SOME ASPECTS OF U.S. GEOLOGICAL SURVEY ACTIVITIES RELATED TO THE EFFECTS OF CONTAMINANTS ON WATER RESOURCES

By Bruce K. Gilbert, William B. Mann IV, and Philip A. Emery

U.S. GEOLOGICAL SURVEY
Open-File Report 87-574

Reston, Virginia
1987

DEPARTMENT OF THE INTERIOR

DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information
write to:

Asst. Chief Hydrologist for Operations
U.S. Geological Survey
441 National Center
12201 Sunrise Valley Drive
Reston, Virginia 22092

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CONVERSION FACTORS

The inch-pound units in this report may be converted to metric (International System) units by using the following factors:

Multiply inch-pound unit	By	To obtain metric unit
mile	1.609	kilometer
foot	0.3048	meter
pound	0.4536	kilogram
square mile	2.590	square kilometer

Some Aspects of U.S. Geological Survey Activities Related to the Effects of Contaminants on Water Resources

By Bruce K. Gilbert, William B. Mann IV, and Philip A. Emery

ABSTRACT

The U.S. Geological Survey has been collecting hydrologic data and conducting water-resources investigations and research since 1888. The Survey's water-resources programs are supported by direct annual appropriations from Congress, the Federal-State Cooperative Program (50:50 matching of funds), and by funds provided by other Federal agencies. For fiscal year 1987, total obligations exceeded $250 million for activities in every State, Puerto Rico, and several territories in cooperation with nearly 1,000 local, State, regional, and other Federal agencies.

The quality of the ground and surface waters has been of concern to the Geological Survey from the time it was established. During the past few years, water-resources contamination has received highest priority consideration and a variety of investigations and research are ongoing to obtain an improved understanding of the Nation's water-quality and the factors affecting it.

This report presents information on program priorities and discusses the coordinated activities focusing on the effects of contaminants on water-resources. The report also describes a number of investigations and research activities in progress during fiscal years 1986 and 1987, and provides guidance on how to obtain additional details.

INTRODUCTION

The U.S. Geological Survey is charged with providing hydrologic information and appraising the quantity, quality, and use of the Nation's water resources. Congress in 1879 established the Geological Survey; in 1888 Congress authorized the Survey to identify irrigable lands and sites appropriate for reservoirs and canals.

During fiscal year (FY) 1987, hydrologic-data collection (table 1) and interpretive investigations were underway in every State, Puerto Rico, and several territories in cooperation with almost 1,000 local, State, regional, and other Federal agencies. Increased emphasis has been given during the past 20 years to water-quality issues--particularly ground-water contamination, river-quality assessments, nonpoint-source runoff, and acid precipitation.

The Geological Survey's water-resources programs are supported by direct annual appropriations from Congress (Federal Program), through the cost sharing of the Federal-State Cooperative Program (50:50 matching of funds; the Survey's part of the funding is appropriated by Congress), and from reimbursable agreements with other Federal agencies (Other Federal Agency Program). During fiscal year 1987, obligations exceeded $250 million. Additional information regarding the Federal-State Cooperative Program, which provides more than 40 percent of the funding, can be found in reports by Gilbert and Buchanan (1981) and Gilbert and Mann (1987).

Health and safety, national defense, economic welfare, and environmental quality are all recognized as public responsibilities and are all related to water resources. Because the availability of water of suitable quality is so vital, there is sufficient universal interest to enable the Geological Survey to fulfill its water-resources mission in partnership with others. The mission is too large to be handled at either the Federal or the State level alone, so the need is increasing for cooperation and collaboration in focusing efforts on highest priority areas. The data and results of investigations are available to all; the Nation's ability to cope with new and challenging water-resources problems and issues depends largely on the pool of information developed during preceding years.

The quality of water supplies for domestic, industrial, and agricultural uses can affect human health as well as the economy. Considerable progress has been made in the identification and solution of complex water problems, but many activities continue to have the potential for degrading the quality of ground and surface water. In some places, disposal of toxic wastes has made ground water unsafe for use. At an isolated point source of contamination, such as an industrial disposal pond, the consequences may be severe in magnitude but only local in extent. In some places, however, many separate agricultural, urban, and industrial activities located over a large area are contributing to widespread

Table 1.--Water-data collection activities of the U.S. Geological Survey, fiscal year 1987

Types of Stations 1/	Number of Stations 2/ A. Federal Program	B. Federal-State Cooperative Program	C. Other Federal Agency Program	D. Combined Support	Total
SURFACE WATER					
Discharge					
Continuous record	481	3,158	1,575	1,786	7,000
Partial record	99	2,880	273	372	3,624
Stage only--Streams					
Continuous record	13	86	245	104	448
Partial record	1	166	28	34	229
Stage only--Lakes and Reservoirs					
Continuous record	12	274	277	216	779
Partial record	11	177	75	87	350
Quality					
Scheduled, long-term	389	1,109	330	357	2,185
Short-term or project	26	512	116	62	716
GROUND WATER					
Water Levels					
Scheduled, long-term	656	17,089	1,098	3,791	22,634
Short-term or project	1,157	4,202	1,061	3,534	9,954
Quality					
Scheduled, long-term	49	3,053	158	640	3,900
Short-term or project	560	3,475	730	455	5,220

1/Types of Stations

CONTINUOUS RECORD: The station is instrumented to monitor hydrologic conditions continually and, in some instances, to transmit data soon after collection.
PARTIAL RECORD: Hydrologic information is collected only during selected periods, for example, during floods.
SCHEDULED, LONG-TERM: Hydrologic information is collected on a fixed schedule for a long period to detect trends. With respect to surface-water quality and ground-water levels, continuous-recording stations are included in this category.
SHORT-TERM OR PROJECT: Hydrologic information is collected to meet the needs of a specific study. Data supplement those available from scheduled, long-term; continuous-record; and partial-record stations.

2/Number of Stations

COLUMN A - Stations totally supported by funds appropriated to the Geological Survey for the Federal Program.
COLUMN B - Stations partially supported by funds appropriated to the Geological Survey for the Federal-State Cooperative Program.
COLUMN C - Stations totally supported by reimbursements as part of the Other Federal Agency Program.
COLUMN D - Stations supported by a combination of two or more of the above.

contamination. The Nation's rivers have historically been used for water supply, irrigation, recreation, commerce, production of fish and other aquatic crops, and for dilution and transport of wastes. Not all these uses are compatible, and water managers and legislators are faced with resolving increasing conflicts.

Looking ahead to fiscal year 1988, the Geological Survey continues to identify water quality as its highest priority concern; this is anticipated to be reflected by activities in its Federal, Federal-State Cooperative, and Other Federal Agency Programs. Some of the issues in need of most attention are:

o Ground-Water Contamination--The effects of waste disposal, contamination by nonpoint sources, and saltwater encroachment; the movement and fate of contaminants in ground-water systems; flow dynamics, solute-transport processes, and the determination of present water-quality characteristics with which future data can be compared.

o Stream-Quality--Overland runoff, ground-water contribution of contaminants, occurrence and movement of toxic substances, effects of contamination on the stream environment and biota, and stream quality and sediment chemistry as related to land use and land-use changes.

o Water Supply and Demand--Stresses on the quantity and quality of existing supplies; and flow-system simulation to anticipate stress responses, particularly for stream-aquifer systems, and to provide information relative to problems of allocation and quality management. Improved information on water availability and use are vital to efforts to better understand water-quality issues.

Water-quality considerations continue to be of extreme importance in data collection and investigations of hydrologic effects of energy and mineral resource extraction; wetlands, lakes, and estuaries; and the chemistry of precipitation.

This report presents information on program priorities and discusses the coordinated activities focusing on the effects of contaminants on water-resources. The report also describes a number of investigations and research activities in progress during fiscal years 1986 and 1987, and provides guidance on how to obtain additional details.

PROGRAM PRIORITIES AND DEVELOPMENT

Program priorities are based on national needs that have been identified by the President and Administration advisors, by the Congress, by the Department of the Interior, by other Federal agencies, and from information that the Geological Survey has received from cooperating agencies and other interested parties. Issues that are identified through the National Water Summary (U.S. Geological Survey 1984, 1985, and 1986) are also taken into consideration. As a result, the priorities are developed in response to mutual local, State, regional, and Federal needs.

The Department of the Interior, in consultation with other Federal agencies and States, began a series of seven pilot studies in fiscal year 1986 to test and evaluate concepts for a National Water-Quality Assessment (NAWQA) Program to continue in its support of development of local, State, regional, and national policy related to water quality. The pilot NAWQA Program is envisioned to last 3-4 years at which time a determination would be made regarding the feasibility of expanding to a full-scale national effort. A full-scale national assessment would be based on the continuing water-quality activities of the Geological Survey, as well as those of other local, State, regional, and Federal agencies. A primary element in this effort is interagency coordination to ensure widespread usefulness of new data through consultation with participants and potential beneficiaries. Decisionmakers would be provided with timely, scientifically sound, and nationally consistent information on water-quality conditions and trends if the pilot studies are successful, and if it is decided to implement a NAWQA Program. The program approach currently being tested focuses on the quality of ground and surface water.

The Geological Survey has included water-quality activities in its programs virtually from the time the Survey was established. By the early 1900's (Durum, 1978) the Geological Survey was pursuing investigations of stream and ground-water contamination problems. Some sample reports produced at the time are "Sewage pollution in the metropolitan area near New York City and its effect on inland water resources" (Leighton, 1902), "Stream pollution by acid-iron wastes, ... Shelby, Ohio" (Stabler, 1906), and "Pollution of underground waters in limestone" (Matson, 1911).

Until 5 to 10 years ago, most of the Geological Survey's emphasis on contamination concerns was concentrated in the Federal-State Cooperative Program. The effects of urban and agricultural runoff, acid precipitation, industrial and sewage discharges, and the storage of wastes, for example, were topics of local urgency and were being investigated long before emerging as problems of national importance. However, the number of activities supported directly by the Geological Survey and other Federal agencies began to increase in the 1950's and has increased markedly since 1980. In addition to continuing to expand the substantial volume of background data, the variety of work that is underway will enable an improved understanding of the Nation's water quality and the factors affecting it. Included in the Geological Survey's Federal Program are investigations and research in:

o Acid Precipitation--To determine the characteristics and variability of atmospheric deposition nationwide, monitor water-quality changes in a number of susceptible lakes and streams resulting from acid deposition, and help predict the effects of increased or decreased pollutants in precipitation.

o National Water Quality Assessment Program--To describe the status and trends in the Nation's surface- and ground-water quality, improve the understanding of factors affecting water quality, and provide the basis to evaluate the likely effects of various proposed remedial and protective actions.

o Nuclear-Waste Hydrology--To determine the hydrologic and geologic conditions important for the shallow burial and containment of low-level radioactive wastes, and support the national effort to select and characterize sites where high-level radioactive wastes can be effectively isolated in suitable geologic environments.

o Regional Aquifer-System Analysis--To evaluate the availability and chemical quality of ground water in regional aquifers, understand the ground-water flow system, and provide information essential for development and management of water supplies.

o Toxic-Substances Hydrology--To provide earth-science information needed to improve waste-disposal practices and to help mitigate existing and future surface- and ground-water contamination problems.

o National Stream Quality Accounting Network--To provide a basis for continuously assessing the quality of major rivers in the Unites States with respect to both natural and human-induced factors.

o Hydrologic Research Program--To increase knowledge of fundamental processes that affect the movement of water and chemical constituents through hydrologic systems, and to improve the understanding of stresses on such systems.

o State Water Resources Research Institutes, and, National Water Resources Research Grants Programs--To provide grants for research related to major water-resources issues including water-quality deterioration, transport and fate of contaminants, and the reclamation of low-quality water.

A substantial and increasing proportion of work related to water-quality contamination problems also is being conducted by request and in support of the requirements and programs of other Federal agencies:

o Department of Defense--To determine the quantity and quality of water available at military installations, and to conduct investigations related to ground-water contamination from hazardous wastes.

o Department of Energy--To conduct research and investigations of hydrologic conditions and concepts at existing and potential nuclear-waste disposal sites.

o Department of the Interior--To participate in an interbureau effort to review present and potential water-quality concerns related to irrigation drainage at Department constructed or managed projects and at management areas that receive water from such projects. Also, assist Department bureaus that administer public land to investigate contamination from hazardous wastes.

o Environmental Protection Agency--To conduct investigations related to municipal waste-disposal sites, and provide hydrologic assistance with respect to toxic-waste cleanup activities.

Many other Geological Survey activities provide a constantly evolving base to help establish past conditions and to detect changes. The material in this report is provided to indicate the types of information available, to indicate what additional information may be available, and to provide assistance as to how to obtain further details. Much progress has been made in identifying contamination and improving water quality. Intensive efforts need to continue to develop a fuller understanding and more effective and economical solutions to the Nation's critical problems with the degraded quality of surface and ground water.

INVESTIGATIONS OF THE EFFECTS OF CONTAMINANTS ON WATER RESOURCES

Since the early 1900's, the Geological Survey has been conducting areal and research water-resources investigations, many of which are related to surface- and ground-water contamination. The authors estimate that between 600 and 1,000 such investigations were completed prior to fiscal year 1977.

During fiscal years 1977-1986, the Geological Survey had about 437 investigations concerned with water-resources contamination in progress at various times; about 220 were completed during this period. Of the 240 investigations in progress during fiscal year 1986, 217 continued into subsequent years. National, regional, or topical research activities accounted for about 10 percent of the total number of investigations, while 90 percent were conducted by field-office personnel in every State, Guam, and Puerto Rico. A directory of Geological Survey offices responsible for water-resources investigations is provided in Appendix A.

The geographic distribution of the completed and ongoing work during fiscal years 1977-86 is shown in figure 1. The investigations were supported by funding from the Geological Survey's Federal, Federal-State Cooperative, and Other Federal Agency Programs. During the period, the most investigations were conducted in Florida, 39; New York, 27; Kansas, 19; Pennsylvania, 18; and, California, Colorado, and New Jersey, 14 each. Only one investigation was conducted in each of the following States: Alabama, Delaware, South Dakota, Utah, Vermont, and West Virginia. The disparity among the numbers of investigations shown in various locations does not necessarily reflect the relative incidence of water-resources contamination. Many local, State, regional, and Federal agencies, as well as universities and private organizations, conduct hydrologic investigations and research in addition to the Geological Survey.

The number of investigations related to water-resources contamination that were underway each fiscal year, 1977 through 1986 is shown in figure 2. The number remained near 100 annually for the first one-half of the decade, but the number began to increase during fiscal year 1982 and reached 240 by fiscal year 1986. The most significant increase took place in the number of ground-water investigations, which increased from about 50 in progress annually during fiscal years 1977 to 1981 to more than 160 during fiscal year 1986.

