CURRENT WATER-RESOURCES ACTIVITIES IN OHIO, 1989

Compiled by S. M. Hindall

U.S. GEOLOGICAL SURVEY

Open-File Report 89-58

Columbus, Ohio

1989

DEPARTMENT OF THE INTERIOR

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U.S. GEOLOGICAL SURVEY

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FOREWORD

The U.S. Geological Survey, Water Resources Division, has been active in water-resources investigations in Ohio for more than 70 years. During that time, volumes of data have been collected, numerous investigations completed, and more than 150 reports published on various aspects of Ohio's water resources. Many changes have taken place in the Geological Survey and the Water Resources Division since its formation in 1879, but our mission remains firm--"to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States." As the water resources of Ohio become increasingly important to its economy and quality of life, the Ohio District's role as an unbiased water-resources investigation and data-collection agency also becomes increasingly important.

Over the years the District's programs have reflected the needs of the people and priority issues of the times. We have evolved from the early days of hydrologic data collection and ground- and surface-water reconnaissance studies into flood and low-flow studies, projects associated with energy production, and finally, into studies relating to toxic- and hazardous-waste disposal and ground-water contamination. Through all of this, the district has continued to expend a considerable amount of its resources in collecting and disseminating basic data on surface water, ground water, water quality, and sediment.

Our present program centers on four areas: basic hydrologic data collection, surface-water modeling, coal-mine reclamation, and ground-water assessment. Of the four areas, basic hydrologic data collection is by far the largest in terms of numbers of employees involved and funds expended. Ground-water assessment is the leader in number of projects. In all of the above areas, chemical quality of the resource is an important factor. In fact, I believe that water quality will become the overriding concern in all water-resources investigations well into the 1990's and beyond. The use of computers and digital modeling will continue to be an integral part of all investigations.

Within the next few years, a growth of new projects will be directed toward contamination of ground and surface waters and associated effects on hydrologic systems. To meet this need, the district will correspondingly increase its technical expertise in the fields of geohydrology and organic geochemistry. I look forward to the U.S. Geological Survey's active role in these activities and a continuing relationship with State, county, local, and other Federal agencies in studying the water-resources issues of Ohio.

Steven M. Hindall,
District Chief

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ABSTRACT

The mission of the U.S. Geological Survey's Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the United States. This report summarizes the Division's program in Ohio in 1989.

The work of the Ohio District is carried out through the District office in Columbus and a field office in New Philadelphia. Collection of basic data needed for continuing determination and evaluation of the quantity, quality, and use of Ohio's water resources is the responsibility of the District's Hydrologic Surveillance Section. The Hydrologic Investigations Section conducts analytical and interpretive water-resources appraisals describing the occurrence, availability, physical, chemical, and biological characteristics of surface water and ground water, and precipitation.

In addition to introductory material describing the structure of the Ohio District, information is presented on current projects, sites at which basic surface- and ground-water data are collected, and reports on Ohio's water resources published by the U.S. Geological Survey and cooperating agencies.

INTRODUCTION

Origin of the U.S. Geological Survey

The U.S. Geological Survey was established by an act of Congress on March 3, 1879, to provide a permanent Federal agency to conduct the systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of national domain." An integral part of that original mission includes publishing and disseminating the earth-science information needed to understand, to plan the use of, and to manage the Nation's energy, land, mineral, and water resources.

Since 1879, the research and fact-finding role of the Survey has grown and been modified to meet the changing needs of the Nation it serves. As part of that evolution, the Survey has become the Federal Government's largest earth-science research agency, the Nation's largest civilian mapmaking agency, the primary source of data on the Nation's surface- and ground-water resources, and the employer of the largest number of professional

earth scientists. Today's programs serve a diversity of needs and users. Programs include:

- Conducting detailed assessments of the energy and mineral potential of the Nation's land and offshore areas.
- Investigating and issuing warnings of earthquakes, volcanic eruptions, landslides, and other geologic and hydrologic hazards.
- Conducting research on the geologic structure of the Nation.
- Studying the geologic features, structure, processes, and history of the other planets of our solar system.
- Conducting topographic surveys of the Nation and preparing topographic and thematic maps and related cartographic products.
- Developing and producing digital cartographic data bases and products.
- Collecting data on a routine basis to determine the quantity, quality, and use of surface water and ground water.
- Conducting water-resources appraisals in order to describe the consequences of alternative plans for developing land and water resources.
- Conducting research in hydraulics and hydrology, and coordinating all Federal water-data acquisition.
- Using remotely sensed data to develop new cartographic, geologic, and hydrologic research techniques for natural resources planning and management.
- Providing earth-science information through an extensive publications program and a network of public access points.

Along with its continuing commitment to meet the growing and changing earth-science needs of the Nation, the Survey remains dedicated to its original mission to collect, analyze, interpret, publish, and disseminate information about the natural resources of the Nation--providing "Earth Science in the Public Service."

Basic Mission and Program of the Water Resources Division

The mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the optimum utilization and management of the Nation's water resources for the overall benefit of the people of the United States.

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 interpretive water-resources appraisals describing the occurrence, availability, and the physical, chemical, and biological characteristics of surface water 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 the 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.

- Administering the provisions of the Water Resources Research Act of 1984, which include the State Water Resources Research Institutes and the Research Grants and Contracts Programs.

- Supporting the provisions of the National Environmental Policy Act of 1969 and managing the Geological Survey conduct of natural resources surveys in response to the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Act) of 1980.

Organization and Activities of the Ohio District

Organization

The Ohio District is part of the U.S. Department of the Interior. Geological Survey. Water Resources Division. There are a total of 43 districts throughout the Country located in each individual State, with the exception of three districts that include two or more States.

The Ohio District is comprised of the district office in Columbus and a field office in New Philadelphia. There are two major sections in the district office--Hydrologic Investigations and Hydrologic Surveillance. The New Philadelphia field office is part of the Hydrologic Surveillance section.

Steven M. Hindall, District Chief, is responsible for the overall operation and management of the district, and is assisted by Section Chiefs Richard V. Swisshelm, Jr., and Harold L. Shindel. To carry out the diversity of tasks in support of its varied program, the Ohio District's additional 50-member staff consists of hydrologists, engineers, hydrologic technicians, and other administrative, clerical, and support personnel.

The chart on the following page depicts the organization of the Ohio District and explains the functions of the individual sections and units within those sections.

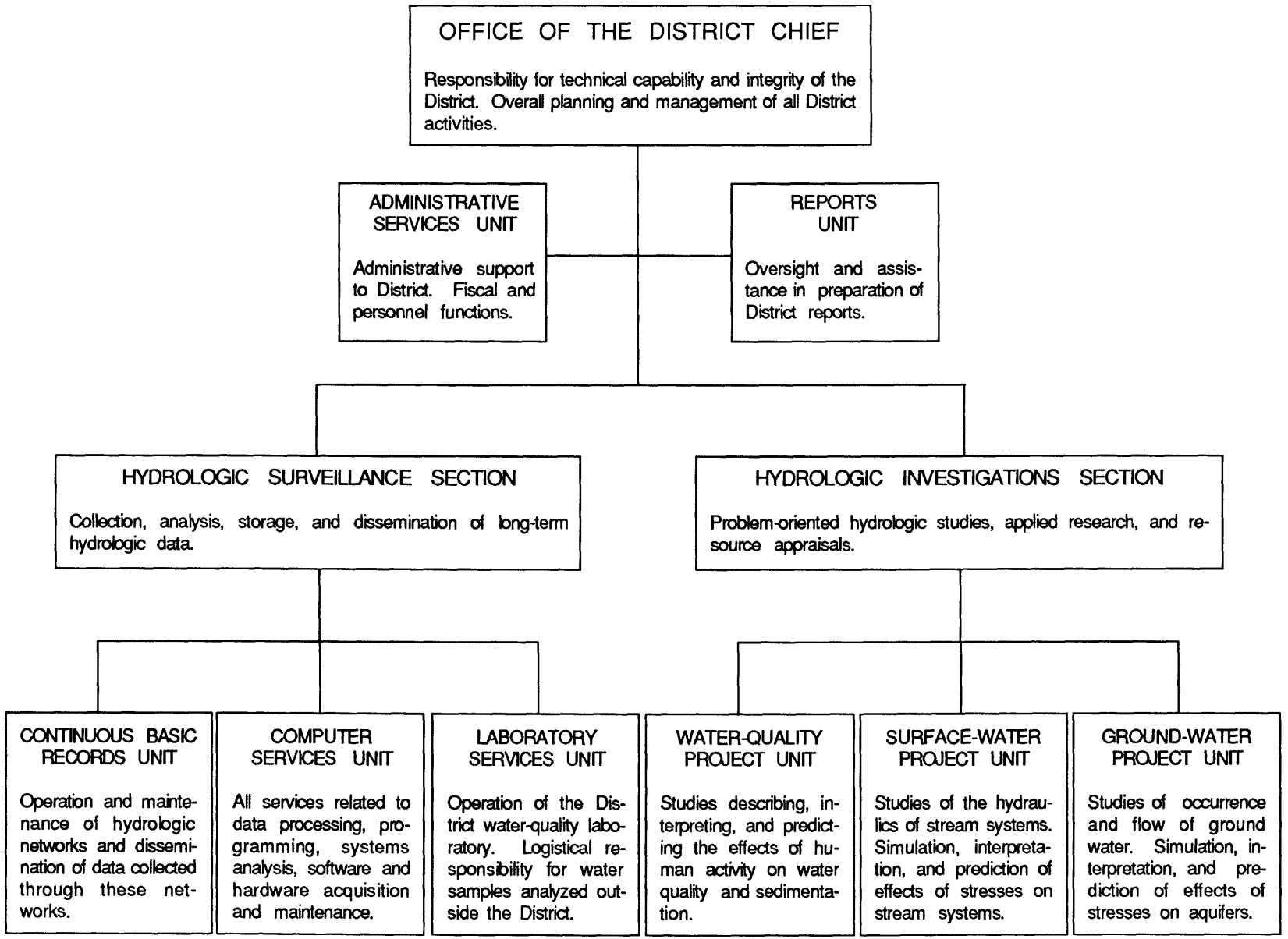
Types of Funding and Cooperating Agencies

Funds to support the work performed by the Ohio District, Water Resources Division, are derived from three principal sources:

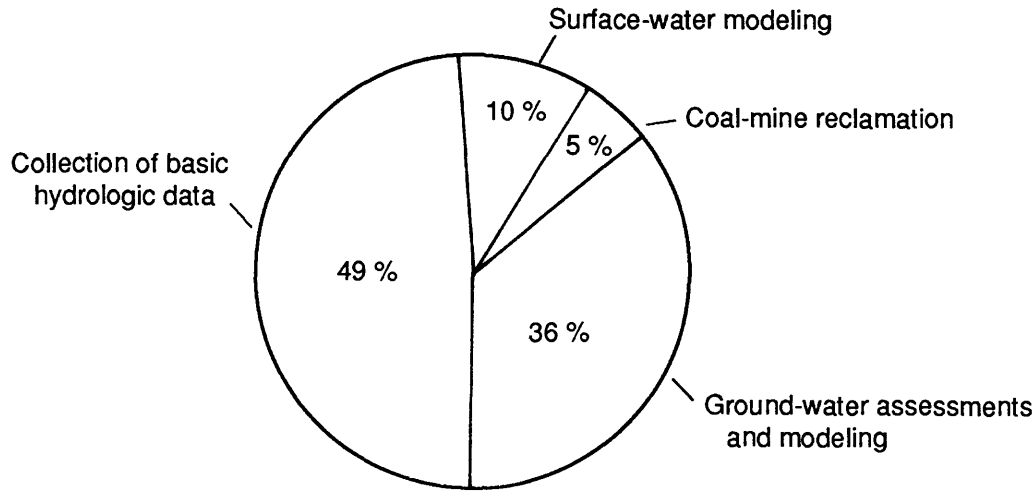
- Federal Program--Funds for the Federal Program are appropriated by the Congress, and are specifically identified in the annual Geological Survey budget. These funds are used to support research, data collection, high-priority topical programs including Regional Aquifer Systems Analysis (RASA), National Water Quality Assessment program (NAWQA), climate research, the coordination of all Federal programs related to collection of water data, and internal support services.

- Federal-State Cooperative Program--Federal funds are appropriated by the Congress and used to match those furnished by State and other tax-supported agencies on an up-to-50-50 basis. These funds are used for a variety of hydrologic data-collection activities and water-resources investigations in which the Water Resources Division represents the national responsibilities, and the cooperating agencies represent State and local interests.

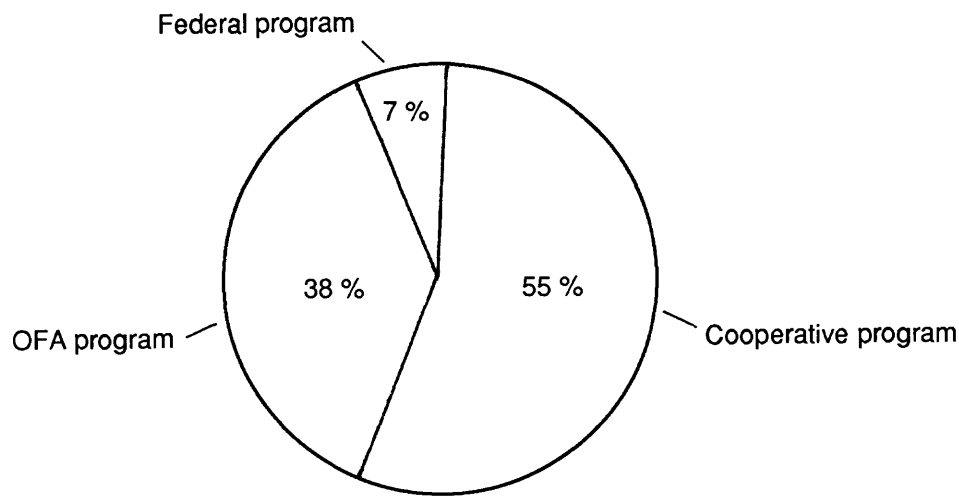
- Other Federal Agencies (OFA) Program--In this program, the funds are transferred to the Geological Survey as reimbursement for work performed at the request of another Federal agency.


