WATER RESOURCES ACTIVITIES IN FLORIDA, 1990–91

Mildred E. Glenn, editor

U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT 91-78

IN COOPERATION WITH

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Florida Department of Natural Resources
Florida Department of Transportation
Florida Game & Fresh Water Fish Commission
Florida Institute of Phosphate Research
Florida Keys Aqueduct Authority
Institute of Phosphate Resources
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1991

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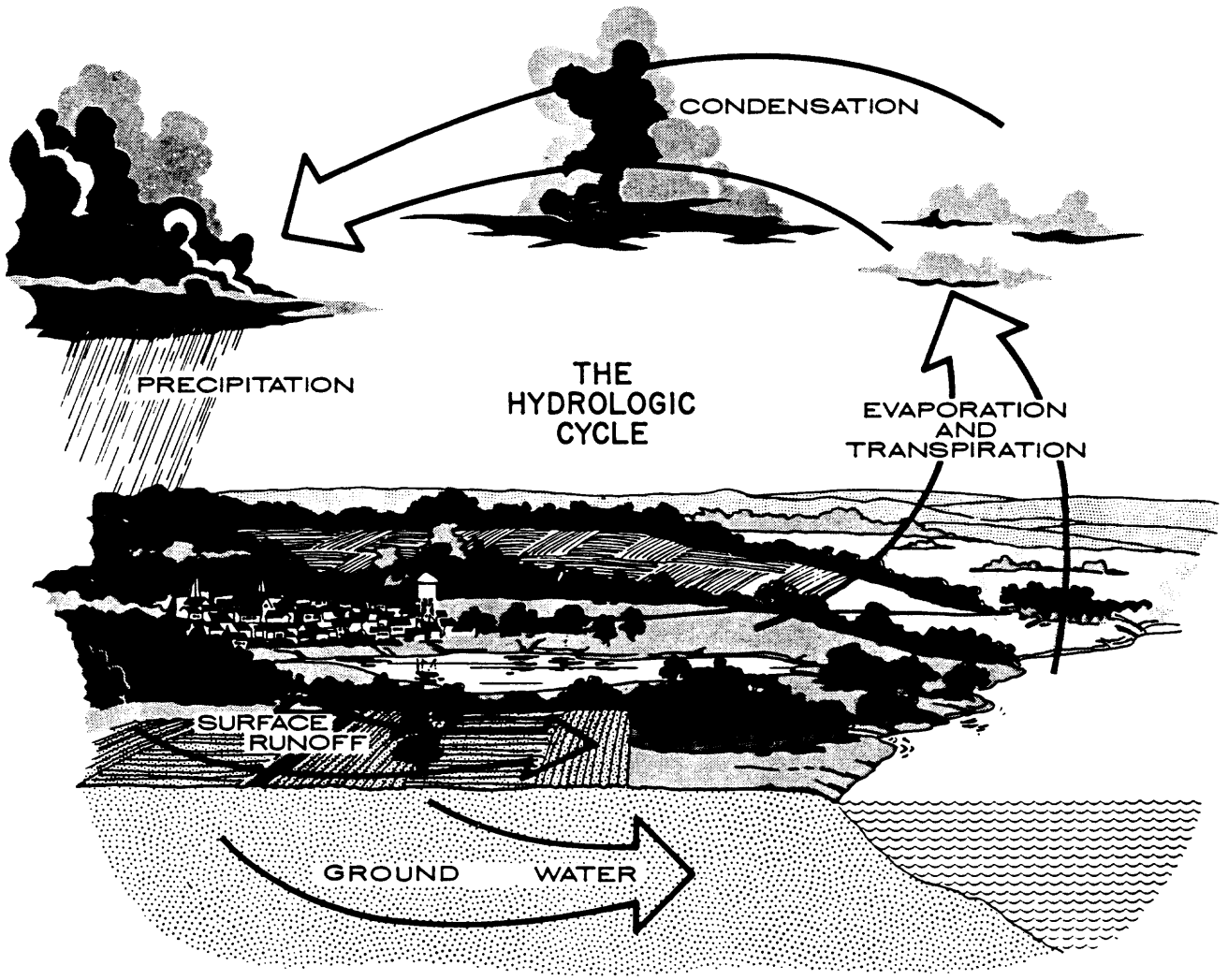
FOREWORD

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 Survey was unable to meet the demand because of 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, Federal Center, Box 25425, Denver, Colorado 80225.


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

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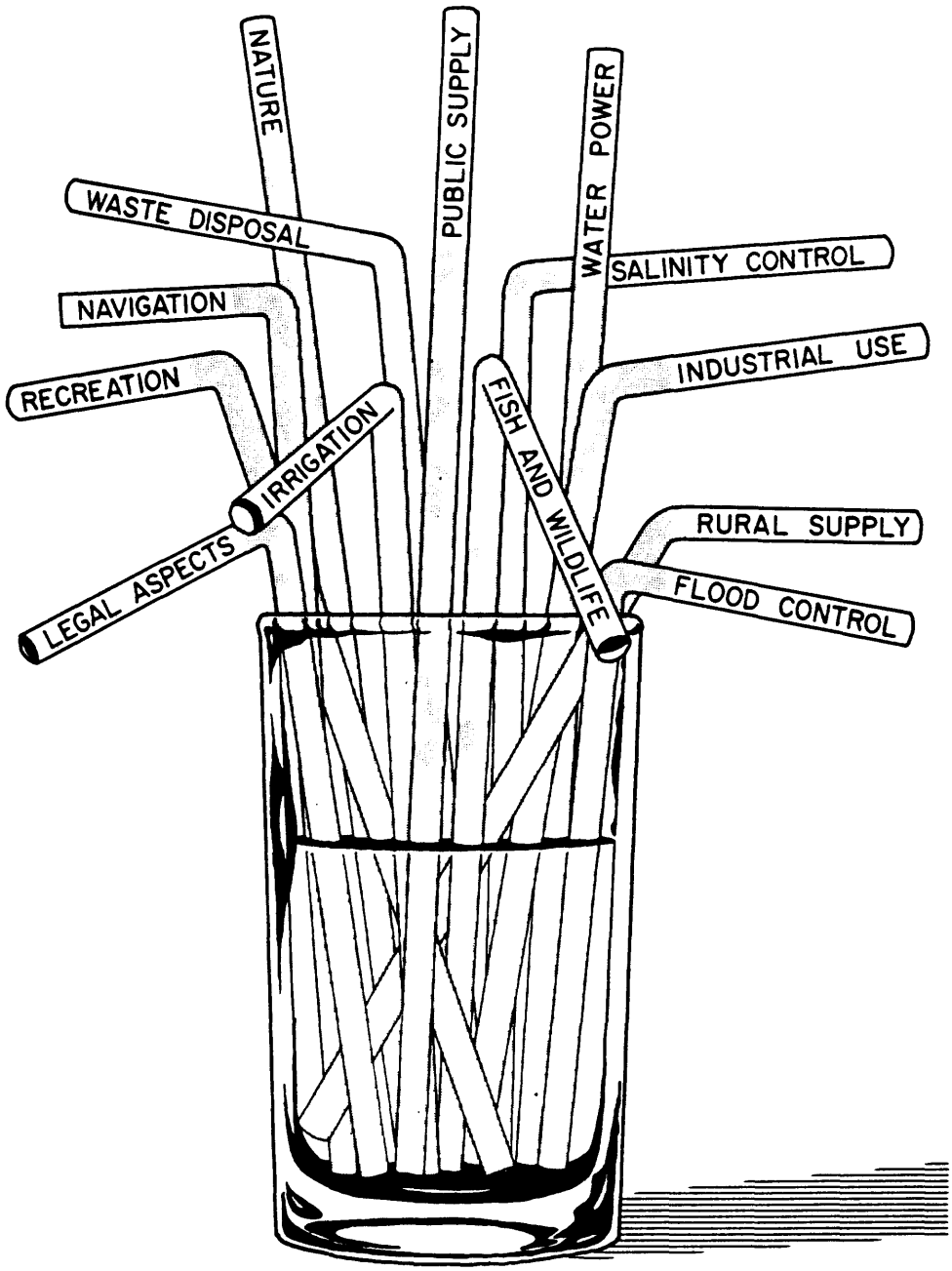


Competition for water is growing. Adequate information and analysis are keys to effective development, protection, and management of a common water resource.

WATER RESOURCES ACTIVITIES IN FLORIDA, 1990–91

Mildred E. Glenn, *editor*

INTRODUCTION

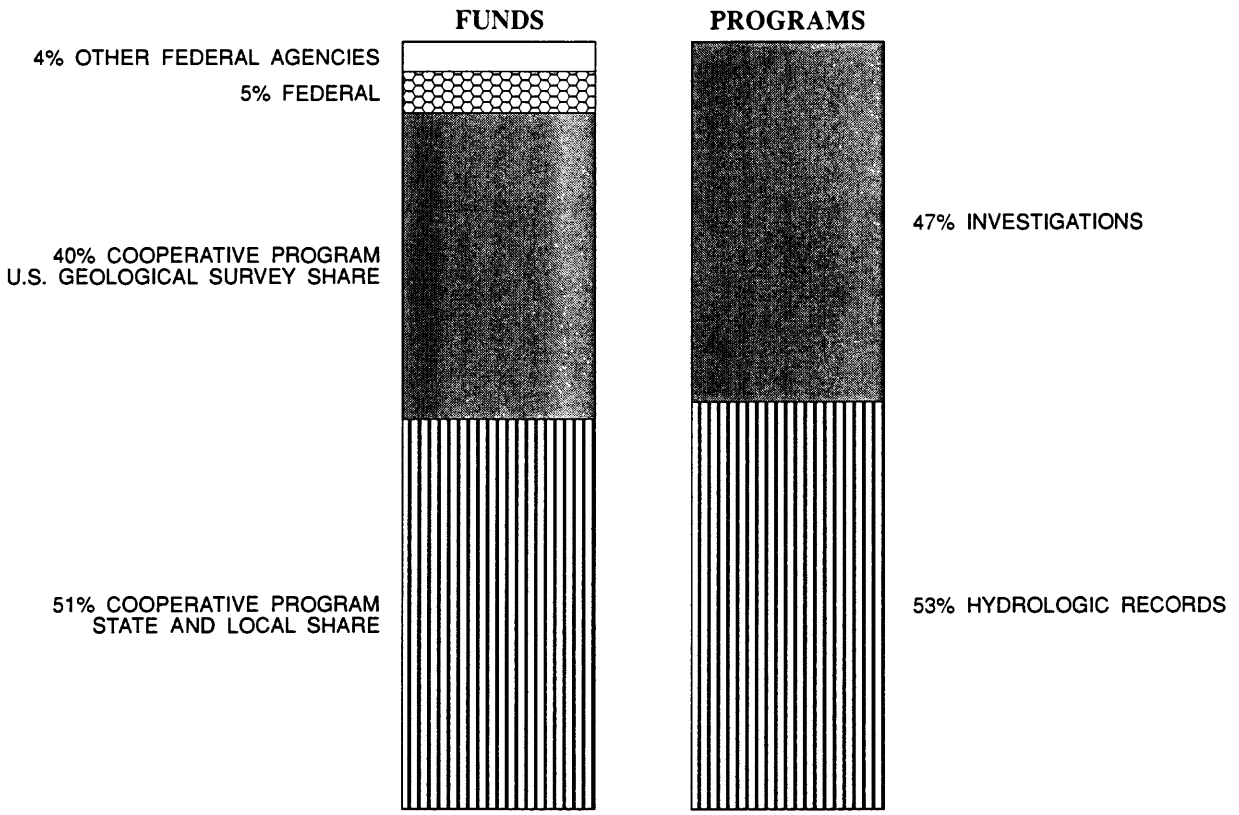
This report contains summary statements of water resources activities in Florida conducted by the Water Resources Division of the U.S. Geological Survey in cooperation with Federal, State, and local agencies during 1990. These activities are part of the Federal program of appraising the Nation's water resources. Included are brief descriptions of the nature and scope of all active studies, summaries of significant results for 1990, and anticipated accomplishments during 1991.

Florida is a water-oriented State that, 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 stormwater 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-water 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 to 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, 1990–91.

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 that 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, 1990

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. Write to the Survey District Office in Tallahassee for information regarding the availability of these publications.

Berndt, M.P., 1990, Sources and distribution of nitrate in ground water at a farmed field irrigated with sewage treatment-plant effluent, Tallahassee, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4006, 33 p.

Burtell, R.T., 1990, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, September 1989: U.S. Geological Survey Open-File Report 90-188, 1 sheet.

Chin, D.A., 1990, A method to estimate canal leakage to the Biscayne aquifer, Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4135, 32 p.

Conover, C.S., Vecchioli, John, and Foose, D.W., 1989, Ground-water sources and 1985 withdrawals in Florida: Florida Geological Survey Map Series 124, 1 sheet.

Embry, T.L., and Hoy, N.D., 1990, Bibliography of U.S. Geological Survey reports on the water resources of Florida, 1886-1989: U.S. Geological Survey Open-File Report 90-143, 196 p.

Fernandez, Mario, Jr., 1990, Surface-water hydrology and salinity of the Anclote River Estuary, Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4046, 34 p.

German, E.R., 1989, Quantity and quality of stormwater runoff recharged to the Floridan aquifer system through two drainage wells in the Orlando, Florida, area: U.S. Geological Survey Water-Supply Paper 2344, 51 p.

German, E.R., 1990, Effect of spray irrigation of treated wastewater on water quality of the surficial aquifer system, Reedy Creek Improvement District, central Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4174, 43 p.

Glenn, M.E., ed., 1990, Water resources activities in Florida, 1989-90: U.S. Geological Survey Open-File Report 90-169, 85 p.

Hammett, K.M., 1990, Land use, water use, streamflow characteristics, and water-quality characteristics of the Charlotte Harbor inflow area, Florida: U.S. Geological Survey Water-Supply Paper 2359-A, 64 p.

Henderson, S.E., and Lopez, M.A., 1989, Trend analysis of Lake Parker stage and relation to various hydrologic factors, 1950-86, Lakeland, Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4037, 19 p.

Hickey, J.J., 1990, An assessment of the flow of variable-salinity ground water in the middle confining unit of the Floridan aquifer system, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4142, 13 p.

Hofstetter, R.H., and Sonenshein, R.S., 1990, Vegetative changes in a wetland in the vicinity of a well field, Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 89-4155, 16 p.

Kimrey, J.O., 1990, Potential for ground-water development in central Volusia County: U.S. Geological Survey Water-Resources Investigations Report 90-4010, 31 p.

Knochenmus, L.A., 1990, Potentiometric surface of the Upper Floridan aquifer system, west-central Florida, September 1989: U.S. Geological Survey Open-File Report 90-133, 1 sheet.
La Rose, H.R., 1990, Geohydrologic framework and an analysis of a well-plugging program, Lee County, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4063.
Mahon, G.L., 1989, Potential for saltwater intrusion into the Upper Floridan aquifer, Hernando and Manatee Counties, Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4171, 47 p.
Marella, R.L., 1989, Freshwater withdrawals and water-use trends in Florida, 1985: Florida Geological Survey Map Series 123, 1 sheet.
Marella, R.L., 1990, Florida water-supply and use, *in* National Water Summary, 1987—Water supply and use: U.S. Geological Survey Water-Supply Paper 2350, p. 207-214.
McKenzie, D.J., 1990, Water-resource potential of the freshwater lens at Key West, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4115.
Meyer, F.W., 1989, Hydrogeology, ground-water movement, and subsurface storage in the Floridan aquifer system in southern Florida: U.S. Geological Survey Professional Paper 1403-G, 59 p.
Murray, L.C., 1990, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, May 1990: U.S. Geological Survey Open-File Report 90-557, 1 sheet.
Phelps, G.G., 1990, Geology, hydrology, and water quality of the surficial aquifer system in Volusia County, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4069.
Rutledge, A.T., 1989, A computer program for converting rectangular coordinates to latitude-longitude coordinates: U.S. Geological Survey Water-Resources Investigations Report 89-4070, 16 p.
Stoker, Y.E., Henderson, S.E., and McPherson, B.F., 1989, Hydraulic and salinity characteristics of the tidal reach of the Peace River, southwestern Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4162, 37 p.
Taylor, G.F., 1990, Quantity and quality of stormwater runoff from western Daytona Beach, Florida, and adjacent areas: U.S. Geological Survey Water-Resources Investigations Report 90-4002, 88 p.
Thompson, T.H., and Metz, P.A., 1990, Summary of hydrogeologic, water-quality, and biological data from two small basins, southeast Hillsborough County, Florida: U.S. Geological Survey Open-File Report 89-395, 34 p.
Tibbals, C.H., 1990, Hydrology of the Floridan aquifer system in east-central Florida: U.S. Geological Survey Professional Paper 1403-E, 98 p.
U.S. Geological Survey, 1989, Water resources data, Florida, water year 1989,
volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-89-1A, 440 p.
volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-89-2A, 204 p.
volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-89-3A, 306 p.
volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-89-4, 256 p.
volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-89-1B, 362 p.
volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-89-2B, 403 p.
volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-89-3B, 327 p.
volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-89-4, 256 p.
Vecchioli, John, Tibbals, C.H., Duerr, A.D., and Hutchinson, C.B., 1990, Ground-water recharge in Florida—A pilot study in Okaloosa, Pasco, and Volusia Counties: U.S. Geological Survey Water-Resources Investigations Report 90-4195.
Yobbi, D.K., and Knochenmus, L.A., 1989, Effects of river discharge and high-tide stage on salinity intrusion in the Weeki Wachee, Crystal, and Withlacoochee River Estuaries, southwest Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4116, 63 p.
Yobbi, D.K., and Knochenmus, L.A., 1989, Salinity and flow relations and effects of reduced flow in the Chassahowitzka River and Homosassa River Estuaries, southwest Florida: U.S. Geological Survey Water-Resources Investigations Report 88-4044, 38 p.