The distribution of investigations and funding during fiscal year 1986, by sources of support, are shown in figure 3. Most of the investigations were conducted as part of the Federal-State Cooperative Program, but most of the funding was provided for investigations done under the Other Federal Agency Program. Expenditures for about 240 investigations are estimated to have been approximately $50 million. The average annual cost per investigation in fiscal year 1986 was about $210,000 in the Federal Program; $170,000 in the Federal-State Cooperative Program, (total including both matching shares), and $440,000 in the Other Federal Agency Program.

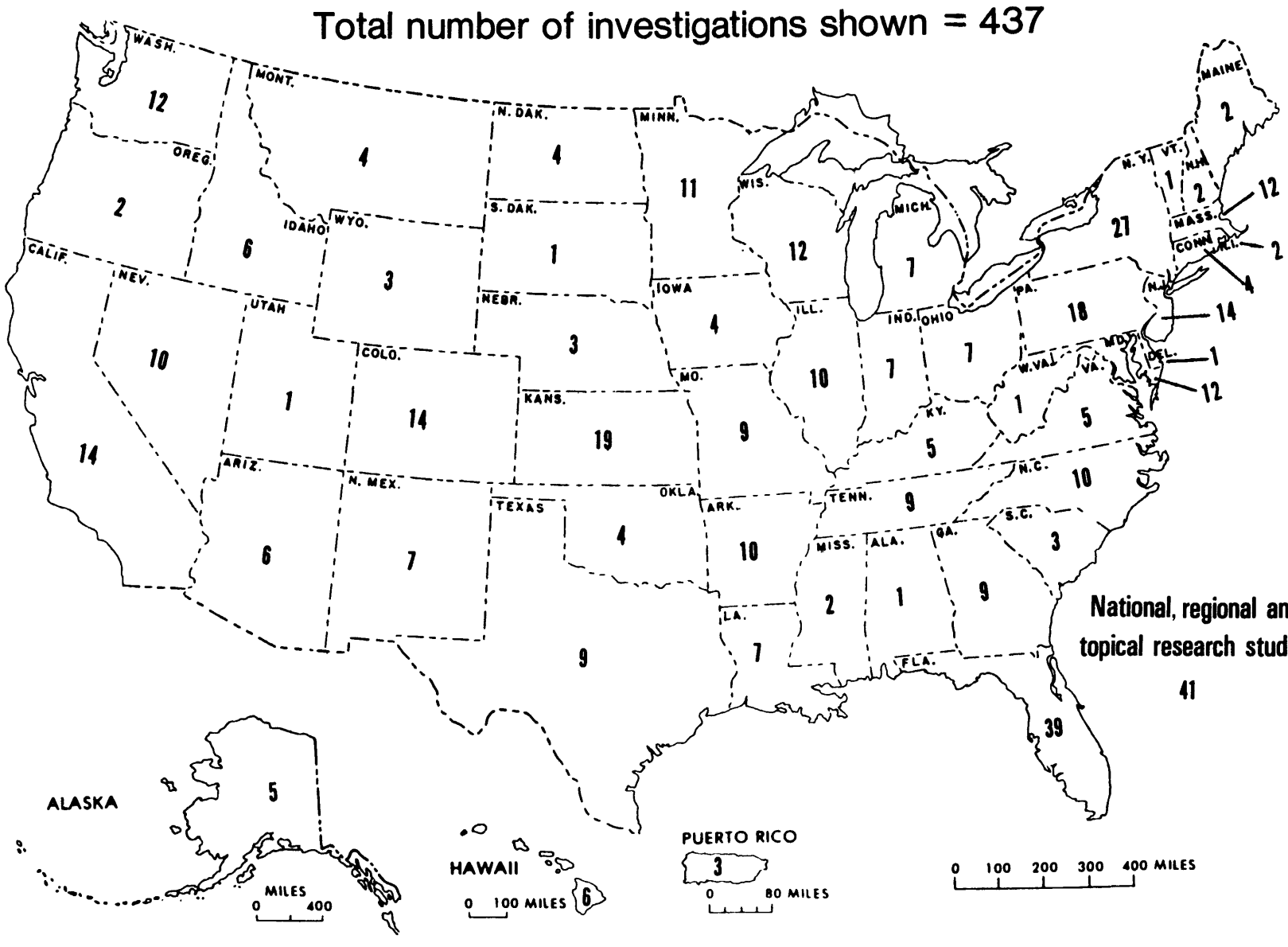

Figure 1.--Distribution of U.S. Geological Survey investigations and research during fiscal years 1977-1986 that were related to water-resources contamination.

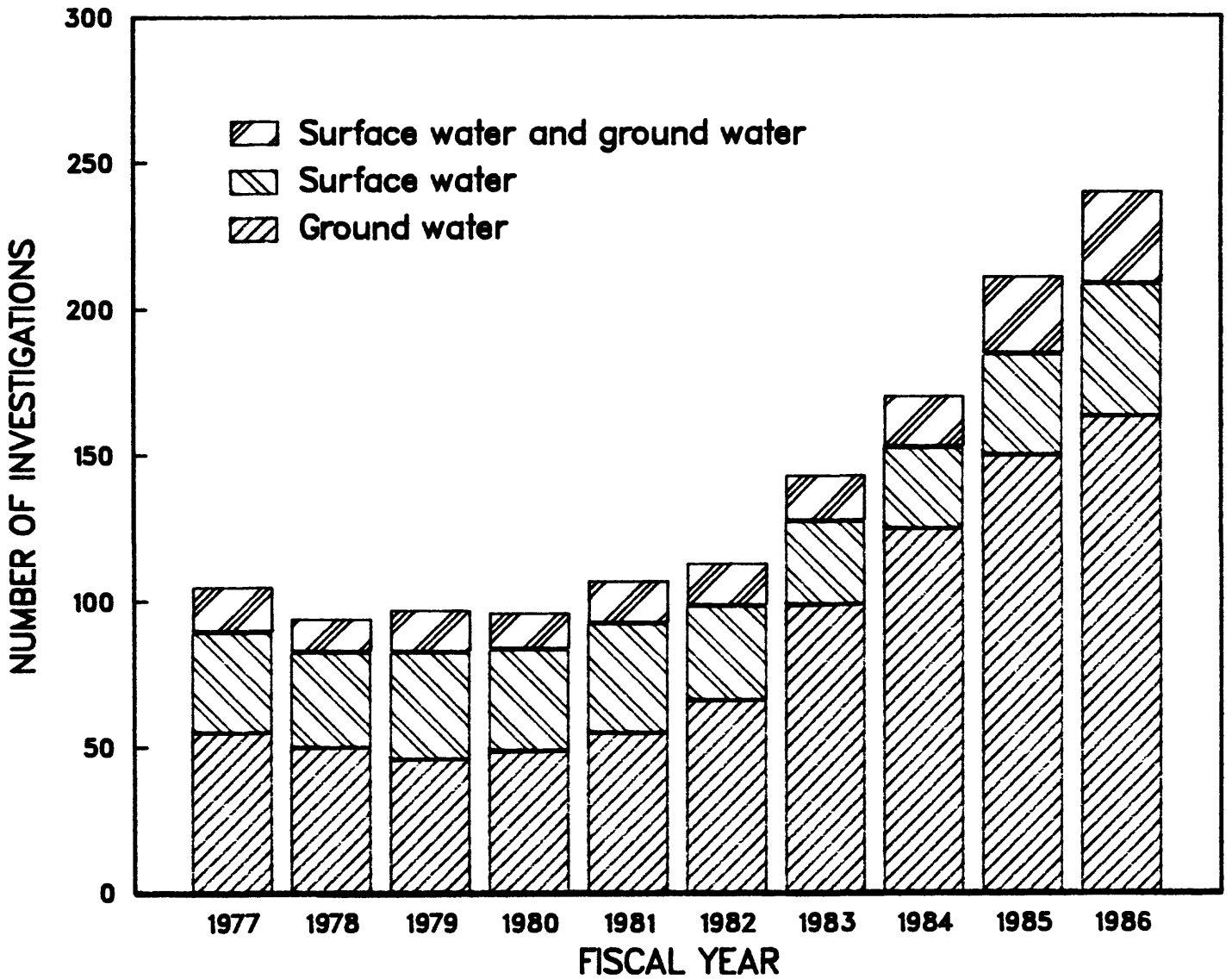

Figure 2.--Number of U.S. Geological Survey investigations related to water-resources contamination that were ongoing each fiscal year, 1977 through 1986.

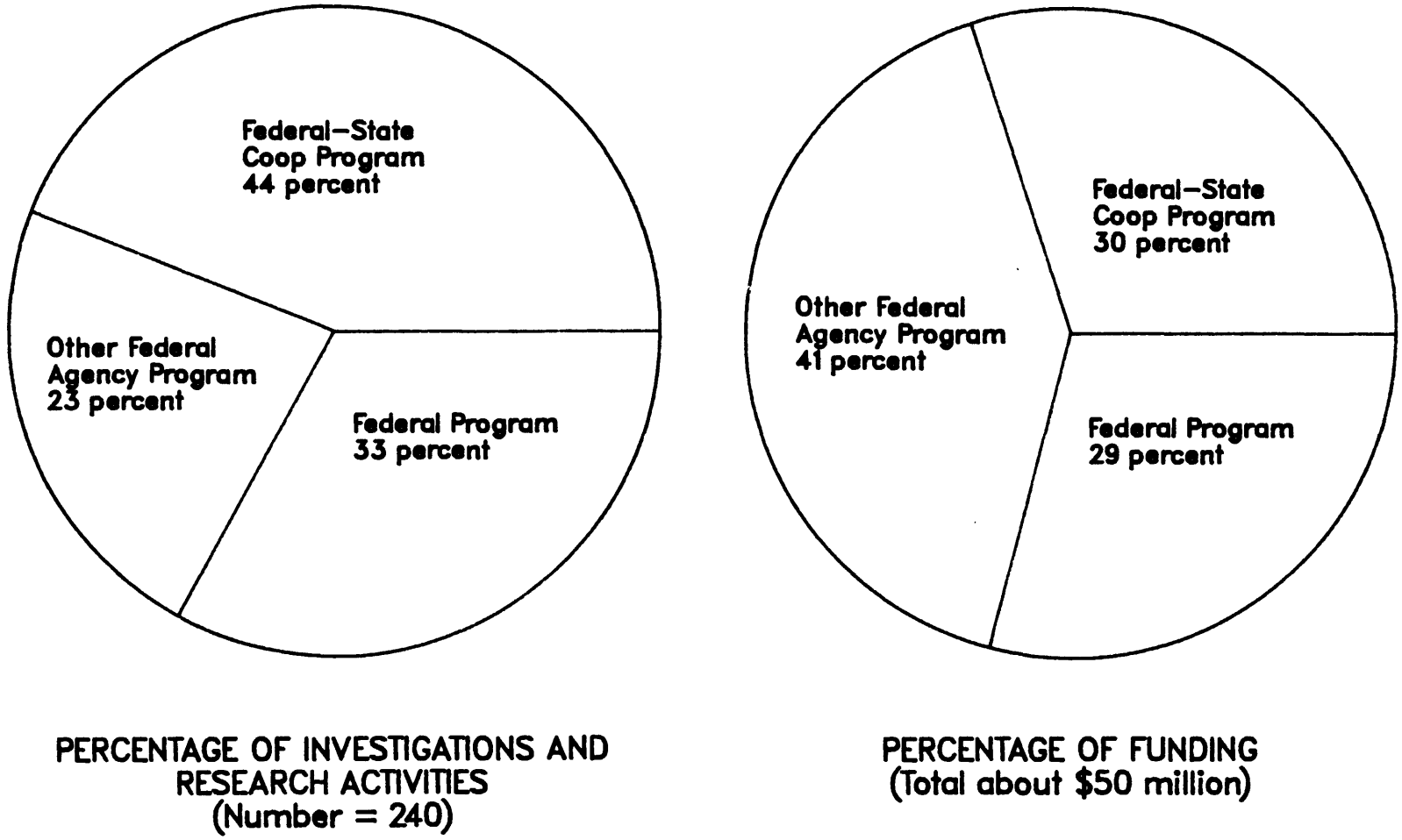

Figure 3.--Distribution of U.S. Geological Survey investigations and research related to water-resources contamination, and funding by sources of support, fiscal year 1986.

Approximately 55 percent of the Geological Survey's overall expenditures for water-resources programs are associated with investigations and research, and nearly 40 percent of those funds were spent for work related to surface- and ground-water contamination during fiscal year 1986. For fiscal year 1987, preliminary analyses indicate that the number of investigations conducted by the Geological Survey on water-resources contamination problems continues to increase. About 260 investigations are in progress. With total funds of about $60 million, the average annual cost per investigation is about $230,000.

The following few examples illustrate the wide diversity of the types of investigations underway during fiscal years 1986 or 1987 or both.

Ground-water contamination, lower Miami Wash and Pinal Creek basins near Globe, Arizona--An investigation by the Geological Survey, in cooperation with the Arizona Department of Health Services and the Salt River Valley Water Users Association, and partly funded by the Survey's Toxic Substances Hydrology Program, has identified a complex group of contaminants affecting both the surface and ground water near Globe. A plume of contaminated ground water more than 10 miles long and 250 feet thick along Miami Wash and Pinal Creek is extremely acidic, with large concentrations of dissolved metals, calcium, and sulfate. The plume is believed to be the result of the intensive copper mining and ore processing in the area during the past 70 years. The findings of the investigation are of special interest not only to local water users but also to those concerned with the quality of the Colorado River, which receives drainage from this hydrologic system.

Hydrology of the western San Joaquin Valley, California--In cooperation with the U.S. Bureau of Reclamation, the Geological Survey is conducting an investigation of the hydrology and geochemistry of western San Joaquin Valley. Shallow ground water in this productive agricultural area contains large concentrations of several potentially toxic trace elements, including selenium. Some of the contaminated water has moved to the land surface and adverse effects have been observed in exposed waterfowl. The area of contamination is extensive and the projected adverse effects of continued irrigation and drainage are considerable. The purpose of the investigation is to provide information for use by the U.S. Bureau of Reclamation in designing and evaluating remedial measures.

Water-quality evaluation of Pueblo Reservoir, Colorado--Water from Pueblo Reservoir is used for municipal, industrial, recreational, and agricultural purposes. The reservoir receives storm runoff, salt from irrigation return flows, mine drainage, municipal and industrial wastewater, spills from transportation activities, and contaminants from recreational activities. Increasing concerns about deterioration in taste and odor along with the potential for other water-quality problems, have led State and local agencies and the U.S. Bureau of Reclamation to request the Survey to study the physical, chemical and biological quality of water in the reservoir inflows, and outflows. A numerical model is being developed to simulate circulation patterns and stratification, to predict potential responses to various contaminants, and to evaluate management alternatives being considered by the U.S. Bureau of Reclamation.

