FORECASTER'S HANDBOOK

FOR

NAVAL AIR STATION

FALLON, NEVADA

Prepared By

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Fallon, Nevada

RECORD OF CHANGES

Change Number	Date of Change	Pages Affected	Date Entered	Entered By

Distribution List

Commander, Naval Meteorology and Oceanography Command (N312)

Commanding Officer, Naval Oceanographic Office, (Code N2513)

Naval Research Laboratory Detachment, (NRL) Monterey, CA.

Meteorological Library (Code 63) of the Naval Postgraduate School, Monterey CA.

Naval Pacific Meteorology and Oceanography Detachment, Lemoore, CA.

Naval Pacific Meteorology and Oceanography Facility, San Diego, CA.

Naval Pacific Meteorology and Oceanography Center, Pearl Harbor HI.

United States Air Force Environmental Technical Applications Center (USAFETAC/LD), Scott AFB, IL

FOREWORD

This handbook is prepared in accordance with NAVOCEANCOMINST 3140.2( ). It's primary objective is to provide guidance to new as well as experienced Forecast Duty Officers, providing insight in the realm of forecasting situations specific to the NAVPACMETOC DET Fallon Area of Responsibility (AOR).

This manual is required reading for all NAVPACMETOC DET Fallon Forecast Duty Officers and Assistant Forecast Duty Officers. Guidance contained in this handbook shall be considered “common knowledge” among all qualified Forecast Duty Officers and will serve as the baseline requisite knowledge for all Forecaster Certification Boards.

The handbook shall be reviewed annually and revised as necessary.

M. S. Nicklin
LT USN
Officer in Charge
NPMOD Fallon

January, 1999

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SECTION I - BASIC DESCRIPTION

A. Geography. Naval Air Station Fallon is located in western Nevada at 39° 25' N, 118° 42' W; fifty nautical miles east of Reno and six nautical miles southeast of the City of Fallon (Figures 1, 2, and 3). Field elevation is 3934 feet above mean sea level. The station is located in the southern portion of a basin composed of the Carson Sink, Lahontan Valley, Carson Lake, and the Stillwater Wildlife Management Area (Figure 2). The basin itself is quite flat, consisting of farmland (near Fallon), large marshy waterfowl areas (Carson Lake and Stillwater), and large expanses of alkali flats (especially in the Carson Sink). Most of this area ranges from 3900 to 4000 feet above mean sea level. Other than the irrigated farmland near Fallon, vegetation is sparse, consisting of plants that can withstand the harsh high desert climate. There is virtually no vegetation within the alkali flats.

The basin itself is interrupted by dramatic mountain ranges, the highest reaching to about 8,800 feet above sea level. They, too, are vegetated sparsely (except in the down-slope canyons, where higher shrubs and cottonwood trees are typically found). A summary of the mountain topography surrounding NAS Fallon follows:

1. The Desert Mountains (5000-6000 ft) are oriented east-west, 17 miles south of the field.

2. The Sand Springs Range (5000-7400 ft) is oriented north-south, 25 miles southeast of the field.

3. The Stillwater Range (5500-8800 ft) is oriented southwest-northeast, 15 miles east to 60 miles northeast of the field.

4. The West Humboldt Range (5000-6400 ft) is oriented southwest-northeast, 32 miles north to 65 miles northeast of the field.

5. The Hot Springs Mountains (5000-7200 ft) are oriented southwest-northeast, 38 miles northwest of the field.

6. The Pyramid Range (5000-8700 ft) is oriented northwest-southeast, 70 miles northwest to 45 miles west-northwest of the field (along the west side of Pyramid Lake.

7. The Pine Nut Mountains (6500-9450 ft) are oriented north-south, 45 miles west-southwest to 55 miles southwest of the field.

8. The Sierra Nevada Range (6000-14,495 ft) is oriented northwest-southeast, 200 miles northwest to 300 miles south of the field.

In addition to the extensive network of canals and irrigated fields near Fallon, there are several fairly large lakes in the region. The Lahontan Reservoir, located about 15 miles west of the station, was formed when the Carson River was dammed for irrigation in the early 1900’s. Pyramid Lake (50 miles northwest) and Walker Lake (40 miles south) are the last large remnants of the ancient Lake Lahontan. Closer to NAS Fallon, the Stillwater marshes (10-25 miles northeast) and Carson Lake (5-15 miles south) constitute large areas of surface water.

B. Local Operating Area. NAS Fallon Military Operating Areas cover an area of over 10,000 square miles (Figure 4). Included within these MOAs is the Fallon Supersonic Operating Area (Figure 5) and four bombing ranges:

Bravo-16 (R4803) is located 9 NM southwest (222 DEG) of NAS Fallon at an altitude of 3942 feet. The soil in the range area is saline in nature with extensive alkali flats and areas of patchy desert sand and sparsely vegetated by sagebrush. Red Mountain is four miles west, the Dead Camel Mountains are one to two miles west to southwest, and the Desert Mountains are eight miles south. During Winter-Spring periods with higher than normal precipitation events, drainage in this range and the immediate area surrounding the range is generally fair to poor. Shallow surface water will have an impact on general range conditions as well as in the general vicinity of target sites and should be incorporated into target forecasts for a one to two week period following a significant precipitation event.

Bravo-17 (R4804) is located 23 NM east-southeast (099 DEG) of NAS Fallon at an altitude of 4153 feet. The soil in the range itself is alkali flats in the northern extreme giving way to a rocky terrain along the west and east foothills and patchy areas of desert sand sparsely vegetated by sagebrush along a gently sloping foothill at the southern extreme. The range is flanked on the west by the Sand Spring Mountains and on the east by Fairview Peak. Of all the Fallon ranges, this range is the most frequently used. During Winter-Spring periods of higher than normal precipitation events, drainage in this range and the immediate area surrounding the range is relatively good resulting in little impact on actual range conditions.

Bravo-19 (R4810) is located 16 NM south-southeast (163 DEG) of NAS Fallon at an altitude of 3882 feet. The soil in the range is alkali with areas of patchy desert sand sparsely vegetated by sagebrush. The Sand Spring Mountains are four miles east of the range and the Desert Mountains are nine miles west. During

Winter-Spring periods of higher than normal precipitation events, drainage in this range and the immediate area surrounding the range is relatively good resulting in little impact on range conditions.

Bravo-20 (R4802) is located 31 NM north-northeast (013 DEG) of NAS Fallon at an altitude of 4040 feet at Lone Rock with the flats at 3890 feet. The soil in the range area consists of salt and alkali flats. The Stillwater Mountain Range is seven miles east. The West Humboldt range is to the west and northwest. During Winter-Spring periods of higher than normal precipitation events, drainage in this range and the immediate area surrounding the range is very poor. This often results in extensive areas of shallow surface water surrounding the general area around many of the target sites. This condition can persist from two to four weeks at a time. Although target sites are not actually impacted by this surface water, consideration of a higher than normal moisture content of the soil must be considered and utilized when providing targeting and range information.

The **Electronic Warfare Range** is located 23 NM east (088 DEG) of NAS Fallon in the southern Dixie Valley at an altitude of 4170 feet. The soil in the general range area is primarily desert sand moderately vegetated by sagebrush and a variety of high desert type plants. The southern Stillwater Mountains are to the west and the Clan Alpine Mountains are just to the east. During Winter-Spring periods of higher than normal precipitation events, drainage in this range and the immediate area surrounding the range is good resulting in no impact on general range conditions. This area, together with B-17, is the most frequently used training destination for pilots flying out of NAS Fallon.

C. Local Flying Area. The local flying area encompasses the state of Nevada, western Utah, extreme northwestern Arizona, the northern two thirds of California, southern Oregon and southwestern Idaho (Figure 6). Pilots may fly throughout the local flying area without filing a DD-175 Flight Plan if weather for their route of flight is VFR. It is the pilot’s responsibility to check the weather for the planned route of flight.

D. NAVPACMETOC DET Fallon Spaces. NAVPACMETOC DET Fallon is located in Bldg. 301, the old tower, first and second decks (Figures 7 and 8). The first deck consists of the OIC’s Office located at the northeast corner of the building, a Balloon Inflation Room and Storage Room with an exterior access door, and the Operations Spaces, consisting of the Forecaster’s area (including the Pilot Briefing Area) and the Observers area. Also on the first deck are the In-House Briefing Area, the Training/Conference Room, and the NEXRAD PUP and ASOS ACU Room.

Located on the second deck is the LCPO’s Office located on the south side of the building, the Publications/Training Aids Library, the Admin Spaces, and the Tactical Forecasters Area. Also located on the second deck at the top of the stairway is a supply closet.

Forecaster’s Work Area (see Figure 9): Within this area is the Forecaster’s Workstation, where most over-the-counter and phone weather briefings are generated and conducted. Also located at this workstation is the Forecaster terminal of the CMW/AWN Data System, the Forecaster MIDDS (METOC Integrated Data Display System) and network server, and the Pilot to Forecaster METRO Radio (operating on 324.8 MHz). This incorporates nearly all the Forecaster tools and information channels necessary to complete tasking for aviation and local forecasting. Located within the Forecasters storage closet is the AN/UMQ 12 MRS (Marwin MW 12 Rawinsonde Set). Adjacent to the Forecaster workstation are the NEXRAD PUP display, and the Supplemental Weather Radar display while the Multi-Monitor Data Display Station is located in the **Pilot Briefing Area**, separating the Forecasters area from the Observers area.

Observer’s Work Area (see Figure 9): This area is located adjacent to and west of the Multi-Monitor Data Display System (MMDDS). The Observer’s workstation contains the following: Automated Surface Observing System (ASOS) Operator Interface, Observer CMW/AWN terminal and printer, Aneroid Barometer, Marine Barograph, MIDDS Workstation #1, and the electric psychrometer storage space. Located on the south wall are the direct phone lines to TRACON, the Control Tower, and the Crash phone. The CMW and MIDDS terminals are on a table facing the In-House Briefing Area.

E. Meteorological Instruments and locations. NAVPACMETOC DET Fallon's instruments consist of: ASOS (Automated Surface Observing System), UMQ-5 (Wind Measuring Equipment), RD-108B (Wind Recorder), NEXRAD WSR-88D PUP (Principal User Processor), AN/UMQ-12 (Marwin MW 12 Rawinsonde Set), LPATS (Lightning Positioning and Tracking System), AN/SMQ-11 Satellite Receiver, Aneroid Barometer, electric psychrometer, and PMQ-3 (hand-held wind anemometer).

ASOS (Automated Surface Observing System) became fully operational in SEP 95. The Sensor Package consists of a visibility sensor, tipping bucket rain/snow gauge, freezing rain sensor, temperature/dewpoint sensor, and ceilometer, plus an aerovane anemometer located 33 feet AGL (Figure 10). This Sensor package is located approximately 1050 feet northeast of the centerline of runway 13L-31R and 4800 feet north of the southeast end of runway 31R (6350 feet east of Bldg – see Figure 11). Data collected from the Sensor Group Data Collection Package (DCP) is transmitted via UHF link to an antenna located on Bldg. 301 (NPMOD), which is connected to the ASOS Control Unit (ACU), the large rack computer located in the NEXRAD PUP room. Within the ACU are three very accurate pressure sensors, located approximately 5 feet AGL or 3939 feet MSL.

Additional ASOS sites have been approved and are scheduled for installation commencing the spring of 1999 at the following sites: B-17, B-20, central-southeastern Gabbs MOA area, Site 70 (central-eastern Dixie Valley area), USMC Mountain Warfare Training Center in Bridgeport, CA, and USA Ammunition Depot in Hawthorne. Each of these sites will contain a full suite of sensors comparable to the current ASOS at NPMOD Fallon and supply twenty four hour a day meteorological data to a central CPU to be located in the forecasters work area.

UMQ-5 - The wind velocity sensor (Transmitter ML-400B/UMQ-5) is located near the 7000 foot marker for Runway 13L-31L, which is approximately 1000 feet east-southeast of Bldg. 301 (Figure 11). The transmitter is 15 feet above the surface and oriented true north, utilizing an established benchmark aligned to true north. One ID-586/UMQ-5 indicator is within the weather office above the NEXRAD monitors and indicates wind speed and direction in degrees true. One ID-2447A wind indicator is located in the control tower and indicates direction in degrees magnetic. With the installation of ASOS, the **RD-108B Wind Recorder**, which plots a wind trace from the UMQ-5, is now a back-up instrument. It is located next to NEXRAD and is used to record significant wind events; particularly those events associated with local wind advisories.

NEXRAD (Next Generation Weather Radar) WSR-88D. This is a Doppler weather radar unit built by UNISYS and sponsored by the DOD, DOC, and FAA. The system consists of the Radar Data Acquisition Unit (RDA) located 43 miles west-northwest of NPMOD Fallon at an elevation of 8366 feet atop Virginia Peak. Data is transmitted using a wide band signal from the RDA to the National Weather Service in Reno, NV, and then via narrow band (telephone line) to NPMOD's Principal User Processor Subsystem (PUP). Two monitors for data display and 1 monitor for alphanumeric control are located within the Forecaster Area. The associated main frame computer and all associated data processing hardware/software, communications hardware/software are located in the NEXRAD PUP room.

AN/UMQ-12 (Marwin MW 12 Rawinsonde Set) is located in the Forecaster's storage closet. The antennas are located on the roof of building 301. The AN/UMQ-12 is used primarily in support of tactical weather forecasts for strike briefs provided to visiting CAGs or during other unique situations requiring upper-air support. Under normal circumstances, the Reno sounding fulfills local forecast requirements.

Lightning Positioning and Tracking System (LPATS). The LPATS monitor and CPU are located in the same cabinet as the Multi-Monitor Data Display Station (MMDDS) located in the Pilot Briefing Area. The satellite receiver antenna is located on the roof of Building 301. It is a PC-based system that displays lightning strike data from throughout the United States. The display can be manipulated to zoom in on any area of interest. Additionally, local area warning boxes with audible alarms have been created to identify lightning strikes within the immediate AOR. Lightning strikes appear on the display within seconds of their actual occurrence.

The **Aneroid Barometer** is located at the Observer workstation at 3941 feet above MSL.

The **Electric Psychrometer** is located at the Observer workstation and is used as a back-up device for verifying temperature and dewpoint.

The **PMQ-3 (Hand Held Anemometer)** is located in the Forecaster's storage closet and is used as a back-up device for ASOS/UMQ-5 wind speed and direction instruments.

F. Communications and METOC Support Equipment. NAVPACMETOC DET Fallon utilizes a variety of communication equipment in its day-to-day functions.

MIDDS - METOC Integrated Data Display System. The main MIDDS terminal and the MIDDS server are located at the Forecaster's workstation. MIDDS workstation #1 is located at the Observer's workstation as an alternate briefing site and training aid, and workstation #2 is located in the OIC's office. A future workstation is planned for the Tactical Forecaster's workstation.

The MIDDS server receives data ingests from a variety of sources. NEXRAD Mosaic data is received via modem using an automated dial-out. DIFAX charts are received via satellite (the receiver is located on the roof of Building 301) and are automatically ingested into the server. The former PCGrafax software is incorporated into MIDDS for DIFAX chart manipulation. GOES imagery is currently received via a variety of Internet sites along with GVAR availability for various satellite imagery. Again, the software to process the imagery is incorporated by Marta into MIDDS. The system is also capable of continuously ingesting CMW data and processing NODDS and OPARS via modem link to FNMOC Monterey.

MIDDS runs on a dual Pentium machine with 64 MB RAM and a 2 GB hard drive. The Forecaster and Server terminals utilize high-resolution 21-inch monitors. The software is from Marta Systems, contracted by NAVOCEANO. In the near future, ASOS and LPATS will be incorporated into the MIDDS software package, as well as weather warning plots.

When the fiber-optic LAN is completed to Building 301, NPMOD will have the capability to send weather products, including the local daily forecast and any product available through MIDDS, to various sites around base. At that time, MIDDS will become our primary tool for ingesting and disseminating virtually all weather-related information.

CMW/AWN - This system connects NPMOD with the nationwide CONTEL meteorological network. It consists of two microcomputers that automate the retrieval, filing, creation, editing, and transmission of weather and aviation data. The Network is controlled and monitored by the USAF Automatic Digital Weather Switch (ADWS) at Tinker AFB, OK. The send/receive terminals are located in the Forecaster and Observer Areas, with printers located in the Observer Area and flight planning spaces, allowing dedicated NAMSUM and NOTAM summaries. The satellite receiver antenna is located at ground level at the southwest corner of Building 301.

Weathervision. This system is currently our primary means of disseminating weather information around NAS Fallon. It is run on a dedicated Micro Q CPU running a Pentium Processor utilizing a Power Point presentation format. Remote 14-inch color console repeaters are located in NSAWC, Building 800 (TRACON/RADAR), Building 466 (TOWER), and in Hangers 1, 2, 3, and 4. This system displays current NAS Fallon weather, warnings, bingo weather, a 24-hour forecast, winds aloft, an electromagnetic propagation summary, advisories, NOTAMS for fields of interest, and field maximum PA/DA. Additionally, satellite imagery, radar imagery and various other forecaster directed graphics are being incorporated into the weathervision presentation to provide full spectrum support/information. The main console is located in the pilot briefing area on the same shelves as LPATS and MMDDS.

Pilot to METRO Radio - The Pilot to METRO system is located at the Forecaster’s workstation. Operating at an assigned frequency of 324.8 MHz, METRO is utilized to provide flight crews flying over the local area with weather data for their destination or other areas of interest. Additionally, Pilot Reports (Pireps) are taken and disseminated via AWN. Weather brief updates and current field weather are also provided via METRO to support aircraft operating locally.

Multi-Monitor Data Display Station (MMDDS) - This system is a set of four 17-inch monitors driven by a dedicated CPU and displaying information from the MIDDS server. It is used to continuously display weather information (imagery, NEXRAD mosaics, charts, etc.) for use by both NPMOD personnel and our various customers. It is located on the shelving separating the Forecaster and Observer Work Areas. Currently, the Weathervision and LPATS Monitors are located on the same shelving. The display is controlled as any other MIDDS workstation. Products displayed at any given time are at the discretion of the Forecast Duty Officer.

OPARS and NODDS. - These FLENUMETOCCEN Monterey systems are accessible from MIDDS via modem link, either using DSN phone lines, commercial lines, or the NIPRNET. The software to use NODDS is kept up to date on the MIDDS server. Forecasters are highly encouraged to utilize the full range of NODDS products, which may be printed at high resolution on the HP-5 printer, for forecasting and briefing. The Optimum Path Aircraft Routing System is available via MIDDS for pilots desiring fuel load planning assistance.

G. Commands and Staffs Supported. The busiest periods of support by NAVPACMETOC DET Fallon are during the nine to eleven **Carrier Airwings (CVWs, or CAGs)** per year that deploy to NAS Fallon. They conduct an intense and specialized three-week training process, which takes advantage of the outstanding weapons ranges and warfare training facilities at and near NAS Fallon. This training is coordinated by the Naval Strike and Air Warfare Center (NSAWC) and includes stand-up flight briefs at NSAWC as well as numerous phone and face to face briefs. Between CVW deployments, the Detachment provides environmental support to numerous squadrons or squadron detachments deploying to NAS Fallon for training, and support is provided to an increasing number of joint exercises, including the annual Desert Rescue exercise.

NPMOD Fallon supports **NAS Fallon** by providing daily local area forecasts, daily range forecasts, terminal aviation weather forecasts, weather warnings and advisories, scheduled and special weather observations, flight weather briefing services for the station C-12 and SAR Helo crews, seasonal climatology briefs when requested, and historical weather data services. Also, Instrument Ground School lectures for pilot recertification are provided to station pilots, as well as any other pilots based at NAS. These are done on an as requested basis.

Support is provided to the **Naval Strike and Air Warfare Center (NSAWC)** in the form of strike weather briefs during CAG visits, weather briefings for NSAWC pilots, climatology studies for the Contingency Cell, and Electro-Optical Tactical Decision Aid (EOTDA) predictions. A close liaison with the NSAWC Operations and Training departments is essential to insure that NPMOD support is complete and appropriate.

NAVPACMETOC DET Fallon provides weather forecasts and flight weather briefings (DD-175-1) upon request to the **U. S. Marine Corps Mountain Warfare Training Center** located 25 NM west-northwest of Bridgeport, CA in the Sierra Nevada Mountains at an elevation of 6800 feet (Figure 1). During summer thunderstorms and winter snowstorms, Bridgeport can have very different conditions from Fallon and particularly careful attention must be given to this service.

Additionally, NPMOD Fallon provides upon request weather forecasts for **Sierra Army Depot** in Herlong, CA, and the **U. S. Army Ammunition Depot** in Hawthorne, NV.

H. <u>Manner of Support</u>. In accordance with NASFINST 3140.1( ), the Forecast Duty Officer (FDO) shall notify appropriate Air Station and Fallon Range personnel of forecast weather conditions that are anticipated to meet a variety of warning or advisory criteria. Recommendations to set appropriate readiness conditions are made by the FDO to the NAS Fallon Operations Duty Officer or to the Operations Officer. After normal working hours, the NAS Fallon OOD will be the point of contact for such notification.

Flight Weather Briefings (DD-175-1) are available via Telephone, FAX, over-the-counter, or via METRO radio and are conducted in accordance with NAVMETOCCOMINST 3140.14( ).

U. S. Navy Flight Forecast Folders (Horizontal Weather Depiction "HWD") are prepared upon request by NAVPACMETOC DET Fallon Forecasters in accordance with NAVMETOCCOMINST 3140.14( ).

OPARS -(**Optimum Path Aircraft Routing System)** is provided to flight crews upon request. Users Manual FLENUMETOCCOMINST 3710.1( ) provides specific procedures for obtaining OPARS.

TAF - **Terminal Aerodrome Forecast** is issued for a 24 hour period for NAS Fallon and is prepared in accordance with NAVMETOCCOMINST 3143.1( ) and transmitted on the AWN at 0300Z, 0900Z, 1500Z and 2100Z.

FOUS KNFL - Target Range Planning Forecast is a 24 hour forecast issued in a plain language format with TAF format applications (refer to appropriate SOP for further information) and transmitted via the AWN twice daily at 1500Z and 0300Z during PST (and at 1400Z and 0200Z during PDT) in accordance with NAVPACMETOC DET Fallon's Standard Operations Procedures.

Upper Air Soundings - Soundings are obtained in two ways for use at Fallon. For day to day upper air data, the synoptic sounding from Reno is used. When operations dictate (especially during a CAG training period), or at the discretion of the FDO, a local launch is done. The data from both of these sources is entered into the Geophysics Fleet Mission Program Library (GFMPL) for the computation of various products, including sound focus (SOCUS) and IREPS predictions. They, of course, are also important tools for providing accurate upper level wind information to all users.

Specialized Forecasts/Products may be provided for any of the products available on GFMPL. Also, NPMOD now does a large number of Electro-Optical Tactical Decision Aid (EOTDA) forecasts, especially during CVW training periods. This program makes predictions, based on atmospheric conditions, as to the detection and lock-on ranges that an aircraft will see for a given target, with a given sensor (TV, IR, or laser). The current TAF is the meteorological input for the program, while intelligence data (aircraft type, sensor, target details, etc.) must be obtained from the requesting individual.

Climatological and Astronomical Data may be provided upon request for any location that is included on the latest climatological CD-ROM from FNMOD Asheville, NC. If the data being requested is unavailable locally, the customer should be referred to Asheville.