OFFICE OF THE DISTRICT CHIEF
Responsibility for technical capability and integrity of the District. Overall planning and management of all District activities.
ADMINISTRATIVE SERVICES UNIT
Administrative support to District. Fiscal and personnel functions.
REPORTS UNIT
Oversight and assistance in preparation of District reports.
HYDROLOGIC SURVEILLANCE SECTION
Collection, analysis, storage, and dissemination of long-term hydrologic data.
HYDROLOGIC INVESTIGATIONS SECTION
Problem-oriented hydrologic studies, applied research, and resource appraisals.
CONTINUOUS BASIC RECORDS UNIT
Operation and maintenance of hydrologic networks and dissemination of data collected through these networks.
COMPUTER SERVICES UNIT
All services related to data processing, programming, systems analysis, software and hardware acquisition and maintenance.
LABORATORY SERVICES UNIT
Operation of the District water-quality laboratory. Logistical responsibility for water samples analyzed outside the District.
WATER-QUALITY PROJECT UNIT
Studies describing, interpreting, and predicting the effects of human activity on water quality and sedimentation.
SURFACE-WATER PROJECT UNIT
Studies of the hydraulics of stream systems. Simulation, interpretation, and prediction of effects of stresses on stream systems.
GROUND-WATER PROJECT UNIT
Studies of occurrence and flow of ground water. Simulation, interpretation, and prediction of effects of stresses on aquifers.

The diagram below shows the percentage of the District's projects for fiscal year 1989 in each of the broad categories of collection of basic hydrologic data, surface-water modeling, ground-water assessment and modeling, and coal-mine reclamation.



The programs are supported by funds provided by State and local units of government and Federal funds from the U.S. Geological Survey and other Federal agencies (OFA program). About 80 percent of the Federal funds contributed by the Geological Survey are used to match, on an up-to-50-50 basis, the funds contributed by the State and other local units of government. In fiscal year 1989, the total financial support for all programs in Ohio is about 3.2 million dollars and is distributed as follows:



Public-Information and Public-Service Activities

The activities of the Ohio district staff are not confined to project work. Much of the daily activity of the staff is devoted to answering requests from landowners, public officials, and business concerns on a wide range of hydrologic and geologic topics. For example, the Ohio district spent 262 hours answering 565 telephone and mail inquiries during 1988.

District personnel also are involved in education. Staff hydrologists and hydrologic technicians have served as instructors and guest lecturers for water-resources courses at Ohio State University, Ohio University, Central State University, and U.S. Geological Survey-sponsored training courses. The district also has sponsored seminars and information-exchange meetings with themes ranging from well design to political and social water-resources issues in Ohio.

Equally important is the involvement of district staff in work groups, committees, and task forces of professional societies and other government agencies. Among these groups are:

- Technical Committee and Toxic Strategy Subcommittee of the Ohio River Valley Water Sanitation Commission (ORSANCO).
- Public Advisory Groups of the Ohio Environmental Protection Agency.
- Board of Directors of Water Management Association of Ohio (WMAO).
- Program Review Panel for the Ohio State University Water Resources Center.
- Steering Committee for the Ohio Water Seminar Luncheon Series.
- Board of Directors and President of the Ohio Lake Management Society.
- President of the Ohio State section of American Institute of Hydrology.
- The Ohio State University Student Chapter of the American Society of Civil Engineers (advisory role as Student Contact Member).
- Planning committees for technical conferences and annual meetings.

Summary of Water Conditions in Ohio

The availability of water has been an important factor in Ohio's development. Ohio's principal streams (fig. 1) were the settlers' first avenues of transportation and their first sources of power for manufacturing. Shallow, hand-dug wells provided water to a growing farm population. The construction of canals beginning in 1825 continued to encourage the growth of cities and industries and to stimulate agricultural production. Today, Ohio is still characterized by a diverse economy in which water resources play a vital part.

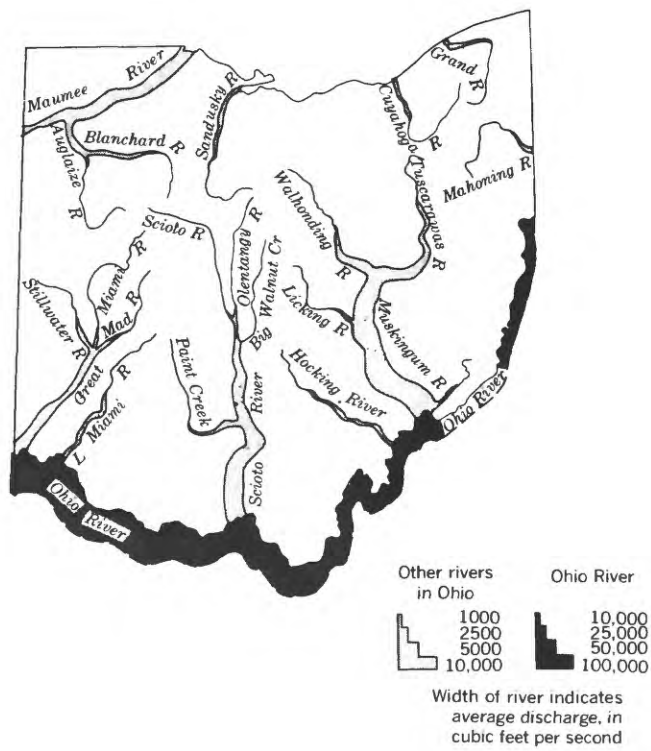


Figure 1.--Average discharge of principal streams in Ohio.

Ohio receives about 38 inches of precipitation annually. About 10 inches runs off immediately, 2 inches is retained at or near the surface and evaporates or transpires, and 26 inches enters the ground. Of the 26 inches that enters the ground, 20 inches is retained in the unsaturated zone and is later lost by evapotranspiration. The remaining 6 inches reaches the water table. Of this 6 inches, 2 inches is eventually discharged to streams, and the rest is lost by evapotranspiration or consumptive use.

Ohio's water problems tend to be localized. Generally, these problems involve excess water (flooding or poor drainage) or water quality. Non-point source (NPS) contamination of surface and ground water is becoming a significant problem in Ohio as more is being learned of the effects of NPS on water-resource systems.

Ohio has serious local flooding nearly every year. Most Ohio floods are either flash floods resulting from intense summer thunderstorms or large-stream floods resulting from a combination of rain and snowmelt. Accelerated erosion of bare ground and streambanks and deposition of sediment in stream channels, culverts, and drainage ditches are negative side effects of flooding. Five projects are active in the Ohio District in 1989 that directly or indirectly contribute to our knowledge of flooding and (or) related sedimentation problems in the State.

The focus of concern about Ohio's water quality in recent years has been on waste disposal and its effects on ground-water quality. Despite the predominance of surface water in terms of total withdrawal, the importance of ground water to Ohio cannot be overlooked. Nearly 80 percent of the public water-supply systems in the State depend to some extent on ground water as a source, and 42 percent of the Ohio population uses ground water as their primary supply. The principal aquifers in Ohio are the unconsolidated deposits of coarse- or fine-grained sediments and sedimentary rocks of shaly sandstone and (or) limestone (carbonate). Figure 2 shows the geographic distribution of the principal aquifers in Ohio.

Of the nine ground-water projects active in the Ohio District in 1989, three deal directly or indirectly with waste-disposal. Each is a scientific study to describe local ground-water levels and flow, and to provide baseline water-quality data. (The other six ground-water projects are resource appraisals.)

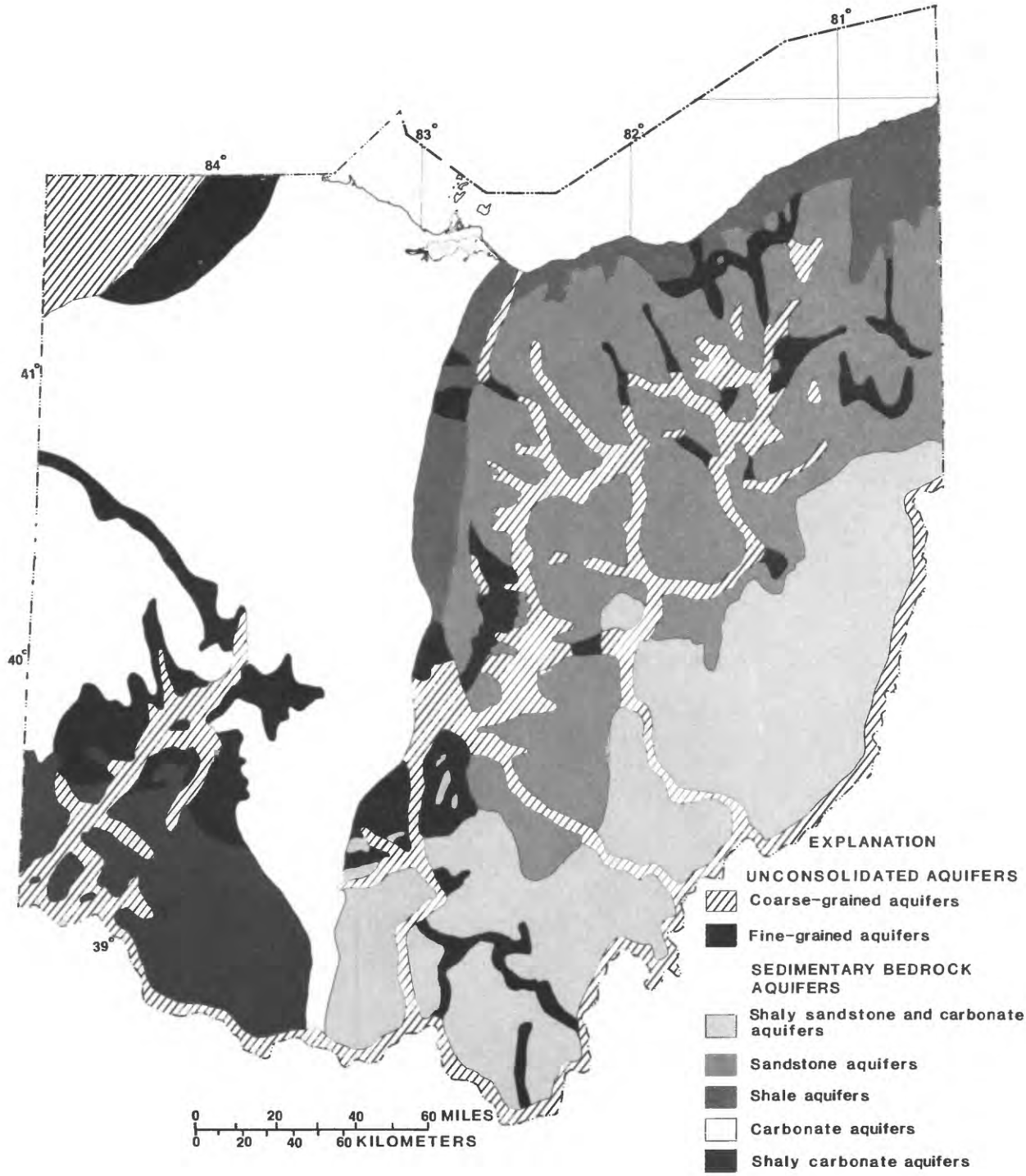


Figure 2.--Geographic distribution of principal aquifers in Ohio.

INFORMATION CONTAINED IN THIS REPORT

Information is presented in the remainder of this report in four parts: (1) A listing and brief description of current projects, (2) a listing of surface-water hydrologic data stations, (3) a listing of ground-water hydrologic data stations, and (4) selected references on Ohio hydrology. The first part contains information on the status of all projects in which there has been activity during 1989. Further information concerning project activities is available from the project leader or from Richard V. Swisshelm, Jr., Chief, Hydrologic Investigations Section. The second and third parts contain tables showing station numbers, station names, and types of data collected. Further information on statewide station activities, unpublished records, or provisional data prior to publication is available from Harold L. Shindel, Chief, Hydrologic Surveillance Section. The fourth part is a selected list of reports issued by the U.S. Geological Survey and its cooperating agencies concerning hydrologic investigations in Ohio. Further information on these reports is available from Ann E. Arnett, Information Officer for the Ohio district.

These contact people can be reached at:

District Office
Water Resources Division
U.S. Geological Survey
975 W. Third Avenue
Columbus, OH 43212
(614) 469-5553

Information about data-collection activities in northeastern Ohio also can be obtained by contacting:

Lowell Trimble
New Philadelphia Field Office
Water Resources Division
U.S. Geological Survey
551 Wabash Avenue, P.O. Box 272
New Philadelphia, OH 44663
(216) 343-2343

OTHER INFORMATION AVAILABLE

The U.S. Geological Survey publishes an annual series of reports titled "Water Resources Data--Ohio," in which the hydrologic data collected during each water year are presented. Information about these reports and how to obtain them is available from the district office at the address and phone number given above.

