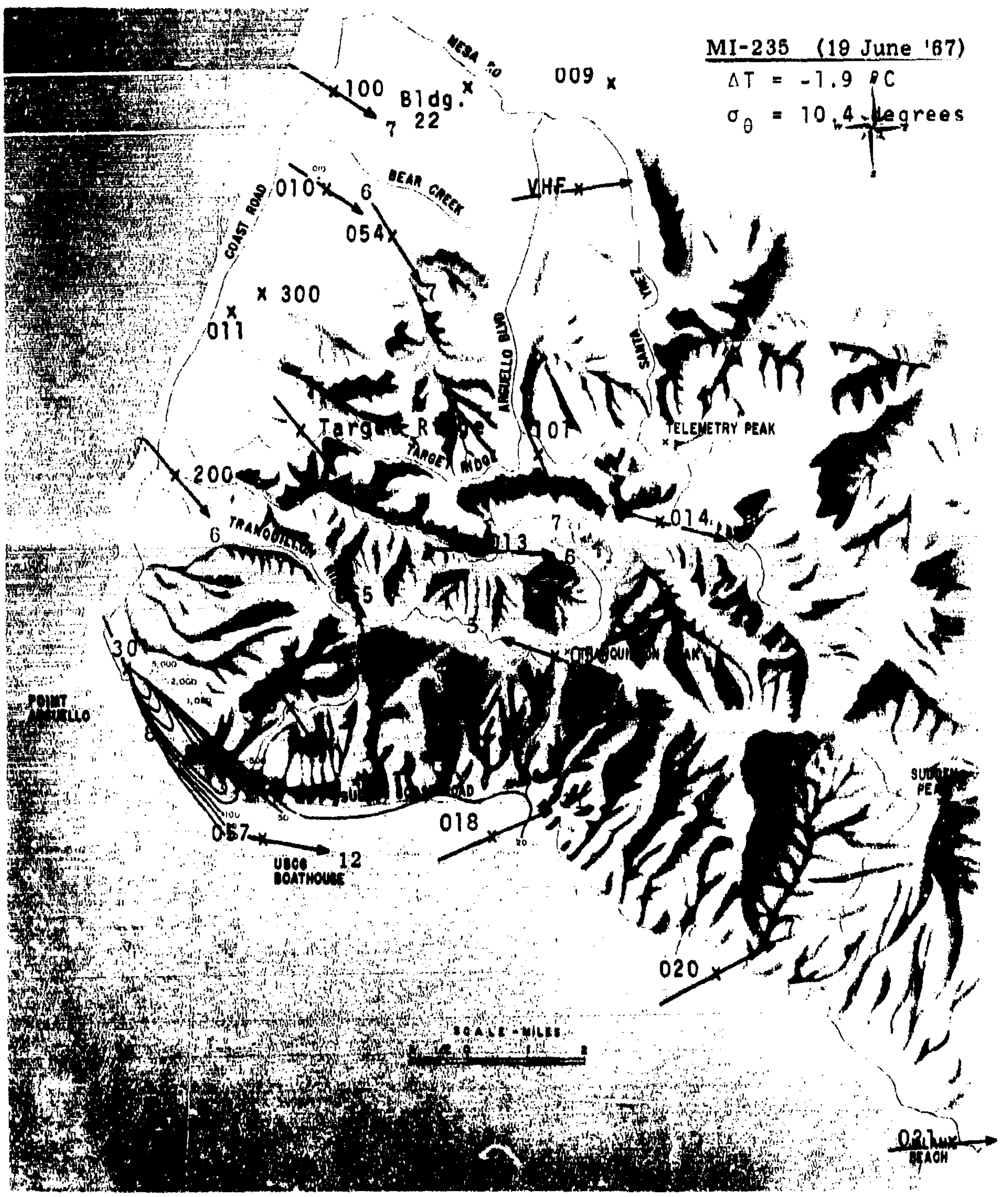

MI-230 (26 May '67)
ΔT = -1.4 °C
σθ = 12.1 degrees
MESA RD
009 x
x100
Bldg. 22
010 x
BEAR CREEK
VHF
12
054x
COAST ROAD
x 300
011
ARGUELLO BLVD
SANTA YNEZ
Target Range
TARGET RIDGE
10
TELEMETRY PEAK
x 200
TRANQUILLON
014
013
55
10,000
5,000
1,000
500
200
100
50
057
BOATHOUSE
12
018
13
020
6
SCALE - MILES
SUDDEN PEAK
021
JALAMA BEACH
8


MI-231 (12 June '67)
ΔT = -2.4 °C
σθ = 6.4 degrees
100 Bldg. 22
009
MESA RD
BEAR CREEK
COAST ROAD
010
054
VHF
13
300
011
8
200
7
TELEMETRY PEAK
014
14
13
30
057
USCG BOATHOUSE
10
018
11
020
11
021
12

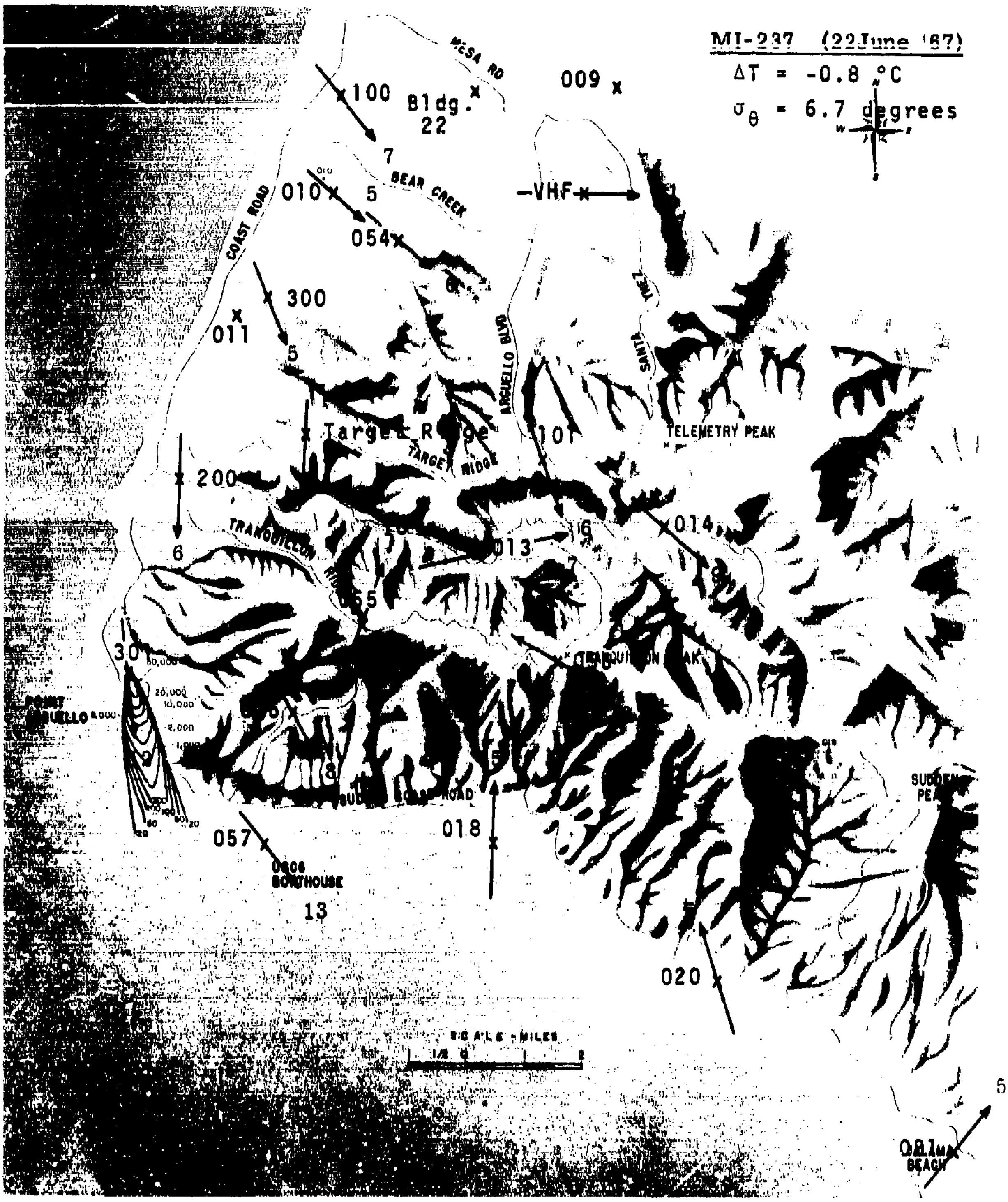

MI-232 (13 June '67)
ΔT = -2.1 °C
σθ = 6.1 degrees
MESA RD
009
100
Bldg. 22
8
BEAR CREEK
010
7
054
VHF
12
COAST ROAD
300
011
8
SANTA YNEZ
ARGUELLO BLVD
TARGET RIDGE
101
TELEMETRY PEAK
200
8
10
014
13
6
5
30
10,000
5,000
2,000
1,000
POINT ARGUELLO
1
057
USCG BOATHOUSE
018
5
020
9
SCALE - MILES
1/2
0
1
2
SUDDEN PEAK
JALAMA BEACH
021
10


MI-233 (14 June '67)
ΔT = -1.4 °C
σθ = 7.7 degrees
100
Bldg. 22
009
5
010
BEAR CREEK
VAF
8
054
5
COAST ROAD
300
011
TELEMETRY PEAK
200
TRANQUILLON
13
014
7
5
30
20,000
10,000
6,000
2,000
1,000
057
018
9
020
8
021
9


MI-234 (15 June '67)
ΔT = -1.0 °C
σθ = 5.5 degrees
MESA RD
009
100 Bldg.
4 22
BEAR CREEK
010
054
VHF
8
COAST ROAD
300
011
5
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
TELEMETRY PEAK
200
014
013
6
TRANQUILLON PEAK
30
018
057
USCG BOATHOUSE
16
SCALE - MILES
020
20
SUDDEN PEAK
6
OCEAN BEACH

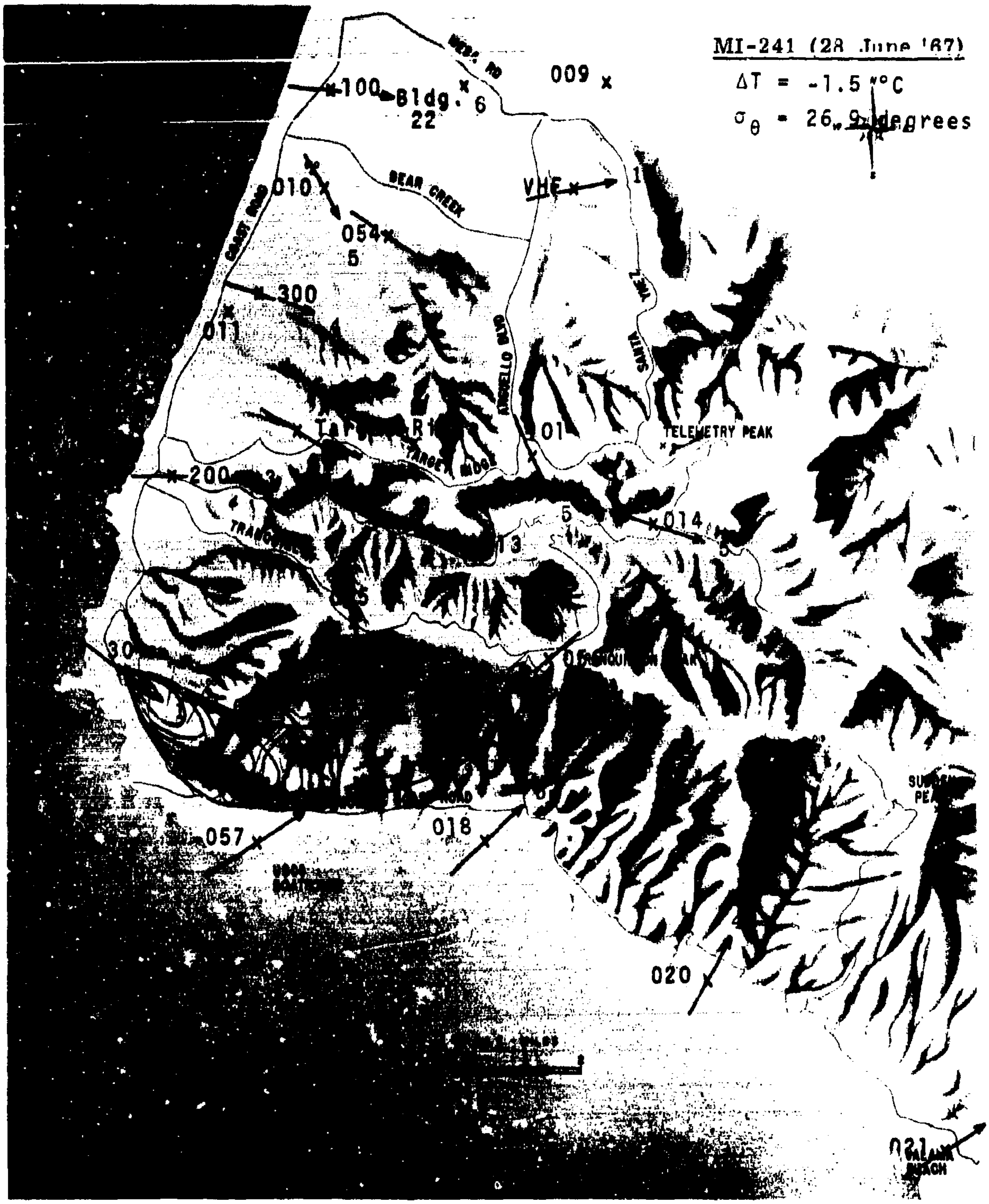

MI-235 (19 June '67)
ΔT = -1.9 °C
σ_θ = 10.4 degrees
MESA RD
009
100
Bldg. 22
7
BEAR CREEK
010
6
054
VHF
COAST ROAD
300
011
7
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
200
6
TRANQUILLON
013
7
6
014
5
5
30
POINT ARGUELLO
8
057
USCG BOATHOUSE
12
018
020
SCALE - MILES
021
9
BEACH


MI-236 (20 June '67)
ΔT = -0.8 °C
σθ = 4.7 degrees
MESA RD
100 Bldg. 22
009
BEAR CREEK
010
054
7
VHF
1
COAST ROAD
300
011
8
ARGUELLO BLVD
SANTA YNEZ
Target Ridge
TARGET RIDGE
101
TELEMETRY PEAK
200
TRANQUILLON RIDGE
013
014
8
055
301
057
018
3
13
BOATHOUSE
020
7
SCALE - MILES
021
7


MI-237 (22June '67)
ΔT = -0.8 °C
σθ = 6.7 degrees
MESA RD
100 Bldg. 22
009
7
BEAR CREEK
010
5
VHF
054
COAST ROAD
300
011
5
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
101
200
TRANQUILLON
013
6
014
6
055
30
POINT ARGUELLO
8
018
057
BOATHOUSE
13
020
SUDDEN PEAK
SCALE - MILES
5
OCEAN BEACH


MI-238 (23 June '67)
ΔT = -1.6 °C
σ_θ = 17.4 degrees
MESA RD
009
100
Bldg. 22
5
BEAR CREEK
010
054
4
VHF
1
COAST ROAD
300
5
011
ARGUELLO BLVD
SANTA
Target Ridge
TARGET RIDGE
10
TELEMETRY PEAK
200
014
6
013
1
55
301
2,000
1,000
POINT
8
ROAD
018
057
USCG BOATHOUSE
SUDDEN PEAK
020
7
SCALE-MILES
021
BEACH


MT-240 (27 June '67)
ΔT = -1.6 °C
σθ = 9.8 degrees
100 Bldg. 22
8
009
BEAR CREEK
010
054
6
VHF
COAST ROAD
300
011
TELEMETRY PEAK
200
014
057
USCG BOATHOUSE
018
020
021
5

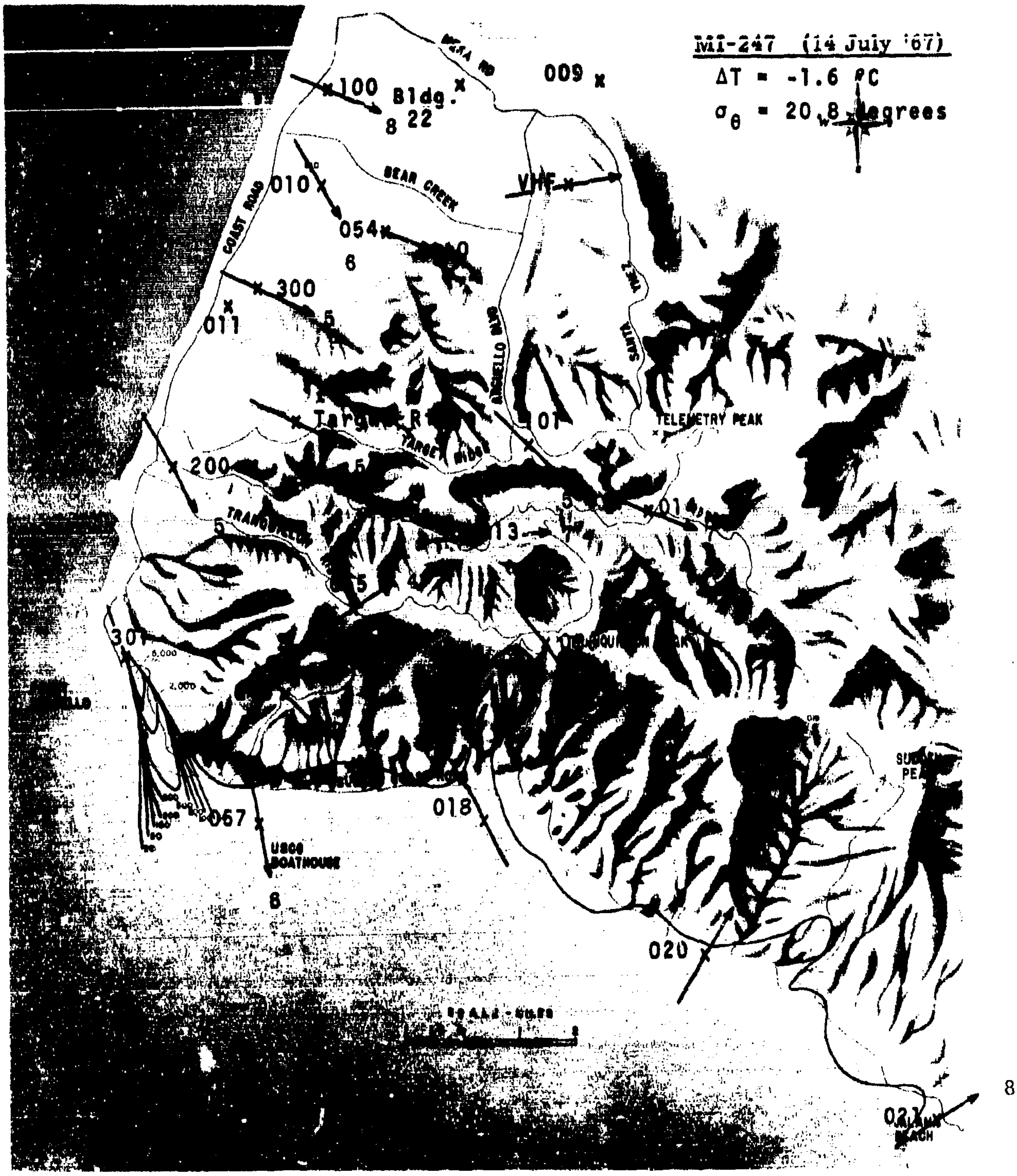

MI-241 (28 June '67)
ΔT = -1.5 °C
σθ = 26.9 degrees
009 x
100
Bldg. 22
6
010
BEAR CREEK
VHF
1
054
5
300
011
TELEMETRY PEAK
200
5
014
13
30
057
018
020
021
6

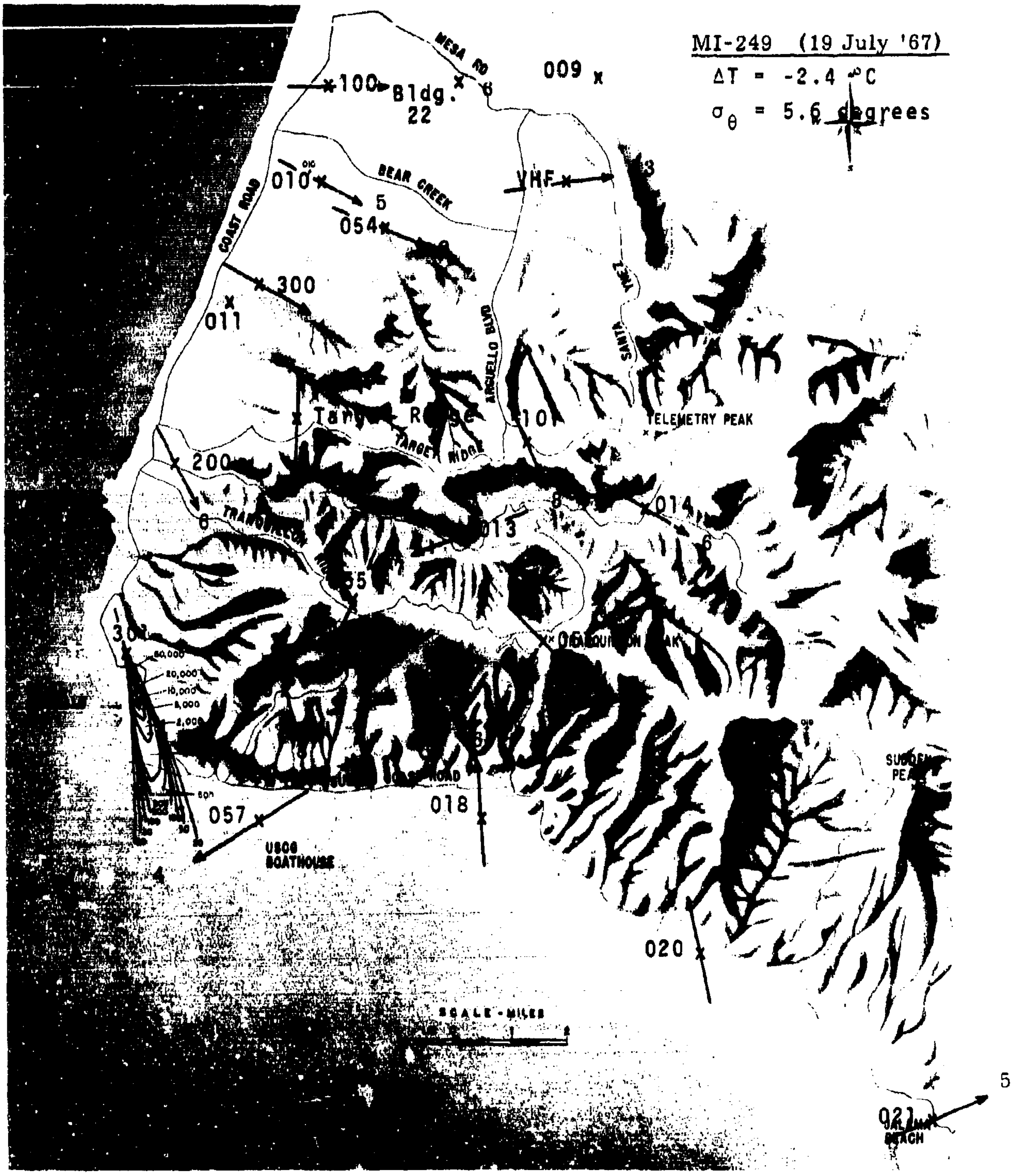

MI-242 (30 June '67)
ΔT = -0.6 °C
σ_θ = 31.1 degrees
009
100
Bldg. 22
BEAR CREEK
010
5
054
VHF
COAST ROAD
300
5
011
Target Ridge
TARGET RIDGE
6
200
TELEMETRY PEAK
101
014
013
TRANQUILLON
5
5
30
057
12
018
USCG BOATHOUSE
020
5
021

