Water Withdrawals, Use, and Trends in Florida, 1990

By Richard L. Marella

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Conversion Factors and Abbreviations

Multiply	By	To obtain
gallons per day (gal/d)	0.003785	cubic meters per day
million gallons per day (Mgal/d)	0.043808	cubic meters per second
gigawatthour (GWh)	1,000	megawatthour
GWh	1,000,000	kilowatthour

Additional Abbreviation: mg/L = milligrams per liter

GLOSSARY

Agricultural water use.—Includes water used for irrigation and nonirrigation purposes. Irrigation water use includes the artificial application of water on lands to assist in the growing of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses. Nonirrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations, and fish farming and other farm needs.

Commercial water use.—Water for motels, hotels, restaurants, office buildings, commercial facilities and civilian and military institutions. The water may be obtained from a public supply or may be self-supplied.

Consumptive use.—That part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Sometimes called water consumed or water depleted. Additionally, any water withdrawn in the basin and transferred out of the basin for use is considered 100 percent consumptively used.

Cooling water.—Water used for cooling purposes by condensers and nuclear reactors.

Desalination.—Refers to the removal of salts from water. Desalination is primarily used to produce public-supply water that meets Florida Department of Environmental Regulation secondary drinking standards. The primary types of desalination are: (1) distillation, (2) electrodialysis, and (3) reverse osmosis (Buros, 1989; and South Florida Water Management District, 1990). Reverse osmosis is the most commonly used process in Florida, followed by electrodialysis (Dykes and Conlon, 1989). Additionally, many public suppliers also dilute or blend saltwater with fresher water to produce potable water. Also see "Reverse osmosis."

Domestic water use.—Water for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens. Also called residential water use. The water can be obtained from a public supply or be self-supplied.

Flood irrigation.— Irrigation systems that control the water table with water supplied by lateral supply ditches or conduits. These include open field ditch systems (furrows), semiclosed conveyance systems, subsurface conduit systems, crown flood systems, and continuous flood systems. Also referred to as seepage irrigation or subsurface irrigation. The efficiencies of these flood irrigation systems range from 20 to 80 percent (Smajstrla and others, 1988), but for this report were assumed to be 60 percent.

Freshwater.—Water that contains less than 1,000 milligrams per liter (mg/L) of dissolved solids; generally, more than 500 mg/L dissolved solids is considered undesirable for drinking and many industrial uses. Generally, freshwater is considered potable.

Gigawatthour (GWh).—A measure of electricity, one billion watthours.

Hydroelectric power water use.—The use of water in the generation of electricity at plants where the turbine generators are driven by falling water; an instream use.

Industrial water use.—Water used for industrial purposes such as fabricating, processing, washing, and cooling. Industries that use large amounts of water include steel, chemical and allied products, paper and allied products, mining, and petroleum refining industries. The water can be obtained from a public supply or be self-supplied.

Instream use.—Water use taking place within the stream channel for such purposes as hydroelectric power generation, navigation, water-quality improvement, fish and wildlife propagation, and recreation. Sometimes called nonwithdrawal use or in-channel use.

Low pressure/low volume irrigation.—Irrigation systems that apply water directly on or near the soil surface, either in discrete drops, small streams, mist, or sprays. They include drip systems, spray systems, jet systems, and bubbler systems. Also referred to as micro or trickle irrigation. The efficiencies of these low pressure irrigation systems range from 75 to 95 percent (Smajstrla and others, 1988), but for this report, the efficiency was assumed to be 80 percent.

Million gallons per day (Mgal/d).—A rate of flow of water.

Net water use.—Refers to public-supply water withdrawals plus or minus water transfers. In most counties, the net water-use and water withdrawals for public supply are equal. However, in counties involved in water transfers (imports and exports), the net water-use represents the actual amount of water used for public supply regardless of the amount of water withdrawn. Also see "water transfers."

Offstream use.—Water withdrawn or diverted from a ground- or surface-water source for public supply, industrial, irrigation, livestock, thermoelectric power generation, and other uses. Sometimes called off-channel use or withdrawal use.

Other water use.—Water used for such purposes as heating, cooling, irrigation (public-supplied only), lake augmentation, and other uses. The water can be obtained from a public supply, or be self supplied.

Per capita use.—The average amount of water used per person during a standard time period, generally given in gallons per day. Public supply per capita use refers to the amount of water used for public supply divided by the population served. Domestic per capita use refers to the amount of water used for domestic (residential) purposes divided by the population served.

Potable water.— Refers to water that meets the quality standards set by the Florida Department of Environmental Regulation (Florida Department of Environmental Regulation, 1990a). Potable water is considered safe for human consumption and is often referred to as drinking water.

Public supply.—Water withdrawn by public and private water suppliers and delivered to users who do not supply their own water. Water suppliers provide water for a variety of uses, such as domestic, commercial, industrial, thermoelectric power (domestic and cooling purposes), and public-water use. See also commercial water use, domestic water use, industrial water use, public-water use, and thermoelectric power water use.

Public-water use.—Water supplied from a public supply for system uses such as firefighting and street washing, and municipal parks and swimming pools. Also referred to as water-utility use.

Reclaimed sewage or wastewater.—Wastewater treatment-plant effluent that has been diverted or intercepted for some beneficial use before it reaches a natural waterway or aquifer. For this report, reclaimed water includes water that is used for landscape irrigation (such as golf courses, cemeteries, highway medians, parks, playgrounds, school yards, nurseries, and commercial or residential properties) and agricultural irrigation (such as food and fruit crops, wholesale nurseries, sod farms, and pasture grass). It does not include reclaimed water that is used for esthetic uses, environmental enhancement, ground-water recharge, or wetland restoration.

Recycled water.—Water that is used more than one time before it passes back into the natural hydrological system or is discharged into a wastewater system. Also referred to as recirculated water.

Resident population.—The number of persons who live in a State who consider it their permanent place of residence. College students, military personnel, and inmates of penal institutions are counted as permanent residents. Tourist and seasonal or part-time residents are considered nonresident population.

Residential water use.—See domestic water use.

Reverse osmosis.—Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through. This differs from electrodialysis, where the salts are extracted from the feedwater by using membranes charged with an electrical current to separate the ions. The positive ions go through one membrane, and the negative ions flow through another membrane, leaving the feedwater less mineralized. In this report, reverse osmosis will be used to describe water treatment processes involving membranes and will include reverse osmosis and electrodialysis. Also see "desalination."

Saline water.—Water that contains more than 1,000 mg/L of dissolved solids.

Self-supplied water.—Water withdrawn from a ground- or surface-water source by a user and not obtained from a public supply.

Sprinkler irrigation.—A pressurized irrigation systems where water is distributed through pipes to the field and applied through a variety of sprinkler heads or nozzles. Pressure is used to spread water droplets above the crop canopy to simulate rainfall (Izuno and Haman, 1987). These systems include portable and traveling gun systems, solid or permanent fixture (overhead or pop ups) systems, center pivot systems, and periodic moving systems. Also referred to as overhead irrigation. The efficiencies of these sprinkler irrigation systems range from 15 to 85 percent (Smajstrla and others, 1988), but for this report, the efficiency of was assumed to be 70 percent.

Thermoelectric power.—Electrical power generated by using fossil-fuel (coal, oil, or natural gas), geothermal, or nuclear energy.

Thermoelectric power water use.—Water used in the process of the generation of electric power. Most of the water used for this category is for cooling purposes (much of which is used only once). Water is also used for boiler make-up or domestic purposes throughout the plant. Boiler make-up water and water used for domestic purposes are usually obtained from public supply, however for plants located in remote areas, water may be self-supplied. Cooling water is generally self-supplied, although some smaller plants may use public-supply water for cooling purposes.

Wastewater.—Water that contains dissolved or suspended solids as a result of human use.

Water transfer.—Artificial conveyance of water from one area to another. This may be referred to as an import or export of water from one basin or county to another.

Withdrawal.—Water removed from the ground or diverted from a surface-water source for use.

Water Withdrawals, Use, and Trends in Florida, 1990

By Richard L. Marella

ABSTRACT

In 1990, the total amount of water withdrawn in Florida was 17,898 million gallons per day (Mgal/d), of which 42 percent (7,532 Mgal/d) was freshwater, and 58 percent (10,366 Mgal/d) was saline. Ground water accounted for nearly 62 percent of freshwater withdrawals (4,665 Mgal/d), and surface water accounted for the remaining 38 percent (2,867 Mgal/d). Surface water accounted for more than 99 percent of saline water withdrawals (10,317 Mgal/d). Agricultural irrigation accounted for most of the fresh ground-water withdrawals for 1990, followed by public supply, self-supplied commercial-industrial, self-supplied domestic, and thermoelectric power generation. Agricultural irrigation accounted for most of the fresh surface-water withdrawals for 1990, followed by thermoelectric power generation, public supply, and self-supplied commercial-industrial. Thermoelectric power generation accounted for more than 99 percent of saline-water withdrawals (10,261 Mgal/d). The remaining saline water withdrawal (56 Mgal/d) was for self-supplied commercial-industrial use.

Freshwater withdrawals increased 31 percent (1,769 Mgal/d) in the 20 years between 1970 and 1990. Ground-water withdrawals increased 1,803 Mgal/d (63 percent), and surface-water withdrawals decreased 34 Mgal/d (1 percent) between 1970 and 1990. During this period, the dependency of ground water as the primary source in Florida continued to increase. In 1990, nearly 62 percent of the total freshwater withdrawn was from ground-water sources compared to 51 percent in 1980, and 21 percent in 1950. Total freshwater withdrawals for public supply increased 1,041 Mgal/d, self-supplied domestic withdrawals increased 134 Mgal/d, and agricultural irrigation withdrawals increased 1,704 Mgal/d, whereas self-supplied commercial-industrial withdrawals decreased 157 Mgal/d and withdrawals for thermoelectric power generation decreased 955 Mgal/d between 1970 and 1990.

INTRODUCTION

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 (Heath and Conover, 1981). These water resources are finite, however, and the growth in population, tourism, and agriculture are placing an increasing demand on these resources.

Florida's population in 1990 totaled nearly 12.94 million, and was ranked fourth in the Nation behind California (29.76 million), New York (17.99 million), and Texas (16.99 million) (Smith, 1991). This represents an increase of nearly 370 percent (10.17 million) from the 1950 population of 2.77 million (Dietrich, 1978), and a 33 percent increase (3.19 million) from the 1980 population of 9.75 million (Smith, 1991)(fig. 1). Florida's population is projected to surpass 16 million by the year 2000, and 20 million by the year 2020 (Smith and Bayya, 1991). Florida also had an estimated 41 million visitors in 1990 (Florida Division of Tourism, 1990).

The agricultural sector in Florida also depends heavily on the water resources of the State. In 1990, Florida was among the top 10 States in the Nation in agricultural production (U.S. Department of Agriculture, 1991). Information on the amount of water required to support this sector is needed if Florida is to maintain its position as a leading agricultural State.

To address the need for accurate information on water use and trends in water use, the U.S. Geological Survey (USGS) in cooperation with the Florida Department of Environmental Regulation and the Northwest Florida, St. Johns River, South Florida, Southwest Florida, and Suwannee River Water Management Districts estimates water use in the State at 5-year intervals. This report presents the water-use estimates for 1990.

Purpose and Scope

This report provides an assessment of water withdrawals and use for 1990. This assessment includes a summary of the quantities of water withdrawn, indicates trends in water use, and provides some of the data required for estimating water budgets and projecting future water needs.

This report presents data on water withdrawals in Florida for each of the following categories: public supply, self-supplied domestic, self-supplied commercial-industrial (including mining uses), agricultural (including irrigation, livestock and fish farming uses), and thermoelectric power generation. Information concerning instream (nonwithdrawal) water use such as navigation, water-based recreation, propagation of fish and wildlife, and dilution and conveyance of liquid or solid wastes, is not included. The only instream use of water presented in this report is for hydroelectric power generation.

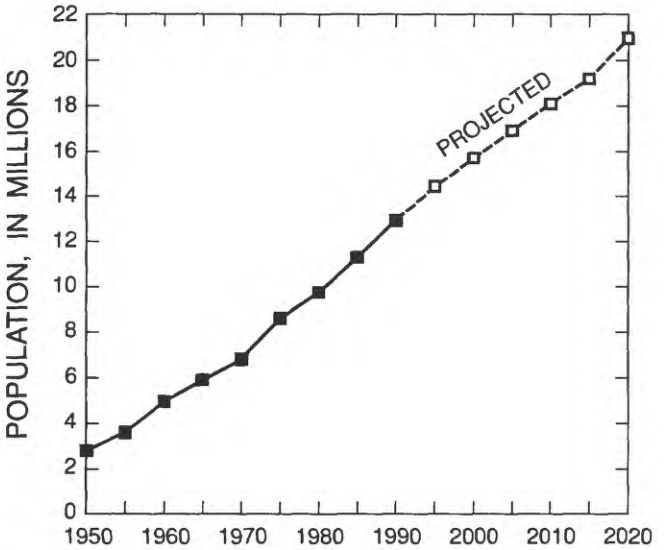

Figure 1. Historical and projected population of Florida. (Modified from Dietrich, 1978, University of Florida, 1991; and Smith and Bayya, 1991.)

Within each category, withdrawal data are presented by source (by stream or aquifer), and where sufficient data are available, seasonal and historical patterns of water use are described. Data are presented by county, State, and water management districts for each category. Locations of counties and selected place names mentioned in this report are shown in figure 2.

Previous Investigations

This report is the seventh in a series of reports documenting the results of water-use investigations in Florida. Statewide water-use data were published for Florida for 1965 (Pride, 1975), for 1970 (Pride, 1973); for 1975 (Leach, 1978), for 1977 (Leach and Healy, 1980), for 1980 (Leach, 1983); and for 1985 (Marella, 1988). These reports included assessments of all water uses in Florida (including public-supply, self-supplied domestic, commercial-industrial, agricultural irrigation, and thermoelectric power generation water uses) by county. Prior to 1965, State water-use data were only published at the National level. Nationwide summaries of water-use data were published for 1950 (MacKichan, 1951), for 1955 (MacKichan, 1957), and for 1960 (Mackichan and Kammerer, 1961). These reports included detailed water-use data at the State level but did not include water-use data for counties.

Data Sources and Reliability

As part of the U.S. Geological Survey's (USGS) National Water-Use Information Program, water-use data are collected and compiled for each State every 5 years (Solley and others, 1988, p. 3). Water-use data are reported for each State by category, county, hydrologic unit (basin), and aquifer. Data used for this report were compiled for Florida through an ongoing cooperative program with the Florida Department of Environmental Regulation (FDER) as part of the 1990 National Water-Use Information Program. Data were obtained from the FDER, the Northwest Florida Water Management District, the St. Johns River Water Management District, the South Florida Water Management District, the Southwest Florida Water Management District, and the Suwannee River Water Management District (fig. 3). Water-use data published in this report may not be identical to the water-use data published by the St. Johns River Water Management District and the Southwest Florida Water Management District, because of differences in data collection procedures, categories, and methodology. Some water-use data used to prepare this report were supplied directly by individual utilities, commercial and industrial plant operators, and power companies.

Water withdrawal and use data presented in this report represent the average daily quantities used, as derived from annual data and are expressed in million gallons per day. Water-use values presented in the tables in this report are reported to two places to the right of the decimal or to the nearest 10,000 gallons per day. Water-use values in the text, however, are rounded to whole numbers. The accuracy of these values varies from category to category. For example, public-supply values usually are more accurate because most public-supply systems meter their usage, as opposed to agricultural or self-supplied domestic values which often are estimated, because they generally are not metered.

Acknowledgments

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Special thanks are extended to the Executive Directors of the five water management districts (Northwest Florida Water Management District, St. Johns River Water Management District, South Florida Water Management District, Southwest Florida Water Management District, and the Suwannee River Water Management District) for their district's participation and staff's cooperation in providing water-use data for their Districts. The participation of the

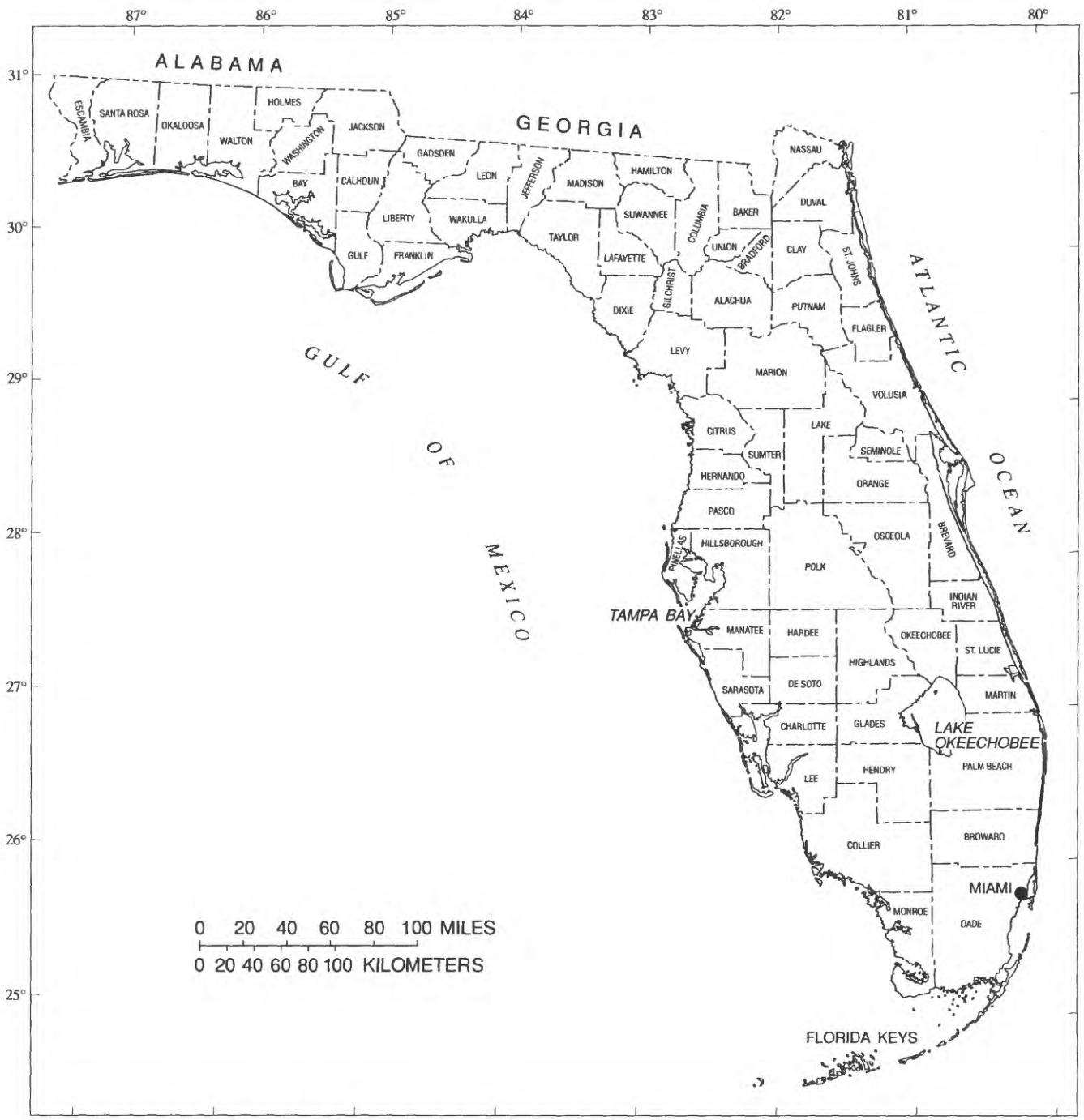

Figure 2. Counties and selected placenames in Florida.

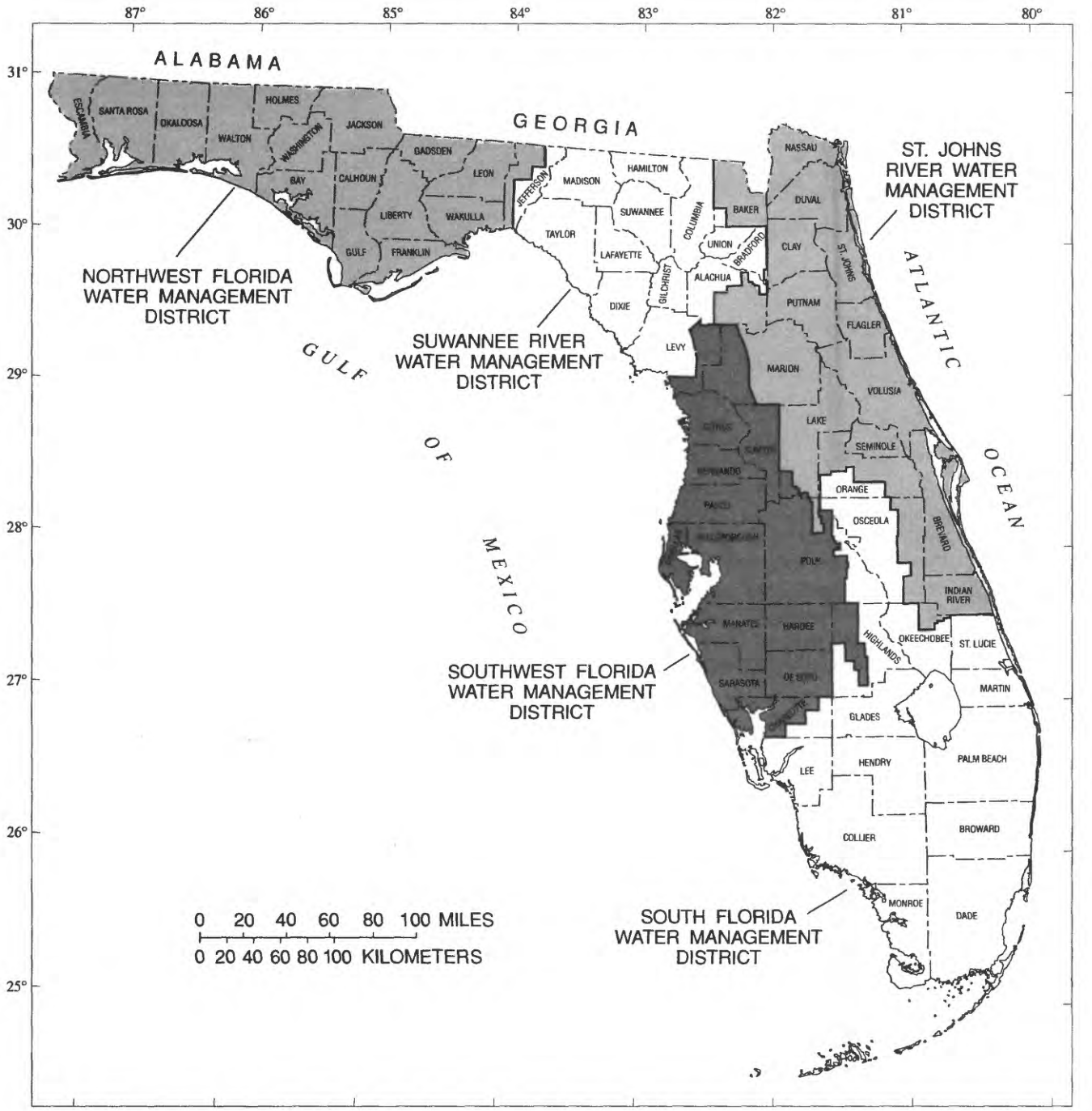

Figure 3. Boundaries of water management districts. (Modified from Marella, 1990b.)

following individuals at the water management districts is acknowledged for their data collection and tabulation efforts and for their technical advice and support: W. Guy Gowens and Christopher Howell at the Northwest Florida Water Management District; Bruce Florence and Barbara Vergara at the St. Johns River Water Management District; Jane Bucca, Jeffrey Giddings, David Gilpin-Hudson, Richard Miessau, Lori Robeson, Bonnie Rose, and Sharon Trost at the South Florida Water Management District; Richard Owen and Lois Sorensen at the Southwest Florida Water Management District; Donald Monroe, Dennis Price, and Kirk Webster at the Suwannee River Water Management District.