Flood-prone-area maps for selected parts of Ohio also are available from the district office. These maps were prepared in cooperation with the U.S. Department of Housing and Urban Development, Federal Insurance Administration, to serve as guides for public agencies and private citizens concerned with present and future land development. The maps were prepared on standard 7-1/2 minute topographic quadrangles, and show the approximate area subject to inundation by a 100-year flood.

CURRENT PROJECTS

The project descriptions that follow show the project number, title, period of the project, cooperating agencies, project leader, purpose of the project, and progress and significant results.

SURFACE-WATER STATIONS
(OH001)

Period of Project:
Continuous since October 1915

Project Leader:
Harold L. Shindel

Cooperators:
Ohio Department of Natural Resources
City of Columbus
Miami Conservancy District
Ohio Environmental Protection Agency
City of Canton
U.S. Army Corps of Engineers
Seneca Soil and Water District
Ross County
City of Fremont
Toledo Metropolitan Area Council of Governments
University of Cincinnati
Eastgate Development
City of Lima
City of Akron

Purpose: To provide a surface-water data base through collection, analysis, and publication of records for gaging stations and selected sites along streams, lakes, and reservoirs throughout Ohio. The gaging-station network is operated in cooperation with other Federal, State, and local agencies. The surface-water data base provides information for research purposes of surveillance, planning, design, hazards warning, accounting systems, operation, and management in various water-related fields.

Progress and significant results: Field data were collected on schedule and prepared for publication (1987 water year). Network maintenance was continued, including modernization equipment in places to improve record quality. Modifications to the network, such as additions or deletions of stations or data-collecting activity, were made in response to program's needs.

GROUND-WATER STATIONS
(OH002)

Period of Project:
Continuous since January 1938

Project Leader:
Stephen A. Vivian

Cooperator:
Ohio Department of Natural Resources

Purpose: To observe the effects on ground-water quantity and quality exerted by such factors as climatic variations and withdrawal patterns. Water-level data are collected to provide a data base against which short- and long-term fluctuations can be compared for proper planning and management.

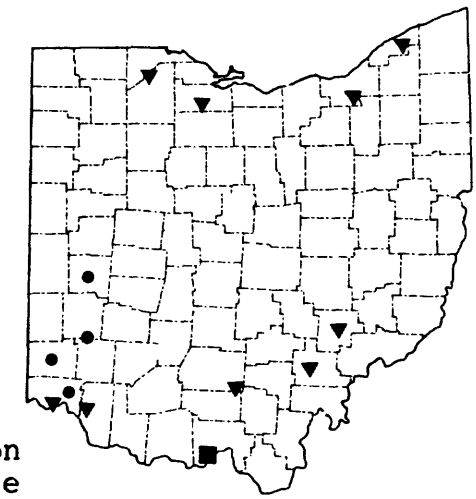
Progress and significant results: Field data were collected and processed on schedule. Network currently consists of 10 sites with continuous recorders, 14 sites with periodic measurements, and 88 state-operated sites with continuous recorders.

WATER-QUALITY STATIONS
(OH003)

Period of Project:
Continuous since January 1946

Project Leader:
Betty B. Palcsak

Cooperators:
Miami Conservancy District
Ohio Environmental Protection Agency



Purpose: To collect, analyze, and publish water-quality records for selected sites in Ohio in cooperation with State and local agencies. The records contribute to a national water-quality data base requisite to nationwide and regional planning and action programs.

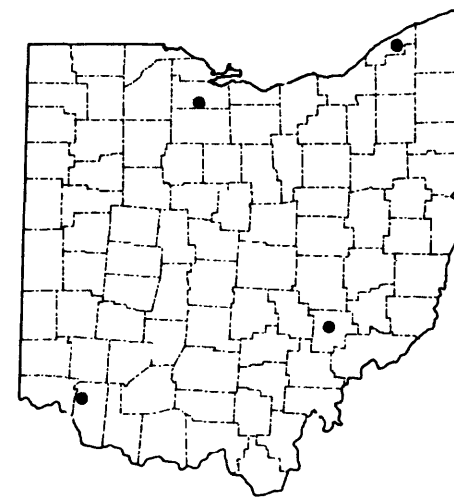
Progress and significant results: Surface-water stations operated by the U.S. Geological Survey consisted of nine NASQAN stations and one Benchmark station in the water-quality network in the 1988 water year. Four Miami Conservancy District ground-water sites also were sampled. The Geological Survey collects a water sample at the NASQAN sites for the Ohio Environmental Protection Agency for the determination of chemical oxygen demand.

SEDIMENT STATIONS
(OH004)

Period of Project:
Continuous since July 1970

Project Leader:
Jesse H. Klingler

Cooperator:
Ohio Department of Natural Resources



Purpose: To provide a data base needed to assess sedimentation characteristics of drainage areas required for planning and management of State and Federal programs. The data also are needed to evaluate effectiveness of Ohio House Bill 513, which concerns the abatement of sediment pollution in agricultural and urban situations.

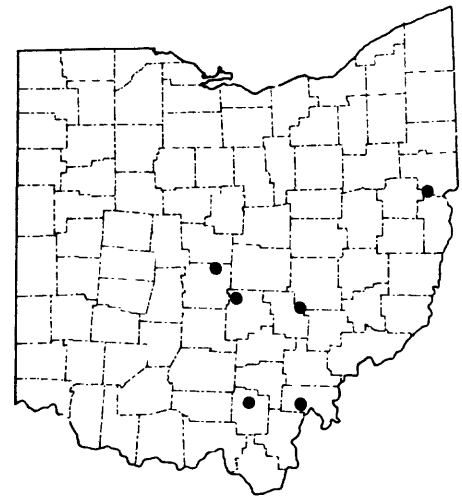
Progress and significant results: A network of four daily sediment stations representative of Ohio's major physiographic provinces is being operated to provide spatial and temporal averages of concentration, discharge, and particle-size distribution of suspended sediment carried by major streams. Suspended-sediment data also were collected from finite-duration studies in selected agricultural, mined, and urban areas. All 1988 data were collected on schedule.

FLOOD INVESTIGATIONS
(OH006)

Period of Project:
March 1984 (reestablished)
through October 1987.

Project Leader:
K. Scott Jackson

Cooperator:
Federal Emergency Management
Agency (FEMA)



Purpose: The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 provide for the operation of a flood insurance program. The Federal Emergency Management Agency (FEMA) needs flood studies in selected areas to determine applicable flood insurance premium rates.

The purpose of this project is to conduct the necessary hydrologic and hydraulic evaluations and studies of areas assigned by FEMA and to present the results in an appropriate format.

Progress and significant results: Work has been completed on FEMA-FIA Type 15 flood-insurance studies at Crooksville, Perry County, and London, Madison County, Ohio. Ten limited-detail studies have been completed. The areas are: St. Marys, Auglaize County; Darbyville, Pickaway County; Jewett, Harrison County; Amesville, Athens County; Middlefield. Geauga County; Jeffersonville, Fayette County; Belle Valley, Noble County; Sabina, Clinton County; Lynchburg, Highland County; and Hamden, Vinton County.

New limited-detail study areas are Salineville, Columbiana County; Coalton, Jackson County; Rutland, Meigs County; Roseville, Perry County; Westerville, Franklin County; and Pickerington, Fairfield County.

WATER USE IN OHIO
(OH007)

Period of Project:
Continuous since October 1977

Project Leader:
Vance E. Nichols

Cooperator:
Ohio Department of Natural Resources

Purpose: To establish an effective and coordinated program for collecting, storing, accessing, and disseminating water-use data. The data are organized to be compatible with a national data base for water use. In Ohio, there is a demonstrated need for local and statewide water-use information that is consistent with regard to definitions, standards, and methods of presentation.

Progress and significant results: A U.S. Geological Survey Fact Sheet, "Water Withdrawals by Thermoelectric Power Plants and Public Water Suppliers in Ohio, 1982," was published. Public-water-supply, commercial, and industrial data were put into the new version of a State Water-Use data base. Quality assurance and quality control are being performed on entered data. A U.S. Geological Survey Water-Resources Investigations Report on public water supply in Ohio, 1985, is in review.

HYDRAULICS OF RIVER VALLEYS AND BRIDGE SITES
(OH010)

Period of Project:
Continuous since June 1963

Project Leader:
G. F. Koltun

Cooperator:
Ohio Department of Transportation

Purpose: To evaluate the hydraulic effects of proposed or existing bridges and highway fills at selected locations. Such structures decrease the capacity of river valleys for conveying floodwaters, and in turn may cause backwater and excessive upstream flooding. This project also provides information to highway engineers on miscellaneous hydrologic topics related to the design or maintenance of highway properties.

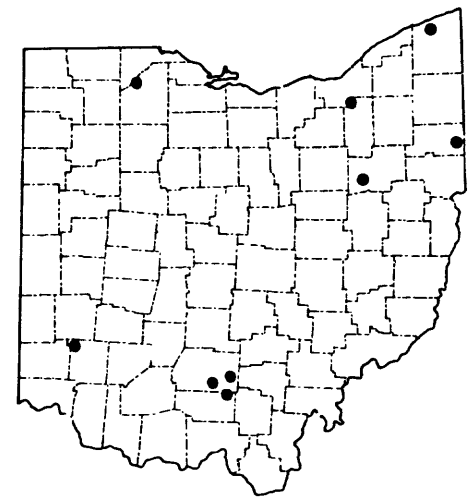
Progress and significant results: Monitoring of discharge from conventional sand and gravel fill and geotextile longitudinal highway drains continues. The conventional drain generally exhibits a quicker, more peaked response following a rain event. Total volume discharged from the geotextile connected drain in a 36-hour period following a rain event is generally appreciably greater than that discharged through the conventional drain system.

AUTOMATIC MEASUREMENT OF TEMPERATURE, SPECIFIC CONDUCTANCE, DISSOLVED OXYGEN AND pH IN SELECTED STREAMS IN OHIO (OH042)

Period of Project:
Continuous (re-established October 1985)

Project Leader:
Max S. Katzenbach

Cooperators:
Ohio Department of Natural Resources
Ross County



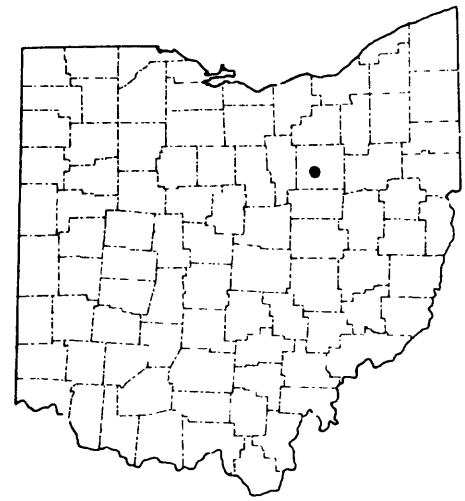
Purpose: (1) To continuously collect stream-temperature, dissolved-oxygen, specific-conductance and pH data, which will serve (either as direct or surrogate) indicators of water-quality conditions in analyses conducted by the U.S. Geological Survey and State agencies to determine the impact and severity of man's influence on surface waters; and (2) provide relevant standardized data collected continously for comprehensive study by the U.S. Geological Survey and other agencies.

Progress and significant results: Data collection and processing continued at all 9 stations. Five stations have been added to real-time data network. Modifications to the network, such as additions or deletions of stations, were made in response to program's needs.

GLACIAL VALLEY AQUIFERS IN NORTHEASTERN OHIO
(OH066)

Period of Project:
March 1982 to September 1989

Project Leader:
Kevin J. Breen

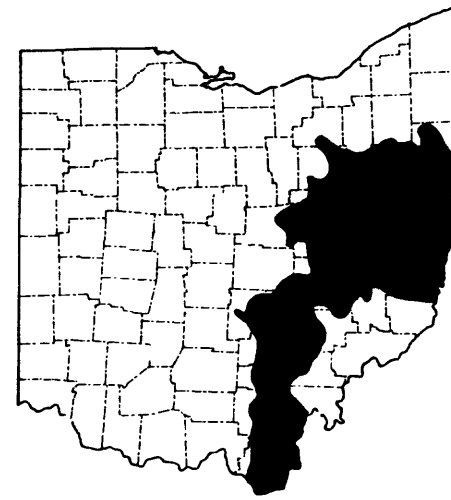


Purpose: To obtain a better understanding and definition of the ground-water flow characteristics of a glacial aquifer west of Wooster, Ohio, as part of the Northeast Glacial Aquifers Regional Aquifer System Analysis study. Emphasis is placed on determining the contribution to pumping wells from stream infiltration and surrounding bedrock. Use will be made of stream and aquifer head relation in combination with computer simulations of flow. Isotopic and inorganic-chemical characteristics of water also will be analyzed.

Progress and significant results: Two summary reports are in preparation. The first is titled "Geochemistry of the Stratified-Drift Aquifer in Killbuck Creek Valley West of Wooster, Ohio." This report describes the use of major-ion geochemistry to demonstrate that upward and lateral ground-water flow from bedrock can contribute more recharge to tne drift aquifer than has generally been assumed in the glaciated northeastern United States. The report also describes an inorganic and isotopic chemistry model that can explain the excessive dissolved-iron concentrations in stratified-drift aquifers.

The second report will describe the hydrology of the Killbuck Creek Valley. The report summarizes water-level data from nearly thirty wells (including wellpoints driven into the streambed), pumpage data, and stream seepage data. The report presents discussion of three-dimensional ground-water flow simulations.

QUALITY OF SURFACE WATER AND GROUND WATER IN ACTIVE COAL MINING AREAS OF OHIO
(OH084)



Period of Project:
July 1985 to October 1992

Project Leader:
A. C. Sedam

Cooperator:
Ohio Department of Natural Resources, Division of Reclamation

Purpose: The Ohio Department of Natural Resources needs baseline water-quality data on ground water and surface water in the active coal mining areas of Ohio. These data will be used for surface mining permit application and compliance and to assess the impact of present and future mining and reclamation. Twenty-one basins in southeastern Ohio will be investigated and monitored during a 7-year period.