Ground-water contamination probability in south Florida--Numerous studies have identified a direct relationship between land use and ground-water quality in south Florida where urban and agricultural areas overlie the shallow, unconfined aquifers. These aquifers provide nearly 90 percent of the potable water for the area. The Geological Survey is conducting an investigation, in cooperation with the South Florida Water Management District, to develop waste-hazard evaluation ratings using a geographic information system (GIS) as a data-base management tool. The objective of the investigation is to assess the contamination probability of the local aquifer systems. The hazard ratings produced by the GIS will include consideration of hydrogeologic characteristics, ground-water flow direction, time of travel, land use, and known sources of contamination. The resulting products will assist the South Florida Water Management District in designing ground-water monitoring networks, siting well fields, and assessing ground-water contamination probability.

Water quality of Cedar Creek, west-central Illinois--In cooperation with the Illinois Environmental Protection Agency, the Geological Survey is conducting an investigation to describe the low-flow water quality of Cedar Creek in west-central Illinois and to identify the effect of combined-sewer overflows and runoff from urban areas on the stream. Measurements of travel times and reaeration rates have been used to develop a numerical water-quality model, which is expected to have considerable value in applications elsewhere. Initial results indicate that substantial oxygen demands of sediment may be the primary cause of small dissolved-oxygen concentrations in the creek. Data are being collected to define the frequency and duration of overflows from combined-sewer overflow structures. Intensive monitoring of the quantity and quality of combined-sewer overflows, as well as flow from several storm sewers and tributaries, will be used by the Illinois Environmental Protection Agency in review and possible revision of current management practices and stream-quality standards.

Pesticides in soil and ground water, Iowa River basin, Iowa--Recently established programs for monitoring ground-water quality have detected the presence of numerous pesticides in shallow ground-water supplies throughout Iowa. Increasing concern about the leaching of agricultural chemicals into aquifers has sparked the need to understand the movement of these contaminants. Nearly 56 million pounds of herbicides are applied annually to cultivated fields in Iowa. In cooperation with the University of Iowa Hygienic Laboratory, the Geological Survey is evaluating the movement and distribution of selected pesticides in the cultivated-field environment. The specific objectives of the investigation are to determine the distribution of selected pesticides in the soil and the characteristics of pesticide movement from the land surface to shallow ground water.

Effects of pesticides in Tuttle Creek Lake, northeastern Kansas--Agricultural pesticides have been detected in Tuttle Creek Lake, a large multipurpose reservoir on the Big Blue River in northeastern Kansas. The lake is used for recreation, flood control, and maintenance of flow and water quality in the Kansas River. The lake also is being considered as a source of public-water supply. In addition to deleterious effects that might result from pesticides in potential drinking-water supplies, atrazine, an extensively used herbicide, is known to adversely affect

phytoplankton. An investigation being conducted by the Geological Survey, in cooperation with the Kansas Department of Health and Environment, is designed to document the occurrence and transport of pesticides in the lake-stream system, which is representative of hydrologic settings in many agricultural areas.

Effects of agricultural best management practices, Patuxent River basin, Maryland--Runoff of nutrients from agricultural areas in the Patuxent River basin markedly affects the water quality of the Chesapeake Bay. Best management practices proposed by the county Soil Conservation Districts to decrease the runoff of nutrients, may result in increased infiltration to the ground-water flow system. These practices may increase the concentration of nutrients in shallow ground water, which is the source of baseflow to streams and the bay. In cooperation with the Maryland Department of the Environment, the Geological Survey is conducting an investigation to determine the effects of best management practices on ground-water flow and nitrogen concentrations. Numerical models will be developed for flow analyses under actual conditions and under various land-management alternatives.

Sewage plume in ground water, Cape Cod, Massachusetts--In 1983, a sewage plume at Otis Air Force Base on Cape Cod was chosen for investigation because of its long history, its relatively simple hydrogeologic setting, and its similarity to many other sites throughout the Nation. Research in this setting is being conducted by the Geological Survey on the transport of solutes and on the processes by which the contaminants mix and react with the ground water. Improved understanding of these mechanisms will help in the development of accurate numerical models of contaminant transport in the subsurface.

Dioxin contamination in ground water, Missouri--The U.S. Environmental Protection Agency has requested the Geological Survey to participate in an investigation of six locations in Missouri where dioxin-contaminated oil was sprayed during the 1970's for dust control. Ground water at these sites will be evaluated to determine the degree of contamination and the potential for movement of the dioxin through the hydrologic system.

Nuclear waste storage investigations, Nevada--The U.S. Department of Energy is responsible for developing repositories for the permanent isolation of high-level nuclear wastes. The Geological Survey is conducting various hydrologic investigations as part of this activity. The Yucca Mountain area, located on and adjacent to the Nevada Test Site northwest of Las Vegas, is being evaluated as a possible repository. The geology and hydrology of the area are under study to assess the potential for transport of radionuclides away from the repository.

Geohydrology at Picatinny Arsenal, New Jersey--The U.S. Army has identified several incidents of water-resources contamination at Picatinny Arsenal, and has asked the Geological Survey for assistance in defining the severity and potential effects of the problem. An investigation is being conducted to determine the rate of movement and extent of plumes of contaminated ground water, and to seek supplemental sources of ground-water supply on the arsenal. The surface-water regime in the area also will be analyzed to evaluate the need for additional water-quality monitoring.

Hydrogeology of the Niagara Falls area, New York--The ground- and surface-water quality along the Niagara River has been degraded by contaminants from industrial plants and waste burial sites. The Geological Survey, at the request of the U.S. Environmental Protection Agency, is conducting an analysis of regional ground-water flow to evaluate the effects of this contamination on the water resources of both the United States and Canada. The hydrogeologic characteristics of the surficial materials and the bedrock in the area will be defined, the natural chemistry of the ground water will be described, and a numerical ground-water flow model of the system will be developed.

Highway deicing and ground-water quality in Ohio--Since 1940, the use of salt to deice highways has increased steadily. Recent evidence indicates that applied salt tends to accumulate in soil adjacent to highways and to cause detrimental effects on vegetation, wildlife, and water quality. A cooperative investigation involving the Geological Survey and the Ohio Department of Transportation is studying the long-term effects of salt applications on shallow aquifers underlying highways. The investigation will examine how different application rates alter ground-water quality. Results of the investigation will provide valuable insights for decisions by the State dealing with a balance between highway safety and environmental health.

Central Oklahoma aquifer pilot study--The Central Oklahoma aquifer underlies about 3,000 square miles of central Oklahoma. It is used for municipal, industrial, and domestic water supplies for most of the metropolitan area outside of Oklahoma City proper. Pumpage has increased markedly in recent years and water levels have declined but the principal threat to the aquifer is water-quality degradation. This investigation is part of the Geological Survey's National Water Quality Assessment Program, and has been designed to study water-quality problems, both natural and human related. The investigation also will develop, test, and improve methods for performing regional assessments of ground-water quality.

Islandwide survey of volatile organic compounds in ground water, Puerto Rico--In cooperation with the Puerto Rico Department of Health and the Puerto Rico Aqueduct and Sewer Authority, the Geological Survey conducted a comprehensive evaluation of volatile organic compounds in public supply wells throughout the island. Samples were analyzed from about 250 wells. The results indicate that water from 16 wells contained volatile organic compounds in concentrations that exceed proposed U.S. Environmental Protection Agency standards for drinking water and that water from an additional 50 wells contained traces of these compounds. Trichloroethylene was the most prevalent compound detected. This investigation provided factual information about organic contamination in public water sources and will assist the Commonwealth in the design of cleanup strategies in several critical areas.

Pesticides at North Hollywood dump, Memphis, Tennessee--The Geological Survey, in cooperation with the city of Memphis, is conducting an investigation of hazardous wastes at a closed municipal-industrial landfill. The study area is the North Hollywood dump, which is Tennessee's top-ranking site on the "Superfund" list of the U.S. Environmental

Protection Agency. The city of Memphis is particularly concerned with the possible contamination of the underlying aquifer, which provides drinking water for almost 1 million people. Toxic wastes of primary concern at the landfill are residues of pesticide manufacturing. These chemicals have been detected in local soils, sediments, biota, and ground and surface water. The goal of the investigation is to describe the present extent of contamination at the landfill and to estimate the potential for migration of toxic constituents outside the landfill.

Ground-water contamination at Kelly Air Force Base, Texas--As part of the U.S. Air Force's Installation Restoration Program, the Geological Survey is conducting an investigation of possible ground-water contamination at a waste burial pit and at an engine test site at Kelly Air Force Base. The type of material in the burial pit is presently unknown. The contaminants in the engine test area are believed to be those compounds associated with fuels and cleansing agents. The investigation is designed to determine the extent of contamination in the immediate areas of the study sites, to identify the compounds, and to provide additional geologic and hydrologic information to support development of remedial action plans for the entire base. The public health and environmental hazards and the potential movement of contaminants in the shallow ground-water system also will be addressed to the extent allowed by the available information.

Gasoline and diesel fuel spill, Yakima Valley area, Washington--The Geological Survey is conducting an investigation of ground water contaminated by gasoline and diesel fuel in the Yakima Valley area. Such contamination is a widespread problem for the Nation and the subject of new Federal regulations. The objective of the investigation is to develop additional understanding of the fate of petroleum products in the subsurface. Processes involving the movement and decomposition of these compounds in the unsaturated and saturated zones are being studied to aid in actions to mitigate the effects of similar spills.

Hydrochemical controls on the migration of radionuclides from uranium-mill tailings (nationwide)--Uranium-mill tailings and related forms of low-level radioactive waste contain naturally occurring radionuclides. After processing, the tailings and other materials have been disposed of in impoundments near land surface. The objectives of this research are to investigate the chemical form in which radionuclides are retained in surficial earth materials and to identify processes operating in natural water and land systems that may affect the transport of radionuclides.

Effects of toxic substances on aquatic communities (nationwide)--Standard methods are not available for evaluating the effects of small concentrations of toxic substances in surface-water ecosystems. This investigation is designed to determine the extent to which trace metals and stable organic compounds affect aquatic plants and animals. In addition, methods will be evaluated for assessing the effects of chronic exposures to toxicants on individual species and communities.

A list of selected Geological Survey investigations related to water-resources contamination is presented in Appendix B. Those investigations concerned with the effects of agricultural chemicals and practices on water resources are specifically identified in the list. This

has been done in recognition of the increasing awareness that nonpoint-source pollution associated with agriculture is emerging as an extremely important national issue.

COORDINATION WITH OTHERS

The Federal Government's responsibilities in water resources include planning, designing, constructing, and operating water projects; flood forecasting and warning services; water-supply planning; emergency response to critical water problems, such as floods, droughts, and hazardous-waste spills; water-pollution control; international treaties and interstate compacts relating to water resources; and many other water-related functions. The Department of the Interior, through the Office of Management and Budget's Circular A-67, coordinates water-data acquisition of the Federal Government. This responsibility is delegated to the Geological Survey. Federal agencies collect hydrologic data and conduct water-resources investigations and research inhouse; they also arrange for such services to be provided on a reimbursable basis by other Federal agencies.

The Federal-State Cooperative Program provides much of the Nation's information on the quantity, quality, and use of its water resources. Investigations proposed by cooperating local, State, or regional agencies clearly reflect the increase in emphasis on water quality and related issues. The priority of proposed investigations is developed in response to mutual, local, State, regional, and Federal needs. Representatives of the Geological Survey and other agencies jointly plan investigations, assuring both Federal and non-Federal priorities are considered.

The National Water Quality Assessment Program was begun by the Geological Survey in fiscal year 1987. The program presently (1987) consists of seven pilot studies, four surface water and three ground water. A primary element in a successful NAWQA Program is interagency coordination to ensure widespread usefulness of the results. The Department of the Interior and the Survey have participated in extensive consultation with representatives of other Federal agencies, State and local governments, and private organizations who are potential beneficiaries and participants in the NAWQA Program. Through these efforts, a sound framework is being developed that will ensure that the NAWQA Program is appropriately responsive to the information needs of the water-resources community.

OUTLOOK FOR THE FUTURE

The key concerns for the foreseeable future are ground-water quality, contamination from agricultural chemicals and practices, toxic pollutants, toxic-waste management, ground-water quality research, nonpoint-source pollution and other environmental-quality issues. The U.S. Environmental Protection Agency (1984) has published its Ground-Water Protection Strategy, which describes planned activities and identifies ground-water contamination as a major environmental issue of the 1980's. The Geological Survey places high priority on the Federal-State Cooperative Program, which provides technical assistance to local and State governments on ground-water contamination and related issues. This emphasis supports efforts such as the Environmental Protection Agency's Ground-Water Protection Strategy. Hydrologic information is needed increasingly at local, State, regional, and national levels to assist water managers in resolving increasing numbers of conflicts among water users.

ADDITIONAL INFORMATION

Further information with respect to the Geological Survey's geologic and hydrologic research related to the disposal and effects of radioactive wastes is provided by Dinwiddie and Trask (1986). Background information for these activities is provided, as are descriptions of investigations regarding high-level and transuranic wastes, low-level wastes, and uranium-mill tailings. Much of the research has been done in consultation with and on behalf of the U.S. Department of Energy and its predecessors. A substantial part of the research is concerned with techniques for characterizing disposal sites and studies of processes related to the retention and transport of radionuclides.

The Geological Survey's formal Toxic Waste--Ground-Water Contamination Program began in fiscal year 1982. A number of investigations are ongoing that provide the opportunity for researchers from a variety of disciplines to work at ground-water contamination sites. The proceedings of a meeting held in March 1987, edited by Franks (1987), describe some of the results and progress of these investigations. The proceedings also include a bibliography of the program.

The Geological Survey also has voluminous information resulting from water-resources data-collection activities and investigations that were not specifically designed to focus on water-contamination problems. Much of this information can be of considerable assistance in providing background, establishing a hydrologic framework, and describing various hydraulic, chemical, and physical characteristics of local or regional surface- or ground-water systems. Such knowledge is essential to the development of an understanding of the potential movement and reactions of hazardous wastes in the water environment. The purposes of the Regional Aquifer-System Analysis Program, for example, are to define the regional hydrology and geology, and to develop critically needed information on the Nation's important aquifers. A report, edited by Sun (1986), summarizes the status and results of the investigations under this program from 1978 through 1984.