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TOTAL WATER WITHDRAWALS, USE, AND TRENDS IN FLORIDA

In 1990, the total amount of water withdrawn in Florida was 17,898 Mgal/d (fig. 4), of which 42 percent (7,532 Mgal/d) was freshwater (fresh ground-water withdrawals accounted for 26 percent and fresh surface-water withdrawals accounted for 16 percent), and 58 percent (10,366 Mgal/d) was saline (saline ground-water withdrawals accounted for less than 1 percent of the total water withdrawals and saline surface-water accounted for almost 58 percent). Ground water accounted for nearly 62 percent of freshwater withdrawals (4,665 Mgal/d), and surface water accounted for the remaining 38 percent (2,867 Mgal/d). Surface water accounted for more than 99 percent of saline water withdrawals (10,317 Mgal/d).

Agricultural irrigation accounted for most of the fresh ground-water withdrawals for 1990 followed by public supply, self-supplied commercial-industrial, domestic, and thermoelectric power generation (fig. 5). Agricultural irrigation also accounted for most of the fresh surface-water withdrawals for 1990, followed by thermoelectric power generation, public supply, and self-supplied commercial-industrial (fig. 5). Thermoelectric power generation accounted for more than 99 percent of saline-water withdrawals (10,261 Mgal/d), and the balance of the saline-water withdrawn (56 Mgal/d) was for self-supplied commercial-industrial use (table 1).

The largest amount of freshwater was withdrawn in Palm Beach County (997 Mgal/d), and the largest amount of saline water was withdrawn in Hillsborough County (2,036 Mgal/d) in 1990 (table 2). Five counties withdrew more than 200 Mgal/d of fresh ground water with Dade County withdrawing the largest amount (527 Mgal/d), followed by Polk, Broward, Orange, and Palm Beach Counties. Four counties withdrew more than 200 Mgal/d of fresh surface water with Palm Beach County accounting for the largest withdrawal (796 Mgal/d), followed by Hendry, Escambia, and Volusia Counties.

With nearly 4,714 Mgal/d of ground water withdrawn (table 1), Florida ranked sixth in the Nation in ground-water withdrawals for 1990, and had the largest ground-water use of any State east of the Mississippi River (Solley and others, 1993). Nearly 90 percent (10.0 million) of Florida's population served by public-supply water systems and all of its residents that use self-supplied domestic systems (1.71 million) depended on ground water for their drinking water needs in 1990. In Florida, five principal aquifers are primarily used: the Floridan aquifer system, the Biscayne aquifer, the Intermediate aquifer, the sand-and-gravel aquifer, and the unnamed surficial aquifers (water-table aquifers). About 60 percent (2,790 Mgal/d) of the total ground water withdrawn in Florida in 1990 was obtained from the Floridan aquifer system, which underlies most of the State (fig. 6). Polk, Orange, Hillsborough, and Duval Counties were the largest users of water from the Floridan aquifer system in 1990

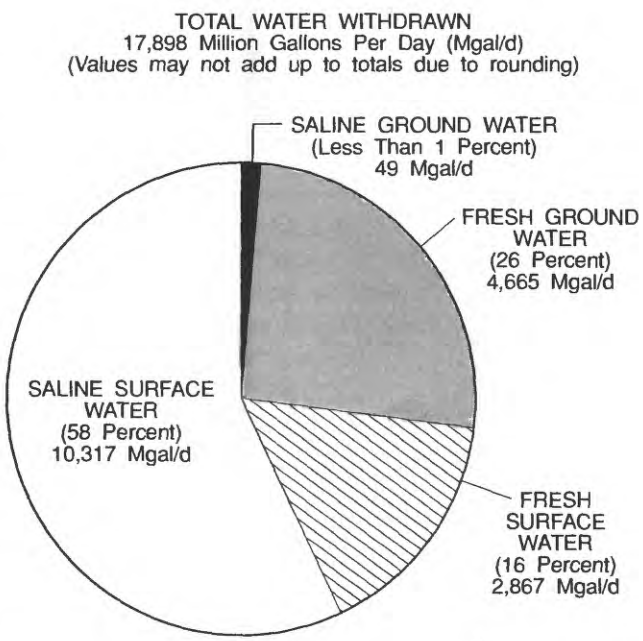

Figure 4. Total water withdrawn in Florida by source, 1990.

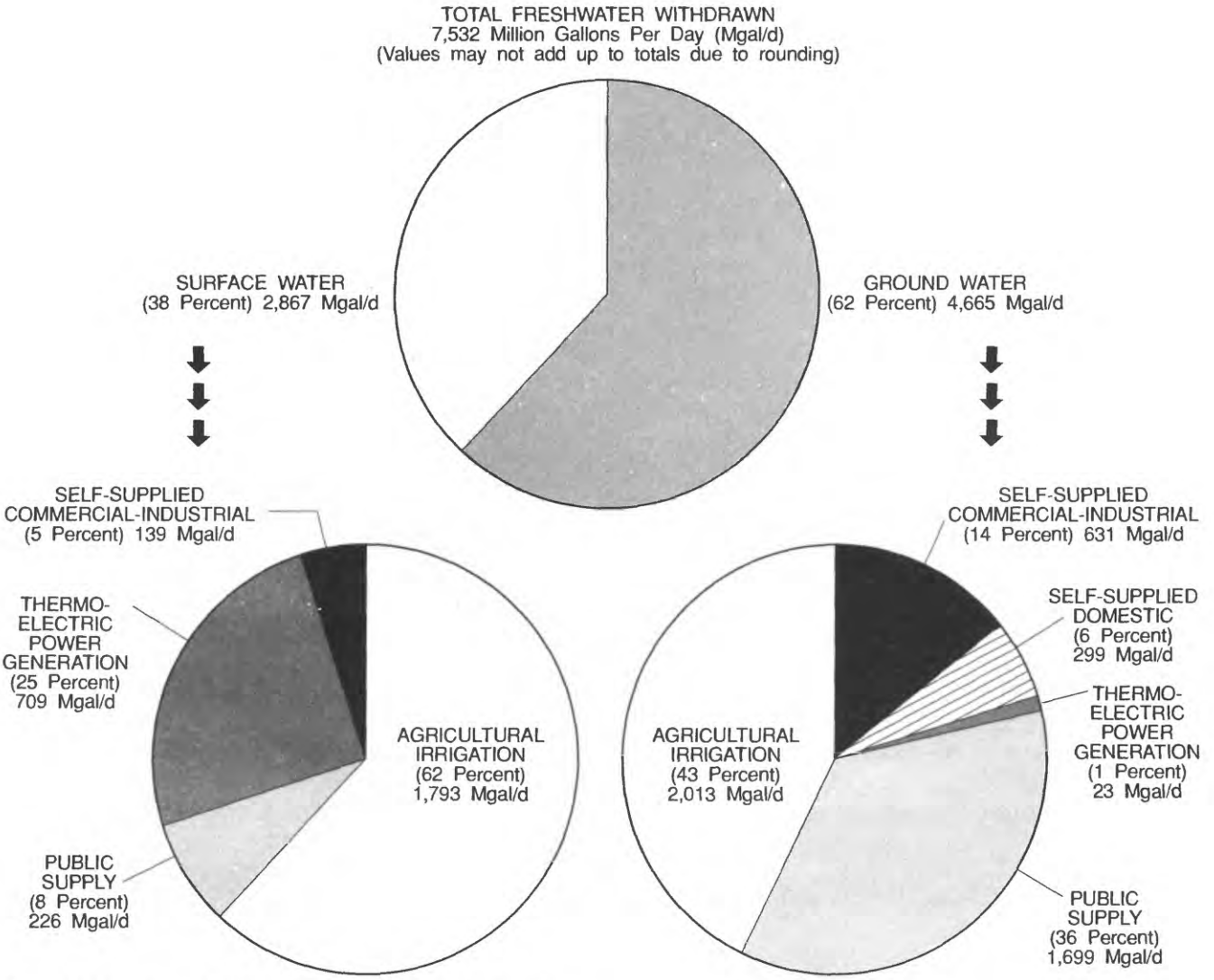

Figure 5. Freshwater withdrawn in Florida by source, 1990.

Table 1. Total water withdrawals in Florida by category, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

Category	Freshwater withdrawals			Saline-water withdrawals			Reclaimed water
	Ground water	Surface water	Total	Ground water	Surface water	Total	Total use
Public supply	1,698.82	226.33	1,925.15	0.00	0.00	0.00	0.00
Self-supplied domestic	299.38	0.00	299.38	0.00	0.00	0.00	0.00
Self-supplied commercial-industrial	630.88	139.06	769.94	0.00	56.36	56.36	0.00
Agricultural irrigation	2,012.50	1,792.75	3,805.25	0.00	0.00	0.00	169.61
Thermoelectric power generation	23.14	708.92	732.06	49.28	10,260.50	10,309.78	4.20
Totals	4,664.72	2,867.06	7,531.78	49.28	10,316.86	10,366.14	173.81

Table 2. Total water withdrawals in Florida by county, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

County	Ground-water withdrawals			Surface-water withdrawals			Total withdrawals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	52.12	0.00	52.12	0.36	0.00	0.36	52.48	0.00	52.48
Baker	7.87	0.00	7.87	2.20	0.00	2.20	10.07	0.00	10.07
Bay	16.02	0.00	16.02	42.16	227.68	269.84	58.18	227.68	285.86
Bradford	8.96	0.00	8.96	0.06	0.00	0.06	9.02	0.00	9.02
Brevard	117.85	0.00	117.85	26.64	1,051.40	1,078.04	144.49	1,051.40	1,195.89
Broward	244.78	0.00	244.78	21.75	1,025.56	1,047.31	266.53	1,025.56	1,292.09
Calhoun	1.88	0.00	1.88	0.50	0.00	0.50	2.38	0.00	2.38
Charlotte	43.95	0.00	43.95	6.72	0.00	6.72	50.67	0.00	50.67
Citrus	25.55	0.00	25.55	0.27	1,455.54	1,455.81	25.82	1,455.54	1,481.36
Clay	25.20	0.00	25.20	0.44	0.00	0.44	25.64	0.00	25.64
Collier	195.30	0.00	195.30	18.49	0.00	18.49	213.79	0.00	213.79
Columbia	11.15	0.00	11.15	0.23	0.00	0.23	11.38	0.00	11.38
Dade	526.60	4.93	531.53	14.37	30.25	44.62	540.97	35.18	576.15
De Soto	102.05	0.00	102.05	19.92	0.00	19.92	121.97	0.00	121.97
Dixie	5.87	0.00	5.87	0.00	0.00	0.00	5.87	0.00	5.87
Duval	152.98	0.00	152.98	1.40	358.09	359.49	154.38	358.09	512.47
Escambia	82.26	0.00	82.26	209.91	0.00	209.91	292.17	0.00	292.17
Flagler	13.47	0.00	13.47	1.20	0.00	1.20	14.67	0.00	14.67
Franklin	2.56	0.00	2.56	0.11	0.00	0.11	2.67	0.00	2.67
Gadsden	9.53	0.00	9.53	8.98	0.00	8.98	18.51	0.00	18.51
Gilchrist	11.06	0.00	11.06	0.00	0.00	0.00	11.06	0.00	11.06
Glades	19.16	0.00	19.16	62.55	0.00	62.55	81.71	0.00	81.71
Gulf	7.11	0.00	7.11	38.06	11.26	49.32	45.17	11.26	56.43
Hamilton	50.60	0.00	50.60	0.00	0.00	0.00	50.60	0.00	50.60
Hardee	60.60	0.00	60.60	5.95	0.00	5.95	66.55	0.00	66.55
Hendry	174.45	0.00	174.45	318.51	0.00	318.51	492.96	0.00	492.96
Hernando	45.48	0.00	45.48	0.35	0.00	0.35	45.83	0.00	45.83
Highlands	129.35	0.00	129.35	12.12	0.00	12.12	141.47	0.00	141.47
Hillsborough	179.73	0.00	179.73	88.94	2,036.27	2,125.21	268.67	2,036.27	2,304.94
Holmes	5.60	0.00	5.60	1.16	0.00	1.16	6.76	0.00	6.76
Indian River	72.85	0.00	72.85	117.53	137.97	255.50	190.38	137.97	328.35
Jackson	30.13	0.00	30.13	111.37	0.00	111.37	141.50	0.00	141.50
Jefferson	10.29	0.00	10.29	1.81	0.00	1.81	12.10	0.00	12.10
Lafayette	9.10	0.00	9.10	0.54	0.00	0.54	9.64	0.00	9.64
Lake	84.35	0.00	84.35	12.68	0.00	12.68	97.03	0.00	97.03
Lee	123.05	0.00	123.05	38.25	411.63	449.88	161.30	411.63	572.93
Leon	39.00	0.00	39.00	0.49	0.00	0.49	39.49	0.00	39.49
Levy	21.52	0.00	21.52	3.04	0.00	3.04	24.56	0.00	24.56
Liberty	3.72	0.00	3.72	0.00	0.00	0.00	3.72	0.00	3.72
Madison	7.19	0.00	7.19	0.27	0.00	0.27	7.46	0.00	7.46
Manatee	96.53	0.00	96.53	45.31	0.00	45.31	141.84	0.00	141.84
Marion	49.20	0.00	49.20	1.87	0.00	1.87	51.07	0.00	51.07
Martin	55.71	0.00	55.71	153.90	0.00	153.90	209.61	0.00	209.61
Monroe	1.29	44.35	45.64	0.00	0.00	0.00	1.29	44.35	45.64
Nassau	42.77	0.00	42.77	0.60	1.40	2.00	43.37	1.40	44.77
Okaloosa	31.59	0.00	31.59	0.00	0.00	0.00	31.59	0.00	31.59
Okeechobee	38.90	0.00	38.90	5.36	0.00	5.36	44.26	0.00	44.26
Orange	220.87	0.00	220.87	61.47	0.00	61.47	282.34	0.00	282.34
Osceola	63.44	0.00	63.44	13.40	0.00	13.40	76.84	0.00	76.84
Palm Beach	201.04	0.00	201.04	795.80	422.24	1,218.04	996.84	422.24	1,419.08
Pasco	138.71	0.00	138.71	2.38	1,324.81	1,327.19	141.09	1,324.81	1,465.90
Pinellas	48.10	0.00	48.10	1.35	514.52	515.87	49.45	514.52	563.97
Polk	353.67	0.00	353.67	83.83	0.00	83.83	437.50	0.00	437.50
Putnam	61.43	0.00	61.43	18.81	0.00	18.81	80.24	0.00	80.24
St. Johns	51.26	0.00	51.26	1.39	0.00	1.39	52.65	0.00	52.65
St. Lucie	83.84	0.00	83.84	170.66	1,256.44	1,427.10	254.50	1,256.44	1,510.94
Santa Rosa	23.54	0.00	23.54	0.29	0.00	0.29	23.83	0.00	23.83
Sarasota	59.49	0.00	59.49	3.18	0.00	3.18	62.67	0.00	62.67
Seminole	65.57	0.00	65.57	1.80	0.00	1.80	67.37	0.00	67.37
Sumter	73.13	0.00	73.13	0.47	0.00	0.47	73.60	0.00	73.60
Suwanne	32.30	0.00	32.30	109.46	0.00	109.46	141.76	0.00	141.76
Taylor	49.38	0.00	49.38	1.28	0.00	1.28	50.66	0.00	50.66
Union	4.37	0.00	4.37	0.68	0.00	0.68	5.05	0.00	5.05
Volusia	74.43	0.00	74.43	203.21	0.00	203.21	277.64	0.00	277.64
Wakulla	2.69	0.00	2.69	0.00	51.80	51.80	2.69	51.80	54.49
Walton	7.93	0.00	7.93	1.12	0.00	1.12	9.05	0.00	9.05
Washington	3.25	0.00	3.25	0.11	0.00	0.11	3.36	0.00	3.36
Totals	4,664.72	49.28	4,714.00	2,867.06	10,316.86	13,183.92	7,531.78	10,366.14	17,897.92

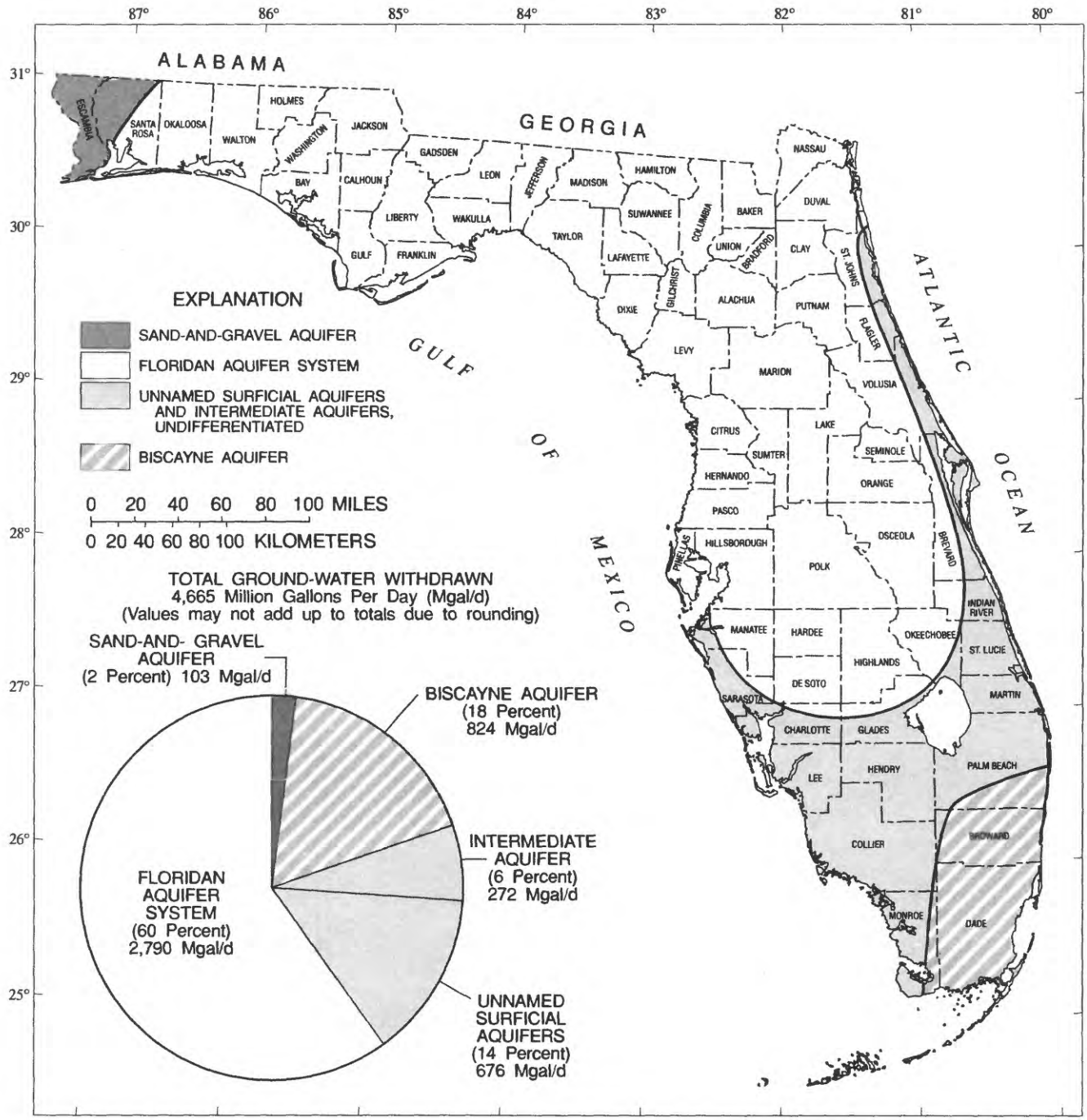

Figure 6. General location of principal aquifers in Florida and ground-water withdrawals from these aquifers in 1990. (Modified from Vecchioli and Foose, 1985; and Marella, 1990b.)

Table 3. Total ground-water withdrawals in Florida by principal aquifer, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

County	Water withdrawals by aquifer					Total withdrawal
	Unnamed surficial aquifer	Intermediate aquifer	Biscayne aquifer	Sand-and-gravel aquifer	Floridan aquifer system	
Alachua	0.68	0.00	0.00	0.00	51.44	52.12
Baker	2.96	0.00	0.00	0.00	4.91	7.87
Bay	3.28	0.00	0.00	0.00	12.74	16.02
Bradford	0.36	0.00	0.00	0.00	8.60	8.96
Brevard	10.98	4.03	0.00	0.00	102.84	117.85
Broward	0.00	0.00	244.78	0.00	0.00	244.78
Calhoun	0.62	0.00	0.00	0.00	1.26	1.88
Charlotte	20.84	13.74	0.00	0.00	9.37	43.95
Citrus	0.10	0.00	0.00	0.00	25.45	25.55
Clay	4.60	0.00	0.00	0.00	20.60	25.20
Collier	149.94	45.36	0.00	0.00	0.00	195.30
Columbia	0.26	0.00	0.00	0.00	10.89	11.15
Dade	0.00	0.00	526.60	0.00	0.00	526.60
De Soto	1.89	11.46	0.00	0.00	88.70	102.05
Dixie	0.00	0.00	0.00	0.00	5.87	5.87
Duval	8.67	0.38	0.00	0.00	143.93	152.98
Escambia	0.00	0.00	0.00	82.26	0.00	82.26
Flagler	3.96	0.15	0.00	0.00	9.36	13.47
Franklin	0.10	0.00	0.00	0.00	2.46	2.56
Gadsden	1.40	0.00	0.00	0.00	8.13	9.53
Gilchrist	0.07	0.00	0.00	0.00	10.99	11.06
Glades	0.68	11.59	0.00	0.00	6.89	19.16
Gulf	0.24	0.00	0.00	0.00	6.87	7.11
Hamilton	0.06	0.00	0.00	0.00	50.54	50.60
Hardee	0.00	7.64	0.00	0.00	52.96	60.60
Hendry	89.64	84.81	0.00	0.00	0.00	174.45
Hernando	0.02	0.00	0.00	0.00	45.46	45.48
Highlands	16.73	1.45	0.00	0.00	111.17	129.35
Hillsborough	0.35	2.23	0.00	0.00	177.15	179.73
Holmes	0.12	0.00	0.00	0.00	5.48	5.60
Indian River	18.24	1.71	0.00	0.00	52.90	72.85
Jackson	0.20	0.00	0.00	0.00	29.93	30.13
Jefferson	0.05	0.00	0.00	0.00	10.24	10.29
Lafaette	0.04	0.00	0.00	0.00	9.06	9.10
Lake	2.39	0.00	0.00	0.00	81.96	84.35
Lee	81.79	31.20	0.00	0.00	10.06	123.05
Leon	0.30	0.00	0.00	0.00	38.70	39.00
Levy	0.10	0.00	0.00	0.00	21.42	21.52
Liberty	0.02	0.00	0.00	0.00	3.70	3.72
Madison	0.10	0.00	0.00	0.00	7.09	7.19
Manatee	0.00	6.73	0.00	0.00	89.80	96.53
Marion	0.85	0.00	0.00	0.00	48.35	49.20
Martin	37.99	0.51	0.00	0.00	17.21	55.71
Monroe	0.00	0.00	0.07	0.00	1.22	1.29
Nassau	4.11	0.00	0.00	0.00	38.66	42.77
Okaloosa	1.98	0.00	0.00	0.00	29.61	31.59
Okeechobee	15.87	0.10	0.00	0.00	22.93	38.90
Orange	3.26	0.00	0.00	0.00	217.61	220.87
Osceola	2.31	0.00	0.00	0.00	61.13	63.44
Palm Beach	140.90	7.74	52.40	0.00	0.00	201.04
Pasco	0.21	0.00	0.00	0.00	138.50	138.71
Pinellas	0.20	0.00	0.00	0.00	47.90	48.10
Polk	7.16	10.65	0.00	0.00	335.86	353.67
Putnam	1.68	0.00	0.00	0.00	59.75	61.43
St. Johns	4.53	0.00	0.00	0.00	46.73	51.26
St. Lucie	28.98	0.60	0.00	0.00	54.26	83.84
Santa Rosa	0.00	0.00	0.00	21.02	2.52	23.54
Sarasota	1.16	29.18	0.00	0.00	29.15	59.49
Seminole	0.49	0.00	0.00	0.00	65.08	65.57
Sumter	0.06	0.00	0.00	0.00	73.07	73.13
Suwannee	0.15	0.00	0.00	0.00	32.15	32.30
Taylor	0.05	0.00	0.00	0.00	49.33	49.38
Union	0.12	0.00	0.00	0.00	4.25	4.37
Volusia	1.92	0.89	0.00	0.00	71.62	74.43
Wakulla	0.03	0.00	0.00	0.00	2.66	2.69
Walton	0.11	0.00	0.00	0.00	7.82	7.93
Washington	0.10	0.00	0.00	0.00	3.15	3.25
Totals	676.00	272.15	823.85	103.28	2,789.44	4,664.72

(table 3). About 18 percent (824 Mgal/d) of Florida's ground-water withdrawals was obtained from the Biscayne aquifer, which underlies southeastern Florida (fig. 6). Dade and Broward Counties withdrew all of their ground water from the Biscayne aquifer, and Palm Beach County withdrew some water from this aquifer. The remaining ground-water withdrawals in the State were from the unnamed surficial aquifer (676 Mgal/d), the intermediate aquifer (272 Mgal/d), and the sand-and-gravel aquifer (103 Mgal/d).