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:

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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 *(formerly Florida Bureau of Geology)* 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 U.S. 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 32611-2013 (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.

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, and M.A. O'Connell, 1988.

No. 102 MICROCOMPUTER-BASED SPREADSHEET AND CAD SYSTEM FOR INVENTORY AND ANALYSIS OF SMALL QUANTITY GENERATORS OF HAZARDOUS WASTES, by J.P. Heaney and L. Knowles, 1988.

No. 103 REGIONAL WATER SUPPLY MANAGEMENT INSTITUTIONS, By E.J. Godreau, 1988.

No. 104 HEURISTIC METHOD FOR THE DESIGN OF STORMWATER DRAINAGE SYSTEMS USING LOTUS 1-2-3, by S.W. Miles, 1988.

No. 105 EFFICIENCY/EQUITY ANALYSIS OF WATER RESOURCE PROBLEMS, by S.N. Payne, 1988.

No. 106 FIELD VALIDATION OF A DISPERSION MODEL BASED ON GEOLOGICAL PARAMETERS, by D.A. Chin, 1988.

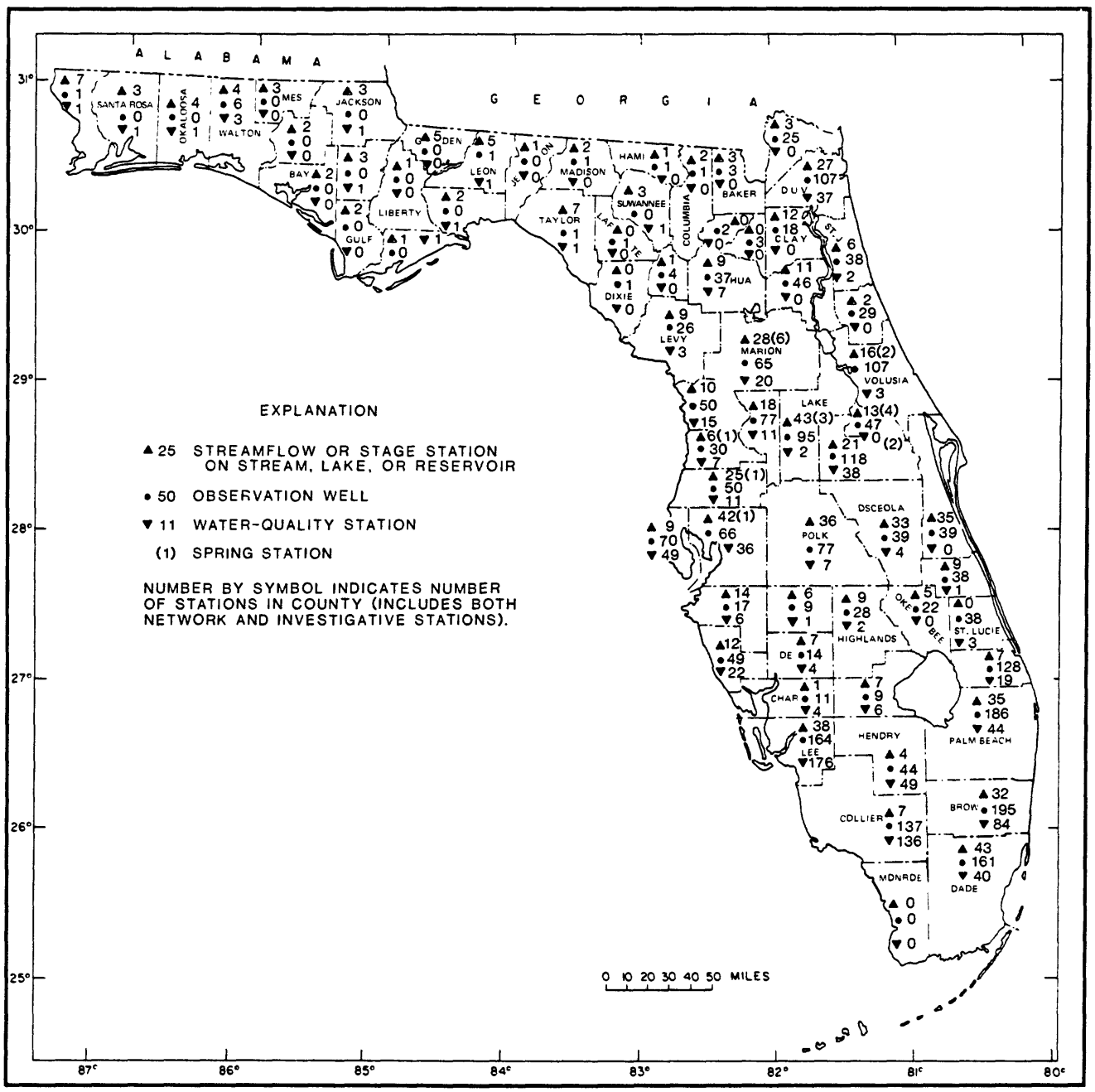
No. 107 USER'S MANUAL FOR A HEC-2 INPUT FILE PREPROCESSOR, by J.L. Fyfe and J.P. Heaney, 1989.

No. 108 WATER RESOURCES ANALYSIS OF A MULTIOBJECTIVE DRAINAGE NETWORK IN THE INDIAN RIVER LAGOON BASIN, by D.B. Bennett, 1989.

No. 109 MODEL OF POROSITY DEVELOPMENT IN A COASTAL AQUIFER SYSTEM, by A.F. Randazzo, 1989.

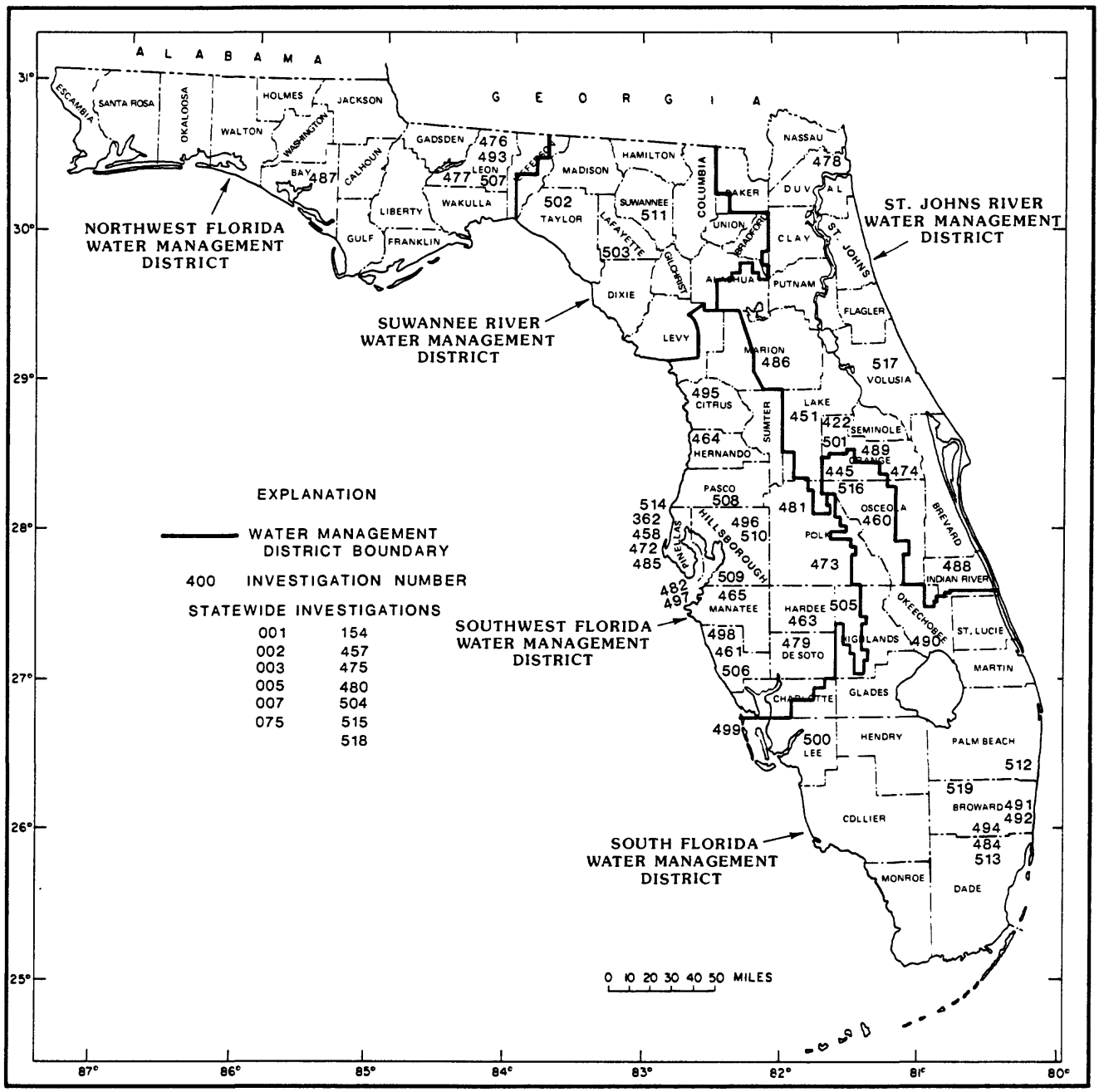
No. 110 DETERMINING SOIL-WATER SEASONAL MOVEMENT, by R.B. Brown, M.E. Collins, and G.J. Sawka, 1989.

No. 111 CONSERVATION OF WATER IN MINERAL PROCESSING OPERATION IN FLORIDA, by B.M. Moudgil, 1989.



Hydrologic data stations in Florida as of September 1990.

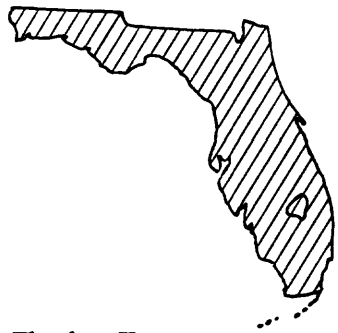
LOCATION OF AREAL INVESTIGATIONS AND THE FIVE WATER MANAGEMENT DISTRICTS



FLORIDA DISTRICT PROJECTS

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

- Number
- Title
- Period of project
- Project Chief
- Cooperating agency(ies)
- Problem
- Objective(s)
- 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; W.L. Fletcher, 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 775 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 year 1990.

STATION CLASSIFICATION	NUMBER OF STATIONS
Stream stations	535
Continuous record:	
Discharge and stage	349
Stage only	105
Partial record:	
Peak (maximum) flow	41
Periodic streamflow	40
Lake and reservoir stations	140
Stage and contents	0
Stage only:	
Continuous	70
Periodic	70

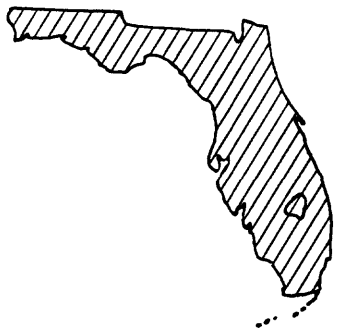
REPORTS RELEASED:

U.S. Geological Survey, 1989, Water resources data, Florida, water year 1989, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-89-1A, 440 p.

– – – 1989, Water resources data, Florida, water year 1989, volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-89-2A, 204 p.

– – – 1989, Water resources data, Florida, water year 1989, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-89-3A, 306 p.

– – – 1989, Water resources data, Florida, water year 1989, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-89-4, 256 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; W.L. Fletcher, 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 1,229 periodic observation sites and 441 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 1990.

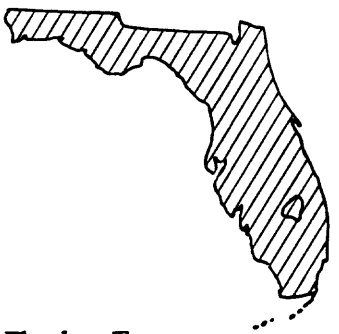
REPORTS RELEASED:

U.S. Geological Survey, 1989, Water resources data, Florida, water year 1989, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-89-1B, 362 p.

———1989, Water resources data, Florida, water year 1989, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-89-2B, 403 p.

———1989, Water resources data, Florida, water year 1989, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-89-3B, 327 p.

———1989, Water resources data, Florida, water year 1989, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-89-4, 256 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; W.L. Fletcher, 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 139 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.

DATA CLASSIFICATION	NUMBER OF SURFACE-WATER SITES
Physical data:	
Temperature, specific conductance, or pH	145
Sediment	24
Chemical data:	
Inorganic constituents	111
Organic constituents	64
Pesticides	29
Radiochemical data	5
Biological data	14

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 WELLS	NUMBER OF SPRINGS
Physical data:		
Temperature, specific conductance, or pH	799	15
Chemical data:		
Inorganic constituents	117	14
Organic constituents	12	3
Biological data	7	0

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

REPORTS IN PROCESS:

Water-resources data for Florida, water year 1990.

REPORTS RELEASED:

U.S. Geological Survey, 1989, Water resources data, Florida, water year 1989, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-89-1A, 440 p.

———1989, Water resources data, Florida, water year 1989, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-89-1B, 362 p.

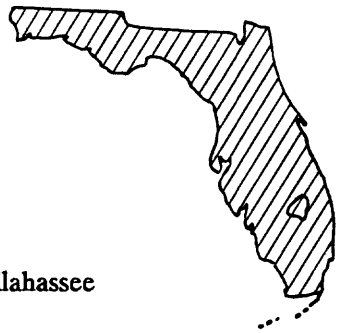
———1989, Water resources data, Florida, water year 1989, volume 2A, south Florida surface water: U.S. Geological Survey Water-Data FL-89-2A, 204 p.

———1989, Water resources data, Florida, water year 1989, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-89-2B, 403 p.

———1989, Water resources data, Florida, water year 1989, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-89-3A, 306 p.

———1989, Water resources data, Florida, water year 1989, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-89-3B, 327 p.

———1989, Water resources data, Florida, water year 1989, volume 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-89-4, 256 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.

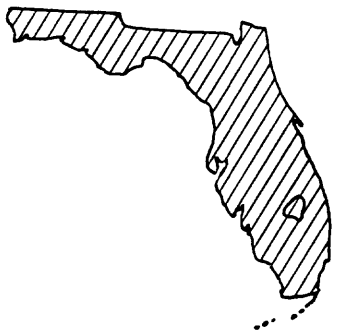
OBJECTIVE: The National Atmospheric Deposition Program (NADP) was created to conduct research on atmospheric deposition and its effect on surface waters and agricultural and forest lands in cooperation with Federal, State, and private research agencies. The U.S. Geological Survey (USGS) is participating 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 are collected at a NADP/NTN approved site at Verna well field 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 nonstandard events. All samples are shipped to NADP Central Analytical Laboratory (CAL) which is operated by the Illinois State Water Survey.

PROGRESS: Weekly precipitation samples were collected from an NTN site and from a collocated site at the Verna well field site near Sarasota, Fla., according to NRN/NADP protocol. The collocated site was operated for the 1990 fiscal year for a study by the USGS Branch of Quality Assurance (BQA).

PLANS FOR THIS YEAR: Operation of the collocated site ends FY 90, and equipment will be shipped back to BQA. The NTN site will be maintained and operated according to NADP/NTN standards and schedules.

