WATER RESOURCES ACTIVITIES IN FLORIDA, 1988–89

By Mildred E. Glenn, editor

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 89-227

IN COOPERATION WITH

Florida Department of Environmental Regulation
Florida Department of Natural Resources
Florida Department of Transportation
Englewood Water District
Florida Game & Fresh Water Fish Commission
Florida Institute of Phosphate Research
Florida Keys Aqueduct Authority
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Tallahassee, Florida

1989

DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
Suite 3015
227 North Bronough Street
Tallahassee, Florida 32301

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Federal Center, Bldg. 810
Box 25425
Denver, Colorado 80225

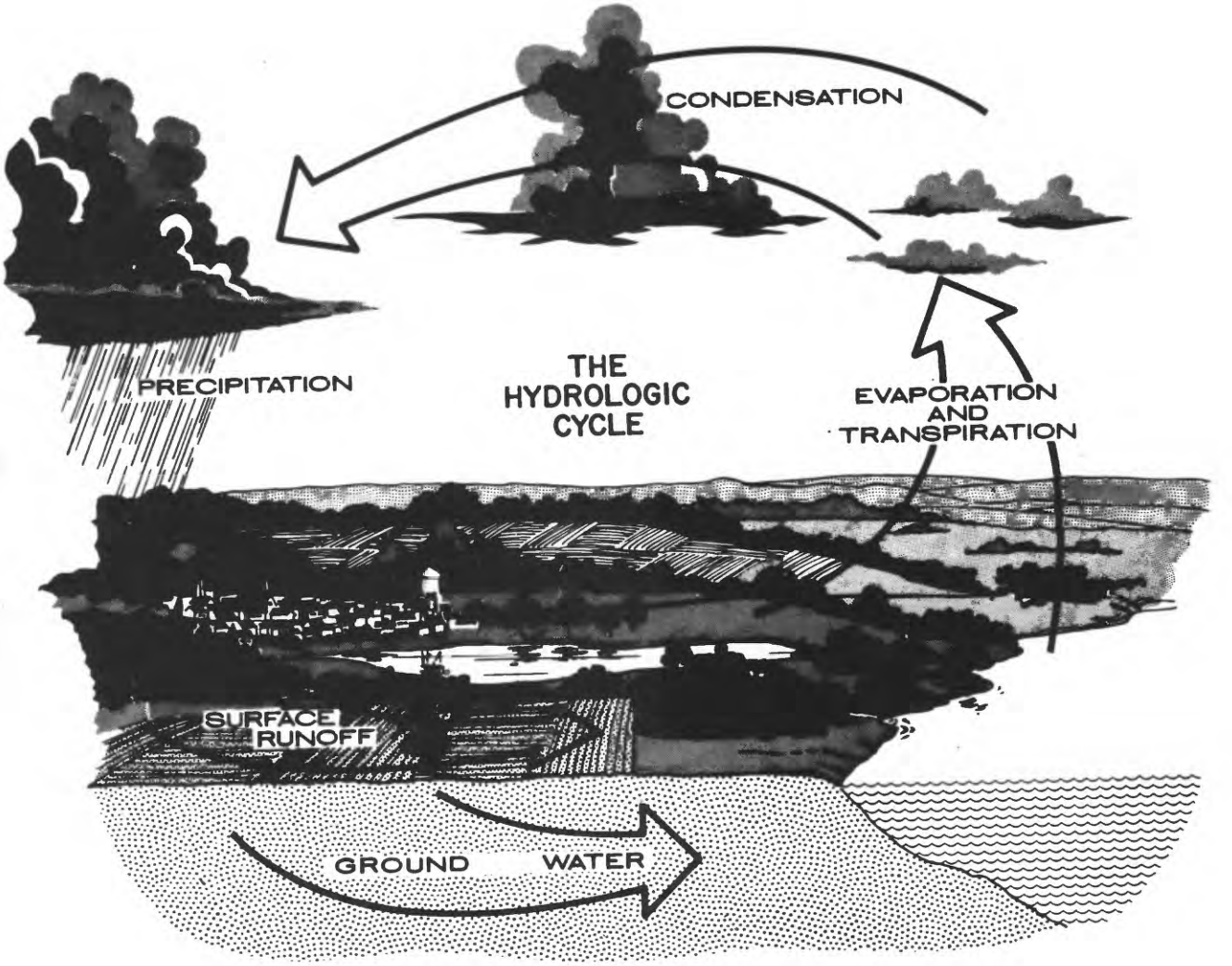
FOREWORD

The U.S. Geological Survey was created by an Act of Congress in 1879, as a bureau of the Department of the Interior, to classify public lands and to examine the geologic structure, mineral resources, and products of the national domain. Since then, the Survey's responsibilities have expanded to include topographic mapping, geochemical and geophysical studies, and the assessment of the quantity, quality, and distribution of water resources. Thus, during the past 100 years, the Survey has become the Nation's principal factfinding and research agency concerned with our physical resources. The mission of the Water Resources Division of the Survey is to provide hydrologic information needed for the development, management, and use of the Nation's water resources.

Although stream gaging began in 1884 as part of a study to identify irrigatable land, the water-resources program of the Survey began in 1894 when a small appropriation was obtained for the specific purpose of "gauging streams and determining the water supply of the United States." In the years following 1884, the need for water resources information grew rapidly but the inability of the Survey to meet the demand was hampered by restricted budgets. Many States initiated water resource programs to fill the deficiency and the Survey worked closely with the various State agencies. However, these efforts did not satisfy the need of the States and the Nation for a comprehensive water resources information program. Accordingly, in 1928 Congress established the cooperative matching program by which the Survey's water resources programs with State agencies may be funded on a 50/50 basis. This cooperative water resources program has grown over the years into the primary source of water information for the Nation. This is accomplished through cooperation with State and local governments and other Federal agencies by:

- Collecting data on a systematic basis to determine the quantity, quality, and use of surface and ground water.
- Conducting interpretive water-resource appraisals to describe the consequences of alternative plans for developing land and water resources.
- Conducting basic and problem-oriented research in hydraulics, hydrology, and related fields.
- Developing information on water-related natural hazards such as floods, landslides, volcanoes, mudflows, and land subsidence.
- Coordinating the activities of all Federal agencies in the acquisition of water data.
- Disseminating data and findings through reports, maps, and other forms of public release.
- Providing scientific and technical assistance in the hydrologic fields to other Federal agencies, to State and local agencies, and, on behalf of the U.S. Department of State, to international agencies.

Water Resources, National Mapping, and the Geologic Division are the three operating divisions of the Survey. General information pertaining to these divisions may be obtained from the Information Office, U.S. Geological Survey, 119 National Center, Reston, VA 22092. Circular 900, "*A Guide to Obtaining Information from the U.S. Geological Survey*" can be obtained free from the U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, Colorado 80225.


CONDENSATION
PRECIPITATION
THE
HYDROLOGIC
CYCLE
EVAPORATION
AND
TRANSPIRATION
SURFACE
RUNOFF
GROUND
WATER

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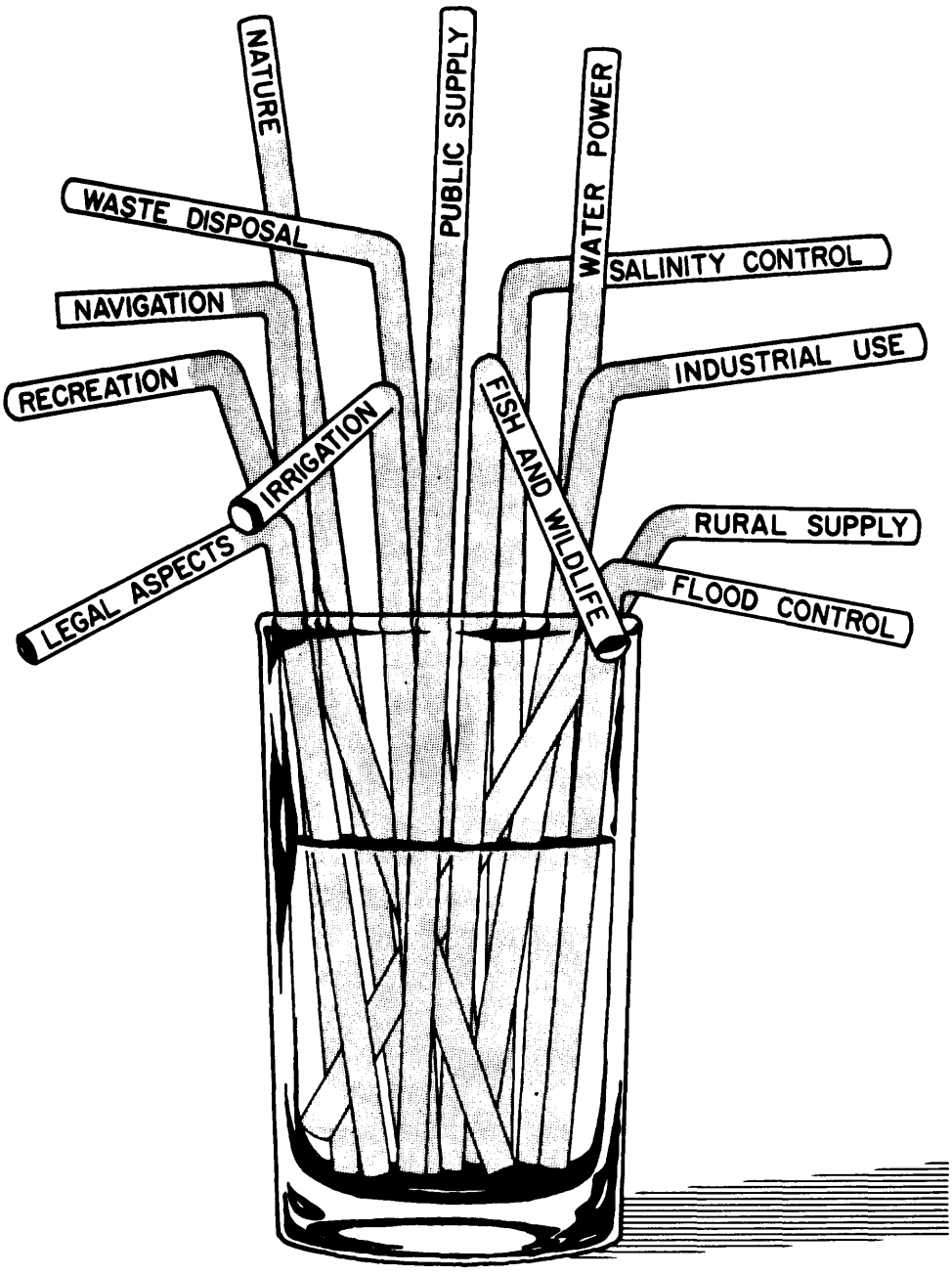


Competition for water is growing. Adequate information and analysis are keys to effective development, protection, and management of a common water resource.

WATER RESOURCES ACTIVITIES IN FLORIDA, 1988–89

By Mildred E. Glenn, *editor*

INTRODUCTION

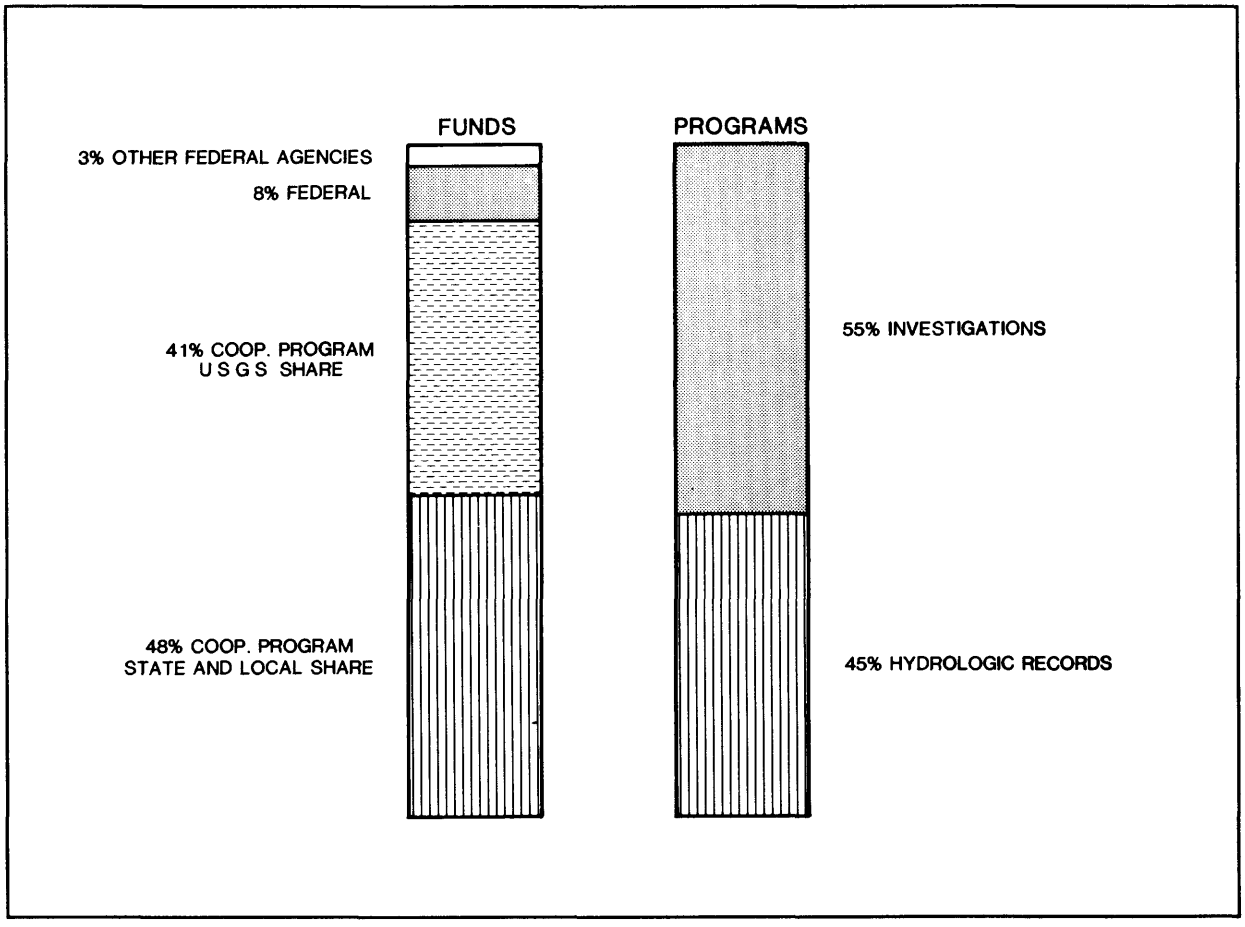
This report contains summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1988. These activities are part of the Federal program of appraising the Nation's water resources. Included are brief descriptions of the nature and scope of all active studies, summaries of significant results for 1988 and anticipated accomplishments during 1989.

Florida is a water oriented State which for many years has experienced a mushrooming increase in population, attendant urban growth, and all the problems associated with such growth, particularly problems of protecting and preserving environmental quality. As the Florida environment is largely water sensitive, most environmental problems are water related. The Florida District of the U.S. Geological Survey has the principal responsibility at the Federal level for appraising water resources and for providing basic hydrologic data on both surface and ground water in the State.

Water resources appraisals in Florida are highly diversified, ranging from hydrologic records networks to interpretive appraisals of water resources and applied research to develop investigative techniques. Thus, water-resource investigations range from basic descriptive water- availability studies for areas of low-intensity water development and management to sophisticated cause and effect studies in areas of high-intensity water development and management. The interpretive reports and records that are products of the investigations are a principal hydrologic foundation upon which the plans for development, management, and protection of Florida's water resources may be based.

The need for water resources information is especially great in urbanized areas, where concern is being expressed that the "carrying" capacity of the land and water resources is being exceeded. Increasingly intensive and sophisticated water-management programs will have to be implemented in these urban areas to meet the increasing needs for water and to maintain good water quality. Water data and information required to implement sound water-management programs in highly urbanized areas relate to the quantity and quality of storm runoff, sources of aquifer contamination, injection of wastes into deep strata, underground storage of freshwater, artificial recharge of aquifers, environmental effects of reuse of water, and effects of land development on changes in ground- and surface-water quality. In some parts of the State broad areas are largely rural. Future growth is anticipated in many of these. However, recognition is given to the need for planned development tailored to the environment. The need for water information in these rural areas is related to a large extent to the need to provide for primary water development and provide information on effects of development.

This report is intended to inform those agencies vitally interested in the water resources of Florida as to the current status and objectives of the U.S. Geological Survey cooperative program. The mission of this program is to collect, interpret, and publish information on water resources. Almost all of this work is done in cooperation with other public agencies.



Source of funds and makeup of program, Florida District, 1988–89.

WATER RESOURCES DIVISION PROGRAMS

Program development in the Water Resources Division is an evolving activity. Programs are reviewed regularly and future needs for water-data and hydrologic investigations are projected. Water problems and data needs brought out by State and local agencies and the public make up a major part of the planning process; thus, program development is a grassroots effort which is strongly influenced by changes in data needs and water problems.

Water Resources Division programs are of three major types: (a) data collection and dissemination, (b) problem-oriented water-resources appraisals, and (c) research. The programs are strongly interrelated; for example, theories arising from research are the foundation of data collection and problem-oriented water-resources appraisals, and data collection is a major component of all water-resources appraisals and most of the research studies.

The Division's activities may be described under three headings: long-term programs, technical-assistance programs, and topical programs.

Long-term programs include the Federal-State cooperative program; coordination of Federal water-data acquisition; assistance to other Federal agencies; the National Research Program; the National Water-Use Information Program; the hydrologic data-collection program, including the national stream quality accounting network and the national benchmark program; and the international hydrology program. These programs are fundamental to the Division's mission and they provide the data and research needed for the topical programs.

Topical programs are designed to provide critically needed information on issues of major and immediate concern to the Nation. These programs include hazardous waste hydrology, including high- and low-level nuclear and toxic-chemical wastes; coal and oil-shale hydrology; regional aquifer systems analysis; acid rain; volcano, subsidence, and flood hazards; and a nationwide water-quality assessment.

Technical-assistance programs include the instrumentation program, a central water-quality laboratory, and the national training center. These programs are internal to the Division but contribute significantly to the continuing development of hydrologic capabilities and thus to the success of the Division's mission.

NEW REPORTS FROM THE U.S. GEOLOGICAL SURVEY FLORIDA DISTRICT

The results of many of the water resources activities of the U.S. Geological Survey are released in reports for use by water agencies and the public. Most Survey reports on the water resources of Florida are available for inspection at the offices listed on the inside of the front cover, at the offices of the five water management districts, and at libraries of the State University system. Contact the Survey District Office in Tallahassee for information regarding the availability of these publications.

Barr, G.L., 1988, Potentiometric surface of the Upper Floridan aquifer in Florida, May 1985: Florida Geological Survey Map Series 119, 1 sheet.

Bradner, L.A., 1987, Potentiometric surface of the Upper Floridan aquifer in central Sumter County, Florida, September 1986: U.S. Geological Survey Open-File Report 87-34, 1 sheet.

———1987, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, September 1987: U.S. Geological Survey Open-File Report 87-688, 1 sheet.

Causaras, C.R., 1987, Geology of the surficial aquifer system, Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 86-4126, 3 sheets.

Claiborne, Maude, Embry, T.L., Hoy, N.D., Weldon, D.H., and Wilson, T.D., 1987, Bibliography of U.S. Geological Survey reports on the water resources of Florida, 1886-1986, U.S. Geological Survey Open-File Report 85–424, 172 p.

Corral, M.A., and Thompson, T.H., 1988, Hydrology of the Citrus Park quadrangle, Hillsborough County, Florida, U.S. Geological Survey Water-Resources Investigations Report 87-4166, 1 sheet.

Duerr, A.D., Hunn, J.D., Lewelling, B.R., and Trommer, J.T., 1988, Geohydrology and 1985 water withdrawals of the aquifer systems in southwest Florida, with emphasis on the Intermediate aquifer system: U.S. Geological Survey Water-Resources Investigations Report 87-4259, 115 p.

Fish, J.E., 1988, Hydrogeology, aquifer characteristics, and ground-water flow of the surficial aquifer system, Broward County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4034, 92 p., 1 sheet.

Foose, D.W., 1988, Long-term stage records of lakes in Florida: Florida Geological Survey Map Series 118, 1 sheet.

Franklin, M.A., and Orr, R.A., 1987, Analysis of water-surface profiles in Leon County and the city of Tallahassee, Florida: U.S. Geological Survey Water-Resources Investigations Report 86-4327, 82 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.

Franks, B.J., 1988, Hydrogeology and flow of water in a sand and gravel aquifer contaminated by wood-preserving compounds, Pensacola, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4260, 72 p.

German, E.R., and Schiffer, D.M., 1988, Application of National Stream Quality Accounting Network (NASQAN) station data for assessing water quality in the Peace River basin, Florida: U.S. Geological Survey Water-Resources Investigations Report 87–4167, 73 p.

Glenn, M.E., ed., 1987, Water resources activities in Florida, 1986-87: U.S. Geological Survey Open-File Report 87-244, 98 p.

———1988, Water resources activities in Florida, 1987-88: U.S. Geological Survey Open-File Report 88-199, 98 p.

