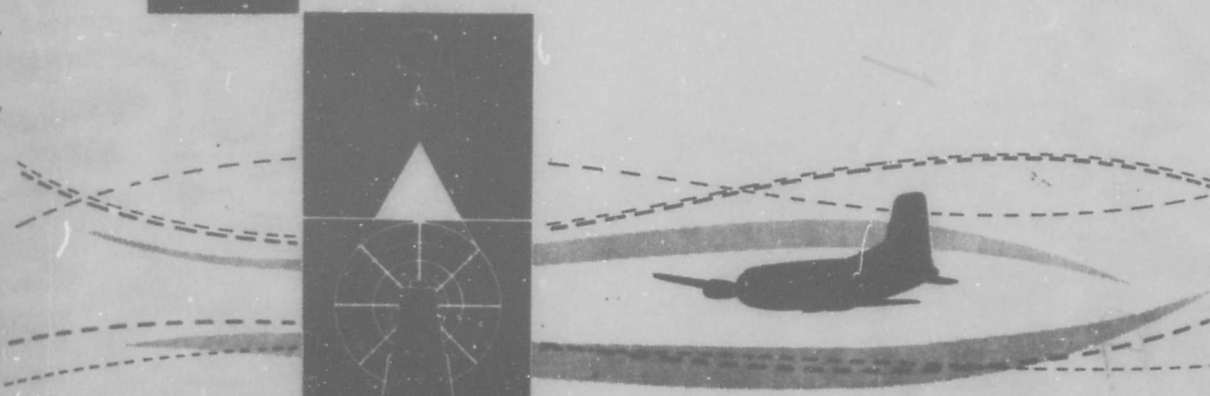
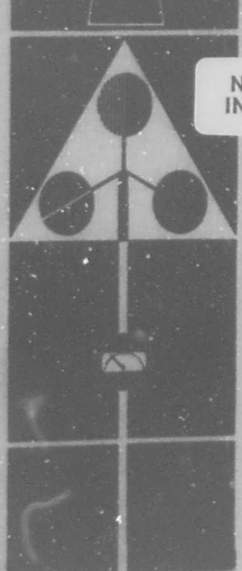
HILL AIR FORCE BASE, UTAH

TERMINAL FORECAST REFERENCE FILE





DETACHMENT 6
17th WEATHER SQUADRON
7th WEATHER WING
AIR WEATHER SERVICE (MAC)

1 FEBRUARY 1972

98

FOREWORD

This manual is intended to serve as an aid to newly assigned forecasters and as a reference for those forecast studies, rules and techniques which have proven to be of value at Hill Air Force Base, Utah.

Principle credit for the original organization and editing of this manual goes to Major Eugene L. Peck, a Reserve Officer, and a career meteorologist with the National Weather Service. Mr. Milton H. Page, Chief Forecaster, and a number of previously assigned personnel have contributed basic material and aided in updating this manual.

It is believed that this manual will also serve as a sound basis for future local studies and aid in further refinement of existing studies.

IRWIN B. ABRAMS
Lt Colonel, USAF
Commander

TERMINAL FORECAST REFERENCE FILES
HILL AFB, UTAH

TABLE OF CONTENTS

SECTION I

LOCATION AND TOPOGRAPHY

SECTION II

WEATHER CONTROLS

SECTION III

CLIMATIC AIDS

SECTION IV

LOCAL FORECAST STUDIES

LIST OF FIGURES

SECTION I

SECTION III

SECTION IV

SECTION I

LOCATION and TOPOGRAPHY

A. Geographic Location.

Hill Air Force Base is located at 41°07'N latitude, 111°58'W longitude at a distance less than five (5) miles from the western foothills of the Wasatch Mountain Range. (Fig I-1). This mountain range extends from Southern Idaho in a gentle arc south through north-central Utah to the center of the state and is one of the more definite north-south weather barriers of the United States. Starting from an elevation near 4,500 feet MSL in the valley to the west, the Wasatch Range rises steeply some 4,000 feet, reaching an average elevation of 8,500 feet MSL. Some of the peaks of the range reach from 10,000 feet to nearly 12,000 feet above sea level. East of the Wasatch Range lies the rugged plateau of eastern Utah and Western Wyoming. This area includes the Uinta Mountains which constitute the only major east-west mountain barrier in the United States. The highest point in Utah is Kings Peak (13,498 feet MSL) in the Uinta Mountains. The Uinta Mountains, together with the northern part of the Wasatch Range, form an "L" shaped mountain barrier, with a rather deep canyon--the Weber Canyon--at the southwest corner of the "L".

The Weber Canyon, together with other passes to the east, offers a path through the Wasatch Range for airflow and is an underlying reason for the occurrences of strong gusty canyon winds at Hill Air Force Base. The Base is located 4½ miles west of the mouth of this canyon on a delta formed when the Weber River flowed into the prehistoric Lake Bonneville.

The field elevation is at an altitude of 4,788 feet MSL, approximately five hundred feet above the general Salt Lake Valley floor.

To the west is the Great Basin oriented north-south and extending to the California Border. It consists of numerous small mountain ranges a few miles wide and a few tens of miles long. These ranges are generally appreciable lower than the Wasatch Range. They are separated by a complicated system of valleys, many of which form separate drainage basins. Hill Air Force Base lies at the eastern side of the largest of these basins, the Great Salt Lake Valley, which extends to the Nevada border and contains the Great Salt Lake. The valley is bounded to the north along the Utah-Idaho border by the Minidoka Range and to the south by the northern ends of a series of ranges, The easternmost of which is the Oquirrh Range-a thunderstorm generator-which lies about 35 miles to the south-south west of Hill AFB. An extension of the Great Salt Lake Valley runs between the Oquirrh and the Wasatch for about 20 miles and contains the metropolitan area of Salt Lake City.

The largest water body in the area is the Great Salt Lake located in the eastern part of the Great Salt Lake Valley. The western part of the valley is occupied mainly by salt flats which are water covered during portions of the year. The Great Salt Lake covers an area of approximately 1600 square miles with an average depth of 14 feet and a maximum depth of 30 feet. The lake is an internal drainage for the Great Salt Lake basin and has a high content of minerals, predominately salts. The waters of the lake are saturated with salt (27 percent) when the lake is at lower levels.

B. Pollution Sources.

1. Dust. The desert regions of the local area are especially subject to drying out during extended periods of deficient rainfall. This is true throughout the year but especially true in late summer and early fall. There are occasionally periods of high surface winds in excess of forty knots. Such winds pick up the light, dry soil from the valley floor and mill tailing ponds (see M on Fig I-1) and carry it along in the form of blowing dust. This dust can sometimes reach elevations of twenty thousand feet. While a noticeable phenomenon in ordinarily clear, dry desert atmosphere, it is only rarely that visibility is reduced to a point where it becomes a hazard to flying operations.

2. Smoke. Air pollution sources are becoming increasingly important both in the Salt Lake Valley and in the vicinity of other cities in the flight area. Industrially, the entire area is growing rapidly with the construction of many new mills, refineries and other factories. The Salt Lake Area is the largest industrialized area in the vicinity at the present time. There are now four refineries located at from ten to twenty miles south of Hill AFB. (see R on Fig. I-1). There are two steel mills located along the eastern side of Utah Lake (see S on Fig. I-1) some fifty to sixty miles south of the Base and several ore smelters located in the

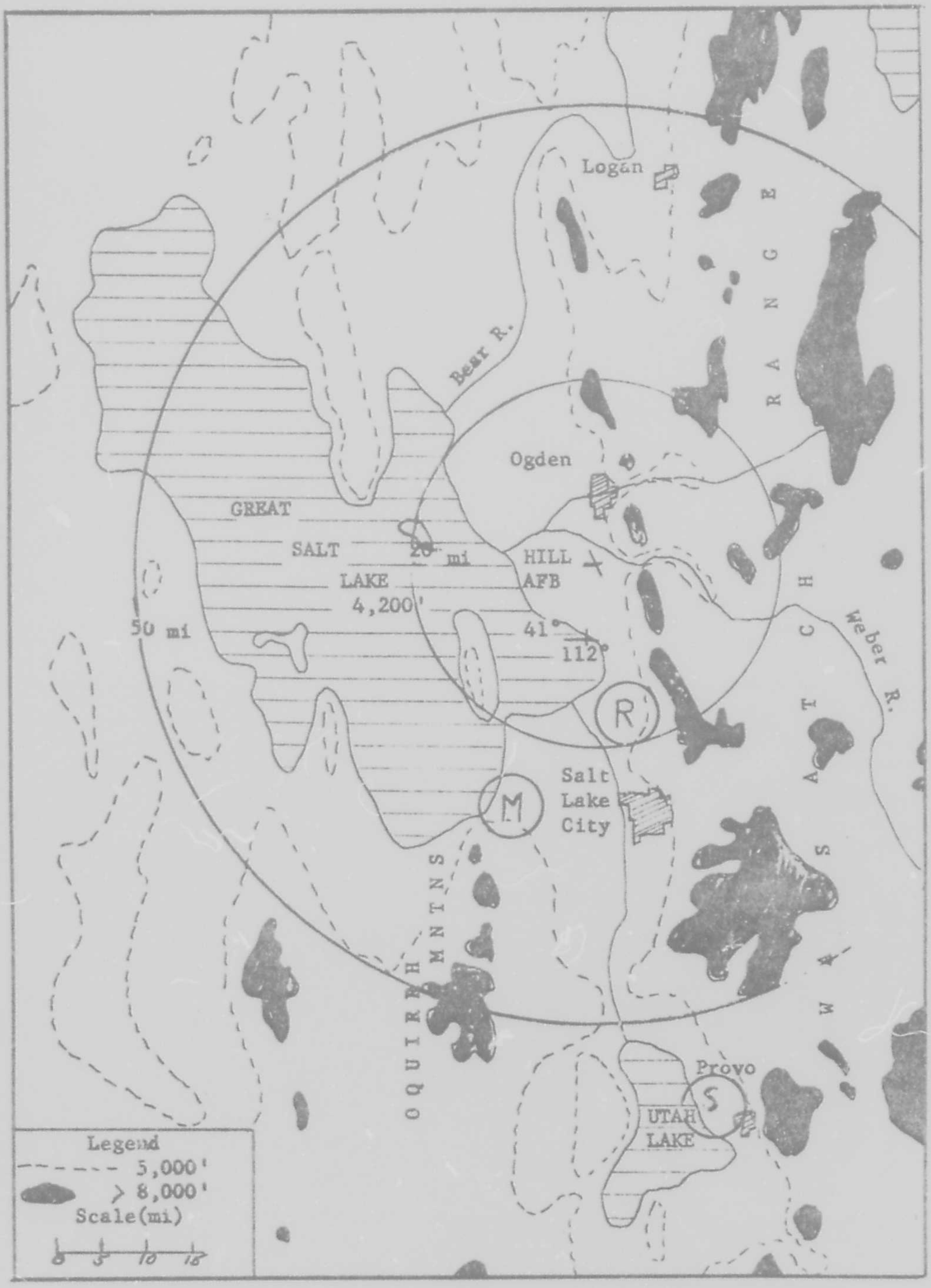


Fig. I-1 Geographic Location of Hill AFB, Utah, in Relation to Surrounding Area.

general vicinity of Salt Lake to the south. In the winter a certain amount of coal and some gas are burned in the area. The result is that when a strong inversion is present over the area a good deal of air pollution and smog is present. Conditions occasionally drop below VFR minimums. Such conditions are especially common during the winter months when the polar basin high dominates the area.

During the summer months the visibility seldom falls below five miles. The summer inversions are almost invariably wiped out during the day and the pollution is dispersed each afternoon. During the winter the inversions sometimes last during the entire day so that one day's accumulation is not eliminated before the next day's accumulation begins to gather. Occasionally the field operations are restricted as a result of a low visibility.

C. Physical Exposure of Station and Meteorological Instruments.

1. Base Weather Station. The Base Weather Station is located in the northwest corner of Building 1, Operations Hanger, Hill AFB, Utah, (see Fig I-2A). The station is one and one half miles south of the primary instrument runway. The Base Weather Station affords a clear view of the weather and surrounding terrain to the north but the view to the south is blocked by the hanger. Measurement of precipitation is the only portion of the surface observations taken from the Base Weather Station. All other parameters are observed from a representative site.

2. Representative Observation Site. Weather observations are taken from the Representative Observation Site (ROS), (see Fig I-2A) which is located 96 feet above the ground on top of the operations hangar. Readouts for the AN/GMQ-11, Wind Equipment; AN/TMQ-11, Temperature Humidity Indicator; AN/GMQ-13, Rotating Beam Ceilometer; GMQ-10B, Transmissometer; FMN-1, RVR Computor; TMQ-15 Wind Indicator; ML-3 Barograph and the ML-102 Barometer are installed at this site. Observations are taken and disseminated from this site 24 hours per day.

3. Physical Location of Sensors.

a. Wind Equipment. AN/GMQ-11 wind transmitters are located near the northern and southern ends of the runway. All weather observations are based on the readouts from the one at the northern end of the runway (see Fig I-2B). However, a TMQ-15 wind transmitter is located adjacent to the east side of the runway, near the mid-field position for measuring Weber Canyon cross winds. For aircraft control purposed tower personnel may select the readout from the transmitter which is most appropriate.

b. The Temperature-Humidity Indicator. The sensor for the AN/GMQ-11, Humidity-Temperature measuring set is located in the runway complex (see Fig I-2B). Readings obtained from this equipment are representative of temperatures throughout the airdrome, including runway temperatures.

c. Rotating Beam Ceilometer. The AN/GMQ-13, Rotating Beam Ceilometer is located 1700 feet from the approach end of runway 14 (see Fig I-2B).

d. Weather Radar. The AN/FPS-77 Weather Radar Antenna, is located approximately 1500 ft southwest of building 1, and is mounted on a 70 ft steel tower. Mountains to the east screen all angles lower than 5 degrees of elevation in this direction. The AN/TPQ-11, Radar Cloud Detector antenna is located on the second floor roof of Building 1.

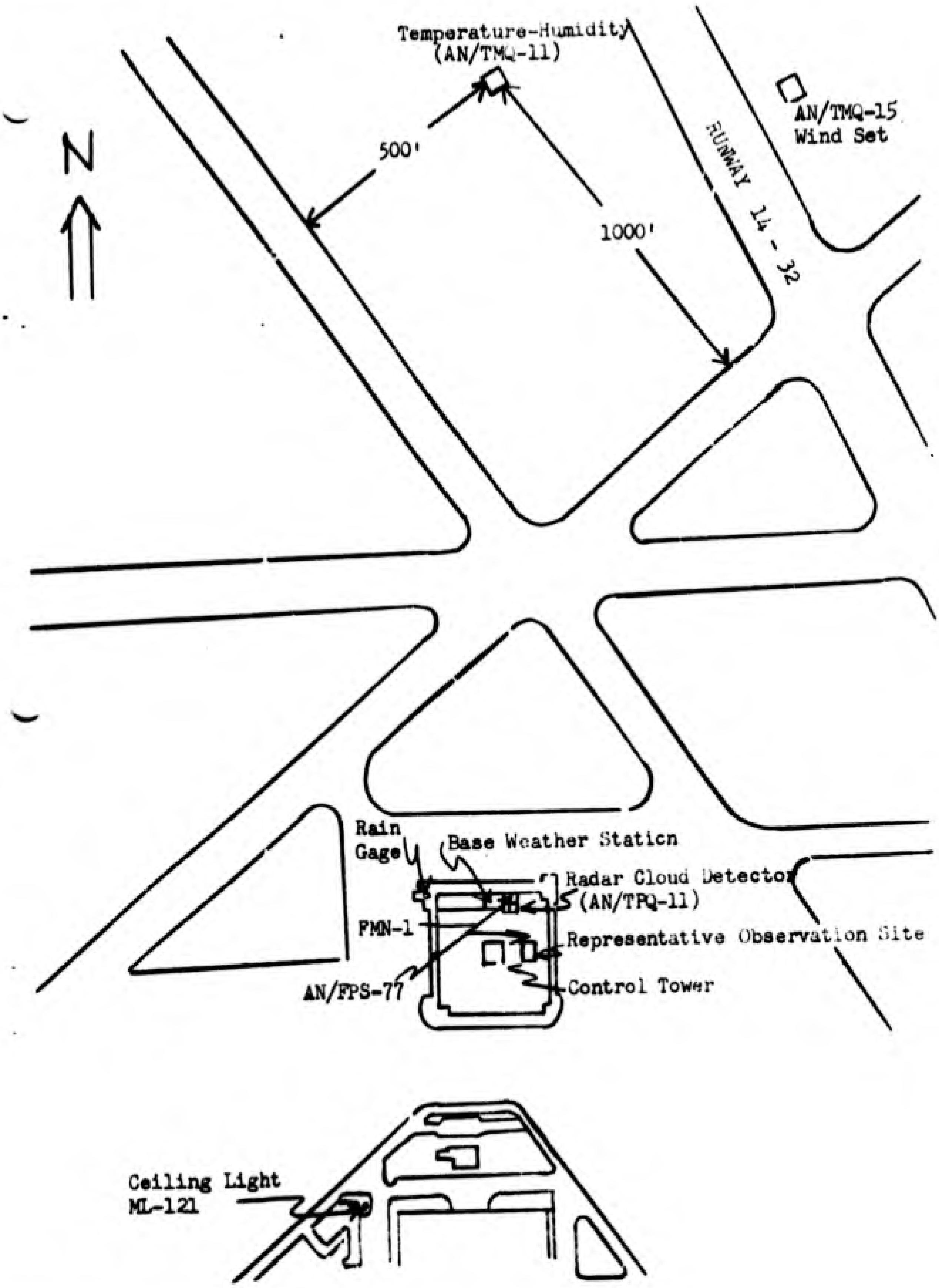


Fig. I-2A Weather Equipment Instrumentation and Location

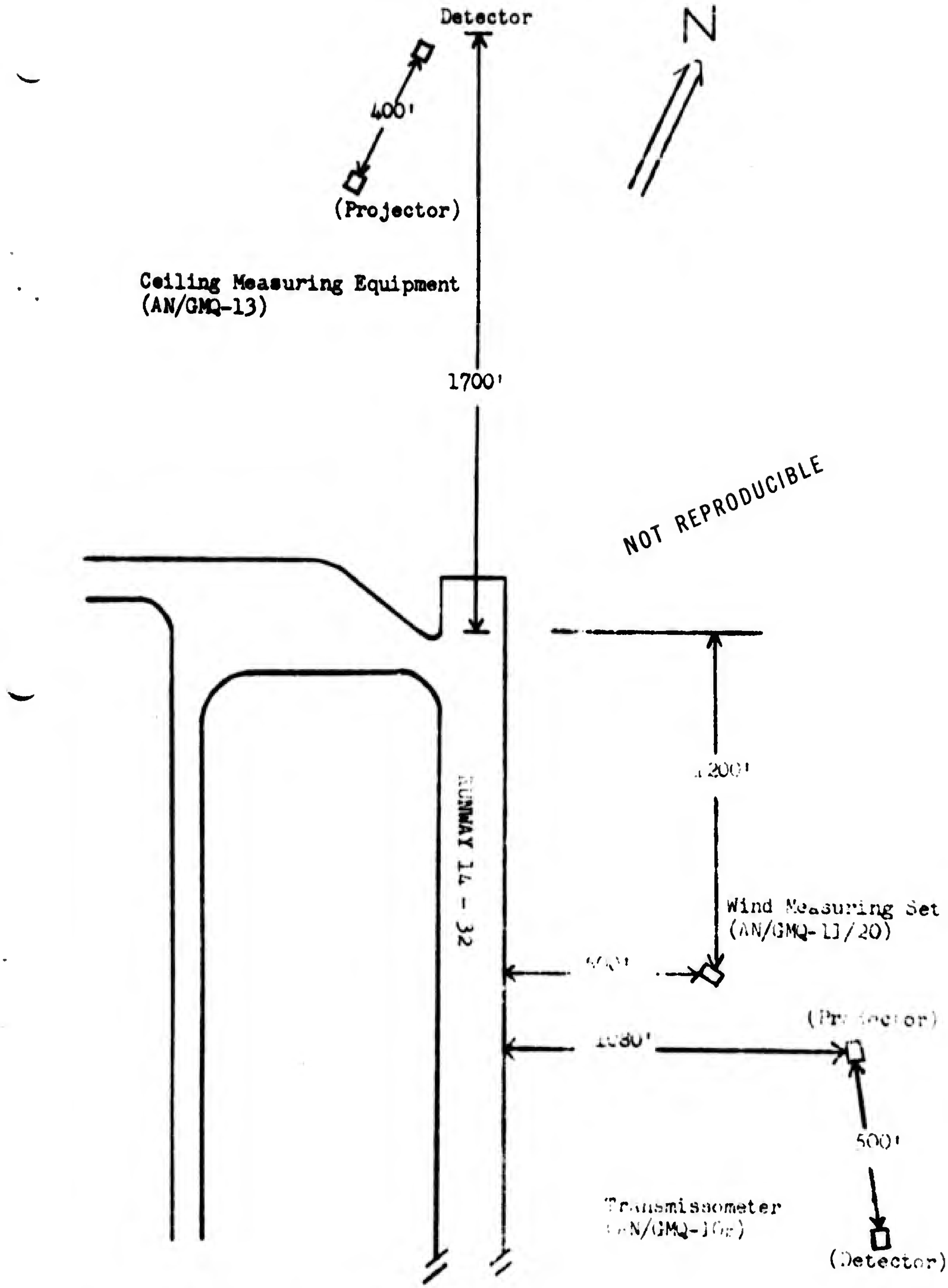


Fig. I-2B Weather Equipment Instrumentation and Location

e. Rain Gage. A standard ML-17, Rain Gage, is located on the top of Building 2, a small building adjacent to the Operations Hangar (see Fig. I-2A). The site is a poor exposure for precipitation measurements but no suitable site is available.

f. Transmissometer. The two small towers holding the projector and receiver of the GMQ-10B Transmissometer for obtaining visibility measurements are located near the northern end of the runway (see Fig I-2B).