Monthly water withdrawals fluctuate dramatically in Florida. Variations in temperatures, precipitation (rainfall), crop production, and tourism generally cause these fluctuations. In 1990, nearly 38 percent of the annual freshwater withdrawals occurred from March through June (fig. 7).

Wastewater discharges from domestic (public and private) industrial systems during 1990 are summarized in table 4. Wastewater-discharge data were obtained from the FDER for 983 domestic wastewater-treatment facilities and 84 industrial facilities. Total wastewater discharge in 1990 were 1,760 Mgal/d, of which 1,363 Mgal/d (77 percent) was from domestic wastewater facilities. The remaining 397 Mgal/d (22 percent) was from industrial facilities. More than 59 percent

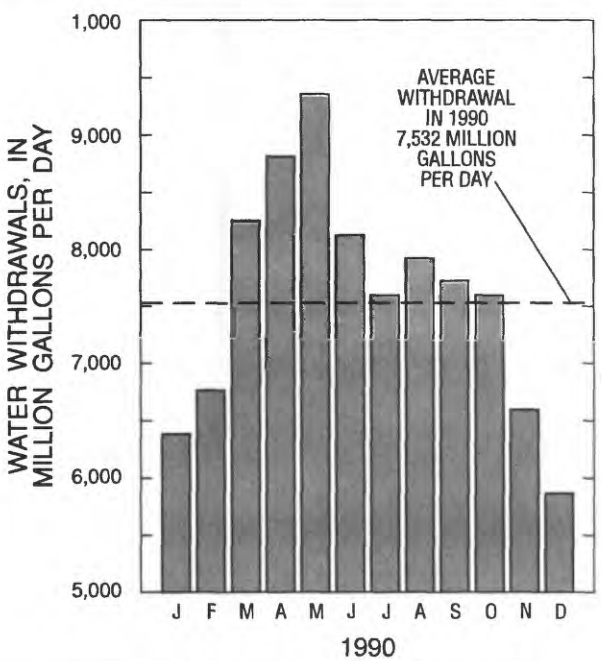

Figure 7. Monthly freshwater withdrawals in Florida, 1990.

Table 4. Domestic and industrial wastewater discharge in Florida by county, 1990

[Discharges are in million gallons per day; 0.00 indicates no discharge were made]

County	Domestic		Industrial		Combined discharge
	Facilities inventoried	Wastewater discharge	Facilities inventoried	Wastewater discharge	
Alachua	10	13.39	1	0.60	13.99
Baker	3	0.81	0	0.00	0.81
Bay	12	33.28	0	0.00	33.28
Bradford	3	2.02	1	6.80	8.82
Brevard	33	41.63	0	0.00	41.63
Broward	13	169.87	0	0.00	169.87
Calhoun	1	0.50	0	0.00	0.50
Charlotte	15	5.38	0	0.00	5.38
Citrus	16	2.57	0	0.00	2.57
Clay	13	6.94	2	6.01	12.95
Collier	36	19.17	0	0.00	19.17
Columbia	1	1.69	0	0.00	1.69
Dade	4	282.72	0	0.00	282.72
De Soto	5	1.10	0	0.00	1.10
Dixie	2	0.26	0	0.00	0.26
Duval	22	66.62	5	9.77	76.39
Escambia	21	18.45	2	41.65	60.10
Flagler	8	2.86	0	0.00	2.86
Franklin	4	1.01	0	0.00	1.01
Gadsden	5	1.96	1	3.07	5.03
Gilchrist	2	0.23	0	0.00	0.23
Glades	2	0.05	0	0.00	0.05
Gulf	4	32.04	1	11.25	43.29
Hamilton	3	0.68	1	16.65	17.33
Hardee	5	1.11	0	0.00	1.11
Hendry	5	2.14	2	8.55	10.69
Hernando	16	4.71	1	5.15	9.86
Highlands	20	2.44	0	0.00	2.44
Hillsborough	49	79.43	12	17.69	97.12
Holmes	1	0.66	0	0.00	0.66
Indian River	16	4.55	1	0.25	4.80
Jackson	6	2.40	0	0.00	2.40
Jefferson	2	0.55	0	0.00	0.55
Lafayette	2	0.12	0	0.00	0.12
Lake	32	7.99	3	0.56	8.55
Lee	67	32.11	0	0.00	32.11
Leon	7	16.37	0	0.00	16.37
Levy	7	0.54	0	0.00	0.54
Liberty	1	0.11	1	0.00	0.11
Madison	1	0.63	0	0.00	0.63
Manatee	7	23.99	4	9.51	33.50
Marion	30	6.83	0	0.00	6.83
Martin	31	4.49	1	0.27	4.76
Monroe	31	9.45	0	0.00	9.45
Nassau	6	2.37	2	29.90	32.27
Okaloosa	19	14.70	0	0.00	14.70
Okeechobee	3	0.38	0	0.00	0.38
Orange	46	91.67	0	0.00	91.67
Osceola	19	10.22	0	0.00	10.22
Palm Beach	17	87.92	4	1.18	89.10
Pasco	38	15.88	1	10.17	26.05
Pinellas	26	104.24	0	0.00	104.24
Polk	70	25.23	28	121.10	146.33
Putnam	4	2.47	1	37.22	39.69
St. Johns	17	5.07	0	0.00	5.07
St. Lucie	26	9.00	0	0.00	9.00
Santa Rosa	9	2.80	2	3.21	6.01
Sarasota	39	19.96	0	0.00	19.96
Seminole	18	29.74	0	0.00	29.74
Sumter	8	0.84	0	0.00	0.84
Suwanne	4	0.78	1	1.00	1.78
Taylor	1	0.79	1	53.90	54.69
Union	2	0.43	0	0.00	0.43
Volusia	25	29.82	2	0.06	29.88
Wakulla	3	0.10	2	0.51	0.61
Walton	6	1.65	1	0.78	2.43
Washington	3	0.74	0	0.00	0.74
Totals	983	1,362.65	84	396.81	1,759.46

of the domestic wastewater for 1990 was discharged into surface-water sources, whereas the remaining 41 percent was discharged into ground water (sprayfields, percolation ponds and deep-well injection). Nearly 97 percent of the industrial wastewater for 1990 was discharged into surface-water sources. Broward, Dade, Pinellas, and Polk Counties each had total wastewater discharges of more than 100 Mgal/d in 1990.

Statewide water-use estimates have been compiled for Florida every 5 years since 1950, however, variations in historical water-use values are sometimes difficult to assess because of differences in data-collection techniques and sources of information through the years. Since 1970, statewide water-use data for all withdrawal categories have been collected five times by eight agencies (five water management districts, the Florida Geological Survey (previously named the Florida Bureau of Geology), the Florida Department of Environmental Regulation, and the U.S. Geological Survey).

Freshwater withdrawals increased 31 percent (1,769 Mgal/d) in Florida during the 20 years between 1970 and 1990. Ground-water withdrawals increased 1,803 Mgal/d (63 percent), and surface-water withdrawals decreased 34 Mgal/d (1 percent) during this period (table 5). Between 1980 and 1990, however, ground-water withdrawals increased 910 Mgal/d (24 percent), and surface-water withdrawals decreased 684 Mgal/d (19 percent). The steady increase in ground-water withdrawals during 1970-90 is a result of improvements in drilling techniques; the ability to pump water more economically from large, deep wells; and the widespread availability of large quantities of high-quality water from wells. The decrease in surface-water withdrawals between 1980 and 1990 is a result of decreased withdrawals for thermoelectric power generation due in part to more efficient use of cooling water.

The dependency on ground water as the primary source of supply in Florida has increased since 1950 (fig. 8). In 1990, nearly 62 percent of the total freshwater withdrawn was from ground-water sources, compared to 51 percent in 1980, and 21 percent in 1950. The use of nonpotable ground water as a source of supply, primarily for public supply, has also increased in Florida. Nonpotable water which contains less than 1,000 mg/L of dissolved solids is sometimes treated to meet the FDER drinking-water standards for potable water. The amount of nonpotable water treated by desalination processes (see glossary) to meet drinking-water standards increased from 17 Mgal/d in 1985 (Marella, 1988, p. 15), to 48 Mgal/d in 1990. The use of reclaimed wastewater also has increased in Florida. In 1990, nearly 170 Mgal/d of reclaimed wastewater was used, primarily for irrigation, more than three times the 51 Mgal/d used in 1985 (Marella, 1988, p. 32).

All categories of freshwater withdrawals in Florida have increased since 1950, but trends differed between 1970 and 1990. During this 20-year period, total freshwater withdrawals for public supply increased 1,041 Mgal/d, self-supplied domestic withdrawals increased 134 Mgal/d, and agricultural irrigation increased 1,704 Mgal/d, whereas self-supplied commercial-industrial withdrawals decreased 157 Mgal/d and withdrawals for thermoelectric power generation decreased 955 Mgal/d (fig. 9 and table 5).

WATER WITHDRAWALS, USE, AND TRENDS BY CATEGORY

Data on water withdrawal and use for 1990 were collected and compiled for the following categories; public supply, self-supplied domestic, self-supplied commercial-industrial, agricultural irrigation, and thermoelectric power generation. Water-use data for these five categories have been collected in Florida since 1970. Miscellaneous water withdrawals and uses included in county totals presented in the 1985 water-use report (Marella, 1988) included water withdrawn for residential lawn irrigation, residential heat pumps and air-conditioning, units and water discharged through free-flowing wells. Because of the inconsistency in data from county to county for these uses, they were not included in the 1985 Statewide totals (Marella, 1988, p. 38). Since then, some of the information on residential lawn watering has been updated and water used to irrigate lawns is included in the agricultural irrigation section of this report under turf grass. However, the 1990 statewide data for water used by residential heat pumps and air conditioning units and water discharged through free-flowing wells have not been updated and remain inconsistent between counties and, therefore, are not included in this report.

Public Supply

The public-supply category refers to water supplied by a publicly or privately owned water system for public distribution. According to the FDER, any water system that serves more than 25 people or has 15 year-round service connections is considered a public supplier (Florida Department of Environmental Regulation, 1990a, p. 6). For this report, public-supply water-use data were collected for those systems that served 400 people or more, or that withdrew 10,000 gal/d (0.01 Mgal/d) or more. Water withdrawals by the smaller suppliers are included in the self-supplied domestic category. Data for public supply were obtained from the FDER (drinking water section) monthly operating reports, and the five water management districts, using information from their consumptive water-use permit files.

For 1990, 987 public and private water systems were inventoried in Florida. Water withdrawals for public supply in Florida totaled 1,925 Mgal/d, and an estimated 11.23 million people were served by these systems. Ground water was the source of more than 88 percent (1,699 Mgal/d) of the water withdrawn for public supply and systems utilizing ground water served an estimated 10.0 million people.

Table 5. Historical freshwater withdrawals in Florida by category, 1970-90

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made; -- indicates no data were available or collected]

Year	Public supply		Self-supplied domestic		Self-supplied commercial-industrial		Agricultural		Thermoelectric power generation		Total freshwater withdrawals		
	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Total
1970[a]	758.80	124.70	165.00	0.00	736.20	190.60	1,190.24	910.43	11.90	1,675.00	2,862.14	2,900.73	5,762.87
1971	--	--	--	--	--	--	--	--	--	--	--	--	--
1972	--	--	--	--	--	--	--	--	--	--	--	--	--
1973	--	--	--	--	--	--	--	--	--	--	--	--	--
1974	--	--	--	--	--	--	--	--	--	--	--	--	--
1975[b]	982.83	162.98	200.93	2.05	778.91	160.70	1,289.93	1,640.67	60.15	1,635.39	3,312.75	3,601.79	6,914.54
1976	--	--	--	--	--	--	--	--	--	--	--	--	--
1977[c]	1,059.06	172.82	191.81	1.01	733.06	189.23	1,467.25	1,469.43	55.22	1,312.05	3,506.40	3,144.54	6,650.94
1978	--	--	--	--	--	--	--	--	--	--	--	--	--
1979	--	--	--	--	--	--	--	--	--	--	--	--	--
1980[d]	1,184.35	176.93	250.78	0.10	643.13	138.20	1,613.75	1,443.15	62.62	1,792.26	3,754.63	3,550.64	7,305.27
1981	--	--	--	--	--	--	--	--	--	--	--	--	--
1982	--	--	--	--	--	--	--	--	--	--	--	--	--
1983	--	--	--	--	--	--	--	--	--	--	--	--	--
1984	--	--	--	--	--	--	--	--	--	--	--	--	--
1985[e]	1,491.80	185.31	259.29	0.00	631.53	77.28	1,646.31	1,332.99	18.74	632.71	4,047.67	2,228.29	6,275.96
1986	--	--	--	--	--	--	--	--	--	--	--	--	--
1987[f]	1,634.68	176.39	--	--	--	--	--	--	--	--	--	--	--
1988	--	--	--	--	--	--	--	--	--	--	--	--	--
1989	--	--	--	--	--	--	--	--	--	--	--	--	--
1990	1,698.82	226.33	299.38	0.00	630.88	139.06	2,012.50	1,792.75	23.14	708.92	4,664.72	2,867.06	7,531.78

[a]Source, Florida Bureau of Geology Information Circular 83 (Pride, 1973).
[b]Source, U.S. Geological Survey Water-Resources Investigations Report 78-17 (Leach, 1978).
[c]Source, U.S. Geological Survey Water-Resources Investigations Report 79-112 (Leach and Healy, 1980).
[d]Source, U.S. Geological Survey Water-Resources Investigations Report 82-4090 (Leach, 1983).
[e]Source, U.S. Geological Survey Water-Resources Investigations Report 88-4103 (Marella, 1988).
[f]Source, U.S. Geological Survey Open-File Report 90-596 (Marella, 1990b).

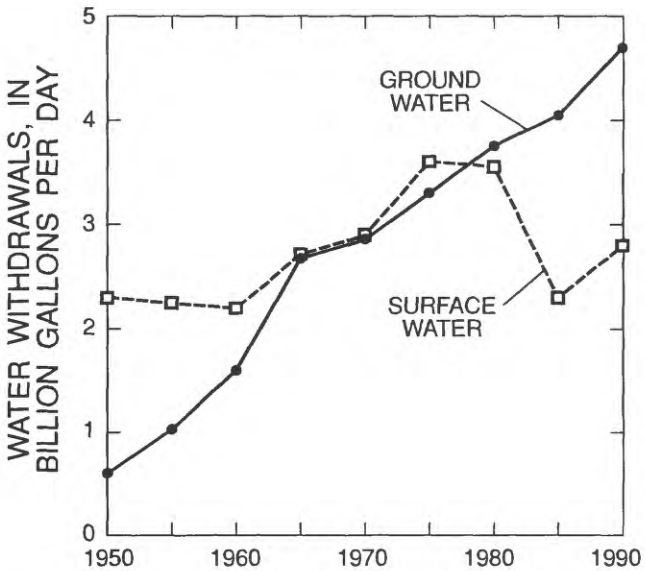

Figure 8. Historical freshwater withdrawals in Florida by source, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)

Surface water accounted for the remaining 12 percent (226 Mgal/d), of the public-supply withdrawals and systems using surface water served 1.23 million people. Monroe County withdrew no water for public supply in 1990 and Okeechobee County relied on surface water for public supply (table 6).

In 1990, Florida ranked second in the Nation after California (Solley and others, 1993) in ground-water withdrawals for public supply (1,699 Mgal/d). The largest source of ground water for public supply was the Floridan aquifer system, which underlies most of the State. This aquifer system supplied 852 Mgal/d of water for public supply, 50 percent of the total public-supply withdrawals (fig. 10). The next largest source of ground-water for public supply was the Biscayne aquifer, which is present only in southeastern Florida. This aquifer supplied 573 Mgal/d of water for public supply, 34 percent of the total public-supply withdrawal. The remaining public ground-water supplies were withdrawn from the unnamed surficial aquifer (178 Mgal/d), the intermediate aquifer (50 Mgal/d), and the sand-and-gravel aquifer (46 Mgal/d).

Water withdrawals for public supply in Florida commonly fluctuate seasonal because of variations in temperature, precipitation, and tourist traffic, which can affect demand. Public-supply withdrawals in 1990 were smallest in January and largest in May (fig. 11). The range of fluctuation for public-supply withdrawals of almost 270 Mgal/d relates to seasonal differences in residential demand, primarily for lawn irrigation, and tourism.

Public suppliers provide water (deliveries) for a variety of users including domestic (residential), commercial, and industrial users (see glossary). In addition to these uses, public-supply water also is used for public (utility) uses, such as firefighting and system maintenance, and some public-supply water is lost to leakage. Domestic water use, which includes indoor and outdoor residential uses, accounted for 65 percent of the public-supply withdrawals in 1990 (fig. 12). Estimates of the use or deliveries of public-supply water for each county in Florida are presented in table 7. Commercial and industrial water deliveries were estimated by multiplying county employment totals by a water use coefficient based on average water use per employee for each major employment sector (Bucca and Marella, 1992). Public use and other water uses were estimated from data provided by the utilities, from the FDER monthly operating reports, or from the individual users directly. Domestic use was then derived from the residual of the total public-supply net water-use in each county minus the commercial, industrial, public, and other deliveries.

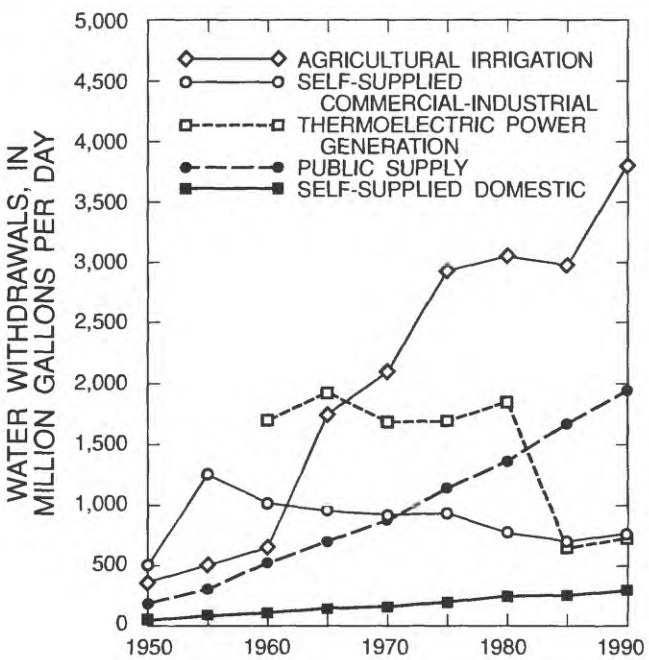

Figure 9. Historical freshwater withdrawals in Florida by category, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)

The statewide public-supply per capita use for Florida in 1990 was 171 gal/d. This value is the total public-supply water withdrawn (1,925 Mgal/d) divided by the total population served by public supply (11.21 million). The per capita use for public-supply water computed in this manner includes water delivered for commercial, industrial, public and other uses as well as domestic uses. In Florida, the public-supply per capita use has remained fairly constant since 1980 (fig. 13). Public-supply water used solely for domestic (residential) purposes totaled 1,249 Mgal/d and the per capita use for domestic purposes was 111 gal/d for 1990 (table 7). This value is lower than the 144 gal/d reported for 1980 (Leach, 1983) and 123 gal/d in 1985 (Marella, 1988, p. 23), but higher than the national average of 105 gal/d (Solley and others, 1993).