Goodwin, C.R., 1987, Tidal-flow, circulation, and flushing changes caused by dredge and fill in Tampa Bay, Florida: U.S. Geological Survey Water-Supply Paper 2282, 88 p.

Hammett, K.M., 1988, Land use, water use, streamflow, and water-quality characteristics of the Charlotte Harbor inflow area, Florida: U.S. Geological Survey Open-File Report 87-472, 104 p.

Henderson, S.E., Hydrology of Hunters Lake, Hernando County, Florida: U.S. Geological Survey Water-Resources Investigations Report 85-4242, 1 sheet.

Hickey, J.J., and Vecchioli, John, 1986, Subsurface injection of liquid waste with emphasis on injection practices in Florida: U.S. Geological Survey Water-Supply Paper 2281, 25 p.

Howie, Barbara, 1987, Chemical characteristics of water in the surficial aquifer system, Broward County, Florida: U.S. Geological Survey Water-Resources Investigations Report 86-4330, 2 sheets.

Irwin, G.A., and Bonds, J.L., 1987, Florida ground-water quality: U.S. Geological Survey Open-File Report 87–719, 9 p.

Kimrey, J.O., and Anderson, Warren, 1987, Reconnaissance of geohydrologic areas and 1981 low-flow conditions, Withlacoochee River basin, Southwest Florida Water Management District: U.S. Geological Survey Water-Resources Investigations Report 86-4203, 53 p.

Leve, G.W., and Conover, C.S., 1987, Water for Florida cities: U.S. Geological Survey Water-Resources Investigations Report 86-4122, 30 p.

Lewelling, B.R., 1987, Potentiometric surface of the intermediate aquifer in west-central Florida, September 1986, U.S. Geological Survey Open-File Report 87-35, 1 sheet.

Lewelling, B.R., 1987, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, May 1987: U.S. Geological Survey Open-File Report 87-451, 1 sheet.

– – – 1987, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, September 1987: U.S. Geological Survey Open-File Report 87-683, 1 sheet.

– – – 1988, Potentiometric surface of the intermediate aquifer system, west-central Florida, May 1987: U.S. Geological Survey Open-File Report 87-705, 1 sheet.

– – – 1988, Potentiometric surface of the intermediate aquifer system, west-central Florida, September 1987: U.S. Geological Survey Open-File Report 88-303, 1 sheet.

– – – 1988, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, May 1988: U.S. Geological Survey Open-File Report 88-461, 1 sheet.

Mattraw, H.C., Scheidt, D.J., and Federico, A.C., 1987, Analysis of trends in water-quality data for Water Conservation Area 3A, The Everglades, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4142, 52 p.

McKenzie, D.J., and Irwin, G.A., 1988, Effects of two stormwater management methods on the quality of water in the upper Biscayne aquifer at two commercial areas in Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 88–4069, 22 p.

Meyer, F.W., 1988, Summary of well construction, testing, and preliminary findings from the Alligator Alley test well, Broward County, Florida: U.S. Geological Survey Open-File Report 87-551, 68 p.

Miller, W.L., 1988, Description and evaluation of the effects of urban and agricultural development on the surficial aquifer system, Palm Beach County, Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4056, 58 p.

Mycyk, R.T., and Heath, R.C., 1988, The U.S. Geological Survey stream-gaging program in west-central Florida: With a section on history of the stream-gaging program in Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4032, 19 p.

Navoy, A.S., and Bradner, L.A., 1987, Ground-water resources of Flagler County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4021, 45 p.

Phelps, G.G., 1987, Effects of surface runoff and treated wastewater recharge on quality of water in the Floridan aquifer system, Gainesville area, Alachua County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4099, 57 p.

Phelps, G.G., and Rohrer, K.P., 1987, Hydrogeology in the area of a freshwater lens in the Floridan aquifer system, northeast Seminole County, Florida: U.S. Geological Survey Water-Resources Investigations Report 86-4078, 74 p.

Russell, G.M., and Goodwin, C.R., 1987, Simulation of tidal flow and circulation patterns in the Loxahatchee River estuary, southeastern Florida: U.S. Geological Survey Water-Resources Investigations Report 87–4201, 32 p.

Rutledge, A.T., 1987, Effects of land use of ground-water quality in central Florida—Preliminary results: U.S. Geological Survey Toxic Waste—Ground-Water-Contamination Program: U.S. Geological Survey Water-Resources Investigations Report 86-4163, 49 p.

Schiner, G.R., 1987, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, May 1987: U.S. Geological Survey Open-File Report 87-464, 1 sheet.

———1988, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, May 1988: U.S. Geological Survey Open-File Report 88-460, 1 sheet.

Seaber, P.R., and Thagard, M.E., 1986, Identification and description of potential ground-water quality monitoring wells in Florida: U.S. Geological Survey Water-Resources Investigations Report 85-4130, 124 p.

Sonntag, W.H., 1987, Chemical characteristics of water in the surficial aquifer system, Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4080, 42 p. and 2 map sheets.

Spechler, R.M., 1987, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, September 1986: U.S. Geological Survey Open-File Report 87-36, 1 sheet.

Swayze, L.J., 1988, Ground-water flow beneath levee 35A from Conservation Area 2B, Broward County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4280, 22 p.

Trommer, J.T., 1987, Potential for pollution of the Upper Floridan aquifer from five sinkholes and an internally drained basin in west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 87–4013, 103 p.

Waller, B.G., Howie, Barbara, and Causaras, C.R., 1987, Effluent migration from septic tank systems in two different lithologies, Broward County, Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4075, 22 p.

Wolansky, R.M., and Thompson, T.H., 1987, Relation between ground water and surface water in the Hillsborough River basin, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 87-4010, 58 p.

The above lists the reports released by the Florida District, U.S. Geological Survey, in calendar year 1988.

HOW TO OBTAIN REPORTS PREPARED BY THE FLORIDA DISTRICT

The Florida District has been preparing reports on water resources for several decades. Titles of new reports prepared by the Florida District are included in the free catalog, *"New Publications of the U.S. Geological Survey."* To subscribe, write to:

"New Publications of the
Geological Survey"
582 National Center
Reston, VA 22092

A bibliography of reports on the water resources of Florida (through 1986) has been published as USGS Open-File Report 85–424. For information on availability of Florida reports, please write to:

District Chief
U.S. Geological Survey,
Suite 3015,
227 N. Bronough Street,
Tallahassee, Florida 32301

PUBLICATION SERIES	CONTACT
OPEN-FILE REPORTS (Florida) WATER-RESOURCES INVESTIGATIONS (Florida)	U.S. Geological Survey 227 N. Bronough St., Suite 3015 Tallahassee, FL 32301
U.S. GEOLOGICAL SURVEY BOOKS Bulletins Circulars Professional Papers Water-Supply Papers	U.S. Geological Survey Books & Open-File Reports Section Box 25425, Federal Center, Bldg. 810 Denver, CO 80225 Phone (303) 236-7476
U.S. GEOLOGICAL SURVEY MAPS Hydrologic Investigations Atlases Hydrologic Unit Maps	U.S. Geological Survey Map Distribution Box 25286, Federal Center Denver, CO 80225 Phone: (303) 236-7477 (This office also handles topographic maps)
FLORIDA GEOLOGICAL SURVEY Bulletins Map Series Reports of Investigations Information Circulars	Florida Geological Survey 903 West Tennessee Street Tallahassee, FL 32304 Phone: (904) 488-9380

FLORIDA WATER RESOURCES RESEARCH CENTER

The Florida Water Resources Research Center, funded by the Department of the Interior, was established in 1964 as a result of the passage of Public Law 88-379, The Water Resources Research Act of 1964, "to stimulate, sponsor, provide for, and supplement present programs for conduct of research, investigation, experiments, and the training of scientists in the fields of water and of resources which affect water." Late in 1983, management of this program was transferred to the U.S. Geological Survey.

Under the administration of the Center, current water resources research pertaining to the achievement of adequate statewide water resource management, and water quality and quantity is being conducted by faculty at the University of Florida and at other universities in the State. For further information concerning the Center, contact Dr. James P. Heaney, Director, Florida Water Resources Research Center, 424 A.P. Black Hall, University of Florida, Gainesville, FL 32611 (904) 392-0840. A list of new publications resulting from the center projects is presented below:

No. 100 *Analysis Of Water Supply Problems Using Microcomputers* by M.A. Moore, 1988, 163 pages.

No. 101 *Management Methods For Impounded Florida Coastal Marshes* by M.E. Rowan, J.P. Heaney, M.D. Shafer, T.G. Potter, S.W. Miles, M.A. O'Connell, 1988, 242 pages.

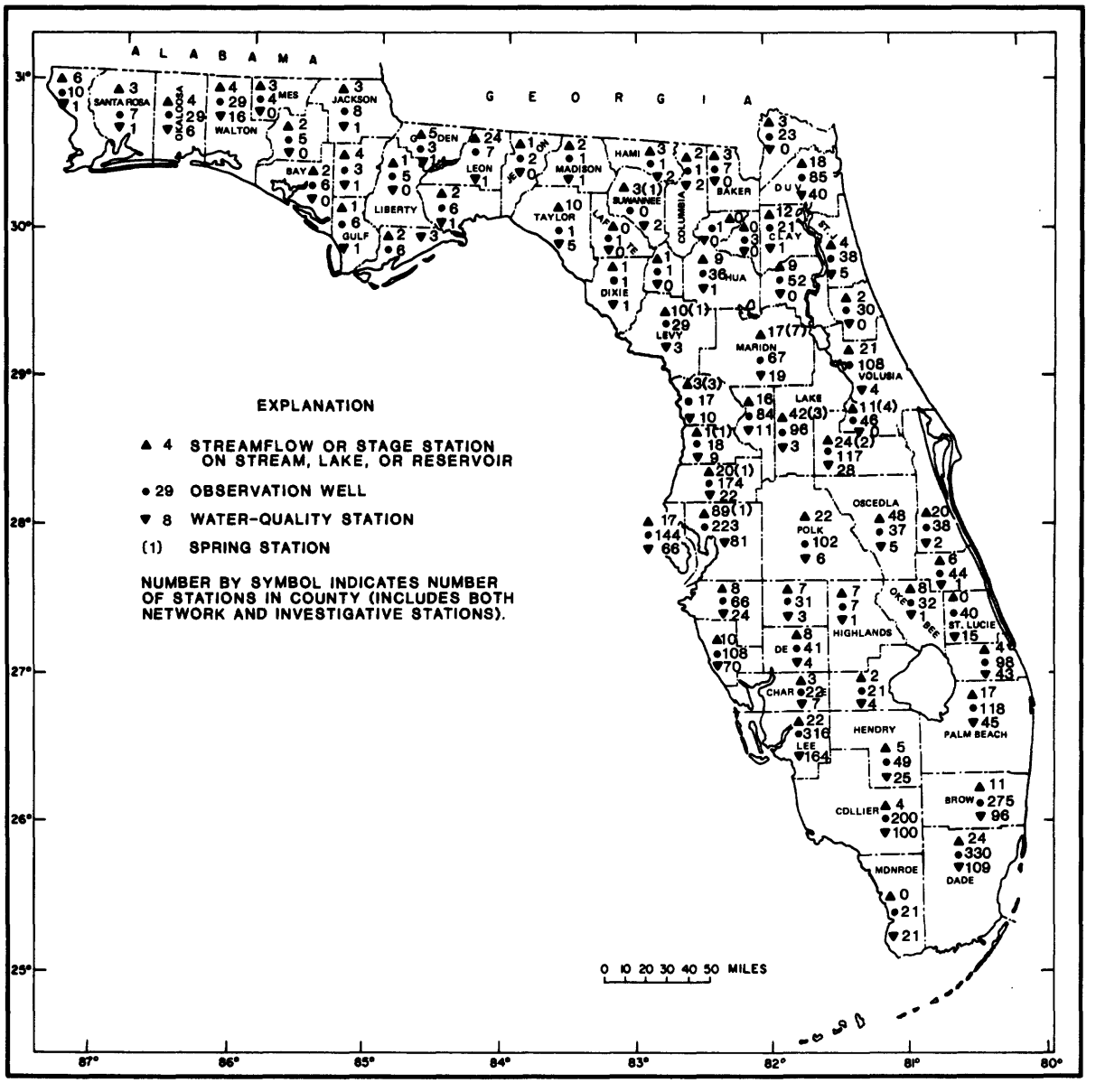
No. 102 *Microcomputer-based Spreadsheet And Cad System For Inventory and Analysis Of Small Quantity Generators Of Hazardous Wastes* by J.P. Heaney and Leel Knowles, 1988, 120 pages.

No. 103 *Regional Water Supply Management Institutions* by E.J. Godreau, 1988, 117 p.

No. 104 *Heuristic Method For The Design Of Stormwater Drainage Systems using Lotus 1-2-3* by S.W. Miles, 1988, 93 pages.

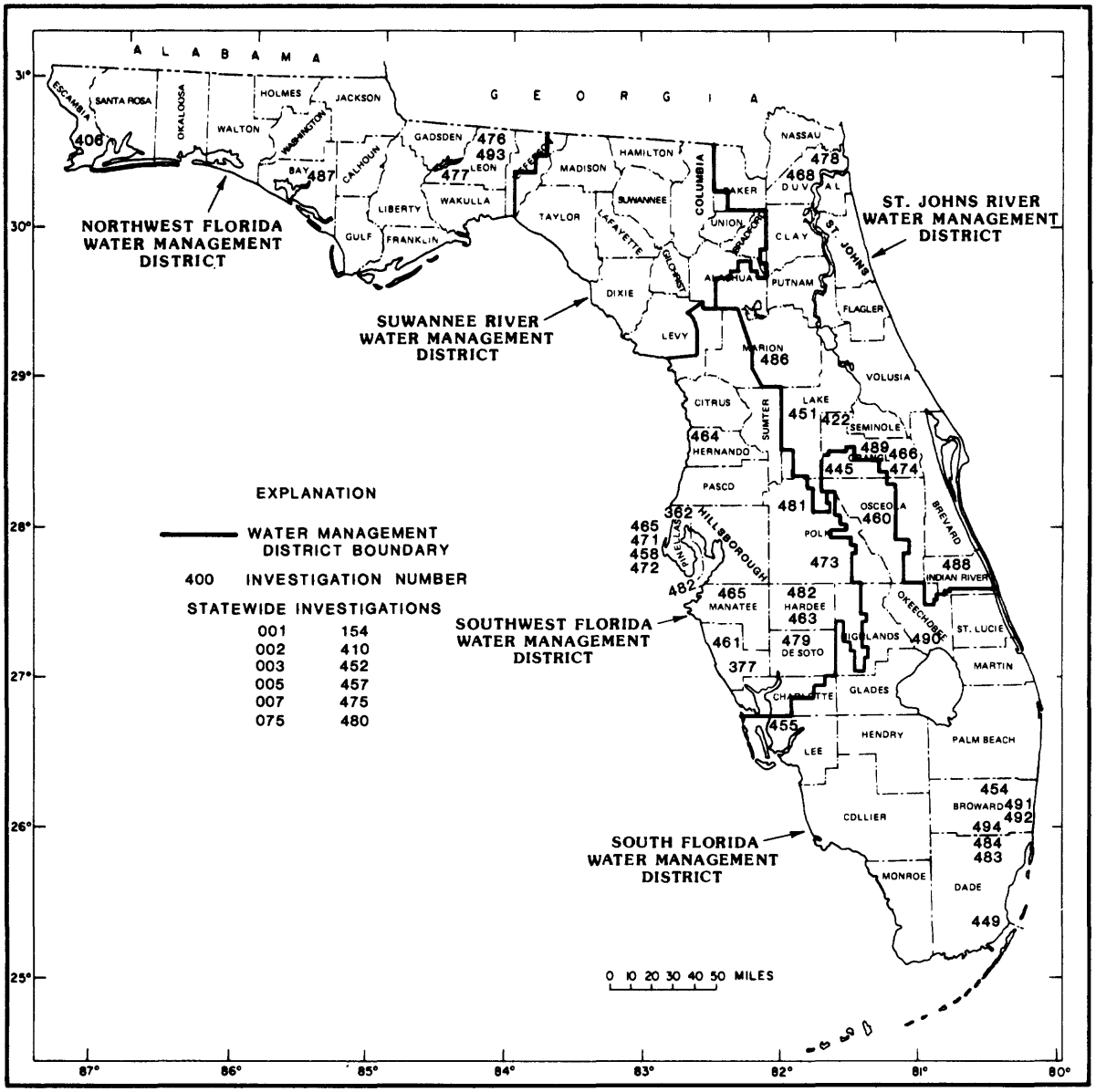
No. 105 *Efficiency/equity Analysis Of Water Resource Problems* by S.N. Payne, 1988, 100 pages.

No. 106 *Field Validation Of A Dispersion Model Based On Geological Parameters* by D.A. Chin, 1988, 89 pages.



Hydrologic data stations in Florida as of September 1988.

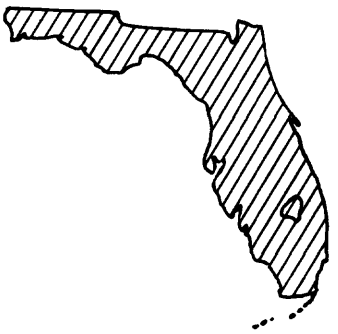
LOCATION OF AREAL INVESTIGATIONS AND OF THE FIVE WATER MANAGEMENT DISTRICTS



FLORIDA DISTRICT PROJECTS

A brief description of current District projects follows and includes the following information:

- Name
- Number
- Location
- Project Chief
- Period of project
- Cooperating agency or agencies
- Problem
- Objectives
- Approach
- Progress
- Plans for this year
- Reports in process
- Reports released



FL-001 SURFACE-WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1926

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: W.C. Bridges, Tallahassee

PRINCIPAL INVESTIGATORS: L.D. Fayard, Orlando; W.J. Haire, Miami; R.T. Mycyk, Tampa; M.A. Franklin, Tallahassee

COOPERATING AGENCIES: Most of the agencies shown in the list of cooperators

PROBLEM: Surface-water information is needed for purposes of surveillance, planning, design, hazard warning, operation, and management in water-related fields such as water supply, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water resources development. To provide this information, an appropriate data base is necessary.

OBJECTIVE: To obtain and document an unbiased inventory of streamflow, stream, and lake stage data for use in the planning and development of the water resources of the State of Florida.

APPROACH: Collect stream discharge, stream, and lake stage data from a network of gaging stations that include daily discharge, periodic discharge, daily stage, and periodic stage stations to define streamflow and stage conditions within the State of Florida.

PROGRESS: Streamflow and stage data were collected from 759 network sites and prepared for publication. Streamflow and stage data currently are being obtained at the number of hydrologic data network stations given below.

PLANS FOR THIS YEAR: Continue operations as needs are defined.

REPORTS IN PROCESS:

Water-resources data for Florida, water years 1987 and 1988.

STATION CLASSIFICATION	NUMBER OF STATIONS
Stream stations	596
Continuous record:	
Discharge and stage	300
Stage only	145
Partial record:	
Peak (maximum) flow	92
Periodic streamflow	59
Lake and reservoir stations	163
Stage and contents	2
Stage only:	
Continuous	73
Periodic	88

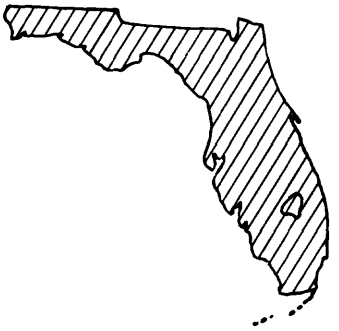
REPORTS RELEASED:

U.S. Geological Survey, 1988, Water resources data, Florida, water year 1987, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-87-1A, 416 p.

– – – 1988, Water resources data, Florida, water year 1987, volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-87-2A, 174 p.

– – – 1988, Water resources data, Florida, water year 1987, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-87-3A, 300 p.

– – – 1988, Water resources data, Florida, water year 1987, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-87-4, 265 p.



FL-002 GROUND-WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1930

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: W.C. Bridges, Tallahassee

PRINCIPAL INVESTIGATORS: L.D. Fayard, Orlando; W.J. Haire, Miami; R.T. Mycyk, Tampa; M.A. Franklin, Tallahassee

COOPERATING AGENCIES: Most of the agencies shown in the list of cooperators

PROBLEM: Long term water level records are needed to evaluate the effects of climatic variations on the recharge to and discharge from the ground-water systems, to provide a data base from which to measure the effects of development, to assist in the prediction of future supplies, and to provide data for management of the resource.

OBJECTIVE: To obtain and document an unbiased inventory of water-level data for use in the planning and development of the water resources of the State of Florida.

APPROACH: Collect water-level data for the various aquifers by a network of observation wells which includes 2,656 periodic observation sites and 450 sites where data are recorded continuously.

PROGRESS: Water-level data were collected and published as planned.

PLANS FOR THIS YEAR: Collection and publication of data will be continued.

REPORTS IN PROCESS:

Water-resources data for Florida, water year 1988.

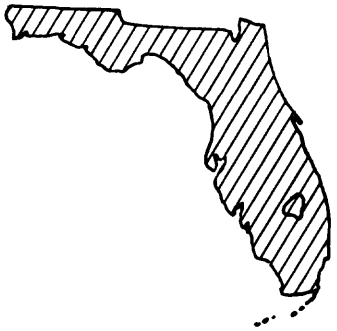
REPORTS RELEASED:

U.S. Geological Survey, 1988, Water resources data, Florida, water year 1987, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-87-1B, 346 p.