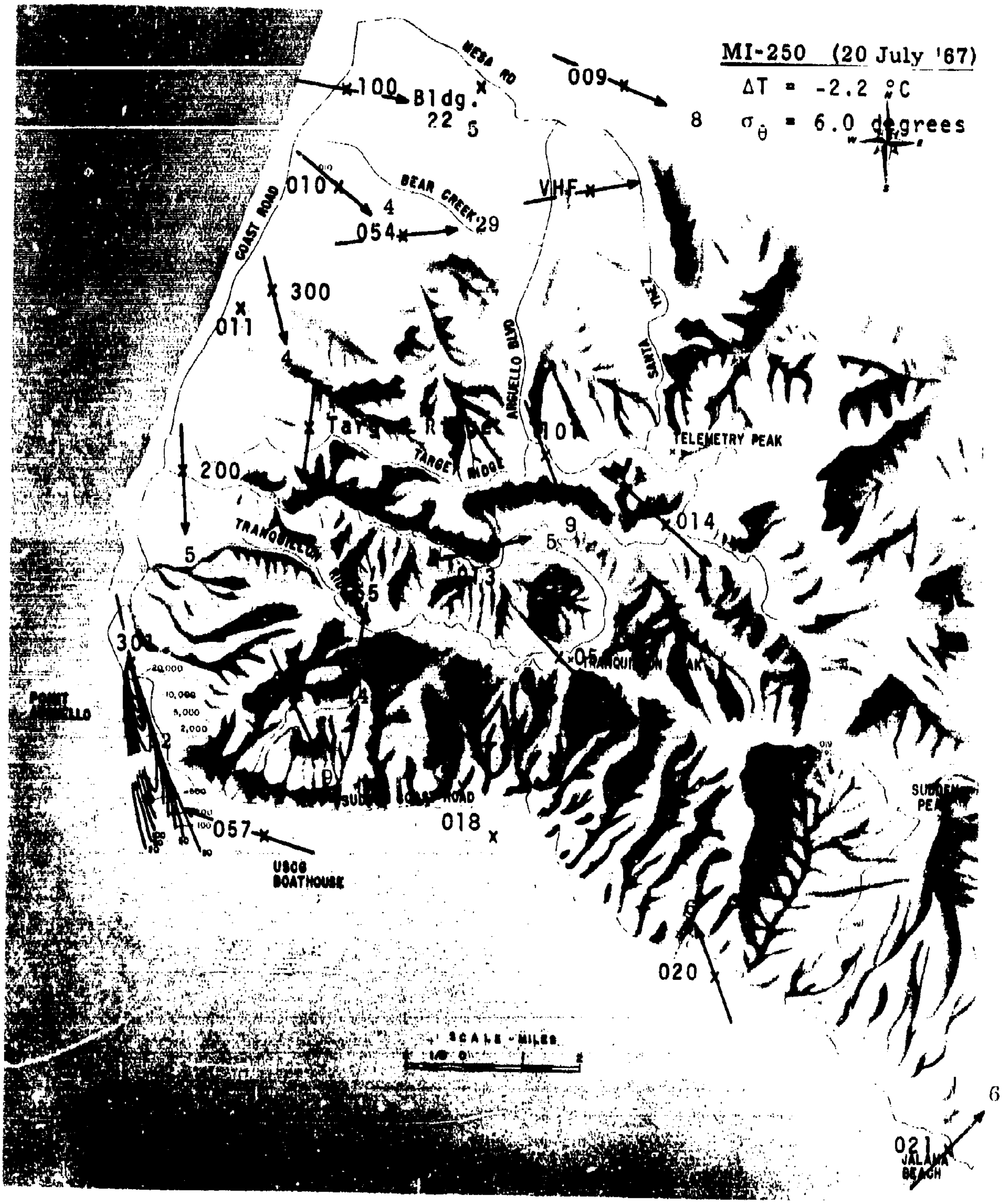

MI-244 (7 July '67)
ΔT = -1.4 °C
σθ = 6.3 degrees
MESA RD
009
100 Bldg. 22
9
BEAR CREEK
VHF
010
054
7
COAST ROAD
300
011
TELEMETRY PEAK
TARGET RIDGE
200
014
TRANQUILLON
10
013
8
30
057
018
6
020
4

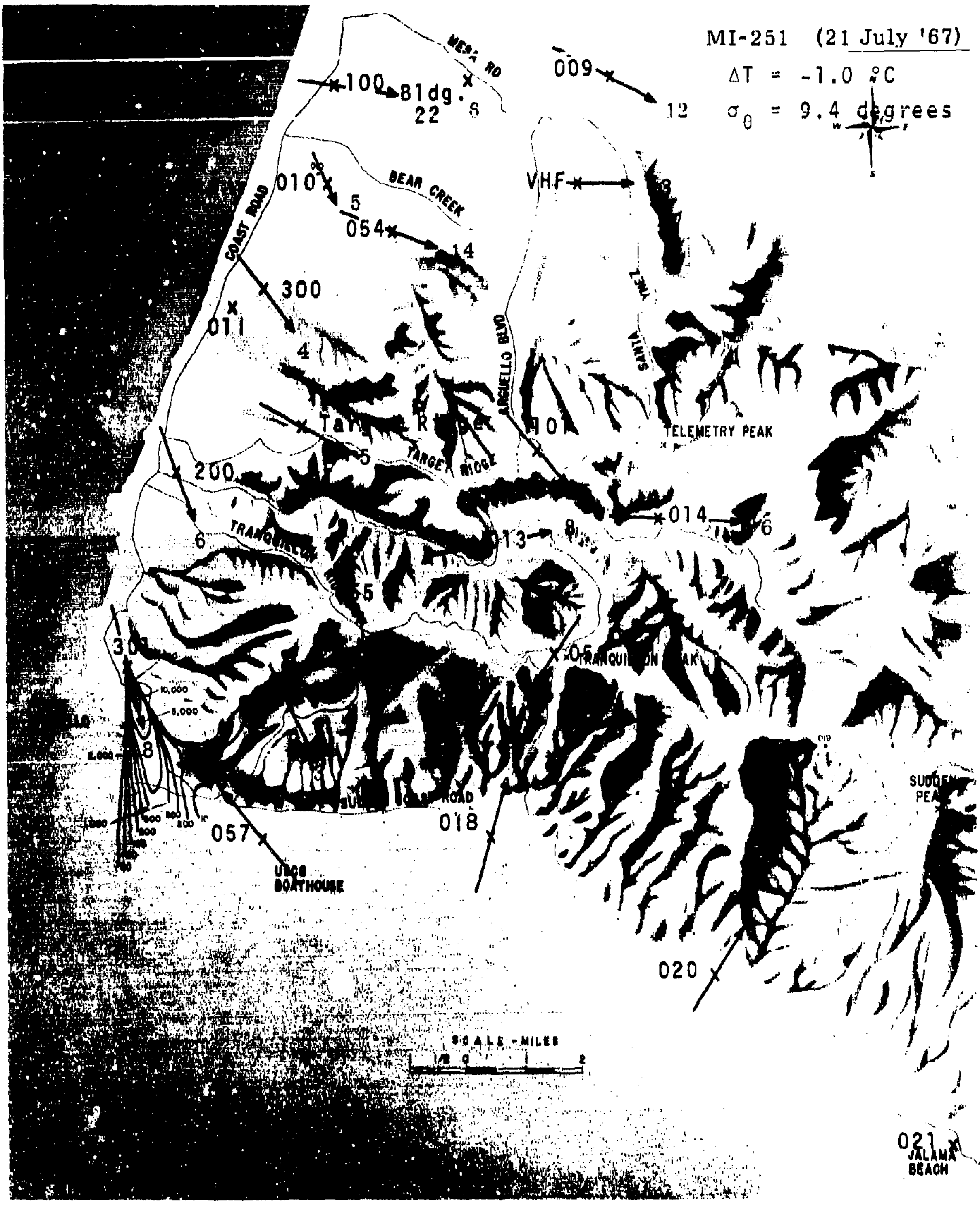

MI-245 (10 July '67)
ΔT = -1.4 °C
σθ = 11.7 degrees
009
100
Bldg.
22
8
BEAR CREEK
COAST ROAD
010
054
7
300
011
VHF
TELEMETRY PEAK
200
4
TRANQUILLON
014
13
018
057
10
020
021
6

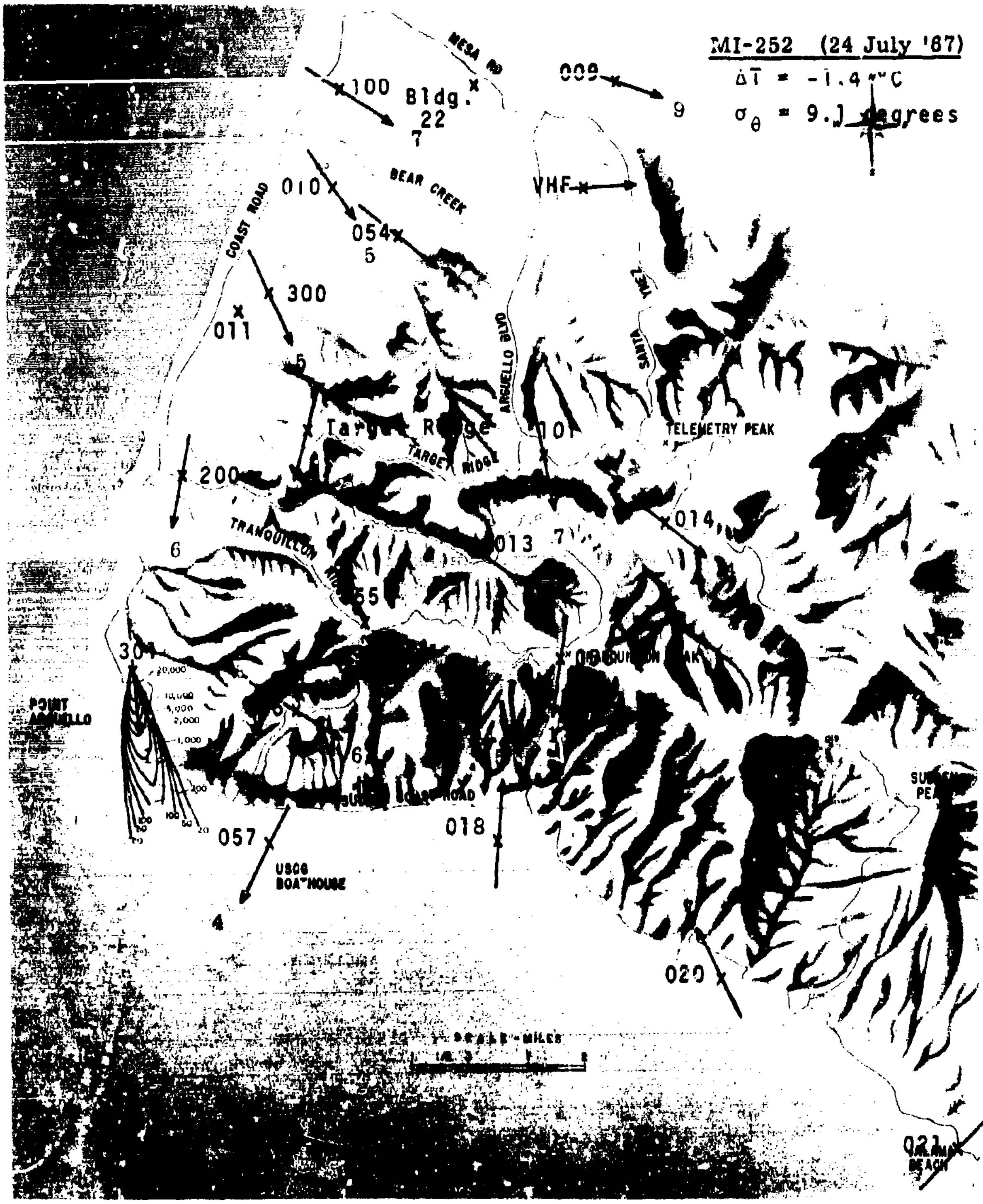

MI-246 (12 July '67)
ΔT = -2.0 °C
σθ = 20.9 degrees
009
100
Bldg. 22
7
BEAR CREEK
010
VHF
COAST ROAD
054
6
300
5
011
ARGUELLO BLVD
TELEMETRY PEAK
200
TARGET RIDGE
014
13
8
057
9
018
USCG BOATHOUSE
020
8
021
6


MI-247 (14 July '67)
ΔT = -1.6 °C
σ_θ = 20.8 degrees
009
100 Bldg.
8 22
BEAR CREEK
VHF
010
054
6
COAST ROAD
300
5
011
Target R
200
5
TRANQUILLON
13
TELEMETRY PEAK
301
067
USCG
BOATHOUSE
6
018
020
8


MI-249 (19 July '67)
ΔT = -2.4 °C
σθ = 5.6 degrees
MESA RD
009
100
Bldg. 22
6
010
BEAR CREEK
5
054
VHF
3
COAST ROAD
300
011
ARGUELLO BLVD
SANTA
TELEMETRY PEAK
TARGET RIDGE
200
6
TRANQUILLON
013
8
014
6
55
30,000
20,000
10,000
5,000
2,000
057
USCG BOATHOUSE
018
020
SCALE - MILES
5


MI-250 (20 July '67)
ΔT = -2.2 °C
σθ = 6.0 degrees
MESA RD
009
8
100
Bldg.
22
5
010
4
BEAR CREEK
29
054
VHF
COAST ROAD
300
011
4
SANTA YNEZ
ARGUELLO BLVD
TARGET RIDGE
TELEMETRY PEAK
200
014
9
5
TRANQUILLON
5
30
20,000
10,000
5,000
2,000
POINT ARGUELLO
TRANQUILLON PEAK
057
USCG
BOATHOUSE
018
SUDDEN PEAK
020
SCALE - MILES
6
021
JALAMA
BEACH


MI-251 (21 July '67)
ΔT = -1.0 °C
σ_θ = 9.4 degrees
MESA RD
100
Bldg. 22
009
12
BEAR CREEK
010
5
054
14
VHF
COAST ROAD
300
011
4
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
6
014
013
8
TRANQUILLON PEAK
3
057
018
UCSB BOATHOUSE
020
SCALE - MILES
021
JALAMA BEACH


MI-252 (24 July '67)
ΔT = -1.4 °C
σθ = 9.1 degrees
MESA RD
100
Bldg. 22
7
009
9
BEAR CREEK
010
054
5
VHF
COAST ROAD
300
011
5
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
Target Ridge
TARGET RIDGE
10
200
6
TRANQUILLON
013
7
014
55
301
POINT ARGUELLO
057
018
USCG BOATHOUSE
4
020
SCALE-MILES
5
021
BEACH


MI-253 (25 July '67)
ΔT = -1.2 °C
σθ = 6.8 degrees
009
100 Bldg.
6 22
MESA RD
VHF
11
010
6
BEAR CREEK
054
COAST ROAD
300
011
ARGUELLO BLVD
SANTA YNEZ
TELEMETRY PEAK
TARGET RIDGE
200
7
TRANQUILLON
013
3
014
55
301
057
USCG BOATHOUSE
018
020
021
JALAMA BEACH

APPENDIX B

BASIC DATA FROM MOUNTAIN IRON PHASE II

APPENDIX B

BASIC DATA FROM MOUNTAIN IRON PHASE II

The data presented in this appendix are a listing of the diffusion and meteorological values used in the mathematical analyses to derive the recommended range safety equation. The tabular values are arranged by experimental run number. The columnar headings are:

X = the radial distance to the centerline sampler, meters

TIME = travel time, seconds

U BAR = the average wind speed at the generation point, measured at 12 ft, knots

SIGMA = the standard deviation of the wind direction fluctuations, as measured at the source point, degrees

DEL T = the temperature difference between 6 and 54 ft, C°

E/Q = the time-integrated centerline exposure normalized by the source strength, sec/m^3

This is a computer compiled listing. Therefore, the notation for E/Q at 500 m for Test 114 is given as; 5.9 - 06. This notation is equivalent to 5.9×10^{-6}.

The wind rose presentation (Figure B-1) depicts the percent frequency of occurrence of wind direction for the test series. The graphical representation is not that usually employed for climatological wind roses, but rather indicates the direction to which tracer would have been carried if the source wind directions had remained constant in space.

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
114	500	114.0	8.50	12.5	-2.1	5.9-06
114	800	182.0	8.50	12.5	-2.1	1.2-06
114	1000	227.0	8.50	12.5	-2.1	9.2-07
114	2275	517.0	8.50	12.5	-2.1	5.8-07
115	500	70.0	13.80	9.6	-2.4	3.7-05
115	1000	141.0	13.80	9.6	-2.4	2.8-06
115	2112	298.0	13.80	9.6	-2.4	4.5-07
116	500	62.0	15.60	7.3	-1.0	5.0-05
116	1000	125.0	15.60	7.3	-1.0	4.4-06
116	2153	269.0	15.60	7.3	-1.0	5.5-07
117	500	85.0	11.40	15.5	-2.0	1.2-05
117	1000	170.0	11.40	15.5	-2.0	2.8-06
117	2245	380.0	11.40	15.5	-2.0	9.8-07
118	500	69.0	14.00	10.6	-2.4	3.4-05
118	1000	139.0	14.00	10.6	-2.4	4.5-06
118	1970	274.0	14.00	10.6	-2.4	8.8-07
122	500	132.0	7.40	13.2	-.4	2.3-05
122	2133	561.0	7.40	13.2	-.4	8.0-07
124	500	68.0	14.30	6.6	-1.3	7.4-05
124	1000	135.0	14.30	6.6	-1.3	7.2-06
124	1930	261.0	14.30	6.6	-1.3	9.2-07
125	500	135.0	7.20	10.6	-1.5	2.0-05
125	800	216.0	7.20	10.6	-1.5	5.1-06
125	1000	270.0	7.20	10.6	-1.5	2.9-06
125	2275	615.0	7.20	10.6	-1.5	1.0-06
126	500	172.0	5.70	11.3	-1.2	1.5-05
126	800	276.0	5.70	11.3	-1.2	4.5-06
126	2265	781.0	5.70	11.3	-1.2	2.1-06
127	500	86.0	11.20	7.5	-1.1	3.1-05
127	1000	172.0	11.20	7.5	-1.1	3.0-06
127	1970	340.0	11.20	7.5	-1.1	4.2-07
128	500	79.0	12.20	5.8	-2.4	8.0-05
128	1000	159.0	12.20	5.8	-2.4	8.3-06
128	2133	339.0	12.20	5.8	-2.4	1.4-06
129	500	53.0	18.40	4.3	-1.4	6.7-05
129	1000	105.0	18.40	4.3	-1.4	6.8-06
129	2153	227.0	18.40	4.3	-1.4	1.2-06
130	2722	972.0	5.40	12.1	-1.1	2.2-07
130	5718	2042.0	5.40	12.1	-1.1	1.1-07
131	500	227.0	4.20	7.3	-1.3	8.1-05

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
131	1000	455.0	4.20	7.3	-1.3	1.5-05
132	2864	1302.0	4.20	10.1	-.6	8.7-07
132	4692	2133.0	4.20	10.1	-.6	2.1-07
132	6927	3149.0	4.20	10.1	-.6	1.1-07
133	500	76.0	12.80	6.5	-1.4	6.1-05
133	1000	152.0	12.80	6.5	-1.4	5.2-06
133	2173	329.0	12.80	6.5	-1.4	3.2-07
135	500	74.0	13.20	8.0	-1.1	6.6-05
135	1000	147.0	13.20	8.0	-1.1	7.0-06
135	2133	314.0	13.20	8.0	-1.1	1.1-06
136	500	86.0	11.20	9.1	-1.6	6.6-05
136	1000	172.0	11.20	9.1	-1.6	5.4-06
136	2153	371.0	11.20	9.1	-1.6	1.1-06
137	500	102.0	9.60	16.2	-1.0	4.1-05
137	1000	204.0	9.60	16.2	-1.0	4.0-06
137	1879	384.0	9.60	16.2	-1.0	4.2-07
138	500	139.0	7.00	16.6	.1	1.1-04
138	1000	278.0	7.00	16.6	.1	2.8-05
138	1970	547.0	7.00	16.6	.1	1.5-06
139	2377	767.0	6.00	14.9	-.6	5.4-07
139	3971	1281.0	6.00	14.9	-.6	3.3-07
139	8399	2709.0	6.00	14.9	-.6	1.5-07
140	500	116.0	8.40	9.7	-.4	9.2-05
140	800	186.0	8.40	9.7	-.4	2.0-05
140	1000	233.0	8.40	9.7	-.4	1.2-05
140	2305	536.0	8.40	9.7	-.4	8.9-07
141	500	109.0	9.00	8.3	-.8	6.1-05
141	800	174.0	9.00	8.3	-.8	1.4-05
141	2163	470.0	9.00	8.3	-.8	1.2-06
143	500	104.0	9.40	6.5	-1.6	7.3-05
143	800	167.0	9.40	6.5	-1.6	1.2-05
143	1000	208.0	9.40	6.5	-1.6	5.9-06
143	2275	474.0	9.40	6.5	-1.6	9.1-07
144	500	185.0	5.30	14.9	-.9	1.8-05
144	800	296.0	5.30	14.9	-.9	5.5-06
145	500	263.0	3.70	14.2	-.8	1.7-05
145	1000	526.0	3.70	14.2	-.8	1.8-06
145	2194	1155.0	3.70	14.2	-.8	9.5-07
147	2864	2046.0	2.70	18.5	.2	3.2-06
147	5302	3787.0	2.70	18.5	.2	7.4-07

RUN	/	TIME	UBAR	SIGMA	DEL T	E/Q
147	6815	4868.0	2.70	18.5	.2	3.1-07
148	500	106.0	9.20	7.7	.1	1.3-04
148	1000	213.0	9.20	7.7	.1	2.5-05
148	2224	473.0	9.20	7.7	.1	3.4-06
149	500	52.0	18.60	4.5	-.7	1.1-04
149	1000	104.0	18.60	4.5	-.7	1.1-05
149	2112	220.0	18.60	4.5	-.7	1.6-06
150	500	139.0	6.90	9.1	-.9	4.0-05
150	1000	278.0	6.90	9.1	-.9	7.1-06
150	2245	624.0	6.90	9.1	-.9	1.7-06
152	500	58.0	16.80	5.4	-.7	1.4-04
152	800	93.0	16.80	5.4	-.7	2.7-05
152	1000	116.0	16.80	5.4	-.7	9.4-06
152	2336	272.0	16.80	5.4	-.7	1.4-06
153	500	185.0	5.30	10.9	-1.0	4.6-05
153	1000	370.0	5.30	10.9	-1.0	8.3-06
153	2143	794.0	5.30	10.9	-1.0	6.2-07
154	500	128.0	7.50	15.4	-.8	6.4-05
154	1000	256.0	7.50	15.4	-.8	1.2-05
154	1879	482.0	7.50	15.4	-.8	3.8-06
155	500	76.0	12.90	6.7	-.4	1.1-04
155	1000	152.0	12.90	6.7	-.4	1.0-05
155	2153	326.0	12.90	6.7	-.4	1.4-06
157	500	76.0	12.80	6.2	-1.1	1.2-04
157	1000	152.0	12.80	6.2	-1.1	9.7-06
157	2173	329.0	12.80	6.2	-1.1	6.0-07
158	500	250.0	3.90	17.5	-.2	2.0-05
158	800	400.0	3.90	17.5	-.2	1.0-05
158	2052	1026.0	3.90	17.5	-.2	1.7-06
159	500	114.0	8.50	8.6	-1.0	6.7-05
159	1000	227.0	8.50	8.6	-1.0	7.9-06
159	2041	464.0	8.50	8.6	-1.0	2.2-06
160	500	93.0	10.40	7.8	-.6	6.3-05
160	1000	185.0	10.40	7.8	-.6	8.4-06
160	2133	395.0	10.40	7.8	-.6	9.9-07
162	2884	801.0	6.90	8.7	-1.2	1.1-06
162	4692	1303.0	6.90	8.7	-1.2	2.4-07
163	500	54.0	18.10	5.9	-.4	1.7-04
163	800	86.0	18.10	5.9	-.4	3.4-05
163	1000	108.0	18.10	5.9	-.4	1.6-05