Table 6. Public-supply water withdrawals in Florida by county, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

County	Ground-water withdrawals			Surface-water withdrawals			Total withdrawals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	22.95	0.00	22.95	0.00	0.00	0.00	22.95	0.00	22.95
Baker	0.81	0.00	0.81	0.00	0.00	0.00	0.81	0.00	0.81
Bay	7.07	0.00	7.07	40.11	0.00	40.11	47.18	0.00	47.18
Bradford	1.61	0.00	1.61	0.00	0.00	0.00	1.61	0.00	1.61
Brevard	11.55	0.00	11.55	16.24	0.00	16.24	27.79	0.00	27.79
Broward	192.53	0.00	192.53	0.00	0.00	0.00	192.53	0.00	192.53
Calhoun	0.53	0.00	0.53	0.00	0.00	0.00	0.53	0.00	0.53
Charlotte	2.62	0.00	2.62	3.44	0.00	3.44	6.06	0.00	6.06
Citrus	8.65	0.00	8.65	0.00	0.00	0.00	8.65	0.00	8.65
Clay	11.11	0.00	11.11	0.00	0.00	0.00	11.11	0.00	11.11
Collier	31.44	0.00	31.44	5.27	0.00	5.27	36.71	0.00	36.71
Columbia	2.93	0.00	2.93	0.00	0.00	0.00	2.93	0.00	2.93
Dade	337.69	0.00	337.69	0.00	0.00	0.00	337.69	0.00	337.69
De Soto	1.63	0.00	1.63	9.19	0.00	9.19	10.82	0.00	10.82
Dixie	0.66	0.00	0.66	0.00	0.00	0.00	0.66	0.00	0.66
Duval	96.32	0.00	96.32	0.00	0.00	0.00	96.32	0.00	96.32
Escambia	37.78	0.00	37.78	0.00	0.00	0.00	37.78	0.00	37.78
Flagler	3.85	0.00	3.85	0.00	0.00	0.00	3.85	0.00	3.85
Franklin	1.63	0.00	1.63	0.00	0.00	0.00	1.63	0.00	1.63
Gadsden	2.13	0.00	2.13	1.29	0.00	1.29	3.42	0.00	3.42
Gilchrist	0.27	0.00	0.27	0.00	0.00	0.00	0.27	0.00	0.27
Glades	0.40	0.00	0.40	0.00	0.00	0.00	0.40	0.00	0.40
Gulf	1.26	0.00	1.26	0.00	0.00	0.00	1.26	0.00	1.26
Hamilton	0.97	0.00	0.97	0.00	0.00	0.00	0.97	0.00	0.97
Hardee	1.43	0.00	1.43	0.00	0.00	0.00	1.43	0.00	1.43
Hendry	3.60	0.00	3.60	0.00	0.00	0.00	3.60	0.00	3.60
Hernando	14.97	0.00	14.97	0.00	0.00	0.00	14.97	0.00	14.97
Highlands	8.30	0.00	8.30	0.00	0.00	0.00	8.30	0.00	8.30
Hillsborough	61.79	0.00	61.79	76.05	0.00	76.05	137.84	0.00	137.84
Holmes	1.10	0.00	1.10	0.00	0.00	0.00	1.10	0.00	1.10
Indian River	13.17	0.00	13.17	0.00	0.00	0.00	13.17	0.00	13.17
Jackson	2.38	0.00	2.38	0.00	0.00	0.00	2.38	0.00	2.38
Jefferson	0.72	0.00	0.72	0.00	0.00	0.00	0.72	0.00	0.72
Lafayette	0.18	0.00	0.18	0.00	0.00	0.00	0.18	0.00	0.18
Lake	20.67	0.00	20.67	0.00	0.00	0.00	20.67	0.00	20.67
Lee	38.88	0.00	38.88	3.25	0.00	3.25	42.13	0.00	42.13
Leon	25.02	0.00	25.02	0.00	0.00	0.00	25.02	0.00	25.02
Levy	1.58	0.00	1.58	0.00	0.00	0.00	1.58	0.00	1.58
Liberty	0.26	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.26
Madison	1.43	0.00	1.43	0.00	0.00	0.00	1.43	0.00	1.43
Manatee	0.09	0.00	0.09	40.30	0.00	40.30	40.39	0.00	40.39
Marion	16.47	0.00	16.47	0.00	0.00	0.00	16.47	0.00	16.47
Martin	13.66	0.00	13.66	0.00	0.00	0.00	13.66	0.00	13.66
Monroe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nassau	3.85	0.00	3.85	0.00	0.00	0.00	3.85	0.00	3.85
Okaloosa	20.92	0.00	20.92	0.00	0.00	0.00	20.92	0.00	20.92
Okeechobee	0.00	0.00	0.00	2.09	0.00	2.09	2.09	0.00	2.09
Orange	161.29	0.00	161.29	0.00	0.00	0.00	161.29	0.00	161.29
Osceola	12.08	0.00	12.08	0.00	0.00	0.00	12.08	0.00	12.08
Palm Beach	135.55	0.00	135.55	29.10	0.00	29.10	164.65	0.00	164.65
Pasco	90.65	0.00	90.65	0.00	0.00	0.00	90.65	0.00	90.65
Pinellas	40.97	0.00	40.97	0.00	0.00	0.00	40.97	0.00	40.97
Polk	65.52	0.00	65.52	0.00	0.00	0.00	65.52	0.00	65.52
Putnam	3.15	0.00	3.15	0.00	0.00	0.00	3.15	0.00	3.15
St. Johns	8.39	0.00	8.39	0.00	0.00	0.00	8.39	0.00	8.39
St. Lucie	14.39	0.00	14.39	0.00	0.00	0.00	14.39	0.00	14.39
Santa Rosa	10.57	0.00	10.57	0.00	0.00	0.00	10.57	0.00	10.57
Sarasota	21.43	0.00	21.43	0.00	0.00	0.00	21.43	0.00	21.43
Seminole	50.79	0.00	50.79	0.00	0.00	0.00	50.79	0.00	50.79
Sumter	1.90	0.00	1.90	0.00	0.00	0.00	1.90	0.00	1.90
Suwanne	1.36	0.00	1.36	0.00	0.00	0.00	1.36	0.00	1.36
Taylor	1.42	0.00	1.42	0.00	0.00	0.00	1.42	0.00	1.42
Union	0.63	0.00	0.63	0.00	0.00	0.00	0.63	0.00	0.63
Volusia	44.21	0.00	44.21	0.00	0.00	0.00	44.21	0.00	44.21
Wakulla	0.77	0.00	0.77	0.00	0.00	0.00	0.77	0.00	0.77
Walton	3.71	0.00	3.71	0.00	0.00	0.00	3.71	0.00	3.71
Washington	1.18	0.00	1.18	0.00	0.00	0.00	1.18	0.00	1.18
Totals	1,698.82	0.00	1,698.82	226.33	0.00	226.33	1,925.15	0.00	1,925.15

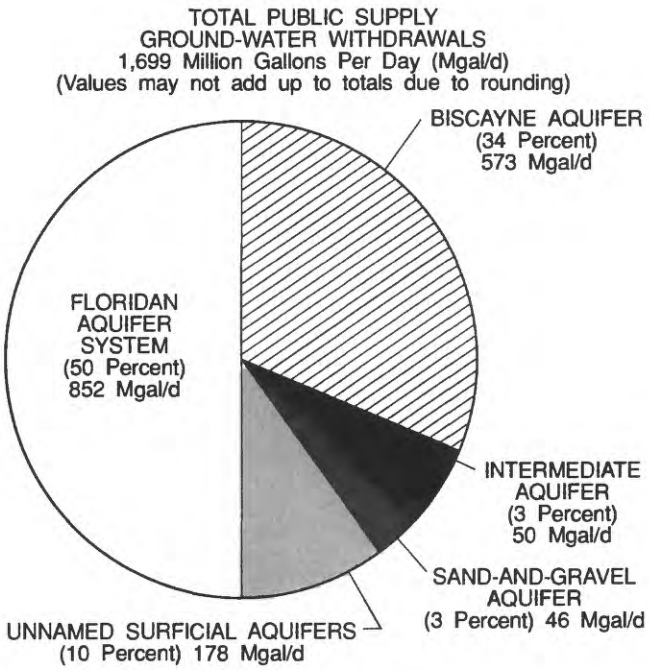

Figure 10. Public supply ground-water withdrawals in Florida by principal aquifer, 1990.

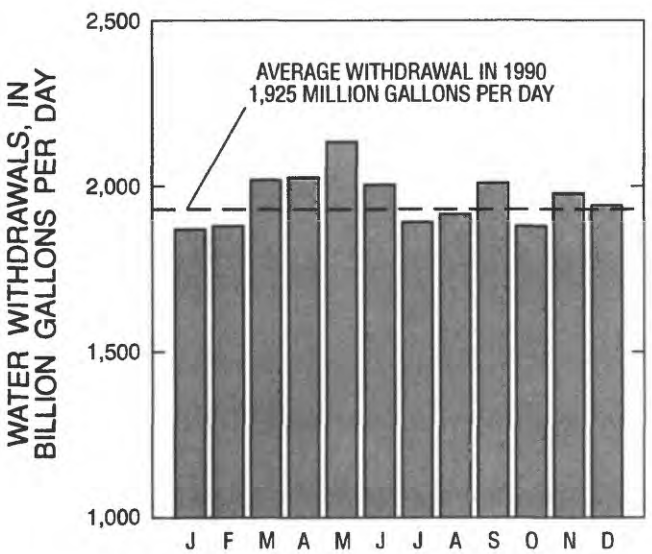

Figure 11. Monthly public-supply freshwater withdrawals in Florida, 1990.

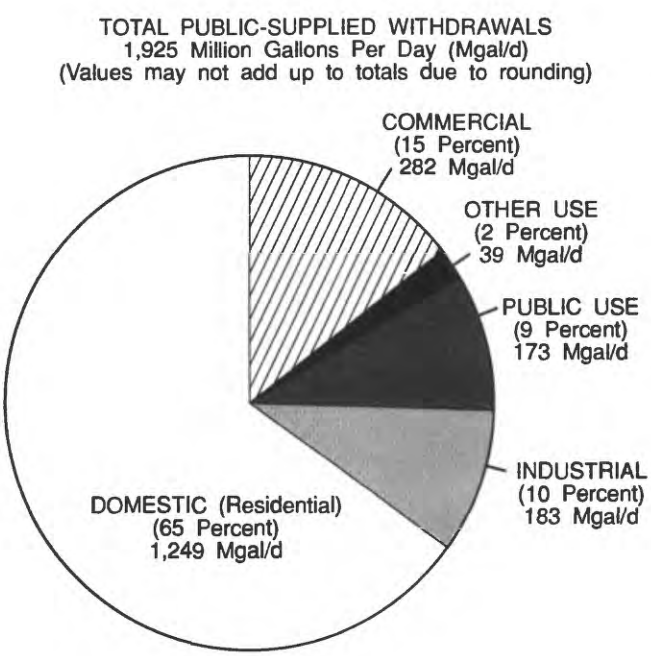

Figure 12. Public-supply water use (deliveries) in Florida, 1990.

Table 7. Estimated public-supply water use (deliveries), and per capita use in Florida by county, 1990

County	Population served	Public-supply water use (deliveries), in million gallons per day						Per capita use, in gallons per day	
		Domestic (residential)	Commercial	Industrial	Public use	Other use	Total	Public Supply	Domestic
Alachua	142,104	14.75	4.05	1.63	2.30	0.22	22.95	162	104
Baker	4,102	0.61	0.08	0.04	0.08	0.00	0.81	197	149
Bay	103,672	15.74	3.09	23.64	4.71	0.00	47.18	455	152
Bradford	7,333	0.82	0.25	0.38	0.12	0.04	1.61	220	112
Brevard	363,066	30.89	7.65	7.13	3.85	1.79	51.31	141	85
Broward	1,195,865	132.25	28.14	15.45	14.44	2.25	192.53	161	111
Calhoun	3,304	0.24	0.10	0.15	0.04	0.00	0.53	160	73
Charlotte	99,870	11.08	1.50	0.31	2.12	0.16	15.17	152	111
Citrus	46,314	6.14	1.17	0.37	0.87	0.10	8.65	187	133
Clay	75,297	8.38	1.39	0.40	0.83	0.11	11.11	148	111
Collier	122,450	27.41	4.09	0.78	3.67	0.76	36.71	300	224
Columbia	15,336	1.16	0.62	0.93	0.22	0.00	2.93	191	76
Dade	1,875,160	212.36	44.33	30.00	32.42	6.51	325.62	174	113
De Soto	7,341	0.44	0.20	0.14	0.06	0.00	0.84	114	60
Dixie	4,555	0.52	0.06	0.04	0.04	0.00	0.66	145	114
Duval	619,196	59.85	16.96	10.29	7.22	2.00	96.32	156	97
Escambia	239,571	27.56	4.96	2.06	2.83	0.37	37.78	158	115
Flagler	19,329	2.70	0.36	0.37	0.39	0.03	3.85	199	140
Franklin	8,021	1.31	0.11	0.06	0.12	0.03	1.63	203	163
Gadsden	25,928	2.03	0.29	0.85	0.25	0.00	3.42	132	78
Gilchrist	1,656	0.17	0.04	0.03	0.02	0.01	0.27	163	103
Glades	3,085	0.28	0.03	0.06	0.03	0.00	0.40	130	91
Gulf	9,079	0.84	0.11	0.24	0.06	0.01	1.26	139	93
Hamilton	5,101	0.62	0.22	0.06	0.07	0.00	0.97	190	122
Hardee	8,302	1.14	0.15	0.04	0.10	0.00	1.43	172	137
Hendry	16,649	1.69	0.24	1.40	0.27	0.00	3.60	216	102
Hernando	90,403	12.43	1.07	0.35	1.12	0.00	14.97	166	137
Highlands	51,441	6.24	0.74	0.29	0.62	0.41	8.30	161	121
Hillsborough	816,641	78.46	20.40	12.97	9.39	3.97	125.19	153	96
Holmes	5,118	0.65	0.18	0.19	0.08	0.00	1.10	215	127
Indian River	53,734	9.03	1.67	0.76	1.58	0.13	13.17	245	168
Jackson	15,758	1.42	0.38	0.41	0.17	0.00	2.38	151	90
Jefferson	4,620	0.46	0.08	0.12	0.05	0.01	0.72	156	100
Lafayette	1,140	0.07	0.03	0.07	0.01	0.00	0.18	158	61
Lake	103,785	15.69	2.13	1.09	1.55	0.21	20.67	199	151
Lee	281,489	29.12	7.10	1.75	4.27	0.51	42.75	152	103
Leon	156,581	15.91	5.87	1.11	1.88	0.25	25.02	160	102
Levy	10,453	1.11	0.22	0.14	0.11	0.00	1.58	151	106
Liberty	2,010	0.15	0.03	0.06	0.02	0.00	0.26	129	75
Madison	5,943	0.46	0.26	0.60	0.11	0.00	1.43	241	77
Manatee	211,105	20.13	3.48	0.93	1.53	1.77	27.84	132	95
Marion	89,903	9.23	2.93	2.99	1.24	0.08	16.47	183	103
Martin	61,863	8.46	1.95	1.06	1.37	0.82	13.66	221	137
Monroe	78,024	6.64	2.64	0.22	1.81	0.76	12.07	155	85
Nassau	22,014	2.45	0.78	0.29	0.29	0.04	3.85	175	111
Okaloosa	126,641	14.94	2.63	1.36	1.57	0.42	20.92	165	118
Okeechobee	17,035	1.37	0.32	0.11	0.29	0.00	2.09	123	80
Orange	653,739	87.55	24.43	12.71	10.33	2.75	137.77	211	134
Osceola	79,625	6.72	3.25	0.71	0.91	0.49	12.08	152	84
Palm Beach	764,425	112.83	22.52	9.59	16.47	3.24	164.65	215	148
Pasco	201,609	19.60	3.27	1.03	1.97	0.20	26.07	129	97
Pinellas	837,617	68.92	20.30	14.61	11.82	2.55	118.20	141	82
Polk	300,574	41.55	7.62	5.90	6.55	3.90	65.52	218	138
Putnam	22,543	1.87	0.59	0.38	0.31	0.00	3.15	140	83
St. Johns	66,138	5.67	1.56	0.49	0.63	0.04	8.39	127	86
St. Lucie	83,500	9.32	2.00	0.92	1.44	0.71	14.39	172	112
Santa Rosa	77,355	8.38	0.98	0.37	0.79	0.05	10.57	137	108
Sarasota	248,778	16.39	6.63	3.88	7.33	0.00	34.23	138	66
Seminole	270,791	38.40	4.71	3.38	3.80	0.50	50.79	188	142
Sumter	12,252	1.15	0.35	0.25	0.14	0.01	1.90	155	94
Suwanne	8,445	0.83	0.28	0.15	0.10	0.00	1.36	161	98
Taylor	10,100	0.73	0.22	0.36	0.11	0.00	1.42	141	72
Union	2,116	0.21	0.30	0.07	0.05	0.00	0.63	298	99
Volusia	321,635	29.06	7.57	3.76	3.32	0.50	44.21	137	90
Wakulla	7,395	0.57	0.09	0.06	0.05	0.00	0.77	104	77
Walton	24,990	2.93	0.21	0.13	0.37	0.07	3.71	148	117
Washington	7,045	0.74	0.13	0.22	0.09	0.00	1.18	167	105
Totals	11,228,059	1,248.82	282.09	182.69	172.77	38.78	1,925.15	171	111

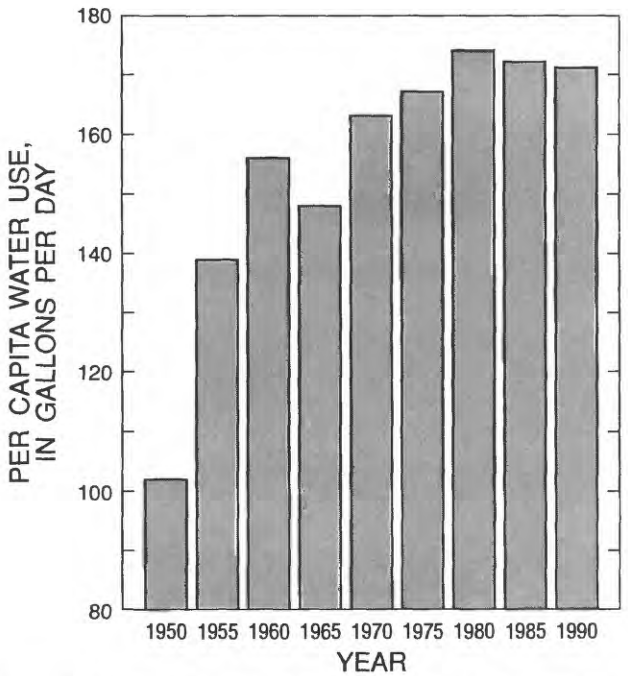

Figure 13. *Historical public-supply per capita water use in Florida, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)*

Returns from public-supply systems to domestic wastewater-treatment plants in 1990 totaled 1,363 Mgal/d. Approximately 71 percent of water withdrawn for public supply is returned to wastewater-treatment plants. In 1990, an estimated 8.58 million people were served by wastewater-treatment plants (0.04 Mgal/d capacities or more) in Florida. The remaining population (4.36 million) is served by small wastewater plants (less than 0.04 Mgal/d capacities) or discharge wastewater into individual septic tanks.

Dade County withdrew 338 Mgal/d of ground water and 1.9 million people in the county were served by public-supply systems in 1990 (table 8). Within Dade County is the single largest water supplier in the State, Miami-Dade Water and Sewer Authority, which withdrew more than 296 Mgal/d of ground water in 1990. Dade County's water withdrawals also included water supplied (exported) to neighboring Monroe County (12 Mgal/d) for public-supply use throughout the Florida Keys. Other counties that had a net water use (see glossary) of more than 100 Mgal/d of public-supply water were Broward, Palm Beach, Orange, Hillsborough, and Pinellas (table 8). Several of these counties rely on water imported from other counties. In 1990, nearly 139 Mgal/d of public-supplied water was withdrawn in one county for use in another county. The largest importer of public-supplied water is Pinellas County which is supplied with nearly 78 Mgal/d of water from adjacent Hillsborough and Pasco Counties. Table 8 also presents the total public-supplied water use, per capita use, and population served for each county in 1990.

Water withdrawals for public supply in Florida have increased rapidly since water-use data were first collected. The total public-supply withdrawal was 170 Mgal/d in 1950 (MacKichan, 1951, p. 6); 530 Mgal/d in 1960 (MacKichan and Kammerer, 1961, p. 13); 884 Mgal/d in 1970 (Pride, 1973, p. 8); 1,361 Mgal/d in 1980 (Leach, 1983, p. 21), and 1,925 Mgal/d in 1990 (fig. 14). Ground-water withdrawals for public supply increased from 759 Mgal/d in 1970, to 1,184 Mgal/d in 1980 and to 1,699 Mgal/d in 1990 (table 5). Surface-water withdrawals for public supply increased from 125 Mgal/d in 1970, to 177 Mgal/d in 1980 and to 226 Mgal/d in 1990. The population served by public-supply systems increased from 5.42 million in 1970, to 7.78 million in 1980, and to 11.23 million in 1990. The percentage of the population served by public-supply systems increased from 79 percent in 1970 to 87 percent in 1990.

The use of treated nonpotable water (primarily ground water) for public supply, has increased in Florida since 1985 because of increased demand for water and expanded use of desalination techniques (Marella, 1988, p. 19). In 1990, 48 Mgal/d of water containing less than 1,000 mg/L of dissolved solids was treated using desalination techniques (see glossary) to meet the FDER drinking water standards for potable water (less than 500 mg/L of dissolved solids). The use of desalination for public supply was documented in 9 counties during 1990 (Brevard, Charlotte, Indian River, Lee, Manatee, Martin, St. Johns, St. Lucie, and Sarasota), with Lee (20 Mgal/d) and Sarasota (19 Mgal/d) Counties accounting for the largest uses of treated nonpotable water.

Self-Supplied Domestic

Self-supplied domestic water-use is the use of water provided by individual domestic wells or by small utility companies (serving fewer than 400 residents or with a daily average pumpage of less than 0.01 Mgal/d). In 1990, an estimated 1.71 million people in Florida used self-supplied water systems and withdrew about 299 Mgal/d of ground-water (table 9). The population using self-supplied water systems listed in table 9 was derived by subtracting the number of residents served by public-supplied systems from the total county populations. Withdrawals by self-supplied domestic systems were calculated by multiplying the overall per capita use (in gallons per day) by the population served by self-supplied domestic systems for each county. The overall per capita use figures in table 7 (and table 9) were derived by taking the public-supplied net water-use for each county and dividing it by the population served by public-supply systems.