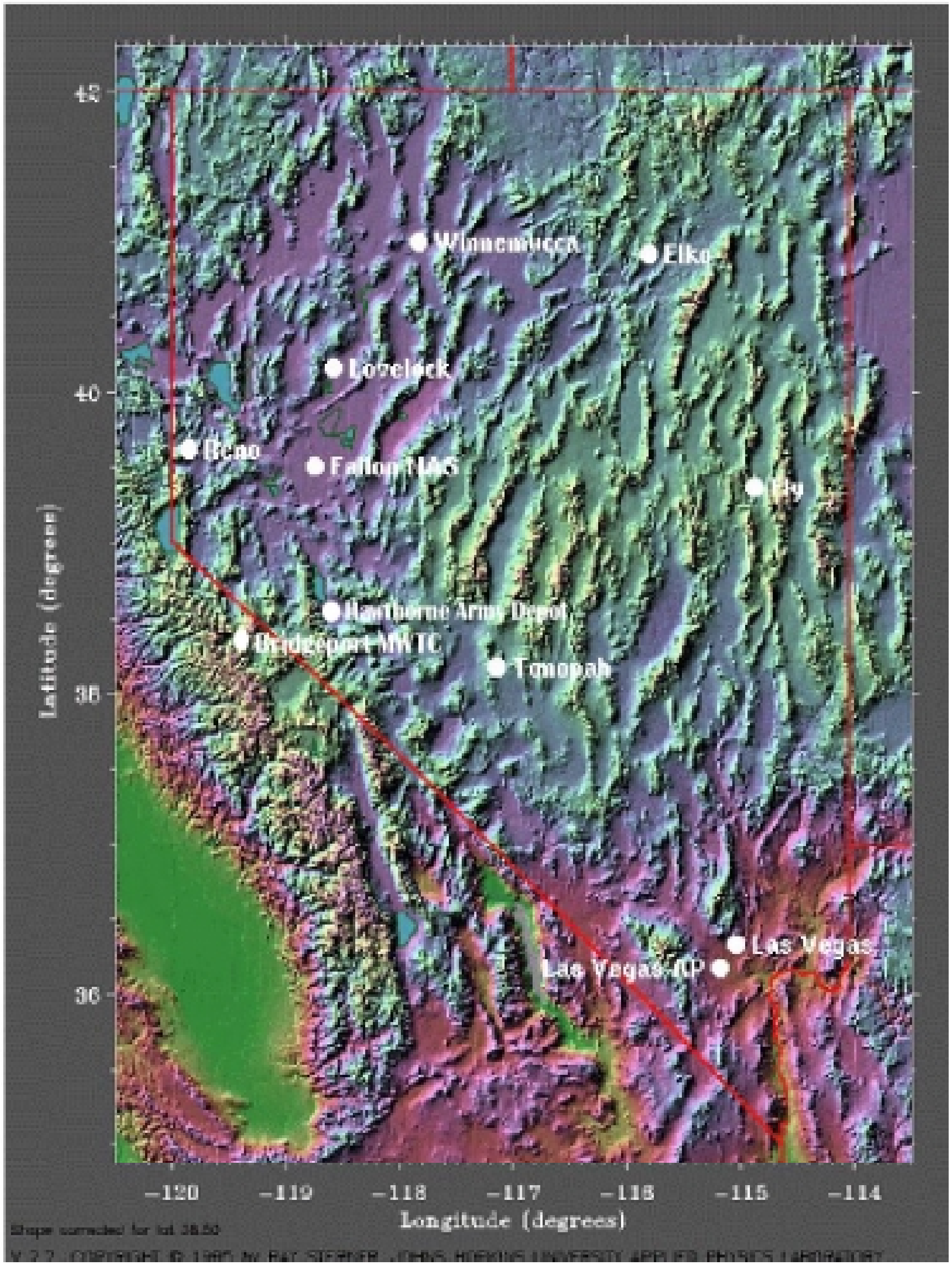

Figure 1 – Topographic Locator Map

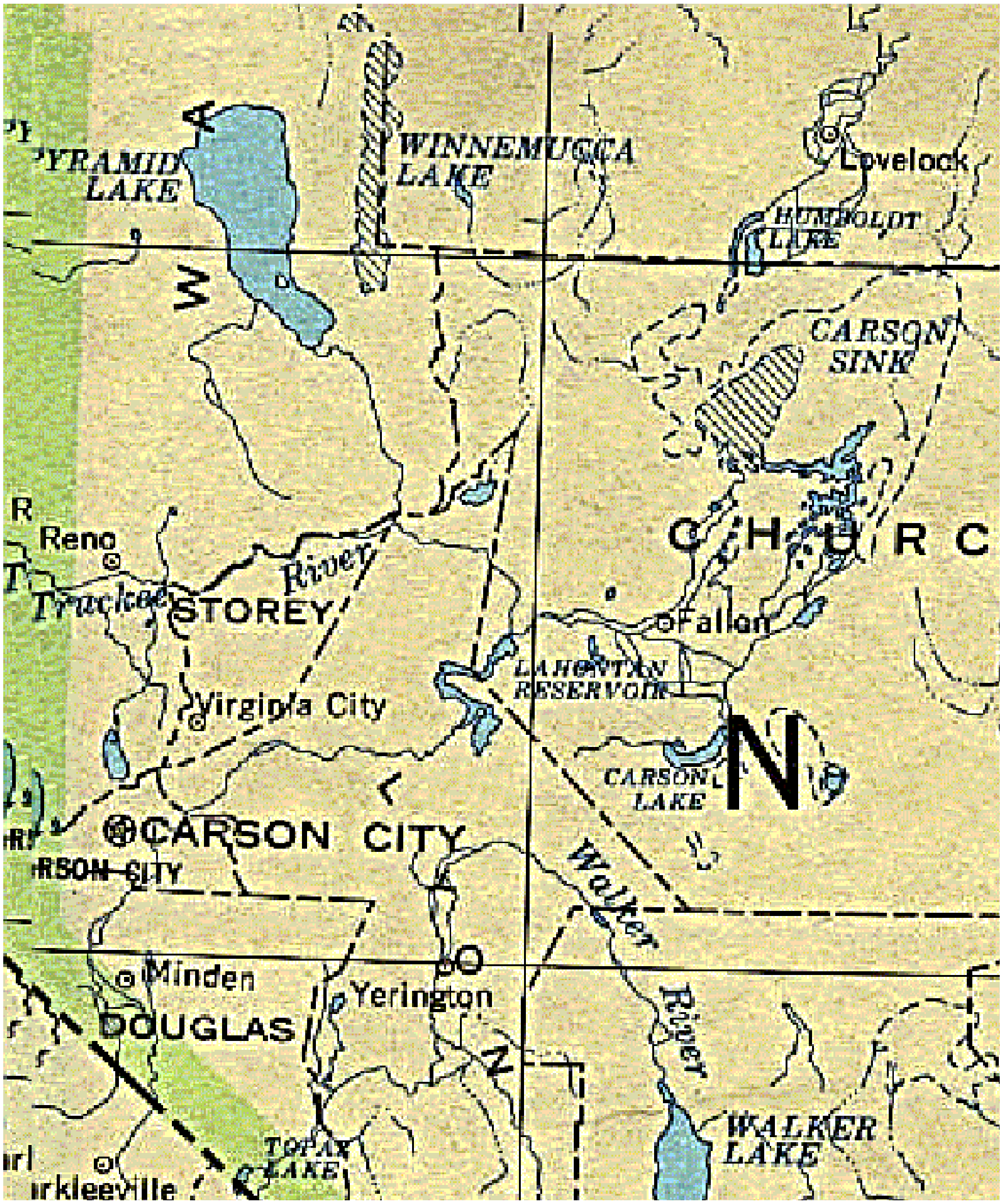

Figure 2 – Locator Map

Counties and Independent City

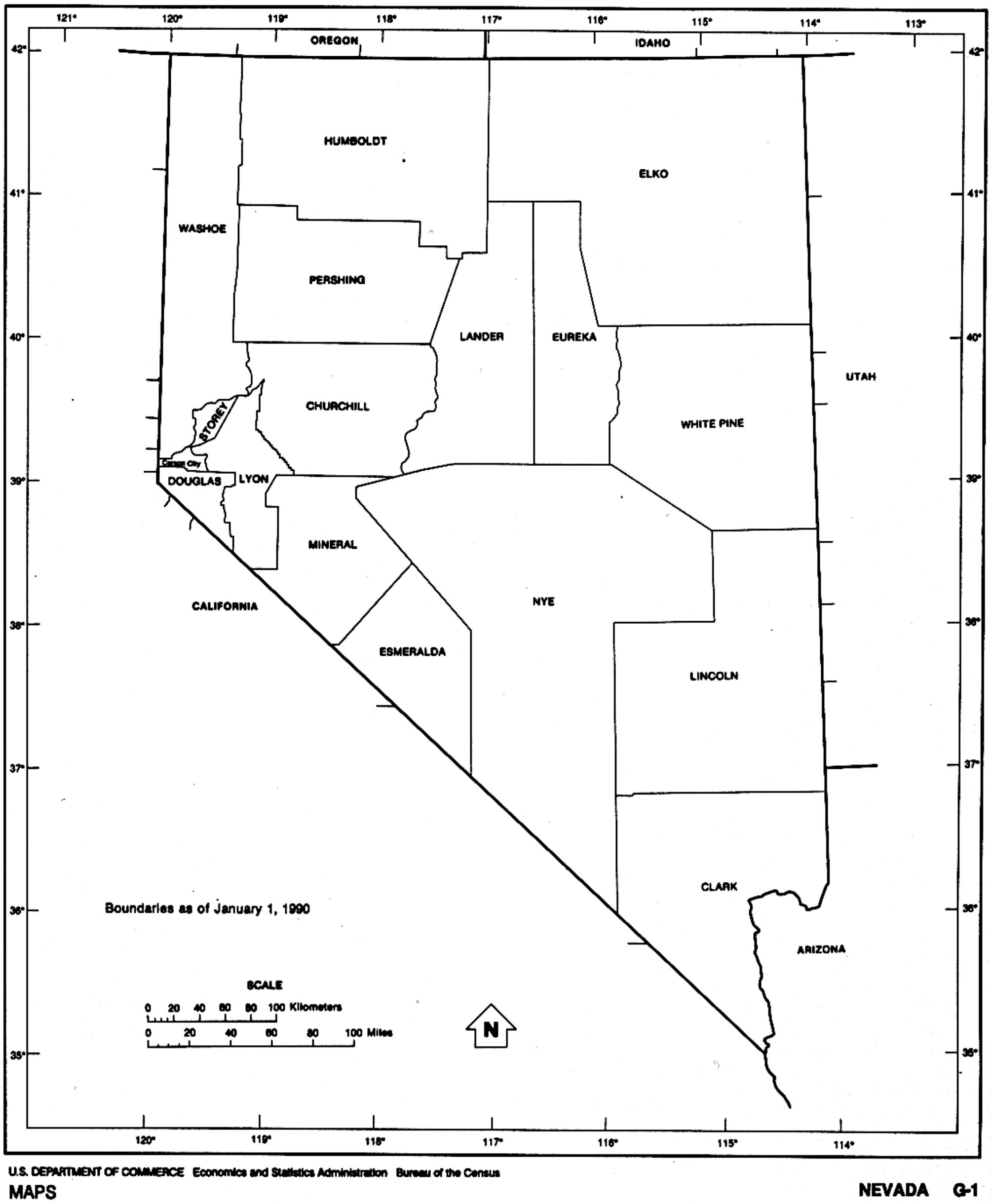

Figure 3 – Nevada Counties

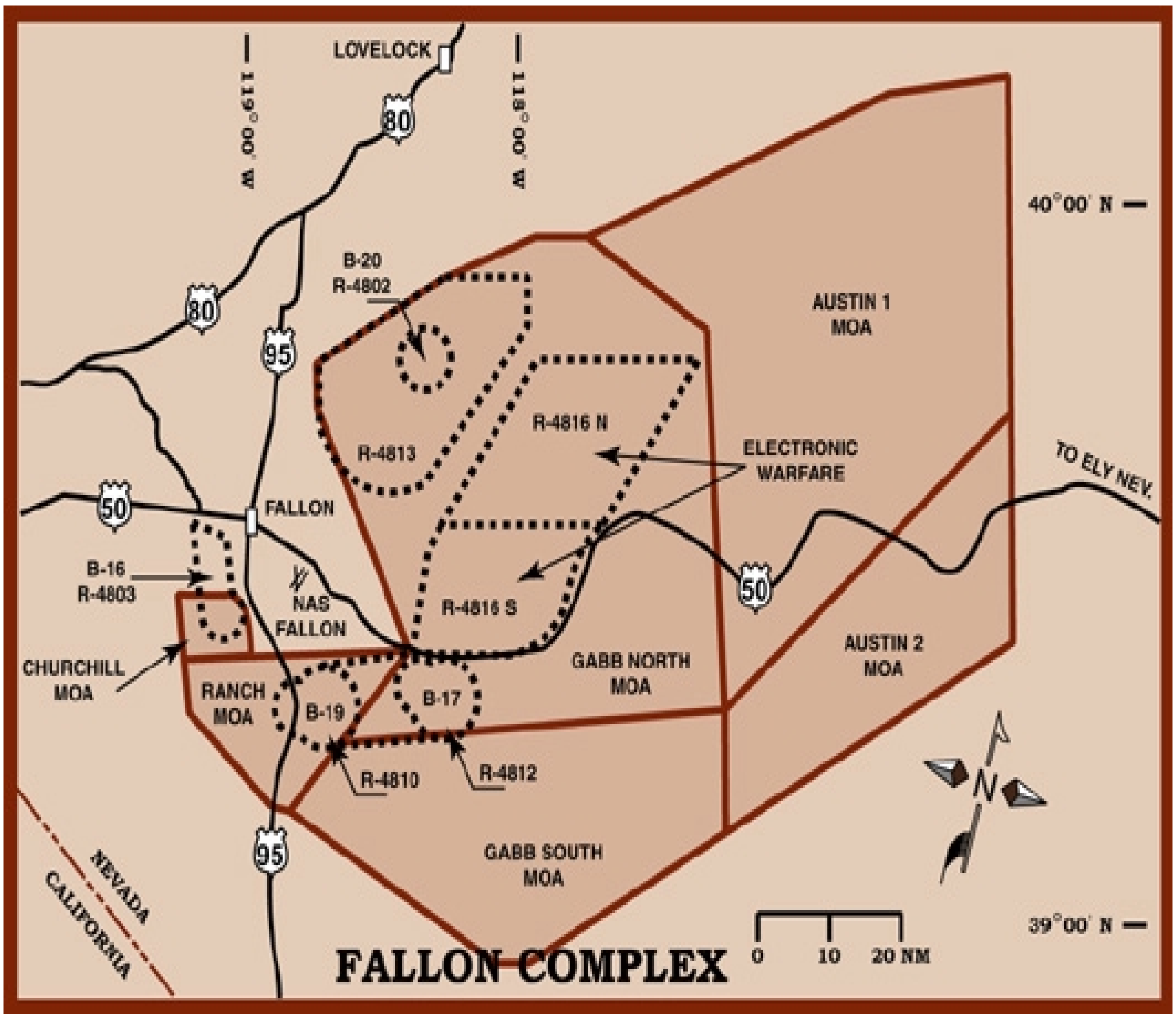

Figure 4– Military Operating Areas (MOAs)

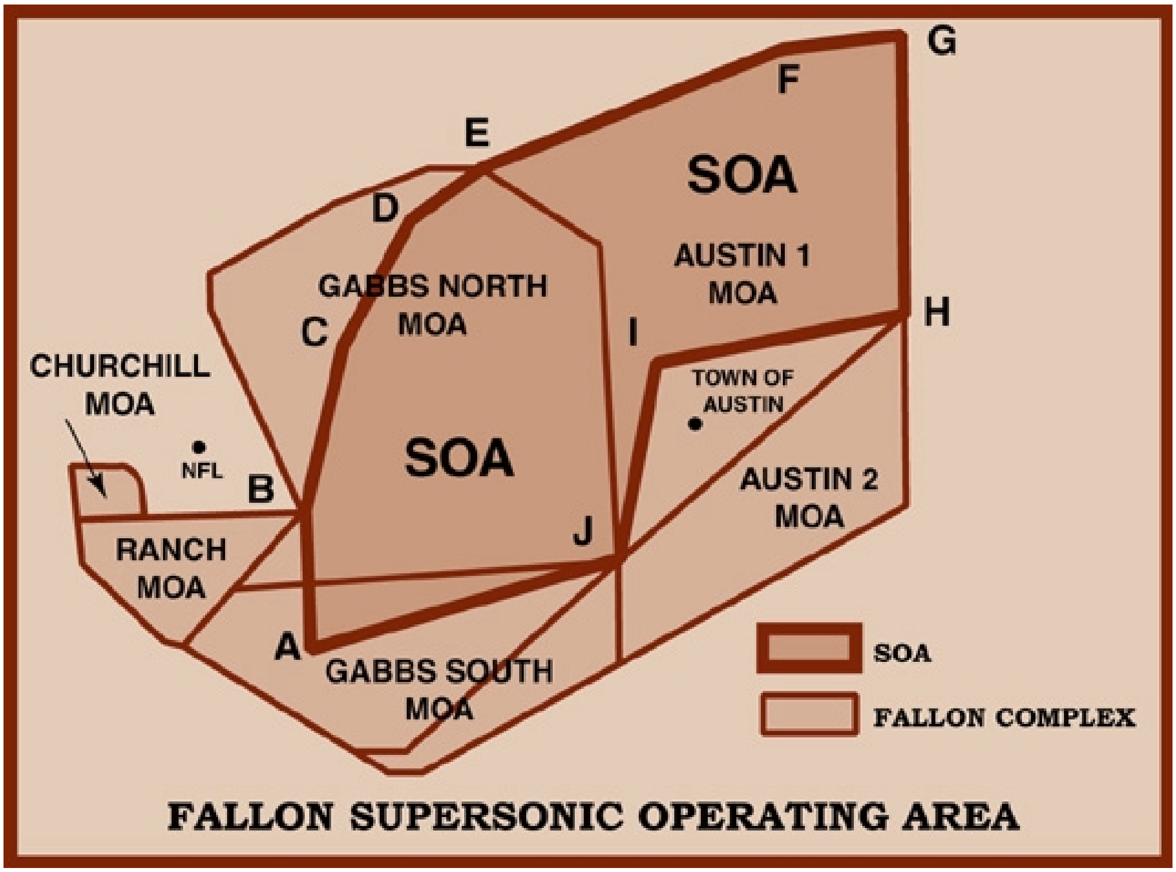

Figure 5– Super Sonic Operating Area (SOA)

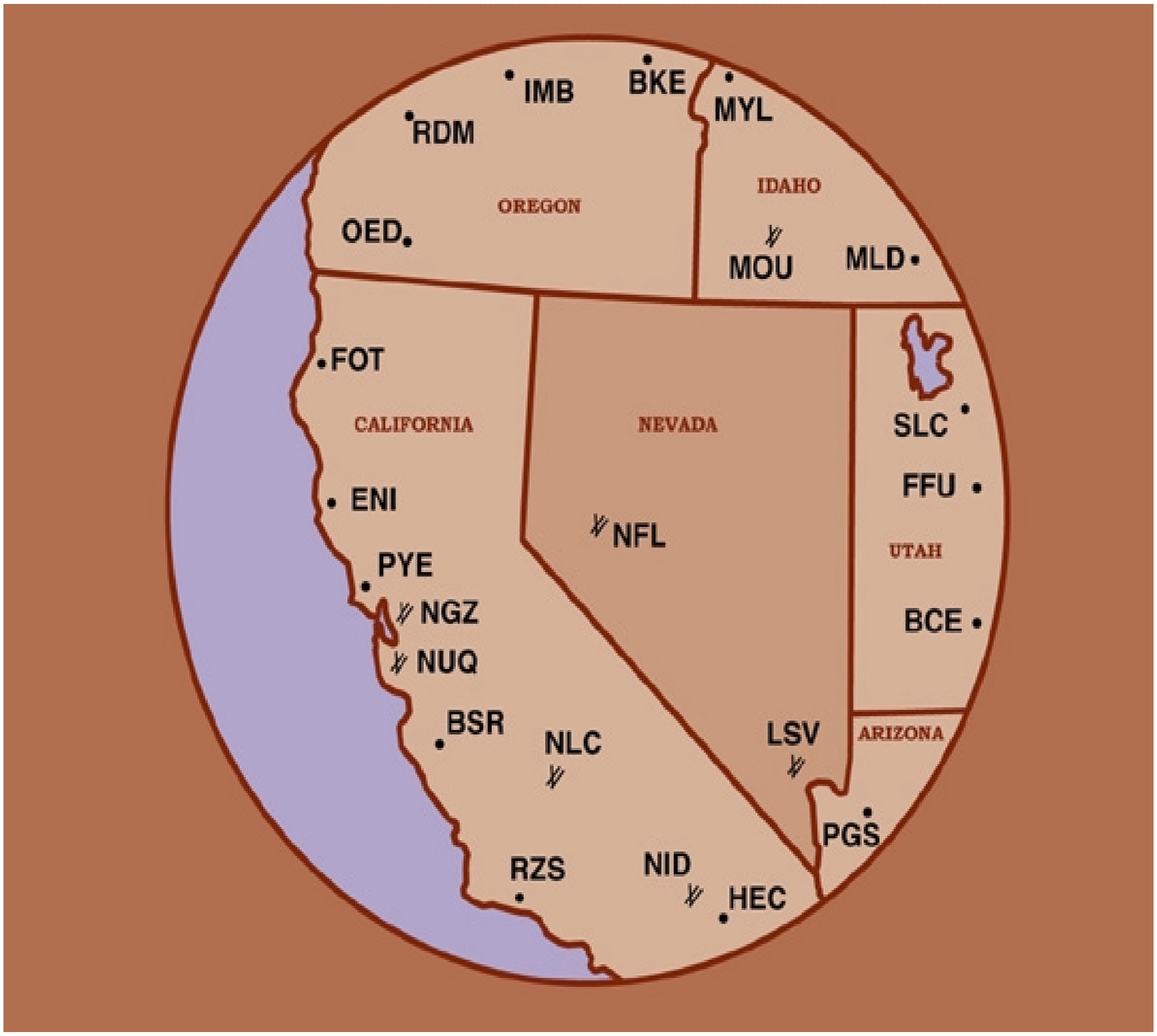

Figure 6 - NAS Fallon Local Flying Area

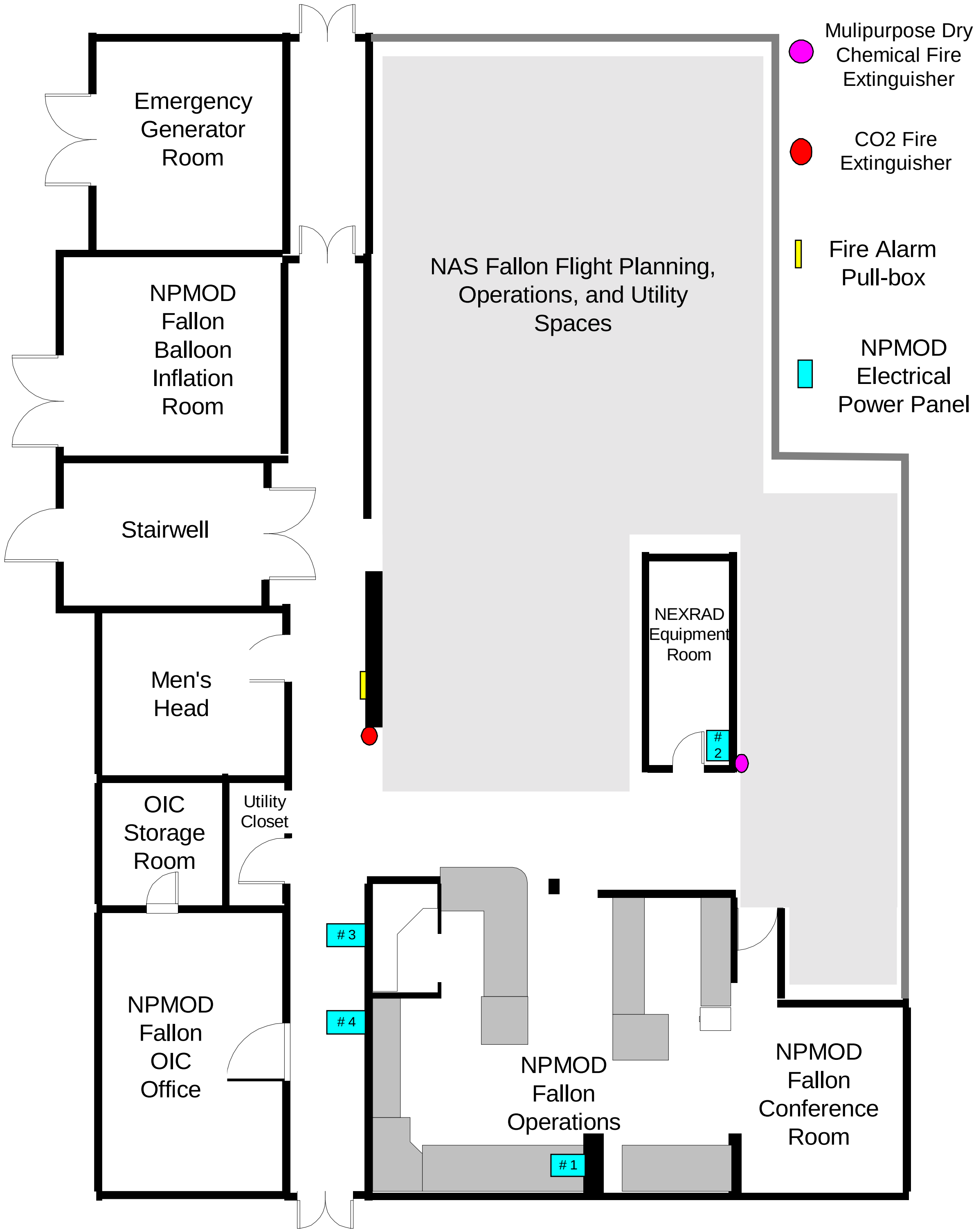

Figure 7 – NPMOD Fallon First Deck (Bldg 301)

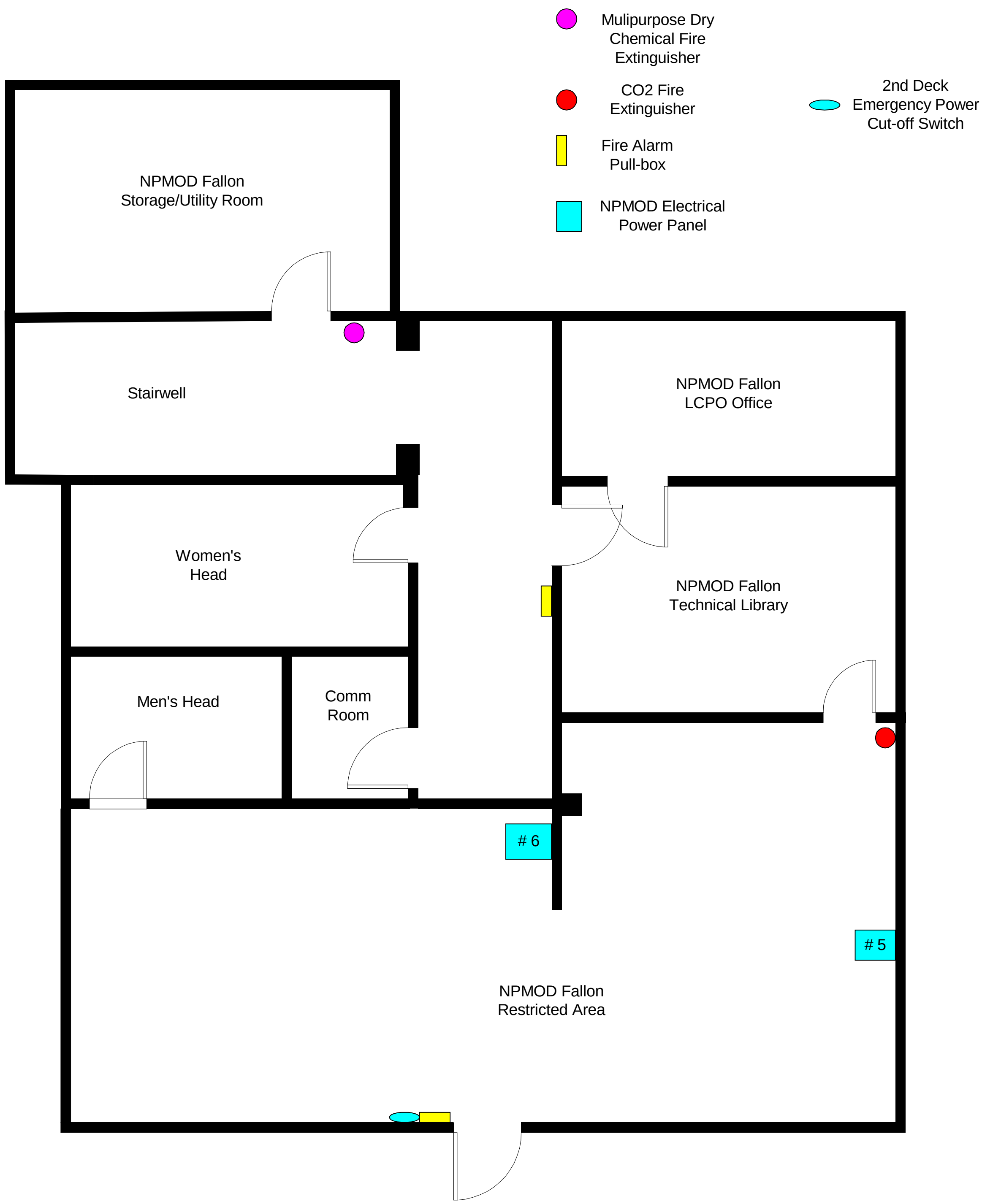

Figure 8 – NPMOD Fallon Second Deck (Bldg 301)