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
163	2336	251.0	18.10	5.9	-.4	1.9-06
165	500	208.0	4.70	16.2	-.6	2.9-05
165	800	333.0	4.70	16.2	-.6	2.0-05
165	1000	417.0	4.70	16.2	-.6	1.3-05
165	2255	940.0	4.70	16.2	-.6	3.8-06
165	2752	1147.0	4.70	16.2	-.6	9.0-07
165	5850	2438.0	4.70	16.2	-.6	4.5-07
166	2387	770.0	6.10	18.3	-.9	1.2-06
166	3748	1209.0	6.10	18.3	-.9	2.4-07
167	2387	1492.0	3.10	23.7	-.6	5.5-07
168	500	128.0	7.60	8.2	-.4	6.8-05
169	500	68.0	14.30	5.9	-1.1	8.5-05
169	1000	135.0	14.30	5.9	-1.1	1.1-05
169	2011	272.0	14.30	5.9	-1.1	1.0-06
170	500	86.0	11.20	10.7	-.9	6.3-05
170	1000	172.0	11.20	10.7	-.9	8.8-06
170	1970	340.0	11.20	10.7	-.9	1.3-06
172	500	64.0	15.20	5.2	-.6	1.0-04
172	1000	128.0	15.20	5.2	-.6	1.1-05
172	1970	253.0	15.20	5.2	-.6	1.8-06
174	2387	1735.0	2.80	26.1	-.4	7.3-07
174	3890	2779.0	2.80	26.1	-.4	3.2-07
175	2478	604.0	8.00	6.3	-1.0	2.3-07
175	4702	1147.0	8.00	6.3	-1.0	1.7-07
179	500	156.0	6.20	17.8	-.6	1.3-05
179	800	250.0	6.20	17.8	-.6	3.9-06
179	1000	312.0	6.20	17.8	-.6	1.4-06
179	2133	667.0	6.20	17.8	-.6	4.5-07
180	500	74.0	13.30	5.9	-.6	1.5-04
180	1000	147.0	13.30	5.9	-.6	1.2-05
180	2245	330.0	13.30	5.9	-.6	1.4-06
181	500	119.0	8.20	3.6	-.4	2.5-04
181	1000	238.0	8.20	3.6	-.4	4.9-05
181	2153	513.0	8.20	3.6	-.4	8.7-06
182	500	74.0	13.30	6.6	-.8	9.6-05
182	800	118.0	13.30	6.6	-.8	1.3-05
182	1000	147.0	13.30	6.6	-.8	7.5-06
182	2255	332.0	13.30	6.6	-.8	1.2-06
183	500	59.0	16.60	4.1	-1.0	1.8-04
183	1000	118.0	16.60	4.1	-1.0	2.3-05

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
183	2153	253.0	16.60	4.1	-1.0	2.1-06
184	500	69.0	14.00	12.4	-1.9	5.5-05
184	1000	139.0	14.00	12.4	-1.9	6.5-06
184	2224	309.0	14.00	12.4	-1.9	8.7-07
185	500	161.0	6.00	10.0	-3.6	6.6-05
185	1000	323.0	6.00	10.0	-3.6	1.6-05
185	1879	606.0	6.00	10.0	-3.6	4.0-06
189	2387	663.0	6.90	8.2	-.5	5.5-07
189	3971	1103.0	6.90	8.2	-.5	1.5-07
190	500	102.0	9.60	9.5	-1.0	4.6-05
190	1000	204.0	9.60	9.5	-1.0	5.6-06
190	1879	384.0	9.60	9.5	-1.0	8.7-07
191	500	179.0	5.40	10.9	-.7	6.1-05
191	1000	357.0	5.40	10.9	-.7	1.4-05
192	500	56.0	17.20	7.2	-1.0	8.6-05
192	800	90.0	17.20	7.2	-1.0	1.3-05
192	1000	112.0	17.20	7.2	-1.0	6.1-06
192	2255	253.0	17.20	7.2	-1.0	1.2-06
193	500	50.0	19.30	5.5	-.9	1.1-04
193	1000	101.0	19.30	5.5	-.9	1.1-05
193	2041	206.0	19.30	5.5	-.9	8.3-0[illegible]
194	500	56.0	17.30	3.1	-.8	1.3-04
194	1000	112.0	17.30	3.1	-.8	1.0-05
194	2153	242.0	17.30	3.1	-.8	9.3-07
196	500	167.0	5.90	8.9	-1.6	4.5-05
196	800	267.0	5.90	8.9	-1.6	1.1-05
196	1000	333.0	5.90	8.9	-1.6	6.7-06
196	2224	741.0	5.90	8.9	-1.6	1.5-06
197	500	161.0	6.00	9.8	-1.7	3.1-05
197	1000	323.0	6.00	9.8	-1.7	3.2-06
197	2082	672.0	6.00	9.8	-1.7	1.2-06
199	2387	852.0	5.50	9.2	-1.1	3.2-07
199	3748	1339.0	5.50	9.2	-1.1	3.5-07
200	500	96.0	10.10	7.5	-1.2	4.8-05
200	1000	192.0	10.10	7.5	-1.2	8.2-06
200	1930	371.0	10.10	7.5	-1.2	1.8-06
201	500	89.0	10.90	6.8	-.8	9.8-05
201	1000	179.0	10.90	6.8	-.8	9.6-06
201	2245	401.0	10.90	6.8	-.8	1.1-06
202	500	122.0	8.00	8.2	-.4	5.6-05

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
202	1000	244.0	8.00	8.2	-.4	9.9-06
202	2153	525.0	8.00	8.2	-.4	3.9-06
203	500	625.0	1.60	33.9	-1.0	2.4-05
204	2265	527.0	8.30	12.3	-.7	2.8-07
204	3595	836.0	8.30	12.3	-.7	1.1-07
205	500	80.0	10.00	7.0	-2.0	1.8-04
205	1000	170.0	10.90	7.9	-1.1	1.8-05
205	2041	364.0	10.90	7.9	-1.1	8.8-07
208	500	104.0	9.30	9.6	-.7	3.7-05
208	1000	208.0	9.30	9.6	-.7	3.5-06
208	2245	468.0	9.30	9.6	-.7	9.7-07
209	500	59.0	16.50	5.5	-1.6	1.0-04
209	800	94.0	16.50	5.5	-1.6	1.5-05
209	1000	118.0	16.50	5.5	-1.6	6.9-06
209	2245	264.0	16.50	5.5	-1.6	7.1-07
210	500	58.0	16.80	5.7	-.0	1.1-04
210	1000	116.0	16.80	5.7	-.0	1.1-05
210	2133	248.0	16.80	5.7	-.0	2.1-06
211	500	59.0	16.50	4.8	-.0	1.5-04
211	1000	118.0	16.50	4.8	-.0	1.1-05
211	2133	251.0	16.50	4.8	-.0	4.0-06
212	500	54.0	17.90	4.6	.2	1.3-04
212	1000	100.0	17.00	4.6	.2	1.8-05
212	2082	226.0	17.90	4.6	.2	2.7-06
213	500	294.0	3.30	26.0	-1.4	1.9-05
213	800	471.0	3.30	26.0	-1.4	7.4-06
213	2092	1231.0	3.30	26.0	-1.4	1.8-06
214	500	122.0	8.00	5.6	-.6	1.3-04
214	1000	244.0	8.00	5.6	-.6	2.6-05
214	2245	548.0	8.00	5.6	-.6	4.2-06
215	500	63.0	15.30	5.5	-1.9	6.0-05
215	800	101.0	15.30	5.5	-1.9	1.2-05
215	1000	127.0	15.30	5.5	-1.9	4.3-06
215	2245	284.0	15.30	5.5	-1.9	5.8-07
216	500	96.0	10.20	8.0	-1.4	3.8-05
216	800	154.0	10.20	8.0	-1.4	8.9-06
216	1000	192.0	10.20	8.0	-1.4	4.3-06
216	2336	449.0	10.20	8.0	-1.4	5.9-07
217	500	109.0	9.00	11.5	-1.0	1.9-05
217	1000	217.0	9.00	11.5	-1.0	2.3-06

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
217	2041	444.0	9.00	11.5	-1.0	4.0-07
218	500	75.0	13.00	6.5	-1.1	6.3-05
218	1000	140.0	13.00	6.5	-2.0	6.0-06
218	2153	321.0	13.00	6.5	-1.1	1.0-06
219	500	89.0	10.80	9.5	-1.3	4.2-05
219	1000	179.0	10.80	9.5	-1.3	3.8-06
219	1970	352.0	10.80	9.5	-1.3	5.8-07
220	500	122.0	7.90	8.8	-1.2	3.5-05
220	800	195.0	7.90	8.8	-1.2	5.5-06
220	1000	244.0	7.90	8.8	-1.2	4.0-06
220	2275	555.0	7.90	8.8	-1.2	5.1-07
221	500	111.0	8.80	12.2	-1.2	1.1-05
221	800	178.0	8.80	12.2	-1.2	1.2-06
221	1000	222.0	8.80	12.2	-1.2	9.1-07
221	2336	519.0	8.80	12.2	-1.2	3.8-07
222	500	93.0	10.50	6.7	-1.5	5.0-05
222	800	148.0	10.50	6.7	-1.5	5.5-06
222	1000	185.0	10.50	6.7	-1.5	4.6-06
222	2224	412.0	10.50	6.7	-1.5	5.9-07
223	500	98.0	9.90	4.4	-.7	9.4-05
223	800	157.0	-.00	4.4	-.7	2.3-05
223	1000	196.0	9.90	4.4	-.7	1.5-05
223	2285	448.0	9.00	4.4	-.7	3.0-06
224	500	100.0	9.80	3.6	-.0	9.4-05
224	1000	200.0	9.80	3.6	-.0	1.6-05
224	2173	435.0	9.80	3.6	-.0	3.2-06
225	500	82.0	11.80	9.1	-1.4	2.7-05
225	1000	164.0	11.80	9.1	-1.4	2.9-06
225	2153	353.0	11.80	9.1	-1.4	4.5-07
226	500	385.0	2.50	19.7	-.6	2.9-05
226	1000	769.0	2.50	19.7	-.6	1.9-05
226	2224	1711.0	2.50	19.7	-.6	1.8-06
227	500	167.0	5.80	16.5	-1.6	1.1-05
227	800	267.0	5.80	16.5	-1.6	4.1-06
227	1000	333.0	5.80	16.5	-1.6	3.9-06
227	2275	758.0	5.80	16.5	-1.6	2.8-06
228	500	68.0	14.30	6.5	-1.3	8.7-05
228	1000	135.0	14.30	6.5	-1.3	9.8-06
228	1879	254.0	14.30	6.5	-1.3	1.4-06
229	500	91.0	10.70	8.3	-1.4	3.8-05

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
229	1000	182.0	10.70	8.3	-1.4	5.3-06
229	2041	371.0	10.70	8.3	-1.4	8.8-07
230	500	89.0	10.80	12.1	-1.4	1.9-05
230	1000	179.0	10.80	12.1	-1.4	1.3-06
230	2153	384.0	10.80	12.1	-1.4	3.1-07
231	500	79.0	12.30	6.4	-2.4	2.9-05
231	1000	159.0	12.30	6.4	-2.4	3.6-06
231	2153	342.0	12.30	6.4	-2.4	8.0-07
232	500	82.0	11.90	6.1	-2.1	1.8-05
232	1000	164.0	11.90	6.1	-2.1	2.4-06
232	2245	368.0	11.90	6.1	-2.1	6.1-07
233	500	83.0	11.60	7.7	-1.4	3.6-05
233	1000	167.0	11.60	7.7	-1.4	3.1-06
233	2173	362.0	11.60	7.7	-1.4	4.4-07
234	500	82.0	11.80	5.5	-1.0	7.3-05
234	1000	164.0	11.80	5.5	-1.0	6.6-06
234	2153	353.0	11.80	5.5	-1.0	8.8-07
235	500	122.0	8.00	10.4	-1.9	9.2-06
235	800	195.0	8.00	10.4	-1.9	2.5-06
235	1000	244.0	8.00	10.4	-1.9	1.7-06
235	2214	540.0	8.00	10.4	-1.9	8.7-07
236	500	47.0	20.70	4.7	-.8	9.5-05
236	1000	94.0	20.70	4.7	-.8	7.1-06
236	2112	197.0	20.70	4.7	-.8	6.7-07
237	500	81.0	12.10	6.7	-.8	5.6-05
237	1000	161.0	12.10	6.7	-.8	4.0-06
237	2112	341.0	12.10	6.7	-.8	4.3-07
238	500	119.0	8.10	17.4	-1.6	6.1-06
238	800	190.0	8.10	17.4	-1.6	1.8-06
238	1000	238.0	8.10	17.4	-1.6	1.5-06
238	2259	538.0	8.10	17.4	-1.6	1.7-06
240	500	135.0	7.20	9.8	-1.6	3.4-05
240	800	216.0	7.20	9.8	-1.6	9.2-06
240	1000	270.0	7.20	9.8	-1.6	4.2-06
240	2245	607.0	7.20	9.8	-1.6	1.3-06
241	500	714.0	1.30	26.9	-1.5	7.8-06
241	800	1143.0	1.30	26.9	-1.5	4.0-06
241	2052	2931.0	1.30	26.9	-1.5	4.8-07
242	500	227.0	4.20	31.1	-.6	7.9-06
242	800	364.0	4.20	31.1	-.6	3.9-06

RUN	X	TIME	UBAR	SIGMA	DEL T	E/Q
242	2194	947.0	4.20	31.1	-.6	1.2-06
244	500	63.0	15.40	6.3	-1.4	7.8-05
244	1000	127.0	15.40	6.3	-1.4	8.4-06
244	2112	267.0	15.40	6.3	-1.4	8.6-07
245	500	111.0	8.80	11.7	-1.4	1.9-05
245	800	178.0	8.80	11.7	-1.4	4.3-06
245	1000	222.0	8.80	11.7	-1.4	2.4-06
245	2153	478.0	8.80	11.7	-1.4	1.3-06
246	500	172.0	5.70	20.9	-2.0	8.9-06
246	800	276.0	5.70	20.9	-2.0	8.8-06
246	1000	345.0	5.70	20.9	-2.0	8.9-06
246	2255	778.0	5.70	20.9	-2.0	2.2-06
247	500	128.0	7.50	20.8	-1.6	8.8-06
247	1000	256.0	7.50	20.8	-1.6	3.9-06
247	2173	557.0	7.50	20.8	-1.6	1.7-06
249	500	85.0	11.40	5.6	-2.4	6.1-05
249	1000	170.0	11.40	5.6	-2.4	7.7-06
249	2112	358.0	11.40	5.6	-2.4	1.3-06
250	500	61.0	12.00	6.0	-2.2	5.6-05
250	1000	161.0	12.00	6.0	-2.2	7.9-06
250	2112	341.0	12.00	6.0	-2.2	1.7-06
251	500	128.0	7.60	9.4	-1.0	2.7-05
251	1000	256.0	7.60	9.4	-1.0	6.2-06
251	2112	542.0	7.60	9.4	-1.0	3.0-06
252	500	79.0	12.20	9.1	-1.4	3.3-05
252	1000	159.0	12.20	9.1	-1.4	3.4-06
252	2112	335.0	12.20	9.1	-1.4	4.9-07
253	500	83.0	11.70	6.8	-1.2	3.4-05
253	1000	167.0	11.70	6.8	-1.2	4.6-06
253	2112	352.0	11.70	6.8	-1.2	1.2-06

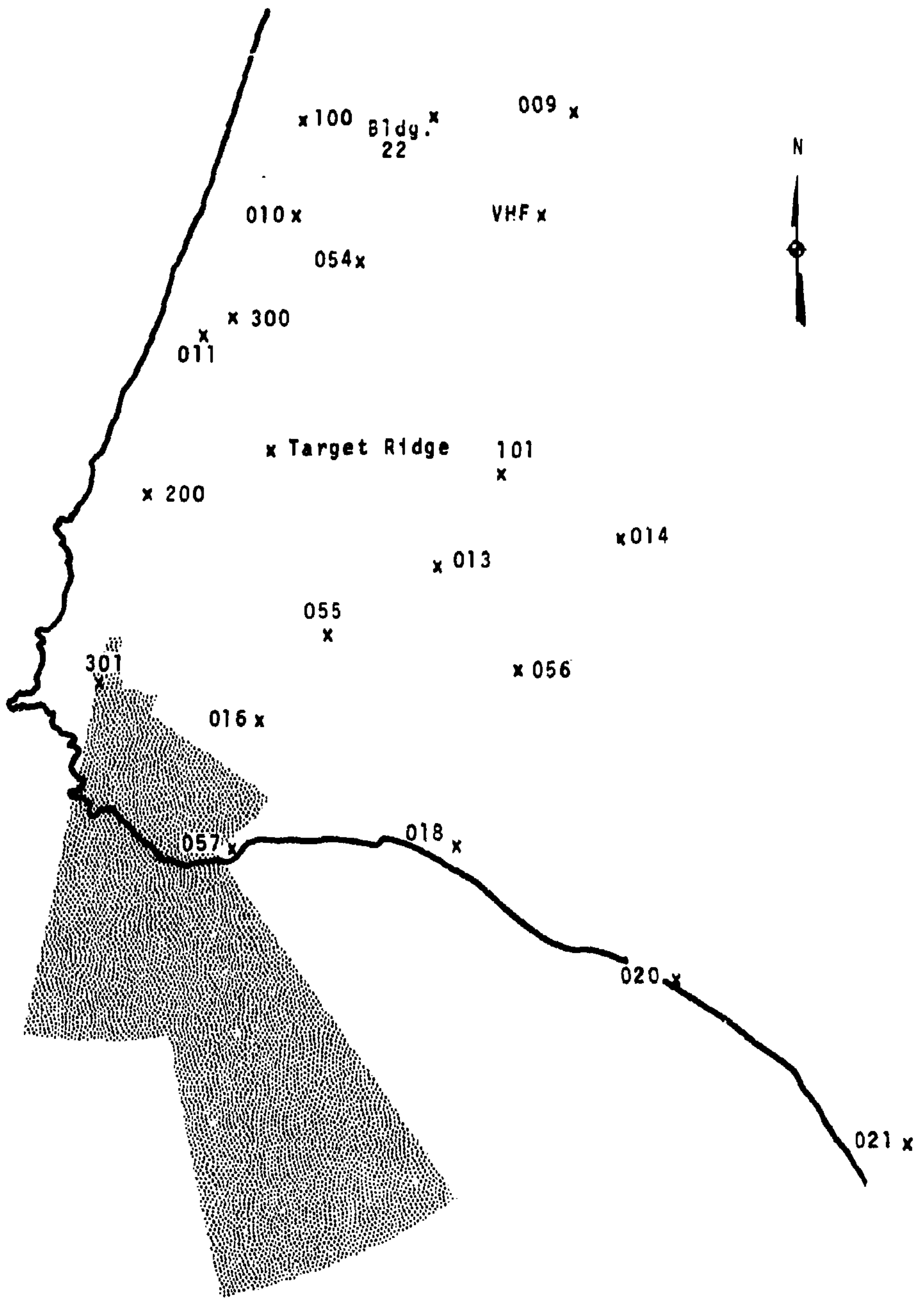


FIGURE B-1. Percent Frequency of Occurrence of the Average Wind Direction During Tests

APPENDIX C

CLIMATOLOGICAL SUMMARY

APPENDIX C
CLIMATOLOGICAL SUMMARY

The following pages contain a climatological summary of the wind data obtained in the Sudden Ranch area during Mountain Iron Phase II, and are based on half-hour averages of speed and direction. The raw wind data for all wind sites including those north of Sudden Ranch are available from the Environmental Technical Applications Center. It is emphasized that this climatological summary is based upon only one year's data rather than the many year's data contained in a standard climatology. Data availability listings, by site for the months August 1966 through July 1967, are presented in Table C-1. Dashed entries represent less than 50% complete data.

The annual percentage distribution of wind directions for Site 301 is shown in Figure C-1. Figure C-1 is not a standard wind rose, however, but has been drawn to indicate the percentage distribution of directions in which potential pollutants would leave a source located at that point. This figure is based upon half-hour averages of wind direction.

Climatological data for each month are presented in two tabular listings: Percent Frequency of Occurrence, Wind Speed vs Direction and Time vs Direction, Percentage Distribution. In the first tabulation, wind direction values are listed for zero wind speed. This apparent inconsistency is the result of either rounding off during data reduction or missing wind speed data.

These percentages are included to give as complete a direction frequency breakdown as possible. When a wind direction was missing the wind speed for that period was disregarded and the percentage of wind direction data available adjusted. In this table the data have not been separated by time of day. The second tabular listing is of the same form as the Mountain Iron Phase I presentation. Wind direction percent distribution for each of the sites is given in six hour periods.

The prevailing wind directions for the Sudden Ranch wind sites for night and day are shown in Figures C-2 through C-5 for January, April, July and October. Wind directions were extracted from the summaries in this appendix. The percentage frequency of occurrence of the prevailing wind is shown in these figures. Similar presentations were made for other sites on South Vandenberg Air Force Base in Volume II, Appendix C of the Phase I report.