D. Terrain Cross-Section.

Diagrams of terrain cross-sections for airway routes from Hill AFB shown in Fig. I-3 through Fig. I-8. The heaviest lines represent the terrain elevations for the center of the airways while the lighter lines indicate the highest terrain within 25 miles either side of the airways.

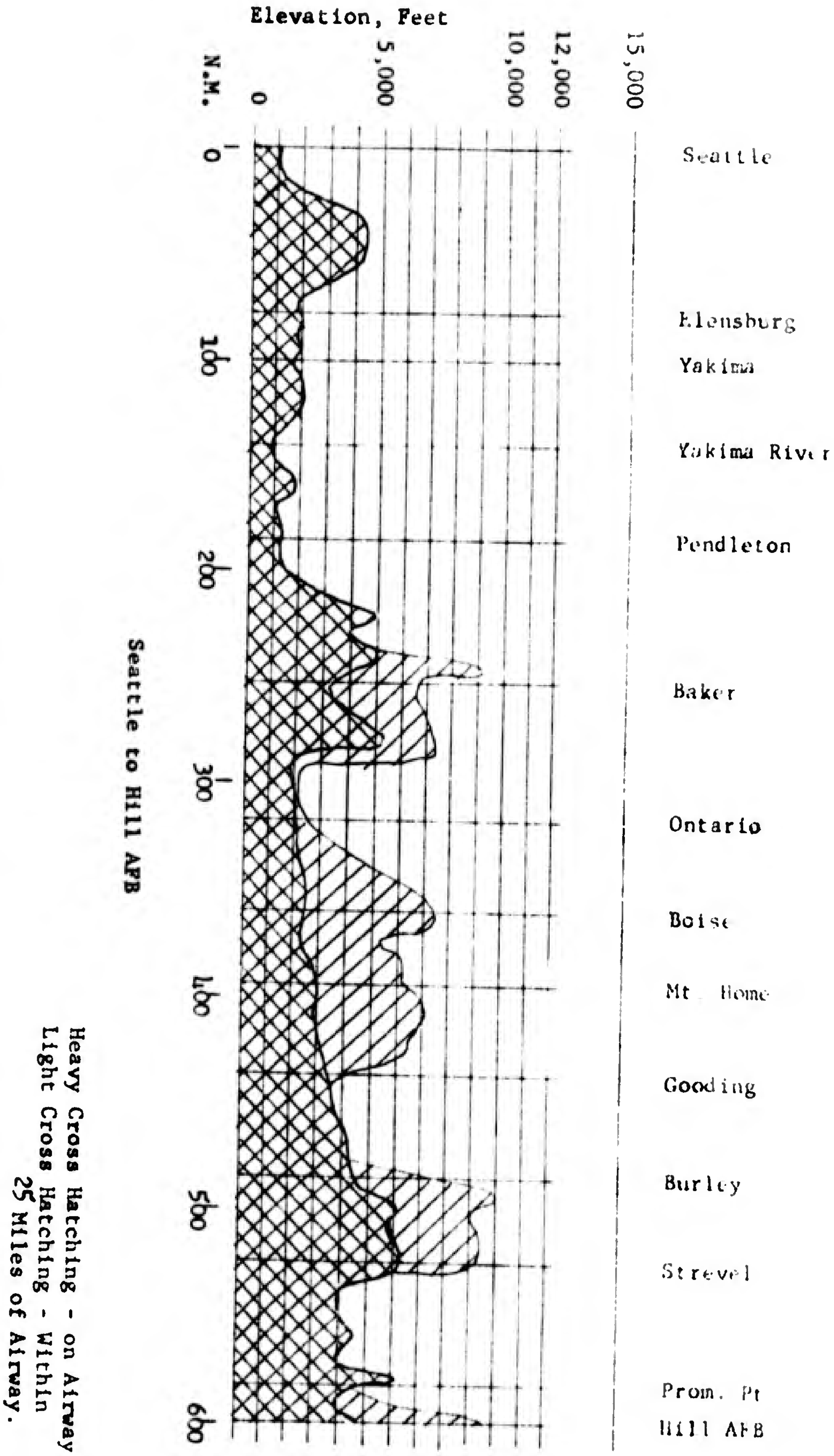
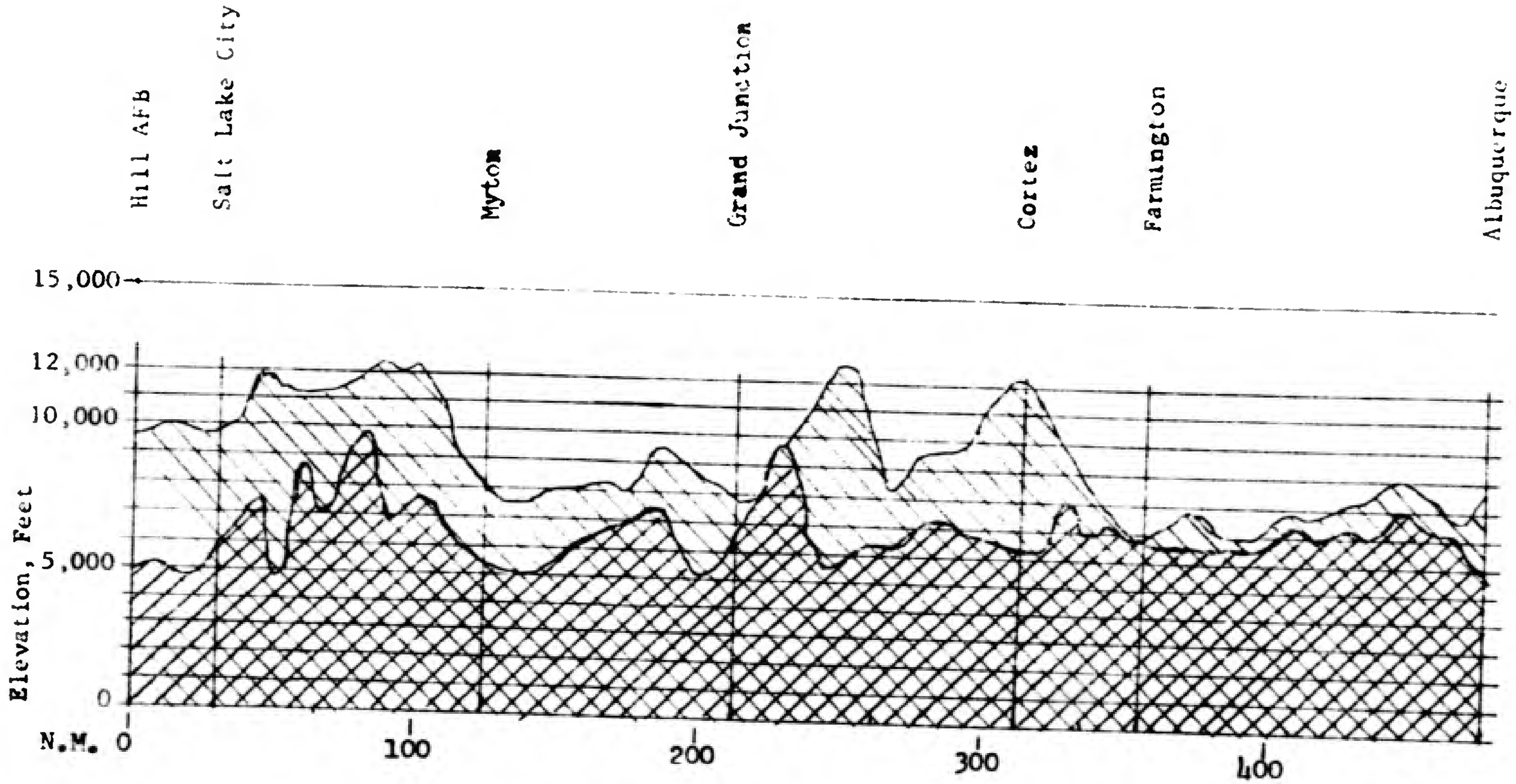


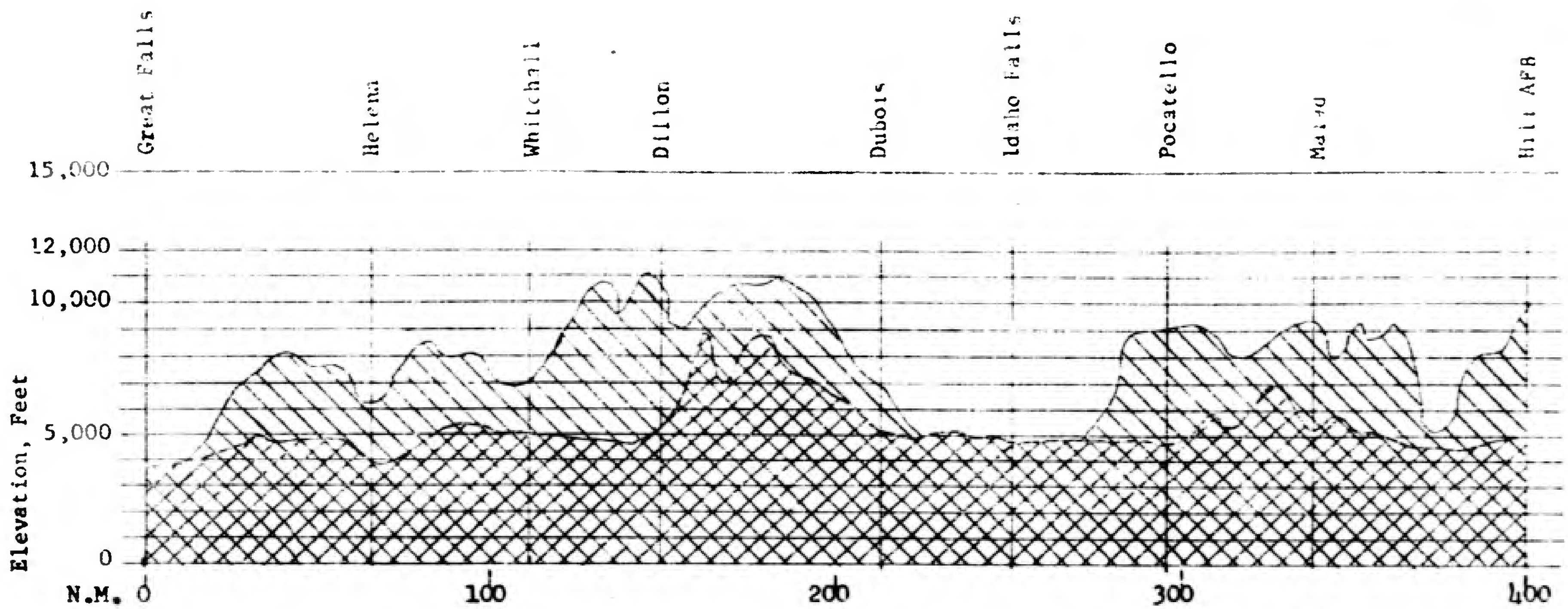
Fig. I-3 Topography Cross Section, Seattle to Hill AFB



Hill AFB to Albuquerque, New Mexico

Heavy Cross Hatching - on Airway.
Light Cross Hatching - Within 25 Miles of Airway.

Fig. I-4 **Topography Cross Section, Hill AFB to Albuquerque, New Mexico**



Great Falls, Montana to Hill AFB

Heavy Cross Hatching - on Airway.
Light Cross Hatching - Within 25 Miles of Airway.

Fig. I-5 Great Falls, Montana to Hill AFB

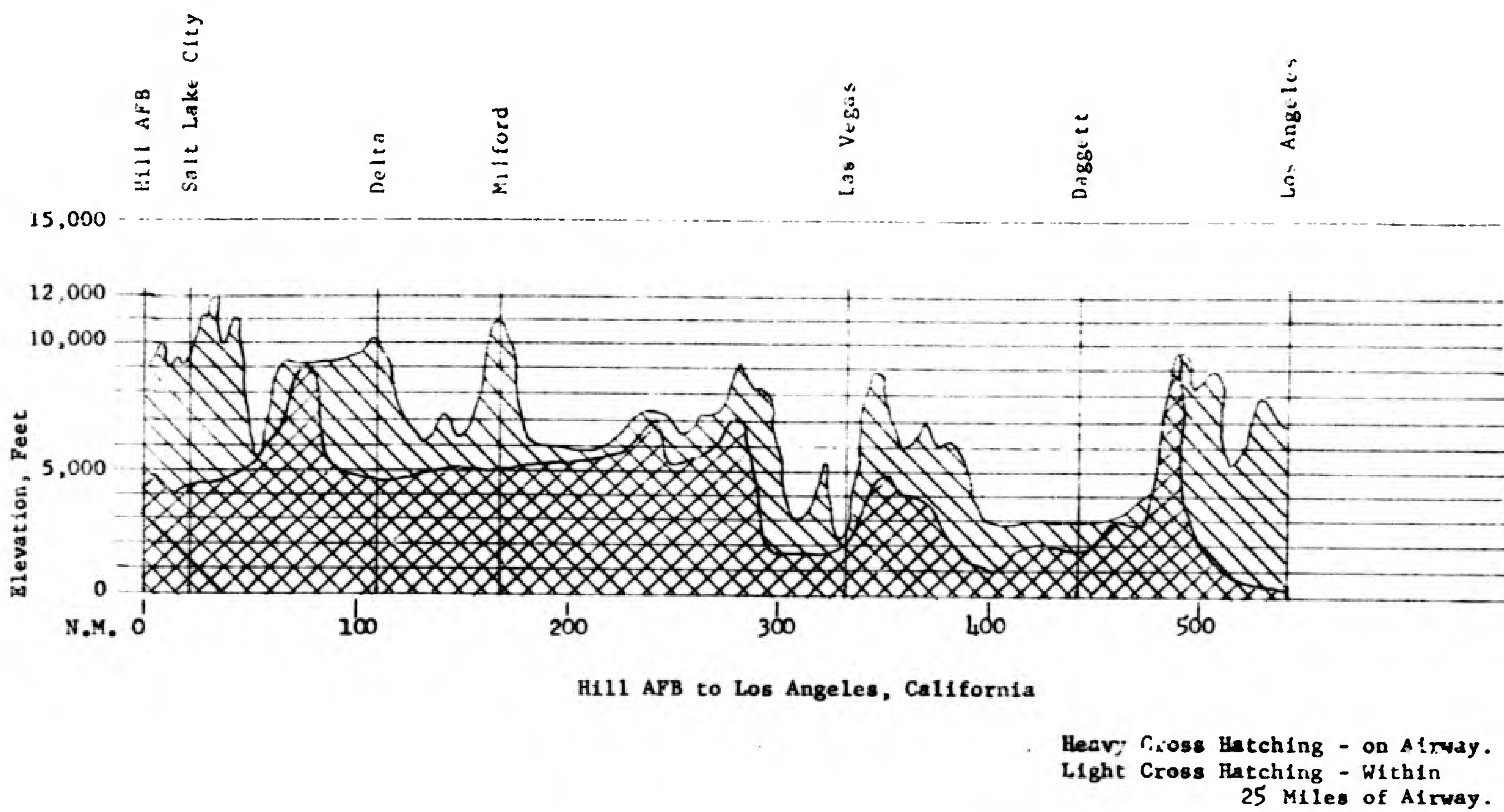


Fig. I-6 Topography Cross Section, Hill AFB to Los Angeles, California

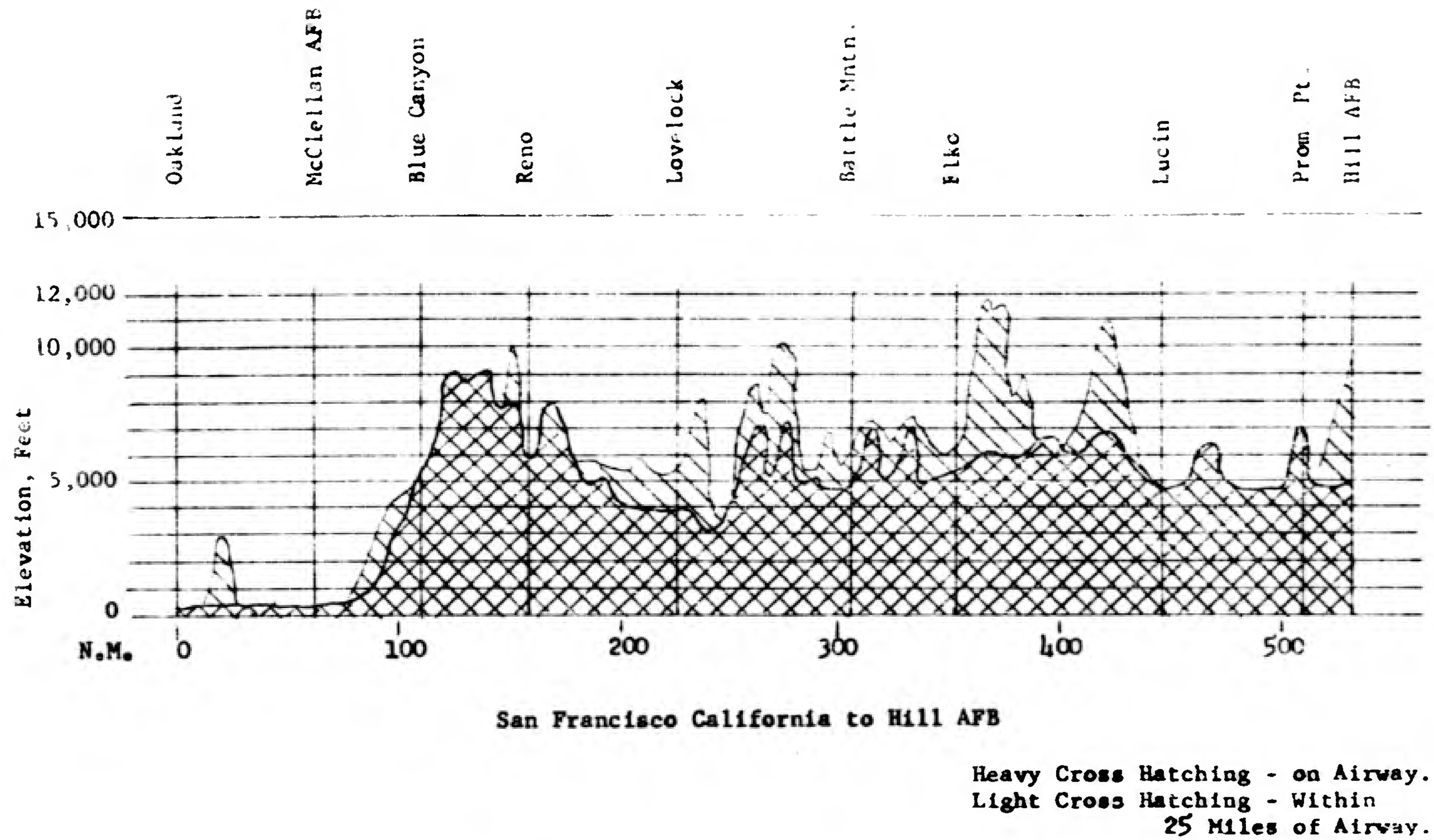


Fig. I-7 Topography Cross Section, San Francisco, California to Hill AFB

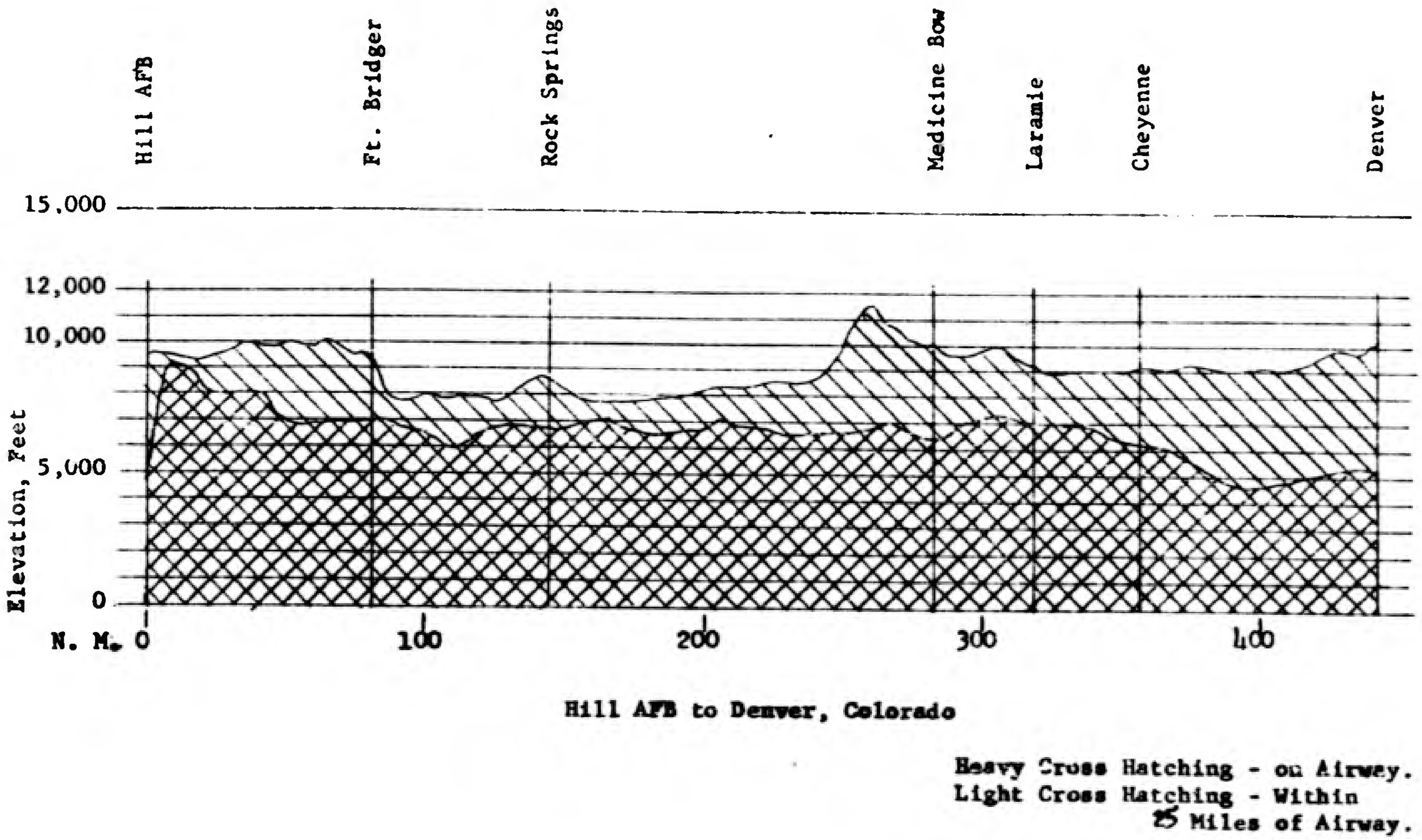


Fig. I-8 Topography Cross Section, Hill AFB to Denver, Colorado

SECTION II

WEATHER CONTROLS

A. Major Synoptic Controls. The major synoptic features controlling the local terminal weather at Hill AFB are the cold fronts and occlusions which move into the area from the west and northwest and upper air "closed-lows" which may or may not be associated with surface systems. The surface frontal systems may move into the area at any time of the year but are least frequent during the late summer months. The occurrence of lows aloft have a maximum in April and a secondary maximum during October with minimums in the summer and winter months. Air mass thunderstorms which form in moist flows, principally from the Gulf of Mexico are frequent during the months of July and August. Moist air originating from the Gulf of Mexico may be an important source of moisture during any period of the year and when present ahead of frontal systems moving into the area lend to the development of adverse weather conditions. The weather patterns associated with frontal systems and the air mass storms often do not follow the "text book" patterns because of the very pronounced and even predominance of orographic influences.