Self-supplied water for domestic use in Florida is derived almost exclusively from ground water, primarily because this source can provide the quantity and quality of water needed for drinking purposes. Furthermore, in most areas of the State, surface water would not meet drinking-water standards without treatment. The Floridan aquifer

Table 8. Population served by public water-supply systems and public-supply water use, withdrawals, and transfers in Florida by county, 1990

[Total population data from University of Florida, 1991; 0.00 indicates no withdrawals were made]

County	Population		Public supply, in million gallons per day (per capita use in gallons per day)						
			Use (net)		Withdrawals			Transfers	
	Total	Served by public-supply systems	Total	Per capita	Total	Ground water	Surface water	Imported	Exported
Alachua	181,596	142,104	22.95	162	22.95	22.95	0.00	0.00	0.00
Baker	18,486	4,102	0.81	197	0.81	0.81	0.00	0.00	0.00
Bay	126,994	103,672	47.18	455	47.18	7.07	40.11	0.00	0.00
Bradford	22,515	7,333	1.61	220	1.61	1.61	0.00	0.00	0.00
Brevard	398,978	363,066	51.31	141	27.79	11.55	16.24	23.52	0.00
Broward	1,255,488	1,195,865	192.53	161	192.53	192.53	0.00	0.00	0.00
Calhoun	11,011	3,304	0.53	160	0.53	0.53	0.00	0.00	0.00
Charlotte	110,975	99,870	15.17	152	6.06	2.62	3.44	9.73	0.62
Citrus	93,515	46,314	8.65	187	8.65	8.65	0.00	0.00	0.00
Clay	105,986	75,297	11.11	148	11.11	11.11	0.00	0.00	0.00
Collier	152,099	122,450	36.71	300	36.71	31.44	5.27	0.00	0.00
Columbia	42,613	15,336	2.93	191	2.93	2.93	0.00	0.00	0.00
Dade	1,937,094	1,875,160	325.62	174	337.69	337.69	0.00	0.00	12.07
De Soto	23,865	7,341	0.84	114	10.82	1.63	9.19	0.00	9.98
Dixie	10,585	4,555	0.66	145	0.66	0.66	0.00	0.00	0.00
Duval	672,971	619,196	96.32	156	96.32	96.32	0.00	0.00	0.00
Escambia	262,798	239,571	37.78	158	37.78	37.78	0.00	0.00	0.00
Flagler	28,701	19,329	3.85	199	3.85	3.85	0.00	0.00	0.00
Franklin	8,967	8,021	1.63	203	1.63	1.63	0.00	0.00	0.00
Gadsden	41,105	25,928	3.42	132	3.42	2.13	1.29	0.00	0.00
Gilchrist	9,667	1,656	0.27	163	0.27	0.27	0.00	0.00	0.00
Glades	7,591	3,085	0.40	130	0.40	0.40	0.00	0.00	0.00
Gulf	11,504	9,079	1.26	139	1.26	1.26	0.00	0.00	0.00
Hamilton	10,930	5,101	0.97	190	0.97	0.97	0.00	0.00	0.00
Hardee	19,499	8,302	1.43	172	1.43	1.43	0.00	0.00	0.00
Hendry	25,773	16,649	3.60	216	3.60	3.60	0.00	0.00	0.00
Hernando	101,115	90,403	14.97	166	14.97	14.97	0.00	0.00	0.00
Highlands	68,432	51,441	8.30	161	8.30	8.30	0.00	0.00	0.00
Hillsborough	834,054	816,641	125.19	153	137.84	61.79	76.05	0.00	12.65
Holmes	15,778	5,118	1.10	215	1.10	1.10	0.00	0.00	0.00
Indian River	90,208	53,734	13.17	245	13.17	13.17	0.00	0.00	0.00
Jackson	41,375	15,758	2.38	151	2.38	2.38	0.00	0.00	0.00
Jefferson	11,296	4,620	0.72	156	0.72	0.72	0.00	0.00	0.00
Lafayette	5,578	1,140	0.18	158	0.18	0.18	0.00	0.00	0.00
Lake	152,104	103,785	20.67	199	20.67	20.67	0.00	0.00	0.00
Lee	335,113	281,489	42.75	152	42.13	38.88	3.25	0.62	0.00
Leon	192,493	156,581	25.02	160	25.02	25.02	0.00	0.00	0.00
Levy	25,923	10,453	1.58	151	1.58	1.58	0.00	0.00	0.00
Liberty	5,569	2,010	0.26	129	0.26	0.26	0.00	0.00	0.00
Madison	16,569	5,943	1.43	241	1.43	1.43	0.00	0.00	0.00
Manatee	211,707	211,105	27.84	132	40.39	0.09	40.30	0.00	12.55
Marion	194,833	89,903	16.47	183	16.47	16.47	0.00	0.00	0.00
Martin	100,900	61,863	13.66	221	13.66	13.66	0.00	0.00	0.00
Monroe	78,024	78,024	12.07	155	0.00	0.00	0.00	12.07	0.00
Nassau	43,941	22,014	3.85	175	3.85	3.85	0.00	0.00	0.00
Okaloosa	143,776	126,641	20.92	165	20.92	20.92	0.00	0.00	0.00
Okeechobee	29,627	17,035	2.09	123	2.09	0.00	2.09	0.00	0.00
Orange	677,491	653,739	137.77	211	161.29	161.29	0.00	0.00	23.52
Osceola	107,728	79,625	12.08	152	12.08	12.08	0.00	0.00	0.00
Palm Beach	863,518	764,425	164.65	215	164.65	135.55	29.10	0.00	0.00
Pasco	281,131	201,609	26.07	129	90.65	90.65	0.00	0.68	65.26
Pinellas	851,659	837,617	118.20	141	40.97	40.97	0.00	77.91	0.68
Polk	405,382	300,574	65.52	218	65.52	65.52	0.00	0.00	0.00
Putnam	65,070	22,543	3.15	140	3.15	3.15	0.00	0.00	0.00
St. Johns	83,829	66,138	8.39	127	8.39	8.39	0.00	0.00	0.00
St. Lucie	150,171	83,500	14.39	172	14.39	14.39	0.00	0.00	0.00
Santa Rosa	81,608	77,355	10.57	137	10.57	10.57	0.00	0.00	0.00
Sarasota	277,776	248,778	34.23	138	21.43	21.43	0.00	14.18	1.38
Seminole	287,529	270,791	50.79	188	50.79	50.79	0.00	0.00	0.00
Sumter	31,577	12,252	1.90	155	1.90	1.90	0.00	0.00	0.00
Suwannee	26,780	8,445	1.36	161	1.36	1.36	0.00	0.00	0.00
Taylor	17,111	10,100	1.42	141	1.42	1.42	0.00	0.00	0.00
Union	10,252	2,116	0.63	298	0.63	0.63	0.00	0.00	0.00
Volusia	370,712	321,635	44.21	137	44.21	44.21	0.00	0.00	0.00
Wakulla	14,202	7,395	0.77	104	0.77	0.77	0.00	0.00	0.00
Walton	27,760	24,990	3.71	148	3.71	3.71	0.00	0.00	0.00
Washington	16,919	7,045	1.18	167	1.18	1.18	0.00	0.00	0.00
Totals	12,937,926	11,228,059	1,925.15	171	1,925.15	1,698.82	226.33	138.71	138.71

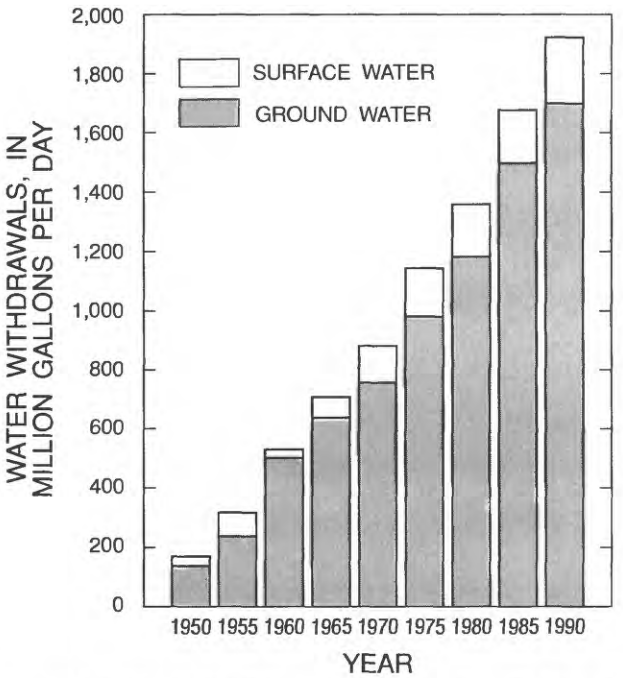

Figure 14. Historical public-supply freshwater withdrawals in Florida by source, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)

system supplied 141 Mgal/d of the ground water withdrawn (47 percent) for self-supplied domestic use and the unnamed surficial aquifers supplied 111 Mgal/d (37 percent) (fig. 15). In many areas of Florida, the shallow aquifers (Biscayne, intermediate, sand-and-gravel, and the unnamed surficial) can yield sufficient water for domestic purposes, precluding the need to tap the deeper Floridan aquifer system. The remaining ground-water withdrawals for self-supplied domestic uses were from the Biscayne aquifer (23 Mgal/d), the intermediate aquifer (20 Mgal/d), and the sand-and-gravel aquifer (4 Mgal/d).

The number of people using self-supplied domestic water systems exceeded 0.10 million in Marion and Polk Counties in 1990 (table 9). Only Monroe County had no self-supplied domestic water use, primarily because the ground and surface water in that county is nonpotable. Withdrawals of more than 10 Mgal/d for self-supplied domestic use in 1990 occurred in Polk, Palm Beach, Marion, Duval, St. Lucie, and Duval Counties (table 9).

Withdrawals for self-supplied domestic use in Florida increased from 165 Mgal/d in 1970, to 299 Mgal/d in 1990 despite only a moderate increase in population (1.4 to 1.71 million). Most of this increase in withdrawals results from a change in tabulation methods. In 1970, an estimated statewide per capita use figure (120 gal/d) was used to estimate withdrawals for all counties, but in 1990 countywide per capita use rates were used for each county based on total public-supply per capita use. It is assumed that the use of public-supply per capita use rates to estimate self-supplied domestic use accounts for small self-supplied commercial and industrial users that are not included under the commercial-industrial self-supplied category (too small to be inventoried) in the following section.

Self-Supplied Commercial-Industrial

Self-supplied commercial use includes water withdrawn at government and military facilities, schools, prisons, hospitals, recreational facilities, and nonmanufacturing establishments. Self-supplied industrial use includes water withdrawn at mining, processing, and manufacturing facilities. In 1990, there were 174 self-supplied commercial users inventoried and 278 self-supplied industrial users inventoried. Each water management district collected water-use data from these systems by direct contact (mail or phone), from the files of consumptive water-use permits, or from the monthly operating reports on file with the FDER.

Total water withdrawn by self-supplied commercial-industrial systems was 826 Mgal/d, of which 93 percent (770 Mgal/d) was freshwater (table 10). Fresh ground-water withdrawals totaled 631 Mgal/d, fresh surface-water withdrawals totaled 139 Mgal/d, and saline surface-water withdrawals accounted for the remaining 56 Mgal/d. Withdrawals by industrial facilities accounted for 92 percent (718 Mgal/d) of the freshwater withdrawals, and withdrawals by commercial facilities accounted for the remaining 8 percent (52 Mgal/d). These withdrawals do not include water delivered by public-supply systems to industrial users (183 Mgal/d) and commercial users (282 Mgal/d) (fig. 12 and table 7).

Of the total water withdrawn for commercial-industrial uses in 1990, 76 percent was obtained from fresh ground-water sources, primarily the Floridan aquifer system. This aquifer system supplied 530 Mgal/d (84 percent) of ground-water withdrawn for this category of use (fig. 16).

Commercial-industrial consumptive water use was estimated at 116 Mgal/d, or 15 percent of the freshwater withdrawals. This number could not be derived accurately from wastewater returns because many of the self-supplied systems discharge wastewater into public systems and many industries recirculate water many times before discharging it. Wastewater returns calculated from the FDER files for 84 inventoried industrial facilities in 1990 totaled nearly 397 Mgal/d (table 4).

Self-supplied commercial-industrial withdrawals fluctuated over a fairly narrow range during 1990. Withdrawals were highest in February and lowest in August (fig. 17). January through April are high-use months primarily because of increases in water demands for citrus and vegetable processing. Low withdrawals in the months of August through December are typically a result of reduced activity at processing plants because of a decrease in agricultural production and the December holidays.

Table 9. Self-supplied domestic water withdrawals and per capita use in Florida by county, 1990

[Total population data from University of Florida, 1991; gal/d, gallons per day]

County	Total population	Population served by self-supplied systems	Per capita use in gal/d[a]	Domestic self-supplied withdrawals in million gallons per day		
				Ground	Surface	Total
Alachua	181,596	39,492	162	6.38	0.00	6.38
Baker	18,486	14,384	197	2.84	0.00	2.84
Bay	126,994	23,322	235[b]	5.47	0.00	5.47
Bradford	22,515	15,182	220	3.33	0.00	3.33
Brevard	398,978	35,912	141	5.08	0.00	5.08
Broward	1,255,488	59,623	161	9.60	0.00	9.60
Calhoun	11,011	7,707	160	1.24	0.00	1.24
Charlotte	110,975	11,105	152	1.62	0.00	1.62
Citrus	93,515	47,201	187	8.80	0.00	8.80
Clay	105,986	30,689	148	4.53	0.00	4.53
Collier	152,099	29,649	300	8.89	0.00	8.89
Columbia	42,613	27,277	191	5.21	0.00	5.21
Dade	1,937,094	61,934	174	10.75	0.00	10.75
De Soto	23,865	16,524	114	1.89	0.00	1.89
Dixie	10,585	6,030	145	0.87	0.00	0.87
Duval	672,971	53,775	156	8.37	0.00	8.37
Escambia	262,798	23,227	158	3.66	0.00	3.66
Flagler	28,701	9,372	199	1.87	0.00	1.87
Franklin	8,967	946	203	0.19	0.00	0.19
Gadsden	41,105	15,177	132	2.00	0.00	2.00
Gilchrist	9,667	8,011	163	1.31	0.00	1.31
Glades	7,591	4,506	130	0.58	0.00	0.58
Gulf	11,504	2,425	139	0.34	0.00	0.34
Hamilton	10,930	5,829	190	1.11	0.00	1.11
Hardee	19,499	11,197	172	1.93	0.00	1.93
Hendry	25,773	9,124	216	1.97	0.00	1.97
Hernando	101,115	10,712	166	1.77	0.00	1.77
Highlands	68,432	16,991	161	3.43	0.00	3.43
Hillsborough	834,054	17,413	153	2.68	0.00	2.68
Holmes	15,778	10,660	215	2.29	0.00	2.29
Indian River	90,208	36,474	245	8.94	0.00	8.94
Jackson	41,375	25,617	151	3.87	0.00	3.87
Jefferson	11,296	6,676	156	1.04	0.00	1.04
Lafayette	5,578	4,438	158	0.70	0.00	0.70
Lake	152,104	48,319	199	9.56	0.00	9.56
Lee	335,113	53,624	152	8.14	0.00	8.14
Leon	192,493	35,912	160	5.74	0.00	5.74
Levy	25,923	15,470	151	2.15	0.00	2.15
Liberty	5,569	3,559	129	0.46	0.00	0.46
Madison	16,569	10,626	241	2.56	0.00	2.56
Manatee	211,707	602	132	0.08	0.00	0.08
Marion	194,833	104,930	183	16.93	0.00	16.93
Martin	100,900	39,037	221	8.63	0.00	8.63
Monroe	78,024	0	155	0.00	0.00	0.00
Nassau	43,941	21,927	175	3.83	0.00	3.83
Okaloosa	143,776	17,135	165	2.83	0.00	2.83
Okeechobee	29,627	12,592	123	1.56	0.00	1.56
Orange	677,491	23,752	211	5.01	0.00	5.01
Osceola	107,728	28,103	152	4.31	0.00	4.31
Palm Beach	863,518	99,093	215	21.34	0.00	21.34
Pasco	281,131	79,522	129	10.33	0.00	10.33
Pinellas	851,659	14,042	141	1.98	0.00	1.98
Polk	405,382	104,808	218	23.26	0.00	23.26
Putnam	65,070	42,527	140	5.94	0.00	5.94
St. Johns	83,829	17,691	127	2.24	0.00	2.24
St. Lucie	150,171	66,671	172	11.49	0.00	11.49
Santa Rosa	81,608	4,253	137	0.58	0.00	0.58
Sarasota	277,776	28,998	138	3.86	0.00	3.86
Seminole	287,529	16,738	188	3.14	0.00	3.14
Sumter	31,577	19,325	155	3.00	0.00	3.00
Suwannee	26,780	18,335	161	2.95	0.00	2.95
Taylor	17,111	7,011	141	0.99	0.00	0.99
Union	10,252	8,136	298	2.42	0.00	2.42
Volusia	370,712	49,077	137	6.75	0.00	6.75
Wakulla	14,202	6,807	104	0.71	0.00	0.71
Walton	27,760	2,770	148	0.41	0.00	0.41
Washington	16,919	9,874	167	1.65	0.00	1.65
Totals	12,937,926	1,709,867	171	299.38	0.00	299.38

[a]The per capita value is the public-supply use (net) divided by the population served (see table 8).

[b]The per capita value was adjusted to reflect the subtraction of a large industrial delivery within Bay County.

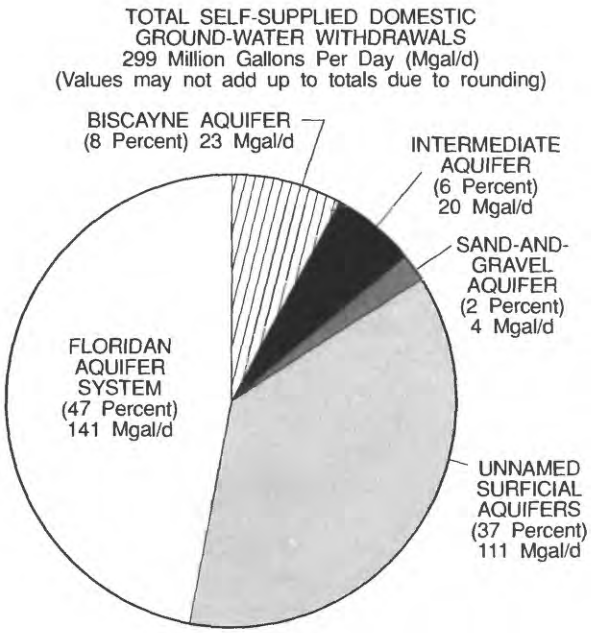

Figure 15. Self-supplied domestic ground-water withdrawals in Florida by principal aquifer, 1990.

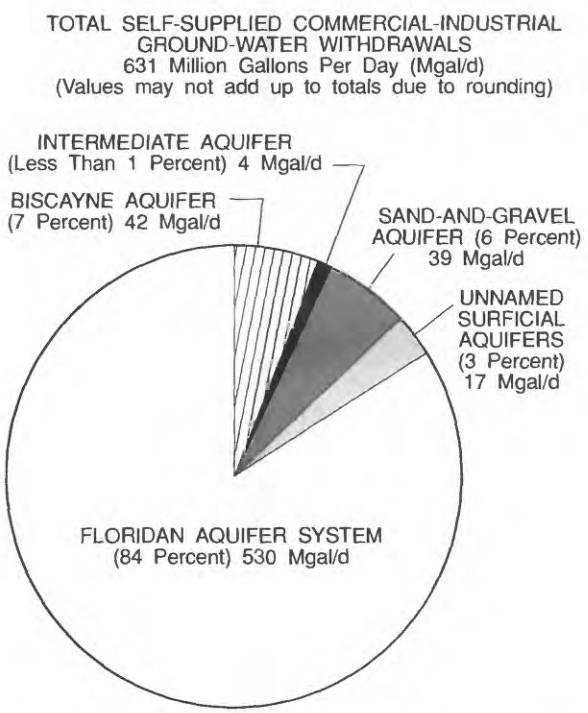

Figure 16. Self-supplied commercial-industrial ground-water withdrawals in Florida by principal aquifer, 1990.

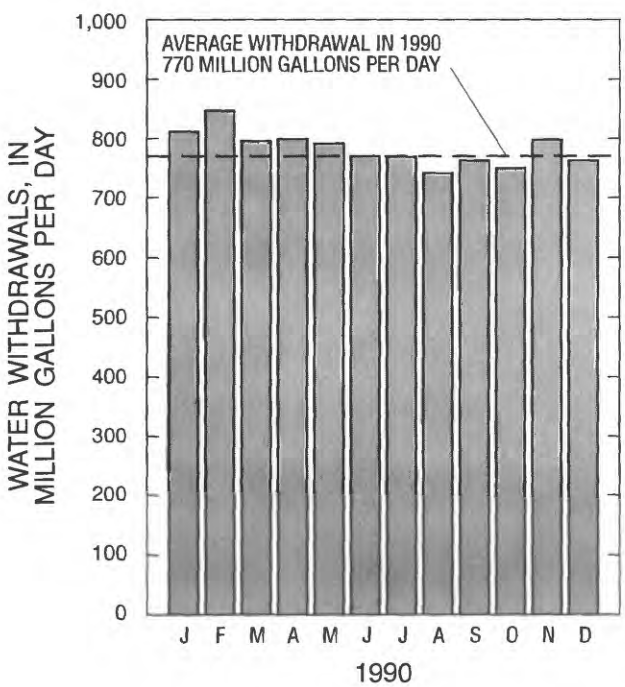

Figure 17. Monthly self-supplied commercial-industrial freshwater withdrawals in Florida, 1990.

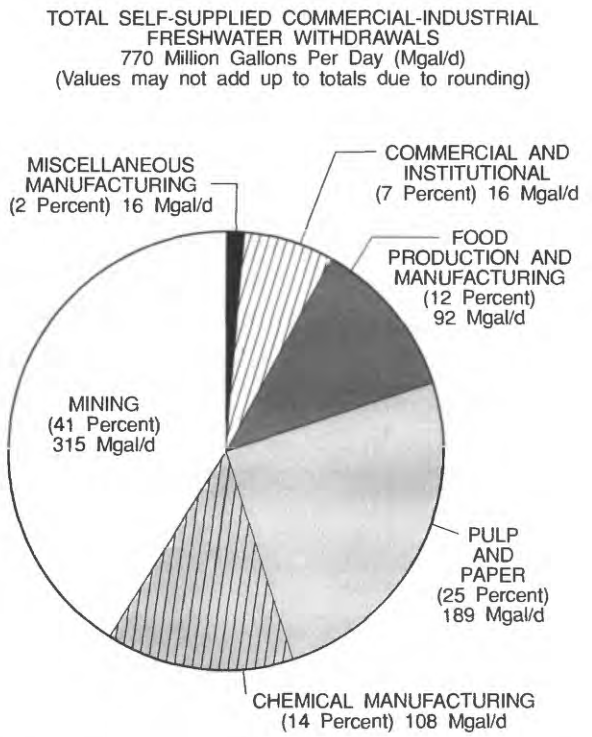

Figure 18. Self-supplied commercial-industrial freshwater use in Florida by major industrial type, 1990.

The largest single use of freshwater within the self-supplied commercial-industrial category in 1990 was for mining, with total withdrawals of 315 Mgal/d (41 percent) from the 98 inventoried mining facilities (fig. 18). Of the water withdrawn for mining during 1990, 188 Mgal/d (60 percent) was for mining limestone and sand, 122 Mgal/d (39 percent) for phosphate, and 5 Mgal/d for mineral mining (1 percent). Mining operations are located throughout Florida but are most concentrated in the central part of the State. Water withdrawn in the mining industry is primarily used for material washing and conveyance, but may include water pumped to dewater the area being mined. The second largest use of freshwater in the self-supplied commercial-industrial category in 1990 was by the pulp and paper industry. Withdrawals for the 12 inventoried pulp and paper industry facilities in 1990 totaled 189 Mgal/d. The pulp and paper industry is located in the heavily forested areas of northern and western Florida. Together, the mining and pulp and paper industries accounted for about 66 percent of industrial freshwater withdrawals in Florida.

Polk County withdrew the largest amount of fresh ground water (143 Mgal/d), and Gulf County withdrew the largest amount of fresh surface water (33 Mgal/d) for self-supplied commercial-industrial uses in 1990 (table 10). Most of the water withdrawn in Polk County for this category of use was for mining (58 percent) and chemical manufacturing (36 percent). Other counties with substantial self-supplied commercial-industrial freshwater withdrawals in 1990 include; Sumter, Escambia, Taylor, Hamilton, and Putnam Counties. These five counties along with Gulf and Polk Counties, accounted for nearly 51 percent of the total self-supplied commercial-industrial withdrawals in Florida.

Freshwater withdrawn for self-supplied commercial-industrial use in Florida has decreased between 1970 (927 Mgal/d), and 1990 (770 Mgal/d), but has not changed much since 1980 (781 Mgal/d) (fig. 19). However, for the same period, deliveries to commercial and industrial users from public-supply systems increased nearly 300 Mgal/d. Because of the cost of producing potable water and treating wastewater, many industries that were formerly self-supplied now receive water from and discharge wastewater to public water-supply and wastewater-treatment systems. Water conservation practices and permitting restrictions on withdrawals and discharges in Florida during the last 20 years have also contributed to the reduction in the amount of water withdrawn for this use. Surface-water withdrawals for 1955 shown in figure 19 probably include values for thermoelectric power generation, because these two categories (self-supplied commercial-industrial and thermoelectric power generation) were combined in the water-use tables published for that year.

