WATER-RESOURCES ACTIVITIES, SOUTH CAROLINA DISTRICT, 1987-88

By Whitney J. Stringfield

U.S. GEOLOGICAL SURVEY

Open-File Report 89-248

Columbia, South Carolina

1989

DEPARTMENT OF THE INTERIOR

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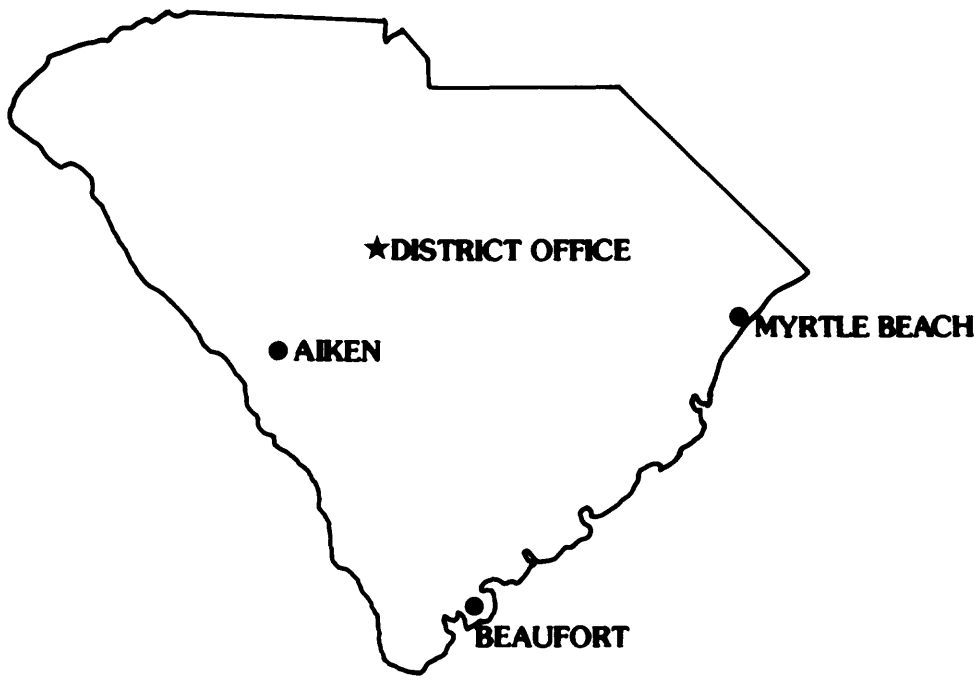
INTRODUCTION

The U.S. Geological Survey was established by an Act of Congress in 1879. Its purpose is to provide comprehensive factual information on the Nation's natural resources. The WRD (Water Resources Division) is responsible for studying and reporting on the status of the water resources of the Nation.

This is accomplished, in large part, through cooperation with other Federal and non-Federal agencies, by:

- Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.
- Conducting analytical and interpretative water-resource appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.
- Conducting supportive basic and problem-oriented research in hydraulics, hydrology, and related fields of science to improve the scientific basis for investigations and measurement techniques and to understand hydrologic systems sufficiently well to quantitatively predict their response to stress, either natural or manmade.
- Disseminating water data and the results of these investigations and research through reports, maps, computerized information services, and other forms of public releases.
- Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground waters.
- Providing scientific and technical assistance in hydrologic fields to other Federal, State and local agencies, to licensees of the Federal Power Commission, and to international agencies on behalf of the Department of State.

The South Carolina District, WRD, through its District Office and Field Headquarters (fig. 1) conducts data collection and interpretative investigations of the water resources of South Carolina. These studies address water-resource related problems in South Carolina that are of National, State, and local interest. This report provides information on investigations in progress in the District during fiscal years 1987-88. The bibliography lists the publications that have been written as a result of South Carolina District studies and studies pertaining to South Carolina that were conducted in other offices of the U.S. Geological Survey.



South Carolina District Office Addresses

District Office (803)765-5966	Rodney N. Cherry, District Chief U.S. Geological Survey, WRD 1835 Assembly Street, Suite 677A Columbia, SC 29201
Myrtle Beach Field Headquarters (803)626-3793	U.S. Geological Survey, WRD 507 28th Avenue North Myrtle Beach, SC 29577
Beaufort Field Headquarters (803)524-1995	U.S. Geological Survey, WRD 144 Ribault Square Beaufort, SC 29902
Aiken Field Headquarters (803)652-3411	U.S. Geological Survey, WRD 706 Main Street South New Ellenton, SC 29809

Figure 1.--Location and addresses of District Office and Field Headquarters.

TYPES OF FUNDING

Figure 2 shows the percentage of the investigations for fiscal years 1987 and 1988 in each of the broad categories of hydrologic data collection, interpretive studies, and research projects.

The investigations are directed toward obtaining the information needed by managers and planners for the solution or alleviation of water problems in the State.

Funding for programs of the South Carolina District falls into three categories:

1. Federal program which includes funds appropriated directly to the Geological Survey.

2. OFA program which includes funds transferred from other Federal agencies.

3. Cooperative program which includes investigations supported by services and (or) funds provided by State and local agencies, matched on a 50-50 basis by Federal funds.

The distribution of funding in these three program categories in fiscal years 1987 and 1988 is shown in figure 3.

COOPERATING AGENCIES

Hydrologic activities are conducted in large part through cooperation with State, local, and other Federal agencies who share in the planning and financial support of the program. The cooperators are:

State Agencies

South Carolina Department of Health and Environmental Control
South Carolina Department of Highways and Public Transportation
South Carolina Geological Survey
South Carolina Public Service Authority
South Carolina Sea Grants Consortium
South Carolina Water Resources Commission
South Carolina Water Resource Institute
South Carolina Wildlife and Marine Resources Department
University of South Carolina

