WATER RESOURCES ACTIVITIES IN FLORIDA, 1993-94

Compiled by Mildred E. Glenn

U.S. GEOLOGICAL SURVEY
Open-File Report 94-330

List of Cooperating Agencies

Florida Dept. of Environmental Protection
Florida Dept. of Transportation
Florida Game & Fresh Water Fish Commission
Florida Institute of Phosphate Research
Florida Keys Aqueduct Authority
Jacksonville Electric Authority
Joshua Water Control District
Metro-Dade Environmental Resources Management
Miami-Dade Water & Sewer Management District
Northwest Florida Water Management District
Reedy Creek Improvement District
St. Johns River Water Management District
South Florida Water Management District
South Indian River Water Control District
Southwest Florida Water Management District
Suwannee River Water Management District
Tampa Bay Regional Planning Council
Tampa Port Authority
Volusia City-County Water Supply Coop.
West Coast Regional Water Supply Authority
Bay County
Broward County
Hillsborough County
Lake County Water Authority
Lee County
Manatee County
Orange County
Pinellas County
Polk County
Santa Rosa County
Sarasota County
Volusia County
Walton County
City of Boca Raton
City of Cocoa
City of Bradenton
City of Daytona Beach
City of Cape Coral
City of Fort Lauderdale
City of Hallandale
City of Hollywood
City of Jacksonville
City of Lake Mary
City of Perry
City of Pompano Beach
City of Port Orange
City of Quincy
City of St. Petersburg
City of Sarasota
City of Stuart
City of Tallahassee
City of Tampa
City of Winter Park
Town of Highland Beach
U.S. Air Force, MacDill Base
U.S.D.O.I, National Park Service
U.S. Army Corps of Engineers
U.S. Navy

Tallahassee, Florida
1994

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Gordon P. Eaton, Director

For additional information write to:

District Chief
U.S. Geological Survey
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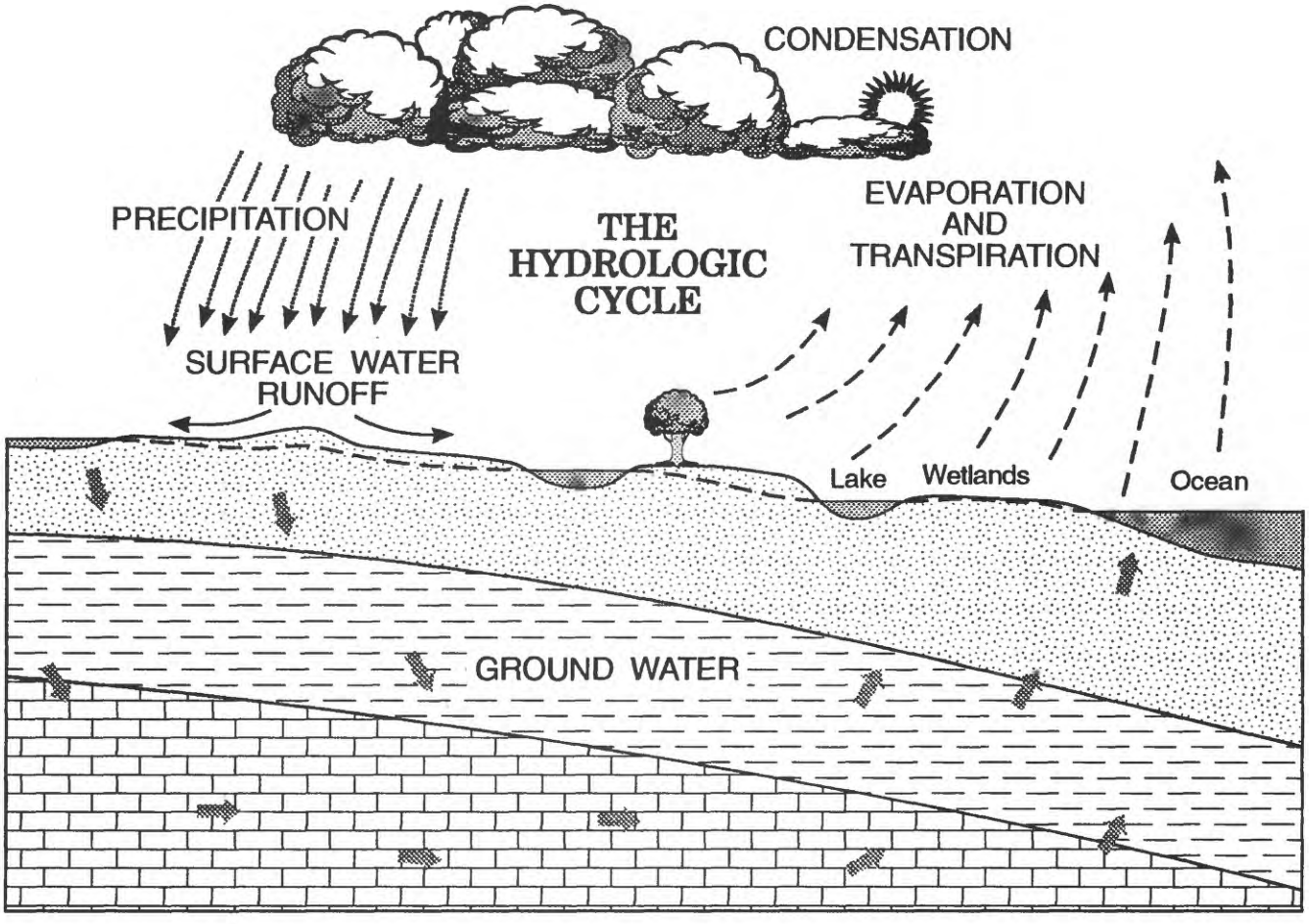
FOREWORD

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 fact-finding 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, 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 media.
- 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.

The Water Resources, National Mapping, and Geologic Divisions 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, Branch of Distribution, Federal Center, P.O. Box 25286, MS-306, Denver, Colorado 80225.


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

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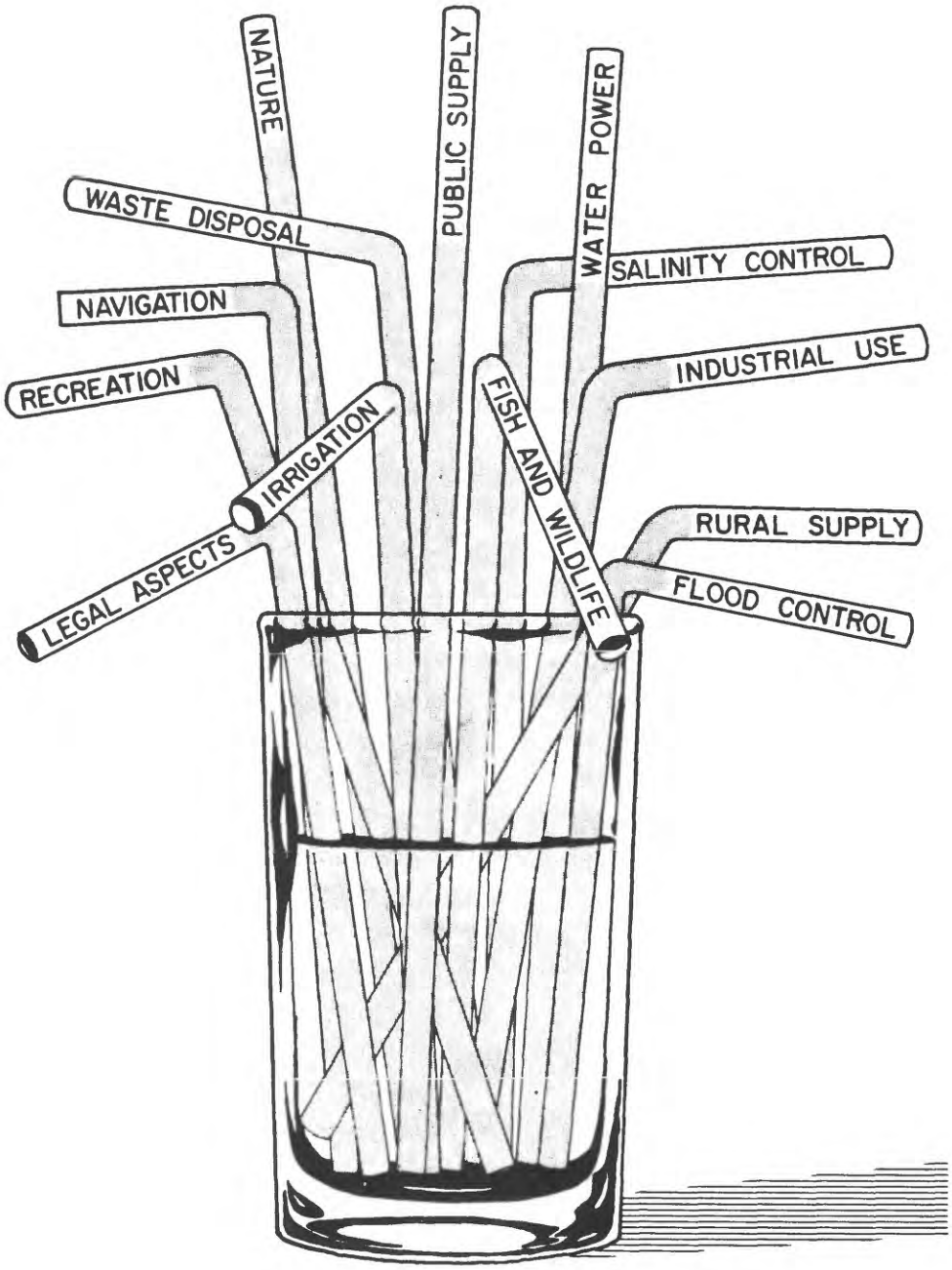
COMPETITION FOR WATER



WATER RESOURCES ACTIVITIES IN FLORIDA, 1993-94
Compiled by Mildred E. Glenn

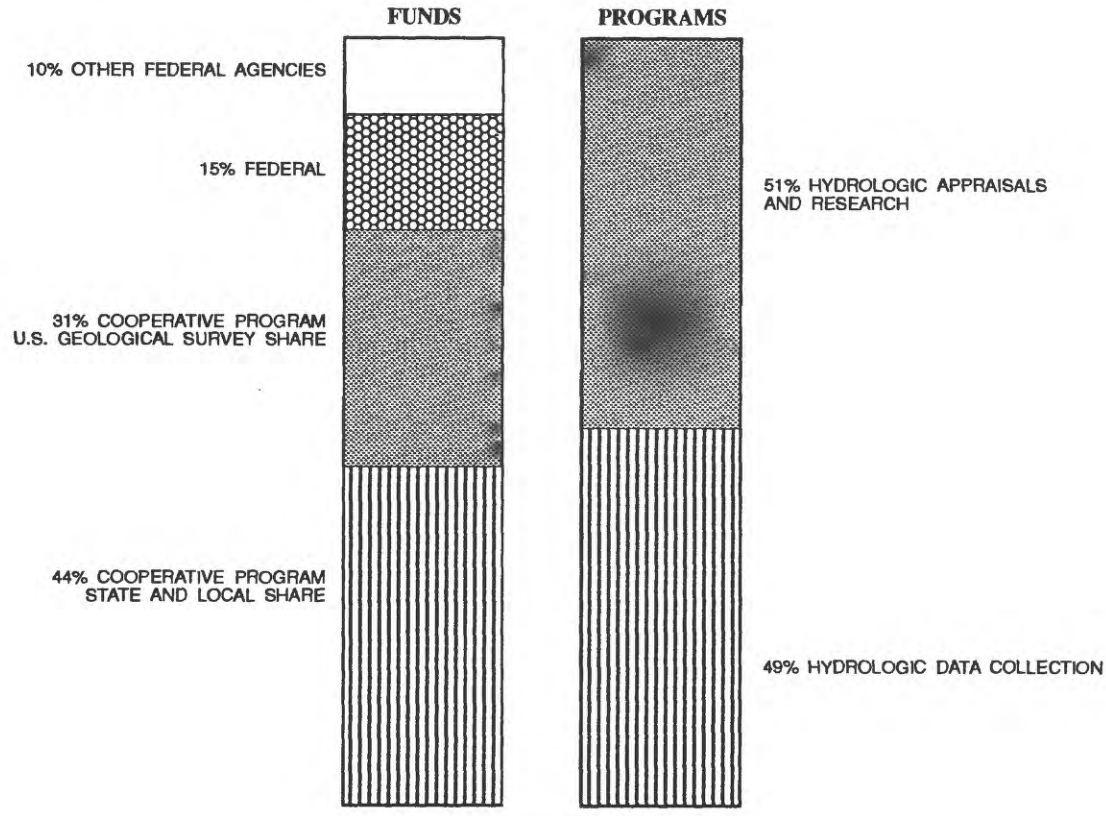
INTRODUCTION

This report contains descriptions 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 1993-94. 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 1993, and anticipated accomplishments during 1994. This report is intended to inform those agencies interested in the water resources of Florida as to the current status and objectives of the U.S. Geological Survey Cooperative Program. Almost all of this work is done in cooperation with other public agencies.

Florida is a water-oriented State that, for many years, has experienced a significant increase in population, attendant urban growth, and all the problems associated with such growth, particularly problems of protecting and preserving environmental quality. Because 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 conducted by the Florida District are highly diversified, ranging from hydrologic records networks to interpretive appraisals of water resources and applied research to develop investigative techniques. Thus, water-resources 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 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 can 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 areas. 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.



Source of funds and type of program, Florida District, 1993-94

WATER RESOURCES DIVISION PROGRAM

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 suggested by State and local agencies and the public constitute a major part of the planning process; thus, program development is an effort that is responsive to 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 can be described under three headings: long-term programs, topical programs, and technical-assistance 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 national water-quality assessment.

Technical-assistance programs include the instrumentation programs, a national 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, 1993

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 district, and at libraries of the State University system. Write to the Geological Survey District Office in Tallahassee for information regarding the availability of these publications.

Barr, G.L., 1993, Application of ground-penetrating radar methods in determining hydrogeologic conditions in a karst area, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 92-4141, 26 p

Barr, G.L., 1993, Potentiometric surface of the Upper Floridan aquifer in Florida, May 1990:Florida Geological Survey Map Series 138, 1 sheet.

Berndt, M.P., 1993, Ground-water quality near an inactive landfill and sludge-spreading area, Tallahassee, Florida: U.S. Geological Survey, Water-Resources Investigations Report 93-4027, 23 p.

Bidlake, W.R., Woodham, W.M., and Lopez, M.A., 1993, Evapotranspiration from areas of native vegetation in west-central Florida: U.S. Geological Survey Open-File Report 93-415, 35 p.

Fernandez, Mario, Jr., and Hutchinson, C.B., 1993, Hydrogeology and chemical quality of water and bottom sediment at three stormwater detention ponds, Pinellas County, Florida: U.S. Geological Survey Water-Resources Investigations Report 92-4139, 31 p.

Glenn, M.E., ed., 1993, Water resources activities in Florida, 1992-1993: U.S. Geological Survey Open-File Report 93-67, 99 p.

Hampson, P.S., 1993, Hydrology and water quality of Reedy Creek in the Reedy Creek Improvement District, Central Florida, 1986-89: U.S. Geological Survey Water-Resources Investigations Report 93-4006, 57 p.

Hutchinson, C.B., Sanders, G.L., and Duerr, A.D., 1993, Underground injection in southwest Florida: U.S. Geological Survey Open-File Video Report 93-450.

Irwin, G.A., and Swihart, T.M., 1993, Florida stream water quality *in* Paulson, R.W.; Chase, E.B.; Williams, J.S., and Moody, D.W., compiler, National Water Summary 1990-91--Hydrologic Events and Stream Water Quality: U.S. Geological Survey Water Supply Paper 2400, 590 p.

Katz, B.G., 1993, Biogeochemical and hydrological processes controlling the transport and fate of 1,2-Dibromoethane (EDB) in soil and ground water, central Florida: U.S. Geological Survey Water-Supply Paper 2402, 35 p.

Katz, B.G., in press, Chemical evolution of ground water near a sinkhole lake, northern Florida: 1. Flow patterns, age of ground water, and influence of lakewater leakage.

Katz, B.G., in press, Chemical evolution of ground water near a sinkhole lake, northern Florida: 2. Chemical patterns, mass-transfer modeling, and rates of chemical reactions.

Lewelling, B.R., and Wylie, R.W., 1993, Hydrology and water quality of unmined and reclaimed basins in phosphate-mining areas, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 93-4002, 93 p.

Marella, R.L., 1993, Public-supply water use in Florida, 1990: U.S. Geological Survey Open-File Report 93-134, 46 p.

Marella, R.L, Fanning, J.L., and Mooty, W.S., 1993, Estimated use of water in the Apalachicola-Chattahoochee-Flint River basin during 1990 with State summaries from 1970 to 1990: U.S. Geological Survey Water-Resources Investigations Report 93-4084, 45 p.

Mularoni, R.A, 1993, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, September 1992: U.S. Geological Survey Open-File Report 93-49, 1 plate.

Mularoni, R.A, 1993, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, September 1992: U.S. Geological Survey Open-File report 93-53, 1 plate.

Mularoni, R.A., 1993, Potentiometric surface of the Upper Floridan aquifer, west-central Florida, May 1993: U.S. Geological Survey Open-File Report 94-32, 1 sheet.

Mularoni, R.A., 1993, Potentiometric surfaces of the intermediate aquifer system, west-central Florida, May 1993: U.S. Geological Survey Open-File Report 94-34, 1 sheet.

Murray, L.C., Spechler, R.M., Phelps, G.G., and Bradner, L.A., 1993, Potentiometric surface of the Upper Floridan aquifer in the St. Johns River Water Management District and vicinity, Florida, September 1992: U.S. Geological Survey Open-File Report 93-50, 1 sheet.

Russell, G.M., and Wexler, E.J., 1993, Hydrogeology and simulation of ground-water flow near the Lantana landfill, Palm Beach County, Florida: U.S. Geological Survey Water-Resources Investigations Report 92-4107, 55 p.

Schiner, G.R., 1993, Geohydology of Osceola County, Florida: U.S. Geological Survey Water-Resources Investigations Report 92-4076, 68 p.

Schoellhamer, D.H., 1993, Response threshold, biological interference, and calibration of optical backscatterance sensors in Tampa Bay, Florida: Elsevier Science Publishers, B.F. Amsterdam, Marine Geology Jour. 110, p. 303-313

Schoellhamer, D.H., 1993, Resuspension of bottom sediments, sedimentation, and tributary storm discharge at Bayboro Harbor and the Port of St. Petersburg, Florida: U.S. Geological Survey Water-Resources Investigations Report 92-4127, 28 p.

Swain, E.D., 1993, Documentation of a computer program (streamlink) to represent direct-flow connections in a coupled ground-water and surface-water model: U.S. Geological Survey Water-Resources Investigations Report 93-4011, 62 p.

Swain, E.D., and Wexler, E.J., 1993, A coupled surface-water and ground-water flow model for simulation of stream-aquifer interaction: U.S. Geological Survey Open-File Report 92-138, 162 p.

Trommer, J.T., 1993, Effects of effluent spray irrigation and sludge disposal on ground water in a karst region, northwest Pinellas County, Florida: U.S. Geological Survey Water-Resources Investigations Report 91-4181, 32 p.

Trommer, J.T., 1993, Description and monitoring of the saltwater transition zone in aquifers along the west-central coast of Florida: U.S. Geological Survey Water-Resources Investigations Report 93-4120, 56 p.

U.S. Geological Survey, 1993, Water resources data Florida, water year 1992, v. 4, northwest Florida: U.S. Geological Survey Water-Data Report FL-92-4, 162 p.

In addition to published material, The National **WAT**er Data **STO**rage and **RE**trieval System (WATSTORE) was established for handling water data collected through the activities of the U.S. Geological Survey and to provide for more effective and efficient means of releasing the data to the public. The system is operated and maintained on the central computer facilities of the Survey at its National Center in Reston, Virginia.

WATSTORE can provide a variety of useful products ranging from simple data tables to complex statistical analyses. A minimal fee, plus the actual computer cost incurred in producing a desired product, is charged to the requester. Information about the availability of specific types of data, the acquisition of data or products, and user charges can be obtained locally from the offices whose addresses are given on the back of the front cover.