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 L. Marella, 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
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 publication 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; (3) collation, interpretation, and publication of statewide data at 5-year intervals starting in 1990; and (4) undertaking special projects to improve accuracy and utility of water-use information.

APPROACH: The water-use program will compile data for 6 major categories of water use for all 67 counties and 5 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 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: Public-supply data for Florida was collected for 1987. These data were compiled by county, water source, and water management district and published in an open-file report. Currently, 1989 public-supply water-use data are being collected and compiled in the same manner as the 1987 data. Additionally, future public-supply water use was projected for each county. Projections were made for the years 2000, 2010, and 2020, and are included in a report that details factors that affect public-supply demands in Florida. This report is in review.

Water-use data for Florida was last collected for all five categories (public-supply, domestic self-supplied, commercial- industrial self-supplied, agricultural irrigation, and thermoelectric power generation) in 1985. These data were published in three reports: U.S. Geological Survey Water-Resources Investigations Report 88-4103, Florida Geological Survey Map Series 123, and U.S. Geological Survey Water-Supply Paper 2350. Additionally, water-use tables presenting 1985 data were published in the 1987 edition of the Florida Statistical Abstract. The 1985 data were also published by three water management districts (Northwest Florida Water Management District, St. Johns River Water Management District, and Southwest Florida Water Management District) in their individual reports. The 1985 data for Florida were provided to the National Water-Use Information Program and used in the compilation of the National Water-Use Report (U.S. Geological Survey Circular 1004). Currently, plans are underway to collect and compile data for all five categories again for 1990. Each water management district has been contacted and visited in 1990 to outline data sources and timeframes.

PLANS FOR THIS YEAR: Work will begin on the 1990 statewide data collection and compilation efforts. Data collection will begin sometime in December 1990, and conclude about June 1991; however, the tabulation of the data will continue into October 1991. Most of the data will be collected by the five water management districts, however, the USGS will be assisting each water management district in either locating data sources, data collection, or compilation. Data will be compiled for the following categories: public-supply, domestic self-supplied, commercial-industrial self-supplied, agricultural irrigation, and thermoelectric power generation; and will be reported by county, hydrologic unit, water source, and water management district. Additionally, wastewater returns will be reported along with the amount of water reuse. Water treated through reverse osmosis will again be inventoried for 1990.

REPORTS IN PROCESS:

Marella, R.L., in review, Factors that affect public-supply water demand and projected public-supply water use in Florida: U.S. Geological Survey Water-Resources Investigations Report.

Marella, R.L., in press, Public-supply water use in Florida, 1987: U.S. Geological Survey Open-File Report.

REPORTS RELEASED:

Pride, R.W., 1973, Estimated use of water in Florida, 1970: Florida Bureau of Geology Information Circular 83, 31 p.

Healy, H.G., 1977, Public water supplies of selected municipalities in Florida, 1975: U.S. Geological Survey Water-Resources Investigations 77-53 (PB-271 691/AS), 309 p.

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

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

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

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

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

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.

Duerr, A.D., and Trommer, J.T., 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.

Duerr, A.D., and Trommer, J.T., 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.

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

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.

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

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

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

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

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

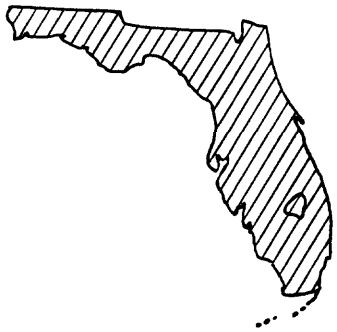
Marella, R.L., 1988, Water withdrawals, use and trends in Florida, 1985: U.S. Geological Survey Water-Resources Investigations Report 88-4103, 43 p.

Solley, W.B., Merk, C.F., and Pierce, R.R., 1988, Estimated use of water in the United States in 1985: U.S. Geological Survey Circular 1004, 82 p.

Marella, R.L., 1989, Freshwater withdrawals, water-use trend in Florida, 1985: Florida Geological Survey Map Series 123, 1 sheet.

Conover, C.S., Vecchioli, John, and Foose, D.W., 1989, Ground-water sources and 1985 withdrawals in Florida: Florida Geological Survey Map Series 124, 1 sheet.

Marella, R.L., 1990, Florida water supply and use, *in* National Water Summary 1987: U.S. Geological Survey Water-Supply Paper 2350, p. 207-214



FL-012 FLOOD ASSESSMENT

DATE PROJECT BEGAN: July 1964

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: Marvin Franklin, Tallahassee

COOPERATING AGENCY: Florida Department of Transportation

PROBLEM: Local and State governments, highway designers, planners, and zoning commissions have a responsibility to avoid uneconomic, hazardous, or incompatible use and development of the State's flood plains. Prime requisites to meet these criteria are a knowledge of the floodflow characteristics of streams and the ability to make reliable estimates of the flood magnitude and frequency.

OBJECTIVE: To assess the hydraulic and hydrologic characteristics of Florida streams. To collect floodflow data and analyze hydraulic problems for selected stream reaches as well as for hydrologic regions. To document and prepare reports for extreme flood events.

APPROACH: Update and maintain the computer files for basin characteristics and peak flow for use in regional flood-frequency analysis. Respond by letter reports to specific requests for hydraulic and hydrologic information for selected stream reaches. Assess extreme flood events, including indirect flood measurements, analysis, and preparation of reports to disseminate the flood information.

PROGRESS: The computerized peak flow and basin characteristics are being edited and updated to include data through the 1990 water year. First trial flood frequencies are being performed to determine outliers in the data base. Preliminary sizing of drainage areas for regionalization of flood frequencies is complete.

PLANS: Complete updating the peak flow and basin characteristics files. Perform final station flood frequencies and regression equations. Prepare draft report.

REPORTS RELEASED:

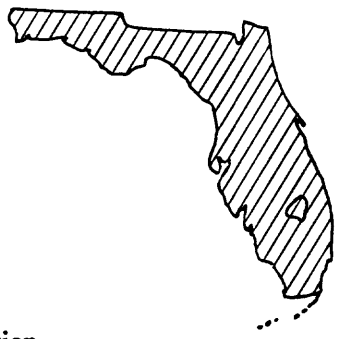
Bridges, W.C., 1972, Effects of Port Orange Bridge-causeway on flow of Halifax River, Volusia County, Florida: U.S. Geological Survey Open-File Report FL-72005, 19 p.

– – – 1974, An analysis of 1972-73 floods on Monroe Street and St. Augustine Branch, Tallahassee, Florida: U.S. Geological Survey Open-File Report FL-74023, 14 p.

– – – 1982, Technique for estimating magnitude and frequency of floods on natural-flow streams in Florida: U.S. Geological Survey Water-Resources Investigations Report 85-4057, 19 p.

– – – 1985, Analysis of water-level fluctuations of the U.S. Highway 90 retention pond, Madison, Florida: U.S. Geological Survey Water-Resources Investigations Report 85-4057, 19 p.

Bridges, W.C., and Davis, D.R., 1972, Floods of September 20-23, 1969, in the Gadsden County area, Florida: Florida Bureau of Geology Information Circular 79, 37 p.



FL-075 FLORIDA WATER ATLAS

DATE PROJECT BEGAN: September 1961

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: Michael P. Planert, 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, hydrologists, and others to provide readily available hydrogeologic information for decision making.

APPROACH: A total of 87 atlas series maps have been published to date. The water atlas program presently consists of statewide map reports prepared using available information and knowledge from other studies. Many of these maps have been published by the Florida Geological Survey. Although money is no longer available for this program, some atlas type maps are still produced as parts of other projects.

The second part of the atlas program is the production of aquifer recharge maps. These will be produced using RASA modeling studies as well as existing soils, runoff, rainfall, potential evaporation, and topographic maps, and information on the base flow of streams.

The third part of the atlas program is a statewide series of maps of interest to planners and water managers that will depict factors that are of interest in locating potential sites for future public water supplies. These factors include recharge, which is already being mapped, aquifer transmissivity/well yields, water quality, and future water demand. The general approach will be to compile map reports for these factors for the Floridan aquifer system first, using existing data. Maps for the other aquifers will be completed later. Some of the maps for the other aquifers will require more than compilation of existing data.

PROGRESS: One report was approved for publication and another was begun during the past year. "Transmissivity of the Floridan aquifer," is in press. Work began on compiling the 1990 statewide potentiometric map for the Floridan aquifer system. Continued progress was made evaluating base-flow characteristics of streams that will be useful in upcoming "Bluebelt" amendment-related recharge determinations.

PLANS FOR THIS YEAR: Work will continue on all of the above listed report projects.

REPORTS RELEASED:

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

Healy, H.G., 1962, Piezometric surface and areas of artesian flow of the Floridan aquifer in Florida, July 6-17, 1961 (2d ed.): Florida Geological Survey Map Series 4.

Hoy, N.D., and Teel, J.R., 1963, Hydrologic features of the Floridan aquifer in Seminole County, Florida: Florida Division of Geology Map Series 5.

Hoy, N.D., 1964, Generalized water-table contours in southern Florida: Florida Division of Geology Map Series 7.

Shattles, D.E., 1965, Quality of water from the Floridan aquifer in Hillsborough County, Florida, 1963: Florida Division of Geology Map Series 9.

Toler, L.G., and Shampine, W.J., 1965, Quality of water from the Floridan aquifer in the Econfina Creek basin area, Florida, 1962: Florida Division of Geology Map Series 10.

Toler, L.G., 1965, Fluoride content of water from the Floridan aquifer of northwest Florida, 1963: Florida Division of Geology Map Series 11.

Shampine, W.J., 1965, Chloride concentration in water from the upper part of the Floridan aquifer in Florida (revised 1975): Florida Bureau of Geology Map Series 12.

Shampine, W.J., 1965, Hardness of water from the upper part of the Floridan aquifer in Florida (revised 1975): 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 (revised 1975): Florida Bureau of Geology Map Series 14.

Shampine W.J., 1965, Sulfate concentration in water from the upper part of the Floridan aquifer in Florida (revised 1975): Florida Bureau of Geology Map Series 15.

Hyde, L.W., 1965, Principal aquifers in Florida (revised 1975): Florida Bureau of Geology Map Series 16.

Shampine, W.J., 1965, Quality of water from the Floridan aquifer in Brevard County, Florida, 1963: Florida Division of Geology Map Series 17.

Cherry, R.N., 1966, Chloride content of ground water in Pinellas County, Florida, 1950 and 1963: Florida Division of Geology Map Series 20.

Lichtler, W.F., and Joyner, B.F., 1966, Availability of ground water in Orange County, Florida: Florida Division of Geology Map Series 21.

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

Toler, L.G., 1966, Fluoride content from water in the Floridan aquifer in northwestern Florida: Florida Division of Geology Map Series 23.

Anderson, Warren, and Joyner, B.F., 1966, Availability and quality of surface water in Orange County, Florida: Florida Division of Geology Map Series 24.

MacKichan, K.A., 1967, Temperature and chemical characteristics of the St. Johns River near Cocoa, Florida: Florida Division of Geology Map Series 25.

Barraclough, J.T., 1967, Ground-water features in Escambia and Santa Rosa Counties, Florida: Florida Division of Geology Map Series 26.

Kaufman, M.I., and Dion, N.P., 1967, Chemical character of water in the Floridan aquifer in southern Peace River basin, Florida: Florida Division of Geology Map Series 27.

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

McCoy, H.J., and Sherwood, C.B., 1968, Water in Broward County, Florida: Florida Division of Geology Map Series 29.

Knochenmus, D.D., 1968, Surface drainage characteristics in Volusia County, Florida: Florida Division of Geology Map Series 30.

Kenner, W.E., 1969, Seasonal variation of streamflow in Florida (revised 1975): Florida Bureau of Geology Map Series 31.

Visher, F.N., and Hughes, G.H., 1969, The difference between rainfall and potential evaporation in Florida (revised 1975): Florida Bureau of Geology Map Series 32.

Kaufman, M.I., 1969, Generalized distribution and concentration of orthophosphate in Florida streams (revised 1975): Florida Bureau of Geology Map Series 33.

Kenner, W.E., Hampton, E.R., and Conover, C.S., 1969, Average flow of major streams in Florida (revised 1975): Florida Bureau of Geology Map Series 34.

Kaufman, M.I., 1969, Color of water in Florida streams and canals (revised 1975): Florida Bureau of Geology Map Series 35.

Pride, R.W., 1970, Estimated water use in Florida, 1965 (revised 1975): Florida Bureau of Geology Map Series 36.

Kaufman, M.I., 1970, The pH of water in Florida streams and canals (revised 1975): Florida Bureau of Geology Map Series 37.

Hughes, G.H., 1970, Hydrologic setting of Deer Point Lake near Panama City, Florida: Florida Bureau of Geology Map Series 38.

Stewart, J.W., and Hanan, R.V., 1970, Hydrologic factors affecting the utilization of land for sanitary landfills in northern Hillsborough County, Florida: Florida Bureau of Geology Map Series 39.

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

Klein, Howard, 1971, Depth to base of potable water in the Floridan aquifer (revised 1975): Florida Bureau of Geology Map Series 42.

Anderson, Warren, 1971, Temperature of Florida streams (revised 1975): Florida Bureau of Geology Map Series 43.

Knochenmus, D.D., 1971, Ground water in Lake County, Florida: Florida Bureau of Geology Map Series 44.

Freiberger, H.J., 1972, Streamflow variation and distribution in the Big Cypress watershed during wet and dry periods: Florida Bureau of Geology Map Series 45.

Foster, J.B., 1972, Guide to users of ground water in Bay County, Florida: Florida Bureau of Geology Map Series 46.

Reichenbaugh, R.C., 1972, Sea-water intrusion in the upper part of the Floridan aquifer in coastal Pasco County, Florida, 1969: Florida Bureau of Geology Map Series 47.

Reichenbaugh, R.C., and Hunn, J.D., 1972, A hydrologic description of Lake Thonotosassa near Tampa, Florida: Florida Bureau of Geology Map Series 48.

Hunn, J.D., and Reichenbaugh, R.C., 1972, A hydrologic description of Lake Magdalene near Tampa, Florida: Florida Bureau of Geology Map Series 49.

Kaufman, M.I., 1972, The chemical type of water in Florida streams (revised 1975): Florida Bureau of Geology Map Series 51.

Klein, Howard, 1972, The shallow aquifer of southwest Florida: Florida Bureau of Geology Map Series 53.

Bush, P.W., 1972, A hydrologic description of Lake Minnehaha at Clermont, Florida: Florida Bureau of Geology Map Series 54.

Anderson, Warren, and Faulkner, G.L., Quantity and quality of surface water in Marion County, Florida: Florida Bureau of Geology Map Series 55.

Slack, L.J., and Kaufman, M.I., 1973, Specific conductance of water in Florida streams and canals (revised 1975): Florida Bureau of Geology Map Series 58.

Rodis, H.G., 1973, Encroaching salt water in northeast Palm Beach County, Florida: Florida Bureau of Geology Map Series 59.

Hunn, J.D., 1974, Hydrology of Lake Tarpon near Tarpon Springs, Florida: Florida Bureau of Geology Map Series 60.

Coble, R.W., 1973, The Anclote and Pithlachascotee Rivers as water-supply sources: Florida Bureau of Geology Map Series 61.

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., 1974, An index to springs of Florida (revised 1975): 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., Surface water features of Florida: Florida Bureau of Geology Map Series 66.

Robertson, A.F., and Mills, L.R., 1974, Ground-water withdrawals in the upper Peace and upper Alafia River basins, Florida: Florida Bureau of Geology Map Series 67.

Tibbals, C.H., 1975, Recharge areas of the Floridan aquifer in Seminole County and vicinity, Florida: Florida Bureau of Geology Map Series 68.

Bush, P.W., 1974, Hydrology of the Oklawaha lakes area of Florida: Florida Bureau of Geology Map Series 69.

Pascale, C.A., 1975, Estimated yield of fresh-water 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., and Leve, G.W., 1976, Thickness of the potable-water zone in the Floridan aquifer: Florida Bureau of Geology Map Series 74.

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

U.S. Geological Survey, 1978, Satellite image mosaic NASA ERTS-1 Imagery—1973.

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, 1 sheet.

Hull, R.W., and 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.

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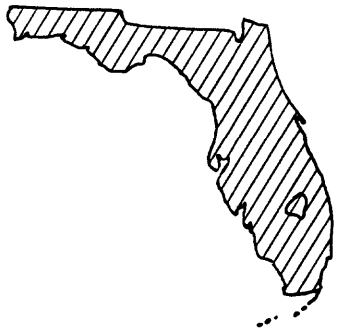

FL-154 SUBSURFACE WASTE STORAGE, FLORIDA

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 through liaison with regulatory agencies, consultants, companies, the Florida Geological Survey and WRD research personnel.