TABLE C-1 Percent of Wind Direction Data Available

Month	Site					
	301	057	016	018	020	021
August 66	--	--	69.02	--	--	--
September 66	76.81	95.07	80.62	83.68	--	90.56
October 66	71.51	98.19	93.68	90.32	50.00	92.00
November 66	89.72	99.17	97.50	74.72	--	53.19
December 66	65.46	93.95	93.08	75.27	--	--
January 67	88.10	98.19	98.32	93.08	84.34	58.00
February 67	97.17	96.73	85.64	96.50	84.60	81.77
March 67	96.30	97.98	99.87	96.64	99.46	95.03
April 67	95.56	82.29	95.90	99.37	84.51	68.26
May 67	93.55	99.40	97.92	96.91	78.56	--
June 67	74.65	98.12	66.32	95.97	80.90	63.47
July 67	84.88	66.26	77.15	69.83	88.64	50.27

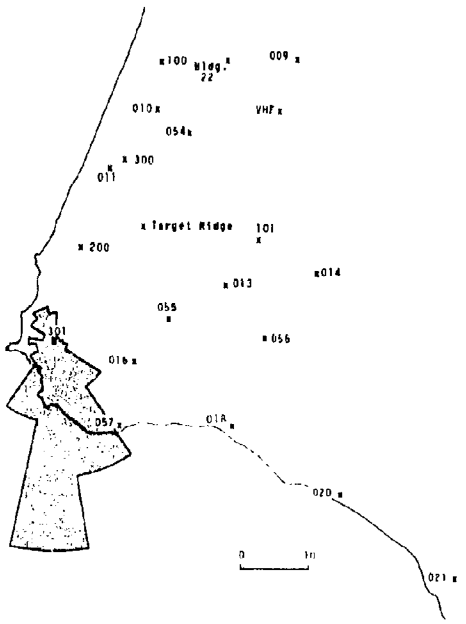


FIGURE C-1. Annual Percentage Distribution of Wind Directions for Site

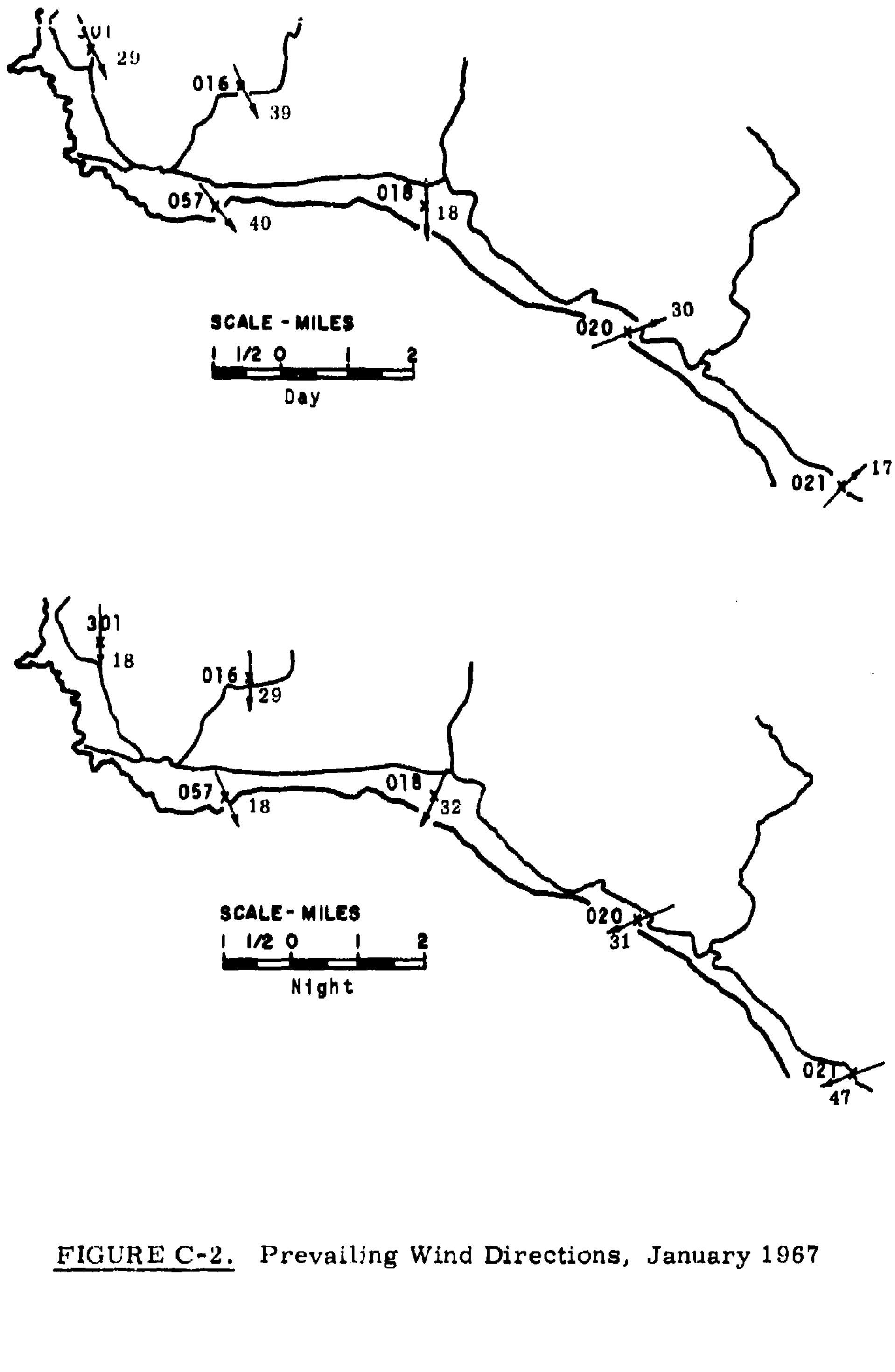


FIGURE C-2. Prevailing Wind Directions, January 1967

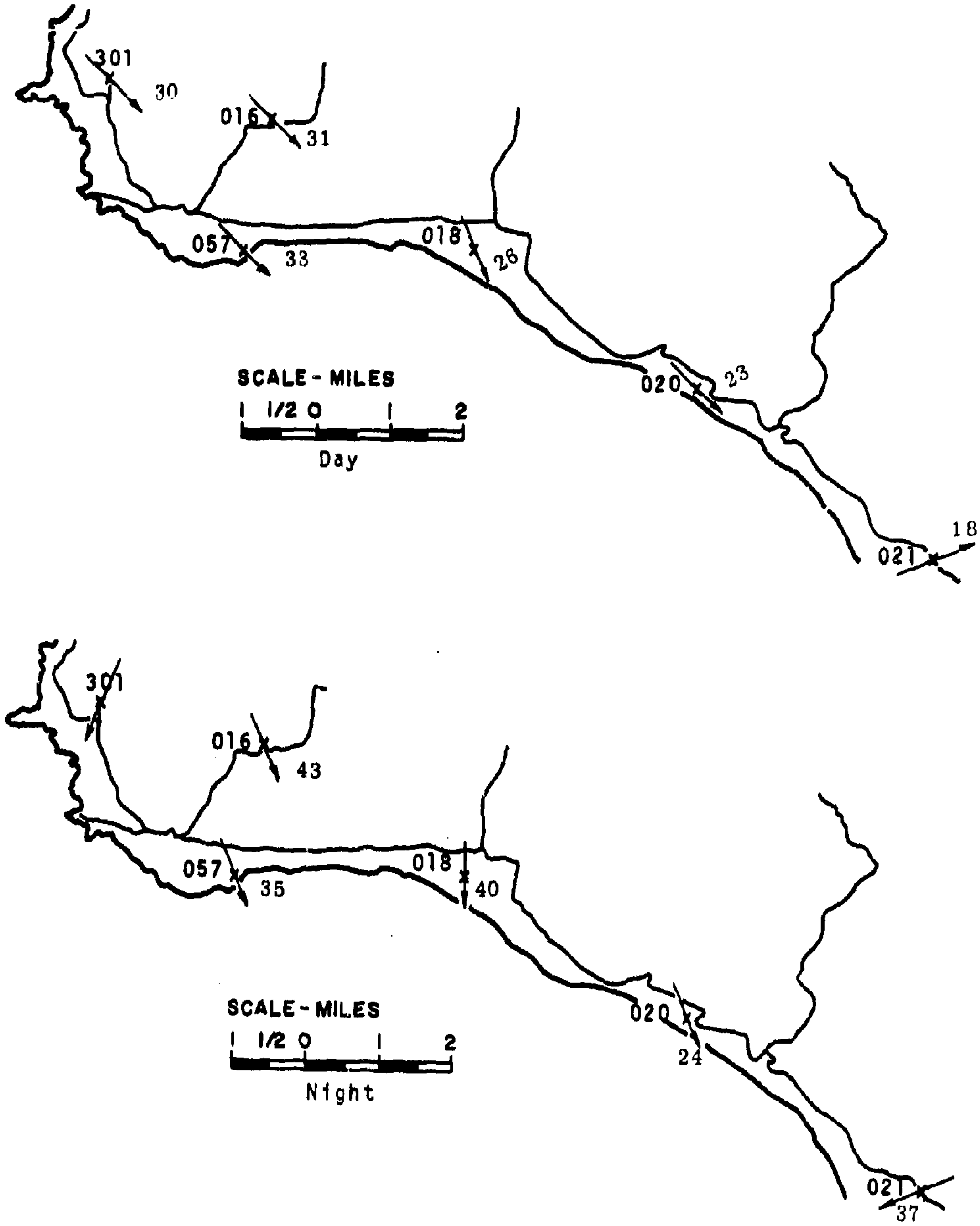


FIGURE C-3. Prevailing Wind Directions, April 1967

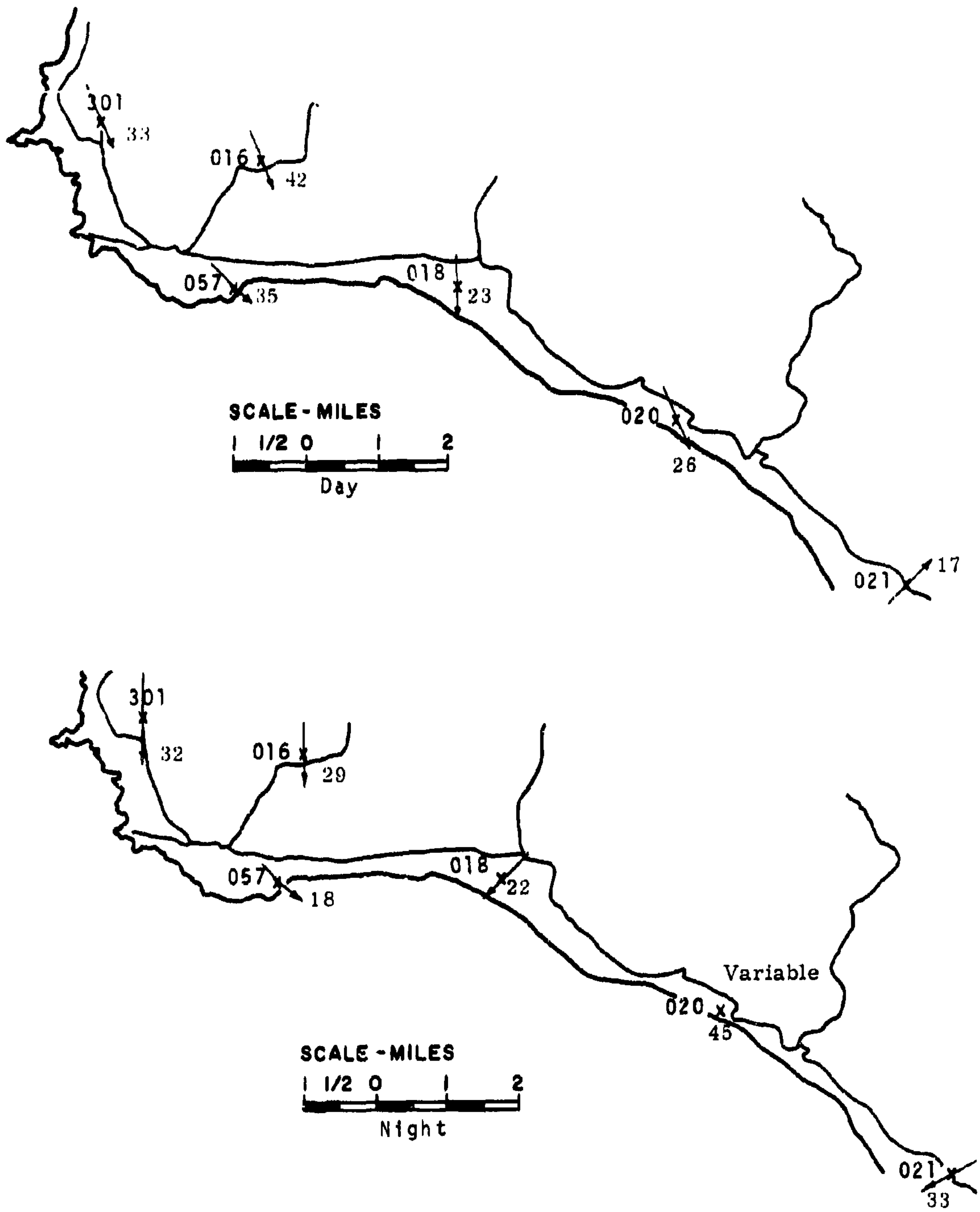


FIGURE C-4. Prevailing Wind Directions, July 1967

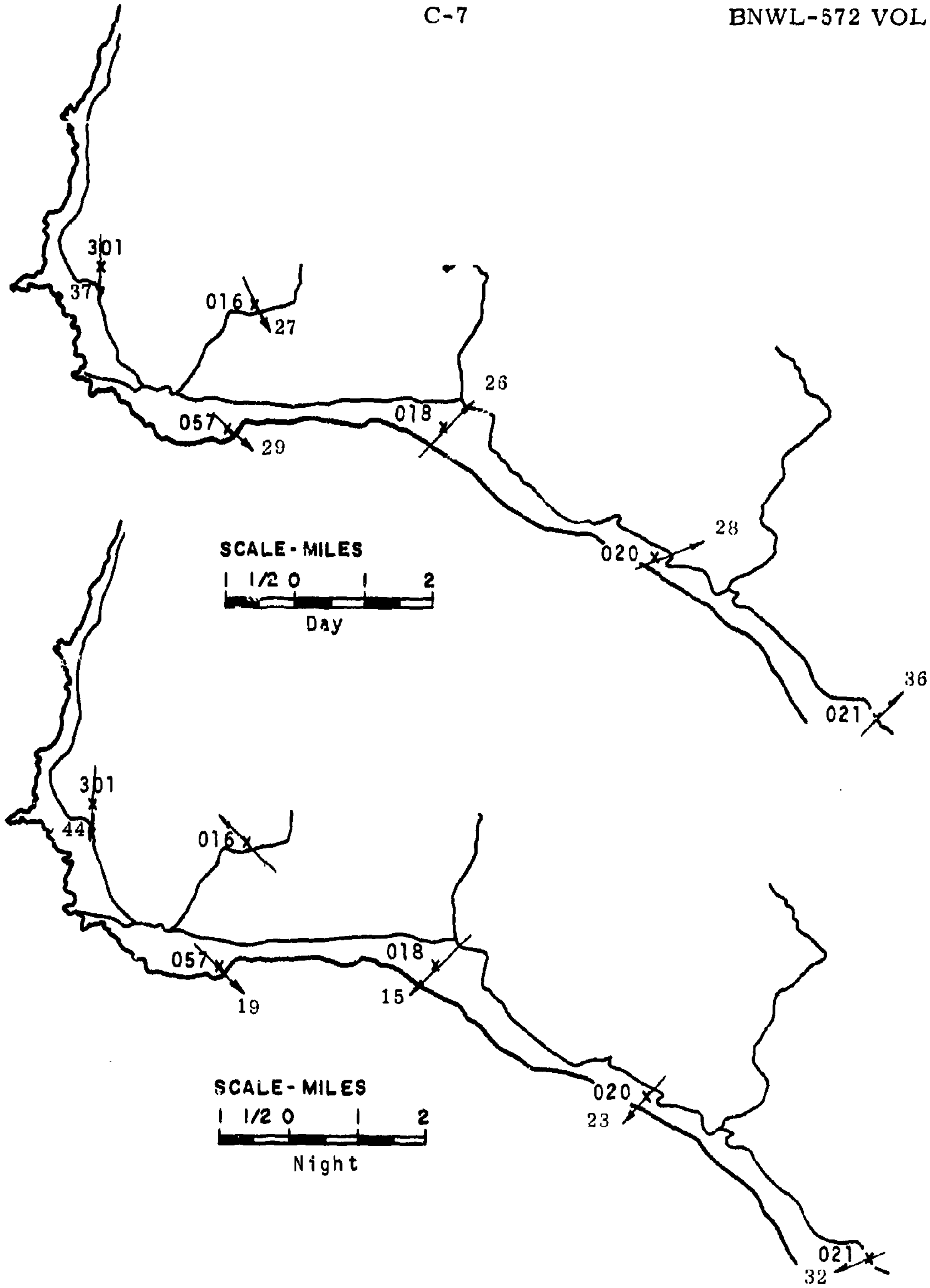


FIGURE C-5. Prevailing Wind Directions, October 1967

SITE 301 SEPT 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.1
1-2	.1	.1	.0	.2	.3	.4	.1	.3	.0	.2	.1	.4	.5	.1	.3	.4
3-4	.5	.5	.5	.6	.4	.6	.5	.7	.6	.3	.5	.4	.0	.6	.8	1.0
5-6	.7	.3	.2	.1	.0	.5	.5	1.0	.4	.5	.4	.1	.3	.6	1.1	.9
7-8	1.4	.2	.1	.0	.0	.1	.1	2.1	.7	.5	.2	.2	.5	1.1	2.2	2.4
9-10	.8	.3	.2	.1	.0	.1	.6	1.0	.7	.3	.6	.1	.4	1.0	2.7	4.2
11-15	3.4	.1	.1	.0	.0	.0	.1	.4	.1	.0	.0	.0	.0	2.4	11.8	18.1
16-20	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	3.1	14.5
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .5

SITE 301 OCT 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.1	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2
1-2	.1	.5	.4	1.3	.8	.9	.2	.7	.1	.1	.4	.2	.1	.1	.0	.6
3-4	1.1	.6	.5	1.1	.4	.3	.1	1.6	.3	.7	.8	.5	.8	2.3	.8	1.1
5-6	2.9	1.2	.2	.6	.0	.4	.3	1.6	.2	.4	.6	.2	.3	1.9	3.2	2.0
7-8	3.2	.8	.3	.8	.0	.5	.4	.5	.3	.0	.0	.0	.2	1.7	3.2	5.0
9-10	3.4	.1	.1	.2	.1	.5	.2	.0	.2	.1	.0	.0	.0	.9	3.2	7.7
11-15	3.7	.3	.5	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	7.0	13.5
16-20	.4	.1	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	4.1
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.4

SITE 301 NOV 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.3	1.4	.1	.0	.0	.0	.0	.0	.2	.0	.1
1-2	.6	1.4	1.0	2.6	.3	.2	1.0	1.3	.5	.4	.3	.3	1.0	.9	.1	.5
3-4	1.3	1.7	1.1	1.7	.4	.8	2.1	1.9	.6	.8	.5	.5	.9	1.7	1.2	1.9
5-6	3.6	2.3	1.0	1.1	.5	1.0	3.6	1.4	.9	1.3	.5	.3	.4	2.6	2.6	4.5
7-8	4.4	1.3	.1	.6	.0	1.5	1.8	.4	.1	.0	.0	.2	.1	2.2	3.3	4.8
9-10	.9	.1	.0	.0	.0	.2	.8	1.5	.0	.0	.0	.0	.0	1.7	1.2	1.2
11-15	.7	.2	.0	.0	.0	.9	.2	2.0	.0	.0	.0	.0	.0	.2	.5	2.3
16-20	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.2	1.2
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.0

SITE 301 DEC 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.2	.4	2.3	.4	.8	.6	.2	.0	.1	.0	.0	.1	.2	.1	.2
1-2	.4	.7	.4	2.3	1.1	1.1	.2	.5	.1	.2	.2	.5	.4	.8	.4	.3
3-4	.3	1.4	.6	3.1	1.5	1.0	.4	.4	.0	.1	.2	.6	.7	.4	1.0	.8
5-6	2.1	2.0	1.0	2.0	.3	.8	.3	.3	.0	.0	.0	.1	.0	.1	2.6	2.7
7-8	2.6	2.6	.8	.4	.5	.4	.2	.0	.0	.0	.0	.0	.0	.8	2.3	2.9
9-10	2.5	1.0	.3	.2	.0	.0	.2	.0	.0	.0	.0	.0	.0	.9	3.2	3.9
11-15	3.4	1.0	.3	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	6.4	9.8
16-20	1.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.0	2.6
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 4.4

SITE 301 JAN 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.4	.0	.5	1.6	.5	.5	2.3	.5	.1	.0	.0	.0	.0	.0	.4	.5
1-2	.2	.5	.5	1.4	.3	.4	.2	.5	.1	.2	.2	.2	.2	.4	.4	.5
3-4	.6	1.8	1.7	1.6	.5	1.1	.9	.6	.5	.6	.4	.6	.2	1.2	.8	.6
5-6	1.2	2.4	.9	.5	.5	1.5	1.3	.9	.1	.6	.5	.4	.6	.8	1.1	.8
7-8	1.9	1.4	.2	.0	.2	1.3	.8	1.1	.5	.5	.2	.5	.2	.3	2.4	2.6
9-10	3.1	.2	.0	.1	.1	1.1	.5	.1	.0	.0	.1	.3	.2	.3	2.3	5.3
11-15	2.0	.3	.1	.0	.0	.9	2.6	.0	.0	.0	.0	.2	.0	.8	5.0	9.2
16-20	.1	.1	.0	.0	.0	.2	1.3	.1	.0	.0	.0	.0	.0	.1	2.3	1.8
21-25	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.4	.7
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.9

SITE 301   FEB. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.1
1-2	.5	1.1	.9	1.1	.5	1.0	.3	.3	.4	.2	.2	.2	.5	.5	.5	.8
3-4	1.8	2.3	.9	2.1	.5	.6	.2	.2	.4	.2	.8	.3	.3	1.4	1.2	1.5
5-6	3.0	2.2	.4	1.1	.5	.7	.4	.2	.5	.1	.0	.4	.2	1.5	2.3	2.8
7-8	4.1	1.5	.5	1.3	.0	1.1	.5	.4	.2	.0	.0	.2	.2	.8	1.8	4.3
9-10	2.5	1.1	.2	.1	.0	.6	.8	.2	.2	.0	.0	.0	.1	.5	1.6	6.2
11-15	3.4	.1	.1	.0	.0	.9	.1	.2	.0	.0	.1	.0	.0	.7	4.2	5.7
16-20	1.3	.2	.1	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	1.0	2.8	2.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.2	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 3.4

SITE 301 MAR 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.5	.1	.0	.0	.0	.2	3.3	1.4	.1	.2	.1	.2	.1	.7	2.4	1.7
1-2	.3	.1	.4	.6	.1	.1	.6	.3	.1	.3	.1	.2	.1	.5	.0	.1
3-4	.4	.6	.5	.5	.1	.5	1.5	.5	.3	.4	.3	.3	.2	.6	.4	.2
5-6	.7	.6	.1	.1	.4	.7	1.3	1.1	.6	.4	.3	.2	.1	.7	1.2	.8
7-8	2.2	.3	.0	.0	.0	.6	1.6	2.0	.1	.0	.0	.3	.2	.6	1.2	2.9
9-10	3.1	.1	.0	.0	.0	.4	1.5	.8	.0	.0	.0	.0	.4	2.0	2.2	7.3
11-15	2.6	.0	.0	.0	.0	1.6	1.8	.6	.0	.0	.0	.3	1.2	3.6	10.0	7.0
16-20	.0	.0	.0	.0	.0	2.8	.5	.0	.1	.0	.1	.1	.1	.3	2.9	.6
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	.1	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .5

SITE 301 APR 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.4	.4	.0	.1	.0	1.5	1.9	.6	.6	.1	.1	.1	.1	.1	.2	.2
1-2	.1	.1	.1	.5	.1	.1	.2	.5	.1	.0	.1	.2	.0	.1	.1	.1
3-4	.6	.7	.6	1.1	.5	.3	.6	.4	.1	.0	.2	.6	.4	.4	.2	.2
5-6	2.8	.4	.3	.3	.1	.5	1.2	1.2	.2	.5	.5	.4	.6	.7	.8	.3
7-8	2.9	.7	.0	.0	.9	2.3	2.3	1.8	.5	.4	.3	.4	1.0	2.8	2.3	1.7
9-10	1.0	.1	.0	.0	.0	2.5	2.4	.5	.1	.2	.1	.4	.5	1.1	2.8	2.6
11-15	.5	.0	.0	.0	.0	4.2	1.2	.0	.0	.1	.1	.4	.3	5.8	12.7	7.0
16-20	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.1	.0	.0	1.7	2.0	1.2
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .2