General inquiries about WATSTORE can be directed to:

Marvin Franklin
U.S. Geological Survey
227 N. Bronough Street
Suite 3015
Tallahassee, FL 32301
(904) 942-9500, Ext. 3058

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The Florida District has been preparing reports of 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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Geological Survey"
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Reston, VA 22092

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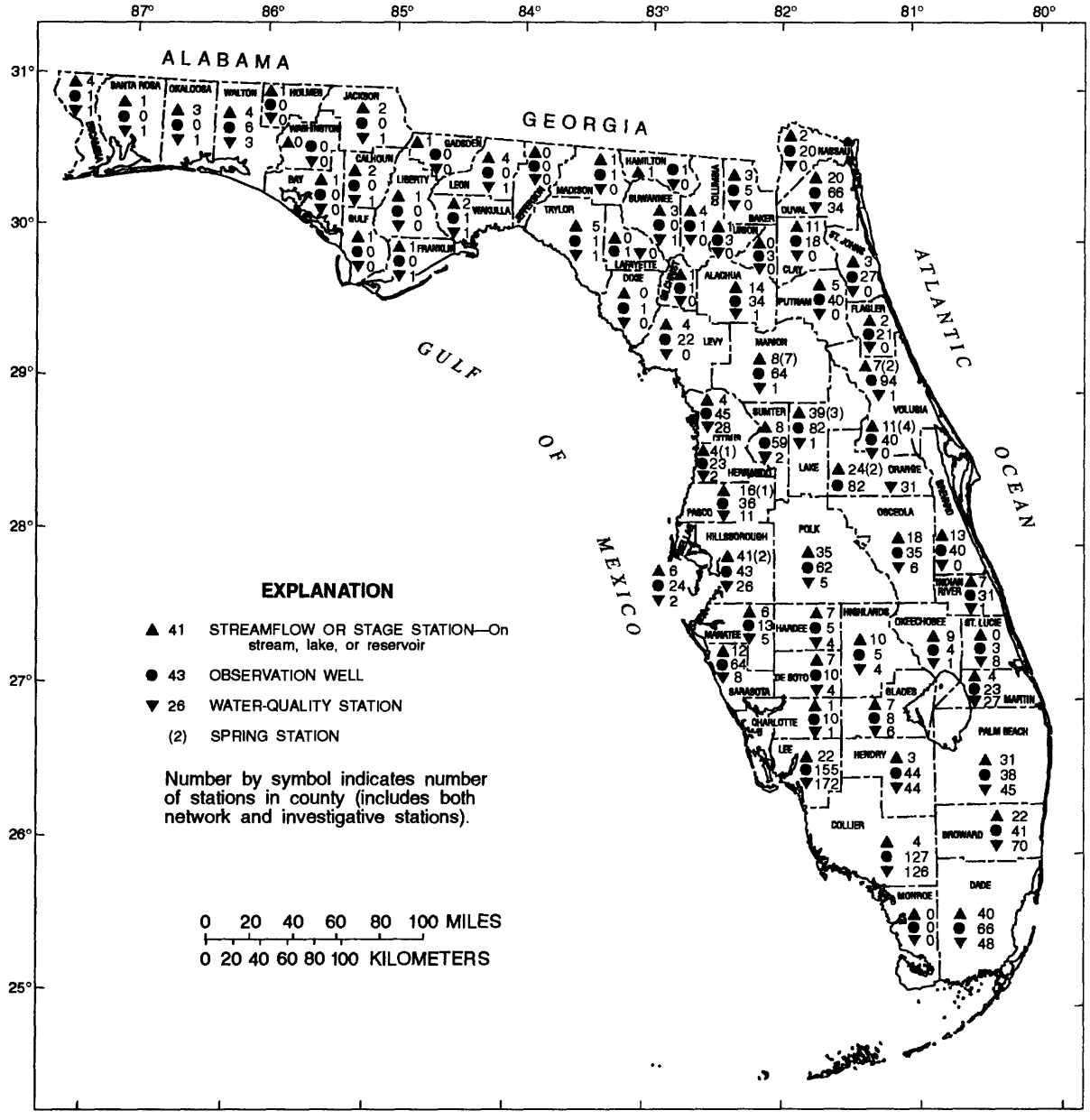
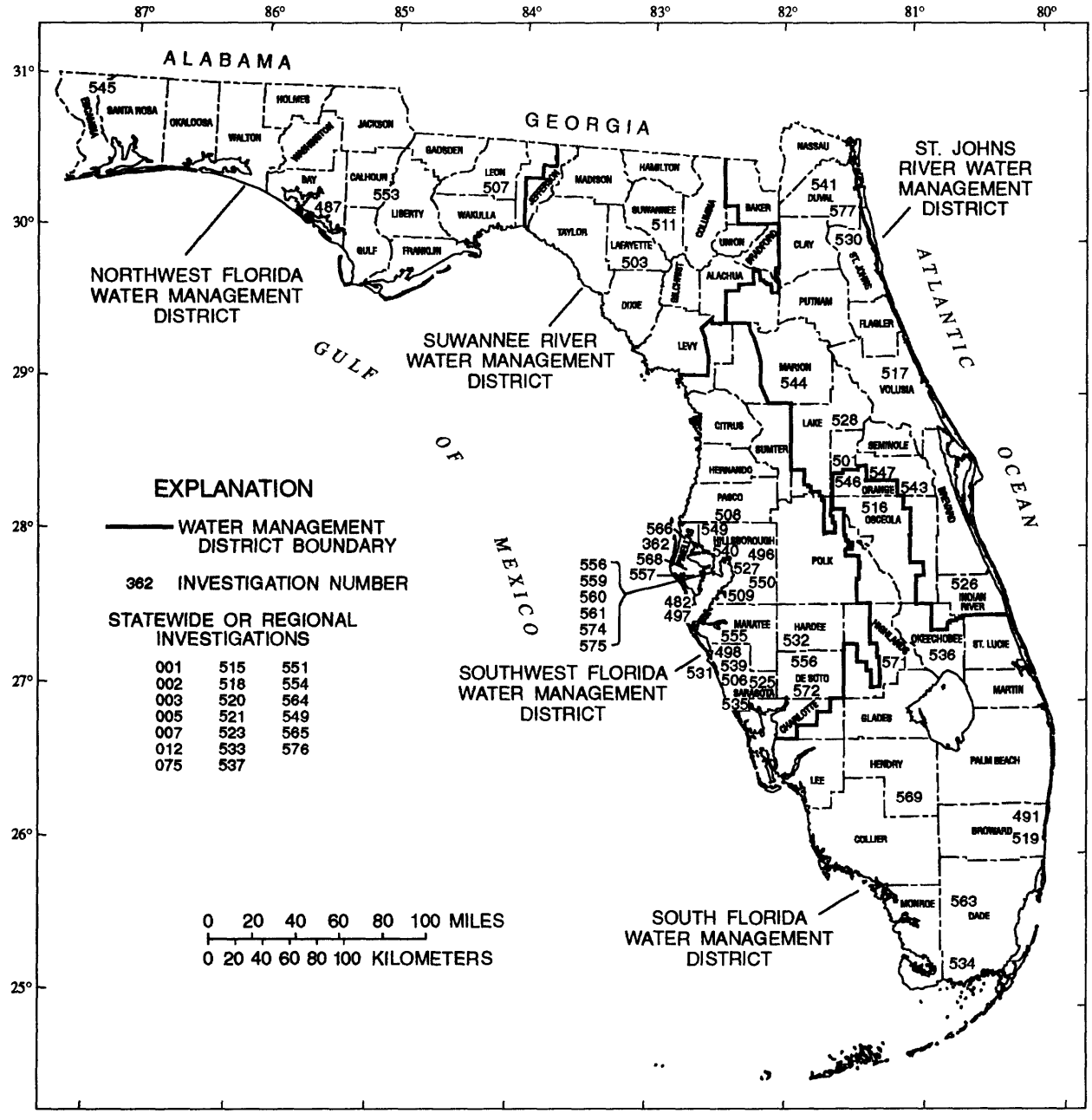


Hydrologic data stations in Florida as of September 1993.

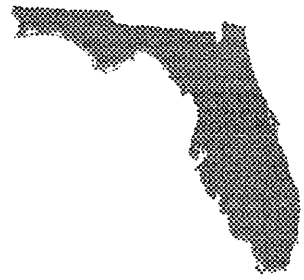
LOCATION OF FLORIDA DISTRICT PROJECT ACTIVITIES



FLORIDA DISTRICT PROJECT ACTIVITIES

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

- Number
- Title
- Period of project
- Principal investigator
- 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: Marvin Franklin, Tallahassee

PRINCIPAL INVESTIGATORS: W. S. Gain, Orlando; Russ Curtis, Miami; J. E. Coffin,Tampa; and 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 582 network sites and prepared for publication. Streamflow and stage data currently are being obtained at the number of hydrologic data network stations given below.

Station Classification	Number of Stations
Stream stations	466
Continuous record:	
Discharge and stage	306
Stage only	98
Partial record:	
Peak (maximum) flow	33
Periodic streamflow	29
Lake and reservoir stations	116
Stage and contents	3
Stage only:	
Continuous	41
Periodic	72

(FL-001)

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

REPORTS IN PROCESS: Water-resources data for Florida, water year 1993.

REPORTS RELEASED:

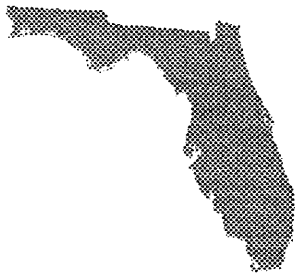
U.S. Geological Survey, 1992, Water resources data, Florida, water year 1992, volume 1A, northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-92-1A, 444 p.

_____1992, Water resources data, Florida, water year 1992, volume 2A, south Florida Surface water: U.S Geological Survey Water-Data Report FL-92-2A, 211 p.

_____1992, Water resources data, Florida, water year 1992, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-92-3A, 291 p.

_____1992, Water resources data, Florida, water year 1992, volume 4, northwest Florida surface water: U.S. Geological Survey Water-Data Report FL-92-4, 162 p.

FL-002 GROUND-WATER NETWORK STATIONS



DATE PROJECT BEGAN: 1926

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: Marvin Franklin, Tallahassee

PRINCIPAL INVESTIGATORS: W.S. Gain, Orlando; Russ Curtis, Miami; J. E. Coffin,Tampa; and 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 that includes 2,276 periodic observation sites and 432 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 continue.

REPORTS IN PROCESS: Water-resources data for Florida, water year 1993.

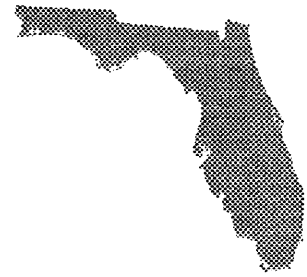
REPORTS RELEASED:

U.S. Geological Survey 1992, Water resources data, Florida, water year 1992, volume 1B, northeast, Florida ground water: U.S. Geological Survey Water-Data Report FL-92-1B, 354 p.

_____1993, Water resources data, Florida, water year 1992, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-92-2B, 406 p.

_____1993, Water resources data, Florida, water year 1992, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-92-3B, 249 p.

_____1993, Water resources data, Florida, water year 1992, volume 4, northwest Florida: U.S. Geological Survey Water Data Report FL-92-4, 162 p.



FL-003 QUALITY OF WATER NETWORK STATIONS

DATE PROJECT BEGAN: 1939

DATE PROJECT ENDS: Continuing

PROJECT COORDINATOR: Marvin Franklin, Tallahassee

PRINCIPAL INVESTIGATOR: R.A. Craig, Orlando; Russ Curtis, Miami; J.E. Coffin, Tampa; and M.A. Franklin, Tallahassee

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

PROBLEM: Water-resource planning and water-quality assessment require a nationwide basic level of relatively standardized information. For 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 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-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 141 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, but 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	115
Sediment	20
Chemical data:	
Inorganic constituents	72
Organic constituents	87
Pesticides	20
Radiochemical data	3
Biological data	16

(FL-003)

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, but 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	658	4
Chemical data:		
Inorganic constituents	629	4
Organic constituents	27	1
Biological data	5	1

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

REPORTS IN PROCESS: Water-resources data for Florida, water year 1993.

REPORTS RELEASED:

U.S. Geological Survey, 1993, Water resources data, Florida, water year 1993, volume 1A northeast Florida surface water: U.S. Geological Survey Water-Data Report FL-92-1A, 444 p.

_____1993, Water resources data, Florida, water year 1993, volume 1B, northeast Florida ground water: U.S. Geological Survey Water-Data Report FL-92-1B, 354 p.

_____1993, Water resources data, Florida, water year 1993, volume 2A, south Florida surface water: U.S Geological Survey Water-Data Report FL-92-2A, 211 p.

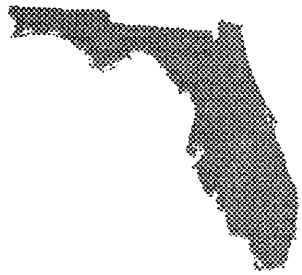
_____1993, Water resources data, Florida, water year 1993, volume 2B, south Florida ground water: U.S. Geological Survey Water-Data Report FL-92-2B, 406 p.

_____1993, Water resources data, Florida, water year 1993, volume 3A, southwest Florida surface water: U.S. Geological Survey Water-Data Report FL-92-3A, 291 p.

_____1993, Water resources data, Florida, water year 1993, volume 3B, southwest Florida ground water: U.S. Geological Survey Water-Data Report FL-92-3B, 249 p.

_____1993, Water resources data, Florida, water year 1993, volume 4, northwest Florida ground water: U.S. Geological Survey Water-Data Report FL-92-4,162 p.

FL-005 QUALITY OF PRECIPITATION



DATE PROJECT BEGAN: July 1983

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATORS: John E. Coffin, Tampa;
Jerilyn J. Collins, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: The amount of substances dispersed in the atmosphere and deposited by precipitation, aerosols, and bases is expected to continue to increase throughout North America. Thus, there is a need for careful measurements of the amounts, nature, and effects of these substances. Such measurements are essential for responsible management of the agricultural, forest, and aquatic ecosystems of the United States.

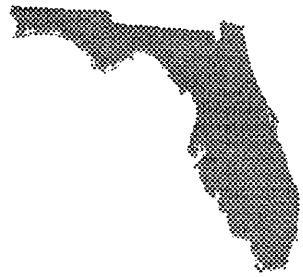
OBJECTIVE: The National Atmospheric Deposition Program (NADP) was created to conduct research on atmospheric deposition and its affect on surface waters and agricultural and forest lands in cooperation with Federal, State and private research agencies. The U.S. Geological Survey (USGS) is participating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

APPROACH: Basic data atmospheric deposition will be collected at NADP/NTN approved sites (FL14 and FL41). Methods of data collection and instrumentation conform to NADP procedures and guidelines. Data collection will be continuous with weekly sample collections in addition to collection of samples for nonstandard events. All samples will be 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 at the Verna well-field site near Sarasota, Florida (FL41), and at the Florida Agricultural Research Center near Quincy, Florida (FL14), according to NTN/NADP protocol.

PLANS FOR THIS YEAR: The NTN sites will be maintained and operated according to NADP/NTN standards and schedules. 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 AGENCY: Florida Department of Environmental Protection

PROBLEM: Florida's water resources are one of the States most valued assets. The State is underlain virtually everywhere by aquifers capable of yielding significant quantities of freshwater to wells and the State includes 1,700 streams and rivers and 7,800 freshwater lakes. These water resources are finite, however, and growth in population, tourism, and agricultural are placing an increasing demand on these resources. The increased demand for water has led to water shortages, encroachment of saltwater into freshwater aquifers, and increased competition for water in some parts of the State. A water-use data base is needed to document current usage and help determine trends in water-use both locally and Statewide. Information on the amount of water used, the location of use, the water source, along with the amount of water returned or discharged is needed by managers and scientist to help properly protect and regulate the States water resources.

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 Protection, 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, and (4) maintain a statewide water-use data base with current and historical information.

APPROACH: The water-use program will compile data for five major categories of water use for all 67 counties and five water management districts on a monthly basis. Data will be collected for all sources of withdrawal including fresh and saline, ground and surface water. Other data collected will include acreage irrigated for 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 commercial, 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 and other key agencies will be maintained on a periodic basis.

PROGRESS: Statewide water-use data for 1990 were compiled and disseminated through three reports. The first of these reports included a detailed summary of all 5 categories of water-use (public-supply, domestic self-supplied, commercial-industrial self-supplied, agricultural irrigation, and thermoelectric power generation), along with total water withdrawals by water management districts, counties, hydrological units, and principal aquifers. The second report summarizes public supply water withdrawals and use for 1990, and includes a detailed listing of nearly 1,000

utilities in Florida, and a third report summarizes domestic and industrial wastewater discharge for 1990, and includes a listing of discharge facilities for each county in Florida. Additionally, all of the 1990 water-use data that was compiled for Florida was summarized with water-use data from the other 49 States and published in a USGS national circular. A fourth report was also published that detailed water-use in the Apalachicola-Chattahoochee-Flint River Basin for 1990. This report summarized water withdrawals in the Apalachicola-Chattahoochee-Flint River basin during 1990 along with trends between 1970 and 1990. This multi-state report was a cooperative effort between the water-use specialists from Alabama, Florida, and Georgia.

During the 1993-94 fiscal year, 1991 public-supply data was collected and compiled for each county in Florida. Public-supply data was also compiled and summarized for 1986 and 1988, completing a continuous data set for monthly public-supply withdrawals in Florida from 1985 through 1991. Historical water-use data in Florida for each category, county and water management district was also compiled during the 1993-94 fiscal year. Data were obtained from the nearly 50 publications in Florida that contain water-use information at some level. This historical water-use data will be formatted into one publication, thus providing one source of data for all information between 1950 and 1990. Additionally, visited each water management district during the year to discuss current and future water-use work and exchange contacts and data.

PLANS FOR THIS YEAR: Continue working on the preparation of the historical water-use report. Will begin collection and compilation of the 1992 and 1993 public-supply withdrawal data. Possible development of a public supply facility data base may begin during the 1994-95 fiscal year which would include information on the location (latitude and longitude) of the public supply wells in Florida. A similar data base may be developed for the wastewater disposal facilities in Florida during this year. Will meet with each water management district during the fiscal year to discuss future data collection and assist with any problems.

REPORTS RELEASED:

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

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.

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

_____1978, Freshwater use in Florida, 1975: Florida Bureau of Geology Map Series 87.

_____1978, Source, use, and disposition of water in Florida, 1975: U.S. Geological Survey Water-Resources Investigations 78-17 (PB-284 126/AS), 90 p.

Leach, S.D., and Healy, H.G., 1980, Estimated water use in Florida, 1977: U.S. Geological Survey Water-Resources 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.

_____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 Investigations 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.

_____1983, Source, use, and disposition of water in Florida, 1980: U.S. Geological Survey Water-Resources Investigations 82-4090, 337 p.

Spechler, R.M., 1983, Estimated irrigation water use in Florida, 1980: Florida Bureau of Geology Map Series 106, 1 sheet.

Geiger, L.H., 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, 1 sheet.

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.

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., 1989, Freshwater withdrawals and water-use trends in Florida, 1985: Florida Geological Survey Map Series 123, 1 sheet.

(FL-007)

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.

_____1990, Public-supply water use in Florida, 1987: U.S. Geological Survey Open-File Report 90-596, 39 p.

_____1991, Water use in the Apalachicola-Chattahoochee-Flint River basin, 1985, *in* proceedings of the 1991 Georgia Water Resource Conference, March 19 and 20, 1991: Athens University of Georgia, Institute of Natural Resources, p. 9.

Bucca, Jane, and Marella, R.L., 1992, An improved method for determining the nonresidential water-use component of total public water-supply estimates, *in* Jones, M.E., and Laenen, Antonius (eds.), Interdisciplinary approaches in hydrology and hydrogeology: American Institute of Hydrology, October 19-21, 1992, Portland, Oregon, p. 511-523.

Holland, T.W., 1992, Water-use data collection techniques in the southeastern United States, Puerto Rico, and the U.S. Virgin Islands: Little Rock, Ark. U.S. Geological Survey Water-Resources Investigations Report 92-4028, 76 p.

Marella, R.L., 1992, Factors that affect public-supply water use in Florida, *with a section on* projected water use to the year 2020: U.S. Geological Survey Water-Resources Investigations Report 91-4123, 35 p.

_____1992, Water withdrawals, use, and trends in Florida, 1990: U.S. Geological Survey Water-Resources Investigations Report 92-4140, 38 p.

_____1992, Water withdrawals in Florida during 1990, with trends from 1950 to 1990: U.S. Geological Survey Open-File Report 92-80, 2 p.

_____1993, Public-supply water use in Florida, 1990: U.S. Geological Survey Open-File Report 93-134, 46 p.

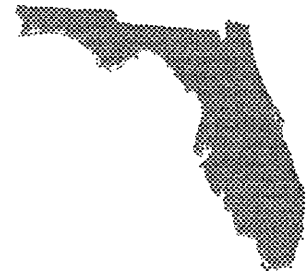
_____1993, Water use in the Apalachicola-Chattahoochee-Flint River basin, 1990, *in* Proceedings of the 1993 Georgia Water Resource Conference, April 20-21, 1993: Athens, University of Georgia, Institute of Natural Resources, p. 54-55

Marella, R.L., Fanning, J.L., and Mooty, W.S., 1993, Estimated use of water in the Apalachicola-Chattahoochee-Flint River basin during 1990, and trends in water use from 1970 to 1990: U.S. Geological Survey Water-Resources Investigations Report 93-4084, 45 p.

Solley, W.B., Pierce, R.R., and Perlman, H.A., 1993, Estimated use of water in the United States in 1990: U.S. Geological Survey Circular 1081, 76 p.

Marella, R.L., 1994, Estimated discharge of treated wastewater in Florida, 1990: U.S Geological Survey Open-File Report 93-364, 52 p.

FL-012 FLOOD ASSESSMENTS



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 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. Collect channel bottom data in tidal inlets for bridge scour.

PROGRESS: Equipment was ordered.

PLANS FOR THIS YEAR: Shift emphasis to bridge scour by installing monitoring system.

REPORTS RELEASED:

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

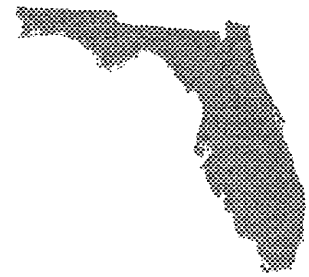
____ 1974, An analysis of 1972-73 floods on Monroe Street and St. Augustine Branch, Tallahassee, Florida: U.S. Geological Survey Open-File Report FL-74023, 14 p.

____ 1982, Technique for estimating magnitude and frequency of floods on natural-flow streams in Florida: U.S. Geological Survey Water-Resources Investigations 82-4012, 44 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, Flood of September 20-23, 1969, in the Gadsden County area, Florida: Florida Bureau of Geology Information Circular no. 79, 37 p.