Progress and significant results: The following basins were intensely investigated in 1985-86:

Stillwater Creek
Symmes/Ice/Indian Guyan Creeks
Moxahala Creek
Little Beaver Creek
McMahon/Captina/Sunfish Creeks.

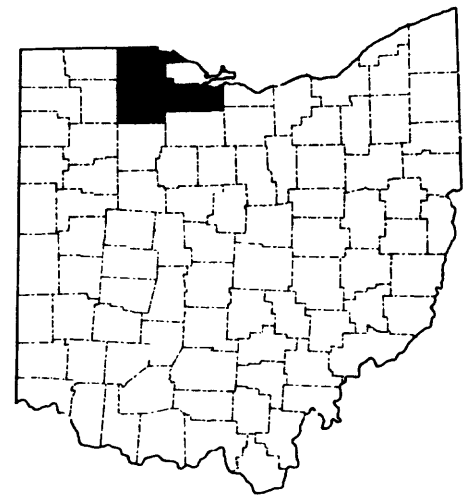
Results of this work are presented in the report "Geologic Setting and Water Quality of Selected Basins in the Active Coal Mining Areas of Ohio, June 1985 through December 1986," by A. L. Jones.

Current (1987-88) work includes intensive investigation of the following basins:

Sandy Creek
Middle Tuscarawas River/Sugar Creek
Lower Tuscarawas River
Short Creek/Wheeling Creek
Upper Wills Creek
Upper Raccoon Creek.

A basin which has been intensely investigated includes the collection of five-to-ten additional surface-water samples, four ground-water samples, and the definition of the approximate location and extent of a productive shallow aquifer in the basin. A network of 41 long-term surface-water sites (sampled twice yearly) is also distributed throughout the study area.

NORTHWESTERN OHIO GROUND WATER
(OH085)



Period of Project:
October 1985 through
September 1989

Project Leader:
Kevin J. Breen

Cooperators:
Wood County
Lucas County
Sandusky County

Purpose: The County planners and health officials of Lucas, Sandusky, and Wood Counties, in northwestern Ohio, are faced with increasing concerns relating to contamination and use of their ground-water resources. A regional ground-water network needs to be established to inventory in detail the location of wells and to provide geohydrologic data, aquifer-head data, and ground-water-quality baseline information.

The objective of this study is to assess the ground-water resources of Lucas, Wood, and Sandusky Counties, and to (1) describe the regional hydrogeologic framework of the carbonate aquifer; (2) describe the hydrogeologic framework of selected Pleistocene-age surficial aquifers; (3) define the direction of ground-water movement; (4) identify factors affecting ground-water quality in carbonate and surficial unconsolidated deposits.

Progress and significant results: A network of 350 wells has been established to monitor water levels in the Silurian-Devonian carbonate (dolomite) aquifer. Seventeen wells have been located or installed as part of the water-level and water-quality network in the sandhills region of Lucas County.

A synoptic survey of ground-water levels in the carbonate aquifer in Silurian and Devonian rocks during July 1986 has been used to complete a map of the potentiometric surface. This map is suitable for (1) defining directions of horizontal ground-water flow, and (2) as a reference to define and compare future rises or declines in ground-water levels. Additional water-level measurements were used to determine the fluctuation of water levels that occurs seasonally.

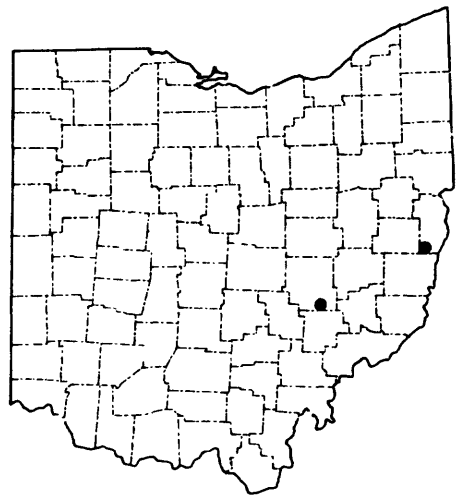
A data base of ground-water-quality information has been established for the carbonate aquifer. Data are available for 52 water-quality properties and constituents that describe the chemical, radiological, and bacterial quality of ground water. Ground-water samples from 136 wells and 11 springs were used to develop the data base. A smaller data base has been established for ground-water quality in the shallow sand aquifer of Lucas County. Analyses of ground water from ten wells that represent the shallow sand aquifer in both developed and undeveloped areas of Lucas County are available. Interpretation of data to identify factors affecting ground-water quality is underway.

GROUND WATER AND SURFACE-MINE RECLAMATION
(OH087)

Period of Project:
September 1985 through
September 1989

Project Leader:
Rick L. Jones

Cooperator:
U.S. Office of Surface Mining



Purpose: Long-term impacts of surface coal mining on ground-water quality and quantity are poorly defined. Resaturation rates, recharge capacity, conductivity, storage, quality changes, and ground-water movement are a few of the hydrologic conditions not completely understood.

The objectives of this study are to (1) describe occurrence of ground water in and beneath the overburden soils of the reclaimed area, (2) describe rates of resaturation, and (3) evaluate chemical changes in the water quality.

Watersheds will be visited bimonthly for water-level measurements. Water-quality samples will be taken from four wells semiannually and from stream and seeps annually. Variations of chemical composition will be identified by the use of Stiff and Piper diagrams.

Progress and significant results: Water levels and water-quality samples have been completed for 1988. No significant results have been noted to date. Analysis of water quality and fluctuation of water levels is continuing.

COMPILATION, EVALUATION AND ANALYSIS OF PRECIPITATION-QUALITY DATA IN OHIO AND ADJACENT AREAS (OH090)

Period of Project:
October 1986 through
April 1988

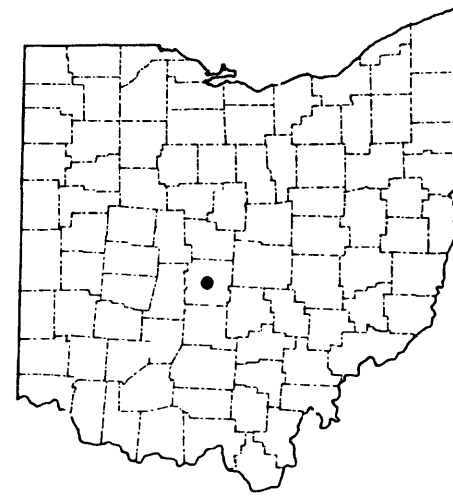
Project Leader:
Donna N. Myers

Cooperator:
Ohio Air Quality Development Authority

Purpose: To determine the geographic (areal) and seasonal (temporal) characteristics of the chemical quality of wet deposition in Ohio and adjacent areas. Ohio receives some of the most acidic wet deposition in the northeastern portion of North America. However, emphasis on characterizing precipitation quality and effects has been focused in other states and provinces. There are several national and regional wet-deposition monitoring programs with sites in Ohio, but data from these have not been combined to date to characterize statewide patterns of acidic wet deposition.

Progress and significant results: Trend analysis and seasonal analysis have been completed and summary statistics have been computed. A final report is in the draft stage.

HYDROLOGIC INTERACTION BETWEEN GROUND WATER AND SCIOTO RIVER, IN THE VICINITY OF THE CITY OF COLUMBUS WELL FIELD, SOUTHERN FRANKLIN COUNTY, OHIO
(OH091)



Period of Project:
October 1986 through
September 1989

Project Leader:
Carolyn J. Oblinger Childress

Cooperator:
City of Columbus, Ohio

Purpose: (1) Determine the effects on water quality of reduced stream flow in the Scioto River between the Jackson Pike STP (Sewage Treatment Plant) and the Southerly STP. (2) Refine the existing ground-water model in terms of the interaction of Scioto River with the ground-water system in the vicinity of the South Columbus well field. (3) Determine the relation between Scioto River water quality and water quality of ground water in the vicinity of the well field. The proposed transfer of sewage influent from the Jackson Pike (STP) to the Southerly STP will significantly reduce flow in a 9-mile reach of the Scioto River. The City of Columbus water-supply well field is located within the affected reach. The reduced flow in that reach of the Scioto River could change the hydrologic interaction between the river and ground water in the area of the well field affecting both water quantity and quality.

Progress and significant results: Ground-water and surface-water quality sample collection, streambed permeability measurement, and water-level measurement have been completed. Ground-water flow and surface-water transport modeling is in progress. The published report is due for publication by fall 1989.

EFFECTS OF HIGHWAY DEICING CHEMICALS ON SHALLOW UNCONSOLIDATED AQUIFERS IN OHIO
(OH092)

Period of Project:
January 1988 through
June 1997

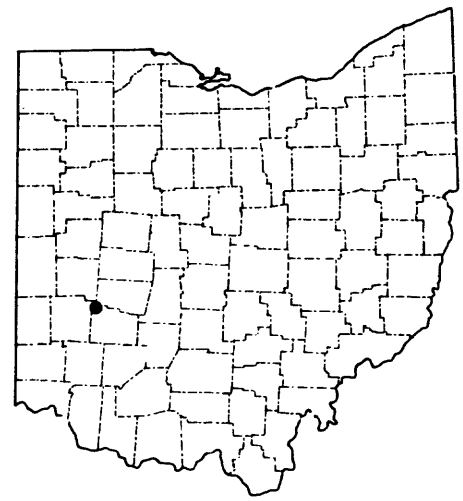
Project Leader:
Allison L. Jones

Cooperator:
Ohio Department of Transportation

Purpose: (1) To determine the impacts of highway-deicing chemicals, predominantly chloride, on the ground-water quality of shallow unconfined aquifers that underlie highways in Ohio, (2) to determine those impacts in different soil-type and climatic areas of Ohio, (3) to track the movement of chlorides away from the highway to observe seasonal variations in chloride migration, (4) to determine yearly changes in impacts caused by variation in snowfall, and (5) to determine the salt concentration present in the soil and unsaturated zone. In Ohio, there is a general lack of detailed knowledge concerning the movement of deicing salts after they have been applied to roads. The use of road salts has been increasing continuously since about 1940. There is growing indication that all applied salts do not leave the area of application, but that some, in fact, accumulate. The Ohio Department of Transportation (ODOT) needs long-term data on the effects of salts on soil and ground water in Ohio.

Progress and significant results: A group of 55 potential sites have been chosen (there will be eight chosen finally) through the use of maps of geology, glacial features, snowfall, and soil types. Records of county salt-application rates, water-well logs, and other literature were also consulted. Each site is being investigated using a ground conductivity electromagnetic geophysical system. Test drilling is being done at each potential site to determine formation type and content, water levels, and direction and velocity of ground-water flow.

HYDROGEOLOGY AND GROUND-WATER QUALITY OF WRIGHT-PATTERSON AIR FORCE BASE, SOUTHWESTERN OHIO (OH093)



Period of Project:
June 1987 through
November 1991

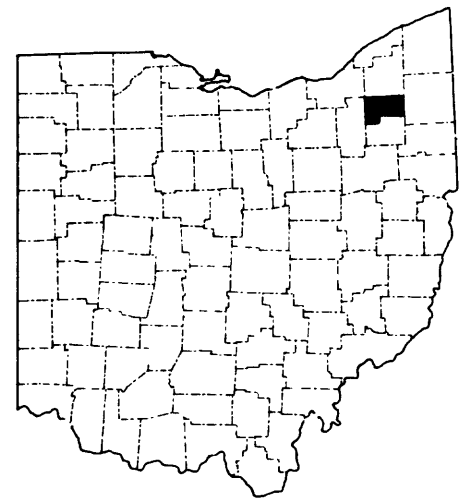
Project Leader:
Jeffrey T. de Roche

Cooperator:
U.S. Air Force,
Air Force Logistics Command

Purpose: To investigate on a regional basis the hydrogeology and ground-water quality of WPAFB. Specific objectives are to (1) compile available hydrologic data; (2) assess the chemical quality of the ground water in the glacial outwash and bedrock aquifers; (3) define the hydrogeology of the base area; (4) develop a digital ground-water model to be used as a tool to interpret the hydrogeology; and (5) outline areas where future water-resource studies may be needed.

Progress and significant results: A computerized data base has been completed and delivered to WPAFB. The data base, which uses the USGS WATSTORE and GWSI systems, is a listing of selected domestic, industrial, public supply, and observation wells and associated water-quality data. A geophysical investigation using seismic refraction and electrical resistivity has been completed. Two rounds of water-level measurements were made. Maps and cross sections showing bedrock contours, drift thickness, and ground-water flow nave been prepared. A conceptual model of the ground-water flow system has been prepared. An exploratory drilling program to determine the specific nature and thickness of the glacial deposits is in progress.

HYDROGEOLOGY AND WATER QUALITY OF THE MAJOR AQUIFERS IN AN AREA OF DEEP-WELL BRINE DISPOSAL SYSTEMS, SHALERSVILLE AND ADJACENT TOWNSHIPS, PORTAGE COUNTY, OHIO
(OH094)



Period of Project:
April 1987 through
April 1989

Project Leader:
Sandra M. Eberts

Cooperators:
City of Akron
(City of Aurora)
(City of Streetsboro)
(Shalersville Township)
(Village of Windham)
(Mantua Township)
(Hiram Township)
(Freedom Township)
(Windham Township)
(Nelson Township)
Ohio Water Development Authority

Purpose: (1) To describe the local geology of the Shalersville area; (2) establish current water levels; (3) describe ground-water flow and the hydrologic connection between the ground water and Lake Rockwell; and (4) document current ground-water quality. There are 14 brine injection wells in the Shalersville area. Ground water accounts for 100 percent of the public water supply in Portage County. Lake Rockwell, a major source of water for the City of Akron, Summit County. also lies in the Shalersville area. Because of the number of brine injection wells and documented violations of the State's brine-disposal law in the study area, there is a growing concern regarding the chemical quality of the aquifers and of Lake Rockwell.