PROGRESS: A Water-Resources Investigations Report was published. Three abstracts for talks at national meetings were published. Two reports are in the review process.

PLANS FOR THIS YEAR: Continue work on factors that influence circular convection, on approaches to the field study of variable-density ground-water flow, and on the identification and characterization of secondary porosity in the carbonate rocks of the Floridan aquifer system.

REPORTS IN PROCESS:

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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: William M. Woodham, 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, coliform, and biochemical oxygen demand (BOD) 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 inflow and outflow of detention basin no. 3 on St. Joe Creek at Pinellas Park. Samples of storm runoff water quality were collected and analyzed for chloride, copper, chromium, lead, zinc, mercury, total solids, and nutrients. Samples of base flow were collected and analyzed quarterly for these same constituents.

PLANS FOR THIS YEAR: Continue the collection of daily discharge and rainfall data at the inflow and outflow of Detention Basin No. 3 through June 30, 1991. Quarterly base flow and storm runoff water-quality samples for four storms will be collected and analyzed at both inflow and outflow stations. Constituent loads of chloride, copper, chromium, lead, zinc, nitrogen, phosporus, biochemical oxygen demand, and total solids will be computed for each storm. Report preparation will begin in the last quarter of FY 91.

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 effect 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: A final report describing findings of the investigation was prepared. The report, "Effects of land use on ground-water quality in central Florida—final results: U.S. Geological Survey Toxic Waste—Ground-Water Contamination Program" is in review.

REPORTS RELEASED:

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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 (RCID)

PROBLEM: Phosphorus concentrations in Reedy Creek which receives treated-sewage discharges are relatively high downstream from Walt Disney World. Dissolved oxygen (DO) 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 include 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 three reaeration coefficient-time of travel measurements have been completed.

REPORTS RELEASED:

Two papers, "Input and output of dissolved solids, nitrogen, and phosphorus to an underdeveloped wetland area, central Florida," by E.R. German, and "Dissolved oxygen concentrations in a central Florida wetlands stream," by P.S. Hampson, were published in the proceedings of the AWRA symposium on wetlands, September 1989, in Tampa. Final report is in preparation.

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

DATE PROJECT BEGAN: May 1986

DATE PROJECT ENDS: September 1991

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.

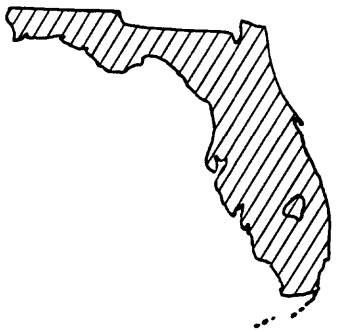
APPROACH: The geographic scope of the study will be the uppermost lakes of the upper Oklawaha basin, with the main emphasis on the northern outlet of Lake Apopka and the Apopka-Beauclair Canal. Data were collected for 2 years; during the second year, a constriction was built in the canal one-half mile downstream from Lake Apopka to facilitate discharge monitoring, 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 biweekly sampling will be carried out, supplemented by additional sampling after storm events. 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. Discharge measurements were made at the constriction site to check rating on a monthly basis. Water quality and bed sediment samples were collected for sites between Lake Apopka and Lake Beauclair during the rainy season.

PLANS FOR THIS YEAR: Routine collection of water-quality data ended September 1990. Discharge was monitored at the upstream (constriction) site through December 1990. Data collected for the investigation will be analyzed and an interpretive report will be written this year.



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: Low-flow frequency data were determined for approximately 190 daily-record stations and 200 of 600 partial-record stations in northeastern and central Florida (St. Johns River Water Management District and Southwest Florida Water Management District). Low-flow data were collected during extreme low-water period in August and September. Low-flow measurements were made at approximately 50 sites in north-central and northeastern Florida. A report for presenting low-flow characteristics of streams is being prepared.

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

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: John T. Trommer, 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. DC-resistivity surveys in Levy, Citrus, and Pinellas Counties, and the final test to determine validity of various sampling techniques has been completed.

The first draft, including illustrations, of the report entitled, "Description of the saltwater-freshwater transition zone in aquifers along the west-central coast of Florida is 50 percent complete.

PLANS FOR THIS YEAR: Manuscript will be completed and submitted for review, approval, and publication.

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

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1990

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) Run geophysical logs 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: Data collection completed. Report completed and in review.

PLANS FOR THIS YEAR: Obtain approval of report. Publish and distribute report.

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

DATE PROJECT BEGAN: October 1986

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: William A. Bidlake, Tampa

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

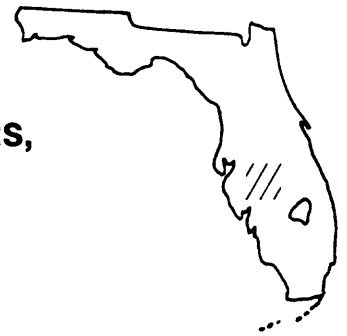
PROBLEM: Water availability is becoming a critical issue even in humid, subtropical climates. By understanding and quantifying the components of the water budget in such areas, unique solutions may be developed to manage water resources. Although evapotranspiration is by far the major component of the 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 (RMR) 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, such as 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: Short-term Bowen ratio and eddy correlation measurements were completed in June. Bowen ratio and eddy correlation data have been analyzed to produce estimates of daily ET for palmetto prairie, wetland, pine flatwood, and cypress head sites.

PLANS FOR THIS YEAR: Analysis of ET data will be completed and the report will be prepared.



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 effects 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 ROMP 17 aquifer test analysis received approval. It was decided that because of probable internal circulation in the borehole of the pumping and observation well at ROMP site 31, and because of the heterogeneous nature of the layered carbonate-clastic formation, a second test at ROMP site 31 would yield inconclusive results. The project report received approval and camera-ready preparation began.

PLANS FOR THIS YEAR: The project report will be published and distributed.

REPORTS IN PROCESS:

Duerr, A.D., and Enos, G.M., in press, Hydrology and water quality of the Intermediate and Upper Floridan aquifers, Hardee and De Soto Counties, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4104.

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 in 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: Report was revised in response to Subdistrict review and submitted for District review.

PLANS FOR THIS YEAR: The project report will be reviewed and submitted for Director's approval.

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 (SWFWMD)

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 to contamination based on available hydrogeologic information and prepare a preliminary map of contamination potential. Field test geochemical ground-water age dating methods, such as tritium, deuterium, oxygen-18, partial pressure of CO_2, redox potential, saturation indices and the presence of compounds such as EDB, 2,4-D, 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 contamination potential map will be updated and an interpretive report will be written.

PROGRESS: A report "Potential for contamination of the Upper Floridan aquifer, west-central Florida," was completed and submitted to outside reviews on May 1, 1990. Potential for contamination was classified and mapped using concentrations of tritium and dissolved oxygen in water from 112 wells that tap the upper part of the Upper Floridan aquifer. Degree of confinement was also a major consideration. A data release was prepared for the cooperator that listed water-quality analyses for all sites sampled as part of the project.

PLANS FOR THIS YEAR: During FY 91, the final report will be processed for publication.

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 ground-water 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 hydrologic 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, insecticides, volatile organic compounds, and priority pollutants; Flame Ionization Detection, gas chromatography, and standard lab analyses will be used.

PROGRESS: Manuscript was completed and submitted for review.

PLANS FOR THIS YEAR: Manuscript will be submitted for approval and publication.

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: Continued collection and processing of rainfall, streamflow, and ground-water data in the monitoring network. Determined datum of remote monitoring network with Global Positioning System satellite technology. Began final report preparation and completed annual report to cooperator.

PLANS FOR THIS YEAR: Termination of data-collection network. Analysis of rainfall, streamflow, and ground-water data. Evaluate water-quality sampling data. Deliver annual progress report to cooperator. Transfer unit-value data readings from network to cooperator for model calibration. Complete report writing phase of the project and begin review process.

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

DATE PROJECT BEGAN: January 1987

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: W. Scott Gain, Orlando

COOPERATING AGENCY: Florida Department of Transportation

PROBLEM: The velocity of water entering a detention pond is dramatically decreased immediately inside the pond. If the traveltime of the water within the pond is significantly lengthened, then an increased particulate load should settle to the bottom of the detention pond. Existing detention ponds may be modified to lengthen the flow path of water by placing a wall in the middle of the pond. This structural change could increase the water-quality treatment ability of this detention facility.

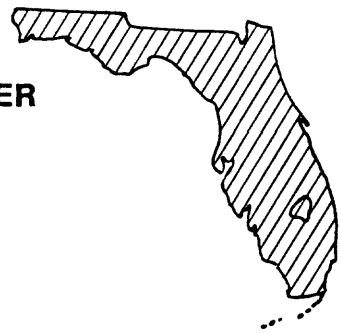
OBJECTIVE: The primary objective of this investigation is to determine the effectiveness of selected structural changes to detention facilities for improving water-quality treatment. Secondary objectives are to: determine and analyze the increased residence time, or detention time, due to the structural 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. Separate tracer studies will be run at three different steady-state discharges. Analyses of these data will be used to calculate the pond's hydraulic residence time(s) as a function of live storage or discharge.

After the structural changes to the pond are made, about 15 to 30 storms will be gaged and sampled at the inlet and outlet of the pond and the outlet of the wetland downstream. Hydraulic analyses of the restructured pond, analogous to the studies completed in the first task, and other evaluations of hydraulic response will be made.

PROGRESS: About 20 storms have been sampled since pond restructuring, and a series of thermocouples has been installed and monitored to describe hydraulic properties of the system. A series of samples was collected from the pond following one storm to determine changes in pond quality between storms. A final report of results is in preparation.

PLANS FOR NEXT YEAR: Dye studies for poststructural changes will be run early next year, and a final report will be completed.



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

DATE PROJECT BEGAN: March 1987

DATE PROJECT ENDS: March 1990

PRINCIPAL INVESTIGATOR: Brian G. Katz, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: A greatly increased level of interest in national and regional 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 the influence of key factors affecting the occurrence of EDB in ground water at local and regional scales.

APPROACH: The EDB data base will be evaluated using statistical and spatial (GIS) techniques to determine the areal, vertical and temporal distribution of EDB in ground water. Mass balance geochemical modeling and statistical modeling will be used to assess the influence of factors related to the distribution of EDB. Results from local- and regional-scale analyses will be compared to assess implications for designing monitoring networks.

PROGRESS: Statistical analyses, including ordinary least squares regression, Logit regression, Kendall's Tau, and nonparametric rank correlation have been performed on a large data base containing information on EDB concentrations in ground water, climate characteristics, soil characteristics, EDB application information, and hydrologic characteristics of the surficial, intermediate, and Floridan aquifer systems.

Mass-balance modeling was used in local ground-water flow systems to quantify biogeochemical processes controlling the movement and fate of EDB in the subsurface. Chemical and microbial degradation reactions accounted for the largest percentage loss of EDB applied. Project is complete except for the report.

PLANS FOR THIS YEAR: Complete final report with Director's approval expected by June 1991.

REPORTS RELEASED:

Katz, B.G., and Choquette, A.F., 1988, An interim assessment of regional and local factors affecting the occurrence, movement, and fate of 1,2-dibromoethane in the subsurface, central Florida, *in* Mallard, G.E., and Ragone, S.E., eds., U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings, Phoenix, Arizona, September 26-30, 1988: U.S. Geological Survey Water-Resources Investigations Report 88-4220, p. 637. (abstract)

Choquette, A.F., and Katz, B.G., 1989, Grid-based groundwater sampling: lessons from an extensive regional network for 1,2-dibromoethane (EDB) in Florida: Stephen Ragone, ed., International Association of Hydrological Science, Proceedings, IAHS Publication No. 182, p. 79-86.

Katz, B.G., in press, Persistence of a soil fumigant (1,2-dibromoethane) in ground water, Florida: A mass-balance approach: Proceedings of the First USA/USSR Joint Conference on Environmental Hydrology and Hydrogeology, Leningrad, USSR.

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

DATE PROJECT BEGAN: July 1987

DATE PROJECT ENDS: September 1990

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 were 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 required data collection and analyses by an interdisciplinary interagency team comprised of hydrologists, botanists, and fisheries biologists. USGS quantified hydrologic fluctuations and characterized plant communities, and sampled fish in cooperation with fishery biologists from the Florida Game and Fresh Water Fish Commission.

PROGRESS: Data collection, data analysis, and report completed.

PLANS FOR THIS YEAR: Publish and distribute report.

REPORTS IN PROCESS:

Leitman, H.M., in press, Fishes in the forested flood plain of the Ochlockonee River, Florida, during flood and drought conditions: U.S. Geological Survey Water-Resources Investigations Report 90-4202.

FL-477 AN EVALUATION OF VARIOUS PHYSICAL AND BIOLOGICAL INDICATORS USED TO DELINEATE WETLAND BOUNDARIES ON RIVER FLOOD PLAINS IN NORTH FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

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. Additional data are needed to manage and regulate stream wetlands and to evaluate the various techniques used by FDER to delineate wetland boundaries.

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

APPROACH: The 4-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: Data-collection phase is nearing completion. Data analysis is underway.

PLANS FOR THIS YEAR: Complete data collection and analysis and prepare two reports. The first report will describe the relation of hydrologic conditions to soils and vegetation. The second report will describe the hydrologic conditions associated with swollen bases of trees, cypress knees, moss lines, and other indicators of flooding in forested wetlands.

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

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1991

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, (b) borehole geophysical logging to determine flow zones and water-quality changes with depth, (c) marine seismic reflection surveys, and (d) maps showing the thickness and lateral extent of various hydrogeologic units.

PROGRESS: The planning document and report outline were prepared. A literature search was conducted to locate all pertinent material. Geophysical logging of eight wells has been completed. Marine seismic reflection surveys were completed on a 25-mile section of the St. Johns River in Duval County. The purpose of the survey was to locate geologic structures, such as solution features or faults, that might be present under the river. Several large paleosinkholes were discovered. Time domain electromagnetic soundings (TDEM) were performed at five sites in Duval and St. Johns County. The objective of the surveys was to locate the saltwater-freshwater interface. Water samples from about 120 wells were analyzed for major chemical constituents. Water from 100 additional wells was analyzed for chloride, sulfate, specific conductance, and temperature. Several sections of the draft report have been written.

PLANS FOR THIS YEAR: Continue to process and analyze data. Work will begin on the final 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 effect will the irrigation of their groves have on the hydrology? What are the long-term effects of citrus irrigation on the hydrology of this area?

OBJECTIVES: (1) Evaluate the present and long- term effects 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 effects of future citrus expansion.

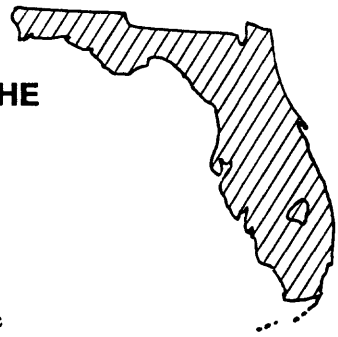
APPROACH: Existing continuous and periodic water-level data from the two-county area will be examined. The nonparametric Seasonal Kendall test will be used to test for monotonic trends in ground-water levels. Tests will be made for the period of record, period prior to 1981, and period after 1981. The 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.

Model simulations, using the McDonald-Harbaugh Finite- Difference model will be used to determine the effects of increased irrigation on the ground-water resources. The model will be calibrated and verified under steady-state and transient conditions. The ground-water model will be developed to simulate historical and current water-level conditions. Future changes in water levels will be simulated using projected trends in pumpage data. 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 and to display the model output. Existing RASA models will be used as the starting point for model calibration.

PROGRESS: The nonparametric Seasonal Kendall test was used to identify monotonic trends in ground-water levels. The test was run for the period of record prior to 1981 and the period after 1981. The nonparametric Mann-Whitney-Wilcoxon test was used to identify step trends in water levels for the pre- and post-1981 periods. Monthly precipitation totals for Arcadia, Fla., were tested for precipitation trends that possibly masked trends in ground-water levels.

The steady-state model was calibrated and verified, and calibration of the transient ground-water model was completed.

PLANS FOR THIS YEAR: Final report will be reviewed and submitted for publication.