The wave patterns of the upper air control the type of synoptic features which are experienced at Hill AFB. During the winter periods the location of the major trough aloft over the United States is very important. If the major trough aloft is stationary in the Great Basin, continued reoccurrence of adverse weather may be observed. These periods of inclement weather are a result of short waves moving thru the region or the result of the formation of a closed low in Nevada. With the major trough in the central United States, the development of a major ridge over the western states will provide fairly long periods of clear or nearly clear weather unless radiation fog is developed. The Wasatch Range acts as a protective barrier for the area against the intrusion of polar Canadian air. Long periods of poor weather with intensive precipitation may occur with the formation of a long north-east southwest trough aloft over Nevada and California allowing waves off the coast of California to bring considerable instability and moisture into the Hill AFB area.

One synoptic situation which is of unusual importance is the weather that may be associated with the movement of minor upper air waves into the Hill AFB area. Whenever a sufficient amount of moisture is present the waves can produce extremely heavy amounts of precipitation in a very short period of time. The trough may have little or no weather connected with it prior to moving into the Wasatch Range area.

B. Winter. Cold fronts and occlusions (primarily cold types) are the predominate frontal types observed in Utah. Normally the fronts approach the area from the west or northwest. The maximum frequency and intensity of frontal activity is in winter. The air mass ahead of fronts in winter is nearly always a modified polar maritime air mass while that behind the fronts is usually a fresh polar maritime air mass. Occassionally a true polar continental air mass arrives from directly north or from the east.

Record breaking minimum temperature may occur when true polar air does move into the area.

The character and duration of the weather associated with the frontal systems that move in from the west or northwest depends primarily on the nature and movement of the upper air circulation pattern and the amount of moisture rather than the characteristic of the surface structure. The passage of a frontal system is often preceded by middle and high clouds associated with the upper circulation pattern. Such clouds often have the appearance of warm front clouds but warm fronts at the surface are seldom identified. Clearing sometimes occurs immediately preceding the cold front passage. In some cases frontal passages occur as a squall line, but with slow clearing behind the front. Much more frequently clouds form along the mountain tops as a front passes and rapidly build to windward, with precipitation beginning over the valley areas an hour or more after the frontal passage. Precipitation ends with passage of the upper (500 MB and higher) trough line, and complete clearing often takes place within two or three hours of the end of precipitation. The above applies to the areas up to ten to fifteen miles to the west of the mountain ranges. Further out in the valley clouds form slower and dissipate more rapidly and precipitation occurs accordingly. Dry fronts, with only middle and high clouds, often occur.

Winter weather may at times be characterized by the stagnation of the Basin High for periods ranging from a day to two months. The weather may then be characterized by low visibilities and occasionally presisting fog or stratus.

C. Spring. Frontal systems from the west and northwest also occur during the spring months. Characteristics of these frontal passages are similar to those indicated for the winter months except that heavy thunderstorms may occur more frequently immediately preceeding and along the front, and variations across the fronts are not as marked. Cut-off lows (commonly called "cold lows or cold pools") have a maximum frequently during April. Low clouds and precipitation may continue for two days or longer when a cold low persists in the area in contrast to the shorter periods of adverse weather associated with many frontal systems. Most thunderstorms during May occur along fronts or upper air trough lines.

D. Summer. Skies are generally clear or nearly so in the summer except during periods of thunderstorm activity. The most normal air mass during the summer would probably be labled either continental or tropical Pacific from the subsiding Pacific high cell. Frontal passage or cut-off cold lows may occur but are fairly uncommon. Precipitation areas associated with such fronts are either non-existent or consist mostly of thunderstorms. Air mass thunderstorms occur almost entirely during the summer season and practically all thunderstorms seem to occur only when the air over the region has come from the Gulf of Mexico and is fairly moist. Air masses from the south and west seldom have the requisite instability or sufficient moisture. This is not to say that cumulus activity cannot occur in air from the south or west, but, seldom does it produce intensive cumulus activity. The principal reason for this seems to be that it requires extreme heating and addition of moisture to overcome the stabilizing influences of the subtropical Pacific high cell through which this air would have passed before arriving in Utah. Pacific air may develop thunderstorms in the area when it is subject to frontal action as well as orographic lifting. Thunderstorms may also occur when an extensive aera of convergence persists for a number of days off the southwest coast of North America.

E. Fall. The summer thunderstorm period is sometimes followed by a period commonly referred to as "Indian Summer" in September or early October. Often the first heavy winter storm occurs during late September or early October. These early storms often result from the formation of a cold low aloft. In some years the trough aloft may shift from a normal north-south orientation to north east-southwest which may allow waves systems to move into the area from the southwest.

If a closed low aloft occurs in conjunction with surface frontal systems the weather pattern may be much larger than normal and the precipitation over the area much more intense than normal. One feature of the precipitation distribution during such storms is that a ratio of low elevation precipitation to that at higher elevation is much greater than usual. The occurrence of cold lows aloft tends to decrease as winter approaches and the weather patterns associated with frontal systems are more normal.

F. Weber Canyon Winds. This weather phenomenon is of importance to all seasons. The Weber Canyon serves as an air drainage channel from some 6,000 square miles starting initially at seven to eight thousand feet above sea level. These canyon winds are the result of air drainage from the large basin and/or results from the circulation pattern of the synoptic situation. In some cases extremely strong easterly winds are observed in the area of Hill Air Force Base which are induced by very strong pressure gradients and air flow may be observed over the entire Wasatch Range rather than only through the canyons. Rules for forecasting these unusual winds are listed in Section IV, Emperical Forecasting Rules.

SECTION III

CLIMATIC AIDS

A. <u>General Climate.</u>

The climate of the Hill AFB area is semi-arid continental, with four well defined seasons. The summers are characterized by hot dry weather. However, low humidity makes these high temperatures more bearable than in more humid regions. Winters are cold, but usually not severe.

The climate of the area is determined by the distance from the equator, its elevation above sea level, the location with respect to the average storm paths and its distance from principle moisture sources, mainly the Pacific Ocean and the Gulf of Mexico. In addition, the mountain ranges over the western United States have a marked influence on the climate. The Great Salt Lake, which never freezes over, tends to moderate the temperatures of cold winds blowing from the west and northwest.

The annual precipitation at the station averages 18.80 inches with the largest monthly totals occurring in the winter and early spring months. Precipitation in the area of Hill AFB varies from near 5 inches per year over the Great Salt Lake Desert to near 60 inches per year over the high mountains near Salt Lake City, Utah.

B. <u>Climatic Aids.</u>

1. Temperature.

A graph of the mean daily maximum, mean daily minimum and mean daily temperatures by months is shown in Figure III-1. Extreme maximum and minimum temperatures recorded for each month are also shown.

2. Precipitation.

Figure III-2, Mean Monthly and Record Monthly Precipitation, shows the variation in Monthly mean precipitation and maximum and minimum observed precipitation amounts for each month. The mean monthly values given on the graph are newly computed values based on approximately 25 years of data. The mean number of days with measurable precipitation data shown on the graph points out that the highest number of days with measurable precipitation occurs during the winter and early spring months.

3. Snowfall and Snow-depth.

The mean monthly snowfall and snowdepth values are given by the bar graphs on Figure III-3. Greatest amount of snowfall in one day has been over 10 inches while the greatest depth on the ground has exceeded 37 inches. Figure III-3a depicts percentage frequency $\geq 1\frac{1}{2}$", by month.

4. Thunderstorm Occurrence.

Figures III-4 and III-4a incorporate several statistical data on thunderstorms, wind gusts and hail occurrence. The time of occurrence of the first thunderstorm each day (after 0800 LST) has been used to develop the graph. Most graphs of this type are based on the occurrence of thunderstorms by hours rather than the time of occurrence of the first reported thunderstorms each day. It is believed that the first thunderstorm is the most important one from an operational viewpoint.

5. Wind.

a. The annual wind rose for Hill AFB, Utah, is shown in Figure III-5. The high percentage of winds from the east reflect the influence of Weber Canyon winds on the base. However, adverse weather conditions occur with the highest frequency with wind directions of southerly or northerly. Figures III-5a thru f are wind roses, by month for speeds less than 11 knots and equal to or greater than 11 knots.

6. Flying Weather.

a. The following data indicates that Hill AFB is IFR approximately 15% of the time during the "poorest weather months", and below minimums only 4% of the same period.

Percentage Frequency of Occurrence

Criteria: $\geq$ 200 ft vs $\geq$ 1/2 miles

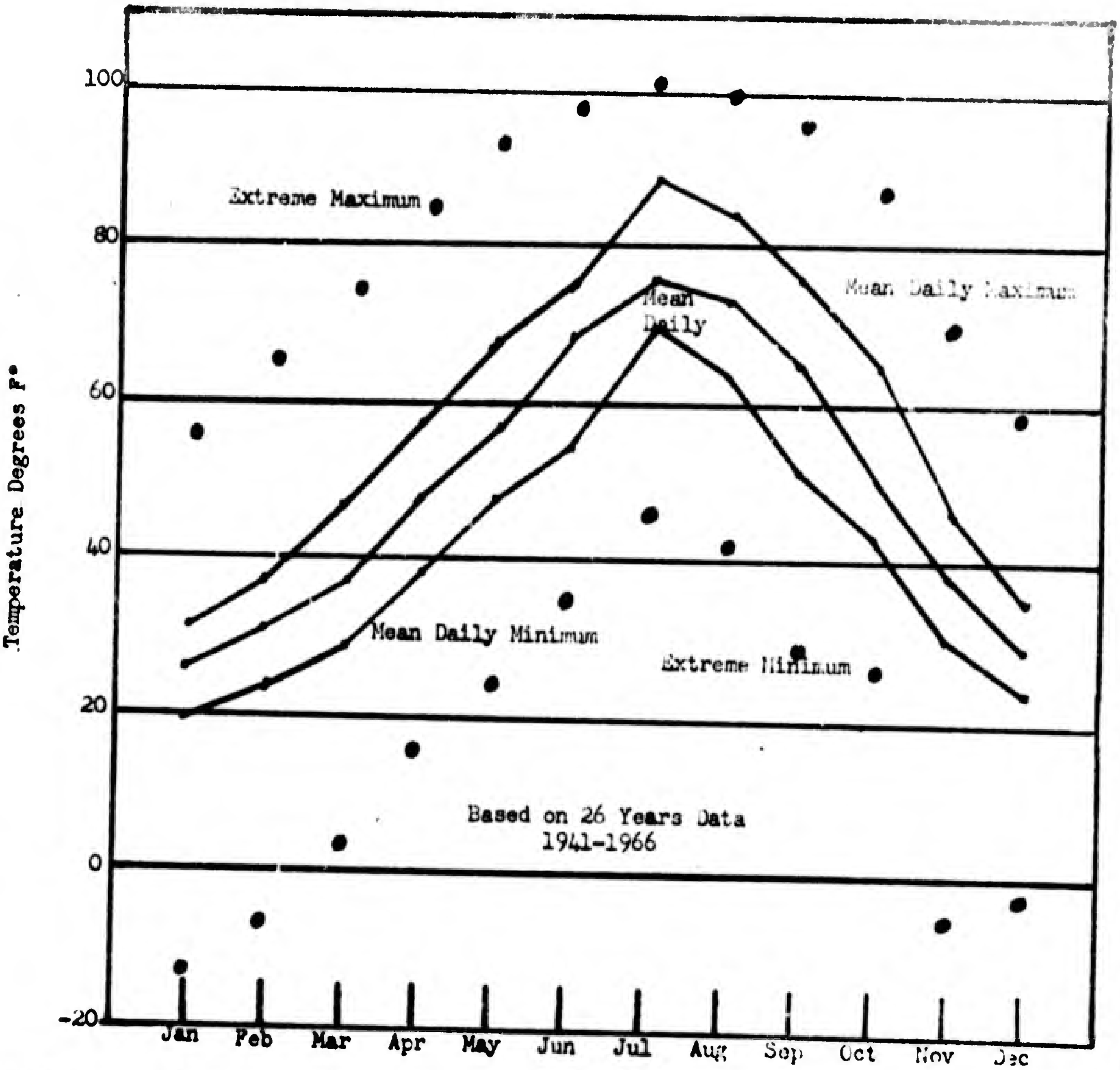
Dec	95.2%	Total Observations	19,312
Jan	96.8		19,272
Feb	97.7		17,291

Criteria: $\geq$ 1500 ft vs $\geq$ 3 miles

Dec	82.2%	Total Observations	19,312
Jan	84.6		19,272
Feb	89.2		17,291

The longest and most significant periods of below minimums and below VFR respectively, occur only during Dec, Jan and Feb. The preponderance of these low ceilings and/or obstructions to vision are caused by falling snow or fog, or a combination.

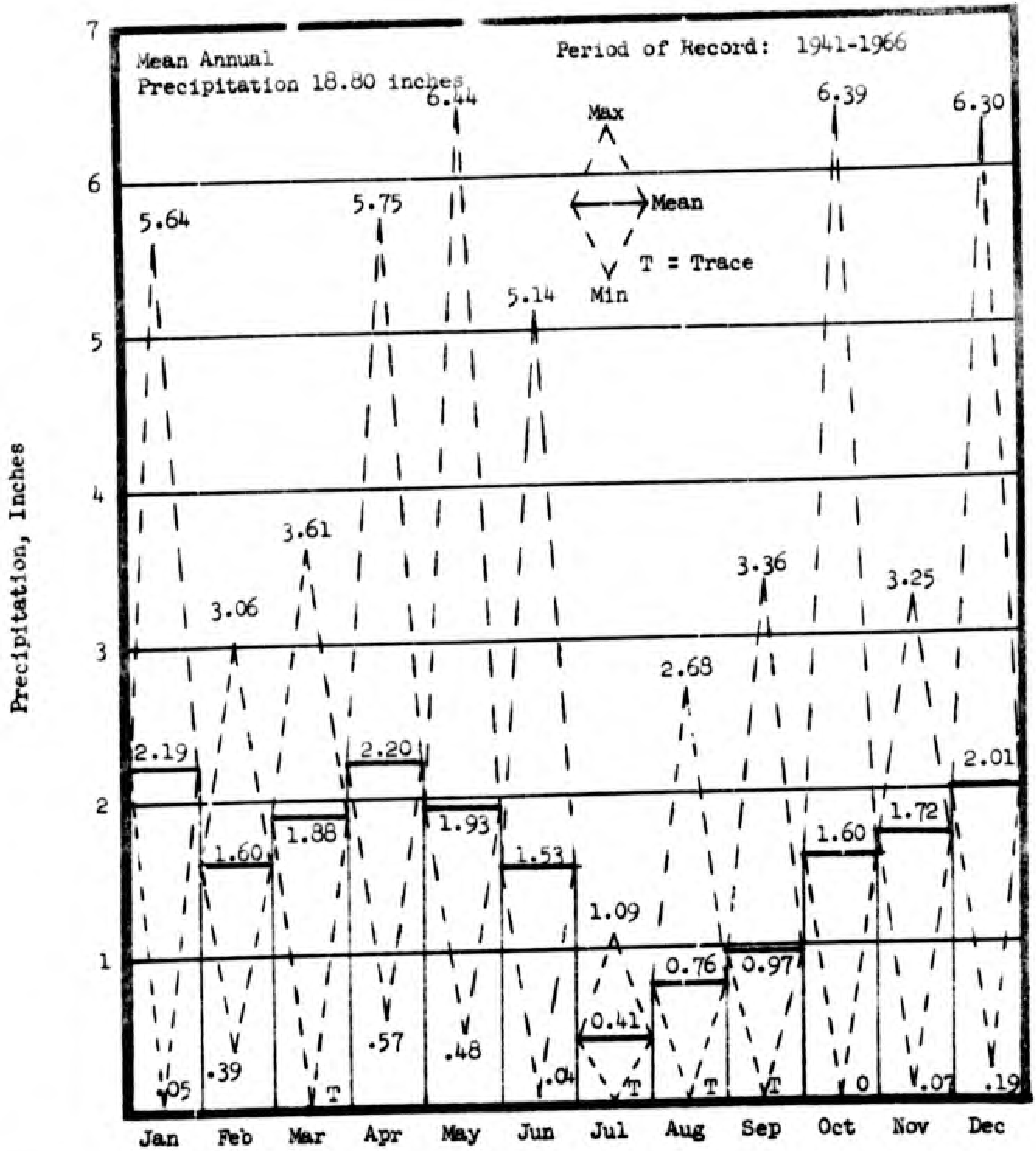
Intelligent use of Persistence Probability Tables will provide guidance in forecasting the duration of the above categories.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Extreme Max	56	65	73	83	91	99	100	99	97	88	70	58
Mean Daily Max	33	38	46	58	68	77	86	85	76	63	46	37
Mean Daily	27	31	38	48	58	66	76	74	64	53	39	30
Mean Daily Min	20	24	29	39	47	54	64	62	53	43	31	25
Extreme Min	-13	-6	3	18	24	36	46	39	28	26	-[illegible]	-[illegible]

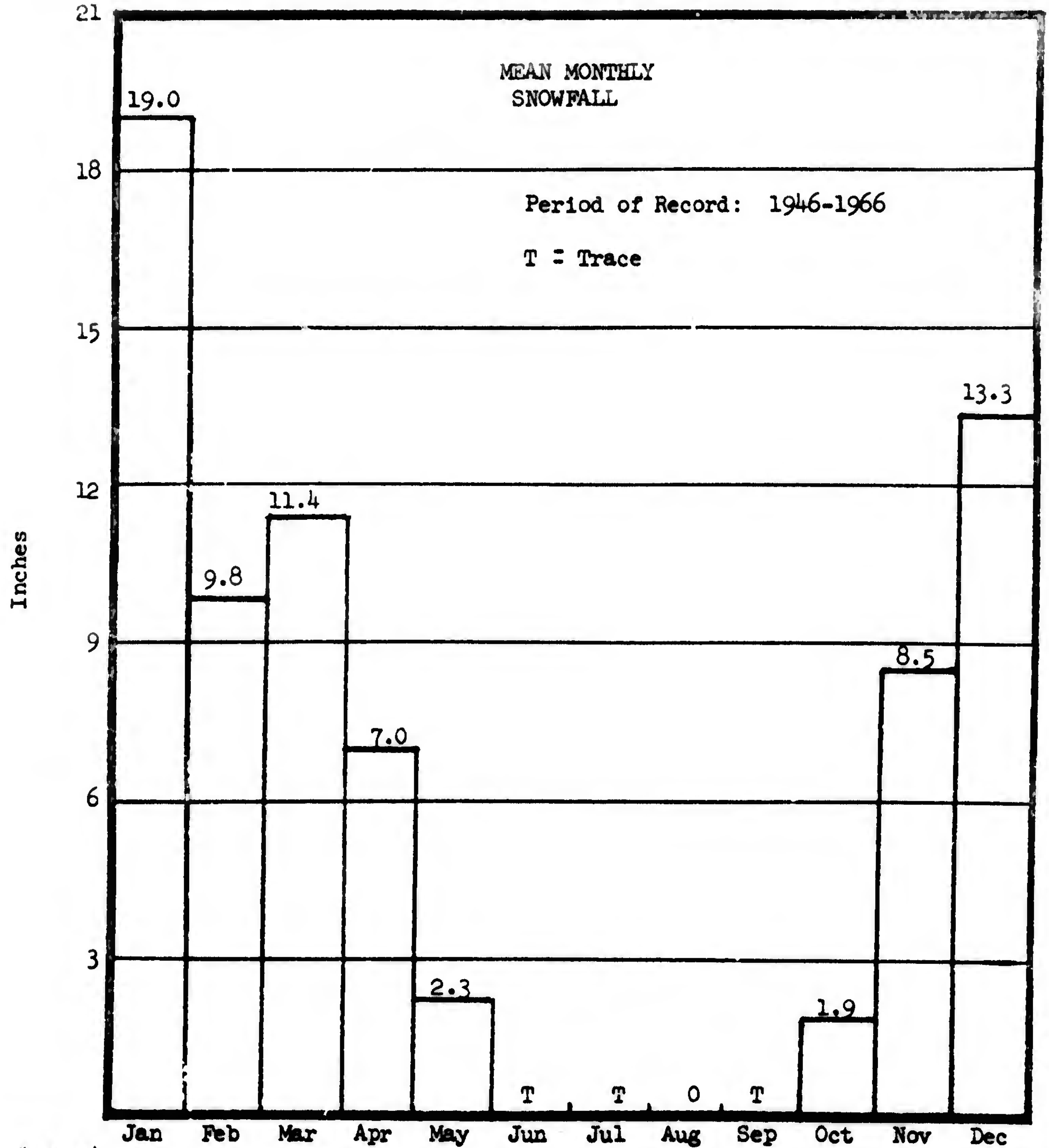
Mean Annual Temperature 50.2° F.