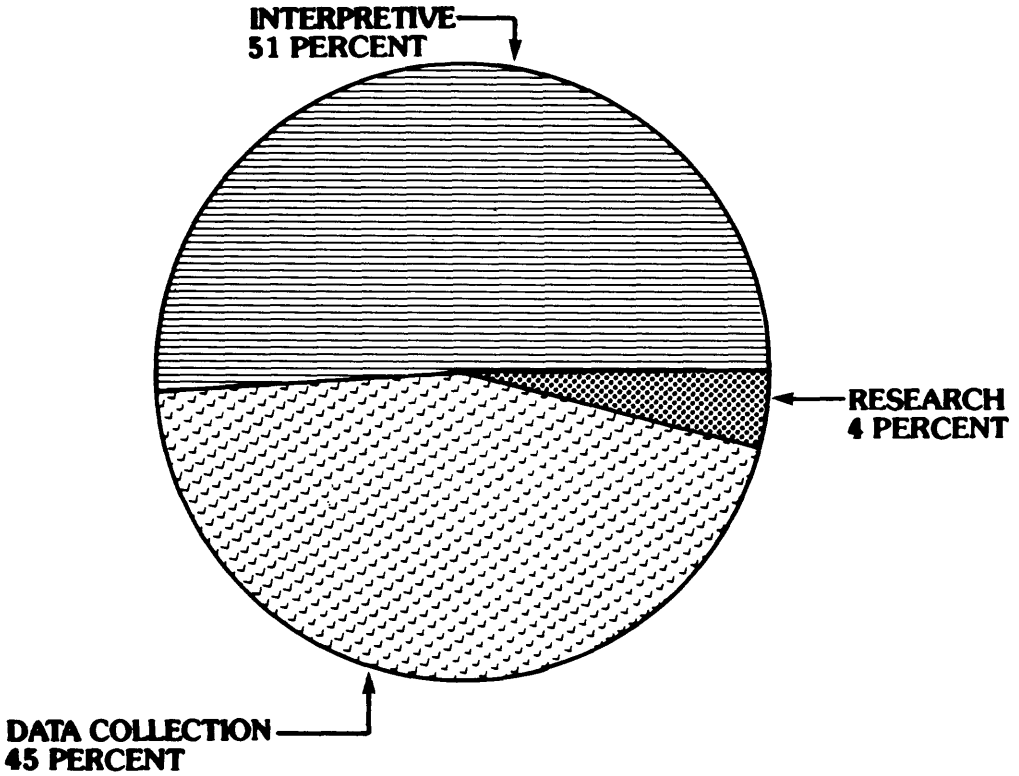


Figure 2.--Types of water-resources activities in South Carolina, fiscal year 1987-88.

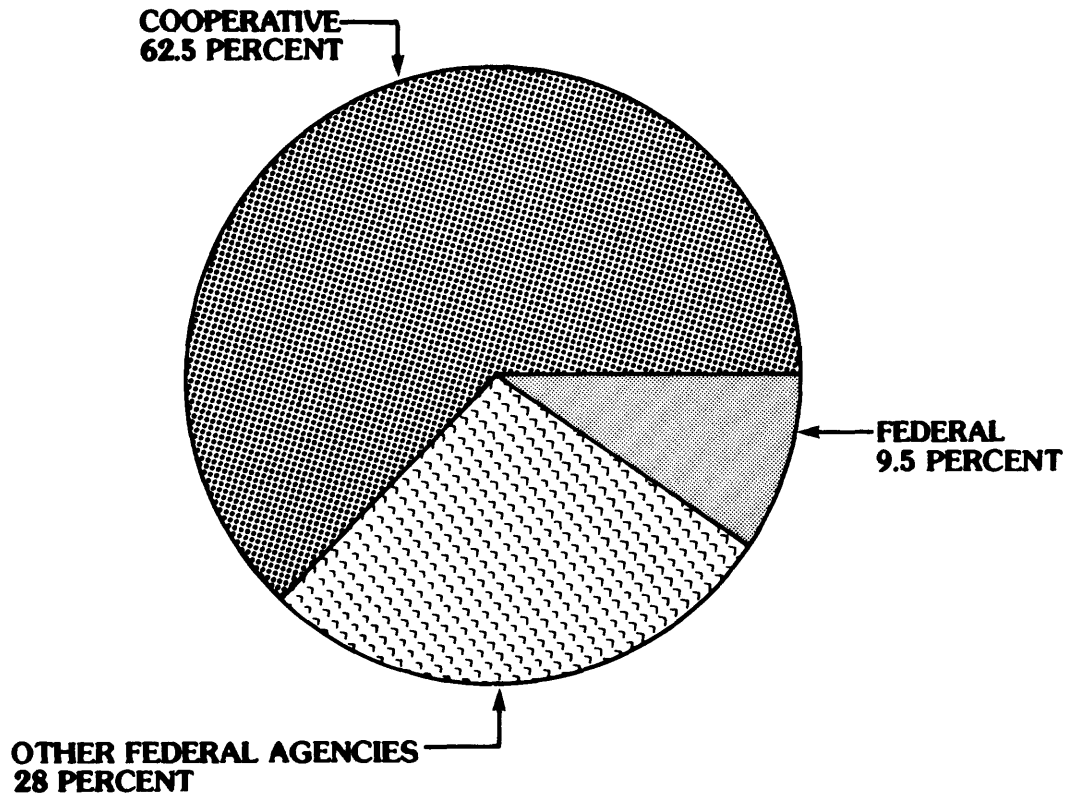


Figure 3.--Sources of funding for water-resources activities in South Carolina, fiscal year 1987-88.

Local Agencies

Beaufort-Jasper County Water Authority
City of Charleston
City of Myrtle Beach
City of Newberry
City of North Myrtle Beach
City of Spartanburg
Cooper River Water Users Association
Georgetown Water and Sewer District
Grand Strand Water and Sewer Authority
Lexington County
Richland County
Spartanburg Sanitary Sewer District
Spartanburg Water System
Town of Irmo
Waccamaw Regional Planning and Development Council
Western Carolina Regional Sewer Authority

Other Local Entities

Bowater-Carolina Corporation
Carolina Power and Light Company
Caro-Knit, Inc.
Duke Power Company
Milliken Corporation
Platt-Saco-Lowell Corporation
South Carolina Electric and Gas Company
Union Camp Corporation

Other Federal Agencies

U.S. Air Force
U.S. Army Corps of Engineers, Charleston District
U.S. Army Corps of Engineers, Savannah District
U.S. Department of Energy
U.S. Federal Energy Regulatory Commission
U.S. National Park Service
U.S. National Weather Service
U.S. Navy
U.S. Soil Conservation Service

SUMMARY OF HYDROLOGIC CONDITIONS, 1987 and 1988 WATER YEARS

Streamflow

Streamflow during the 1987 water year was above normal over most of the State. Drought conditions which persisted during 1986 were eased near the end of October and in November and December with above normal precipitation. Heavy rains during late February and March caused the most severe flooding in nearly ten years along sections of the Santee, Pee Dee and Lynches Rivers. Most of the peak discharges during the 1987 water year occurred during March. Nearly normal streamflow was recorded from April through August. In September heavy rainfall caused considerable flooding along the coastal sections of the State and local flooding in the Irmo-St. Andrews area and resulted in above normal streamflows through the western part of the State.

The minimum mean daily discharge in 1987 at six representative streamflow stations are given along with the computed 7-day, 10-year minimum discharge in table 1. The minimum mean daily flow exceeded the 7-day, 10-year minimum discharge at the two sites in the Lower Coastal Plain, but was equal to or less than the 7-day, 10-year minimum discharge at the sites in the Upper Coastal Plain and in the Piedmont.

