Water-Data Program of the U.S. Geological Survey

GEOLOGICAL SURVEY CIRCULAR 863

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By Bruce K. Gilbert and Thomas J. Buchanan

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ABSTRACT

The U.S. Geological Survey is the principal Federal agency responsible for the collection of hydrologic data needed for the planning, development, use, and management of the Nation's water resources. These data are the foundation necessary for conducting analytical and interpretive appraisals describing the occurrence and availability of surface and ground waters and their physical, chemical, and biological characteristics. The data are likewise required for basic and problem-oriented research in hydraulics, hydrology, and related fields.

Hydrologic data collection by the Geological Survey began in 1888. Current operations include about 17,000 stations for collection of river, lake, and reservoir data; about 27,000 wells for collection of ground-water data; and almost 17,000 sites for collection of water-quality information. These activities, the means by which the data are made available, and how the program is coordinated with other agencies are described in the circular.

INTRODUCTION

In virtually all parts of the Nation, the quantity, quality, and distribution of water are becoming increasingly critical to economic growth and people's health, safety, and well-being. A number of areas are experiencing increasing demands on water supplies because of population growth, industrial expansion, and agricultural requirements. Many places are subject to floods, and many parts of the country have been severely affected by drought, if not by chronic water shortages. In some locations, deteriorating quality of surface water and, especially, ground water is of major concern. Shifts in population, changes in energy use, and mineral and food-production activities, such as those taking place in the Great Plains and Rocky Mountain areas, are burdening existing water supplies. Thus, competition for currently available supplies of water of acceptable quality has heightened dramatically among domestic, industrial, and agricultural users. As a result, there is a growing urgency for reliable hydrologic data to facilitate planning, development, and management of the resource.

The U.S. Geological Survey provides much of the hydrologic information collected in our Nation. This report describes the Survey's role as the Nation's principal water-data collector—what its activities are, how it makes the information available, and how it coordinates the water-data program with other agencies.

To meet both local and national data needs, the Survey cooperates with State and local governments and other Federal agencies in conducting investigations and research on the occurrence, quality, quantity, distribution, utilization, movement, and availability of surface- and ground-water resources. Work in this regard depends on the systematic nationwide program of data collection, analysis, and dissemination.

The functions described above are supported by Federal appropriations, by reimbursements from other Federal agencies, and by the Federal-State Cooperative Program (50–50 matching). Figure 1 shows the sources of funds for the Water Resources Division's budget in fiscal year 1981.

The U.S. Geological Survey was established March 3, 1879, with the responsibility for classifying the public lands and examining the geological structure, mineral resources, and products of the

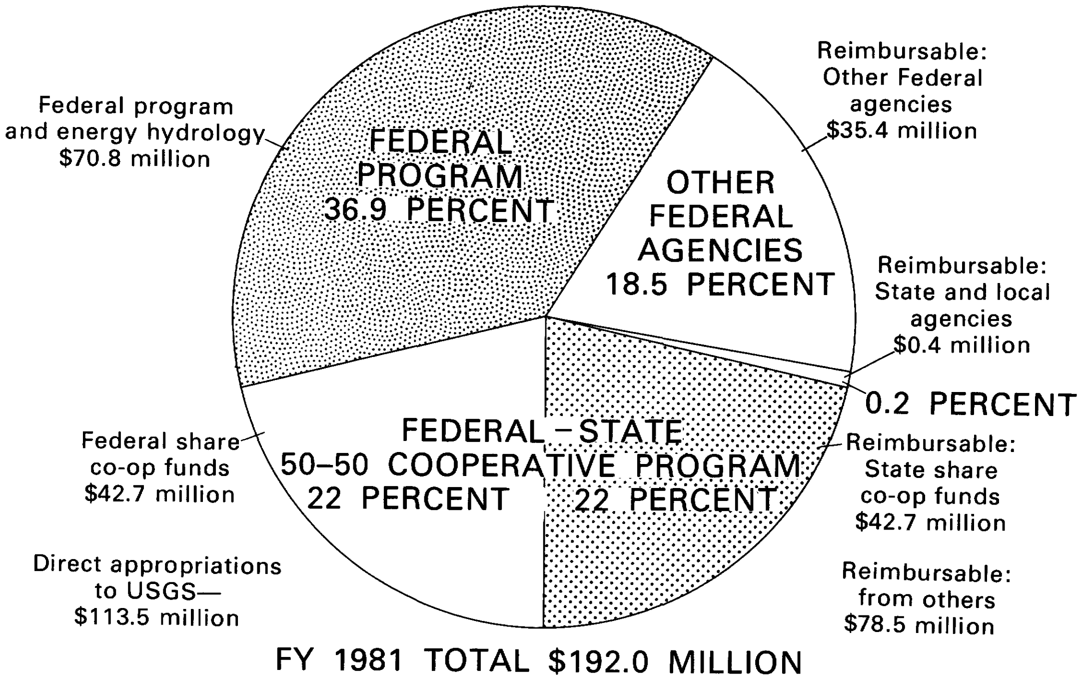


FIGURE 1.–The fiscal year 1981 budget for the U.S. Geological Survey's Water Resources Division.

national domain. Stream measurement began in the West in 1888 under an appropriation made that year to conduct a survey of irrigable lands in arid regions and of sites for reservoirs and other hydraulic works. The Survey received its first appropriation specifically for stream gaging and for determining the water supply of the United States in 1894, and the continuing national program of cooperation with the States began in 1895.

With time, water-data collection requests to the Geological Survey by States besides those in the West increased, and program activity grew in size and scope. The needs for information became more diverse, and the program expanded to include ground-water exploration and evaluation and water-quality investigations. A framework began to take shape for a nationwide water-data system. This eventually led to a water-data program that is closely attuned to respond to local data needs, yet is also sufficiently broad to provide the information required to plan and assess regional water-resources development and management.

The Survey's 1879 organic act prohibits Survey employees from having personal or private interest in the lands or mineral wealth under investigation. This, together with a rigorous scientific approach to problems and the fact that the Survey neither designs, constructs, nor operates water projects, is the basis for the impartiality that has characterized the Survey's work through the years.

The increasing need for hydrologic data, the discovery of numerous chemical constituents in our waters, and the increasing operating costs for salaries and travel make it necessary to develop new instrumentation. For example, an improved method of determining water levels, preferably a noncontact type of sensor, is needed. New devices also are needed to measure velocity and (or) discharge across a stream cross section. There are also emerging needs for new sensors for a variety of water-quality parameters, especially for toxics, synthetic organics, heavy metals, nutrients, and biological parameters.

One of the most needed improvements in the water-data program is an automated field-data acquisition system that directly tabulates data from multiple sensors. The system will consist of a core unit at a station to supply power and programing to operate sensors of several different parameters and to record specific information obtained from each. The technology exists today to combine and automate the collection of various data under a central control system, which is the key to the development of this equipment. Ideally, all the systems should operate from a standard power source and timer. The required design would permit newly developed sensors to be added and operated through the central control system.