Fig. III-1 Mean and Extreme Daily Temperature Data by Months, Hill AFB, Utah



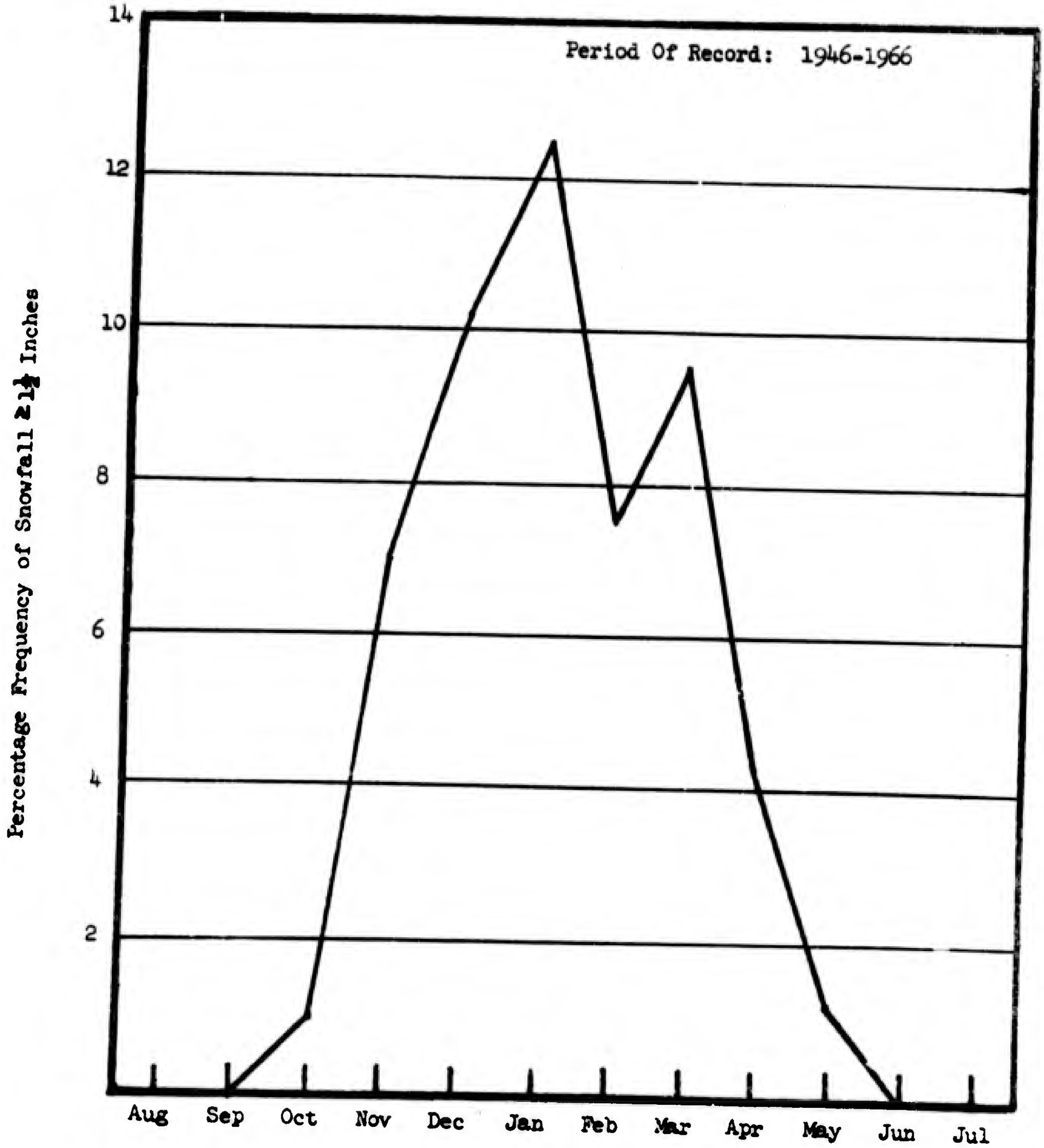
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean # Days with Measurable Precip.	10	8	9	8	8	5	3	4	4	6	8	9

Fig. III-2 Mean Monthly and Record Monthly Precipitation



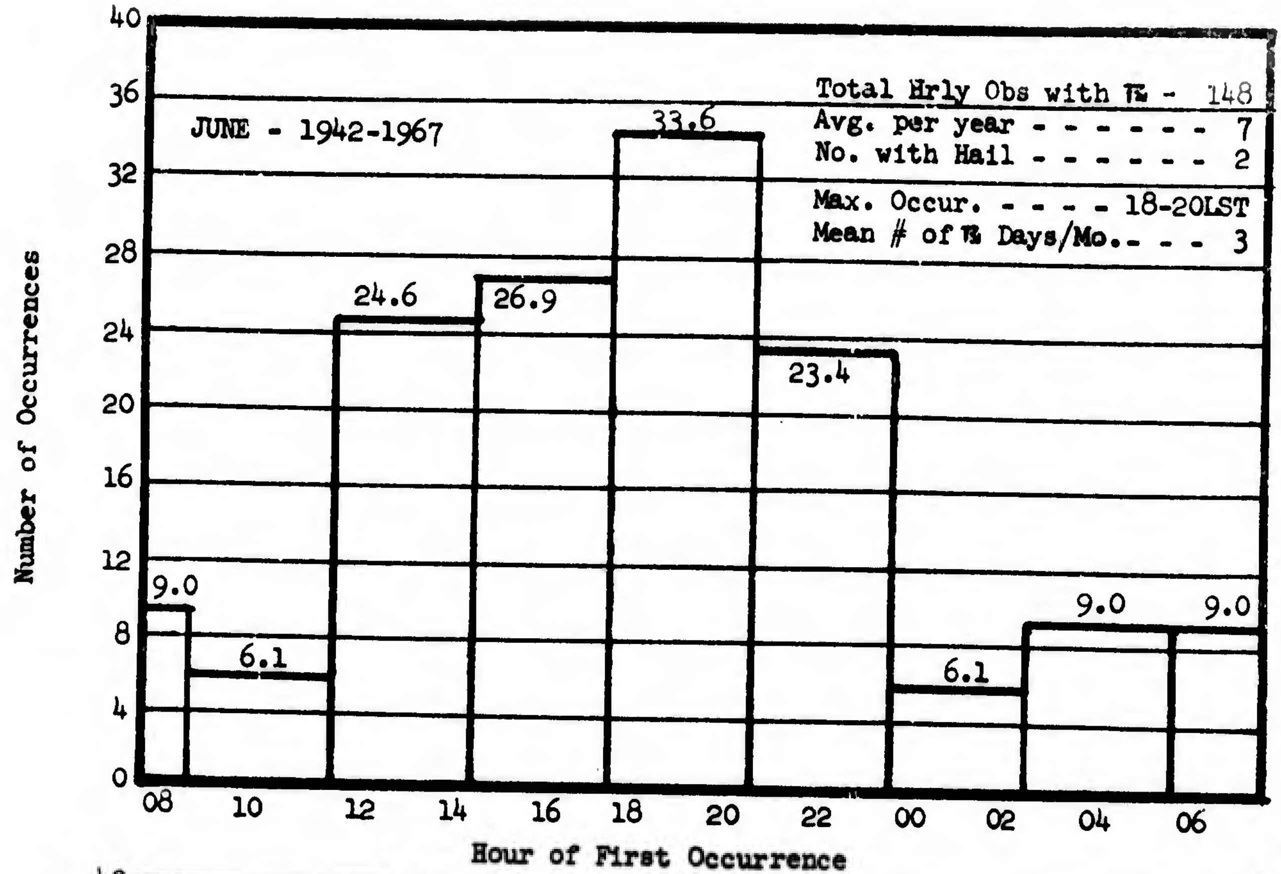
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean # Days with measurable Snow Depth	21.2	16.9	10.8	2.0	0.3	0.0	0.0	0.0	0.0	0.4	6.1	12.1
Mean # Days with Measurable Snowfall	9.1	5.9	6.4	3.4	0.6	0.0	0.0	0.0	0.0	0.7	4.3	7.0

Fig. III-3 Snowfall and Snow Depth Data, Hill AFB, Utah



Percentage Frequency of Snowfall ≥ 1½ Inches for Each Month
(From Daily Observations)

Figure III-3a



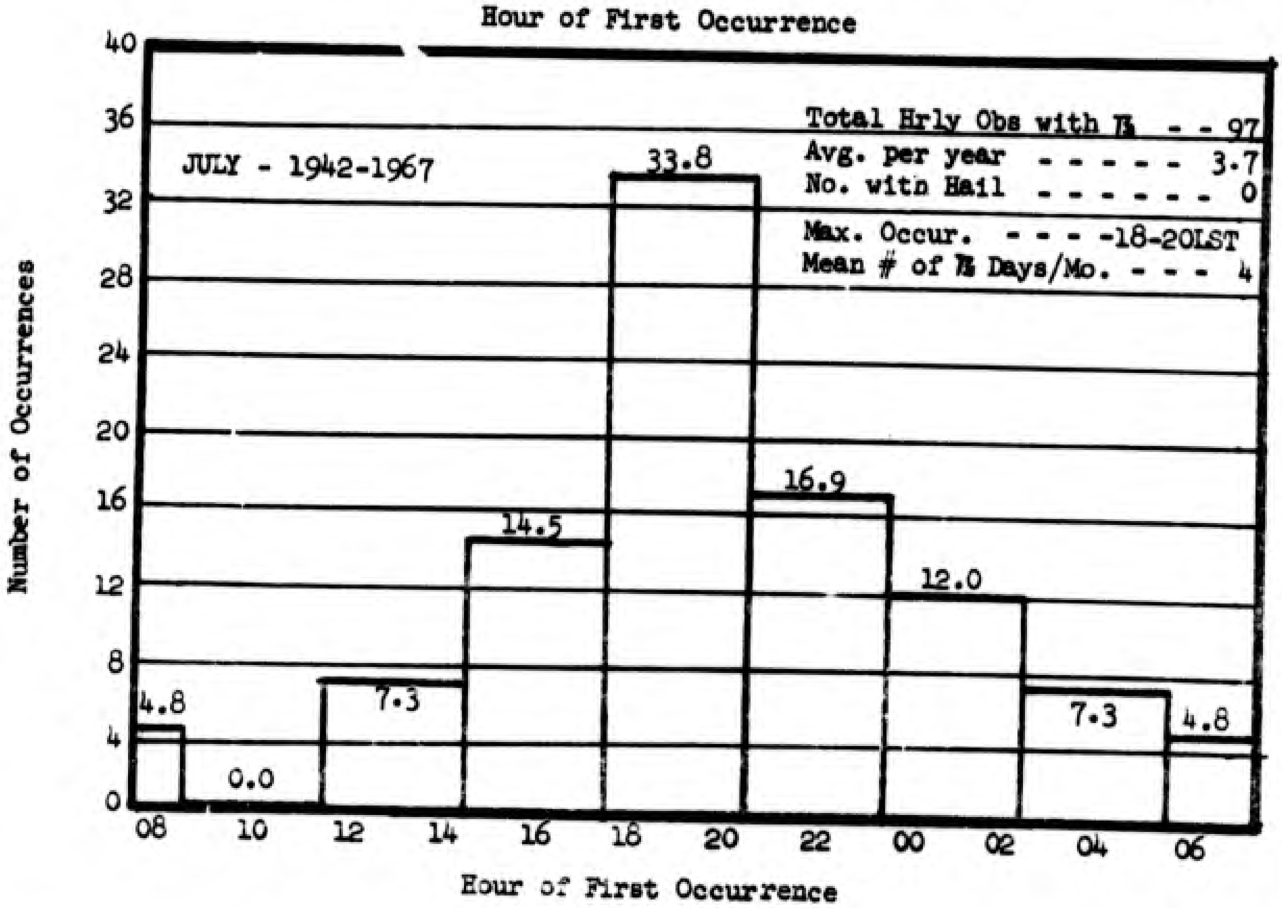


Fig. III-4 Number of Thunderstorms during June and July by Hours of Occurrence.

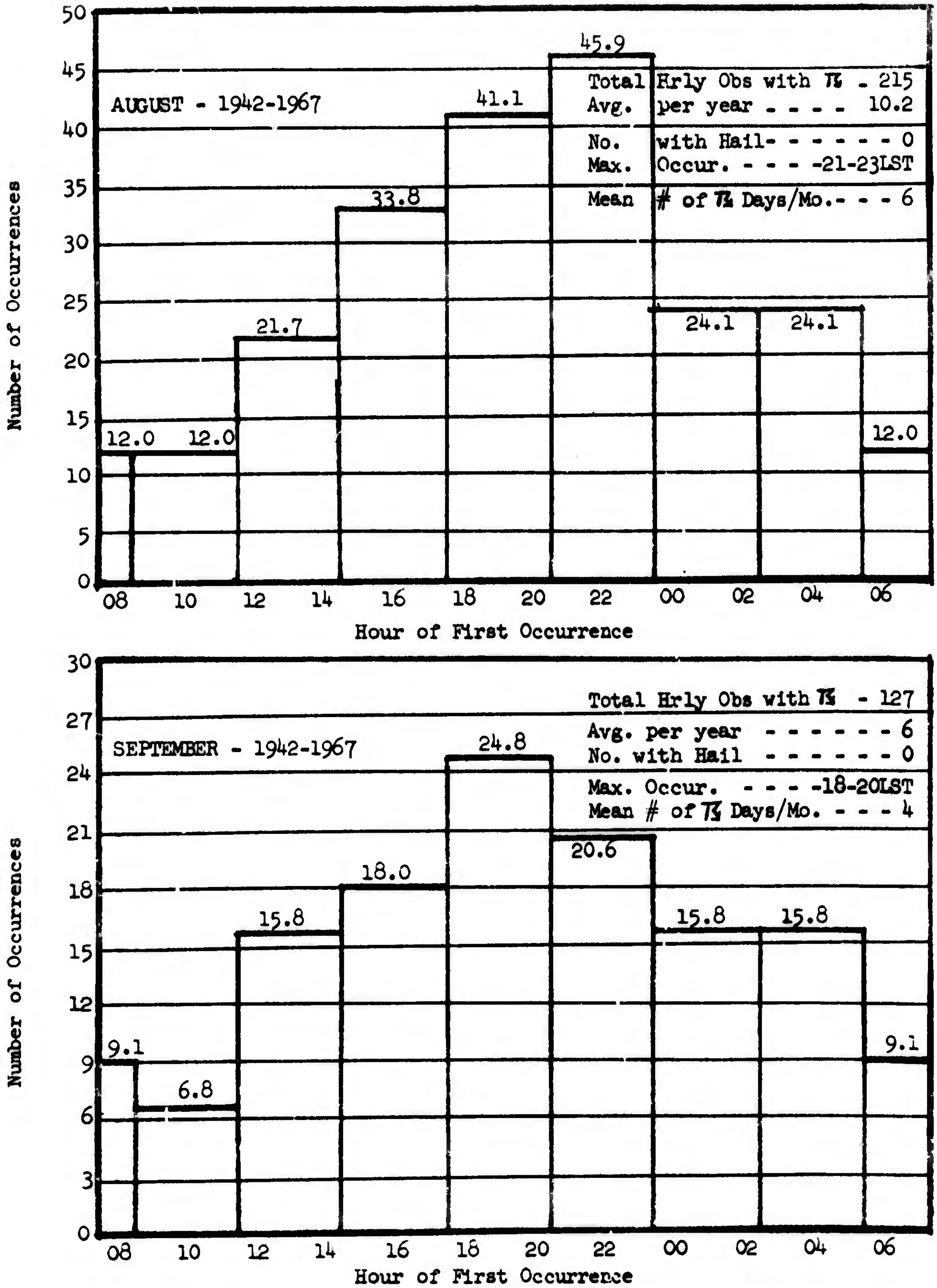
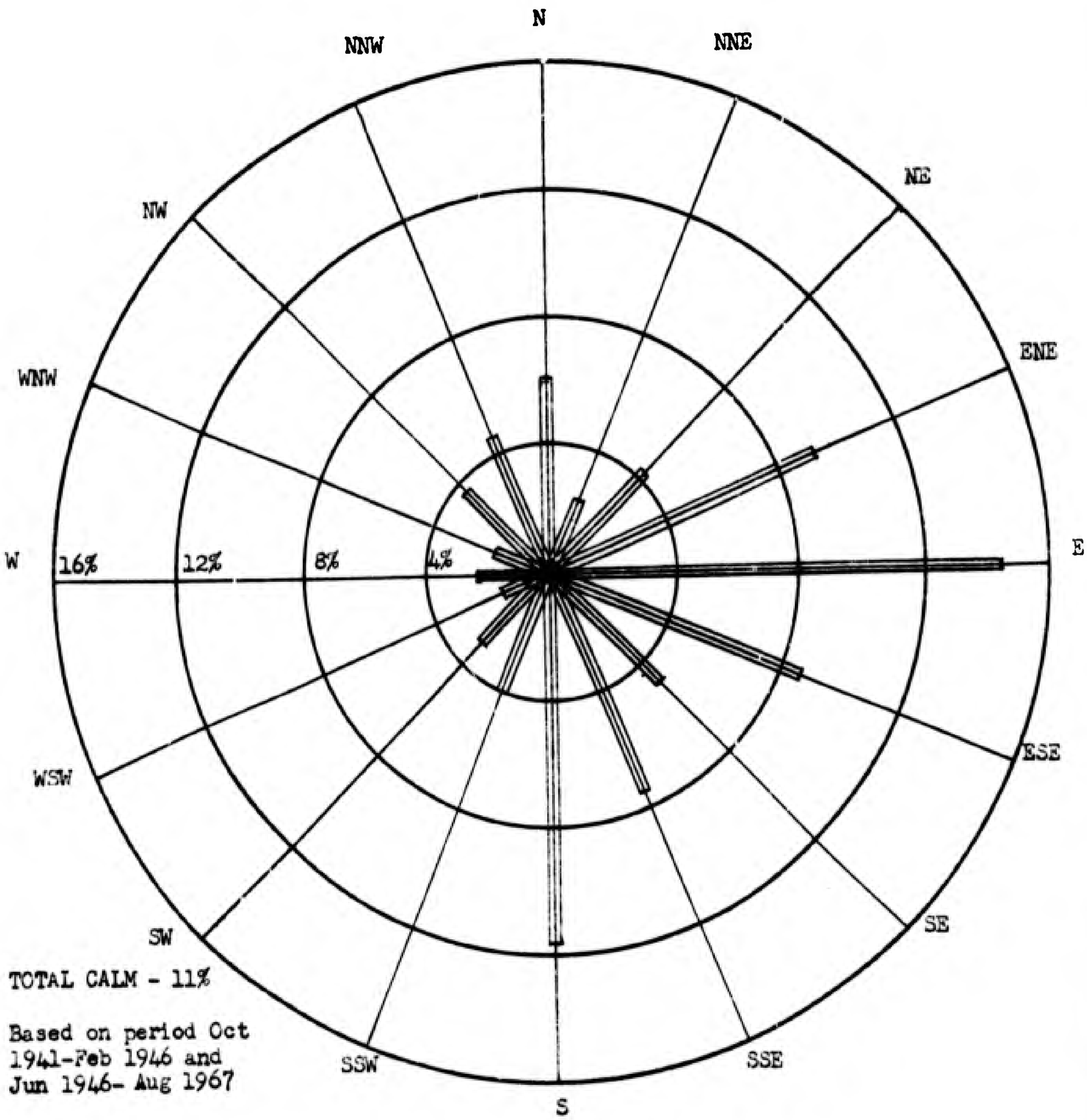


Fig. III-4a Number of Thunderstorms during August and September by Hours of Occurrence.

