1. INTRODUCTION

The National Weather Service maintains a network of approximately 11,565 cooperative weather observation stations called substations, that provides weather data for climatology, hydrology, and local service programs. The distinctive feature of this program is that observations are taken by cooperative observers -- private citizens who perform the service for free or who are paid a small fee for their efforts. Equipment at substations varies. While a number of these substations are fully automated, most are manually operated.

The use of the information is for basic data and/or reporting purposes. The data usually are provided through published records and are used in climatic studies, hydrologic design, and other planning.

Reports serve operational purposes and are transmitted in accordance with specific criteria to meet the needs of hydrologic forecasting, agricultural advisories, hurricane and severe storm warnings, control of hydrologic structures, crop summaries etc.

Special cooperative projects are operated for other agencies to meet their particular needs when these are beyond those normally provided by NWS. A total of 51 Substation Network Specialists, supported by reimbursable, State, and NWS funds, inspect and maintain this network of almost 11,565 substations.

2. NETWORK CLASSIFICATIONS

All substations have a network classification to represent the basic purpose for which they are established:

"a" Network

The "a" Network includes only those temperature-precipitation substations required to provide an adequate sample of data for areal statistics on weather and climate. The network should ordinarily contain about one temperature-precipitation substation per 625 square miles.

"ab" Network

The "ab" Network includes all stations which serve the purpose of both the "a" and "b" Networks.

"b" Network

The "b" Network includes all stations serving a hydrologic purpose such as the following:

(1) Rainfall and River, Rainfall (river) and River reporting substations.

(2) Evaporation substations.

(3) All recording raingage substations, including those in networks such as FC-1, IRPN, etc.; and those published in HPD.

(4) Other precipitation and special observation substations such as soil moisture, hygrothermograph, etc. stations designed to meet the hydrologic needs of the National Weather Service or cooperative agencies.

"c" Network

The "c" Network includes three general classes of stations, as follows:

(1) Temperature and/or precipitation stations primarily for local public service purposes (Metropolitan networks, stations established at radio stations, newspapers, etc.);

(2) Temperature and/or precipitation stations which have a long record but are not included in the "a" or "b" networks. Generally, the period of record should be at least 50 years and the prospects should be good for continuing the station with little change in environment;

(3) Temperature and/or precipitation and special purpose stations at tower sites, experimental stations, research farms, etc.

"x" Network

The "x" Network includes substations having 30-year normals. A decision to continue these substations will be made in 1980.

3. REFERENCE CLIMATOLOGICAL STATION NETWORK

Reference Climatological Stations (formerly known as Climatological Bench Mark Stations) are stations or substations selected by the
Environmental Data Service as meeting the World Meteorological Organization (WMO) standards for such stations where homogeneous series of observations over a period, not less than 30 years, have been made or are expected to be made. They are sited with an adequate and unchanged exposure where the observations can be made in representative conditions. The surroundings of the station should not alter in time to such an extent as to affect the homogeneity of the series of observations. The "surroundings of the
station" have been defined by the Environmental Data Service (EDS) as the area within 100 feet of the station, plus the space over 20 feet above the surface to a distance of one-fourth mile from the station, and in general the space which subtends an angle of 18 degrees above the horizon from the observation site. Although Reference Climatological Stations are selected without regard to network classification, most of them are "a" or "b" Network substations.

4. RESOURCES AUTHORIZED

The Organic Act (33 U.S.C. 706) of October 1, 1890 provides the basic authority for the substation program. Section 313 sets forth the statutory requirements of the program; i.e., report temperature and rainfall conditions, and take such meteorological observations as may be necessary to establish and record the climatic conditions of the United States.

The Hydroclimatic Network, known as the FC-1, was approved by Congress on June 28, 1938, and established under Public Law 761 as a means of providing rainfall information for use in civil works activities of the Corps of Engineers (COE). This network had been operated by the National Weather Service in cooperation with the Corps of Engineers on a reimbursable basis. With the organization of the National Oceanic and Atmospheric Administration (NOAA), the Hydrologic Network (FC-1) was transferred from the support of the Corps of Engineers to direct NOAA funding, effective October 18, 1970. Approximately $850,000 and 29 Substation Network Specialists' positions were transferred as SEE funds to NWS.

The National Weather Service has cooperated with the Corps of Engineers since 1937 in establishing and operating networks of river and rainfall reporting stations. Reports from these stations supplement those stations maintained by the NWS and are made available to the Corps of Engineers for flood control operations and flood forecasting. Today, there are 41 reporting networks with stations reporting systematically or in accordance with the established criteria.

The Bureau of Reclamation Networks (USBR) are based upon a Memorandum of Understanding between the two agencies, dated February 13, 1948, and provide for the NWS to establish and operate networks of meteorological substations to meet the needs of USBR. Installations are varied and include recording, storage, and standard 8-inch precipitation gages, temperature, evaporation, solar radiation, and other equipment. Both basic and reporting data substations are included. The Bonneville Power Administration (BPA) Network is based upon the Memorandum of Understanding executed November 26, 1957. Annual adjustments are made in accordance with current need and costs. The tasks call for the operation and maintenance of temperature and precipitation substations for basic data and/or reporting services and for developing forecasting procedures for streamflow in the Pacific Northwest.