Many improvements in hydrologic instrumentation are expected during the 1980's. In addition, changes in sampling strategies made possible by the new sensors and other technologic advances, such as the transmission of data by satellite, can be anticipated.

Another matter of increasing importance relates to the need for critical analysis of the hydrologic data. Additional resources need to be applied to understand and evaluate the information already at hand. To allocate most effectively the funds and personnel available, it is essential to have a better grasp of which data are most critical. These analyses demonstrate the need for improved instrumentation – particularly sensors and recorders – and for development of new approaches to the timing of measurements and sampling. Ideally, the most efficient scheme is to measure or sample only when it is required, and this calls for a greater sensitivity to anticipated changes in the hydrologic system.

DATA COLLECTION ACTIVITIES

The Geological Survey maintains a nationwide system of stream gaging stations, ground-water observation wells, and locations for collecting samples of both ground and surface waters for measuring quality. The Survey's Water-Data Program provides the basic data for water-resources appraisals, environmental impact assessments, and energy-related studies and, in establishing the baseline conditions of the Nation's water, forms an invaluable foundation for solving emerging issues. These issues include identification and analysis of potential problems related to movement and storage of toxic wastes, acid precipitation, organic contamination in surface and ground water, oil shale hydrology, food and fiber production, land-use changes, and hydrologic hazards.

Personnel assigned to Water Resources Division offices throughout the 50 States (fig. 2), Guam, and Puerto Rico currently collect data at many sites: almost 17,000 stage and discharge stations, about 27,000 wells where water level and (or) pumpage data are collected annually or more frequently, and approximately 9,400 surface-water stations and 7,400 wells where water-quality information is collected. Almost 1,600 projects (areal, topical, and research) are underway as well. The principal purpose of the data-collection activities is to fulfill mission goals for furnishing hydrologic data and producing related analyses, interpretations, and research findings for the use of all agencies and citizens in the United States. The sources and allocation of funds for hydrologic data activities in fiscal year 1981 are shown in figure 3. A wide variety of agencies at Federal, State, and local levels furnish support to the Survey, and activities at a single data-collection site are often funded by a combination of sources.

Although hydrologic data have been and are being collected, it is likely that there will always be some deficiencies in the geographical distribution and in the kinds and frequency of data obtained. This situation exists not only because of growth and shifts in population and depletion of some local sources of water, but also because the development and management of water resources on a regional and national basis require that more data be obtained on a more timely basis.

SURFACE WATER

The Geological Survey collects continuous stage (water-level) records at about 8,000 stream sites and 1,000 lake and reservoir sites throughout the Nation (fig. 4) and computes discharge (flow) of most of the streams from the stage records. Discharges at almost 8,000 additional stream sites are measured periodically or at peak stages or low flows or in response to other selected hydrologic conditions. In 1980, the Survey measured the discharge of some 3,000 streams on a one-time basis to meet the needs of special investigations. This is representative of activities during a typical year. Thus, there are literally thousands of stream-gaging sites, including naturally flowing streams, streams or canals that are at times affected by man's activities, and waterways where the discharge is completely controlled.

Digital recorders store water-stage data automatically by means of punched paper tape. The tapes are than processed for discharge computation, analysis, retrieval, and use. Analyses include streamflow duration, storage and frequency studies, and other statistical computations. Stage and discharge data from stream-gaging stations are used, for example, in interpretive studies of

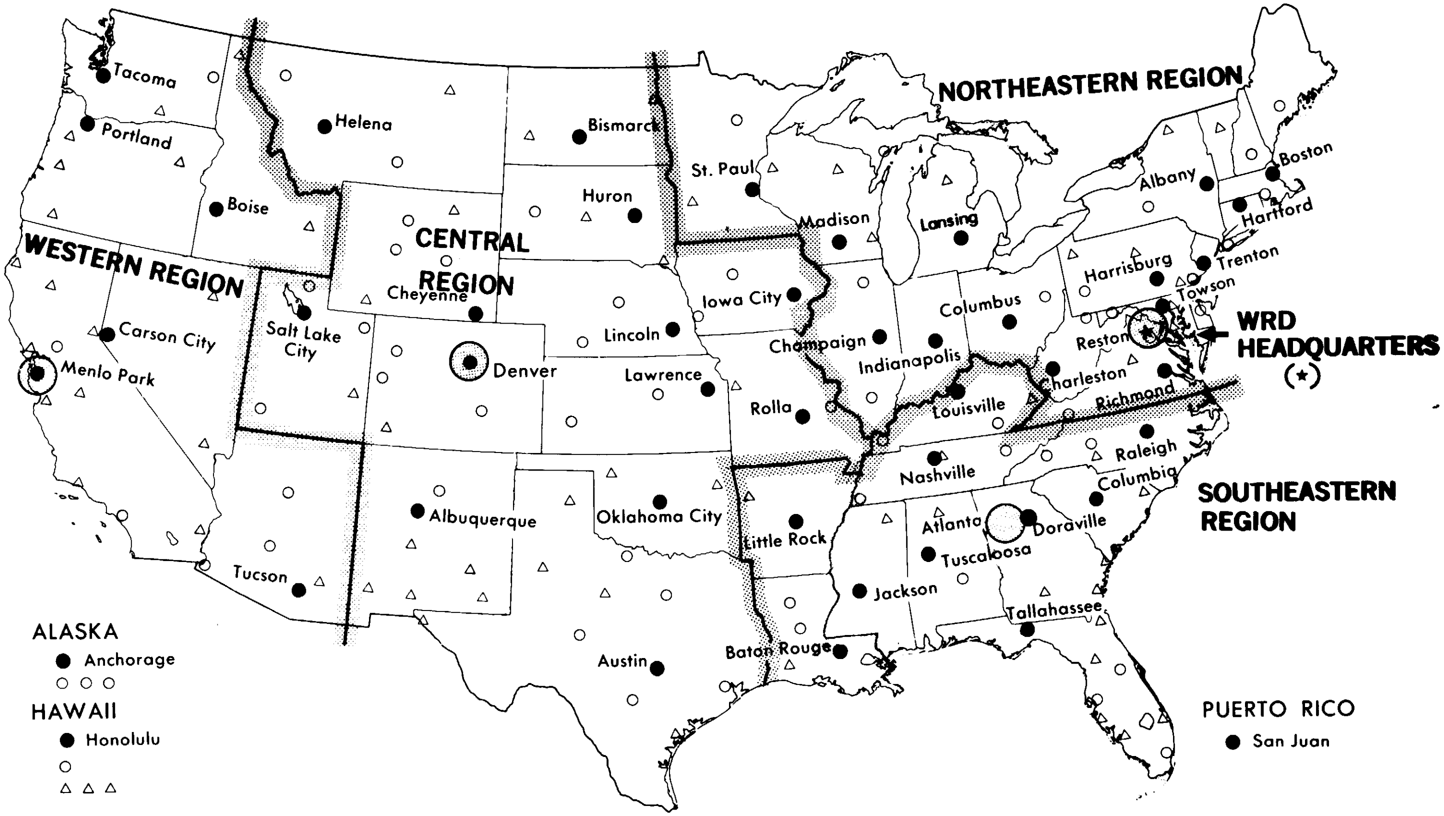
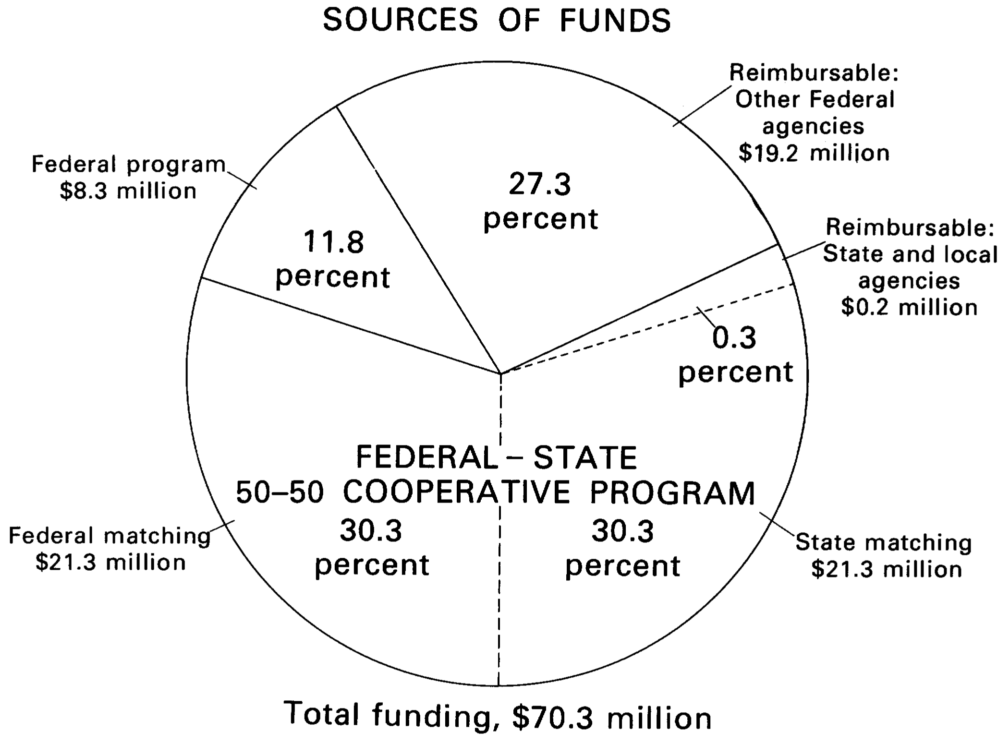