HILL AIR FORCE BASE, UTAH
WIND ROSE
(PERCENTAGE FREQUENCY OF WIND DIRECTION & ALL SPEEDS)



TOTAL CALM - 11%

Based on period Oct 1941-Feb 1946 and Jun 1946- Aug 1967

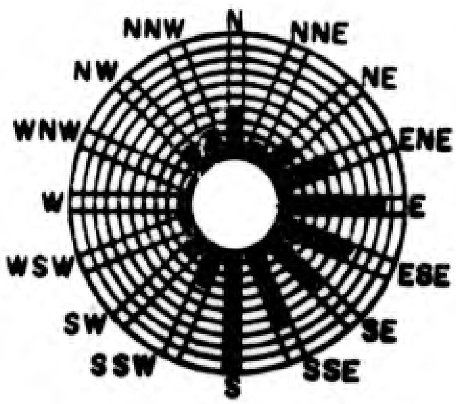
Total Number of Observations: 224,172

Fig. III-5 All Months, All Hours

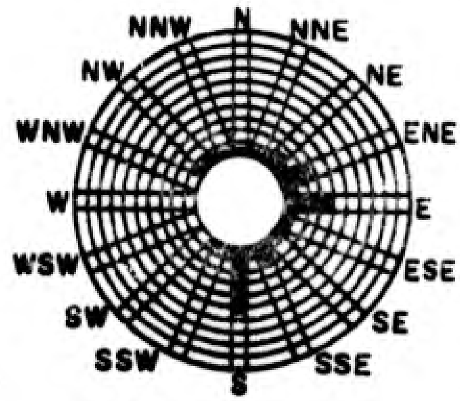
SURFACE WINDS

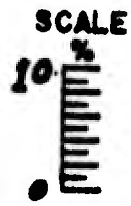
HILL AFB, UTAH - Years 42-67 (All hours combined)

LESS THAN 11 KTS (63.1%)



EQUAL TO/GREATER THAN 11 KTS (19.0%)



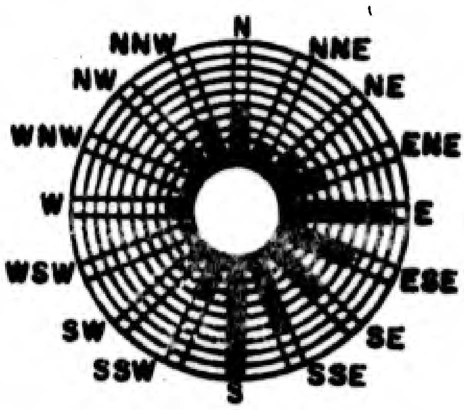


CALM (17.9%)

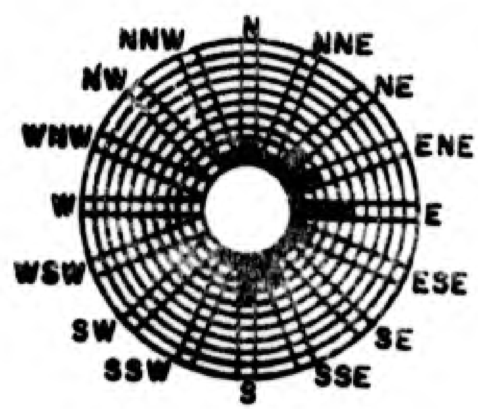
MONTH: JAN

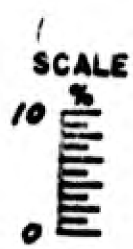
SURFACE WINDS

LESS THAN 11 KTS (64.5%)



EQUAL TO/GREATER THAN 11 KTS (22.4%)





CALM (13.1%)

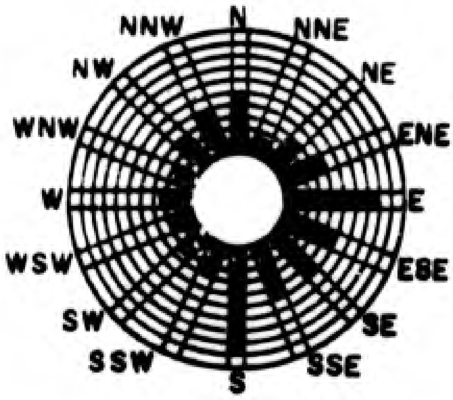
MONTH: FEB

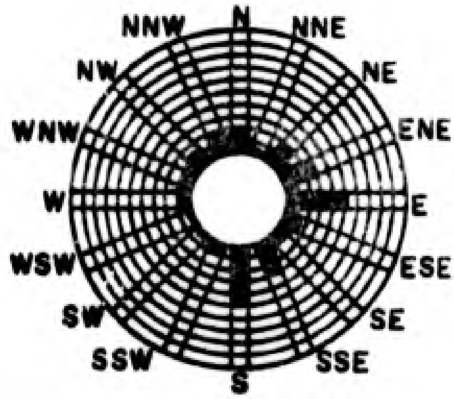
Figure III-5a Jan & Feb

SURFACE WINDS

HILL AFB, UTAH - Years 42-45, 47-67 (All hours combined)

LESS THAN 11 KTS (63.0%) EQUAL TO/GREATER THAN 11 KTS (27.0%)

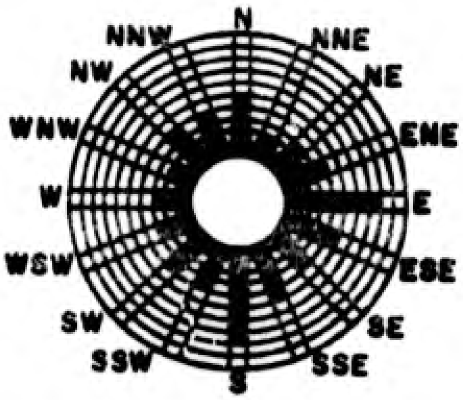


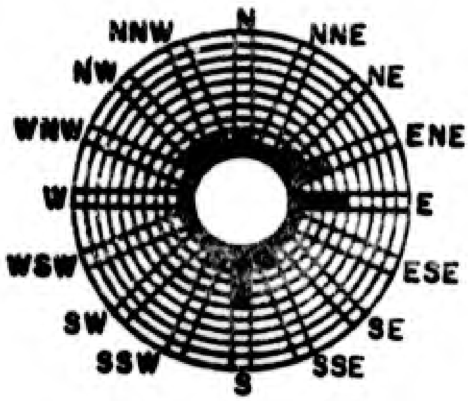


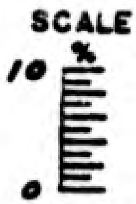
CALM (10.0%) MONTH: MAR

SURFACE WINDS

LESS THAN 11 KTS (63.8%) EQUAL TO/GREATER THAN 11 KTS (27.5%)







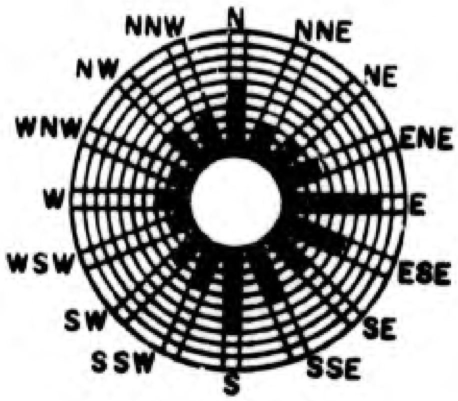
CALM (8.7%) MONTH: APR

Figure III-5b Mar & Apr

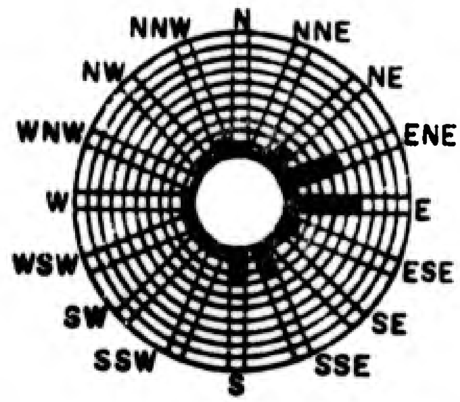
SURFACE WINDS

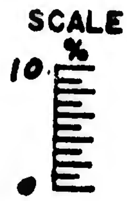
HILL AFB, UTAH - Years 42-45, 47-67 (All hours combined)

LESS THAN 11 KTS (63.6%)



EQUAL TO/GREATER THAN 11 KTS (27.9%)





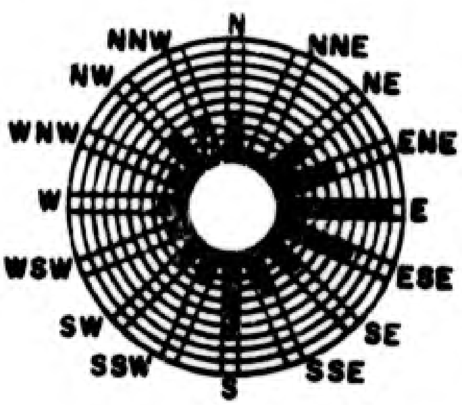
CALM (8.5%)

MONTH: MAY

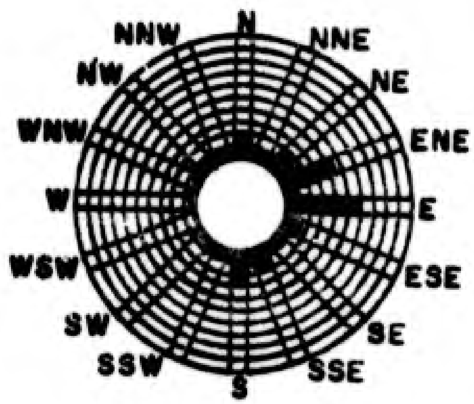
SURFACE WINDS

Years - 42-67

LESS THAN 11 KTS (65.4%)



EQUAL TO/GREATER THAN 11 KTS (26.7%)



CALM (7.9%)

MONTH: JUNE

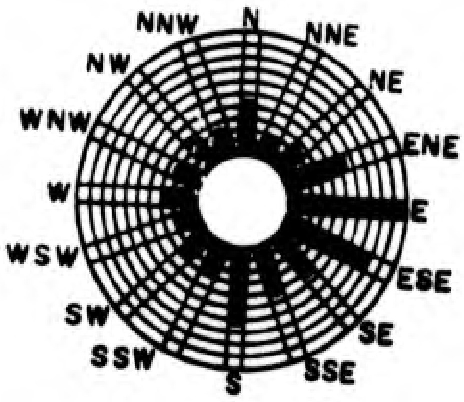
Figure III-5c May & June

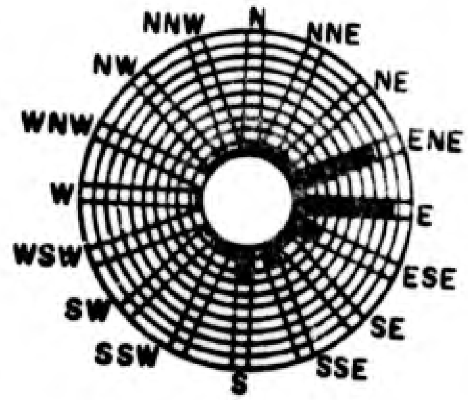
SURFACE WINDS

HILL AFB, UTAH - Years 42-67 (All hours combined)

LESS THAN 11 KTS (64.3%)

EQUAL TO/GREATER THAN 11 KTS (28.7%)





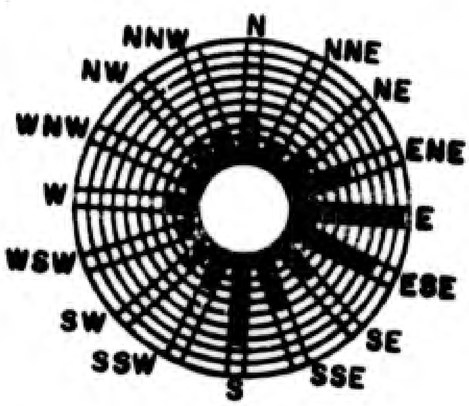
CALM (7.0%)

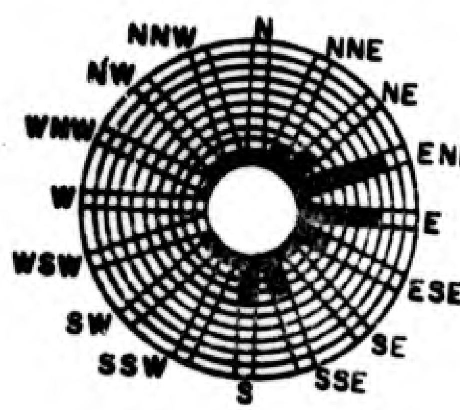
MONTH: July

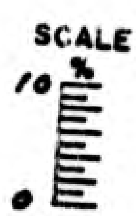
SURFACE WINDS

LESS THAN 11 KTS (64.3%)

EQUAL TO/GREATER THAN 11 KTS (29.5%)







CALM (6.2%)

MONTH: Aug

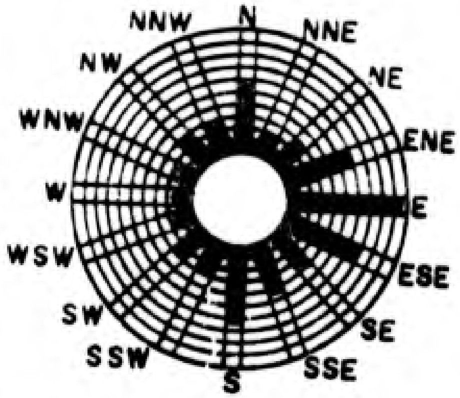
Figure III-5d Jul & Aug

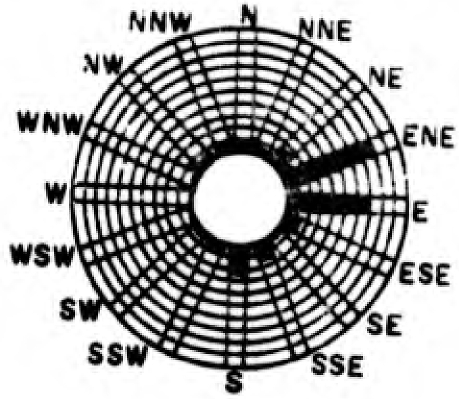
SURFACE WINDS

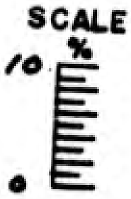
HILL AFB, UTAH - Years 42-66 (All hours combined)

LESS THAN 11 KTS (64.4%)

EQUAL TO/GREATER THAN 11 KTS (26.2%)







CALM (9.4%)

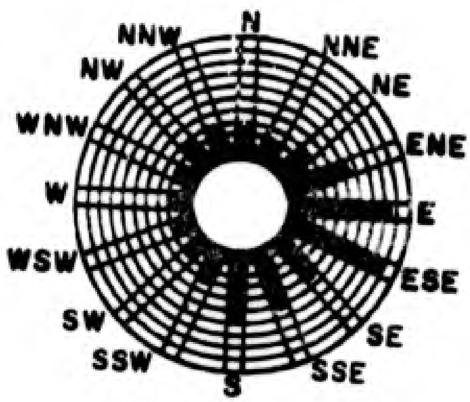
MONTH: Sept

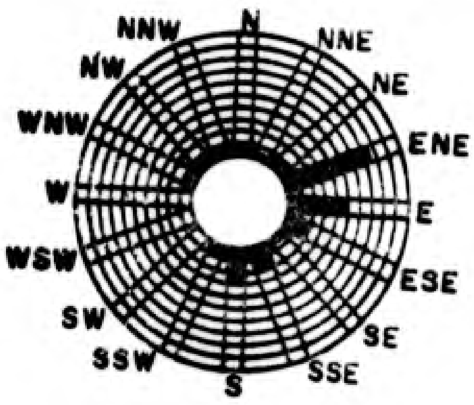
SURFACE WINDS

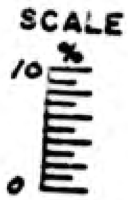
Years 41-66

LESS THAN 11 KTS (64.8%)

EQUAL TO/GREATER THAN 11 KTS (24.5%)







CALM (10.7%)

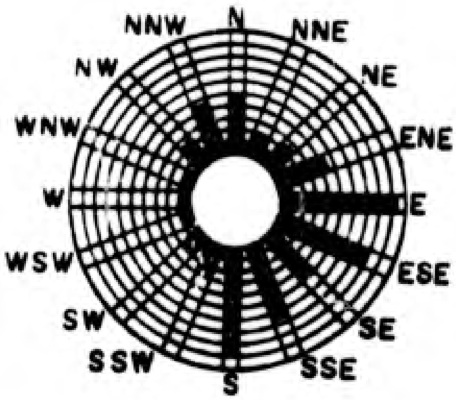
MONTH: Oct

Figure III-5e Sept & Oct

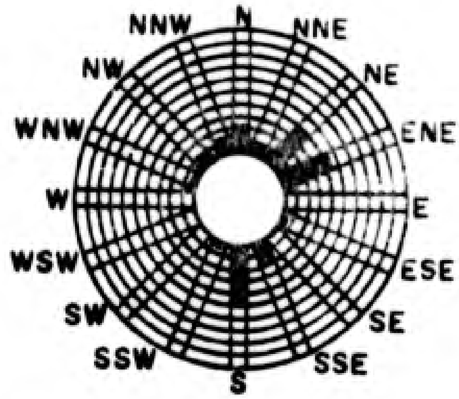
SURFACE WINDS

HILL AFB, UTAH -Years 41-66 (All hours combined)

LESS THAN 11 KTS (65.6%)



EQUAL TO/GREATER THAN 11 KTS (21.1%)



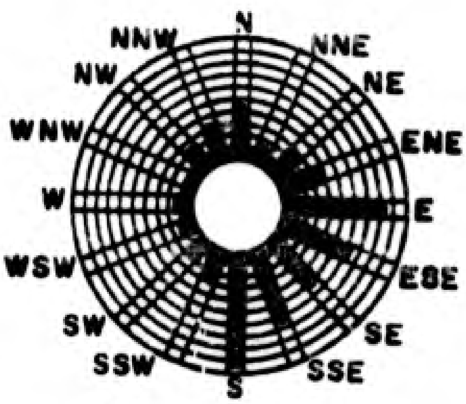
SCALE %

CALM (13.3%)

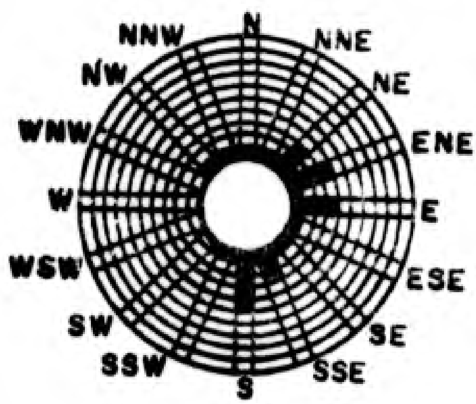
MONTH: Nov

SURFACE WINDS

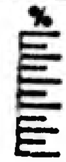
LESS THAN 11 KTS (62.3%)



EQUAL TO/GREATER THAN 11 KTS (19.1%)



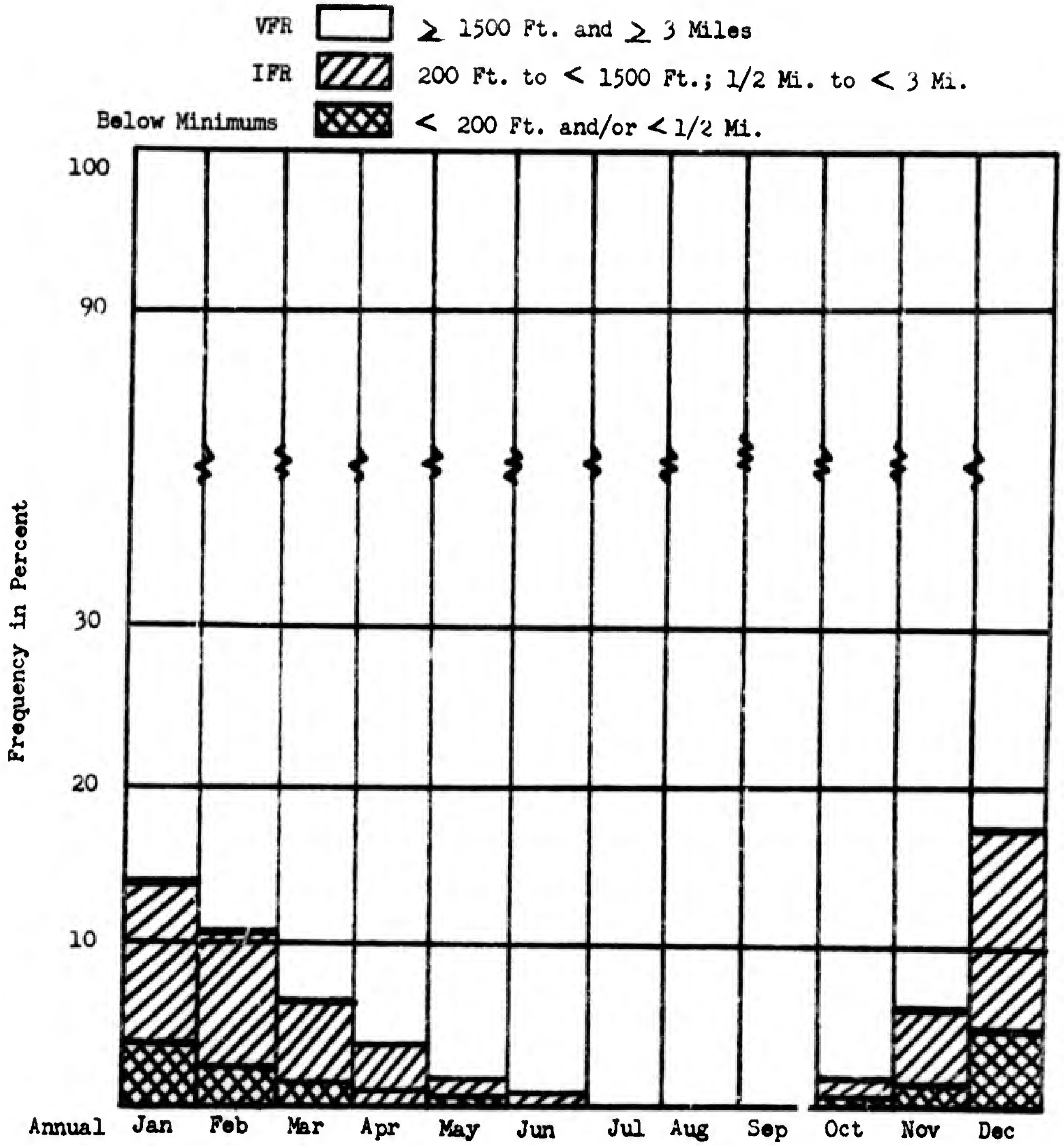
SCALE %



CALM (18.6%)

MONTH: DEC

Figure III-5f Nov & Dec



	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
VFR	94.6	84.6	89.2	93.4	95.6	98.7	99.6	100	99.9	99.6	98.3	93.9	82.2
IFR	4.2	12.2	7.5	5.4	3.7	1.1	0.4	0	0.1	0.4	1.7	4.8	13.0
Below Minimums	1.2	3.2	2.3	1.2	0.7	0.2	0	0	0	0	0.2	1.3	4.8

Based on Climatological Data for Period
1941-1967 Inclusive

Fig. III-6 Frequency of Flying Weather, Monthly and Annual, Hill AFB, Utah

SECTION IV

LOCAL FORECAST STUDIES

A - Operational Weather Requirements: Terminal Forecast (TAF) amendments and Local Terminal Met Watch Advisories are based and issued on Hill AFB operational weather criteria.