FL-480 CHARACTERIZATION OF WATER QUALITY FOR THE MAJOR AQUIFER SYSTEMS IN FLORIDA

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

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 effects required information on background (baseline) 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: Geochemical and statistical analyses have been performed on baseline water-quality data for the major aquifer systems in Florida. A report on the aqueous geochemistry of the sand-and-gravel aquifer has been approved by the Director for publication in an upcoming issue of the Journal of Ground Water. A report on the major-ion and trace-metal chemistry of the Biscayne aquifer has been written and has been reviewed by colleagues and is currently in headquarters. A report on the hydrochemistry of the Floridan aquifer system is currently being reviewed by colleagues. Two other reports that have been written and are in the precolleague review stage include the geochemistry of the surficial and intermediate aquifer systems and a geostatistical analysis of the design of the statewide monitoring network.

PLANS FOR THIS YEAR: Complete final reports with Director's approval expected by May 1991.

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 circumneutral Lake Lucerne in Polk County, Florida. The hydrologic budget of each lake will include evaporation losses quantified by the energy budget 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: Hydrologic and chemical data were collected on schedule over the past year at Lake Lucerne and Lake Barco. At Lake Barco, deficit rainfall has resulted in a 6-foot drop in lake stage and a 3- to 6-foot drop in ground-water levels. Climatic data for calculation of lake evaporation by the energy budget and mass-transfer methods were collected continuously during this year and have been reviewed and summarized. Lake and ground-water samples were collected at both lakes every 6 weeks until January 1990. Thereafter, lake samples were collected monthly and ground-water samples were collected quarterly. Lake leakage influences the ground-water chemistry downgradient of the lake. Quarterly water-quality analyses of sediment porewater at Lake Barco are being interpreted by researchers at the University of Florida. A preliminary numerical ground-water model of the basin has been developed. Several reports were prepared during the year.

PLANS FOR THIS YEAR: The focus in FY 91 will be on preparing interpretive reports on the chemical budget of Lake Lucerne and the hydrologic budget of Lake Barco. Hydrologic and chemical data collection was ended at Lake Lucerne at the end of FY 90, and will end at Lake Barco in January 1991. Remaining tasks include the analysis and interpretation of hydrologic and geochemical data from Lake Lucerne. The hydrologic budget analysis of Lake Barco will require computation of evaporation rates by the energy-budget method and ground-water fluxes by a combination of numerical modeling results and simpler flow-net calculations.

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, Hillsborough County Environmental Protection Commission, Pinellas County, Southwest Florida Water Management District, 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 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, each of which are representative of a large part of the bay bottom in relatively deep water, were selected. At the Old Tampa Bay site, a platform was built from which vertical profiles of velocity and suspended solids can be monitored and used to detect resuspension caused by tidal currents, cold fronts, tropical storms, thunderstorms, and ship wakes. A submersible instrument package was used to monitor velocity and suspended solids at a companion shallow-water site in Old Tampa Bay. After the hurricane season in 1990, the platform equipment was reconfigured into two new submersible instrument packages for use in Hillsborough Bay in 1991.

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), light and water-quality data are collected at least every month at the two primary sites and at two nearby companion sites with sandy bottoms. The data are analyzed to determine the significance of resuspended sediment on light attenuation and to determine other causes of light attenuation.

PROGRESS: During FY 90, the Old Tampa Bay instrumentation was deployed during events which were anticipated to be able to cause resuspension, including spring tides, cold fronts, and thunderstorms. In Hillsborough Bay, two reconnaissance deployments of the existing submersible instrument package at the deep-water site were made. Light and water-quality monitoring continued at four sites during FY 90.

PLANS FOR THIS YEAR: In the fall of 1990, the instrumentation at the Old Tampa Bay platform were used to monitor resuspension from tropical storms and a cold front. The instrumentation was then reconfigured into two new submersible instrument packages for deployment in Hillsborough Bay during 1991. Light and water-quality sampling will continue. Reports on bottom sediment distribution and on sedimentation in the port of St. Petersburg will be completed.

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

DATE PROJECT BEGAN: October 1987

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: David Chin, 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 relations 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 acoustic velocity meter and to calculate the effect of bottom material on leakage to the aquifer. The ground-water flow adjacent to the canal will be defined using MODFLOW or a finite-element model.

PROGRESS: The final report, "Canal-aquifer relations in the Biscayne aquifer, Dade County, Florida" has been approved by the Director and is awaiting publication.

PLANS FOR THIS YEAR: None.

REPORTS RELEASED:

Chin, D.A., 1990, A method to estimate canal leakage to the Biscayne aquifer, Dade County, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4135, 32 p.

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: L.A. Knochenmus, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Ground water in Pinellas County has chloride and 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 dissolved solids 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 report was prepared and revised in response to District, colleague, and Southeastern Region review comments. Results of the study were presented at the Southeastern Region meeting of the Geological Society of America.

PLANS FOR THIS YEAR: Submit report for approval by Director and prepare report for publication.

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: September 1991

PRINCIPAL INVESTIGATOR: G.G. Phelps, Orlando

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

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: Potentiometric-surface map refined. Sampling of recharge water and wells complete. Surface geophysics complete. Seven test wells drilled of which four were geophysically logged. Dye traces were planned at three sites to determine direction and velocity of ground-water flow. One dye trace was completed.

PLANS FOR THIS YEAR: Complete remaining dye traces and miscellaneous field work. Analyze data. Write report.

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

DATE PROJECT BEGAN: June 1988

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Anne F. Choquette, 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 toward 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 effect on the degree of ANC.

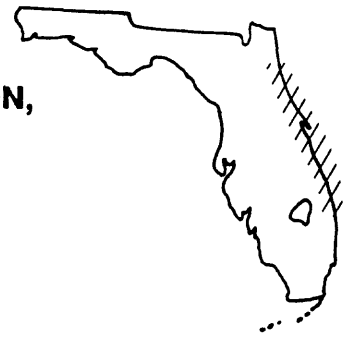
OBJECTIVES: The primary objectives of this study are to establish a complete hydrologic budget for Lake Five-0 and to collect samples of precipitation, ground water, and lake water for chemical analysis.

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. 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 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: Two reports have been completed and a summary report is in preparation.

REPORTS IN PROCESS:

Andrews, WJ., Oliveros, J.P., and Collins, J.J., in press, Preliminary report on the hydrogeology of Lake Five-0 and vicinity, Bay County, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4148.



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, or simulating discharges using a computer model; 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: Five new stations are being monitored closely to define ratings for discharge. Tidally affected sites are being measured with a directional current meter to define better 1–D BRANCH calibration flow. Measured rainfall is adjusted for intensity, an error component of tipping-bucket rain gages. Radio telemetry has been installed to 10 stations for realtime data retrieval.

PLANS FOR THIS YEAR: DR3M (rainfall-runoff) model will be used to define runoff volumes for the Goat Creek subbasin. Acoustic Velocity Meter (AVM) will be installed at a tidally affected site to observe and define flows of these low-velocity streams. Telemetry will be installed on three more gaging stations.

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 lakes in the Winter Park chain of 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: Inflow to the lakes was gaged and sampled at three locations. Samples of water quality at 13 locations were taken at bimonthly intervals. Stormwater monitoring equipment was installed and operated at two locations. Vegetative mapping of the lakes was begun.

PLANS FOR THIS YEAR: Sample stormwater at the two sites to determine relative contribution of dissolved, fine, and coarse particulate material to the total input load of nutrients to the lakes. Complete the vegetative mapping of the lakes and a bathymetric survey. Sample bottom sediments at selected locations to determine if bottom sediments are affected by stormwater inflow.

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

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: Anne Bradner, 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 South Florida Water Management District, and the St. Johns River Water Management District, 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-observation wells to collect information on water levels, lithology, and water quality. Conduct 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: An inventory of wells was completed. Most water-quality sampling was completed. Geophysical data were reviewed and compared to existing geologic maps of the county. One test-observation well was drilled by the South Florida Water Management District.

PLANS FOR THIS YEAR: Complete water-quality sampling and geophysical logging. Complete draft of final report.

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 agencies need 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 special data describing quantitatively the mechanisms 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 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: Drilling of water-quality reconnaissance wells was continued by the Miami office personnel. One well failed to detect saltwater at depths where it was expected. In another, saltwater appeared to be detected at a lower depth than expected, but drilling was discontinued before firm confirmation. A well drilled 100 feet west of Hollywood Canal detected a distinct zone of saltwater underlain by fresher water, probably indicating contamination due to canal leakage rather than landward movement of the interface.

Modeling began with the redesign and testing a two-dimensional cross-sectional solute-transport model to evaluate aspects of the behavior of the solute transport simulator. Also, the design of a generalized regional flow model to provide some basis for the assignment of predevelopment boundary conditions began.

PLANS FOR THIS YEAR: Continued work with the cross-sectional solute-transport model will lead to its extension into three dimensions and with representations of well fields, canals, and other local features. Work with the large-area flow simulator will verify historic, recent, and present boundary conditions. A multilayer, sharp-interface code developed by Hedel Assaud of the U.S. Geological Survey will be evaluated for its potential in simulating the Broward County saltwater intrusion problem. Test drilling will resume.

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 interfaces 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: Software interfaces were developed linking output from the particle tracking program (USGS Open-File Report 89-381) and the GIS. Data from a regional ground-water flow model for south Broward County will be used to test the interface under several scenarios representing different stress conditions. A report describing all phases of this study is in preparation.

PLANS FOR THIS YEAR: Additional scenarios will be developed to continue testing of the interface. Work will also continue on report preparation.

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, Department of Public Works

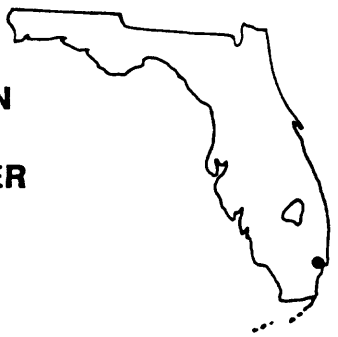
PROBLEM: Ground-water samples from wells located around the perimeter of a landfill, in operation from approximately 1959 to about 1976, show local contamination of ground water. Sulfate, tetrachloroethene, nitrate, sodium and manganese concentrations have been detected in concentrations above maximum 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.

PROGRESS: Installed one additional well in 1990. A total of 21 monitoring wells are located at the site. Prepared draft of final report. Report in review.

PLANS FOR THIS YEAR: Complete report, submit for approval, and prepare for publication.



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 (MODFLOW) 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 MODFLOW ground-water flow model will be modified to include the BRANCH model as a replacement for the RIVER module. An iterative 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 MODFLOW model. Once the modified MODFLOW 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 MODFLOW model to demonstrate the improvement in simulation capabilities and the model's effectiveness as a management tool.

PROGRESS: Data for simulating ground-water and surface-water flow has been incorporated into a regional ground-water flow model for south Broward County. Model calibration for steady-state conditions is proceeding.

The BRANCH model was first modified to include stream leakage terms and to allow the channel to run dry and rewet. BRANCH was then restructured and incorporated as a module of the MODFLOW model. Because the timescales of the ground-water and surface-water flow differ, provision was made to allow for multiple BRANCH timesteps for each MODFLOW timestep.

PLANS FOR THIS YEAR: Refinement and calibration of the south Broward County flow model will continue. Testing and verification of the coupled MODFLOW-BRANCH model is also planned. Preparation of report documenting the new model has begun.

FL-495 WATER MOTION AND RETENTION TIMES IN KINGS BAY, FLORIDA

DATE PROJECT BEGAN: January 1989

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: G. Larry Sanders, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Kings Bay is presently producing large standing crops of nuisance algae, hydrilla and lyngbya that are having a negative effect on the use of the resource by fish, wildlife, and the many residents and visitors to the area. The water-resource management problem in Kings Bay, as in most water bodies with similar conditions, is the identification of the primary causes and contributors to the algal blooms. The specific aspect of the management problem addressed in this proposal is the lack of information on the movement, mixing, and retention time of water and an evaluation of how these physical elements may influence the distribution of nutrients in Kings Bay.

OBJECTIVES: The purpose of this study is to determine the dynamics of water motion in Kings Bay (including velocity, mixing, and retention time) and to evaluate the effect of such water motion on the distribution of nutrients and salinity. The study will include development of a two-dimensional, hydrodynamic simulation model and collection of tidal stage, tidal velocity, tidal discharge, and bathymetry data.

APPROACH: The first year of the study will include compilation of existing data and collection of new data for development of a preliminary two-dimensional hydrodynamic model of Kings Bay. This will include boundary condition information for bathymetry, tidal stage, and the quantity and distribution of spring discharge within the study area. Results from initial data collection and preliminary model results will be used to help plan data-collection efforts during the second year. The second year will include continued collection of tidal-stage data and intensive tidal-cycle velocity measurements at the bay mouth and throughout the bay. These data will be collected in conjunction with tidal-cycle, water-quality sampling by the cooperating agency. This concurrent stage, discharge, velocity, and water-quality information will be used to calibrate and verify the model. The model will then be applied to determine water motion and constituent retention times in Kings Bay.

PROGRESS: During the second year of the project, progress was made in all aspects of the project. The tidal cycle measurement, which was made on June 7, 1990, recorded stage, velocity, and discharge data during a low-flow event. Analysis and computation of the measurements is being completed. The inventory of significant springs has been completed to provide information on the quantity and distribution of spring flow. Bathemetry data have been used in a graphical information system (GIS) program to generate various preliminary hydrodynamic model grids. The GIS program is being used to generate various base maps for the report.

PLANS FOR THIS YEAR: Available data will be used to calibrate the hydrodynamic model by comparing the model predicted values to the field observations. The calibrated model will then be used in application simulations to test the circulation and retention times in Kings Bay. The report will be written and reviewed to complete the project.

FL-496 TRACER TESTS OF GROUND-WATER FLOW IN A KARST AQUIFER IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: James T. Robinson, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The rationale for delineating protection zones, which considers the Upper Floridan aquifer a homogeneous medium, probably is not valid for west-central Florida. If the aquifer cannot be treated as a homogeneous, porous medium, which appears to be the case, there is the need to reconsider the guidelines for establishing protection zones.

OBJECTIVES: The study will provide information and hydrogeologic data needed to evaluate ground-water flow near pumping wells in a karst aquifer system and apply this knowledge to well-head protection strategies for west-central Florida. Specific objectives are: (1) estimate the extent of fracture systems/solution cavities within a selected well-head protection zone, (2) define the hydraulic properties of the aquifer system in the protection zone, (3) measure movement of tracers in the protection zone, (4) simulate the measured tracer movement and quantify transport properties of the karst aquifer within the protection zone, and (5) propose guidelines to assist in evaluation the adequacy of present well-head protection strategies for west-central Florida.

APPROACH: The study will consist of four main phases: (1) geophysical studies will be conducted at a suitable test site with well-developed karst features; (2) aquifer tests will be conducted to define hydraulic properties that control flow to a production well and observations wells for tracer injection and monitoring; (3) tracer tests will be conducted over large and small depth intervals of the aquifer with monitoring of tracer movement for up to 6 months; and (4) the USGS modular ground-water flow model with a recently developed particle tracking model or another existing analytical method will be used to simulate tracer movement and to test the validity of relations among aquifer heterogeneity, hydrodynamic dispersion, and porosity.

PROGRESS: Surficial and downhole geophysical investigations have been performed at the test site. Borehole video logging was conducted to determine the vertical distribution of apparent secondary porosity. Four aquifer tests have been performed at the test site. A tracer test over a large depth interval of the aquifer was begun in July 1990. Monitoring of the tracer movement is ongoing. Work has begun to simulate the drawdown observed during aquifer tests using the USGS modular ground-water flow model (MODFLOW). Some background sections of the written report have been prepared.

PLANS FOR THIS YEAR: Complete the ongoing tracer test and initiate small depth interval tracer test. Complete the calibration of the MODFLOW computer program to simulate aquifer response to pumping. Simulate tracer movement within the aquifer using the USGS particle tracking model MODPATH. Begin preparation of a written report.

FL-497 LIGHT ATTENUATION IN THE ESTUARINE AND COASTAL WATERS OF SOUTHWEST FLORIDA – CAUSE AND IMPLICATIONS

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Benjamin F. McPherson, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The amount of photosynthetically active radiation (PAR) in estuarine and coastal waters is of fundamental importance in determining growth and vigor of aquatic plants. The availability of PAR in these waters may be severely limited by dissolved (color) and suspended material so that plants compete with one another for light. In deep-water environments, phytoplankton have an advantage over benthic plants and may flourish in the upper sunlit waters and thereby shade benthic algae, periphyton, and seagrasses. In shallow water, drift algae and periphyton may cover seagrasses and reduce light available to the seagrasses. Cultural enrichment of estuarine waters favors the growth of phytoplankton, drift algae, and periphyton, and that growth may greatly reduce light penetration and light available to seagrasses. Understanding the causes of light attenuation that result from the complex interaction of these physical, chemical, and biological processes will be necessary to help set long-term goals for properly manging our estuarine and coastal water resources.