– – – 1988, Water resources data, Florida, water year 1987, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-87-2B, 354 p.

– – – 1988, Water resources data, Florida, water year 1987, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-87-3B, 340 p.

– – – 1988, Water resources data, Florida, water year 1987, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-87-4, 265 p.



FL-003 QUALITY OF WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1939

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: W.C. Bridges, Tallahassee

PRINCIPAL INVESTIGATORS: L.D. Fayard, Orlando; W.J. Haire, Miami; R.T. Mycyk, Tampa; M.A. Franklin, Tallahassee

COOPERATING AGENCIES: Most of the agencies shown in the list of cooperators

PROBLEM: Water resource planning and water-quality assessment require a nationwide base level of relatively standardized information. For intelligent planning and realistic assessment of the water resource, the chemical and physical quality of surface and ground waters must be defined and monitored.

OBJECTIVE: To obtain and document unbiased inventory of water-quality data for use in the planning and development of the water resources of the State of Florida.

APPROACH: Collect water-quality data from a network of daily, weekly, and periodic stations which include streams, lakes, springs, and wells to define water quality conditions within the State of Florida.

PROGRESS: Water-quality data are obtained at 159 surface-water network stations. These stations are used to monitor the quality of surface water in Florida. Some of these stations also are part of a U.S. Geological Survey nationwide network known as the National Stream Quality Accounting Network which is used to detect nationwide trends in water quality. The types of data determined at these sites are given below. Inasmuch as several types of data may be determined at a particular site and not all types of data are determined at each site, the number given below will not equal the total number of surface water sites.

Water-quality data are obtained at network observation wells and springs. The types of data determined at these sites are listed below. Inasmuch as several types of data may be determined at a particular site, and not all types of data are determined at each site, the number given below will not equal the total number of ground-water sites.

DATA CLASSIFICATION	NUMBER OF SURFACE-WATER SITES
Physical data:	
Temperature, specific conductance, or pH	159
Sediment	27
Chemical data:	
Inorganic constituents	110
Organic constituents	62
Pesticides	20
Radiochemical data	3
Biological data	29

DATA CLASSIFICATION	NUMBER OF WELLS	NUMBER OF SPRINGS
Physical data:		
Temperature, specific conductance, or pH	837	7
Chemical data:		
Inorganic constituents	117	5
Organic constituents	5	2
Biological data	11	1

REPORTS IN PROCESS:

Water-resources data for Florida, water year 1988.

REPORTS RELEASED:

U.S. Geological Survey, 1988, Water resources data, Florida, water year 1987, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-87-1A, 416 p.

———1988, Water resources data, Florida, water year 1987, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-87-1B, 346 p.

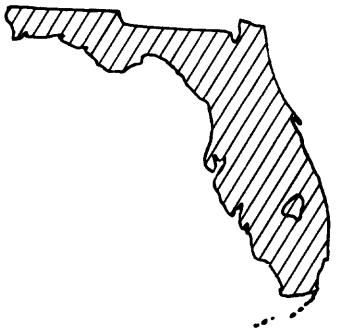
———1988, Water resources data, Florida, water year 1987, volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-87-2A, 174 p.

———1988, Water resources data, Florida, water year 1987, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-87-2B, 354 p.

———1988, Water resources data, Florida, water year 1987, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-87-3A, 300 p.

———1988, Water resources data, Florida, water year 1987, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-87-3B, 340 p.

———1988, Water resources data, Florida, water year 1987, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-87-4, 265 p.



FL-005 QUALITY OF PRECIPITATION

DATE PROJECT BEGAN: July 1983

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATORS: Terrie M. Lee, Tampa, and George A. Irwin, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: The amount of substances dispersed in the atmosphere and deposited by precipitation is expected to continue to increase throughout North America. Thus, there is a need for reliable and long-term measurements of the chemical constituents in precipitation. Such measurements are essential for responsible management of the agricultural, forest, and aquatic ecosystems of the United States.

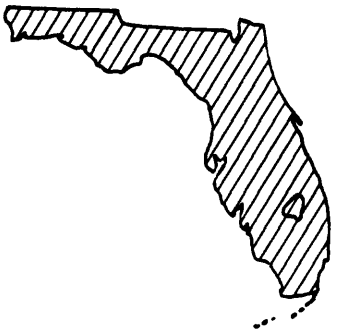
OBJECTIVE: The National Atmospheric Deposition Program (NADP) was created to conduct research on atmospheric deposition and its affect on surface waters and agricultural and forest lands in cooperation with federal, state and private research agencies. The U.S. Geological Survey (USGS) is participating in this program under the title of the National Trends Network (NTN) by establishing up to 40 stations nationwide with coordination and analytical services provided by NADP. These stations are established for the purpose of long term coordinated data collection for use in local, regional and national studies.

APPROACH: Basic data on atmospheric deposition will be collected at a NADP/NTN approved site at Verna Wellfield near Sarasota, Fla. Methods of data collection and instrumentation conform to NADP procedures and guidelines. Weekly precipitation samples are collected on a continuous basis, with additional samples collected for non-standard events. All samples are shipped to NADP Central Analytical Laboratory (CAL) which is operated by the Illinois State Water Survey.

PROGRESS: Weekly wet side precipitation samples were collected at the Verna Wellfield site near Sarasota, Florida according to NTN/NADP protocol. Review water chemistry data from this site as they are made available from Illinois Central Analytical Laboratory (CAL).

PLANS FOR THIS YEAR: The data collection sites will be maintained and operated according to NADP/NTN standards and schedule.

REPORTS IN PROCESS: No reports planned for this project; data will be stored in WATSTORE data files.



FL-007 FLORIDA WATER-USE PROGRAM

DATE PROJECT BEGAN: July 1975

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: Richard Marella, District Office, Tallahassee

COOPERATING AGENCIES: Florida Department of Environmental Regulation, Northwest Florida Water Management District, St. Johns River Water Management District, South Florida Water Management District, Southwest Florida Water Management District and Suwannee River Water Management District.

PROBLEM: Consistent and accurate statewide water use data are essential for the sound management of Florida's water resources. To date, periodic compilations of water-use data have been hampered by a lack of adequate long-term funding for water use in the cooperative program. The five water management districts are the primary collectors of water-use information. Consequently, within the State, there are five different levels of data collection, storage, compilation and publications of water-use information.

OBJECTIVE: The water-use program will ensure long-term continuity and technical coordination of water-use data in Florida. Specifically, the water-use program will include: (1) a liaison between the five water management districts, Florida Department of Environmental Regulation, and other State agencies regarding water-use data; (2) consultation and assistance with each water management district to locate, collect, tabulate and interpret water-use data; and (3) collation, interpretation, and publication of statewide data at 5-year intervals starting in 1990.

APPROACH: The water-use program will compile data for six major categories of water use for all 67 counties and five water management districts on a monthly basis. Data will be collected for all sources of withdrawal including fresh and saline, ground and surface water. Other data collected will include acreage irrigated for 29 specific crop types, wastewater discharge from public and industrial facilities, aquifer withdrawals, water reused for irrigation, water used for desalinization, and site-specific pumpage for commerical, industrial, and power generation facilities. Special projects to improve collection and accuracy of water-use data will be undertaken during time not devoted to the major assessment every 5 years. Additionally, periodic contact with key personnel at the five water management districts will be maintained.

PROGRESS: All of the 1985 data have been collected and tabulated for the State by the USGS and St. Johns River WMD. The 1985 data was provided to the National Water-Use Information Program and used in the compilation of the national report (USGS Circular 1004). The data collection effort for 1985 also helped produce reports by three water management districts (Northwest, St. Johns River, and Southwest). Three statewide reports have been generated from this 1985 data, a Water-Resources Investigation Report, a Water-Supply Paper and a Florida Geological Survey Map Series (in preparation). Additionally, water use tables were published in the 1987 edition of the Florida Statistical Abstract.

PLANS FOR THIS YEAR: Evaluate methods to determine water use trends and projections. This will include using the IWR-main water use project model and the straight line per capita method. Initiate detailed collection of public-supply pumpage by well field with 1987 or 1988 data. An additional effort will be spent evaluating accurate sources of agricultural irrigation acreage by county and crop.

REPORTS RELEASED:

Duerr, A.D., and Trommer, J.T., 1981, Estimated water use in the Southwest Florida Water Management District and adjacent areas, 1979: U.S. Geological Survey Open-File Report 81-56, 58 p.

– – –1981, Estimated water use in the Southwest Florida Water Management District and adjacent areas, 1980: U.S. Geological Survey Open-File Report 81-1060, 60 p.

– – –1982, The benchmark farm program – a method for estimating irrigation water use in southwest Florida: U.S. Geological Survey Water-Resources Investigation 82-17, 49 p.

Duerr, A.D., and Sohm, J.E., 1983, Estimated water use in southwest Florida 1981, and summary of water use, 1970, 1975, and 1977-81: U.S. Geological Survey Open-File Report 83-45, 75 p.

Geiger, L.J., 1984, Water-use computer programs for Florida: U.S. Geological Survey Open-File Report 84-442, 91 p.

Healy, H.G., Public water supplies of selected municipalities in Florida, 1975: U.S. Geological Survey Water-Resources Investigations 77-53 (PB-271 691/AS), 309 p.

Leach, S.D., 1977, Water use inventory in Florida, 1975: U.S. Geological Survey Open-File Report 77-577, 57 p.

– – –1978, Source, use, and disposition of water in Florida, 1975: U.S. Geological Survey Water-Resources Investigations 78-17, 90 p.

– – –1978, Freshwater use in Florida, 1975: Florida Bureau of Geology Map Series 87.

– – –1982, Estimated water use in Florida, 1980, Florida Bureau of Geology Map Series 103.

Leach, S.D., and Healy, H.G., 1980, Estimated water use in Florida, 1977: U.S. Geological Survey WaterResources Investigations 79-112, 76 p.

Leach, S.D., 1983, Consumptive use of freshwater in Florida, 1980: Florida Bureau of Geology Map Series 105.

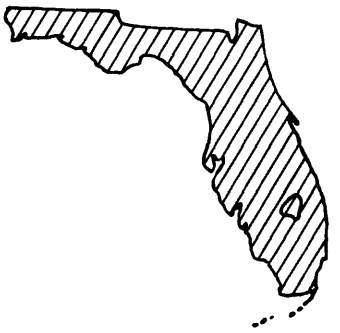
– – –1983, Source, use and disposition of water in Florida, 1980: U.S. Geological Survey Water-Resources Investigation 82-4090, 337 p.

– – –1984, Projected public supply and rural (self-supplied) water use in Florida through year 2020: Florida Bureau of Geology Map Series 108.

Marella, R.L., 1988, Water withdrawals, use and trends in Florida, 1985: U.S. Geological Survey WaterResources Investigations Report 88-4103, 43 p.

– – –in press, National Water Summary 1987: U.S. Geological Survey Water-Supply Paper 2350.

Spechler, R.M., 1983, Estimated irrigation water use in Florida, 1980: Florida Bureau of Geology Map Series 106.



FL-075 FLORIDA WATER ATLAS

DATE PROJECT BEGAN: September 1963

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: Walter R. Aucott, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Water-use planners have repeatedly expressed the need for maps that show the characteristics and availability of water in Florida or that show related information such as climate. Prior to the start of this project only a few maps had been published that give hydrologic data or other data closely related to hydrologic problems in Florida.

OBJECTIVE: This project seeks to make available the needed information in the form of a water atlas – a series of map reports designed to furnish to the user generalized hydrologic, geologic, and related information, portrayed graphically on a standard size map. These maps are most useful for broad planning to aid legislators, planners, industrialists, laymen, and others as well as hydrologists to provide readily available hydrogeologic information for decision making.

APPROACH: Using available information and knowledge from other statewide studies, maps portraying aspects of the hydrologic cycle will be prepared by the U.S. Geological Survey and published by the Florida Geological Survey.

PROGRESS: Five water atlas reports were worked on during the past year. Two were approved, drafted and sent to the publisher. Two were completed and are in the review process.

PLANS FOR THIS YEAR: Publish reports now in review. Begin work on two new atlas reports. Continue work on "Recharge to the surficial aquifers".

REPORTS IN PROCESS:

Rumenik, R.P., Runoff in hydrologic units in Florida

Aucott, Walter R., Recharge to the Floridan aquifer

Aucott, Walter R., Recharge to the surficial aquifers

Marella, Richard L., Water use in Florida, 1985

REPORTS RELEASED:

Healy, H.G., 1962, Piezometric surface of the Floridan aquifer in Florida, July 6-17, 1961: Florida Division of Geology Map Series 1.

Vernon, R.O., and Puri, H.S., 1964, Geologic map of Florida: Florida Bureau of Geology Map Series 3.

Healy, H.G., 1975, Piezometric surface and areas of artesian flow of the Floridan aquifer in Florida, July 6-17, 1961 (2d ed.): Florida Bureau of Geology Map Series 4.

Calver, J.L., 1965, Mineral resources and industries of Florida: Florida Bureau of Geology Map Series 8.

Shampine, W.J., 1975, Chloride concentration in water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 12.

Shampine, W.J., 1975, Hardness of water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 13.

Shampine, W.J., 1965, Dissolved solids in water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 14.

Shampine, W.J., 1975, Sulfate concentration in water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 15.

Hyde, L.W., 1975, Principal aquifers of Florida (2d ed.): Florida Bureau of Geology Map Series 16.

Vernon, R.O., Puri, H.S., 1964, Geologic map of Florida: Florida Bureau of Geology Map Series 18.

Kenner, W.E., 1966, Runoff in Florida: Florida Bureau of Geology Map Series 22.

Kenner, W.E., Pride, R.W., Conover, C.S., 1967, Drainage basins in Florida: Florida Bureau of Geology Map Series 28.

Kenner, W.E., 1975, Seasonal variation of streamflow in Florida (2nd ed.): Florida Bureau of Geology Map Series 31.

Visher, F.N., Hughes, G.H., 1975, The difference between rainfall and potential evaporation in Florida (2d ed.): Florida Bureau of Geology Map Series 32.

Kaufman, M.I., 1975, Generalized distribution and concentration of orthophosphate in Florida streams (2d ed.): Florida Bureau of Geology Map Series 33.

Kenner, W.E., Hampton, E.R., Conover, C.S., 1975, Average flow of major streams in Florida (2d ed.): Florida Bureau of Geology Map Series 34.

Kaufman, M.I., 1975, Color of water in Florida streams and canals (2nd ed.): Florida Bureau of Geology Map Series 35.

Pride, R. W., 1975, Estimated water use in Florida, 1965 (2d ed.): Florida Bureau of Geology Map Series 36.

Kaufman, M.I., 1975, The pH of water in Florida streams and canals, (2d ed.): Florida Bureau of Geology Map Series 37.

Hughes, G. H., Hampton, E.R., Tucker, D.F., 1971, Annual and seasonal rainfall in Florida: Florida Bureau of Geology Map Series 40.

Klein, H., 1975, Depth to base of potable water in the Floridan aquifer (2nd ed.): Florida Bureau of Geology Map Series 42.

Anderson, W., 1975, Temperature of Florida streams (2d ed.): Florida Bureau of Geology Map Series 43.

Kaufman, M.I., 1975, The chemical type of water in Florida streams (2nd ed.): Florida Bureau of Geology Map Series 51.

Vernon, R.O., 1973, Top of the Floridan artesian aquifer: Florida Bureau of Geology Map Series 56.

Slack, L.J., Kaufman, M.I., 1973, Special conductance of water in Florida streams and canals (2d ed.): Florida Bureau of Geology Map Series 58.

Hughes, G.H., 1974, Water-level fluctuations of lakes in Florida: Florida Bureau of Geology Map Series 62.

Rosenau, J.C., and Faulkner, G.L., 1975, An index to springs of Florida, (2d ed.): Florida Bureau of Geology Map Series 63.

Stone, R.B., 1974, Low streamflow in Florida – magnitude and frequency: Florida Bureau of Geology Map Series 64.

Healy, H.G., 1974, The observation-well network of the U.S. Geological Survey in Florida: Florida Bureau of Geology Map Series 65.

Snell, L.J., and Kenner, W.E., 1974, Surface water features of Florida: Florida Bureau of Geology Map Series 66.

Pascale, C.A., 1975, Estimated yield of freshwater wells in Florida: Florida Bureau of Geology Map Series 70.

Healy, H.G., 1975, Terraces and shorelines of Florida: Florida Bureau of Geology Map Series 71.

Conover, C.S., and Leach, S.D., 1975, River basin and hydrologic unit map of Florida: Florida Bureau of Geology Map Series 72.

Healy, H.G., 1975, Potentiometric surface and areas of artesian flow of the Floridan aquifer in Florida, May 1974: Florida Bureau of Geology Map Series 73.

Causey, L.V., Leve, G.W., 1976, Thickness of the potable-water zone in the Floridan aquifer: Florida Bureau of Geology Map Series 74.

Slack, L.J., Goolsby, D.A., 1976, Nitrogen loads and concentrations in Florida streams: Florida Bureau of Geology Map Series 75.

Slack, L.J., 1977, Program for monitoring surface-water quality in Florida: Florida Bureau of Geology Map Series 76.

Dysart, J. E., Goolsby, D.A., 1977, Dissolved-solids concentrations and loads in Florida surface waters: Florida Bureau of Geology Map Series 77.

Hughes, G.H., 1978, Runoff from hydrologic units in Florida: Florida Bureau of Geology Map Series 81.

Phelps, G.G., 1978, Chemical quality of water used for municipal supply in Florida, 1975: Florida Bureau of Geology Map Series 82.

Phelps, G.G., 1978, Principal uses of freshwater in Florida, 1975: Florida Bureau of Geology Map Series 83.

Leach, S.D., 1978, Freshwater use in Florida, 1975: Florida Bureau of Geology Map Series 87.

Hull, R.W., Irwin, G.A., 1979, Quality of untreated water for public supplies in Florida with reference to the National Primary Drinking Water Regulations: Florida Bureau of Geology Map Series 91.

Miller, J.A., 1979, Potential subsurface zones for liquid- waste storage in Florida: Florida Bureau of Geology Map Series 94.

Slack, L.J., Rosenau, J.C., 1979, Water quality of Florida springs: Florida Bureau of Geology Map Series 96.

Stewart, J.W., 1980, Areas of natural recharge to the Floridan aquifer in Florida: Florida Bureau of Geology Map Series 98.

Healy, H.G., 1981, Estimated pumpage from ground-water sources for public supply and rural domestic use in Florida, 1977: Florida Bureau of Geology Map Series 102.

Leach, S.D., 1982, Estimated water use in Florida, 1980: Florida Bureau of Geology Map Series 103.

Healy, H.G., 1982, Potentiometric surface of the Floridan aquifer, May 1980: Florida Bureau of Geology Map Series 104.

Leach, S.D., 1983, Consumptive water use in Florida, 1980: Florida Bureau of Geology Map Series 105.

Spechler, R.M., 1983, Estimated irrigation water use in Florida, 1980: Bureau of Geology Map Series 106.

Foose, D.W., and Sohm, J.E., 1983, Long-term streamflow stations in Florida, 1980: Florida Bureau of Geology Map Series 107.

Leach, S.D., 1985, Projected public supply and rural (self-supplied) water use in Florida through year 2020: Florida Bureau of Geology Map Series 108.

Hampson, P.S., 1984, Wetlands in Florida: Florida Bureau of Geology Map Series 109.

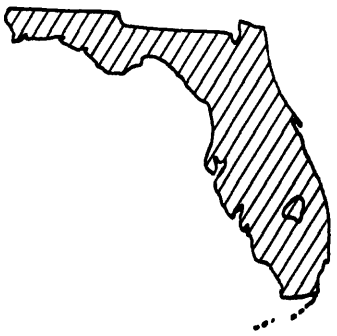
Sinclair, W.C., and Stewart, J.W., 1985, Sinkhole type, development, and distribution in Florida: Florida Bureau of Geology Map Series 110.

Foose, D.F., 1987, Long-term stage records of lakes in Florida: Florida Bureau of Geology Map Series 118.

Barr, G.L., 1987, Potentiometric surface of the Upper Floridan aquifer in Florida, 1985: Florida Bureau of Geology Map Series 119.

Rumenik, R.P., 1988, Runoff to streams in Florida: Florida Bureau of Geology Map Series 122.

Dysart, J.E., 1978, Satellite image mosaic NASA ERTS-1 Imagery-1973: U.S. Geological Survey.



FL-154 SUBSURFACE WASTE STORAGE, FLORIDA

DATE PROJECT BEGAN: October 1970

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: J.J. Hickey, Tampa

COOPERATING AGENCY: Federal Program

PROBLEM: Liquid wastes are now being injected into saline water in the deeper zones of the Floridan aquifer with indication of expanded use of the aquifer waste-storage capacity, especially in regard to storing and disposing of secondary treated sewage effluent. The hydrologic and geochemical characteristics needed to effectively evaluate the potential consequences of subsurface waste storage are not adequately known. Based on the present state of knowledge, reliable prediction of the movement, chemical interactions, and ultimate fate of liquid wastes underground is uncertain.

OBJECTIVE: To provide the needed scientific information base and guidelines for a comprehensive evaluation of the lithology, hydrology and geochemistry of the deep saline parts of the aquifer systems, and for planning and management decisions among a multiplicity of possible uses of the saline aquifers, including subsurface liquid waste storage.