SITE 301 MAY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.1	.2	.1	.2	.0	.2	.2	.3	.0	.0	.1	.0	.1	.1	6.0	13.1
1-2	.5	.4	.2	.0	.1	.1	.1	.1	.2	.1	.1	.1	.2	.5	.5	.5
3-4	.8	.3	.1	.1	.1	.1	.1	.1	.1	.3	.1	.1	.0	1.0	.4	1.1
5-6	1.9	.4	.1	.1	.1	.1	.1	.3	.1	.1	.0	.0	.0	1.6	2.7	1.5
7-8	1.1	.0	.1	.3	.1	.1	.1	.4	.1	.0	.0	.1	.1	.9	1.3	2.9
9-10	1.4	.1	.1	.1	.0	.0	.0	.3	.1	.1	.1	.0	.0	.9	5.3	5.2
11-15	3.4	.2	.7	.2	.0	.0	.0	.4	.0	.0	.1	.0	.0	1.9	10.2	15.3
16-20	1.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.9	2.2
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.1

SITE 301 JUNE 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	2.1	.3	.0	.0	.0	.0	.0	.0	.1	.0	.0	.1	.0	.8	5.9	15.0
1-2	.7	.1	.2	.1	.0	.3	.7	.0	.0	.2	.0	.0	.2	.4	.5	2.3
3-4	.7	.2	.0	.0	.0	.0	.9	.1	.4	.3	.0	.0	.1	1.0	1.3	1.0
5-6	.5	.3	.0	.0	.0	.1	.1	.3	.5	.2	.1	.2	.1	1.8	1.5	2.0
7-8	2.5	.0	.0	.0	.0	.1	.4	.1	.3	.1	.3	.9	.7	3.1	2.0	4.1
9-10	.7	.0	.0	.0	.1	.0	.2	.0	.2	.0	.0	.0	.0	1.0	3.4	3.6
11-15	1.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	6.0	15.8
16-20	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.1	5.3
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	.2
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
31-	.C	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .5

SITE 301 JULY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.1	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.1	.2	.1	1.2	1.7
1-2	2.4	.9	.2	.2	.2	.0	.6	.6	.4	.2	.3	.5	1.0	.7	1.8	1.7
3-4	2.0	.3	.1	.0	.1	.2	.5	2.1	.7	.6	.3	.4	1.0	1.0	1.7	2.7
5-6	1.0	.0	.1	.0	.0	.2	.6	.6	.6	.4	.4	.9	1.3	2.9	4.9	2.9
7-8	.4	.0	.0	.1	.0	.1	.6	.4	.2	.1	.0	.0	.1	1.6	4.8	5.5
9-10	.2	.0	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	2.2	4.4	5.1
11-15	.1	.0	.0	.0	.0	.4	.0	.0	.0	.1	.0	.0	.0	.2	4.9	16.0
16-20	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.6	5.9
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .6

SITE 057 SEPT 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.4	.2	.6	.0	.0
1-2	.1	.4	.3	.1	.0	.1	.2	.1	.1	.1	.3	.2	.1	.1	.1	.1
3-4	.3	.9	2.0	1.9	.9	.7	1.4	.2	.5	.7	.9	1.0	.5	.7	.2	.5
5-6	.1	.9	1.3	1.7	.6	.4	.3	.4	.9	1.6	.5	.9	.4	.5	.6	.1
7-8	.1	.3	.7	.7	.6	.1	.2	.0	.2	.4	1.3	1.1	1.1	1.2	.4	.1
9-10	.1	.1	.1	.2	.4	.7	.5	.0	.0	.3	1.2	1.4	2.0	2.2	.2	.0
11-15	.0	.0	.1	.1	.6	1.4	.4	.0	.0	.0	.4	.9	2.7	4.7	1.4	.1
16-20	.0	.0	.0	.0	.0	.4	.1	.0	.0	.0	.1	.1	2.3	5.5	1.5	.1
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.7	5.4	.2	.1
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	3.4	5.4	.7	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.9	3.7	3.1	.3	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 3.4

SITE 057 OCT 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	.8	.9	3.1	2.9	2.0	1.1	1.2	.5	1.1	1.3	1.6	.8	.4	.3	.5	.3
3-4	.7	.9	1.6	1.8	1.4	.8	1.0	.3	1.0	1.0	.4	1.0	.5	.6	.3	.2
5-6	.1	.3	.4	.1	.1	.2	.4	.3	.3	1.0	.8	.5	1.2	1.8	.3	.2
7-8	.2	.0	.1	.1	.1	.2	.3	.1	.1	.1	.5	1.0	.9	3.7	1.0	.1
9-10	.1	.0	.1	.0	.1	.0	.3	.0	.0	.0	.1	.4	1.6	2.1	.8	.6
11-15	.1	.0	.0	.1	.1	.2	.0	.0	.0	.0	.0	.1	1.4	4.7	3.6	2.1
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.4	2.6	4.8	.8
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.3	4.5	3.8	.2
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.2	2.5	1.6	.5
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.6	.2	.1	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 6.1

SITE 057 NOV 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.1	.4	.1	.0	.0	.0	.0	.0	.0	.0
1-2	.7	2.0	3.0	2.2	1.5	1.1	.9	.7	1.4	1.5	1.0	1.1	.8	.8	.9	.6
3-4	.3	.7	1.6	1.9	1.3	.6	.6	.1	.3	.8	1.1	.9	1.3	1.6	2.0	.1
5-6	.4	.1	.3	1.1	1.8	.6	.2	.1	.0	.9	2.1	1.1	1.3	2.7	2.8	1.0
7-8	.2	.0	.1	.1	.8	.9	.4	.0	.0	.4	.8	.8	1.8	3.3	3.6	.1
9-10	.0	.0	.0	.0	.1	.6	.2	.1	.0	.0	.0	.3	1.5	2.4	2.4	.6
11-15	.0	.0	.0	.1	1.5	.8	.6	1.1	.0	.0	.0	.1	2.0	5.5	3.1	.1
16-20	.0	.0	.0	.0	.5	1.6	.8	.1	.0	.0	.0	.0	.1	.8	.9	.1
21-25	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.2	.5	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 4.7

SITE 057 DEC 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.4	.5	.9	1.6	.9	.4	.4	.7	2.2	1.4	.4	.3	1.1	5.9	4.9	1.4
1-2	2.2	2.3	1.5	.7	.7	.8	1.4	.4	.1	1.2	.4	.5	.9	.6	2.0	3.9
3-4	1.1	.4	.3	.4	.7	.3	.1	.1	.1	.9	.4	.4	.4	.8	1.7	2.4
5-6	.5	.9	.5	.1	.1	.2	.1	.0	.0	.0	.2	.2	.4	.7	1.7	1.0
7-8	.3	.4	.1	.1	.1	.0	.0	.0	.0	.0	.0	.2	.4	1.5	3.3	1.3
9-10	.1	.0	.0	.0	.1	.1	.0	.0	.0	.0	.0	.1	.1	3.0	4.4	.1
11-15	.0	.0	.0	.0	1.1	.6	.4	.0	.1	.1	.1	.1	.6	3.0	3.1	.3
16-20	.0	.0	.0	.0	.2	.1	.0	.0	.1	.0	.0	.0	.0	2.3	1.5	.0
21-25	.0	.0	.0	.2	.2	.1	.0	.0	.0	.0	.0	.0	.0	.1	.4	.0
26-30	.0	.0	.0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 8.9

SITE 057 JAN 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.5	.2	.3	.3	.3	.0	.0	.1	.0	.1	.1	.1	.4	.2	.3	.5
1-2	2.4	3.1	2.5	1.0	1.8	.8	1.2	1.5	.7	1.2	.5	.4	.5	1.2	1.8	3.2
3-4	.4	.5	.8	.3	.7	1.4	.6	.5	.4	.8	1.1	.7	1.0	1.2	1.4	2.6
5-6	.2	.1	.3	.2	.2	1.1	.8	.1	.1	.1	.3	.5	1.9	1.2	2.7	1.0
7-8	.3	.1	.1	.0	.1	.2	.6	.3	.1	.1	.5	.3	1.5	2.4	1.8	.7
9-10	.1	.1	.0	.0	.0	.3	.1	.1	.1	.0	.1	.1	1.3	2.8	2.5	1.0
11-15	.0	.1	.0	.0	.1	.5	.6	.0	.0	.0	.0	.1	.7	5.6	6.8	.9
16-20	.0	.0	.0	.1	.1	.1	1.6	.0	.0	.0	.0	.0	.2	2.4	1.5	.0
21-25	.0	.0	.0	.5	.4	.3	.1	.0	.0	.0	.0	.0	.0	.0	.3	.0
26-30	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 6.6

SITE 057 FEB. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.1	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	3.2	2.4	1.8	1.8	1.2	2.2	.7	.5	.5	1.5	.5	.5	.5	1.4	4.5	3.2
3-4	1.7	1.7	1.0	.7	1.3	1.7	.6	.2	.8	2.2	.5	.6	1.5	2.9	3.8	1.3
5-6	.5	.1	.2	.2	.5	1.0	.3	.2	.0	.5	.9	1.2	1.2	2.8	1.8	.4
7-8	.2	.0	.0	.0	.1	.2	.0	.2	.1	.2	.2	.8	1.9	3.6	.5	.2
9-10	.0	.0	.0	.0	.3	.2	.0	.2	.1	.0	.3	.5	2.4	3.6	.5	.0
11-15	.2	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.4	5.3	4.8	1.1	.4
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.2	2.0	.2	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.2	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 7.2

SITE 057 MAR 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.1	.0	.1	.0	.0	.0	.0	.0	.0	.0
1-2	.6	.5	.3	.5	.1	.6	.3	.3	.1	.3	.1	.2	.1	.5	1.0	1.0
3-4	.6	.5	1.2	.8	.8	1.0	.5	1.0	.7	1.1	.5	.3	.4	1.2	2.1	1.0
5-6	.1	.2	.4	.1	.3	.8	.5	1.1	.5	.5	1.0	.5	2.0	1.7	1.2	.3
7-8	.1	.2	.4	.1	.6	.8	.1	.1	.1	.1	.4	1.1	2.8	1.5	2.3	.7
9-10	.0	.0	.3	.3	1.4	1.2	.2	.0	.1	.1	.1	1.4	6.7	2.1	4.5	.5
11-15	.0	.1	.3	2.1	2.1	2.5	.1	.1	.0	.0	.1	1.2	6.7	2.8	7.2	.7
16-20	.0	.0	.0	.1	.3	.9	.0	.0	.0	.0	.1	.0	1.1	3.0	2.1	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.3	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 4.3

SITE 057 APR 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	2.5	.8	.4	.8	.7	.3	.9	.1	.2	.2	.2	.0	.2	.6	1.4	2.6
3-4	.6	.7	.3	.8	1.3	1.3	.9	.3	.4	1.3	.3	.3	.5	1.4	4.9	1.8
5-6	.6	.1	.3	.3	1.3	1.4	.5	.1	.0	.7	.4	1.0	1.3	1.9	3.8	.9
7-8	.0	.0	.0	.3	1.0	.7	.3	.0	.1	.3	.3	.7	1.9	4.1	5.1	.3
9-10	.0	.0	.0	.2	1.4	1.4	.2	.0	.0	.1	.3	.9	1.9	4.8	5.1	.0
11-15	.0	.0	.0	.0	.2	2.0	.2	.0	.0	.0	.2	.5	3.6	9.5	3.5	.0
16-20	.0	.0	.0	.0	.2	.3	.0	.0	.0	.0	.0	.0	1.0	2.3	.5	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.2

SITE 057 MAY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
1-2	.3	.3	.4	1.3	.7	1.4	1.1	.1	.4	1.0	.4	.3	.2	.3	.7	.7
3-4	.5	.4	.5	.5	.5	1.4	.7	.0	.0	.9	1.1	.6	.5	.7	2.0	.5
5-6	.4	.0	.1	.1	.0	.3	.0	.0	.0	.3	.5	.4	.4	1.3	2.0	1.2
7-8	.4	.0	.0	.1	.1	.1	.0	.0	.0	.0	.3	.2	.6	2.5	3.1	.8
9-10	.2	.0	.0	.1	.0	.1	.0	.0	.0	.0	.0	.1	.7	2.5	3.9	1.1
11-15	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.5	11.1	13.0	2.6
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	6.4	7.6	.3
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.0	.4
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.2
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 8.9

SITE 057 JUNE 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.1	.1	.0	.0	.1	.0	.1	.0	.1	.0	.0	.1
1-2	1.0	.4	.8	1.4	1.5	2.1	.7	.1	.5	1.4	1.0	.7	1.5	2.8	3.0	1.9
3-4	.1	.4	1.3	.7	1.1	.8	.1	.0	.4	.3	.3	.3	.8	2.5	2.8	.4
5-6	.1	.1	.1	.2	.4	.5	.1	.0	.1	.2	.4	.3	1.8	3.8	2.7	.3
7-8	.1	.1	.1	.1	.0	.2	.0	.0	.1	.1	.6	.6	2.0	5.2	2.5	.6
9-10	.3	.0	.1	.0	.0	.1	.0	.0	.0	.4	.4	.7	1.9	6.7	2.8	.4
11-15	.0	.0	.0	.0	.0	.1	.1	.0	.0	.1	.5	.7	6.2	10.0	2.8	.1
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.8	2.4	.6	.1
21-25	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.1	.7	.1
26-30	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.0	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.0

SITE 057 JULY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
1-2	2.5	2.0	1.7	1.8	3.1	1.9	.0	.7	.8	1.8	1.1	.8	1.5	.9	3.1	2.3
3-4	1.2	1.6	3.2	3.2	3.2	1.8	.0	.5	1.0	2.3	2.0	1.3	1.4	2.5	1.3	.4
5-6	.1	.3	.5	.7	.6	.1	.0	.1	.1	1.0	1.0	.6	.9	1.6	.3	.5
7-8	.1	.2	.3	.3	.3	.0	.0	.0	.0	.7	.7	.7	1.4	1.9	.3	.5
9-10	.1	.1	.1	.0	.1	.0	.0	.0	.0	.3	1.3	.6	1.3	2.9	1.0	.3
11-15	.1	.0	.0	.1	.1	.2	.0	.0	.0	.0	1.0	.8	2.7	7.2	.8	.2
16-20	.0	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.4	.5	2.3	.6	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.8	.1	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.3	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.4	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .9

SITE 016 AUGUST 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	.4	.6	.3	.3	1.1	5.1	3.7	1.0	.0	.2	.0	.4	.2	1.7	2.1	2.3
3-4	1.3	.1	.1	.2	.2	2.8	2.3	.8	.0	.1	.4	.3	.7	3.4	3.1	1.3
5-6	.3	.3	.0	.0	.0	1.3	.4	.0	.0	.0	.0	.0	.0	1.5	1.7	1.8
7-8	.5	.1	.0	.0	.0	.3	.0	.1	.0	.0	.0	.0	.0	.6	4.1	3.1
9-10	.2	.1	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	3.3	1.9
11-15	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	3.5	10.6
16-20	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.4	7.5
21-25	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.5	8.8
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	5.2
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.5

SITE 016 SEPT. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.2	.0	.7	.0	.0	.0	.0	.0	.0	.0	.6	8.3	2.4
1-2	.4	.1	.0	.3	.3	1.6	.1	.2	.1	.2	.0	.1	.1	.2	.3	.3
3-4	.3	.3	.3	.6	1.0	2.8	.7	.7	.2	.3	.0	.4	1.1	2.2	.7	.9
5-6	.2	.0	.1	.0	.4	4.0	.8	.0	.0	.0	.1	.0	.9	.4	.7	.4
7-8	.0	.3	.1	.0	.7	2.0	.3	.0	.0	.0	.0	.1	.3	.7	1.8	.8
9-10	.0	.3	.0	.2	.9	1.9	.1	.0	.0	.0	.0	.0	.0	1.0	1.9	1.1
11-15	.3	1.1	.0	.1	.2	1.4	.0	.0	.0	.0	.0	.0	.0	2.0	5.5	3.9
16-20	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	1.1	11.2	2.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.3	13.2	1.2
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	3.4	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS - .7

SITE 016 OCT. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.3	.1	.1	.1	.6	1.3	.6	.1	.0	.1	.0	.1	.4	.6	1.4	2.1
1-2	.6	1.0	.9	.9	.7	1.1	2.9	.3	.4	.3	.5	.9	.9	.6	1.0	1.5
3-4	.6	.5	.4	1.2	.5	2.6	2.4	.1	.6	.1	.1	.0	.6	1.2	1.1	1.9
5-6	.9	.5	1.1	.6	.2	1.1	.7	.0	.1	.1	.0	.1	.6	.9	3.2	1.4
7-8	1.2	.5	.2	.0	.0	.3	.0	.0	.1	.3	.1	.0	.1	1.2	1.7	.9
9-10	1.3	.1	.2	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2	.4	2.9	2.9
11-15	1.5	.0	.1	.0	.3	.0	.1	.1	.1	.8	.4	.3	.1	1.0	3.9	5.8
16-20	.0	.0	.0	.0	.1	.1	.0	.0	.0	.0	.0	.1	.0	.1	3.5	2.5
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.1	.0	4.7	.4
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.2	1.1	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7	1.4	3.1	3.4

PERCENT CALM OR LIGHT AND VARIABLE WINDS .1

SITE 016 NOV. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.1	.1	.1	.1	.0	.3	.2	.5	.9	1.6	.0
1-2	1.3	.9	.9	.9	.7	2.5	2.4	1.1	1.5	1.8	.5	2.1	1.8	2.1	2.0	1.9
3-4	.9	.2	.9	2.0	.7	5.6	2.4	.2	.9	2.3	.9	1.0	1.5	2.3	2.7	1.6
5-6	.3	.0	.4	.9	.1	2.4	.9	.0	.6	2.6	.3	.1	1.2	1.6	4.5	2.1
7-8	.1	.3	.1	.9	.0	1.0	2.0	.1	.1	2.5	.2	.0	.6	1.6	4.3	2.8
9-10	.0	.0	.0	1.1	.0	.1	1.1	.0	.3	.2	.0	.0	.0	1.1	1.4	.6
11-15	.0	.0	.1	.3	.0	.0	.6	.0	.0	.1	.0	.0	.0	.2	1.3	1.0
16-20	.1	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.8	.2	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .4

SITE 016 DEC. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.9	.1	.3	.6	.6	1.7	1.7	.1	.1	.1	.3	.1	.1	.3	.9	1.7
1-2	.9	.9	.7	.8	.9	1.7	1.7	.5	.6	.4	.6	.9	.6	1.4	1.7	2.9
3-4	1.2	.1	.3	1.4	1.6	2.1	.6	.1	.6	.0	.0	.0	.6	.6	1.3	3.0
5-6	.4	.1	.0	.2	.4	1.5	.8	.0	.9	.4	.2	.0	.1	.3	3.2	3.0
7-8	.6	.5	.0	.0	.0	1.4	.8	.0	1.0	.4	.0	.0	.1	1.7	2.6	4.4
9-10	.4	.3	.0	.0	.0	1.0	.6	.0	.1	.1	.0	.1	.3	.6	3.5	3.8
11-15	.0	.0	.0	.0	.0	.6	.0	.0	.0	.0	.0	.7	2.7	1.7	9.6	5.9
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.1	.3	1.4	.8
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .1

SITE 616 JAN. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.1	.4	.1	.0	.0	.0	.0	.0	.0	1.2	2.1	.0
1-2	.8	.6	.3	.5	1.2	4.0	1.6	.6	.3	.1	.1	.5	.5	.7	1.5	1.7
3-4	.5	.3	.2	.3	2.7	4.4	3.8	.4	.4	.1	.0	.3	1.2	1.1	1.6	2.5
5-6	.5	.1	.0	.3	.8	2.4	1.6	.0	.1	.1	.1	.1	.6	1.0	2.0	2.3
7-8	.5	.3	.0	.1	.0	.0	.8	.0	.0	.1	.0	.0	.3	.7	3.6	2.7
9-10	1.2	.0	.0	.0	.0	.0	.9	.0	.0	.0	.0	.1	.1	.4	4.6	3.3
11-15	.3	.0	.0	.0	.0	.4	3.3	.0	.1	.0	.0	.0	.1	1.4	9.0	10.5
16-20	.0	.0	.0	.0	.0	.2	.4	.0	.0	.0	.0	.0	.0	.0	1.3	1.4
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .1

SITE 016 FEB. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	1.1	.7	.7	2.8	2.6	3.6	3.2	.3	.3	.6	.3	.6	1.5	1.8	2.0	2.2
3-4	2.0	.4	.3	.9	1.7	3.9	1.4	.1	.0	.0	.0	.0	.3	1.8	1.6	3.3
5-6	1.9	.0	.1	.5	1.2	3.0	1.2	.0	.0	.1	.0	.0	.0	1.3	1.7	3.6
7-8	1.5	.3	.0	.0	.5	1.0	.6	.0	.0	.0	.0	.0	.1	1.0	2.7	5.1
9-10	.6	.0	.0	.0	.0	.3	.2	.0	.0	.0	.0	.0	.0	.1	2.7	5.7
11-15	.4	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.4	11.6	5.1
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.0	.6
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .3

SITE 016 MAR. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.3	.1	.0	.1	.0	.7	.1	.1	.0	.0	.0	.0	.1	.0	.9	.4
1-2	.3	.9	.6	.3	.3	.9	.9	.5	.1	.5	.2	.4	.9	.4	.7	1.0
3-4	.0	.3	.1	.0	.2	2.2	1.4	.9	.3	.7	.3	.6	.7	1.1	.9	1.3
5-6	.1	.4	.0	.0	.1	1.7	2.0	.3	.0	.0	.0	.3	1.2	1.4	2.4	.8
7-8	.5	.2	.0	.0	.1	3.2	4.8	.3	.0	.0	.0	.1	.3	1.1	2.9	2.0
9-10	.3	.0	.0	.0	.0	2.5	2.4	.1	.0	.0	.0	.0	.3	1.7	4.3	2.9
11-15	.0	.0	.0	.0	.2	.4	2.2	.0	.0	.0	.0	.0	.1	2.1	18.6	6.5
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	5.1	.1
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .7

SITE 016 APR. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	.0	.1	.1	.2	.1	.7	1.3	.2	.7	.5	.1	.7	.5	1.1	.4	.4
3-4	.7	.8	1.2	.4	.8	4.3	2.8	.2	.9	.3	.6	.5	.4	2.2	1.3	.9
5-6	.2	.0	.5	.1	.0	2.9	2.9	.2	.1	.4	.1	.1	1.7	2.5	4.3	.7
7-8	.2	.0	.5	.0	.0	3.5	1.7	.0	.0	.1	.0	.0	.5	2.9	6.5	1.0
9-10	.0	.0	.1	.0	.0	.7	.4	.0	.0	.0	.0	.1	.7	1.8	5.4	.7
11-15	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	6.1	16.6	.9
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.1	5.9	.1
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .0