Progress and significant results: Began constructing geologic sections from geophysical logs of oil and gas wells to assess potential geologic containment of injected brines. Measured water levels twice in a network of 90 domestic wells. Began contouring water-level data to describe directions of ground-water flow. Measured specific conductance in most wells within 1/4 mile of each of the 14 brine injection wells.

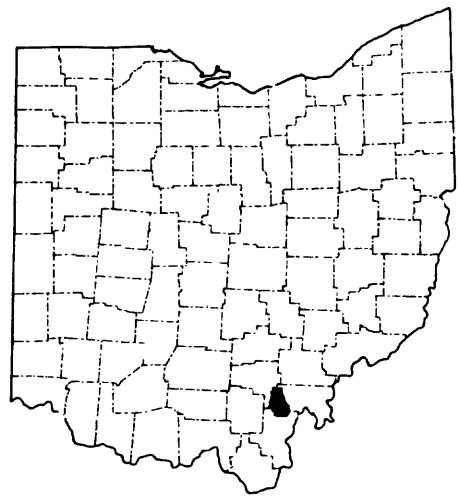
Water from seven domestic wells exhibits higher-than-background values of specific conductance. Five of these wells along with twenty-one other wells were sampled to detect brine contamination and to describe general water quality within the study area. Samples from three of the five "high specific conductance wells" exhibit higher-than-background concentrations of chloride and bromide.

HYDROLOGIC IMPACTS OF LONGWALL MINING IN OHIO
(OH095)

Period of Project:
July 1987 through
June 1992

Project Leader:
Alban W. Coen, III

Cooperator:
Ohio Department of Natural Resources,
Division of Reclamation



Purpose: To determine and describe the impacts of longwall mining on selected hydrologic environments typical of those found in Ohio. Specifically, this study will examine the impacts of longwall mining on (1) the magnitude of stream discharge, and (2) the chemical and biological quality of surface water. Little is known about the effects that longwall mining will have on hydrologic systems, and longwall mining is rapidly becoming the primary form of mining in Ohio. The impacts of longwall mining on surface-water flow and quality need to be monitored, interpreted, and reported in Ohio.

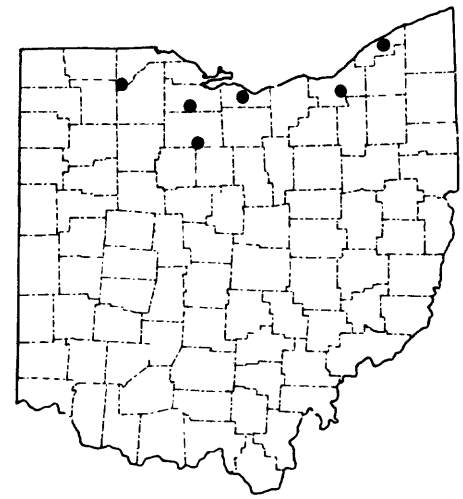
Progress and significant results: Streams have been sampled and discharges have been measured when there was significant flow in the streams. Two years of excessively dry weather have left most of the streams dry much of the year. Data collection consequently has been hampered, and the scope of the project is being reevaluated.

LAKE ERIE TRIBUTARY LOADING--OHIO, INDIANA, AND MICHIGAN (OH096)

Period of Project:
August 1987 through
December 1990

Project Leader:
John W. Roberts

Cooperator:
Ohio Department of Natural Resources



Purpose: To determine phosphorus, sediment, and selected chemical loads in several major streams tributary to Lake Erie. Agriculture is the primary land use in the Ohio portion of the Lake Erie basin and is considered responsible for a large part of the water-quality degradation of Lake Erie and its tributaries. In June 1983, the United States and Canada agreed to reduce phosphorus loading to Lake Erie by an additional 2,000 metric tons per year. A network of monitoring stations needs to be established on Lake Erie tributaries to determine (1) if this goal is being met, (2) the amounts of other chemicals entering the lake, and (3) other impacts of agricultural land use.

Progress and significant results: A network of monitoring stations has been established in Ohio on the Huron, Maumee, Sandusky, Cuyahoga, and Grand Rivers, and Honey Creek.

BACTERIOLOGICAL QUALITY OF THE SCIOTO AND OLENTANGY RIVERS IN THE COLUMBUS AREA, OHIO
(OH097)

Period of Project:
October 1987 through
December 1989

Project Leader:
Donna N. Myers

Cooperator:
City of Columbus, Ohio

Purpose: (1) Determine fecal coliform and E. coli densities in the Scioto and Olentangy Rivers at various locations in the Columbus metropolitan area; (2) determine the duration of bacteriological contamination in the proposed recreational segment after combined stormwater-sewage discharge events; (3) determine suitability of Scioto River for body-contact recreation, and (4) gain a better understanding of water-quality conditions in the upper Scioto and Olentangy Rivers, which are the main sources of water in a proposed recreation area. Scioto River flows through a highly urbanized land-use setting. Urban sources of contaminants affect the recreational quality of the river. The extent and nature of bacterial contaminants needs to be determined so the water resource can be managed to provide safe recreation.

Progress and significant results: Completed data collection of base-flow water-quality data at 10 sites on a monthly basis from May through September 1988. Completed weekly sampling at three sites to determine geometric mean densities of fecal coliform and E. coli. Evaluated two rain events to determine length of time elevated bacterial densities occur in proposed recreational segment of the Scioto River.

SURFACE-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

[Letter after station name designates type of data: (B) biological, (C) chemical, (D) discharge, (E) contents and (or) elevation, (M) water-quality monitor, (NASQAN) National stream-quality accounting network, (R) radiochemical, (S) sediment, and (T) temperature.]

Station number	Station	Type of data
	OHIO RIVER BASIN	
	Ohio River:	
	BEAVER RIVER BASIN	
03086500	Mahoning R (head of Beaver R) at Alliance	D
03090500	Mahoning R bl Berlin Dam, nr Berlin Center	D
03091500	Mahoning R at Pricetown	D
03092000	Kale C nr Pricetown	D
03092090	W B Mahoning R nr Ravenna	D
03092460	W B Mahoning R bl M. J. Kirwan Dam, at Wayland	D
03093000	Eagle C at Phalanx Station	D
03094000	Mahoning R at Leavittsburg	D
	Mosquito Creek:	
03095500	Mosquito C bl Mosquito C Dam, nr Cortland	D
03097550	Mahoning R at Ohio Edison Power Plant at Niles	D
03098600	Mahoning R below West Avenue Bridge at Youngstown	D
03099500	Mahoning R at Lowellville	D
03099510	Mahoning R at Oh-Pa State line bl Lowellville	CMT
	Shenango River:	
03102950	Pymatuning C at Kinsman	D
	LITTLE BEAVER CREEK BASIN	
	North Fork L Beaver Creek:	
03109500	L Beaver C nr East Liverpool	D
	YELLOW CREEK BASIN	
03110000	Yellow C nr Hammondsville	D
	SHORT CREEK BASIN	
	Short Creek:	
03111500	Short C nr Dillonvale	D
	CAPTINA CREEK BASIN	
03114000	Captina C at Armstrong Mills	D
	MUSKINGUM RIVER BASIN	
	Tuscarawas R (head of Muskingum R):	
03117000	Tuscarawas R at Massillon	D
03117100	Tuscarawas R at Navarre	MT
03117500	Sandy C at Waynesburg	D
03118000	M B Nimishillen C (head of Nimishillen Creek) at Canton	D
03118500	Nimishillen C at North Industry	D

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
	McGuire Creek:	
03120500	McGuire C bl Leesville Dam, nr Leesville	D
03122500	Tuscarawas R bl Dover Dam, nr Dover	D
03124000	Sugar Creek bl Beach City Dam, nr Beach City	D
03124500	Sugar Creek at Strasburg	D
	Stillwater Creek:	
03126000	Stillwater C at Piedmont	D
03127000	Stillwater C at Tippecanoe	D
03127500	Stillwater C at Uhrichsville	D
	Clear Fork (head of L Stillwater Creek):	
03128500	L Stillwater C bl Tappan Dam, at Tappan	D
03129000	Tuscarawas R at Newcomerstown	D
03130000	Black F (head of Walhonding River) bl Charles Mill Dam, nr Mifflin	D
03131500	Black F at Loudonville	D
03133500	Clear F bl Pleasant Hill Dam nr Perrysville	D
	Mohican R (continuation of Black Fork):	
	Lake Fork:	
03135000	L F bl Mohicanville Dam, nr Mohicanville	D
03136500	Kokosing R nr Mount Vernon	D
03138500	Walhonding R (continuation of Mohican R) bl Mohawk Dam, at Nellie	D
03139000	Killbuck C at Killbuck	D
03140000	Mill C nr Coshocton	D
03140500	Muskingum R (continuation of Tuscarawas R) nr Coshocton	D
	Wills Creek:	
	Seneca Fork:	
03141500	Seneca F bl Senecaville Dam, nr Senecaville	D
03142000	Wills C at Cambridge	D
03143500	Wills C bl Wills C Dam, at Wills Creek	D
03144000	Wakatomika C nr Frazeysburg	D
	Licking River	
03145000	S F Licking R (head of Licking River) nr Hebron	D
03146500	Licking R nr Newark	D
03147500	Licking R bl Dillon Dam, nr Dillon Falls	D
03150000	Muskingum R at McConnelsville (NASQAN)	DCBS
	HOCKING RIVER BASIN	
	Hocking River:	
03157000	Clear C nr Rockbridge	D
03157500	Hocking River at Enterprise	D
03159510	Hocking River bl Athens (NASQAN)	DCS

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
	SHADE RIVER BASIN	
03159540	Shade R nr Chester	D
	LEADING CREEK BASIN	
03160004	Leading C at Carpenter	DC
	RACCOON CREEK BASIN	
03201929	Zinns r nr Radcliff	DC
03201947	Strongs R nr Ewington	DC
	SCIOTO RIVER BASIN	
03219500	Scioto R nr Prospect	D
03219590	Bokes C nr Warrensburg	D
03220000	Mill C nr Bellepoint	D
03221000	Scioto R bl O'Shaughnessy Dam nr Dublin	D
	Olentangy River:	
03223000	Olentangy R at Claridon	D
03225500	Olentangy R nr Delaware	D
03227200	Scioto R at Broad Street, Columbus	D
03227500	Scioto R at Columbus	D
03228300	Big Walnut C at Sunbury	D
03228500	Big Walnut C at Central College	D
03228805	Alum C at Africa	D
03229000	Alum C at Columbus	D
03229500	Big Walnut C at Rees	D
03230500	Big Darby C at Darbyville	D
03230900	Deer C nr Pancoastburg	D
03231000	Deer C at Williamsport	D
03231500	Scioto R at Chillicothe	DM
	Paint Creek:	
03232470	Paint C bl Paint C Dam nr Bainbridge	D
	Rocky Fork:	
03232500	Rocky F nr Barretts Mills	D
03234000	Paint C nr Bourneville	D
03234300	Paint C at Chillicothe	DM
03234500	Scioto R at Higby (NASQAN)	DCBMTS
	Reservoirs in Scioto R basin	E
	UPPER TWIN CREEK BASIN	
03237280	Upper Twin C at McGaw (HBM)	DCBMSR
	OHIO BRUSH CREEK BASIN	
03237500	Ohio Brush C nr West Union	D
	WHITEOAK CREEK BASIN	
03238500	Whiteoak C nr Georgetown	D
	LITTLE MIAMI RIVER BASIN	
03240000	L Miami R nr Oldtown	D
03241500	Massies C at Wilberforce	D
03245500	L Miami R at Milford (NASQAN)	DCBTS
03247050	E F L Miami R nr Batavia	D
03247500	E F L Miami R at Perintown	D
03248100	L Miami R at Cincinnati	D

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
	MIAMI CREEK BASIN	
03255500	Mill C at Reading	D
03259000	Mill C at Carthage	D
	GREAT MIAMI RIVER BASIN	
	G Miami River:	
03260325	N F Great Miami R nr Indian Lake	D
03260450	S F Great Miami R nr Huntsville	D
03260502	Great Miami R bl Indian L at Russels Pt	D
03260700	Bokengehalas C nr De Graff	D
03261500	G Miami R at Sidney	D
03261950	Loramie C nr Newport	D
03262000	Loramie C at Lockington	D
03262700	G Miami R at Troy	D
03263000	G Miami R at Taylorsville	D
	Stillwater River:	
03264000	Greenville C nr Bradford	D
03265000	Stillwater R at Pleasant Hill	D
03266000	Stillwater R at Englewood	D
03267000	Mad R nr Urbana	D
03267900	Mad R (at St. Paris Pike) at Eagle City	D
03269500	Mad R nr Springfield	D
03270000	Mad R nr Dayton	D
03270500	G Miami R at Dayton	D
03271000	Wolf C at Dayton	D
03271500	G Miami R at Miamisburg	D
03271510	G Miami R nr Linden Ave at Miamisburg	M
03271800	Twin C nr Ingomar	D
03272000	Twin C nr Germantown	D
	Sevenmile Creek:	
03272700	Sevenmile C at Camden	D
03274000	G Miami at Hamilton	D
03274600	G Miami R at New Baltimore (NASQAN)	CBTS
	ST LAWRENCE RIVER BASIN	
	(STREAMS TRIBUTARY TO LAKE ERIE)	
04177000	Ottawa R at Toledo University	D
04185000	Tiffin R at Stryker	D
04185440	Lost C nr Farmer	D
04186500	Auglaize R nr Ft Jennings	D
04187100	Ottawa R at Lima	D
04189000	Blanchard R nr Findlay	D
04191500	Auglaize R nr Defiance	D