FIGURE 2.—Location of principal offices of the U.S. Geological Survey's Water Resources Division. Large open circles represent regional office; small black circles, district office; small open circles, subdistrict office; small triangles, field office; thick black lines, regional boundary.



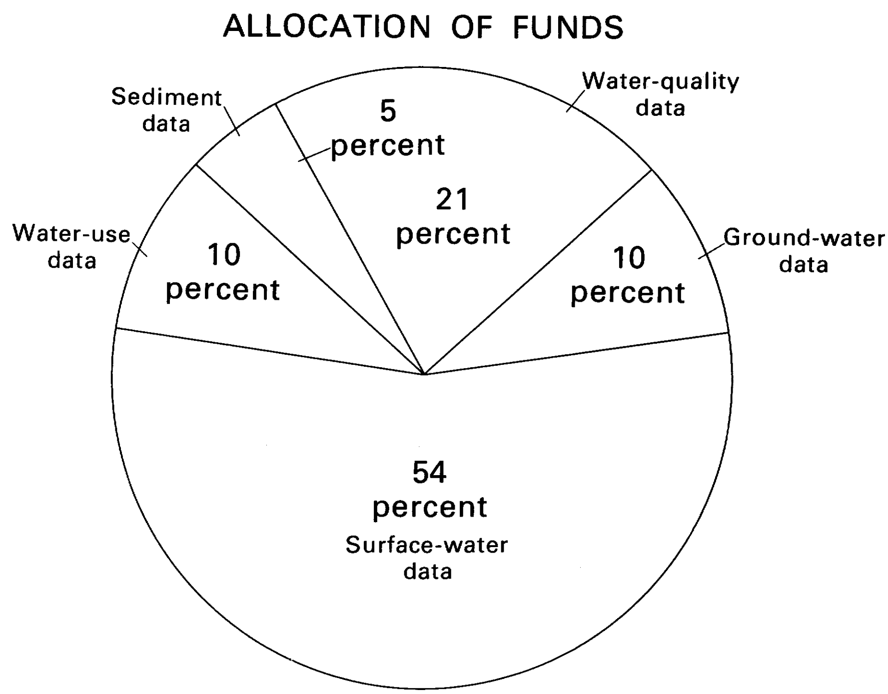


FIGURE 3.–Sources and allocation of funds for the U.S. Geological Survey's Water-Data Program in fiscal year 1981.