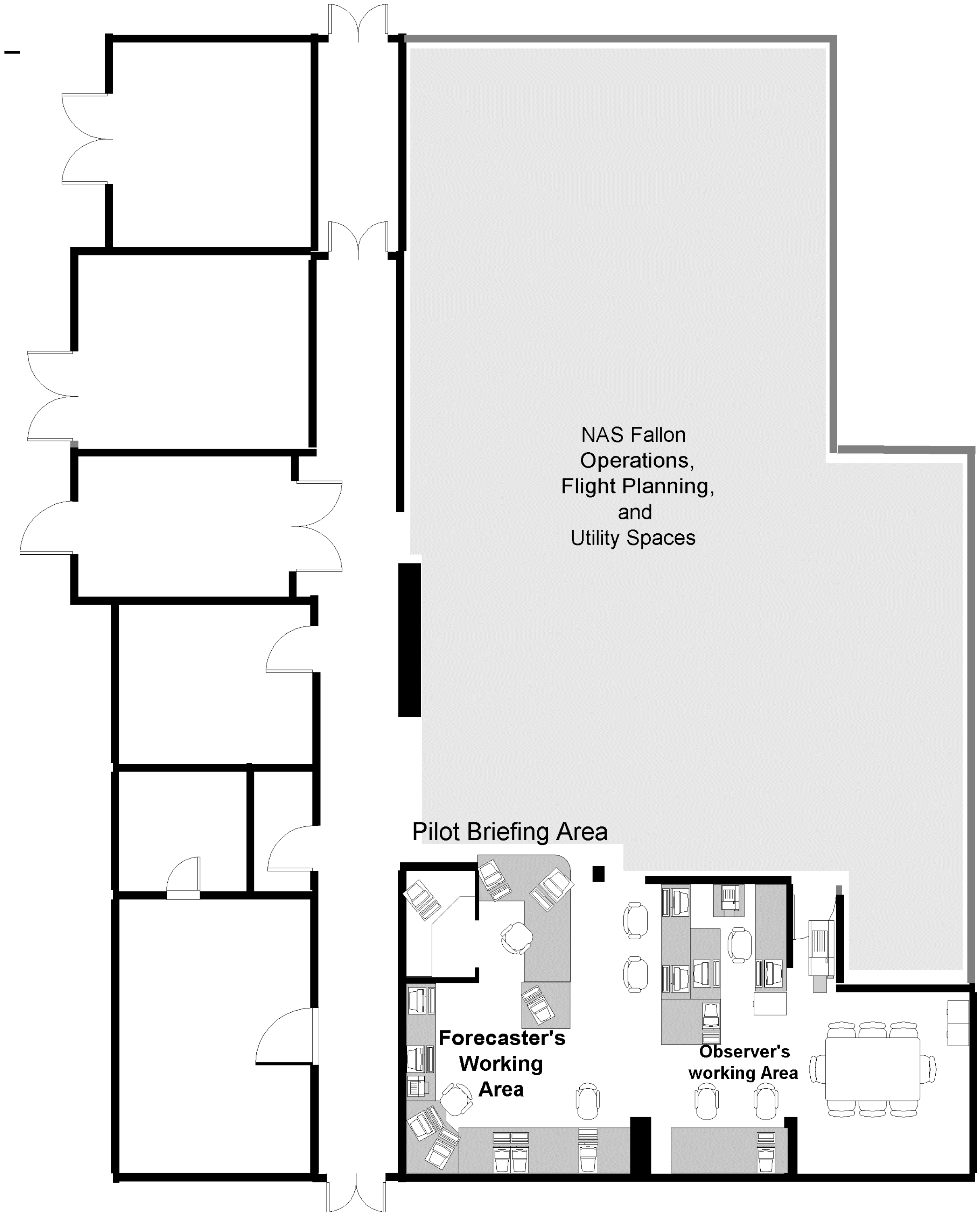

Figure 9 – Forecaster/Observer Work Areas

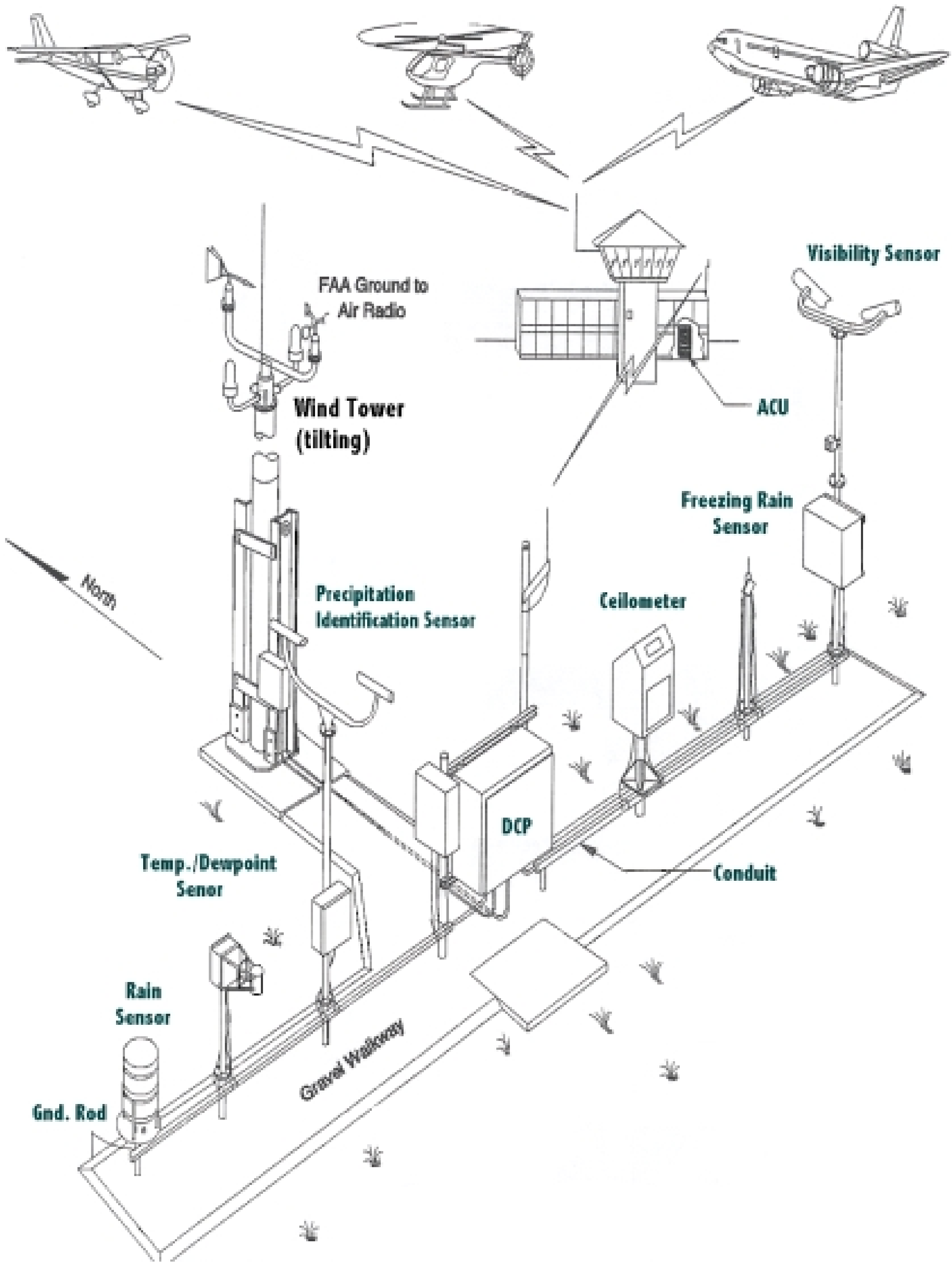

Figure 10 – Automated Surface Observing Station
(Remote Sensors)

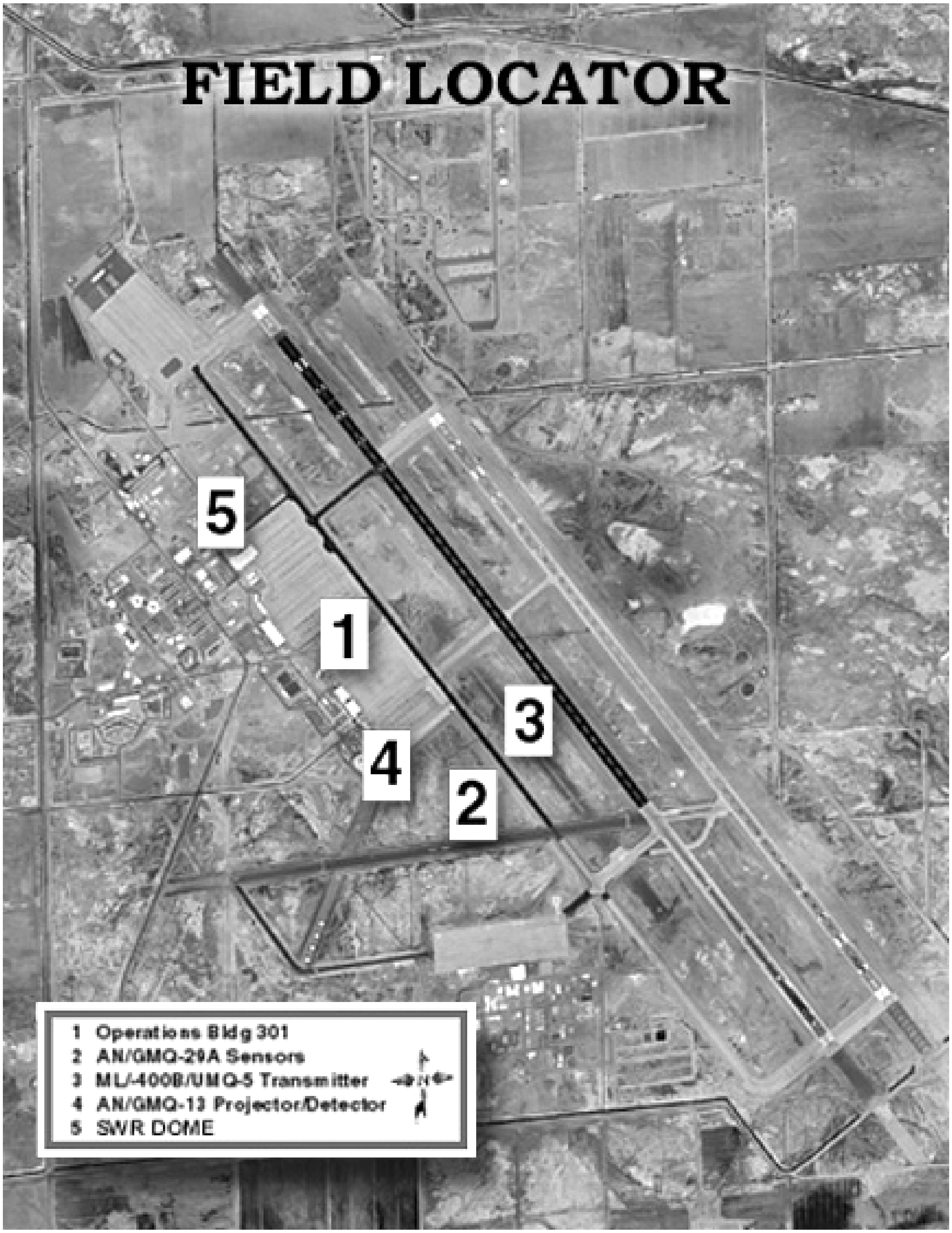

Figure 11 – NAS Fallon Airfield Locator

SECTION II - CLIMATOLOGY

A. **General**.

Nevada offers extremes of weather and climate not normally found in other states. Cut off from the moisture of the Pacific by the Sierra Nevada and Cascades mountain ranges, and from the moisture of the Gulf of Mexico by the Rocky Mountains, it is the driest of the fifty states. Because it lies within the zone of interaction of tropical and polar airmasses, Nevada also has marked seasonal and day-to-day temperature contrasts typical of the mid-latitudes. With more mountain ranges than any other state, Nevada's weather is also strongly dependent on specific location, since elevation is a major factor in determining climatological norms.

Naval Air Station Fallon lies in a high desert basin that is the remnant of an ancient Pleistocene lake. The terrain is largely alkali flats and sand dunes with numerous dry lakes and marshes dotting the area. Characteristic vegetation includes greasewood, shadscale, and sagebrush. Much of the land in the immediate Fallon area is irrigated and farmed, with alfalfa being the primary crop.

In winter, moisture-laden air masses that move inland from the Pacific Ocean are rapidly modified as they lift orographically over the Sierra Nevada and Cascades mountain ranges. Significant precipitation events are recorded on the western slopes during these storm passages, often leaving the frontal passage in the Fallon area as primarily a wind shift and temperature fall, with little or no precipitation.

A summary of the typical seasons experienced at Fallon is provided here:

Winter is characterized by sunny, dry weather, interrupted by periods of extensive cloudiness and cool to cold temperatures. Winter-like weather will generally persist from mid-November through mid-March. Passing frontal systems will typically cause a temperature fall and winds will shift to northwesterly, northerly, or even northeasterly. These frontal passages may produce gusty winds and scattered to broken mid-level cloudiness. But they will generally produce only light precipitation, if any. Zonal flow during the winter months produces fast moving low pressure systems impacting the Sierra Nevada and Cascade mountain ranges with abundant moisture, severe turbulence and icing conditions. However, as mentioned previously, much of the moisture will be depleted by the time the system reaches NAS Fallon. The typical winter storm track is generally located to the north of Fallon, bringing only the peripheral effects to our area.

Precipitation averages 0.5 inches per month during the winter, falling usually in the form of light showers. Snowfall exceeding 2 inches seldom occurs. Intense sunshine and warmer maximum temperatures usually melt any accumulated snow within a day or two. Fog is an occasional phenomenon after the passage of a precipitation event, but it rarely persists beyond the morning hours.

This typical pattern can be offset by rather extreme winter conditions. Periods of very warm temperatures with highs of 60 degrees F or more are not uncommon. Very cold periods, with highs not reaching above freezing, generally accompanied by extensive cloudiness are also possible. Fallon's record low temperature is -23 degrees F. Heavier snowfalls with accumulations of 8 or more inches can also occur, but generally only once every three to five years. Extended periods of winter fog, lasting a week or more have been known to occur as well. Also, longer periods of unsettled weather may occur, due to upper level lows that can sit off the California coast for a week or more.

The contrast between cold airmasses to the north and rapidly warming air to the south makes **Spring** a windy and unsettled season in western Nevada. Winter-like upper level systems may effect the area for extended periods, only to be replaced by a strong ridge associated with a summertime pattern. From mid-March to mid-June, a dramatic range of conditions is possible. The most predominant feature of the weather during this period is generally the wind, which can reach warning criteria for several days at a time, with associated blowing dust and sand contributing as a significant obstacle to local aviation. Thunderstorms also become a very real possibility during this season, especially toward the end of this period.

During the **Summer**, hot dry weather dominates. Frontal systems with any significant weather are extremely rare, as a strong ridge extends over the area from the eastern Pacific. Airmass thunderstorms become the primary forecast problem during this period, which typically lasts from mid-June to mid-September. These will often develop late in the afternoon in the mountains south of Fallon, but may kick off most anywhere in the area. Strong, gusty winds associated with thunderstorm cells often produce dust storms of short duration, which briefly reduce visibilities to less than 3 miles. Small hail and heavy rain are possible, but more often the precipitation is light and brief. Thunderstorm activity is primarily associated with periods of southerly flow that advects moisture up from the Gulf of California. When the flow is more zonal, summer weather is characterized by very dry conditions and high temperatures. Dust devils are frequent during the day. In July and August the daily maximum temperature is consistently above 90 degrees F. The record high temperature for Fallon is 108 degrees F. Low humidity prevails, producing heat indices that are typically lower than the actual temperature. The high altitude and low dew points of the area allow cooling of as much as 40 degrees F from the day's maximum temperature.

As summer wanes, the strong ridging aloft begins to break down and the area enters a transition period where frontal systems begin to effect the weather to varying degrees. Thus, **Fall (Autumn)** is also a time of great variability. The months of October and November can be warm and pleasant, often referred to as "Indian Summer", but the threat of very winter-like weather conditions still persists.

B. Geographic and Topographic Influences

Nevada is a land of very complex terrain variations over short distances. Flat valleys at 3,900 to 5,500 feet in elevation are broken up by a variety of low foothills extending into mountain ranges with elevations as high as 13,000 feet. Many of these foothills and ranges are closely spaced (an average separation from ridge top to ridge top is often about 18 miles), causing the climate of the entire state to be highly influenced by their presence (Figure 1).

Due to this mountainous terrain, low-level moisture advection is often deterred. This can serve to trap winter fog within the valleys, deter winter convective activity from reaching into Nevada that can occur to the west, and in general can create very different conditions from one side of a mountain range to another, especially during the winter months.

Subsidence during the winter months occasionally results in warm air aloft acting as a capping mechanism over the lower valleys of the state. Although this condition develops infrequently, it does result in a Stratus event which produces low ceilings that can persist for several days to as long as a week or so when winds are insufficient to scour the valley areas free from these clouds.

Moist air and thunderstorm activity can move into southern Nevada when a high pressure area centered to the east of the state over the Four Corners area advects subtropical air northward from southern California. Due to multiple mountain ranges between Fallon and the source of the moisture, much of the thunderstorm activity from southern Nevada generally tracks to the east of Fallon. Thus, NAS Fallon experiences an annual average of only 13 thunderstorm days, while Ely, in eastern Nevada, records an average of 30 thunderstorm days per year.

Winds will often increase from the west during periods of maximum heating. This is primarily due to the fact that an extensive alkali flat, known as the Forty Mile Desert, lies between Fallon and Lovelock. The flow is established in the afternoon by cooler air draining eastward from the Sierra Nevadas into this area. Also, daytime surface heating and convection cause the higher winds aloft to be “mixed down” to the surface in the afternoon.

NAS Fallon presents a unique challenge to forecasters. It is essential that all forecasts be made with full consideration of these topographic effects. Forecasters must be very familiar with the local terrain. Typical mid-latitude or coastal methods simply do not work in this high desert mountainous terrain.

C. Special Meteorological Features

1. **Circulation Patterns.** Nevada lies in the belt of prevailing westerly winds. These winds are strongest and most constant in the atmosphere above the earth's surface at heights of 10,000 feet or more. Figures 12 and 13 depict the prevailing pattern of winds near the 18,000 foot level in January and July, respectively, over the western U. S. In January, the Polar Front is located in the vicinity of Nevada, marking the transition area between the cold, low pressure of the arctic to the warm, higher pressures of the subtropics. This dramatic height change in the upper levels over a relatively short distance causes the strong prevailing westerlies characteristic of Winter. The core of strongest winds in this belt is called the jet stream, in which speeds of more than 100 knots are common. The location of the jet plays a vital role in the movement of weather systems.

Due to a reduction in contrast between the poles and the subtropics, and a retreat of the polar air northward in summer, the flow aloft is much weaker. It is typically oriented more out of the southwest, or even south, as shown in Figure 13.

a. **Winter Circulation Pattern.** The average January pressure pattern at the surface is shown in (Figure 14). During the winter the Aleutian and Icelandic lows are well developed, and the Pacific and Bermuda highs are weaker and lie further south than in summer. Pressure is generally high over the cold continent, causing the seasonal Great Basin and Arctic highs. The Aleutian Low is an area of almost constant stormy weather. In contrast, fair weather is common in the high-pressure belts of the continent, though periodically interrupted by storms that will “spin off” from the semi-permanent Aleutian Low and follow the jet stream.

b. **Summer Circulation Pattern.** The summer surface pressure pattern shifts northward as shown in (Figure 15). The subtropical highs at the surface dominate most of the North Pacific and North Atlantic Oceans, while the subpolar lows are much weaker and lie over the Arctic regions. Storm tracks lie mostly over Canada. A dominant feature of the average surface map in summer is the thermal low centered in the southwest deserts and extending up the Central Valley of California. This is a dry feature caused by intense heating and has little effect on local weather. Summer weather is governed to a much greater extent by the upper level pressure pattern, as discussed previously. Summer precipitation over Nevada comes mainly as showers associated with the advection of warm moist air from the Gulf of Mexico, the Gulf of California, or the tropical Pacific Ocean.

In Nevada the summers are dry despite the proximity of the Pacific Ocean. Two major climatic controls are responsible for these dry summers. First, the Pacific subtropical high is in a position to block storms from entering the area; and second, the cold California Current keeps the sea surface temperatures low along the west coast. With cold surface water the air is very stable; in other words, it will not rise unless forced to do so because the heaviest, coolest air is near the surface. Precipitation, which is associated with rising air, will therefore not occur unless a low-pressure center passes through the region, a rare phenomenon in the summer.

2. **Air Masses.** In Nevada, five different types of air masses may be seen during the course of the year. They show marked variation in seasonal occurrence, and some types are more common than others in the total weather picture. Figure 16 depicts the major air flow patterns and air mass types affecting Nevada.

a. **Continental Arctic Air Mass.** The continental arctic air mass is the rarest and is confined to the winter months. It develops over the Canadian Arctic, where temperatures are extremely cold, then moves southward into the U. S. Although Nevada's climate is basically continental, most arctic air masses are blocked out of our area by the presence of the Rocky Mountains and by prevailing westerly winds. Arctic air thus penetrates Nevada rarely, but can bring subzero weather to the northern and central parts of the state, including Fallon.

b. **Continental Polar Air Mass.** This is much more common in western Nevada. It brings cool dry weather with subfreezing nights in the fall, winter, and spring. From November to April it is the most common air mass. Continental polar air is normally associated with northerly winds from western Canada or with stagnant Great Basin highs. During the months when it is most common, it alternates with maritime polar air from the Pacific Ocean.

c. **Maritime Polar Air Mass.** Maritime polar air is the chief source of precipitation in Nevada. It generally brings cloudy, wet weather into Fallon in the form of Pacific storms. Since these storms are transitory in nature, maritime polar air normally remains over Nevada for shorter periods than continental polar air. However, it is the second most common air mass in the winter and spring months when precipitation is heaviest. From December to March, much of the precipitation from maritime polar air in northern and central Nevada falls as snow.

d. **Maritime Tropical Air Mass.** Maritime tropical air occurs mainly in the summer and is relatively uncommon for the year as a whole. During the late fall and winter, abnormally warm, moist air occasionally penetrates the area from the tropical Pacific Ocean, bringing heavy precipitation with rain, rather than snow, even at high elevations in the mountains. Such storms may cause major flooding in northern California and western Nevada, but they occur only rarely, once or twice in a given winter. The last significant occurrence resulted in a significant rainfall in late December 1997, causing widespread melting of the Sierra Nevada snowcap, resulting in extensive flooding of the Truckee and Carson Rivers that persisted through the first several weeks of 1998. This caused extensive flooding and extensive damage throughout western Nevada, in particular affecting the Reno area with areas of flood waters engulfing the lower valley regions for several weeks. Local affects from this "El Nino" event were evidenced by large portions of the areas surrounding NAS Fallon's Ranges remaining under water for the bulk of the winter. More commonly though, maritime tropical air is associated with local thunderstorms in July, August, and September when moist air flows northwestward into Nevada from the Gulf of Mexico or the Gulf of California.

e. **Continental Tropical Air Mass.** By far the dominant warm air mass is continental tropical air, which occurs on more than half of all days from May to October. It brings sunny, dry weather for prolonged periods during the warm seasons, when entire months may pass without measurable rainfall. Continental tropical air masses are associated with the subtropical high pressure belt, although the extreme heat in the Desert Southwest gives rise to a shallow, stagnant thermal low at the surface. Much of Nevada is a source region for this type of air in the summer.

3. **Cyclones and Troughs.** Western Nevada is affected by several definitive cyclone and trough scenarios. They are (a) extratropical maritime cyclones of the Pacific, (b) upper air cutoff lows off the California coast, (c) the summertime thermal trough or heat low of the southwest deserts, and (d) the Nevada low.

a. **Extratropical Maritime Cyclones.** These affect western Nevada during the late fall, winter, and spring. Figure 17 depicts the average cyclone tracks over the U. S. during the winter. Depending on the steering flow aloft, there are two basic maritime cyclone tracks to consider: tracks associated with meridional flow (north-northwest) and those with zonal flow (westerly).

(1) **Meridional Flow.** Meridional flow generally develops when a ridge dominates the basic flow pattern in the east-central Pacific with the ridge line often tilted in a northwest-southeast direction and the longwave moving onshore. As seen in Figure 17, most extratropical cyclones form over the northeastern Pacific and move toward the northeast along the Polar Front. The center of the cyclone generally makes landfall along the northwest coast of the U. S., Canada, or Alaska. The effect seen in western Nevada is generally that of the cold front associated with the cyclone center, as opposed to the low itself. Since polar outbreaks are strongest in winter, it is then that more intense and frequent frontal passages occur. During early Fall, late Spring, and summer, when polar outbreaks are less severe and less frequent, fewer and much less intense frontal passages are experienced at Fallon.

(2) **Zonal Flow.** If the Pacific High recedes further south than normal, during the winter months the Polar Front will move south and lie in an east/west orientation at the approximate latitude of San Francisco.
Zonal flow aloft will steer rapidly moving shortwaves onto the California coast. If the shortwave is strong enough, it will be reflected as a surface wave on the Polar Front west of San Francisco. As waves move rapidly eastward they will produce severe turbulence and icing over the Sierra Nevadas, while abundant moisture associated with the system will often produce blizzard conditions. Snowfall of a foot or more in the mountains is common. The Fallon area will generally experience only cloudy skies, gusty surface winds causing reduced visibilities in blowing dust/sand, and occasional showers of rain or snow.

b. **Cutoff Low.** Cutoff lows are associated with a blocking situation at upper levels, such that a sharp ridge is located west of the longwave trough, or cutoff low position, oriented southwest to northeast at 500 millibars. As cold air plunges down the eastern side of a large amplitude ridge in the Gulf of Alaska, an isolated pool of cold air will persist with this closed low aloft, resulting in the formation of a Cutoff Low as shown in Figures 18 and 19. These lows tend to occur with their centers just off the California coast. They form because, occasionally, a strong ridge located in the Gulf of Alaska which has shown a pronounced tendency to move eastward onto the west coast suddenly stops and builds. As the pressure in the Gulf region rises, the anticyclonic curvature around the crest of the ridge becomes so great that the strong winds associated with the jet stream "overshoot" the top of the ridge. Thus the trough will deepen, resulting in the formation of a closed low aloft as far south as southern California. As cold air continues to pour into it from higher latitudes, the low will deepen and may stall off the coast, accumulate moisture, and produce unstable, showery conditions over California, the Sierras, and western Nevada. Once the height contours and isotherms become closed-off and nearly in-phase, vorticity is no longer advected out of the low and it becomes essentially stationary. One clue useful in forecasting the formation of this low is the presence of a strong (1040 Mb or higher) stationary surface high in the northern latitudes of the Gulf of Alaska.

c. **Thermal Trough (Low).** During the spring, increased solar heating in the Desert Southwest allows a quasi-stationary low pressure area to develop northwestward from central Mexico, often extending northward into Oregon and Washington by mid-summer. It is sometimes referred to as the California or Mojave Low. This is a thermal feature and is thus quite shallow. It will do little more than produce extreme daily maximum temperatures over western Nevada.

d. **The Nevada or Tonopah Low.** This fairly infrequent feature is depicted in Figures 20 and 21. NAS Fallon can experience some of its worst weather from such a system. It consists of a surface low pressure area centered in south-central Nevada (near the town of Tonopah). Formation occurs during fall, winter, and most commonly spring. Coincident with the development of the Nevada Low, a stronger than normal high pressure system is usually observed off the California coast with ridging over the Pacific Northwest states into southwestern Canada. The resultant flow advects cold air from the interior of Canada into the warmer air mass over the Great Basin. This unstable situation is intensified by one of the following mechanisms:

(1) a wave on an east-west oriented front.

(2) a secondary low in an unstable air mass following the passage of a cold front.

(3) Beneath a cutoff low, or at the tip of a long wave trough which has a jet maximum over the area.

The precipitation pattern accompanying the Nevada Low is very different from that of Pacific extratropical systems that traverse Nevada. Since the main development occurs over the Great Basin, Nevada receives greater precipitation amounts than the West Coast. The strong pressure gradient associated with the Nevada Low typically produces strong winds along much of the California coast. Interior California winds may be even stronger with a chance of Cumuliform clouds and thunderstorms. On the eastern slopes of the Sierra Nevada and extending into central Nevada, widespread low ceilings and moderate to heavy precipitation may occur. This can be in the form of heavy snowfall during colder months. Nevada Lows often move eastward and intensify, at times causing severe weather east of the Rockies.

4. **Fronts**.

a. **Cold Fronts.** A cold front, where cold air invades an area and displaces warm air, is the most common type of front in Nevada. The arrival of the front is usually signaled by a wind shift from the southwest to the northwest or north, a pressure minimum, and a temperature drop. There may be heavy precipitation or violent weather such as dust storms in the desert and blizzards in the Sierra Nevada, although less dramatic weather is more often experienced.

b. **Warm Fronts.** Warm fronts, where warmer air replaces retreating cold, tend to move more slowly and produce less dramatic weather than cold fronts. Typical warm-frontal type weather in Nevada is rare due to the proximity of the Sierra Nevada mountain ranges. When dynamics are sufficient, a steady light precipitation may occur for a short duration. Precipitation with this type of front is seldom observed locally, most often it is associated with an overrunning condition that begins with a thickening Cirrus shield that lowers to Altostratus and Stratiform cloudiness with a brief period of rain, or even snow during the winter months. Most warm frontal events are evidenced by a southeasterly wind component, few to scattered low clouds, and scattered to broken middle and high level cloudiness. Classic warm frontal passage is rarely seen in the Fallon area due to topographic modification of approaching systems.

c. **Occluded Fronts.** The occluded front occurs where the air at the earth's surface is cold on both sides of the front. Typically for the Nevada region, the faster moving cold front has overtaken the warm front, thereby lifting the warm air completely above the ground. These fronts are difficult to discern in their classic form in Nevada due to the interaction with the Sierra Nevada mountain range.

5. **Wind Regimes.** The speed and direction of surface winds in Nevada are reflective of the combination of prevailing storm tracks and the general Great Basin topography. Wind patterns are governed by the current synoptic situation, but, especially when the flow is light, can be altered significantly by the local topography.

a. **Diurnal and Local Winds.** In the absence of significant synoptic flow, a well-marked daily cycle of wind speed and direction is evident at nearly all places in Nevada. This is associated with the complex mountain topography discussed previously. At night, cool dense air flows down along the surface toward the bottom of the valley, creating a downslope, or mountain wind. In the morning, because of the general north-south orientation of the mountain ranges in Nevada, the east slopes heat up and induce an upslope, or valley, wind. With further heating of the entire range, valley winds dominate the local flow on both sides of a mountain range. In the early evening, the mountain tops cool first, especially on their east sides, and a mountain wind forms. This is typically weaker than the daytime valley winds. Local diurnally varying winds are generally fairly weak, with speeds consistently below 25 knots.

b. **Dust Storms.** Strong winds of 25 knots or more occur only a small fraction of the time, and show much less hourly directional variation because they are usually generated by larger scale storms rather than local diurnal effects. These winds commonly stir up dust and sand, particularly during dry periods, causing significant reductions in visibility. Southern Nevada, with its true desert areas, is the site of the most frequent dust storms. Severe dust storms are typically associated with winds of more than 40 knots, but dust clouds may be visible on the desert floor at much lower wind velocities.

c. **Dust Devils.** Extremely local wind currents of a circular nature, known as "Dust Devils," are common in Nevada during the summer months and occur at other times when surface temperatures are high and prevailing winds are light. They are produced as a result of unstable air at the surface; large vertical temperature gradients occur within just a few feet of the hot surface. This very unstable situation leads to sudden and turbulent mixing, in the form of a rapid circulation, of that lowest portion of the atmosphere. The circulation may be triggered by rocks, isolated shrubs, or even animals. These dust devils sometimes reach as high as 3000 feet, although they normally range from 100 to 300 feet AGL. The larger disturbances may uproot vegetation and disturb obstacles in their path. Generally, however, they transfer debris and other loose particles from one area to another without causing significant damage. Dust devils can turn either clockwise or counterclockwise, but in Nevada these disturbances seem to favor a clockwise direction.

d. **Lake Breezes.** The reservoirs and lakes in Nevada also produce local winds. A lake breeze, blowing from a lake toward land, occurs when the land is warmer than the body of water, usually during a warm summer day. A land breeze occurs when the opposite is true. In the Fallon area, these breezes, also occurring during periods of light prevailing winds (which is most of the summer season), can be seen in the lower 1000 feet of the atmosphere near Pyramid Lake and Walker Lake, and to a lesser degree near Carson Lake.

e. **Mountain Waves.** A distinctive wind feature also associated with Nevada's terrain is the formation of wave clouds near the crests of the mountain ranges. Lenticular shaped clouds form as a result of the flow over the mountain range, especially when the flow is nearly perpendicular to the range. Downwind of the range, the atmosphere is perturbed into a wave pattern, often creating standing lenticular clouds at each crest of the wave. These clouds, roughly parallel to the mountain crest, appear stationary but are actually in a state of continuous motion. As the cloud is being formed by condensation on the rising upwind side of a wave, it is simultaneously being dissolved by evaporation on the downwind side.