SURFACE-WATER STATIONS--Continued

Station number	Station	Type of data
04192500	Maumee R near Defiance	D
04193500	Maumee R at Waterville (NASQAN)	DCBTS
04194107	Lake Erie at Reno Beach	E
04195500	Portage R at Woodville	D
04195825	Lacarpe Cr nr Oak Harbor	D
04195830	Bayou Ditch nr Oak Harbor	D
	SANDUSKY RIVER BASIN	
04196800	Tymochtee C at Crawford	D
04197020	Honey C nr New Washington	D
04197100	Honey C at Melmore	D
04197170	Rock C at Tiffin	D
04198000	Sandusky R near Fremont (NASQAN)	DCMBTS
04199155	Old Woman's C at Berlin Road	D
04199165	Old Woman's C at U.S. 6 nr Huron	D
04199175	Lake Erie at Ruggles Beach	E
04200500	Black R at Elyria	D
04201500	Rocky R nr Berea	D
04202000	Cuyahoga R at Hiram Rapids	D
04206000	Cuyahoga R at Old Portage	D
04207200	Tinkers C at Bedford	D
04208000	Cuyahoga R at Independence (NASQAN)	DCMTS
04208506	Cuyahoga R at W 3rd St bridge in Cleveland	CT
04209000	Chagrin R at Willoughby	D
04212100	Grand R nr Painesville	DS
04212200	Grand R at Painesville (NASQAN)	DCMTS
04212680	Fields Brook at Ashtabula	M
04213000	Conneaut C at Conneaut	D

STANDARD ABBREVIATIONS USED IN STATION NAMES

ab	above	e	east	nr	near
b	branch	f	fork	r	river
bk	brook	g	great	re	reservoir
bl	below	l	little	rn	run
c	creek	lk	lake	s	south
ca	canal	m	middle	tr	tributary
d	ditch	n	north	w	west

GROUND-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

The following table lists the ground-water stations in Ohio for which the U.S. Geological Survey is publishing data in 1986. The first six digits of the well numbers denote degrees, minutes, and seconds of latitude, and the next seven digits denote degrees, minutes, and seconds of longitude. The last two digits are used, if needed, for sequential numbering within a 1-second grid.

In addition to the sites listed, data on water levels, yield, and chemical quality of ground water have been collected at many other locations in Ohio. Information about these miscellaneous measurements is available upon request.

GROUND-WATER STATIONS FOR WHICH RECORDS ARE PUBLISHED

[Letter after station location designates type of data: c chemical; l, water level.]

Well number	Local number	Location
		ASHLAND COUNTY
405303082170700	AS-2	Ashland (l)
405425082173000	AS-3	Jerome Fork (l)
		ATHENS COUNTY
392004082071600	AT-2A	Athens (l)
392009082072200	AT-5	Athens (l)
		AUGLAIZE COUNTY
403233083574500	AU-3	Southwest of New Hampshire (l)
		BELMONT COUNTY
400118081082200	B-3	Mount Olivett (l)
		BUTLER COUNTY
391805084261800	BU-9	Northwest of Sharonville (l)
393202084241500	BU-15	Middletown (l)
391904084371800	BU-12	East of Ross (l)
392017084345200	BU-7	Fairfield (l)
392021084340300	BU-56	Fairfield (l)
392048084311400	BU-8	East of Hamilton (l)
392445084333000	BU-36	Hamilton (c)
392515084322000	BU-5	North of Hamilton (l)
392939084231700	BU-3	Middletown (l)
393103084240900	BU-2	Middletown (l)
		CARROLL COUNTY
403709081052800	C-1	North of Carrollton (l)
		CHAMPAIGN COUNTY
400638083453900	CH-3	Urbana (l)
		CLARK COUNTY
395639084012200	CL-9	New Carlisle (l)
395840083495200	CL-7	Northwest of Springfield (l)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		COSHOCTON COUNTY
401256081525100	CS-3	North of Conesville (1)
		CRAWFORD COUNTY
404838082563100	CR-1	Bucyrus (1)
		DARKE COUNTY
400514084345700	D-2	East of Greenville (1)
		DELAWARE COUNTY
402126083040400	DL-3	Delaware (1)
		FAIRFIELD COUNTY
393450082403600	F-7	Southeast of Amanda
394257082362900	F-6	Lancaster (1)
394544082271000	F-1	West Rushville (1)
395053082361900	F-5	Baltimore (1)
		FAYETTE COUNTY
393153083322000	FA-1	West of Washington Court House (1)
		FRANKLIN COUNTY
394956083002700	FR-18	Shadeville (1)
395118083573300	FR-3	Southwest of Rees (1)
395157083003500	FR-109	Columbus (1)
400101083021800	FR-10	Columbus (1)
		GALLIA COUNTY
383638082103300	G-2	East of Crown City (1)
		GEAUGA COUNTY
412518081221500	GE-3A	Southeast of Chagrin Falls (1)
		GREENE COUNTY
394330083531400	GR-11	Near Wilberforce
394411083561300	GR-1	North of Xenia (1)
394425083551100	GR-10	North of Xenia (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		HAMILTON COUNTY
391039084291500	H-11	Cincinnati (1)
391101084172100	H-3	Southeast of Miamiville (1)
391201084281600	H-10	Cincinnati (1)
391214084470100	H-1	Southeast of Harrison (1)
391324084272500	H-9	Cincinnati (1)
391341084275300	H-8	Wyoming (1)
391442084262900	H-7	Evendale (1)
391608084254400	H-6	Glendale (1)
391733084392400	H-2	South of Ross (1)
391748084393800	H-19	Southwest of Venice (c)
391817084393300	H-4	Southwest of Ross (1)
		HANCOCK COUNTY
405940083275500	HA-3	North of Van Lue
		HARDIN COUNTY
404218083503700	HN-1	Alger (1)
404648083412600	HN-2A	Southeast of Dola (1)
		HENRY COUNTY
412123083574000	HY-2	Southwest of McClure (1)
		HOCKING COUNTY
393200082235300	HK-1	Logan (1)
		KNOX COUNTY
402344082300700	K-1	Mt. Vernon (1)
		LUCAS COUNTY
413704083362200	LU-1	Toledo (1)
		MADISON COUNTY
395301083272200	M-2	London (1)
395352083292100	M-5	Near London
395357083304400	M-4	Northwest of London (1)
395740083255700	M-3	North of London (1)
		MAHONING COUNTY
410042080453800	MA-1	Canfield (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		MARION COUNTY
403413083170500	MN-4	Southeast of New Bloomington (1)
403443083230400	MN-1	LaRue (1)
403601083110400	MN-2	West of Marion (1)
		MEDINA COUNTY
410120081431800	MD-3	Wadsworth (1)
410142082005900	MD-1	Lodi (1)
		MERCER COUNTY
402833084375200	MR-2	Coldwater (1)
		MIAMI COUNTY
395848084085500	MI-3	Northeast of Tipp City (1)
400208084112900	MI-44	Troy (c)
		MONTGOMERY COUNTY
393757084173600	MT-928	Miamisburg (c)
394012084151700	MT-55	West Carrollton (1)
394025084162800	MT-49	West Carrollton (1)
394425084113200	MT-3	Dayton (1c)
394533084113800	MT-6	Dayton (1)
		MUSKINGUM COUNTY
395804081593200	MU-1A	Zanesville (1)
		OTTAWA COUNTY
413434082494000	O-2	Catawba Island
		PICKAWAY COUNTY
393327082571600	PK-7	South of Circleville (1)
393402082572500	PK-4	South of Circleville (1)
393638082572300	PK-6	Northwest of Circleville (1)
393438083072200	PK-8	Williamsport (1)
394742083094800	PK-9	Near Orient (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		PIKE COUNTY
390359083015100	PI-2	West of Piketon (1)
		PORTAGE COUNTY
411401081025000	PO-1	Windham (1)
410540081213600	PO-7	Brimfield (1)
410920081192000	PO-6	East of Kent (1)
		PREBLE COUNTY
394438084335900	PR-2	East of Eaton (1)
		PUTNAM COUNTY
405505084032900	PU-1	Columbus Grove (1)
		RICHLAND COUNTY
404625082305100	R-4	Mansfield (1)
405753082360800	R-3	Shiloh (1)
		ROSS COUNTY
391341083172200	RO-7	West of Bainbridge (1)
391913082580500	RO-8	Chillicothe (1)
		SANDUSKY COUNTY
411914083045300	S-3	Fremont (1)
412703083213600	S-2	Woodville (1)
		SENECA COUNTY
410802083093900	SE-2	Tiffin (1)
		SHELBY COUNTY
401712084103500	SH-4	Sidney (1)
		STARK COUNTY
404939081203800	ST-5A	Canton (1)
405211081253500	ST-27	North Canton (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		SUMMIT COUNTY
410141081315200	SU-4A	Akron (1)
410330081282000	SU-6	Akron (1)
410846081271600	SU-7	Cuyahoga Falls (1)
		TRUMBULL COUNTY
411604080505600	T-3	Near Warren (1)
		TUSCARAWAS COUNTY
403207081293800	TU-3	Dover (1)
403557081313600	TU-4	Strasburg (1)
403653081321800	TU-1	North of Strasburg (1)
403823081324200	TU-5	Near Strasburg (1)
		UNION COUNTY
401826083255200	U-4	Southeast of Raymond (1)
		VAN WERT COUNTY
405215084335400	VW-1	Van Wert (1)
		VINTON COUNTY
391452082282900	V-1	McArthur (1)
		WARREN COUNTY
392712084191700	W-5	East of Monroe (1)
		WASHINGTON COUNTY
392553081281600	WA-2	Marietta (1)
		WAYNE COUNTY
404655081553200	WN-3	Near Wooster (1)
404802081583100	WN-2A	Near Wooster (1)
405745081510200	WN-7	Near Sterling (1)
405805081462300	WN-6	Rittman (1)
		WILLIAMS COUNTY
412821084313600	WM-1	Near Bryan (1)
412930084320900	WM-3	Bryan (1)
413108084415300	WM-12	East of Blakeslee (1)

GROUND-WATER STATIONS--Continued

Well number	Local number	Location
		WYANDOT COUNTY
405009083172600	WY-1	Upper Sandusky (1)

SELECTED REFERENCES ON OHIO HYDROLOGY

Selected references on water resources in Ohio are listed below; many of them are available for inspection at the Ohio District office and at large public and university libraries. The publications are grouped as follows: (1) U.S. Geological Survey publications; (2) reports prepared by the Geological Survey in cooperation with specific agencies and which can be obtained from the cooperating agencies; and (3) other publications, such as contributions to technical journals.

Professional Papers

450-B Temperature-depth relations in wells as indicators of semiconfining beds in valley-train aquifers, by S.E. Norris and A.M. Spieker. 1962.

450-E Permeability of glacial till, by S.E. Norris. 1963.

475-D Anomalous streamflow-ground-water regimen in the Mad River basin, near Springfield, Ohio, by W.P. Cross and A.J. Feulner. 1963.

511 Geology and ground-water resources of Portage County, Ohio, by J.D. Winslow and G.W. White. 1966.

525-D Relation of permeability to particle size in a glacial-outwash aquifer at Piketon, Ohio, by S.E. Norris and R.E. Fidler. 1965.

550-C Water-quality variations in the Cuyahoga River at Cleveland, Ohio, by M.E. Schroeder and C.R. Collier. 1966.

550-D Effect of sampling and testing methods on computed hydraulic properties of glacial outwash at Piketon, Ohio, by S.E. Norris and R.E. Fidler. 1966.

605-A Ground-water hydrology and geology of the lower Great Miami River valley, Ohio, by A.M. Spieker. 1968.

605-B Seismic refraction survey of Pleistocene drainage channels in the lower Great Miami River valley, Ohio, by J.S. Watkins and A.M. Spieker. 1971.

605-C Effects of increased pumping of ground water in the Fairfield-New Baltimore area (Hamilton County), Ohio--A prediction by analog-model study, by A.M. Spieker. 1968.

605-D Future development of the ground-water resources in the lower Great Miami River valley, Ohio--Problems and alternative solutions, by A.M. Spieker. 1968.

650-B Correlation of carbonate rock units in northwest Ohio by natural gamma logging, by S.E. Norris and R.E. Fidler. 1969.

700-D The effect of stream discharge on streambed leakage to a glacial outwash aquifer, by S.E. Norris, in Geological Survey Research 1970, Chapter D, p. D262-D265. 1970.

750-B Availability of ground water from limestone and dolomite aquifers in northwest Ohio and its relation to geologic structure, by S.E. Norris and R.E. Fidler, in Geological Survey Research 1971, Chapter B, p. B229-B235. 1971.

750-C Carbonate equilibria distribution and its relation to an area of high ground-water yield in northwest Ohio, by S.E. Norris and R.E. Fidler, in Geological Survey Research 1971, Chapter C, p. C202-C206. 1971.

750-D Resistivity and neutron logging in Silurian dolomite of northwest Ohio, by L.M. MacCary. in Geological Survey Research 1971, Chapter D, p. D190-D197. 1971.

813-A Summary appraisals of the Nation's ground-water resources--Ohio Region, by R.M. Bloyd, Jr. 1974.