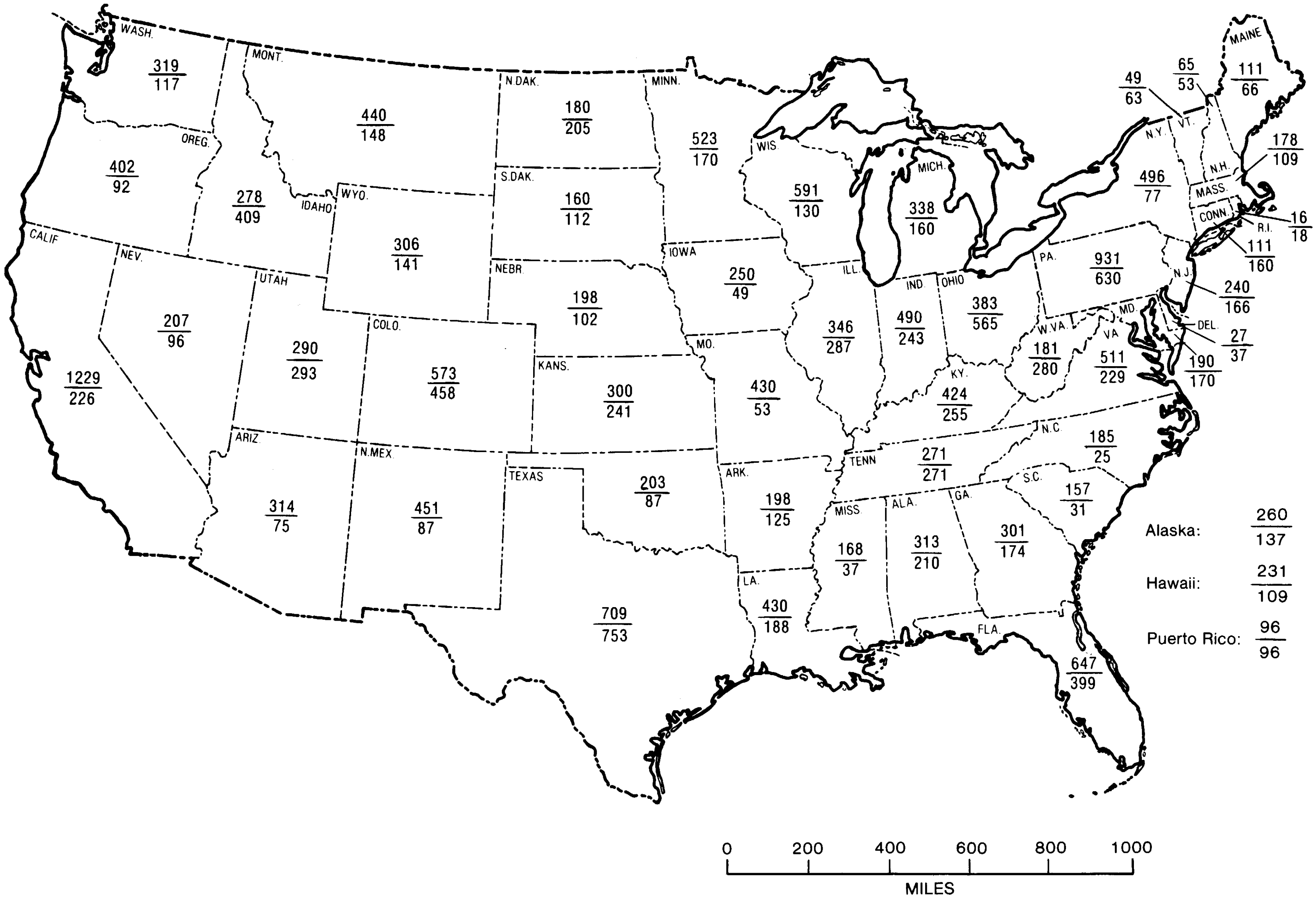


FIGURE 4.—Number, by State, of continuous and partial-record surface-water stations and surface-water quality sites operated by the U.S. Geological Survey in fiscal year 1980. This includes stations on streams, lakes, reservoirs, estuaries, canals, and ditches. Data for New Mexico are from fiscal year 1979. For each State, the number above the bar indicates surface-water stations; the number below the bar indicates surface-water quality sites. The total is 16,697 surface-water stations; 9,414 surface-water quality sites.

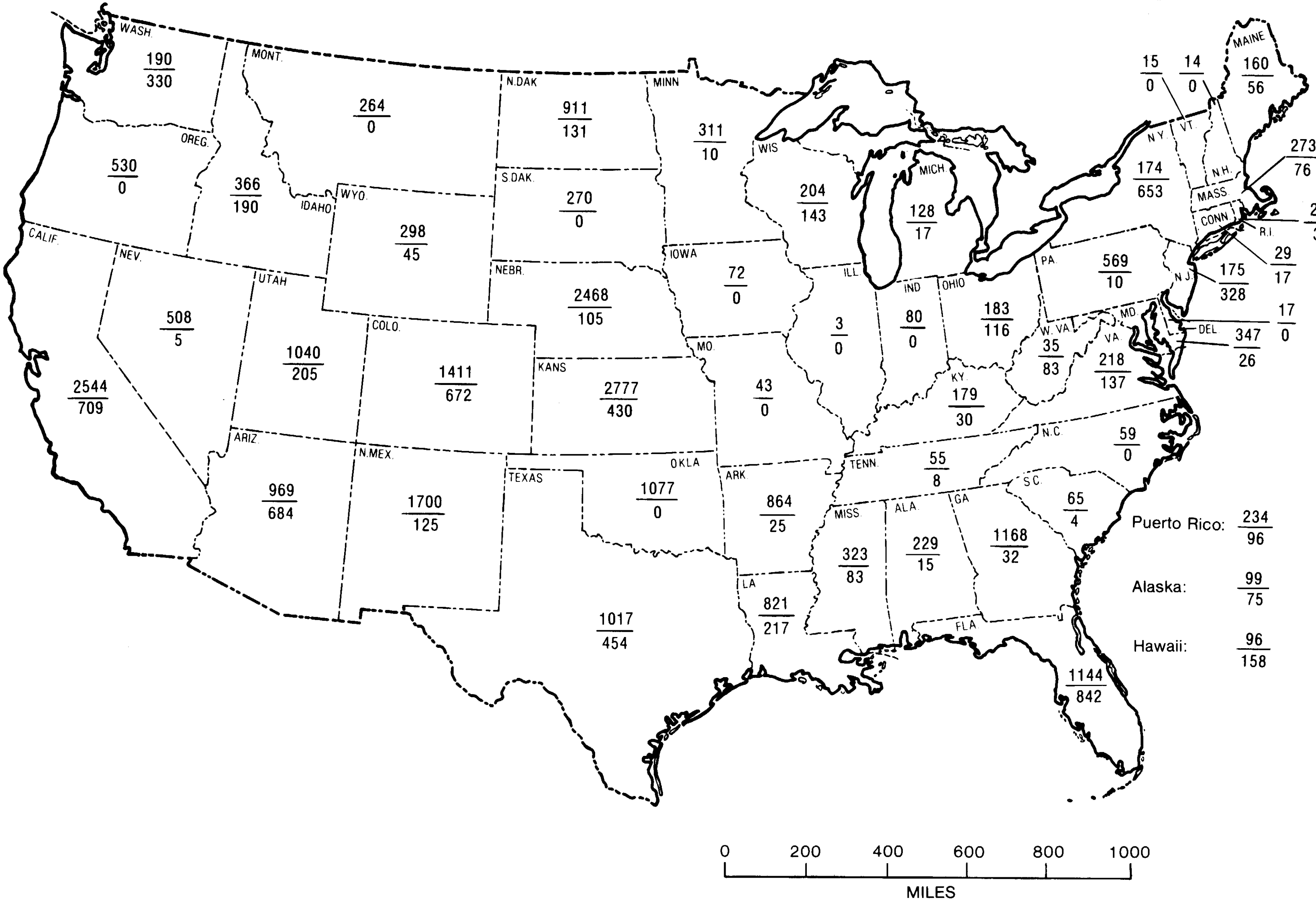


FIGURE 5.—Number, by State, of ground-water observation wells and ground-water quality sites operated by the U.S. Geological Survey in fiscal year 1980. Data for New Mexico are from fiscal year 1979. For each State, the number above the bar indicates ground-water observation wells; the number below the bar indicates ground-water quality sites. The total is 26,747 ground-water observation wells and 7,345 ground-water quality sites.

water supply, water storage, irrigation, and flood control. The gaging stations also provide data for research in hydrology and river hydraulics.

GROUND WATER

The gound-water data-collection network maintained by the Geological Survey consists of almost 27,000 public and privately owned wells (fig. 5). Measurements of the depth to water below land surface (or the height above land surface in flowing wells) are made on a continuous or periodic basis. Continous recorders are used on more than 2,000 of these wells. Additional wells are measured as part of specific investigations, and typically some of these are added to the observation well program.