Severe turbulence often accompanies mountain wave conditions and creates a hazard for flying in the lee of the Sierra Nevada. A well developed mountain wave pattern requires strong mid-level westerly winds.

D. Synoptic Meteorological Patterns.

1. Monthly Summaries.

January Some of the most intense weather of the winter is experienced during the month of January. Average snowfall is among the highest of the year. The second highest frequency of fog occurs during January and is generally of the post-frontal type after a precipitation event. The fog seldom persists beyond noon but in 1962 extensive fog, known locally as "Pogonip," settled over western Nevada and persisted for 17 days. January is also one of the coldest months of the year with an average temperature of 33 DEG F. Surface winds are generally light and variable but gusty winds can be expected with frontal passage/and or the formation of a low pressure system in the vicinity of Tonopah, Nevada. VFR flight conditions prevail over 93% of the time during January.

February is one of the cloudiest months of the year at Fallon. However, statistics reveal only twenty-five percent of ceilings reported are below 10,000 feet. Precipitation increases as modified maritime air becomes more frequent over Nevada. The increase in cloud cover limits the diurnal temperature range and reduces the probability of fog. VFR flight conditions prevail approximately 98% of the time during February.

March marks the beginning of the spring transition season. Most climatological elements reveal a positive trend towards improvement. Frontal type weather becomes less pronounced and precipitation shows a decrease from February. The fog season is over by the end of the month and low ceilings have become a rarity, with most between 3000 and 10,000 feet. VFR flight conditions prevail 97% of the time.

April ends the spring transition season at NAS Fallon. Frontal activity decreases and air mass instability increases resulting in occasional rain or snow shower activity. Surface winds are light favoring a west-northwest direction. Overall cloudiness decreases during the month and temperatures continue to show a warming trend. The mean number of days with thunderstorms is one. VFR flying conditions prevail 98% of the time.

May marks the beginning of the summer weather season. Average daily temperatures rise rapidly, frontal activity becomes a rarity producing little or no weather when frontal passages do occur over the local area. The mean number of days with thunderstorms in May is two. VFR flight conditions prevail 99% of the time.

June climatological averages reflect the commencement of the hot, dry summer period at NAS Fallon. The few occurrences of IFR flight conditions are usually due to blowing dust and/or sand that is lifted by gusty afternoon winds caused by maximum heating. Instability showers account for most of the precipitation during June. The mean number of days with thunderstorms is two. June is the first month of the year when extreme maximum temperatures top the 100 degree mark.

July is the core of the summer season. The mean number of days with temperatures soaring into the nineties is twenty-four and temperatures exceeding 100 degrees are not uncommon. Mean surface winds are west-northwest at five knots. Although the mean number of days with thunderstorms is three, July is one of the driest months of the year.

August ends the summer season at NAS Fallon. Although temperatures are slightly lower than those in July, temperatures surpassing the one hundred degree mark are not uncommon. Precipitation is light and generally associated with afternoon showers and/or thunderstorms. Surface winds are light and variable during morning hours becoming moderate and gusty during the afternoon due to maximum heating and thunderstorm activity. The mean number of days with thunderstorms over the field is three. VFR flight conditions prevail 99% of the time.

September is the beginning of the fall transition period at NAS Fallon. There is a significant drop in the mean temperature, with minimum temperatures occasionally dipping into the thirties. Although frontal activity increases towards month's end, average precipitation is among the lowest of the year. VFR flight conditions prevail 99% of the time.

October marks the end of the fall transition season. Increasing cloudiness can be expected as the frequency of troughs and frontal passages increase. Precipitation is light and of the showery type. The threat of snow is always present during the latter part of the month. Early morning temperatures frequently fall below freezing. Surface winds are generally light and favor a northerly direction. Flying conditions continue to be excellent throughout the month with VFR conditions prevailing 99% of the time.

November marks the beginning of the winter season at NAS Fallon. The average temperature drops 12 DEG F when compared to October. Cloudiness increases with most ceilings reported between 3000 and 10,000 feet. Precipitation also increases and is usually associated with frontal passages. IFR conditions occur two percent of the time.

December is one of the cloudiest, foggiest months of the year. The average number of days with fog is five. IFR conditions of low ceilings and visibility hamper flight operations approximately five percent of the time. Precipitation, frequently in the form of snow, is generally associated with frontal activity. December is the second coldest month of the year with a mean temperature near freezing at 33.9 DEG F.

2. **Winter Synoptic Storm Patterns.** There are four basic weather patterns during the winter that impact on local operations to varying extent: (1) the northeast-southwest oriented cold front, (2) the east-west oriented cold front, (3) Nevada low, and (4) cutoff low.

a. **Northeast-Southwest Frontal Orientation.** Winter cold fronts usually approach Nevada from the northwest (see Figure 22). Before the passage of the front, the flow above the mountains is from the west or southwest while surface winds in the valleys and basins are mild from the south, occasionally southeast. After frontal passage the upper flow becomes northwesterly and cold northerly winds sweep across the mountain ridges and along the valleys. The Sierra Nevada has a profound effect on most fronts, causing them to stall west of the crest while their northern sectors move rapidly across Oregon, then southward over northern Nevada. Thus many fronts converge on the Sierra and become deformed, with the cold air usually reaching the Truckee Meadows, Owens Valley, Fish Lake Valley and other leeward basins from the north before the cold air from the west can surmount the High Sierra. Cold frontal passages of this type are common at NAS Fallon during winter and spring. They are usually dry, producing little precipitation and seldom impacting local flight operations significantly.

Often times, due to topographical effects in the region, forecasting of surface winds is extremely difficult. Many times as a frontal system stalls along the Sierra Nevada Mountain range, a new low will develop generally to the northeast or southeast of the Fallon area, well within approximately a one hundred mile area of NAS Fallon. Development of this low normally appears coincidental with what is identified as frontal passage on station. Identification of this low is extremely difficult since weather conditions at NAS Fallon are often reflective of the basic post-frontal weather pattern, a northwest to northerly wind shift, partial clearing, and a slight increase in pressure for the local area.

As the main trough or front finally peaks the Sierras and begins to move more quickly to the east or southeast, winds may shift back to a southwest or westerly component with continued frontal characteristics influencing local operations for an additional three to six hours. This scenario can often catch the forecaster off-guard when indicators of a frontal passage have been assumed to have already occurred and in actuality, it was the development of a new low as previously mentioned.

Although there is a lack of reporting stations in the region, the forecaster does have resources available to ascertain this difficult scenario of a new low developing ahead of the frontal system. In an attempt to identify this event, a close review of all meteorological data available must be monitored from the onset. This data is obtained from local data sources at NPMOD, data available through Western Regional Climate Center (WRCC) associated with the Desert Research Institute, and a variety of automated sensors scattered throughout northwestern and central Nevada. Normally if Reno is still carrying a southerly component, and Fallon is carrying a northwesterly component, a new low has occurred as previously mentioned in this paragraph.

As cold fronts approach Nevada from the west or northwest they are preceded by broken to overcast middle and high clouds with scattered Cumulus clouds and isolated showers mainly over mountain terrain. Surface pressure falls steadily and normally rises rapidly after frontal passage. Depending on the intensity of the Low Pressure System, surface winds are usually light to moderate from the south (occasionally southeast) to southwest shifting to the west-northwest and remaining gusty for approximately six hours after frontal passage. Skies usually become partly cloudy to clear two to three hours after frontal passage. If surface pressure levels off or continues to fall after frontal passage an upper level trough is lagging behind the front and the winds will return to the southwest and skies will remain cloudy until the upper level trough moves to the east of NAS Fallon.

b. **East-West Frontal Orientation.** East-west oriented cold fronts occur with a shallow upper level trough along or near the Pacific coast (Figures 23 and 24). The frontal movement will depend greatly on the movement of the upper trough. Scattered

Cumulus clouds and broken to scattered mid-level cloudiness will precede the front. Strong surface winds from the southwest averaging a sustained 15 to 20 knots with gusts reaching up to 40 knots can be expected six to twelve hours prior to frontal passage. After frontal passage winds will shift to the northwest and gradually clearing skies will occur.

If the upstream trough continues to deepen, which is common over the western U. S. during the winter, the forecaster should be alert for the formation of a low pressure system along the cold frontal boundary. In these cases, widespread low cloudiness with rain or snow may blanket northern Nevada westward to the Sierra and prevail until the upper level trough and associated surface low pressure system progress into eastern Nevada. After the upper level trough moves east of NAS Fallon the skies will become partly cloudy with moderate northeast winds gradually diminishing.

c. **Tonopah Low.** Also called a Nevada Low, this feature was discussed previously. The easterly flow to the north of the low often brings cold polar continental air, low clouds, and snowfall to the Great Basin. If the northerly fetch is sufficiently long, such as from interior Alaska or the Yukon, arctic air may invade the eastern Sierra for a few days, bringing extremely low temperatures.

d. **Cutoff Low.** As discussed previously, these features can bring extended periods of low ceilings, showery conditions, and generally unstable air.

Cutoff lows situated in the vicinity of the California coast north of 35 degrees North produce the heaviest precipitation in Nevada east of the Sierra. They often become stationary and advect sufficient moisture from the southwest around the low to produce extensive cloud cover and rain or snowfall throughout Nevada. These features are almost entirely limited to late Fall through early Spring, but they can bring cool, moist conditions to Fallon as late as June.

E. **Local Climatology.** Data for this section has been extracted from a CD-ROM containing data collected by the Fleet Numerical Meteorology and Oceanography Detachment at Asheville, North Carolina, dated September 1996. The information is based on the period from 1945 to 1995. Local records of monthly temperature or precipitation extremes occurring since January 1996 through December 1998 have also been included in the local climatology listings.

1. **Sky Cover.** Partly cloudy to mostly clear skies prevail June through October except for brief periods of mostly cloudy skies during late afternoon and evening associated with

thunderstorm activity over mountains surrounding the Naval Air Station. For Sky Cover % of Occurrence, see Table 1.

November through May sky cover is quite variable. Mostly cloudy to cloudy skies prevail as periodic Pacific fronts and upper level troughs traverse the local area. Cloudy skies with variable middle and high level cloudiness will prevail normally for a week or more when a long wave trough or cutoff low lies stationary off the California coast. The cloudy skies will persist until the long wave moves east of Nevada or the cutoff low moves through the local area or dissipates. Clear skies usually prevail for three to five days following a cold frontal passage (see Table 1 for sky cover percentages).

2. **Ceilings and Visibility.** Naval Air Station Fallon experiences a very low percentage of IFR weather. The months with the greatest frequency of IFR conditions are January (6.0 percent) and December (5.0 percent). VFR conditions prevail greater than 98 percent of the time for all other months. The higher frequency of IFR conditions during January and December is the result of migratory frontal activity and occasional radiation fog. Infrequent visibility less than five miles is associated primarily with early morning radiational fog from November through February; the fog rarely persists beyond late morning. Blowing dust and sand occasionally reduce visibility below three miles during spring and fall due to strong surface winds in advance of fast moving cold fronts. Visibility is also briefly reduced in summer by blowing dust and sand in the vicinity of late afternoon and evening thunderstorms (see Table 2 for ceiling versus visibility).

3. **Precipitation.** Mean annual precipitation at Naval Air Station Fallon is 5.3 inches which is evenly distributed throughout the year. Precipitation received during spring and summer is from scattered thunderstorm activity and during the fall and winter from Pacific fronts and upper level disturbances traversing western Nevada (see Table 3 Monthly Precipitation) (see Table 4 Daily Extreme Precipitation by Month) (see Table 5 Year/Month Total Precipitation from Daily Obs).

4. **Temperatures.** If Nevada's overall climate could be summarized in one word, the term "continental" would be appropriate. Dry air, light precipitation, and large temperature ranges predominate. The continental environment prevails because mountain ranges from Washington through California block out or greatly modify any maritime air moving inland from the Pacific Ocean.

A particularly distinctive feature of Nevada's environment is the large difference in temperature between day and night. This wide daily range occurs because clear skies and lack of moisture in the air allows maximum penetration of solar energy to extend to the surface, causing intense heating of the bare ground during the daytime. At night the same clear skies permit rapid radiational cooling and the loss of daytime heating. Consequently, temperatures are quite cool at night for most of Nevada, even during the summer.

The coldest months of the year at NAS Fallon are January and December with the mean temperature in the low 30s (see Table 6). Maximum temperatures are reached in July and August when the mean daily temperature is in the middle 70's. Temperatures for the year at Fallon are summarized in the graphs below. Of note, the extremes to date are -23 and 108 degrees F. An average daily maximum temperature equal to or greater than 95 degrees can be expected 15 days during July and 11 days during August. The mean diurnal temperature range during summer is 30 to 35 degrees and 25 degrees in the winter
(Refer to Tables 7 and 8 for Extreme Daily Maximum and Minimum Temperature by Month).

5. Thunderstorm Occurrence. Compared with many parts of the United States, thunderstorms in western Nevada are relatively infrequent. Nevertheless, their destructive effects on the ground and significance to flight operations and ordnance handling make thunderstorms one of the most critical phenomena to forecast properly and monitor closely.

Tornadoes in Nevada are rare but they do occur. The seasonal occurrence of tornadoes is similar to that for the United States as a whole; they come during thunderstorm season, April to October, but are most numerous from May through August. (Table 8) shows the monthly average number of thunderstorm days for NAS Fallon. On the whole, thunderstorm activity is twice as frequent over eastern Nevada as it is over western Nevada. Hail also increases with elevation, and the highest frequency is found above the 6000 foot level. Eastern Nevada is not only higher in elevation than western Nevada, it is also the meeting ground for generally moist summer air from the south and drier air from the north and west.

Thunderstorms that do develop in western Nevada generally do not contain as much moisture, so rain and hail associated with western Nevada thunderstorms are not as heavy as eastern Nevada thunderstorms.

At any time from early May to early October, an incursion of tropical air from the south may occur, making thunderstorms possible over the local area. The intense heating of the arid Southwest during the summer months creates
the upper air anti-cyclone and surface low pressure area which provides the circulation necessary for the flow northward of tropical air.

In eastern California and Nevada this summer monsoon is best developed during the period from early July to late August. At first, moisture enters the Fallon area at high levels and the onset of thunderstorm activity is often heralded by the appearance of rather exotic Cirrus clouds from the southern quadrant. Within a day or two, if the flow persists and the atmosphere at middle and low levels is also moist, daily thunderstorms can be expected to occur. The thunderstorms are strongly diurnal in their development; they develop as a result of daily solar heating of mountain slopes and decline after sunset.

The appearance of patchy, turreted Altocumulus clouds at sunrise is a rather good indication of possible thunderstorms later in the day. Heating of the rocky mountain slopes causes air to rise toward the crests and soon Cumulus clouds form above these upslope currents. The clouds continue to rise upward, becoming towering Cumulus. Near midday their tops develop a fibrous appearance indicative of ice crystal formation and they are said to be glaciated. Soon the clouds develop anvil-shaped Cirrus tops with streamers of ice clouds stretching in the direction of the wind at 30,000 to 40,000 feet. Lightning flashes from cloud to mountain and heavy local showers of rain, graupel (sleet or soft hail), or pea sized hail may fall on the crests and ridges of the mountain ranges.

By late evening, downdrafts of cool air predominate, thunderstorm activity decreases, and skies brighten to the west over the Sierra. Clouds thicken over leeward valleys where day-long heating has created rising thermal currents. It is often near 1700 or 1800 PST when a brief thunderstorm is experienced in valley locations such as Reno, Carson City, and Bishop.

6. **Snow.** The occurrence of snow is shown in Tables 8 and 9. Snow or sleet falls at NAS Fallon an average of 3 to 6 days per month from November through April (see Table 8). Damaging forms of frozen precipitation other than snow and hail are rare in Nevada. Freezing rain, one of the most destructive precipitation types in more humid parts of the United States, rarely occurs in damaging amounts in Nevada. Sleet is also uncommon. During showery periods, snow often falls at Fallon in the form of brief showers of snow pellets, or snowgrains.

7. **Fog.** The occurrence of fog is shown in Table 8. Fog in Fallon occurs almost entirely during the winter season, and primarily in night and morning hours. NAS Fallon averages six to eight days per year with heavy fog that reduces the visibility to one-fourth of a mile or less. Not all fogs are heavy, and light ground fog with visibility greater than a quarter of a mile also occurs.

Commonly, the temperature is below freezing when fog forms, causing a layer of rime often half an inch thick to form on trees, cars, aircraft, and other cold objects. Rime is different from ground frost in that it forms only when fog is present. The type of fog which forms rime is locally called "Pogonip," from the Paiute Indian word meaning white death.

Most fogs tend to burn off by late morning as the sun heats the air above the dew point. During occasional winters, however, a stagnant mass of moist air may last for a week or more over some valleys of northern Nevada, with fog and low clouds persisting throughout the day and night. Under these conditions airfield operations may be severely curtailed. Extended periods of fogginess are most common over areas in which abundant moisture is available.

8. **Surface Winds.** The speed and direction of surface winds at NAS Fallon are depicted in Table 8, and Table 9 depicts the Daily Extreme Peak Gust. These winds reflect a combination of prevailing storm tracks and local topography. The major patterns of wind throughout the year are associated with the general atmospheric circulation.

Summer winds are normally light and variable in the morning and tend to blow toward areas of highest temperatures during the afternoon, as previously discussed earlier in this chapter.

During winter, migratory storms will cause wind velocities to undergo much greater variation. Local winds are generally light and variable increasing to southerly as frontal systems approach the Sierra. Sustained winds of 20 to 30 knots with gusts up to 40 knots frequently occur prior to frontal passages. Post frontal winds are northwesterly to northerly and usually subside within 12 to 18 hours of frontal passage. Quite frequently, winds exceeding or meeting warning criteria decrease well below advisory criteria generally about 3-5 hours after sunset, even if frontal passage only occurred just several hours prior to sunset. This is not always the case, but it has been noted on many occurrences and requires consideration.

MONTH	% of Occurrence			
	CLR	FEW-SCT	BKN	OVC
Jan	19.2	22.2	23.2	34.1
Feb	19.7	23.7	24.8	31.8
Mar	20.7	25.2	25.8	28.2
Apr	21.4	27.0	26.3	25.3
May	23.1	31.0	26.0	19.9
Jun	33.8	34.3	19.8	12.1
Jul	45.9	32.4	16.2	5.5
Aug	46.2	33.4	14.8	5.6
Sep	51.3	27.7	14.0	7.0
Oct	41.1	28.0	18.7	12.3
Nov	25.6	25.1	24.0	24.3
Dec	22.4	26.7	23.6	27.3
Annual	30.9	28.0	21.4	19.5

Table 1 - SKY COVER

MONTH	% of Frequency			
	10,000/5	5,000/5	1,000/3	200/ 3/4
Jan	27.1	15.3	6.5	3.0
Feb	22.9	11.2	2.4	1.0
Mar	23.0	11.5	1.1	0
Apr	19.2	9.0	.5	.1
May	18.1	8.2	.2	.1
Jun	11.0	4.0	.1	0
Jul	6.1	.9	.1	0
Aug	5.5	1.0	.2	0
Sep	6.8	2.0	.1	0
Oct	8.9	3.5	.3	.1
Nov	18.7	8.9	1.7	.7
Dec	24.4	13.9	5.3	3.0
Annual	15.9	7.4	1.5	.7

Table 2 - CEILING VERSUS VISIBILITY

MONTH	Mean	Min	Max	24hr Max
Jan	.5	T	2.2	1.0
Feb	.5	T	2.4	.8
Mar	.5	T	1.5	.7
Apr	.5	T	2.7	1.1
May	.8	T	3.6	1.3
Jun	.6	T	3.0	1.5
Jul	.2	T	1.2	.6
Aug	.3	T	1.8	1.8
Sep	.3	T	1.9	1.2
Oct	.4	T	2.3	.8
Nov	.5	T	1.6	.6
Dec	.4	T	1.5	1.0
Annual	5.6	2.0	10.1	1.8

Table 3 - MONTHLY PRECIPITATION

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	MONTH												
1945	-	-	.24	-	-	-	-	T	T	.36	.11	.20*	-
1946	.10	-	-	0*	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	.16	.21	-
1955	.11	.19	.06	.11	.25	T	.03	0	.21	.01	.50	.98	.98
1956	.50	T	T	.31	.34	.37	.03*	0	.40	.20	.05	T	.50*
1957	.20	.33	.15	1.00	.34	T	.10	T	.56	.33	.28	.07	1.00
1958	.05	.26	.14	.26	.30	.53	.28	T	.25	0	.09	.11	.53
1959	T	.14	T	T*	.39	0	.02	1.75	.14	.06	0	.03	1.75*
1960	.07	.05	.11	.02	.02	T	.16	T	.03	.03	.52	.42	.52
1961	.19	.22	.34	.04	.33	.50	.15	.55	.23	.20	.25	.21	.55
1962	.32	.78	.28	.01	.71	.57	.47	T	T	T	.11	T	.78
1963	.17	.33	.38	.26	.20	.34	0	.05	.44	.37	.12	.50	.50
1964	.06	.10	.48	.18	.62	.54	.03	.14	0	.24	.08	.12	.62
1965	.15	.14	.22	.47	.85	.23	.23	.56	.20	.03	.43	.16	.85
1966	.04	.14	.08	.15	.12	.30	.01	.04	.37	0	.12	.61	.61
1967	.13	.05	.33	.30	.27	.51	.48	.13	1.20	.01	.44	T	1.20
1968	.35	.45	.20	.84	.19	.23	.13	.73	T	.21	.22	.35	.84
1969	.48	.28	.08	.15	.24	.51	.02	T	.01	.22	.27	.31	.51
1970	.19	.21	.22	.05	.11	.97	.33	.17	T	T	.11	.14	.97
1971	.47	.25	.15	.20	.45	.10	.21	.16	-	.40	.18	.32*	.47*
1972	.09	.05	T	.10	.17	.56	.07	.10	.57	.73	.21	.10	.73
1973	.40	.67	.15	.13	.31	.06	.07	.03	T	.19	.38	.18	.67
1974	.26	.06	.10	.27	.03	.04	.27	.27	0	.35*	.48	.40	.48*
1975	.13	.09	.36	.09	.13	.45	T	.34	.35	.29	.08	.04	.45
1976	.19	.33	.18	.25	.06	.65	.41	.18	-	.81	.07	.02*	.81*
1977	.15	.02	.04	.06	.39	1.46	.17	.08	T	T	.02	.45*	1.46*
1978	.32*	.37	.51	.53	.06	.03	.02	T	.25	.08	.27	.21	.53*
1979	.15	.20	.63	.49	.14	.05	.17	.33	T	.05	.16	.09	.63
1980	.75*	30	.27	.19	.32	.03	.20	.04	.34	.08	.39	.03	.75*
1981	.09	.09	.40	.32	.25	.01	.01	T	.08	.24	.27	.06	.40
1982	1.00*	.20	.22	.14	.11	1.08	.02	.01*	.52*	.54*	.28*	.23*	1.08*
1983	.43*	.12*	.40*	.27*	.04	.25	T*	.39	.32*	.38	.35	.24*	.43*
1984	.06*	.10	.09	.17	.13	.18	.25*	.02	.19*	.27	.23*	.03	.27*
1985	.13*	.06	.59	.79	.04	.15	.01	T	.10	.15	.45	.21*	.79*
1986	.06*	.19	.05	.51	.02	.04	.14*	.02*	.20*	.09*	.02	.14*	.51*
1987	.10*	.07	.06	.37	.86	.12	T*	.02	.10	.53*	.12*	.43*	.86*
1988	.70*	.27*	.03	1.10*	.27*	.33	.17*	.11	.04*	.04	.18*	.15*	1.10*
1989	.02*	.50	.17*	.16	.58	.08	.01*	.42	.59*	.25*	.06*	0*	.59*
1990	.73*	.20	.08	.94	.70	.18	.01	.34	.32	.13	.15	.38	.94*
1991	.06	.25	.15	.09	.41	.28	.07	.02	.45	.05	.14	.35	.45
1992	.25	.18	.29	.09	.04	.47	.59	.32	.55	.09	.02	.35	.59
1993	.39	.25	.71	.01	.14	.85	T	T	.04	.84	.34	.07	.85
1994	.03	.19	.11	.43	.70	0	.54	.01	.06	.05	.57	.20	.70
1995	.38	.37	.25	.14	1.34	1.21	.02	.05	.07	0	T	.38	1.34
MEAN	.20	.22	.22	.28	.32	.35	.16	.18	.22	.19	.22	.22	.72
STDV	.14	.16	.17	.25	.28	.35	.17	.31	.25	.22	.16	.21	.24
#OBS	31	39	40	38	40	41	34	40	34	37	38	32	24

T = TRACE AMOUNTS (LESS THAN .01 INCH)
*** = INCOMPLETE**
- = MISSING DATA
 # = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED

Table 4 - DAILY EXTREME PRECIPITATION (Inches) BY MONTH

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1945	-	-	.46	-	-	-	-	T	T	.43	.16	.42*	-
1946	.10	-	-	0*	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	.29	.57	-
1955	.22	.34	.12	.17	.83	T	.03	0	.30	.01	.98	1.47	4.47
1956	1.33	T	T	.45	.94	.39	.03*	0	.51	.36	.05	T	4.06*
1957	.59	.62	.31	1.03	.80	T	.10	T	.66	.94	.57	.07	5.69
1958	.12	.34	.23	.26	.30	1.64	.30	T	.34	0	.14	.11	3.78
1959	T	.37	T	T*	.42	0	.02	1.78	.22	.06	0	.03	2.90*
1960	.09	.06	.12	.04	.02	T	.33	T	.03	.03	.91	.42	2.05
1961	.23	.22	.50	.05	.42	.50	.29	1.26	.46	.20	.40	.24	4.77
1962	.45	2.37	.75	.01	1.70	.66	.51	T	T	T	.16	T	6.61
1963	.31	.81	.43	1.10	.49	1.44	0	.05	.49	.60	.30	.58	6.60
1964	.08	.14	.97	.46	1.57	.70	.03	.15	0	.24	.19	.57	5.10
1965	.49	.14	.41	1.07	1.13	.77	.39	.88	.20	.03	1.56	.57	7.64
1966	.04	.27	.09	.17	.38	.45	.01	.04	.37	0	.21	1.28	3.31
1967	.35	.05	.86	1.13	.27	1.34	.52	.27	1.88	.01	.61	T	7.29
1968	.40	1.00	.23	.87	.34	.40	.13	.81	T	.25	.42	.50	5.35
1969	1.66	1.11	.19	.25	.32	1.11	.02	T	.01	.46	.43	.92	6.48
1970	.68	.26	.25	.06	.11	1.45	.63	.23	T	T	.30	.28	4.25
1971	.81	.58	.41	.27	1.51	.20	.39	.19	-	.89	.21	.63*	-
1972	.12	.08	T	.17	.24	1.38	.07	.10	.86	2.26	.58	.26	6.12
1973	1.50	1.24	.70	.23	.39	.08	.07	.03	T	.41	.66	.51	5.82
1974	.64	.11	.31	.38	.03	.04	.36	.32	0	1.32*	.51	.78	4.80*
1975	.25	.29	.93	.41	.21	.61	T	.51	.47	.45	.09	.10	4.32
1976	.38	.90	.28	.47	.06	.94	1.24	.66	-	.94	.07	.02*	-
1977	.36	.02	.07	.06	1.72	2.14	.20	.12	T	T	.02	1.39*	6.10*
1978	.71*	.96	1.46	1.01	.06	.03	.02	T	.78	.14	1.02	.40	6.59*
1979	.39	.56	1.35	.52	.26	.06	.23	.98	T	.10	.17	.09	4.71
1980	2.17*	.50	.31	.54	1.18	.07	.40	.05	.63	.12	.51	.05	6.53*
1981	.31	.28	.68	.47	1.06	.01	.01	T	.09	.52	.44	.12	3.99
1982	1.16*	.22	.61	.16	.18	3.04	.04	.01*	1.50*	.90*	.70*	.25*	8.77*
1983	.98*	.55*	1.34*	.95*	.13	.69	T*	1.67	.57*	.78	1.39	1.02*	10.07*
1984	.23*	.22	.09	.46	.26	.35	.53*	.07	.33*	.62	.66*	.03	3.85*
1985	.24*	.09	1.32	.79	.10	.18	.02	T	.21	.30	1.17	.34*	4.76*
1986	.07*	.79	.21	.86	.04	.04	.16*	.04*	.30*	.21*	.02	.28*	3.02*
1987	.13*	.21	.17	.57	2.44	.17	T*	.02	.10	1.26*	.43*	.66*	6.16*
1988	1.11*	.27*	.04	1.97*	.55*	.48	.19*	.24	.06*	.05	.41*	.27*	5.64*
1989	.02*	.66	.63*	.16	1.42	.20	.01*	.82	1.01*	.25*	.09*	0*	5.27*
1990	.87*	.40	.08	2.71	.92	.18	.01	.57	.53	.13	.17	.50	7.07*
1991	.10	.30	.45	.13	1.52	.40	.09	.02	.50	.05	.35	.35	4.26
1992	.32	.50	.89	.09	.06	.86	.91	.32	.55	.18	.04	1.17	5.89
1993	1.29	.51	1.93	.03	.23	1.59	T	T	.04	1.51	.48	.19	7.80
1994	.06	.94	.24	1.18	3.32	0	1.12	.02	.18	.26	3.04	.51	10.87
1995	.79	.95	.56	.53	3.57	2.12	.02	.05	.11	0	T	.57	9.27