FL-075 FLORIDA WATER ATLAS



DATE PROJECT BEGAN: September 1961

DATE PROJECT ENDS: Continuing

PRINCIPAL INVESTIGATOR: Anne Choquette, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Protection

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

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

APPROACH: Emphasis will be largely on graphical presentation of hydrologic data. Although each map will contain some text, it will be generalized and will be used to supplement the graphical presentation. No special or involved methods of synthesis or analysis are contemplated. All the maps will be of identical size and will depict conditions through the State. No field mapping or testing will be done; all maps will be prepared from existing data.

PROGRESS: Map report of the potentiometric surface of the Upper Floridan aquifer in Florida was published. Information is being compiled for a statewide map depicting low-flow discharge of Florida streams. Map report of low-flow discharge is in preparation.

PLANS FOR THIS YEAR: Finalize compilation of data and complete report on low-flow discharge of Florida streams.

REPORTS RELEASED:

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

_____1962, Piezometric surface and areas of artesian flow of the Floridan aquifer in Florida, July 6-17, 1961, (2d ed.): Florida Bureau of Geology Map Series 4, 1 sheet.

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, 1 sheet.

Hoy, N.D., 1964, Generalized water-table contours in southern Florida: Florida Division of Geology Map Series 7, 1 sheet.

Shattles, D.E., 1965, Quality of water from the Floridan aquifer in Hillsborough County, Florida, 1963: Florida Division of Geology Map Series 9, 1 sheet.

Toler, L.G., and Shampine, W.J., 1965, Quality of water from the Florida aquifer in the Econfina Creek basin area, Florida, 1962: Florida Division of Geology Map Series 10, 1 sheet.

Toler, L.G., 1965, Fluoride content of water from the Floridan aquifer of northwest Florida, 1963: Florida Division of Geology Map Series 11, 1 sheet.

Shampine, W.J., 1975, Chloride concentration in water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 12, 1 sheet.

_____1975, Hardness of water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 13, 1 sheet.

_____1975, Dissolved solids in water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 14, 1 sheet.

_____1975, Sulfate concentration in water from the upper part of the Floridan aquifer in Florida (2d ed.): Florida Bureau of Geology Map Series 15, 1 sheet.

Hyde, L.W., 1975, Principal aquifers in Florida (2d ed.): Florida Bureau of Geology Map Series 16, 1 sheet.

Shampine, W.J., 1965, Quality of water from the Floridan aquifer in Brevard County, Florida, 1963: Florida Division of Geology Map Series 17, 1 sheet.

Cherry, R.N., 1966, Chloride content of ground water in Pinellas County, Florida, in 1950 and 1963: Florida Division of Geology Map Series 20, 1 sheet.

Lichtler, W.F., and Joyner, B.F., 1966, Availability of ground water in Orange County, Florida: Florida Geological Survey Map Series 21, 1 sheet.

Kenner, W.E., 1966, Runoff in Florida: Florida Division of Geology Map Series 22, 1 sheet.

Toler, L.G., 1966, Fluoride content of water from the Floridan aquifer in northwestern Florida: Florida Division of Geology Map Series 23, 1 sheet.

Anderson, Warren, and Joyner, B.F., 1966, Availability and quality of surface water in Orange County, Florida: Florida Division of Geology Map Series 24, 1 sheet.

MacKichan, K.A., 1967, Temperature and chemical characteristics of the St. Johns River near Cocoa, Florida: Florida Division of Geology Map Series 25, 1 sheet.

Barraclough, J.T., 1967, Ground-water features in Escambia and Santa Rosa Counties, Florida: Florida Division of Geology Map Series 26, 1 sheet.

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, 1 sheet.

Kenner, W.E., Pride, R.W., and Conover, C.S., 1967, Drainage basins in Florida: Florida Division of Geology Map Series 28, 1 sheet.

McCoy, H.J., and Sherwood, C.B., 1968, Water in Broward County, Florida: Florida Division of Geology Map Series 29, 1 sheet.

Knochenmus, D.D., 1968, Surface drainage characteristics in Volusia County, Florida: Florida Division of Geology Map Series 30, 1 sheet.

Kenner, W.E., 1975, Seasonal variation of streamflow in Florida (2d ed.): Florida Bureau of Geology Map Series 31, 1 sheet.

Visher, F.N., and Hughes, G.H., 1975, The difference between rainfall and potential evaporation in Florida (2d ed.): Florida Bureau of Geology Map Series 32, 1 sheet.

Kaufman, M.I., 1975, Generalized distribution and concentration of orthophosphate in Florida streams 2d ed.): Florida Bureau of Geology Map Series 33, 1 sheet.

Kenner, W.E., Hampton, E.R., and Conover, C.S., 1975, Average flow of major streams in Florida (2d ed.): Florida Bureau of Geology Map Series 34, 1 sheet.

Kaufman, M.I., 1975, Color of water in Florida streams and canals (2d ed.): Florida Bureau of Geology Map Series 35, 1 sheet.

Pride, R.W., 1975, Estimated water use in Florida, 1965 (revised 1975): Florida Bureau of Geology Map Series 36, 1 sheet.

Kaufman, M.I., 1975, The pH of water in Florida streams and canals (2d ed.): Florida Bureau of Geology Map Series 37,1 sheet.

Hughes, G.H., 1970, Hydrologic setting of Deer Point Lake near Panama City, Florida: Florida Bureau of Geology Map Series 38, 1 sheet.

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, 1 sheet.

Hughes, G.H., Hampton, E.R., and Tucker, D.F., 1971, Annual and seasonal rainfall in Florida: Florida Bureau of Geology Map Series 40, 1 sheet.

Klein, Howard, 1975, Depth to base of potable water in the Floridan aquifer (2d ed.): Florida Bureau of Geology Map Series 42, 1 sheet.

Anderson, Warren, 1975, Temperature of Florida streams (2d ed.): Florida Bureau of Geology Map Series 43, 1 sheet.

Knochenmus, D.D., 1971, Ground water in Lake County, Florida: Florida Bureau of Geology Map Series 44, 1 sheet.

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, 1 sheet.

Foster, J.B., 1972, Guide to users of ground water in Bay County, Florida: Florida Bureau of Geology Map Series 46, 1 sheet.

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

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, 1 sheet.

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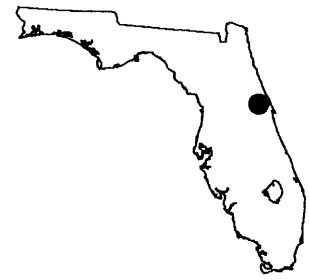


FL-489 WATER QUALITY IN THE WINTER PARK CHAIN OF LAKES, AND IMPACT OF DEVELOPMENT, CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: E.R. German, Orlando

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

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

OBJECTIVE: Establish a systematic program of data collection to determine rainfall quantity, lake level, water quality, and surface inflow quality and quantity. Investigate composition of lake sediments and rate of sediment buildup. Estimate loads of nutrients to the lakes from atmospheric deposition, stormwater runoff, and ground-water seepage. Determine contribution of coarse, fine, very fine, and dissolved material to the total stormwater loading to the lakes for nutrient 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 lake water-quality sampling. Sample bottom sediments and conduct bathymetric surveys with sound reflection and ground-penetrating radar. Determine major source of nutrient inflow by sampling stormwater inflow, surface inflow from upstream lakes, and ground water. Select two stormwater inflow sites for determination of loading of oxygen demand and nutrient inflow due to coarse, fine, very fine, and dissolved materials in the runoff.

PROGRESS: Data analysis was completed. Nutrient budgets indicate that, although ground water inflow and outflow are the components of the budget with the most uncertainty, they are important with respect to the eutrophication potential for the lakes. For water year 1992, a year with about average rainfall and no change in lake storage, the constituent loads into the lakes were as follows: Ground water contributed 47% of the chloride, 16% of the nitrogen and 15% of the phosphorus; stormwater, 4% of Cl, 19% of N and 42% of P; rainfall, 3% of Cl, 36% of N and 18% of P; and surface inflow, 45% of the Cl, 29% of the N and 18% of the P. The final report was written and is in review.

PLANS FOR THIS YEAR: Publish final report.

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

DATE PROJECT BEGAN: October 1988

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: Michael Merritt, Miami

COOPERATING AGENCIES: Broward County Office of Environmental Services and South Florida Water Management District

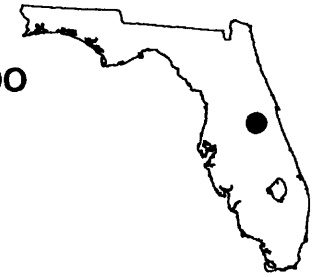
PROBLEM: Water management agencies need simulation modeling to reduce the cost of data collection in assessing the degree of saltwater intrusion and to permit assessments of scenarios for amelioration.

OBJECTIVE: The objectives of the study are to collect special data that quantitatively describe the mechanisms of saltwater intrusion and to develop, evaluate, and apply digital simulation methodology to represent the saltwater intrusion process and to predict 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 the saltwater intrusion where it is not presently known. In addition, geologic test wells and hydraulic test wells will be installed that will provide data to be used for hydrologic models. Simulation efforts using a cross-sectional model will be conducted at a 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: The SHARP code was used to estimate the position of the freshwater/saltwater interface in the study area under both present-day and historical conditions, as represented by a change in boundary conditions. Hydraulic parameters used were determined by previous studies in the area. The estimated historical position is considerably landward of its known position in the early part of the century. Analyses with the SHARP and SWIP codes show that a position closer to the likely historical position is simulated when offshore strata at depths corresponding to the pumping zone have far less permeability than estimated for the onshore pumping zone based on hydraulic testing. The SWIP code was applied to test the effect of hydrodynamic dispersion and pulse recharge on the predicted interface position. Preliminary findings indicate that the predicted interface position shifts seaward only slightly and not enough to resolve the discrepancy with observed data. Final report is in preparation.

PLANS FOR THIS YEAR: Complete report and submit for Director's approval.



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

DATE PROJECT BEGAN: April 1990

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Louis Murray, Orlando

COOPERATING AGENCIES: Florida Department of Environmental Protection, St. Johns River Water Management District, and South Florida Water Management District

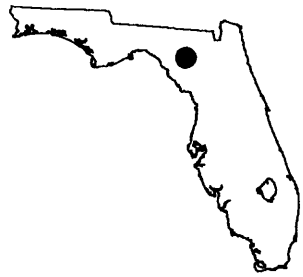
PROBLEM: Growth in the Orlando metropolitan area is expected to cause ever-increasing demands on the ground-water resources. Available well-field locations are constrained by the occurrence of salty water, contaminated ground water, and zones of low aquifer transmissivity, and by the proximity of existing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

OBJECTIVE: 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: The steady-state flow model for 1988 stressed conditions was calibrated to reflect measured 1988 spring flows and the average 1988 potentiometric surface of the upper Floridan aquifer. Water-quality data were collected for chloride, sulfate, and dissolved solids. Transient simulations have been initiated.

PLANS FOR THIS YEAR: (1) Complete transient ground-water flow simulations; (2) perform predictive simulations and particle-tracking analyses; and (3) complete report and submit for review.



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

DATE PROJECT BEGAN: November 1989

DATE PROJECT ENDS: December 1994

PRINCIPAL INVESTIGATOR: William Andrews, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Protection

PROBLEM: In the past 10 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 are 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 discharge 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 quality of ground water near four North Florida dairy farms, and in ground water discharging to the Suwannee River in nearby springs, and how the contamination relates to varying waste-management practices and hydrogeologic ground-water-quality settings in Lafayette and Suwannee Counties.

APPROACH: Twelve to thirteen monitoring wells were installed at each of four dairies located near the Suwannee River. In addition, three springs in the vicinity of the river were sampled. Water samples are being analyzed for dissolved nitrogen species, chloride, inorganic carbon, oxygen, denitrifying bacteria, and physical parameters in order to assess the role of denitrification in reducing nitrate concentrations in ground water in the region. Selected water samples were also analyzed for nitrogen-isotope ratios in nitrate to determine the sources of nitrate to determine the sources of nitrate in those samples.

PROGRESS: The second report of this investigation is in review.

PLANS FOR THIS YEAR: Will complete review process of the final reports.

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, occupying 700 square miles in central Polk and Highland Counties, is an uplands recharge area along the axis of the Florida 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. 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 the effects 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, 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 the regional effects of water-resources development.

PROGRESS: Model was completed as well as the first draft of the final report.

PLANS FOR THIS YEAR: Forward report for Director's approval and publish report.

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: W.R. Bidlake, Tampa

COOPERATING AGENCIES: Southwest Florida Water Management District and Sarasota County

PROBLEM: Water and energy exchanges 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 of the unsaturated zone. The model will be used to examine and predict evapotranspiration and other water-balance components under different vegetative conditions.

PROGRESS: Analysis and interpretation of field data were completed. Simulations of the unsaturated-zone water balance were also completed and sensitivity analyses were performed. A slide presentation of the major study findings was given to representatives of the two cooperating agencies. A draft of the first interpretative report for the project entitled, "Near-surface water balance of an undeveloped upland site in west-central Florida," was completed and is in review. A draft of the second interpretative report is 90 percent completed.

PLANS FOR THIS YEAR: Complete draft of second interpretative report and submit for review. Forward both reports for additional review and approval.

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: September 1994

PRINCIPAL INVESTIGATOR: James H. Davis, Tallahassee

COOPERATING AGENCIES: Florida Department of Environmental Protection

PROBLEM: The city of Tallahassee discontinued the use of several city supply wells due to contamination. The city and the Florida Department of Environmental Protection (FDEP) 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 and 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 and conduit flow.

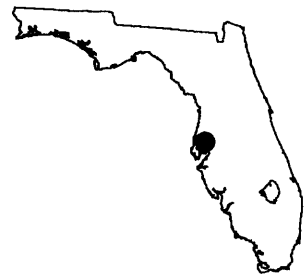
OBJECTIVE: To improve understanding of the flow system in the complex fracture and conduit dominated environment of the city of Tallahassee and Leon County in order to allow local officials to develop ground-water protection strategies including wellhead protection.

APPROACH: (1) Assemble existing hydrogeologic and well information. This includes 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 2-4 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 will be used; and (4) Conduct a preliminary evaluation of wellhead protection methods.

PROGRESS: Two aquifer tests were conducted to determine the transmissivity and storativity of the Upper Floridan aquifer in the Tallahassee area. The first test lasted one day, the results of this test were used in planning a more extensive 1 week test. Both tests used Tallahassee's municipal well #2 as the pumping well and drawdowns were measured in five monitoring wells (including the deep monitoring well drilled as part of this study).

The calibration of the ground-water flow model, MODFLOW, has begun. The flow system is being simulated using three layers; the first layer represents the intermediate confining unit, the second layer represents the upper 200 feet of the Upper Floridan aquifer, and the third layer represents the Upper Floridan aquifer below 200 feet. Each grid layer contains 9,108 cells. The calibration will be complete when the model can accurately match water-level measurements and river discharges measured earlier in this study.

PLANS FOR THIS YEAR: The calibration of the model will continue until completed. Once the calibration is complete, the model will be used to estimate zones of capture for municipal supply wells within the city of Tallahassee. A report will be written detailing procedures and results.



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 Protection

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, areas that contribute water to these wells must be known as well as factors that affect the size and shape of the contributing area.

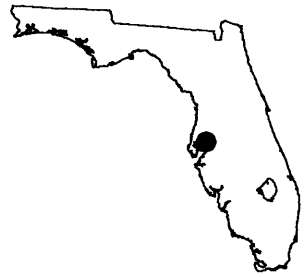
OBJECTIVE: Define ground-water flow in a carbonate aquifer system and apply this knowledge to wellhead protection strategies for west-central Florida. Test the validity of Darcian ground-water flow in a carbonate aquifer. Simulate the flow system to indicate which factors affect the size and shape of 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 area. Compare the results of the study with previous wellhead protection strategies.

PROGRESS: The effects on traveltime and size and shape of areas of contribution to public supply well fields in west-central Florida were simulated by incorporating secondary porosity features into ground-water flow and particle-tracking models. Hypothetical secondary porosity distributions were determined from analytical models of aquifer anisotropy and borehole geophysical and television log interpretations. The simulated areas of contribution to well fields were compared with one another. Draft report is complete and in review.

PLANS FOR THIS YEAR: Report in review for Water-Supply Paper release. Obtain Director's approval and prepare for publication.

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: April 1993

PRINCIPAL INVESTIGATOR: Yvonne E. Stoker, 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. These nutrient loads must be measured to 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 the nonpoint-source loading of nutrients to Hillsborough Bay 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 and 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: Interpretations of water quality, discharge, and loading data were completed. A draft of the final report was prepared and submitted for review.

PLANS FOR THIS YEAR: Revise report as needed and submit for approval and publication.

FL-511 AN EVALUATION OF THE EFFECTS OF 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: September 1993

PRINCIPAL INVESTIGATOR: Jerilyn Collins, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Protection

PROBLEM: The presence of swine and poultry operations in north Florida potentially can affect the water quality of the Suwannee River and the Upper Floridan aquifer. 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 if ground water and surface water in the vicinity of swine and poultry operations are contaminated and to relate the contamination to varying waste-management practices and hydrogeology in Lafayette, Suwannee, and Jackson 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. Water from the wells will be examined for concentrations of nitrogen species and other waste tracers such as phosphorus, chloride, and fecal bacteria. The relative abundance of nitrogen and nitrogen isotopes in nitrates will be used to evaluate the pattern of organic and inorganic nitrate sources in the study area.

PROGRESS: The collection and evaluation of water samples from monitoring wells on five poultry farms was completed. A report describing the effects of poultry (broiler) farms on nitrate concentrations of ground water in north-central Florida is in review. After an extended delay related to problems with the mass spectrophotometer, the nitrogen-isotope analysis of water samples collected from private wells in the vicinity of the Suwannee River was completed. The installation of monitoring wells on four swine farms and quarterly collection of water samples were completed.

PLANS FOR NEXT YEAR: A report describing the regional pattern of organic and inorganic sources of nitrates in the study area will be prepared. Evaluation of chemical analyses of water samples from the swine farm monitoring wells will be started along with a report describing the results.

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 Protection

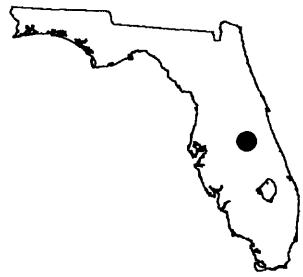
PROBLEM: Demands for low-flow information in many areas of Florida exceed the capabilities of existing data-collection resources. To meet these demands, methods of estimating low-flow characteristics at sites with little or no streamflow data (ungaged sites) are needed. Methods using multiple regression 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. This additional information is 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 10-15 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. 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: Coverages, as variables of basin characteristics, for topography, soils, drainage area, basin slope, and environmental geology were developed through a Geographical Information System (GIS) and were tested for their significance to regional variability of low flow using ARC/Info software. Preliminary model runs were made using regression analyses. Approximately 90 base-flow measurements, made during November 1992 and August 1993, at a network of low-flow sites, were used to augment the low-flow data base and provide additional data for low-flow analyses. Report writing continued.

PLANS FOR NEXT YEAR: Continue to quantify basin characteristics. Complete all coverages and test for their significance to regional variability of low flow. Make final model runs. Complete final report.



FL-516 UNSATURATED FLOW AND TRANSPORT UNDER RAPID INFILTRATION BASINS

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: October 1994

PRINCIPAL INVESTIGATOR: David Sumner, Orlando

COOPERATING AGENCY: Reedy Creek Improvement District

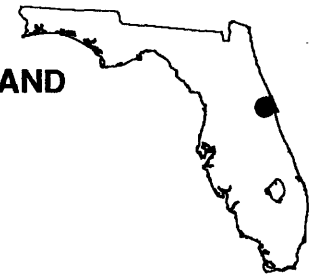
PROBLEM: Beginning in 1991, the Reedy Creek Improvement District will discharge up to 15 million gallons per day of treated sewage effluent into rapid infiltration basins (RIBS) southwest of Orlando. The effects of this practice on the quality and quantity of local surface-water and ground-water resources 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 effect 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; and (3) Observations of 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: The effect of disposing secondary-treated wastewater through rapid infiltration basins in conjunction with percolation through the vadose zone was estimated through extensive aquifer and soil water sampling. Nutrient chemical transformations were proposed to explain the collected data. The hydraulic response of the saturated and unsaturated hydrologic system was measured under field conditions. Numerical modeling was used to simulate the response and thus develop a quantitative understanding of the hydraulic system.

PLANS FOR THIS YEAR: Project report will be completed.



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 AGENCIES: St. Johns River Management District and Volusia County

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 wetland hydrologic systems are often not practical for use by water-resources managers.

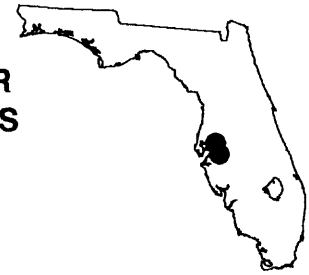
OBJECTIVE: To develop a direct, simple methodology for estimating the effects of development on wetland hydrology when given measurable, physical parameters and variables.

APPROACH: The overall design of the study is to use a surface-water and(or) 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. 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 monographs 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: A ground-water flow model was used to simulate wetland water levels as a function of ground-water withdrawal for wetlands having surface inflow and outflow. Rainfall, surficial aquifer water level, and Upper Floridan aquifer potentiometric-surface levels were monitored in a wetland in Volusia County, for use in calibrating the water budget model.