Water-level data are used to assess changes in ground-water storage; the changes can result from natural causes or from man's activities. In recent years, ground-water data have been used in computer-modeling studies to predict changes in the water levels and available supplies, in response to various stresses on the hydrologic system. Related investigations may involve general geologic appraisals, detailed surface and subsurface mapping, test drilling and geophysical work, or intensive analysis of aquifer characteristics such as saturated thickness, porosity, horizontal and vertical hydraulic conductivity, transmissivity, and storage coefficients. This information is needed to inventory the resource.

QUALITY OF WATER

In addition to making quantitative measurements of streams and wells, the Geological Survey monitors the quality of surface and ground water. Water samples are collected at selected surface-water stations for laboratory determination of a variety of constituents, depending on requirements (fig. 6). The number of surface-water quality sites shown in figure 4 does not agree with the total of the numbers shown in figure 6 because more than one type of data is collected at many sites. Water temperature is measured onsite at nearly every station. Commonly, pH, specific conductance, and dissolved oxygen are measured onsite also. Major inorganic constituents, the major nutrients nitrogen and phosphorus, and often trace metals and organic compounds are determined in most samples. Samples for determination of suspended-sediment concentration are taken at some of the same stations. In recent years, analyses for pesticide and radiochemical constituents have been increased in response to the growing awareness and concern about these potential sources of contamination. Fecal coliform and fecal streptococcus counts are obtained at several hundred stations, and samples for phytoplankton identification and counting are commonly collected from lakes and reservoirs.

Surface water is generally sampled more frequently than ground water because contaminants are transmitted and dispersed more quickly in surface water. Some surface-water stations are equipped with automatic sampling or onsite monitoring devices. Others are sampled manually at intervals ranging from daily to annually. The use of automatic monitoring facilitates the collection and dissemination of important water-quality information. Some of the characteristics that the monitors can automatically measure, record, and store are temperature, pH, specific conductance, and dissolved oxygen.

Selected chemical constituents in ground-water samples are measured as part of the observation-well network (fig. 5), although far fewer wells are sampled for water quality than are measured for water level. Wells typically are sampled only once or twice a year.

Water-quality data are used in an increasing number of ways by Federal, State, and local agencies and by private organizations. This information is essential for planning and managing municipal and industrial waste-treatment facilities, designing cooling equipment, determining suitability of water supplies for domestic and recreational purposes, and monitoring water-quality impacts on the environment.

SEDIMENT

Suspended-sediment data on concentration, load, or particle size are collected at approximately 2,800 stream-gaging sites, partly as background information and for investigative purposes (fig. 6). In some instances, the data are needed in planning for adequate storage of sediment in proposed reservoirs, identifying areas of erosion to evaluate the feasibility of remedial treatment, and establishing a sedimentation baseline for future comparison. Quantities of sediment transported

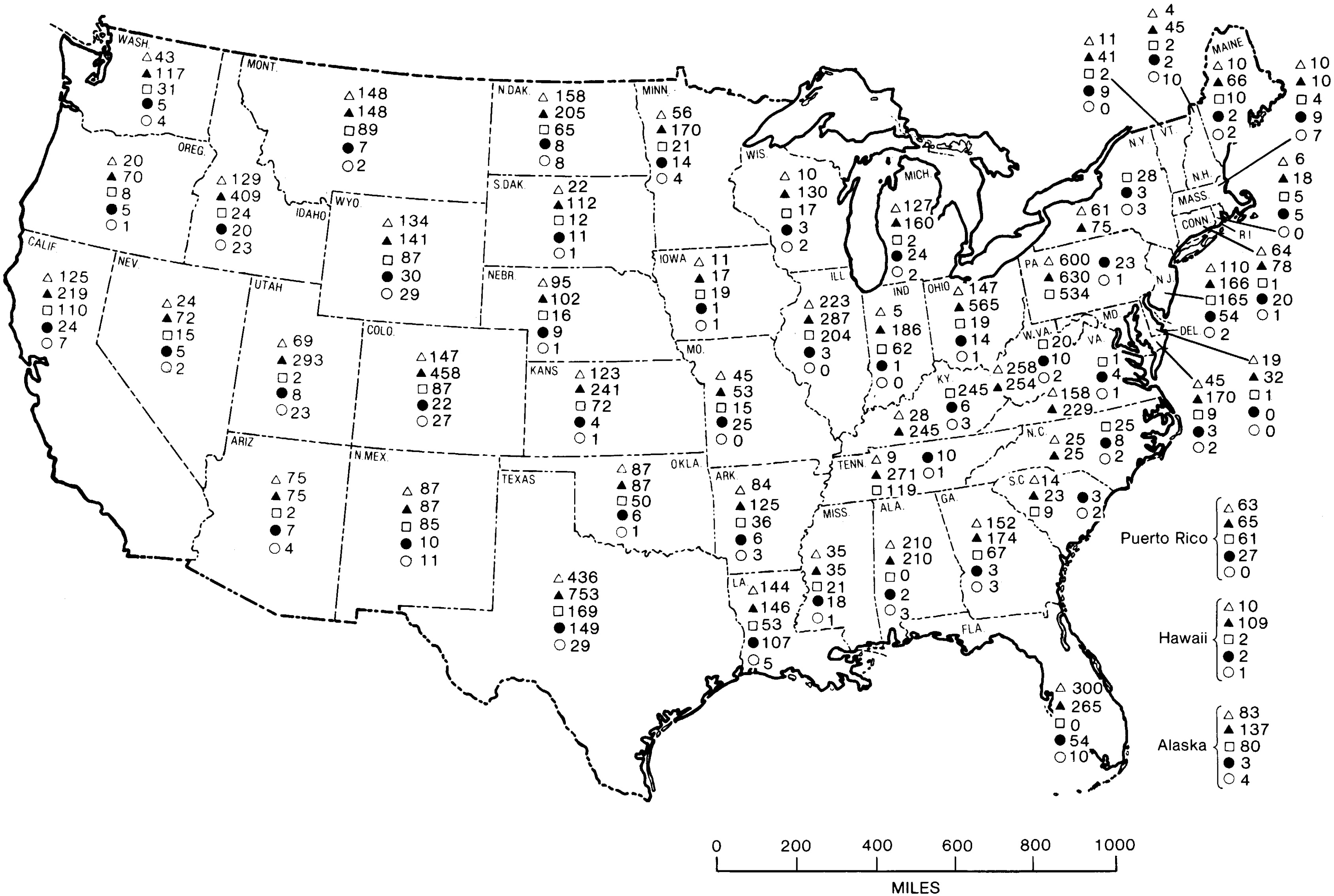


FIGURE 6.—Number of sites, by State, at which selected types of surface-water quality information were collected by the U.S. Geological Survey in fiscal year 1980. Data for New Mexico are from fiscal year 1979. Numbers associated with open triangles represent chemical quality; solid triangles, water temperature, pH, and (or) specific conductance; open squares, sediment; solid circles, pesticide; open circles, radiochemical constituents.

are determined by measuring sediment concentration in streams and relating these measurements to concurrent streamflow. Thus, this technique requires stream-gaging stations to provide flow data to determine sediment transport.