Deficient rainfall recorded throughout South Carolina produced below normal streamflow for most of the 1988 water year. Streamflow in the Piedmont Province is very sensitive to precipitation due to geologic and topographic conditions. Streams located in the lower Piedmont just above the Fall Line experienced highly variable flows during drought conditions. Rainfall at a National Weather Service station at the Greenville-Spartanburg Airport was 28 percent below normal for the 1988 water year. Low-flow conditions in the Coastal Plain Province were also below normal due to the drought experienced over the State. Rainfall recorded near Columbia and Charleston by the National Weather Service was 4 percent and 11 percent below normal, respectively, for the 1988 water year. Much of the rainfall in the Coastal Plain Province occurred during the months of August and September; therefore, most of the other months experienced a more severe deficit than reflected by the annual totals. The minimum mean daily discharge in 1988 at six representative streamflow stations along with the computed 7-day, 10-year minimum discharge are given in table 2. The minimum mean daily discharge for the 1988 water year was less than the 7-day, 10-year discharge at 5 of the 6 stations.

Ground water

Ground-water levels during fiscal year 1987 recovered from the drought of 1986. Like streamflow, ground-water levels strongly reflect the climatic conditions. In the Piedmont, ground water occurs in the fault and fracture systems of the crystalline rocks and in places in the shallow material overlying the rocks. Water levels in this area quickly reflect the amount of precipitation received. The water level in well GRV-709 near Greenville, an unused 80-foot deep water table well rose from 33.33 feet below land surface on October 1, 1986, to 31.39 feet below land surface on

Table 1.--Minimum mean daily discharge in 1987 and the computed 7-day, 10-year minimum discharge for six stations on streams in South Carolina

Station	Drainage area (square mile)	Minimum mean daily discharge (cubic foot per second)	$7Q_{10}$ discharge (cubic foot) per second)
Piedmont			
02157000 N.Tyger River near Fairmont	44.4	7.6	10
02162010 Cedar Creek near Blythewood	48.9	0.08	0.5
Upper Coastal Plain			
02130900 Black Creek near McBee	108	22	22
02173000 South Fork Edisto River near Denmark	720	201	211
Lower Coastal Plain			
02132000 Lynches River at Effingham	1,030	157	132
021765000 Coosawhatchie River near Hampton	203	.09	.03

Table 2.--Minimum mean daily discharge in 1988 and the computed 7-day, 10-year minimum discharge for six stations on streams in South Carolina

Station	Drainage area (square mile)	Minimum mean daily discharge (cubic foot per second)	$7Q_{10}$ discharge (cubic foot) per second)
Piedmont			
02157000 N.Tyger River near Fairmont	44.4	4.6	10
02162010 Cedar Creek near Blythewood	48.9	0.12	0.5
Upper Coastal Plain			
02130900 Black Creek near McBee	108	25	22
02173000 South Fork Edisto River near Denmark	720	171	211
Lower Coastal Plain			
02132000 Lynches River at Effingham	1,030	120	132
021765000 Coosawhatchie River near Hampton	203	.00	.03

September 30, 1987. The following year the water-level declined from 31.44 feet below land surface on October 1, 1987, to 34.96 feet below land surface on September 30, 1988.

Ground water in the Coastal Plain occurs in multiple aquifer systems, mostly under artesian or confined conditions. Ground water is used extensively in this portion of the State, and in areas of heavy withdrawal of ground water from the artesian aquifer, a reduction of the pressure head caused the water level to decline. This decline persists in areas where there is continual pumping on a year round basis. However, during periods of above normal rainfall, ground-water levels in the Coastal Plain can recover.

Water Quality

Water-quality data were collected at 52 surface-water sites during the 1987 water year and at 61 surface-water sites during the 1988 water year. Comparison of these data with previous years showed that little change in the chemical quality occurred in either year. Temperatures were above normal during the latter part of the 1987 water year causing low dissolved oxygen content in many streams.

WATER-RESOURCES INVESTIGATIONS IN SOUTH CAROLINA, 1987-88

The U.S. Geological Survey, Water Resources Division, conducts three major types of activities in South Carolina in order to provide the hydrologic information and understanding need for the best management of South Carolina's and the Nation's water resources. The activities are:

1. Data collection and dissemination.
2. Water-resources appraisals (interpretive studies).
3. Research.

The descriptions of these activities for water-years 1987 and 1988 in this report include the following information:

- Project Number
- Title
- Cooperating Agency
- Principal Investigator
- Period of Investigation
- Objective
- Approach
- Plans for This Year (1989)

The water-resources investigations or projects that were active in fiscal years 1987 and 1988, and the page on which the activities in that project are described are as follows:

Number and Title: SC 00-001, Surface-Water Stations

Cooperating Agency: Most of those shown in the list of cooperators

Principal Investigator: Curtis S. Bennett, III

Period of Investigation: Continuous

Objective: To provide information necessary to assess the surface-water resources, establish a data base for long-term planning and design and provide current information for special purposes including operation of reservoirs, flood forecasting, waste disposal, pollution control, legal requirements, bridge and culvert design, research or special studies.

Approach: Collect stream discharge, stream and lake stage data from a network of gaging stations which include continuous discharge, periodic discharge, continuous stage, and peak stage to define streamflow and stage conditions within the State.

Plans for This Year: Operate 114 discharge, 54 stage-only, 47 crest-stage, 9 lake, and 28 drainage stations. Periodic discharge measurements will be made at 5 other stations. Publish Water Resources Data for South Carolina, Water Year 1988.

Figure 4.--Streamflow stations, reservoir or lake gaging stations, and water-quality stations.

Figure 5.--Crest-stage stations.

Number and Title: SC 00-001 (subproject), Flood of August 18, 1986, Newberry, South Carolina

Cooperating Agency: City of Newberry, South Carolina
S.C. Water Resources Commission

Principal Investigator: Noel M. Hurley, Jr., C. Lamar Sanders, Jr.

Period of Investigation: August 1986 -- Report Published September, 1988

Objective: To document flooding on Scotts Creek and South Scotts Creek within the city of Newberry by showing quantity of rainfall, magnitude and frequency of flood discharges at two streamflow sites, and elevations of high-water marks obtained at road crossing of the creeks.

Approach: Flagged and surveyed high-water marks (HWM). Used HWM's to make indirect discharge computations. Compared discharges to flood frequency values to determine recurrence intervals.

Plans for This Year: Report published.