PLANS FOR THIS YEAR: Use the models to predict relation of wetland water levels to rainfall, evaporation, quantities of surface inflow and outflow, and downward leakage from the surficial aquifer to the Floridan aquifer system. Prepare a report presenting relation of wetland water levels to water sources/sinks in a way that managers can use to evaluate effects of hydrologic stress that affect the water sources and sinks on wetland water levels.



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

DATE PROJECT BEGAN: January 1991

DATE PROJECT ENDS: December 1993

PRINCIPAL INVESTIGATOR: Amy Swancar, Tampa

COOPERATING AGENCY: Florida Department of Environmental Protection

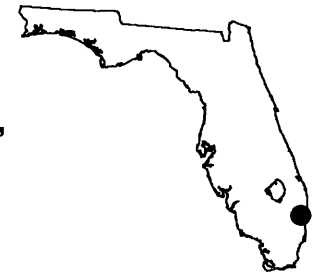
PROBLEM: Reuse of treated municipal wastewater for nonpotable uses, such as irrigation of public and private green areas, is expected to become an important part of sound water-conservation practices, especially in areas experiencing water shortages. The effect of humic and fulvic acids, surfactants, 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 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. In phase III, three additional golf courses will be selected in northwest, north central, and southern Florida to evaluate pesticide leaching on the different hydrogeologic settings throughout the State.

PROGRESS: The final two quarters of sampling for the six phase I golf courses was completed by March 1993. All data for phase I was released to the participating golf courses in August. Preliminary data from the study was presented at the Pesticide Review Council meeting in Gainesville, Florida. An amendment to the quality assurance plan was sent to the cooperator. Monitor wells were installed at two of the phase III courses, and were sampled for three quarters. The selection of the third course for phase III was finalized in August 1993. Wells were installed and sampled at this course in October 1993. Final report preparation began.

PLANS FOR THIS YEAR: Complete sampling for the three phase III golf courses. Collect additional effluent source samples for phase I. Review and analyze all data collected for this project. Complete a draft of the final report.



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 INVESTIGATORS: Roy Sonenshein and Eric D. Swain, Miami

COOPERATING AGENCIES: 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.

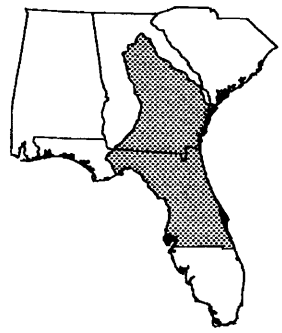
OBJECTIVE: (1) Develop criteria for monitoring saltwater intrusion, water-table elevation, well-field protection zones, and regional water quality; (2) develop methods for designing monitoring networks based on mathematical models and statistical techniques; and (3) design regional monitoring networks, 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 analysis.

PROGRESS: A total of 201 monitor wells were inventoried with data entered into the National Water Information System (NWIS) data base. Data from the ambient water-quality monitoring network were analyzed using MODPATH and GIS and data from the water-level recorder monitoring network were analyzed using semivariogram analysis. Results of the study indicate that water level wells in Broward County can be prioritized according to their statistical correlations although some subjective interpretation is required. A report on the water-quality analysis is in preparation and a report on the water-level network analysis is in review.

PLANS FOR THIS YEAR: Complete two reports and submit for Director's approval.

FL-520 NATIONAL WATER QUALITY ASSESSMENT (NAWQA) PROGRAM--GEORGIA-FLORIDA COASTAL PLAIN



DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: December 1999

PRINCIPAL INVESTIGATOR: Edward T. Oaksford, Tallahassee

COOPERATING AGENCY: Federal Program

PROBLEM: There is a need to describe the status and trends of the water quality of the Nation's ground- and surface-water resources in order to provide a sound understanding of the natural and man-made factors affecting the usability of these resources. The Georgia-Florida Coastal Plain study unit is one of 60 representative areas chosen for a national assessment. Within the study unit, water is generally of good chemical quality suitable for most uses, but in some areas quality has been impaired as the result of agricultural practices, mining, waste disposal, storage and use of toxic chemicals, stormwater disposal, and water withdrawals. Naturally occurring constituents and properties have also affected the usability of water locally. Saltwater in coastal areas has been induced to move into freshwater aquifers and rivers as these resources are developed for use.

OBJECTIVE: The three major objectives of the National Water Quality Assessment (NAWQA) Program are (1) to provide a consistent description of current water-quality conditions for a large part of the Nation's water resources; (2) define long-term trends (or lack of trends) in water quality; and (3) identify, describe, and explain, as possible, the major factors that affect observed water-quality conditions and trends.

APPROACH: During the first 2 years, a project team will be assembled, an extensive project workplan will be developed, and existing data will be summarized and analyzed. A 3-year period of intensive data collection, analysis, and interpretation will begin in 1993. A long-term monitoring network will be established for trend analysis, subbasins will undergo synoptic surveys to better define sources of pollutants, and selected sites will undergo intensive process-oriented study to provide a better understanding of the cause-and-effect relation between land use and water quality. Intensive data-collection and interpretation efforts will be followed by a period of report writing and low-level sampling and analysis.

PROGRESS: Data collection at surface-water sites began March 1993. Monthly water-quality samples were taken at all 9 sites for nutrients, major constituents, sediment and dissolved and suspended organic carbon. At a subset of 4 sites, weekly samples were taken for pesticides, nutrients, and sediment. Three synoptic samplings were accomplished in two agricultural basins in Georgia to characterize nutrient and selected pesticide concentrations during high and low water conditions. Thirty-seven bed sediment/tissue samples were taken at 28 surface-water sites to assess trace elements and organic compounds in those media.

Ecological sampling consisted of conducting habitat assessments along measured stream reaches at four sites in Georgia. Fish and algal community assessments were also completed within these same measured reaches.

(FL-520)

Ground-water quality sampling for the regional study-unit survey began in July and consisted of sample collection at 30 domestic wells in the Georgia part of the study unit.

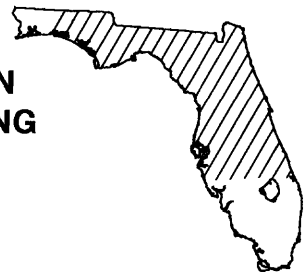
One report describing ground-water nitrate concentrations in the study unit was approved. Three reports are currently in preparation; one describing the surface-water sampling design and sampling procedures, one describing water use within the study unit, and one describing the environmental setting of the study unit.

PLANS FOR THIS YEAR: Plans for surface-water data collection next year include continued monthly sampling at all 9 fixed sites, completing an annual cycle of sampling at the 4 sites sampled weekly, collecting bed sediment/tissue samples from 12 additional sites, conducting a 20 sample synoptic sampling in the southern part of the study unit to assess citrus agrichemicals, and two 48 sample synoptics (high-flow/low-flow) to compare with data collected at 6 of the 9 fixed sites in the study unit.

Ecological sampling plans for next year include completion of all remaining habitat, fish, and algal community sampling at sites not completed in fiscal year 1993, as well as conducting macroinvertebrate sampling at all 9 fixed surface-water sites. In addition, multiple-reach assessments are planned at three sites to examine within-site variation.

Ground-water sampling plans for next year include completion of sampling in the study-unit survey well network, conducting three ground-water land-use studies, and one flow system study. The ground-water land-use studies will each consist of 25-30 wells located or installed in land uses representing agriculture/row crop, agriculture/animal operations, and urban/ suburban classifications.

Reports planned for completion include reports describing water-use in the study unit, the environmental setting of the study unit, and surface-water sampling design and procedures. Two additional reports are also planned for completion that describe existing nutrient and pesticide data within the study unit.



FL-521 RECOGNITION OF HYDROCHEMICAL PROCESSES IN THE UNCONFINED UPPER FLORIDAN AQUIFER USING ENVIRONMENTAL ISOTOPES, ANTHROPOGENIC TRACERS, AND GEOCHEMICAL REACTION MODELING

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: Brian G. Katz, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Protection

PROBLEM: There is a substantial lack of knowledge regarding the hydrochemical processes that control the observed water chemistry in unconfined and semiconfined areas of the Upper Floridan aquifer. As a result, assessing the susceptibility of these areas to contamination from surface sources is difficult. In north and central Florida, where significant recharge to the aquifer occurs from precipitation or direct input from the surface through sinkholes, there is a high potential for widespread contamination of the aquifer system. To more completely understand the processes that affect the rate and movement of water and solutes (contaminants) from land surface to the unconfined Upper Floridan aquifer, information on water chemistry and hydrogeology needs to be integrated with more specialized analyses of ground water, such as environmental isotopes and selected anthropogenic organic compounds.

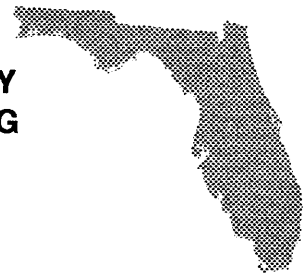
OBJECTIVE: (1) Collect specialized information on environmental isotopes, anthropogenic tracers, and other water-quality parameters in unconfined and semiconfined areas of the Upper Floridan aquifer, and (2) integrate this information with hydrogeologic processes to better understand and quantify the geochemical processes that control the water chemistry along regional flow paths in these areas and to characterize waters moving vertically through the surficial aquifer and Upper Floridan aquifer.

APPROACH: Approximately 30 wells will be sampled along four selected flow paths in unconfined and semiconfined areas of the Upper Floridan aquifer and two vertical profiles in the surficial and the Upper Floridan aquifers. The relative age of water and its rate of movement at the six sites will be determined using analyses of chlorofluorocarbons in conjunction with detailed hydrogeologic information and analyses for tritium, deuterium, sulfur-34, carbon-13, carbon-14, and oxygen-18. Geochemical reactions along flow paths and vertical profiles will be evaluated from detailed chemical analyses of water from wells using the geochemical and flow models WATEQF, NETPATH, and PHREEQE. Samples of rainfall will be collected at a station in central Florida four times per year and will be analyzed for environmental isotopes. Chlorofluorocarbons will be measured on recent precipitation collected in the field during selected rainfall events and on selected surface-water sources. Minerals in samples of aquifer material will be analyzed for selected environmental isotopes.

PROGRESS: Chemical and isotopic analyses of ground water, lake water, and rainfall were completed. Selected samples of aquifer material from various depths were analyzed for clay mineralogy. Environmental tracers (isotopes, chlorofluorocarbons, and inorganic solutes) in

conjunction with geochemical reaction modeling were used to quantify the patterns and rates of chemical evolution of ground water near Lake Barco. Two journal manuscripts (final report) were prepared on the hydrochemical interaction between ground water and a sinkhole lake.

PLANS FOR THIS YEAR: Publish journal articles.



FL-523 CHARACTERISTICS OF THE SECONDARY POROSITY OF CARBONATE INJECTION ZONES AND CONFINING UNITS UNDERLYING PENINSULAR FLORIDA

DATE PROJECT BEGAN: October 1990

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: A.D. Duerr, Tampa

COOPERATING AGENCY: Florida Department of Environmental Protection

PROBLEM: For approximately the past 20 years, cavern porosity has been assumed to be the principal type of secondary porosity in most of the carbonate injection zones underlying peninsular Florida. Also, an apparently dense dolomite above and within injection zones has been assumed to contain no vertically interconnected secondary porosity. However, a recent study (Safko and Hickey, WRIR 91-4168) concluded that, along the east coast of Florida, fracture porosity is the principal type of secondary porosity both within the injection zones and in the dolomite rocks that lie above and within injection zones. Because of these findings, the traditional assumptions about cavern porosity and the lack of fracturing in the dolomites should be reassessed.

OBJECTIVE: To determine the principal types of secondary porosity that occur in carbonate injection zones and confining units at subsurface-injection sites throughout peninsular Florida.

APPROACH: Borehole television surveys and other borehole data to characterize secondary porosity of carbonate rocks penetrated by test holes at selected injection sites will be used. Borehole data used in the approach will include drilling records, and caliper, flowmeter, and temperature logs. The goal of this approach is to identify secondary porosity features that are spatially interconnected beyond the immediate vicinity of a borehole. Such secondary porosity features would have their origin in geologic processes rather than being caused by drilling.

PROGRESS: Borehole data collection and interpretation was completed and a first draft of the final report was prepared. The report contains comprehensive borehole interpretations, records of wells, secondary porosity classifications, generalized sections, and detailed descriptions of television surveys of boreholes.

PLANS FOR THIS YEAR: Report was approved and will be published as a U.S. Geological Survey Water-Resources Investigations Report.

FL-525 COMPARISON AND EVALUATION OF TECHNIQUES USED TO ESTIMATE STORMWATER RUNOFF FROM LOW-GRADIENT STREAMS IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: April 1991

DATE PROJECT ENDS: March 1995

PRINCIPAL INVESTIGATOR: John Trommer, Tampa

COOPERATING AGENCY: Sarasota County

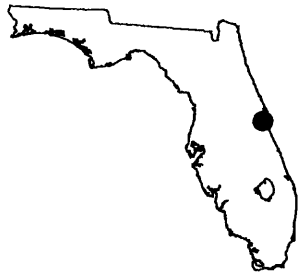
PROBLEM: Low topographic relief, flat water-surface gradients, and prolonged or intense rainfall can produce recurring stormwater-flooding problems. Several techniques for estimating the volume of stormwater runoff exist; however, it is necessary to extrapolate empirical relation beyond tested ranges to apply these techniques to the coastal lowlands of west-central Florida. The economic and environmental consequences of inaccurately estimating the volume of stormwater runoff can be substantial. If projects for carrying stormwater are underdesigned, property could be needlessly flooded. If projects are overdesigned, unnecessary tax dollars are spent for overabundant land acquisition, construction, and maintenance.

OBJECTIVE: Evaluate the reliability and accuracy of traditional techniques for estimating stormwater runoff by comparing computed estimates to field measurements. Define the range of watershed characteristics for which traditional techniques produce reliable results. Possibly develop techniques for estimating stormwater runoff from watersheds outside the range where traditional techniques can be applied.

APPROACH: Install six to eight new rainfall and discharge sites in low-gradient coastal basins in Sarasota County. Three or four basins will be developed basins and the remaining will be undeveloped basins. Use traditional engineering techniques and measured runoff results to estimate stormwater runoff for each basin. Using statistical techniques, evaluate the relative importance of basin characteristics on the accuracy of the estimated runoff.

PROGRESS: Two and a half years of data collection ended on September 31, 1993. Sixty-six storm events were chosen to estimate peak discharge and runoff volumes. The Soil Conservation Service TR20 model, the U.S. Army Corps of Engineers HEC1 model, and the U.S. Environ-mental Protection Agency's SWMM model, were used to estimate discharges and runoff volumes from 15 watersheds in Polk, Pinellas, Hillsborough, and Sarasota Counties. Preliminary comparisons of measured discharges and runoff volume were made for 66 storms with estimates from the SCS TR20 model. Two reports are planned for this study. The first, a Water Resources Investigations Report is in preparation. The second is planned and will be released as a Water Supply Paper.

PLANS FOR THIS YEAR: Complete discharge estimates and runoff volumes using the EPA SWMM model, the USGS regression technique, and the rational method. Both reports are to be completed in 1994.



FL-526 MODELING THE HYDRODYNAMICS AND SALINITY OF THE SEBASTIAN CREEK CONFLUENCE

DATE PROJECT BEGAN: August 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Robert A. Miller, Orlando

COOPERATING AGENCY: St. Johns River Water Management District

PROBLEM: Major surface-water inflows to the Sebastian Creek area occur from several directions. One canal tributary to Sebastian Creek is controlled, and waters released from the canal during periods of flooding could cause high discharges within Sebastian Creek. The results of such releases could have effects on the salinity of the Indian River that are difficult to ascertain.

OBJECTIVE: The objectives of this study are to (1) enhance the understanding of the hydraulics of the confluence, including the patterns of circulation within Sebastian Creek, (2) simulate the hydraulic and salinity changes within Sebastian Creek under extreme discharges (both large and small); and (3) use the calibrated and verified model to simulate the full range of flow and the direction of flow at all gaged locations.

APPROACH: The hydraulics and salinity of the Sebastian Creek confluence will be modeled using the U.S. Geological Survey model for two-dimensional hydrodynamic/transport-SWIFT2D. After acceptance of the boundary conditions and parameter values through calibration and verification, the model will be used to simulate responses to varied discharge at the Sebastian Creek stations, and varied tidal and salinity conditions at the open boundaries. Because of the interest in the effects on salinity produced by freshwater entering the confluence from the west, most of the work will involve high freshwater discharges.

PROGRESS: Data collection and storage the continuous data stations were continued throughout the year. Episodic data were collected three times during the year, in May, July, and September. These data are being used in the calibration and verification of the 2-D model, SWIFT2D. Several sections of the final report were written.

PLANS FOR THIS YEAR: The 2-D model will be calibrated and verified. Two reports, one containing basic data and one containing the modeling effort, will be written.

FL-527 MEASUREMENT OF NONPOINT SOURCE NUTRIENT LOADING FROM EAST BAY TO HILLSBOROUGH BAY, FLORIDA

DATE PROJECT BEGAN: September 1991

DATE PROJECT ENDS: March 1994

PRINCIPAL INVESTIGATOR: Yvonne E. Stoker, Tampa

COOPERATING AGENCIES: City of Tampa and
Tampa Bay Regional Planning Council

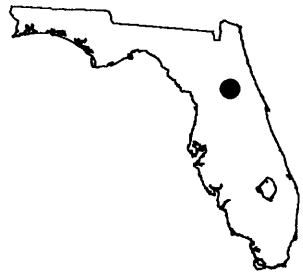
PROBLEM: Hillsborough Bay has the most degraded water quality in the Tampa Bay system. Hillsborough Bay receives over half of the tributary freshwater runoff that enters Tampa Bay, has a large industrial complex with the seventh largest port in the nation on it's shore, and receives about 60 million gallons per day of advanced-waste-treatment effluent. East Bay, a subembayment of Hillsborough Bay, contains a part of the port with extensive fertilizer-loading facilities, and receives freshwater inflow from the Tampa Bypass Canal, Delaney Creek, and from local stormwater runoff. Studies underway by the U.S. Geological Survey and other agencies are quantifying nutrient loading from the major tributaries to Tampa Bay, but there is a lack of information on nutrient loading from East Bay to Hillsborough Bay. This information is essential for estimating a reasonable nutrient budget for Tampa Bay.

OBJECTIVE: Nitrogen and phosphorus loads from East Bay to Hillsborough Bay will be measured during selected periods. These data will be used to provide estimates of seasonal and annual loading for the period of data collection.

APPROACH: (1) Continuous discharge data will be computed from continuous velocity-index and stage measurements. Discharge measurements will be made to establish a mean velocity-index velocity relation, and will be made during the study to assure rating stability. (2) Water-quality samples will be collected at the mouth of East Bay during various tide and freshwater inflow conditions to describe horizontal and vertical variability. (3) Continuous recording of specific conductance and temperature will be made at two depths. The measurements will be made near the index velocity station.

PROGRESS: More than 100 discharge measurements were used to relate the index velocity and stage to mean velocity and cross-sectional area at East Bay at 22nd Street. Using the relation established, continuous discharge was computed. Samples for total nutrients, specific conductance, turbidity, color, and suspended solids were collected at the head of East Bay, at the mouth of East Bay, and near the mouth of Delaney Creek during June 1992 through May 1993. Field measurements of specific conductance, temperature, dissolved oxygen, and pH were made at the time of sample collection. Continuous specific conductance and temperature data were collected at East Bay and Delaney Creek. All data collection is complete and gages were discontinued. Preliminary discharge computations are completed and data interpretation is continuing. Preparation of a draft copy of the final report is in preparation.

PLANS FOR THIS YEAR: Complete data interpretations and finalize discharge and nutrient loading computations. Draft of report is in review.



FL-528 HYDROLOGY OF THE WOLF BRANCH CREEK SINKHOLE BASIN, LAKE COUNTY, EAST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: April 1995

PRINCIPAL INVESTIGATOR: Donna Schiffer, Orlando

COOPERATING AGENCY: Lake County Water Authority

PROBLEM: The Wolf Branch sinkhole is a direct conduit through which surface water can enter the Upper Floridan aquifer, the principal source of water for public and domestic supplies in north Lake County, central Florida. Although the basin is undeveloped at present, the potential exists for degradation of the aquifer from surface contaminants from roads and some businesses in the area. Possible plans to protect the aquifer from this potential contamination include partial or total plugging of the sinkhole. However, the hydrology of the basin is not understood well enough to predict the degree and extent of flooding which may result from such plugging.

OBJECTIVE: (1) Quantify the surface-water hydrology (flow frequency, duration, and volume) of the Wolf Branch basin and estimate the possible effects of sinkhole plugging on flooding in the lower basin, assuming a normal range of rainfall and discharge conditions, and (2) define the general relation of the sinkhole to the ground-water hydrology of the area, and estimate the direction and rate of movement, and the dispersion of a conservative contaminant entering the Upper Floridan aquifer at the sinkhole. This information will help water managers to better understand the present contamination potential and possible effects of alterations to the sinkhole or Wolf Creek basin.

APPROACH: (1) Evaluate surface-water hydrology by monitoring rainfall and surface-water discharge in the basin and determine a runoff-rainfall relation for the basin, then estimate long-term flow characteristics from existing rainfall record for the area. (2) Evaluate flooding potential resulting from plugging of the sink by evaluating the hydraulic conductivity of the sinkhole and estimating the rates at which the sinkhole would receive water when the conductivity is reduced by plugging. Based on these rates, estimate water levels in the basin using topographic maps and additional topographic data obtained during the study. (3) Inventory Upper Floridan aquifer wells in the basin, and summarize available data on ground-water quality and geology from previous studies. (4) Construct local potentiometric-surface maps of the Upper Floridan aquifer for both wet and dry periods and determine gradients in the area. (5) Determine direction and rate of travel, and dispersion (if possible) of potential contaminants through one or two dye studies.