WATER USE

The Geological Survey started a water-use information program in 1978 to provide for the comprehensive and systematic collection, storage, analysis, and dissemination of water-use data and information throughout the United States. Statistics on domestic, industrial, and agricultural water use are required for the planning, management, and development of the Nation's water resources and to provide information necessary to identify and resolve critical water problems relating to water quality, residuals, environmental impacts, energy development, and resource allocations. The Geological Survey is designing and managing the program and is developing the system in stages in cooperation with State and Federal agencies. The manpower-intensive collection of data at the field level is done by State or local agency personnel.

The aggregated water withdrawal, use, and return data are furnished to the Survey for central computer storage. The detailed information is held at the local level by collaborating agencies. Inasmuch as the water-use data activity is not fully implemented as yet, the availability of information is not at design levels.

SPECIAL-PURPOSE NETWORKS

The Geological Survey operates two special-purpose data networks – the National Stream Quality Accounting Network (NASQAN) (Ficke and Hawkinson, 1975) and the Hydrologic Bench-Mark Program (Cobb and Biesecker, 1971).

NASQAN comprises more than 500 stations at which samples for chemical analyses are taken at fixed frequencies to determine the water quality of the Nation's streams. Design of the network specifies measurements of a broad range of water-quality characteristics which were selected to meet many of the information needs of those involved in planning and management on a national or regional scale. The primary objectives are to account for the quantity and quality of water moving within and from the United States, to depict areal variability in stream quality, to detect changes in stream quality, and to lay the groundwork for future assessments of changes in stream-water quality. Data of this type are needed to determine long-term trends and the physical, chemical, and biological characteristics of the Nation's surface waters. The network began in 1973 with 50 stations, expanded to 345 stations by 1975, and reached its current level of 516 stations in 1978.

The Hydrologic Bench-Mark Program was established in 1958 to collect data in selected areas where water resources were known to be minimally affected by man and where, it is anticipated, that land use and land cover will remain unchanged. Data obtained from this network can be used to document changes, largely unaffected by man, in hydrologic characteristics with time. The goal is to provide a better understanding of the hydrologic structure of natural basins and to provide a comparative base for studying the effects of man on the hydrologic environment. The network includes 57 stations located in 37 States. Hydrologic variables measured in the bench-mark basins include continuous streamflow and water quality at most sites, with observations of ground-water levels, precipitation, and stream temperatures at some sites. Data are also obtained on radioactivity levels, pesticide concentrations, nutrients, and biota in many of the basins.

REPORTING AND AVAILABILITY OF DATA

The Survey disseminates water data and results of investigations and research through reports, maps, computerized information services, and other forms of public releases.

Information collected from hydrologic-data sites is stored in the Survey's National Water Data Storage and Retrieval System (WATSTORE) and is available on request. These computerized data files include a Daily Values Files that contains more than 200 million daily observations of streamflow, water-quality, sediment-discharge, and ground-water level data; a Water Quality File that contains more than 1.8 million chemical analyses of both surface and ground water; a Peak Flow File that contains over 400,000 annual peak observations of streamflow and river-stage data; and a Ground Water Site Inventory File that contains inventory information for over 700,000 wells.

These data can be retrieved in machine-readable form or as computer-printed tables, graphs, or results of statistical analyses.

Inquiries regarding the information in WATSTORE and other program activities should be referred to the Water Resources Division office for the pertinent State, as identified in the list at the end of this report. Technical and policy questions may be addressed to the Chief Hydrologist or to the appropriate Regional Hydrologist.

The Geological Survey publishes hydrologic data in an annual series of reports for each State (U.S. Geological Survey, 1980) and catalogs these reports in the monthly list of Survey publications. Other reports are published by cooperating agencies or in technical journals. These can also be located by contacting the offices described above.

REAL-TIME DATA

Generally, because of the many operations required to collect, analyze, and process hydrologic data, it takes 4–6 weeks for the data to be made available to the user. However, reliable hydrologic data are often required on a more timely basis for a variety of purposes; for example, flood warnings, irrigation-water allocations, water-supply forecasting, reservoir management, water-quality monitoring, hydropower generation, management of navigational waters, and allocation of urban water supplies.

Telemetry of data from remote data-collection sites can greatly reduce time for delivery of the data to the user and can be accomplished by a variety of mechanisms. Conventional methods include landlines (telephone) and high-frequency and ultrahigh-frequency (microwave line of sight) radios. Extraterrestrial methods include meteor-burst and satellite data-collection systems. Telemetry can also provide benefits to the data collector, including reduction of field travel costs, remote monitoring of instrumentation functions, and automated data handling.

The telephone and radio telemetry systems work satisfactorily but have the disadvantages of high cost, limited flexibility, and reliability problems, which are typically caused by storm damage. Of the extraterrestrial methods, the Geostationary Operational Environmental Satellite (GOES), a Government-owned system of two operational in-orbit space satellites operated by the National Oceanic and Atmospheric Administration, seems to offer the greatest potential at this time for real-time telemetry (Shope and Paulson, 1980).

There are three basic elements of any satellite data-collection system. The first is a field radio, usually called a data-collection platform (DCP), which is connected to a hydrologic sensing device such as a water-stage recorder. The second element is a radio transponder, consisting of a receiver and transmitter on the satellite, that can receive data from a large number of DCP's. The third element is the Earth receiving station where data are retrieved from the satellite and disseminated to users.

The Geological Survey currently operates over 250 DCP's using the GOES satellite; as a test, a contractor who also uses the GOES satellite operates another 105 sites for the Geological Survey. Satellite data telemetry has already proven to be a reliable and, for many applications, a cost-effective tool for the acquisition of remote hydrological data. A significant expansion of the existing satellite telemetry network now depends on a more complete evaluation of the needs for and benefits of having real-time hydrologic data for water-resources management.

NETWORK ANALYSIS

Hydrologic network analysis is a process for determining the locations at which data are to be collected, the types of data that are to be collected at each site, the frequency of collection of each type of data at each site, and the duration of each data-collection activity. These are the design variables that must be defined in some optimal sense to meet the information need most efficiently.

Interest in hydrologic network analysis received added impetus in the United States by the passage of Public Law 92–500 which mandated establishment of networks to monitor the quality of the Nation's waters. The need for network analysis has been widely recognized only within the past few decades and, thus, the process is still in a rather immature stage.

With respect to Geological Survey programs, hydrologic data-collection networks can be classified as surface water, surface-water quality, ground water, and ground-water quality.

The techniques associated with the design and analysis of surface-water data-collection networks are the most advanced. The object of many surface-water data networks is to provide hydrologic information at ungaged sites. Regression analysis is the mechanism most often used to transfer information from gaged sites to ungaged sites (Matalas and Gilroy, 1968). Moss and Karlinger (1974) developed an operational technique for network evaluation, given that regression analysis is the transfer mechanism.