Number and Title: SC 00-001 (subproject), Impact on Water-Surface Elevations in the Congaree River near Columbia, South Carolina

Cooperating Agency: South Carolina Department of Highways and Public Transportation

Principal Investigator: R. Erik Schuck-Kolben

Period of Investigation: June 1985 - September 1988

Objective: To determine the hydraulic impact of the I-326 crossing, the proposed Twelfth Street Extension, and the growth of pine trees in various areas in the flood plain (previously open fields) on water-surface elevations produced by the 100- and 500-year floods. The distribution of discharge through the bridge openings produced by the 100- and 500-year floods for various conditions of flood plain development was also of interest.

Approach: The system was described hydrodynamically for both the 100- and 500-year floods for each of the following three conditions by the use of a two-dimensional horizontal, vertically-averaged, finite element model (FESWMS-2HD): (1) with I-326 and Twelfth Street Extension in place and no pine trees; (2) with I-326 and Twelfth Street Extension in place and semi-mature pine trees; and (3) with I-326 and Twelfth Street Extension and mature pine trees. The effect of Twelfth Street Extension was also analyzed separately.

Plans for This Year: The Water Resources Investigation Report will be submited for the approval of the director, and will be sent to the printing office.

Number and Title: SC 00-001 (subproject), Impact of Water Withdrawals from the Intracoastal Waterway, and Bull Creek in the Grand Strand Area, South Carolina

Cooperating Agency: Grand Strand Water and Sewer Authority

Principal Investigator: Erik Schuck-Kolben, Paul A. Drewes

Period of Investigation: October 1984 - September 1988

Objective: The objective of this study is to determine the impacts of withdrawing freshwater from the AIW (Atlantic Intracoastal Waterway) in the vicinity of Enterprise Landing and from Bull Creek approximately 7.0 miles upstream from its confluence with the AIW. Of special interest will be the movement of the freshwater-saltwater interface as a result of the withdrawals during low-flow periods. This study will include hydrologic and hydraulic evaluations of the surface-water flow system in the Grand Strand area. Data will be obtained to define flow patterns and movement of the freshwater-saltwater interface in the study area.

Approach: Ten additional stage and two conductivity gages were installed in the southern part of the study area. Approximately eight discharge measurements will be made over a complete tidal cycle, and variations in conductivity will be examined during the data collection period. The data will be used to calibrate and verify unsteady flow and transport models for the stream network in the study area. The models will be used to assess the effects of water supply withdrawals on the location of the freshwater-saltwater interfaces in the study area.

Plans for this Year: Determine location of cross-sections for the flow model, and measure geometry. Calibrate and verify flow model. Begin imposing stress conditions on models. Begin outlining reports. Complete data collection.

Number and Title: SC 00-002, Ground-Water Stations

Cooperating Agency: South Carolina Water Resources Commission; South Carolina Geological Survey; U.S. Navy; South Carolina Department of Health and Environmental Control

Principal Investigator: Curtis S. Bennett III

Period of Investigation: Continuous

Objective: To obtain and document ground-water-level data for use in the planning and development of the ground-water resources of the State. To collect ground-water-level data to provide a long-term data base so that the general response of the hydrologic system to natural climatic variations and induced stresses is known and potential problems can be defined early enough to allow proper planning and management. To provide a data base against which short-term records acquired in short-term hydrologic investigations can be compared.

Approach: Collect ground-water-level data for the various aquifers in a network of 54 continuous-record observation wells.

Plans for This Year: Collect ground-water-level data from 54 observation wells. Publish data in Water Resources Data for South Carolina, Water Year 1988.

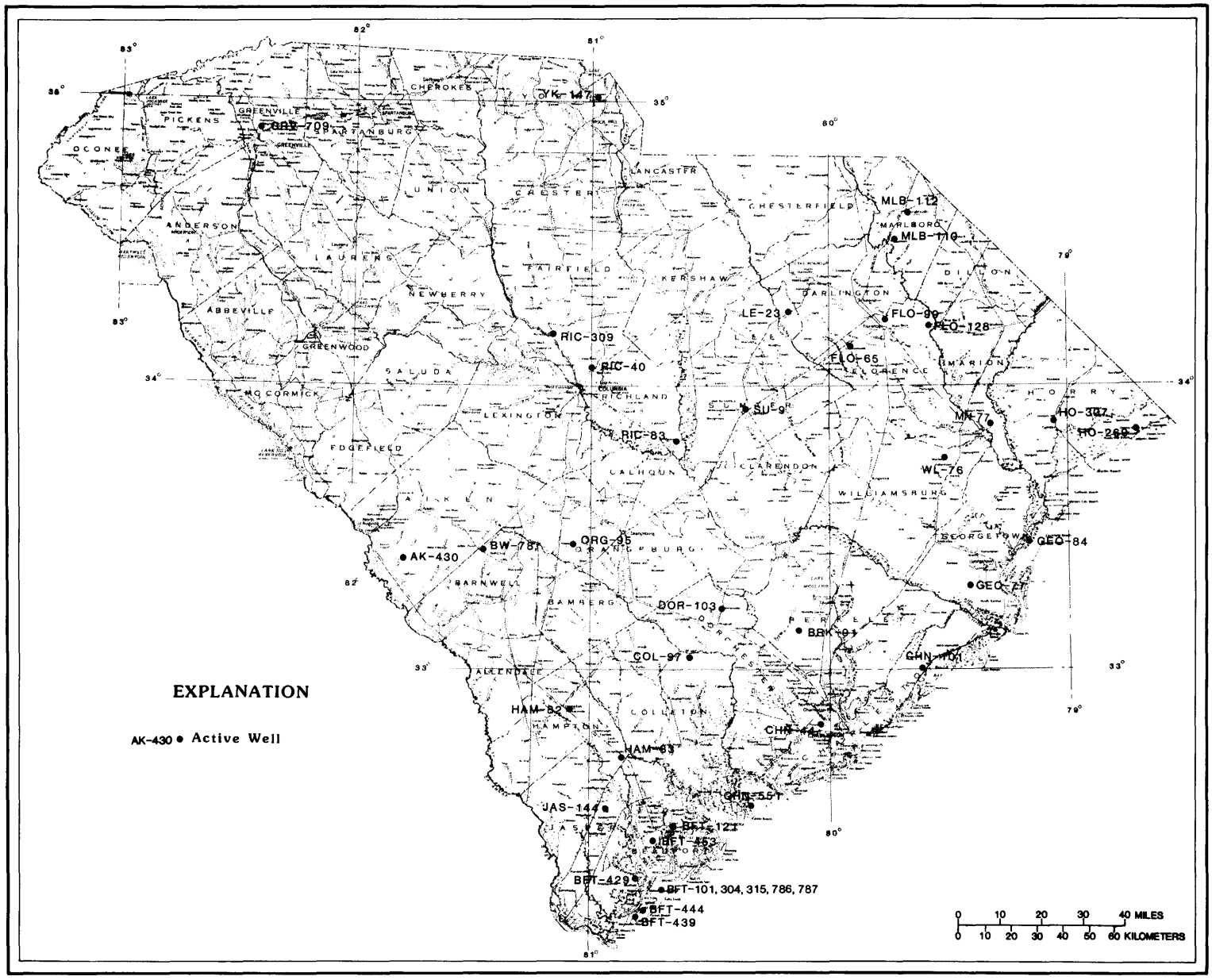


Figure 6.--Ground-water wells.