In addition to reporting investigative accomplishments to cooperating agencies at local, State, regional, and national levels, the Geological Survey disseminates water data and the results of investigations through reports, computerized information services, and other forms of public releases. Hydrologic data are contained in an annual series of reports published for each State, and interpretive and analytical material is published in a variety of media. Many of these reports are listed in Survey catalogs of publications, and information on other reports published elsewhere can be provided by the Geological Survey offices listed in Appendix A.

Requests for general information on water resources of an area or the Nation, on published reports, or on the water-resources activities of the Geological Survey can be addressed to the appropriate office in the area of interest listed in Appendix A. Questions regarding policy and programs may be addressed to the Chief Hydrologist or to the Regional Office in the area of interest.

Data collected from hydrologic-data sites also is stored in the U.S. Geological Survey National Water Data Storage and Retrieval System (WATSTORE) and is available on request. WATSTORE files contain 220 million values including streamflow, reservoir contents, lake stage, stream sediment, and ground-water level data; 2.5 million chemical, physical, biological, and radiochemical analyses of surface and ground water; and, hydrologic and geologic data on 900,000 inventoried wells. These data can be retrieved in machine-readable form or as computer-printed tables or graphs, statistical analyses, and digital plots. In addition, the National Water Data Exchange (NAWDEX) is a confederation of Federal and non-Federal water-oriented organizations working together to improve access to water data. The offices listed in Appendix A can provide local assistance in obtaining data from WATSTORE and in identifying other sources of information through NAWDEX.

Report titles and abstracts on various topics and geographic areas can be obtained from the Water Resources Scientific Information Center (WRSIC), which is a national program for acquisition, indexing, and abstracting of scientific and technical literature in the water-resources field, and for dissemination of information about this literature. The computerized WRSIC file consists of about 175,000 abstracts and is used as the authoritative bibliographic data base on water resources in the United States. The mailing address of the WRSIC office is listed in Appendix A.

SUMMARY

The U.S. Geological Survey has been providing information on the quantity and quality of the Nation's water resources since 1888. Investigations focusing on problems resulting from contamination of surface and ground water began in the early 1900's. The Geological Survey also has voluminous information resulting from hydrologic data-collection activities and investigations not specifically emphasizing the effects of water contamination. Together, this body of knowledge can be of considerable assistance in understanding the potential fate of hazardous wastes in the water-resources system.

This report describes the types of information available and the nature of ongoing activities. The report also provides information on how to obtain further details, when needed. Much progress has been made in identifying water-resources contamination and its effects. Continued efforts are needed to prevent water-quality degradation and to develop effective and economical remedial actions where needed.

Geological Survey activities in the Federal, Federal-State Cooperative, and Other Federal Agency Programs take place on a nationwide basis. Thus, the development of priorities and the conduct of the data collection, investigations, and research are done to reflect a coordinated response to local, State, regional, and national needs. Today, the quality of surface and ground water is one of the principal concerns in the United States and as a result, tops the list of the Geological Survey's priorities for water-resources programs. In addition to the continuing expansion of collecting hydrologic data, investigations and research presently are ongoing to assess the mechanisms and effects of water-resources contamination. Hydrologic data and the results of investigations and research are made available through reports, computerized information services, and other forms of public releases.

During fiscal years 1977-86, the Geological Survey had about 437 investigations concerned with water-resources contamination in progress at various times. About 240 of these investigations were ongoing in fiscal year 1986, with a total funding of about $50 million during that year. This represents about 40 percent of the Geological Survey's expenditures on water-resources investigations and research. The number of investigations conducted by the Geological Survey on water-resources contamination continues to increase; during fiscal year 1987, about 260 investigations are in progress, with funding of about $60 million.

SELECTED REFERENCES

Dinwiddie, G. A., and Trask, N. J., 1986, U.S. Geological Survey research in radioactive waste disposal--Fiscal years 1983, 1984, and 1985: U.S. Geological Survey Water-Resources Investigations Report 87-4009, 109 p.

Durum, W. H., 1978, Historical profile of quality of water laboratories and activities, 1879-1973, Part 2, History of water quality activities: U.S. Geological Survey Open-File Report 78-432, 152 p.

Franks, B. J., ed., 1987, U.S. Geological Survey program on toxic waste--Ground-water contamination: Proceedings of the Third Technical Meeting, Pensacola, Florida, March 23-27, 1987: U.S. Geological Survey Open-File Report 87-109, 214 p.

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Matson, G. C., 1911, Pollution of underground waters in limestone, in Fuller, M. L., Clapp, F. G., Matson, G. C., Sanford, Samuel, and Wolff, H. C., Underground-water papers, 1910: U.S. Geological Survey Water-Supply Paper 258, p. 48-56.

Ragone, S. E., ed., in press, U.S. Geological Survey Toxic Waste--Ground-Water Contamination Program - Fiscal Year 1986: Program overview and selected abstracts presented at the Toxic Waste Program technical meeting, Cape Cod, Mass., October 21-25, 1985: U.S. Geological Survey Open-File Report 86-481.

Ragone, S. E., and Sulam, D., eds., in press, U.S. Geological Survey Toxic Waste--Ground-Water Contamination Program - Fiscal Year 1984: Program overview and selected papers presented at the first technical meeting, Tucson, Ariz., March 20-22, 1984: U.S. Geological Survey Open-File Report 86-324.

Smith, J. A., Witkowski, P. J., and Fusillo, T. V., 1987, Manmade organic compounds in the surface waters of the United States; A review of current understanding: U.S. Geological Survey Open-File Report 87-209, 182 p.

Stabler, Herman, 1906, Stream pollution by acid-iron wastes--A report based on investigations made at Shelby, Ohio: U.S. Geological Survey Water-Supply Paper 186, 36 p.

Sun, R. J. ed., 1986, Regional Aquifer-System Analysis Program of the U.S. Geological Survey--Summary of projects, 1978-84: U.S. Geological Survey Circular 1002, 264 p.

U.S. Congress, Office of Technology Assessment, 1987, From pollution to prevention--A progress report on waste reduction: Special report OTA-ITE-347, 54 p.

U.S. Environmental Protection Agency, 1984, Ground-water protection strategy, 56 p.

U.S. Geological Survey, 1984, National water summary 1983--Hydrologic events and issues: U.S. Geological Survey Water-Supply Paper 2250, 243 p.

U.S. Geological Survey, 1985, National water summary 1984--Hydrologic events, selected water-quality trends, and ground-water resources: U.S. Geological Survey Water-Supply Paper 2275, 467 p.

U.S. Geological Survey, 1986, National water summary 1985--Hydrologic events and surface-water resources: U.S. Geological Survey Water-Supply Paper 2300, 506 p.

Appendix A.--*Directory of U.S. Geological Survey offices responsible for water-resources investigations*

Inquiries about water-resources information for a particular State should be referred to the U.S. Geological Survey office at the appropriate address shown below. Questions regarding multistate and national programs or policy matters should be addressed to the Chief Hydrologist or to one of the Regional Hydrologists listed.

CHIEF HYDROLOGIST
409 National Center
Reston, Virginia 22092

HYDROLOGIC INFORMATION UNIT
419 National Center
Reston, Virginia 22092

WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC)
425 National Center
Reston, Virginia 22092

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

Regional Hydrologist
433 National Center
Reston, VA 22092

SOUTHEASTERN REGION
Alabama, Arkansas, Florida Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, Virgin Islands

Regional Hydrologist
Richard B. Russell Federal Bldg.
75 Spring Street, SW, Suite 772
Atlanta, GA 30303

CENTRAL REGION
Colorado, Iowa, Kansas, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, Wyoming

Regional Hydrologist
Mail Stop 406, Box 25046
Denver Federal Center
Lakewood, CO 80225

WESTERN REGION
Alaska, Arizona, California, Guam, Hawaii, Idaho, Nevada, Oregon, Washington

Regional Hydrologist
345 Middlefield Road, MS 470
Menlo Park, CA 94025

Appendix A.--*Directory of U.S. Geological Survey offices responsible for water-resources investigations--continued*

ALABAMA
520 19th Avenue
Tuscaloosa, AL 35401

ALASKA
4230 University Drive, Suite 201
Anchorage, AK 99508

ARIZONA
Federal Building, Room 300
West Congress Street, FB-44
Tucson, AZ 85701

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

CALIFORNIA
Federal Building, Rm. W-2234
2800 Cottage Way
Sacramento, CA 95825

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

CONNECTICUT
Abraham A. Ribicoff Fed. Bldg.
450 Main Street, Room 525
Hartford, CT 06103

DELAWARE
Federal Building, Room 1201
300 S. New Street
Dover, Delaware 19901

DISTRICT OF COLUMBIA
See "MARYLAND" Listing

FLORIDA
227 N. Bronough St., Suite 3015
Tallahassee, FL 32301

GEORGIA
6481 Peachtree Industrial Blvd.
Suite B
Doraville, GA 30360

GUAM
See "HAWAII" Listing

HAWAII
P.O. Box 50166, Room 6110
300 Ala Moana Boulevard
Honolulu, HI 96850

IDAHO
230 Collins Road
Boise, ID 83702

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

INDIANA
5957 Lakeside Boulevard
Indianapolis, IN 46278

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

KANSAS
1950 Constant Avenue-Campus West
Lawrence, KS 66046

KENTUCKY
2301 Bradley Avenue
Louisville, KY 40217

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

MAINE
26 Ganneston Drive
Augusta, Maine 04330

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

MASSACHUSETTS
150 Causeway Street, Suite 1309
Boston, MA 02114

MICHIGAN
6520 Mercantile Way, Suite 5
Lansing, MI 48911

Appendix A.--*Directory of U.S. Geological Survey offices responsible for water-resources investigations--continued*

MINNESOTA
Post Office Bldg., Room 702
St. Paul, MN 55101

MISSISSIPPI
Federal Office Bldg., Suite 710
100 West Capitol Street
Jackson, MS 39269

MISSOURI
1400 Independence Road, MS 200
Rolla, MO 65401

MONTANA
301 South Park Avenue
Federal Building, Drawer 10076
Helena, MT 59626

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

NEVADA
Federal Building, Room 224
705 North Plaza Street
Carson City, NV 89701

NEW HAMPSHIRE
525 Clinton Street, RFD 12
Bow, NH 03301

NEW JERSEY
Mountain View Office Park
810 Bear Tavern Rd., Suite 206
Trenton, NJ 08628

NEW MEXICO
Pinetree Office Park, Suite 200
4501 Indian School Road, NE
Albuquerque, NM 87110

NEW YORK
P.O. Box 1669
343 U.S. Post Office and
Courthouse Building
Albany, NY 12201

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

NORTH DAKOTA
821 Interstate Avenue
Bismarck, ND 58501

OHIO
975 West Third Avenue
Columbus, OH 43212

OKLAHOMA
215 Dean A. McGee St., Room 621
Oklahoma City, OK 73102

OREGON
847 NE 19th Avenue, Suite 300
Portland, OR 97232

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

PUERTO RICO
G.P.O. Box 4424
San Juan, PR 00936

RHODE ISLAND
Room 237, John O. Pastore
Federal Bldg & U.S. Post Office
Providence, RI 02903

SOUTH CAROLINA
1835 Assembly Street, Suite 677A
Columbia, SC 29201

SOUTH DAKOTA
200 Fourth Street, SW
Federal Building, Room 317
Huron, SD 57350

TENNESSEE
Federal Bldg. & U.S. Courthouse
Room A-413
Nashville, TN 37203

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

Appendix A.--*Directory of U.S. Geological Survey offices responsible for water-resources investigations--continued*

UTAH
Administrative Bldg., Room 1016
1745 West 1700 South
Salt Lake City, UT 84104

VERMONT
See "NEW HAMPSHIRE" Listing

VIRGIN ISLANDS
See "PUERTO RICO" Listing

VIRGINIA
3600 West Broad Street, Rm. 606
Richmond, VA 23230

WASHINGTON
1201 Pacific Avenue, Suite 600
Tacoma, WA 98402

WEST VIRGINIA
603 Morris Street
Charleston, WV 25301

WISCONSIN
6417 Normandy Lane
Madison, WI 53719

WYOMING
P.O. Box 1125
Cheyenne, WY 82003

Appendix B--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

[Note: Asterisk (*) following project number indicates investigation related to the effects of agricultural chemicals or practices on water resources. Principal emphasis--GW, ground water; SW, surface water.]