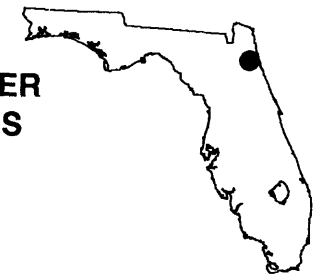
PROGRESS: Three additional sites were added to the data-collection network: two staff gages were installed in wetlands south of State Road 46, and one streamgaging site was installed on Wolf Branch north of State Road 46. These sites will provide the data needed to evaluate the effect of storage in wetlands on the discharge observed at the gaging station above Wolf Sink. There are now 7 data collection sites in the basin: Two discharge sites, three staff gages (one at the sink with a transducer), a rainfall site, and a ground-water site.

Although the project had been scaled back to basic data collection due to dry weather conditions, the 1993 water year proved to be more normal than the 1992 water year, and several project objectives were met during the year.

In October, discharge measurements were made at several sites along Wolf Branch between the primary gaging station and Wolf Sink, to determine seepage losses along the channel. Two dye studies were conducted, one in October 1992, when water began entering the sink after an extended dry period (more than 5 months), and one in early April 1993, following an unusually wet period in late March. No dye was recovered from either dye test. A second transducer was installed at the sink in February 1993, but the post to which the transducers were attached toppled over in late March, as a result of higher flows to the sink. The post and one transducer were reinstalled in May, and a staff gage was installed at the sink at that time. The transducer at the sink was then field calibrated using readings from the staff gage.

In late August and early September, heavy rainfall caused high stages in the sink, providing the opportunity to monitor the rising and declining water levels in the sink in response to the rainfall. Ground-water levels in a well network were measured in May and September (dry and wet seasons, respectively). The report outline has been revised, preliminary sections have been written, and the detailed outline is being developed.

PLANS FOR THIS YEAR: The project is being done at reduced funding, allowing primarily the data-collection activities only. Hydrologic data will be collected and processed during the water year, and significant hydrologic events will be monitored. Other project objectives will be met as funding allows, including data analysis and report writing.



FL-530 LOCATIONS OF PREVIOUSLY UNDETERMINED UPPER FLORIDAN AQUIFER DISCHARGE TO THE ST. JOHNS RIVER, JACKSONVILLE AREA AND VICINITY, NORTHEAST FLORIDA

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: March 1994

PRINCIPAL INVESTIGATOR: Rick M. Spechler, Orlando

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

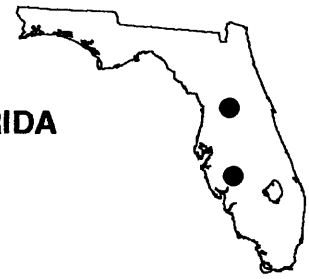
PROBLEM: Potentiometric-surface maps of the Upper Floridan aquifer show extensive depressions along the St. Johns River south of Jacksonville and in the vicinity of Green Cove Springs. Natural spring flows or upward leakage from the Upper Floridan that would help explain the potentiometric-surface depressions have been dismissed because of the presence of relatively thick confining beds that should hydraulically isolate the Floridan aquifer system from overlying aquifers and surface-water bodies. However, it is possible there are unknown submerged springs as well as a substantial amount of diffuse upward leakage.

OBJECTIVE: (1) Locate and attempt to quantify Upper Floridan aquifer discharges to the St. Johns River in the Jacksonville-Green Cove reach. (2) Determine the quality of Upper Floridan aquifer water that is being discharged as springs or upward leakage.

APPROACH: Refine maps of the Upper Floridan potentiometric surface in order to verify and better define the cone of depression in the Jacksonville-Green Cove reach. Collect subsurface geologic and structural information by geophysical methods. Attempt to locate submerged springs by using remote sensing and by performing vertical and horizontal temperature and specific conductivity traverses to determine significant differences in river-water quality that may be due to ground-water discharge.

PROGRESS: Reconnaissance of the St. Johns River was completed. A small number of previously unknown submerged springs were located in the St. Johns River from Green Cove Springs to Jacksonville. Water from the springs were sampled and analyzed. Inventoried wells were leveled-in and a detailed potentiometric surface map showing the cone of depression of the Upper Floridan aquifer along the St. Johns River was constructed.

PLANS FOR THIS YEAR: Final report will be completed and submitted for review and approval.



FL-531 DISTRIBUTION AND SOURCES OF SULFATE IN THE UPPER FLORIDAN AQUIFER, WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR Laura A. Sacks, Tampa

COOPERATING AGENCIES: Southwest Florida Water Management District and City of Sarasota

PROBLEM: Zones of ground water with elevated sulfate concentrations occur in parts of the Upper Floridan aquifer. Dissolution of aquifer minerals, such as gypsum and anhydrite, adds sulfate to the ground water, particularly at the base of the Upper Floridan aquifer. Upward movement of this water could result in elevated sulfate concentrations in upper zones of the aquifer. Other sources of sulfate include mixing with present-day seawater, saline water originating in the Lower Floridan aquifer, and rainwater recharged to the aquifer. Sulfur isotope data combined with hydrologic and geochemical data can be used to identify the sources of sulfate within the aquifer. Sulfate sources might differ depending on the vertical sampling interval and the location in the flow system.

OBJECTIVE: To describe the distribution and sources of sulfate in the Upper Floridan aquifer in west-central Florida. The study will focus on two areas where anomalously high sulfate concentrations occur within the aquifer. Isotopic and geochemical data will be used to characterize sources of sulfur species vertically and spatially within the aquifer.

APPROACH: Geochemical and isotopic data will be collected from two study regions, one which is in Sumter and Marion Counties and the other in the vicinity of the Peace and Myakka Rivers. Data collection will include sampling of ground water, spatially and from different vertical intervals, for major ions, trace metals, sulfur isotopes, and selected stable isotopes. Potential sulfate sources will also be sampled, including deep mineralized ground water, recent recharge, water from the saltwater mixing zone, and sulfate minerals occurring within the aquifer. Geochemical mass-balance and reaction path models will be used to test hypotheses of sulfate sources within the aquifer.

PROGRESS: Approximately 45 wells were sampled for chemical and isotopic analysis. The majority of these were from wells in the northern study area, in parts of Marion, Sumter, and Citrus Counties. Sampling focused on paired wells completed at different depths in the Upper Floridan aquifer. Gypsum and anhydrite samples from rock cores and cuttings were analyzed for sulfur isotope ratios. Select carbonate and evaporite samples were also analyzed for strontium isotope ratios. Carbonate rock samples were sent for carbon-13 analysis. Saturation states of waters with respect to mineral phases were computed. Mass-transfer modeling was initiated for the three flow paths in the southern study area.

(FL-531)

PLANS FOR THIS YEAR: Changes in chemical and isotopic composition of ground water will be evaluated along flow paths using mass-transfer modeling. These results will aid in interpreting changes in sulfur sources along flow paths and between the northern and southern study areas. An interpretive report will be prepared that compares results from the two study areas.

FL-532 THE POTENTIAL FOR WATER-QUALITY DEGRADATION OF INTERCONNECTED AQUIFERS IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Patricia A. Metz, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Hundreds of wells in west-central Florida are constructed open to both the Upper Floridan aquifer and the overlying intermediate aquifer system. When wells are not pumping, internal flow in the borehole transmits water from the aquifer with the highest head to that with the lowest head. This becomes a problem when water moves upward through the open borehole and contaminates the intermediate aquifer in areas where the Upper Floridan aquifer contains high concentrations of sulfate and chloride. Other problems occur where high levels of radium-226 in the intermediate aquifer contaminates the Upper Floridan aquifer by moving down through the boreholes in areas of downward head gradient.

OBJECTIVE: Delineate geographical areas where there is a potential for ground-water quality degradation caused by aquifer interflow in wells that tap multiple permeable zones.

APPROACH: Borehole flow measurements made in wells open to interconnected aquifers will be used to calculate interaquifer flow rates. Geophysical logs and a borehole video camera will aid in the determination of these flow measurements. Water-quality data will be collected from individual flow zones in the boreholes to delineate differences in the quality of ground water from specific contributing zones. The borehole flow measurements and water-quality data will be used to delineate areas where hydraulic head or water quality are likely to be affected by interaquifer flow. A concerted effort will be made to identify and document all boreholes where interaquifer flow could occur. Based on this inventory, a sufficient number of field measurements of internal flow will be made to permit a reasonable estimate of the total exchange of water. This data base will be entered into an existing ground-water flow model of the Hardee-DeSoto County area to simulate water-level changes that might occur with respect to well plugging.

PROGRESS: A detailed planning document was prepared. Previous work in the study area was reviewed, including water quality and hydrogeologic framework. A well inventory was conducted to locate wells open to multiaquifer flow. Approximately 87 wells were logged to determine internal flow characteristics.

PLANS FOR THIS YEAR: Complete report preparation.

FL-533 DETERMINATION OF ROUGHNESS COEFFICIENTS FOR STREAMS, DRAINAGE CHANNELS, AND OVERBANK AREAS IN WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Denis F. Gillen, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

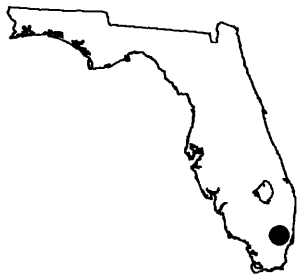
PROBLEM: Previous studies for the field verification of roughness coefficients have not included the low gradient channels and densely vegetated overbank areas that are so characteristic of west-central Florida.

OBJECTIVE: To examine current techniques for determining roughness coefficients for streams, drainage channels, and overbank areas in west-central Florida. By comparing Manning's n values computed from existing discharge measurements with Manning's n values derived through the field verification and quantification of factors, (such as slope, vegetation type and density, size of bed material, etc., affecting the flow resistance in low gradient, densely vegetated streams and overbank areas), a determination of the effectiveness of the currently accepted methods for estimating Manning's n values as applied to west-central Florida conditions can be made.

APPROACH: The roughness coefficient of 10-12 streams and(or) channels in west-central Florida will be determined through the collection of field data at selected reaches. Previous discharge measurements made at these sites will be used to calculate a roughness coefficient. Manning's roughness coefficient will also be determined for these same sites through field determinations of slope, cross-section area, and all other physical characteristics (vegetation density, and bed material) as outlined in Survey manuals. A comparison of the findings will be used as an indicator of the reliability of the methodology used to determine Manning's n values for conditions found in west-central Florida.

PROGRESS: Completed field collection of data from 12 study sites including cross-section surveys, water-surface profiles, bed samples, and discharge measurements. Photographs of vegetation and channel conditions were taken at all study reaches. A physical measurement of the vegetation density at Pithlachascotee was completed. Calculations of Manning's n values at 6 sites were finished.

PLANS FOR THIS YEAR: Complete calculations of Manning's n values for all sites. Make final selection of photographs for each study reach. Finalize report.



FL-534 DEVELOPMENT AND COMPARISON OF ALTERNATE METHODS FOR WETLAND REPRESENTATION IN GROUND-WATER MODELS

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Eric Swain, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: There are three general conditions related to wetlands in Dade County for which enhancements to the present digital models are needed: (1) wetlands commonly alternate between wet and dry conditions but the MODFLOW model does not allow for rewetting cells; (2) although river models have been linked to ground-water models and ground-water models can represent areas as aquifer blocks, there is no technique for linking the river models directly to the wetland areas; and (3) the ground-water models have no capability for simulation of tidal boundaries in south Dade County.

OBJECTIVES: To (1) modify the existing MODBRANCH model for wetland-canal aquifer interactions; (2) couple the two-dimensional surface-water flow model SWIFT2D to the three-dimensional ground-water flow model MODFLOW to simulate wetland-aquifer interactions; (3) construct, calibrate and verify the modified MODBRANCH and coupled SWIFT2D-MODFLOW models using field data collected in and available in south Florida; and (4) compare the two methods of wetland representation, aquifer blocks and free-surface flow cells, and determine the relative merits of each to different hydrologic situations.

APPROACH: The investigation involves incorporation of modifications to existing digital models followed by construction, calibration, and verification of two wetland-aquifer schematizations and final comparison of methods to determine appropriate uses and areas of applicability for the different types of representation. The investigation will include the following: (1) MODBRANCH model modifications: modifications to the MODBRANCH model will represent wetland areas as aquifer blocks. (2) SWIFT2D-MODFLOW coupling: SWIFT2D model will be thoroughly surveyed for the most efficient format for communication with the MODFLOW model. (3) MODBRANCH and SWIFT2D-MODFLOW model construction, calibration, and verifications: the modified models will be used to simulate aquifer-wetland-canal interactions in southern Dade County and the eastern Everglades National Park. (4) Comparison of the aquifer block and free-surface representations: results of the two models will be compared and contrasted for the south Florida study areas. Comparison for different types of wetland situations, flooded, seasonal, and tidally affected, will indicate which representations are most appropriate for different situations.

PROGRESS: The modifications to MODBRANCH were made to allow wetland- canal-aquifer interactions in the new connection package. The steady-state model of Dade County has been constructed with all the model options. A paper entitled, "Incorporating hydraulic structures in an open channel model" was presented at Water Forum 1992 (August 1992). A report and journal article were approved on the wetland interaction program. The steady-state model was

completed, and the transient model is in its final calibration and sensitivity analysis stage. The SWIFT2D wetland model was constructed and awaits calibration.

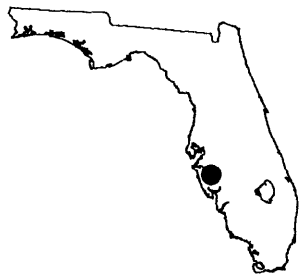
PLANS FOR THIS YEAR: Complete calibrations and sensitivity analyses on transient and SWIFT2D models. Implement comparison and complete final report and journal article.

REPORTS RELEASED:

Swain, E.D., 1992, Incorporating hydraulic structures in an open channel model, Proceedings of the Hydraulics Division at Water Forum '92, Baltimore, Maryland, August 3-6, 1992.

_____ 1993, Documentation of a computer program (Streamlink) to represent direct-flow connections in a coupled ground-water and surface-water model: U.S. Geological Survey Water-Resources Investigations Report 93-4011, 62 p.

FL-535 HYDROGEOLOGY OF THE INTERMEDIATE AQUIFER SYSTEM IN SARASOTA AND ADJACENT COUNTIES AND GROUND-WATER SALINITY IN SOUTHWEST SARASOTA COUNTY, FLORIDA



DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: Gerald L. Barr, Tampa

COOPERATING AGENCIES: Southwest Florida Water Management District and Sarasota County

PROBLEM: Ground water in Sarasota County, in coastal southwestern Florida is principally being developed from the surficial aquifer and the upper permeable zones of the intermediate aquifer system. Deeper permeable zones of the intermediate and Floridan aquifer systems are not used for drinking because water contains high concentrations of dissolved solids. Continued withdrawal from surficial and intermediate aquifers can cause upconing of saline water and result in degradation of freshwater. The confining units of the intermediate aquifer system retard movement of water between the various permeable zones. The Venice Clay is a significant confining unit within the intermediate aquifer system. Many supply wells tap permeable zones above and below the Venice Clay, allowing for movement of water between the zones. The areal extent, thickness, and hydraulic properties of the Venice Clay are important hydrogeologic characteristics that can be used to manage the water resources. Maps of depth to the top and thickness of confining units of the intermediate aquifer system would assist in designing production well casing depths and screened intervals. Hydraulic properties of the confining units control the interconnection between permeable zones, and hence, vertical leakages.

Sarasota County is seeking areas where ground water has low potential for saltwater intrusion. A specific effort in the southwestern coastal area of Sarasota County is needed to evaluate the extent of saltwater intrusion and the long-term trends in ground-water quality to manage ground water for public supply.

OBJECTIVE: First, to evaluate the hydrogeology of the intermediate aquifer system in Sarasota County, particularly where deposits of the Venice Clay exist. This will be accomplished by: (1) mapping the intermediate aquifer system where the Venice Clay exists; (2) describing hydrogeology of the intermediate aquifer system in Sarasota County, including lithostratigraphy, mineralogy, age, and depositional environment at three selected sites; (3) determining the thickness of the freshwater zone at two core sites; and (4) compiling and evaluating hydraulic properties, and water-quality and water-level data from existing sources at selected representative sites. Second, to evaluate the potential for development of ground water for public supply in southwestern Sarasota County. Analyze how ground-water quality might be affected by lateral intrusion from the Gulf of Mexico and upconing from the upper Floridan aquifer. Data collected would be used to determine movement into aquifers in the region between Osprey and Englewood. This will be accomplished by: (1) inventory wells open to the major aquifers for public supply; (2) design a long-term network of water-quality monitoring

wells; (3) collect water-quality data from the well network; (4) produce maps showing chloride and sulfate concentrations in the aquifers; (5) show graphic changes over time of chloride and sulfate concentrations in water from wells in the Venice, Venice Gardens, Plantation, and Englewood well fields; and (6) construct a numerical model to simulate the movement of ground water and dissolved constituents. The results of the study will be published as a U.S. Geological Survey report.

APPROACH: Compile a data base of gamma-ray and electric geophysical logs and lithostratigraphic descriptions that identify units of the intermediate aquifer system. Correlation techniques and cross sections will be used to identify permeable zones and confining units. Use core samples from one existing site and two new cores to be drilled as part of the study to describe the hydrogeology. Correlation will be made between the three core sites. Geophysical logs will be collected and used to establish benchmark geophysical profiles of the intermediate aquifer system. Compute existing hydrogeologic information from the Venice and other well fields in Sarasota County. Maps and cross sections will be prepared that depict the intermediate aquifer system and the areal extent of the Venice Clay.

Tasks for the ground-water salinity part of the study will include: a well inventory of 50-100 wells supplemented by existing information in the files of the Southwest Florida Water Management District, U.S. Geological Survey, Sarasota County, and municipal and private water-supply franchises; analyzing ground-water quality from water samples collected from the inventoried wells. Illustrations will be prepared to show concentration distributions of selected chemical constituents; ground-water modeling using the USGS modular model to estimate the potential for ground-water contamination by lateral intrusion and upconing. The model will be used conceptually and will not be calibrated to actual field conditions; a report that incorporates the results of the study as a U.S. Geological Survey report.

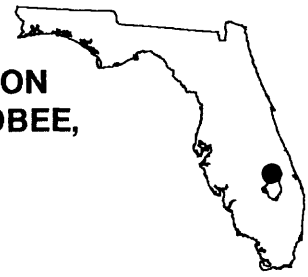
PROGRESS: A data base of geophysical and lithologic logs from 85 wells from existing files was completed. Ten cross-sections were used to evaluate the well-log data. Completed the evaluation of the cores from the Carlton Reserve and South Venice test sites. Analyzed 10 core samples for laboratory hydraulic conductances. Quality-water analyses for six ground-water samples from the South Venice site were analyzed for selected chemical constituents.

The study workplan was modified to include a ground-water salinity study in southwestern Sarasota County. Isopach maps of the surficial aquifer, intermediate aquifer, and the Upper Floridan aquifer were prepared to evaluate the hydrogeology of southwestern Sarasota County. An inventory of over 100 wells was completed and water from 70 wells was analyzed for field measurements and selected chemical constituents. A table of well records and water-quality information was compiled for all sampled sites. Compilation of hydrogeologic data continued that included hydraulic properties and water-quality from previous studies and reports.

Ground-water modeling activities were started that included the conceptualization of a 5-layer ground-water flow system; a grid design of half-mile equal node spacing using GIS; preparation and evaluation of isopach maps of the intermediate aquifer system layers; preparation of potentiometric surface maps of the surficial aquifer system, intermediate aquifer system layers,

and the Upper Floridan aquifer; evaluation of starting head values for all 5 layers; and evaluation of system stresses due to ground-water withdrawal from major pumping centers and well fields for public supply.

PLANS FOR THIS YEAR: Complete all hydrogeologic data collection and evaluation, cross-sections, preparation of isopach maps, water-quality data collection and laboratory analysis of about 20 wells, complete all ground-water modeling simulations and analyze results, and begin preparation of report.



FL-536 AQUIFER STORAGE AND RECOVERY FOR REDUCTION OF PHOSPHATE IN CANAL WATER, LAKE OKEECHOBEE, FLORIDA

DATE PROJECT BEGAN: April 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Vicente Quinones-Aponte, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: The Lake Okeechobee Technical Advisory Committee (LOTAC) was formed in 1985 with the commitment to search for solutions to reduce the increasing contamination trend of Lake Okeechobee. At present, the most serious contamination problem to the lake is posed by the increasing phosphorus and nitrogen loads from contributing canal systems. This creates the threat of accelerated eutrophication and degradation of lake water. LOTAC recommended a study of the feasibility of aquifer storage and recovery (ASR), among other remedial techniques, to eliminate the phosphate contamination problem.

OBJECTIVE: To (1) assess the feasibility of ASR as a mechanism for reducing phosphate loads in the canal water; (2) study the chemical behavior of the canal and native-aquifer waters mix during ASR, focusing on the fate of phosphate; and (3) estimate the recovery efficiency of the well or aquifer system for different well or aquifer configurations. The location of the study site is on the northern part of Lake Okeechobee, Florida. The study is limited to some flow zones within the Lower Floridan aquifer. The recovered water is intended for agricultural purposes.