CEILINGS AND/OR VISIBILITY

3,000 ft	3 miles (4800 meters)	. . Alternate not required.
1,500 ft	3 miles (4800 meters)	. . VFR Minimums.
1,000 ft	2 miles (3200 meters)	. . Alternate Minimums.
700 ft	2 miles (3200 meters)	. . 1550th ATTW (Day)
200 ft	½ mile (0800 meters)(RVR 24)	. . Precision Approach Radar Minimums.

B - Other Weather Requirements: Surface wind gusts 30K or greater are criteria established by the base for the protection of parked aircraft and installed property. Thunderstorm activity in the local flying area constitutes a possible hazard to airborne aircraft. Electrical discharge (within 3 NM of Hill AFB) presents a hazard to ground aircraft refueling operations and may be a source of damage to missile instrumentation at the Boeing Titan Missile Assembly Plant located in the West Area of Hill AFB.

C. Objective Procedures

1. General

These procedures were first developed to forecast the occurrence of thunderstorms in the Hill AFB Local Flying Area (1955) and later expanded to predict the percentage probability of occurence at the field. Data is collected daily through the thunderstorm season, and evaluated for skill scores annually. An abbreviated outline for the procedure is given in paragraph 2, below. A complete report on procedures was presented at the American Meteorological Society national meeting, in Logan, Utah, in June 1958 by the author.

2. Summer Thunderstorms

a. The objective forecasting method for predicting thunderstorm activity in the area of and at Hill AFB, Utah, is described below. The technique is based on the study, "Probability Forecasting of Summer Thunderstorm Occurrence at Hill AFB, Utah", as developed by Major Eugene L. Peck, AFRES. Modifications, as suggested by the Scientific Services Section of

Air Weather Service, have been included in the graphs attached to this study. A copy of the original study by Major Peck is on file at Hill AFB.

a. Forecast Period - Twenty-four hour (1200Z - 1200Z), forecasts for convective activity and for thunderstorm occurrence at Hill AFB, are prepared using data from the 1200Z radiosonde sounding.

b. Forecast Procedures: Two parameters, the convective condensation level (CCL) and the maximum difference (Max Dif), defined below, are used for forecasting the degree of convective activity expected in the Hill AFB area. The 400 MB level wind speed and direction are used to determine the probability of a thunderstorm occurrence at Hill AFB.

(1) Step one - Radiosonde Analysis

(a) For the purpose of this study the CCL is determined from the plotted sounding on the Skew-T diagram by averaging the dew point curve from the surface to 700 millibars using the equal area method and following the mixing ratio lines from the point upward to the intersection with the free air temperature curve (Fig IV-1.). The point of intersection expressed in millibars, is the CCL.

(b) The Max Dif is determined by following upward from the CCL point to the 500 MB level along a line parallel to the moist adiabatic lines. The greatest temp difference, in degrees centigrade, between this projected line and the free air temperature curve is the Max Dif. (Fig. IV-1). This may occur anywhere between the CCL and 500 MB.

(2) Step Two - Area Convective Activity Forecast

(a) The graph in Figure IV-2 is used to determine the area convective activity forecast. This graph is based upon the results of a scatter diagram which appeared in the original study in which the following types of observed activity were plotted.

T	Thunderstorm reported at Hill AFB.
X	Cumulonimbus reported, no thunderstorm observed.
ϟ	Lightning observed, no T or X reported.
W	Rainshower observed, no T, X or ϟ reported.
△	Towering cumulus reported, no T, X, ϟ or W reported.
•	No convective activity of any type reported.

(b) Figures IV-2 is entered with the CCL and Max Dif as coordinates. Five Zones of area convective activity are shown on the graph. If the point is located in Zone 1 considerable convective activity is forecast for the area. In Zone 2 and 3 less convectivity activity is to be expected. No convective activity is forecast if the point falls in Zone 4 while only rainshowers without thunderstorms are forecast for the RW Zone.

(3) Step three - Probability Forecast

If the area forecast chart indicates Zone 1, 2, or 3 additional charts are used to determine the probability of a thunderstorm coordinates for the five wind charts. (Figures IV-3A, IV-3B, IV-4A, IV-4B and IV-5). The chart used depends upon the zone determined from the area forecast chart and the particular month. (June - July or Aug - Sep) Probabilities

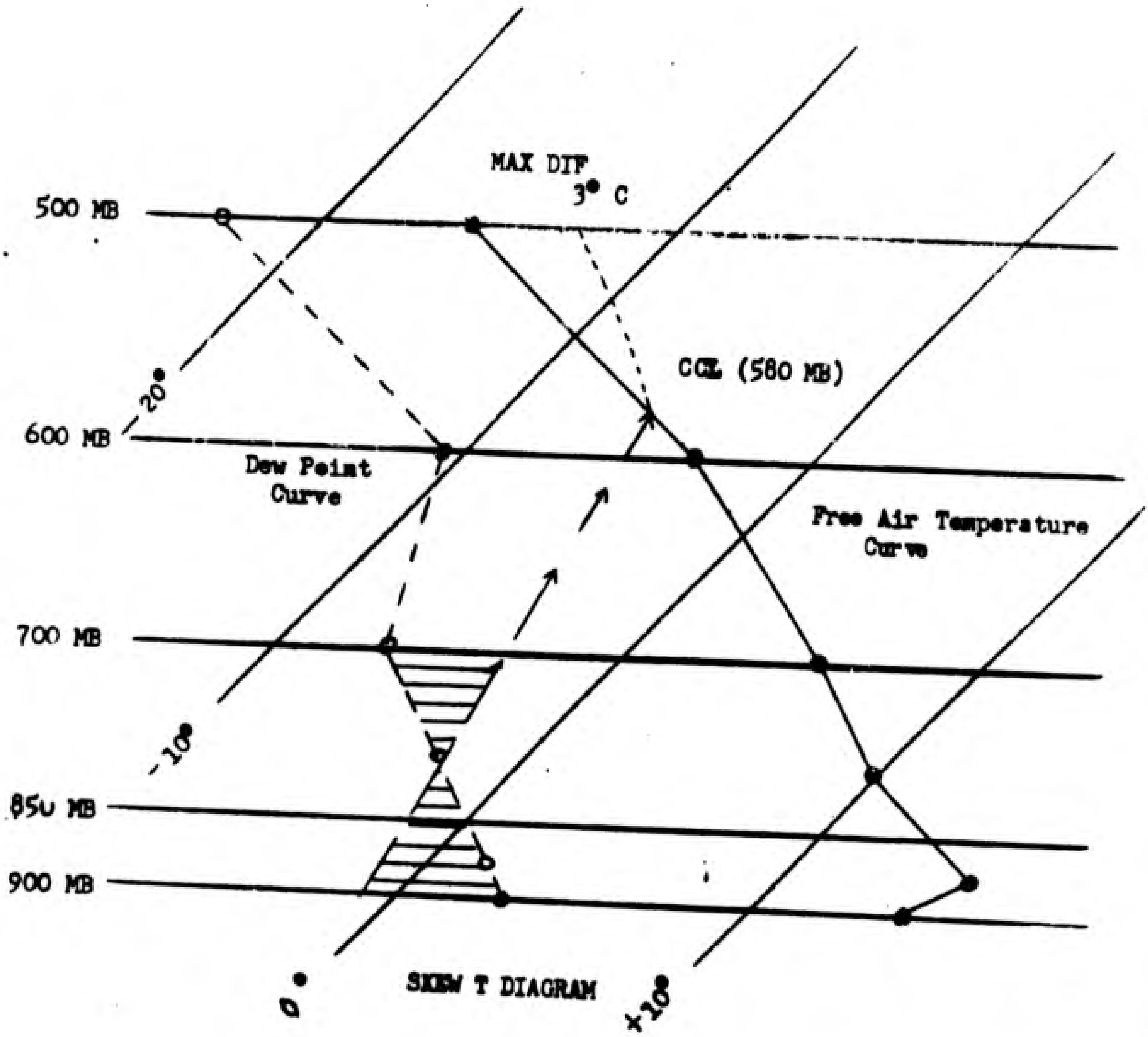


Fig. IV-1 Determination of maximum difference (MAX DIF) and convective condensation level (CCL)

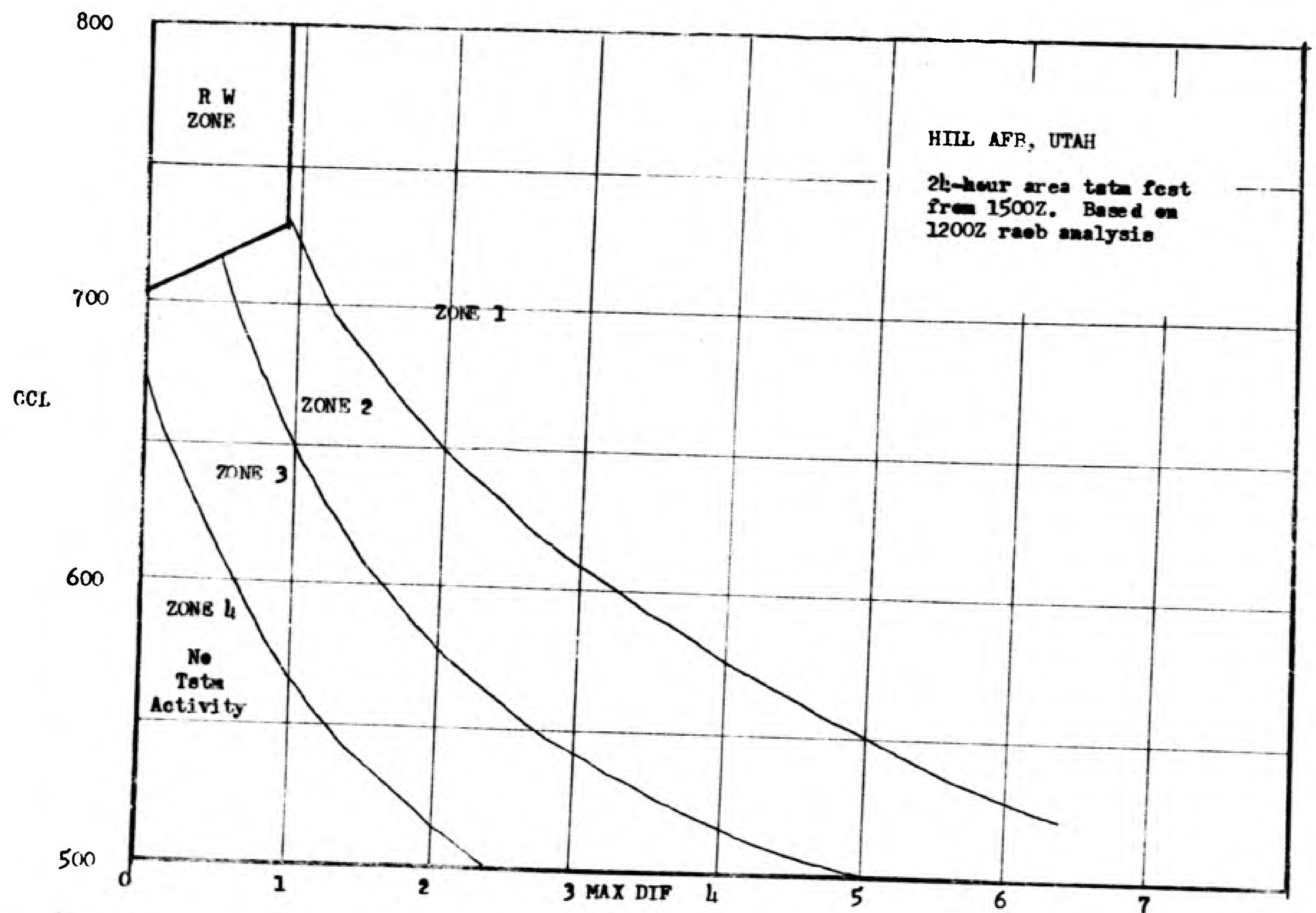
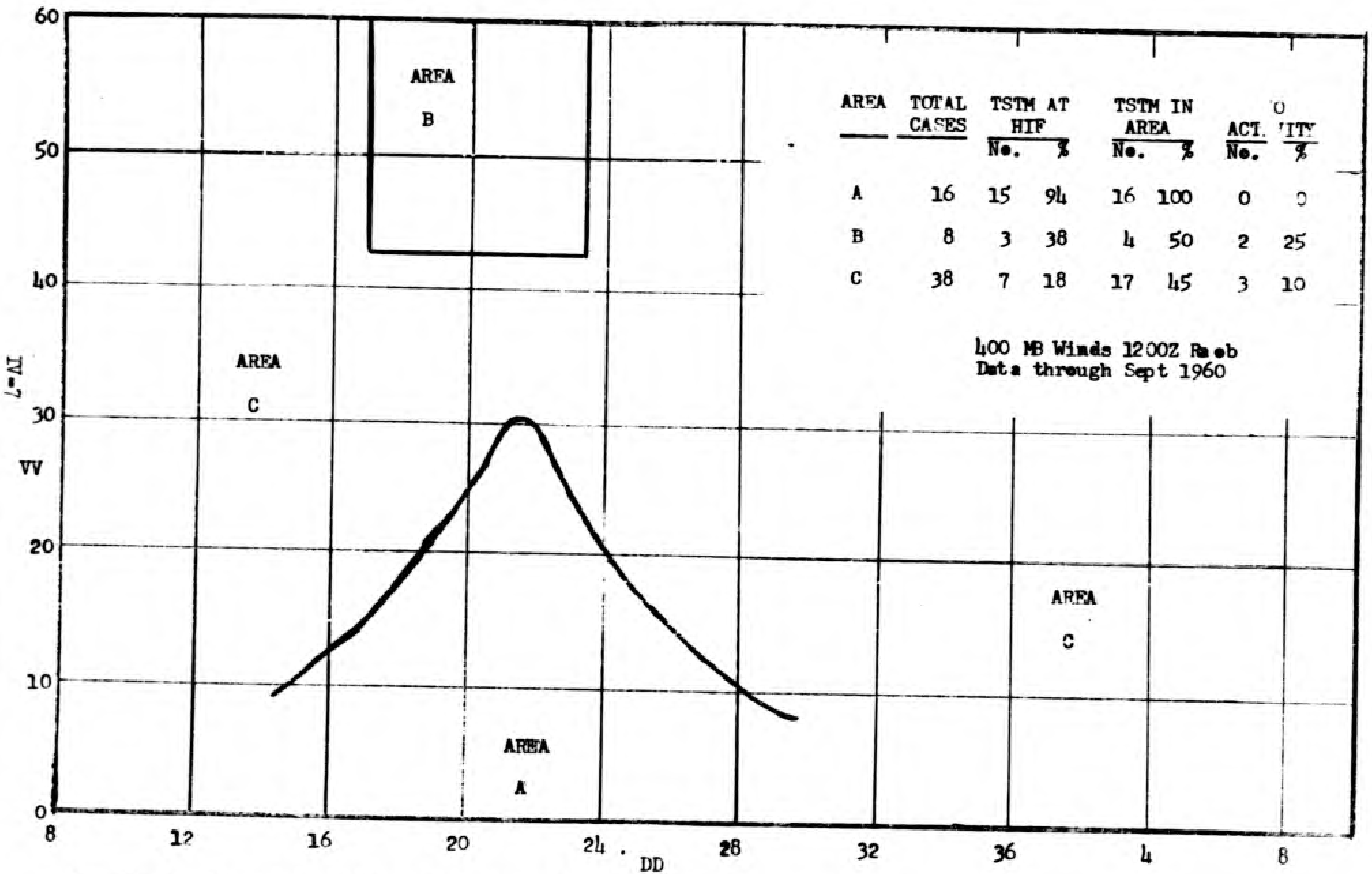
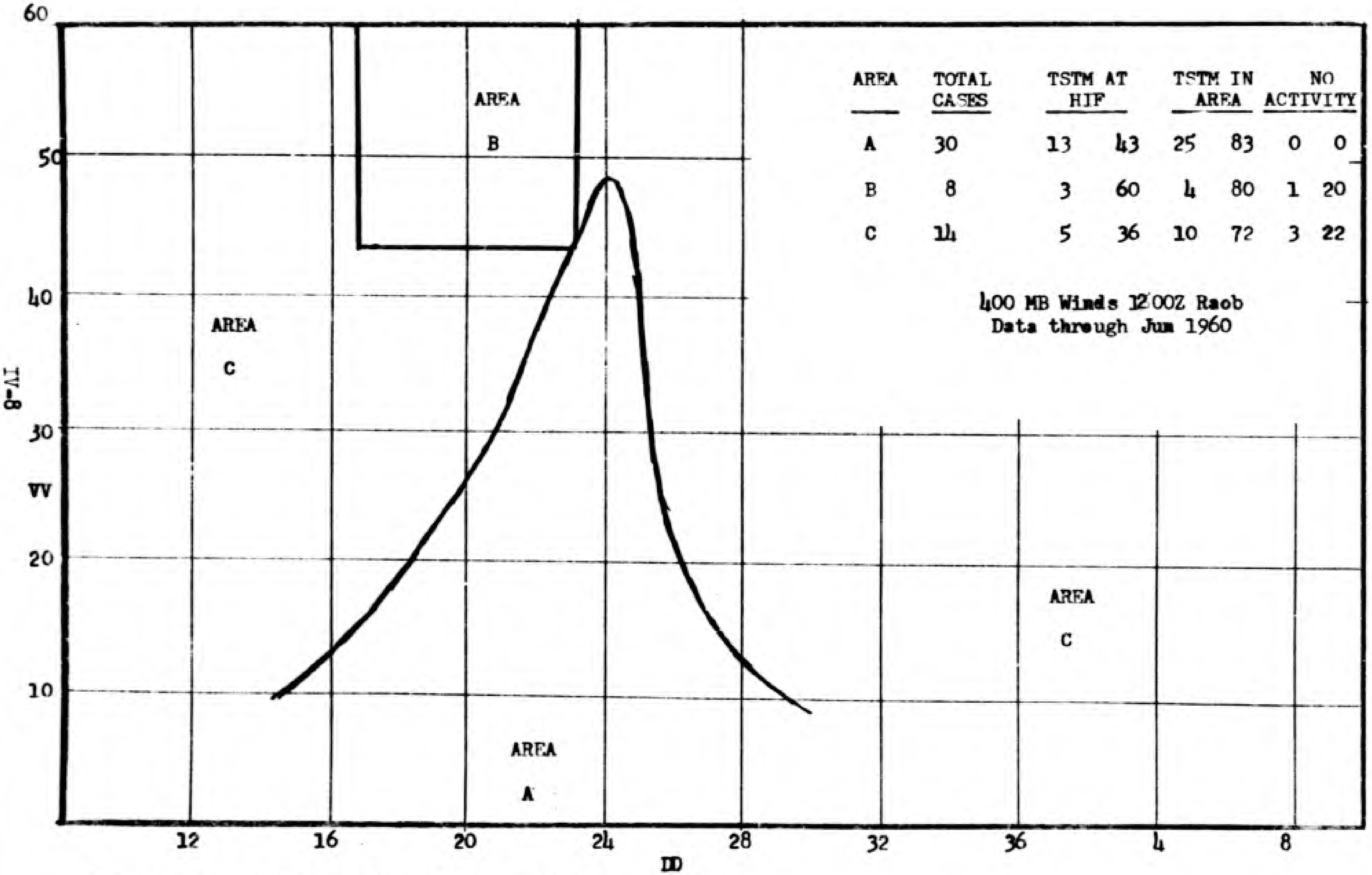


Fig. IV-2 Area Forecast Chart



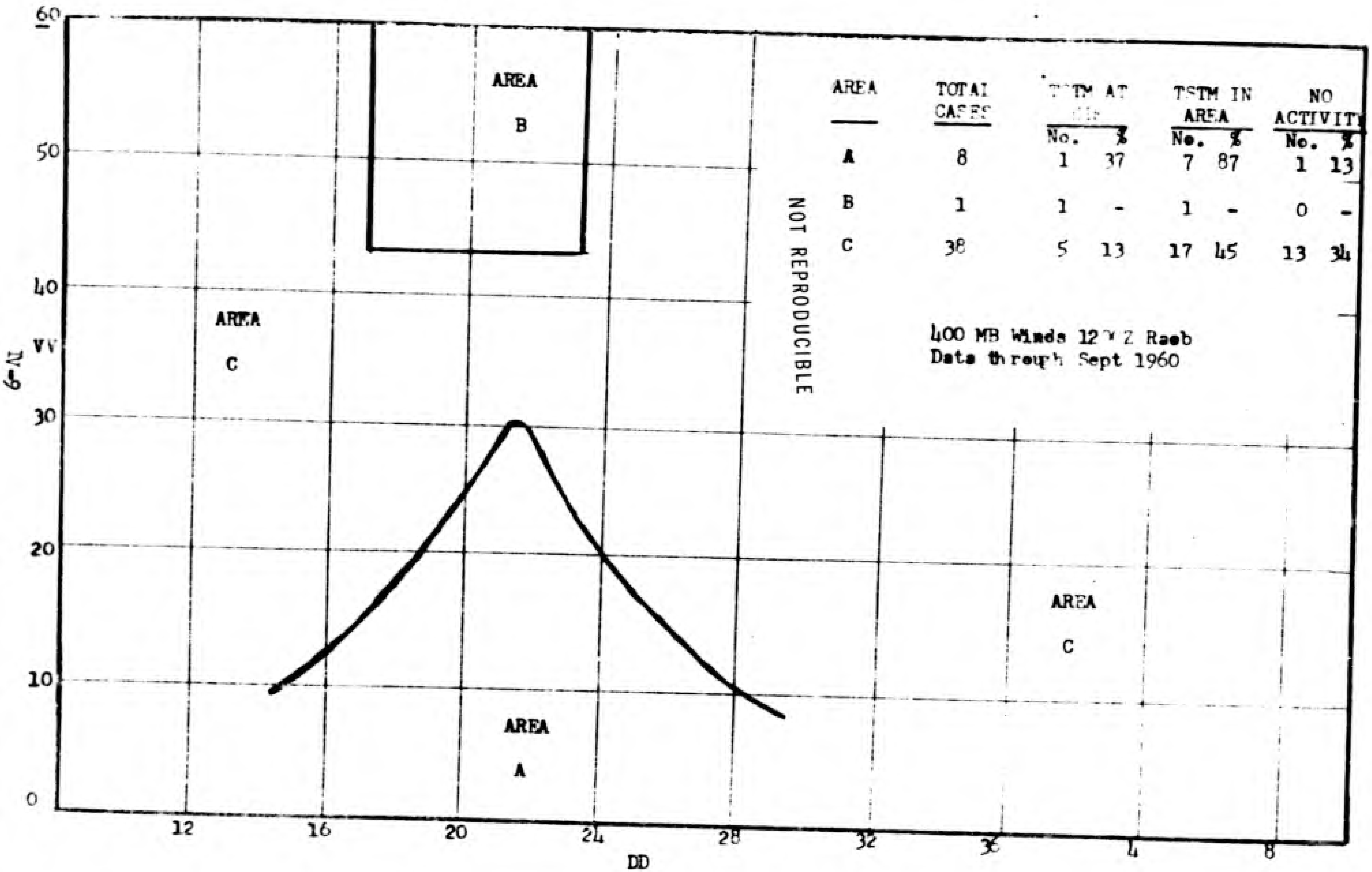
AREA	TOTAL CASES	TSTM AT HIF No.	TSTM AT HIF %	TSTM IN AREA No.	TSTM IN AREA %	ACT. 'ITY No.	ACT. 'ITY %
A	16	15	94	16	100	0	0
B	8	3	38	4	50	2	25
C	38	7	18	17	45	3	10