A study recently completed in Arizona (Moss and Gilroy, 1980) presents methods for determining the uncertainty or potential error in computations of annual mean discharges for sites in a network as a function of the number of discharge measurements made in a year. These uncertainty relations have been used with cost data to determine cost-effective stream-gaging strategies for the Lower Colorado River Basin.

The objectives in the design of surface-water quality networks are to characterize stream-water quality, to provide information needed to enforce stream standards, and to detect long-term trends. Sampling frequency is highly important in the design of a water-quality monitoring network. The multivariate nature of water-quality data complicates the design of water-quality data-collection networks.

Observation well networks are used to determine the hydraulic and hydrologic characteristics of aquifers. One of the basic objectives of collecting water-level data is to reduce the uncertainty in the decisionmaking process. The observation network needs to be designed so that the available funds are used in such a manner as to obtain the most information.

Inherent inhomogeneity of natural ground-water systems makes the objective design of ground-water quality monitoring networks difficult. The design of ground-water quality networks today relies heavily on subjective judgments.

Periodic reappraisals of networks are desirable for bringing about improvements to keep pace with changing needs and conditions. A reluctance to change prevailing practices can lead to overcollection of some records and failure to begin other records needed for the future. From 1968 to 1970, the U.S. Geological Survey conducted a nationwide evaluation of its surface-water network. In 1981, the surface-water data networks in Idaho, Iowa, Maine, and Pennsylvania are being reviewed, using the techniques described by Moss (1976). The techniques developed in the Arizona study to determine cost-effective stream-gaging strategies for the Lower Colorado River Basin (Moss and Gilroy, 1980) are also being tested in these four States to determine their applicability in diverse hydrologic environments.

QUALITY ASSURANCE AND CREDIBILITY

Over the years, the Water-Data Program has achieved a high degree of credibility, as the resulting information has been used and tested by many organizations and individuals in both government and private sectors. In large measure, this is the result of continuous efforts to ensure that data are collected, analyzed, and disseminated through thoroughly proven methods and techniques under rigorous standards of quality control. Because more and more organizations are entering the water-data activity, in terms of collectors and users of data, it is essential for communication to be improved to assure data compatibility and uniformity whenever possible. Moreover, standard techniques need to be documented and made available so as to promulgate quality control, and linkages need to be maintained between those who need data and those who collect data.

Toward this goal, the Survey is working with Federal agencies and the non-Federal community to publish the "National Handbook of Recommended Methods for Water Data Acquisition." This national handbook identifies methods for collecting a wide variety of data – surface water, ground water, chemical and biological water quality, sediment, soil moisture, drainage-basin characteristics, evaporation and transpiration, snow and ice, and hydrometeorology (Johnson, Knapp, and Kapinos, 1978). This can be a strong step to continued quality assurance but only if data-collection agencies at all levels subscribe to these methods and require their use.

Viewed from today's perspective of environmental concerns, technologic change, resource depletion, and population stress, the Survey's Water-Data Program is the foundation for many decisions involving water and related resources. The program's success in anticipating and responding to changing priorities and emergencies stems directly from its effective blending of Federal, State, and local inputs. In this activity, the Survey carries out a scientific information service which is directly related to water-resources conservation, development, and management responsibilities appropriate to all levels of government. It shares with non-Federal cooperators both the cost and the responsibility for the design and management of the system. It provides advisory services, but it does not arbitrate nor does it take adversary positions with respect to governmental policy or action. As a result of these and other characteristics, it has acquired an unusual record of scientific objectivity which is especially significant in assessing the environmental impacts of water-resource developments and control measures.

Water issues often arouse intense public feelings. Yet, what is often missed in these public postures are the complex sets of facts involved. In such situations, the impartial fact finder can be a harmonizing influence which allows the adversaries to concentrate on the policy issues.

COORDINATION AND EXCHANGE OF WATER DATA

Federal agencies acquire water data used by literally hundreds of State and local agencies and by the private sector and other Federal agencies. Furthermore, many State and other non-Federal governmental organizations, universities, and private companies also acquire water data. In an effort to meet the needs for water data in the most efficient and economical way possible, the Bureau of the Budget (now the Office of Management and Budget) issued, in 1964, Circular A–67 prescribing guidelines for the coordination of water-data acquisition activities by the more than 30 Federal agencies involved directly or indirectly in acquiring and using water data. Included in such activities are processing, storing, and disseminating data and collecting quantitative and qualitative data on the Nation's streams, lakes, reservoirs, estuaries, and ground water.

Circular A–67 assigns the task of coordinating water-data acquisition activities to the Department of the Interior. The Department's Geological Survey was selected as the lead agency; in October 1964, the Office of Water Data Coordination (OWDC) was established within the Survey (U.S. Geological Survey, 1979).

To provide advice and assistance to OWDC in carrying out the program, the Secretary of the Interior established two advisory committees–the Interagency Advisory Committee on Water Data and the Advisory Committee on Water Data for Public Use. The Interagency Advisory Committee is composed of representatives of Federal agencies concerned with acquiring or using water data and represents their interest in the coordination effort. The Advisory Committee on Water Data for Public Use represents the interests of State, local, and private organizations. These two committees and their subgroups have made valuable contributions to the coordination effort.

As a result of coordination activities and a proposal by a task group of the Federal Interagency Advisory Committee on Water Data, the National Water Data Exchange (NAWDEX) was established by the Geological Survey in 1976. NAWDEX is a national confederation of water-oriented organizations working together to improve access to water data (Edwards, 1977). Its primary objective is to assist users of water data in the identification, location, and acquisition of needed data.

NAWDEX consists of member organizations from the water-data community. The water-data holdings of these members are linked so that they may be readily exchanged for maximum use. A central program office, located administratively within the U.S. Geological Survey, coordinates this linkage and provides overall management of the program. The office provides data-exchange policy and guidelines to all participants in the NAWDEX program.

The program office operates in four major areas by:

(1) Providing central access to automated data-processing facilities for maintenance and use of its information files,
(2) Indexing water data held by participating organizations,
(3) Providing facilities and personnel for responding to requests for water data, and
(4) Formulating recommended water-data handling and exchange methods.

Membership in NAWDEX is open to any water-oriented organization that wishes to take an active role in the program. Current membership includes organizations from the Federal, State, interstate, local government; academic; and private sectors of the water-data community. No dues or fees are associated with becoming a member. Members are required, however, to sign a memorandum of understanding with the program office that defines a member's general commitment to take an active role in NAWDEX activities, to provide information on its data holdings for indexing purposes, and to provide data from its holdings upon request.

For users' convenience, NAWDEX services are available through a nationwide network of 63 assistance centers, located in 45 States and Puerto Rico. The centers provide direct access to NAWDEX and make local expertise available to aid in identifying and locating needed data. The Survey supports this activity by providing assistance center services in 52 of its district and subdistrict offices.