Agricultural Irrigation and Nonirrigation

Agricultural water use includes withdrawals for irrigation of crops and nonirrigation uses associated with farming operations. Irrigation withdrawals include withdrawals for irrigating fruit and vegetable crops, ornamental plants, and grasses. Nonirrigation withdrawals include water used for watering livestock, for washing down dairy barns and farm equipment, and for fish farming. Withdrawals for irrigation were calculated in two steps. First, the number of acres irrigated and method of irrigation was determined for the crops inventoried in each county. In 1990, acreage data were obtained by the five water management districts from a variety of sources that included the agricultural extension agent (University of Florida, Institute of Food and Agriculture Science) in each county, the water management district's consumptive water-use permit files, and the Florida Crop and Livestock Reporting Service (Florida Department of Agriculture). The second step was to determine the amount of supplemental irrigation water needed to grow each crop in 1990 and the amount of water necessary to overcome the inefficiency of the irrigation system and to provide frost and freeze protection. This determination was made by the water management districts, utilizing a variety of methods and information services including the modified Blaney-Criddle[1] irrigation model; "Irrigation Water Requirements, 1970, revised" (U.S. Soil Conservation Service, 1970); the University of

[1]Use of brand or trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

Table 10. Self-supplied commercial-industrial water withdrawals in Florida by county, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

County	Ground-water withdrawals			Surface-water withdrawals			Total withdrawals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	2.29	0.00	2.29	0.00	0.00	0.00	2.29	0.00	2.29
Baker	0.92	0.00	0.92	0.00	0.00	0.00	0.92	0.00	0.92
Bay	0.65	0.00	0.65	1.46	0.00	1.46	2.11	0.00	2.11
Bradford	2.99	0.00	2.99	0.00	0.00	0.00	2.99	0.00	2.99
Brevard	0.19	0.00	0.19	0.00	0.00	0.00	0.19	0.00	0.19
Broward	1.63	0.00	1.63	0.00	0.00	0.00	1.63	0.00	1.63
Calhoun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charlotte	4.25	0.00	4.25	0.00	0.00	0.00	4.25	0.00	4.25
Citrus	2.13	0.00	2.13	0.00	0.00	0.00	2.13	0.00	2.13
Clay	6.56	0.00	6.56	0.00	0.00	0.00	6.56	0.00	6.56
Collier	0.58	0.00	0.58	3.72	0.00	3.72	4.30	0.00	4.30
Columbia	0.03	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.03
Dade	40.34	0.00	40.34	0.00	0.00	0.00	40.34	0.00	40.34
De Soto	0.26	0.00	0.26	0.22	0.00	0.22	0.48	0.00	0.48
Dixie	0.90	0.00	0.90	0.00	0.00	0.00	0.90	0.00	0.90
Duval	33.93	0.00	33.93	0.00	43.70	43.70	33.93	43.70	77.63
Escambia	32.39	0.00	32.39	19.34	0.00	19.34	51.73	0.00	51.73
Flagler	0.25	0.00	0.25	0.00	0.00	0.00	0.25	0.00	0.25
Franklin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gadsden	2.16	0.00	2.16	0.00	0.00	0.00	2.16	0.00	2.16
Gilchrist	0.13	0.00	0.13	0.00	0.00	0.00	0.13	0.00	0.13
Glades	0.27	0.00	0.27	0.00	0.00	0.00	0.27	0.00	0.27
Gulf	0.58	0.00	0.58	32.89	11.26	44.15	33.47	11.26	44.73
Hamilton	44.08	0.00	44.08	0.00	0.00	0.00	44.08	0.00	44.08
Hardee	0.10	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.10
Hendry	1.06	0.00	1.06	0.00	0.00	0.00	1.06	0.00	1.06
Hernando	23.31	0.00	23.31	0.00	0.00	0.00	23.31	0.00	23.31
Highlands	0.21	0.00	0.21	0.00	0.00	0.00	0.21	0.00	0.21
Hillsborough	25.82	0.00	25.82	4.21	0.00	4.21	30.03	0.00	30.03
Holmes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian River	0.29	0.00	0.29	0.00	0.00	0.00	0.29	0.00	0.29
Jackson	1.38	0.00	1.38	0.00	0.00	0.00	1.38	0.00	1.38
Jefferson	0.08	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08
Lafayette	0.14	0.00	0.14	0.00	0.00	0.00	0.14	0.00	0.14
Lake	9.51	0.00	9.51	0.00	0.00	0.00	9.51	0.00	9.51
Lee	7.73	0.00	7.73	2.75	0.00	2.75	10.48	0.00	10.48
Leon	0.26	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.26
Levy	0.36	0.00	0.36	1.70	0.00	1.70	2.06	0.00	2.06
Liberty	0.68	0.00	0.68	0.00	0.00	0.00	0.68	0.00	0.68
Madison	0.23	0.00	0.23	0.00	0.00	0.00	0.23	0.00	0.23
Manatee	2.58	0.00	2.58	0.00	0.00	0.00	2.58	0.00	2.58
Marion	1.07	0.00	1.07	0.00	0.00	0.00	1.07	0.00	1.07
Martin	0.77	0.00	0.77	28.77	0.00	28.77	29.54	0.00	29.54
Monroe	0.07	0.00	0.07	0.00	0.00	0.00	0.07	0.00	0.07
Nassau	32.69	0.00	32.69	0.00	1.40	1.40	32.69	1.40	34.09
Okaloosa	5.98	0.00	5.98	0.00	0.00	0.00	5.98	0.00	5.98
Okeechobee	0.15	0.00	0.15	0.00	0.00	0.00	0.15	0.00	0.15
Orange	18.88	0.00	18.88	0.00	0.00	0.00	18.88	0.00	18.88
Osceola	2.33	0.00	2.33	0.00	0.00	0.00	2.33	0.00	2.33
Palm Beach	1.99	0.00	1.99	30.18	0.00	30.18	32.17	0.00	32.17
Pasco	18.68	0.00	18.68	0.07	0.00	0.07	18.75	0.00	18.75
Pinellas	0.08	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08
Polk	143.35	0.00	143.35	0.00	0.00	0.00	143.35	0.00	143.35
Putnam	33.52	0.00	33.52	10.27	0.00	10.27	43.79	0.00	43.79
St. Johns	0.09	0.00	0.09	0.00	0.00	0.00	0.09	0.00	0.09
St. Lucie	1.59	0.00	1.59	1.50	0.00	1.50	3.09	0.00	3.09
Santa Rosa	6.48	0.00	6.48	0.00	0.00	0.00	6.48	0.00	6.48
Sarasota	1.87	0.00	1.87	0.48	0.00	0.48	2.35	0.00	2.35
Seminole	0.49	0.00	0.49	0.00	0.00	0.00	0.49	0.00	0.49
Sumter	60.02	0.00	60.02	0.00	0.00	0.00	60.02	0.00	60.02
Suwanne	0.81	0.00	0.81	0.30	0.00	0.30	1.11	0.00	1.11
Taylor	46.37	0.00	46.37	1.20	0.00	1.20	47.57	0.00	47.57
Union	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volusia	0.69	0.00	0.69	0.00	0.00	0.00	0.69	0.00	0.69
Wakulla	0.79	0.00	0.79	0.00	0.00	0.00	0.79	0.00	0.79
Walton	0.86	0.00	0.86	0.00	0.00	0.00	0.86	0.00	0.86
Washington	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
Totals	630.88	0.00	630.88	139.06	56.36	195.42	769.94	56.36	826.30

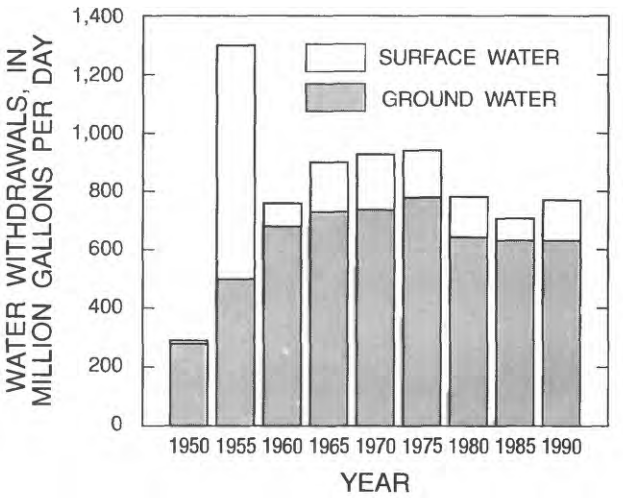

Figure 19. Historical self-supplied commercial-industrial freshwater withdrawals in Florida by source, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)

Florida's "AFSIRS" computer model (Smajstrla, 1986), the "Florida Irrigation Guide" (U.S. Soil Conservation Service, 1982), and selected agricultural monitoring programs (for example, benchmark farms) throughout the State. Once this supplemental irrigation requirement was determined, that figure was multiplied by the number of irrigated acres and a water-use value was derived.

Withdrawals also were calculated for nonirrigation uses (primarily livestock and fish farming) for each county. To estimate withdrawals for use by livestock, the numbers of cows (including dairy cows), chickens, horses, and pigs were compiled for each county. These numbers were obtained from the Florida Crop and Livestock Reporting Service (Florida Department of Agriculture) Poultry Summary (Florida Agricultural Statistics Service, 1990), and Dairy Summary (Florida Agricultural Statistics Service, 1991b), and The Florida Cattleman and Livestock Journal (The Florida Cattleman and Livestock Journal, 1990, p. 60). The next step was to obtain the average water-use coefficients for each type of animal and multiply the use coefficient by the number of animals in the county. Water-use coefficients were obtained from the University of Florida Institute of Food and Agriculture Science (St. Johns River Water Management District, 1984, p. 39). Water withdrawn for fish farming was obtained from the water management district's consumptive water-use permit files.

Agriculture was the largest user of freshwater in Florida in 1990. Agricultural water withdrawals totaled 3,805 Mgal/d (table 11), of which 53 percent (2,012 Mgal/d) was ground water and 47 percent was surface water (1,793 Mgal/d). An additional 170 Mgal/d of reclaimed wastewater was used for irrigation purposes. Florida had the largest irrigation withdrawals of any State east of the Mississippi River in 1990 (Solley and others, 1993). No saline water was withdrawn for irrigation purposes in Florida during 1990.

Estimated agricultural irrigation consumptive water use totaled 2,561 Mgal/d, or 67 percent of water withdrawn for the agricultural use category (irrigation and nonirrigation uses). This represents the amount of water that the plant or crop consumes and was based on the evapotranspiration rates reported for each crop. Consumptive use for agricultural nonirrigation uses was estimated at 100 percent of withdrawals. The Floridan aquifer system supplied 1,249 Mgal/d (62 percent) of the ground water withdrawn for agricultural irrigation in 1990 (fig. 20). The remaining ground water was withdrawn from the unnamed surficial aquifers (370 Mgal/d), the intermediate aquifer (198 Mgal/d), the Biscayne aquifer (183 Mgal/d), and the sand-and-gravel aquifer (12 Mgal/d) (fig. 20). surface-water canals, mostly from Lake Okeechobee, supplied large amounts of water for agricultural use in South Florida. This area is intensively irrigated for sugarcane, citrus, and vegetables and accounted for 55 percent of the State's surface-water withdrawals during 1990.

Agricultural irrigation withdrawals in 1990 had large seasonal variations. Irrigation withdrawals were greatest in May and were at a seasonal low in December (fig. 21). A seasonal fluctuation of more than 2,900 Mgal/d was the result of intense crop production and dry conditions during the early spring. The months of March, April, and May account for more than 32 percent of the water used for irrigation, whereas the months of October, November, and December account for less than 20 percent of the water used for irrigation during 1990.

Agricultural irrigation data for 1990 were compiled for four crop categories: vegetable, fruit, field, and ornamentals and grasses. Within these 4 categories, irrigation water uses were tabulated for 31 specific crops and 3 miscellaneous crops (table 11). The number of acres farmed (excluding gardens) totaled 3.46 million acres, of which nearly 2.15 million acres (62 percent) were irrigated. Excluding improved pasture acreage, more than 85 percent of the acreage farmed in Florida was irrigated. Most of the irrigated acreage (53 percent) was irrigated by flood systems (see glossary). The remaining acreage was irrigated by sprinkler (29 percent) and low pressure/low volume systems (18 percent).

Of the four major crop types, fruit crops were the largest users of water for irrigation (fig. 22) in 1990, accounting for 36 percent of the agricultural water use. Citrus crops accounted for the largest acreage and withdrawals for irrigation (33 percent). Other crops for which large water withdrawals were made for irrigation were sugarcane (22 percent), sod (5 percent) and turf grass on golf courses (5 percent). Acreage and water withdrawals for the 31 crops irrigated are listed in table 11.

Table 11. Irrigated acreage and irrigation water use in Florida by crop type, 1990

[0.00 indicates no withdrawal or use were made; NA indicates data are not applicable]

	Acres		Water use, in million gallons per day			
	Farmed	Irrigated	Ground water	Surface water	Reclaimed water	Total[a]
Vegetable crops						
Cabbage	11,483	10,982	10.01	0.44	0.00	10.45
Carrots	16,240	14,340	2.55	13.60	0.00	16.15
Cucumbers	22,306	22,126	19.40	7.41	0.00	26.81
Peppers	35,886	35,886	34.23	11.28	0.00	45.51
Potatoes	39,894	39,894	51.13	0.52	0.00	51.65
Tomatoes	78,442	78,472	108.63	45.77	0.00	154.40
Sweet corn	58,749	58,324	23.20	38.68	0.00	61.88
Watercress	150	150	0.17	14.31	0.00	14.48
Miscellaneous	121,615	119,288	73.82	49.33	0.00	123.15
Fruit crops						
Blueberries	1,916	1,814	1.63	1.13	0.00	2.76
Citrus	744,090	709,237	761.12	507.72	27.24	1,268.84
Grapes	433	430	0.43	0.00	0.00	0.43
Peaches	202	202	0.26	0.05	0.00	0.31
Pecans	6,805	4,055	4.22	0.86	0.00	5.08
Strawberries	5,551	5,551	15.65	1.61	0.00	17.26
Watermellons	55,675	50,496	63.80	4.45	0.00	68.25
Miscellaneous	23,455	23,345	34.85	0.81	0.00	35.66
Field crops						
Field corn	109,680	37,330	28.64	4.28	0.00	32.92
Peanuts	93,505	27,464	24.45	2.53	0.00	26.98
Rice	15,200	15,200	0.10	15.72	0.00	15.82
Sorghum	7,650	4,300	3.62	0.37	0.00	3.99
Soybeans	76,750	7,350	5.59	0.22	0.00	5.81
Sugarcane	432,966	432,966	10.69	812.58	0.00	823.27
Tabacco	7,935	6,608	6.45	0.49	0.00	6.94
Wheat	4,951	4,601	4.34	0.06	0.00	4.40
Cotton	34,170	3,920	3.22	0.31	0.00	3.53
Miscellaneous	23,132	13,248	16.78	1.13	14.05	17.91
Ornamentals and grasses						
Ferns	7,520	7,114	15.85	3.11	0.00	18.96
Flowers and foliage	6,223	6,064	12.84	2.16	7.50	15.00
Woody ornamentals	32,248	30,772	130.67	41.73	0.14	172.40
Improved pasture	1,125,446	158,271	135.41	28.03	30.07	163.44
Sod	65,727	65,627	127.90	74.74	4.03	202.64
Turf grass (golf course)	118,712	77,099	132.50	65.36	54.91	197.86
Turf grass (other)	76,290	76,147	79.81	32.36	26.37	112.17
Miscellaneous agricultural						
Aesthetic and wildlife	NA	NA	6.73	0.28	5.30	7.01
Fish farming	1,006	1,006	11.83	0.31	0.00	12.14
Livestock	NA	NA	49.98	9.01	0.00	58.99
Totals	3,462,003	2,149,679[b]	2,012.50	1,792.75	169.61	3,805.25

[a]Reclaimed water use values are not included in the totals.

[b]Sprinkler acreage, 628,101; Low pressure acreage 390,245; and flood acreage 1,131,333.

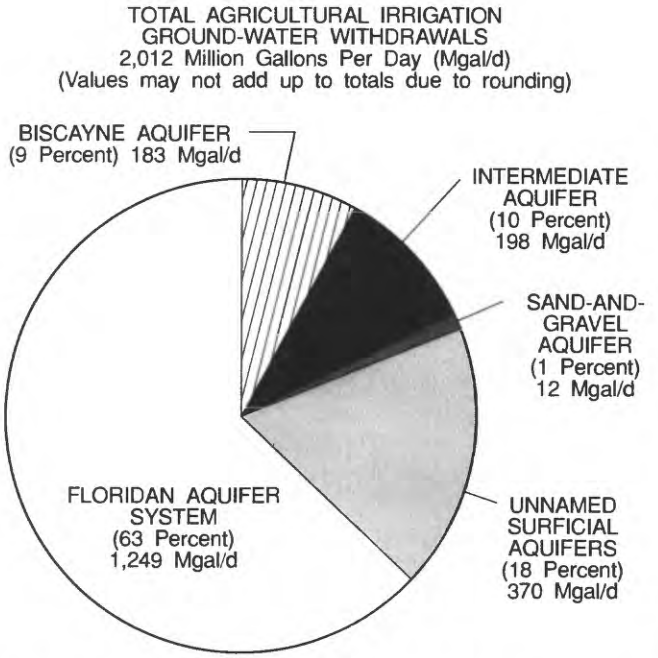

Figure 20. Agricultural irrigation ground-water withdrawals in Florida by principal aquifer, 1990.

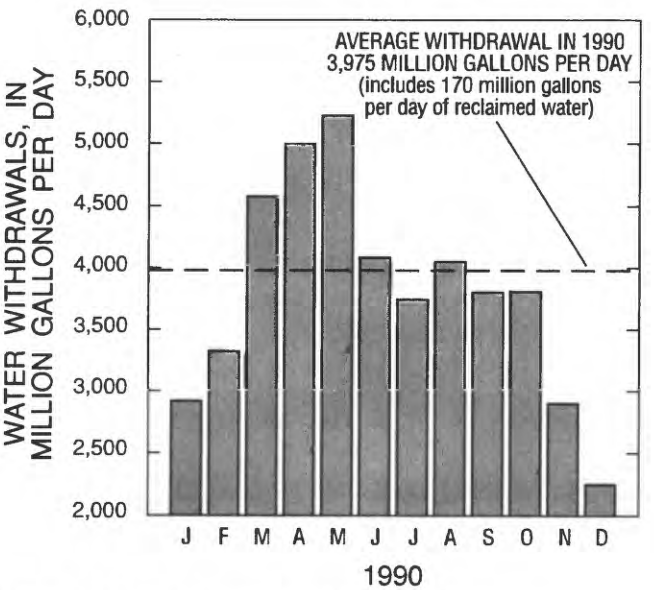

Figure 21. Monthly agicultural irrigation freshwater withdrawals in Florida, 1990.

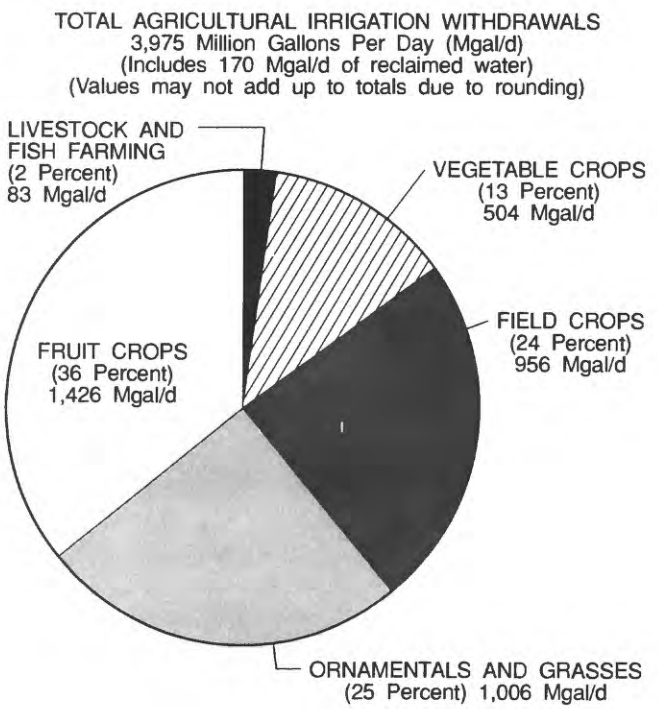

Figure 22. Agricultural irrigation water use in Florida by major crop type, 1990.

Palm Beach County had the largest irrigation withdrawals (20 percent) and irrigated acreage (23 percent) of any county in Florida in 1990. Palm Beach County irrigation withdrawals totaled 779 Mgal/d of which nearly 95 percent (737 Mgal/d) was surface water, making Palm Beach County the largest user of surface water for irrigation in 1990 (table 2). Other counties that withdrew more than 100 Mgal/d of surface water for irrigation were Hendry, St. Lucie, Indian River, and Martin (table 12). These five counties accounted for nearly 81 percent of surface-water withdrawals used for irrigation in 1990. Hendry County had the largest withdrawals of ground water for 1990 (168 Mgal/d), followed by Collier, Dade, Polk, Highlands, and Brevard Counties (table 12). Each of these counties withdrew more than 100 Mgal/d and collectively they accounted for more than 39 percent of ground-water withdrawals for irrigation in 1990.

The number of acres irrigated in Florida totaled nearly 2.15 million for 1990 (table 11). Palm Beach, Hendry, Dade, Polk, and Brevard Counties each had more than 100,000 acres irrigated in 1990. These counties accounted for 46 percent of the irrigated acreage in Florida. Irrigated acreage in Florida increased between 1980 and 1990, despite agricultural losses related to freezes, diseases, insect infestation, and increased urbanization of agricultural areas. This increase resulted in part from the replanting of freeze-damaged citrus and vegetable crops, expanded sugarcane production, and from an increased awareness of the economic advantages of irrigation. Citrus and sugarcane crops, collectively accounted for 53 percent of Florida's irrigated acreage in 1990. Sugarcane is grown in only four counties (Glades, Hendry, Martin, and Palm Beach), but sugarcane acreage has increased from 178,400 acres in 1970 (Wade Adams, Florida Agricultural Statistics Service, oral commun., 1992) to more than 400,000 acres in 1990 (Florida Agricultural Statistics Service, 1991c) (fig. 23). The largest gain in sugarcane acreage occurred in Palm Beach County near Lake Okeechobee where the sugarcane acreage increased from 219,000 in 1975 to 313,000 in 1990 (Florida Agricultural Statistics Service, 1978 and 1991c). Citrus crops are primarily grown in the central and southern part of Florida. Acreage devoted to citrus crops has significantly decreased from 941,500 acres in 1970, to 732,800 acres in 1990 (Florida Agricultural Statistical Service, 1992, p. 2). Citrus acreage decreased sharply in the early 1980's because of several damaging freezes but increased nearly 110,000 acres between 1986 and 1990 (fig. 23). Large gains in citrus acreage occurred in Hendry, De Soto, Collier, and St. Lucie Counties, and large losses in citrus acreage occurred in Lake, Orange, Pasco, Hillsborough, and Volusia Counties between 1970 and 1990 (table 13).

Water withdrawn for agricultural irrigation increased nearly 1,705 Mgal/d (82 percent) between 1970 and 1990 and 748 Mgal/d (25 percent) between 1980 and 1990 (fig. 24). Ground-water withdrawals for irrigation increased 822 Mgal/d and surface-water withdrawals increased 883 Mgal/d between 1970 and 1990 (fig. 24). Also, reclaimed wastewater used for irrigation increased from 0 Mgal/d in 1970 (David York, Florida Department of Environmental Regulation, oral commun., October 1992), to 51 Mgal/d in 1985 (Marella, 1988, p. 32), to 170 Mgal/d in 1990. The increase in ground water can be attributed to the widespread availability of the resource and the increased use of ground water for frost and freeze protection of crops during the winter months. The increase in surface-water withdrawals can be attributed to: (1) the increase in irrigated sugarcane acreage in Florida and (2) the increased use of tail-water runoff from irrigated fields. Surface water accounted for 43 percent of irrigation withdrawals in 1970 and 47 percent in 1990.

Thermoelectric Power Generation

In 1990, water withdrawals for thermoelectric power generation were inventoried at 57 thermoelectric powerplants in Florida. Data were obtained by the water management districts and the U.S. Geological Survey from the consumptive water-use permits on file with the water management districts, or by direct contact with the power plants. Withdrawal data were collected for ground and surface waters, both fresh and saline sources. Information on the amount of water purchased from public supply was also obtained from each facility along with the total gross power generated at the facility.

Total water withdrawals for the 52 self-supplied thermoelectric powerplants in Florida amounted to 11,042 Mgal/d but only about 7 percent of that amount (732 Mgal/d) was freshwater (fig. 25). The remaining 5 powerplants obtain water solely from public water-supply potable or wastewater systems. Of the total freshwater withdrawn, 97 percent (709 Mgal/d) was surface water and the remaining 3 percent (23 Mgal/d) was ground water. The Floridan aquifer system was the source of nearly 18 Mgal/d (76 percent) of the fresh ground-water withdrawals (fig. 26) and also supplied an additional 49 Mgal/d of saline-water withdrawals. Public-supply deliveries to thermoelectric powerplants during 1990 totaled nearly 6 Mgal/d. This water is mostly used for domestic purposes throughout the plants or used as boiler make-up water. An additional 4 Mgal/d of reclaimed wastewater was used, primarily as cooling water at four plants in 1990. However, a much larger amount of reclaimed wastewater was discharged to lakes or ponds that are also used for powerplant cooling.