Fig. IV-3A Zone 1 Wind Chart (August-September)



AREA	TOTAL CASES	TSTM AT HIF		TSTM IN AREA		NO ACTIVITY	
A	30	13	43	25	83	0	0
B	8	3	60	4	80	1	20
C	14	5	36	10	72	3	22

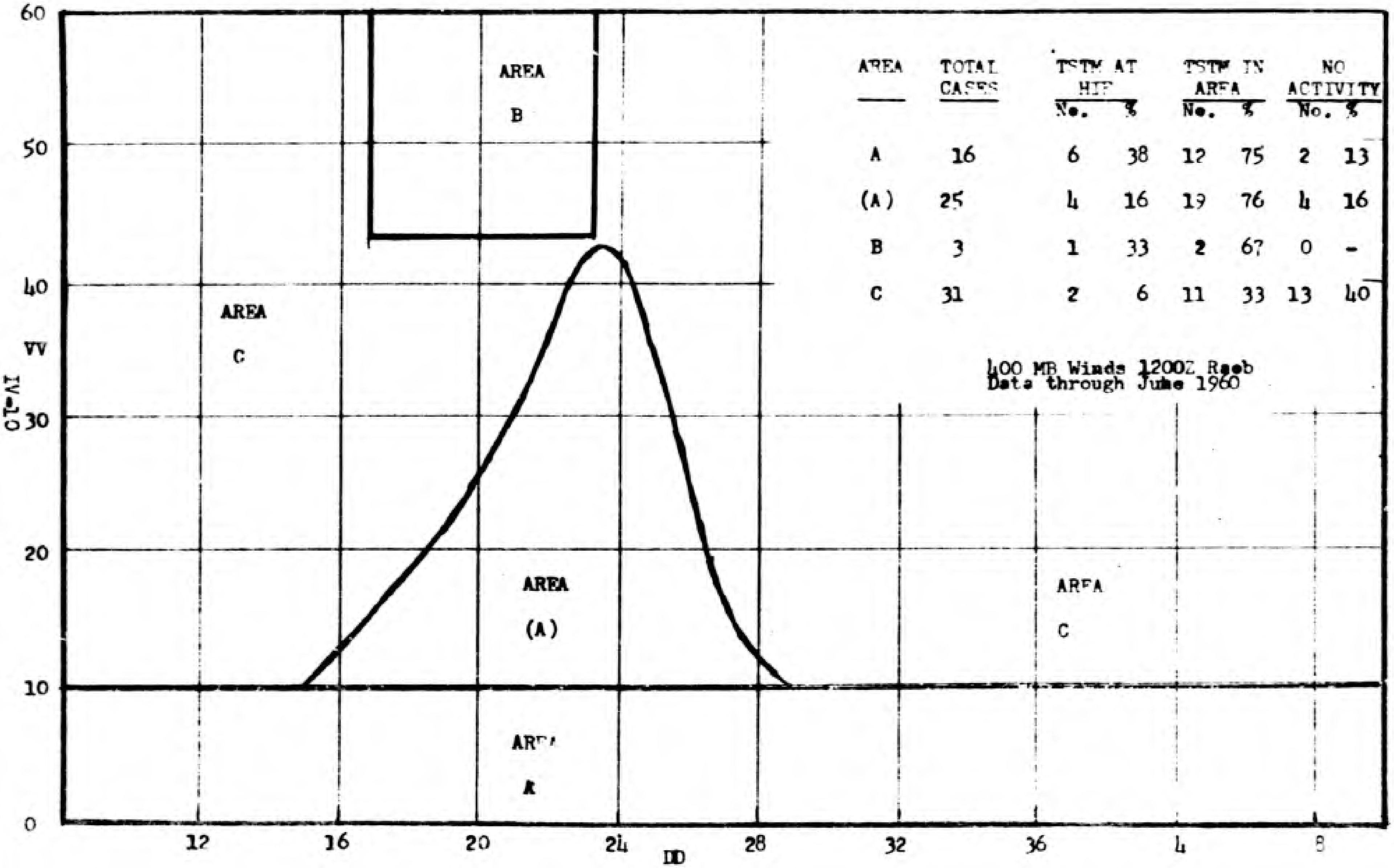
Fig. IV-3B   Zone 1 Wind Chart (June-July)



AREA	TOTAL CASES	TSTM AT [illegible] No.	TSTM AT [illegible] %	TSTM IN AREA No.	TSTM IN AREA %	NO ACTIVITY No.	NO ACTIVITY %
A	8	1	37	7	87	1	13
B	1	1	-	1	-	0	-
C	38	5	13	17	45	13	34

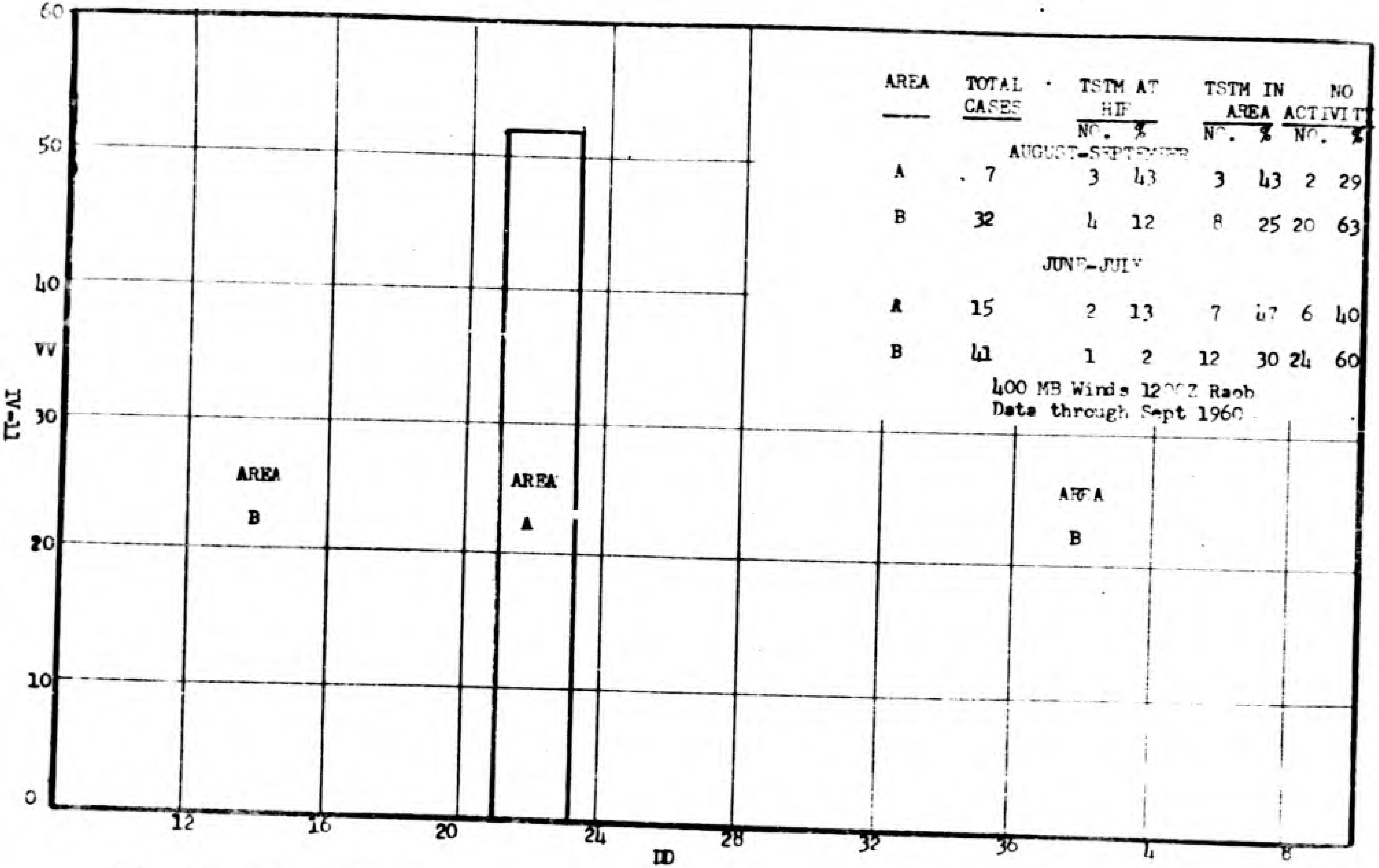
400 MB Winds 12 Z Raob
Data through Sept 1960

Fig. IV-4A Zone 2 Wind Chart (August-September)



AREA	TOTAL CASES	TSTM AT HIF No.	TSTM AT HIF %	TSTM IN AREA No.	TSTM IN AREA %	NO ACTIVITY No.	NO ACTIVITY %
A	16	6	38	12	75	2	13
(A)	25	4	16	19	76	4	16
B	3	1	33	2	67	0	-
C	31	2	6	11	33	13	40

Fig. IV-4B Zone 2 Wind Chart (June-July)



AREA	TOTAL CASES	TSTM AT HIF NO.	TSTM AT HIF %	TSTM IN AREA NO.	TSTM IN AREA %	NO ACTIVITY NO.	NO ACTIVITY %
AUGUST-SEPTEMBER							
A	7	3	43	3	43	2	29
B	32	4	12	8	25	20	63
JUNE-JULY							
A	15	2	13	7	47	6	40
B	41	1	2	12	30	24	60

Fig. IV-5 Zone 3 Wind Chart (August-September, and June-July) of thunderstorm occurrence at the field.

(4) Step four - Time of Thunderstorm Occurrence

To this date no satisfactory objective technique for forecasting the time of occurrence of thunderstorms at the field has been developed.

c. Objective forecast techniques are not designed to eliminate the need for forecasters, but rather to serve as a time saver and as a help in having past experience available in a compact and easily readable form. Although the skill of the procedure outlined above has been fairly good, there are many cases which are not correctly predicted. Most of the cases which are incorrectly forecast are associated with an abrupt change in airmass during the forecast period. An experienced forecaster should be able to temper the objective forecast in the light of expected airmass change. Verification statistics for thunderstorms within 20 nautical miles of the station are included.

PECK THUNDERSTORM STUDY

April 1971 thru October 1971

		FORECAST		
		Yes	No	Total
OBSERVED	Yes	35	11	46
	No	14	146	160
	Total	49	157	206

Percent yes fcst Correct 71.4%   Total percent fcst correct 87.8%

Percent no fcst correct 93.0%   Heidke skill score 0.66

April 1970 thru October 1970

		FORECAST		
		Yes	No	Total
OBSERVED	Yes	53	12	65
	No	79	65	144
	Total	132	77	209

Percent yes fcst correct 40.1%

Percent no fcst correct 84.4%

Total percent fcst correct 56.4%

Heidke Skill Score 0.21

April 1969 thru October 1969

		FORECAST		
		Yes	No	Total
OBSERVED	Yes	17	18	35
	No	19	160	179
	Total	36	178	214

Percent yes fcst correct 47.2%

Percent no fcst correct 90.0%

Total percent fcst correct 82.7%

Heidke Skill Score 0.41

Objective Procedure for Forecasting Canyon Winds

Hill AFB, Utah

Major Eugene L. Peck, AFRES, and Captain Aris M. Christensen, USAF

INTRODUCTION

Hill Air Force Base is situated immediately west of the Wasatch Front in Northern Utah near the mouth of Weber Canyon. The Weber River canyon is the lowest drainage outlet for a large and fairly high elevation basin to the east of the Wasatch Front. With favorable conditions for raditional cooling, the air from the basin funnels down the rather steep and narrow Weber Canyon and frequently results in gusty winds at Hill AFB of 20 knots or greater. When the synoptic pressure system is properly orientated the gradient winds strengthin the easterly drainage winds and gusts of 30 knots or greater are not uncommon. These gusty winds are locally referred to as "canyon winds".

Local studies on the "canyon wind" problem have been subjective and primarily a description of the synoptic weather associated with the strong gusty winds. Eddy (1957) attempted to correlate the maximum wind speed observed at Hill AFB with pressure differences for various stations in the area but reported essentially negative results. The basic data available for the development of an objective forecast technique are somewhat limited but it was believed that a graphical analysis of the data might produce a forecast method that would be of value. The study should also serve as a basis for a more comprehensive study.

BASIC DATA

The maximum gusts of the easterly canyon winds usually occur during the morning hours from midnight to noon. The dependent parameter for the study was chosen as the maximum gust reported on the observations form (WBAN 10A) for the Hill AFB weather station, during the twelve-hour period ending at noon. Gusty winds caused in part or all by the drainage from the Weber Canyon occur with easterly wind directions. Many gusts with wind direction of SSE are the result of strong pressure gradients induced by approaching troughs or fronts and are not the result of drainage wind conditions. Only maximum gusts with wind directions of NNE through SE were considered. If no winds from these directions were recorded during the twelve-hour period the value of zero was used for the maximum gust. Gusty winds at Hill AFB occur the year around but many of the winds with easterly directions during the summer months are associated with convective activity. To avoid the possible difficulty in using data where the gustiness might be the result of convective activity, only records from September through May were used in the initial study. Forecasts of the maximum gustiness for the following morning are issued in the evening and therefore data used in the procedure were based on the 1700M synoptic time. Upper air data were used from the Salt Lake City, Utah, radiosonde station. The original development was based on the 1958 - 1959 and 1959 - 1960 seasons.

Factors Relating to Drainage Winds

Radiational cooling during the night is the primary factor for the development of strong drainage winds. The total cloud cover as reported at Hill AFB was selected as a parameter to represent the magnitude of the radiational cooling. The cloud cover at 2300M was used in place of the 1700M cover since convective clouds normally dissipate shortly after dark and a total cloud cover at 1700M including this type of cloud might not be representative of the cloud cover during most of the night. (In operational use the expected cloud cover at 2300M would have to be forecast.)

Additional Parameters

Several other parameters were investigated. For the pressure gradient the 850 millibar height difference between Pocatello, Idaho (PIH) and Hill AFB, Utah (HIF) was found to be the best single index that was correlated with the gusty winds. The upper air wind speed and direction should have some effect on the strength of the surface wind especially the winds at the lower levels which are near the elevation of the drainage basin. To account for this effect the wind speed and direction of the 8,000 foot level were used. Parameters representing air mass stability and the isallobaric gradient were also tested.

GRAPHICAL RELATIONSHIPS

Simple graphical correlations of the independent parameters with the maximum gusts failed to show significance. A plotting of the PIH-HIF 850 millibar height differences and the 2300M cloud cover (Fig IV-6) tended to segregate the maximum gust values. This graph was divided into five sections with the selection of the boundaries based on the plotted data and subjective consideration of the inter-relationships, of the dependent and independent variables. Section A was drawn to include those cases where the 850 millibar height differnece (plus 20 feet or greater) indicated that the pressure gradient was in the right direction and magnitude for strong easterly winds. Excluded from this section were those cases with a favorable pressure gradient but with a relatively large cloud cover. Over half of the maximum gusts in Section A, for the development data, exceeded 20 knots. As a further step to separate the strongest gusts in Section A from the lighter gusts, upper air data were used. (Fig IV-7) is a plotting of the wind direction with wind speed of the 8,000 foot level. (Plotted data are points for the 1960 - 1961 test period.) Lines representing maximum gusts for each 5-knot interval from 20 to 35 knots as determined from the development data have been drawn. The analysis shows that the maximum gusts recorded are related to the upper air wind direction with the strongest gusts occuring when the upper air direction is from the east.

The stability of the airmass should have some effect on the amount of gustiness expected. The difference in the equivalent potential temperatures of the 700 and 850 millibar levels was used as an index for the airmass stability. When the air mass was stable (plus 1.0 deg C or greater) a correction of plus five knots improved the forecast wind speed accuracy. Trial investigation using computed isallobaric gradient (from the three-hour pressure tendency differences between KPIH and KHIF and Rock Springs, Wyoming(KRKS), and KHIF) gave no additional improvement.

Section B, Fig IV-6, was selected to include those cases where the pressure gradient was fairly weak (minus 20 to plus 10 feet difference) and with clear or scattered sky cover. A wind chart (Fig IV-8) similar to that prepared for Section A was developed. The isolines of maximum gusts for this chart were similar to those for Section A but the indicated maximum gusts were less. The airmass stability and isallobaric gradient indices were not found to make any improvement for Section B data. Section C of Fig IV-6 are those points where the cloud cover was small but where the pressure gradient was negative. Use of upper air data showed no improvement in forecast accuracy but gustiness of over 20 knots generally occurred when the airmass was very stable (difference in equivalent potential temperature plus 2.0° C or greater). When the airmass is very stable and the pressure gradient is opposite to easterly wind development it is assumed that a very shallow layer of relatively cold air is formed which drains down the canyon and out over the air base under westerly flow above. The gustiness that would be expected in such cases is limited. For the development data the gustiness was usually observed between 20 and 25 knots under these conditions and did not exceed 27 knots. (One case during the test data for 1960 - 1961 had a gust of 33 knots). The remaining two sections D and E were drawn to include those cases where the cloudiness did not indicate effective radiational cooling. In the case of Section D data the pressure gradient was positive. Several of the points in Section D had maximum gusts greater than 20 knots. These cases were found to be associated with at least one of the following two factors; (1) The 850 millibar height difference between RKS and HIF was 100 ft or greater or (2) the wind at 8,000 or 10.000 feet was from an easterly direction and over 10 knots. If both of the above conditions were met, the maximum gust for the following morning was usually greater than 30 knots. Normally, with a negative pressure gradient and cloudiness, no gusts above 20 knots would be expected for the cases falling in Section E.

TEST DATA

As an indication of the effectiveness of using Fig IV-6 to separate the maximum gusts from the ligher ones, Table 1 gives a tabulation of the number of cases in each section for various values of observed maximum gusts, for the two seasons used in the development of the procedure and for one test year.

TABLE I

Section and Period	Total No of Cases	Observed Maximum Gusts Below 20 Knots		Observed Maximum Gusts 20-29 Knots		Observed Maximum Gusts Above 29 Knots	
		No. Cases	%	No. Cases	%	No. Cases	%
A Development	80	37	46	43	54	10	13
Test	70	34	49	36	51	18	26
B Development	101	67	66	34	34	2	2
Test	43	18	42	25	58	1	2
C Development	72	50	69	22	31	0	0
Test	31	21	68	10	32	1	3
D Development	99	88	89	11	11	3	3
Test	62	53	85	9	15	4	6
E Development	185	172	93	13	7	0	0
Test	63	69	95	3	5	0	0

Note: Development period September-May, 1958-59 and 1959-60. Test data September-May, 1960-1961.

The additional use of the wind charts and other corrections indicated for Section A, C and D should further improve the forecast of maximum gustiness. Because of the limited data in the preliminary study no attempt has been made to objectively evaluate the usefulness of these additional parameters. The data plotted on Fig IV-7 & IV-8 are those observed for Section A and B during the 1960 and 1961 test year when the procedure was in actual use at the Hill AFB Weather Station. The test data during this period as shown on the wind chart for Section A (Fig IV-7) shows higher values for NNE 8,000 foot winds than indicated by the isolines. The occurrence of strong NNE winds is not too common and none occurred during the development period. The original isolines on Fig IV-7 should be corrected to account for the higher maximum gusts with NNE wind directions at the 8,000 foot level. The fact that Hill AFB is south as well as west of the mouth of Weber Canyon makes it appear logical to expect that high gusts would also be observed with NNE wind direction as well as with NE or easterly winds.

Use of Procedure During Summer

The data for the period June-August 1960 were used to test the forecast value of the procedure during the summer months. The forecasts for this period verified fairly well for the cases where strong gusts were predicted but fell down on verification for the cases when less than 30 knots gustiness was forecast. The observed verification was in keeping with the original reasoning why the data should be limited to the Semptember-May season. The procedure may be used during the summer months if it is recognized that strong gusty winds may also occur when only light gusts are indicated due to other causative factors.

Reference

Eddy, Richard, June 1957. Canyon Winds at Hill AFB, Unpublished. Master Degree Thesis, University of Utah.