T = TRACE AMOUNTS (LESS THAN .01 INCH)
*** = INCOMPLETE**
- = MISSING DATA
 # = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED

Table 5 - YEAR/MONTH TOTAL PRECIPITATION (Inches) FROM DAILY OBS

MONTH	Mean Max	Mean Min	Mean	Extreme Max	Extreme Min
Jan	45	21	33	72	-17
Feb	52	26	40	81	-23
Mar	59	31	45	84	3
Apr	66	36	52	96	16
May	75	45	60	101	23
Jun	85	52	69	106	33
Jul	94	58	76	108	38
Aug	92	57	75	108	32
Sep	83	48	66	103	24
Oct	71	38	54	92	11
Nov	55	28	42	80	5
Dec	46	21	34	71	-15

Table 6 - MONTHLY TEMPERATURES

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
1945	-	-	70	83	86	97	102	97	94	83	70	62	102*
1946	67	68	75*	91*	-	-	-	-	-	-	-	-	-
1947	-	-	-	-	-	-	-	-	-	-	-	-	-
1948	-	-	-	-	-	-	-	-	-	-	-	-	-
1949	-	-	-	-	-	-	-	-	-	-	-	-	-
1950	-	-	-	-	-	-	-	-	-	-	-	-	-
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	73	59	-
1955	52	65	68	75	92	103	101	104	103	84	70	68	104
1956	62	66	77	80	90	103	100*	95	97	81	74	63	103*
1957	52	67	75	79	87	102	100	97	98	77	63	60	102
1958	64	67	64	78	92	97	101	100	93	88	80	64	101
1959	63	63	69	84	92	101	105	101	93	86	70	58	105
1960	59	62	78	82	90	97	105	102	94	85	75	61	105
1961	57	70	72	86	90	104	102	102	88	86	63	58	104
1962	62	59	74	85	84	96	98	103	93	87	72	65	103
1963	61	73	69	77	90	91	98	98	93	91	68	61	98
1964	58	64	75	80	92	96	100	101	92	90	65	69	101
1965	65	68	70	88	85	92	98	97	88	89	74	60	98
1966	61	57	80	85	91	96	103	99	93	82	72	63	103
1967	58	67	71	65	95	101	102	100	95	81	73	57	102
1968	61	66	76	81	91	100	100	95	96	80	69	61	100
1969	69	59	77	83	90	95	101	102	95	81	75	65	102
1970	67	72	72	76	92	99	100	102	92	87	78	64*	102*
1971	72	73	80	83	89	93	102	100	-	84	69	57	102*
1972	61	69	82	77	90	101	101	100	87	75	62	59	101
1973	59	61*	65	82	90	102	102	101	95	80	71	59	102*
1974	67	64	71	83	89	96	95	93	91	79*	67	59	96*
1975	69	68	69	68	87	92	100	94	89	82	72	62*	100*
1976	58	65	72	77	91	94	100	94	-	78	71	60*	100*
1977	52	70	75	86	95	98	100	103	98	86	76*	71*	103*
1978	63*	66	79	77	90	92	105	105	96	87	70*	57	105*
1979	59*	66	72	79	95	100	106	105	99	89	66	66	106*
1980	64*	71	67	87	93	99	106	103	95	92	-	65	106*
1981	63	75	67	96	91*	102*	106*	108	99	80*	75*	69	108*
1982	53	79	69	82	92	96	106	103*	97*	80*	70*	70*	106*
1983	66*	72*	73*	73*	99	96	103*	106*	98*	85*	76	63*	106*
1984	60*	63	77	88	101	103	105*	103	98*	78	76*	57	105*
1985	50*	70	73	90	92	106	106	102	87	88	74	58*	106*
1986	67*	81	84	84*	96	103	101*	105*	99*	85*	73	64*	105*
1987	64*	68*	75	92	96*	101	104*	105	102	91*	68*	68*	105*
1988	56*	70*	80	87*	96*	103	108*	102	101*	92	80*	58*	108*
1989	65*	71	76*	90	92	98	106*	101	93*	87*	74*	67*	106*
1990	70*	68	78	87	90	106	106	108	102	92	77	61	108*
1991	58	74	72	82	88	101	106	101	97	90	78	62	106
1992	64	73	74	91	98	98	104	107	96	92	74	63	107
1993	54	53	80	82	91	100	100	101	100	89	71	64	101
1994	59	71	80	87	91	101	104	101	93	81	69	57	104
1995	68	73	72	78	87	99	101	101	98	87	73	69	101
MEAN	61.1	67.8	73.8	82.3	91.2	98.7	101.9	100.8	94.7	85.1	71.4	61.8	102.4
STDV	5.3	5.6	4.8	6.1	3.5	3.8	2.8	3.6	4.1	4.7	4.3	3.7	2.4
#OBS	31	38	70	39	39	41	34	39	34	35	34	32	20

*** = INCOMPLETE**
- = MISSING DATA
 # = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED

Table 7 - EXTREME DAILY MAXIMUM TEMPERATURE (Deg F) BY MONTH

MONTH	TEMPERATURE (DEG F) MEANS MAX	MEANS MIN	MEANS AVG	EXTREME MAX	EXTREME MIN	PRECIPITATION (Inches) (^) PRECIPITATION MEAN	PRECIPITATION MAX	PRECIPITATION MIN	PRECIPITATION 24H MAX	SNOWFALL (@) MEAN	SNOWFALL MAX	SNOWFALL 24H MAX	REL HUM PERCENT (LST) AM 07	REL HUM PM 16	VAP PR IN. HG.	DEW PT. (F)	PR ALT FT.	WIND (KTS) PREVAIL DIR	PREVAIL SPD	MAX GST
JAN	45	21	33	72	-17	.5	2.2	T	1.0	2	11	10	77	51	.12	21	455	S	6	53
FEB	52	26	40	81	-23	.5	2.4	T	.8	2	10	4	74	41	.13	24	460	S	6	54
MAR	59	31	45	84	3	.5	1.9	T	.7	1	9	6	65	31	.13	24	465	S	5	50
APR	66	36	52	96	16	.5	2.7	0	1.1	1	8	3	53	26	.15	27	450	W	8	56
MAY	75	45	60	101	23	.8	3.6	T	1.3	T	7	6	48	25	.19	33	450	W	7	51
JUN	85	52	69	106	33	.6	3.0	0	1.5	0	0	0	42	21	.22	37	440	WNW	7	51
JUL	94	58	76	108	38	.2	1.2	0	.6	0	0	0	38	18	.26	41	435	WNW	6	47
AUG	92	57	75	108	32	.3	1.8	0	1.8	0	0	0	40	18	.24	40	435	WNW	6	48
SEP	83	48	66	103	24	.3	1.9	0	1.2	T	2	2	48	21	.21	36	435	N	5	46
OCT	71	38	54	92	11	.4	2.3	0	.8	T	3	3	60	27	.17	30	445	N	6	46
NOV	55	28	42	80	5	.5	1.6	0	.6	1	13	5	72	41	.14	26	450	S	5	48
DEC	46	21	34	71	-15	.4	1.5	0	1.0	1	6	5	77	51	.12	22	460	S	6	55
ANN	69	39	54	108	-23	5.6	10.1	2.0	1.8	9	24	10	58	31	.17	30	450	N	6	56
POR	43	42	42	43	42	42	42	42	42	42	42	42	48	48	43	43	41	42	42	40

T = TRACE AMOUNTS (< .05 < .5 INCHES
 # = MEAN NO. DAYS < .5 DAYS
$ = PRESSURE ALTITUDE IN TENS OF FEET (I.E. 50 = 500 FEET)
@ = NAVY STATIONS REPORT HAIL AS SNOWFALL; ALSO NWS FROM JUL 1948 – DEC 1955
+ = THE PREDOMINANY SKY CONDITION
*** = VISIBILITY IS NOT CONSIDERED**
& = ANNUAL TOTALS MAY NOT EQUAL SUM OF MONTHLY VALUES DUE TO ROUNDING
^ = 24 HR MAX PREDIP AND SNOWFALL ARE DAILY TOTALS (MID-NIGHT TO MID-NIGHT)
I = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED
" = INCHES

Table 8 - STATION CLIMATIC SUMMARY FOR 1945-1995

MONTH	SKY COV +	MEAN NUMBER OF DAYS WITH (&) PRECIP INCHES >= .01	PRECIP INCHES >= .50	SNOWFALL (") >= .10	SNOWFALL (") >= 1.5	THDR STRM	FOG *	TEMP (DEG F) MAX >= 90	TEMP MAX >= 75	TEMP MIN <= 32	TEMP MIN <= 0	PRECIPITATION RN/ DZ	PRECIPITATION FRZ RN/ DZ	PRECIPITATION SNW	PRECIPITATION HL/ SLT	PRCP	OBSTR TO VISION SMK HZ	OBSTR BLW SNW	OBSTR DST SND	OBS VIS
JAN	OVR	4	#	2	1	#	6	0	0	28	1	5	#	6	0	10	#	#	#	7
FEB	OVR	5	#	2	#	#	3	0	#	21	#	6	0	5	0	10	#	#	#	3
MAR	OVR	5	#	1	#	#	1	0	2	18	0	7	0	4	0	10	#	#	1	2
APR	SCT	4	#	1	#	1	1	#	7	8	0	7	0	3	#	9	#	#	1	1
MAY	SCT	5	#	#	#	3	#	2	17	1	0	10	0	1	#	10	#	0	1	1
JUN	SCT	4	#	0	0	3	#	11	25	0	0	7	0	0	#	7	#	0	1	1
JUL	CLR	2	#	0	0	3	#	24	31	0	0	5	0	0	#	5	#	0	#	#
AUG	CLR	2	#	0	0	3	#	22	30	#	0	5	0	0	#	5	1	0	#	1
SEP	CLR	3	#	#	#	1	#	8	24	1	0	5	0	0	#	5	1	0	1	1
OCT	CLR	3	#	#	#	1	1	#	12	7	0	5	0	1	#	5	#	#	#	1
NOV	SCT	5	#	1	#	#	2	0	#	21	0	6	0	3	0	8	#	0	#	2
DEC	OVR	4	#	1	#	0	6	0	0	27	1	5	#	6	0	9	#	#	1	6
ANN	SCT	46	2	8	1	15	20	68	148	133	2	73	#	29	1	93	2	1	6	26
POR	44	42	42	42	42	29	29	43	42	42	42	29	29	29	29	29	29	29	29	29

T = TRACE AMOUNTS (< .05 < .5 INCHES
 # = MEAN NO. DAYS < .5 DAYS
$ = PRESSURE ALTITUDE IN TENS OF FEET (I.E. 50 = 500 FEET)
@ = NAVY STATIONS REPORT HAIL AS SNOWFALL; ALSO NWS FROM JUL 1948 – DEC 1955
+ = THE PREDOMINANY SKY CONDITION
*** = VISIBILITY IS NOT CONSIDERED**
& = ANNUAL TOTALS MAY NOT EQUAL SUM OF MONTHLY VALUES DUE TO ROUNDING
^ = 24 HR MAX PREDIP AND SNOWFALL ARE DAILY TOTALS (MID-NIGHT TO MID-NIGHT)
I = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED
" = INCHES

Table 8 – (Continued)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
	MONTH												
1954	-	-	-	-	-	-	-	-	-	-	36S	44SW	-
1955	45SSE	52SW	48WNW	42*	40*	42NNE	36W	27NE	30NW	37W	35N	41*	52*
1956	52SSW	40*	50W	41WNW	30WSW	31N	34*	33WNW	30NW	39WSW	39N	42SW	52*
1957	36WSW	44WSW	40WSW	39SSW	32SW	29W	32WSW	26WNW	43NNW	35SW	41*	41*	44*
1958	53SW	46SSW	50SSE	46S	44SW	34SW	32WNW	34ESE	31ENE	37WNW	42W	22WSW	53SW
1959	32SSE	37SSE	43WSW	38NNW	47*	42ESE	44SSW	31WSW	36SSW	26NNE	35W	42W	47*
1960	28WSW	48WSW	45WSW	33SSE	39WSW	40WNW	33WSW	33W	36SSW	30N	36WSW	34SSE	48WSW
1961	32NW	38WNW	41W	42SW	42WNW	47WSW	32SW	48N	31WSW	46W	34WSW	42W	48N
1962	46SSW	29SW	43NNW	52W	40WNW	31WNW	31WNW	33WNW	46SSW	42SSW	29N	28SSE	52W
1963	28NNW	29SW	43SW	42SW	35WSW	40SE	35W	32SW	43WSW	42WNW	39SSW	33SW	43SW
1964	43SSW	32N	39W	40*	40W	38SW	32SW	38SW	31NE	27WNW	33WSW	42W	43*
1965	44SW	35W	32SE	32WSW	36W	37SE	35SE	46SSE	29NW	34W	28SE	40S	46SSE
1966	30N	40N	44W	35W	36SSE	29W	37SW	38SE	29NE	33W	40SW	34SSW	44W
1967	36SSW	36SW	38*	39WSW	42SW	38N	39SW	33WNW	37SE	40W	38W	38SW	42*
1968	37SSW	33W	43SW	31NW	28W	30N	41S	41SW	31NW	35SW	40W	38SSW	43SW
1969	44S	33S	37W	39WSW	29N	35W	34SW	32SSE	29NW	34W	24N	36SW	44S
1970	41W	37SW	35NE	41SW	32W	38N	42NW	22SE	35NE	27W	34SW	34SW	42NW
1971	31N	43NW	46SW	38W	39N	33W	41NW	35*	-	34N	-	40S	46*
1972	35W	35WSW	37W	39WSW	46*	42NW	29WNW	29ESE	31N	40NNW	23NNW	33W	46*
1973	37S	29SSW	33SW	34NNW	40WSW	31WNW	35ESE	38WSW	32N	35SW	36SW	50SSW	50SSW
1974	37S	49SSW	40S	45SSW	34W	40SSE	41SSW	38N	25N	26*	31S	31WNW	49*
1975	36W	37WSW	41W	41SSW	39W	44WSW	36WNW	37W	33ESE	31*	31*	37NNW	44*
1976	28*	34SW	41*	40NNW	32W	28SW	32ESE	31WNW	-	29ESE	23N	22*	41*
1977	32W	38WNW	45W	35WNW	36W	35SW	33SSE	30SSE	25*	31*	-	36*	45*
1978	36*	35*	31W	33WSW	-	-	47*	39*	-	25N	30*	38*	47*
1979	38*	39*	34*	33*	41*	39SW	28WSW	35*	26W	35*	39*	37SSE	41*
1980	35*	33WSW	39*	37*	36*	34W	30*	35NW	28*	32SSW	-	31*	39*
1981	32SSE	-	-	31WNW	37*	43*	40*	42W	38*	33SW	38*	47*	47*
1982	44W	36WSW	49*	56W	38N	42SSW	28SE	34*	35*	32*	-	44*	56*
1983	-	54*	42*	45*	43W	40SW	38*	32ESE	29*	33W	42S	42*	54*
1984	19*	-	-	43NE	38?	51?	42*	44?	-	40*	48*	44*	51*
1985	20*	41?	46NNW	32?	40?	43?	47?	32*	34*	31*	38?	34*	47*
1986	35*	40?	38?	-	-	-	31*	34*	44*	25*	28*	17*	44*
1987	-	-	-	42*	38*	34*	-	30*	34*	34*	-	-	-
1988	42*	32*	40*	45*	39*	50NNW	45*	43*	-	28*	42*	35*	50*
1989	35*	45ENE	50*	50?	38?	46?	43*	35?	41*	42*	32*	29*	50*
1990	36*	38?	49?	38?	42?	37?	39?	36?	40*	28ESE	42ESE	29?	49*
1991	28?	34?	50?	37?	45?	35?	43?	45?	33?	36?	38?	34?	50?
1992	36?	39?	40?	38?	41?	50E	32?	41?	44?	42?	40ENE	55NNW	55NNW
1993	30?	46?	44?	39?	51?	45?	39?	32?	29?	38?	40?	43?	51?
1994	30?	39NE	34?	26?	41?	40?	41?	42?	27?	35?	37ESE	36?	42?
1995	43?	44NE	50?	45?	41?	51?	47?	38?	34?	34?	39?	41NE	51?
MEAN	37.2	38.5	41.9	39.1	38.2	38.8	36.3	35.5	33.1	34.6	35.4	37.6	47.6
STDV	7.0	5.9	5.5	6.3	5.0	6.4	5.2	5.9	5.5	5.2	5.5	6.7	4.2
#OBS	29	33	30	33	31	37	31	33	26	30	28	27	16

*** = INCOMPLETE**
- = MISSING DATA
? = UNKNOWN WIND DIRECTION
 # = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED

Table 9 - DAILY EXTREME PEAK GUST (Knots)

MONTH	NONE	TRACE	.1-.4	.5-1.4	1.5-2.4	2.5-3.4	3.5-4.4	4.5-6.4	6.5-10.4	10.5-15.4
	INCHES									
JAN	81.0	13.4	2.1	1.8	.7	.4	.2	.2	.2	0
FEB	84.9	9.1	1.9	2.5	.9	.5	.1	0	0	0
MAR	87.4	8.8	1.4	1.6	.2	.3	.2	.2	0	0
APR	91.4	6.1	1.2	.9	.2	.1	0	0	0	0
MAY	97.8	1.8	.2	.2	.1	0	0	.1	0	0
JUN	100	0	0	0	0	0	0	0	0	0
JUL	100	0	0	0	0	0	0	0	0	0
AUG	100	0	0	0	0	0	0	0	0	0
SEP	99.9	0	0	0	.1	0	0	0	0	0
OCT	98.2	1.5	.1	.1	.1	.1	0	0	0	0
NOV	90.2	6.4	1.5	.9	.4	.2	.2	.2	0	0
DEC	84.5	11.1	1.7	1.6	.6	.2	.2	.1	0	0
ANN	92.9	4.9	.8	.8	.3	.1	.1	.1	*	0

*** = PERCENT < .05**
T = ZERO PRECIP, SNOWFALL OR SNOW DEPTH MEASURED BUT A TRACE WAS NOTED
+ = ANNUAL HI AND LOW VALUES ARE DERIVED FROM ANNUAL TOTALS
 # = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED

Table 10 - PERCENT FREQUENCY DAILY SNOWFALL

MONTH	15.5-25.4	25.5-50.4	>50.4	PERCENT OF DAYS WITH AMOUNTS >=.1	TOTAL NO. OF OBS	MEAN	TOTAL SNOWFALL (INCHES) HI	LOW
	INCHES							
JAN	0	0	0	5.7	1309	2.4	11.3	0
FEB	0	0	0	5.9	1182	1.7	10.1	0
MAR	0	0	0	3.8	1324	1.3	8.7	0
APR	0	0	0	2.4	1273	.5	7.6	0
MAY	0	0	0	.5	1296	.2	6.8	0
JUN	0	0	0	0	1254	0	0	0
JUL	0	0	0	0	1292	0	0	0
AUG	0	0	0	0	1327	0	0	0
SEP	0	0	0	.1	1218	T	1.5	0
OCT	0	0	0	.3	1319	.1	2.7	0
NOV	0	0	0	3.4	1308	1.3	12.6	0
DEC	0	0	0	4.4	1310	1.4	6.2	0
ANN	0	0	0	2.2	15412	9.0	23.6	T

*** = PERCENT < .05**
T = ZERO PRECIP, SNOWFALL OR SNOW DEPTH MEASURED BUT A TRACE WAS NOTED
+ = ANNUAL HI AND LOW VALUES ARE DERIVED FROM ANNUAL TOTALS
 # = EXCESSIVE MISSING DATA – VALUE NOT COMPUTED

Table 10 (Continued)

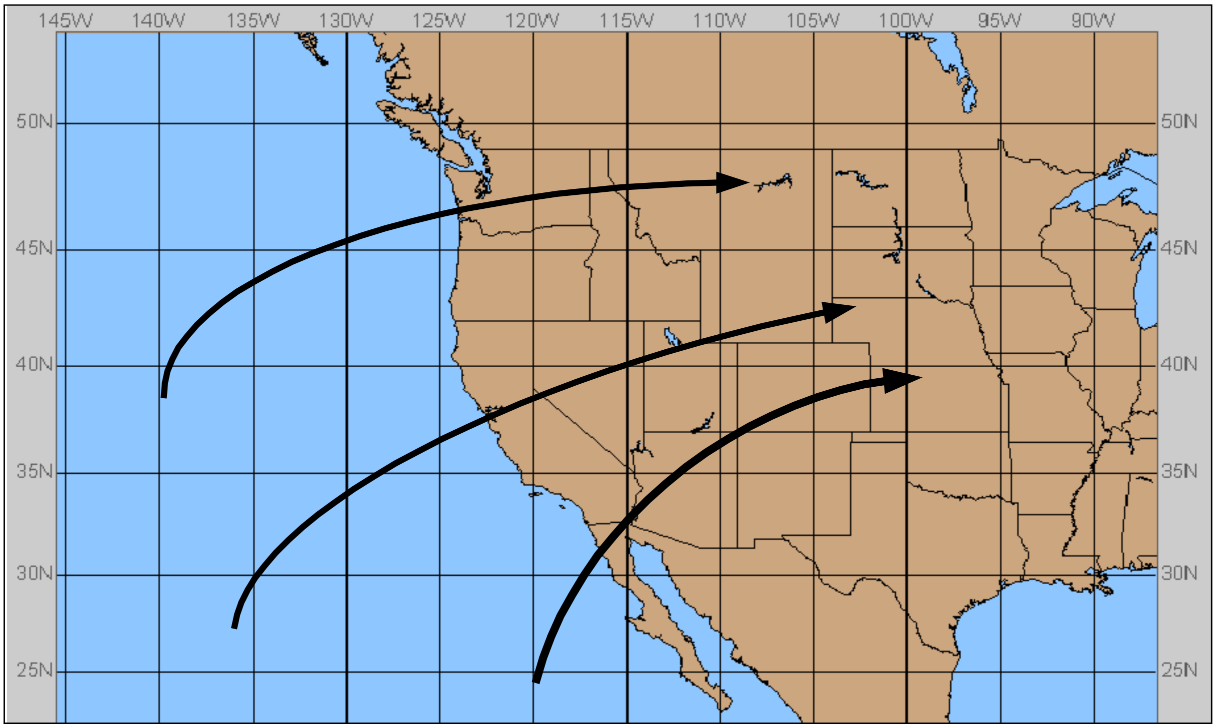

Figure 12 – Winter General Upper Air Flow

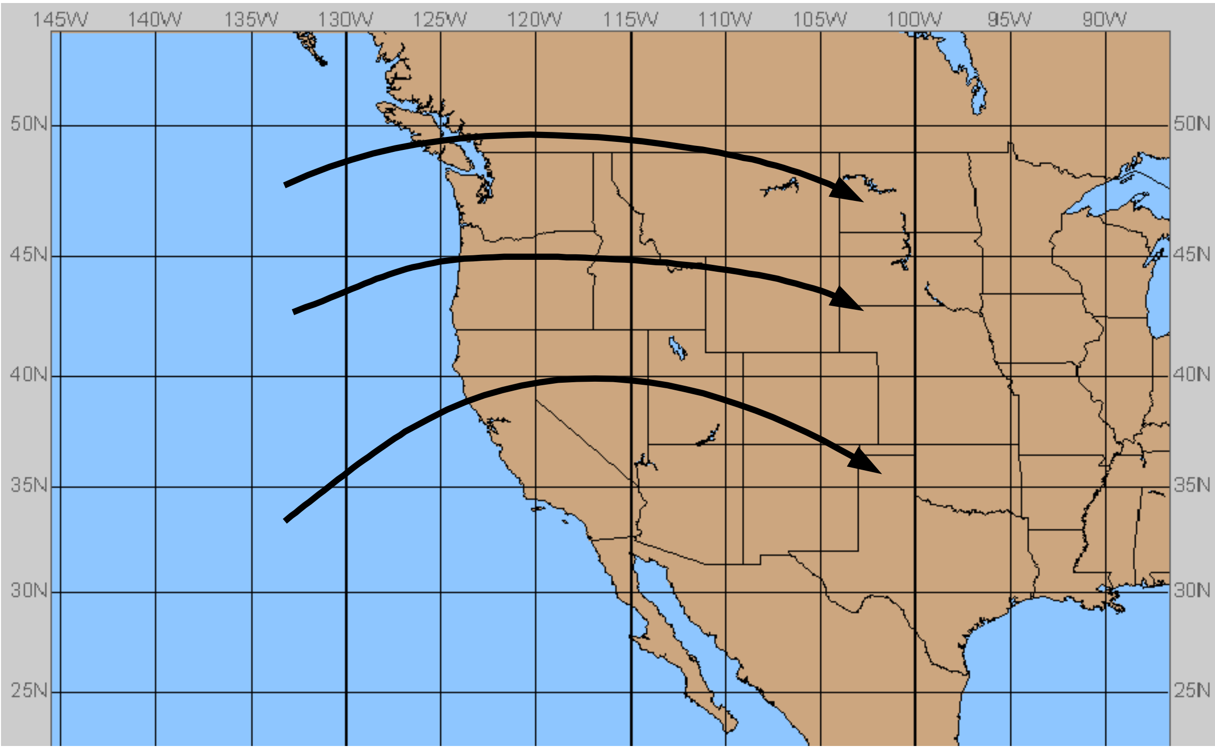

Figure 13 – Summer General Upper Air Flow

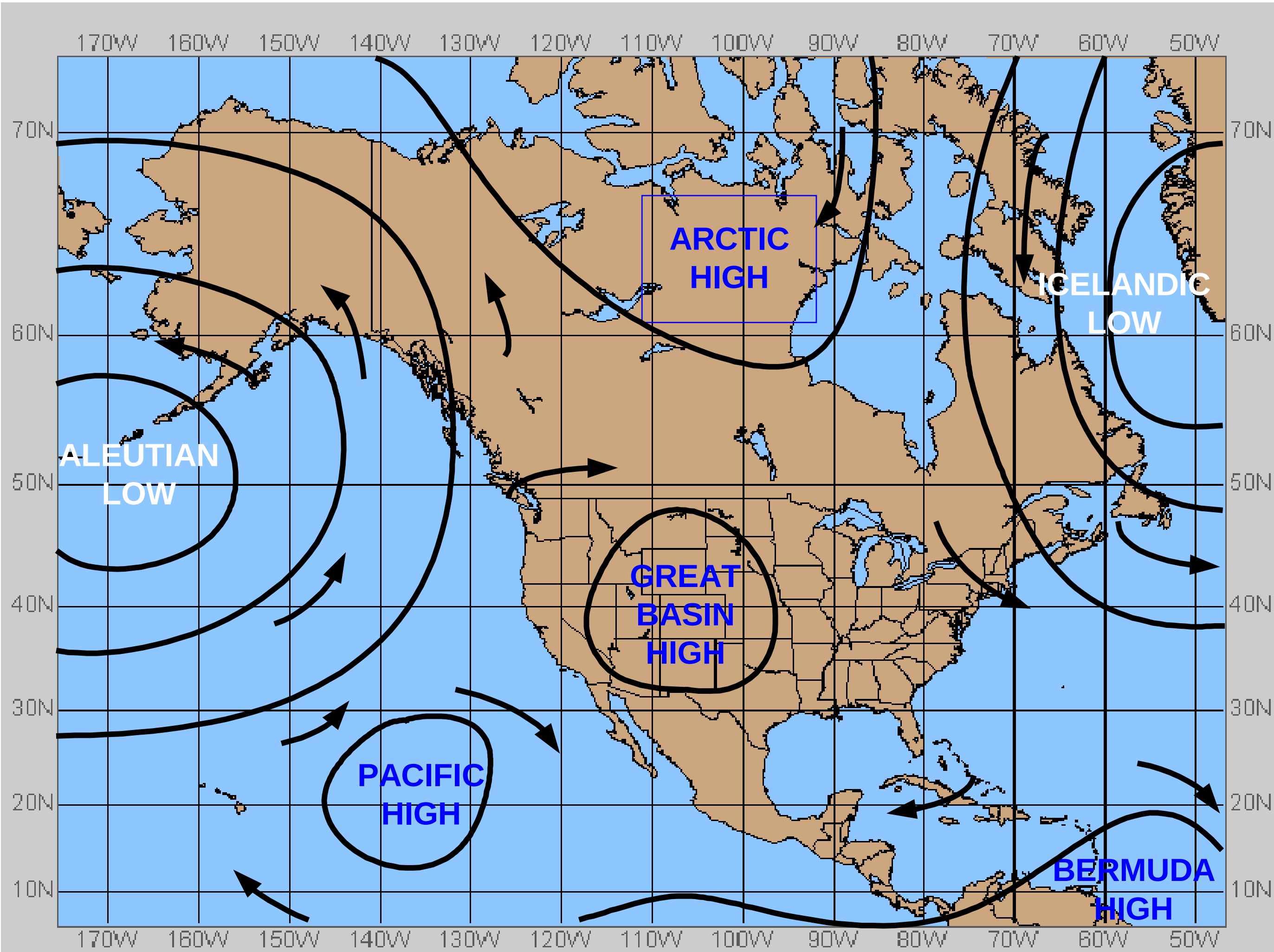

Figure 14 – Sea-level Pressure Climatology (January)