813-J Summary appraisals of the Nation's ground-water resources--Great Lakes Region, by W.G. Weist, Jr. 1978.

Water-Supply Papers

161 Quality of water in upper Ohio River basin and at Erie, Pa., by S.J. Lewis. 1906.

179 Prevention of stream pollution by distillery refuse, based on investigations at Lynchburg, Ohio, by Herman Stabler. 1906.

186 Stream pollution by acid-iron wastes, a report based on investigations made at Shelby, Ohio, by Herman Stabler. 1906.

334 The Ohio valley flood of March-April, 1913, including comparisons with some earlier floods, by A.H. Horton and H.J. Jackson. 1913.

800 The floods of March 1936--Part 3, Potomac- James, and upper Ohio Rivers, by N.C. Grover, with a section area, Butler and Hamilton Counties, Ohio, by F.H. Klaer, Jr., and D.G. Thompson. 1948.

838 Floods of Ohio and Mississippi Rivers, January-February 1937, by N.C. Grover, with a section on flood deposits of the Ohio River, January-February 1937, by G.R. Mansfield. 1938.

869 Flood of August 1935 in the Muskingum River basin, Ohio, by C.V. Youngquist and W.B. Langbein. 1941.

999 Ground-water resources of the Cincinnati area, Butler and Hamilton Counties, Ohio, by F.H. Klaer. Jr., and D.G. Thompson. 1948.

1460-E Geological and geophysical study of the preglacial Teays valley in west-central Ohio, by S.E. Norris and H.C. Spicer. 1958.

1619-A Hydrogeology of a spring in a glacial terrane near Ashland, Ohio, by S.E. Norris. 1963.

1750-A Floods of January-February 1959 in Ohio and adjacent states, by E.L. Hendricks. 1964.

1798-I Fluvial sediment in Hocking River subwatershed 1 (North Branch Hunters Run, Hocking County), Ohio, by R.F. Flint. 1972.

1808 Ground-water resources of the Dayton area (Montgomery County), Ohio, by S.E. Norris and A.M. Spieker. 1966.

1840-A Floods of March 1964 along the Ohio River, by H.C. Beaber and J.O. Rostvedt. 1965.

1859-C Analysis of water quality of the Mahoning River in Ohio, by G.A. Bednar, C.R. Collier, and W.P. Cross. 1968.

1872 Hydrogeology of the Scioto River valley near Piketon (Pike County), Ohio, by S.E. Norris and R.E. Fidler. 1969.

1893 Potential development and recharge of ground water in Mill Creek valley, Butler and Hamilton Counties, Ohio, based on analog model analysis, by R.E. Fidler. 1970.

2045 Fluvial sediment in Ohio, by P.W. Anttila and R.L. Tobin. 1978.

2220 Basic ground-water hydrology, by R.C. Heath. 1983.

2250 National water summary, 1983.

2275 National water summary, 1984.

2295-A Water-quality data-collection activities in Colorado and Ohio: Phase I--inventory and evaluation of 1984 programs and costs, by Janet Hren, T.H. Chaney, J.M. Norris, and C. J. Oblinger Childress. 1987.

2300 National water summary, 1985.

2325 National water summary, 1986.

Bulletins

1133-A Geology and hydrology of the Piqua area (Miami County), Ohio, by S.E. Norris and A.M. Spieker. 1961.

Circulars

177 Water resources of the Mahoning River basin, Ohio, with special reference to the Youngstown area, by W.P. Cross, M.E. Schroeder, and S.E. Norris. 1952.

340 Water resources of the Wheeling-Steubenville area, West Virginia and Ohio, by R.C. Smith, W.L. Doll, and Garland Stratton. 1955.

418 Floods of January-February 1959 in Ohio, by W.P. Cross and H.P. Brooks. 1959.

526 Stream quality in Appalachia as related to coal-mine drainage, 1965, by J.E. Biesecker and J.R. George. 1966.

546 Time of travel of water in the Great Miami River, Dayton to Cleves, Ohio, by D.P. Bauer. 1968.

719 The National Stream Quality Accounting Network (NASQAN)--Some questions and answers, by J.F. Ficke and R.O. Hawkinson. 1975.

Journal of Research of the U.S. Geological Survey

Norris, S.E., 1974, Regional flow system and ground-water quality in western Ohio: U.S. Geological Survey Journal of Research, v. 2, no. 5, p. 527-531.

Hydrologic Investigations Atlases

40 Floods at Mount Vernon (Knox County), Ohio, by G.W. Edelen, Jr., F.H. Ruggles. Jr., and W.P. Cross. 1961 (revised 1964).

43 Floods at Springfield (Clark County), Ohio, in 1913 and 1959, by G.W. Edelen, Jr., F.H. Ruggles, Jr., and W.P. Cross. 1961.

44 Floods at Newark (Licking County), Ohio, by G.W. Edelen. Jr., F.H. Ruggles, Jr., and W.P. Cross. 1962 (revised 1964).

45 Floods at Chillicothe (Ross County), Ohio, by G.W. Edelen, Jr., F.H. Ruggles, Jr., and W.P. Cross. 1964.

46 Floods at Zanesville (Muskingum County), Ohio, by G.W. Edelen, Jr., F.H. Ruggles, Jr., and W.P. Cross. 1964.

47 Floods at Fremont (Sandusky County), Ohio, by G.W. Edelen, Jr., F.H. Ruggles, Jr., and W.P. Cross. 1962.

48 Floods at Circleville (Pickaway County), Ohio, by G.W. Edelen. Jr., F.H. Ruggles, Jr., and W.P. Cross. 1964.

49 Floods at Barberton (Summit County), Ohio, by G.W. Edelen, Jr., F.H. Ruggles, Jr., and W.P. Cross. 1962.

50 Floods at Canton (Stark County), Ohio, by G.W. Edelen, Jr.. W.P. Somers, and W.P. Cross. 1962.

51 Floods at Warren (Trumbull County), Ohio, by G.W. Edelen. Jr., F.H. Ruggles. Jr., and W.P. Cross. 1963.

52 Floods at Columbus (Franklin County), Ohio, by G.W. Edelen. Jr., F.H. Ruggles. Jr.. W.P. Somers, and W.P. Cross. 1962.

56 Floods on Crab Creek at Youngstown (Mahoning County), Ohio, by G.W. Edelen. Jr., W.P. Cross, and W.P. Somers. 1963.

198 Water resources of the Appalachian Region, Pennsylvania to Alabama, by W.J. Schneider and others. 1965.

295 Ground-water resources of the Appalachian region, by G.G. Wyrick. 1968.

324 Floods at Amesville (Athens County), Ohio, by R.I. Mayo and E.E. Webber. 1969.

325 Floods at Jackson (Jackson County), Ohio, by E.E. Webber and R.I. Mayo. 1968.

341 Hydrogeology of the Berea and Cussewago Sandstones in northeastern Ohio, by J.L. Rau. 1969.

366 Saline ground-water resources of Ohio, by A.C. Sedam and R.B. Stein. 1970.

494 Hydrogeology of the Pottsville Formation in northeastern Ohio, by A.C. Sedam. 1973.

Miscellaneous Investigations Series

316 Glacial map of Ohio, by R.P. Goldthwait, G.W. White, and J.L. Forsyth. 1961 (revised in part, 1967).

Hydrologic Unit Map

U.S. Geological Survey, 1974. Hydrologic unit map of Ohio. An overprint of the 1:500,000 scale state base map. No contours. Sheet is 36 by 40 inches. 1951 base, drainage modified in 1974. This map and accompanying table show hydrologic units that are basically hydrographic in nature. The Cataloging Units shown supplant those previously used by the U.S. Geological Survey in its Catalog of Information on Water Data (1966-72).

Open-File Reports of the U.S. Geological Survey

Open-file reports are available for inspection at the Columbus, Ohio, and Reston, Virginia, offices of the U.S. Geological Survey. For information about purchasing these reports, contact Books and Open-File Reports, U.S. Geological Survey, Box 25425, Federal Center, Denver, CO 80225, telephone (303) 236-7476.

Unnumbered Open-File Reports

Anttila, P.W., 1970, A proposed streamflow program for Ohio.

Cross, W.P., 1967, Flood of July 12, 1966, in the vicinity of Sandusky (Huron County), Ohio.

Deutsch, Morris, and Wallace, J.C., 1966, Six illustrations showing water-resources information on Maumee River basin, Ohio.

Feulner, A.J., 1960, The ground-water resources of Champaign County, Ohio.

Mayo, R.I., Webber, E.E., and Ellis, D.W., 1971, Floods of July 4-8, 1969, in north-central Ohio.

U.S. Geological Survey, 1961-64, Surface-water records of Ohio (published annually).

----- 1964. Water-quality records of Ohio.

----- 1965-74, Water-resources data for Ohio--Part 1, Surface-water records; Part 2. Water-quality records (published annually).

Webber, E.E., and Mayo, R.I., 1970, Flood of July 5, 1969, in the vicinity of Wooster (Wayne County), Ohio.

----- 1971, Low-flow study for southwest Ohio streams.

Numbered Open-File Reports

76-768 Floods in Ohio--magnitude and frequency, by E.E. Webber and W.P. Bartlett, Jr. 1976.

77-399 Hydraulic analysis, Mad River at State Highway 41, Springfield, Ohio, by R.I. Mayo. 1977.

78-684 Hydrologic environment of the Silurian salt deposits in parts of Michigan, Ohio, and New York, by S.E. Norris. 1978.

79-269 The Silurian salt deposits in eastern Lake, northwestern Ashtabula, and northeastern Geauga Counties, Ohio, by S.E. Norris. 1978.

81-343 Hydrology of Area 4, Eastern Coal Province, Pennsylvania, Ohio, and West Virginia, by D.K. Roth, M.J. Engelke, Jr., and others. 1981.

81-350 Hydraulic analysis, Paint Creek at State Route 772, Chillicothe, Ohio, by R.I. Mayo and W.P. Bartlett, Jr. 1981.

81-409 Assessment of water quality in streams draining coal-producing areas in Ohio, by C.L. Pfaff, D.R. Helsel, D.P. Johnson, and C.G. Angelo. 1981.

81-414 Flood of August 20, 1979, on a tributary of Chickamauga Creek, near Gallipolis, Ohio, by R.I. Mayo and E.E. Webber. 1981.

81-815 Hydrology of Area 7, Eastern Coal Province, Ohio, by M.J. Engelke. Jr., D.K. Roth, and others. 1981.

81-913 Ground-water hydrology of strip-mine areas in eastern Ohio, by J.O. Helgesen and A.C. Razem. 1981.

81-919 Ground-water quality in the vicinity of landfill sites, southern Franklin County, Ohio, by J.T. de Roche and A.C. Razem, 1981.

81-1105 Floodflow characteristics related to channel geometry in Ohio, by E.E. Webber and J.W. Roberts. 1981.

81-1195 Low-flow characteristics of Ohio streams, by D.P. Johnson and K.D. Metzker. 1981.

82-109 Potential impacts of a proposed reservoir on hydrologic and water-quality conditions in Little Rush Creek watershed, Fairfield County, Ohio, by Janet Hren and R.L. Jones. 1982.

82-170 Water resources of the Black Hand Sandstone Member of the Cuyahoga Formation and associated aquifers of Mississippian age in southeastern Ohio, by S.E. Norris and G.C. Mayer. 1982.

83-217 Drift mine reclamation in Big Four Hollow near Lake Hope, Ohio--A preliminary data report, by V.E. Nichols. 1983.

83-681 Guidelines for use of water-quality monitors, by A.B. Gordon and M.S. Katzenbach. 1983.

84-233 Hydrology of Area 11, Eastern Coal Province, Ohio, Kentucky, and West Virginia, by D.K. Roth and S.C. Cooper. 1984.

84-249 Chemical and biological quality of selected lakes in Ohio, 1978 and 1979, by C.G. Angelo and J.D. Youger. 1985.

84-470 Preliminary report on a study to establish flood volumes of small rural streams in Ohio--Methods, site selection, and data base, by J.M. Sherwood. 1985.

84-619 Literature review and need for additional study of surface-water quality in the Cuyahoga Valley National Recreation Area, Ohio, by C.J. Oblinger Childress. 1984.

84-824 Low-flow data for selected partial-record stations in Ohio, by R.R. Schwartz. 1985.

85-099 Occurrence of uranium in ground water in the vicinity of the U.S. Department of Energy Feed Materials Production Center, Fernald, Ohio, by A.C. Sedam. 1984.

85-194 Preliminary evaluation of magnitude and frequency of floods in selected small drainage basins in Ohio, by J.R. Kolva. 1985.

85-552 Sedimentation and water quality in the West Branch Shade River basin, Ohio, 1984 water year, by C.J. Oblinger Childress and R.L. Jones. 1985.

85-574 Water-quality data-collection activities in Colorado and Ohio: Phase I--Inventory and evaluation of 1984 programs and costs, by Janet Hren, T.H. Chaney, J. M. Norris, and C. J. Oblinger Childress. 1985.

85-639 Offstream water withdrawals by thermoelectric powerplants and public water supplies in Ohio. 1982, by Michael Eberle and J.A. McClure. 1986.

86-308 Water-Resources Activities in Ohio, 1986, by S.M. Hindall. 1986.

87-33 Water-quality data-collection activities in Colorado and Ohio: Phase II--evaluation of 1984 field and laboratory quality-assurance practices, by C.J. Oblinger Childress, T.H. Chaney, Donna Myers, J. M. Norris, and Janet Hren. 1987.

87-247 National and regional trends in water-well drilling in the United States, 1964-84, by S.M. Hindall and Michael Eberle. 1987.