SITE 016 MAY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	2.8	.1
1-2	.5	.3	.1	.3	.4	1.5	2.1	.0	.4	.1	.3	.3	1.2	1.3	.6	.5
3-4	.6	.3	.2	.3	.1	1.9	.9	.0	.1	.1	.0	.0	.5	1.7	1.2	1.2
5-6	.5	.1	.3	.3	.0	.7	.1	.0	.0	.0	.0	.0	.1	2.3	2.1	1.9
7-8	1.5	.4	.5	.1	.0	.1	.3	.0	.0	.0	.0	.0	.0	1.2	4.4	1.9
9-10	.6	.3	.1	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	1.3	5.8	1.8
11-15	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	1.9	4.0	15.9	5.0
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	1.0	18.5	1.2
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.0

SITE 016 JUNE 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.2	.3	.2	.3	.3	.9	.3	.0	.0	.0	.0	.0	.0	1.4	.2	.2
1-2	.4	.4	.2	.2	.1	2.5	2.0	.1	.0	.0	.0	.1	.0	.4	.6	1.5
3-4	.6	.1	.0	.0	.0	4.8	1.2	.2	.1	.1	.0	.0	.4	.7	1.8	2.0
5-6	.2	.0	.0	.0	.0	.8	.0	.0	.0	.0	.0	.0	.4	2.2	2.5	2.2
7-8	.6	.0	.0	.0	.0	.3	.0	.0	.0	.0	.0	.0	.5	.6	2.9	2.2
9-10	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	3.5	1.8
11-15	.0	.0	.0	.0	.0	.0	.0	.0	.6	.0	.0	.0	.0	1.5	17.3	8.1
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.5	.0	.0	1.2	.0	.3	21.2	2.8
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .2

SITE 016 JULY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0
1-2	.7	.5	.2	.2	.5	4.0	4.8	2.2	.1	.3	.3	.3	.8	2.7	1.9	2.0
3-4	1.0	.5	.3	.3	.0	8.4	8.0	1.3	.2	.4	.3	.1	1.2	3.8	2.7	2.2
5-6	1.4	.2	.1	.1	.0	1.9	1.2	.1	.2	.0	.2	.1	1.0	3.3	3.1	3.4
7-8	.6	.1	.0	.0	.0	1.0	.2	.0	.2	.0	.0	.0	.3	.8	2.8	2.2
9-10	.6	.0	.0	.0	.0	.2	.2	.0	.1	.0	.1	.0	.1	.3	.6	1.4
11-15	.4	.0	.0	.0	.0	.2	.0	.0	.0	.0	1.1	.3	.0	.3	2.1	6.8
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.2	.0	1.4	4.1
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.7
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.4

SITE 018 SEPT 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	2.9	1.8	.4	.7	.7	.8	1.0	.3	.2	1.0	.4	.3	.2	.8	.8	1.9
3-4	2.5	1.2	1.3	.8	.3	2.7	2.1	1.4	1.9	3.4	1.7	.4	.2	.1	1.3	2.6
5-6	.7	.3	.1	.1	.6	1.4	1.2	.2	.3	1.9	1.9	.2	.2	1.0	.4	1.2
7-8	1.7	.6	.3	.2	.1	.0	1.6	.6	.1	1.0	1.0	.1	.5	.6	.5	1.8
9-10	1.1	1.1	.0	.1	.0	.0	.4	.0	.1	.2	.0	.2	.0	.7	1.2	1.5
11-15	1.8	1.2	.1	.0	.0	.1	.5	.0	.1	.0	.0	.0	.4	.8	1.7	4.9
16-20	2.5	.3	.1	.1	.1	.0	.0	.0	.0	.0	.0	.1	.2	.2	.8	5.1
21-25	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.5	5.5
26-30	.2	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.2	2.6
31-	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.8

PERCENT CALM OR LIGHT AND VARIABLE WINDS .0

SITE 018 OCT 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	1.9	4.0	1.9	.7	.4	.6	1.3	.7	.9	1.0	.1	.5	.8	1.2	.3	2.5
3-4	2.7	2.8	1.3	.4	.5	.9	2.7	3.2	5.7	3.5	.9	.7	.4	.7	1.7	1.4
5-6	.8	.5	.3	.1	.4	.2	1.5	.4	1.0	1.0	.4	.3	.1	.8	1.5	.5
7-8	.7	.6	.1	.1	.0	.2	.3	.1	.1	.6	.4	.4	.4	1.3	1.3	.7
9-10	1.0	.7	.2	.0	.0	.0	.1	.0	.1	.3	.2	.0	.0	.8	.4	.6
11-15	1.5	1.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.1	.4	1.4	.5	2.2
16-20	2.7	1.3	.1	.0	.0	.0	.0	.1	.0	.0	.0	.1	.0	.0	.3	4.3
21-25	2.3	.1	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	1.2	4.3
26-30	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	2.8
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .7

SITE 018 NOV 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.2	.4	.0	.0	.0	.0	.0	.0	.7	.1	.2	.1	.1	.1	.1	.9
1-2	4.8	5.9	1.8	1.1	1.1	.7	1.6	.7	.9	1.0	.6	.6	.6	.7	1.0	3.0
3-4	4.0	2.8	1.2	.6	.5	.4	2.0	2.2	3.2	1.1	.4	.6	.5	1.0	1.6	1.7
5-6	1.5	.5	.4	.1	.0	.5	2.4	.4	.5	.6	1.2	.2	.5	.8	2.8	3.0
7-8	.4	.9	.0	.0	.1	.2	2.0	.7	.7	.4	.5	.3	.3	.7	.8	1.3
9-10	1.0	.4	.0	.3	.5	.1	.3	.6	1.9	.6	.4	.0	.1	.5	1.1	.9
11-15	.5	.6	.2	.3	.1	.1	1.0	.2	.1	.3	.4	.3	.3	.8	2.2	2.0
16-20	.7	.7	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.1	.3	.4	.7
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .5

SITE 018 DEC 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	2.6	2.6	.4	.3	.4	.3	.7	.0	.5	.4	.2	.6	.5	1.0	1.1	2.1
1-2	1.7	1.8	.5	.4	.1	.7	.4	.8	.6	.5	.1	.2	.4	.4	.4	.5
3-4	6.7	4.3	.7	.2	.2	.3	.9	3.5	1.7	1.9	.4	.5	.1	.9	1.4	2.1
5-6	1.4	1.0	.3	.1	.0	.1	.1	.0	.4	.4	.3	.1	.4	1.1	.9	1.2
7-8	.3	.6	.0	.0	.0	.1	.1	.0	.2	.1	.2	.0	.4	.4	2.1	1.6
9-10	.5	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.1	.4	1.1	1.6
11-15	1.2	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.4	1.5	2.1	5.6	4.4
16-20	.2	.2	.0	.1	.1	.0	.0	.0	.0	.0	.0	.6	1.7	3.6	2.1	3.4
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.2	1.4	.3	1.1
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.0

SITE 018 JAN 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.6	.4	.1	.1	.0	.1	.1	.1	.1	.0	.0	.2	.2	.2	.1	.5
1-2	1.7	1.5	.5	.2	.1	.4	.7	.5	.4	.1	.0	.0	.1	.1	.3	.5
3-4	9.0	4.4	1.0	.2	.9	1.1	1.8	2.3	3.3	2.7	.5	.5	.3	.7	1.2	3.0
5-6	3.0	1.4	.8	.0	.5	.6	1.2	.6	.9	.9	.6	.2	.4	.9	1.0	1.9
7-8	.6	.4	.1	.0	.1	.1	.5	.0	.1	.2	.3	.1	.3	.5	1.4	1.2
9-10	.8	.5	.1	.1	.0	.2	.1	.0	.1	.1	.1	.1	.1	.5	.9	.4
11-15	2.3	.6	.1	.1	.0	.0	1.4	.0	.4	.1	.0	.1	.1	1.4	2.2	2.2
16-20	2.7	1.5	.1	.0	.0	.1	3.5	.0	.0	.0	.0	.0	.0	.2	1.4	8.2
21-25	1.3	.1	.0	.0	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	1.2
26-30	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .2

SITE 018 FEB. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.5	.2	.2	.2	.1	.1	.1	.0	.2	.1	.0	.0	.1	.2	.3	.2
1-2	4.6	7.2	1.0	.6	.4	.7	1.2	.5	2.5	2.2	.5	.2	.5	.3	1.1	1.2
3-4	5.9	3.6	1.3	.5	.5	.8	.8	1.8	3.4	1.9	.5	1.1	.2	1.5	1.3	3.0
5-6	1.1	.5	.2	.1	.2	.2	.8	.2	.7	.1	.1	.5	.4	.7	.8	1.7
7-8	.9	1.2	.0	.0	.0	.0	1.2	.2	.1	.0	.0	.0	.5	.5	1.0	1.2
9-10	.2	.5	.2	.1	.0	.0	.2	.0	.5	1.1	.0	.0	.1	.7	1.2	1.7
11-15	1.1	.8	.1	.0	.0	.0	.0	.0	.1	.0	.6	.1	.2	1.2	2.4	3.5
16-20	2.6	.8	.1	.0	.0	.0	.0	.1	.1	.0	.0	.0	.1	.8	2.3	2.5
21-25	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.5
26-30	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.5

SITE 018 MAR 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.9	.2	.1	.0	.0	.1	.0	.1	.1	.1	.1	.0	.2	2.2	2.4	3.0
1-2	1.0	1.1	.8	1.0	.3	.6	.7	.1	.8	.4	.3	.2	.3	.7	.7	.6
3-4	3.1	2.4	.8	.8	1.1	1.0	2.0	1.1	3.3	2.7	.6	.4	.2	.4	1.7	2.3
5-6	1.3	.3	.0	.3	.3	.6	1.9	.6	1.9	.6	.1	.4	.7	.9	1.0	1.3
7-8	.3	.2	.1	.1	.0	1.1	1.9	.1	1.0	.1	.1	.0	.4	.1	1.4	2.4
9-10	.6	.0	.0	.0	.1	1.7	1.5	.1	.6	.1	.0	.0	.0	.1	1.3	2.2
11-15	1.7	.1	.0	.0	.1	1.7	3.0	.0	.1	.0	.0	.0	.0	.5	4.7	6.7
16-20	1.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	1.0	4.4
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.1

SITE 018 APR 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.3	.3	.3	.1	.0	.8	1.6	1.0	1.1	.7	.6	.3	1.6	1.1	4.3	7.1
1-2	1.5	.8	.4	.2	.7	.6	.8	.1	.3	.1	.2	.0	.3	.6	.5	1.4
3-4	3.0	1.0	.4	.2	.4	1.0	2.1	.3	1.1	.8	.6	.4	.6	1.4	2.0	4.3
5-6	.8	.6	.1	.1	.1	1.6	2.0	.1	1.0	.4	.1	.4	.6	1.1	1.7	3.1
7-8	.7	.2	.0	.0	.1	.6	.6	.3	.1	.1	.0	.3	.7	1.3	3.1	4.0
9-10	.6	.1	.0	.1	.0	.8	1.1	.0	.3	.0	.0	.1	.0	.6	3.3	2.4
11-15	.2	.1	.0	.0	.0	.3	.1	.0	.1	.0	.0	.0	.1	.8	5.5	3.9
16-20	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.3	1.8
21-25	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .5

SITE 013 MAY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	.8	.8	.8	.5	.6	.8	1.9	1.0	1.9	.8	.3	.2	.2	.6	.6	.6
3-4	.6	.7	.3	.0	.3	.4	2.4	1.9	3.3	2.5	.6	.5	.5	.7	1.5	1.9
5-6	1.2	.6	.1	.0	.1	.2	1.1	.1	1.1	1.7	.5	.1	.2	.3	.6	1.4
7-8	1.2	1.0	.1	.0	.1	.1	.1	.1	.3	.5	.2	.1	.1	.6	1.3	1.0
9-10	1.3	.6	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.2	.6	.8	.9
11-15	3.7	1.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.1	.0	.8	7.4	7.6
16-20	2.8	.7	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	3.9	7.8
21-25	1.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.6	7.2
26-30	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	1.5
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .7

SITE 319 JUNE 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.1	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.1	.1	.1	.0
1-2	1.2	1.6	1.2	.4	.3	1.1	.5	1.7	1.6	2.1	.9	.6	.3	.4	.4	.7
3-4	3.8	1.7	.5	.4	.4	.4	2.0	4.0	1.9	2.5	.9	.2	.4	1.0	1.4	1.6
5-6	1.2	.4	.2	.0	.1	.0	2.5	.9	1.0	2.6	.4	.4	.7	1.2	2.0	1.5
7-8	1.2	.5	.1	.1	.1	.0	.3	.1	.1	2.0	.5	.3	.2	1.9	4.3	2.2
9-10	.8	.2	.1	.0	.0	.0	.2	.0	.0	.2	.2	.0	.2	.9	2.1	.6
11-15	2.1	.5	.1	.0	.0	.0	.0	.0	.0	.0	.3	.1	.0	1.6	5.5	2.5
16-20	1.0	.2	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	1.2	2.1
21-25	.9	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	2.2
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 6.2

SITE 018 JULY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.4	.4	.3	.0	.1	.3	.5	2.7	.1	1.0	.1	.3	.0	.1	.0	.4
1-2	2.4	3.2	1.7	1.3	.7	1.0	.7	3.6	.6	.9	1.3	.6	.7	1.3	2.0	2.0
3-4	.8	1.5	1.6	.2	1.0	1.6	3.6	10.9	2.7	6.4	2.4	.6	.7	1.4	1.3	1.3
5-6	.4	.4	.0	.1	.1	.4	3.0	5.5	1.1	5.6	1.2	.2	.1	.0	.3	.5
7-8	.2	.1	.3	.2	.0	.5	.5	.8	.2	1.7	.5	.2	.2	.0	.3	.2
9-10	.1	.5	.0	.0	.0	.0	.0	.1	.2	.3	.0	.1	.0	.0	.1	.1
11-15	.5	.4	.2	.0	.0	.0	.3	.0	.0	.0	.1	.0	.0	.0	.2	.1
16-20	.3	.6	.1	.0	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.1	.2
21-25	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3
26-30	.5	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.3

SITE 020 OCT. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	.1	.7	.0	.0	.0	.0	.0	1.2	.0	.1	.0	.1	.5	.4	.0	.0
3-4	3.4	4.3	.0	.0	.3	.3	2.4	5.8	.9	2.8	.4	.3	.7	.4	.1	.7
5-6	1.9	3.0	.0	.1	.1	.8	1.3	1.1	.7	1.6	.9	.3	.3	.3	.8	.9
7-8	2.0	.9	.0	.0	.0	.0	.0	.7	.0	.4	.9	.1	.3	.4	.8	.7
9-10	2.3	.5	.0	.0	.0	.0	.0	.1	.0	.4	1.2	.0	.0	.1	.1	1.1
11-15	7.4	.1	.0	.0	.0	.0	.0	.0	.0	.4	.0	.0	.5	.7	1.3	1.7
16-20	8.3	.8	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.5	.9	2.2	3.0
21-25	.8	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	1.5	.5
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	1.1	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 13.4

SITE 020 JAN. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.8	.1	.0	.0	.0	.0	.0	.0	.1	.0	.1	.1	.2	.0	.1	.5
1-2	.4	1.6	3.8	.5	.2	.1	.2	.2	1.0	1.9	.8	1.0	.3	.2	.2	.1
3-4	.7	2.2	5.1	1.4	.6	.3	.6	1.0	.8	2.3	1.9	1.4	.7	.6	.1	.5
5-6	.9	2.1	3.1	1.1	.2	.2	1.0	.9	.7	.0	.4	.4	.9	.7	.7	1.0
7-8	.9	2.3	2.0	1.8	.2	.1	.8	.7	.1	.0	.2	.2	.4	.8	.8	1.0
9-10	1.4	2.1	.6	.3	.0	.1	.7	.2	.1	.0	.2	.3	.2	.9	.4	.7
11-15	2.0	2.2	1.5	.3	.0	.0	1.6	.5	.0	.0	.1	.3	.6	.5	.9	1.0
16-20	1.0	1.8	1.1	.2	.0	.0	.9	1.3	.0	.0	.0	.0	.0	.2	.0	.2
21-25	.6	.1	.2	.0	.0	.0	.0	.5	.0	.0	.0	.0	.0	.0	.0	.2
26-30	.0	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 10.9

SITE 020 FEB. 1967

PERCENT FREQUENCY OF OCCURRENCE. WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.1	.0	.0	.0	.0
1-2	.2	1.2	3.1	.3	.1	.0	.2	.5	.6	.9	.2	.1	.2	.1	.0	.5
3-4	.5	1.5	4.7	.1	.1	.1	.9	1.7	2.4	2.7	2.2	1.6	.2	.1	.6	.3
5-6	1.1	2.6	4.2	.4	.0	.1	.4	1.2	.2	.2	1.0	1.9	.4	.4	.4	.4
7-8	.8	1.7	2.4	.2	.1	.1	.4	.2	.4	.4	.0	1.0	.2	.4	.5	.6
9-10	1.3	1.8	.4	.0	.0	.0	.1	.1	.0	.2	.5	.1	.3	.9	1.0	.9
11-15	4.3	2.9	.2	.0	.0	.0	.0	.1	.4	.2	.4	.6	.7	1.6	1.5	1.9
16-20	1.2	1.9	.4	.0	.0	.0	.0	.0	.1	.0	.4	.4	.1	.3	.8	1.6
21-25	.9	1.0	.2	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0	.5	1.6
26-30	.9	.6	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.2
31-	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 12.2

SITE 020 MAR. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
1-2	.2	.3	.5	.1	.0	.0	.2	.2	.1	.3	.0	.0	.0	.1	.3	.5
3-4	.2	.9	1.8	.5	.1	.1	.3	.4	1.4	1.2	.2	.4	.1	.1	.3	.5
5-6	.7	1.7	2.8	.6	.4	.3	.5	.5	.8	1.1	.4	.4	.1	.3	.9	.8
7-8	.7	1.0	1.6	.3	.5	.4	.8	2.0	.6	.3	.5	.9	.1	.5	1.0	1.7
9-10	.9	1.4	.7	.5	.7	.3	1.4	1.9	.3	.0	.1	.5	.5	.2	1.4	1.6
11-15	2.6	2.1	1.2	.6	2.1	1.4	2.7	.7	.1	.0	.1	.8	.3	1.9	4.7	5.3
16-20	2.3	2.5	1.6	.5	.0	.3	.0	.0	.1	.1	.0	.1	.0	.4	2.0	3.6
21-25	.3	1.1	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	.3	.5
26-30	.0	.1	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 8.1

SITE 020 APR. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0
1-2	.2	.2	.2	.1	.1	.0	.1	.2	.1	.7	.2	.1	.0	.2	.2	.2
3-4	.8	.7	.9	.4	.7	.2	.6	1.6	.3	1.0	.3	.4	.2	.6	1.1	.8
5-6	.6	.5	1.0	.6	.7	.1	1.1	1.3	.2	.7	.5	.5	.3	.7	1.3	1.0
7-8	1.0	.7	2.5	.8	.1	.4	2.3	1.3	.3	.4	.5	.7	1.0	1.8	3.2	2.2
9-10	.8	.4	.6	.4	.2	.0	.9	.2	.0	.2	.0	.6	.5	1.7	2.8	2.0
11-15	2.2	.8	.1	.1	.2	.7	.4	.0	.2	.0	.1	1.7	2.5	4.8	6.2	4.2
16-20	.4	.6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	2.1	2.3	2.6	1.6
21-25	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	1.6	.7
26-30	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.5	.4
31-	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.2

PERCENT CALM OR LIGHT AND VARIABLE WINDS 6.5

SITE 020 MAY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.0	.0
1-2	.6	.6	.5	.2	.0	.0	.2	.9	.3	.5	.1	.2	.3	.2	.3	.3
3-4	.6	.4	.3	.1	.0	.1	.0	1.5	1.2	1.2	.5	.5	.3	.3	.7	.3
5-6	.2	.4	.1	.0	.0	.0	.1	1.4	.0	.5	.7	.9	.3	.7	1.2	.1
7-8	.9	.2	.0	.0	.0	.0	.1	.3	.0	.1	.6	.9	.3	.7	1.9	1.0
9-10	1.2	.4	.1	.0	.0	.0	.0	.2	.0	.1	.1	.3	1.1	1.1	2.5	1.7
11-15	2.8	2.5	.0	.0	.0	.0	.0	.0	.0	.0	.1	.9	1.9	4.9	5.7	3.7
16-20	3.6	2.0	.1	.0	.0	.0	.0	.0	.0	.0	.0	.3	2.1	3.3	4.7	1.5
21-25	1.0	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.9	2.0	2.5	.2
26-30	.6	.1	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	1.5	1.9	.0
31-	.0	.1	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.9	1.2	.9	.3

PERCENT CALM OR LIGHT AND VARIABLE WINDS 8.9

SITE 020 JUNE 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.1	1.7	.5	.0	.0	.2	.7	1.1	.3	.6	.2	.0	.0	.0	.0	.0
1-2	.7	1.0	.9	.2	.4	.6	.1	.7	.6	.6	.2	.2	.3	.7	.4	.3
3-4	.4	1.3	.6	.3	.0	.4	.1	.9	.8	1.6	.5	.6	.2	.7	.4	.8
5-6	.6	1.6	1.2	.1	.2	.4	.2	1.7	.7	1.3	1.1	.6	.6	.3	.3	.4
7-8	1.1	.6	.6	.2	.0	.9	.1	.2	.2	.9	2.0	.4	.8	.9	.9	1.5
9-10	1.1	.9	.3	.0	.0	.2	.0	.0	.0	.4	1.4	.9	.3	1.6	2.1	1.0
11-15	2.7	2.5	.4	.0	.0	.0	.0	.0	.0	.0	2.1	1.7	2.3	3.9	5.7	3.2
16-20	3.2	1.8	.4	.0	.0	.0	.0	.0	.0	.0	.2	.2	.7	1.0	1.9	.8
21-25	2.4	2.3	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.2	.1
26-30	.4	.1	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.5	.0
31-	.6	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.2	.1	.1

PERCENT CALM OR LIGHT AND VARIABLE WINDS 1.4

SITE 020 JULY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.9	5.8	2.0	1.2	.9	.7	3.6	1.7	2.4	3.3	5.1	1.1	1.7	1.9	.7	1.7
1-2	.9	1.7	1.4	1.3	1.0	.9	1.7	1.5	1.6	1.1	1.1	1.1	.8	.6	.5	1.5
3-4	.4	.6	.2	.5	.3	1.3	3.0	1.2	1.5	1.5	2.6	.4	.8	.2	.1	.8
5-6	.4	.8	.2	.0	.4	1.4	1.9	.5	.5	1.7	3.1	.8	.2	.3	.2	.2
7-8	.4	.1	.0	.2	.1	.5	.5	.1	.0	1.7	2.0	.2	.1	.2	.1	.3
9-10	.3	.1	.1	.0	.0	.2	.0	.1	.0	.4	1.1	.0	.1	.0	.0	.0
11-15	.7	.2	.0	.0	.0	.0	.4	.1	.1	.0	.0	.2	.0	.0	.2	.3
16-20	1.7	.4	.2	.0	.0	.0	.1	.1	.0	.0	.0	.1	.0	.0	.2	.2
21-25	1.4	.5	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1
26-30	.3	1.1	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .5