Number and Title: SC 00-003, Water-Quality Stations

Cooperating Agency: Many of those shown in the list of cooperators

Principal Investigator: Curtis S. Bennett III

Period of Investigation: Continuous

Objective: To obtain and document water-quality data for use in the planning and development of the water resources of the State. To collect, store, and publish current data necessary to define quality of ground and surface waters.

Approach: Collect water-quality data continuously and at monthly, bimonthly, quarterly, and yearly frequencies at stations located on streams, lakes, and wells to define water quality within the State.

Plans for This Year: Operate 59 multiparameter continuous monitors at surface-water sites. Collect water samples at 9 surface sites at various frequencies. Publish data in Water Resources Data for South Carolina, Water Year 1988.

Figure 7.--Water-quality stations.

Number and Title: SC 00-004, Sediment Stations

Cooperating Agency: U.S. Geological Survey; South Carolina Department of Health and Environmental Control; University of South Carolina

Principal Investigator: Curtis S. Bennett III

Period of Investigation: Continuous

Objective: To provide a national bank of sediment data for use in broad Federal and State planning and action programs. To provide data for Federal management of interstate and international waters.

Approach: Operate a network of sediment stations to provide spatial and temporal averages and trends in sediment concentration, sediment discharge, and particle size of sediment transported by rivers and streams.

Plans for This Year: Operate two benchmark and seven NASQAN sediment stations. Attempt to sample sediment during at least one flood event at each station. Publish data in Water Resources Data for South Carolina, Water Year 1988.

Number and Title: SC 84-005, Atmospheric Deposition Station

Cooperating Agency: U.S. Geological Survey

Principal Investigator: Curtis S. Bennett III

Period of Investigation: Continuous since 1983

Objective: To determine variations in atmospheric deposition that occur on a week-to-week basis in South Carolina. To collect wet and dry deposition products for analysis of elements and compounds that can contribute to the chemical composition of surface waters.

Approach: Set up monitoring station as part of the National Trends Network. Maintain station, make on-site measurements, process samples, and submit samples to an analytical laboratory. Verify data retrievals and report on results.

Plans for This Year: Continued operation.

Number and Title: SC 79-007, Water Use

Cooperating Agency: South Carolina Water Resources Commission

Principal Investigator: Whitney Stringfield

Period of Investigation: Continuous since 1978

Objective: To provide water-use information to aid in the formulation of plans for the optimum utilization and management of South Carolina's water resources. To collect, store, and disseminate water-use information.

Approach: The South Carolina Water Resources Commission and the Geological Survey will collect water-use data from water users throughout the State using reporting forms and on-site inspections. Compile water-use data by county into categories such as public, agriculture, power, domestic, or industrial supply.

Plans for This Year: Collect data from existing sources and analyze the data. Train personnel in the water-use program. Implement the data collection, storage, and retrieval system. Enter water-use data in State and District's computer.

Number and Title: SC 68-010, Flood Studies and Assessment

Cooperating Agency: South Carolina Department of Highways and Public Transportation

Principal Investigator: Curtis L. Sanders, Jr.

Period of Investigation: Continuous since 1968

Objective: To collect and analyze flood flow data and assess the hydraulic and hydrologic characteristics of streams for specific sites and selected stream reaches. To document and prepare reports of flood events.

Approach: Collect specific flood data at ungaged sites to supplement the statewide gaging station network. Maintain and update computer files of basin characteristics and peak flow for use in flood frequency analyses. Respond by letter to specific requests for hydraulic and hydrologic information for selected stream reaches. Assess and analyze flood data, and prepare reports to disseminate flood information.

Plans for This Year: Furnish flood frequency data and flood information at proposed stream crossings as requested by South Carolina Department of Highways and Public Transportation. Tabulate peak discharge data through the 1988 water year. Perform computer analysis to update current magnitudes and frequencies of peak discharges of regulated and unregulated streams of South Carolina when adequate data are available.

Number and Title: SC 79-045, Water Resource Evaluation: Horry and Georgetown Counties

Cooperating Agency: City of Myrtle Beach, S.C., City of North Myrtle Beach, S.C., Grand Strand Water and Sewer Authority, Georgetown County Water and Sewer District, Myrtle Beach Air Force Base.

Principal Investigator: Bryan B. McDonald

Period of Investigation: January 1985 - May 1987

Objective: The purpose of this study is to develop, interpret and present hydrogeologic information on the water supply potential of the Black Creek aquifer in Horry and Georgetown counties, South Carolina. This information will help evaluate the aquifer as a source of future water supplies. Specific objectives are: (1) To evaluate the hydraulic characteristics of the Black Creek aquifer and the confining materials that partly control recharge to the aquifer. (2) To simulate by digital computer model the hydraulic response of existing or hypothetical well fields pumping at various sustained rates within the Black Creek aquifer.

Approach:

(1) Initially assemble and evaluate existing information and develop a detailed work plan for the study; (2) Collect water level data within the Black Creek aquifer and construct a potentiometric surface map of the study area for the period March 1985; (3) Develop, calibrate and verify a quasi-three-dimensional ground-water flow model for Horry and Georgetown counties and the surrounding area; (4) Simulate by digital computer model aquifer response to: (a) Increased/decreased pumpage at existing well fields in and around the Myrtle Beach area; and (b) The placement of hypothetical well fields at various locations within the study area.

Plans for this Year: Obtain Director's approval for final report and publish report.

Number and Title: SC 80-048, Coastal Plain Aquifer Study

Cooperating Agency: U.S. Geological Survey

Principal Investigator: Walter R. Aucott

Period of Investigation: October 1979 - June 1987

Objective: To describe the geohydrology of the sand aquifers in the Coastal Plain of South Carolina. To define the boundaries of the sand aquifer systems, determine the occurrence and movement of water in the Coastal Plain aquifers and the hydrologic changes which have occurred as a result of development.