APPROACH: Conduct four ASR tests where water samples will be collected from the injection well and two observation wells (nested wells) located at 560 feet from the injection well. One of the observation wells is open to the injection zone and the other is open to an upper confining unit. The water samples will be analyzed and the results will be used to study the chemical behavior of the mix of injected canal water and native aquifer water. Geochemical models (WATEQF and PHREEQE) will be applied to extend the study on a theoretical basis focusing on the fate of orthophosphate. A model capable of simulating density dependent flow and solute transport (HST3D or SUTRA) will be applied to study the feasibility of ASR for different well/ aquifer configurations.

PROGRESS: All four field ASR tests were completed as well as the analysis of chemical data. Two papers are currently in review, one describes the chemical processes from a chemical equilibrium approach and the other from a kinetic approach. A solute transport model was developed using the SUTRA code implementing all available data. The hydraulic calibration is complete, and the solute transport calibration is approximately 90% complete. A modeling report is in preparation.

PLANS FOR THIS YEAR: Complete model calibration and publish all reports relating to the ASR project.

FL-537 A METHOD TO ESTIMATE NONSTEADY-STATE LEAKAGE FROM COASTAL CANALS IN THE SURFICIAL AQUIFER SYSTEM, SOUTHEAST FLORIDA

DATE PROJECT BEGAN: October 1991

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Eric Swain, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Previous research into field determination of reach transmissivity has relied on steady-state conditions for field measurements (Chin, 1990). However, tidal fluctuations can propagate far enough to affect the ground water near structures. When the structures are opened, unsteady conditions will persist in the aquifer for significant parts of the measurement periods. The unsteady flow will invalidate previous assumptions that the leakage flow rate is constant between the canal and the characteristic distance to where transmissivity is measured. Thus, the standard direct determination of reach transmissivity by application of Darcy's law over the characteristic distance would be invalid.

OBJECTIVE: The objectives are to: (1) develop a method of quantifying water exchange between canals and aquifer under estuarine-tidal conditions and varying water-management practices at selected surface-water controls, and (2) determine the effects of these canals on the ground-water system.

APPROACH: At the start of this investigation, water-level recorders will be installed at the salinity control gates on a canal and about 1 mile upstream. Additional water-level monitoring wells will be installed at about 5 and 500 feet from the canal on both sides of the canal. Canal discharge measurements by ultrasonic velocity meter (UVM) will be made when the salinity controls and the upstream station controls are open. The difference in discharge measured at two points in the canals will give the leakage in or out of the canal. These measurements will be used to determine reach transmissivity upstream from the controls.

PROGRESS: Completed field installation. Initial data were collected. Quality check was completed on data. Hurricane Andrew damaged field installations.

PLANS FOR THIS YEAR: Complete repair of damaged sites. Continue collection and create analysis routine.

FL-539 FACTORS AFFECTING THE MOVEMENT OF THE SALTWATER INTERFACE IN RESPONSE TO PUMPING AT A NEAR-SHORE WELL FIELD, WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: March 1992

DATE PROJECT ENDS: February 1995

PRINCIPAL INVESTIGATOR: Lari Knochenmus, Tampa

COOPERATING AGENCY: City of Sarasota

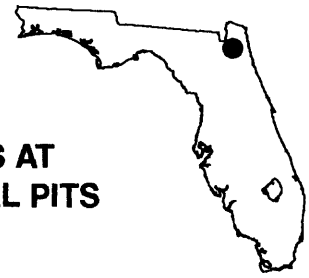
PROBLEM: The city of Sarasota operates a downtown well field consisting of six production wells. The water from the well field, which is high in chlorides and sulfates, is treated by reverse-osmosis (RO). Well withdrawal is about 6 million gallons per day, which yields 4.5 million gallons of potable water. An additional production well and two standby wells are planned. Increased stress to the system caused by overlapping cones of depression needs to be addressed.

OBJECTIVE: Define the balance between pumping from a coastal well field and saltwater intrusion. Evaluate how historical pumping has affected ground-water levels by studying history of water use, defining the hydrogeologic framework, and analyzing the quality of ground water. Models will be utilized to assess potential movement of saltwater toward wells. Evaluate possible courses of action to maintain quality and yield.

APPROACH: An inventory of existing wells within the cone of depression of the well field will be made. Hydrogeologic framework will be determined from drill cuttings, water-quality samples, and geophysical logs. Core samples from the confining units will be analyzed in the lab for hydraulic conductivity. Hydrologic units and producing zones will be delineated. Ground-water quality will be evaluated. Models will be used to estimate how an increase in pumpage will affect yield and movement of the saltwater interface.

PROGRESS: Geophysical logging, water-quality sampling, and aquifer testing were completed for the city of Sarasota production wells 1,3,4,5, and 6. Geophysical logging and water-quality sampling were completed for the city of Sarasota production well #2. A 1,200-foot corehole was completed by the Florida Geological Survey. Data collected from the corehole includes geophysical logs, water-quality samples, core samples, and borehole television surveys. Geophysical logs were digitized for the city of Sarasota production wells and regionally dispersed wells to create a 3-D picture of the Upper Floridan aquifer system in the vicinity of the city of Sarasota. Cores were collected from the semiconfining units in the Upper Floridan aquifer. These cores were analyzed for hydraulic conductivity by the Florida Geological Survey. Water samples from the corehole were analyzed for strontium isotope data to age date the water. Water-level data in the vicinity of the City of Sarasota were collected in May and September 1993. Numerical modeling of the ground-water flow system was initiated using MODFLOW and MODPATH models.

PLANS FOR THIS YEAR: Complete numerical modeling and draft of the final report.



FL-541 SIMULATION OF GROUND-WATER FLOW AND ASSESSMENT OF TRANSPORT OF CONTAMINANTS AT OPERABLE UNIT #1, OIL AND SOLVENTS DISPOSAL PITS AREA, JACKSONVILLE NAVAL AIR STATION

DATE PROJECT BEGAN: June 1992

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: James H. Davis, Tallahassee

COOPERATING AGENCY: U.S. Navy, Charleston, South Carolina

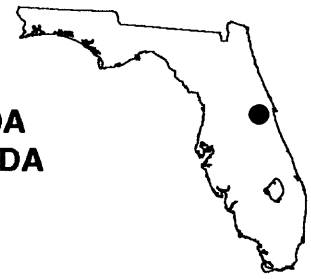
PROBLEM: Organic and inorganic EPA priority pollutants have been discovered in ground water, sediments, and surface water surrounding Operable Unit #1 (OU#1) at Naval Air Station (NAS), Jacksonville. As part of the Installation Restoration Program, the NAS is planning remedial-action alternatives to control the movement of these pollutants from the site. However, insufficient quantitative hydrological information exists to evaluate the movement of these pollutants in the ground to the adjacent St. Johns River.

OBJECTIVE: Develop an understanding of ground-water flow in the surficial aquifer in the immediate vicinity of OU#1. The study will determine, by use of a computer model, paths of ground-water flow that should delineate the directions of contaminant transport. The final report for the study will provide a discussion of the modeling procedures, the source of input data, and the flow paths for ground-water movement.

APPROACH: (1) Review existing hydrogeologic and water-quality data collected by previous investigators at NAS Jacksonville; (2) identify locations for additional wells to define the water table within the modeled area; (3) construct a preliminary 2D ground-water model based on data at hand; (4) refine ground-water model after final data collection by ABB consultants (under separate contract to the Navy); and (5) produce flow paths of probable contaminant travel.

PROGRESS: Preliminary modeling of the ground-water flow system at OU#1 was updated using new water-level measurements and additional stream-discharge measurements. Ground-water flow is being simulated using the U.S. Geological Survey MODFLOW model. Ground-water flow paths were projected using the USGS MODPATH program. Based on these results, suggested locations for additional water-level monitoring wells were made to the Navy.

PLANS FOR THIS YEAR: Additional modeling will be conducted using data collected by ABB Environmental Services, Inc., as part of their ongoing work at the site. The additional modeling will include both ground-water flow and solute transport. A report will be written detailing procedures and results.



FL-543 VERTICAL HYDRAULIC DIFFUSIVITY OF SELECTED ZONES IN THE FLORIDAN AQUIFER SYSTEM, COCOA WELL-FIELD AREA, EAST ORANGE COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: April 1995

PRINCIPAL INVESTIGATOR: Gertrude G. Phelps, Orlando

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

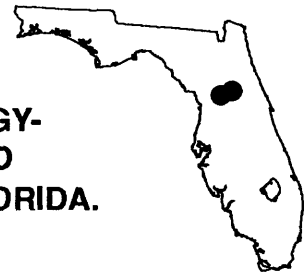
PROBLEM: In eastern Orange County, upper zones of the Floridan aquifer system contain freshwater but lower zones contain brackish water. The Cocoa well field pumps about 24 million gallons per day and expansion is planned. No field-derived quantitative information is available to estimate the rate at which salty water may move upward into the freshwater zone.

OBJECTIVE: Determine the vertical hydraulic diffusivities of aquifer materials at selected depths beneath pumped zones of the Floridan aquifer system in eastern Orange County.

APPROACH: A series of aquifer tests will be conducted using selected supply wells as pumped wells. Pressure transducers will be used to measure head changes in five aquifer zones tapped by existing monitor wells. Data will be analyzed using the Neuman-Witherspoon method. Sample calculations of vertical times-of-travel will be made for several ranges of vertical diffusivity, aquifer porosity and specific storage, and withdrawal rates and locations.

PROGRESS: Slug tests were run in several zones of a multizone test well so that the horizontal hydraulic conductivity of the aquifer layers can be estimated. Two 48-hour aquifer tests were run. A water-supply well about 150 feet from the multizone well was pumped and pressure transducers were used to measure drawdown and recovery in four zones of the multizone well, a surficial aquifer well and another Upper Floridan aquifer well. Analysis of the data from the tests has begun.

PLANS FOR THIS YEAR: Conduct one or two additional aquifer tests in another part of the well field. Complete analysis of all aquifer tests. Begin writing final report.



FL-544 COMPARISON OF AREAL EVAPOTRANSPIRATION ESTIMATES COMPUTED USING WATER- AND ENERGY-BUDGET ANALYSES FOR THE SILVER SPRINGS AND RAINBOW SPRINGS BASIN IN NORTH-CENTRAL FLORIDA.

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: Leel Knowles, Jr., Orlando

COOPERATING AGENCIES: Southwest Florida Water Management District
St. Johns River Water Management District

PROBLEM: Evapotranspiration (ET) is an important component of all terrestrial hydrologic budgets and is influenced by changes in climate. Though the physics of evaporation are well known, physically based (energy-budget) model results are not always related to spatially averaged actual evapotranspiration (AET). This results, in part, from extreme spatial and temporal variations in physical resistance to evaporation (differences in conductance through various vegetation types, for example), and variations in the availability of water. Site-specific energy-budget estimates of ET are readily determined and provide refined temporal resolution, but lack the spatial integration of a regional water budget. A regional water budget, in contrast, is a good indicator of overall AET, but sometimes is difficult to define, providing little information about temporal changes and patterns in AET. Estimates of regional AET could be improved by combining energy-budget and regional water-budget approaches to resolve differences in temporal and spatial scales, but retain temporal resolution and spatial integration.

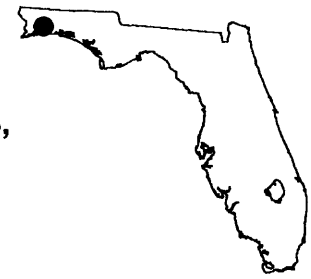
OBJECTIVE: The general objective is to present how regional estimates of AET can be improved by combining small-scale energy-budget and regional water-budget approaches. This includes the following three specific objectives: (1) determine the optimum differential interval (time-lag) for decomposed time series of AET estimates for a variety of differential intervals; (2) compare long-term water-budget ET estimates to long-term pan evaporation, then compare shorter-term modified Priestley-Taylor ET estimates to water-budget ET estimates (or pan evaporation), and then compare eddy-correlation-derived AET estimates to the Priestley-Taylor estimates; and (3) develop and use an AET model to examine temporal (monthly, seasonal, annual, and multiannual) trends in AET based on existing hydrologic data.

APPROACH: This study will look at time-series data for two spring basins in Florida (Silver and Rainbow Springs), for which principal hydrologic fluxes have been accurately measured for more than 40 years. Spectral analysis and other autocorrelative time-series analyses will be used to filter the delay effects of rainfall and other hydrologic fluxes on ET computed by budget-residual analysis. Filtered ET (resolved to the shortest time-scale practicable) will be related to available climatic data for the period of record and will be examined for trends. Filtered ET estimates also will be related to results from AET data collected using eddy-correlation for a test period of 18-months.

PROGRESS: Regional ET has been computed using water-budget analysis. Meteorological station is installed. AET is measured monthly using eddy-correlation equipment.

(FL-544)

PLANS FOR THIS YEAR: (1) Compute ET (penman) using energy-budget data; (2) spectral and autocorrelative analysis on ET (water-budget) to filter delays in hydrologic fluxes within the basins; (3) relate AET (eddy-correlation) to penman ET; and (4) relate Penman ET to long-term ET estimates.



FL-545 DELINEATION OF GROUND-WATER RECHARGE AREAS IN ESCAMBIA AND SANTA ROSA COUNTIES, FLORIDA

DATE PROJECT BEGAN: August 1992

DATE PROJECT ENDS: September 1993

PRINCIPAL INVESTIGATOR: Trey Grubbs, Tallahassee

COOPERATING AGENCY: Florida Department of Environmental Protection

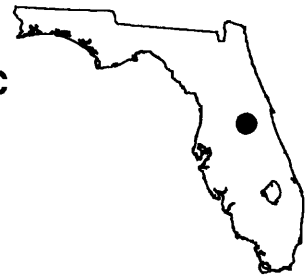
PROBLEM: Information on ground-water recharge areas at a large scale is needed by the State of Florida for implementing various ground-water programs. Delineation of recharge and accompanying rates is required for assessing the effects of ground-water development on a subregional and local basis. Recharge mapping in Escambia and Santa Rosa Counties is needed to support ongoing flow-modeling efforts being used in defining zones of contributions for public supply needs.

OBJECTIVE: (1) To delineate recharge areas for the surficial and Upper Floridan aquifer at a scale of 1:100,000 and (2) to define the recharge areas as high and low rate.

APPROACH: Recharge areas will be separated from discharge areas by (1) identifying all wetlands and major surface-water drains as discharge areas for the surficial aquifer (using topographic maps) and (2) by identifying discharge areas from the Upper Floridan aquifer as those areas where the potentiometric surface of the Upper Floridan is above the water table. Recharge rates to the surficial aquifer will be determined through hydrograph separation and regression analysis techniques. Recharge rates to the Upper Floridan aquifer will be determined from hydrogeologic data and aquifer properties determined from regional modeling studies.

PROGRESS: Recharge to surficial aquifer was greater than 10 inches per year in all areas except floodplains and wetlands that have a surface drainage outlet. Recharge rates for the Upper Floridan aquifer were negligible for most of the two-county area. Final recharge maps were prepared for both counties. A draft map report was completed.

PLANS FOR THIS YEAR: Publish final map report.



FL-546 A COUPLED SOIL-WATER DYNAMICS AND CLIMATIC EVALUATION OF EVAPOTRANSPIRATION AND AQUIFER RECHARGE RELATIONS

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: David M. Sumner, Orlando

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

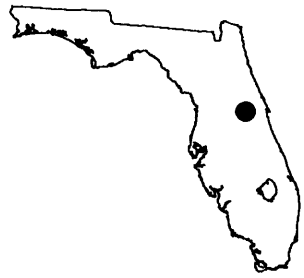
PROBLEM: An understanding of the magnitude and temporal patterns of evapotranspiration and phrenetic aquifer recharge is hampered by the lack of a physics-based integration of soil-water dynamics, plant stomatal response, and meteorological forcing.

OBJECTIVE: (1) Development of one-dimensional numerical model of evapotranspiration/ recharge processes; (2) instrumentation of field site to calibrate and test model; and (3) application of the model to evaluate patterns of evapotranspiration and phrenetic aquifer recharge.

APPROACH: Penman-Monteith formulation for evapotranspiration will be linked to Richard's equation for unsaturated soil-water transport, along with mass budgeting of rainfall between canopy reservoir storage and infiltration.

PROGRESS: All site instrumentation (Penman Station, Time Domain Reflectometer probes, infrared temperature sensor) was installed and is fully operational. Eddy correlation measurements of actual evapotranspiration replaced lysimeter measurements to avoid the effects of soil/plant disturbance involved in lysimeter construction. Data reduction and analysis is ongoing.

PLANS FOR THIS YEAR: Continue data collection/analysis. Begin development of numerical flow model to simulate soil water infiltration/drainage/depletion due to evapotranspiration.



FL-547 EFFECTS OF DIVERTED STORMWATER RUNOFF FROM DRAINAGE WELLS ON RECHARGE TO THE UPPER FLORIDAN AQUIFER, ORANGE COUNTY, FLORIDA

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: Laura A. Bradner, Orlando

COOPERATING AGENCIES: Orange County Public Utilities
St. Johns River Water Management District
South Florida Water Management District

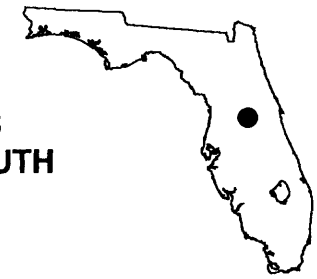
PROBLEM: Drainage wells have the potential to adversely affect water quality in the Floridan aquifer system, the source of drinking water in Orange County. The remedial options are pretreatment of the inflow prior to discharge into the wells and closure of the wells. Quantitative information is needed to evaluate the feasibility of closure of 23 noncritical wells.

OBJECTIVE: (1) Estimate recharge through noncritical drainage wells; (2) evaluate potential effects of drainage-well closure on the potentiometric surface of the Upper Floridan aquifer; and (3) evaluate potential effects of land disposal of rerouted stormwater on recharge rates to the Floridan aquifer system.

APPROACH: (1) Instrument 3 selected drainage wells to measure inflow and (2) use groundwater flow model to simulate effects of well closure and rerouted inflow on the Upper Floridan aquifer in selected areas in western Orange County.

PROGRESS: Three wells were instrumented and stage-discharge rating curves were calculated. Drainage basins were delineated and land-use data were collected.

PLANS FOR THIS YEAR: Estimate maximum possible inflow to drainage wells on a seasonal and annual basis. Use the range of estimated inflow in a numerical model to simulate potential effects of drainage-well closure on the potentiometric surface of the Upper Floridan aquifer.



FL-548 HYDROLOGIC IMPACT OF TREATED WASTEWATER DISPOSAL THROUGH RAPID INFILTRATION BASINS AND CITRUS IRRIGATION, WEST ORANGE AND SOUTH LAKE COUNTIES, FLORIDA

DATE PROJECT BEGAN: April 1992

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: David M. Sumner, Orlando

COOPERATING AGENCY: Reedy Creek Improvement District

PROBLEM: The long-term effects of disposal of treated wastewater through rapid infiltration basins and citrus irrigation on the surficial aquifer system in central Florida is unquantified.

OBJECTIVE: To (1) estimate the movement of treated wastewater applications through the ground-water system; (2) define the surface-water response to present and future disposals; and (3) define the response of hydraulic head and flow paths within the Upper Floridan aquifer.

APPROACH: (1) Multilayer areal ground-water flow model of the surficial and Upper Floridan aquifer is developed; (2) model will be used to address questions of rates and directions of flow and lake-level response, upon model calibration.

PROGRESS: Collected existing data regarding lithology, well locations, ground-water levels, stream stage-discharge, lake levels, rainfall, and wastewater disposal rates. Began drilling additional surficial aquifer wells. Surveyed existing wells to establish accurate measuring point altitudes. Began installing water-level recorders. Established boundaries for ground-water flow model and started construction of conceptual model.

PLANS FOR THIS YEAR: Continue data collection. Finish drilling of surficial aquifer wells and installation of water-level recorders. Survey new surficial aquifer wells. Finish construction of conceptual model. Construct ground-water flow model, compile input data, and begin model calibration. Complete topical and annotated outlines and begin writing descriptive sections of report.

FL-549 TRENDS IN WATER QUALITY AT PUBLIC SUPPLY WELLS IN THE TAMPA BAY AREA, FLORIDA

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Miguel A. Corral, Jr., Tampa

COOPERATING AGENCIES: West Coast Regional Water Supply Authority and Pinellas County

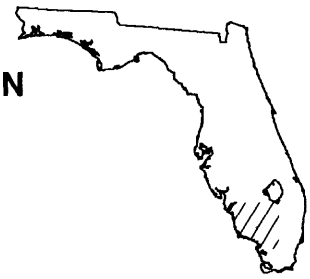
PROBLEM: Ground-water quality in west-central Florida, particularly along the coast of the Gulf of Mexico, appears to be deteriorating. In the last decade water from public supply wells that draw water from the transition zone between freshwater inland and saltwater from the gulf has had increased concentrations of dissolved solids (Clearwater, Venice, and Englewood). Additionally, long-term increases in nutrient concentrations of water discharging from springs could be caused by human activity.

OBJECTIVE: To tabulate the ambient water quality of the Upper Floridan aquifer at pumping centers in Hillsborough, Pinellas, and Pasco Counties and evaluate whether long-term changes in water quality are occurring.

APPROACH: A compilation of water-quality data from the files of U.S. Geological Survey, Southwest Florida Water Management District, West Coast Regional Water Supply Authority, County Public Health Departments, and other govemmental agencies that can supply reliable information on water quality will be graphed and interpreted to assess water quality trends of selected wells used for municipal supply.

PROGRESS: Data were compiled. Graphing was completed. Interpretation of data is near completion.

PLANS FOR THIS YEAR: Finish interpretation of data. Prepare interpretative report and submit for review and approval.