Almost all of the water used for thermoelectric power generation in 1990 was for cooling purposes. Much of the water used was for once-through cooling although some systems recirculated water several times before it was returned to its surface source. The small amount of ground water withdrawn for thermoelectric power generation was used for boiler make-up water or for domestic purposes throughout the plant.

Table 12. Agricultural irrigation water withdrawals in Florida by county, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

County	Ground-water withdrawals			Surface-water withdrawals			Total withdrawals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	18.09	0.00	18.09	0.36	0.00	0.36	18.45	0.00	18.45
Baker	3.30	0.00	3.30	2.20	0.00	2.20	5.50	0.00	5.50
Bay	1.69	0.00	1.69	0.59	0.00	0.59	2.28	0.00	2.28
Bradford	1.03	0.00	1.03	0.06	0.00	0.06	1.09	0.00	1.09
Brevard	100.78	0.00	100.78	10.40	0.00	10.40	111.18	0.00	111.18
Broward	40.97	0.00	40.97	21.75	0.00	21.75	62.72	0.00	62.72
Calhoun	0.11	0.00	0.11	0.50	0.00	0.50	0.61	0.00	0.61
Charlotte	35.46	0.00	35.46	3.28	0.00	3.28	38.74	0.00	38.74
Citrus	4.47	0.00	4.47	0.27	0.00	0.27	4.74	0.00	4.74
Clay	3.00	0.00	3.00	0.44	0.00	0.44	3.44	0.00	3.44
Collier	154.39	0.00	154.39	9.50	0.00	9.50	163.89	0.00	163.89
Columbia	2.98	0.00	2.98	0.23	0.00	0.23	3.21	0.00	3.21
Dade	135.56	0.00	135.56	14.37	0.00	14.37	149.93	0.00	149.93
De Soto	98.27	0.00	98.27	10.51	0.00	10.51	108.78	0.00	108.78
Dixie	3.44	0.00	3.44	0.00	0.00	0.00	3.44	0.00	3.44
Duval	9.53	0.00	9.53	1.40	0.00	1.40	10.93	0.00	10.93
Escambia	6.23	0.00	6.23	0.14	0.00	0.14	6.37	0.00	6.37
Flagler	7.50	0.00	7.50	1.20	0.00	1.20	8.70	0.00	8.70
Franklin	0.74	0.00	0.74	0.11	0.00	0.11	0.85	0.00	0.85
Gadsden	3.24	0.00	3.24	7.69	0.00	7.69	10.93	0.00	10.93
Gilchrist	9.35	0.00	9.35	0.00	0.00	0.00	9.35	0.00	9.35
Glades	17.91	0.00	17.91	62.55	0.00	62.55	80.46	0.00	80.46
Gulf	4.93	0.00	4.93	5.17	0.00	5.17	10.10	0.00	10.10
Hamilton	4.44	0.00	4.44	0.00	0.00	0.00	4.44	0.00	4.44
Hardee	57.14	0.00	57.14	5.95	0.00	5.95	63.09	0.00	63.09
Hendry	167.82	0.00	167.82	318.51	0.00	318.51	486.33	0.00	486.33
Hernando	5.43	0.00	5.43	0.35	0.00	0.35	5.78	0.00	5.78
Highlands	117.34	0.00	117.34	10.14	0.00	10.14	127.48	0.00	127.48
Hillsborough	89.44	0.00	89.44	8.68	0.00	8.68	98.12	0.00	98.12
Holmes	2.21	0.00	2.21	1.16	0.00	1.16	3.37	0.00	3.37
Indian River	50.37	0.00	50.37	117.53	0.00	117.53	167.90	0.00	167.90
Jackson	22.13	0.00	22.13	3.38	0.00	3.38	25.51	0.00	25.51
Jefferson	8.45	0.00	8.45	1.81	0.00	1.81	10.26	0.00	10.26
Lafayette	8.08	0.00	8.08	0.54	0.00	0.54	8.62	0.00	8.62
Lake	44.61	0.00	44.61	12.68	0.00	12.68	57.29	0.00	57.29
Lee	68.05	0.00	68.05	32.25	0.00	32.25	100.30	0.00	100.30
Leon	3.87	0.00	3.87	0.49	0.00	0.49	4.36	0.00	4.36
Levy	17.43	0.00	17.43	1.34	0.00	1.34	18.77	0.00	18.77
Liberty	2.32	0.00	2.32	0.00	0.00	0.00	2.32	0.00	2.32
Madison	2.97	0.00	2.97	0.27	0.00	0.27	3.24	0.00	3.24
Manatee	93.78	0.00	93.78	1.74	0.00	1.74	95.52	0.00	95.52
Marion	14.73	0.00	14.73	1.87	0.00	1.87	16.60	0.00	16.60
Martin	32.12	0.00	32.12	105.57	0.00	105.57	137.69	0.00	137.69
Monroe	1.22	0.00	1.22	0.00	0.00	0.00	1.22	0.00	1.22
Nassau	2.40	0.00	2.40	0.60	0.00	0.60	3.00	0.00	3.00
Okaloosa	1.86	0.00	1.86	0.00	0.00	0.00	1.86	0.00	1.86
Okeechobee	37.19	0.00	37.19	3.27	0.00	3.27	40.46	0.00	40.46
Orange	35.36	0.00	35.36	61.47	0.00	61.47	96.83	0.00	96.83
Osceola	44.72	0.00	44.72	13.40	0.00	13.40	58.12	0.00	58.12
Palm Beach	42.16	0.00	42.16	736.52	0.00	736.52	778.68	0.00	778.68
Pasco	19.05	0.00	19.05	2.31	0.00	2.31	21.36	0.00	21.36
Pinellas	5.07	0.00	5.07	1.35	0.00	1.35	6.42	0.00	6.42
Polk	120.13	0.00	120.13	13.21	0.00	13.21	133.34	0.00	133.34
Putnam	18.29	0.00	18.29	0.83	0.00	0.83	19.12	0.00	19.12
St. Johns	40.54	0.00	40.54	1.39	0.00	1.39	41.93	0.00	41.93
St. Lucie	56.37	0.00	56.37	169.16	0.00	169.16	225.53	0.00	225.53
Santa Rosa	5.91	0.00	5.91	0.29	0.00	0.29	6.20	0.00	6.20
Sarasota	32.33	0.00	32.33	2.70	0.00	2.70	35.03	0.00	35.03
Seminole	11.15	0.00	11.15	1.80	0.00	1.80	12.95	0.00	12.95
Sumter	8.21	0.00	8.21	0.47	0.00	0.47	8.68	0.00	8.68
Suwanne	27.11	0.00	27.11	0.65	0.00	0.65	27.76	0.00	27.76
Taylor	0.60	0.00	0.60	0.08	0.00	0.08	0.68	0.00	0.68
Union	1.32	0.00	1.32	0.68	0.00	0.68	2.00	0.00	2.00
Volusia	22.34	0.00	22.34	4.36	0.00	4.36	26.70	0.00	26.70
Wakulla	0.11	0.00	0.11	0.00	0.00	0.00	0.11	0.00	0.11
Walton	2.95	0.00	2.95	1.12	0.00	1.12	4.07	0.00	4.07
Washington	0.41	0.00	0.41	0.11	0.00	0.11	0.52	0.00	0.52
Totals	2,012.50	0.00	2,012.50	1,792.75	0.00	1,792.75	3,805.25	0.00	3,805.25

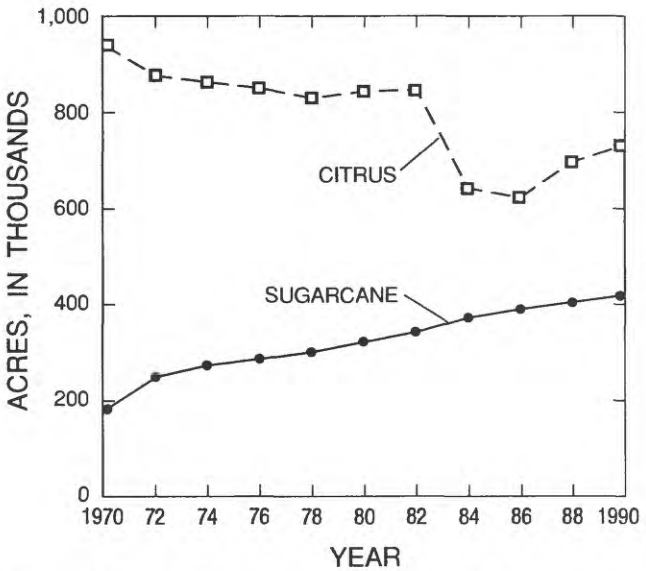

Figure 23. Historical citrus and sugarcane acreage in Florida, 1970-90. (Modified from Florida Agricultural Statistical Service, 1978, 1987, 1991a, 1991c, and 1992.)

Gross power generated at thermoelectric powerplants in Florida totaled 128,327 megawatts in 1990. This includes 105,640 megawatts from the 52 fossil-fuel plants (coal, gas, and oil burning), 22,510 megawatts from 3 nuclear plants, and 177 megawatts from 2 hydroelectric plants. In 1985, gross power generated in Florida from the 54 powerplants inventoried totaled 95,450 megawatts (Solley and others, 1988, p. 41, 47).

Freshwater withdrawals for thermoelectric power generation fluctuate from month to month (fig. 27). These monthly fluctuations are often a result of powerplant shutdowns for maintenance. Most of the water withdrawals are from large surface-water bodies and are returned to the source after their use.

Water withdrawn for self-supplied thermoelectric power generation occurred in 27 of Florida's 67 counties in 1990 (table 14). Hillsborough County accounted for the largest saline-water withdrawals (19 percent) and Volusia and Escambia Counties accounted for the largest freshwater withdrawals (27 and 26 percent respectively). Three thermoelectric powerplants withdrew saline ground water (49 Mgal/d) for cooling purposes; these plants were in Dade and Monroe Counties. Several plants in Hillsborough, Orange, Osceola, and Polk Counties used reclaimed wastewater for cooling.

Total freshwater withdrawals for thermoelectric power generation decreased more than 955 Mgal/d (57 percent) between 1970 and 1990 (table 5). During this period, power production increased 124 percent. The reduction in water withdrawals was due in part to increased recycling of cooling water after routing the water to cooling ponds or cooling towers (water withdrawals at these plants are only made now to augment or replenish the water in the cooling ponds). Ground-water withdrawals for power generation increased 11 Mgal/d and fresh surface-water withdrawals decreased 966 Mgal/d between 1970 and 1990 (fig. 28). Since 1980, both saline- and freshwater withdrawals for thermoelectric power generation have decreased (fig. 28).

WATER WITHDRAWALS AND TRENDS BY WATER MANAGEMENT DISTRICT

The Florida Water Resource Act of 1972 established authority for management of the State's water resources through five water management districts that operate under the general supervision of the Florida Department of Natural Resources. These five districts, which encompass the entire State, are the Northwest Florida Water Management District, the St. Johns River Water Management District, the South Florida Water Management District, the Southwest Florida Water Management District, and the Suwannee River Water Management District (fig. 3). These districts oversee a variety of water issues on a regional level and are currently under the general supervision of the FDER (Marella, 1990a, p. 213-214).

The estimated resident population of the South Florida Water Management District for 1990 was nearly 5.20 million (fig. 29), or more than 40 percent of the State's population in 1990. Populations of the other water management districts in 1990 were: Southwest Florida Water Management District (3.35 million), St. Johns River Water Management District (3.17 million), Northwest Florida Water Management District (1.01 million), and Suwannee River Water Management District (0.22 million). The South Florida Water Management District included the largest number of residents served by public water-supply systems in 1990 (fig. 29).

The South Florida Water Management District, which includes all of the sugarcane acreage and 44 percent of the citrus acreage in the State, accounted for nearly 46 percent of the total freshwater withdrawn in 1990 (fig. 30). Estimated freshwater withdrawals in the South Florida Water Management District in 1990 totaled nearly 3,460 Mgal/d. Withdrawals in the other water management districts in 1990 were: Southwest Florida Water Management District, 1,572 Mgal/d; St. Johns River Water Management District, 1,479 Mgal/d; Northwest Florida Water Management District, 686 Mgal/d; and Suwannee River Water Management District, 335 Mgal/d. The South Florida Water Management District accounted for the largest amount of freshwater withdrawn for public supply, self-supplied domestic, and agricultural irrigation, whereas the Southwest Florida Water Management District accounted for the largest amount of freshwater withdrawn for self-supplied commercial-industrial use, and the Northwest Florida Water Management District accounted for the largest amount of freshwater withdrawn for thermoelectric power generation (table 15).

Table 13. Historical commercial citrus acreage in Florida by county, 1970-90

[Florida Agricultural Statistics Service, Commercial Citrus Inventory, 1991a and 1992]

County	1970	1972	1974	1976	1978	1980	1982	1984-85	1986	1988	1990
Alachua	230	183	174	155	109	109	101	0	0	0	0
Baker	0	0	0	0	0	0	0	0	0	0	0
Bay	0	0	0	0	0	0	0	0	0	0	0
Bradford	0	0	0	0	0	0	0	0	0	0	0
Brevard	20,160	18,504	18,274	18,158	17,039	17,006	15,827	15,804	11,676	11,641	10,519
Broward	5,030	4,772	3,999	3,317	3,199	2,147	1,770	1,646	1,276	764	589
Calhoun	0	0	0	0	0	0	0	0	0	0	0
Charlotte	6,734	6,640	6,549	6,408	6,100	6,122	6,120	8,220	8,759	9,345	11,718
Citrus	2,222	1,536	1,447	1,379	1,280	1,260	1,256	35	75	191	103
Clay	0	0	0	0	0	0	0	0	0	0	0
Collier	5,052	5,228	5,474	5,396	5,975	6,706	7,931	8,425	10,063	17,309	23,565
Columbia	0	0	0	0	0	0	0	0	0	0	0
Dade	4,531	4,403	4,340	4,536	4,587	6,142	7,158	6,976	6,976	6,656	6,305
De Soto	25,478	29,074	35,783	34,963	33,882	36,157	34,212	34,786	36,042	43,143	52,584
Dixie	0	0	0	0	0	0	0	0	0	0	0
Duval	0	0	0	0	0	0	0	0	0	0	0
Escambia	0	0	0	0	0	0	0	0	0	0	0
Flagler	190	175	182	192	192	177	179	126	0	0	0
Franklin	0	0	0	0	0	0	0	0	0	0	0
Gadsden	0	0	0	0	0	0	0	0	0	0	0
Gilchrist	0	0	0	0	0	0	0	0	0	0	0
Glades	1,572	1,639	1,661	1,615	1,613	3,395	4,026	5,141	6,076	6,235	7,523
Gulf	0	0	0	0	0	0	0	0	0	0	0
Hamilton	0	0	0	0	0	0	0	0	0	0	0
Hardee	50,716	45,986	44,964	44,812	44,084	45,161	43,568	43,954	42,751	45,898	51,069
Hendry	22,447	22,684	24,225	25,944	28,903	30,086	32,944	36,807	40,269	54,953	73,754
Hernando	9,150	6,998	6,804	6,717	6,554	6,765	6,471	0	167	695	598
Highlands	38,803	37,765	37,996	37,375	37,105	37,767	37,661	44,030	46,012	48,569	57,048
Hillsborough	59,727	42,912	40,397	39,750	38,163	37,976	37,631	24,111	23,754	25,507	26,007
Holmes	0	0	0	0	0	0	0	0	0	0	0
Indian River	51,815	52,052	52,261	56,206	56,200	58,262	62,703	63,510	64,302	65,162	66,116
Jackson	0	0	0	0	0	0	0	0	0	0	0
Jefferson	0	0	0	0	0	0	0	0	0	0	0
Lafayette	0	0	0	0	0	0	0	0	0	0	0
Lake	142,796	132,674	129,570	126,016	123,246	122,777	117,730	12,183	13,523	26,228	13,960
Lee	7,439	7,290	7,397	6,243	5,384	5,451	6,711	6,575	7,313	8,247	9,692
Leon	0	0	0	0	0	0	0	0	0	0	0
Levy	0	0	0	0	0	0	0	0	0	0	0
Liberty	0	0	0	0	0	0	0	0	0	0	0
Madison	0	0	0	0	0	0	0	0	0	0	0
Manatee	18,943	15,821	15,430	15,221	14,730	14,802	14,071	14,360	15,688	18,779	20,331
Marion	13,988	11,784	11,223	11,327	11,272	11,484	11,396	198	329	1,209	277
Martin	41,385	41,358	40,473	40,264	38,361	40,768	40,646	40,483	41,095	40,921	46,283
Monroe	0	0	0	0	0	0	0	0	0	0	0
Nassau	0	0	0	0	0	0	0	0	0	0	0
Okaloosa	0	0	0	0	0	0	0	0	0	0	0
Okeechobee	3,597	3,676	4,087	4,162	4,171	4,281	6,954	8,044	7,449	8,124	8,541
Orange	65,961	60,567	56,320	54,007	51,174	50,673	48,547	16,670	14,692	17,356	8,399
Osceola	19,051	17,587	17,115	16,922	16,231	16,457	17,959	16,133	13,035	14,114	16,101
Palm Beach	17,566	17,488	16,694	16,030	16,343	16,797	15,664	15,382	15,198	14,887	15,545
Pasco	42,331	36,785	35,940	34,286	33,367	33,314	33,425	2,949	3,903	9,371	6,937
Pinellas	5,825	4,936	3,937	3,770	3,205	2,579	2,417	1,674	394	276	218
Polk	150,122	144,153	141,475	137,693	134,261	132,124	133,545	129,912	106,993	108,546	99,732
Putnam	4,709	3,440	3,329	3,041	2,692	2,631	2,464	4	14	46	20
St. Johns	122	126	125	127	125	112	110	0	0	0	0
St. Lucie	75,397	73,822	73,036	73,912	70,462	75,140	76,863	80,402	82,770	88,893	94,878
Santa Rosa	0	0	0	0	0	0	0	0	0	0	0
Sarasota	1,612	1,539	1,449	1,661	1,604	1,538	1,570	1,619	1,568	1,929	2,127
Seminole	12,067	10,969	9,120	8,276	7,635	7,202	6,823	1,360	1,194	1,440	1,024
Sumter	2,379	1,771	1,677	1,760	1,760	1,772	1,593	62	116	116	6
Suwannee	0	0	0	0	0	0	0	0	0	0	0
Taylor	0	0	0	0	0	0	0	0	0	0	0
Union	0	0	0	0	0	0	0	0	0	0	0
Volusia	12,324	11,682	11,171	10,728	10,227	10,143	9,810	1,275	1,020	1,379	1,198
Wakulla	0	0	0	0	0	0	0	0	0	0	0
Walton	0	0	0	0	0	0	0	0	0	0	0
Washington	0	0	0	0	0	0	0	0	0	0	0
Totals	941,471	878,019	864,098	852,369	831,235	845,283	847,856	642,856	624,492	697,929	732,767

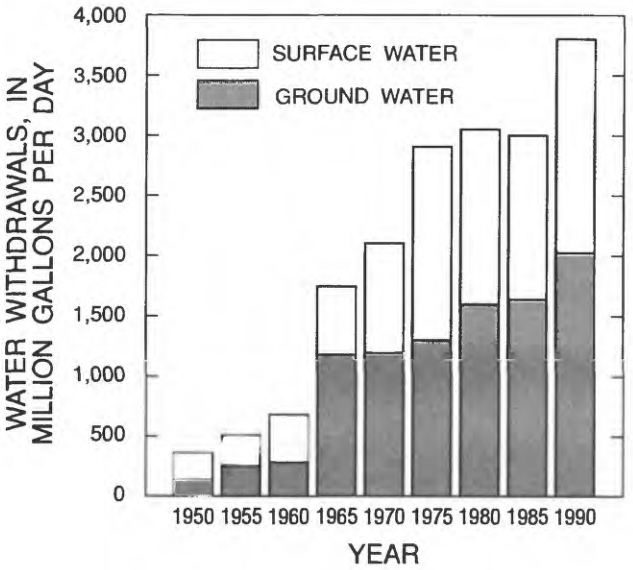

Figure 24. Historical agricultural irrigation freshwater withdrawals in Florida by source, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)

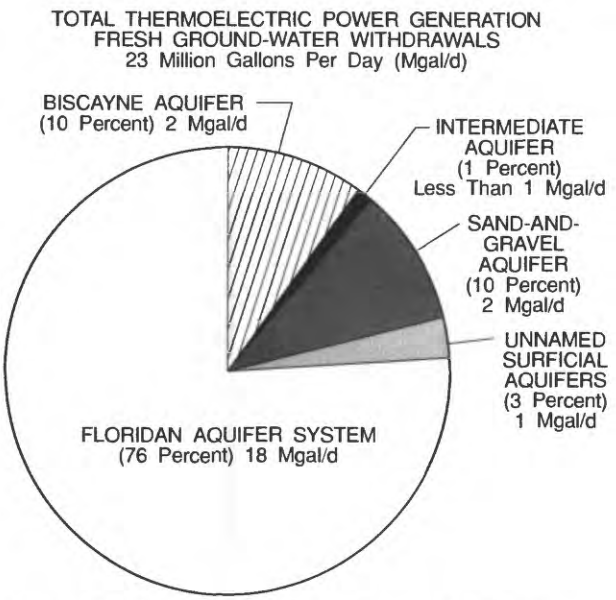

Figure 26. Thermoelectric power generation fresh ground-water withdrawals in Florida by principal aquifer, 1990.

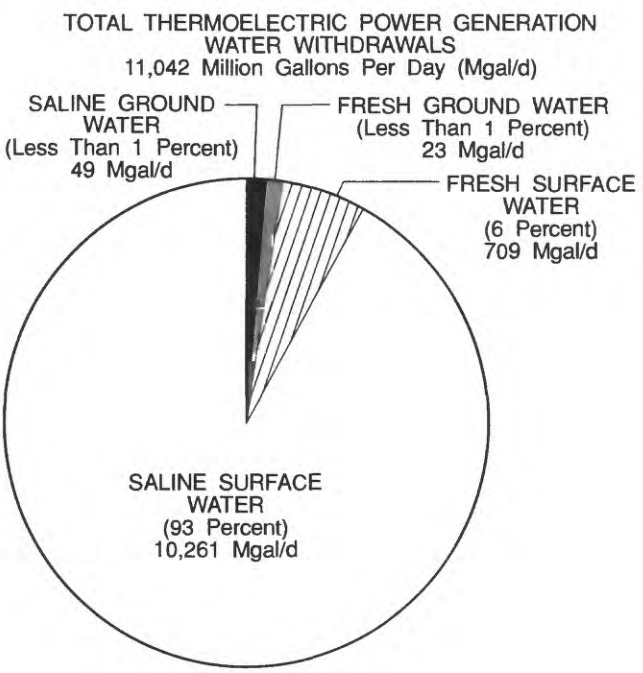

Figure 25. Thermoelectric power generation water withdrawals in Florida by source, 1990.