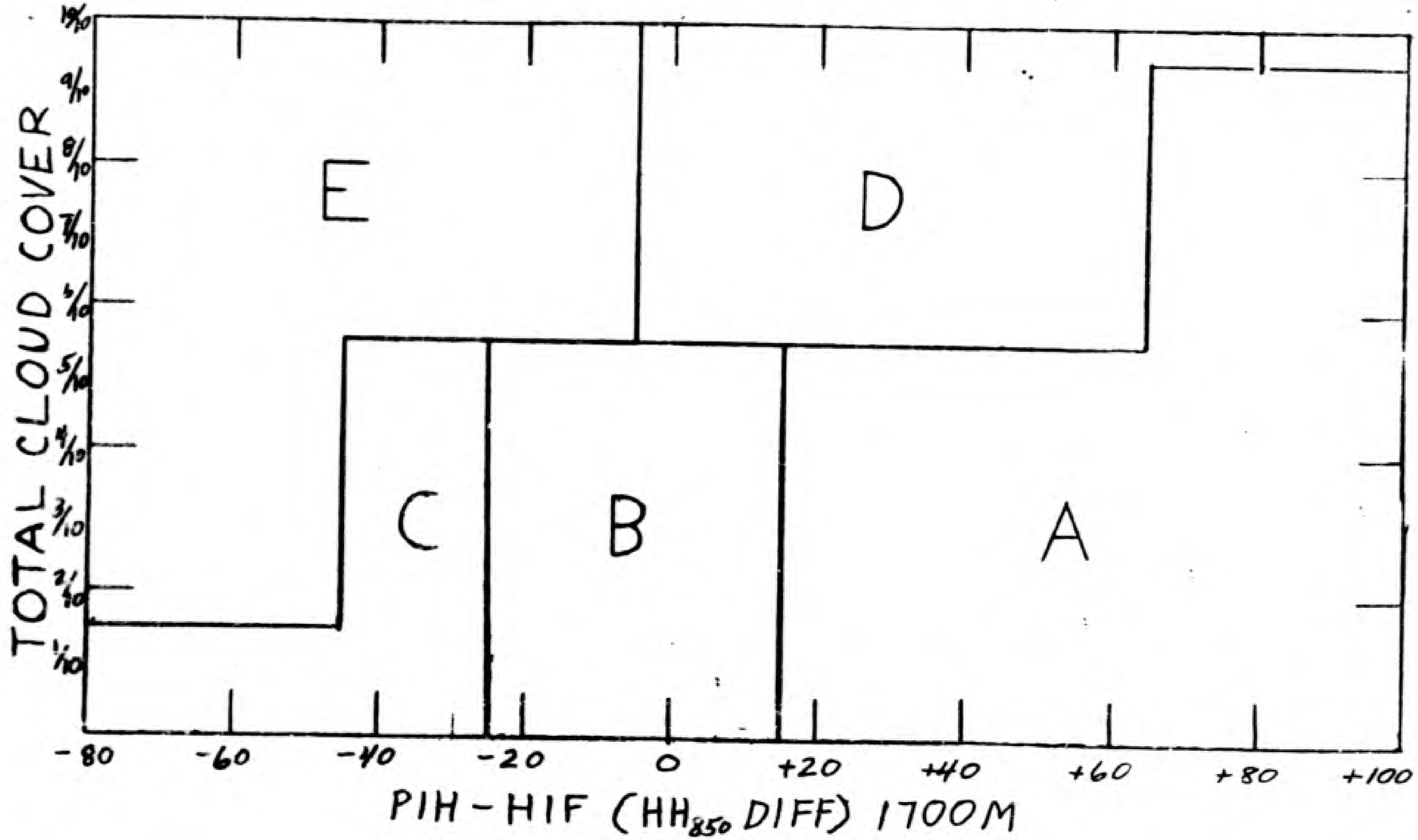


Fig. IV-6 - SECTION SELECTION CHART

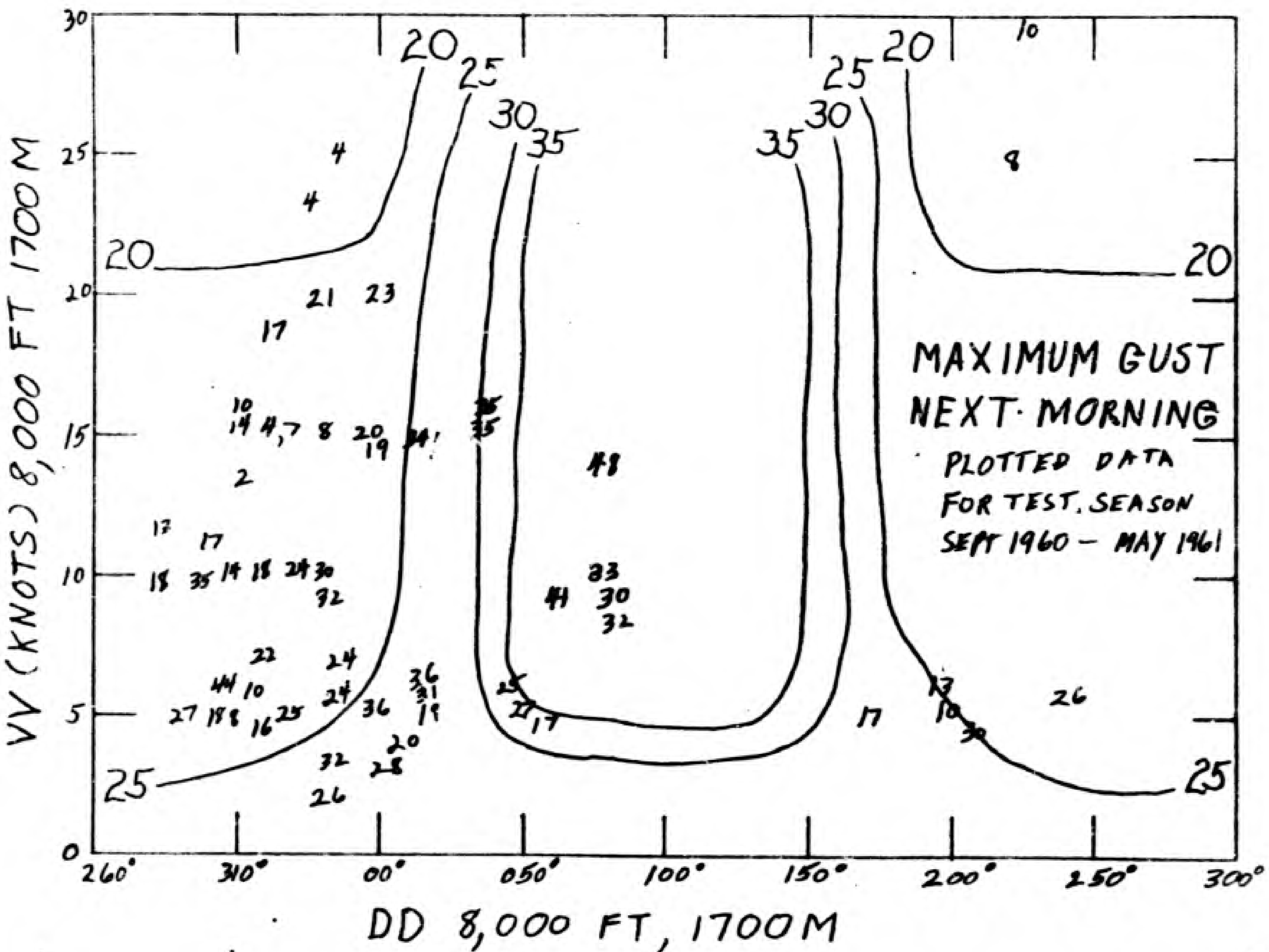


Fig. IV-7 - SECTION A WIND CHART

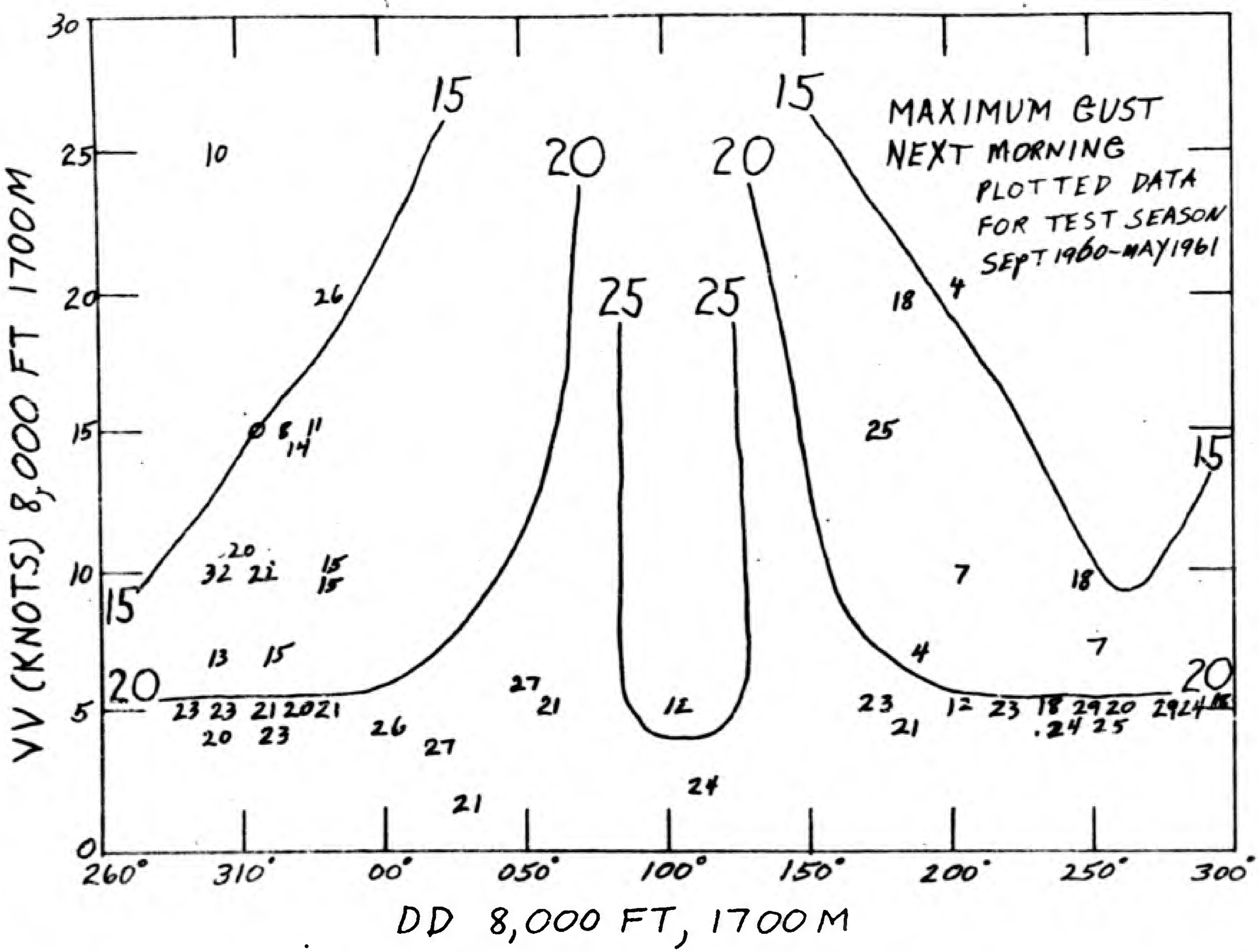


Fig. IV-8 -SECTION B WIND CHART

INSTRUCTIONS TO THE DUTY FORECASTER:

1. Data Collection: Upon receipt of the 0000Z KSLC RAOB, extract and compute the following parameters, and record them in the appropriate data blocks in the Canyon Wind Study folder:

a. 850 mb height for KPIH (interpolate).

b. 850 mb height for KSLC.

c. 8000 ft MSL wind speed and direction over KSLC.

d. Forecast cloud cover, in tenths, over KHIF at 2300L.

e. Compute the KSLC Equivalent Potential Temperature (EPT) Difference-(700 mb minus 850 mb). Affix the correct algebraic sign.

2. Canyon Wind Forecast: To obtain an objective canyon drainage wind forecast for KHIF from this study proceed as follows:

Enter the Fig 1 diagram with the 0000Z 850 mb height difference between KPIH and KSLC along the absissa, and the forecast cloud cover at KHIF along the ordinate. Select the appropriate block, A thru E, and extract the objective forecast guidance as outlined below.

SECTION A: Excellent Probability. Forecast canyon drainage winds to exceed 20K. Enter Section A Wind Chart with the KSLC 8000 ft MSL Wind and obtain the maximum gust value. If the air mass is stable e.g. (EPT = +0.5 deg C or greater) add 5 knots to the above wind speed. If the air mass is unstable (EPT = -2.0 deg C or less, subtract 5 knots.

SECTION B: Moderate Probability. Enter Section B Wind Chart with the KSLC 8000 ft MSL Wind, and obtain the maximum gust value.

SECTION C: Low Probability. Forecast no canyon drainage winds to exceed 20K. EXCEPTION - If the air mass is very stable e.g., (EPT = +2.0 deg C or greater, then forecast speeds of 20 to 25k, but not over 30k.

SECTION D: Low Probability. Forecast no canyon drainage winds in excess of 20k. EXCEPTION - If the KRKS - KSLC height difference is 100 ft or greater, and the 8000 ft MSL Wind over KSLC is greater than 10k, and has an easterly component, forecast canyon drainage winds 30k or greater.

SECTION E: Very Low Probability: Forecast no canyon drainage winds in excess of 20k.

NOTE: All of the above forecasts are for canyon drainage winds to occur the next morning between 0000-1200L and for the directions of NNE through SE only.

VERIFICATION OF PECK CANYON WIND STUDY

November 1970 thru March 1971 for canyon drainage winds ≥ 20K

FORECAST

OBSERVED	YES	NO	TOTAL
YES	41	15	56
NO	10	80	90
TOTAL	51	95	146

Percent Yes Fcst Correct	80.4%
Percent No Fcst Correct	84.2%
Total Percent Fcst Correct	82.9%
Heidke Skill Score	0.64

D. EMPIRICAL FORECAST RULES

1. Forecasting Snow vs Rain

When the 700 MB temperature is forecast to be -7C or colder, and the 5,640 meter contour is progged to lie south and east of KHIF, any precipitation reaching the surface will be snow.

E. Special Studies.

A list of references is given below of articles (published or unpublished) which have been prepared on weather subjects for northern Utah. Copies of all articles are available at either the Hill AFB Weather Station or at the Weather Bureau Airport Station in Salt Lake City, Utah and may be obtained on loan from the research forecaster, Mr. Phillip Williams, Jr.

1. Frontal and Pressure Systems

a. Forecasting the Formation of Cut-off Lows over the Western Plateau, P. Williams, Jr., WB Manuscript, SLC, Utah, May 1962

b. On the Movement of the Southwest Low (A Masters Thesis - U of Chicago, 1949) Note No. 6, USWB Manuscript, Jan 1962

c. An Experiment in the Use of "Perfect" Prognostic Chart, P. Williams, Jr., MWR, June 1960.

d. Forecasting the Movement and Development of Low Centers and Troughs on the 700 mb Chart, E. L. Peck, Unpublished paper, June 1948.

e. The Utah Storm of April 22-23, 1957, N. J. Brown, MWR, Sept 1957.

f. Some Winter Weather Signs in Utah, J. C. Alter, MWR, Oct 1919.

g. A Preliminary Report of the Development of Pre-Frontal Squal Lines West of the Continental Divide, Arlo Richardson, USWB Unpublished paper, 1951.

h. Discussions of Weather Systems (The passage of a Weak Cold Front, 19-20 Oct 1954, The Passage of a Strong Squall Line Type Cold Front on 12 Nov 1954, A Moderate Frontal Passage 15-16 Nov 1954, A Cold Frontal Passage, 31 Mar - 4 Apr 1955), Unpublished, Major A. H. Thompson, (copy at Hill AFB only).

2. Winds and Turbulence

   a. Wasatch Winds of Northwest Utah, P. Williams, Jr., Weatherwise, Dec 1952.

   b. Air flow of a Mountain Barrier, DeVer Colson, Trans, Amer. Geophysical Union, Vol 30, No. 6, Dec 1949.

   c. Canyon Winds at Hill AFB. Utah, R.L. Eddy, U of Utah Meteorology Dept, Tech Report No. 1.

   d. Strong Winds of May 15-17, 1952, Author Unknown, on file at Hill AFB, only.

   e. Objective Procedure for Forecasting Canyon Winds, Hill AFB, Utah. Maj. E.E. Peck and Capt A.M. Christensen, Unpublished, Hill AFB, July 1961.

3. Fog and Air Pollution

   a. An objective Method for Forecasting Radiation Fog at Salt Lake City Airport, Utah, M.G. Lloyd, Feb 1955, WB Manuscript.

   b. Atmospheric Conditions in Salt Lake Valley Regarding Fog and Smoke A.H. Thiessen, Journal of Assn. of Eng. Societies, Vol L I, No. 6, 1913.

   c. Additional Findings of Fact in Smoke Trailer's Path, J.C. Alter. Mines and Methods, Vol IV, No. 7, March 1913.

   d. Following the Smoke Trails, J.C. Alter, Mines and Methods, Vol IV, No. 6, Feb 1913.

   e. Who Taught Salt Lake City to Smoke, J.C. Alter, Mines and Methods, Vol IV, No. 5, 1913.

   f. A review of the Air Pollution Situation in Salt Lake Valley Utah, D.M. Keagy, and J.M. Leavitt, U.S. Dept of Health, Education and Welfare, R.A. Taft, Sanitary Eng. Center, Cincinnati Ohio, Aug 1959.

   g. Fog in the Vicintiy of Salt Lake Valley, Feb 1-11,1954 (discussion of Weather System) Unpublished (Copy at Hill AFB only) Maj A.H. Thompson.

   h. Formation of Fog and Low Stratus, Hill AFB, Utah, Maj A.H. Thompson, Unpublished (Copy at Hill AFB, only).

   i. Detachment Air Pollution File per AWS directives.

4. Clouds and Precipitation

a. Terrain Influences on Precipitation in the Intermountain West as Related to Synoptic Systems, P. Williams, Jr, and E. L. Peck, Journal of Applied Meteorology, Vol 1, No. 3, Sept 1962.

b. A Study of Wet and Dry Thunderstorms in the Intermountain Region During the Summer of 1961, P. Mallory, USWB, Salt Lake City, Utah, Feb 1962, unpublished (Presented at Portland Fire Weather Conference, Feb 1962.)

c. Severe Hailstorm at Salt Lake City, Utah, Aug 19 1945, G. K. Greening, USWB, unpublished.

d. Reliability of Precipitation Measurements as Related to Exposure, M. J. Brown and E. L. Peck, Journal of Applied Meteorology, Vol 1, No 2, June 1962.

e. Normal Precipitation in Utah, J. C. Alter, MWR, Sept 1919.

f. An Approach to the Development of Isohyetal Maps for Mountainous Areas, E. L. Peck, and M. J. Brown, Journal of Geophysical Research, Feb 1962.

g. Forecasting Summer Shower Activity at Salt Lake City, Utah, P. Williams, Jr., USWB Manuscript.

h. Forecasting Frontal Precipitation at Salt Lake City, Utah, During March and April, P. Williams, Jr., USWB Manuscript.

i. Forecasting Rain or Snow at Salt Lake City, Utah, P. Williams, Jr., USWB Manuscript.

j. An Objective Method of Forecasting Summer Precipitation at Salt Lake City, Utah, P. Williams, Jr., MWR, Aug 1950.

k. An Illustration of Cumulus Forming Over the Oquirrh Range, 14 Jul 1954 (Discussion of Weather System) Maj A. H. Thompson, Unpublished (Copy at Hill AFB only).

l. Probability Forecasting of Summer Thunderstorms Occurrence at Hill AFB, Utah, E. L. Peck, Unpublished (Presented at National Meeting AMS, Logan, Utah, June 1958).

5. Temperature

a. An Objective Method of Forecasting Maximum Temperature at Salt Lake City, P. Williams, Jr., Bulletin AMS, April 1958.

b. Preliminary Results of a Micro-Meteorological Study at Salt Lake City, Including a Comparison of Several Methods of Measuring Air-Soil Interface Temperature, Wayne Harrell and Arlo Richardson, MWR, Vol 88, No 8, Aug 1960.

c. Ground Layer Temperature Inversions in an Interior Valley and Canyon, C. R. Dickson, Dept of Meteorology, U. of Utah. 30 Aug 1958.

6. Climate

a. Review of Hydro-Climatological Network for State of Utah, E. L. Peck and M. J. Brown, Hydrology Subcommittee, Pacific Southwest Inter-Agency Committee, Aug 17, 1960.

b. Maximum Snow Loads along the Wasatch Slopes of the Wasatch Mountains of Utah. P. Williams, Jr., and M. J. Brown, Journal of Applied Meteorology, Vol 1, No 1, March 1962.

c. Climate of the States, Utah, USWB, Feb 1960.

d. Local Climatological Data, with Comparative Data, 1962, Salt Lake City, Utah. USWB.

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Det 6, 17TH Weather Squadron Hill AFB, UT 84401	2a. REPORT SECURITY CLASSIFICATION N/A 2b. GROUP N/A

3. REPORT TITLE

TERMINAL FORECAST REFERENCE FILE, HILL AFB, UT

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final

5. AUTHOR(S) (First name, middle initial, last name)
N/A

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
1 February 1972	70	41

8a. CONTRACT OR GRANT NO. N/A	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. N/A	N/A
c. N/A	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d. N/A	N/A

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
N/A	Hq 7TH Weather Wing Scott AFB, IL 62225

13. ABSTRACT

This reference file discusses factors affecting the weather at Hill AFB, UT. Included are location and topography, weather controls, climatic aids, and local forecast studies.

DD FORM 1 NOV 65 1473

UNCLASSIFIED
Security Classification

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Meteorology						
Climatic Data						
Hill AFB, UT						
Local Forecast Studies						

UNCLASSIFIED

Security Classification