FL-551 HYDROGEOLOGIC FRAMEWORK AND DISTRIBUTION OF SALINITY IN THE FLORIDAN AQUIFER SYSTEM, SOUTHWESTERN, FLORIDA

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Ronald Reese, Miami

COOPERATING AGENCY: South Florida Water Management District

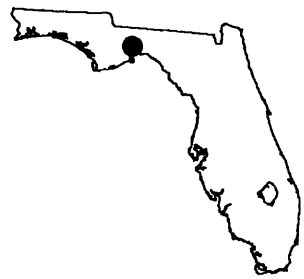
PROBLEM: The growing population of southern Florida has prompted a need to find supplemental sources for public water supply. The virtually untapped Floridan aquifer system can potentially be used to assist in this need. Salinity in the aquifer system is high, and the produced water must be treated or blended with freshwater. The hydrogeologic framework and distribution of salinity need to be defined and better understood in order to efficiently plan the development of this resource.

OBJECTIVE: This study is to include the lower part of the intermediate aquifer system (lower Hawthorn aquifer) as well as the Floridan aquifer system in Lee, Collier and Hendry Counties. The objectives of this study are as follows: (1) establish a hydrogeologic framework; (2) delineate hydrochemical zones based on salinity and map the top, base, and, in some cases, the thickness of these zones; and (3) map the areal distribution of salinity in hydrogeologic units.

APPROACH: Correlation of important hydrogeologic units will be done using geophysical logs such as the gamma ray and flowmeter logs and by using lithologic data. The hydrologic framework will be displayed by constructing geologic sections and subsurface maps. Delineation of hydrochemical zones will be done using geophysical logs, mainly the resistivity and porosity log responses, and water sample analyses. Sources of water-quality data samples are to include: (1) previously collected USGS data (QWDATA); (2) samples obtained during the deep well plugging program by South Florida Water Management District and USGS; (3) samples obtained from deep wastewater injection well systems; (4) samples obtained from deep oil field wells; (5) samples obtained from wells currently being drilled and from six deep test wells SFWMD plans to drill in the study area in 1993 and 1994. Head data from wells and zones will be collected for the purpose of relating to hydrochemical boundaries. Geophysical logs will be digitized for the purpose of correlation and construction of geological sections. A GIS system will be used to assist in the construction of a base map and subsurface maps.

PROGRESS: Existing well data were acquired and inventoried, including geophysical and lithologic logs, core data, water quality data and aquifer test. A 1:250,000 scale base map was constructed using negative films of quadrangles supplied by the Earth Science Information Center. Determination of hydrogeologic tops and hydrochemical boundaries and water quality mapping has begun.

PLANS FOR THIS YEAR: The compilation of tables, construction of cross sections and maps, and data analysis will be completed this year. The first draft of a report will be completed and submitted to the USGS review process system.



FL-553 HYDROLOGIC CONDITIONS IN FLOOD-PLAIN HABITATS OF APALACHICOLA RIVER

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: Helen M. Light, Tallahassee

COOPERATING AGENCY: Northwest Florida Water Management District

PROBLEM: The current controversy over water allocation in the Apalachicola-Chattahoochee-Flint (ACF) Rivers involving the city of Atlanta, the States of Georgia, Alabama, and Florida, and the U.S. Army Corps of Engineers is a strong signal that water resources in this basin are limited and competition for water is increasing. Florida's needs for the water resources of the ACF basin are primarily ecosystem based and relate to the healthy maintenance of the river, flood plain, and estuary. Relations between river flow and flood-plain habitats need to be defined to understand the potential effect of increased upstream water withdrawals on the Apalachicola River flood-plain system.

OBJECTIVE: To describe how Apalachicola River flood-plain habitats and the biological communities known to utilize those habitats might be expected to change if river flows are altered by upstream withdrawals.

APPROACH: The 3-year study will include 2 years of research and analysis and 1 year of interpretation and report writing. During the first 2 years: (1) field data collections will be made to document the hydrologic conditions in selected flood-plain habitats; (2) limited statistical analysis of historical flow and stage will be conducted; and (3) literature research on the biological communities of flood-plain habitats in the Apalachicola and other river systems will be performed. In the final year, results of the field data, hydrologic analysis, and biological literature review will be combined in a report discussing the changes in flood-plain habitats and associated biological communities that may occur under various hypothetical low-flow scenarios.

PROGRESS: Field reconnaissance completed, study sites selected, data-collection methods developed, data-collection networks established, and data collection begun. Baseline hydrologic data sets designed and partially completed, and evaluation of riverbed entrenchment in upper river conducted. Maps digitized, aerial photographs scanned and digitized, and preliminary mapping categories assigned. Updated species list of fishes in Apalachicola River completed, extensive list of references compiled, and preliminary review of literature begun on the dependence of fishes on flood-plain habitats.

PLANS FOR THIS YEAR: Complete approximately 80-90% of field-data collection, complete data entry and preliminary analysis of field data collected to date, complete development of hydrologic data base, conduct statistical analyses of hydrologic data, begin mapping habitats on GIS data base, continue literature review of dependence of fishes on flood-plain habitats.

FL-554 CHARACTERISTICS OF TRANSPORT IN THE CAVERNOUS AND CONDUIT TYPE AQUIFERS OF SOUTH FLORIDA

DATE PROJECT BEGAN: April 1993

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: Vicente Quinones-Aponte, Miami

COOPERATING AGENCY: South Florida Water Management District

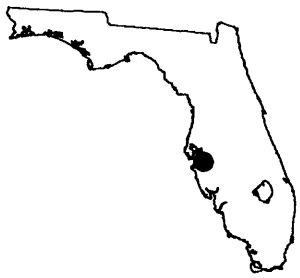
PROBLEM: Presently, models that assume porous-media type flow are used to simulate the transport of contaminants through the often cavernous type ground-water flow systems of southern Florida. The use of porous-media type models can be justified for large-scale studies (regional studies), but a more comprehensive modeling technique may be needed for small-scale studies. This study is intended to enhance the present knowledge of flow types and transport mechanisms in cavernous and conduit type flow aquifers located in south Florida.

OBJECTIVE: (1) Ground-water flow and transport characteristics will be identified in the Floridan aquifer system and units of the shallow aquifers that have unique cavernous or conduit type systems, (2) new or modified approaches based on a megascopic representation (real scale) of the aquifer system to simulate flow and transport processes in cavernous or conduit type systems will be tested, and (3) the proposed real-scale-based models will be compared to the classical continuum-based porous-media models.

APPROACH: Existing conduit and cavernous type ground-water flow and transport models will be developed or modified using the "equivalent aperture" approach and analytical and numerical solutions. These models will be coupled with various statistical distributions (binomial, uniform, and others) to represent multiple conduit systems. Existing ground-water flow and transport models, which are based on the porous-media concept (continuum), will be used to construct hypothetical aquifer models with hydraulic characteristics equivalent to that of some other hypothetical conduit or cavernous type system. The equivalent porous-media type models will be compared to the conduit and cavernous type models. Both the conduit and cavernous type models and an equivalent porous media model will be applied to data from a selected case study.

PROGRESS: Existing analytical and numerical solutions for the case of solute transport along a single conduit type aquifer for plug flow (volumetric flow) conditions were modified and tested. A journal article is in review.

PLANS FOR THIS YEAR: A single conduit type aquifer model will be coupled with various statistical distributions to represent the case of a multiple conduit system. Existing fracture flow type model will be modified to represent flow in a cavernous type aquifer system.



FL-555 HYDROLOGIC CHARACTERISTICS OF THE BRADEN RIVER WATERSHED AND EVERS RESERVOIR, MANATEE COUNTY, FLORIDA

DATE PROJECT BEGAN: February 1993

DATE PROJECT ENDS: April 1997

PRINCIPAL INVESTIGATOR: Billy Lewelling, Tampa

COOPERATING AGENCIES: Southwest Florida Water Management District, City of Bradenton and Manatee County

PROBLEM: The Evers Reservoir is an impoundment basin on the Braden River that is the sole source of water for the city of Bradenton. Estimates of the water supply potential of the river, inflow to the reservoir and estimates of the freshwater discharge out of the reservoir are quantitatively unsubstantiated. An increasing awareness of potential environmental stresses that result from decreasing freshwater inflow to estuarine systems make it necessary to quantify and analyze the hydrologic characteristics, including water quality of the system.

OBJECTIVE: To define streamflow and water quality characteristics throughout the Braden River Watershed, including a detailed water budget of Evers Reservoir. A further objective is to evaluate the potential effect that changes in freshwater outflow from the reservoir could have on the transport of constituents and salinity characteristics in the downstream tidal reach and estuary.

APPROACH: The initial thrust of the study will be to install a data-collection network to continuously monitor discharge in the hydraulically complex tidal reach downstream from the Evers Reservoir dam, as well as the remainder of the watershed. As the result of a reconnaissance effort, an acoustic velocity meter was installed in the tidal reach downstream of the dam. This meter will record continuous velocity to be used as index in defining streamflow at high discharges. Volumetric measurements of flow over the weir will be made at low flow. The relation between the ground water and the Braden River will also be investigated. A piezometer network will be installed around the control to help define possible seepage around the dam. Water-quality sampling will be done at 6 week intervals to be analyzed for field parameters, major ions, nutrients, total organic carbon, and total suspended and dissolved solids. To define elements of the water budget within the reservoir, two climate stations will be installed to collect data needed to compute evaporation using the energy budget method. Continuous temperature and conductivity probes will be installed on the tidal reach of the river to help define vertical and temporal distributions of salinity. Data collection will continue for 3.5 years. A report will be prepared to describe the results of the study.

PROGRESS: A stable discharge rating for the control was developed using volumetric and standard meter streamgaging techniques. The continuous discharge monitoring network was improved by relocating several gages and by further defining the rating curves for high and low water stages. Five partial-record sites were established and rated for peak flows using crest stage indicators (CSI). A piezometer network was installed at the dam. Dye studies were done

at the dam to test for significant leakages around, under or through the dam. The acoustic velocity meter was discontinued after testing standard high-water measurements upstream of the control. Water-quality sampling was initiated. Water-quality profiles of the Braden River estuary downstream of the control were done and will continue. Continuous conductivity probes were installed in the Braden River estuary approximately 1,000 feet downstream of the control.

PLANS FOR THIS YEAR: Data collection will continue. Data will be included in the annual data report. Analysis of data will continue. Water-quality sampling at continuously gaged sites will be done quarterly.

FL-556 BASELINE HYDROLOGIC ASSESSMENT OF THE HORSE CREEK WATERSHED, CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: Billy R. Lewelling, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: The Horse Creek watershed drains approximately a 241-square mile area in the central Florida's phosphate mining district. Almost all of the watershed is still in its natural state, but phosphate companies own about 50 percent of the watershed and have designated the land for future mining reserves.

OBJECTIVE: To define existing surface-water, ground-water, and water-quality characteristics of the watershed. The secondary objective will be to design and implement a data-collection network to provide water managers with information needed to evaluate the effect of changes that could occur during mining operations.

APPROACH: (1) Historical water-resources data will be compiled. (2) Installation of monitoring network and data collection; (3) seepage studies will be conducted during spring low flow and after summer runoff season has ended; (4) recharge to the surficial aquifer system will be assessed; (5) rainfall-runoff relations will be developed; (6) hydrogeology will be defined; and (7) surface-water and ground-water interactions will be defined.

PROGRESS: Data-collection network was installed and instrumented. Network included four streamflow gages, eight rainfall gages and eight surficial aquifer wells. Water-quality sampling for ground-water and rainfall has begun to evaluate recharge. Slug tests were performed on all eight wells to determine hydraulic conductivity. Historical well-inventory list was compiled.

PLANS FOR THIS YEAR: Continue collecting, processing, and storage of hydrologic data (streamflow, ground water, and rainfall). Begin quarterly water-quality sampling of streamflow. Perform seepage runs during high- and low-water table conditions. Evaluate streamflow characteristics, and recharge data.

FL-557 POTENTIAL FOR AQUIFER STORAGE AND RECOVERY OF TREATED EFFLUENT AT ST. PETERSBURG, FLORIDA

DATE PROJECT BEGAN: May 1993

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: Dann K. Yobbi, Tampa

COOPERATING AGENCY: City of St. Petersburg

PROBLEM: Aquifer storage and recovery (ASR) of treated effluent at St. Petersburg is a concept that needs investigation. There is a deficiency of wastewater for irrigation in the dry spring months and an excess in the wet summer months, during which time the excess is disposed through deep injection wells. This study will examine the feasibility of storing the treated effluent in shallow less transmissive formations in wet periods and recovering it for irrigation in dry periods.

OBJECTIVE: To assess the potential for aquifer storage and recovery of treated effluent at St. Petersburg. If the study demonstrates that ASR is viable, then reuse gray water should expand and pumping from inland well fields 50 miles from St. Petersburg will be alleviated.

APPROACH: The project will be conducted in two phases. Phase I will involve analysis of hydrogeologic and chemical data and development of a computer model of a single injection well. Phase 2 will involve the design and testing of a much more complicated prototype 3-dimensional model.

PROGRESS: New project, little progress to date.

PLANS FOR THIS YEAR: Prepare planning document and assess the hydrogeologic conditions at St. Petersburg's four wastewater-treatment plants. Evaluate the potential effects of injecting and mixing effluent with native water. Simulate a single injection-recovery well using the HST3D model.

FL-563 TECHNIQUE FOR DEFINING WETLANDS USING A MODIFIED GROUND-WATER FLOW MODEL

DATE PROJECT BEGAN: January 1993

DATE PROJECT ENDS: September 1995

PRINCIPAL INVESTIGATOR: Roy Sonenshein, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Prior to development, most of southeastern Florida west of the coastal ridge was wetlands (The Everglades). Currently, vast areas of wetlands are confined behind levees. Most of these wetlands are under Federal or State jurisdiction. East of the levee system in Dade and Broward Counties are remnants of the predevelopment Everglades. There are two immediate threats to the wetlands areas in Dade and Broward Counties. First, the smaller wetlands east of the levee occupy much of the remaining undeveloped land in the two highly populated counties, and there is intense political pressure being brought to bear for their filling and development. Second, the degradation of ground-water quality to the east by saltwater encroachment and surface contamination requires new well fields to be located very close to the levee system. This will lower water levels on both sides of the levee. A method is needed to evaluate wetlands hydroperiod to determine the effects of well-field withdrawals.

OBJECTIVE: Develop and test a technique for defining hydroperiod using the results of a modified ground-water flow model simulation as input to a geographic information system (GIS).

APPROACH: (1) Develop a model of a wetlands area from an existing coarse grid regional model of southern Dade County, (2) input into a spatial data layer, land-surface elevations and the transient heads for model cells representing approximately a 1-square mile test area of the wetlands selected for study, (3) hydroperiod for the test area of the wetlands will be determined using the GIS data and layers will also be determined for vegetative communities using existing vegetative data layers.

PROGRESS: The wetlands area selected for study is the Bird Drive basin, located east of the levee system. A ground-water level, surface-water stage, and rainfall monitoring network was established in the basin with data collected weekly beginning in June 1993. The network consists of seven wells, two staff gages, and a rainfall gage. Additional ground-water, surface-water, and rainfall stations monitored by the U.S. Geological Survey and the South Florida Water Management District were identified for use in calibrating the model.

PLANS FOR THIS YEAR: Continue collection of water-level, rainfall, and land-surface elevation data. Collect data on the thickness of the wetlands soil and perform tests to determine the rate of infiltration through the soil. Begin development of the ground-water flow model, the GIS interface, and the GIS programs to determine hydroperiod.

FL-564 USE OF ULTRASONIC VELOCITY METER TECHNOLOGY AS AN INDICATOR OF SUSPENDED SOLIDS CONCENTRATIONS IN STREAMS

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: September 1994

PRINCIPAL INVESTIGATOR: Eduardo Patino, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: Improved measuring techniques are needed to understand the mechanics of suspended solids (sediment) in order to address various environmental problems. Suspended solids concentrations in water are directly related to the transport of contaminants, mainly those that adhere to fine solid particles. An instrument capable of accurately measuring the velocity of water, and at the same time producing a continuous index of suspended solids concentrations during ambient conditions and flood events, would greatly aid in the computation of suspended solids loadings.

OBJECTIVE: Determine the feasibility of using ultrasonic velocity meter (UVM) systems to estimate concentrations of suspended solids in southern Florida canals by analyzing automatic gain control (AGC) data recorded at the time of suspended solids samplings.

APPROACH: The project will be divided into two phases. Phase I will include the procurement and installation of instrumentation and an initial test. Instrumentation will consist of two UVM systems, a 200 kilohertz system and a 500 kilohertz system (higher frequency equals higher sensitivity); a stage recorder; a data-collection platform; and a four-parameter water-quality monitor to be fully operational during phase II. The initial test will consist of performing suspended solids samplings for different flow conditions and determining if a correlation is observed between AGC values and suspended solids concentrations. Phase II will consist of monthly samplings for suspended solids, continuation of UVM and water-quality data collection, analysis of data, and preparation of a report. Water-quality parameters will be used to monitor environmental effects on the acoustic signal other than that of the solids in the water.

PROGRESS: The wetlands area selected for study is the Bird Drive basin, located east of the levee system. A ground-water level, surface-water stage, and rainfall monitoring network was established in the basin with data collected weekly beginning in June 1993. The network consists of seven wells, two staff gages, and a rainfall gage. Additional ground-water, surface-water, and rainfall stations monitored by the U.S. Geological Survey and the South Florida Water Management District were identified for use in calibrating the model.

PLANS FOR THIS YEAR: Continue data collection and suspended solids samplings to determine if greater correlation can be attained and to determine its repeatability. All data collection will be analyzed, and an interpretative report will be prepared.

FL-565 A PRIMER ON THE LAKES IN CENTRAL FLORIDA

DATE PROJECT BEGAN: May, 1993

DATE PROJECT ENDS: May 1995

PRINCIPAL INVESTIGATOR: Donna Schiffer, Orlando

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

PROBLEM: Many residents of central Florida have a very limited understanding of the complexity of the hydrology of Florida lakes, even though they live on the shores of these lakes and use them regularly for boating, fishing, and other recreation. The St. Johns River Water Management District and the South Florida Water Management District are responsible for the regulation and protection of lakes within their respective Districts, and have a need to educate the general public about the basic hydrologic characteristics of central Florida lakes and how the lakes are affected by regional hydrologic conditions.

OBJECTIVE: Produce a readable, informative, and visually appealing publication that describes the characteristics of central Florida lakes. Hydrologic budget, lake types, and some water quality will be included. The hydraulic aspects of lakes and interactions with ground water and surface water will be described in the report.

APPROACH: (1) Review available literature on lakes in central Florida; (2) discuss general mechanisms of formation of lakes in central Florida (solution processes primarily); (3) describe the general ground-water hydrology in central Florida and its relation to lake hydrology; (4) discuss how lake levels respond to rainfall; (5) discuss the hydrologic budget for lakes under different conditions (open and closed basins, discharge and recharge areas); (6) explain the concept of residence time and its relation to water quality; (7) describe the basic classification of lakes according to water-quality characteristics (acidic/colored and alkaline/clear, for example); (8) describe some of the Best Management Practices (BMPs) in use in some of central Florida lakes; and (9) compute summary statistics for central Florida lakes, including surface area, depth, and water-quality status (oligotrophic, mesotrophic, eutrophic).

PROGRESS: List of publications and journal articles was obtained from the USGS library. Much of the literature has been reviewed. A report outline was written, and the report outlet was decided (booklet). Some conceptual drawings were sketched which illustrate hydraulic relations between lake water and surface and ground waters.

PLANS FOR THIS YEAR: A first draft of the report will be prepared this year.

FL-566 EVALUATION OF BRACKISH-WATER RESOURCES AND THE POTENTIAL FOR SALTWATER INTRUSION AT DUNEDIN, FLORIDA

DATE PROJECT BEGAN: October 1993

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: Lari A. Knochenmus, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

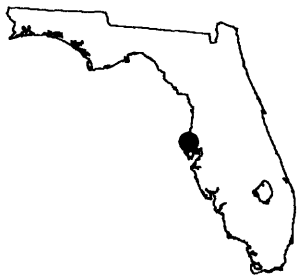
PROBLEM: Little is known about the areal and vertical extent of the brackish-water resources in the Upper Floridan aquifer in coastal Florida. The feasibility of a dependable supply of constant quality brackish ground water is dependent on the existing water-quality distribution and subsequent movement induced by pumping.

OBJECTIVE: Assess the hydraulic characteristics and water-quality distribution of zone A, the underlying semiconfining unit, and zone B, and assess model simulation of potential changes in brackish-water quality in response to pumping.

APPROACH: Collect pertinent data during test drilling, geophysical logging, water-quality sampling and aquifer testing to determine physical and chemical characteristics for flow zones utilized by the city of Dunedin. Simulate the potential changes in water quality in response to pumping.

PROGRESS: New project.

PLANS FOR THIS YEAR: Collect water-quality lithologic samples and water-level measurements during drilling. Collect geophysical logs and water-quality samples from test well and proposed production well to evaluate vertical extent of brackish water. Collect additional samples from existing wells to evaluate the water. Collect additional samples from existing wells to evaluate the areal extent of brackish water.