88-128 Water fact sheet: U.S. Geological Survey ground-water studies in Ohio, by S.M. Hindall. 1988.

88-196 Water fact sheet: Water-resources activities in Ohio, 1988, by L.D. Camp. 1988.

Water-Resources Investigations Reports of the U.S. Geological Survey

Reports in this series are available for inspection at the Columbus, Ohio, and Reston. Virginia, offices of the U.S. Geological Survey. Information about purchasing these reports may be obtained from the District Chief. Water Resources Division, in Columbus.

17-73 Availability of water from limestone and dolomite aquifers in southwest Ohio and the relation of water quality to the regional flow system, by S.E. Norris and R.E. Fidler. 1973.

18-75 Digital model simulation of the glacial-outwash aquifer at Dayton, Ohio, by R.E. Fidler. 1975.

76-50 Time of travel of solutes in selected reaches of the Sandusky River basin, Ohio, 1972 and 1973, by A.O. Westfall. 1976.

77-23 Time of travel of solutes in the Tuscarawas River basin, Ohio, August and September 1974, by A.O. Westfall and E.E. Webber. 1977.

77-76 Water quality of the glacial-outwash aquifer in the Great Miami River basin, Ohio, by K.F. Evans. 1977.

77-105 Limnology of selected lakes in Ohio, 1975, by R.L. Tobin and J.D. Youger. 1977.

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Publications of the Ohio Department of Natural Resources, Division of Water, Prepared by or in Cooperation with the U.S. Geological Survey

These reports may be obtained from the Chief, Division of Water, who can furnish a more complete list of reports of the Ohio Department of Natural Resources, or they may be consulted in the offices of the Chief, Division of Water, or of the District Chief, Water Resources Division, U.S. Geological Survey, at the address given in this report.

Archer, R.J., 1960, Sediment discharge of Ohio streams during floods of January-February 1959: Miscellaneous Report 13.

Cross, W.P., 1961, Floods of January-February 1959 in Ohio: Bulletin 35.

----- 1963, Low-flow frequencies and storage requirements for selected Ohio streams: Bulletin 37.

----- 1964, Floods of March 1963 in Ohio: Bulletin 38.

----- 1964, Floods of March 1964 in Ohio: Bulletin 39.

----- 1965, Low-flow frequency and storage-requirement indices for Ohio streams: Bulletin 40.

----- 1966, Flood of July 23, 1965, in the vicinity of Hillsboro (Highland County), Ohio: Miscellaneous Report 16.

----- 1967, Drainage areas of Ohio streams, supplement to Gazetteer of Ohio streams: Inventory Report 12a.

----- 1968, Flow duration of Ohio streams, based on gaging-station records through 1965: Bulletin 42.

Cross, W.P., and Hedges, R.E., 1959, Flow duration of Ohio streams: Bulletin 31.

Cross, W.P., and Mayo, R.I., 1969, Floods in Ohio, magnitude and frequency--Supplement to Bulletin 32 (Cross and Webber, 1959): Bulletin 43.

Cross, W.P.and Webber, E.E., 1950, Ohio streamflow characteristics--Part 2, Water supply and storage requirements: Bulletin 13.

----- 1959, Floods in Ohio--Magnitude and frequency: Bulletin 32.

Cummins, J.W., and Sanderson, E.E., 1947, The water resources of Tuscarawas County, Ohio: (Ohio Water Resources Board) Bulletin 6.

Dove, G.D., 1960, Water resources of Licking County, Ohio: Bulletin 36.

----- 1961, A hydrologic study of the valley-fill deposits in the Venice area (Butler County), Ohio: Technical Report 4.

Hubble, J.H., and Collier, C.R., 1960, Quality of surface waters in Ohio, 1946-58: Inventory Report 14.

Kaser, Paul, and Harstine, L.J., 1965, Ground-water levels in Ohio, October 1959-September 1964: Bulletin 41.

Lamar, W.L., and Schroeder, M.E., 1951, Chemical character of surface waters in Ohio, 1946-50: Bulletin 23.

Norris, S.E., 1959, The water resources of Madison County, Ohio: Bulletin 33.

----- 1959, Vertical leakage through till as a source of recharge to a buried-valley aquifer at Dayton (Montgomery County), Ohio: Technical Report 2.

Norris, S.E., Cross, W.P., and Goldthwait, R.P., 1948, The water resources of Montgomery County, Ohio: (Ohio Water Resources Board) Bulletin 12.

----- 1950, The water resources of Greene County, Ohio: Bulletin 19.

Norris, S.E., Cross, W.P., Goldthwait, R.P., and Sanderson, E.E., 1952, The water resources of Clark County, Ohio: Bulletin 22.

Ohio Department of Natural Resources, Division of Water, 1970, Ground water for planning in northwest Ohio--A study of the carbonate rock aquifers: Inventory Report 22.

Schaefer, E.J.. White. G.W., and Van Tuyl, D.W., 1946, The ground-water resources of the glacial deposits in the vicinity of Canton (Stark County), Ohio: (Ohio Water Resources Board) Bulletin 3.

Schmidt, J.J., 1958, The ground-water resources of Franklin County, Ohio: Bulletin 30.

Smith, R.C., and White, G.W., 1953, The ground-water resources of Summit County, Ohio: Bulletin 27.

Walton, W.C., 1953, The hydraulic properties of a dolomite aquifer underlying the village of Ada (Hardin County), Ohio: Technical Report 1.

Walton, W.C., and Scudder, G.D., 1960. Ground-water resources of the valley-train deposits in the Fairborn area (Greene County), Ohio: Technical Report 3.

Winslow, J.D., White, G.W., and Webber, E.E., 1953, The water resources of Cuyahoga County, Ohio: Bulletin 26.

Other Publications

Address inquiries about availability of these reports and papers to the publishers.

Breen, K.J., 1988, Factors affecting major-ion chemistry of ground water in the Lockport Dolomite of northwestern Ohio, in 33rd Annual Midwest Ground Water Conference, Program with Abstracts: p. 2.

Cross, W.P., 1949, The relation of geology to dry-weather stream flow in Ohio: Transactions of the American Geophysical Union, v. 30, no. 4, p. 563-566.

Crouch, T.M., Collins, H.R., and Helgesen, J.O., 1980, Abandoned subsurface coal mines as a source of water for coal conversion in eastern Ohio: Ohio Department of Natural Resources Division of Geological Survey Report of Investigations 118.

Deutsch, Morris, Dove, G.D., Jordan, P.R., and Wallace, J.C., 1967. Ground-water distribution and potential in the Ohio River basin: U.S. Army Corps of Engineers, Ohio River Basin Comprehensive Survey, v. VII, app. E--Ground Water.

Dove, G.D., 1960, Drainage of the Teays-stage Mount Vernon and Cambridge Rivers: Ohio Journal of Science, v. 60, no. 2, p. 122-124.

----- 1962, Ground-water resources, in Geology of Fairfield County: Ohio Department of Natural Resources Division of Geological Survey Bulletin 60.

Eberts. S.M., and Bair, E.S., 1987, Effects of quarry dewatering on ground-water levels and landfill-leachate migration, southern Franklin County, Ohio. in 32nd Annual Midwest Ground Water Conference, Program with Abstracts: p. 9.

Feulner, A.J., 1961, Cyclic-fluctuation methods for determining permeability as applied to valley train in the Mad River valley in Champaign County, Ohio: Ohio Journal of Science, v. 61, no. 2, p. 99-106.

Feulner, A.J., and Hubble, J.H., 1960, Occurrence of strontium in the surface and ground waters of Champaign County, Ohio: Economic Geology, v. 55, no. 1, p. 176-186.

Hamon, W.R., Haghiri, Faz, and Knochenmus, Darwin, 1977, Research on the hydrology and water quality of watersheds subjected to surface mining, in Fifth Symposium on Surface Mining and Reclamation: Louisville, Ky., National Coal Association and Bituminous Coal Research, Inc., p. 37-40.

Hamon, W.R., Bonta- J.V., Haghiri, Faz, and Helgesen, J.O., 1979, Research on the hydrology and water quality of watersheds subjected to surface mining, I--Premining hydrology and water quality conditions, in Coal Conference and Expo V, Symposium on Surface Coal Mining and Reclamation. Louisville, Ky.: Coal Age, p. 70-98.

Helgesen, J.O., and Razem, A.C., 1980, preliminary observation of surface-mine impacts on ground water in two small watersheds in eastern Ohio, in Symposium on Surface Mining Hydrology, Sedimentation and Reclamation: Lexington, Kentucky, University of Kentucky and Institute for Mining and Minerals Research.

Helsel, D.R., and Pfaff, C.L., 1982, Surface-water quality in coal regions of Ohio. in Proceedings, Abandoned Mine Reclamation Symposium, St. Clairsville, Ohio, November 3-5, 1982: Soil Conservation Society of America, All-Ohio Chapter, p. 2/1-2/7.

Lamar, W.L., and Collier, C.R., 1956, Suspended sediment characteristics of Ohio streams: Journal of Soil and Water Conservation, v. 11, no. 5, p. 233-237.

Nichols, V.E., 1982, Drift mine reclamation in Big Four Hollow near Lake Hope, Ohio--An overview of preliminary data, in proceedings, Abandoned Mine Reclamation Symposium, St. Clairsville, Ohio, November 3-5, 1982: Soil Conservation Society of America, All-Ohio Chapter, p. 16/1-16/9.

Norris, S.E., 1948, The bedrock surface and former drainage systems of Montgomery County, Ohio: Ohio Journal of Science, v. 48, no. 4, p. 146-150.

----- 1951, The bedrock surface and the distribution of the consolidated rocks in Montgomery, Greene, Clark, and Madison Counties, Ohio: Ohio Journal of Science, v. 51, no. 1, p. 13-15.

----- 1957, Groundwater investigations--Problems faced by geologists in Ohio: Water Well Journal, July, 1957, p. 1-3.

----- 1957, Characteristics of limestone and dolomite aquifers in western Ohio: Journal of the American Water Works Association, v. 49, no. 4, p. 464-468.

----- 1959a, Minford silt and ground water quality in western Ohio: Journal of the American Water Works Association, v. 51, no. 9, p. 1170-1174.

----- 1959b, Buried topography and its relation to an important aquifer in Franklin County, Ohio: Ohio Journal of Science, v. 59, no. 6, p. 341-343.

----- 1967, Effects on ground-water quality and induced infiltration of wastes disposed into the Hocking River at Lancaster (Fairfield County), Ohio: Ground Water, v. 5, no. 3, p. 15-19.

----- 1967, The ground-water situation in Ohio: Ohio Chamber of Commerce.

----- 1969, The ground-water situation in Ohio: Ground Water, v. 7, no. 5, p. 25-33.

----- 1972, The use of gamma logs in determining the character of unconsolidated sediments and well construction features: Ground Water, v. 10, no. 6, p. 14-21.

----- 1975a, The ground-water situation in the Circleville area (Pickaway County), south-central Ohio: Ohio Department of Natural Resources Division of Geological Survey Report of Investigations 96.

----- 1975b, Geological structure of near-surface rocks in western Ohio: Ohio Journal of Science, v. 75, no. 5, p. 225-228.

----- 1976, Change in drawdown caused by enlarging a well in a dolomite aquifer: Ground Water, v. 14, no. 4, p. 191-193.

----- 1979, Hydraulic properties of a limestone-dolomite aquifer near Marion, north-central Ohio: Ohio Department of Natural Resources Division of Geological Survey Report of Investigations 110.

----- 1983a, Aquifer tests and well field performance, Scioto River valley, Ohio; Part I: Ground Water, v. 21, no. 3, p. 287-92.

----- 1983b, Aquifer tests and well field performance, Scioto River valley, Ohio; Part II: Ground Water, v. 21, no. 4, p. 438-44.

Norris, S.E., and Eagon, H.B., Jr., 1971, Recharge characteristics of a watercourse aquifer system at Springfield (Clark County), Ohio: Ground Water, v. 9, no. 1, p. 30-41.

Norris, S.E., and Fidler, R.E., 1966- Use of type curves developed from electric analog studies of unconfined flow to determine the vertical permeability of an aquifer at Piketon (Pike County), Ohio: Ground Water, v. 4, no. 3, p. 43-48.

Razem, A.C., 1982, Comparisons of premining, mining, and postmining ground-water conditions in three small watersheds in eastern Ohio: Geological Society of America Abstracts with Programs, v. 15, no. 7.

----- 1983, Ground-water monitoring of three small surface-mined watersheds of eastern Ohio (abstract): Ground Water Monitoring Review, v. 3, no. 1, p. 153.

Razem, A.C., and Helgesen. J.O., 1981, Preliminary observation of surface-mine impacts on ground water in two small watersheds in eastern Ohio (abstract), in Indiana Water Resources Second Annual Symposium, Spencer, Indiana.

Schneider. W.J., 1957, Relation of geology to streamflow in the Upper Miami basin: Ohio Journal of Science, v. 57, no. 1, p. 11-14.

Sheets, R.A., Bair, E.S., and Eberts, S.M., 1988, Determination of flow paths and traveltimes of contaminants from hypothetical spill sites surrounding a municipal well field, in 33rd Annual Midwest Ground Water Conference, Program with Abstracts: p. 20.

White, G.W., 1951, Illinoian and Wisconsin drift of the southern part of the Grand River lobe in eastern Ohio: Geological Society of America Bulletin, v. 62, no. 9, p. 967-977.

----- 1953, Sangamon soil and early Wisconsin loesses at Cleveland (Cuyahoga County), Ohio: American Journal of Science, v. 251, no. 5, p. 362-368.