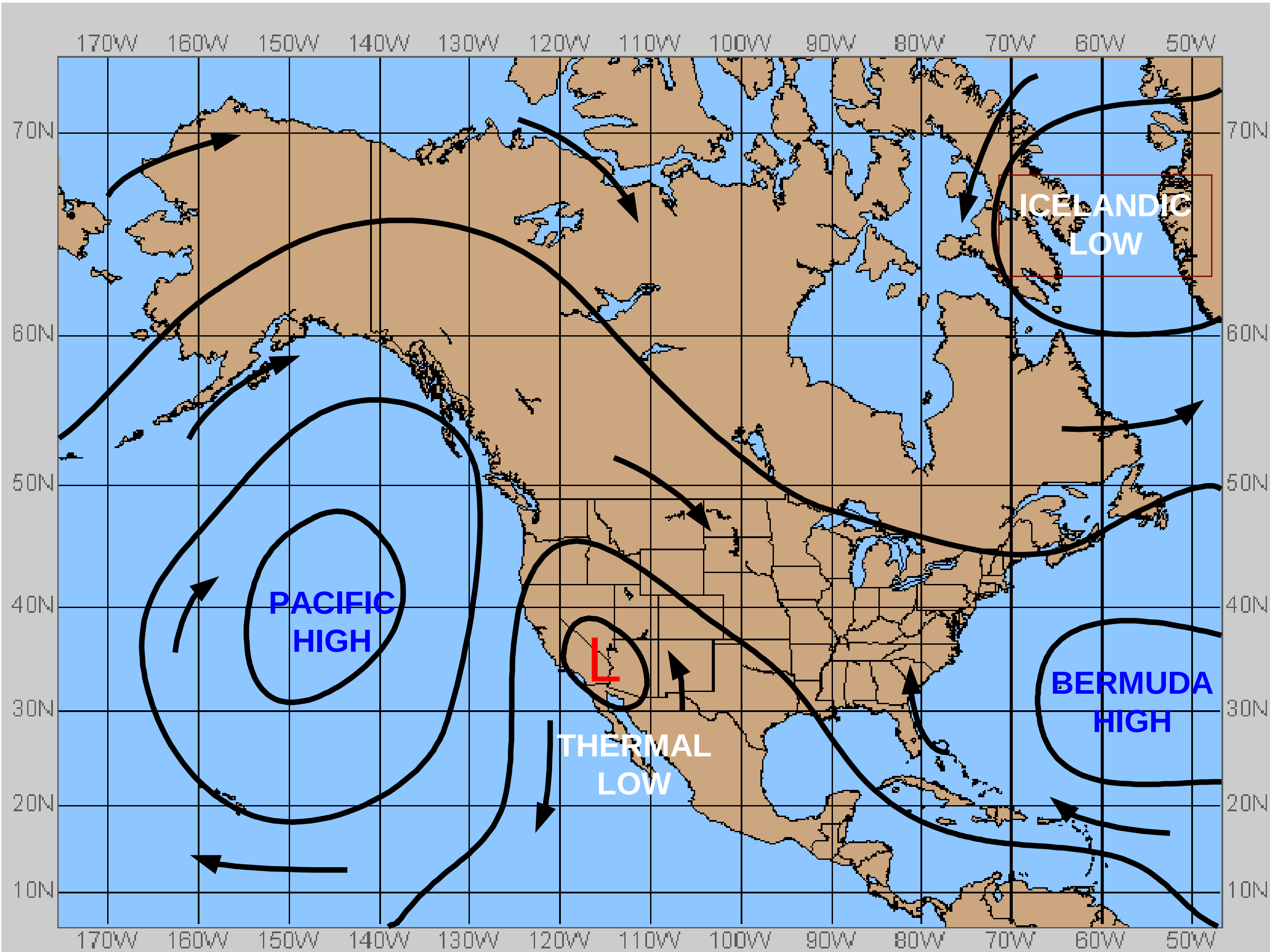

Figure 15 - Sea-level Pressure Climatology (July)