Part 1. Investigations conducted in field offices

	Project number	Title	Period of study	Principal emphasis
ALABAMA	AL 85-062	Delineation of aquifers and recharge areas in Alabama	8/85 to 9/87	GW
ALASKA	AK 75-094	Hydrologic studies and data collection related to water availability and quality for Alaskan Air Command	7/74 to 1/77	SW-GW
	AK 76-100	Hydrologic problems related to construction of Trans-Alaska Pipeline System	7/75 to 6/77	SW
	AK 86-163	Ground-water contamination in glacial materials: Methods of investigation	10/85 to 9/87	GW
	AK 86-168	Ground-water conditions at landfills in the Matanuska-Susitna Borough	2/86 to 9/87	GW
	CR 67-160	See Central Region listing in part 2		
ARIZONA	AZ 72-029	Ground-water resources of southern Navajo County	7/71 to 6/74	GW
	AZ 80-066*	Ground-water/surface-water relationships in the Verde Valley, Yavapai County	7/80 to 7/83	SW-GW
	AZ 81-069	Urban rainfall-runoff and runoff modeling in an arid climate, Tucson metropolitan area, Pima County	7/81 to 9/93	SW
	AZ 84-078	Distribution and movement of trichloroethylene in ground water in Tucson area	10/83 to 12/84	GW
	AZ 84-081	Movement and contaminants in ground water, lower Miami Wash and Pinal Creek basins near Globe	4/84 to 9/87	GW
	AZ 86-091	Water resources of the Bisbee-Naco area, Cochise County	10/85 to 9/87	GW
	AZ 86-097*	Irrigation drainage quality activities for Lower Colorado and Gila River Valley Projects	9/85 to 9/87	SW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
ARKANSAS	AR 70-021	Time-of-travel studies of Arkansas streams	7/69 to 9/82	SW
	AR 79-035*	Water-quality assessment of the L'Anguille River basin	10/78 to 9/79	SW
	AR 80-038	Stream water-quality modeling of selected streams in Arkansas	10/79 to 9/81	SW
	AR 80-039	Water-quality modeling of the lower Quachita River and selected tributaries	10/79 to 9/84	SW
	AR 82-044	West Gulf Coast Regional Aquifer Systems Analysis (RASA), Arkansas subproject	3/82 to 9/87	GW
	AR 82-045	A reconnaissance study of saltwater contamination in the Sparta Sand aquifer, south-central Arkansas	3/82 to 1/83	GW
	AR 83-046	A reconnaissance study of saltwater contamination in the alluvial and Sparta Sand aquifers, Brinkley area	10/82 to 9/85	GW
	AR 83-047	Reconnaissance study of saltwater contamination in the Mississippi River alluvial aquifer in Chicot, Desha, and Lincoln Counties	6/83 to 9/84	GW
	AR 85-051	Geohydrologic characteristics of the Sparta aquifer in south-central Arkansas	1/85 to 9/87	GW
	AR 85-053	A proposed ground-water protection strategy for Arkansas	9/85 to 9/87	GW
CALIFORNIA	CA 71-231	Water quality degradation of ground water Basin, Barstow area	7/70 to 6/73	GW
	CA 71-242	Mercury investigation and monitoring program relative to Warm Springs Dam construction in Dry Creek basin tributary to Russian River	1/71 to 6/71	SW-GW
	CA 72-258	Infiltration study near the city of Mt. Shasta, Siskiyou County	8/71 to 12/72	GW
	CA 72-277	Barstow water quality model	7/71 to 1/73	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	CA 78-349*	Ground-water quality in the Santa Ana River basin	10/77 to 9/79	GW
	CA 80-369	Investigation of gasoline contamination of ground water at Stovepipe Wells, Death Valley National Monument	10/79 to 9/80	GW
	CA 81-389	Characterization of urban runoff in Fresno	10/80 to 9/86	SW
	CA 83-414	Giardia Lamblia--Viability and detection in waters of the alpine and sub-alpine regions of the Sierra Nevada	10/82 to 9/87	SW
	CA 83-416	Fuel spill at the U.S. Marine Corps Air Station at Tustin	4/83 to 9/85	GW
	CA 84-424	Southern California Regional Aquifer System Analysis	10/83 to 9/85	GW
	CA 84-428*	Central Valley RASA II	1/85 to 9/90	GW
	CA 84-441*	An assessment of quality and contaminant transport in the soils and ground water of the San Luis Project service area	10/83 to 9/86	GW
	CA 85-455	Hydrologic evaluation of a gasoline leak at the Seal Beach Naval Weapons Station	10/84 to 9/86	GW
	CA 85-456*	Western San Joaquin Valley hydrologic studies	10/84 to 9/89	SW-GW
	CA 86-458	Effects of urban storm runoff on receiving soils and ground water in Fresno	10/85 to 9/90	GW
	CA 86-462*	Irrigation drainage field-reconnaissance study, Salton Sea area	5/86 to 9/87	SW
	CA 86-463*	Irrigation drainage field-reconnaissance study, Tulare Lake	5/86 to 9/87	SW
	CA 86-464	Ground-water quality in the Bunker Hill basin, San Bernardino Valley	10/85 to 9/87	GW
COLORADO	CO 72-044	Description of the hydrology of the Rocky Flats plant site	5/72 to 6/77	SW-GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	CO 72-046	Transport and dispersion of contaminants in a shallow ground-water aquifer	9/71 to 6/77	GW
	CO 75-073	Monitoring of storm runoff quality, Denver metropolitan area	1/75 to 9/82	SW
	CO 76-078*	Water quality and availability in Boulder County	7/75 to 10/77	SW-GW
	CO 77-097	Effects of sludge land disposal on ground-water quality	5/77 to 9/88	GW
	CO 79-121	Reconnaissance of ground water contamination by landfill leachate	2/79 to 9/81	GW
	CO 80-133	Traveltime and reaeration study along selected stream reaches in coal producing areas of Colorado	2/80 to 9/83	SW
	CO 84-180*	Sources and movement of hazardous waste in a heavily-used stream-aquifer system	4/84 to 9/87	SW-GW
	CO 84-184	An update of fluvial-sediment discharge to the oceans from the United States	4/84 to 9/87	SW
	CO 85-197*	Ground-water quality effects of soil application of sewage sludge on farmland near Denver	10/84 to 9/88	GW
	CO 85-198*	Comprehensive water-quality evaluation of Pueblo Reservoir, including the effects of potential contamination	3/85 to 9/89	SW
	CO 85-204	Geohydrology and quality of ground water in the Lincoln Park area, Canon City	12/84 to 9/86	GW
	CO 85-209*	Water-quality evaluation, Pueblo Reservoir	3/85 to 9/89	SW
	CO 86-217	Mechanisms of stream recovery from metal contamination	2/86 to 9/89	SW
CONNECTICUT	CT 77-017*	Significant changes in ground-water quality in Connecticut as a result of human activities	1/77 to 9/78	GW
	CT 84-051*	Relationships between land use and ground-water quality in stratified-drift aquifers in Connecticut	7/84 to 9/87	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	CT 85-053	Hydrogeologic investigation of the characteristics of glacial tills in Connecticut	3/85 to 9/88	GW
	CT 87-055*	Effect of pesticides on ground-water quality in Connecticut	10/86 to 9/89	GW
DELAWARE	DE 85-019*	Geochemistry of water in the unconfined aquifer in eastern Sussex County, Delaware with emphasis on the occurrence and distribution of iron and nitrate problems	10/84 to 9/87	GW
FLORIDA	FL 68-090	Water resources, Lee County	7/67 to 9/81	SW-GW
	FL 69-117	Remote sensing, Alafia and Peace River basins	7/68 to 6/72	GW
	FL 69-124	Effects of man-made contaminants on water resources of Broward County	9/68 to 9/79	SW-GW
	FL 71-139	Hydrology of the sand and gravel aquifer, Pensacola	7/71 to 9/82	GW
	FL 71-153	Hydrologic and biologic studies of southwest Florida	7/70 to 7/72	GW
	FL 72-165	Effects of septic tank effluent on ground-water quality in Dade County	10/71 to 9/74	GW
	FL 72-184	Water quality management plan for Jacksonville	3/72 to 6/73	SW-GW
	FL 74-202	Effects of solid waste land fills on ground water quality, Dade County	7/73 to 6/76	GW
	FL 74-216	Investigation of contaminants in storm water runoff in Broward County	11/73 to 6/78	SW
	FL 75-242*	Preliminary evaluation of hydrologic conditions in Manatee County	10/74 to 10/77	SW-GW
	FL 76-265*	Water supply assessment and evaluation of the Hillsborough River basin	10/75 to 9/80	SW
	FL 77-282	Water resources of the Fort Walton Beach area	6/77 to 5/80	GW
	FL 77-283	Storm-water runoff quality in a multiple-family residential area	4/77 to 6/78	SW
	FL 77-287	Biscayne aquifer--A sole-source evaluation	9/77 to 2/78	GW
	FL 78-291	Geohydrology of drainage wells	10/77 to 9/82	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

Project number	Title	Period of study	Principal emphasis
FL 78-305	Impact of traffic related contaminants on the Miami canal, Dade County	4/78 to 9/81	SW
FL 79-307	Apalachicola River Quality Assessment	10/78 to 9/83	SW
FL 79-309	Pollution to Floridan aquifer, western Lake County area: phase I	10/78 to 9/82	GW
FL 79-320	Impact of phosphate industry activities on ground-water in Florida	6/79 to 12/81	GW
FL 81-361	Impact of industrial wastewater impoundments on ground water	3/81 to 6/82	GW
FL 81-362	Evaluation of stormwater detention basins in the Tampa Bay area, west-central Florida	10/80 to 9/90	SW
FL 81-377	Environmental assessment of the Charlotte Harbor estuarine system, southwest Florida	5/81 to 6/89	SW
FL 82-390	Pollutant attenuation capacity of unsaturated zone of Biscayne aquifer, southeast Florida	1/82 to 9/84	GW
FL 83-401*	Organic contaminants in waste and ground water in Florida	10/82 to 9/84	GW
FL 83-405	Sources, generic composition, and mortality of pathogenic bacteria in the Apalachicola River and Estuary: effects of flooding and temperature	10/82 to 9/86	SW
FL 83-406	Transport of organic contaminants in ground water, Pensacola	10/82 to 9/89	GW
FL 83-408	Hydrology and water quality of Pasco County	7/83 to 9/86	GW
FL 84-422*	Impacts of selected developmental activities on the quality of water in the Floridan aquifer system, central Florida	4/84 to 9/90	GW
FL 84-425	Reconnaissance of water quality at a Department of Energy site, Pinellas County	5/84 to 9/89	GW
FL 85-427	Pollution potential of the Floridan aquifer system from sinkholes and internally drained areas in west-central Florida	10/84 to 9/86	GW
FL 85-430	Geologic controls on ground-water movement and contamination in Polk County	10/84 to 9/88	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	FL 85-432*	Effects on ground-water quality from the application of domestic wastewater-treatment sludge to soils overlying the Biscayne aquifer, Dade County	10/84 to 9/88	GW
	FL 85-433	Effects of stormwater contaminants from exfiltration trenches on the Biscayne aquifer, Dade County	10/84 to 9/86	GW
	FL 85-439	Numerical simulation of the migration of landfill leachate in a highly permeable surficial aquifer, Palm Beach County	6/85 to 9/87	GW
	FL 86-442	Effects of septic tanks and domestic wells on water quality and levels, northeast Palm Beach County	10/85 to 9/88	GW
	FL 86-446	Water-resources evaluation of the freshwater lens on Key West	10/85 to 9/88	GW
	FL 86-449	Simulation of a saltwater plume from a flowing well in a surficial aquifer, Dade County	10/85 to 9/88	GW
	FL 87-452	Delineation of protection zones around public supply wells in Florida	10/86 to 9/88	GW
	FL 87-453	Coprostanol as a tracer for sewage-derived contamination in ground water	10/86 to 9/89	GW
	FL 87-454	Procedure for assessing contamination probability in the sole-source surficial aquifer system, southeast Florida, using a geographical information system	10/86 to 9/89	GW
	FL 87-458	Monitoring and transition zone between saltwater and freshwater in the major ground water producing zones in the coastal area of southwest Florida	10/86 to 9/91	GW
	FL 87-459*	Sources of nitrogen in ground water from areas subject to the application of wastewater by spray irrigation and commercial fertilizers near Tallahassee	10/86 to 9/88	GW
	FL 87-465*	Potential for contamination of the Floridan aquifer system, west-central Florida	10/86 to 9/90	GW
	WD 78-134	See Headquarters listing		
GEORGIA	GA 60-011	Investigation of salt-water encroachment in the Brunswick area	7/59 to 6/73	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	GA 76-057*	Impact of summer storm runoff on water quality in the greater Atlanta area	7/76 to 6/78	SW
	GA 77-058*	A preliminary appraisal of the effects of agriculture on stream quality in southwest Georgia	1/77 to 9/79	SW
	GA 80-015	Occurrence, source and flux of toxic organic compounds in Lake Sidney Lanier	3/80 to 12/82	SW
	GA 82-075	Impact of increased water use on the quantity and quality of ground water resources of coastal Georgia	10/81 to 9/88	GW
	GA 83-005	Measurement and analysis of spatial and temporal variability in wet-dry precipitation chemical quality in Georgia	8/83 -- continuing	SW
	GA 83-079*	Migration of pesticides through the unsaturated and saturated zones at a selected site in southeast Lee County	10/82 to 9/89	GW
	GA 84-083	Simulation of fluid flow in fractured limestone formations near Brunswick	10/83 to 9/87	GW
	GA 85-087*	Movement and fate of agricultural chemicals in the subsurface, southwest Georgia	10/84 to 9/89	GW
	GA 86-089*	Effects of ground-water pumping on streamflow in the Appalachicola Chattahoochee-Flint basin	10/86 to 9/90	SW-GW
	GA 86-091*	Ground-water and surface-water relations near Albany	9/86 to 9/90	SW-GW
HAWAII	HI 74-133	Design of a ground-water monitoring network for water-quality management in Hawaii	4/74 to 9/75	GW
	HI 83-173*	Investigation of perched and underlying ground-water bodies in relation to contamination by pesticides	5/83 to 9/86	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	HI 84-177	Evaluating the effects of the cell grazing method on soil loss and water quality	3/84 to 9/86	SW
	HI 85-179*	Evaluation of organic constituents in ground-water aquifers	10/84 to 9/86	GW
	HI 86-194	Phase II investigation, Installation Restoration Program, Hickam AFB POL, island of Oahu	10/85 to 9/88	GW
	HI 86-195	Application of GIS for evaluating ground-water contamination potential of injection wells and mapping sole source aquifer designation in Oahu	6/86 to 9/86	GW
	HI 86-819	Ground-water resource evaluation in Pohnpei State, Mokil and Pinelap Atolls	6/86 to 9/88	GW
IDAHO	ID 79-137*	A hydrologic assessment of the Snake River Plain regional aquifer, southern Idaho	6/79 to 9/88	GW
	ID 80-139*	Water quality of irrigation return flows, Bannock and Twin Falls Counties	10/79 to 1/82	SW
	ID 81-142	Ground-water contamination in the Michaud Flats, Fort Hall Indian Reservation	10/80 to 9/88	GW
	ID 84-154*	Ground-water contamination in the westside area, Bingham County	1/84 to 12/86	GW
	ID 60-165	Hydrology of subsurface waste disposal, Idaho National Engineering Laboratory	10/59--continuing	GW
	ID 86-169	Implementation of a ground-water quality monitoring network in Idaho	10/86 to 9/88	GW
	WR 71-071	See Western Region listing		
	WR 72-096	See Western Region listing		
ILLINOIS	IL 81-044	Hydrology of unsaturated flow through porous media at the low-level radioactive waste disposal site near Sheffield	10/81 to 9/89	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	IL 82-049	Tritium migration in a shallow dolomite aquifer near Chicago	10/81 to 9/84	GW
	IL 82-052	Ground-water quality of the American Bottoms	10/81 to 9/83	GW
	IL 83-059	Recharge potential to the shallow dolomite aquifer in northwest Illinois	1/83 to 1/84	GW
	IL 84-062*	Illinois ground-water observation network	10/83 to 9/87	GW
	IL 84-063	Transport of radioactive gases and exchange of 14(C) in the unsaturated zone at a low-level radioactive waste site, Sheffield	10/83 to 9/87	GW
	IL 85-067	Ground-water flow and tritium movement in fractured dolomite near Chicago	10/84 to 9/88	GW
	IL 85-070	Cedar Creek water-quality assessment; impact of storm runoff and combined-sewer overflows from Galesburg	1/85 to 9/87	SW
	IL 86-075*	Upper Illinois River basin water-quality assessment	4/86 to 9/89	SW
	IL 86-076	Hydrology and radionuclide movement at a low-level radioactive-waste disposal site, Sheffield	4/86 to 9/87	GW
INDIANA	IN 66-011	Time-of-travel studies in Indiana	7/65 to 10/74	SW
	IN 73-025	Investigation and monitoring of landfill sites in Marion County	7/72 to 9/80	SW-GW
	IN 74-034*	Descriptions of the water quality of selected watershed management projects	1/74 to 9/79	SW
	IN 77-051	Ground-water availability and chloride contamination in the Wabash River valley near Vincennes	10/76 to 9/78	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	IN 85-096	Water quality of the Grand Calumet River, Lake County	10/84 to 9/85	SW
	IN 85-098	Hydrologic effects of two landfills in Marion County	12/84 to 12/86	GW
	IN 86-105	Ground-water effects on two sludge management practices in Marion County	10/85 to 9/87	GW
	IN 86-107	Water quality of the Calumet aquifer in the drainage basin of the Grand Calumet River/ Indiana Harbor Canal, northwest Indiana	10/85 to 9/88	GW
IOWA	IA 83-047	Iowa groundwater-quality monitoring program	10/82-- continuing	GW
	IA 84-050	Des Moines Air National Guard Base, Installation Restoration Program, phase II stages I and II	7/84 to 9/88	SW-GW
	IA 85-053*	Southwest Iowa ground-water appraisal	10/84 to 10/88	GW
	IA 86-055*	An accounting of pesticides in soil and ground water at selected sites in the Iowa River basin	10/85 to 9/88	GW
KANSAS	KS 84-005	National Atmospheric Deposition Program (NADP) and National Trends Network (NTN) stations	2/84-- continuing	SW
	KS 62-020	Chemical quality of water in the South Fork Ninnescah basin	10/61 to 9/76	SW-GW
	KS 75-073	Discharge of saline water from the Wellington Formation to major unconsolidated aquifer systems in central and south-central Kansas	1/75 to 9/78	GW
	KS 76-074	Saline discharge to the Smoky Hill River between Salina and Abilene, central Kansas	7/75 to 6/80	SW-GW
	KS 76-077*	Evaluation of the ground-water quality network and interpretive analyses of data from the network operation in Kansas	4/76 to 9/85	GW