OBJECTIVES: The overall objective of this study is to provide information to help guide management strategies in the estuarine and coastal waters of southwestern Florida by determining the causes of light attenuation. The causes of light attenuation include both the identification of the material (i.e., dissolved organic material, suspended sediment, phytoplankton, periphyton, drift algae) and the processes that contribute to its presence in the water column or on seagrasses (i.e., wind, tide, water depth, type of shoreline, benthic plants and animals, bottom and suspended sediment characteristics, freshwater inflow, nutrient concentrations and loads, etc.). The study area will include Tampa Bay, Charlotte Harbor, and nearshore waters of the Gulf of Mexico. The study will include 6 months of method development and testing, and approximately 2 years of data collection and analysis, including two summers of intensive sampling.

APPROACH: Ten study areas in Tampa Bay and Charlotte Harbor that represent different regional environments and different levels of basin development are proposed for this study. Within each of these areas, several stations will be established to characterize the light-attenuating properties of different benthic and shoreline environments. If seagrasses occur in the study area, a station will be established within the seagrass meadow and another will be established beyond the meadow in deeper water.

The study areas will be sampled approximately 20 times over 2 years. The most intensive sampling will be during May through September. The 2-year span provides the minimum time needed for an annual comparison. Measurements will be made of light attenuation (photosynthetically active radiation, PAR) in the water column and in seagrass and drift algal communities. Physical, chemical, and biological data that may affect light attenuation will also be collected.

PROGRESS: Literature on light attenuation was reviewed. Methods were developed to measure light attenuation and the causes of light attenuation. Reconnaissance surveys and sampling trips were carried out in Tampa Bay and Charlotte Harbor monthly during the summer and bimonthly during the remainder of the year. Solar radiation over daylight hours was measured for selected periods at a site near Tampa Bay. Data on light attenuation, solar radiation, and water quality were processed.

PLANS FOR THIS YEAR: Continue field sampling of light attenuation, solar radiation, and water-quality in Tampa Bay and Charlotte Harbor. Develop a model to predict the available photosynthetic active radiation at selected water depths and for given light attenuation coefficients. Continue to process data.

FL-498 CIRCULATION AND CONSTITUENT TRANSPORT IN SARASOTA BAY, FLORIDA

DATE PROJECT BEGAN: January 1990

DATE PROJECT ENDS: April 1993

PRINCIPAL INVESTIGATOR: Kathleen M. Hammett, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Sarasota Bay has been selected by the Environmental Protection Agency for inclusion in the National Estuary Program (NEP). As part of the NEP, a comprehensive management plan that includes strategies for preservation, restoration, and enhancement will be developed for Sarasota Bay. To preserve, restore, or enhance the estuary, it is necessary to describe and quantify the circulation and constituent transport characteristics of the system. A hydrodynamic model provides a tool for evaluating both circulation and constituent transport. No hydrodynamic model presently exists for the whole Sarasota Bay study area.

OBJECTIVES: The primary purpose of this investigation is to develop a calibrated and verified hydrodynamic model of water circulation and constituent transport in Sarasota Bay. The model will closely simulate the existing system and will be able to evaluate the changes in circulation and constituent transport characteristics due to natural and proposed manmade physical changes in the system. A related objective is to develop the hydrodynamic model so that as understanding is gained about the physical, chemical, and biological processes that affect water clarity, these processes can be eventually incorporated into the model.

APPROACH: This investigation will be a joint effort between the U.S. Geological Survey and the University of Florida (UF) Coastal and Oceanographic Engineering Department. Bathymetric and tidal stage data collection will be started while the workplan is being prepared. Following approval of the workplan, preliminary modeling and intensive data collection will begin. Model calibration will begin when reliable data are available from the field. Model calibration will be documented in an interim report prepared by UF. Following calibration, an independent data set will be used to verify the model.

PROGRESS: Prepared project description forms. Installed seven gaging stations. Collected bathymetry data. Prepared workplan.

PLANS FOR THIS YEAR: Install network of tide and salinity gages. Continue to collect bathmetry data. Revise workplan. Begin preliminary model calibration.

FL-499 HYDRAULIC AND SALINITY CHARACTERISTICS OF MATLACHA PASS ESTUARY, LEE COUNTY, FLORIDA

DATE PROJECT BEGAN: July 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Gary Russell, Stuart

COOPERATING AGENCY: Florida Department of Environmental Regulation, Lee County, and the City of Cape Coral

PROBLEM: The western spreader canal system in Cape Coral, has altered the sheetflow patterns of freshwater runoff into Matlacha Pass. The Florida Department of Natural Resources has expressed concern that altering the freshwater runoff patterns into the pass may have a detrimental effect on salinity distribution which, in turn, may affect the aquatic system of the pass. Adequate data are not available to evaluate the effects of redistribution of freshwater inflow, its movement, and mixing. This proposed study will help identify the hydrodynamic aspects for managing the estuary.

OBJECTIVES: The objectives of the study are to determine the hydrodynamics of tidal-flow freshwater inflow and water circulation in Matlacha Pass estuary and to evaluate the effects that water circulation may have on the distribution of selected physical and chemical characteristics of the pass. The study will provide baseline information on bathymetry, salinity, and selected water-quality data. The main focus of the study will include development of a two- dimensional hydrodynamic simulation model of Matlacha Pass. The model will be calibrated by the use of bathymetry, tidal stage, tidal velocity, tidal discharge, freshwater inflow, and selected water-quality data.

APPROACH: (1) A preliminary two-dimensional flow and circulation model will be simulated by use of an existing two-dimensional model of the Charlotte Harbor estuary; (2) continuous collection of calibration data in the estuary will be compared with data generated from the initial model, and concurrent water-quality information will be used in conjunction with stage and velocity measurements to calibrate and verify the model; and (3) documentation of the model will be prepared.

PROGRESS: Initial bathymetric surveys within Matlacha Pass have been completed. Installation and instrumentation of tidal stage and freshwater inflow sites has been completed.

PLANS FOR THIS YEAR: Placement of bathymetric survey of the estuary into GIS and initial runs using collected data are planned.

FL-500 DELINEATION OF GROUND-WATER RECHARGE AREAS OF THE SURFICIAL AQUIFER IN SOUTH FLORIDA

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: Richard K. Krulikas, Fort Myers

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Information on ground-water recharge in Florida is of vital importance to studies involved with quantification of the effects of ground-water development. Presently, recharge has been evaluated only with respect to the Upper Floridan aquifer and for the Floridan RASA study on small scales. Delineation of recharge rates at a larger scale is required for detailed comprehensive assessments of the effects of ground-water development on a subregional to local basis. Moreover, delineation of high-rate ground-water recharge areas at a large scale is needed by the State regulatory agencies for implementation of the "Blue Belt" constitutional amendment. This amendment authorizes a tax break to owners of land that remains in an undeveloped state and which provides a high rate of recharge to Florida's ground water.

OBJECTIVES: The objective of the study is to evaluate feasibility, cost, and time for large-scale mapping of high- and low-rate recharge areas to the surficial aquifer where it is unconfined.

APPROACH: Spring discharge and stream base- flow data will be used as indirect measurements of ground-water recharge to the respective drainage basins where definable. This recharge total will then be distributed across the area, taking into account as appropriate: (1) topographic features, (2) soils, (3) surficial deposits, (4) intermediate confining unit thickness and characteristics, and (5) potentiometric surface of the surficial aquifer in relation to land surface and the water table. Available model-derived recharge distribution to the surficial aquifer will be used to guide the analysis, although at a lesser scale. Hydrogeologic judgment will be applied in assessing the net effect of the above factors on rate of recharge and on the extrapolation of discharge data into areas devoid of measurements but similar hydrogeologically to areas having measurements.

PROGRESS: A potentiometric map of the surficial aquifer was constructed to delineate flow patterns in Lee County. Precipitation and ground-water samples were collected and geochemical techniques applied. Chloride ratios and oxygen isotope ratios of ground water and precipitation were determined. Topographic and soil features were delineated. Using the information collected, high- and low-rate recharge areas were defined. A report describing the results and techniques used is currently being written.

PLANS FOR THIS YEAR: The report for this phase I project will be completed. A phase II project will begin using the techniques and methods described in phase I. The anticipated areas of study are Collier, Martin, and Palm Beach Counties.

FL-501 AVAILABILITY OF GROUND WATER IN THE ORLANDO METROPOLITAN AREA, EAST-CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1990

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: Louis Murray, Orlando

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

PROBLEM: Growth in the Orlando metropolitan area is expected to cause ever-increasing demands on the ground-water resources. Available well-field locations are constrained by the occurrence of salty water, contaminated ground water, zones of low aquifer transmissivity, and by the proximity of existing well fields. At present, there is insufficient interpretive information to assess what long-term effect land-use changes and increasing water use will have on the ground-water resources.

OBJECTIVES: To assess the potential for developing additional large ground-water supplies in the Orlando metropolitan area, to identify favorable locations for well fields, and to develop a strategy for monitoring changes in the geohydrology.

APPROACH: (1) Assimilate all ground-water and geologic information from published and unpublished reports; (2) Use existing current and historical ground-water quality data to prepare interpretive thematic maps of the areal and depth distribution of selected water-quality constituents; (3) Construct and calibrate a high-resolution, 3-D finite-difference ground-water flow model, a particle-tracking model, and an optimizing model for identifying areas where aquifer characteristics are suitable for development; (4) Outline a strategic ground-water monitoring network to observe changes in ground-water quality and quantity.

PROGRESS: Municipal, irrigation, and industrial water-supply well data and pumpages are being collected for the study area; reports on the hydrogeology of the study area have been collected; postprocessors have been collected for use with MODFLOW; a revised starting head contour map has been constructed for calibration of the predevelopment flow model; boundary conditions have been defined; a pilot study is underway to map the proximity of existing drainage wells to large water-supply wells and potential sources of ground-water contamination.

PLANS FOR THIS YEAR: Compile data on amounts, sources, and locations of water used by municipalities and other public suppliers, industry, agriculture, and private owners. Run geophysical logs and sample water quality at selected wells and artesian springs. Store water-resources data collected in computer and hard-copy files. Calibrate predevelopment ground-water flow model. Produce map report and conduct pilot drainage-well study.

FL-502 TRANSPORT OF SELECTED CHEMICAL CONSTITUENTS IN FIELDS AMENDED WITH CRAB-SCRAP COMPOST

DATE PROJECT BEGAN: January 1990

DATE PROJECT ENDS: October 1991

PRINCIPAL INVESTIGATOR: Hilda H. Hatzell, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

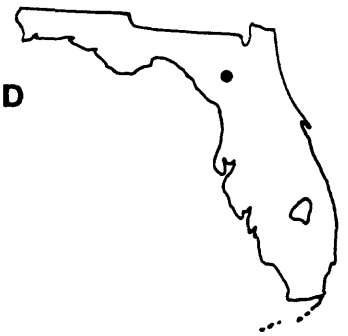
PROBLEM: Composting of crab scrap with wood products provides a possible solution for two situations. The first is the need to reduce the amount of materials entering landfills. Wastes from crab-processing operations may consume as much as 20 percent of the landfill space in several Florida counties. The second is the need to increase the agricultural productivity of acid-sand soils in a way that is compatible with the environment. An organic amendment, such as compost, can increase water infiltration, levels of soil moisture, and cation-exchange capacity. Although the use of compost may provide beneficial soil effects, the crab compost may also affect the quality of ground water.

OBJECTIVES: The potential effects of crab compost on ground water will be evaluated to (1) determine if crab scrap compost retards the movement of a field-applied pesticide to the water table, and (2) evaluate the leaching of selected organic compounds and trace metal ions released during decomposition of field- applied crab compost.

APPROACH: Field plots containing a selected crop will be located at the IFAS Experiment Station at Live Oak. Each plot will receive the same amount of pesticide and one of three levels of compost. The leaching of selected organic compounds, metal ions, and the pesticide will be monitored with lysimeters and wells located in the plots. Sampling events will be timed to account for cropping practices.

PROGRESS: The incubation part of the project has been completed. Samples from the incubation study have been sent to the Tennessee Valley Authority Environmental Chemistry Laboratory for analysis of the EPA priority pollutants. Additional samples were sent to a USGS laboratory for analysis of selected nutrients and metals. The tub lysimeter study has been initiated. The first leaching event will occur in mid-October followed by the second leaching at the end of October.

PLANS FOR THIS YEAR: The incubation data will be evaluated. The lysimeter leaching samples will be collected and sent to the USGS laboratory for analysis and then evaluated. A final report will be prepared.



FL-503 EFFECTS OF DAIRY FEEDLOTS ON GROUND- AND SURFACE-WATER QUALITY IN NORTH FLORIDA

DATE PROJECT BEGAN: November 1989

DATE PROJECT ENDS: September 1991

PRINCIPAL INVESTIGATOR: William Andrews, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: In the past few years, an increasing number of dairies have been located near the Suwannee River in Lafayette and Suwannee Counties. Dairy cows deposit approximately 75 kilograms of nitrogen per year per animal as manure, much of which can be converted to nitrate which is highly soluble and mobile in ground-water systems and can cause human health problems. The area where the dairies have been located is highly susceptible to ground-water contamination because the principal source aquifer in the area, the Upper Floridan aquifer, consisting of the Suwannee and Ocala Limestones, is unconfined, near the land surface, and in many places is directly connected to the land surface by karstic drainage features. The Suwannee River, designated as an Outstanding Florida Water requiring the highest priority of protection, is directly connected to the Upper Floridan aquifer in the area through numerous springs which flow from the aquifer into the river. Elevated nutrient concentrations in surface waters can cause undesirable eutrophication of those waters.

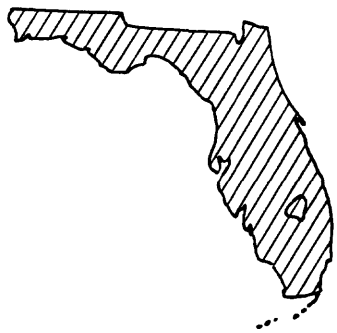
State regulatory agencies require more detailed information on the effects that these dairy operations are having on water quality in north Florida in order to identify waste-management practices that minimize ground- and surface-water contamination from these operations.

OBJECTIVE: To determine the extent of contamination of ground water beneath and surface water flowing from dairy operations and how the contamination relates to varying waste-management practices and hydrogeological conditions in LaFayette and Suwannee Counties.

APPROACH: Nine dairy operations with differing waste-disposal practices have had three to four wells installed per dairy into the top of the saturated zones, and surface-water sampling sites have been established. Wells are located within or downgradient from the sites of waste deposition. Water samples are being collected and analyzed quarterly from each well or collection site, with selected sites being sampled in the intervening months in order to monitor seasonal variations in water quality. Dissolved constituents analyzed include those considered to be waste tracers and the results are being statistically analyzed to examine relations between dissolved nitrogen species, other waste tracers, waste-disposal practices, and hydrogeological factors.

PROGRESS: Ground water in the vicinity of waste-disposal sites has been sampled and analyzed for concentrations of nitrate-nitrogen. Deeper production wells in the area have also been sampled for chemical analysis. Analysis of the water-quality data is underway.

PLANS FOR THIS YEAR: Additional wells will be drilled and sampled at selected dairies through the remainder of the year. The last samples will be collected in March 1991, with report writing to be completed in May 1991.



FL-504 RECHARGE AREAS, FLORIDA

DATE PROJECT BEGAN: September 1990

DATE PROJECT ENDS: September 1990

PRINCIPAL INVESTIGATOR: John Vecchioli, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: Delineation of high-rate ground-water recharge areas at a large scale is needed by the State for implementation of the "Blue-Belt" Amendment.

OBJECTIVE: To evaluate feasibility of mapping high- and low-rate recharge areas to the water table and to the Upper Floridan aquifer where it is confined.

APPROACH: Spring discharge and stream baseflow data will be used as indirect measurements of ground-water recharge to the respective drainage basins. This recharge total will then be distributed across the drainage basin taking into account as appropriate: (1) topographic features, (2) soils, (3) surficial deposits, (4) intermediate confining unit thickness and characteristics, and (5) potentiometric surface of the Upper Floridan aquifer in relation to land surface and the water table. Available model-derived recharge distribution to the Upper Floridan aquifer, although at a lesser scale, will be used to guide the analysis. Hydrogeologic judgement will be applied in assessing the net effect of the above factors on rate of recharge and on the extrapolation of discharge data into areas devoid of measurements but similar hydrogeologically to areas having measurements.