APPROACH: Assessment and synthesis of available hydrologic and geochemical data into a regional appraisal of the deep saline-water part of the aquifer system; inventory, assessment and evaluation of active and planned subsurface waste disposal systems in Florida, compilation of data, field investigations, and preparation of summary report including case studies, and establishment of a foundation for expanded effort in subsequent years via liaison with regulatory agencies, consultants, companies, the Florida Bureau of Geology and WRD research personnel.

PROGRESS: Two articles were accepted for publication in national journals. Two abstracts were approved for publication by the Director.

PLANS FOR THIS YEAR: Guide variable-salinity report through the approval process. Continue work on study dealing with physical factors that influence circular convection during subsurface injection. Start a study about the hydrogeology of injection zones and associated confining units in the Floridan aquifer system of peninsular Florida.

REPORTS IN PROCESS:

Hickey, J.J., Some hydrogeologic and water-quality characteristics of the middle confining units of the Floridan aquifer system, west-central Florida.

– – – An interpretation of Hubbert's concept about the relationship between ground-water potential and ground-water density variation.

REPORTS RELEASED:

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Ehrlich, G.G., Godsy, E.M., Pascale, C.A., and Vecchioli, John, 1979, Chemical changes in an industrial waste liquid during post-injection movement in a limestone aquifer: Pensacola, Florida, Ground Water, v. 17, no. 6, p. 562-573.

Faulkner, G.L., and Pascale, C.A., 1975, Monitoring regional effects of pressure injection of wastewater in a limestone aquifer: Ground Water, v. 13, no. 2, p. 197-208.

Goolsby, D.A., 1972, Geochemical effects and movement of injected industrial waste in limestone aquifer: Amer. Assoc. Petroleum Geologists Memoir 18, p. 355-368.

Hickey, J.J., 1981, Hydrogeology, estimated impact, and regional well monitoring of effects of subsurface wastewater injection, Tampa Bay area, Florida: U.S. Geological Survey Water-Resources Investigations 80118, 40 p.

– – – 1982, Hydrogeology and results of injection tests at waste-injection test sites in Pinellas County, Florida: U.S. Geological Survey Water-Supply Paper 2183, 42 p.

– – – 1984, Subsurface injection of treated sewage into a saline- water aquifer – aquifer pressure buildup: Ground Water, v. 22, no. 1, p. 48-55.

– – – 1984, Field testing the hypothesis of Darcian flow through a carbonate aquifer: Ground Water, v. 22, no 5, p. 544-547.

– – – 1987, Convective circulation during subsurface injection of liquid waste: Proceedings of the International Symposium on Subsurface Injection of Oil Field Brines sponsored by the Underground Injection Practices Council and U.S. Environmental Protection Agency, New Orleans, Louisiana, May 4-6, p. 318-341.

Hickey, J.J., and Ehrlich, G.G., 1984, Subsurface injection of treated sewage into a saline-water aquifer – water quality changes and potential for recovery of injected sewage: Ground Water, v. 22, no. 4, p. 397-405.

Hickey, J.J. and Vecchioli, J., 1986, Subsurface injection of liquid waste with emphasis on injection practices in Florida, U.S. Geological Survey Water Supply Paper 2281, 25 p.

Hickey, J.J., and Wilson, W.E., 1982, Results of deep-well injection testing at Mulberry, Florida: U.S. Geological Survey Water- Resources Investigations 81-75, 15 p.

Hull, R.W., and Martin, J.B., 1982, Data on subsurface storage of liquid waste near Pensacola, Florida, 1963–1980: U.S. Geological Survey Open-File Report 82-689, 179 p.

Kaufman, M.I., 1973, Subsurface wastewater injection, Florida: Amer. Soc. Civil Engineers, Proc. Paper 9598, v. 99, no. IRI, p. 53-70.

Kaufman, M.I., Goolsby, D.A., and Faulkner, G.L., 1973, Injection of acidic industrial waste into a saline carbonate aquifer: Geochemical aspects: Amer. Assoc. Petroleum Geologists, Underground Waste Management and Artificial Recharge, v. 1, p. 526-551.

Kaufman, M.I., and McKenzie, D.J., 1975, Upward migration of deep-well waste-injection fluids in Floridan aquifer, south Florida: U.S. Geological Survey Journal Research, v. 3, no. 3, 261-271.

Kimrey, J.O., and Fayard, L.D., 1984, Geohydrologic reconnaissance of drainage wells in Florida – an interim report: U.S. Geological Survey Water-Resources Investigations Report 84-4021, 67 p.

Merritt, M.L., 1984, Digital simulation of the regional effects of subsurface injection of liquid waste near Pensacola, Florida: U.S. Geological Survey Water-Resources Investigations Report 84-4042, 73 p.

Meyer, F.W., 1974, Evaluation of hydraulic characteristics of a deep artesian aquifer from natural water-level fluctuations, Miami, Florida: Florida Bur. of Geology, Report of Investigations no. 75, 32 p.

– – – 1984, Disposal of liquid wastes in cavernous dolostones beneath southeastern Florida, *in* Hydrology of Karstic Terrains: International Association of Hydrogeologists, v. 1, p. 211-216.

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FL-362 EVALUATION OF STORMWATER DETENTION BASINS IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1980

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Miguel A. Lopez, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Pinellas County is one of the most densely populated counties in Florida, and serious water quality problems in the Gulf of Mexico and Tampa Bay are caused by the increase in urban runoff. There is a need for data to evaluate the cost-effectiveness of the pollution control measures being planned to satisfy receiving water quality standards.

OBJECTIVE: To determine the effectiveness of runoff detention ponds in reducing suspended solids, nutrients, metals, BOD, and coliform loading entering receiving waters from urban areas in Pinellas County.

APPROACH: Runoff quantity and quality of an urban watershed will be monitored for a year before the construction of a stormwater detention pond just upstream from the monitoring station. This will provide background information to compare with data after the completion of the pond in the second year. After completion of the pond, an additional monitoring station will be operated at the inflow. Loads entering and leaving the pond will be compared. An interpretive report will be written in the third year after at least one complete year of inflow and outflow data have been analyzed.

PROGRESS: Daily discharge and rainfall were recorded at the outflow of the proposed Detention Basin No. 3 on St. Joes Creek near Pinellas Park. Samples of storm runoff water quality were collected, and constituent loads for chloride, copper, chromium, lead zinc, total solids, and nutrients were computed for storms. Samples of base flow were collected quarterly for these same constituents.

PLANS FOR THIS YEAR: Continue the collection of daily discharge and rainfall at the outflow of Detention Basin No. 3. Detention Basin No. 3 is to be completed in FY 1988-89. An inflow daily discharge station will be installed at the inflow to Detention Basin No. 3. Quarterly base flow and storm runoff water quality samples for six storms will be collected at both inflow and outflow stations. Constituent loads of chloride, copper, chromium, lead, zinc, nitrogen, phosphorus, BOD, and total solids will be computed for each storm.

FL-377 ENVIRONMENTAL ASSESSMENT STUDY OF THE CHARLOTTE HARBOR ESTUARINE SYSTEM AND SURROUNDING AREA SOUTHWEST FLORIDA

DATE PROJECT BEGAN: July 1982

DATE PROJECT ENDS: June 1989

PRINCIPAL INVESTIGATOR: B.F. McPherson, Tampa

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The area surrounding the Charlotte Harbor estuarine system is undergoing rapid development and population growth. As development occurs, surface-drainage features will be modified, and area water resources will undergo increased stress from water-supply withdrawals and waste disposal. Consequently, the magnitude of freshwater inflow to the estuarine system will be reduced and the inflow patterns altered. Saltwater may move upstream on principal tributaries and into surficial and intermediate aquifer systems, and salinity in the estuarine system may increase. Altered inflow patterns and increased chemical constituent loads will affect physical, chemical, and biological processes in the estuarine system.

OBJECTIVE: To determine existing conditions and evaluate the impact of future development on water-related resources of the Charlotte Harbor estuary. Specific objectives are to evaluate: (1) Freshwater runoff in the major tributaries and salinity distribution in the estuary. (2) Land and water use in the basin. (3) Material transport and water- quality characteristics in the major tributaries. (4) Circulation, flushing, and transport characteristics of the estuarine system. (5) Water-quality characteristics of the estuarine system, including physical, optical, chemical, radiochemical, and biological properties. (6) Relationships between freshwater runoff, nutrient loading, and water-quality characteristics in the estuarine system.

APPROACH: Information will be gathered from the existing literature and from field data collected to define and describe the estuarine system so as to meet the objectives listed above. Available information includes (1) numerous scientific and technical reports, maps, etc.; and (2) rainfall, temperature, streamflow, water-quality, stream channel cross-sections, tide stage and velocity, water-use, land-use, and topographic data. However, much additional biologic and hydrologic data will be required to meet study objectives. Evaluation will require application of various engineering and hydrologic methods including digital models that simulate hydraulic and water-quality conditions in streams and estuaries.

PROGRESS: Work continued on analysis of hydrodynamic data and on calibration of a 2-dimensional circulation model of the estuary. Additional data were collected on water quality and phytoplankton biomass and productivity twice a week during June and July 1988. Work continued on analysis and interpretation of salinity data and on the preparation of reports on salinity, circulation and flushing, residence times, nutrients, and biological productivity.

PLANS FOR THIS YEAR: Continue to process and analyze data for preparation of reports. Calibrate and verify the 2-dimensional circulation model of the estuarine system. Describe the relation between freshwater runoff, rainfall, and tide and salinity distribution in the estuary. Analyze nutrient and phytoplankton data and describe the relation between nutrient loading and availability and algae productivity.

REPORTS IN PROCESS:

Miller, R.L., McPherson, B.F., and Kraemer, Origin of ^{228}Ra, ^{226}Ra and ^{222}Rn in Charlotte Harbor estuary, Florida, with estimates of ground-water inflow using ^{226}Ra and salinity data.

Stoker, Y.E., Phytoplankton composition and abundance and relation to environmental parameters in the Charlotte Harbor estuarine system, southwestern Florida.

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REPORTS RELEASED:

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Fraser, T.H., 1986, Long-term water-quality characteristics of Charlotte Harbor, Florida: Water-Resources Investigations Report 86-4180, 43 p.

Hammett, K.M., 1988, Land use, water use, streamflow and water quality characteristics of the Charlotte Harbor inflow area, Florida: U.S. Geological Survey Open File Report 87-472, 104 p.

McPherson, B.F., and Miller, R.L., 1987, The vertical attenuation of light in Charlotte Harbor, a shallow, subtropical estuary, southwestern Florida: Estuarine, Coastal and Shelf Science, v. 25, p. 721-737.

Stoker, Y. E., 1985, Water quality of the Charlotte Harbor estuarine system, Florida, November 1982 through October 1984, U.S. Geological Survey Open File Report 85-563, 213 p.

Stoker, Y. E. and Karavitis, G. A., 1983, Literature assessment of the Charlotte Harbor Estuarine System and surrounding area, southwest Florida: U.S. Geological Survey Open-File Report 83-127, 143 p.

FL-406 OCCURRENCE, MOVEMENT, AND FATE OF ORGANIC CONTAMINANTS IN GROUND WATER NEAR PENSACOLA, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATORS: W.R. Aucott and Tom Stodd, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: American Creosote Works, Inc. (ACW), located in northwest Florida within the city limits of Pensacola, presents an opportunity to investigate the biodegradation of hazardous wastes and the feasibility of enhancement of aquifer restoration processes under one set of hydrogeologic conditions. During the 70 years of continuous operation, wastewaters generated from the use of creosote and PCP in the wood-treatment process were discharged into two unlined surface impoundments which are in direct contact with the sand-and-gravel aquifer, the principal source of water in western panhandle Florida.

OBJECTIVE: (1) To define the chemical constituents in the subsurface and the extent of contaminant movement in the aquifer. (2) To study processes involved in the degradation of organic compounds. (3) To investigate impacts of organic contaminants on the nearshore environments in Pensacola Bay. (4) To continue field testing of analytical methods useful in defining organic contamination in ground water.

APPROACH: (1) Describe hydrogeology and ground water flow system of the site. (2) Provide field support to other researchers and coordinate concurrent multidisciplinary research efforts concerned with geochemical and microbial processes affecting contaminant distribution and movement.

PROGRESS: Summary report on hydrogeology and flow of water in a sand and gravel aquifer contaminated by wood-preserving compounds was approved. New geohydrologic analyis begun and poster presented at Phoenix.

PLANS FOR THIS YEAR: Complete geohydrology work, write chapter for water supply series, close field site, end project.

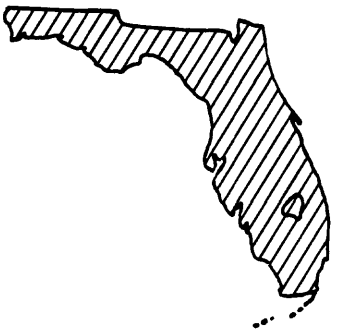
REPORTS RELEASED:

Franks, B.J., 1988, Hydrogeology and flow of water in a sand and gravel aquifer contaminated by wood-preserving compounds, Pensacola, Florida: U.S. Geological Survey Water-Resources Investigations Report 87–4260, 72 p.

Goerlitz, D.F., Troutman, D.E., Godsy, E.M., and Franks, B.J., 1985, Migration of wood-preserving chemicals in contaminated groundwater in a sand aquifer at Pensacola, Florida: Environmental Science and Technology, v. 19, no. 10, p. 955-961.

Mattraw, H.C., Jr., and Franks, B.J., eds., 1986, Movement and fate of creosote waste in ground water, Pensacola, Florida: U.S. Geological Survey toxic-waste – ground-water contamination program: U.S. Geological Survey Water-Supply Paper 2285, 63 p.

Ragone, S.E., ed., 1986, U.S. Geological Survey Program on Toxic Waste – Ground-Water Contamination: Proceedings of the second technical meeting, Cape Code, Massachusetts, October 21-25, 1985: U.S. Geological Survey Open-File Report 86-481, 173 p.



FL-410 ADAPTATION OF FLORIDAN AQUIFER SYSTEM RASA MODELS FOR WATER-MANAGEMENT NEEDS, FLORIDA

DATE PROJECT BEGAN: October 1983

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: C.H. Tibbals, Orlando

COOPERATING AGENCIES: South Florida Water Management District, Southwest Florida Water Management District, St. Johns River Water Management District, and Suwannee River Water Management, District

PROBLEM: From 1950 to 1980, the population of Florida grew from about 2.8 million to about 9.8 million, an increase of 350 percent. By 2000, the population is expected to grow to about 17 million. Population growth, plus that of industry and the increased use of ground water for crop irrigation has placed great demand on the ground-water resource. The principal source of fresh ground water is the Floridan aquifer system which underlies all of Florida and parts of Alabama, Georgia, and South Carolina. The effects of increased pumping of ground water have been responsible, in part, for lower pressure heads in the Floridan which, in turn, are responsible for intrusion of salty water along both the east and west coasts of peninsular Florida and along the Gulf coast of north-central Florida; lower lake levels; lower water levels in the surficial aquifer; reduced streamflow; and, to some degree, increased potential for sinkhole activity.

OBJECTIVE: The overall objective is to provide the basis for long-term liaison and, thus, coordination between the U.S. Geological Survey (USGS) and the five State Water Management Districts as regards refinement and uses of the regional and subregional Floridan aquifer computer models constructed during the now-completed Floridan Regional Aquifer Systems Analysis (RASA) projects; to provide information on new modeling techniques; and to provide, on an as-needed basis, general guidance and advice on matters that relate to ground-water modeling in general and ground-water hydraulics. Other, more specific, objectives are: (1) Identify data and investigate needs on an areal basis; (2) Suggest and help implement changes to existing models; (3) Help provide results of specific-purpose modeling runs done in cooperation with the Southeastern Region staff that maintains the regional model; (4) Participate in the development of a high resolution (small grid block), multi-District ground-water model data base; (5) Develop techniques to access that data base at any location so as to provide "moveable models," small models for any area that are, for the most part, already calibrated and that can be quickly constructed.

APPROACH: Liaison and coordination will be accomplished by means of both formal and informal meetings and discussions between the USGS District project leader, the Water Management District staffs, and the USGS Southeast Regional staff. Data and investigative needs will be assessed on a continuing basis by the USGS and the Water Management District staffs as the Districts implement their respective water-management plans. Some of these needs will be identified as the USGS regional RASA model is called upon to furnish results of specific purpose modeling runs to determine various stress-effect relations. The high-resolution data base will be constructed by adapting and incorporating the data bases generated for the regional and subregional models. The USGS Trescott-Larson three-dimensional source code will be the first to be modified to access the data base. Later, the USGS McDonald-Harbaugh three-dimensional modular model will be modified. Programs will be written in Fortran 77 to be executed in interactive mode.

PROGRESS: The "Moveable Model" is operational for use with either the McDonald-Harbaugh or the Trescott-Larson ground-water flow models. Interactive modules have been developed for both models. PC versions of both models have also been developed. A preprocessor program was developed for input of pumping/recharging well data. Digitize/discretize programs for large-scale arrays remain under development for input of thematic map data. Color 3D graphics interface has been refined and improved. The "Moveable Model" is available for use by WRD personnel via netlink.

PLANS FOR THIS YEAR: Continue to develop and refine the " Moveable Model". Complete digitize/discretize programs. Input historical statewide potentiometric maps to master database. Continue to develop preprocessor programs.

REPORTS IN PROCESS:

Rutledge, A.T., A program for converting rectangular coordinates to latitude-longitude coordinates.

FL-422 IMPACTS OF SELECTED DEVELOPMENTAL ACTIVITIES ON THE QUALITY OF GROUND WATER, CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1984

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Edward R. German, Orlando

COOPERATING AGENCY: Federal Program

PROBLEM: There is a need to appraise the quality of ground water in relation to major developmental activities prevalent in recharge areas of the Floridan aquifer system. Many studies have dealt with ground-water quality, although most have not emphasized organic chemicals or trace metals. The three developmental activities of concern are: (1) use of drainage wells for stormwater disposal in urban areas, (2) use of pesticides and fertilizers in citrus groves, and (3) use of various chemicals in processing of phosphate ore and use of interconnector wells for drainage in phosphate mining areas.

OBJECTIVES: Determine the impact of citrus growing, phosphate mining, and urban storm water disposal on ground-water quality. Test the transferability of findings to other areas of similar land use and hydrology. Determine surface loadings of potential contaminants and evaluate contaminant potentials based on chemical properties and transport models. Determine vertical patterns of flow and quality in the surficial aquifer underlying the citrus area.

APPROACH: Design and install a network of wells representative of the land-use types. Sample the wells for selected constituents with a ground water contamination potential. Compile data on pesticide usage, including type and application quantities. Evaluate pesticide contamination potential based on chemical properties and transport, using simple unsaturated-zone flow models. Install and sample nests of wells in a typical cross-section of the citrus area to determine vertical patterns of flow and quality. Statistically examine data for evidence of ground water contamination and for factors affecting ground-water quality in each land-use type. Test conclusions by sampling in different areas of similar land use.

PROGRESS: Wells in the control area (8 wells) were sampled for selected pesticides used in the citrus area. Wells were installed in the citrus area (10 wells) to complete the network. Wells in the citrus area were sampled for pesticides, as well as nutrients and, in the new wells, selected metals. A total of 20 sites were sampled in the citrus area, including 6 samples taken with a removable drive-point sampler. Wells were installed and sampled in the mining area (12 wells). A conceptual model of the urban area, based on the completely-mixed tank reactor principle, was used to evaluate the potential for impact of drainage-well recharge on the Upper Floridan aquifer. A paper describing this model and its application was prepared for the Fourth Toxic Substances Hydrology Technical Meeting, September 1988.

PLANS FOR THIS YEAR: Sample ground water in areas similar in hydrology and land use to the main study areas previously sampled, to confirm conclusions regarding impact of land use on ground-water quality. Continue analysis of data and final report preparation.

REPORTS RELEASED:

Rutledge, A.T., 1986, Effects of land use on ground-water quality in central Florida – preliminary results: U.S. Geological Survey Water-Resources Investigations Report 86-4163, 49 p.

German, E.R., in press, Assessment of potential for contamination of the Upper Floridan aquifer from drainage-well recharge in the Orlando area, central Florida, *in* Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program – Proceedings of the technical meeting, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigtions Report 88-4220.

FL-445 ASSESSMENT OF WATER-QUALITY PROCESSES AFFECTING NUTRIENTS IN WETLANDS STREAM

DATE PROJECT BEGAN: October 1985

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Paul S. Hampson, Orlando

COOPERATING AGENCY: Reedy Creek Improvement District

PROBLEM: Phosphorus concentrations in Reedy Creek which receives treated-sewage discharges are relatively high downstream from Walt Disney World. Dissolved oxygen concentrations are at times much lower than allowed by state regulations. The low DO may be due largely to natural runoff from swampy areas, or it may be related to nitrogen-conversion processes related to the wastewater effluent. Little is known about how Reedy Creek assimilates and cycles nutrients. A better understanding of the efficiency of wetlands streams in nutrient assimilation, and the effect of nutrient enrichment on such streams is required.