Approach: Information from Geological Survey reports and files and other sources will be reviewed and compiled. Additional data will be collected as necessary. Aquifer delineation and hydrologic boundary determinations will be based on geophysical, geologic, chemical, and hydrologic data. Ground-water flow will be described using water-level maps, aquifer performance tests, and a 3-dimensional flow model. Historical changes will be determined by comparing predevelopment and current potentiometric surface maps.

Plans for This Year: Project completed.

Number and Title: SC 80-049, Low-Flow Characteristics of Headwater Streams

Cooperating Agency: South Carolina Department of Health and Environmental Control

Principal Investigator: A. Carroll Barker

Period of Investigation: October 1980 - September 1988

Objectives: To determine the low-flow characteristics of the headwaters of selected streams by direct means. To develop a method of estimating low-flow characteristics of headwaters of other streams from physical basin characteristics using the data from the selected streams as control.

Approach: Low-flow characteristics on selected ungaged streams will be determined by correlation of instantaneous discharge at ungaged sites with discharge at continuous record stations established for this study. Variables will be statistically examined for selected basin characteristics to determine the multiple regression equation with the least standard error of estimate.

Plans for This Year: Complete report with a map of unit $7Q_{10}$'s with drainage basins delineated.

Number and Title: SC 84-056, Salt-Water Encroachment, Hilton Head Island Area

Cooperating Agency: South Carolina Water Resources Commission

Principal Investigator: Ronald A. Burt, Columbia

Period of Investigation: October 1983 - September 1988

Objective: To investigate: 1) the location and nature of the interface between freshwater and saltwater in the aquifer near Hilton Head Island; 2) the hydrologic characteristics of the aquifer and confining beds; 3) the rate and direction of movement of the freshwater-saltwater interface; 4) the length of time before saltwater in the aquifer encroaches beneath the Hilton Head Island; 5) the extent of local recharge to the aquifer; 6) the effects of increasing local freshwater recharge and 7) the possibility of stabilizing the saltwater and freshwater interface offshore by recharge on shore.

Approach: The ground-water hydrology of the aquifer will be investigated by test drilling and sampling onshore and offshore. Maps or graphs of water levels, aquifer transmissivity, aquifer chemistry, ground-water pumping, water-level changes, confining-bed hydraulic conductivity, and hydrogeologic framework will be drawn from new data, from data of previous investigations, and from data in existing files of the U.S. Geological Survey and the South Carolina Water Resources Commission. Ground-water flow, solute-transport, and geochemical models of the aquifer will be constructed to aid in investigating the ground-water hydrology of the aquifer and to aid in meeting the objectives of the project.

Plans for This Year: Reports describing a solute-transport model, constructed to aid in depicting brackish and salt-water encroachment, and the quality of ground water in the study area with respect to the potential impacts of encroaching saltwater, are currently in review. Report describing ground-water flow model has been published.

Number and Title: SC 84-058, Flood Hydrographs

Cooperating Agency: South Carolina Department of Highways and Public Transportation

Principal Investigator: Larry R. Bohman

Period of Investigation: May 1984 - September 1990

Objective: To define techniques for simulating flood hydrographs for specific design discharges of ungaged rural and urban sites in South Carolina. Develop a method for estimating peak discharges for ungaged urban sites.

Approach: Two approaches will be investigated in this study; 1) a dimensionless hydrograph approach, and 2) a unit hydrograph method. In the dimensionless hydrograph approach, average unit hydrographs and lagtimes will be computed for each station. These hydrographs are then transformed to unit hydrographs having durations of one-fourth, one-third, one-half, and two-thirds lagtime and then reduced to dimensionless terms. Regional dimensionless hydrographs will be determined by comparing observed and predicted hydrograph widths. Regression equations to define lagtime from physical basin characteristics will be developed. A unit hydrograph approach using the gamma function and Soil Conservation Service methods, is also under investigation. This method will assign a recurrence interval based on the rainfall as compared to the dimensionless hydrograph, whose design recurrence is based on the peak discharge. An urban rainfall-discharge network consisting of 27 stations will collect data to calibrate a rainfall-runoff model. Long term sequences of flood peaks will then be synthesized and used in regression analyses to determine urban peak discharge magnitude and frequency. A hydrograph analysis similar to the rural dimensionless hydrograph will be performed.

Plans for This Year: The rural flood hydrograph report will be published this year. Data collection and development of stage-discharge relations at urban sites will continue. Long-term evaporation and rainfall data for annual peak synthesis will be assembled for later use. Preparation for model calibration will begin.

Number and Title: SC 85-061, Real-Time Data Processing

Cooperating Agency: U.S. Geological Survey

Principal Investigator: Jan C. Ciegler

Period of Investigation: October 1984 - September 1987

Objective: To provide real-time data processing software for use on the Prime mini-computer. Specific activities will include: (1) Transfer data from the direct readout ground station (DRGS) to the host Prime, and forward to other Primes and provide data distribution backup; (2) Convert data for processing, screen and store; (3) Compute engineering values using ratings, datum corrections, and shifts and store unit and daily values; and (4) Develop edit and output capability including graphics.

Approach: In cooperation with the Data Relay Committee (DRC) and Automated Data Processing Systems Committee (ADPSC) software code will be written as specified by the committees to develop an integrated data processing system. Documentation will be written as software is developed.

Plans for This Year: Continue ongoing support of real-time software on a nationwide scale. Support the integration of real-time data processing with the automated data processing system (ADAPS). Advise and support ADAPS personnel and field personnel with real-time data processing software problems. Design, develop and install the automated instrument monitoring system (AIMS) that will be part of ADAPS.

Number and Title: SC 85-064, Aquatic Macrophytes in South Carolina

Cooperating Agency: South Carolina Water Resources Commission

Principal Investigator: Glenn G. Patterson

Period of Investigation: March 1985 - September 1987

Objective: The objectives of this study are to determine the areal extent of the significant aquatic macrophyte infestations in the public waters of South Carolina, to determine the major plant species in each infestation, and to depict the information on maps of the study areas.

Approach: The method used in mapping the distribution of aquatic macrophytes relies heavily on field surveying by boat, with guidance and verification from aerial photographs. Color infrared aerial photographs were obtained a short time prior to field surveying to determine gross outlines of infestations and tentative identification of plants. Field surveying by boat during the height of the growing season (June through September) verified information derived from remote sensing and determined infestation boundaries and plant identifications not obtainable by remote sensing.

Plans for This Year: Obtain Director's approval for report and publish.

Number and Title: SC 87-070, Bacterial Influences on Ground-Water Chemistry

Cooperating Agency: U.S. Geological Survey

Principal Investigator: Francis H. Chapelle

Period of Investigation: October 1986 - October 1989

Objective: The objectives of the study are to: (1) provide a basic characterization of the bacteria present in Coastal Plain sediments including abundance and types and, (2) examine some imports of bacterial metabolism on the major-ion, carbon isotope, and oxygen isotope composition of ground water.