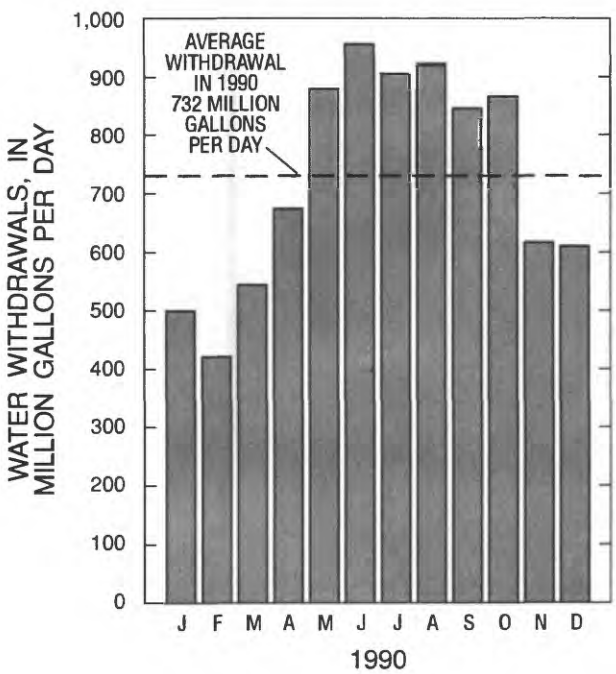

Figure 27. Monthly thermoelectric power generation freshwater withdrawals in Florida, 1990.

Table 14. Thermoelectric power generation water withdrawals in Florida by county, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made]

County	Ground-water withdrawals			Surface-water withdrawals			Total withdrawals		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Combined
Alachua	2.41	0.00	2.41	0.00	0.00	0.00	2.41	0.00	2.41
Baker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay	1.14	0.00	1.14	0.00	227.68	227.68	1.14	227.68	228.82
Bradford	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brevard	0.25	0.00	0.25	0.00	1,051.40	1,051.40	0.25	1,051.40	1,051.65
Broward	0.05	0.00	0.05	0.00	1,025.56	1,025.56	0.05	1,025.56	1,025.61
Calhoun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charlotte	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Citrus	1.50	0.00	1.50	0.00	1,455.54	1,455.54	1.50	1,455.54	1,457.04
Clay	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Collier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Columbia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dade	2.26	4.93	7.19	0.00	30.25	30.25	2.26	35.18	37.44
De Soto	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dixie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Duval	4.83	0.00	4.83	0.00	314.39	314.39	4.83	314.39	319.22
Escambia	2.20	0.00	2.20	190.43	0.00	190.43	192.63	0.00	192.63
Flagler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Franklin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gadsden	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gilchrist	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glades	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gulf	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hamilton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hardee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hendry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hernando	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Highlands	0.07	0.00	0.07	1.98	0.00	1.98	2.05	0.00	2.05
Hillsborough	0.00	0.00	0.00	0.00	2,036.27	2,036.27	0.00	2,036.27	2,036.27
Holmes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian River	0.08	0.00	0.08	0.00	137.97	137.97	0.08	137.97	138.05
Jackson	0.37	0.00	0.37	107.99	0.00	107.99	108.36	0.00	108.36
Jefferson	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lafayette	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lake	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lee	0.25	0.00	0.25	0.00	411.63	411.63	0.25	411.63	411.88
Leon	4.11	0.00	4.11	0.00	0.00	0.00	4.11	0.00	4.11
Levy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liberty	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Madison	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manatee	0.00	0.00	0.00	3.27	0.00	3.27	3.27	0.00	3.27
Marion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Martin	0.53	0.00	0.53	19.56	0.00	19.56	20.09	0.00	20.09
Monroe	0.00	44.35	44.35	0.00	0.00	0.00	0.00	44.35	44.35
Nassau	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Okaloosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Okeechobee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Orange	0.33	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.33
Osceola	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Palm Beach	0.00	0.00	0.00	0.00	422.24	422.24	0.00	422.24	422.24
Pasco	0.00	0.00	0.00	0.00	1,324.81	1,324.81	0.00	1,324.81	1,324.81
Pinellas	0.00	0.00	0.00	0.00	514.52	514.52	0.00	514.52	514.52
Polk	1.41	0.00	1.41	70.62	0.00	70.62	72.03	0.00	72.03
Putnam	0.53	0.00	0.53	7.71	0.00	7.71	8.24	0.00	8.24
St. Johns	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
St. Lucie	0.00	0.00	0.00	0.00	1,256.44	1,256.44	0.00	1,256.44	1,256.44
Santa Rosa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sarasota	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seminole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sumter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Suwanne	0.07	0.00	0.07	108.51	0.00	108.51	108.58	0.00	108.58
Taylor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Union	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volusia	0.44	0.00	0.44	198.85	0.00	198.85	199.29	0.00	199.29
Wakulla	0.31	0.00	0.31	0.00	51.80	51.80	0.31	51.80	52.11
Walton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Washington	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Totals	23.14	49.28	72.42	708.92	10,260.50	10,969.42	732.06	10,309.78	11,041.84

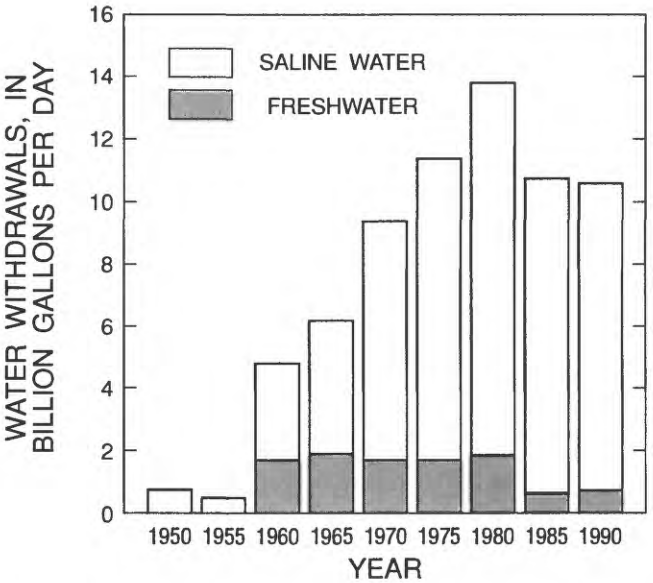

Figure 28. Historical thermoelectric power generation water withdrawals in Florida by source, 1950-90. (Modified from Leach, 1983; and Marella, 1988.)

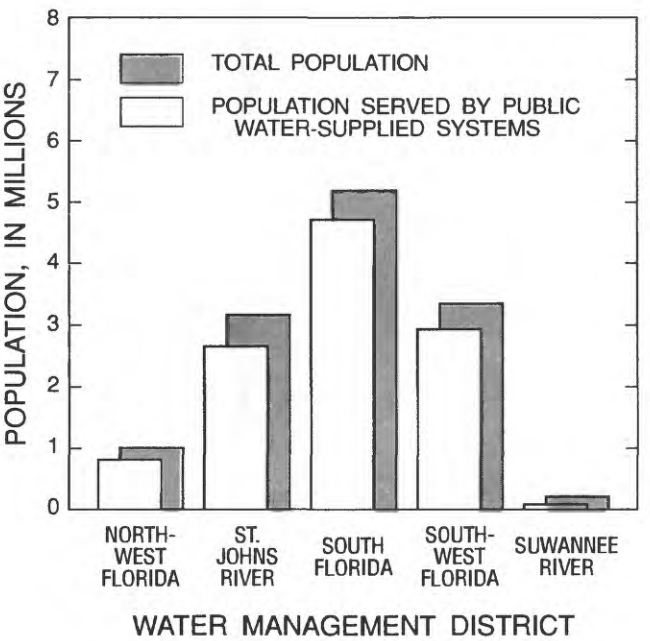

Figure 29. Total population and population served by public-supply systems in Florida by water management district, 1990.

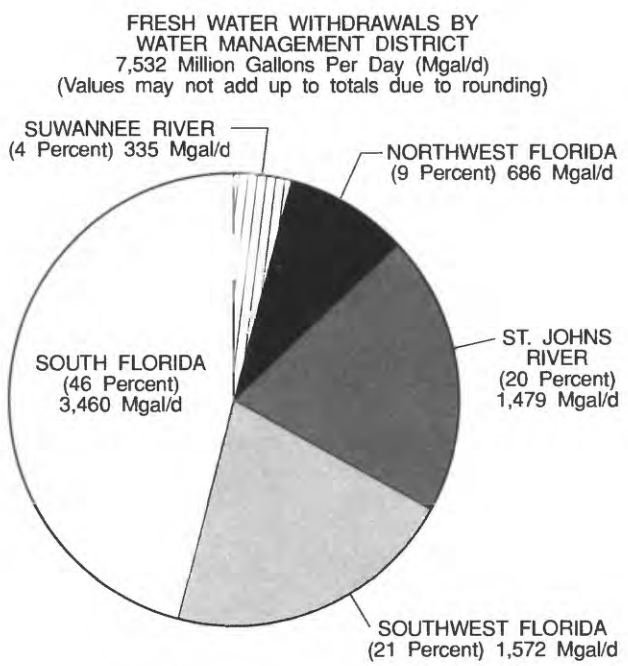

Figure 30. Total freshwater withdrawals in Florida by water management district, 1990.

Table 15. Total freshwater withdrawals for principal water-use categories in Florida by water management district, 1990

[Withdrawals are in million gallons per day; 0.00 indicates no withdrawals were made; Data collected and compiled by five water management districts and the U.S. Geological Survey, and may not be identical to data reported or published by the water management districts due to differences in data collection procedures and categories of use or revisions in reported values]

Water management district	Public supply		Self-supplied domestic		Self-supplied commercial-industrial		Agricultural		Thermoelectric power generation		Total freshwater withdrawals		
	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Ground water	Surface water	Total
Northwest Florida	117.03	41.40	31.95	0.00	52.27	53.69	61.47	21.21	8.13	298.42	270.85	414.72	685.57
St Johns River	427.90	16.24	85.98	0.00	126.09	10.27	374.61	224.87	6.75	206.56	1,021.33	457.94	1,479.27
South Florida	815.82	39.71	89.10	0.00	77.59	66.92	865.37	1,483.26	3.16	19.56	1,851.04	1,609.45	3,460.49
Southwest Florida	323.88	128.98	67.60	0.00	277.92	4.98	630.13	59.37	2.91	75.87	1,302.44	269.20	1,571.64
Suwannee River	14.19	0.00	24.75	0.00	97.01	3.20	80.92	4.04	2.19	108.51	219.06	115.75	334.81
State totals	1,698.82	226.33	299.38	0.00	630.88	139.06	2,012.50	1,792.75	23.14	708.92	4,664.72	2,867.06	7,531.78

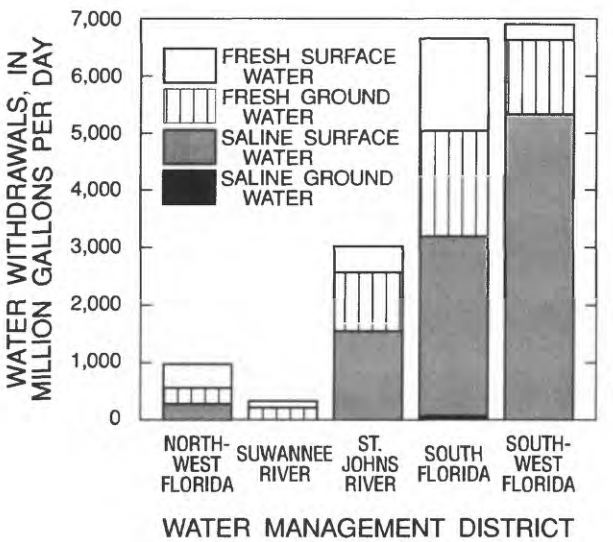

Figure 31. Total water withdrawals in Florida by water management district, 1990.

The Southwest Florida Water Management District accounted for the largest amount of total water withdrawn (freshwater and saline) in 1990 (fig. 31). Withdrawals in Southwest Florida Water Management District included more than 5,330 Mgal/d of saline surface water withdrawn for cooling purposes at several thermoelectric power generation facilities located along Tampa Bay or the Gulf of Mexico. Also located within the Southwest Florida Water Management District is most of the States phosphate and limerock mining water use.

Ground-water withdrawals have increased in all five water management districts since 1975 (fig. 32). Much of the increase is because of increases in population, tourism, and agricultural production. Ground water is the preferred source of water for new public supplies and agricultural irrigation in the districts. Surface-water use, however, has decreased in all but the South Florida Water Management District since 1975 (fig. 33). Most of the decrease in surface water occurred because of decreases in surface-water withdrawals for thermoelectric power generation between 1975 and 1990. In the South Florida Water Management District, surface-water withdrawals increased between 1975 and 1990, primarily because of an increase in irrigated citrus and sugarcane acreage. During 1990, nearly 50 percent of the water withdrawn for citrus irrigation and all of the water withdrawn for sugarcane irrigation in the South Florida Water Management District was from surface-water sources.

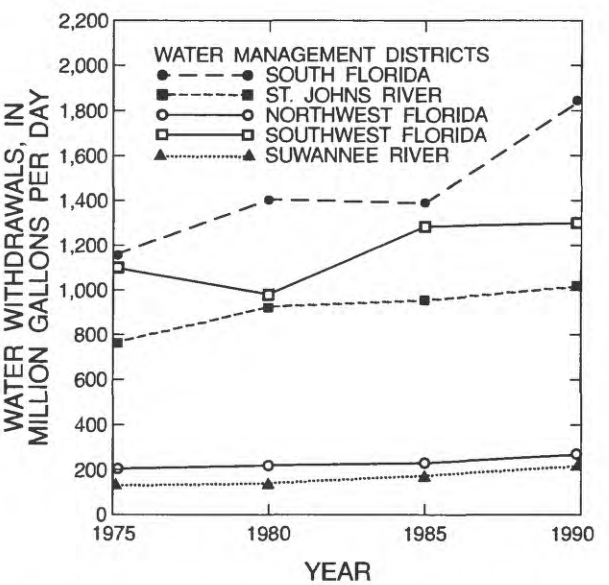

Figure 32. Historical fresh ground-water withdrawals in Florida by water management district, 1975-90. (Modified from Leach, 1978, 1983; Marella, 1986, 1987; Steiglitz, 1985; and Bielby, 1987.)

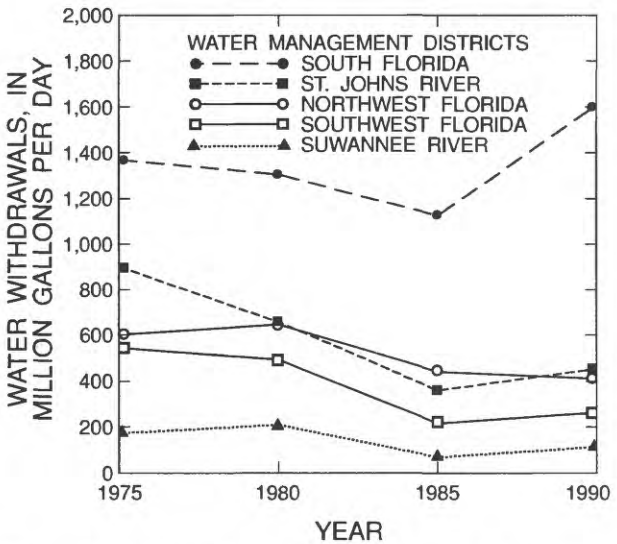

Figure 33. Historical fresh surface-water withdrawals in Florida by water management district, 1975-90. (Modified from Leach, 1978, 1983; Marella, 1986, 1987; Steiglitz, 1986; and Bielby, 1987.)

SUMMARY

In 1990, the total amount of water withdrawn for all uses in Florida was 17,898 Mgal/d, of which 42 percent (7,532 Mgal/d) was freshwater, and 58 percent (10,366 Mgal/d) was saline. Ground water accounted for nearly 62 percent of freshwater withdrawals (4,665 Mgal/d), and surface water accounted for 38 percent (2,867 Mgal/d). Surface water accounted for more than 99 percent of the saline water withdrawals (10,317 Mgal/d). Monthly water withdrawals can fluctuate dramatically in Florida as a consequence of variations in temperatures, precipitation, crop production, and seasonal population. In 1990, nearly 38 percent of the freshwater withdrawals were made from March through June. Much of the water withdrawn for use by the public-supply systems or by commercial-industrial facilities was subsequently discharged as wastewater. Wastewater discharged in 1990 totaled nearly 1,760 Mgal/d of which 1,363 Mgal/d (77 percent) was from public and private domestic wastewater facilities (983), and 397 Mgal/d (22 percent) was from 84 industrial facilities.

Agricultural irrigation accounted for the largest use of fresh ground water for 1990, followed by public supply, self-supplied commercial-industrial use, self-supplied domestic use, and thermoelectric power generation. Agricultural irrigation also accounted for the largest use of fresh surface water for 1990, followed by thermoelectric power generation, public-supply, and self-supplied commercial-industrial use. Thermoelectric power generation accounted for more than 99 percent of saline-water withdrawals (10,261 Mgal/d) in 1990.

The largest amount of freshwater was withdrawn in Palm Beach County, and the largest amount of saline water was withdrawn in Hillsborough County in 1990. Five counties withdrew more than 200 Mgal/d of fresh ground water with Dade County withdrawing the largest amount (527 Mgal/d), followed by Polk, Broward, Orange, and Palm Beach Counties. Four counties withdrew more than 200 Mgal/d of fresh surface water with Palm Beach County accounting for the largest withdrawal (796 Mgal/d), followed by Hendry, Escambia, and Volusia Counties.

With an average ground-water withdrawal of nearly 4,714 Mgal/d, the State of Florida ranked sixth in the Nation in ground-water withdrawals in 1990, and had the largest ground-water withdrawals of any State east of the Mississippi River. Nearly 10.0 million people in Florida served by public supply and all residents that use self-supplied domestic systems (1.71 million) depended on ground water for their drinking water needs in 1990. The Floridan aquifer system, which underlies most of the State, was the source for 60 percent of the total ground water withdrawn in 1990. Polk, Orange, Hillsborough, and Duval Counties were the largest users of water from the Floridan aquifer system in 1990. The Biscayne aquifer, which underlies the southeastern part of the State was the source for 18 percent of the ground-water withdrawals. Dade and Broward Counties withdrew all of their ground water from the Biscayne aquifer, and Palm Beach County withdrew some water from this aquifer.

Freshwater withdrawals have increased 31 percent (1,769 Mgal/d) in the 20 years between 1970 and 1990. Fresh ground-water withdrawals increased 1,803 Mgal/d (63 percent), and fresh surface-water withdrawals decreased 34 Mgal/d (1 percent) during this period. Overall, the dependency on ground water as the primary supply in Florida increased. In 1990, nearly 62 percent of the total freshwater withdrawn was from ground-water sources, compared to 51 percent in 1980, and 21 percent in 1950. The use of treated nonpotable ground water, primarily for public supply, also increased. The use of water treated through desalination to meet drinking water standards increased from 17 Mgal/d in 1985, to 48 Mgal/d in 1990. The use of reclaimed wastewater also has increased in recent years. In 1990, nearly 170 Mgal/d of reclaimed wastewater was used, primarily for irrigation, compared to 51 Mgal/d in 1985.

Since 1950, all categories of freshwater withdrawals in Florida have increased. Between 1970 and 1990, however, freshwater withdrawals for public-supply, self-supplied domestic use, and agricultural irrigation have increased and withdrawals for self-supplied commercial-industrial use and thermoelectric power generation have decreased. Total freshwater withdrawals for public supply increased 1,041 Mgal/d, withdrawals for self-supplied domestic use increased 134 Mgal/d, and withdrawals for agricultural irrigation increased 1,704 Mgal/d, whereas withdrawals for self-supplied commercial-industrial use decreased 157 Mgal/d and withdrawals for thermoelectric power generation decreased 955 Mgal/d between 1970 and 1990.

Florida's population totaled 12.94 million in 1990 and is projected to surpass 16 million by the year 2000, and 20 million by the year 2020. Nearly 87 percent of the population (11.23 million people) was served by public water-supply systems in 1990. Water withdrawn for public supply in Florida totaled 1,925 Mgal/d. Ground water was the source of more than 88 percent (1,699 Mgal/d) of the water withdrawn for public supply and served an estimated 10.0 million people. Surface water accounted for the remaining 12 percent (226 Mgal/d), and served 1.23 million people. Florida ranked second in the Nation behind California in ground-water withdrawals for public supply (1,699 Mgal/d) in 1990. The Floridan aquifer system supplied 852 Mgal/d (50 percent) of water for public supply. Public-supply withdrawals from the other major aquifers were the Biscayne, 573 Mgal/d; the unnamed surficial aquifer, 178 Mgal/d; the intermediate aquifer, 50 Mgal/d; and the sand-and-gravel aquifer, 46 Mgal/d. Public-supply withdrawals were lowest in January and highest in May during 1990. The statewide public-supply per-capita use for Florida in 1990 was 171 gal/d and includes water delivered for commercial, industrial and public uses and other uses as well as domestic uses. Public-supply water used solely for domestic (residential) purposes totaled 1,249 Mgal/d, representing a per capita use of 111 gal/d for 1990.

Agriculture was the largest user of freshwater in Florida in 1990. Agricultural withdrawals totaled 3,805 Mgal/d, of which 53 percent (2,012 Mgal/d) was ground water and 47 percent was surface water (1,793 Mgal/d). An additional 170 Mgal/d of reclaimed wastewater was used for irrigation purposes. Withdrawals for agricultural irrigation in 1990 varied seasonally and were lowest in December and highest in May. A seasonal fluctuation of more than 2,900 Mgal/d was the result of intense crop production and dry conditions during the early spring. More than 32 percent of the water used for irrigation was withdrawn during the months of March, April, and May and less than 20 percent was withdrawn during the months of October, November, and December. Irrigation of citrus crops accounted for the largest amount of water withdrawn (33 percent), followed by sugarcane irrigation (22 percent), irrigation of sod (5 percent), and irrigation of turf grass (golf courses) (5 percent).

The number of acres irrigated in Florida totaled 2.15 million for 1990. Palm Beach, Hendry, Dade, Polk, and Brevard Counties each had more than 100,000 acres irrigated in 1990. Irrigated acreage in Florida increased between 1980 and 1990, despite a reduction in citrus acreage. Citrus acreage decreased from 941,500 acres in 1970, to 732,800 acres in 1990 but increased nearly 110,000 acres between 1986 and 1990. Collectively, citrus and sugarcane accounted for 53 percent of Florida's irrigated acreage in 1990.

The South Florida Water Management District accounted for more than 40 percent of the State's population in 1990. The estimated resident population of the five water management districts in Florida in 1990 was: South Florida Water Management District, 5.20 million; Southwest Florida Water Management District, 3.35 million; St. Johns River Water Management District, 3.17 million; Northwest Florida Water Management District, 1.01 million; and Suwannee River Water Management District, 0.22 million. The South Florida Water Management District had more than 40 percent of the State's population and the most people served by public water-supply systems in 1990.

Nearly 46 percent of the total freshwater withdrawn in 1990 was withdrawn in the South Florida Water Management District. Estimated freshwater withdrawals in the five water management district in 1990 were: South Florida Water Management District, 3,460 Mgal/d; Southwest Florida Water Management District, 1,572 Mgal/d; St. Johns River Water Management District, 1,479 Mgal/d; Northwest Florida Water Management District, 686 Mgal/d; and Suwannee River Water Management District, 335 Mgal/d. The South Florida Water Management District accounted for the largest amount of freshwater withdrawn for public-supply, self-supplied domestic use, and agricultural irrigation, whereas the Southwest Florida Water Management District accounted for the largest amount of freshwater withdrawn for self-supplied commercial-industrial use, and the Northwest Florida Water Management District accounted for the largest amount of freshwater withdrawn for thermoelectric power generation.

Ground-water withdrawals have increased in all five water management districts since 1975. The increases are due largely to increased population, tourism, and agricultural production. Ground water generally is the preferred source of water for new public-supply systems and for agricultural irrigation use in the districts. surface-water withdrawals have decreased in all water management districts except the South Florida Water Management District since 1975. The decreased in surface-water withdrawals was primarily because of decreased surface-water withdrawals for thermoelectric power generation. In the South Florida Water Management District, surface-water withdrawals increased between 1975 and 1990, primarily because of an increase in irrigated citrus and sugarcane acreage.

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