PROGRESS: Mapping of recharge in Okaloosa, Pasco, and Volusia Counties was completed. A report presenting the maps and describing the methodology used was completed and approved for publication.

REPORTS IN PROCESS:

Vecchioli, John, Tibbals, C.H., Duerr, A.D., and Hutchinson, C.B., in press, Ground-water recharge in Florida—A pilot study in Okaloosa, Pasco, and Volusia Counties, U.S. Geological Survey Water-Resources Investigations Report 90-4195.

FL-505 HYDROLOGY AND EFFECTS OF WATER-RESOURCES DEVELOPMENT IN THE HIGHLANDS RIDGE OF WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: July 1989

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: D.K. Yobbi, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The Highlands Ridge, which occupies 700 square miles in central Polk and Highland Counties, is an uplands recharge area along the axis of the Floridan Peninsula. Many large sinkhole lakes occur along the crest of the ridge. Since the early 1960's, significant declines in lake levels have occurred in this important citrus-producing area. The problem of declining lake levels may be related to several factors, including below normal rainfall, increased ground-water pumpage for agricultural and industrial use, reduced recharge and drainage related to the channelization of the Kissimmee River, and agricultural drainage practices. In order to maintain the lake environment, it is important to understand and quantify the flow to, from, and within the ground-water system.

OBJECTIVE: To develop an understanding of the hydrogeologic regime and impacts of water-resources development in a regional lake environment that is strongly affected by pumping. A numerical model of ground-water flow will be used to simulate the response of the water table and lake levels to hydrologic stress.

APPROACH: Literature and file searches will be made and existing data will be compiled and geologic maps and cross sections will be prepared. The hydrogeologic system in the Highlands Ridge will be simulated using the USGS finite-difference modular computer code. Existing coarsely-gridded models will be divided into 1-square mile or 1-minute (latitude and longitude) grid blocks. Starting heads, recharge, evapotranspiration, streamflow, pumping, and aquifer hydraulic properties will be estimated using the best available information. The initial steady-state calibration will be based on September 1989 hydrologic conditions. A transient model calibration will be made for the time period September 1989–September 1990. A sensitivity analysis of the model-input parameters will be performed following the steady-state and transient calibrations. Simulation runs will be made to demonstrate how the model can be used to assess regional impacts of water-resources development.

PROGRESS: A project proposal and planning document were completed. A submodel of the Highlands Ridge was extracted from the U.S. Geological Survey Regional Aquifer System Analysis (RASA) model. This model provides interim use by the Southwest Florida Water Management District while the Highlands Ridge model is being developed. Performed seismic survey of Lake Jackson and developed seismic-survey proposal to define hydrogeology of lakes along the Ridge. Compiled hydrogeologic data and began input of data to the model.

PLANS FOR THIS YEAR: Complete calibration of steady-state and transient models and conduct a sensitivity analysis. Perform verification and prediction model runs.

FL-506 NEAR-SURFACE WATER BALANCE FOR A SITE IN CENTRAL FLORIDA: A CASE STUDY AND MODELING INVESTIGATION

DATE PROJECT BEGAN: July 1990

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: William R. Bidlake, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District and Sarasota County

PROBLEM: Water and energy exchange between the atmosphere and terrestrial ecosystems are crucial components of the hydrologic cycle. Recharge and contaminant transport to saturated ground-water systems are regulated by hydrologic processes that occur near the soil surface. A greater understanding of these processes is needed to help elucidate potential effects of management decisions and climate change.

OBJECTIVES: Study objectives are to provide a site-specific example of the near-surface water balance and to develop predictive capabilities for key near-surface hydrologic processes through the use of a physically based hydrologic process model.

APPROACH: Investigators will conduct a detailed examination of the near-surface water balance for a site in a prevalent type of native vegetation in west-central Florida. Principal water-balance components to be monitored include: precipitation, evapotranspiration, and changes in soil-water storage. A physically based model will be used to simulate the water balance. Hydrologic parameters for the model will be obtained from measurement at the site. The model will be used to examine and predict evapotranspiration and other water- balance components under different vegetative conditions.

PROGRESS: A study site has been selected and the data-collection network is being designed.

PLANS FOR THIS YEAR: The data-collection network will be installed and water-balance components will be monitored. Several hydrologic process models have been published. These will be reviewed and one model will be selected and modified for use in this study.

FL-507 DEFINITION OF THE UPPER FLORIDAN FLOW SYSTEM IN THE CITY OF TALLAHASSEE AND LEON COUNTY

DATE PROJECT BEGAN: July 1990

DATE PROJECT ENDS: January 1994

PRINCIPAL INVESTIGATOR: Mary Jo Radell, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The city of Tallahassee has had to discontinue use of several city supply wells due to contamination. The city and the Florida Department of Environmental Regulation (FDER) realize the importance of protecting ground-water resources. One approach is to delineate wellhead protection areas. This cannot be done effectively until the aquifer's flow system is well understood. The Tallahassee/Leon County area is an ideal location in which to evaluate the efficacy of different wellhead protection methods in an environment of complex, possibly anisotropic, fracture/conduit flow.

OBJECTIVE: To improve understanding of the flow system in the complex fracture/conduit dominated environment of the city of Tallahassee and Leon County in order to allow local officials to develop ground-water protection strategies including wellhead protection.

APPROACH: (1) Assemble existing hydrogeologic and well information. This will include a detailed well inventory and study of well logs and other published materials. (2) Collect additional hydrogeologic and well information. A potentiometric-surface map will be constructed for the Upper Floridan aquifer in the study area and aquifer tests will be conducted to determine anisotropy. This may include installation of two to four monitor wells. (3) Construct a detailed ground-water flow model and delineate areas contributing water to pumping centers based on capture areas and time criteria. The USGS modular model well be used. (4) Conduct a preliminary evaluation of wellhead protection methods.

PROGRESS: New project.

PLANS FOR THIS YEAR: Conduct detailed well inventory for study area. Study existing well logs and other published material to determine site specific hydrogeologic information. Prepare potentiometric-surface map of the Upper Floridan aquifer for the study area. Determine location for aquifer tests. Conduct preliminary evaluation of wellhead protection methods.

FL-508 TECHNIQUES FOR ESTIMATING AREAS THAT CONTRIBUTE GROUND WATER TO PUBLIC SUPPLY WELLS IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: July 1990

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: L.A. Knochenmus, Tampa

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The Upper Floridan aquifer is the primary source of public water supply in west-central Florida. Over most of the area of northern Hillsborough and Pinellas Counties, and most of Pasco County, the aquifer is at or near land surface and is vulnerable to contamination. To protect public water supplies from possible sources of contamination, the areas that contribute water to these wells must be known and the factors that affect the size and shape of the contributing areas to public supply wells must be known.

OBJECTIVE: Define ground-water flow in a carbonate aquifer system and apply this knowledge to well-head protection strategies for west-central Florida. Test the validity of Darcian ground-water flow in a carbonate aquifer. Simulate the flow system to indicate which factors affect the size and shape of the contributing areas. Compare methods for area delineation. Suggest areas in the State where methodologies can be applied.

APPROACH: Experimentally use analytical and numerical-mathematical models to estimate ground-water flow pathlines, velocity fields, time-of-travel, and contributing areas to wells. The hydrologic parameters will be compiled from previous numerical modeling results, aquifer-test data, and laboratory values of effective porosity from core samples. Vary the controlling factors including model grid size, pumping rate, transmissivity, porosity, anisotropy, and well penetration depth to evaluate the effects on size and shape of the contributing areas. Compare the results of the study with previous well-head protection strategies.

PROGRESS: Began literature review and data computation.

PLANS FOR THIS YEAR: Compile the appropriate data to begin the analytical and numerical modeling to determine the best techniques for well-head protection.

FL-509 MEASUREMENT OF NONPOINT-SOURCE NUTRIENT LOADING TO ESTUARIES WITH EMPHASIS ON TIDALLY DOMINATED RIVERS: A CASE STUDY OF HILLSBOROUGH BAY, FLORIDA

DATE PROJECT BEGAN: August 1990

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: W.M. Woodham, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The effects of land-use changes and other human activities on the water quality and ecology of estuaries and other coastal waters is a national concern that is being addressed in many coastal areas of the country. Increased nutrient availability in estuaries and coastal waters creates conditions conducive to eutrophication. There is a lack of recent measurements of major point-source loads and little information on nonpoint-source loads of nutrients from three major tributaries: the Hillsborough, Palm, and Alafia Rivers. It is essential that these nutrient loads be measured in order to help develop a realistic estimate of the nutrient budget of both Hillsborough and Tampa Bays. Standard constituent loading measurement techniques for streams are of limited usefulness because tidal conditions extend for large distances upstream. Standard stage/discharge relations cannot be established in tidal reaches and large parts of the drainage basin cannot be measured for nutrient load contributions in a cost-effective manner.

OBJECTIVE: Provide realistic estimates of nonpoint-source loading of nutrients to Hillsborough Bay in order to satisfy the need to develop a nutrient budget and provide reliable data for input to a eutrophication model to be developed at some future time. Develop and operate a cost-effective technique for measuring nutrient loads in a tidally dominated river at its most downstream point in order to eliminate unmeasured loads from parts of the drainage basin.

APPROACH: The overall approach for developing reliable nonpoint-source nutrient loading estimates for Hillsborough Bay is based on an extensive program of field measurements and sampling. An innovative application of state-of-the-art velocity measuring equipment and automated water sampling will be tested and evaluated for continual measurement of tidal discharge and appropriate nutrient concentrations at the mouth of the Alafia River for determining nutrient loading rates from the entire basin. If successful, such techniques could later be applied to other major tributaries to Tampa Bay. Results will be used to design a data-collection program which will provide yearly constituent loading and seasonal variability from the Alafia River basin.

PROGRESS: A temporary index-velocity recorder was installed. Discharge measurements for outgoing tidal flow were made. Water-quality samples for slack, ebb, and tidal flows were collected at two cross sections for comparison as part of the reconnaissance effort in August. Water-quality samples were collected at about 2-hour intervals at two to three depths in three verticals, and vertical composites for one vertical for consecutive semidiurnal tides on September 18-19. Measurements were made of water temperature, specific conductance, dissolved oxygen, and pH at 2-foot vertical intervals in six verticals during the same effort. Sampled constituents included dissolved and total ammonia, nitrate plus nitrite, organic nitrogen, carbon, orthophosphate, phosphorous; dissolved silica; chlorophyll a and b; total suspended solids; conductance; chloride, and 5-day biochemical oxygen demand.

PLANS FOR THIS YEAR: Continue operation of stage and velocity-index recorders. Install ultrasonic velocity meter. Continue evaluation of sampling procedures and establish 5-day per month sample collection schedule for Alafia, Hillsborough, and Palm Rivers. Compile and analyze velocity and water-quality parameters. Begin definition of load computation procedures. Modify plans as necessary.

FL-510 SOURCE AND EXTENT OF NITRATE-NITROGEN CONTAMINATION OF GROUND WATER NEAR THE STAFF HOUSING AREA, MACDILL AIR FORCE BASE, FLORIDA

DATE PROJECT BEGAN: August 1990

DATE PROJECT ENDS: July 1991

PRINCIPAL INVESTIGATOR: Mario Fernandez, Jr., Tampa

COOPERATING AGENCY: MacDill Air Force Base

PROBLEM: Findings from a reconnaissance study to determine the possible source of elevated nitrate-nitrogen concentration indicated three sites of elevated nitrate distribution in ground water beneath the base golf course. It was not possible to positively conclude whether the nitrate sources are from excessive overfertilization during the recent past, effluent irrigation, or from materials that may have been buried earlier.

OBJECTIVE: To determine the source of elevated nitrate concentrations in ground water at MacDill Air Force Base.

APPROACH: This study is composed of four major tasks: (1) to evaluate the study area for buried materials using surface geophysical techniques which include ground-penetrating radar, electromagnetic induction, and proton magnetometry; (2) to obtain a detailed description of the water-table configuration and ground-water movement; (3) to better define the nitrate distribution, to establish the presence or absence of other possible contaminants, to characterize the types of water in the ground-water system, and to determine whether lake sediments are a repository of contaminants; and (4) to evaluate the activity of denitrifying bacteria in the aquifer which may be a key factor in determining the most cost effective site remediation method.

PROGRESS: Management Information System forms were prepared, but work on a planning document was delayed. Geophysical surveys using ground-penetrating radar and electromagnetic induction instrumentation was performed.

PLANS FOR THIS YEAR: A project planning document will be prepared. All geophysical surveys will be completed and analyzed. Water-table configuration and flow directions will be determined. Water will be sampled and analyzed. Bacterial experiments will be run. All data will be analyzed and a report prepared.

FL-511 AN EVALUATION OF THE EFFECTS ON NONPOINT-SOURCE POLLUTION FROM SWINE AND POULTRY OPERATIONS ON GROUND- AND SURFACE-WATER QUALITY IN NORTH FLORIDA

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: March 1993

PRINCIPAL INVESTIGATOR: Hilda H. Hatzell, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation

PROBLEM: The presence of swine and poultry operations in north Florida poses a potential threat to the water quality of the Suwannee River and the Floridan aquifer system. Data obtained from a statewide monitoring network show elevated nitrate concentrations in wells in the vicinity of the river. Ammonium in livestock waste is oxidized to nitrate, a form of nitrogen that is not readily retained by sandy soils. In areas where swine and poultry wastes are concentrated, nitrates may be lost by runoff to surface water or by leaching to ground water.

OBJECTIVE: To determine the degree to which ground water and surface water flowing from swine and poultry operations are contaminated and to relate the contamination to varying waste-management practices and hydrogeology in Lafayette and Suwannee Counties in northern Florida.

APPROACH: Swine and poultry sites representative of differing production and waste-disposal practices will be selected. Monitoring wells will be located within or adjacent to areas of animal activity and waste disposal. The wells will be used to examine concentrations of nitrogen species and other waste tracers, such as phosphorus, chloride, and sulfates. Surface water from holding ponds and small creeks draining the areas will also be sampled. The relative abundance of nitrogen-15 and nitrogen-14 isotopes in nitrates will be used to evaluate the pattern of organic and inorganic nitrate sources in the study area.

PROGRESS: Information concerning waste-management practices of swine and poultry operations in the project area was obtained through interviews. A literature search involving the chemistry of nitrogen release from animal manure and the use of nitrogen isotopes was initiated.

PLANS FOR THIS YEAR: Locations of swine and poultry operations and types of waste management used will be determined for the project area. Based on this information, sites to be monitored will be selected. Monitoring wells will be established and sampled.

FL-512 EFFECTS OF THE HILLSBORO CANAL PUMPAGE ON WATER QUALITY OF THE SECONDARY CANALS IN BOCA RATON, FLORIDA

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Donald McKenzie, Miami

COOPERATING AGENCY: City of Boca Raton

PROBLEM: The major source of water, other than local rainfall and runoff, to maintain stages of the Lake Worth Drainage District (LWDD) canals in the Boca Raton area is the Hillsboro Canal. Rapidly increasing water demands in the Boca Raton area have required that increasing amounts of water be pumped from the Hillsboro Canal. The city of Boca Raton is concerned that the water quality of the LWDD canals flowing through the city and near its well field may be degraded by pumpage from the Hillsboro Canal. This concern has arisen partly because water in the Hillsboro Canal flows from Lake Okeechobee, through an area of organic soils and intensive agriculture, receiving highly mineralized ground water. There have been sporadic water-quality analyses of the Boca Raton canals in recent years, but because of varying sampling sites and infrequent sampling, appraisal of water-quality conditions and trends has not been feasible.

OBJECTIVE: The objectives of the investigation are to (1) collect and compile all available historical data, and select target constituents for long-term trend analysis, and (2) characterize the present water quality of the Boca Raton canal system and determine the effect of pumpage from the Hillsboro Canal.

APPROACH: All available canal-water analyses for the area of investigation will be evaluated. Canal sampling sites will be selected according to the movement of water from the Hillsboro Canal, land-use patterns, and sediment deposition. The sampling frequency for most of the constituents will be determined by seasonal rainfall distribution and the discharge from the Hillsboro Canal pump station. High- flow sampling will be emphasized. Samples collected will be analyzed for major inorganic constituents, nutrients, and metals. GS-FID reconnaissance sampling will also be conducted to qualitatively detect organic contaminants. All data collected will be evaluated and analyzed using summary statistics for individual sampling sites. An analysis will be made for constituent trends with attention to seasonal effects (rainfall) and pumpage at the Hillsboro Canal. Relations of constituents to land use and point sources of contamination will be developed. A long-term water-quality monitoring program is anticipated to follow the 3-year investigation.