Approach: (1) Use fluoresent microscopy and cell-staining techniques to determine direct counts of total and viable bacteria per gram of sediment; (2) compare data obtained in (1) with a geologic characterization of sediments to determine how bacteria counts vary with sediments texture; (3) perform elemental analyses on lignite materials obtained from cores. In addition, Nuclear Magnetic Resonance spectroscopy will be used to compare the relative amounts of different hydrocarbon groups (alphatic, aromatic, polysacharride) present in lignitic materials; (4) based in part on the results of (3), a series of enrichment study (Wallis and Ladd, 1985) will be designed and performed using bacteria-containing core subsamples to inoculate each media.

In order to document microbial impacts on ground water quality:

(1) Select one or two well-defined flowpaths in the Cape Fear, Middendorf, and Black Creek aquifers near areas where cores for microbiologic analysis will be obtained. These flowpath segments will include 5-15 wells each. Water from each well will be scanned for the presence and concentration of volitile fatty acids, alcohols and other hydrocarbons. Samples for gas analysis of CH_4, N_2, CO_2, H_2S, and O_2 will also be obtained.

(2) Major and minor ion chemical analyses are presently available for many of the wells to be used. Some additional sampling for these constitutents may be necessary. Samples for determination of stable carbon isotope composition of dissolved carbonate species will be obtained.

(3) Presently available techniques of inverse ground water quality modeling will be used to assess the impacts of microbial activity on water quality. The role of microbial activity on the formation of high-bicarbonate ground water will be the primary focus of interest.

Plans for This Year: Sample core holes in Barnwell, Aiken, Sumter, and Horry Counties for bacterial abundance, CO_2 production, and isotopic composition of CO_2 gas and sedimentary organic material.

Number and Title: SC 87-071, Transport Simulation of Striped Bass Eggs

Cooperating Agency: South Carolina Electric and Gas Company
Duke Power Company
South Carolina Public Service Authority
South Carolina Wildlife and Marine Resources Department
South Carolina Department of Health and Environmental Control
South Carolina Water Resources Commission

Principal Investigator: Noel M. Hurley

Period of Investigation: March 1987 - October 1989

Objective: To determine and optimize hatching location of striped bass eggs in Congaree, Wateree, and Santee Rivers.

Approach: Use 1-D flow model (Branch) to simulate riverflow in study area and power Lagrangian Transport Model (LTM) to simulate transport and dispersion of striped bass eggs.

Plans for This Year: Complete project and write report.

Number and Title: SC 87-073, Geohydrologic Investigation of the Hazardous-Waste Landfill Near GSX Site

Cooperating Agency: South Carolina Public Service Authority

Principal Investigator: Ronald A. Burt

Period of Investigation: October 1987 - September 1990

Objectives: 1) Define the geohydrologic framework; 2) Characterize the water quality in aquifers, streams, and parts of Lake Marion; 3) Characterize the composition of sediments in streams and parts of Lake Marion; 4) Describe streamflow characteristics; 5) Describe and mathematically model the ground-water flow systems; and 6) Numerically simulate movement of a potential conservative contaminant.

Approach: Review existing information to identify data requirements and to characterize the wastes being landfilled. Install stream gaging stations and a rain gage. Collect field data on streamflow, lake flow patterns (dye plume studies), geohydrology (cores, geophysics, wells, piezometers, aquifer tests), water quality (chemical, benthic invertebrates), and sediment composition. Conceptualize and develop a mathematical model of the ground-water flow system and assess the potential for ground-water transport of contaminants.

Plans for This Year: Data collection will be completed with regard to the characterization of stream and lake flow, rainfall, surface-water quality, sediment composition, and the geologic framework. Reports covering these areas are anticipated this year. Ground-water hydrologic and water-quality data collection will continue.

Number and Title: SC 88-074, Piedmont Aquifer Yield Prediction

Cooperating Agency: South Carolina Water Resources Commission

Principal Investigator: Whitney J. Stringfield

Period of Investigation: December 1987 - September 1990

Objectives: To evaluate the utility of a variety of techniques for assessing the ground-water resources of a selected basin in the Piedmont. Also assess the availability of ground water in the basin using selected techniques and where possible, verify the availability with well production data.

Approach: (1) Select a small drainage basin in which to conduct the various ground-water exploration techniques as well as perform low-flow studies; (2) inventory wells in the basin; (3) perform lithologic-geomorphic terrain analysis; (4) perform remote sensing lineament mapping; (5) conduct surface-geophysical surveys; (6) analyze the results; develop a ground-water availability map and test it with well inventory data, and (8) evaluate exploration methods.

Plans for This Year: Digitize maps and data when they become available. Construct a preliminary model of ground-water flow in a cross section to test hypothesis. Continue to operate weather station. Check low-flow conditions of Hellers Creek.

Number and Title: SC 88-075, Savannah River Management Model

Cooperating Agency: South Carolina Water Resources Commission

Principal Investigator: Dale Johnson

Period of Investigation: April 1988 - September 1990

Objectives: To develop a basin-wide hydrologic model that can be used in real time to maximize the efficiency of water management in the basin.

Approach: Use existing data-collection stations, with some additions, to calibrate and verify stochastic and deterministic models of hydrologic processes.

Plans for This Year: (1) Implement PRMS, HSPF, HEC-5, and the Branch model for portions of the basin and begin calibration. (2) Investigate optimization methods. (3) Generate long-term daily inflow data for sub-basins. (4) Conduct a statistical study of inflows for use in establishing frequency of inflow discharges for use in long-term flow simulations.

Number and Title: SC 88-076, Cone Mills Toxic Waste Research

Cooperating Agency: U.S. Geological Survey

Principal Investigator: Glenn G. Patterson

Period of Investigation: August 1988 - June 1989

Objectives: Develop a plan of study for a research effort on the effect of matrix diffusion on chromium transport, and bacterial mediation of oxidation products of organics in relation to chromium reduction in anaerobic subsurface environments.

Approach: Assemble and assimilate all available data on the site and on the process to be investigated. Gather additional field data as needed. Develop work plan in consultation with other specialist.

Plans for This Year: Assemble and assimilate data. Develop approved, detailed work plan.