OBJECTIVES: Define the hydrologic environment of the Reedy Creek wetlands system in terms of water storage capacity, mean depth, stage duration, and water residence time. Evaluate role of wetlands in nutrient cycling and DO variation. Determine loads and speciation of nitrogen and phosphorus at selected points in the basin. Measure the nutrient-retention capacity of the RCID wetlands, and the effect of the wetlands on downstream water quality.

APPROACH: The methods used to accomplish the objectives will require six different types of data collection. These are: sampling of soil cores and sediments from the wetlands; *in situ* experiments to measure sediment oxygen demand and mechanism of nutrient cycling; aerial and field surveys for determination of flooded area and water depth; operation of continuous DO monitors and streamflow stations; sampling of nutrients at selected load stations under a range of discharge conditions; and collection of samples along Reedy Creek to establish profiles of water quality.

PROGRESS: Continuous monitoring of temperature, DO, and conductance has continued at 4 stations along Reedy Creek. Water-quality samples have been collected monthly and one reaeration coefficient - time of travel measurement has been completed. Preliminary data analysis shows that sewage outfall is the major source of phosphorus to the Reedy Creek wetland area. Analysis of background data from undeveloped Big Creek indicates that low DO concentrations are natural in many central Florida wetland streams.

PLANS FOR THIS YEAR: Continue minimonitor operation and water-quality sample collection. Complete four additional reaeration coefficient and time of travel measurements. Begin analysis of data with respect to nutrient cycling and processes affecting dissolved oxygen concentrations.

FL-449 SIMULATION OF A SALTWATER PLUME FROM A FLOWING WELL IN A SURFICIAL AQUIFER, DADE COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Michael L. Merritt, Miami

COOPERATING AGENCY: Metro-Dade Environmental Resources Management

PROBLEM: Water supply in highly populated southeastern peninsular Florida is obtained almost entirely from the surficial aquifer. The presence of a chloride plume in the aquifer was established in 1979 and traced to a flowing well in Chekika State Park that was constructed in 1944. It was plugged in March 1985. Dade County plans to develop a new wellfield to the northeast of the plume, and concerns exist about possible wellfield contamination and about the future movement and rate of dilution of the plume.

OBJECTIVES: The objectives are to obtain information about the hydrologic regime in the surficial aquifer of south central Dade County and about the local movement and dispersal of pollutants, and to use this information to assess the future migration and attenuation of the chloride plume and the possibility of contamination of water withdrawn from the proposed new well field.

APPROACH: Digital models will be constructed to represent flow and transport in the area containing the chloride plume. Information used to design the models will include descriptions of rock samples and cores and the results of hydraulic testing now taking place as part of a separate study. Information used to calibrate the model will include the results of a synoptic QW reconnaissance by the USGS in 1979, a time series of QW data collected by DERM at various sites since 1981, and surface resistivity surveys in 1979 and 1986. The hydraulic regime will be simulated first, to be followed by chloride transport calculations and analyses to predict future plume movement and assess possible wellfield contamination.

PROGRESS: The calibration of the flow model was refined and extended to later time periods in which more data points were available for comparison. The model was modified to provide a set of boundary conditions for a smaller-scale simulation of chloride transport in the area surrounding Chekika State Park.

PLANS FOR THE YEAR: Continue the verification of the flow model and begin model documentation. Continue small-scale simulation of chloride transport and begin final report.

FL-451 NUTRIENT LOADS IN THE APOPKA-BEAUCLAIR CANAL, UPPER OKLAWAHA BASIN, CENTRAL FLORIDA

DATE PROJECT BEGAN: May 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Donna M. Schiffer, Orlando

COOPERATING AGENCIES: St. Johns River Water Management District and Lake County

PROBLEM: The water entering Lake Beauclair is thought to have high nutrient concentrations. Presently, two sources of nutrient are suspect– Lake Apopka and the muck-farming operations adjacent to the Apopka-Beauclair Canal. The problem is to determine the relative contribution of nutrients from each source.

OBJECTIVES: Collect discharge data and nutrient data for the Apopka- Beauclair Canal in order to determine the nutrient loads leaving Lake Apopka and those entering Lake Beauclair. The difference between the input and output loads of the canal will be considered as the load entering from the muck farms along the canal.

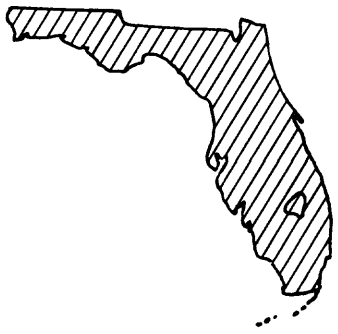
APPROACH: The geographic scope of the study will be the uppermost lakes of the upper Oklawaha basin, with the main emphasis on the northern outlet of Lake Apopka and the Apopka-Beauclair Canal. Data were collected for 2 years; during the second year, a constriction was built, and the project was extended to include data collection for an additional 2 years. The last year of the study will be devoted to writing and processing the report.

Instrumentation will include an electro-magnetic current meter for gaging purposes at the upstream site, and monitoring equipment at the lock and dam site to record gate openings and stages for computation of discharge at that site. At both sites, a microprocessor-controlled water-quality monitoring system will be installed, which includes continuous monitoring of temperature, specific conductance, and dissolved oxygen.

Discharge monitoring will be conducted on a continuous basis, limited only by equipment failure and maintenance problems. Routine monthly to bi-weekly sampling will be carried out, and supplemented by additional sampling during storms. Analysis of the field-collected data will begin by calculating canal discharge and having nutrient concentrations analyzed in the laboratory.

PROGRESS: Data were collected for the entire year at the two study sites. Data collected on a continuous basis at each site include stage, temperature, conductance and dissolved oxygen. At the lock-and-dam site, continuous data were also collected for rainfall and the operation of the two radial-arm gates. Water-quality samples were taken at each site on a monthly to biweekly basis. A constriction was built at the upstream site to improve velocity measurements. The equipment at the existing upstream station was moved to the constriction. Discharge measurements were made at the new station. Water quality and bed sediment samples were collected for sites between Lake Apopka and Lake Beauclair during the dry season.

PLANS FOR THIS YEAR: Routine data collection will be continued at the two data-collection sites and bed sediment samples will be collected once at selected sites in the study area. Data analysis will continue and the discharge at the constriction will be measured frequently to obtain a relation between the point velocity being recorded at the station and discharge. Nutrient loads can then be computed based on the discharge at both the constriction and the lock and dam stations.



FL-452 DELINEATION OF PROTECTION ZONES AROUND PUBLIC-SUPPLY WELLS IN FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: James D. Hunn, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Aquifers in much of Florida are vulnerable to contamination because they occur at shallow depths and may be overlain by highly permeable materials. The Florida Department of Environmental Regulation (FDER) is developing regulations to protect vulnerable segments of aquifers that are for public supply. FDER requested the U.S. Geological Survey to delineate "protection zones" around public-supply wells and well fields that tap aquifers vulnerable to contamination from the land surface.

OBJECTIVES: Evaluate hydrogeologic conditions at public-supply well sites and calculate the size of individual "protection zones" around each well or well field tapping unconfined aquifers or "leaky confined aquifers."

APPROACH: The first phase of the study will be made in west-central Florida in which all public-supply wells or well fields producting 100,000 gal/day or more will be evaluated. The results and methodology will then be applied statewide. Areas containing unconfined and "leaky confined" aquifers will be delineated. A list of municipal supply wells will be assembled using water management district data. "Protection zones" around individual wells will be constructed that extend to the radius of a cylinder of aquifer around the well that contains a volume of water equal to 5 years of permitted pumpage. Protection zones of well fields will be determined diagramatically.

PROGRESS: A preliminary report of the first phase of the study was prepared and is in review. The statewide phase of the study was begun.

PLANS FOR THIS YEAR: Delineate protection zones for northern southwest Florida, around wells and well fields producing 100,000 gallons per day or more from unconfined or "leaky confined" aquifers.

FL-454 WASTE CONTAMINATION USING A GEOGRAPHICAL INFORMATION SYSTEM

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Bradley G. Waller, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: The southeast coast of Florida stretches from Palm Beach County on the north to Dade County on the south and has a population that is projected to increase from 3 to 5.5 million people in the next 15 years. This projected growth in population will increase the demand for drainage and water supply, thereby placing a greater stress on the water resources of the area and requiring more intense water management. Presently, more than 90 percent of the nearly 1 billion gallons per day of water used on the southeast coast comes from ground-water sources, primarily from the sole source aquifer. County agencies are formulating county-wide well-field protection ordinances and are in need of a means to assess risk of ground-water contamination within the cones of influence. At present, there is no method to correlate probable contamination versus land use within these cones of influence.

OBJECTIVES: Develop a procedure to assess the probability of contamination, based on land-use information, flow direction, hydrogeologic characteristics, time-of-travel models, water use, and known contaminant sources, in the cone of influence of wells using a Geographic Information System (GIS) as a data-base management tool.

APPROACH: Existing data bases would be analyzed to determine how to best enter these data to maintain both accuracy and spatial integrity. Most data bases (coverages) will be digitized, and information tables formatted. Some of the data are already in a digital format, and the spatial coverages and information tables can be processed without digitizing and hand entering data. These data can then be combined to produce various coverages with accompanying information tables for evaluation of waste hazard potential near well fields.

PROGRESS: All data layers entered for the Broward County test area. Coverages done under subcontract included Department of Revenue tax-based real estate data, water-use coefficients, township/range/section polygon grid, regional flow direction, and DRASTIC geohydrologic analysis. Most coverages for Dade County have been entered and checked. Waste hazard evaluation algorithm has been determined.

PLANS FOR THIS YEAR: Complete analysis of Broward County test areas. Finish planned reports. Extend waste hazard evaluation to Dade County. Assist County and State agencies, develop ground-water monitoring networks and well-field protection strategies based on the data-base management system developed.

REPORTS IN PROCESS:

Waller, B.G., Ground-water protection strategies developed from real estate tax based data using a grographic information system (Conference Paper).

Waller, B.G., and Higer, A.L., Design of a GIS data base management system to develop a ground-water quality management model in Broward County, Florida (Conference Paper).

FL-455 FEASIBILITY OF STORING FRESHWATER IN SUBSURFACE FORMATIONS, CAPE CORAL, LEE COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: E.J. Wexler, Miami

COOPERATING AGENCIES: South Florida Water Management District and City of Cape Coral

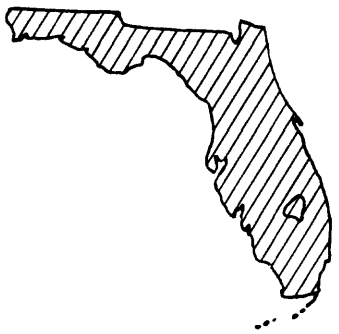
PROBLEM: Cape Coral is a southwest Florida coastal city, whose fresh ground-water resources are heavily stressed. The city has an 8.8 MGD reverse-osmosis plant that utilizes saline ground water, but the current growth rate of 29 percent will soon stress this resource also. The city has about 300 miles of freshwater canals. It has been proposed that excess runoff during the rainy season should be stored in deep saline aquifers as an additional source of supply during the high-demand dry season. First, the excess freshwater canal runoff must be quantified and an appropriate ground-water aquifer storage site needs to be investigated. Next, digital modelings need to be developed for the Cape Coral area to test the various methods of storage/retrieval and recharge schemes.

OBJECTIVES: To define the runoff pattern of the freshwater canal system, assess quantities of excess runoff occurring during the wet season, and assess the feasibility of conserving this freshwater in Cape Coral by artificial recharge or subsurface storage. Secondarily, to develop a multivariate relation among recovery efficiency, aquifer permeability, and cost, constrained by maximum permitted injection pressure and selected values for native aquifer water salinity.

APPROACH: Excess runoff and pattern of runoff will be determined from surface-water records from selected freshwater canal sites. Geohydrological data will be used as a basis for construction of digital flow and transport models. Digital modeling will be used to evaluate proposed injection, storage, and recovery efficiency after multiple cycles. Digital modeling will also be used to determine the optimum relationship between aquifer transmissivity, recovery efficiency, and cost of pumping for various values of native water salinity.

PROGRESS: Previously published data on hydrogeology has been reviewed. Literature on simulation of freshwater storage reviewed. Work has begun with HST model for freshwater storage and with AQMAN for optimization study of artificial recharge in the mid-Hawthorn. All surface-water stations were installed and the data reviewed to assess runoff.

PLANS FOR THIS YEAR: Continue to work on development and calibration of both models. Prepare first draft of final report.



FL-457 LOW-FLOW CHARACTERISTICS OF FLORIDA STREAMS

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Roger P. Rumenik, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: A rapid growth in State population and the increased demand for environmental protection has emphasized a need for information on low stream flows. Low-flow frequency information is needed to assess water-supply potential and waste-load assimilation capacity of streams in Florida.

OBJECTIVES: (1) Develop a centralized computer-storage data base for existing miscellaneous measurements. (2) Determine low-flow frequencies (7- and 30-day 2-year, and 7- and 30-day 10-year low-flow) for daily-record stations, and for partial-record stations where data can be correlated with long-term index stations. (3) Prepare a report that describes the data base useage, and presents low-flow data and frequency information.

APPROACH: Enter all miscellaneous streamflow- measurement data in the MEAS/INSP file of the WRD ADAPS (System), selected as the project's data base. Test and select distributions that best define low-flow frequencies for daily-record stations. Evaluate the adequacy of correlation between partial-record stations and daily-record index stations using statistical programs on the computer, and determine low-flow frequencies when correlations exist. Prepare final report that describes the data base usages, and presents low-flow data and frequency information in text and map format.

PROGRESS: Miscellaneous streamflow-measurement data have been entered into the USGS Automatic Data Processing System (ADAPS) for 80% of 1,600 estimated sites. The ADAPS MEAS/INSP file was selected as the centralized computer data base for Florida. Five USGS offices in Florida participated in the data entry under the direct coordination and review of the project chief. A plan for testing several distributions for selected streamflow stations to define low-flow frequencies has been formulated.

PLANS FOR THIS YEAR: Complete the data entry of all miscellaneous streamflow-measurements into a computerized data base. Determine magnitude and frequency of low flows for daily-record streamflow stations. Begin procedures to correlate data from partial-record stations with data at long-term index stations.

FL-458 SALTWATER-FRESHWATER INTERFACE IN THE COASTAL AREA OF SOUTHWEST FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Judy D. Fretwell, Tampa

COOPERATING AGENCIES: Southwest Florida Water Management District and West Coast Regional Water Supply Authority

PROBLEM: Increased ground-water development associated with a rapidly growing population along the southwest coast of Florida poses a threat of contamination to major freshwater supplies through the introduction of saltwater into the upper Floridan and intermediate aquifers. To predict and prevent this occurrence, it is necessary to define the present location of the saltwater-freshwater transition zone in the major ground-water production zones along the southwest Florida coast.

OBJECTIVES: (1) To select and monitor 50 to 75 primary wells and up to 250 secondary wells in and near the transition zone in the major ground-water producing areas of the coastal area of southwest Florida, (2) to describe each monitor well by defining the hydrogeologic setting, (3) to recommend frequency of sampling, sampling protocol, and chemical analyses, (4) to describe short- and long-term changes in chloride concentration and specific conductance with time at selected wells, and (5) to use the data collected to define the location of the saltwater- freshwater transition zone.

APPROACH: (1) Compile available data including water-level, water-quality, well-construction and geophysical data. (2) collect new data as necessary to supplement and update existing data which will include: (a) Surface-DC resistivity and/or EM induction surveys; (b) borehole geophysical logging; (c) water-quality analysis for chloride, sulfate, specific conductance, density and temperature, and (d) continuous specific conductance and water-level monitoring at selected sites.

PROGRESS: Comprehensive data on existing and potential transition-zone monitor wells have been updated as new information has become available. Geophysical logging of 41 wells has been completed this year. Logs were run to determine well construction and hydrogeology at the site. Three long-term and three short-term sites have provided continuous water-level and specific conductance data and several have provided temperature data. These monitors provide information on short-term changes in water-quality in a well. Water-quality samples have been collected from approximately 200 wells in May and September (dry and wet seasons). Specific conductance, chloride, sulfate, and temperature analyses have been made on most samples and additional characteristics of calcium, magnesium, potassium, sodium, fluoride, silica, pH, and alkalinity at selected sites. Water levels were also measured when samples were collected.

Data collected has been processed and stored and some has been analyzed. The initial monitor network has been updated based on new data. A first draft of the preliminary sections of the report has been completed. A proposal has been written to expand the project to look more closely at sampling techniques.

PLANS FOR THIS YEAR: Wells selected for the chloride-monitor network will be tied to sea level. Temporary mini-monitors will continue to be rotated as necessary. Permanent mini-monitors will continue to be monitored. Water-quality sampling will continue in May and September. Surface geophysics work will be done in areas where needed to interpolate water-quality between wells. The water-quality network will be adjusted as necessary based on new data. Data collected will continue to be processed, stored, analyzed, and interpreted. Manuscript preparation will continue.

A proposed project expansion calls for additional borehole logging, installation of additional mini-monitors and water-level recorders, and additional water-quality sampling at 3 selected sites. These additional data will be used to test the validity of different sampling techniques.

FL-460 GROUND-WATER HYDROLOGY OF THE SURFICIAL AND FLORIDAN AQUIFER SYSTEMS IN OSCEOLA COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: March 1989

PRINCIPAL INVESTIGATOR: George R. Schiner, Orlando

COOPERATING AGENCIES: South Florida Water Management District and St. Johns River Water Management District

PROBLEM: Osceola County is undergoing a rapid growth in population, more than doubling in the last 5 years. With this growth, the need for additional water supplies is becoming more acute. Evaluation of water use and water supply potential is particularly needed for the rural areas that have been incorporated or taken over by cities. More than 90 percent of all water used by domestic, municipal, and agriculture water users is obtained from the Floridan aquifer system, the rest is supplied by the overlying surficial aquifer system. Overdraft could result in water-quality degradation from saltwater intrusion.

OBJECTIVES: (1) To determine the relations between rainfall and water levels in aquifers, (2) to describe the hydrologic and water-quality characteristics of the aquifers and their individual and collective response to changes in recharge, and to pumping, (3) to delineate areas where water quality or quantity is or may become a problem, (4) to establish a network of hydrologic stations to monitor water level changes in the major aquifers, and changes in water quality in ground waters and (5) to prepare an interpretative report.

APPROACH: (1) Prepare a page size base map showing major drainage, cultural, and political features. (2) Collect and synthesize historical water-resources information from published and unpublished reports. (3) Inventory existing wells. (4) Geophysically log and sample wells for water-quality. (5) Drill 5-12 test observations wells and collect information on water levels, lithology, and water quality. (6) Conduct specific capacity, or short-term aquifer tests. Conduct longer-term aquifer tests on selected wells. (7) Establish a hydrologic network and install instruments.

PROGRESS: Existing and new hydrologic data was analyzed. Water-quality samples were obtained from about 25 wells. A water level recorder was installed on a test well. One test well was completed and seven additional test sites selected.

PLANS FOR THIS YEAR: Complete test drilling program that will include aquifer tests and water-quality sampling. Complete final report.

FL-461 EVAPOTRANSPIRATION FROM AREAS OF NATIVE VEGETATION IN CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Miguel A. Lopez, Tampa

COOPERATING AGENCIES: Sarasota County, Southwest Florida Water Management District, and West Coast Regional Water Supply Authority

PROBLEM: Water availability is becoming a critical issue even in humid, subtropical climates. By understanding and quantifying the components of the water budget in such areas, unique solutions may be developed to manage water resources. Although evapotranspiration is by far the major component of the water budget in humid, subtropical climates, very little has been done to obtain reliable estimates of evapotranspiration (ET). Accurate estimates of ET of four common, major native vegetation types in central Florida will be determined by selected energy budget techniques. The results of this investigation will provide a significant new knowledge by developing more accurate ET values for extensive and ecologically important wetland areas.

OBJECTIVES: The objectives of the study are: (1) to develop accurate estimates of evapotranspiration from palmetto prairie, pine flatwoods, grass ponds and cypress heads in the Ringling-MacArthur Reserve and the Cypress Creek and Big Cypress swamp area, (2) to estimate total ET from RMR, and (3) to analyze for error in the estimated ET.

APPROACH: The approach to this study will include delineating areas of native vegetation in the study area; and evaluating the use of energy budget techniques, e.g., Penman, Bowen ratio and eddy correlation using 2 years of field data and estimate ET for the study area using the best applicable techniques. Vegetative cover will be delineated with detailed aerial color photography. Field data collection sites will be selected, assuring that sites are representative for each vegetative type. Periods of monitoring for each site will be (a) permanent-continuous for parameters used in calculating ET by the Penman method and (b) portable short-term for parameters used in energy budget techniques, generally monthly to bimonthly for 24 to 48 hour periods.

PROGRESS: Permanent continuous, Penman potential evapotranspiration sites were installed in a palmetto prairie in Ringling MacArthur Reserve and in a cypress dome in Starkey well field. Short-term measurements of ET by the Bowen ratio and eddy correlation methods were made at the palmetto prairie, grassy pond, and pine flat woods sites in Ringling MacArthur Reserve and in the cypress dome in Starkey well field. Data from the Penman potential ET continuous sites and the short-term Bowen ratio and eddy correlation measurements were processed and stored.