PROGRESS: Available historical water-quality data have been assimilated and land-use patterns have been defined. Special attention was given to potable water-supply well fields and possible point sources of contamination. Ten water-quality sampling sites were selected. One site is near the Hillsboro Canal pumping station and the other sites are equally spaced about the Boca Raton secondary canals. These sites were selected to reflect possible chemical influence from the Hillsboro Canal and characterize the general water quality of the basin. Samples were collected during the wet season for analysis of major inorganic ions, macronutrients, and trace metals. Flame ionization detection scan analysis was used as a reconnaissance method for the location of synthetic organic contaminants.

PLANS FOR THIS YEAR: Continue data collection and compilation. Continue sampling of canal waters based upon seasonal rainfall distribution and begin statistical analysis of sampling data at selected sites.

FL-513 GEOCHEMISTRY AND WATER QUALITY OF THE FLORIDAN AQUIFER SYSTEM, DADE COUNTY, FLORIDA

DATE PROJECT BEGAN: August 1990

DATE PROJECT ENDS: September 1992

PRINCIPAL INVESTIGATOR: Ron Reese, Miami

COOPERATING AGENCY: Miami-Dade Water and Sewer Authority Department; South Florida Water Management District

PROBLEM: The Floridan aquifer system may be used to provide additional public-water supply as the population of southeastern Florida increases. Three methods are being considered for using the Floridan: (1) blending the brackish ground water from the Floridan aquifer system with the freshwater withdrawal from the overlying Biscayne aquifer, (2) temporarily storing excess freshwater in the Upper Floridan aquifer and withdrawing it when needed, and (3) treating the Upper Floridan water directly by reverse osmosis (RO). Previous study of the water quality in the Floridan aquifer system in southern Florida has not been done on a comprehensive basis, and an evaluation of background data is needed.

OBJECTIVE: Objectives for the characterization of the geochemistry of the Floridan aquifer system are as follows: (1) delineate zones of high permeability in the Floridan, (2) delineate geochemical zones in the Floridan (zones of similar water quality), (3) determine possible geochemical areal trends in constituents that may affect the use of Floridan aquifer system water for RO processing or blending, and (4) use geochemical modeling techniques to determine the state of equilibrium of ground water with respect to minerals present within the aquifer and determine the effects of mixing Upper Floridan water with Biscayne aquifer water.

APPROACH: Zones of high permeability will be defined, along with geologic units, on cross sections using geophysical logs of key wells and data from aquifer tests and core samples at existing wells. Zones of similar water chemistry will be delineated based upon total dissolved solids and major ion concentrations using samples produced from specified intervals in the Floridan placement of geochemical zone boundaries will be made taking into account the hydrogeology and flow system boundaries. Areal geochemical trends within a zone will be mapped using constituents such as dissolved solids and chloride. Consideration will be given to the hydrogeology, ground-water movement, and possible recharge areas when defining a trend. Geochemical modeling of the Upper Floridan will involve using U.S. Geological Survey models, such as PHREEQE and SOLMINEQ. These models output thermodynamic speciation calculations, the equilibrium state with respect to minerals (saturation index), and reaction path simulations.

PROGRESS: Most of the existing water-quality data have been collected and preliminary constituent concentration maps have been made for the Upper Floridan aquifer. Some of the logs on key wells have been digitized and stored in a data base. Mixing of Biscayne and Upper Floridan waters has been simulated using PHREEQE.

PLANS FOR THIS YEAR: Continue with the compilation and evaluation of existing water quality, geophysical log, and core data, particularly the data collected by consulting firms in connection with the drilling of municipal wastewater injection wells in the Floridan. Continue digitizing well logs, and construct cross sections using these data. Collect water-quality samples from existing wells open to the Floridan aquifer and begin the geochemical zonations based upon available data.

FL-514 APPLICATION OF GROUND-PENETRATING RADAR METHODS IN HYDROGEOLOGIC STUDIES IN A KARST AREA, WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1989

DATE PROJECT ENDS: December 1991

PRINCIPAL INVESTIGATOR: G.L. Barr, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: Ground-penetrating radar (GPR) is a relatively new surface geophysical method that produces a continuous high-resolution profile of the shallow subsurface. Experimental testing in west-central Florida has demonstrated the method's potential for defining the stratigraphy of shallow formations and depth to water table, in filled sinkholes, underground cavities, and burial tanks and pipes. Although GPR records are easy to obtain, their interpretation should be made by an experienced geophysicist. There is a need to a study of GPR methods and a handbook that explains how to interpret records obtained in Florida's karst environment.

OBJECTIVE: The study will investigate the use of GPR to profile and subsequently delineate subsurface features in a karst area. Several hydrogeologic settings will be explored to determine the limitations and uses of GPR methods in hydrogeologic studies.

APPROACH: Study sites in Pinellas and Hillsborough Counties will be profiled. The Pinellas County sites include the sinkhole-riddled Eldridge-Wilde well field, the swampy Eastlake well field, a proposed tract for well field expansion, and a karst area in Hillsborough County where photolineaments were delineated. Each site has an area greater than 1 square mile. At least ten 500-foot-long test profiles will be made at each site. Subsurface features that should be recognizable in the GPR records include: (1) depth to water table, (2) depth to bedrock, (3) thickness of confining beds, (4) breaches in confining beds, (5) fractures and joints, (6) underground cavities, (7) buried objects and (8) structure beneath a lake. Records made on land will be compared to those made on water to evaluate how organic substances affect the record. Topographic and geologic controls for the GPR profiles will be obtained by surveying and auger drilling, with at least one test hole along each transect. Shallow wells will be installed at selected breaches in the intermediate confining unit. Water- level measurements and GPR profiles will be used to detect depressions in the water table, thereby substantiating or refuting the hypothesis that downward leakance is enhanced in such areas.

PROGRESS: Attempts to install 2-inch PVC casing to be used for gamma logging using the U.S. Geological Survey miniauger were unsuccessful at East Lake where the water table was very shallow (1-2 feet), because wet, loose sediments filled the boring and prevented the installation of casing. A report outline was prepared. Preparation of the manuscript, illustrations, and table was started.

PLANS FOR THIS YEAR: Contract private driller to install test wells. Cutting samples will be collected to define lithology along selected radar traverses. Lithologic and gamma logs will help verify radar profiles. Use U.S. Geological Survey geophysical logger for gamma logs at five test wells. Complete manuscript and send through review process. Publish report.

FL-515 REGIONALIZATION OF LOW-FLOW CHARACTERISTICS IN STREAMS IN NORTHERN FLORIDA

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: March 1994

PRINCIPAL INVESTIGATOR: Roger P. Rumenik, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Regulation and the Suwannee River Water Management District

PROBLEM: Demands for low-flow information in many areas of Florida exceed the capabilities of existing data-collection resources. To meet these demands, methods of estimating low-flow characteristics at sites with little or no streamflow data (ungaged sites) are needed. Methods using multiple regression analysis could provide significant benefits for managers responsible for protecting surface-water quality, and allocation of surface-water supplies. In addition, new measurement sites are needed in basins that lack an adequate number of low-flow measurement sites. The additional sites are needed to establish an acceptable network of low-flow stations to support regional models or other methods of estimating low-flow characteristics.

OBJECTIVE: (1) To develop regional models using multiple-linear regression analysis to estimate the magnitude and frequency of low-flows at sites where little or no streamflow information is available, (2) to develop alternate methods for estimating low-flow frequency data in areas where use of the models does not provide favorable results, and (3) to augment low-flow information by designing a network of low-flow data-collection stations. This network will increase the coverage of data available for regional analyses.

APPROACH: Analysis of variance (ANOVA) will be used to test approximately 10 to 15 basin characteristics for their significance to regional variability of low flow. Ordinary least squares and estimated generalized least squares regression analysis will be used to estimate functional relations between low-flow characteristics and basin characteristics found to be significant by the ANOVA analysis. Alternate methods of estimating low-flow characteristics at ungaged sites will be examined concurrently when testing regression techniques.

The adequacy of the data base, as it applies to each river basin, will be evaluated. The results of the evaluation will be used to design a data-collection network of selected sites where base-flow measurements are needed.

PROGRESS: New project.

PLANS FOR THIS YEAR: Review low-flow data available for model studies. Collect additional low-flow data. Review basin characteristics data for model studies. Make preliminary model runs (multiple regression analyses).

FL-516 UNSATURATED FLOW AND TRANSPORT UNDER RAPID INFILTRATION BASINS

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: David Sumner, Orlando

COOPERATING AGENCY: Reedy Creek Improvement District

PROBLEM: Beginning in 1991, the Reedy Creek Improvement District will discharge up to 15 million gallons per day of treated sewage effluent into rapid infiltration basins (RIBS) southwest of Orlando. The effects of this practice on the quality and quantity of local surface-water and ground-water resources are unknown. Because infiltration is largely an unsaturated-flow process, a better understanding of unsaturated flow and transport in the soil and surficial aquifer system under and around the RIBS is necessary to predict the effects of the RIBS on local hydrology. What is known of unsaturated flow and transport in this area and their interaction with the regional ground-water system is principally derived from limited laboratory investigations or studies of the upper soil horizons only.

OBJECTIVE: (1) Characterize flow and transport in the unsaturated zone beneath RIBS in central Florida, (2) evaluate the long-term effects on chemical and physical properties of the surficial aquifer system beneath RIBS, and (3) assess the interaction of RIBS hydrology with local water-table and ground-water recharge.

APPROACH: (1) Two basins will be instrumented to measure the rate and quality of moisture moving vertically and horizontally through the surficial aquifer system during infiltration events, and to monitor changes in the water-table and underlying aquifer system. Inverse problem techniques (advancing front, or others) will be applied to determine principal hydrologic characteristics that describe or control flow and transport (hydraulic conductivity function, soil moisture retention curves, among others) and the results will be compared to values determined from cores in laboratory tests.

(2) Soil samples will be collected from six basins before discharge infiltration begins and after 2 years of normal operation. Changes in soil chemistry and physical properties will be related to the quality, duration, and intensity of inflow.

(3) Observations about unsaturated flow and transport will be combined with regional ground-water flow models and hydrologic budgets to assess RIBS effects on subregional and local hydrology.

PROGRESS: New project.

PLANS FOR THIS YEAR: Set up a weather station to record rainfall, temperature, and other data to evaluate daily evaporation and net recharge; (2) select six basins for soil sampling and two for instrumentation, (3) obtain neutron probe and soil moisture monitoring equipment, (4) sample soils on all six basins at several locations and depths in each, and (5) drill shallow wells, obtain intact core samples, and install instruments (well recorders and soil moisture sensors) on two basins.

FL-517 A DIRECT METHODOLOGY FOR PREDICTING WETLAND RESPONSES TO HYDROLOGIC STRESSES

DATE PROJECT BEGAN: April 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Edward R. German, Orlando

COOPERATING AGENCY: Volusia County and St. Johns River Water Management District

PROBLEM: Deterministic models simulating ground-water/wetlands flow are usually mathematically complex, regional in scope, and require large amounts of time and expense to develop. Site specific models to quickly evaluate effects of development on wetlands hydrologic systems are often not practical for use by water-resources managers.

OBJECTIVE: To develop a direct, simple methodology for estimating the effects of development on wetland hydrology when given measurable, physical parameters and variables.

APPROACH: The overall design of the study is to use a surface-water/ground-water simulation model, the parameters of which are controlled by experimental design, to provide results that can be analyzed by regression techniques to produce simple analytical tools useful for estimating the effects of hydrologic stresses on a wetland environment.

A calibrated flow model will be initially prepared, covering a wetlands area of Volusia County, an adjacent uplands area, and a surface-water outflow channel. Although calibration data do not presently exist, a field site will be established during the earliest part of the study. After calibration, numerous model runs will be made, each time changing some of the parameter and external-variable values of the model, as directed by experimental-design techniques. Statistical methods (most likely linear regression analysis) will be used to analyze model output to generate simple equations, plots, and/or nomographs relating model results with input parameters and variables. These analyses represent the final product of this study and can be readily used by water-resource managers in place of further flow modeling to help evaluate the effects of hydrologic stresses on a site-by-site basis.

PROGRESS: New project.

PLANS FOR THIS YEAR: Conduct a literature search, develop a conceptual model of the field site, pick a field site and start to instrument the field site, and choose the models that will be used in the simulation.

FL-518 INFLUENCE OF TREATED MUNICIPAL WASTEWATER ON THE LEACHING AND RETENTION OF PESTICIDES IN THE UNSATURATED ZONE

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: R.L. Miller, Tampa

COOPERATING AGENCY: Florida Department of Environmental Regulation (FDER)

PROBLEM: Reuse of treated municipal wastewater for nonpotable uses, such as irrigation of public and private green areas, is expected to become an important part of sound water-conservation practices, especially in areas experiencing water shortages. The effect of humic and fulvic acids, surfactants, and other soluble organic compounds on the solubility, adsorption, degradation, and movement of pesticides in the unsaturated zone is poorly understood. This lack of information limits the ability of environmental scientists and regulators to wisely balance the need to reuse municipal wastewater for irrigation with the need to provide adequate protection of potable ground-water supplies.

OBJECTIVE: (1) To determine if selected pesticides applied to golf courses receiving treated municipal wastewater are leached into ground water, and (2) to evaluate the effect of treated municipal wastewater on leaching potential by studying the mechanisms of interaction between wastewater and pesticides.

APPROACH: In phase I, three pairs of golf courses will be selected. Each pair will consist of one golf course that uses municipal wastewater for irrigation and another golf course with similar hydrogeology and pesticide-application practices that does not receive wastewater. Monitoring wells will be installed where needed and ground water will be sampled quarterly for 1 year for pesticides, nutrients, major ions, and trace elements. A limited number of tension lysimeters will be installed to sample water from the unsaturated zone for selected pesticides. In phase II, laboratory, green house, or test-plot experiments will be devised to study the mechanisms that increase or decrease the leaching of selected pesticides from the unsaturated zone.

PROGRESS: New study.

PLANS FOR THIS YEAR: A project quality assurance plan will be developed for FDER review and approval. Develop, distribute, and evaluate a questionnaire that will be sent to golf course superintendents in selected parts of Florida. Select three pairs of golf courses for study in phase I. Wells will be installed and sampled quarterly thereafter for 1 year. Begin evaluation of phase I data and planning for phase II.

FL-519 EVALUATION AND DESIGN OF GROUND-WATER MONITORING NETWORKS FOR BROWARD COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1991

DATE PROJECT ENDS: June 1993

PRINCIPAL INVESTIGATOR: Roy Sonenshein and Eric D. Swain, Miami

COOPERATING AGENCY: South Florida Water Management District
Broward County Office of Natural Resources Protection

PROBLEM: Networks to monitor saltwater intrusion, ground-water quality, and water-table elevation have been developed in Broward County, but these networks have not kept up with the growth in the county. Other networks, such as those set up by well-field operators for well-field protection, have not been included in a comprehensive ground-water monitoring system. New canals and water-management structures, changing land use, and expansion of municipal well fields have resulted in wells no longer monitoring the situations they were originally designed to monitor. Thus, a need exists to evaluate the current ground-water monitoring network, develop criteria for future monitoring needs, and design optimal regional monitoring networks.

OBJECTIVE: (1) Develop criteria for monitoring saltwater intrusion, water-table elevation, well-field protection zones, and regional water quality; (2) develop methods for designing monitoring networks based on mathematical models and statistical techniques; and (3) design regional monitoring networks, with the ultimate objective of eliminating existing monitoring wells that do not meet criteria or are redundant and determining the location and type of additional wells where data are lacking.

APPROACH: (1) Develop criteria for each of the monitoring requirements with officials of the cooperating agencies based on consideration of cost, well construction, quantities to be monitored, adequacy of past collected data, and predicted changes in water quality in important locations; (2) develop techniques for evaluating the monitoring network using geostatistical techniques, ground-water flow models, and GIS data; (3) evaluate existing network and design new network for Broward County using the criteria and techniques developed in the first two parts; and (4) prepare documentation reports describing the techniques developed and the results of the analyses. A final Water-Resources Investigations Report, tying together all the phases, will be prepared.

PROGRESS: New project.

PLANS FOR THIS YEAR: The monitoring criteria will be worked out with the cooperators. An inventory of existing monitoring wells will be made and the necessary GIS data for land use and pollutant tracking will be compiled. The required data for computer modeling of canal-aquifer relations for implementation in the pollutant and saltwater intrusion tracking will be surveyed.