Appendix B.-- *List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

Project number	Title	Period of study	Principal emphasis
KS 77-079	Availability and chemical quality of ground water from sandstone aquifers in southwestern Kansas	10/76 to 9/80	GW
KS 77-080	Hydrologic aspects of enhanced oil-recovery projects in Kansas	7/77 to 9/80	GW
KS 78-092	Hydrogeology of the "Equus Beds" aquifer, south-central Kansas, including a solute transport model	6/78 to 12/81	GW
KS 80-110	Geohydrology of the Wellington Formation and Smoky Hill Valley alluvium in the Salina area, central Kansas	3/80 to 12/82	GW
KS 81-119	Quality of ground and surface waters in the lead-zinc mined areas in Cherokee County	4/81 to 9/82	SW-GW
KS 81-125*	Effects of irrigation return flow on the chemical quality of water in the Smokey Hill River, Prairie Dog Creek and Republican River	7/81 to 6/83	SW-GW
KS 83-132*	Effects of multi-purpose use on the water quality of public supply lakes	4/83 to 3/84	SW
KS 84-135*	Water quality in the High Plains aquifer, western Kansas, related to petroleum production, irrigated and non-irrigated cropping land use	1/84 to 9/87	GW
KS 84-136*	Hydrology and water quality of Sedgwick County	1/84 to 5/87	SW-GW
KS 85-138	Geohydrologic evaluation of hazardous waste sites in selected areas of Kansas	10/84 to 9/87	GW
KS 85-145*	Assessment of agricultural pesticides in the saturated and unsaturated Zones, in Kansas	5/85 to 9/85	GW
KS 85-147	Reconnaissance of Arkansas City dump site, Arkansas City	7/85 to 3/86	SW-GW
KS 86-150*	Transport, occurrence, and effects of agricultural pesticides in Tuttle Creek Lake	10/85 to 9/88	SW
KS 86-151*	Movement and persistence of agricultural pesticides in the saturated and unsaturated zones	10/85 to 9/88	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	KS 86-152*	National water-quality assessment of the lower Kansas River basin, Kansas and Nebraska	4/86 to 9/89	SW-GW
KENTUCKY	KY 72-022	Hydrology of the Covington-Lexington-Louisville triangle	11/71 to 11/75	SW-GW
	KY 76-038	Effects of coal mining activity on the hydrologic environment of Grapevine Creek, Pike County	7/75 to 6/80	SW
	KY 78-045	Determination of extent of chloroform contamination of the alluvial aquifer, Louisville	3/78 to 9/78	GW
	KY 83-062	Feasibility of deep disposal in crystalline rocks of high-level radioactive wastes	4/83 to 9/86	GW
	KY 85-068	Sedimentation and erosion rates at the Maxey Flats radioactive waste burial site, Fleming County	10/84 to 9/87	SW
	KY 86-071	Surface water quality assessment of the Kentucky River basin (hydrologic accounting unit 051002)	3/86 to 3/90	SW
LOUISIANA	LA 70-044	Velocity of Louisiana streams	7/69 to 9/82	SW
	LA 81-066	Limnological study of Lake Bruin	3/81 to 9/83	SW
	LA 82-070	Hydrology and quality of ground-water resources, Livingston and St. Helena Parishes	4/82 to 9/85	GW
	LA 83-076	Radioactive elements in ground water in Louisiana	10/82 to 9/85	GW
	LA 85-090	Presence and extent of minor elements, including barium, lead, and other toxic substances, in ground water of Louisiana	10/84 to 9/87	GW
	LA 85-091	Geohydrologic characteristics of the Sparta aquifer, north-central Louisiana	10/84 to 9/87	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	LA 86-096	Reaeration coefficients for inland streams in Louisiana	4/86 to 9/87	SW
MAINE	ME 79-028	Maine sand and gravel aquifers	10/78 to 9/81	GW
	ME 81-039	Hydrogeology and water quality of significant sand and gravel aquifers in Maine	7/81 to 9/88	GW
MARYLAND	MD 78-029	Piedmont upland-sole source aquifer study	4/78 to 9/78	GW
	MD 80-036	Analysis and characterization of urban storm-water runoff for selected basins in the Baltimore metropolitan area	12/79 to 9/82	SW
	MD 68-038	Time-of-travel - principal Maryland streams	11/67 to 6/74	SW
	MD 68-041	Evaluation of the Magothy aquifer, Annapolis area	1/68 to 12/71	GW
	MD 71-049	Geohydrology of northeastern Worcester County	7/70 to 6/72	GW
	MD 81-060	Time-of-travel and attenuation of a soluble dye in Jones Falls	4/81 to 9/82	SW
	MD 81-064	Dispersion and travel of dissolved contaminants in the Potomac River	8/81 to 12/81	SW
	MD 83-072	Ground-Water quality of Catoctin Mountain National Park	4/83 to 9/85	GW
	MD 84-077	Investigation of groundwater in the vicinity of O-Field Edgewood area, Aberdeen Proving Ground	4/84 to 10/87	GW
	MD 85-080*	Modeling nonpoint source inputs to the Patuxent River Estuary, phase I: existing conditions and model application	5/84 to 9/87	SW
	MD 86-082	Impact of storm-water infiltration practices on ground-water quality	10/85 to 3/90	SW-GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	MD 85-084	Investigation of ground-water contamination in the Canal Creek area, Aberdeen Proving Ground	8/85 to 11/90	GW
	MD 85-085*	Effects of agricultural best management practices on shallow ground water in the Patuxent River basin	7/85 to 9/91	SW-GW
	MD 86-086*	National Water Quality Assessment--Ground-water quality on the Delmarva Peninsula, Delaware, Maryland, and Virginia	3/86 to 9/90	GW
	MD 86-087	Potential for ground-water supply in the coastal plain of Harford County, Maryland	7/86 to 12/89	GW
MASSACHUSETTS	MA 77-017	Hydrologic effects of waste water disposal, Otis Air Force Base, Cape Cod	7/77 to 1/80	GW
	MA 80-026	Water resources of the French and Quinebaug River basins	10/79 to 3/84	SW-GW
	MA 72-039	Hydrology and water resources of the Connecticut River lowlands in Massachusetts	7/71 to 6/75	SW-GW
	MA 76-043	Ground water resources of Nantucket Island	7/76 to 6/77	GW
	MA 76-044	Ground water resources of Martha's Vineyard island	7/76 to 6/79	GW
	MA 78-047*	Ground-water contamination from surface impoundments	8/78 to 9/79	SW-GW
	MA 79-048	Effectiveness of highway-drainage system in preventing salt contamination of ground water, Route 25 from Wareham to the Cape Cod Canal	1/79 to 12/94	SW-GW
	MA 83-061	Plymouth-Carver aquifer model	10/82 to 9/86	GW
	MA 83-062	Processed controlling transport of solutes in a sewage plume in ground water at Otis Air Base, Cape Cod	4/83 to 9/90	GW
	MA 84-066	Ground-water resources of the North River basin	10/83 to 1/88	GW
	MA 85-070	Ground-water resources of the Neponset River basin	3/85 to 9/88	GW

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	Project number	Title	Period of study	Principal emphasis
	MA 85-073	Hydrogeological technical assistance to USEPA Waste Management Division, Region I, Boston	6/85 to 9/89	SW-GW
	MA 86-076	Chemistry of precipitation during storm events	10/85 to 9/88	SW
MICHIGAN	MI 80-033*	Water resources of Van Buren County	1/80 to 12/82	GW
	MI 82-037	Ground-water model of the city of Battle Creek	4/82 to 9/83	GW
	MI 82-038	Ground-water contamination at the United States Coast Guard Air Station, Traverse City	7/82 to 9/83	GW
	MI 84-040*	Water resources of Grand Traverse County	5/84 to 5/87	SW-GW
	MI 85-043	Ground-water contamination at K.I. Sawyer Air Force Base	12/84 to 9/87	GW
	MI 85-045	Ground-water movement near Great Lakes connecting channels	7/85 to 8/87	GW
	MI 86-046*	Ground-water protection in Kalamazoo County	3/86 to 9/88	GW
	MI 87-048*	Hydrogeology of Huron County	10/86 to 9/89	GW
MINNESOTA	MN 73-029	Hydrogeologic reconnaissance of ground-water pollution in the Pine Bend area, Dakota County	1/73 to 6/73	GW
	MN 77-056	Interflow in uncased multi-aquifer wells in relation to groundwater pollution in karst regions of southeastern Minnesota	7/77 to 9/79	GW
	MN 78-057	Design for a ground-water-quality monitoring network	10/77 to 5/78	GW
	MN 78-061	Investigation of coal-tar derivatives in ground water in the St. Louis Park area	7/78 to 9/80	GW

Appendix B.-- *List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	MN 80-078	Hydrogeologic and water-quality characteristics of aquifers in Minnesota	6/80 to 9/87	GW
	MN 83-092	Hydrology of proposed hazardous/toxic waste sites in Minnesota	4/83 to 9/85	GW
	MN 83-094	Modeling of contaminant migration from a chemical-waste-disposal site in the Twin Cities metropolitan area	7/83 to 9/87	GW
	MN 83-095	Crude-oil contamination of ground water near Bemidji	3/83 to 9/86	GW
	MN 84-102	Preliminary evaluation of possible ground-water contamination near pesticide-burial sites in Minnesota	7/84 to 9/85	GW
	MN 85-104	Effects of treated wastewater discharge on hydrology and water quality of wetlands in Minnesota and Wisconsin	4/85 to 9/87	SW-GW
	MN 86-106*	Hydrogeology and water quality of the Bemidji and Bagley surficial-outwash aquifers, north-central Minnesota	10/85 to 9/88	GW
	MN 86-107*	Use of stable nitrogen-isotope ratios to identify sources of nitrate in unconfined sand and gravel aquifers in Minnesota	10/85 to 9/87	GW
	MN 87-110*	Agricultural chemicals, Rosholt Farm	10/86 to 9/90	GW
	MN 87-114*	Straight River investigation	10/86 to 9/90	SW
MISSISSIPPI	MS 69-021	Waste assimilation capacity of Mississippi streams	1/69 to 9/81	SW
	MS 73-034	A reconnaissance of the Pascagoula River estuary	7/72 to 6/73	SW
	MS 81-065	Apparent brine contamination of freshwater aquifers and streams in petroleum-producing areas in southern Mississippi	3/81 to 9/86	SW-GW
MISSOURI	MO 73-024	Water resources of the Springfield area	7/72 to 12/75	SW-GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	MO 76-031	An evaluation of the effects of abandoned lead and zinc mines and tailing piles on water quality in the Joplin area	1/76 to 6/77	SW-GW
	MO 81-049	Characteristics of urban runoff in the Blue River basin in Kansas City	10/80 to 9/82	SW
	MO 82-053	Hydrology of the Verona-Aurora area, southwestern Missouri	8/82 to 3/83	SW-GW
	MO 84-059	Potential effects of hazardous wastes on the hydrologic system in the Weldon Spring area, St. Charles County	10/83 to 9/87	GW
	MO 85-060	Water quality in the Missouri River alluvial aquifer near Kansas City and Independence	10/84 to 9/87	GW
	MO 85-064	Geology, hydrology, and pedology at six dioxin-contaminated sites in Missouri	12/84 to 9/87	GW
	MO 85-065	Water-quality characterization of Spring River basin, southwestern Missouri	7/85 to 9/87	SW
	MO 86-068*	Effects of special area land treatment on sediment and nutrient transport in the Higginsville Reservoir watershed	10/85 to 9/90	SW
	MO 86-069*	The occurrence of pesticides in ground water, streams, and streambed sediments in the southeast lowlands	7/86 to 9/87	SW-GW
MONTANA	MT 72-037	Quality of ground water in the Helena valley	7/71 to 3/73	GW
	MT 72-040	Ground water in the Rock Creek valley, western Montana	10/71 to 6/73	GW
	MT 82-091	Evaluation of ground-water quality in Montana as related to hazardous waste disposal	7/82 to 9/83	GW
	MT 86-108	Quantification of canal seepage on the Flathead Indian Reservation, northwest Montana	10/85 to 3/88	SW-GW
	MT 86-115*	Irrigation drainage field-screening study, Sun River unit	6/86 to 9/87	SW