SITE 021 SEPT. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.5	.3	.2	2.1	3.7	.5	.2	.0	.0	.0	.0	.5	1.1	.5	.5	1.0
1-2	.0	.2	.5	.2	.1	.2	.2	.1	.1	.0	.2	.2	.1	.2	.4	.3
3-4	.2	.9	1.9	2.0	1.3	.8	2.0	1.2	.3	3.3	2.3	1.0	.7	.8	.8	1.7
5-6	.3	.2	2.6	3.1	1.8	1.0	.8	.8	.2	3.5	.8	.5	.4	.8	.8	1.2
7-8	.5	.5	4.1	3.9	1.7	1.5	.4	1.1	.2	.8	.8	.7	.5	.7	1.2	2.1
9-10	.1	.5	1.6	2.8	.8	.3	.2	.6	.0	.1	.5	.2	.2	.3	.8	.5
11-15	.1	.2	1.5	4.5	1.5	.5	.4	.3	.0	.0	.2	1.3	.9	.8	1.1	.5
16-20	.2	.0	.0	.1	.0	.0	.0	.0	.0	.0	.0	.2	.2	.3	.0	.7
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .2

SITE 021 OCT. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	2.6	.1	.5	2.0	.4	.1	.0	.4	.4	.5	.2	.1	.1	.2	.1	.6
1-2	.1	.5	.7	.2	.1	.0	.0	.1	.4	.5	.1	.5	.8	.4	.1	.1
3-4	.6	1.3	2.5	1.2	1.0	.9	.1	1.2	1.5	5.5	1.5	1.4	3.0	.9	.9	1.0
5-6	.4	1.3	3.5	2.3	.6	.2	.0	.4	1.2	2.3	1.0	.7	.7	.4	.2	.3
7-8	.6	2.8	4.2	3.0	.1	.1	.0	.1	.4	.9	1.8	.9	.2	.5	.3	.4
9-10	.1	1.5	3.7	1.5	.0	.0	.0	.0	.0	.3	.5	.6	.1	.5	.4	.2
11-15	.3	2.9	7.2	2.6	.0	.0	.0	.0	.0	.0	.4	1.1	.9	1.8	.5	.2
16-20	.1	.4	.0	.0	.0	.0	.0	.0	.0	.1	.1	.4	.0	.2	.4	.0
21-25	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.1	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .0

SITE #21 NOV. 1966

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	2.0	2.6	.5	1.0	.7	.0	1.0	.4	.4	1.2	1.2	.1	.0	.5	1.0
1-2	.1	.1	1.4	.9	.3	.1	.8	.1	.3	1.2	1.2	.3	.7	.3	.4	.7
3-4	1.6	1.6	4.3	2.6	.8	.8	2.2	.7	2.3	4.8	1.8	2.0	1.6	.3	.5	1.3
5-6	1.2	1.2	4.6	1.7	.1	.3	.4	.8	.5	1.8	1.4	.9	.1	.3	.7	.7
7-8	2.6	1.0	8.9	.0	.0	.0	.0	.0	.0	.3	1.0	.7	.1	.7	.1	2.6
9-10	1.2	.3	2.1	.0	.0	.0	.0	.1	.0	.0	1.0	.4	.1	.0	.1	1.2
11-15	.0	.1	3.0	.0	.0	.0	.0	.0	.0	.0	.8	.1	.0	.0	.0	.9
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 3.4

SITE 021 JAN. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	1.7	.8	3.6	5.8	.5	.2	.0	.1	.2	.6	.2	.6	.6	.8	.1	.9
1-2	.2	.6	.8	.7	.2	.5	.3	.0	.1	.7	1.0	.8	.7	.6	.9	.5
3-4	.3	1.0	2.7	2.9	1.2	.6	.6	.1	.3	4.4	2.7	1.3	1.4	.8	.8	1.2
5-6	.2	.6	3.5	1.7	.1	.2	.1	.1	.1	.6	.1	.2	.7	1.0	1.4	.8
7-8	.1	1.5	4.8	1.3	.1	.6	.6	.6	.0	.1	.0	.1	.2	1.2	1.5	.9
9-10	.0	1.0	6.4	.3	.2	.6	.1	.2	.0	.0	.0	.2	.1	.5	1.2	.1
11-15	.1	.8	2.1	.1	.0	2.5	.5	.2	.0	.0	.0	.1	.3	1.6	1.0	.5
16-20	.0	.0	.0	.0	.0	.9	.6	.6	.0	.0	.0	.0	.0	.0	.0	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 4.1

SITE 021 FEB. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	6.2	2.6	4.4	2.3	.5	.2	.0	.6	.2	.8	.5	1.3	.7	.3	.2	1.1
1-2	.3	.4	.9	.4	.1	.1	.0	.0	.4	.8	.7	.2	.3	.4	.3	.1
3-4	.3	.6	1.8	1.9	.5	.0	.3	.2	.9	4.8	2.5	.7	1.5	.5	.9	.5
5-6	.5	.3	2.5	1.5	.0	.0	.5	.0	.2	.5	.6	.4	.6	.5	.8	.2
7-8	1.0	.4	5.0	2.6	.1	.1	.1	.0	.4	.2	.2	.5	.5	.5	.4	.4
9-10	1.5	.2	6.0	1.7	.0	.0	.0	.0	.1	.0	.3	.2	.5	.5	.1	.6
11-15	1.5	.3	3.7	3.5	.0	.0	.0	.0	.0	.0	.6	.8	.5	1.6	1.3	1.4
16-20	.5	.0	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2	.0	.0	.5	.4
21-25	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 4.2

SITE 021 MAR. 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	DIRECTION NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.3	.1	.1	.2	.1	.0	.0
1-2	.1	.3	.7	.3	.4	.5	.0	.0	.1	.1	.1	.1	.0	.1	.0	.2
3-4	.3	.6	2.3	1.1	1.1	.8	.6	.1	.5	3.0	.9	.6	.6	.6	.6	.1
5-6	.2	.9	3.3	1.8	.6	.4	.5	.5	.5	2.8	.6	.7	.4	.6	.4	.2
7-8	.1	.2	5.2	1.7	.4	.8	1.6	.7	.4	.8	.5	1.3	.6	1.1	1.8	.9
9-10	.2	.1	5.0	1.2	.3	.6	.9	1.0	.1	.1	.5	1.0	.6	2.2	2.0	.5
11-15	.1	.1	1.6	1.9	1.5	.6	2.0	3.0	.2	.0	.6	1.8	2.5	3.9	3.2	.7
16-20	.0	.0	.1	.6	1.4	.0	.6	.5	.1	.0	.0	.4	.5	2.5	.4	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.6

SITE 021 APR, 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.1	.4	.9	.0	.0	.0	.0	.0	.2	.7	1.3	2.1	2.1	.2	.2	.5
1-2	.2	.0	.4	.0	.0	.0	.0	.1	.1	.2	.1	.3	.0	.0	.0	.1
3-4	.3	1.2	3.2	1.0	.6	1.0	.5	.6	.0	1.7	.9	.5	1.0	1.0	.8	.7
5-6	.1	1.2	5.2	1.2	.2	.7	.1	.2	1.0	2.2	.5	1.4	1.4	1.1	1.3	.6
7-8	.2	1.5	6.1	.7	.8	.7	1.0	2.2	1.2	.7	1.5	.6	1.4	2.1	2.2	.0
9-10	.0	.3	3.0	.4	1.6	.9	.6	1.5	.0	.2	1.0	.8	1.4	1.2	.9	.0
11-15	.0	.0	.2	.4	2.0	.8	.1	1.3	[illegible]	.4	2.2	2.3	1.4	1.0	.3	.0
16-20	.0	.0	.0	.0	.0	.0	.0	.0	.0	.1	.1	.2	1.1	1.7	.0	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 2.8

SITE 021 JUNE 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.0	.0	.0	.1	.0	.0	.1	.0	.2	.2	.2	.1	.0	.2	.2	.0
1-2	.0	.1	.0	.3	.1	.1	.5	.4	.1	.8	.7	.7	.3	.4	.1	.2
3-4	.3	.3	1.6	2.0	.3	.8	.4	1.4	.1	2.1	1.2	.7	.2	.8	1.2	1.1
5-6	.0	.3	1.6	1.8	.4	.5	.1	.4	.5	3.5	2.6	2.0	.3	.8	1.1	1.0
7-8	.1	.4	1.3	1.5	.1	.0	.0	.2	.1	3.1	2.5	1.0	1.1	2.5	1.3	1.0
9-10	.0	.2	1.0	1.5	.3	.1	.0	.0	.0	.7	1.8	1.3	.8	2.5	1.0	.2
11-15	.4	.2	1.2	3.5	.1	.0	.0	.0	.0	.0	1.0	1.2	3.1	7.8	1.8	.1
16-20	1.1	.1	.2	1.0	.0	.0	.0	.0	.0	.0	.0	.7	.6	3.9	1.6	.0
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.4	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS 4.2

SITE 021 JULY 1967

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS DIRECTION

SPEED	DIRECTION															
KNOTS	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0	.7	1.9	.7	.1	.0	.0	.0	.0	.0	.5	.7	.5	.5	.3	.5	.4
1-2	.0	.0	.1	.1	.0	.4	.0	.8	.3	1.3	.8	1.1	.4	.1	.0	.4
3-4	.5	.5	2.3	1.2	.4	.5	.1	1.2	.8	5.9	2.4	1.2	.3	.7	.4	2.0
5-6	.0	.0	1.7	2.7	.1	.4	.1	1.2	1.1	7.2	2.9	1.2	.5	.3	.4	.3
7-8	.0	.3	1.5	1.9	.1	.0	.0	.7	.0	2.7	3.7	3.7	.0	.1	.4	.3
9-10	.0	.0	1.3	2.3	.1	.0	.0	.0	.0	.4	.7	.9	.1	.0	.0	.3
11-15	.1	.1	5.7	8.3	.0	.1	.0	.0	.0	.0	.3	.1	.0	.0	.0	1.5
16-20	.1	.0	1.6	4.7	.0	.0	.0	.0	.0	.0	.0	.0	.1	.0	.0	.8
21-25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.3	.0	.0
26-30	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
31-	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

PERCENT CALM OR LIGHT AND VARIABLE WINDS .6

SITE 301 SFC SEPTEMBER,1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	10	17	N NNW	2	0	11	3	4	2	2	4	3	3	0	1	0	1	0	3	11	5[illegible]
0600-1200	10	18	N NNW	0	0	4	1	1	0	0	1	3	6	4	4	4	3	3	10	28	2[illegible]
1200-1800	12	18	N	0	0	2	0	0	0	0	0	1	9	6	1	3	1	3	10	31	3[illegible]
1800-2400	12	19	N	0	0	15	1	0	1	0	2	1	4	0	0	0	0	0	1	17	5[illegible]

SITE 301 SFC OCTOBER,1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	16	N	2	0	22	4	4	9	4	5	2	10	0	0	0	0	0	2	4	3[illegible]
0600-1200	8	18	N NNW	2	0	10	2	1	2	1	4	2	7	4	2	4	0	2	9	20	2[illegible]
1200-1800	9	19	N	0	0	6	1	0	0	0	0	1	0	0	2	3	3	3	14	33	3[illegible]
1800-2400	9	19	N	1	0	22	7	4	6	0	0	0	0	0	0	0	0	0	2	11	4[illegible]

SITE 301 SFC NOVEMBER,1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	15	S NNE	1	2	18	9	6	13	3	10	10	4	1	2	1	0	0	2	3	17
0600-1200	5	19	N	0	0	8	4	1	4	1	4	11	14	2	2	2	2	4	11	8	19
1200-1800	6	19	N	1	1	3	2	1	1	0	2	10	9	5	5	2	2	4	21	18	16
1800-2400	6	18	NNE N	1	2	18	13	5	6	1	4	13	7	1	1	0	1	1	3	7	15

SITE 301 SFC DECEMBER,1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	18	NNE	5	0	18	9	6	21	7	8	2	3	0	0	0	0	0	0	4	16
0600-1200	8	22	N	4	1	7	5	2	8	5	4	3	2	0	1	2	3	2	3	21	25
1200-1800	10	20	N NNW	1	0	7	4	2	2	0	1	2	0	0	0	0	2	3	12	39	24
1800-2400	8	19	NNE	5	0	16	17	6	11	3	4	0	0	0	0	0	0	0	0	7	27

SITE 301 SFC JANUARY,1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	26	N	5	1	11	9	10	10	3	8	14	1	1	0	0	2	2	2	5	18
0600-1200	8	23	N	1	2	9	6	4	5	2	8	11	7	2	2	1	1	1	6	14	19
1200-1800	9	24	NNW	0	0	3	2	0	0	0	8	7	5	2	4	3	3	1	6	29	24
1800-2400	9	28	N	2	0	15	10	2	6	3	4	9	1	0	1	1	2	1	2	10	28

SITE 301 SFC FEBRUARY,1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
				* * * * * * * * * * DIRECTION PERCENTAGE DISTRIBUTION * * * * * * * * * *																	
0000-0600	7	20	NNE	2	4	25	13	7	13	3	4	1	1	0	0	0	1	1	1	6	18
0600-1200	7	25	NW NNW	2	1	10	9	3	5	1	7	2	3	3	1	2	2	3	7	18	21
1200-1800	9	19	N NNW NW	0	0	5	1	0	1	0	5	4	1	3	1	2	1	1	17	25	32
1800-2400	8	18	N	2	2	26	11	3	5	2	4	2	2	1	0	0	0	0	0	9	30

SITE 301 SFC MARCH,1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
				* * * * * * * * * * DIRECTION PERCENTAGE DISTRIBUTION * * * * * * * * * *																	
0000-0600	9	18	W N	1	1	20	3	2	2	1	9	11	5	1	0	1	2	3	4	16	21
0600-1200	9	21	NNW	0	0	8	3	1	2	1	6	16	5	1	2	0	1	1	7	22	24
1200-1800	11	23	NW	0	0	1	0	0	0	0	6	10	9	2	2	1	2	3	23	21	18
1800-2400	10	20	NW	0	0	14	1	1	1	1	6	12	8	1	1	1	2	3	4	23	21

SITE 301 SFC APRIL,1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
				* * * * * * * * * * DIRECTION PERCENTAGE DISTRIBUTION * * * * * * * * * *																	
0000-0600	8	16	NNW N	0	0	19	6	2	4	4	18	5	4	0	1	1	2	2	4	12	15
0600-1200	10	21	NW	0	0	5	1	0	1	1	11	11	6	1	1	2	2	3	13	23	19
1200-1800	11	20	NW	0	0	1	0	0	0	0	6	13	7	3	3	2	3	5	30	22	5
1800-2400	9	18	N	1	0	13	2	1	3	2	11	10	3	2	1	1	3	2	5	27	14

SITE 301 SFC MAY,1967

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	19	NNE	1	1	24	4	4	3	1	0	0	2	0	0	0	0	1	1	11	46
0600-1200	9	18	NNE NNW	1	1	3	0	0	1	1	2	1	2	2	1	1	1	1	12	38	34
1200-1800	11	18	NNW	0	0	2	0	0	0	0	0	0	1	0	2	0	0	0	13	50	32
1800-2400	11	18	N	1	0	16	2	2	0	0	0	1	2	1	0	1	0	0	2	18	55

SITE 301 SFC JUNE,1967

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	18	N NNE	2	0	16	3	1	0	0	1	2	0	0	0	0	0	0	0	17	56
0600-1200	9	20	NNW	0	0	2	0	0	0	0	1	3	1	3	2	1	1	2	19	24	42
1200-1800	11	26	N	0	0	1	0	0	0	0	0	1	1	2	1	1	4	3	13	41	33
1800-2400	10	19	NNW N	0	0	17	0	0	0	0	0	2	0	0	0	0	0	0	1	12	67

SITE 301 SFC JULY,1967

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	17	N NNW	1	2	17	4	1	1	0	0	2	2	1	0	0	1	2	3	18	44
0600-1200	5	16	N	0	0	2	0	0	0	0	3	6	9	3	2	2	4	6	14	26	24
1200-1800	11	18	N	0	0	0	0	0	0	0	1	0	1	4	3	2	2	6	15	29	37
1800-2400	11	18	N	0	0	6	1	0	0	1	0	1	2	1	0	0	0	0	3	24	61

SITE 057 SEPT 1966

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	12	37	NW WNW	6	0	1	4	7	6	2	2	1	1	2	1	3	7	21	24	9	5
0600-1200	11	35	NW	1	0	1	1	3	7	5	8	4	1	2	8	6	10	13	30	1	1
1200-1800	17	35	NW WNW	0	0	0	0	2	2	2	4	5	1	3	3	8	8	25	33	3	3
1800-2400	16	39	WNW	7	0	1	5	5	4	3	2	1	0	0	1	2	4	22	31	9	1

SITE 057 OCT 1966

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	32	NW	15	0	4	3	10	5	2	1	3	1	2	3	3	5	9	18	16	7
0600-1200	7	30	WNW	7	0	2	2	3	9	9	6	6	2	4	5	4	4	8	15	12	4
1200-1800	14	35	WNW	0	0	0	0	2	2	1	2	4	1	4	4	4	4	19	35	19	1
1800-2400	11	35	WNW	7	0	1	4	7	5	3	1	0	1	1	2	3	3	7	25	21	9

SITE 057 NOV 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	18	SSE SE ESE	6	0	2	6	8	6	9	6	3	0	1	3	3	3	6	15	21	3
0600-1200	7	21	SE	4	0	1	1	4	7	9	10	6	4	2	6	4	3	6	18	13	2
1200-1800	9	34	NW	1	0	0	1	1	4	5	7	3	4	2	4	7	6	16	25	11	1
1800-2400	6	22	NNW	7	0	3	4	7	5	6	2	3	3	2	1	5	5	7	15	19	5

SITE 057 DEC 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	5	22	NNW	9	0	8	7	4	5	3	0	1	1	1	2	1	1	4	16	23	14
0600-1200	6	20	NNW	13	0	3	5	3	4	7	4	3	2	4	4	1	1	4	8	24	11
1200-1800	9	26	NNW	3	0	1	1	2	2	6	5	3	1	2	7	4	3	6	24	27	5
1800-2400	6	27	E	12	0	6	5	4	4	1	1	2	0	2	2	1	2	4	23	19	13

SITE 057 JAN 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	26	ESE	6	0	8	5	9	3	4	3	2	0	1	0	1	2	6	15	18	16
0600-1200	6	27	ESE	7	0	3	5	4	3	7	6	8	5	1	4	2	2	2	17	16	7
1200-1800	8	23	NNW	2	0	1	0	1	1	2	8	8	5	3	5	6	4	11	20	20	4
1800-2400	7	26	ESE	12	0	4	7	2	3	3	1	5	1	0	6	1	2	11	16	22	12

SITE 057 FEB. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	4	23	WNW	11	0	8	5	4	1	1	0	0	1	1	2	1	4	7	24	20	10
0600-1200	5	17	NW	3	0	5	3	6	6	6	10	4	3	3	6	4	4	8	17	7	3
1200-1800	8	26		4	0	0	1	2	2	6	10	2	0	2	5	4	7	25	23	6	0
1800-2400	6	22	NW	10	0	10	8	0	1	2	0	0	1	1	4	0	1	16	21	15	8

SITE 057 MAR 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	20	NW	7	0	3	2	5	4	1	9	0	0	1	1	2	4	17	13	24	7
0600-1200	8	20	SE	2	0	1	1	3	4	9	11	6	3	2	4	1	3	20	8	19	3
1200-1800	11	22	NNW	2	0	0	0	2	4	7	7	1	5	2	2	4	7	22	19	12	2
1800-2400	9	25	NNW	6	0	2	3	2	3	5	4	0	3	2	2	1	4	20	11	28	4

SITE 057 APR 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	20		2	0	9	4	4	2	5	4	1	0	0	1	1	1	6	12	35	13
0600-1200	8	60	NNW	2	0	2	0	0	6	9	9	3	1	0	4	1	4	7	18	31	2
1200-1800	10	18	NW WNW	0	0	0	0	0	1	4	11	6	0	2	4	3	6	22	33	6	0
1800-2400	7	17	NW NNW	1	0	4	1	0	0	6	6	2	1	0	1	1	2	7	36	25	7

SITE 057 MAY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	23	NNW	15	0	5	2	1	1	1	2	1	0	0	2	0	2	3	16	38	11
0600-1200	9	22	NNW	4	0	2	0	1	3	3	7	5	1	1	4	5	2	3	22	32	6
1200-1800	12	21	NNW N	2	0	1	0	0	2	1	3	1	0	0	3	2	2	8	38	32	6
1800-2400	10	26	N NNW	15	0	1	1	2	1	0	2	1	0	0	1	2	1	2	25	36	9

SITE 057 JUNE 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	21	NW	2	0	2	1	2	2	3	4	1	0	0	3	5	1	13	36	19	6
0600-1200	7	16	NW WNW	1	0	1	0	3	4	5	9	2	0	4	5	5	6	13	28	15	1
1200-1300	10	28	NW	1	0	0	0	3	2	3	3	1	0	0	3	3	6	25	41	9	1
1800-2400	8	27	NNE	4	0	4	2	2	2	1	0	0	0	0	0	1	1	10	35	29	9

SITE 057 JULY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	4	15	NW	2	0	10	8	5	7	6	2	0	0	1	4	5	4	6	19	13	8
0600-1200	6	16	SE	0	0	0	0	8	7	17	12	0	4	4	13	9	4	5	15	2	1
1200-1800	11	34	NW	0	0	[illegible]	1	6	7	3	3	0	0	2	5	9	8	14	29	7	5
1800-2400	7	34	NW	2	0	7	8	5	4	2	0	0	0	2	2	6	6	14	30	8	5

SITE 016 AUGUST 1966

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	28	N	4	0	6	4	1	1	4	20	4	0	0	0	0	0	0	1	8	47
0600-1200	6	27	N	0	0	1	0	0	1	1	15	20	6	0	0	0	0	1	13	16	26
1200-1800	12	29	N	1	0	0	0	0	0	0	0	0	1	0	0	2	2	3	13	50	28
1800-2400	14	30	N	2	0	7	1	0	0	1	5	2	0	0	0	0	1	0	2	13	67

SITE 016 SEPT. 1966

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	12	26	NNW	0	0	1	5	1	2	7	14	2	0	0	0	0	0	1	5	37	24
0600-1200	11	30	NNW	1	0	1	3	0	1	4	16	3	2	1	1	0	1	3	13	41	7
1200-1800	14	33	NNW	2	0	0	0	0	1	0	17	2	1	0	1	0	1	5	19	50	1
1800-2400	15	29	NNW	0	0	2	0	0	1	3	10	1	0	0	0	0	0	0	5	59	20

SITE 016 OCT. 1966

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	11	60	N	0	0	10	4	8	6	5	6	4	1	1	0	1	1	3	4	18	29
0600-1200	11	55	N NNW	0	0	6	3	1	1	4	13	11	0	2	3	2	3	5	7	26	12
1200-1800	14	60	NW NNW	0	0	1	0	0	0	0	5	8	1	2	2	2	1	8	17	42	11
1800-2400	14	60	NNW	0	0	9	4	5	5	1	2	3	0	0	2	0	1	0	3	24	40

SITE 016 NOV. 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	5	30	NNW N	1	0	5	2	2	6	3	14	6	1	1	9	2	3	8	11	12	13
0600-1200	5	18	NE	0	0	1	1	2	7	1	18	13	1	6	7	1	4	6	6	17	8
1200-1800	6	18	NE NW	0	0	0	3	1	8	1	6	11	1	5	11	1	3	4	17	22	4
1800-2400	5	17	NW	0	0	4	2	5	4	1	9	7	1	2	10	5	4	4	5	22	15

SITE 016 DEC. 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	20	W	0	0	5	2	1	3	7	10	6	2	2	1	1	2	2	6	17	33
0600-1200	7	16	N	0	0	5	1	1	1	1	17	9	0	3	2	1	1	4	6	18	30
1200-1800	9	18	NNW	0	0	1	1	0	2	2	0	6	0	5	1	1	3	10	7	39	14
1800-2400	8	19	N	0	0	6	3	3	5	5	6	3	1	3	1	1	3	3	8	22	26