The Cold Regions Research and Engineering Laboratory (CERREL) project began in FY1962 in cooperation with the U.S. Army in connection with its soil thaw, snow, and ice measurements.

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service 7/1/79

COUNT OF SUBSTATIONS AND SERVICES ALL SUBSTATIONS

<table>
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<th>SUBSTATIONS</th>
<th>Number of substations by network:</th>
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<tr>
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<td>A LIDOS A P UTS 1 24 x 125</td>
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<tr>
<td></td>
<td>Number of stations with paid services</td>
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<tr>
<td></td>
<td>Number of stations without paid services</td>
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<td>Number of stations having associate services</td>
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<td>First and second order stations</td>
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SUBSTATION SERVICES

Number of stations having the following services:
- Both temperature and non-recording precipitation stations | 9,033 |
- Non-recording precipitation without temperature | 3,714 |
- Storage gage | 30 |
- FC-1 precip (recording and/or non-recording) stations | 2,084 |
- Hourly precipitation stations (recording precipitation) sponsored by SEE | 437 |
- River stage and rainfall reporting stations sponsored by SEE (FC-1) | 7,625 |
- River stage and rainfall reporting stations sponsored by other government agencies | 127 |
- Associated stations | 126 |
- Substations with both daily (or storage) and hourly precipitation services | 1,933 |
- Crop reporting stations | 713 |
- River and/or rainfall reporting stations | 9,408 |
- River stage reports only | 925 |
- Rainfall reports only | 3,382 |
- River stage and rainfall reports | 1,018 |
- Evaporation stations | 424 |
- Telemetered stations (includes ANOS, BMT, Telemark, PPH) | 1,406 |
- Automated Hydrological Observing System (AHOS) | 415 |
- AHOS/T | 46 |
- AHOS/S | 4 |
- Special Reporting Stations | 196 |
- Miscellaneous (snow density, special meteorological) | 976 |
- Number of publishing stations that have these services:
  - Temperature | 5,794 |
  - Daily (or storage) precipitation | 3,822 |
  - Hourly precipitation | 3,107 |
  - Evaporation | 644 |
  - Soil temperature | 256 |

TOTAL NUMBER OF STATIONS PUBLISHED | 9,420 |
The United States Geological Survey (USGS) is provided with river and precipitation data.

In order to arrive at separate cost figures of the "a", "ab", "b", "c", and "x" Networks, it becomes necessary to define the areas of accounting responsibility assigned to each. This is very complex in the case of the operation and maintenance of these networks because of the multiple-purpose nature of many of the stations. Since multiple services are provided at many substations, the plan provides, insofar as practicable, for an equitable grouping of inspection services under a single network classification. Salary, per diem, and vehicle costs for the Substation Network Specialists will be charged to the number for the activity served.

5. MANPOWER ALLOCATIONS

The Weather Service Headquarters

The Weather Service Headquarters determines policy and provides guidelines for substation management as the program relates in common to the several regions. The staffing of the headquarters follows:

<table>
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<tr>
<th>Substation Network Specialist (SNS)</th>
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<tr>
<td>This position is usually located at a Weather Service Forecast Office or Weather Service Office as a base of operations in order to make maximum utilization of the total number of SNS positions in the region. An SNS is primarily responsible for the maintenance and efficient operation of several cooperative observational networks in an assigned geographical area, which is usually confined to a state. The SNS travels to Cooperative Weather Observing stations manned by people who perform their services without pay or receive only token compensation. There are 51 SNS’s supported by National Weather Service and reimbursable funds, who inspect and maintain equipment, recruit and train cooperative observers, and maintain liaison with the approximately 11,565 substations. A criterion of one specialist for 335 periodic substation visits per year, plus visits for special purposes (post-flood studies, snow-sampling surveys, etc.) is recognized. Annual visits are required to all substations, and twice-yearly visits are required for recording precipitation and evaporation substations.</td>
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The Cooperative Weather Observer

Cooperative weather observers are selected to take observations at predetermined locations in order to define the climate of the area. While cooperative observers may take several different kinds of observations, they usually make daily readings of maximum and minimum temperature and precipitation. Observers are usually selected from permanent residents in a community who have an interest in observing weather, so that a long record can be assured. Observations must be taken seven days a week throughout the year. The use of data is enhanced to a great extent by the records extending over a number of years. Most cooperative observers have served from 25 to 50 years.
A cooperative station represents an area of approximately 625 square miles. This distribution of stations varies somewhat in accordance with the topographic features of the country.

Where a cooperative station is needed, the Weather Service provides the shelter, thermometers, and rain gage. The observer takes one observation daily, preferably near sunset, and records the data on forms provided for this purpose. These records are forwarded to a processing center at the end of each month where the data are verified and published in a Climatological Data bulletin for each state or area.