SOURCES OF U.S. GEOLOGICAL SURVEY PUBLICATIONS AND INFORMATION

Water-Data Program

Water data are collected at thousands of locations throughout the Nation by the Geological Survey to monitor stream discharge (flow) and stage (height), reservoir and lake storage, ground-water levels, well and spring discharge, and the quality of surface and ground water. These data provide a continuing record of the quantity and quality of the Nation's surface and ground-water resources, and thus provide the hydrologic information needed by Federal, State, and local agencies and the private sector for the development and management of land and water resources. All data collected are stored in the Survey's National Water Data Storage and Retrieval System (see WATSTORE for additional information) and also are published by water year for each State in a publication series entitled "U.S. Geological Survey Water-Data Reports". Information about the Water-Data Program can be obtained by writing:

Assistant Chief Hydrologist for Operations
441 National Center
Reston, Virginia 22092

or from the District Chief of the State of interest.

NAWDEX

The National Water Data Exchange was established to assist users of water data to identify, locate, and acquire needed data. It provides a nationwide service for indexing and describing the characteristics of data available from the entire spectrum of data-collection activities throughout the Federal and non-Federal water-data community. NAWDEX maintains two data bases: (1) a Water-Data Sources Directory, which identifies organizations that are sources of water and water-related data and locations within these organizations from which data may be obtained, and (2) a Master-Data Index of data collection sites. For services or additional information, contact:

National Water Data Exchange
U.S. Geological Survey
421 National Center
Reston, Virginia 22092
(703) 860-6031

WATSTORE

Access to all types of water data is through the National Water Data Storage and Retrieval System. Data are grouped and stored on the basis of common characteristics and data-collection frequencies. These data are organized into seven files. They are: (1) Station Header File, (2) Ground-Water Site Inventory File, (3) Water-Use File, (4) Daily-Values File, (5) Peak-Flow File, (6) Water-Quality File, and (7) Unit-Values File. All types of water data can be retrieved through the central computer facilities in Reston, Virginia from a number of localities nationwide. The requestor is charged a minimal fee plus the actual computer cost incurred in retrieving the data. Cost estimates and information about WATSTORE can be obtained from Water Resources Division district offices and from:

Chief Hydrologist
U.S. Geological Survey
437 National Center
Reston, Virginia 22092

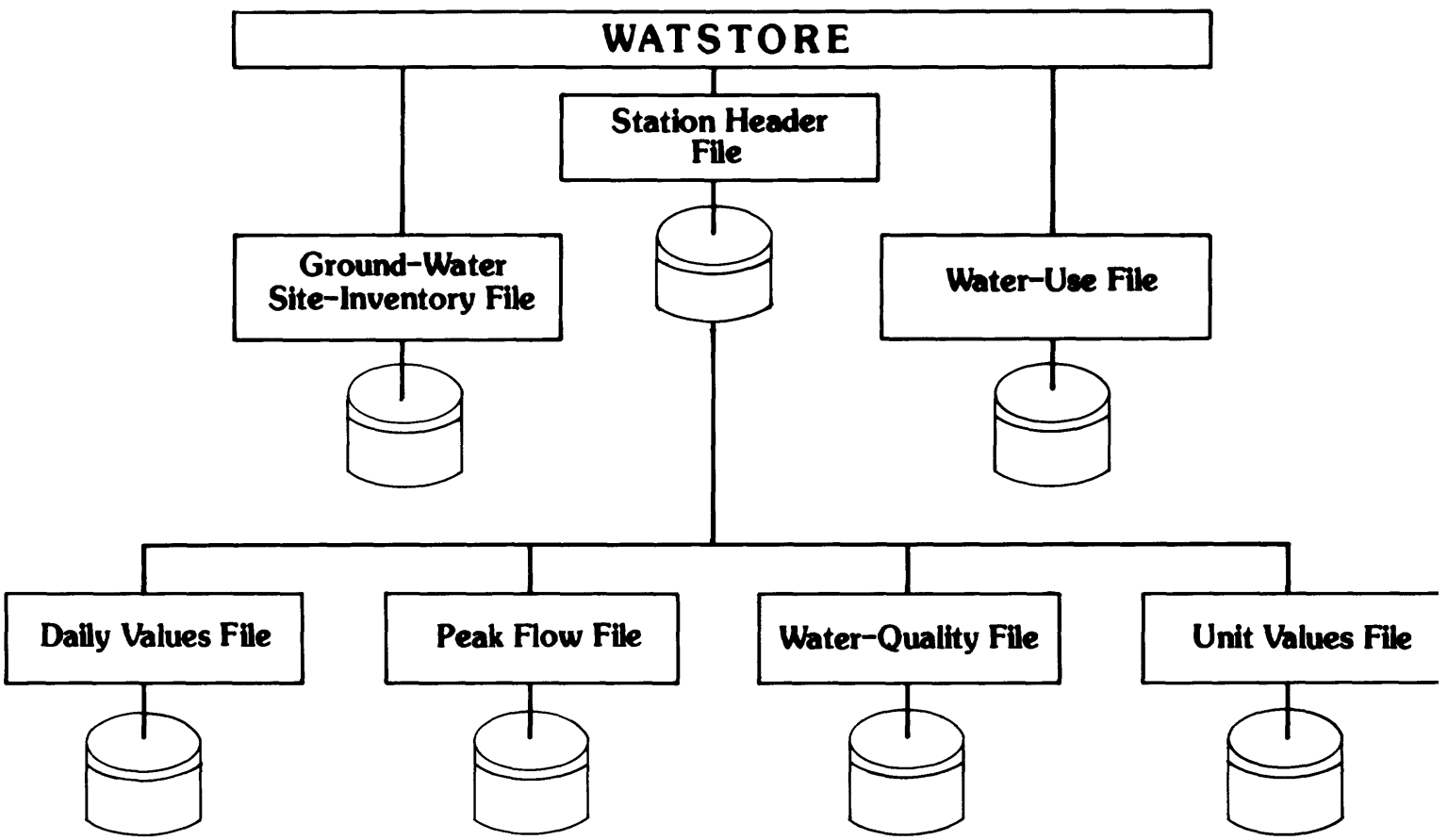


Figure 8.--Organization in WATSTORE.

Public Inquiries Office

The Public Inquiries Office provides general information about the programs of the Geological Survey and its reports and maps. The Public Inquiries Office answers requests made in person, by mail, or by telephone; recommend publications relating to specific subjects and areas; and refers requests for specific technical information to the appropriate people. The Public Inquires Office sells limited quantities of published maps and books over the counter and distribute circulars, non-technical publications, catalogs and indexes free of charge. This office is also a depository for Open-File Reports. The address is:

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Professional Papers, Bulletins, Water-Supply Papers, the Geological Survey's Annual Report, and other text products pertaining to South Carolina may be obtained by writing:

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REPORTS OF INVESTIGATIONS--SELECTED REFERENCES

Because the number of publications pertaining to water resources in South Carolina is large, the publications listed below were selected to show the types of information available to those interested in or in need of water facts. Many of these publications are available for inspection at the offices listed in the front of this report and at large public and university libraries.

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