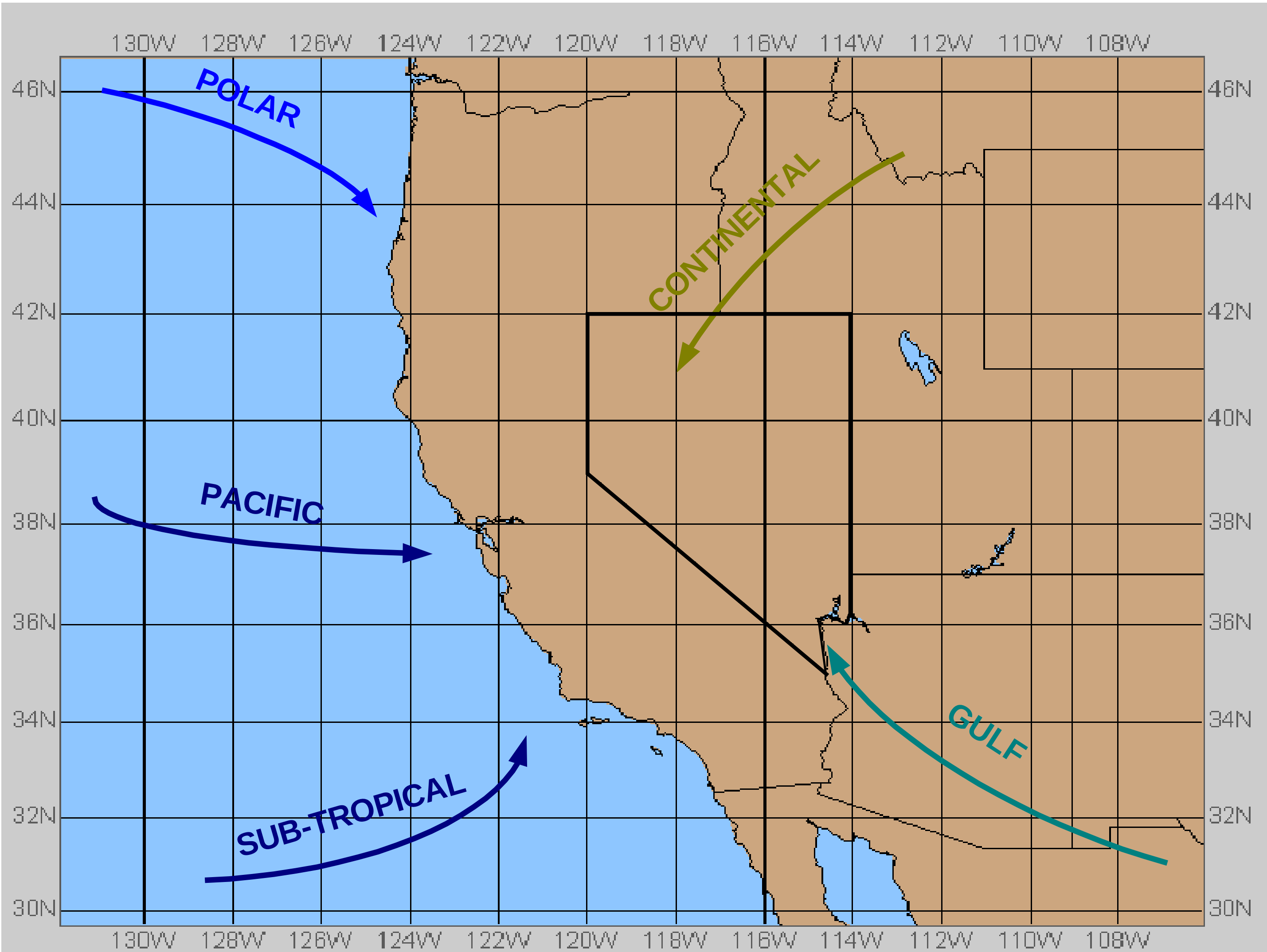

Figure 16 – Air Mass Flow Pattern

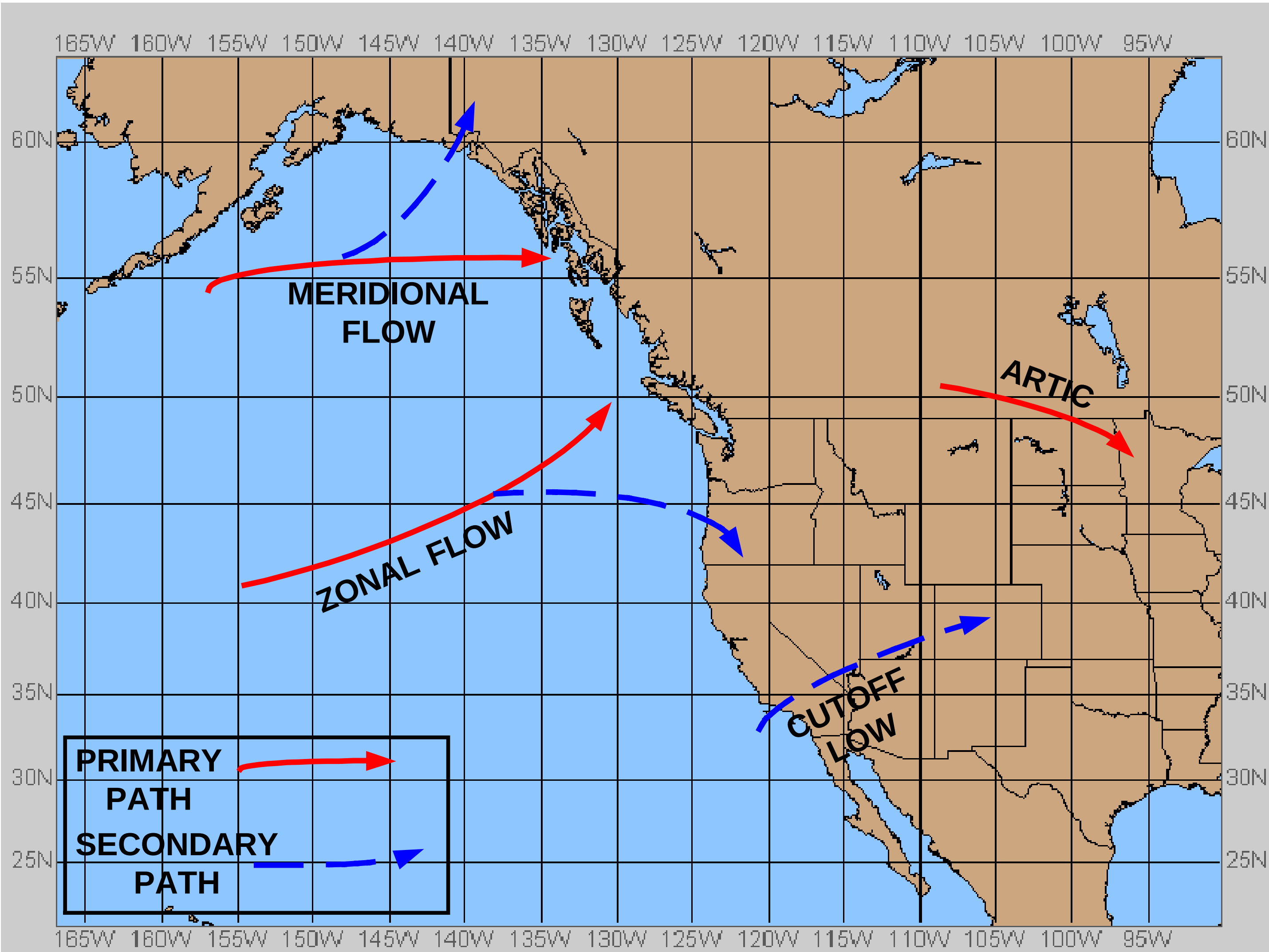

Figure 17 – Winter Storm Tracks

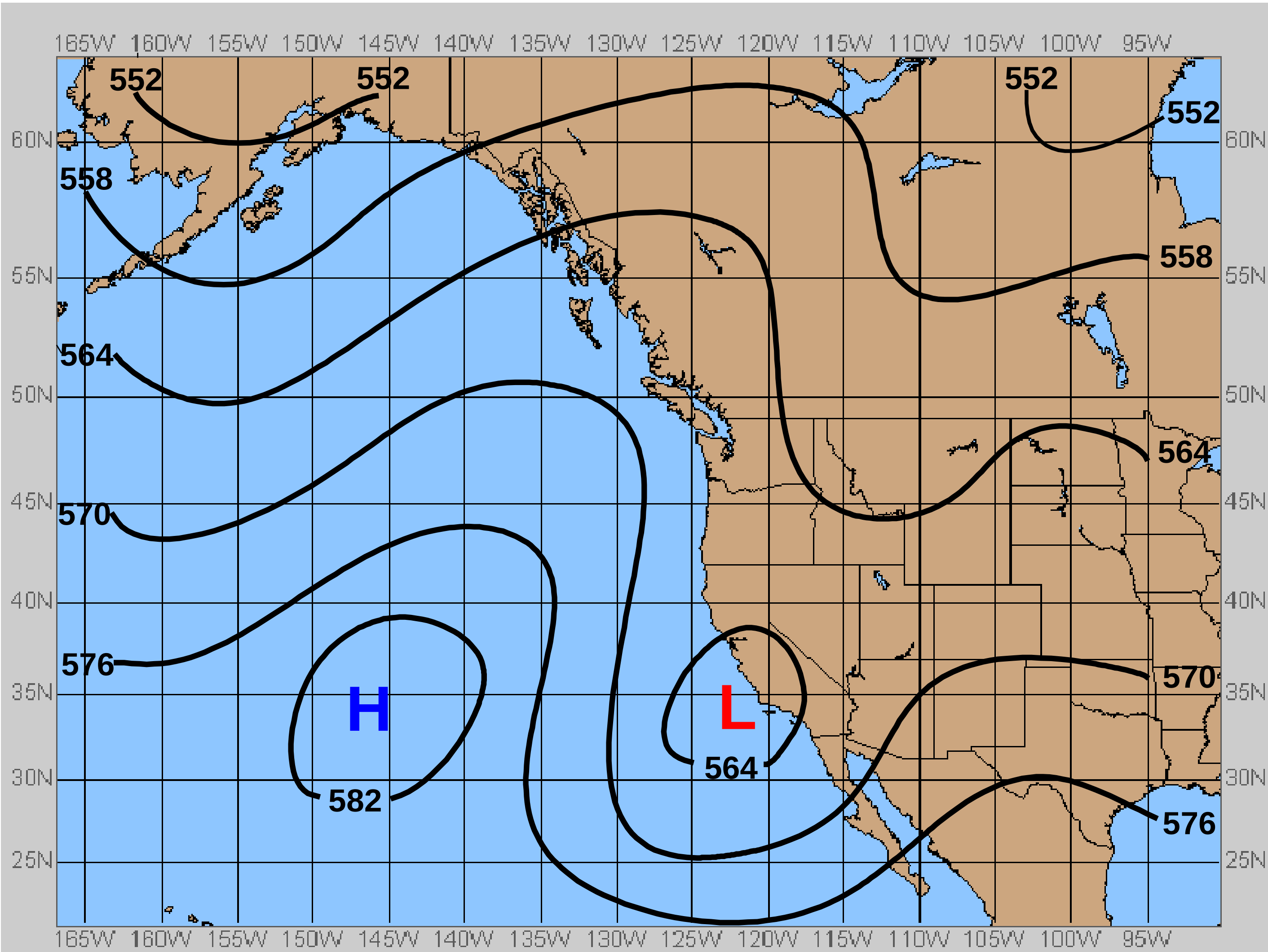

Figure 18 – Typical Cut-off Low at 500 MB

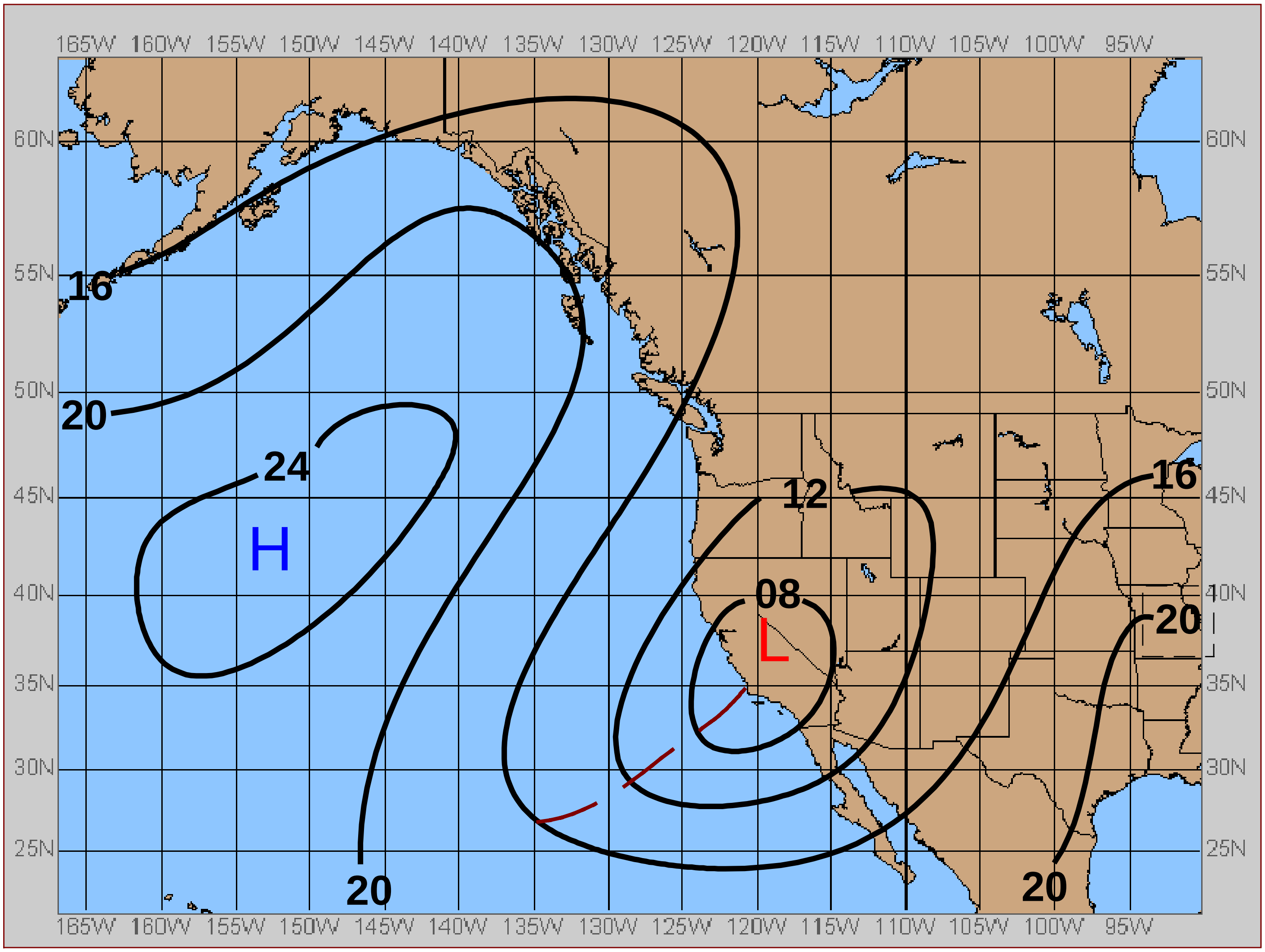

Figure 19 – Typical Cut-off Low at Surface

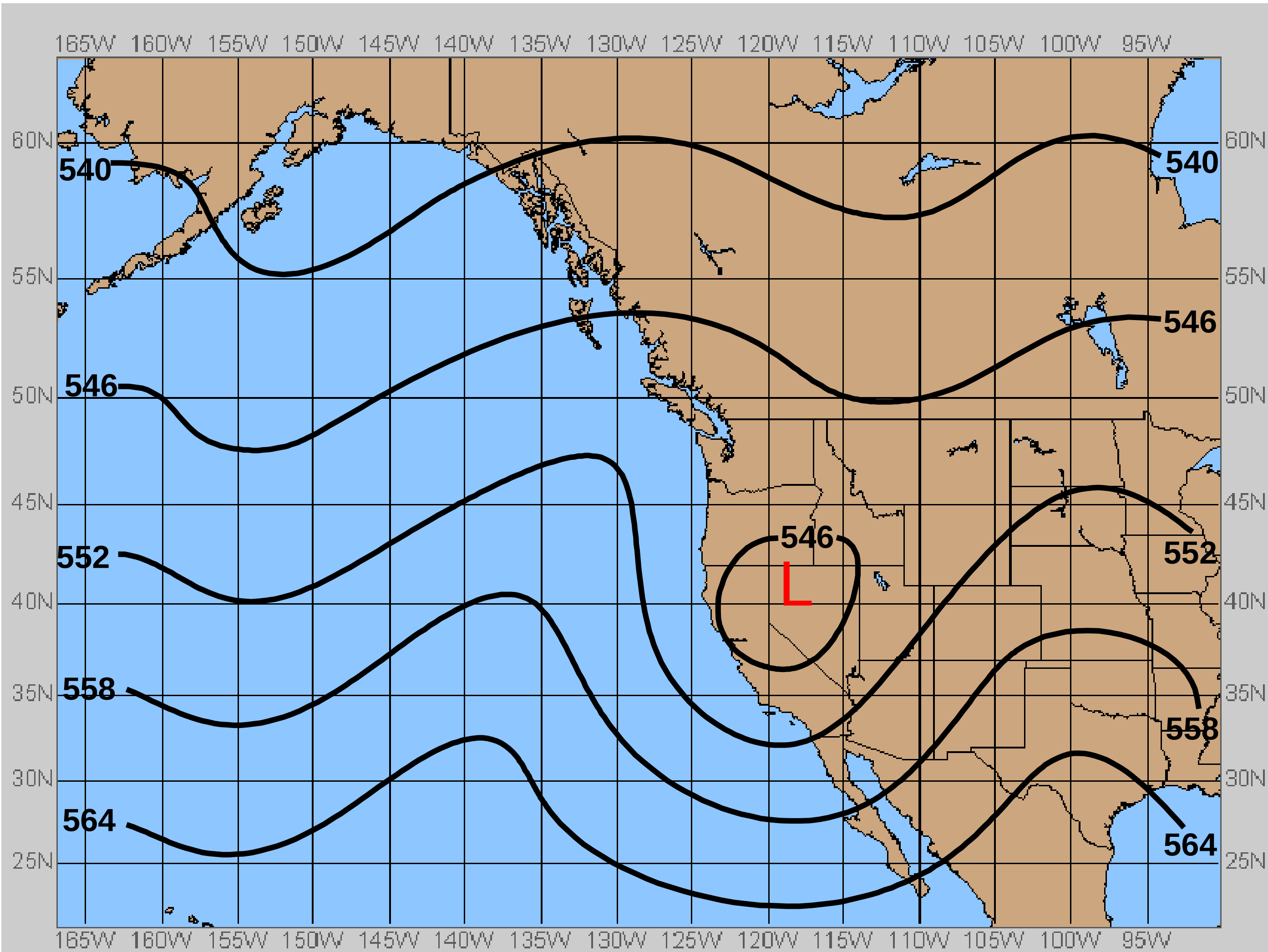

Figure 20 – Typical Nevada Low at 500 MB

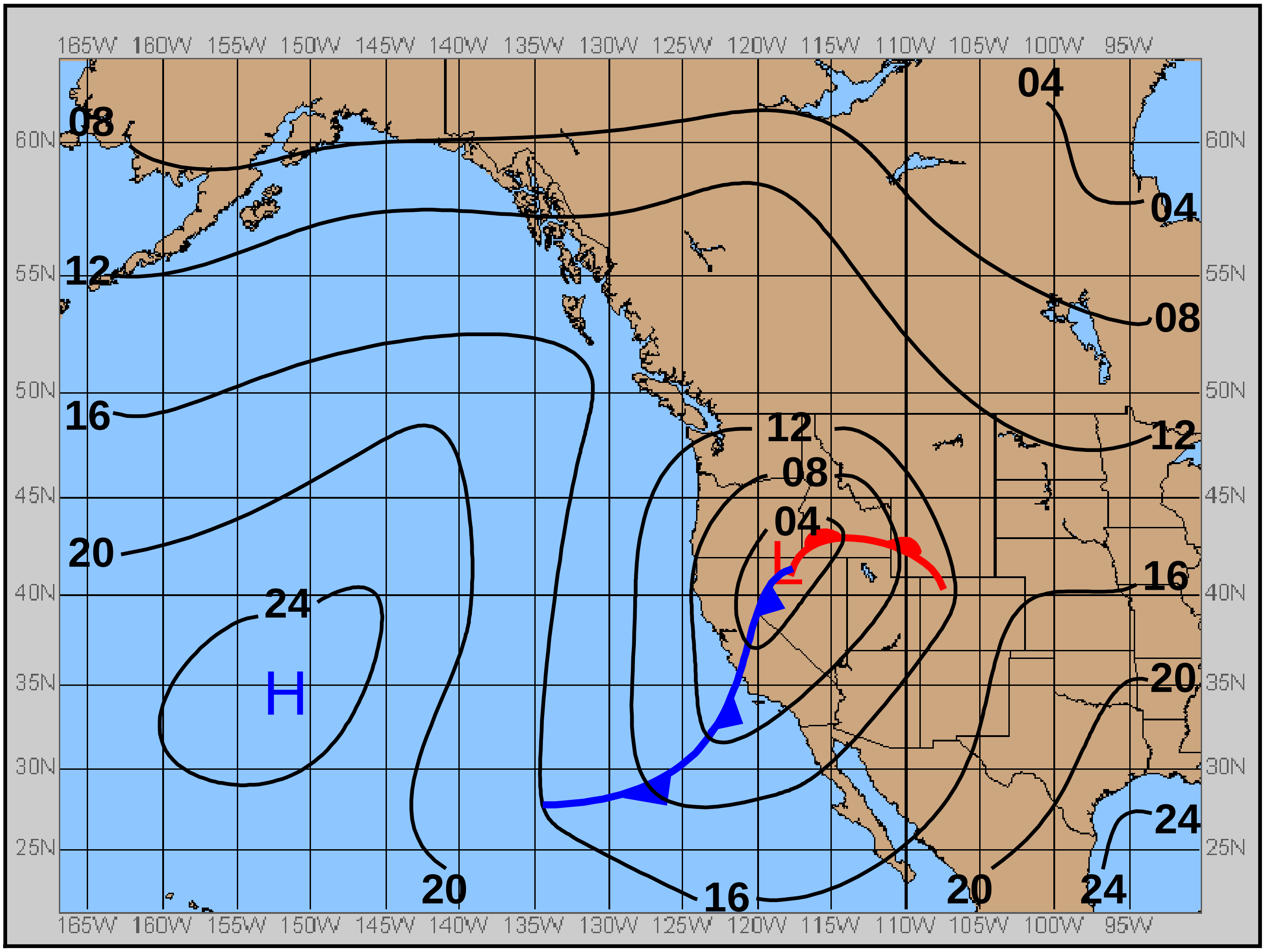

Figure 21 – Typical Nevada Low at Surface

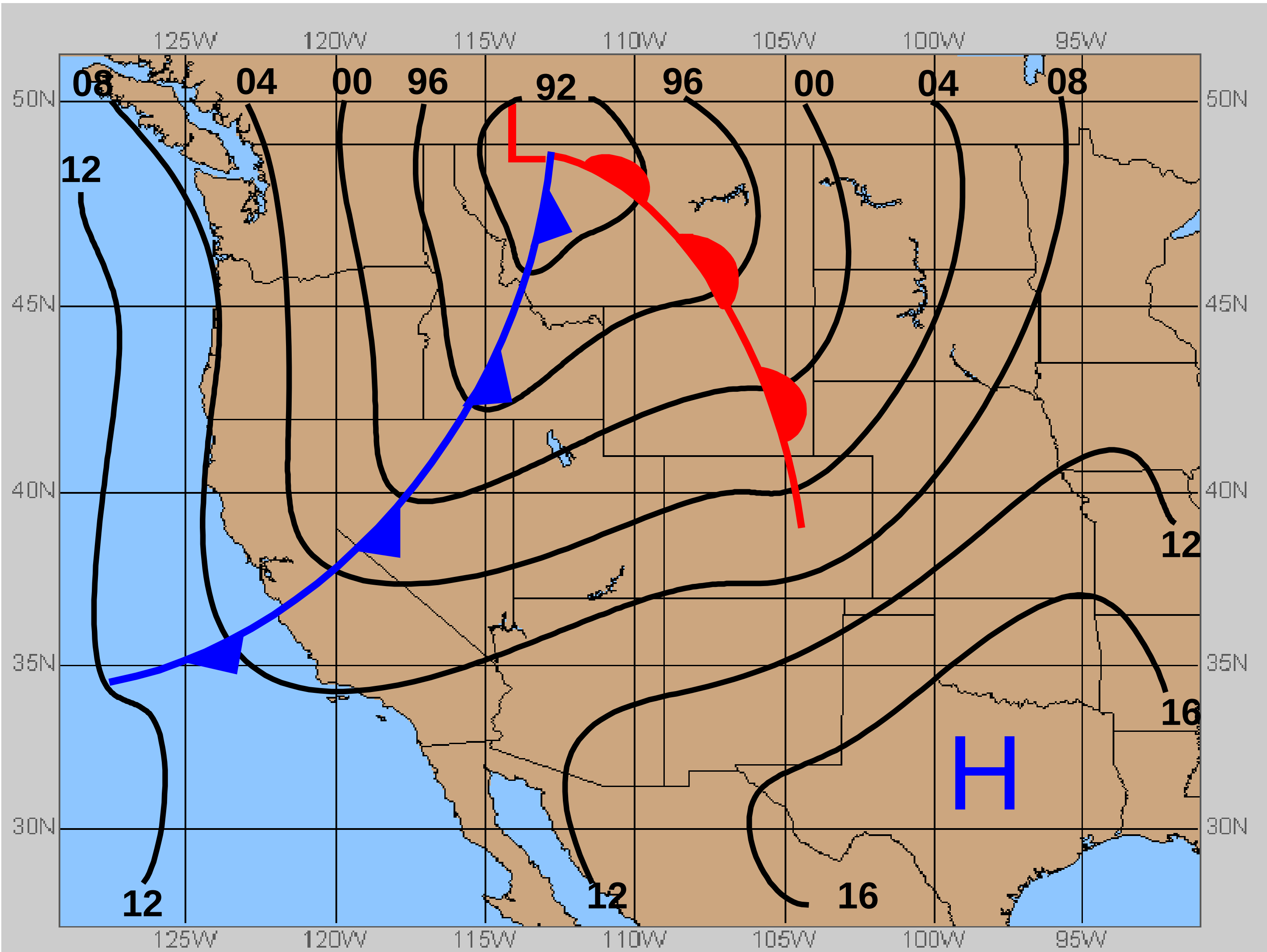

Figure 22 – Cold Front (NE to SW Orientation)

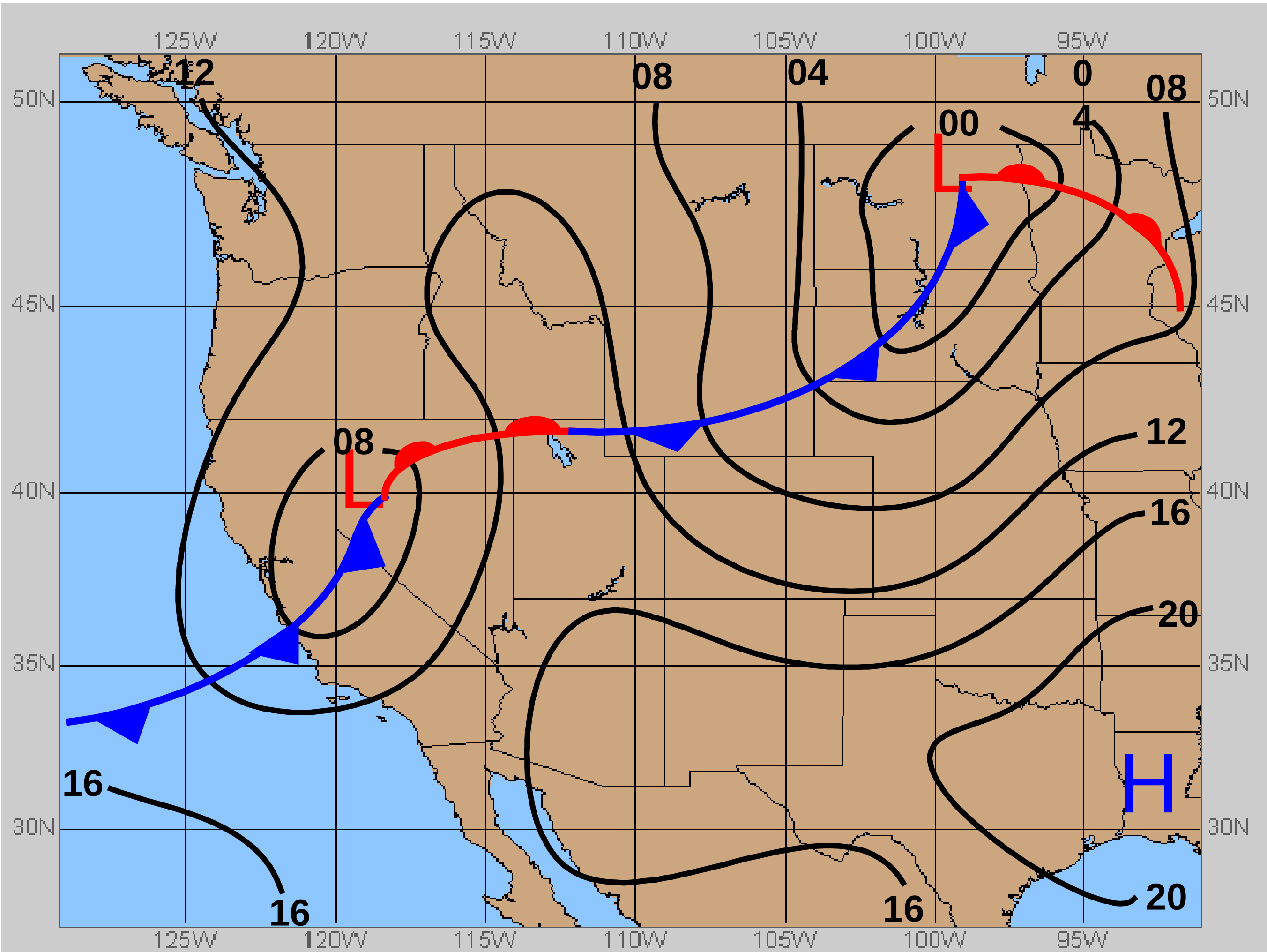

Figure 23 – Cold Front (E to W Orientation)

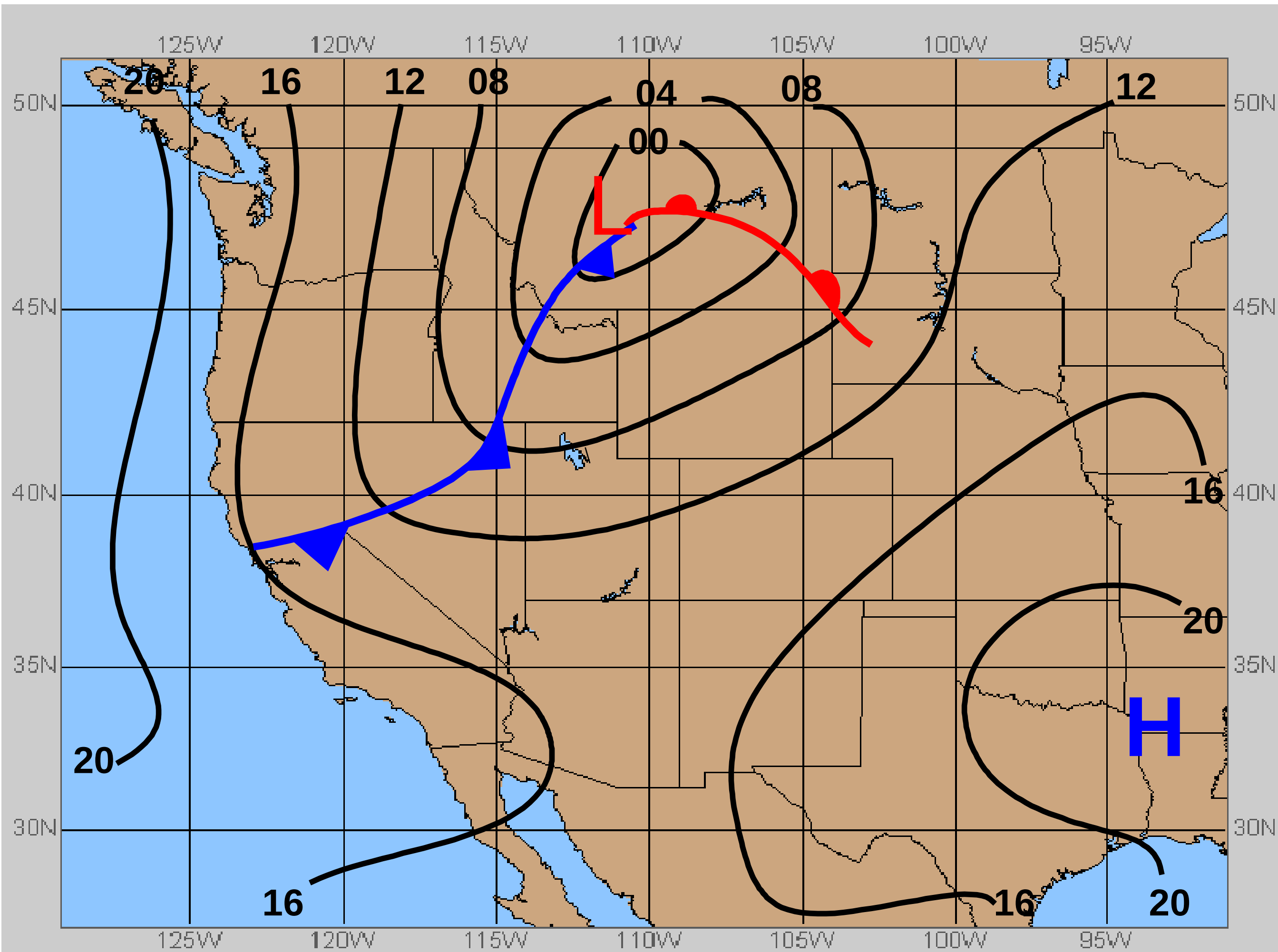

Figure 24 – Cold Front (E to W Orientation – 12 hours later)

SECTION III - FORECASTING

A. Subjective Rules.

1. Fronts.

a. Due to orographic lifting over the mountains surrounding the Fallon area, most cloud bases accompanying weak cold frontal passages are near 10,000 feet AGL.

b. Cold fronts approaching Fallon from the north during the Winter months produce some of the most intense weather observed. If the wind flow preceding the front has a northerly component, snow usually results, if it has a southerly component, rain will occur.

c. Cold fronts crossing the Sierra Nevada Mountain Range from the west to northwest undergo rapid modification and lose a great deal of their frontal identity by the time of passage at NAS Fallon. Surface winds, in advance of the front, are normally the only factor that affects airfield operations unless one of the following occurs in conjunction with the front:

(1) The front is embedded in a strong short-wave trough.

(2) A well-developed jet is over the station or just to the south of the station with a southwest to northeast orientation.

(3) A low forms on the front in Nevada.

d. Warm fronts generally pass the station as an upper level front unless they approach from a more southerly direction. Upper level warm fronts produce little weather in the Fallon area. As mentioned previously in Section II, a potential for light precipitation does on occasion occur, associated with an overrunning condition. Although this is a somewhat infrequent occurrence, it does normally result in a thick mid and high level cloud layer producing broken to overcast condition and ceilings normally ranging from 8,000 to 12,000 feet AGL.

e. Warm fronts approaching the station from the south in connection with a Tonopah Low on occasion produce heavy and widespread areas of precipitation when the upper level wind flow is southwesterly from the ocean area off the Southern California Coast.

f. Strong fast moving cold fronts will have cloud bases near 3000 feet AGL. Precipitation is normally very brief in duration but will appear as a very solid band of showers on the NEXRAD, maintaining a nearly constant decibel level as the showers track from west to east over NAS Fallon.

g. Fast moving cold fronts with upper level flow normal to the front provide minimal significant weather. Any that does occur will be primarily in advance of the front.

h. A slow moving cold front with upper level flow parallel to the front is accompanied by considerable cloudiness and weather behind the front.

i. Very little weather is experienced with fronts located well south of the jet stream.

j. A cold front moving southward through Idaho will become stationary and return rapidly as a warm front if a low is developing over or moving into Nevada.

k. Rapidly moving cold fronts in the Spring are nearly always accompanied by blowing dust, with occasional visibility reductions to less than one mile. This is much more prevalent adjacent to the hillsides to the east and south of NAS Fallon.

2. **WINDS**.

a. When a well-developed thermal trough over the San Joaquin Valley extends into northern California, gusty westerly winds may be expected. If a low develops in the trough, local winds will likely reach warning criteria.

b. Surface winds, prior to cold frontal passage, will be southwesterly (on occasion a more southerly to south-southeast component may persist), ranging from 15 knots to 25 knots, with gusts to 35 knots when a lee trough develops ahead of the cold front.

c. When surface winds reach a sustained speed of 20 knots or a sustained speed of 15 knots with frequent gusts to 25 knots, expect blowing dust to occasionally restrict visibility to less than five miles. Sustained winds greater than 25 knots or frequent gusts in excess of 35 knots will reduce visibility to one mile or less. If a measurable amount of precipitation has fallen within 48 hours, blowing dust is less likely.

d. When forecasting surface winds under light gradient conditions, use the 850 Mb analysis chart and the local upper air sounding. The 850 Mb flow will generally be quite representative of conditions at the surface.

e. During the Winter months, Reno's hourly weather observations provide a good indicator for wind direction and speed as associated with approaching frontal systems and frontal passage. Reno’s winds will begin to increase and become gusty up to several hours prior to those at NAS Fallon. Frequently Fallon will have slightly lower wind velocities than those observed at Reno due to funneling effects near the Sierras. Subtract 8 to 10 knots from Reno’s winds to obtain a fair approximation of Fallon’s forecast winds.

f. Under conditions of weak pressure gradient, abnormal wind flow occurs during the early morning as the air moves toward areas of lowest pressure. Check observations from surrounding stations. Pressure variations of only a few millibars may be the reason for the abnormal winds at NAS Fallon.

g. If a low is present at the 700 or 500 Mb level over Nevada, gusty surface winds and precipitation may be expected.

h. Forecast gusty northwesterly winds ahead of a strong high pressure ridge if a deep trough behind moves eastward during daylight hours.

i. Early morning rawinsonde winds at NAS Fallon or Reno do not necessarily reflect daytime winds at the surface or in the lower levels. Late morning rawinsondes provide a more accurate reflection of local winds for the day.

j. When rotor type altocumulus standing lenticular (ACSL) clouds appear to the west of NAS Fallon, the surface winds will usually increase and become gusty from the west. If the lenticular clouds are widespread, expect surface winds to increase to warning criteria.

k. A southerly to westerly surface wind above 10 knots at sunrise is a strong indicator that surface winds will increase to warning criteria by noon.

i. Summer winds tend to flow toward areas of highest temperature during the afternoon. Winds increase from the west during periods of maximum heating.

m. Summer wind gusts for NAS Fallon can be predicted by determining the sea level pressure difference between Fallon and San Francisco. The value obtained is multiplied by four, this value is the approximate wind gust speed for NAS Fallon during the afternoon.

n. Surface wind gusts at the ranges will be 8 to 12 knots higher when wind gusts at NAS Fallon exceed 35 knots.

o. Due to the valley orientation at Bravo 17, winds from the northwest through northeast and south through southwest will be enhanced by funneling. Sustained winds will typically be 8 to 12 knots stronger than at NAS Fallon. Nighttime katabatic winds of 4 to 8 knots should be expected at Bravo 17 when gradient flow is weak.

p. At Bravo 19, nighttime katabatic winds will be easterly 4 to 8 knots during periods of weak gradient flow. Sustained winds will be 8 to 12 knots higher at Bravo 19 than at NAS Fallon when the prevailing winds are from the south or north.

q. A moderate northeast or southeast gradient wind flow will produce sustained surface winds of 18 to 22 knots with gusts greater than 28 knots at Bravo 20. The winds give rise to blowing dust and sand which often obscures the range and makes it unusable.

3. **Precipitation**

a. The formation of a surface low in central Nevada results in a warm southerly flow into northeast Nevada with orographic channeling and enhancement of precipitation over the mountains of northeast Nevada.

b. Post-frontal upslope precipitation is most likely to occur at Reno and Ely when surface winds shift to the northeast or east.

c. Rain typically turns to snow at the elevation of Fallon when the 1000-500 Mb thickness value drops below 5400 meters.

d. Precipitation will occur in advance of an upper level trough if a low forms at the surface over Nevada.

e. Precipitation usually ends when the 500 Mb trough axis passes to the east of the station.

f. Snow flurries over nearby mountains during the Winter often make the ranges unusable.

g. Precipitation intensities will be greater and visibility restricted more at the ranges than at NAS Fallon due to orographic lifting over nearby mountains.

4. **Fog**

a. Formation of morning fog is most likely when the ground is wet from recent rain or melting snow and a stagnant high has existed over Nevada for two to three days or more. Fog forms near dawn and normally persists until approximately 1000L. On infrequent occasions, fog may persist for several days in valley areas with little or no daytime burnoff, when strong high pressure dominates the local area in Winter.

5. **Pogonip**.

Pogonip is an Native American word meaning “white death.” It is a regional name for a Winter fog that freezes to objects near the surface. It is simply a ground fog where the suspended water droplets are supercooled below the freezing point, causing them to freeze when they come in contact with trees, fences, cars, aircraft, etc. A layer of rime (frost feathers) up to half an inch thick will form on these objects.

As stated in Chapter 2, most fogs tend to burn off by early afternoon, but during occasional Winters, high pressure with subsiding air may persist for a week or more. This can prevent the fog and Pogonip from clearing out in some valleys of northern Nevada for extended periods, even during daylight hours. Under these conditions, airfield operations may be severely curtailed when field conditions remain below minimums. For this reason, careful attention must be paid to careful forecasts of fog and Pogonip.

Forecasters should be alert for the following synoptic conditions, which may herald the onset of fog/Pogonip:

a. The passage of a Winter storm which leaves an appreciable amount of snow or rain in its wake.

b. The passage of the associated upper level trough resulting in a strong north to northwest flow of very cold air over the western states.

c. Development of a strong high pressure cell over the Great Basin, which remains nearly stationary and maintains its intensity.

Specifically, fog should be forecast when the following conditions are met:

a. Saturation of the air in the lower levels due to melting snow or other abundant surface moisture.

b. Formation of a surface based inversion extending to about 2000 feet above the surface.

c. Western Nevada is under the influence of a surface high to the east or northeast of Fallon, with ridging aloft producing subsidence over the area.

Forecast fog dissipation when the Great Basin High weakens or moves eastward, or when a front or an upper level disturbance moves eastward into Nevada. The fog may also dissipate during the day without the high weakening or a significant disturbance moving in. This, in fact, is most often the case, since the subsidence and moisture content are not usually sufficient to offset the effects of daytime heating of the shallow moist layer. This explains the typical mid-morning burnoff.

6. **Cloudiness**

a. Northwesterly to northerly flow at the 500 Mb level will produce clear skies during the Winter unless a jet maximum is embedded in the flow, in which case scattered to broken cirrus will prevail.

b. A southwesterly flow at the 500 Mb level generally indicates broken Cirriform cloudiness will form within 24 hours.

c. When a strong coastal inversion is present along the California coast, seen in satellite imagery as widespread coastal Stratus, the inversion will trap moisture and the skies will generally be clear at Fallon even with a strong southwesterly flow aloft.

d. Elongated “V” shaped troughs will have cloudiness but not necessarily precipitation in the southerly flow in advance of the trough.

e. During periods of moist low-level wind flow from the north through east at Bravo 16, cloud bases will normally be 1000 to 2000 feet lower than at NAS Fallon due to the orographic lifting of the moist area over nearby mountains. Additionally, following a cold frontal passage, if sufficient low-level cloudiness exits, a northerly component will result in producing broken to overcast conditions in the southern Dixie Valley area, encompassing the Bravo-17 complex, while scattered conditions are being experienced at NAS Fallon.

f. During periods of moist low-level wind flow from the southeast through north at Bravo 17, expect cloud bases to be 1000 to 2000 feet lower than at NAS Fallon due to orographic lifting of the moist air over nearby mountains.

g. Cloud bases at Bravo 19 will be 1000 to 2000 feet lower than bases at NAS Fallon when a northerly or southerly moist low-level wind flow prevails.

7. **Upper Level Systems**

a. With a long wave trough just off the California coast, monitor pressure trends closely. When the local pressure begins to fall and winds at Slide Mountain increase rapidly, expect the upper level trough to pass through the Fallon area within 12 to 24 hours. (Slide Mountain ASOS observations are currently only available to the NWS forecaster at Reno who will provide this observation via telephone if requested. The Slide Mountain observation is expected to become an additive remark in the Reno ASOS observation in the near future).

b. The development of a “Nevada Low” (cutoff low aloft over Nevada) requires a strong northwesterly wind flow at 500 Mb along the California coast and large persistent height rises in southern and southeastern Alaska.

c. Troughs aloft slow down and deepen when there are surface pressure falls and cold air advection in the 1000-500 Mb layer on the west side of the trough.

d. Cold lows and warm highs usually move slowly or stagnate.

e. When a ribbon of high speed easterlies aloft moves southward across Washington and Oregon and reaches the latitude of a cutoff low over Nevada, the low will fill and/or move out rapidly.

f. Plateau highs break down rapidly under a strong westerly flow aloft.

8. **Temperatures**

a. During the Summer, a well-developed high pressure ridge will send surface temperatures above 95 degrees Fahrenheit; if the ridge is also overhead at the 500 Mb level, temperatures of over 100 degrees are likely.

b. When the thermal trough extends into Nevada from Arizona, expect abnormally high temperatures.

c. Daily maximum temperatures will be reached at approximately 1600 PST during the Summer.

d. Summer temperature variation is dependent upon the amount of opaque cloud cover. Research has revealed the following:

(1) Clear skies (less than 3/10) - temperatures will rise 35 to 40 degrees above the previous night's minimum temperature.

(2) Partly cloudy to mostly cloudy skies (4/10 to 8/10) - temperatures will rise 25 to 30 degrees above the previous night's minimum temperature.

(3) Mostly cloudy to cloudy skies (more than 8/10) - temperatures will rise 20 to 25 degrees above the previous night's minimum temperature.

e. When an Omega Block forms over Nevada during the Spring and Fall, expect abnormally high temperatures.

f. When surface temperatures exceed 70 degrees Fahrenheit, dust devils and gusty low-level winds can be expected at all ranges.

g. Winter temperatures do not have the daily variation that occurs in Summer. On clear to partly cloudy Winter days in the absence of significant synoptic change, a maximum of 20 to 30 degrees above the morning minimum can normally be expected.

9. **Thunderstorms**

a. Thunderstorms are a rare event in Nevada in the Winter. The few thunderstorms that do occur are typically associated with a closed upper level low.

b. Severe and nocturnal thunderstorms are rare over Nevada. When they do occur, they are produced by strong divergence aloft provided by an approaching jet max or a dynamic feature such as a closed low aloft.

c. Westerly downslope winds have a dissipating effect on thunderstorm activity along the Sierra Nevada mountains due to low level speed divergence. Thunderstorms are more likely over the Sierra Nevada mountains when the thermal trough axis is along the Sierras with the 700 Mb flow from the south or southeast in the Summer.

d. Thunderstorm activity often passes to the east of the station when approaching from the south, or to the northwest of the station when approaching the station from the west. Occasionally, a thunderstorm cell will pass over the station producing strong gusty surface winds to 40 knots which gives rise to blowing dust that can briefly lower visibility to less than one mile. Shower activity is generally minimal and on occasion pea sized or smaller hail is briefly observed. Ceilings in and near thunderstorms are generally near 2500 feet (occasionally ranging to near 6000 feet during summer months) with scattered Stratus

Fractus clouds at 1000 to 1500 feet. Average time of thunderstorm activity is between 1600 and 1900 local, but during moist monsoon type flow periods, they can occur much earlier and have on occasion, continued into the early morning hours.

e. The appearance of patchy, turreted Altocumulus Castellanus clouds at sunrise is a good indication of possible thunderstorm activity later in the day during the Summer.

f. Weak winds aloft result in little thunderstorm cell movement and possible localized flash flooding. The presence of strong mid-level winds may produce thunderstorm gusts approaching severe thunderstorm intensity.

g. Moisture advection necessary for thunderstorm development in the local area can be provided by a closed low aloft off the coast of California, tropical cyclone activity in the vicinity of Baja, California. Additionally, the eastward ridging of the Bermuda High towards the southwestern U.S., causes low/mid level moisture to be advected northward from it’s source region in the Gulf of California.

h. During periods of thunderstorm activity at NAS Fallon, thunderstorm activity of equal or greater intensity can be expected at the EW range. This should be monitored closely with the NEXRAD at all time during thunderstorm conditions.

i. A close approximation of thunderstorm gusts can be obtained by forecasting one knot of wind for every thousand feet of thunderstorm top, i.e. 35000 ft top thunderstorm, maximum gusts 35 knots.

j. During the Spring and Fall, unstable back-flow around upper level lows east of Fallon may produce thunderstorms that approach NAS Fallon from the north to northeast. Wind gusts from these storms kick up abundant alkali dust and sand from the Forty Mile Desert between Fallon and Lovelock. This material can extend to a significant height. As these storms approach NAS Fallon, visibility may drop below minimums and may stay there for up to an hour. Even after winds subside, visibility may remain reduced to IFR conditions for two to three additional hours due to suspended dust and sand.

k. A typical thunderstorm development for the Fallon area is as follows: The appearance of patchy, turreted altocumulus clouds at sunrise is a rather good indication of possible thunderstorms later in the day. Heating of the rocky mountain slopes causes air to rise toward the crests and soon cumulus clouds form in these upslope currents. The clouds will typically continue to build to towering cumulus. Near midday, their tops develop a fibrous appearance indicative of ice crystal formation and they are said to be glaciated. Soon the clouds develop anvil-shaped cirrus tops with streamers of cirrus stretching in the direction of the wind at 30,000 to 40,000 feet. Lightning flashes from cloud to mountain and heavy local showers of rain, graupel (sleet or soft hail), or pea sized hail may fall on the crests and ridges of the mountain ranges.