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	Project number	Title	Period of study	Principal emphasis
	MT 86-116*	Irrigation drainage field-screening study, Milk River unit	6/86 to 9/87	SW
NEBRASKA	NE 81-043	Central Midwest regional aquifer system analyses in Nebraska	10/80 to 9/85	GW
	NE 81-045	Evaluation of ground-water quality in Nebraska	5/81 to 4/82	GW
	NE 84-048*	A study of nonpoint-source derived nitrate-nitrogen and organic constituents in water from selected areas of the High Plains aquifer in Nebraska	12/83 to 3/88	GW
NEVADA	NV 74-057	Ground-water contamination, U.S. Naval Ammunition Depot, Hawthorne	9/73 to 6/74	GW
	NV 75-061	Ground-water contamination by explosive wastes, Hawthorne Ammunition Depot	9/74 to 9/79	GW
	NV 76-064	Ground-water conditions in an area of gasoline contamination near Yerington	7/76 to 12/77	GW
	NV 76-065	Evaluation of ground water contamination by possible seepage from tailings ponds near Weed Heights	7/75 to 9/78	GW
	NV 76-066	Design of a ground-water water-quality monitoring network for Nevada	7/75 to 9/76	GW
	NV 77-072	Geohydrology and radioactive solute migration, Beatty Disposal site, Nye County	10/76-- continuing	GW
	NV 82-104	Las Vegas valley ground-water quality monitoring network design	2/82 to 2/84	GW
	NV 77-130	Nuclear hydrology program at the Nevada Test Site	10/76-- continuing	GW
	CR 61-120	See Central Region listing		
	CR 67-159	See Central Region listing		
	NN 86-310	See Central Region listing		
	NN 86-332	See Central Region listing		
	NN 86-333	See Central Region listing		

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	Project number	Title	Period of study	Principal emphasis
NEW HAMPSHIRE	NH 77-026	Hydrologic effects of waste disposal, Pease Air Force Base	7/77 to 7/78	GW
	NH 82-028	Ground-water quality information for southern New Hampshire	10/81 to 3/85	GW
NEW JERSEY	NJ 73-012*	Wastewater solids utilization on land demonstration project	7/72 to 6/77	GW
	NJ 80-042	Quality of ground- and surface-waters in the area of the Potomac-Raritan-Magothy aquifer outcrop south of Trenton	10/79 to 9/83	GW
	NJ 81-045	Ground-water movement in the Cohansey aquifer of the central coastal plain of New Jersey	10/80 to 9/84	GW
	NJ 82-051	Ground-water quality and the simulation of the surface-ground water relationships in the Ramapo River basin of New Jersey	10/81 to 9/84	SW-GW
	NJ 82-059	The geohydrology at Picatinny Arsenal in Morris County	8/82 to 9/90	SW-GW
	NJ 83-061	Hydrologic processes with special emphasis on ground-water quality near Atlantic City	7/83 to 6/88	GW
	NJ 83-062	Hydrologic processes with special emphasis on ground-water quality near Camden	7/83 to 6/88	GW
	NJ 83-064	Hydrologic processes with special emphasis on ground-water quality near South River	7/83 to 6/88	GW
	NJ 83-066	Assessment of the water resources of Logan Township, Gloucester County	6/83 to 9/87	GW
	NJ 83-069	Evaluation of field sampling techniques and analytical methods for organic compounds in ground water	7/83 to 9/87	GW
	NJ 69-070	Channel geometry of New Jersey streams	7/68 to 6/76	SW
	NJ 84-078	Lead contamination of ground water in Ocean County	10/83 to 9/86	GW

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	Project number	Title	Period of study	Principal emphasis
	NJ 85-086	Geohydrology in the vicinity of a fusion test reactor, Plainsboro Township, Middlesex County	4/85 to 9/89	GW
	NJ 86-089	An assessment of ground-water resources in the vicinity of ground-water contamination sites in Greenwich Township, Gloucester County	10/85 to 9/88	GW
	NJ 86-091	Geohydrologic investigations at U.S. Environmental Protection Agency Superfund sites	2/86 to 9/87	SW-GW
NEW MEXICO	NM 83-248	Availability of ground water in mountain areas of eastern Bernalillo County	7/83 to 9/85	GW
	NM 84-252	Hydrology of the Albuquerque South Valley area	1/84 to 12/86	GW
	NM 86-259	Assessment of the impacts of atmospheric precipitation on water quality and fishery resources in high mountain lakes	6/86 to 12/95	SW
	NM 73-312	Water resources investigation of Laguna Indian Reservation	1/73 to 6/77	GW
	NM 73-313	Water resources investigation of Acoma Indian Reservation	1/73 to 6/77	SW-GW
	NM 75-324	Hydrologic investigations related to a radioactive wastes repository in salt, southeastern New Mexico	5/75 to 9/87	GW
	NM 84-421	Organic and heavy metal contamination of ground water in the Albuquerque-Belen basin	4/84 to 9/86	GW
NEW YORK	NY 67-013	Time-of-travel studies	7/66 to 9/79	SW
	NY 72-014	Geochemical aspects of ground-water pollution in the Babylon-Islip area, Long Island	7/71 to 6/74	GW
	NY 72-016	Design and support of Suffolk County, New York, water-quality observation well program	1/72 to 6/76	GW
	NY 75-032	Water resources of the south fork of Long Island	7/74 to 6/77	SW-GW
	NY 76-038	Ground-water hydrology of the West Branch Tioughnioga River valley	7/75 to 9/77	GW

Appendix B.-- *List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

Project number	Title	Period of study	Principal emphasis
NY 77-051*	Reconnaissance of organic compounds in ground-water systems	8/77 to 9/79	GW
NY 69-054	Hydrologic models of the ground-water flow system on Long Island	7/68 to 12/81	GW
NY 78-056*	Removal of nitrogen pollution from an aquifer near Olean	10/77 to 9/80	GW
NY 79-073	Urban hydrology of Long Island	10/79 to 9/83	SW
NY 79-075	Migration of chemical wastes from landfills in Oswego County	8/79 to 9/81	SW-GW
NY 79-077*	Nonpoint source pollution of Irondequoit Bay	8/79 to 9/79	SW
NY 80-093	Hydrology of selected aquifers in upstate New York in support of USEPA Underground Injection Control Program	8/80 to 12/81	GW
NY 80-094	Simulating ground-surface water interaction in a glacial outwash aquifer in southwestern New York	8/80 to 9/82	GW
NY 81-100	Concentration, distribution, and source of heavy metals and organic compounds in the Saw Mill River, Westchester County	10/80 to 9/83	SW
NY 81-103*	Ground-water contamination resulting from the use of aldicarb pesticide in eastern Suffolk County, Long Island	11/80 to 7/83	GW
NY 81-105	Long Island's ground-water resource	3/81 to 9/83	GW
NY 81-113	Hydrologic characteristics and ground-water quality of selected aquifers in western New York	8/81 to 9/83	GW
NY 82-114	Baseline water quality assessment of selected aquifers in New York	10/81 to 9/90	GW
NY 82-118	Source and areal distribution of barium in ground water in western New York-phase I	3/82 to 9/82	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	NY 83-123	Quality of water on Long Island	10/82 to 12/84	SW-GW
	NY 83-124	Appraisal of hydrogeologic conditions in Nassau County	9/82 to 9/84	GW
	NY 83-125	Hydrologic models of the ground-water flow system on Long Island	10/83 to 9/87	GW
	NY 83-128	Evaluation of ground-water flow patterns and the movement of toxic waste in and around the Hyde Park landfill, Niagara County	4/83 to 6/85	GW
	NY 84-141	Solute transport in a deep aquifer recharge zone of Long Island	10/83 to 9/84	GW
	NY 84-145	Effect of waste-disposal on ground water in the upper glacial aquifer of Long Island	10/83 to 9/87	GW
	NY 84-148	Ground-water quality appraisal of Long Island	4/84 to 9/87	GW
	NY 85-153	Selected topics in ground-water geochemistry on Long Island	1/85 to 4/89	GW
	NY 86-164	Hydrogeology of the Niagara Falls area	6/86 to 9/90	SW-GW
	NY 86-165	Sorptive and transport characteristics of PCB congeners in the upper Hudson River	7/86 to 9/89	SW
	NY 87-169*	Pesticide transport in ground water	10/86 to 9/90	GW
NORTH CAROLINA	NC 76-056*	Study of non-point source pollution	7/76 to 9/79	SW
	NC 78-062	Effect of land use on streamflow quality	10/77 to 9/79	SW
	NC 79-066	Water quality variability, pollution loads, and long-term trends in the major rivers of North Carolina	10/78 to 9/83	SW
	NC 84-077	The effects of land use on ground-water quality in a combined regolith-fractured-rock aquifer system	5/84 to 12/85	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	NC 84-078	North Atlantic coastal plain hydrology and its relation to disposal of high-level radioactive waste in buried crystalline rock	10/83 to 9/85	GW
	NC 85-081*	Effects of land-management practices on sediment and chemical transport in Guilford County	10/84 to 9/90	SW-GW
	NC 85-082	Evaluation of hydrogeology in the Cincinnati Arch region with regard to isolation of nuclear wastes in buried crystalline rocks	10/84 to 9/86	GW
	NC 86-083	Ground-Water supply and potential for contamination, Cherry Point Marine Corps Air Station	4/86 to 9/90	GW
	NC 86-084	An appraisal of the ground-water resources of Camp Lejeune Marine Corps Base	4/86 to 9/90	GW
	NC 86-085	A reconnaissance evaluation of surface water, drinking water, and effluent water quality in the Greensboro, North Carolina area	3/86 to 9/88	SW
NORTH DAKOTA	ND 78-083	Northern Great Plains regional aquifer assessment in North Dakota	10/77 to 9/81	GW
	ND 83-123	Hydrogeochemical consequences of hazardous waste disposal associated with surface mining, in situ ashing and reclamation of lignitic uranium deposits in western North Dakota	4/83 to 9/83	GW
	ND 84-125	Hydrogeochemical controls on the mobility of radiogenic constituents in uraniferous lignite and ash in North Dakota	10/83 to 3/88	SW-GW
	ND 86-140	In situ monitoring of organic contaminants in ground water using a portable field laser fluorescence spectrometer	7/86 to 9/88	GW
OHIO	OH 72-016	Low-flow characteristics of Ohio streams	7/71 to 9/83	SW
	OH 79-042	Water quality of selected streams in Ohio	10/78 to 9/92	SW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	OH 79-047	Nature and extent of ground-water quality changes resulting from solid-waste disposal southeastern Franklin County	5/79 to 10/80	GW
	OH 80-050	Assessment of water quality conditions in the upper Hocking River basin	3/80 to 1/82	SW
	OH 81-062	Comparing radioactive and hydrocarbon gas methods for measuring reaeration coefficients	7/81 to 8/82	SW
	OH 84-078	Ambient organic levels, landfill surface leaching, and risk assessment modeling near a municipal ground-water supply, Franklin County	11/83 to 9/86	GW
	OH 85-084	Quality of surface water and ground water in active coal mining areas	4/85 to 9/92	SW-GW
	OH 87-092	Environmental impact of highway snow and ice removal	1/87 to 7/96	GW
OKLAHOMA	OK 80-059	Hydrology of Orphan Lands in eastern Oklahoma	10/79 to 9/83	SW-GW
	OK 86-080	Hydrogeologic characteristics of selected shaley formations in Oklahoma, with particular emphasis on their suitability for containment of hazardous wastes	10/85 to 9/88	GW
	OK 86-082	Central Oklahoma aquifer pilot study	4/86 to 9/90	GW
	OK 86-083	Altus Air Force Base hydrology: reconnaissance and presurvey phase	8/86 to 9/88	GW
OREGON	OR 72-052	Ground water in northern Clackamas County	8/71 to 6/76	GW
	OR 76-082	Urban runoff water-quality study for the Portland metropolitan area	7/75 to 6/77	SW
	OR 83-119*	Columbia basin regional aquifer system analysis (RASA), north central Oregon and Washington	12/82 to 9/87	GW
PENNSYLVANIA	PA 70-020	Water resources of the Clarion River and the Redbank Creek basins in western Pennsylvania	10/69 to 10/78	SW-GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