PLANS FOR THIS YEAR: Continue to collect continuous Penman potential ET data at the RMR and Starkey well field sites. Make seasonal short-term measurements of ET at the three vegetative sites in RMR and the cypress dome in Starkey well field. Process and store data.

FL-462 POTENTIOMETRIC MAPS OF THE INTERMEDIATE AQUIFER SYSTEM, WEST-CENTRAL FLORIDA, SUMMARY OF HYDROLOGIC CONDITIONS FOR HIGH AND LOW WATER

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Billy R. Lewelling, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: In west-central Florida, the intermediate aquifer system occurs in parts of all of an eight county area. The aquifer is an important source of water in three of these counties because water in the deeper Floridan aquifer has a high mineral content near the Gulf coast. Rapid growth has taken place here the past 5 years, and in 1985, this was one of the leading growth areas of the State. Associated with this growth is an increased demand on water for public supply, industrial and agricultural uses. Extremes in water-level fluctuation need to be known to better manage the resources.

OBJECTIVES: A potentiometric surface map of the intermediate aquifer will be produced in May and September. A list of water level data will be prepared from the potentiometric surface maps. Hydrographs will be prepared for selected wells to show continuous water-level data. A brief text summarizing water-level conditions during the high and low water conditions will be prepared.

APPROACH: The water level monitoring network established for the "Hydrogeology of the intermediate aquifer system" project (FL-411) will be expanded and revised for this project for making semiannual water level measurements and producing a potentiometric map.

PROGRESS: The September 1986, May 1987 and September 1987 potentiometric surface maps were published. Network wells were measured in May 1988. The May 1988 map was prepared and submitted for review. The scope of study was expanded to include mapping the potentiometric surface in two water bearing units of the intermediate aquifer system. Maps previous to May 1987 showed only a composite surface from wells open to both units.

PLANS FOR THIS YEAR: Complete the review process and publish the May 1988 potentiometric map. Collect water levels, draft, review and publish the September 1988 map. Inventory new wells to improve data base.

REPORTS RELEASED:

Lewelling, B.R., 1987, Potentiometric surface of the intermediate aquifer, west-central Florida, September 1986: U.S. Geological Survey Open-File Report 87-35, 1 sheet.

———1987, Potentiometric surface of the intermediate aquifer, west-central Florida, May 1987: U.S. Geological Survey Open-File Report 87-705, 1 sheet.

———1987, Potentiometric surface of the intermediate aquifer, west-central Florida, September 1987: U.S. Geological Survey Open-File Report 88-303, 1 sheet.

FL-463 HYDROLOGY AND WATER QUALITY OF THE INTERMEDIATE AND UPPER FLORIDAN AQUIFERS, HARDEE AND DE SOTO COUNTIES, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: A.D. Duerr, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Hardee and De Soto Counties are experiencing increases in population and expansion of industry and citrus groves. Because of the increase in population and water use, there is concern about the long-term impacts of increased withdrawals from the intermediate and upper Floridan aquifers. There is a potential for degrading the quality of water in the upper aquifers due to improper well construction, such as open hole in multiple zones containing water of varying quality.

OBJECTIVES: The purpose of the study is to identify the major aquifers, define their lateral extent, identify areas where they are interconnected, and describe the hydraulic and water-quality characteristics of each aquifer.

APPROACH: Field data collection will include an inventory of existing wells, collection of geologic and water-quality samples during drilling of new wells, collection of geophysical data, aquifer tests, and collection of water-quality samples and water-level data from existing wells. Maps will be prepared showing the thickness and lateral extent of the intermediate and upper Floridan aquifers. Potentiometric surface maps will be drawn and the lateral and vertical variations of selected water-quality parameters will be mapped. Seepage runs will be conducted on the Peace River to study the relation between ground and surface water and to identify areas of recharge and discharge.

PROGRESS: The reconnaissance of wells needed for collecting water quality and lithologic data continued. Hydrologic data were collected from 10 new wells drilled for citrus irrigation. Water samples were collected from 28 wells and were analyzed for dissolved solids, hardness, chloride, sulfate, fluoride, iron, pH, specific conductance, silica, boron, and nitrate. A 2-day test of the intermediate aquifer system was conducted in Hardee County. A 343-ft deep intermediate aquifer system was conducted in Hardee County. A 343-ft deep intermediate aquifer well was drilled in De Soto County and used as an observation well during a 30-hour aquifer test. A 70-mile-long seepage run was conducted on the Peace River from the Hardee/Polk County line to Bee Gum Lake in De Soto County. The effort was made to determine reaches of the river that are gaining or losing water to the limestone aquifers. Five boat crews and supporting land personnel measured discharge at 30 river sections and 38 tributaries during a 3-day period of low flow.

PLANS FOR THIS YEAR: Continue collecting water- quality data. Compile hydrologic data collected from new wells drilled for citrus irrigation. Compile and analyze data from 2 aquifer tests and from the seepage run conducted on the Peace River. Begin report preparation.

REPORTS IN PROCESS:

Duerr, A.D., Hydrology and water quality of the intermediate and Upper Floridan aquifers, Hardee and De Soto Counties, Florida (in data-collection stage).

FL-464 SALTWATER INTRUSION IN SPRINGS ALONG THE COASTAL MARGIN OF CITRUS AND HERNANDO COUNTIES, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: D.K. Yobbi, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Because of the potential for increased saltwater intrusion due to expanding use of groundwater, it is important to develop a better understanding of coastal springs and their role and relationship to the hydrology of the area. Insufficient data exist for evaluating the dynamics associated with seawater and the level and quantity of freshwater in coastal springs. Such data collection and development of hydrologic relations are needed to understand coastal spring hydrology and requirements to maintain healthy estuaries.

OBJECTIVES: To collect and analyze data to define movement of saltwater in springs along the coastal margin of Citrus and Hernando Counties.

APPROACH: Water quality and streamflow measurements will be made over a range of hydrologic conditions. Continuous recording streamflow, tide-stage, and water quality monitoring stations will be established on selected springs. Near major springs, recording water-level and water-quality stations will be established on selected wells. A well inventory and test-drilling program will be conducted. Ground-water levels will be measured and potentiometric maps prepared. Surface- geophysical techniques will be applied over a range of hydrologic conditions.

PROGRESS: Conducted field reconnaissance of wells and springs in the study area. Water-quality and spring-flow measurements were made at 25 springs, 2 wells, and 2 surface-water sites on the coast of the Gulf of Mexico. Long-term continuous recording tide-stage and water-quality monitoring stations were established at Salt Springs, Crab Creek Spring, and at two well sites. Short-term continuous recording tide-stage and water-quality instruments were rotated among 14 spring sites. Ground-water levels were collected in May and September to supplement district-wide sampling. Salinity reconnaissance surveys were conducted on Kings Bay at high and low tides in May, June, and September. Surface geophysics were collected at selected spring sites.

PLANS FOR THIS YEAR: Water-level and water quality instruments will be rotated among the 20 springs as necessary. Collection and processing of daily specific conductance, water levels, and spring flows will be completed. Water-quality samples will be collected and spring flow measurements will be made as needed. Data analysis, interpretation, and manuscript preparation will be completed.

FL-465 POTENTIAL FOR CONTAMINATION OF THE FLORIDAN AQUIFER SYSTEM, WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Craig B. Hutchinson, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: West-central Florida is undergoing rapid growth and in some areas, water is already in short supply. The Floridan aquifer system supplies more than 90 percent of the freshwater used in west-central Florida. Areas that are particularly vulnerable to contamination occur where the Floridan aquifer system is near land surface or where recharge to the aquifer is rapid. Recently, the pesticide EDB, used only for the past 30 years, has been detected in water from the Floridan aquifer system. In order to safeguard the water supply, the potential for water quality degradation in the Floridan aquifer system must be assessed.

OBJECTIVES: Map hydrogeologic conditions suspected to rapidly convey recharge to the upper Floridan aquifer. Develop data base of existing radiochemical and stable isotopes in the SWFWMD. Evaluate chemical, radiochemical, and stable isotope methods used to indicate relatively recent recharge water. Supplement data base of radiochemical and stable isotopes in the SWFWMD. Use hydrogeologic and chemical data to map qualitatively the potential for contamination of the Floridan aquifer system.

APPROACH: Make a qualitative assessment of susceptibility based on available hydrogeologic information and prepare a preliminary map of pollution potentials. Field test geochemical ground-water age dating methods, such as tritium, deuterium, oxygen-18, partial pressure of CO2, redox potential, saturation indices and the presence of compounds such as EDB, 24-D, stilbenes and alkyl benzene sulfanate. About 30 wells will be sampled to validate these methods. About 90 additional wells will be sampled throughout SWFWMD in order to identify relatively recent recharge areas. The existing geochemical data base and preliminary pollution potential map will be updated and an interpretive report will be written.

PROGRESS: Sixty wells that tap the upper part of the Floridan aquifer system were inventoried and sampled for chemical quality parameters that indicate ground-water age. All wells were sampled for field pH, alkalinity, specific conductance, dissolved oxygen, temperature, and EH. Samples were sent to the Denver and Ocala laboratories for analyses of common ions, sulfide, and environmental deuterium, oxygen–18/oxygen–16, and tritium. Six wells were constructed at a site in the Starkey wellfield to provide a profile of ground-water age with depth. A data release was prepared for the cooperator that describes progress during the first 2 years of investigation.

PLANS FOR THIS YEAR: During FY89, 30 wells will be inventoried and sampled. Eight of these wells are at the Starkey wellfield test site. Water quality data from 120 wells will be compiled, tested statistically, and used to prepare a map of pollution potential to the Floridan aquifer system. Work will begin on the final report that summarizes the study.

FL-466 FLORIDAN AQUIFER SYSTEM WATER QUALITY IN AN AREA OF DRAINAGE-WELL INFLOW

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: L. Anne Bradner, Orlando

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The Floridan aquifer system serves as the principal source of drinking water for the area. Because of the dual usage of the Floridan aquifer system, there is a potential for contamination of the area's drinking-water supply by drainage-wells. Studies aimed at investigating the effect of drainage-well inflow on water quality in the Floridan aquifer system have not revealed any widespread water-quality problems. There was no evidence of a direct link between supply water quality and drainage-well proximity. Study of areas downgradient of drainage wells having large inflows is needed to determine if contamination of the aquifer system is occurring.

OBJECTIVE: To determine the impact of drainage well inflow on the quality of water in the Floridan aquifer in the vicinity of drainage wells.

APPROACH: Inventory and evaluate potential sites. Select 2 to 3 sites for intensive investigation. Drill additional wells at the selected sites as necessary. Use geophysical logging to determine characteristics of the drainage wells and the depth. Install and operate a water level, specific conductance, and temperature recorder on one of the monitor wells at each study site. Sample wells near end of dry season, several weeks after onset of wet season, and after wet season has ended. Sample sediments.

PROGRESS: Monitoring wells were completed and equipment installed. Sampling of other existing wells completed. Initial report writing and figures begun. Significant results include the finding of hydrocarbons and other constituents related to storm runoff. Other results include water quality data that show recent influence of drainage well inflow, such as high tritium values, high nitrogen concentrations, and other constituents that indicate high recharge. Recorder data indicate inflow pulses cause generally a 3-6 feet rise in water levels and a slight decrease in conductance.

PLANS FOR THIS YEAR: Collect daily water level and water quality data from monitoring wells. Sample and identify problem sites and analyze all data. Sediments will be removed by split-spoon method.

FL-468 WATER RESOURCES OF DUVAL COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Eugene C. Hayes, Orlando

COOPERATING AGENCY: City of Jacksonville

PROBLEM: Jacksonville is rapidly increasing in population and expanding commercially and industrially. As a result, areas that were once rural are now becoming urbanized and stresses are being placed on the physical environment including the quality and quantity of water supplies. A large amount of hydrologic data has been obtained and many technical reports have been prepared as a result of 27 years of investigations. Most of the reports are moderately to highly technical and were prepared mainly for the scientist, engineer, and professional water manager. A non-technical report is needed, prepared from historical data, to help educate the public on vital aspects of the water resources of Duval County. Proper management of the system cannot occur without the cooperation of an informed public.

OBJECTIVE: The principal objectives of this investigation and resulting report are to summarize and interpret some of the major results of the 27-year program of investigation of the water resources of Duval County and northeast Florida in a manner that will be useful to local citizens as well as to the scientific and professional water manager. Specifically, the report will be prepared using STOP FORMAT and present (1) the source, occurrence, and movement of water in Duval County (natural hydrologic system and (2) the effects of man's activities on the system.

APPROACH: (1) Collect, synthesize, and interpret historical information from published and unpublished reports and maps and from records of the U.S. Geological Survey and from other sources as available and necessary; (2) prepare the resulting Water Atlas report using STOP FORMAT. Where possible maps for illustrations will be generated from the GIS ARC-INFO data base. New layers of information will also be generated and stored in a Duval County data base accessible to the cooperator.

PROGRESS: All historical information available from U.S. Geological Survey and the City of Jacksonville files have been collected. Approximately 50 percent of the first draft has been completed.

PLANS FOR THIS YEAR: Complete the first draft, process and publish report during FY89.

FL-471 GROUND-WATER QUALITY IN THE VICINITY OF STORMWATER PONDS, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Mario Fernandez, Jr., Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: The effects of ground-water alterations by stormwater detention ponds is covered by Chapter 17-31404(2), Florida Administrative Code. During the wet season, ponds located into the water table will recharge the aquifer only when there is a head difference between it and the surrounding water level. Poly-aromatic hydrocarbons have been found in pond sediments. Phenols have been detected in pond sediment and water.

OBJECTIVE: To investigate inorganic and organic contaminants in ground water near stormwater ponds and bottom deposits in ponds receiving runoff from residential and commercial/urbanized areas; to evaluate the effects of the ponds on the ground water at each site; and attempt to determine the direction of migration of leachate from the ponds.

APPROACH: Bathymetric surveys will be used to locate pond sediments. Wells located in the water table will be used for water-quality and water-level measurements. Direction of ground-water will be established. Ground- and surface-water samples and pond sediments will be collected for analysis of inorganic and organic constituents.

PROGRESS: The investigation of the three stormwater retention ponds had been completed. Preliminary findings indicate that:

(1) The pond in the highly developed residential and commercial area, estimated to be in operation about 30 years, is in a hydrologic sink; it is highly doubtful that any contamination will migrate from the pond and alter the surrounding groundwater. There is an outlet that is connected to a series of connecting ditches that permits almost continuous draining of the pond into Allen Creek. Preliminary findings indicate that the pond water is of equal or better quality than the surrounding groundwater. However, analysis of pond sediments, which are indicative of urban runoff, show high levels of chromium and lead at 480 and 420 μg/kg, respectively. Ten insecticides were identified in the sediments including those belonging to the DDT family: DDD (18 μg/kg), DDE (40 μg/kg), and DDT (17 μg/kg). Analysis of the sediments for extractable organic compounds also showed that there were 12 polyaromatic hydrocarbons (PAH's) present. Concentrations ranged from about 50 to 1,100 μg/kg. The PAH are coal tar derivatives that occur in asphaltic street paving material and as combustion by products;

(2) The pond in the all residential area, estimated to be about 20 years old, also functions as a hydrologic sink. This pond discharges directly into Allen Creek. Preliminary findings indicate that the pond water is about the same quality as the surrounding groundwater. Analysis of pond sediments show levels of chromium and lead to be about 400 μg/kg. There were 10 insecticides identified, the most notable being those belonging to the DDT family: DDD (7 μg/kg), DDE (13 μg/kg), and DDT (23 μg/kg). Analysis for extractable organic compounds indicated the presence of only 6 PAH compounds ranging from about 20 to 200 μg/kg;

(3) The third pond, in operation about 2 years, is not in a hydrologic sink. Water in the pond will move laterally and vertically into the surficial aquifer with sufficient head difference between the pond and water table. The pond was observed to discharge into an overflow system during the investigation. Overall, the pond water was found to be of better quality than the surrounding groundwater. Analysis of pond sediments show relatively low levels of chromium, 80 mg/kg, with levels of lead less than detection limits (10 μg/kg). There were

μg/kg. There were no extractable organic compounds identified in the sediments. A preliminary draft of the final report is in preparation.

PLANS FOR THIS YEAR: A report titled "Surface and ground-water relationship in the vicinity of stormwater retention ponds, Pinellas County, Florida" by Mario Fernandez, Jr. will begin preparation.

FL-472 HYDROGEOLOGICAL ASSESSMENT OF SPRAY EFFLUENT AND SLUDGE DISPOSAL BASINS AT A DISPOSAL SITE, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: John T. Trommer, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Results of previous water-quality monitoring at the Northwest Pinellas County sewage treatment plant effluent and sludge disposal sites and private wells, have indicated increasing concentrations of some chemical constituents. The treatment plant is located in an area of rapid urban development, and water from a private well to the south is beginning to show changes in water quality. Because the general direction of groundwater movement is toward the west, privately owned wells in that direction also may begin to show water- quality changes. The overall effects of the disposal system on the surrounding environment has not been evaluated.

OBJECTIVE: To determine if land application of effluents and fertilizers at a nearby resort to the east is migrating through the groundwater into the site; to determine the extent that effluent and sludge disposal operations have affected ground-water quality at the disposal site and in areas downgradient from the site; to conduct a reconnaissance of downgradient private wells to determine whether they have been, or will be affected by the disposal operations.

APPROACH: All existing water-quality and hydrologic data will be evaluated. A surface geophysical survey will be conducted using resistivity and electromagnetic methods to locate and delineate any plumes. About 20 additional wells will be drilled to monitor water quality and water levels. In addition, three 4-inch wells will be installed in order to determine aquifer characteristics and rate of ground-water movement. Samples will be collected and analyzed for nutrients, metals, herbicides, pesticides, volatile organic compounds, and priority pollutants; standard complete Flame Ionization Detection (FID), gas chromatography and standard lab analyses will be used.

PROGRESS: The planning document and annotated outline were prepared. A literature and file search were conducted to locate all pertinent material. The location and condition of existing wells was evaluated and where necessary, wells used in the study were repaired. Resistivity and electromagnetic surveys were run to locate possible leachate plumes. The surveys were unsuccessful, possibly due to dry soil conditions or because the ground water has been affected by the effluent to a point where little contrast in water quality exists. The resistivity data was useful in defining geology at the study site. Ground-penetrating radar (GPR) was used to further define hydrogeology and subsurface features. Data indicated that the water table in the surficial aquifer system does not follow topographic contours and is relatively flat. Twenty-seven additional surficial aquifer wells and 8 upper Floridan aquifer wells were drilled at the site. Split-spoon samples collected during drilling operations were sent to the University of South Florida, Geology Department, for mineralogy and physical property analysis. Water levels in all wells were measured periodically and preliminary water table and potentiometric surface maps have been prepared. Water quality samples were collected and analyzed for nutrients, organic and inorganic constituents, trace elements, methylene blue active substance (detergents), and volatile organic compounds. The introduction, purpose, and scope sections of the draft report have been written.

PLANS FOR THIS YEAR: Periodic water level measurements will continue through May, 1989 and may be used to construct additional maps. Water quality samples will be collected from all wells and some surface water sites. They will be analyzed for standard chemical constituents, nutrients, methylene active blue substance, and nitrogen isotopes. Three slug tests will be conducted at the study site, and the results compared to laboratory values obtained from the previously collected split spoon samples. The remaining parts of the report will be completed and ready for review.

FL-473 HYDROLOGIC IMPACTS OF PHOSPHATE MINING ON SMALL BASINS, CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1987

DATE PROJECT ENDS: March 1992

PRINCIPAL INVESTIGATOR: Billy R. Lewelling, Tampa

COOPERATING AGENCY: Florida Institute of Phosphate Research

PROBLEM: The hydrologic characteristics of small basins in central Florida are poorly defined. Permits for mined-land reclamation require that runoff from reclaimed land not exceed pre-mining conditions and there be no degradation of water quality of the receiving stream. There are no data on the hydrologic characteristics of reclaimed land forms.

OBJECTIVE: (1) Define the hydrology and water quality of undistributed small basins in the phosphate mining area of central Florida; (2) define the hydrology and water-quality characteristics of the four most common reclaimed land forms: a clay settling area, land and lakes (graded overburden) area, in sand-clay mix settling area, and an overburden capped sandtailings fill area; (3) compare results from 1 and 2 above.

APPROACH: Collect hydrologic data from small undisturbed basins and from four nearby basins representing the common reclaimed land forms to define streamflow and aquifer characteristics. Collect ground-water samples during high and low water table conditions to define ground-water quality. Collect streamflow samples during baseflow and during related storm runoff to define water quality of streamflow. Compare and describe statistical differences between unmined and reclaimed basin pairs and among various reclamation types.

PROGRESS: Monitor sites were established on five reclaimed mine drainage basins and three nearby unmined basins. Each drainage basin has a monitor network that includes a continuous streamflow station, 1 or 2 rain gages, ten small-diameter observatory wells for periodic measurement of the water table, a large-diameter well for continuous observation of water table, and a deep well for monitoring the intermediate aquifer. Reclaimed basins are paired with unmined basins having approximately the same size catchment area.

PLANS FOR THIS YEAR: Continued data collection and processing for the eight small-basin network. Provide hydrologic data necessary for model development to the contractor. Each drainage basin will be scheduled for water-quality sampling to include 1 ground-water sample and two Surface Water samples (high and base flow). Aquifer testing and analysis in selected basins. Prepare annual report for publication.