NAWDEX is not a repository of water data. It provides indexes of the data held by NAWDEX members and participants as a central source of information about water data available from a large number of organizations. This information is in both computerized and noncomputerized form.

SUMMARY

The U.S. Geological Survey has collected hydrologic data for the Nation since 1888. Today, the Survey maintains a system of stream-gaging stations, ground-water observation wells, and sites where the quality of the Nation's surface or ground waters is monitored. These activities are carried out in each State, Puerto Rico, and the Trust Territories, with the participation of agencies at all governmental levels.

As part of its responsibilities, the Survey coordinates water-data acquisition with Federal, State, and local agencies and with the private sector, and the Survey makes hydrologic information available through reports and computer output and in response to individual requests. Because of a rigorous system of quality control developed over many years, the user community views these water-resource data with considerable credibility.

The Geological Survey modifies the data-collection programs as needed to facilitate shifts in focus due to emerging needs and changing conditions. In addition, full advantage is taken of available technology to insure use of the most economical and efficient techniques of data collection. Current activities include testing and evaluation of data transmission by satellite and potential improvements in automated data-collection systems.

The Water-Data Program is a principal part of the U.S. Geological Survey's water-resources investigations, in which many Federal, State, and local agencies cooperate. The program is designed to gain basic information about water as it occurs naturally and as it is influenced by man. The Water-Data Program is important not only to water development and water management, but also to research, which will lead to a better understanding of water in the atmosphere, on the Earth's surface, and beneath the ground.

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LISTS OF SELECTED U.S. GEOLOGICAL SURVEY WATER RESOURCES DIVISION OFFICES

Inquiries about water-resources information for a particular State should be referred to the *U.S. Geological Survey, Water Resources Division,* at the appropriate address, as shown below. Questions regarding multi-State programs or policy matters should be addressed to one of the regional offices shown at the end of this list.

ALABAMA
P.O. Box V, Oil & Gas Board Building
University, AL 35486

ALASKA
733 West 4th Avenue, Suite 400
Anchorage, AK 99501

ARIZONA
Federal Building
301 West Congress Street, FB-44
Tuscon, AZ 85701

ARKANSAS
Federal Office Building, Room 2301
700 West Capitol Avenue
Little Rock, AR 72201

CALIFORNIA
855 Oak Grove Avenue
Menlo Park, CA 94025

COLORADO
Box 25046, Mail Stop 415
Denver Federal Center, Building 53
Lakewood, CO 80225

CONNECTICUT
135 High Street, Room 235
Hartford, CT 06103

DELAWARE
See **MARYLAND** Listing

DISTRICT OF COLUMBIA
See **MARYLAND** Listing

FLORIDA
325 John Knox Road, Suite F-240
Tallahassee, FL 32303

GEORGIA
6481 Peachtree Industrial Boulevard, Suite B
Doraville, GA 30360

HAWAII
P.O. Box 50166
300 Ala Moana Boulevard, Room 6610
Honolulu, HI 96850

IDAHO
Room 365, 550 West Fort Street
Boise, ID 83724

ILLINOIS
Champaign City Bank Plaza
102 E. Main Street, 4th Floor
Champaign, IL 61801

INDIANA
1819 North Meridian Street
Indianapolis, IN 46202

IOWA
P.O. Box 1230, Federal Building
Room 269, 400 South Clinton Street
Iowa City, IA 52244

KANSAS
1950 Avenue A – Campus West
University of Kansas
Lawrence, KS 66045

KENTUCKY
Federal Building, Room 572
600 Federal Place
Louisville, KY 40202

LOUISIANA
P.O. Box 66492, 6554 Florida Boulevard
Baton Rouge, LA 70896

MAINE
See **MASSACHUSETTS** listing

MARYLAND
Carroll Building, Room 208
8600 LaSalle Road
Towson, MD 21204

MASSACHUSETTS
150 Causeway Street, Suite 1001
Boston, MA 02114

MICHIGAN
6520 Mercantile Way, Suite 5
Lansing, MI 48910

MINNESOTA
Post Office Building, Room 702
Saint Paul, MN 55101

MISSISSIPPI
Federal Office Building, Suite 710
100 West Capitol Street
Jackson, MS 39201

MISSOURI
1400 Independence Road, Mail Stop 200
Rolla, MO 65401

MONTANA
Drawer 10076
Helena, MT 59626

NEBRASKA
Federal Building and U.S. Courthouse,
Room 406, 100 Centennial Mall North
Lincoln, NE 68508

NEVADA
Federal Building, Room 229
705 North Plaza Street
Carson City, NV 89701

NEW HAMPSHIRE
See **MASSACHUSETTS** listing

NEW JERSEY
430 Federal Building
402 East State Street
Trenton, NJ 08608

NEW MEXICO
P.O. Box 22659,
Western Bank Building
505 Marquette, North West
Albuquerque, NM 87125

NEW YORK
P.O. Box 1350, 236 U.S. Post Office and Courthouse Building
Albany, NY 12201

NORTH CAROLINA
P.O. Box 2857, Century Station
Post Office Building, Room 436
Raleigh, NC 27602

NORTH DAKOTA
821 East Interstate Avenue
Bismarck, ND 58501

OHIO
975 West Third Avenue
Columbus, OH 43212

OKLAHOMA
215 Dean A. McGee Street
Room 521
Oklahoma City, OK 73102

OREGON
P.O. Box 3202
830 Northeast Holladay Street
Portland, OR 97208

PENNSYLVANIA
P.O. Box 1107, Federal Building
4th Floor, 228 Walnut Street
Harrisburg, PA 17108

PUERTO RICO
G.P.O. Box 4424, Building 652
Fort Buchanan
San Juan, PR 00936

RHODE ISLAND
See **MASSACHUSETTS** listing

SOUTH CAROLINA
Strom Thurmond Federal Building, Suite 658
1835 Assembly Street
Columbia, SC 29201

SOUTH DAKOTA
200 Fourth Street, South West
Federal Building, 317
Huron, SD 57350

TENNESSEE
Federal Building and U.S. Courthouse,
Room A-413
Nashville, TN 37203

TEXAS
Federal Building, Room 649
300 East Eighth Street
Austin, TX 78701

UTAH
Administrative Building, Room 1016
1745 West 1700 South
Salt Lake City, UT 84109

VERMONT
See **MASSACHUSETTS** listing

VIRGINIA
200 West Grace Street, Room 304
Richmond, VA 23220

WASHINGTON
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

WEST VIRGINIA
Federal Building and U.S. Courthouse
Room 3017, 500 Quarrier Street, East
Charleston, WV 25301

WISCONSIN
1815 University Avenue
Madison, WI 53706

WYOMING
P.O. Box 1125
J. C. O'Mahoney Federal Center
Room 5017, 2120 Capitol Avenue
Cheyenne, WY 82001

NORTHEASTERN REGION
Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, Washington, D.C., West Virginia, Wisconsin

433 U.S. Geological Survey National Center
12201 Sunrise Valley Drive
Reston, VA 22092

SOUTHEASTERN REGION
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