SITE 016 JAN. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	20	N	0	0	5	2	1	1	9	16	11	0	0	1	0	1	1	5	18	29
0600-1200	7	17	NNW	0	0	4	1	1	1	3	17	16	1	1	0	1	1	2	4	21	27
1200-1800	8	19	NNW	0	0	1	1	1	1	2	10	13	2	2	1	0	2	5	13	39	9
1800-2400	8	22	N	1	0	6	1	0	3	5	8	9	1	0	0	0	1	3	4	25	34

SITE 016 FEB. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	17	N	0	0	9	2	2	8	13	10	5	0	0	1	1	0	1	3	13	32
0600-1200	6	22		0	0	4	3	1	3	4	18	9	0	1	1	0	1	4	6	19	26
1200-1800	7	21	NNW	0	0	1	0	0	1	2	15	7	1	0	0	0	0	2	18	43	8
1800-2400	6	17	NNW N	0	1	16	2	2	5	5	5	5	0	1	1	0	0	0	2	18	37

SITE 016 MAR. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	18	NNW	1	0	3	1	1	1	2	12	13	1	0	1	0	1	5	7	28	23
0600-1200	8	19	NNW	0	0	2	5	1	0	1	13	15	2	0	2	0	2	1	5	38	13
1200-1800	9	19	NW NNW	0	0	0	1	0	0	1	10	16	2	1	1	1	1	4	16	42	4
1800-2400	9	18	NNW N	2	0	2	1	1	1	1	12	12	4	0	0	1	1	5	5	35	20

SITE 016 APR. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	18	NNW	0	0	3	3	3	1	2	12	7	0	1	1	1	1	4	12	43	8
0600-1200	8	19	NNW	0	0	1	0	3	1	1	12	12	0	1	1	0	1	3	14	43	6
1200-1800	9	18	NW	0	0	1	0	3	0	0	11	10	1	3	2	2	2	3	34	27	1
1800-2400	8	17	NNW	0	0	0	0	1	1	1	13	7	1	2	1	1	2	6	10	48	5

SITE 016 MAY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	20	NNW	2	0	9	3	4	3	1	2	4	0	1	0	0	1	1	6	49	15
0600-1200	8	20	NNW	1	0	3	1	1	0	1	10	6	0	1	1	1	1	5	10	49	9
1200-1800	11	21	NNW	0	0	0	0	0	0	0	2	3	0	0	0	0	0	6	31	51	6
1800-2400	12	22	NNW	1	0	3	2	0	1	0	3	1	0	0	0	0	0	4	3	58	24

SITE 016 JUNE 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	20	NNW	0	0	5	3	1	1	0	14	5	0	1	0	0	0	2	0	39	28
0600-1200	8	20	NNW	0	0	2	0	0	0	1	13	6	1	0	0	0	0	2	6	51	16
1200-1800	11	20	NNW	0	0	0	0	0	0	0	6	2	0	0	0	0	3	2	19	52	15
1800-2400	12	20	NNW	0	0	2	1	0	1	0	6	2	0	4	0	0	1	0	2	56	24

SITE 016 JULY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	4	17	N	7	0	9	2	0	0	1	27	15	4	0	1	0	1	2	3	6	20
0600-1200	4	13	N	0	0	3	2	0	0	0	21	28	5	0	2	2	1	4	12	12	9
1200-1800	6	22	N	0	0	0	1	0	0	0	5	12	3	1	1	2	0	5	20	27	16
1800-2400	8	22	N	2	0	7	1	2	2	1	9	3	1	2	0	1	1	3	4	14	46

SITE 018 SEPT 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	31	NNE N	0	0	19	12	3	3	4	4	4	0	2	5	3	2	2	4	8	27
0600-1200	6	22		0	0	9	4	2	3	1	5	11	4	5	14	11	1	2	5	7	17
1200-1800	11	29	N	0	0	9	4	0	0	1	5	9	5	4	10	6	1	2	3	13	27
1800-2400	12	34	N	0	0	18	7	4	2	2	5	3	1	0	0	1	1	1	5	7	41

SITE 018 OCT 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	28	N	0	0	17	22	6	2	2	1	4	0	2	2	1	2	1	7	12	18
0600-1200	6	24	NNE	2	0	10	9	5	2	1	2	12	9	16	9	2	2	2	4	4	11
1200-1800	11	35	N	0	0	9	1	2	0	0	3	3	8	10	12	4	2	2	7	12	23
1800-2400	10	34	N	1	0	20	13	4	2	2	2	5	1	3	2	1	3	4	7	5	27

SITE 018 NOV 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	5	16	E NE NNE ENE NNW NW N	0	0	16	25	5	3	3	3	11	3	1	1	1	2	1	3	7	16
0600-1200	5	16	N NNE ENE WNW NNW	1	0	12	6	4	2	2	2	13	9	11	5	3	2	2	3	7	14
1200-1800	7	30	[illegible]	0	0	6	1	1	1	1	1	8	5	15	8	8	3	5	10	15	13
1800-2400	5	17	[illegible]	1	0	22	16	4	4	3	2	6	2	5	2	2	1	1	4	11	15

SITE 018 DEC 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	22	N NW	1	0	23	17	2	1	1	3	1	0	0	1	0	4	4	10	14	18
0600-1200	7	23	NW	2	0	14	11	3	2	1	0	5	7	5	3	2	1	3	12	12	16
1200-1800	9	22	NW N	0	0	7	4	1	0	0	1	2	9	7	8	3	6	7	12	18	16
1800-2400	9	22	N	1	0	17	13	2	1	1	2	1	0	2	1	0	4	7	10	15	22

SITE 018 JAN 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	25	NNE	0	0	32	17	3	1	2	2	9	0	2	0	1	1	1	4	5	20
0600-1200	8	26	NNE	0	0	20	16	5	1	1	3	12	6	5	4	1	1	1	1	8	16
1200-1800	9	24	NNE	0	0	9	3	1	0	1	3	9	7	11	11	3	1	2	9	11	18
1800-2400	9	26	NNE	0	0	28	8	2	1	2	3	8	0	3	2	1	2	3	5	9	22

SITE 018 FEB. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	5	36	NNE	3	0	28	25	5	2	1	0	2	0	2	0	0	1	1	5	11	14
0600-1200	6	24	NNE	2	1	9	14	4	2	1	2	6	2	10	9	2	4	2	5	10	13
1200-1800	6	26	N	1	1	6	1	1	0	1	2	7	8	16	12	4	0	3	10	11	16
1800-2400	7	21	NNE N	2	0	28	23	3	2	2	2	2	0	2	6	2	2	1	4	10	19

SITE 018 MAR 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	19	N	1	0	18	7	1	4	3	5	9	0	5	1	1	0	2	7	6	28
0600-1200	6	16	N	1	0	9	4	2	0	2	11	15	4	8	4	1	1	1	1	15	20
1200-1800	9	21	N	0	0	3	0	0	0	1	7	12	3	12	9	2	2	3	8	24	13
1800-2400	8	20	NNE	1	0	11	6	3	4	2	6	8	2	7	2	1	1	2	5	13	30

SITE 018 APR 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	22	NNE	0	0	13	6	2	2	2	2	6	0	1	1	0	0	2	4	13	40
0600-1200	7	22	NNE	0	0	9	3	2	1	1	7	14	1	4	2	3	2	3	6	15	26
1200-1800	8	17	N	0	0	1	1	0	0	0	6	8	4	11	6	2	4	8	14	25	9
1800-2400	7	19	N	1	0	11	4	1	1	2	7	5	1	1	0	1	1	2	4	22	36

SITE 018 MAY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	27	N	1	0	17	12	2	1	3	2	6	0	2	2	3	1	2	3	7	33
0600-1200	8	25	N	1	0	11	4	1	0	0	1	6	8	7	10	2	2	1	3	16	25
1200-1800	12	28	N	0	0	8	1	0	0	0	0	4	3	12	10	1	1	1	5	34	21
1800-2400	12	29	N	1	0	16	5	1	1	2	3	5	1	5	1	1	1	1	4	13	41

SITE 018 JUNE 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	5	25	N	13	0	13	8	5	2	1	4	2	5	3	3	2	2	1	5	19	12
0600-1200	5	22	N	5	0	6	1	2	1	0	1	7	18	10	15	4	1	0	5	12	11
1200-1800	9	25	NNE	1	0	9	2	0	0	1	0	12	4	4	17	4	2	3	9	21	10
1800-2400	8	27	N	5	0	20	8	2	1	2	1	4	1	2	3	2	1	3	9	16	20

SITE C18 JULY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	3	6	SSE	2	0	9	15	9	4	5	5	8	9	1	4	5	3	3	6	6	0
0600-1200	4	16	SSE	0	0	2	0	1	1	1	2	6	42	4	26	9	2	0	1	1	1
1200-1800	6	28	NE	0	0	4	5	1	0	0	2	14	25	11	26	3	1	1	0	2	5
1800-2400	5	26	NNE	4	0	9	8	6	2	2	6	6	18	3	7	5	2	3	4	7	9

SITE 020 OCT 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	24	N	45	3	0	0	0	0	0	0	0	0	0	1	1	1	5	4	8	31
0600-1200	6	24		37	0	0	0	0	0	0	0	0	0	0	22	9	3	1	9	3	16
1200-1800	9	30	NNW	6	0	0	0	0	0	0	0	0	0	0	23	18	1	9	15	26	2
1800-2400	10	28	NNW	34	0	0	0	0	0	0	0	0	0	0	2	1	2	6	4	23	29

SITE 020 JAN. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	24	S	14	0	9	16	31	12	2	0	3	5	0	0	0	0	1	2	3	2
0600-1200	7	27	ENE	11	0	3	9	21	3	0	1	10	7	6	7	4	4	3	2	4	7
1200-1800	7	27	N	7	0	10	9	2	1	1	2	6	6	5	10	10	10	6	7	5	6
1800-2400	8	24	NE	11	0	13	24	18	7	2	0	5	2	1	0	1	1	4	3	1	6

SITE 020 FEB. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	34		16	0	15	22	26	1	0	0	1	1	0	1	2	2	1	1	3	7
0600-1200	7	30		14	0	2	6	13	1	0	0	2	7	7	8	7	9	4	3	7	10
1200-1800	9	28	NNW	6	0	6	9	1	0	0	0	4	8	9	9	11	12	3	9	8	4
1800-2400	10	30	NE	12	0	23	24	22	1	0	0	1	0	0	1	0	0	0	1	4	10

SITE 020 MAR. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	23	NNW N NE	13	0	13	10	17	4	5	2	5	5	0	1	0	1	1	1	9	14
0600-1200	9	18	NNE NE NW	13	0	7	8	7	2	4	7	9	6	5	5	1	1	1	2	9	16
1200-1800	12	27	NE	3	0	1	9	3	5	4	1	5	6	6	6	4	10	2	12	13	11
1800-2400	11	26	ENE	6	0	12	17	15	2	3	1	5	5	2	0	0	1	0	1	13	17

SITE 020 APR. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	25	NNW	7	0	11	5	14	5	1	0	3	0	0	1	0	1	3	8	24	18
0600-1200	9	22	N	8	0	3	2	2	2	3	3	6	9	2	4	3	6	10	6	17	15
1200-1800	11	32	NNE N	3	0	2	1	0	1	2	2	6	8	2	6	4	11	12	23	14	6
1800-2400	10	34	N	8	0	11	9	5	2	1	0	6	1	1	1	0	0	2	13	24	15

SITE 020 MAY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	10	33	NW	13	0	14	6	3	1	0	0	1	2	0	1	0	1	5	21	17	13
0600-1200	9	32	NNW	8	0	6	7	1	0	0	0	0	3	4	8	4	8	5	11	23	11
1200-1800	14	37	NNW	5	0	9	8	0	0	0	0	0	8	1	1	3	6	15	19	22	2
1800-2400	15	42	WNW	9	0	16	7	2	0	0	0	0	3	0	0	0	0	9	16	27	10

SITE 020 JUNE 1967

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	30	NW	2	0	16	21	10	2	0	1	0	2	1	2	1	1	5	11	12	14
0600-1200	7	23	N	2	0	6	6	5	0	1	1	4	11	6	9	12	6	1	5	12	10
1200-1800	12	35	NNE	1	0	14	6	1	0	0	4	1	6	3	9	16	0	9	3	13	3
1800-2400	11	35	NNE N	1	0	18	22	6	1	1	4	0	0	6	2	1	2	6	15	13	7

SITE 020 JULY 1967

TIME	WIND SPEED (KNOTS) AVG	WIND SPEED (KNOTS) MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	4	20	NNE	1	0	11	23	7	6	3	2	3	5	2	2	7	6	3	6	3	0
0600-1200	5	17	SSE	0	0	1	1	1	1	1	[illegible]	16	11	17	21	21	1	1	1	0	1
1200-1800	8	32	NE	0	0	8	5	2	1	1	9	21	3	4	15	[illegible]	2	1	0	0	1
1800-2400	8	32	NE	1	0	14	17	7	5	5	6	4	2	1	1	4	5	9	6	4	10

SITE 021 SEPT 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	15	ENE	0	0	2	5	23	33	12	4	5	4	0	0	0	0	0	2	4	5
0600-1200	6	17	WNW	0	0	1	2	5	11	11	5	2	4	1	13	8	8	5	6	8	12
1200-1800	7	21	NW	0	0	1	1	2	4	3	5	0	3	2	17	10	9	9	10	10	11
1800-2400	8	20	N	0	0	3	4	20	27	18	4	9	4	1	1	0	1	2	0	1	5

SITE 021 OCT. 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	22	NNE	0	0	8	17	33	18	[illegible]	1	0	1	1	0	2	3	5	3	2	4
0600-1200	6	12	ENE NE NNE W NNW WNW	0	0	6	5	19	11	4	1	0	4	5	20	5	7	5	2	3	3
1200-1800	7	25	WNW	0	0	1	2	4	5	2	3	0	4	9	20	15	10	10	10	3	2
1800-2400	8	17	WSW NE	0	0	5	20	33	18	2	1	0	1	0	1	2	3	3	4	4	4

SITE 021 NOV, 1966

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	6	18		4	0	6	12	42	9	2	1	4	0	1	0	0	2	1	0	3	14
0600-1200	5	18		3	0	5	3	24	8	4	2	4	4	9	14	9	3	3	1	2	3
1200-1800	5	15		3	0	3	4	6	1	0	5	2	7	5	26	20	14	4	4	2	2
1800-2400	5	12	N	1	1	12	7	34	6	3	0	3	0	0	1	5	3	3	0	2	15

SITE 021 JAN. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	19		3	0	1	5	47	20	4	4	1	3	0	0	0	3	1	4	3	6
0600-1200	7	20		3	0	1	5	19	12	2	9	3	3	2	6	4	7	5	4	10	3
1200-1800	6	14	SSE	9	0	4	3	3	1	1	7	3	2	1	17	12	5	9	10	7	5
1800-2400	7	18	SE	4	0	4	13	28	19	2	5	3	0	0	0	0	0	1	7	7	6

SITE 021 FEB. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	9	25		1	0	18	5	39	17	0	1	0	0	1	0	0	0	0	6	6	5
0600-1200	6	19		7	0	7	7	19	9	1	0	1	1	4	12	8	5	6	6	5	4
1200-1800	6	18	WSW	7	0	7	3	5	4	1	0	1	2	3	17	14	11	13	4	2	3
1800-2400	9	23	NNE	1	0	16	4	36	26	1	0	1	0	1	0	0	1	0	3	5	4

SITE 021 MAR. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	17	ESE	2	0	2	4	29	13	6	5	4	5	0	0	1	3	4	6	11	4
0600-1200	8	18	ESE NW	4	0	1	0	12	7	8	5	11	2	3	11	2	3	8	10	8	4
1200-1800	10	20	NW	2	0	1	0	5	4	3	2	5	10	3	15	7	15	8	16	3	1
1800-2400	9	18	NW	3	0	1	4	27	11	6	2	6	6	1	0	3	3	2	12	11	2

SITE 021 APR. 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	15	ESE	4	0	1	12	37	4	4	6	1	1	0	1	0	1	10	10	8	2
0600-1200	7	18	NW	4	0	0	3	8	6	7	5	2	7	5	10	11	13	6	10	5	1
1200-1800	9	20	WSW	1	0	0	0	1	2	4	3	3	10	5	14	16	15	15	7	2	0
1800-2400	7	17	SW	2	0	2	4	29	4	7	2	3	6	0	1	2	8	9	7	9	5

SITE 021 JUNE 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	7	19	NNW	5	0	6	4	15	19	1	1	1	2	0	1	2	6	6	17	11	4
0600-1200	7	21	NW	6	0	0	1	2	7	2	1	1	2	1	13	15	8	6	23	9	5
1200-1800	10	24	NW	2	0	0	0	0	1	0	1	0	2	2	24	22	11	8	20	3	1
1800-2400	9	20	NW WNW	4	0	2	3	11	20	2	3	2	4	1	2	6	4	7	18	10	5

SITE 021 JULY 1967

TIME	WIND SPEED (KNOTS) AVG	MAX	MAX DIR	VAR	CALM	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0000-0600	8	18	N	1	0	4	3	32	28	1	1	1	1	0	1	1	3	2	3	6	4
0600-1200	5	14	ENE	1	0	1	1	4	11	0	2	0	4	1	32	29	13	5	2	1	2
1200-1800	6	23	NW	0	0	1	1	3	2	0	1	1	10	6	36	23	17	1	1	1	1
1800-2400	11	20	E	1	0	1	7	24	44	2	2	0	2	2	3	1	1	1	1	0	8

APPENDIX D

Time and Date of Phase II Tests

APPENDIX D
TIME AND DATE OF PHASE II TESTS

The date and time of generation for each of the tracer releases for Mountain Iron, Phase II are contained in this appendix. All tracer releases were made from Site 301 near the SLC-6 Launch Complex and were 30 minutes in duration. All times are for the beginning of tracer generation and are Pacific Standard Time. Annotations indicating those tests not used in the regression analysis and the reason for exclusion are included, as is an annotation indicating the tests in which airborne sampling was conducted. The annotations are defined on page D-4. Other information pertinent to the tracer releases is presented in Appendix B.

Test	Date	Time	Test	Date	Time
114	7 Sep 66	1225	146[ab]	18	1202
115	8	1121	147	21	1708
116	9	1113	148	22	1710
117	14	1113	149	29	1145
118	15	1200	150	30	1148
119[a]	19	1530	151[a]	1 Dec 66	1155
120[a]	20	1511	152	8	1205
121[a]	20	1659	153	9	1203
122	21	1506	154	12	1152
123[a]	21	1730	155	13	1155
124	22	1501	156[a]	19	1319
125	3 Oct 66	1101	157	20	1158
126	4	1048	158	22	1218
127	6	1122	159	28	1200
128	7	1102	160	29	1200
129	13	1102	161[a]	3 Jan 67	1236
130	14	1206	162	4	1300
131	17	1100	163	5	1200
132	19	1318	164[a]	6	1212
133	21	1100	165[b]	9	1354
134[a]	24	1131	166	10	1236
135	26	1055	167	11	1221
136	27	1103	168[b]	11	1545
137	28	1205	169[b]	12	1415
138	31	1545	170	13	1200
139	2 Nov 66	1502	171[ab]	13	1726
140[b]	4	1550	172[b]	16	1154
141[b]	8	1446	173[ab]	17	0630
142[ab]	9	1130	174	17	1203
143	10	1232	175	18	1158
144[b]	14	1251	176[ab]	19	0610
145[b]	15	1207	177[ab]	19	1216

Test	Date	Time	Test	Date	Time
178[a]	20	1200	211	24	2005
179	23	1225	212	24	2150
180	25	1200	213	27	1201
181	27	1200	214	28	1802
182	31	1201	215	29	1046
183	1 Feb 67	1200	216	30	1055
184	2	1300	217	1 May 67	1002
185	3	1155	218	2	1000
186[a]	6	1217	219	3	1000
187[a]	7	1200	220	4	0900
188[a]	7	1500	221	4	1100
189	8	1200	222	4	1356
190	9	1200	223	4	1651
191	10	1200	224	4	2004
192	14	1145	225	5	1000
193	15	1206	226	23	0931
194	16	1100	227	23	1300
195	17	1130	228	24	0902
196	20	1200	229	25	1100
197	21	1100	230	26	1100
198[a]	24	1350	231	12 Jun 67	1100
199	27	1140	232	13	1100
200	2 Mar 67	1100	233	14	1100
201	3	1100	234	15	1130
202	6	1050	235	19	1058
203	8	1200	236	20	1100
204	9	1102	237	22	1130
205	21	1045	238	23	1100
206[c]	22	1109	239[d]	26	1101
207[c]	22	1319	240	27	1131
208	23	1104	241[b]	28	1200
209	24	1052	242[b]	30	1145
210	24	1759	243[ab]	3 Jul 67	1130

Test	Date	Time	Test	Date	Time
244[b]	7	1245			
245[b]	10	1200			
246[b]	12	1200			
247[b]	14	1220			
248[bd]	18	1230			
249[b]	19	1220			
250[b]	20	1245			
251	21	1100			
252	24	1130			
253	25	1130			

[a] Not included in regression analysis, plume centerline not contained in the sampling network

[b] Aircraft sampling conducted

[c] Not included in regression analysis, all meteorological parameters not available

[d] Not included in regression analysis, samples mislabeled.

APPENDIX E

LIST OF ABBREVIATIONS AND TERMINOLOGY

APPENDIX E

LIST OF ABBREVIATIONS AND TERMINOLOGY

The terminology of the various symbols used throughout the body of the text are given here. The units associated with the variables are given in the text.

E	Time integrated air concentration
E_p	Centerline time integrated air concentration
Q	Rate of release of tracer
Q_T	Mass of tracer released during test period
χ	Air concentration of tracer or pollutant
M	Molecular weight of gases (used in prediction equations)
X	Downwind distance from release point, along mean wind, usually in meters
y	Horizontal crosswind distance from mean plume centerline
t	Travel time downwind from release point
τ	Averaging increment of time
σ_y	Standard deviation of horizontal crosswind plume distribution
σ_θ	Standard deviation of horizontal crosswind wind fluctuations
ΔT	Temperature difference (upper minus lower level, heights above ground)
$\bar{U}$	Wind speed
AFWTR	Air Force Western Test Range
QARTS	Queen Air Real Time Sampler
RTS	Real Time Sampler
ETAC	Environmental Technical Applications Center

Subscripts	Superscripts	Description
NO_2		Nitrogen Dioxide
G		Arbitrary Gas
6		Lower level at which temperature is measured for ΔT
	54 or 300	Upper level at which temperature is measured for ΔT
RTS		Indicates "At location of real time sampler"
℄		Indicates "At location of plume centerline"
p		Indicates "Peak value of associated parameter"
s		Indicates "Relatively short time increment"
L		Indicates "Relatively long time increment"
5		Indicates "Averaged over 5 sec increment"
X		Value at a distance X

The engineering units used in the operational equations are:

χ/Q	Normalized concentration in ppm NO_2/lb/min release
X	Distance in feet
σ_θ	Standard deviation of horizontal wind direction fluctuations in degrees, measured at 12 ft and averaged over 10-sec intervals
$\overline{U}$	Mean wind speed in knots, measured at 12 ft
ΔT_1^2	Temperature difference in Fahrenheit degrees, between heights 1 and 2 (heights in feet)

These units are common to all equations unless explicitly noted.