FL-474 EFFECTS OF STRUCTURAL CHANGES ON THE WATER-QUALITY EFFICIENCY OF STORMWATER DETENTION POND

DATE PROJECT BEGAN: January 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: W. Scott Gain, Orlando

COOPERATING AGENCY: Florida Department of Transportation

PROBLEM: It is reasoned that if the velocity of the water entering a detention pond is dramatically decreased immediately inside the pond, and if the travel time of the water within the pond is significantly lengthened, then an increased constituent load will settle to the bottom of the detention pond. These two hydraulic conditions can be brought about by constructing a baffle near the entrance culvert, and by placing a wall in the middle of the pond. These structural changes should increase the water-quality treatment ability of this detention facility.

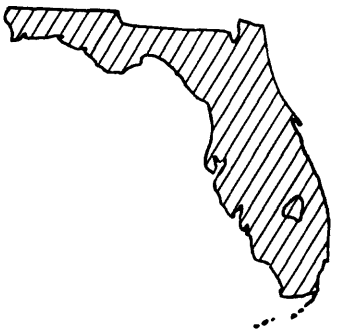
OBJECTIVE: The primary objective of this investigation is to determine the effectiveness of selected structural changes to detention facilities for improving water-quality treatment. Secondary objectives include: determine and analyze the increased residence time, or detention time, due to the structural changes; and determine if the hydraulic conditions caused by the structural changes can be modeled, either with an existing model or one that is easily modified.

APPROACH: The first task is to perform a hydraulic study of the presently structured pond. Samples will be collected at nine sampling points within the pond. Separate tracer studies will be run at three different steady-state discharges. Analyses of these data will permit the calculation of the pond's hydraulic residence time(s), probably as a function of live storage or discharge.

Once the pond is restructured, about 10 to 15 storms will be gaged and sampled. The last task is to perform a hydraulic analysis of the restructured pond, analogous to the study completed in the first task.

PROGRESS: Dye studies were run at high and medium discharges. Residence times of dye have been analyzed. Paper containing dye-study results was prepared and presented to Engineering Foundation Conference. Structural changes of the pond were started. Trees and brush were cleared, sand- cement bags were placed on pond embankment to increase storage capacity, anchor posts and cable for holding curtain-wall were installed, and curtain was ordered.

PLANS FOR NEXT YEAR: Structural changes will be completed by installing curtain-wall. Dye studies for post-structural changes will be run. Some discharge and quality data will be collected for a few storms.



FL-475 EVALUATION OF THE DESIGN OF GROUND-WATER QUALITY MONITORING NETWORKS IN FLORIDA

DATE PROJECT BEGAN: March 1987

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Brian G. Katz, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: A greatly increased national level of interest and funding in ground-water quality monitoring has occurred in the past few years. For example, a large data base has been developed in Florida to determine the extent of EDB (pesticide) contamination of ground water. Little detailed work has been done in terms of evaluating different network design strategies, applied to an existing data base, for characterizing the areal and vertical distribution of a contaminant in ground water.

OBJECTIVES: (1) To describe the regional distribution of EDB in ground water in Polk and Highlands Counties spatially and in association with various key factors such as hydrogeology and soil characteristics and (2) To evaluate different sampling strategies involving subsets of the entire EDB data base for describing the distribution of EDB in ground water.

APPROACH: The EDB data base will be evaluated using various statistical and spatial (GIS) techniques to determine the areal, vertical and temporal distribution of EDB in ground water. The efficiency of different network design strategies will be evaluated involving subsets of the original data base using systematic, stratified, and other sampling design approaches.

PROGRESS: Staffing and project planning have been completed. The EDB data base consisting of about 4,000 wells for Polk and Highlands Counties was retrieved from state files and converted to an INFO data base. Available well-construction information for these wells has been gathered from water management district files, mail surveys, and drillers records.

PLANS FOR THIS YEAR: Continue to verify and input additional information on well construction data. Evaluate quality assurance data from different laboratories who have performed EDB analyses. Prepare maps showing the areal distribution of EDB in ground water for Polk and Highland Counties. Prepare grid patterns of different sampling densities and compare the resolution with which EDB contaminated areas can be delineated using different sampling densities. Statistically compare differences in regional probability of EDB contamination determined by systematic sampling techniques using grid patterns.

FL-476 IMPORTANCE OF HYDROLOGIC AND VEGETATIVE FACTORS TO FISH ECOLOGY IN A SEASONALLY INUNDATED FLOOD-PLAIN FOREST

DATE PROJECT BEGAN: September 1987

DATE PROJECT ENDS: June 1988

PRINCIPAL INVESTIGATOR: Helen M. Leitman, Tallahassee

COOPERATING AGENCY: Florida Game and Fresh Water Fish Commission

PROBLEM: River flood-plain forests are a valuable and productive national resource under considerable development pressure from agricultural interest. Ecological linkages between biotic and abiotic factors operating in river wetlands must be established if this important natural resource is to be properly managed. Habitat characteristics of the flood plain that are important to fish populations will be evaluated in an interdisciplinary study of an alluvial river in north Florida.

OBJECTIVE: Relate hydrologic conditions and vegetative communities to fish diversity and abundance in a seasonally inundated river flood-plain forest.

APPROACH: The 3-year study will require data collection and analyses by an interdisciplinary interagency team comprised of hydrologists, botanists, and fisheries biologists. USGS will quantify hydrologic fluctuations and characterize plant communities at the same locations and during the same time period that fish are sampled by the Florida Game and Fresh Water Fish Commission.

PROGRESS: New Project.

PLANS FOR THIS YEAR: Conduct reconnaissance of flood plain in coordination with Florida Game and Fresh Water Fish Commission (FGFWFC) to select transects and sampling sites. Design and test fish and vegetation sampling methods. Survey elevations, identify trees and shrubs, sample ground cover vegetation seasonally, install simple crest stage gages and measure water depths monthly at each site. Assist FGFWFC with fish sampling seasonally, more often during floods. Prepare and submit annual progress report to cooperator.

FL-477 AN EVALUATION OF VARIOUS PHYSICAL AND BIOLOGICAL INDICATORS USED TO DELINEATE WETLAND BOUNDARIES ON BLACKWATER STREAM SYSTEMS IN FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Helen M. Leitman, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Protection of Florida's wetlands is entrusted primarily to the Florida Department of Environmental Regulation (FDER). River wetlands are of particular importance to the State because inflow of nutrients from freshwater river wetland systems are largely responsible for high productivity in estuaries. The proposed study will improve the management and regulation of blackwater stream wetlands by evaluating the various indicators used by FDER to delineate wetland boundaries on those systems.

OBJECTIVE: To quantitatively describe the occurrence of wetland plants, hydric soils, and other wetland indicators in flood-plain sites along several north Florida blackwater streams, and relate these indicators to duration of inundation.

APPROACH: The 3-year study will require data collection and analyses by an interdisciplinary interagency team comprised of hydrologists, botanists, and soil scientists. USGS will describe depth and duration of flooding at each site based on a long period of gage record. USGS and DER will work together to describe plant communities, soil types, and other hydrologic indicators at the sites. USGS will relate the various indicators to the long term hydrologic conditions at each site.

PROGRESS: Reconnaissance, site selection, and plot layout complete. Analysis of gage records and field measurements of plants, soils, and other wetland indicators is well underway.

PLANS FOR THIS YEAR: Conduct reconnaissance of north Florida blackwater streams in coordination with Florida Department of Environmental Regulation (FDER) to select study sites on gaged streams. Survey sites to tie into long-term gages. Observe surface water and surficial water-table levels monthly at most sites. Locate and describe physical and biological indicators at all sites. Analyze long-term surface water records at each site. Assist FDER with preparation of annual progress report to cooperator.

FL-478 OCCURRENCE AND SIGNIFICANCE OF SALINE WATER IN THE FLORIDAN AQUIFER, NORTHEAST FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Rick Spechler, Orlando

COOPERATING AGENCIES: City of Jacksonville and the St. Johns River Water Management District

PROBLEM: Increased ground-water withdrawals from the Floridan aquifer have lowered water levels 0.5 to 2.0 feet per year in parts of northeast Florida. Associated with the decline in water levels has been an increased potential for saltwater intrusion into the freshwater zones of the Floridan aquifer along the coast. Gradual but continual increases in salinity of the water from the aquifer have been observed in several areas along the coast in Nassau, Duval, and St. Johns Counties. Further intrusion of saltwater into the aquifer could seriously affect water supplies.

OBJECTIVE: (1) Provide a refined conceptual model of the hydrogeologic framework of the Floridan aquifer system in northeast Florida, and (2) delineate areas where saline water occurs in the various water-bearing zones of the Floridan aquifer system and possibly deeper zones.

APPROACH: Compile all existing geologic, geophysical and chemical data to help determine the lateral and vertical distributions of saltwater in the Floridan aquifer. Collect new data to supplement and update the existing data base which will include: (a) water-quality analysis for major ions, density, specific conductance and temperature, and (b) borehole geophysical logging to determine flow zones and water-quality changes with depth.

PROGRESS: A report outline and planning document were completed. A literature and data search was conducted to locate all material pertinent to the study. Geophysical logging of 6 wells has been completed. Several others have been selected for logging. Water samples from about 75 wells were analyzed for major chemical constituents. Data collected have been processed and stored for evaluation.

PLANS FOR THIS YEAR: Geophysical logging of wells will continue. Sampling of wells for major chemical constituents will be completed. Work will continue on data compilation, analysis and interpretation, and on preparation of report.

FL-479 IMPACTS OF A MIGRATING CITRUS INDUSTRY ON THE WATER RESOURCES OF HARDEE AND DE SOTO COUNTIES, FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPLE INVESTIGATOR: James L. Kiesler, Jr., Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Citrus growers began to migrate southward after freezes in northern and central Florida devastated the citrus industry during the early 1980's. As growers moved south the need for water to irrigate citrus increased. Irrigated citrus acreage in Hardee and De Soto Counties, Florida, increased from 59,000 acres in 1980 to 82,000 in 1986. How has the hydrology of Hardee and DeSoto Counties, and southwest Florida, been affected by the increased irrigation? As additional growers move into this area what impact will the irrigation of their groves have on the hydrology? What are the long-term impacts of citrus irrigation on the hydrology of this area?

OBJECTIVES: (1) Evaluate the present and long-term impacts of the current citrus industry on the hydrology of Hardee and De Soto Counties. (2) Develop a technique using GIS and mathematical models that will allow resource managers to evaluate the probable hydrologic impacts of future citrus expansion.

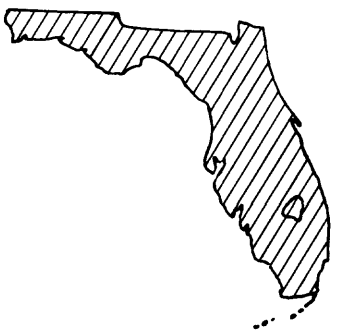
APPROACH: Existing continuous and periodic water- level data from the two county area will be examined. The nonparametric Seasonal Kendall test will be used to test for monotonic trends in ground-water levels. Periods to be tested are the period of record, period prior to 1981, and period after 1981. The nonparametric Mann-Whitney-Wilcoxon test will be used to test for step trends in water levels for the pre- and post-1981 periods. Monthly precipitation totals for Arcadia, Fla., will be tested for precipitation trends that may mask trends in ground-water levels. The McDonald-Harbaugh Finite-Difference Model will be calibrated, verified, and used to simulate the change in water levels for two 30 year periods: the first representing conditions as they existed in 1980 and the second as they existed in 1985. These model simulations will be examined to determine the impact of the increased irrigation. The existing RASA model will be used as the starting point for model calibration. The data required to run the model will be loaded into a GIS data base. The GIS will then be used to create the model input stream and to display the model output.

PROGRESS: The Geographical Information System software and a personal computer have been purchased and installed. Construction of the GIS and hydrologic data bases has begun. USGS National Mapping Division (NMD) 1:100000 scale digital line graph (DLG) data for the Tampa Subdistrict have been obtained. The Bartow and Arcadia quads have been loaded into the GIS data base. Edge matching of these quads and cleanup of the polygon topology for these two quads has begun. The Sarasota and St. Petersburg quads will be added next year. The digital elevation model data (DEM), digital geologic data, political boundaries, soils, and land use data have been ordered.

Information on the tops and bottoms of the Floridan and Intermediate aquifers and information on the hydraulic characteristics of these aquifers have been compiled. About 30 percent of this data is loaded into the data base. Statistical analyses of existing ground-water and precipitation data have been performed. Preliminary analysis of this data indicate that no statistically significant monotonic or step trends exist in the historical data. Information on linking the ground-water model to the GIS has been obtained. Programs to develop model grids as part of the GIS have been developed. Procedures for creating the model input data sets from data in the GIS were researched and development of a procedure for this project has begun.

PLANS FOR THIS YEAR: The second year of the project will be spent completing the data base and calibrating and verifying the model. Land use and cover data from NMD will be loaded into the data base for the pre-1988 period. Data from the University of Florida, Florida Department of Transportation, Florida Department of

Citrus and the Southwest Florida Water Management District will be used to produce a land use and cover data base for 1985. Soil survey's from the Soil Conservation Service (SCS) will be entered into the GIS. Hydrologic descriptions of the soils will be linked to the soil types in the GIS. The remaining geologic data will be loaded into the data base. Procedures to link the ground-water model and the GIS will be completed and the ground-water model calibrated and verified. Existing potentiometric maps for the project area will be entered into the GIS data base. The GIS will then be used to determine the amount of water available at the making of each map. This data will be examined to see if any trends or changes have occurred.



FL-480 EVALUATION OF THE AMBIENT GROUND-WATER MONITORING NETWORK FOR DESCRIBING BACKGROUND WATER QUALITY IN FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: December 1989

PRINCIPAL INVESTIGATORS: Brian G. Katz and Anne Choquette, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Assessment of water-quality degradation due to human impacts required information on background (natural) water-quality characteristics. A statewide sampling network has been established to determine background water-quality conditions of principal aquifers in Florida. The data from the network need to be evaluated to determine if the sampling network is adequate for meeting program objectives and to outline long-term sampling needs.

OBJECTIVE: (1) To delineate hydrochemical zones that define areas of similar background water quality in Florida's aquifers on the basis of data from the statewide sampling network and other sources. (2) To evaluate the design of the statewide sampling network for long-term monitoring of background water quality of principal aquifers in Florida.

APPROACH: Geochemical and statistical methods will be used to characterize background water quality based on data from the sampling network. Zones of similar background hydrochemistry will be delineated based on spatial differences in the distribution and relative abundance of major ions and selected trace constituents. The sampling network design will be evaluated using geostatistical techniques and existing information on geochemical and hydraulic properties of principal aquifers.

PROGRESS: Well-construction and ground-water quality data were obtained from the Florida Department of Environmental Regulation (FDER) for the statewide ambient network. Screening programs were developed and the data were evaluated for chemical, logic, internal consistency, and missing fields. DER and the Water Management Districts are verifying and updating flagged data.

PLANS FOR THIS YEAR: Complete verification and update of the statewide data base. Summarize water quality in major aquifer sysems. Define hydrochemical facies and subfacies in selected aquifers.

FL-481 THE RELATIVE IMPORTANCE OF GROUND WATER TO THE CHEMICAL BUDGET OF SEEPAGE LAKES

DATE PROJECT BEGAN: June 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Terrie M. Lee, Tampa

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: In order to predict long-term trends in lake pH there is a need to understand the relative quantitative importance of individual hydrologic and chemical factors regulating acid neutralizing capacity (ANC) in lakes. This is particularly true of Florida's numerous acidic seepage lakes which have hydrologic budgets dominated by precipitation. Even small amounts of ground-water inflow, and certain in-lake processes, contribute ANC to lakes and may play important roles in the chemical budget of acidic, seepage lakes.

OBJECTIVES: The objectives of this study are: (1) to understand the factors that regulate ANC in seepage lakes, particularly the relative importance of ground-water contributions of ANC to seepage lakes; (2) to improve our conceptual and physical models of the hydrologic and chemical processes affecting the chemistry of seepage lakes; and (3) to use these models to predict the vulnerability of seepage lakes to changes in acidic deposition or alterations in ground-water flow.

APPROACH: The approach of the study is to compare and contrast the hydrologic and chemical budgets of two seepage lakes with different acid-neutralizing capacities; acidic Lake Barco in Putnam County and circum-neutral Lake Lucerne in Polk County, Florida. The hydrologic budget of each lake will include evaporation losses quantified by the energy budget evaporation method, and ground-water inflows and outflows calculated by flow-net analysis and numerical modeling studies. The evaluation of the geologic setting of each lake will be a central part of the investigation of lake/ground-water interactions. Lake chemical budgets will be derived from lake, precipitation, and ground-water chemical data, and an evaluation of in-lake solute fluxes at the sediment-water interface. An input-output chemical model will be used to simulate trends in lake ANC.

PROGRESS: Project activities started the last quarter of this year. Drilling at Lake Barco has been scheduled to begin in October.

PLANS FOR THIS YEAR: Plans for FY 89 focus on establishing hydrologic data collection sites in the basin around Lake Barco, and reviewing historical water quality data from Lake Lucerne. Activities at Lake Barco will include: installing network of deep and shallow monitor wells around lake, characterizing local geology, mapping lake bathymetry, installing continuous lake stage recorder. Installation of precipitation and evaporation monitoring equipment will begin near the end of this year.

FL-482 FINE SEDIMENT RESUSPENSION PROCESSES AND LIGHT ATTENUATION IN SHALLOW ESTUARINE ENVIRONMENTS

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: David H. Schoellhamer, Tampa

COOPERATING AGENCIES: City of St. Petersburg, City of Tampa, Hillsborough County Environmental Protection Commission, Pinellas County, Tampa Port Authority

PROBLEM: Fine sediment plays an important role in the overall health of shallow estuaries, such as Tampa Bay, in at least two ways. Elevated concentrations of fine sediment in the water column reduce the depths to which sunlight can support photosynthesis. This could be at least partly why Tampa Bay has lost over 80 percent of its seagrass beds over the last 100 years. Fine sediment also adsorbs a wide range of toxic organic and inorganic chemicals whose distribution and availability to various biological communities are then primarily governed by fine sediment transport processes. These processes, particularly the mechanisms of resuspension from the bay bottom, are poorly understood and can presently contribute little toward proper management of Tampa Bay.

OBJECTIVE: The objectives of the project are to both determine the mechanisms that cause resuspension of fine sediments from the bottom of Tampa Bay and to determine the effect of these resuspended materials on light attenuation.

APPROACH: To accomplish the first of these objectives, one site in Hillsborough Bay and one site in Old Tampa Bay will be established to continuously measure the vertical structure of both velocity and suspended sediment. The sites will be chosen to be representative of fine sediment deposits known to exist in Hillsborough Bay and to be determined in Old Tampa Bay. Data from instruments at these sites will be analyzed to detect resuspension events and relate them to velocity variations and bottom shear stress caused by tidal currents, storms, ship wakes, and other disturbances.

To relate the resuspension information to light attenuation and to detect possible interferences from nonresuspension processes (such as phytoplankton blooms, river discharges, and stormwater runoff) a wide range of supplemental weekly and monthly data will be collected at the two primary sites as well as nearby companion sites having sandy bottoms. Parameters will include suspended solids, suspended organic carbon, color, chlorophyll, light intensity, specific conductance, temperature, and turbidity. Horizontal gradients of suspended solids in the vicinity of the primary sites will be measured by towing of optically sensitive meters. The ability of benthic organisms to inhibit resuspension by effectively armoring the bay bottom will be documented by periodic bottom samples.

Instrumentation at the two primary sites will include five electro-magnetic velocity meters, five optical backscatterance meters, an electronic data logger, and equipment to transmit data directly to the U.S. Geological Survey computer. This will all be mounted on pile-supported platforms for necessary stability and servicing requirements and operated for one year at each site. Prior to deployment in the bay, the instruments and data transmission equipment will be tested at a site in Bayboro Harbor at St. Petersburg.

PROGRESS: During FY 1988, all instrumentation was purchased, calibrated, and tested. The location of fine-grained sediment deposits was determined in Old Tampa Bay and verified in Hillsborough Bay. A pilesupported structure was constructed in Old Tampa Bay, instrumentation installed, and data-transmission via cellular phone established with the Tampa Subdistrict computer. Monthly and weekly field trips have been routinely made for collection of water-quality data.

PLANS FOR THIS YEAR: Water-quality and resuspension data collection will continue. Resuspension data will be analyzed daily. Installation of instruments at the companion site in Old Tampa Bay will be done as well as planning, permitting, and construction of the primary site in Hillsborough Bay. An experiment will be conducted to determine the possible effect of shrimp trawling on resuspension measurements. A report will be prepared on the distribution of fine sediment in Tampa Bay.

FL-483 APPLICATION OF ACOUSTICAL-VELOCITY METER (AVM) SYSTEMS TO DISCHARGE MEASUREMENTS IN LOW-VELOCITY FLOW CONDITIONS OF SOUTH FLORIDA CANALS

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1989

PRINCIPAL INVESTIGATOR: Eduardo Patino, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Velocities that range from 0.0 to 0.2 foot per second are common in south Florida canals, and conventional discharge-measuring techniques do not lend themselves to reasonably accurate results. There is a need to develop a velocity-measuring device and companion field techniques that would allow for more reliable discharge measurements in these canals.