### BASE STATION (Mail Address)  SUBSTATION NETWORK SPECIALIST  AREA ASSIGNMENT

#### EASTERN REGION
- **Albany, NY (W5FO)**  Quick, Donald L.  NY (Ex., S.NY)
- **Allentown, PA (W5FO)**  Karlock, John R.  Eastern PA
- **Baltimore, MD (W5FO)**  Snider, Arthur J.  MD, DE, N.VA, E.WV
- **New York, NY (W5FO)**  Lance, L.  SC & W.NC
- **Pittsburgh, PA (W5FO)**  Seidel, Lloys B.  OH
- **Portsmouth, NE (W5FO)**  Williams, Donald L.  CT, NJ, S.NJ, & RI
- **Raleigh, NC (W5FO)**  Jennings, Thomas H.  W.NY & W.PA
- **Rochester, NY (W5FO)**  Daniels, Robert E.  ME, MA, NH, & VT
- **Springfield, MA (W5FO)**  Nunziata, Vincent J.  E.NC & S.VA

#### SOUTHERN REGION
- **Albuquerque, NM (W5FO)**  Snyder, Richard A.  NM, W. of 104 deg.
- **Baton Rouge, LA (W5FO)**  Boreau, Malcolm E.  LA, TX, E. of 94 deg 30' W
- **Fort Worth, TX (ERHI)**  Manning, Robert S.  OK & TX bet. 32 deg 30' & 34 deg 34'N & 94'30' & 101 deg.
- **Jackson, MS (W5FO)**  Brown, Maxie R.  MS
- **Lake Park, AR (W5FO)**  Clarke, Thomas P.  AR
- **Lubbock, TX (W5FO)**  Currence, Elwood E.  NM, E. of 104 deg, TX, W of 101 deg & N. of 34 deg 30' N
- **Macon, GA (W5FO)**  Megee, Charles H.  GA
- **Memphis, TN (W5FO)**  Funderburk, Ralph S.  TN, AR, E. of 91 deg 31'W
- **Oklahoma City, OK (W5FO)**  Lambert, John R.  OK, N. of 34 deg 30'W
- **San Antonio, TX (W5FO)**  Hutchison, Harold E.  TX, S. of 30 deg 4 & bet. 90 deg 30' & 101 deg W
- **San Juan, PR (W5FO)**  Noboa, Carlos E.  PR & VI
- **Waco, TX (W5FO)**  Starnes, Allen R.  TX, S. of 32 deg 30' to 30 deg N & bet. 94 deg 31' & 101 deg W

#### CENTRAL REGION
- **Ann Arbor, MI (W5FO)**  Graves, Donald A.  MI
- **Bismarck, ND (W5FO)**  Chamberlain, Clarence C.  ND
- **Cheyenne, WY (W5FO)**  Simpson, Clinton  WY
- **Denver, CO (W5FO)**  Tate, William H.  W. CO
- **Des Moines, IA (W5FO)**  Farmer, Homer D.  IA
- **Fargo, ND (W5FO)**  Behrens, Leo W.  MN
- **Goodland, KS (W5FO)**  Elam, Michael G.  E. CO, W. KS, NE, W. of 100 deg W
- **Indianapolis, IN (W5FO)**  Hennek, John P.  IN
- **Louisville, KY (W5FO)**  Teliez, Pete  KY
- **Minneapolis, MN (W5FO)**  Thurston, Thomas R.  WI
- **St. Louis, MO (W5FO)**  Loveless, John R., Jr.  MO
- **Omaha, NE (W5FO)**  Marechale, Allen  NE, E. of 100 deg W
- **Sioux Falls, SD (W5FO)**  Johnson, Robert D.  SD
- **Springfield, IL (W5FO)**  Wolfe, Jerry F.  IL
- **Topeka, KS (W5FO)**  Hall, Wilbur  KS

#### WESTERN REGION
- **Boise, ID (W5FO)**  Inye, Julian  ID
- **Great Falls, MT (W5FO)**  McFadden, Jerald  MT (exc. N. MT)
- **Phoenix, AZ (W5FO)**  Filer, Jerold  AZ
- **Portland, OR (W5FO)**  Howick, Sidney O.  OR
- **Reno, NV (W5FO)**  Solleau, James B.  NV & NE. CA
- **Sacramento, CA (W5FO)**  O'Shaughnessy, Arthur G.  CA (exc. NE.)
- **Salt Lake City, UT (W5FO)**  Hirschi, Dean C.  UT
- **Seattle, WA (W5FO)**  Freeman, Carl W.  WA

#### PACIFIC REGION
- **Hilo, HI (W5FO)**  Taboniar, John  HI, Maui, Lanai, Molokai
- **Honolulu, HI (PRHI)**  Ho, Roland  Oahu, Kauai, American Samoa, Guam

#### ALASKA REGION
- **Anchorage, AK (W5FO)**  Hisiecz, Edward H.  AK