By late evening, downdrafts of cool air predominate, thunderstorm activity decreases, and skies brighten to the west over the Sierra. Clouds thicken over leeward valleys where day-long heating has created rising thermal currents. It is often near 1700 or 1800 PST when a brief thunderstorm is experienced in valley locations such as Reno, Carson City, Bishop, and Bravo-17.

10. **Subjective Rules for Forecasting Thunderstorms.** In summary, the frequency of thunderstorm days at NAS Fallon is low, an average of 13 days per year, between April and October. Moisture advection, necessary for thunderstorm development, is associated with one of the following synoptic situations:

a. A cold core cutoff low aloft in the vicinity of the central California coast.

b. Westward ridging of the Bermuda High into the southwestern U.S.

c. Tropical cyclone activity in the vicinity of northern Baja California.

d. An anticyclone aloft over the Four Corners area.

When forecasting thunderstorms, good predictors are the Showalter Stability Index, K-Index, and Lifted Index. Local forecasters have found the following minimum limits work fairly well in this area:

K-Index. Equal to or greater than 28

Lifted Index. Equal to or less than 4

Showalter Stability Index:

(1) Equal to or less than +3: scattered showers are probable with isolated thunderstorms in the vicinity.

(2) +1 to -2: scattered thunderstorms probable.

(3) Values of -3 or less: severe thunderstorms can be expected.

The National Weather Service transmits a four panel stability chart twice a day which includes the Lifted Index and K-Index for selected stations throughout CONUS. The local sounding may be entered into GFMPL for the computation of the Showalter Stability Index. Manual procedures for this computation can be found in the Aerographer's Mate First and Chief and in Air Weather Service/tr-70/006 (The use of the Skew-T, Log P Diagram in Analysis and Forecasting). In any potential thunderstorm situation the forecaster will have to determine if adequate moisture exists. On the National Weather Service four panel stability chart, two of the panels will show moisture content; specifically, precipitable water and average relative humidity from surface to 300 Mb. Values that favor thunderstorm development are 0.70 inches or greater precipitable water and 80% relative humidity or greater.

e. Another general rule for Summer thunderstorm likelihood is a morning dew point of greater than 40 degrees. This is by no means an assurance of thunderstorm activity, but provides an indication of sufficient low-level moisture for later development.

B. Mountain Waves.

The forecaster must be alert for the formation of mountain waves due to the numerous mountain ranges throughout Nevada, most significantly the Sierras and Cascades. A thorough understanding of the dynamics that produce mountain waves is essential since turbulence produced by mountain waves can have a significant impact on flight operations throughout the local flying area.

When strong winds (50 knots or greater) blow approximately perpendicular to a mountain range, the resulting turbulence may be quite severe. Associated areas of steady updrafts and down-drafts in the vicinity of mountain ridges may extend two to 20 times the height of the mountain peaks. Under these conditions, when the air is stable, large waves tend to form directly over the mountains and can extend upward to the lower stratosphere. These are typically evidenced by a pronounced cap cloud over the ridge. Pilots have reported that the flow in these waves is often remarkably smooth; other pilots have reported severe turbulence.

As air moves up the windward side of the mountain range the wind speed gradually increases, reaching a maximum near the ridge top. After passing the peak, the flow breaks down in a more complicated pattern with downdrafts predominating. Downrange from the ridge, a series of standing lenticular clouds will usually be seen. These can extend downrange for hundreds of miles, with a characteristic ribbed pattern evident on satellite imagery.

Mountain waves will start to develop and are most pronounced when:

a. The winds are within 30 degrees of perpendicular to the mountain range with a speed of 25 knots or more at mountain top level.

b. The wind does not change direction with height.

c. The wind speed increases with height.

Wind speed and direction at the ridge level is critical for the development of the mountain wave. Wind information at the ridge level is available for the Sierra Nevada in the vicinity of Lake Tahoe. Instantaneous wind and temperature data is recorded and transmitted from Slide Mountain and Peavine Peak every ten minutes (this data is available presently by contacting the NWS forecaster at Reno by telephone). Slide mountain is located approximately 12 miles southwest of the Reno Airport with sensors at 9650 feet MSL. Peavine Peak is 9 miles northwest of the airport with sensors at 8266 feet MSL. Reno’s hourly ASOS observation is expected to include Slide Mountain’s ASOS observation in the near future. Use of this data will aid the forecaster in determining the potential for mountain waves. In addition, aviation surface weather observations should be scanned carefully for remarks concerning rotor and lenticular clouds. Good stations to monitor are: Bishop (KBIH), Reno (KRNO), Lovelock (KLOL), China Lake (KNID), Truckee (KTRK), South Lake Tahoe (KTVL), Mammoth Mountain (KMMH), Yakima (KYKM), Lakeview (KLKV), and Redmond (KRDM).

C. Turbulence.

Light to moderate turbulence below 15,000 feet (MSL) can be expected during Summer afternoons associated with intense heating of the desert and resulting thermal currents. Due to irregular terrain and mountains surrounding the Naval Air Station, sustained winds of 20 knots and/or gusts in excess of 25 knots will produce moderate low level turbulence.

1. **Clear-Air Turbulence (CAT).** Given the type of flying done on the Fallon ranges, the problem of CAT cannot be taken lightly. CAT is produced by a relatively steep gradient in wind velocity in a particular direction (either vertical or

horizontal) which produces churning motion or eddies. The greater the change of wind speed and/or direction, the more severe the turbulence. Turbulent flight conditions are frequently encountered in the vicinity of the jet stream where large shears in the horizontal and vertical are often found. Since this turbulence may occur in perfectly clear air without any visual warnings in the form of clouds, the forecaster must pay particular attention to sudden changes either vertically or horizontally in the wind speed and/or direction in the upper levels (especially in the vicinity of the jet stream).

The association of CAT with recognizable synoptic features meets with only limited success. Even so, the forecaster must alert flight personnel to the hazards of CAT by indicating the possibility of occurrence. CAT may be expected as follows:

a. Generally, in any region along the jet stream axis where wind shear appears to be strong horizontally, vertically, or both.

b. In the vicinity of a traveling jet maximum, particularly on the cyclonic shear sides (left exit region, right entrance region) where most occurrences of moderate and severe CAT have been reported.

c. In the jet stream "front", below and to the south of the core.

d. Near 35,000 feet in cold deep troughs.

2. **Forecasting Turbulence.** The intensity and location of probable turbulence are detailed as follows:

a. **Light Turbulence**.

(1) In hilly and mountainous areas, even with light winds.

(2) In and near small cumulus clouds.

(3) In clear air convective currents over heated land.

(4) With weak wind shear in the vicinity of troughs aloft, the jet stream, and tropopause.

(5) In the lower 5000 feet of the atmosphere when winds exceed 15 knots.

(6) In areas where the atmosphere is unstable (warm air is underlying cold).

b. **Moderate Turbulence**.

(1) In mountainous areas with a wind component of 25 to 50 knots perpendicular to and near the level of the ridge.

(2) In and near thunderstorms in the dissipating stage.
(3) In and near towering Cumuliform clouds.

(4) Near the surface when surface winds exceed 25 knots.

(5) Near the surface when heating of the ground is unusually strong.

(6) In areas of very strong cold air advection.

(7) In fronts aloft.

(8) In areas where vertical wind shear exceeds six knots per 1000 feet or horizontal wind shear exceeds 18 knots per 150 miles.

c. **Severe Turbulence**.

(1) In mountainous areas with a wind component exceeding 50 knots perpendicular to and near the level of the mountain ridge.

(2) At and below the mountain ridge level, on the downwind side, in rotor clouds or rotor action. Rotor action is simply the presence of rotor cloud type motion without sufficient moisture for the formation of the rotor cloud (often the case in Nevada).

(3) In and near growing mature thunderstorms.

(4) 50 to 100 miles on the cold side of the center of the jet stream, in cyclonic shear zones of especially strong jet streaks, and in lows aloft where vertical wind shear exceeds ten knots per 1000 feet and horizontal wind shear exceeds 40 knots per 150 miles.

d. **Extreme Turbulence**.

(1) In mountain wave situations, in and below well developed rotor clouds; turbulence may extend to the ground.

(2) In mature severe thunderstorms, characterized by large hailstones (3/4 inch or more in diameter), heavy rain, very gusty wind, and strong NEXRAD reflectivity (greater than 55 DBZ).

The forecaster should refer to NAVMETOCCOMINST 3140.4( ) for turbulence criteria tables and additional information on forecasting turbulence.

D. **Icing**.

Aircraft icing is one of the major weather hazards to aviation. Freezing levels in the Fallon region range from the surface during Winter nights (or during the day during colder periods) to 15,000 feet or more during Summer afternoons. Icing occurrences outside of Winter months are associated with convective clouds extending through the freezing level.

1. **Types of Icing**. There are three basic forms of ice accumulation on aircraft: rime ice, clear ice, and frost. In addition, mixtures of rime and clear ice are common.

a. Rime ice is a rough, milky, opaque ice formed by the instantaneous freezing of small supercooled droplets as they strike the aircraft. The fact that droplets maintain their nearly spherical shape upon freezing and thus trap air between them gives the ice its opaque appearance and makes it porous and brittle. Rime is formed in Stratiform clouds with temperatures between -15 and -20 degrees C.

b. Clear ice is a glossy, clear or translucent ice formed by the relatively slow freezing of large supercooled droplets. The large droplets spread out over the airfoil before completely freezing, forming a sheet of clear ice. Clear ice is formed in Cumuliform clouds with temperatures between 0 degrees and -10 degrees C.

c. Frost is a light, feathery deposit of ice crystals which usually forms on the upper surfaces of parked aircraft by radiational cooling in a manner similar to the formation of frost on the ground. Frost may also form on aircraft in flight during descent from subfreezing air into a warmer, moist layer, but it is considered rare and harmless. (Refer to paragraph A, subparagraph 5, for information on **"Pogonip",** a condition of fog that freezes to surface and or near surface objects, resulting in a form of frost or rime icing)

2. **Icing Intensity**. Based on knowledge of moisture levels and temperature patterns, weather forecasters can predict the probable maximum intensity of icing that may be encountered during flight. Many variables bear upon this problem. There are four icing intensities; trace, light, moderate, and severe.

a. Trace - Ice becomes PERCEPTIBLE. Rate of accumulation is slightly greater than the rate of sublimation. It is not hazardous and does not require de-icing equipment unless it builds up to the point of being readily visible.

b. Light - The rate of accumulation may create a problem if flight is prolonged in this environment (over one hour). Occasional use of de-icing/anti-icing equipment removes ice and prevents further accumulation.

c. Moderate - The rate of accumulation is such that even short encounters become potentially hazardous and use of de-icing equipment or diversion is necessary.

d. Severe - The rate of accumulation is such that de-icing equipment fails to reduce or control the hazard. Immediate diversion is necessary.

3. **Distribution of Icing.** It is widely accepted that aircraft icing is limited to the layer of the atmosphere lying between the freezing level and -40 degrees C, whether that temperature is reached in the upper parts of cumulonimbus clouds or other types of clouds. In general, the frequency of icing decreases rapidly with decreasing temperature, becoming rare at temperatures below -30 degrees C. The normal vertical temperature distribution in the atmosphere is such that icing is usually restricted to below 30,000 feet.

a. **Clouds.** Aircraft icing can occur in Stratiform or Cumuliform clouds.

(1) **Stratiform.** Icing in middle and-low-level Stratiform clouds is confined, on the average, to a layer between 3000 and 4000 feet thick. The intensity of icing generally ranges from a trace to light, with the maximum values occurring in the upper portions of the cloud. Both rime and mixed icing are observed in Stratiform clouds. The main hazard lies in the great horizontal extent of some of these cloud decks. Aircraft remaining in such a deck could gradually build up significant icing. High-level Stratiform clouds are composed of ice crystals and produce little or no icing.

(2) **Cumuliform.** The zone of probable icing in Cumuliform clouds is smaller horizontally but greater vertically than in Stratiform clouds. Further, icing is more variable in Cumuliform clouds because the factors conducive to icing depend to a large extent on the stage of development of the particular cloud. Icing intensities may range from a trace in small supercooled cumulus cloud to often light to moderate in Cumulus Congestus and Cumulonimbus. The most severe icing occurs in Cumulus Congestus clouds prior to their development into Cumulonimbus. Although icing occurs at all levels above the freezing level in a building cumulus cloud, it is most intense in the upper half of the cloud.

Icing is generally restricted to the updraft regions in a mature cumulonimbus, and to a shallow layer near the freezing level in a dissipating thunderstorm. Icing in Cumuliform clouds is usually clear or mixed. Aircraft icing rarely occurs in cirrus clouds, some of which contain a small proportion of water droplets. However, icing of light intensity has been reported in the dense cirrus anvil-tops of cumulonimbus, where updrafts may maintain considerable water at very low temperatures.

b. **Frontal System.** It is rather difficult to represent frontal icing conditions by an idealized model, since the structure of the clouds in frontal regions and in regions of intense low pressure systems is very complex. In general, frontal clouds have a higher icing probability than other clouds. It has been estimated that 85% of observed aircraft icing occurs in the vicinity of frontal zones. Usually, the greatest horizontal extent of icing is associated with warm fronts, and the most intense icing with cold fronts.

(1) **Warm Frontal Icing.** Warm frontal icing may occur both above and below the frontal surface. Moderate or severe clear icing usually occurs where freezing rain or drizzle falls through the cold air beneath the front. This condition is most often found when the temperature above the frontal inversion is above freezing and the temperature below it is below freezing. Icing above the frontal surface, in regions where the cloud temperatures are subfreezing, is usually confined to a layer less than 3000 feet thick. Moderate mixed or clear icing can usually be expected within 100 to 200 miles ahead of the warm front’s surface position. Light rime icing can usually be expected in altostratus clouds up to 300 miles ahead of the surface warm front.

(2) **Cold Frontal Icing.** Whereas warm frontal icing is generally widespread, icing associated with cold fronts is usually spotty. Its horizontal extent is less, and areas of moderate icing are localized. Clear icing is more prevalent than rime icing in unstable clouds associated with cold fronts. Moderate clear icing is usually limited to supercooled Cumuliform clouds within 100 miles behind the surface cold front, and is usually most intense immediately above the frontal zone. Light icing is often encountered in the extensive layers of supercooled stratocumulus clouds which frequently exist behind cold fronts. Icing conditions associated with occluded and stationary fronts are similar to those of a warm front or a cold front, depending on whether the occlusion is a warm type or cold type. Moderate icing conditions are frequently associated with deep, cold low pressure areas in which frontal systems are not well defined.

4. **Forecasting Rules for Icing**.

a. **Icing Intensity Forecasts from Upper-Air Data**. Check upper-air charts, pilot or reconnaissance reports, and rawinsonde reports for dew point spread at flight level and check the upper air charts for the type of temperature advection along the route. The following guidelines have a reliability of about 80-90%.

(1) When the temperature is zero degrees C to -7 degrees C, and the dew point spread is greater than 2 degrees C, forecast no icing.

(2) When the temperature is -8 degrees C to -15 degrees C, and the dew point spread is greater than 3 degrees C, forecast no icing.

(3) When the temperature is -16 degrees C to -33 degrees C, and the dew point spread is greater than 4 degrees C, forecast no icing.

(4) At temperatures colder than -33 degrees C, forecast no icing regardless of the dew point spread.

b. **Icing Intensity Forecasts from Surface Chart Data**. If upper air data and charts are unavailable, the conditions shown on the surface chart may be used as a guide for icing conditions, even though they are not as reliable as direct upper air observations. Check the surface charts for locations of the cloud shields of fronts, low pressure centers, and precipitation areas along the route.

(1) Within clouds up to 300 miles ahead of the warm front position, forecast light icing.

(2) Within clouds 100 miles behind the cold front surface position, forecast moderate icing.

(3) Within clouds over a deep, almost vertical, low pressure center, forecast moderate icing.

(4) In freezing drizzle, below or in clouds, forecast moderate icing.

(5) In freezing rain, below or in clouds, forecast severe icing.

c. **Icing Type Forecast Rules**.

(1) Forecast rime icing when temperatures at flight level are colder than -15 degrees C in Cumuliform clouds, or between -1 degree C and -15 degrees C in Stratiform clouds.

(2) Forecast clear icing when temperatures are between 0 degrees C and -8 degrees C in Cumuliform clouds or freezing precipitation.

(3) Forecast mixed rime-and-clear icing when temperatures are between -9 degrees C and -15 degrees C in unstable clouds.

E. Lowest Altimeter Settings.

Tables III-1a through **III-1c** are an extract of mean pressure data from the SMOS. Three hourly mean pressure values for each month were plotted, and data points connected and smoothed; the resultant displays mean diurnal change by month. Data points were read at hourly intervals.

The forecaster can assume that during periods of stable weather conditions, (without the intervention of major pressure systems) hourly change to altimeter settings can be forecast. It will approximate the mean diurnal pressure change. The forecaster need only enter the appropriate TAF forecast period table and extract the greatest negative forecast period in question.

The following example is offered to assist forecasters in a step-by-step analysis of the minimum altimeter forecast procedure. On 15 July, in preparation of the 15Z to 15Z TAF, the forecaster has determined that relatively stable conditions exist and the TAF is written as follows:

NFL TAF 1515 13008KT 9999 SCT300 QNH29.98INS
BECMG 2123 29012G24KT SCT050
BKN120 BKN300 510008
QNH29.88INS VC-SHRA
BECMG 0406 VRB05KT 9999
SCT120 SCT300 QNH29.90INS

All that remains is to determine the minimum altimeter settings occurring through each forecast period. The 15Z (base time) altimeter is determined to be 29.98INS. Entering the 15Z - 15Z TAF table, below the column labeled July, the forecaster finds that during the period 15Z through 06Z, the greatest departure from the base altimeter is -.10 inches of mercury. The minimum forecast altimeter for the period is entered as 29.88INS. Between 06Z and 15Z, the greatest negative departure is .08 inches. Thus, a minimum forecast altimeter of 29.90INS is entered.

To determine the lowest altimeter settings under unstable conditions, the forecaster should use the NGM prognosis to compute surface pressure change.

F. Procedures for the Preparation, Revision and Verification of Routine Forecasts.

1. **Terminal Aerodrome Forecast (TAF).** The TAF is an encoded 24 hour forecast, issued daily at 03Z, 09Z, 15Z and 21Z. NAVMETOCCOMINST 3143.1( ) contains an explanation of the encoding format.

a. **Amendment Criteria,** The forecaster is responsible for ensuring an accurate forecast is available to customers. An amended terminal forecast will be issued anytime the forecaster considers it advisable in the interest of safety, efficiency of aircraft operations, flight planning, dispatching, operational control, and in-flight assistance to aircrews. NAVMETOCCOMINST 3143.1( ) provides required amendment criteria.

b. **Verification Criteria.** TAFs will be verified from weather observations recorded on CNMOC 3140/12 form and via ASOS data fields utilizing parameters established by NPMOD Fallon as in-house procedures and in concurrence with NAVPACMETOCFACSDINST 3147.1( ).

2. **Target Range Planning Forecast.** The target range forecast is prepared daily for Bravo 20 (R4802), Bravo 16 (R4803), Bravo 17 (R4803) and Bravo 19 (R4810). The forecast is encoded in a plain language format utilizing the basics of the TAF format and transmitted via CMW/AWN at 0700 and 1900 local (03Z and 15Z during PST; and 02Z and 14Z during PDT). Further guidance is contained within the applicable detachment SOP. The Target Range Forecast may be ARQ’d via CMW/AWN under the heading FOUS KNFL.

3. **Destructive Weather Warnings and Advisories.** The forecaster is responsible for notifying appropriate station personnel of approaching potentially destructive weather phenomena. Recommendations to set appropriate readiness conditions shall be made to the NAS Fallon Operations Duty Officer (ODO) or to NAS Fallon Officer of the Deck (OOD) when the ODO Watch is secured.

SECTION IV - SPECIALIZED FORECASTS

Apart from aviation weather briefs, local forecasts and warnings, strike weather briefs, and specialized briefs mentioned previously, additional support consists primarily of the following products. These are mentioned in previous sections, but more detail is provided here.

A. Optimum Path Aircraft Routing System (OPARS).

OPARS is a pilot pre-flight planning aid. It does not replace the required flight forecast (DD-175-1). OPARS is available for many types and configurations of military aircraft. Various outputs are provided. This enables the pilot to choose the output that best suits his mission, and arrive at an optimal fuel utilization plan. OPARS requests are processed utilizing one of the MIDDS workstations (forecaster or observer) linked by modem with a computer at FLENUMETOCCEN Monterey via DSN, commercial, or NIPRNET. OPARS requests should be filled in accordance with local policy and the OPARS User's Manual.

B. Electro-Optical Decision Training Aid (EOTDA).

EOTDA is a computer model, created as an Air Force program, that predicts the performance of Precision Guided Munitions (PGM) and direct view optics based on atmospheric conditions. Given inputs that provide the sensor of interest and detail the target and background, it can make predictions of detection and lock-on ranges, total atmospheric moisture and thermal contrast. It is capable of computing this information for actively or passively heated targets over a variety of backgrounds. The meteorological input to EOTDA is the current TAF for the area of interest. Data is entered into the forecaster’s MIDDS terminal. Classified runs can be done in the SECRET computer in the Admin spaces. The output is available in both alphanumeric and graphical formats. Systems supported are in the Infrared (IR) spectrum, TV (visible), and laser wave lengths. EOTDA data is provided upon request with a minimum lead time of 2 hours. This product is used very frequently by visiting CAGs. Detailed information on EOTDA can be found in the EOTDA User’s Manual located at the forecasters workstation. All FDOs should be familiar with this manual.

C. Integrated Refractive Effects Prediction System (IREPS).

IREPS is a model, contained within the GFMPL package, that predicts electromagnetic propagation. Surface and air based radar operators and mission planners utilize this information to maximize tactical employment of the atmosphere. Radar holes, long ranges due to ducting, and detection avoidance using atmospheric layers are examples of its application. Many different outputs are available, including propagation conditions summary, coverage diagram, path loss diagram, and refractivity index. A file of RADAR characteristics for standard Navy systems is contained in the FNMOC IREPS User's Manual, Appendix "B". IREPS products are produced by entering the latest sounding into one of the MIDDS workstations and running the IREPS program. If a local sounding is not available, the latest Reno sounding should be used.

D. Sound Focusing (SOCUS).

The GFMPL SOCUS program is used to determine the extent to which sound will be focused in a given area in the wake of an explosion or other major sound producing event, such as a sonic boom. It will determine whether atmospheric conditions favor the formation of caustics (sound focusing points) and it can predict whether there will be significant focusing of potentially damaging energy toward populated areas during Naval exercises employing ordinance. A current sounding must be entered for these calculations, and details concerning the sound source must be known, including its explosive weight and its bearing from the location of interest. Guidance is contained in the GFMPL User's Manual.

E. Radiological Fallout Forecast (RADFO).

The Radiological Fallout Forecast provides predictions of the fallout patterns of hazardous radiation associated with nuclear detonations. This application is also contained within GFMPL. Present generation RADFO products, also known as Effective Downwind Forecasts, are used in conjunction with ATP-45.

RADFO uses analyzed or forecast winds to compute the trajectory path and fallout characteristics of a nuclear detonation. With this data and appropriate templates the fallout pattern is constructed. Specific instructions are contained in ATP-45 concerning the construction of the fallout pattern from an Effective Downwind Forecast.

F. Cimatological and Astronomical Data.

As discussed previously, requests for climatological data from any DOD entity will be honored if at all possible. Most requests will be for historical weather patterns in the Fallon area. If these are for a specific period of time in the recent past, the data may be obtained by viewing the observation sheets for the period requested. If the requester needs general Fallon climatology, the FNMOD Asheville CD ROM is the primary source, although many questions may be answered using prepared summaries located in the climatology binder at the FDO’s desk. Requests for data from other sites may be answered with data from the CD ROM, or if the site has a Navy weather office, the individual may be referred to that office.

Astronomical data is also kept in the FDO climatology binder. Additionally, the SLAP software is included in GFMPL, found on all MIDDS terminals.

SECTION V - ENVIRONMENTAL EFFECTS

This section will address natural environmental phenomena of which the forecaster must be aware in order to provide optimum environmental services to Naval commands at NAS Fallon. It is not the intent of this section to duplicate existing detailed instructions and publications on meteorological and oceanographic support, but rather to provide supplementary information to assist the forecaster in understanding and properly addressing the specific requirements of supported commands.

A. **NAS Fallon Runway Conditions.**

1. **Selection of Duty Runway.** All aircraft operating under IFR flight plans or conditions either into or out of NAS Fallon are provided air traffic control services by the Navy Fallon Approach Control Facility. The local controller, working in the control tower, will determine which runway will be in use based upon wind, weather, and amount of traffic. The following is the runway use program at NAS Fallon:

a. When the wind is ten knots or less, Runway 31 will be used.

b. When the wind is 11 to 14 knots, either Runway 13 or 31 will be used, whichever runway is most nearly aligned into the wind.

c. When the wind is 15 knots or greater, the runway most nearly aligned into the wind will be used.

2. **Runway Minimums.** The forecaster must refer to the latest IFR Supplement, NATOPS Manual, and the NAS Fallon Operations Manual for detailed information.

3. **Precision Approach RADAR (PAR).** Runways 31L, 13R, and Runway 07 must have at least 200 ft and 3/4NM. Runway 25 has PAR because of the close proximity of mountains to the east of NAS Fallon.

B. **Destructive Weather Warnings and Advisories.**

The Duty Forecaster shall notify appropriate personnel of approaching or potentially destructive weather phenomena. Recommendations to set appropriate readiness conditions shall be made to the Operations Duty Officer (ODO), or the NAS Fallon Officer of the Deck (OOD) after the field is closed.

Although NAS Fallon receives an annual average of just 13 Thunderstorm days, these days are often frequented by rapid changes in the setting of conditions from TSTM I to TSTM II, and much higher annual count of Thunderstorm activity within the local area surrounding NAS Fallon, impacting the various ranges within NPMOD Fallon's AOR.

The status of fueling and ordnance operations can be greatly affected during periods when thunderstorm activity occurs locally and results in the setting of Thunderstorm Condition I (TSTM I). In all instances, the main concern of the forecaster shall be safety of flight and safety of all personnel within NPMOD’s AOR. Cancellation of TSTM I should never be predicated on external pressure for any reason. When problems arise, the FDO should refer the customer to the Officer in Charge.

TSTM I shall be set when thunderstorm activity is within ten (10) miles or expected to occur within thirty (30) minutes. Thunderstorm Condition II (TSTM II) shall be set when thunderstorm activity is within a forty five (45) mile radius of NAS Fallon or expected to occur within six (6) hours. Both forecaster and the observer shall be alert for lightning activity when a thunderstorm warning is in effect for NAS Fallon.

SECTION VI - REFERENCES

1. Forecaster's Guide on Aircraft Icing, USAF, Air Weather Service Manual 105-39, Jan 69.

2. Atmospheric Turbulence and Icing Criteria, NAVOCEANCOM Instruction 3140.4B, , 27 FEB 81.

3. Geophysics Fleet Mission Program Library (GFMPL), Volumes I through IV, Naval Oceanographic Office, Stennis Space Center, Bay St. Louis, Mississippi.

4. Meteorology for Naval Aviators, NAVAIR 00-80U-24-1, Volume I, 1973.

5. NATOPS Instrument Flight Manual, NAVAIR 00-80T-112, 01 APR 86.

6. NATOPS General Flight and Operating Instructions, OPNAV Instruction 3710.7Q, Chapter 4 as applicable, 01 MAY 95.

7. Naval Air Station, Fallon, Nevada Air Operations Manual, NASFINST 3710.1( ).

8. Naval Air Station, Fallon, Nevada Range User's Manual, NASFINST 3752.1( ).

9. Fleet Numerical Oceanography Center, Optimum Path Aircraft Routing System (OPARS) Users Manual, FLEETNUMOCEANCENINST 3710.1( ), (as revised/updated), 01 MAR 90.

10. Electrical-Optical Tactical Decision Aid (EOTDA), User’s Manual, Version 3.1, (as revised/updated), 03 JUN 94.

11. International Station Meteorological Climate Summary, Fleet Numerical Meteorological and Oceanography Detachment, Asheville, North Carolina, SEP 96.

12. U. S. Navy Marine Climatic Atlas of the World, Fleet Numerical Meteorological and Oceanography Detachment, Asheville, North Carolina, AUG 95.