Project number	Title	Period of study	Principal emphasis
PA 71-022	Geology and hydrology of northern Berks County	7/70 to 5/77	GW
PA 71-026	Time-of-travel study, Lehigh River	10/70 to 9/77	SW
PA 64-027	The effects of urbanization upon the water resources of Philadelphia	12/63 to 9/79	SW
PA 72-038	Measurement of quantity and quality of urban stormwater	9/71 to 9/79	SW
PA 74-053	Arsenic pollution in the Tulpehocken Creek basin	7/73 to 9/73	SW
PA 74-055	Quality of surface waters in the Tioga River basin	9/73 to 9/78	SW
PA 79-094	River quality assessment of the Schuylkill River basin	10/78 to 9/81	SW
PA 80-110	Ground-water resources of anthracite areas in and near Schuylkill County	10/82 to 6/83	GW
PA 82-136	Appraisal of ground-water quality in Pennsylvania	6/82 to 5/83	GW
PA 84-144	Hydrologic impacts from soils made from dredge spoil and sewage sludge at Neshaminy State Park, Bucks County	10/83 to 3/86	GW
PA 83-146	Ground-water resources of Cambrian and Ordovician carbonate rocks in the Valley and Ridge Province in Pennsylvania	7/83 to 9/87	GW
PA 84-155*	Ground water--its sources, movement, and quality in agricultural areas	7/84 to 12/85	GW
PA 84-157	Ground-water quality assessment of Warren County	7/84 to 12/88	GW
PA 85-158*	Evaluation of agricultural best management practices and other innovative methods of controlling nutrient discharges in the lower Susquehanna River basin	10/84 to 9/90	SW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	PA 85-161	Hydrology of Indian Creek basin, Fayette and Westmoreland Counties	3/85 to 9/89	SW-GW
	PA 85-163	Effects of strip mining on the hydrology of a small watershed in Fayette County	7/85 to 9/88	SW-GW
	PA 85-164*	Ground-water flow systems and water quality of the Gettysburg area	9/85 to 9/87	GW
	PA 86-168	Ground-water quality of Erie County	10/85 to 9/87	GW
PUERTO RICO	PR 00-003	Quality of water; islandwide survey of volatile organic compounds in ground water	11/61--continuing	SW-GW
	PR 76-056	Water-quality reconnaissance study at solid-waste disposal sites in Puerto Rico	1/76 to 6/76	SW-GW
	PR 77-061	Effects of spillage on quality of ground water in Catano oil storage area	3/77 to 12/77	GW
	PR 79-072	Hydrogeologic reconnaissance of selected surface impoundments in Puerto Rico	10/78 to 9/79	SW-GW
RHODE ISLAND	RI 81-017	Geohydrologic study and computer model simulation of radionuclide movement in a sand and gravel aquifer at Charlestown	3/81 to 9/85	GW
	RI 85-023	Geohydrologic information for ground-water protection in Rhode Island	10/84 to 9/86	GW
SOUTH CAROLINA	SC 72-024	Arsenic reconnaissance in Wateree River basin	3/72 to 5/72	SW
	SC 75-037	Radioactive waste burial ground study	5/75 to 4/80	GW
	SC 79-043	Collection and definition of ground-water data at the low-level radioactive waste burial site near Barnwell	8/79 to 9/81	GW
	SC 84-059	Investigation of ground-water protection at the Defense waste processing facility, Savannah River Plant	7/84 to 1/90	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
SOUTH DAKOTA	SD 83-067	Investigation of hazardous wastes along Whitewood Creek and the Belle Fourche and Cheyenne Rivers	10/82 to 9/84	SW-GW
TENNESSEE	TN 67-014	Effects of development on the Memphis aquifer system	1/67 to 9/81	GW
	TN 74-024	Radioactive-waste disposal at Oak Ridge National Laboratory: An assessment of burial ground suitability and monitoring	11/73 to 12/75	GW
	TN 76-030	Burial ground studies at Oak Ridge National Laboratory	7/75 to 9/89	GW
	TN 77-036	Ground-water resources in the metropolitan region of Nashville	5/77 to 3/78	GW
	TN 81-049	Geohydrology and solute transport in freshwater aquifers in the Memphis area, Tennessee, Arkansas, Mississippi	10/80 to 9/83	GW
	TN 82-050	Chemical character of ground water at the Hollywood dump in Memphis	10/81 to 9/83	GW
	TN 83-059	Pollution susceptibility evaluation with radar data, eastern and western Tennessee	3/83 to 9/87	GW
	TN 86-069	Geohydrology and pesticide transport at North Hollywood dump, Memphis	10/85 to 9/88	GW
	TN 86-070	Background water-quality data for selected trace constituents and organic compounds in the shallow water-table aquifer in the Memphis area	10/85 to 9/87	GW
	TN 87-075	Toxic plume delineation by bacterial bioassay and unsaturated-zone gas analysis at a hazardous waste site near Nashville	10/86 to 9/88	GW
TEXAS	TX 49-013	Ground-water resources of the San Antonio area and the Balcones Fault Zone	1/49 to 8/76	GW
	TX 73-051	Salt-water encroachment, Houston area	3/73 to 9/75	GW
	TX 75-060	Urban hydrology study, Austin	9/74 to 9/85	SW-GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	TX 77-064	Hydrology of salt domes in northeast Texas salt dome basin (phase I)	6/77 to 9/78	GW
	TX 84-085*	Assessment of ground-water contamination in Houston	10/83 to 9/86	GW
	TX 84-086	Assessment of water quality and contamination problems within the Edwards aquifer	10/83 to 9/86	GW
	TX 85-093	Attenuation of selected pollutants in the unsaturated zone of the Edwards aquifer, Austin	3/85 to 9/92	GW
	TX 86-097	Assessment of the overall water quality of U.S. lakes and reservoirs	10/85 to 9/87	SW
	TX 86-099	Determination of recharge characteristics of the Georgetown Formation in the Georgetown area	3/86 to 9/88	GW
	TX 86-101	Geohydrology of the water resources and the potential for contamination of Oak Spring, Big Bend National Park	6/86 to 9/88	GW
	TX 87-102	Ground-water contamination at two sites, Kelly Air Force Base	10/86 to 9/88	GW
UTAH	UT 80-144	Jordan River quality study	12/79 to 9/83	SW
VERMONT	VT 78-019	Preliminary evaluation of ground-water quality and pollution problems in Vermont	12/77 to 6/79	GW
VIRGINIA	VA 76-044*	Assessment of the water quality of selected watersheds	7/76 to 10/77	SW
	VA 83-074	Traveltime and dispersion of a water-soluble contaminant in the Shenandoah River, Virginia, West Virginia	8/83 to 9/85	SW
	VA 84-077	Hydrology of the Defense General Supply Center and surrounding area with emphasis on contaminated ground water	4/84 to 9/87	GW
	VA 84-078	Disposal of high-level radioactive waste in buried crystalline rock	10/83 to 9/84	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	VA 86-082	Analysis of Federal, State, and local earth science and natural resource data by use of a geographical information system to improve environmental management capabilities in the Elizabeth River, a tributary to the Chesapeake Bay	5/86 to 9/88	SW-GW
WASHINGTON	WA 74-172	Movement of contaminants in ground water at Keyport Naval Training Station, Bangor	7/73 to 6/75	GW
	WA 76-191	Water resources of the Makah Indian Reservation	11/75 to 9/79	SW-GW
	WA 76-195*	Sulphur Creek pilot program evaluation	3/76 to 10/81	SW
	WA 77-200	Evaluation of ground-water quality in the Spokane basin	12/76 to 9/78	GW
	WA 78-208	Water resources of the Gig Harbor Peninsula, Pierce County	10/77 to 9/79	SW-GW
	WA 78-212*	Water resources of developed areas in Clallam County	4/78 to 9/81	SW-GW
	WA 80-239	Midnite Mine water-quality study	2/80 to 9/81	SW-GW
	WA 84-297	Hazardous waste assessment in the State of Washington	10/83--continuing	SW-GW
	WA 85-307	Implementation of water resources segment of state of Washington geographic information system	10/84--continuing	SW-GW
	WA 86-314	Yakima, Washington gasoline and diesel spill study	10/86 to 9/87	GW
	WA 86-318	Preliminary quantification of ground-water in southwest King County	10/85 to 9/89	GW
	WA 86-320	Ground-water contamination assessment at Gas Works Park, Seattle	6/86 to 9/87	GW
	WA 86-321*	National Water-Quality Assessment Program, Surface Water Phase - pilot study in the Pacific Northwest District	10/85 to 9/88	SW-GW
	WA 87-322*	Pesticides in ground water in selected agricultural areas	10/86 to 9/90	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
WEST VIRGINIA	WV 82-049	Travel of dissolved contaminants in the South Branch Potomac River	3/82 to 9/82	SW
WISCONSIN	WI 71-026	Study of ground-water pollution in the Niagara Dolomite of Door County	7/70 to 6/74	GW
	WI 74-048	Ground-water resources of Columbia County	2/74 to 9/77	GW
	WI 75-063	Ground-water contamination potential in the dolomite aquifer of eastern Wisconsin	10/74 to 6/76	GW
	WI 75-064	Areas of rapid recharge through shallow unconsolidated deposits and bedrock in Wisconsin	10/74 to 12/74	GW
	WI 75-066	Ground-water quality monitoring in Wisconsin	3/75 to 9/77	GW
	WI 76-074	Simulation of urban runoff to determine nitrogen and phosphorus loadings in Dane County	5/76 to 9/78	SW
	WI 76-079	Hydrogeology and ground-water quality in northeastern Waukesha County, an area of near-surface dolomite bedrock	7/76 to 9/80	GW
	WI 77-082	Water-table, depth-to-water, and contamination-potential maps of Washington, Ozaukee, Waukesha, Milwaukee, Walworth, Racine, and Kenosha Counties	11/76 to 9/77	GW
	WI 78-090	Reconnaissance of nonpoint source pollution	10/77 to 9/87	SW
	WI 79-096	Nonpoint-source pollution for urban and rural areas in lower Fox River basin	10/78 to 9/81	SW
	WI 81-115	Nonpoint-source pollution loading for urban and rural areas in lower Fox River basin	3/81 to 9/81	SW
	WI 81-117	Evaluation of ground-water quality in Wisconsin	5/81 to 9/82	GW
	WI 85-144	East River water-quality assessment study	1/85 to 9/87	SW

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	Project number	Title	Period of study	Principal emphasis
	WI 86-146*	Ground-water quality monitoring--long-term effects of intensive farming and sprinkler irrigation on ground-water quality	10/85 to 9/88	GW
	WI 86-150	Assessment of contaminant effects on aquatic biota in selected reaches of the Illinois river system: An application of bioassay methodology	6/86 to 9/89	SW
	WI 87-155*	Hydrology and water quality of southwest Wisconsin bass streams	10/86 to 9/90	SW
WYOMING	WY 78-044	Evaluation of hydrologic impacts of in-situ coal gasification experiment near Hanna	10/77 to 2/78	GW
	WY 86-095	Organic and inorganic contaminants in the shallow aquifer at Francis E. Warren Air Force Base	12/85 to 9/87	GW
	WY 86-096*	Water-quality field screening of irrigation drainage from the Kendrick Project Near Casper	1/86 to 9/87	SW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

Part 2. Investigations conducted in national and regional headquarters

	Project number	Title	Period of study	Principal emphasis
HEADQUARTERS	WD 68-013	Hydraulic permeability of limestone aquifers in the United States	7/67 to 11/81	GW
	WD 74-108	Evaluate hydrogeological parameters related to radioactive waste management and disposal sites for EPA Office of Radiation Programs	7/73 to 9/77	GW
	WD 75-046	Burial of radioactive waste from nuclear fuel cycle	7/72-- continuing	GW
	WD 78-134	Storm-water quality data analysis for south Florida	10/77 to 9/78	SW
	WD 80-150	National Stream Quality Accounting Network support activities	10/79-- continuing	SW
	WD 81-160	National water-quality networks research	10/80-- continuing	SW
	WD 82-164	Ground-water contamination and toxic waste	10/81-- continuing	GW
	WD 84-187	Disposal of high-level radioactive waste in buried crystalline rock	10/83 to 9/84	GW
	WD 85-213	Preliminary natural resources survey	1/85-- continuing	SW-GW
	TX 86-097	See Texas listing		
NORTHEASTERN REGION	NR 71-013	Ground water in the southeastern Gulf Atlantic States	4/71 to 6/75	GW
	NR 68-037	Hydrodynamic study of turbulence and its solute transport mechanics (advection, diffusion, and interface exchange) in rivers and estuaries	4/68 to 9/86	SW
	NR 70-039	Hydrologic interpretations based on remote sensing techniques -- Long Island, Lake Ontario, Chesapeake Bay	7/69 to 11/77	SW

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	Project number	Title	Period of study	Principal emphasis
	NR 72-045	Analysis of sediment erosion, movement, and deposition in and from construction areas in the Piedmont	7/71 to 9/79	SW
	NR 72-047	Distribution of PCBs and pesticides in a real estate lake	3/72 to 9/80	SW
	NR 78-092	Hydrogeochemical controls on the migration of radionuclides from uranium mill tailings	3/78--continuing	GW
	NR 79-095	Disposal of radioactive waste in shale by hydraulic fracturing	10/78 to 11/79	GW
	NR 81-122	Dispersion of toxic and radioactive wastes in ground water systems	7/81--continuing	GW
	NR 82-128	Monitoring of streams, lakes and ground waters for effects of acid rain	10/81--continuing	SW-GW
	NR 83-129	Comparative study of organic degradation in selected hydrogeologic environments	10/82 to 9/87	GW
SOUTHEASTERN REGION	SR 72-014	Nationwide canvass of major areas of ground-water contamination	10/71 to 9/72	GW
	SR 66-037	Hydrology of carbonate rock terranes	1/66 to 6/75	GW
	SR 84-077	Earth-science criteria for burial of hazardous chemical waste	10/83 to 9/84	GW
CENTRAL REGION	CR 61-120	Hydrology of small nuclear test sites, Nevada	7/60 to 6/75	SW-GW
	CR 67-159	Hydrology of central Nevada nuclear test site	11/66 to 9/78	GW
	CR 67-160	Hydrology of Amchitka Island test site, Alaska	3/67 to 6/77	GW
	CR 68-027	Thermal pollution of reservoirs and streams	9/67 to 6/77	SW
	CR 68-138	Identification and behavior of organic materials in water	8/67 to 7/74	SW-GW
	CR 69-200*	Field applications of unsaturated zone flow theory	12/68--continuing	GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

Project number	Title	Period of study	Principal emphasis
CR 73-085	The mathematical simulation of the transport and reaction of chemical species in ground water	7/72--continuing	GW
CR 77-223	Transuranium research	1/77--continuing	GW
CR 79-253	Identification of favorable environments providing multiple barriers to radionuclide transport	5/79 to 9/88	GW
CR 79-254*	Central Midwest Regional Aquifer System Analysis	7/79 to 9/88	GW
CR 81-266	Transport and deposition of sediments and sediment-borne contaminants in tidal rivers and estuaries	10/80 to 9/88	SW
CR 82-275	Organic geochemistry of ground water; interstitial, and pore waters - the effects of pollution	10/81--continuing	GW
CR 82-276	Geochemistry of clay-water reactions	10/81--continuing	GW
CR 83-278	Origin, fate, and transport of organic compounds in surface waters and their effect on water quality	10/82--continuing	SW
CR 83-282	Research in the measurement and evaluation of impact of inorganic constituents in water chemistry and water quality	3/83--continuing	SW
CR 83-283	Environmental dynamics of persistent organic compounds	5/83--continuing	SW-GW
CR 85-292	Ground-water solute-transport simulation	10/84--continuing	GW
CR 86-295	Microbial transformation of dissolved organic carbon in aquatic environments	10/85--continuing	SW-GW
CR 86-296	Colloid geochemistry and transport research	10/85--continuing	SW-GW

Appendix B.--*List of selected U.S. Geological Survey investigations and research related to water-resources contamination*

	Project number	Title	Period of study	Principal emphasis
	NN 86-310	Management and integration of Nevada Nuclear Waste Storage Investigations Hydrologic Program	10/85--continuing	GW
	NN 86-332	Saturated zone hydrology, Nevada	10/85--continuing	GW
	NN 86-333	Hydrology of unsaturated zone, Yucca Mountain and vicinity, Nevada	10/85--continuing	GW
	SD 85-080	Plan of study for an evaluation of the hydrologic suitability of potential sites for the shallow land disposal of low-level radioactive waste	6/85 to 9/87	GW
WESTERN REGION	WR 70-039	Modeling and simulation of surface-water quality	5/70 to 8/80	SW
	WR 68-043	Dispersion processes in estuaries and rivers	7/67 to 7/73	SW
	WR 71-068	Fate of organic chemicals in subsurface environments	7/70 to 9/95	GW
	WR 71-071	Influence of geologic and hydrologic factors upon migration of radionuclides from solid-waste burial ground, National Reactor Testing Station, Idaho	11/70 to 10/72	GW
	WR 72-096	Mathematical modeling of waste transport and dispersion in the Snake River Plain aquifer, National Reactor Testing Station, Idaho	7/71 to 6/74	GW
	WR 75-125	Availability of trace elements in sediments to aquatic organisms	8/74--continuing	SW
	WR 75-137	Effects of toxic substances on aquatic communities	6/75--continuing	SW
	WR 76-149	Chemistry of aquatic organic matter	1/76 to 10/78	SW
	WR 83-184	Hydrology of fractured rocks	3/83--continuing	GW
	WR 84-189	Chemistry of aquatic organic matter	10/83--continuing	GW
	WR 86-190	Solute transport involving biological processes in surface waters	10/85--continuing	SW

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