OBJECTIVES: (1) Acquire an off-the-shelf AVM that has been adapted to read only velocity, use battery power, and be portable; (2) develop field techniques for a portable AVM as it would be used to make an instantaneous measurement of discharge; and (3) test the AVM device and field techniques at an existing surface-water gaging station where low-velocity conditions exist.

APPROACH: The gaging station used will be 02289500 Tamiami Canal near Coral Gables, which has been rated in the range of 35 to 200 cubic feet per second by the a stationary AVM calibrated using the Price AA current meter. A mew unit being tested at HIF can be modified to accept battery power and read only velocity. The specifications will be drawn up with the help of HIF and a solicitation for bids conducted through proper channels. It is anticipated that a cross-patch adaption will be necessary at the selected site and a transducer frequency of 200 kilohertz used. Four posts will be erected in the channel at the prescribed spacing and fitted with vertically adjustable brackets that will hold the transducers.

PROGRESS: The AVM has been acquired, and the transducers have been installed in the field. The AVM is currently collecting instantaneous measurements of discharge at the gaging station.

PLANS FOR THIS YEAR: Continue to collect measurements during the first half of the year and complete planned Water-Resources Investigations Report, documenting the results of the field activities.

REPORTS IN PROCESS:

Curtis, R.E., and Laenen, Antonius, Evaluating the capability of acoustic velocity meters for making discharge measurements in low velocity canals: U.S. Geological Survey Water-Resources Investigations Report (coauthor is revising; report has received colleague review).

FL-484 STUDY OF CANAL-AQUIFER RELATIONSHIPS IN THE SURFICIAL AQUIFER SYSTEM, SOUTHEAST FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Leo Swayze, Miami

COOPERATING AGENCIES: South Florida Water Management District and Metro-Dade Environmental Resources Management

PROBLEM: The surface of the surficial aquifer system has been cut by an extensive canal network. Because of the high hydraulic conductivity in the upper part of the system (Biscayne and surficial aquifers), there is an exchange of water between the canal and the aquifers. Water managers have long recognized the fact that canals recharge the aquifers. Studies have been conducted to evaluate the infiltration from the Miami Canal into the Biscayne aquifer in the vicinity of the Miami Springs-Hialeah well field. Attempts to determine the hydraulic relationship between the canal and the aquifer in other areas have not been as successful.

OBJECTIVES: (1) Develop methods for quantifying water exchange between canal and aquifer; and (2) determine effect of the canal on the ground- water flow system.

APPROACH: The approach is to calculate losses from a canal using an AVM and to calculate the effect of bottom material on leakage to the aquifer. Also, using the MODFLO or a finite-element model, the flow net adjacent to the canal will be defined.

PROGRESS: Cross section sites have been selected, an AVM has been acquired, and installation has been completed. The development of a canal-aquifer model has been started.

PLANS FOR THIS YEAR: Continue data collection using the AVM, collect water-level data, and continue to develop the canal-aquifer model.

FL-485 SALINE GROUND-WATER RESOURCES IN THE UPPERMOST PART OF THE FLORIDAN AQUIFER SYSTEM, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1988

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: T.H. Thompson, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Ground water in Pinellas County has chloride and total dissolved solids concentrations that exceed drinking water standards. Water must be imported from other counties. Two agencies are considering use of reverse osmosis to replace part or all of the imported water. The uppermost part of the Floridan aquifer system, with TDS less than 10,000 mg/L, needs to be more precisely defined in order to evaluate the saline ground-water resources. A solute-transport model is needed to estimate changes in salinity that may occur at these sites under various rates of pumping.

OBJECTIVES: Describe and map the hydrogeologic units above and in the uppermost part of the Floridan aquifer system in and adjacent to Pinellas County. Describe and map the regional distribution of the saline water and freshwater. Identify sites that may be suitable for development of the saline-water resources. Select and develop a solute-transport model for two or three of the most suitable sites for well-field development and siting of water-treatment plants. Using the model, estimate long-term changes in the salinity at the well-field sites under various pumping scenarios.

APPROACH: Prepare planning document, conduct literature and file search on the hydrogeologic character and water quality of the study area. Prepare maps and sections showing the top and thickness of the hydrogeologic units, the potentiometric surface, and salinity distribution. Tables will be prepared showing values of transmissivity, storage coefficients, and leakance or hydraulic conductivity. The HST3D solute-transport model with R-Z radial discretization will be used to simulate upconing of saltwater and changes in salinity of the pumped water with time at two or three sites. Model sensitivity analysis will be used to guide additional data collection.

PROGRESS: The planning document was prepared and submitted to the cooperator and the Southeast Region for review. The file search was completed. Conducted inventory of wells, compiled geologic data, geophysical logs, and water-quality data, with the focus on south-central Pinellas County where data are sparse. Locations of wells with available geologic and geophysical data were plotted on maps as were well locations where water-quality data were available from deep zones. Because help was available from Gary Mahon for model development, field work was postponed and initial work on the HST3D model was started. Created generalized parameter data files for input to the model. Initial boundary conditions have been defined and a time-step selected that gives stable (nonoscillating) results. Began evaluation of aquifer characteristics including transmissivity, leakance, and dispersivity. Continued to work on model development, in conjunction with data compilation and analysis.

PLANS FOR THIS YEAR: Complete model development and execute model using various pumping rates, well penetrations, and multiple-well combinations. Test model sensitivity to changes in model parameters. Complete preparation of maps and cross sections and write final report.

FL-486 HYDROGEOLOGY AND EFFECTS OF SELECTED DRAINAGE WELLS AND IMPROVED SINKHOLES ON WATER QUALITY IN THE UPPER FLORIDAN AQUIFER, SILVER SPRINGS BASIN, MARION COUNTY, FLORIDA

DATE PROJECT BEGAN: July 1988

DATE PROJECT ENDS: June 1991

PRINCIPAL INVESTIGATOR: G.G. Phelps, Orlando

COOPERATING AGENCIES: City of Ocala, Marion County, and St. Johns River Water Management District

PROBLEM: Because of the highly karstic character of the hydrogeologic system, the potential exists for significant contamination of the Upper Floridan aquifer in the Silver Springs basin either from direct emplacement of surface waters into the aquifer, or from an accidental spill. Because the aquifer is the principal source of water supply in the basin, a need exists for documentation of any major potential sources of contamination, and a better understanding of the geohydrologic system.

OBJECTIVES: (1) Develop a better understanding of the geohydrology of the Silver Springs basin; (2) Document locations of concentrated points of recharge entering the Upper Floridan aquifer and major potential sources of contamination; (3) Evaluate the potential movement and effects of contaminants introduced into the aquifer at a few selected sites.

APPROACH: Inventory existing wells, sinkholes and other points of recharge and potential contamination. Update and analyze existing geologic and hydrologic data. Select several sites for detailed study. At those sites, collect samples of recharge water and water from existing wells; run geophysical logs of selected wells; and perform dye-trace studies to determine local flow systems. Analyze existing tritium data to help determine flow paths. If contaminated sites are found, drill monitor wells to supplement existing wells. Run geophysical logs and collect water samples from new monitor wells.

PROGRESS: Review of existing data and literature begun. Base maps prepared. Well inventory begun and field visits made to begin site selection for detailed study.

PLANS FOR THIS YEAR: Complete inventory of potential contamination sites and existing wells. Select sites for detailed study and sample inflow. Sample existing wells at study sites and run geophysical logs. Begin analysis of existing tritium data.

FL-487 WATER BUDGET OF A SOFTWATER SEEPAGE LAKE IN THE FLORIDA PANHANDLE

DATE PROJECT BEGAN: June 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATORS: James P. Oliveros and Walter R. Aucott, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Acidification of lakes over much of eastern Canada and the northeastern United States has become a serious problem in recent years. Although it has not been demonstrated that Florida lakes have shown a clear trend towards acidity, some of Florida's lakes are acidic. Many lakes may be naturally acidic but an assessment of the contribution of acidic precipitation to lake acidification has not been made. Softwater seepage lakes having low conductance and low alkalinity may be the most susceptible to further acidification from acid deposition and it is important to establish the relative quantitative importance of hydrologic and chemical parameters on the acid neutralization capacity (ANC) of softwater seepage lakes. An accurate hydrologic budget is essential in assessing the effects of acid precipitation on the ANC of a given lake because ground water may have a significant impact on the degree of ANC.

OBJECTIVES: The primary objectives of this study are to establish a complete hydrologic budget for lake Five – O and to collect samples of precipitation, ground water, and lake water for chemical analysis.

APPROACH: The approach to the establishment of the hydrologic budget is to make accurate and independent calculations of each component of the hydrologic budget including ground water, evaporation, and precipitation. A network of monitoring wells and piezometer nests distributed vertically within the ground-water flow system will be used to establish detailed water-level maps and determine horizontal and vertical hydraulic head gradients. Piezometers will be placed in the lake bed to identify areas of ground-water recharge and discharge within the lake. Using these data, ground-water inflows and outflows will be determined by flow-net analysis and numerical modeling studies. Evaporation losses will be determined by the energy budget evaporation method. This requires detailed measurements of various parameters such as wind speed and direction, relative humidity, air and water temperature, and incoming solar radiation. Lake volume will be monitored throughout the study using lake bathymetry data and lake stage. Precipitation in the lake basin will be measured directly using two different types of rain gages.

PROGRESS: Thirty monitoring wells were installed and developed. Geologic logs were made at several sites and formation samples and cores were collected. Geophysical logs were made at the three deepest borings. Samples were taken from several wells for pH and conductance. The wells were leveled in and two synoptic water-level measurements were made.

PLANS FOR THIS YEAR: Complete data-collection network including climate station, geophysical surveys, and well network. Begin collecting hydrologic and water-quality data.

FL-488 FRESHWATER INFLOW TO INDIAN RIVER LAGOON, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Larry D. Fayard, Orlando

COOPERATING AGENCY: St. Johns River Water Management District

PROBLEM: Estuarine-dependent fish are adversely affected by the lower salinities that are caused by excessive freshwater inflows to the Indian River Lagoon. Data are needed to quantify the natural inflows so that controlled flows can be more effectively managed.

OBJECTIVE: Define the runoff of freshwater from natural basins by: (1) operating gaging stations, including 1-D BRANCH models; and (2) using inference techniques.

APPROACH: Traditional gaging will be used on some of the sites. Flow in tide affected areas will be defined using the 1-D BRANCH model. Discharge on some of the smaller streams will be defined by using regionalization, rainfall-runoff, or other inference techniques.

PROGRESS: New project.

PLANS FOR THIS YEAR: Install gaging stations where needed for the standard gaging stations and the 1-D BRANCH model stations. Define cross sections as needed for the 1-D BRANCH reaches. Install rain gages where needed. Some reconnaissance will be done on the small drainage basins.

FL-489 WATER QUALITY IN THE WINTER PARK CHAIN OF LAKES, AND IMPACT OF DEVELOPMENT, CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: E.R. German, Orlando

COOPERATING AGENCIES: City of Winter Park and the St. Johns Water Management District

PROBLEM: Although data are sparse, there are indications that the lakes are eutrophic and are receiving phosphorus loading in excess amounts. Lake water clarity may be decreasing and inflow of vegetative and other debris with stormwater runoff may be contributing to excessive sediment buildup in the lakes. Because of the lack of knowledge of the relative inputs from the various nutrient sources, a practical water-quality management strategy is not possible.

OBJECTIVE: Establish a systematic program of data collection to determine rainfall quantity, lake level and water quality, and surface inflow quality and quantity. Investigate composition of lake sediments and rate of sediment buildup. Estimate loads of nutrients and bacteria to the lakes from atmospheric deposition, storm runoff, and ground-water seepage. Determine contribution of coarse, fine, very fine, and dissolved material in the total stormwater loading to the lakes, for nutrients and oxygen demand.

APPROACH: Install and operate discharge stations on the three major surface-inflow canals, and the outflow canal. Install and operate lake-level recorder and rain gage. Begin a bimonthly schedule of sampling for nutrients, major ions, chlorophyll, and field determinations at nine locations. Sample bottom sediments to determine if chemical composition may indicate source of materials: stormwater or decaying in-lake vegetation. Conduct bathymetric surveys with sound reflection and ground-penetrating radar to determine sediment thickness and rate of buildup. Determine major source of nutrient inflow by sampling stormwater inflow, surface inflow from upstream lakes, and ground water. Select two stormwater inflow sites for collection of composite samples of runoff. Determine loading of oxygen demand and nutrient inflow due to coarse, fine, very fine, and dissolved materials in the runoff.

PROGRESS: New project.

PLANS FOR THIS YEAR: Install equipment at the continuous monitoring stations. Select two stormwater outfalls and install sampling equipment for stormwater runoff. Review literature for results of any similar studies related to evaluating nutrient and oxygen demand loading of particulate material in stormwater runoff.

FL-490 GROUND-WATER RESOURCES OF OKEECHOBEE COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: George R. Schiner, Orlando

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: A countywide ground-water resource study of Okeechobee County has never been done. Data needed to assess and interpret the occurrence and quality of water in the surficial, intermediate, and Floridan aquifer systems in Okeechobee County are lacking. In some areas, ground water is too highly mineralized even for irrigation use. A description of the county's ground-water resources is needed for orderly planning, management, and the best use of the resource. Evaluation of water use and water supply potential is particularly needed for additional municipal supply and for expanding irrigation use.

OBJECTIVES: The primary objective of the investigation is to supply the framework of water-resources data needed to conserve and manage the ground-water resources of Okeechobee County. Elements involved in the primary objective are: (1) An evaluation of ground-water use, water-level trends, and availability of water from the major aquifers; (2) A description of selected water-quality characteristics of the major aquifers, such as chloride and iron concentrations, and their individual and collective response to changes in water levels and to pumping; (3) Reconnaissance appraisal of priority-type pollutants in the surficial aquifer system; (4) Delineation of areas where nonpotable saline ground water is or may become a problem; and (5) A description of the water-bearing characteristics of the geologic formations.

APPROACH: Collect and analyze historical water-resources information from published and unpublished reports and from records of the SFWMD, and the SJRWMD, municipalities and their consulting firms, and from local well drillers. Inventory existing wells by interviewing well owners to obtain information on water levels, well yields, and water quality. Sample for major constituents (including chloride and nitrate) and priority pollutants at selected sites to assess water quality of the major aquifers. Use surface and subsurface geophysics to aid in evaluation of geology and water quality. Drill 5 to 12 test-observations wells to collect information on water levels, lithology, and water quality. Make specific capacity and longer-term aquifer tests on selected wells as necessary to determine hydraulic characteristics of aquifers. Establish a hydrologic network and install instruments where necessary to collect continuous and periodic data. Collect and compile data on amounts and sources of water used by municipalities and other public suppliers, industry, agriculture, and private owners.

PROGRESS: New Project.

PLANS FOR THIS YEAR: Compile existing data. Inventory wells in selected areas. Sample water from wells at selected sites for various constituents. By using geophysical techniques, map geology and water quality. Drill at least three test-observation wells. Make aquifer tests. Install monitoring equipment.

FL-491 ASSESSMENT OF SALTWATER INTRUSION IN COASTAL BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Michael Merritt, Miami

COOPERATING AGENCIES: Broward County and the South Florida Water Management District

PROBLEM: Water management needs simulation modeling techniques to reduce the cost of data collection in assessing the degree of saltwater intrusion and to permit assessments of scenarios for amelioration.

OBJECTIVES: The objectives of the study are to collect more data describing the degree of saltwater intrusion and to develop, evaluate, and apply digital simulation methodology for representing the saltwater intrusion process and for predicting future changes under hypothetical scenarios.

APPROACH: Approximately 10 additional pairs of sampling wells will be added to the current observation network. These wells are intended to locate the position of saltwater intrusion where it is not presently known. In addition, geologic test wells and hydraulic test wells will be installed which will provide data to be used for hydrologic models. Simulation will provide data to be used for hydrologic models. Simulation efforts using a cross-sectional model will be conducted at a selected well field located near the saltwater interface. When the vertical layering is adequately simplified, the model will be extended into three dimensions which will include additional well fields, canals, and other local features for more realistic and precise simulations.

PROGRESS: New project

PLANS FOR THIS YEAR: The main effort this year is to advertise and award a drilling contract for the test wells and monitoring network. Also, data collection, especially water-quality and hydraulic characteristics data, will be a major task during this period.

FL-492 DEVELOPMENT OF AN ARTIFICIAL INTELLIGENCE ROUTINE IN BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Roy Sonenshein, Miami

COOPERATING AGENCIES: Broward County and the South Florida Water Management District

PROBLEM: The Florida Department of Environmental Regulation requires each of the five water-management districts within the State to design and implement a monitoring network that will be utilized to determine the effects of land use on ground-water quality. However, a cost-effective method to design a monitoring network that describes land-use effects has not been technically defined.

OBJECTIVES: (1) Develop a routine within the framework of an existing artificial intelligence (AI) software package that will analyze hydrogeologic and anthropogenic information, and (2) develop the computer program for interfacing ground-water flow model results and Geographic Information System (GIS) information with AI.

APPROACH: The first phase of the development of the AI software will be accomplished using the commercial AI program "Insight." It will house the decision tree elements, and a search aspect will be developed using a FORTRAN routine that would interface initially with GIS programs. The second phase will be using an operational AI that interfaces with a number of data bases from ground-water model output.

PROGRESS: New project.

PLANS FOR THIS YEAR: Plans are to develop the data format for AI using the output from the current Geographic Information System (GIS) Project. Also, develop the types of scenarios that would be answered by AI, such as direction of contaminant movement and the location of potential areas (polygons) or supply wells with minimum contaminant risk. Software for searching the polygons and using the decision trees will be developed during this time.

FL-493 HYDROGEOLOGY AND THE EFFECTS OF DEGRADATION OF THE AIRPORT LANDFILL MATERIALS ON GEOCHEMISTRY OF GROUND WATER SOUTHWEST OF TALLAHASSEE, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Marian P. Berndt, Tallahassee

COOPERATING AGENCY: City of Tallahassee, Dept. of Public Works

PROBLEM: Ground-water samples from wells located around the perimeter of a landfill, in operation from approximately 1959-1976, show local contamination of ground water. Sulfate, tetrachloroethene, nitrate sodium and manganese concentrations have been detected above their maximum contaminant levels (MCLs) in ground-water samples. The seven wells at the site are not adequate to provide the information necessary to characterize the hydrogeology, determine the direction of ground-water flow and determine the processes of degradation of the landfill materials.

OBJECTIVE: (1) Characterize the geology and hydrogeology of the site; (2) determine the areal and vertical extent of contamination; and (3) determine the processes of degradation of landfill materials.

APPROACH: Electromagnetic terrain conductivity measurements will be used as a reconnaissance tool to determine the approximate extent of contamination. Public and private wells in the area will be sampled and additional wells will be drilled so the hydrogeology of the site can be described, water levels measured and water samples can be collected to determine the extent of contamination. Both the oxidized and reduced species of compounds containing organic carbon, oxygen, sulfur and nitrogen will be analyzed to determine the types of reactions and processes controlling degradation of landfill materials.

PROGRESS: New project.

PLANS FOR THIS YEAR: Use surface geophysics to determine approximate extent of ground-water contamination. Determine history of landfill operation. Install 12 to 15 additional wells. Prepare potentiometric surface map. Sample 7 existing wells, plus all new wells, quarterly in order to determine the nature and extent of contamination due to the landfill materials.

FL-494 ASSESSMENT OF CANAL-AQUIFER INTERACTION IN THE SURFICIAL AQUIFER SYSTEM USING A COUPLED SURFACE-WATER AND GROUND-WATER FLOW MODEL, BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: E.J. Wexler, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Simulation techniques for surface- water/ground-water flow modeling need improvement to better analyze canal-aquifer interaction on a regional scale. Several ground-water flow models have been developed by the U.S. Geological Survey and others which incorporate surface-water routing models. These models are generally developed for two-dimensional ground-water flow and would be inadequate for simulating flow in the multilayer or multiple aquifer systems of south Florida.

OBJECTIVES: The objective of this study is to develop a hybrid ground- water surface-water flow model by modifying the U.S. Geological Survey modular three-dimensional finite-difference ground-water flow (MODFLO) model to incorporate the flow routing techniques of the U.S. Geological Survey surface-water flow (BRANCH) model to better simulate canal-aquifer interaction. After testing and verification, the model will be used to simulate regional ground-water flow and canal flow in Broward County, Florida.

APPROACH: The MODFLO ground-water flow model will be modified to include the BRANCH model as a replacement for the RIVER module. An iteractive procedure will be designed within the main program to solve the resulting nonlinear system of equations. The modified model will be extensively tested to verify that no coding or computational errors have been introduced. Documentation of changes made to the two computer codes will be provided to the South Florida Water Management District along with a user's guide describing additional input data requirements for the modified MODFLO model. Once the modified MODFLO model has been tested and verified as computationally correct, data collected in this investigation will be used to simulate coupled ground-water and surface-water flow in the area. The results of these simulations will be compared to those obtained using the original MODFLO model to demonstrate the improvement in simulation capabilities and the model's effectiveness as a management tool.

PROGRESS: New project.

PLANS FOR THIS YEAR: During the first year, available hydrogeologic data will be compiled and interpreted to develop a preliminary model of Broward County. Published interpretive reports describing the geology, hydrologic characteristics, and water-quality data will be used in designing the framework of the model.

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