FL-568 EFFECTIVENESS OF A STORMWATER COLLECTION SYSTEM AND DETENTION PONDS IN TREATING RUNOFF FROM THE 49TH STREET BRIDGE, PINELLAS COUNTY, FLORIDA

DATE PROJECT BEGAN: April 1993

DATE PROJECT ENDS: December 1996

PRINCIPAL INVESTIGATOR: Terrie M. Lee, Tampa

COOPERATING AGENCY: Pinellas County

PROBLEM: A stormwater collection system and detention ponds were constructed to treat runoff from the Bayside Bridge in Pinellas County, Fla. The precedent setting design of the stormwater collection system is unique in Florida and nationwide. While adding substantially to the cost of the bridge, the benefits and actual field performance of a system to collect and treat bridge runoff has not previously been documented. Field studies are needed to determine the effectiveness of the stormwater collection and detention ponds in treating runoff from an urban highway bridge.

OBJECTIVE: To determine the water-quantity and water-quality characteristics of roadway runoff from the 49th Street Bridge in Pinellas County and to evaluate the effectiveness and field performance of the unique stormwater collection and detention-pond system that was designed and constructed for the bridge. Based on these analyses, a long-term monitoring plan will be developed.

APPROACH: The efficiency of the stormwater collection system will be determined by gaging runoff from the northern side of the bridge and comparing it to the predicted and design flows. Stormwater treatment efficiencies will be determined by comparing water-quality constituent loads in water entering and exiting the detention pond that receives runoff from the northern half of the bridge.

PROGRESS: The 49th Streeet Bridge was instrumented to monitor the quantity and water quality of stormwater runoff entering and exiting a wet detention pond. Runoff water quality was sampled for 11 storms between May and September 1993. Preliminary study results were presented at the Stormwater Research Conference, October 7-8, 1993, in Tampa.

PLANS FOR THIS YEAR: Continue monitoring rainfall and stormwater inflow to and discharge from the wet-detention pond. Continue sampling water quality of stormwater runoff entering the pond, and detention pond outflow. Calculate contaminant loads entering and exiting the pond for various storm events.

FL-569 BURIED CHANNEL IN SOUTHWESTERN FLORIDA

DATE PROJECT BEGAN: October 1992

DATE PROJECT ENDS: June 1995

PRINCIPAL INVESTIGATOR: Richard Krulikas, Miami

COOPERATING AGENCY: South Florida Water Management District

PROBLEM: The surficial aquifer system and the upper water-bearing units of the intermediate aquifer system are divided vertically by a buried channel lying below the Ocaloacoochee Slough in Hendry and Collier Counties. This channel extends in a north-south direction along the western boundary of Hendry County into Collier County, and its surrounding vertical boundaries act as a semiconfining zone that affects the horizontal ground-water flow pattems of the water-bearing units across the counties. An understanding of the channel's relation to potentiometric surface and ground-water flow direction is important to properly manage the water resources. Thus, the need to define the areal extent, thickness and hydrogeology of the channel is imperative if the ground-water flow dynamics are to be understood in this area for future management decision.

OBJECTIVE: Delineate and describe the physiographic setting of the buried channel in western Hendry and north-central Collier Counties. Describe the ground-water flow directions at and in the vicinity of the buried channel and compare those directions to the regional flow in the surficial and intermediate aquifer systems. Determine the applicability of geophysical techniques (surface and borehole) in defining stratigraphic changes of southwestern Florida.

APPROACH: Construct water-table and potentiometric-surface maps from existing water-level data to determine ground-water flow directions within the approximate areal extent of the channel and adjacent surficial and intermediate aquifer systems. Conduct a surface-geophysical survey in selected areas that need additional hydrogeologic data. The direct-current resistivity method is proposed for the survey because it can indicate changes in porosity hydraulic conductivity, water content, and water salinity.

PROGRESS: Direct current resistivity data (transverses) collection was completed. Now in the process of evaluating the data.

PLANS FOR THIS YEAR: Write first draft of report. Complete evaluation of existing and field-collected data.

FL-571 EVALUATION OF NITRATE SOURCES IN GROUND WATER USING NITROGEN ISOTOPE TECHNIQUES NEAR AVON PARK, FLORIDA

DATE PROJECT BEGAN: September 1993

DATE PROJECT ENDS: October 1994

PRINCIPAL INVESTIGATOR: Laura A. Sacks, Tampa

COOPERATING AGENCY: Florida Department of Environmental Protection (FDEP)

PROBLEM: Elevated nitrate concentrations in ground water are often attributed to land-use practices. Sources include inorganic fertilizers, animal and human waste, and naturally occurring soil nitrogen. The identification of nitrate sources can aid in management decisions regarding land use to help protect water resources. The ratio of nitrogen isotopes ($^{15}N/^{14}N$) in inorganic fertilizers is distinctly different from that of human and animal wastes, and can thus be used to identify sources of nitrate in ground water. The surficial aquifer system in Highlands County is a common source of drinking water for private domestic wells. Nitrate concentrations above the recommended drinking water standard (10 mg/L as N) have been documented in over 50 percent of domestic wells sampled in the Stryker Road area in Avon Park. Likely sources of nitrate in the area include a nearby citrus grove and septic-tank leachate from homes.

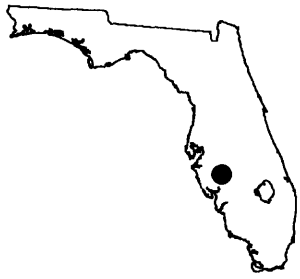
OBJECTIVE: Evaluate nitrate sources in the surficial aquifer system using nitrogen isotopes in the Stryker Road area of Avon Park, and compare the results of this analysis with other studies using nitrogen isotopes to determine the utility of this technique under this set of hydrogeologic and climatic conditions. Vertically clustered wells will be sampled along several flow paths in a downgradient direction and in wells to determine how nitrate concentrations and nitrate sources change downgradient within the aquifer.

APPROACH: Chemical and nitrogen isotope data will be collected from about 25 wells in the Stryker Road area. These include samples from monitoring wells along selected ground-water flow paths, and several samples collected near or within the citrus grove on public right of way. The same 25 wells will be resampled prior to the application of fertilizers to the grove (January to February). Sampling at both the beginning and end of the citrus fertilizer season may establish whether nitrate sources vary seasonally within the aquifer. Graphical and statistical techniques will be used to determine whether nitrate sources vary within the study area. Changes in isotope fractionation along flow paths and with depth in the aquifer and seasonal variability of nitrate so rces within the aquifer will be assessed.

PROGRESS: Met with FDEP and Ben Hill Griffin officials to do an initial site reconnaissance and discuss project plans. Obtained instructions and disk copy of FDEP's quality assurance plan requirements and guidelines. Initiated quality assurance plan preparation. Obtained quality assurance plans for contract laboratory and QWSU (USGS-Ocala). Began preparation of planning document.

(FL-571)

PLANS FOR THIS YEAR: Meet with FDEP officials and develop specifics of workplan as it pertains to USGS part of the project. Submit quality assurance plan to FDEP for approval. Conduct two sampling events of approximately 25 wells each. These events will correspond to the beginning and end of the fertilizing cycle. Compile and review water-quality data addressing nitrogen-isotope composition and sources. Analyze and interpret data and prepare report.



FL-572 COMPARISON OF MEASURED AND ESTIMATED CONSTITUENT LOADS OF TIDALLY AFFECTED REACHES OF THE PEACE AND MYAKKA RIVERS, WEST-CENTRAL FLORIDA

DATE PROJECT BEGAN: October 1993

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: Victor A. Levesque, Tampa

COOPERATING AGENCY: Southwest Florida Water Management District

PROBLEM: Measurement of discharge near the mouths of tidally affected rivers is not a common practice because of the difficulty associated with the measurement of continuously varying flow. Estimates of constituent loading at the mouths of tidal rivers are based on flows from the nontidal part of the rivers. An assessment of the accuracy of estimating loading at the mouths of tidal rivers is needed to assist resource management.

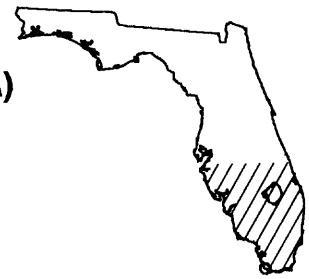
OBJECTIVE: Compare measured flows and associated constituent loads with estimates produced using the basin-ratio method for selected seasonal and tidal conditions on the Peace and Myakka Rivers.

APPROACH: In the first year of the study, one site near the mouth of the Peace River and one site near the mount of the Myakka River will be selected for discharge measurements. For one month during the wet season and another month during the dry season, the two sites will be instrumented with submersible equipment packages that can measure water velocity, water depth, temperature, and conductance. Approximately 100 discharge measurements will be made at each discharge site over the 1-month period and will include different tidal cycles and inflow conditions. Discharge measurements will be made using new state-of-the-art equipment, a Broad Band Acoustic Doppler Current Profiler. Velocity data from the submersible instrument packages will be compared to mean velocity data from the discharge measurements to determine whether accurate continuous flow data can be computed for the conditions that existed during the deployment period. Water-quality samples will be collected in coordination with the discharge measurements at high, low, and slack tides. The water samples will be analyzed for nutrients, suspended solids, turbidity, color, and specific conductance. Based on results of the first year of data collection, two additional month-long deployments will be done during the summer rainy season and will be scheduled to coincide with tide and inflow conditions that are different from those monitored during the first year.

PROGRESS: New project.

PLANS FOR THIS YEAR: Reconnaissance of project areas. Establish temporary gages, collect water-quality samples and perform discharge measurements at study sites. Review and edit collected data, develop preliminary discharge ratings for sites, and begin writing report. A review of existing and pertinent information will be conducted.

FL-576 NATIONAL WATER QUALITY ASSESSMENT (NAWQA) PROGRAM--SOUTHERN FLORIDA



DATE PROJECT BEGAN: October 1993

DATE PROJECT ENDS: September 1999

PRINCIPAL INVESTIGATOR: Ben F. McPherson, Tampa

COOPERATING AGENCY: Federal Program

PROBLEM: There is a need to describe the status and trends of the water quality of the Nation's surface and ground water resources in order to provide a sound understanding of the natural and manmade factors affecting the usability of these resources. The Southern Florida Study Unit is one of sixty representative areas chosen for a national assessment.

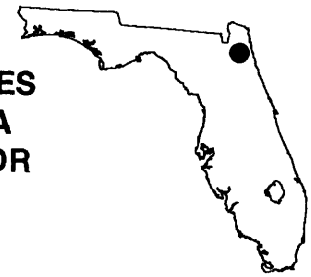
In the Study Unit, both surface and ground waters are susceptible to contamination by nutrients, pesticides, and a variety of other constituents. Surface waters in canals, ponds, lakes, borrow pits, and marshes receive runoff from urban and agricultural sources. Increased nutrient inputs to The Everglades are a threat to this unique and valuable ecosystem. Ground water in the southeastern part of the study unit is highly vulnerable to contamination from surface sources because the highly permeable Biscayne aquifer allows rapid infiltration of rainfall from urban areas.

OBJECTIVE: The three major objectives of the NAWQA program are (1) to provide a consistent description of current water-quality conditions for a large part of the nations water resources; (2) define long-term trends (or lack of trends) in water-quality; and (3) identify, describe, and explain, as possible, the major factors that affect observed water-quality conditions and trends.

APPROACH: During the first 2 years a project team will be assembled, an extensive project work plan will be developed, and existing data will be summarized and analyzed. A 3-year period of intensive data collection, analysis, and interpretation will begin in 1996. A long-term monitoring network will be established for trend analysis, subbasins will undergo synoptic surveys to better define sources of pollutants, and select sites will undergo intensive process-oriented study to provide a better understanding of the cause-and-effect relation between land use and water quality. Intensive data collection and interpretation efforts will be followed by a period of report writing and low-level sampling and analysis.

PROGRESS: Began to assemble project team. Identified a liaison committee. Began design and development of a project data base. Assembled GIS coverages. Published Open-File Water Fact Sheet.

PLANS FOR THIS YEAR: Develop a workplan, formulate and meet with liaison committee, identify water-quality issues, compile water-quality information, plan retrospective report on nutrients, prepare an environmental setting report, and plan field and support needs.



FL-577 HYDROGEOLOGIC FRAMEWORK OF AQUIFER ZONES OF THE FLORIDAN AQUIFER SYSTEM, INCLUDING A WATER-QUALITY MONITORING-WELL NETWORK FOR DUVAL COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1994

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: G.G. Phelps, Orlando

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

PROBLEM: Recent studies indicate that increases in salinity in the freshwater zones of the Floridan aquifer system in Duval County probably result from mineralized water moving vertically upward from deep zones in response to pumping. Continued lowering of water levels in the upper zones of the aquifer is likely to accelerate the upward movement of mineralized water. At present, no systematic monitor-well network has been established within Duval County to identify changes in water quality in the Floridan aquifer system (especially in the Lower Floridan aquifer) in sensitive well-field areas, or to provide the type of baseline data needed for planning in potential new well-field areas.

Also, the areal delineation of the Lower Floridan aquifer and variations in hydrogeologic properties of the Lower Floridan are not well known. A better understanding of the Lower Floridan, coupled with a network to monitor water-quality changes in all zones of the Floridan will provide water managers with information needed to choose sites for new well fields, as well as give early warning of deteriorating water quality in the area of existing wells.

OBJECTIVE: (1) To better define the areal and vertical extent of the upper zone of the Lower Floridan aquifer underlying Duval County and to better understand the hydrogeologic and hydraulic characteristics of that zone (including thickness, lithology, hydraulic conductivity, and the presence of fractures), particularly as they relate to water-quality variations. (2) Based in part on the information from item 1 above, to outline a country-wide monitor well network that will provide water-level and water-quality data for existing and potential water-supply zones of the Floridan aquifer system so that changes in water quality in either the Upper or Lower Floridan aquifers can be observed if and when they occur. Particular attention will be given to sensitive well-field areas that include areas of (a) poor or degrading water quality, (b) areas within major cones of depression as identified from potentiometric surface maps, and (c) areas of existing high pumpage.

APPROACH: (A) Analyze existing geophysical logs and conduct additional geophysical logging of selected wells, including some that are scheduled to be abandoned (grouted), to help identify preferential flow zones and water quality changes with depth. Logging will be done by both the USGS and the St. Johns River Water Management District. The logs will include downhole flowmeter and fluid conductivity, as well as caliper, natural gamma and electric logs. The USGS regional logger will also be utilized to make heat-pulse and television logs of selected wells. Heat-pulse flowmeter logs are used to determine the direction and rate of ground-water flow in

an open borehole. Analysis of the logs will help to define and correlate from one area to another discrete water-bearing zones in the Floridan aquifer system, and possibly, the presence of fracture zones. From these data, the identification of problematic zones that contribute highly mineralized water may be possible.

(B) Conduct one aquifer test in a selected area where hydraulic data are most needed. The most likely areas for a test will be where water-quality deterioration has been observed. Existing wells will be used if possible. Test results will be used to estimate the transmissivity and storage coefficient of the upper zone of the Lower Floridan aquifer, and, if possible, the coefficients of leakage of overlying and underlying semiconfining units. Also, specific-capacity data for existing wells will be analyzed.

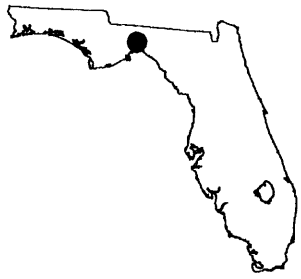
(C) Analyze all existing geologic, water-quality and other hydrologic data for existing wells to identify areas of significant ground-water withdrawals and sensitive areas where increases in chloride concentrations have been observed. This will include using statistical analyses of historical water-quality data to determine trends and to help understand the relation between chloride concentrations, water levels, and rainfall. The resulting analyses can be used by water managers to determine optimum sampling intervals based on a range of climatic and hydrologic conditions. Additional wells will be sampled for major ion analysis (including calcium, magnesium, sodium, potassium, chloride, sulfate). Analysis for total iron, total hardness and dissolved solids will also be made in addition to field determinations of pH, specific conductance, and temperature. In selected wells, samples may also be analyzed for strontium and oxygen isotope ratios. Using new and existing data, areal and vertical variations in chemical water type (using such tools as trilinear diagrams) will be documented.

(D) Identify areas of potential future pumping where no background water-level and/or water-quality data exist for the upper zone of the Lower Floridan aquifer and the Fernandina permeable zone. City water managers will provide information about locations of possible future well-field sites, based on their distribution system design criteria.

Using all the information collected, design a monitor-well network which will include locations and completion specifications of selected existing wells in addition to new wells to be drilled by the city of Jacksonville. Identification of potential sites for new monitor wells will be completed during the first year of the study. Included in the network plans will be suggestions for locations and depths of test well clusters so that water levels can be measured and water quality sampled in the various zones at one or more specific sites. Among the wells to be included in the network will be some existing wells that had been scheduled to be abandoned, but will be retained as monitor wells.

PROGRESS: New project.

PLANS FOR THIS YEAR: Existing hydrogeologic and water-quality data will be compiled and analyzed. The Southeast Region logger and the St. Johns River Water Management District logger will collect geophysical logs from selected wells so that the hydrogeology of the upper zone of the Lower Floridan aquifer can be better defined.



FL-578 INTERACTION BETWEEN SOLUTION LAKES AND GROUND WATER: PROCESSES CONTROLLING THE CHEMICAL EVOLUTION OF WATER IN THE UPPER FLORIDAN AQUIFER, LEON COUNTY, FLORIDA

DATE PROJECT BEGAN: January 1994

DATE PROJECT ENDS: September 1996

PRINCIPAL INVESTIGATOR: Brian Katz, Tallahassee

COOPERATING AGENCIES: Florida Department of Environmental Protection

PROBLEM: The hydrochemical interaction between ground water and lake water in karst areas is poorly understood. In northern Florida, unconsolidated sediments (sands and clays) that overlie the Upper Floridan aquifer (UFA) can be breached as a result of erosion, subsidence or collapse into solution cavities in the underlying limestone. No systematic studies have been conducted in the Ocala Uplift physiographic district, where large solution basins contain lakes that are hydraulically connected to the UFA. Solution lakes and their underlying structure can serve as an effective conduit for recharge to the UFA. The potential is great for degradation of water quality in the UFA, as leakage of lake water that migrates through organic-rich sediments on the lake bottom can cause ground-water downgradient from the lake to be anoxic. The anoxic water has the capability to mobilize trace metals and organic contaminants.

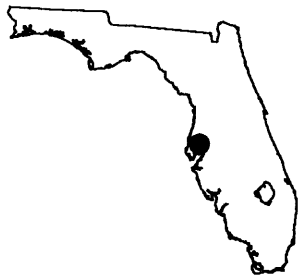
OBJECTIVE: (1) To determine more precisely the ground-water flow patterns surrounding solution lakes that naturally recharge the UFA. (2) To identify the dominant hydrochemical processes that control the composition of ground water as it chemically evolves downgradient from subsurface lake outflow. (3) To determine the transport and fate of selected trace metals, volatile and nonvolatile organic compounds in ground water along principal pathways of flow.

APPROACH: To investigate the hydrochemical interaction between sinkhole lakes and ground water, flow systems have been selected downgradient from Lake Jackson and Lake Bradford. Flow patterns near the two lakes will be established using water-level data from observation wells and from stable isotope analyses of ground water and lake water. Transient tracers, such as tritium and chlorofluorocarbons, will be measured to estimate the age of ground water along principal pathways of flow. To identify the dominant processes controlling the composition of ground water, water samples will be collected and analyzed for isotopes of carbon, strontium, and uranium; and major and minor dissolved constituents. Geochemical mass-transfer modeling will be used to identify and quantify the dominant abiotic and biotic reactions that contribute to the chemical evolution of ground water along flow paths. Relative rates of mass transfer will be determined by combining the results of the mass-transfer modeling with estimates of the age of ground water along flow paths.

PROGRESS: Ground-water flow patterns downgradient from Lake Jackson and Lake Bradford were inferred from hydraulic head data and ground-water flow modeling results from previous studies.

(FL-578)

PLANS FOR THIS YEAR: Collect samples of ground water along flow paths downgradient from Lakes Jackson and Bradford in Leon County for analyses of environmental isotopes (deuterium, oxygen-18, carbon-13, strontium-87, uranium activity ratio, tritium), major and minor dissolved inorganic constituents, and selected organic compounds. Determine mineralogy of aquifer material. Install additional monitoring wells where needed.



FL-550 PRELIMINARY CONTAMINATION ASSESSMENT OF
FL-558 VARIOUS SITES AT MACDILL AIR FORCE BASE,
FL-559 FLORIDA
FL-560
FL-561
FL-562
FL-573
FL-574
FL-575

DATE PROJECT BEGAN: October 1992

DATE PROJECTS END: September 1995

PRINCIPAL INVESTIGATOR: Mario Fernandez, Jr., and George R.Kish, Tampa;

COOPERATING AGENCY: MacDill Air Force Base

PROBLEM: Site-specific activities at various facilities at MacDill Air Force Base may have the potential for releasing hazardous substances into the environment. These activities include the use and storage of waste oils, fuels, solvents, pesticides and PCB-filled capacitors. Information on contamination from these activities is needed to assess the environmental effect and the potential for remedial activities.

OBJECTIVE: Determine the extent, if any, of soil and ground-water contamination in the vicinity of these facilities at MacDill Air Force Base.

APPROACH: Prepare site safety and quality assurance plans; conduct field screening of soil, soil gas, and ground water for selected volatile organic compounds and total petroleum hydrocarbons using field gas chromatography and portable infrared spectrometry; install monitoring wells; collect ground-water and soil samples for chemical analysis; and describe and interpret the results of the investigations.

PROGRESS: Field screening was conducted at approximately half of the facilities, field screening and monitoring well installation and sampling is continuing.

PLANS FOR THIS YEAR: Continue field screening and the installation and sampling of monitoring wells and the collection of soil samples.

*U.S. GOVERNMENT PRINTING OFFICE: 1994-533-168/80019