Water Withdrawals, Use, Discharge, and Trends in Florida, 2000

By Richard L. Marella

Prepared in cooperation with the
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Conversion Factors, Abbreviations and Acronyms

Multiply	By	To obtain
Area		
acre	4,047	square meter (m^2)
acre	0.00156	square mile (mi^2)
acre feet	0.325851	million gallons (Mgal)
square mile (mi^2)	2.590	square kilometer (km^2)
Flow rate		
gallon per day (gal/d)	3.785	liters per day (L/d)
million gallons per day (Mgal/d)	0.003785	million cubic meters per day (Mm^3/d)
Energy		
gigawatthour (GWh)	1,000	megawatthour (mWh)
gigawatthour (GWh)	1,000,000	kilowatthour (kWh)

FASS	Florida Agricultural Statistic Service
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
IFAS	Institute of Food and Agricultural Science (University of Florida)
NRCS	Natural Resources Conservation Service (U.S. Department of Agriculture)
NWFWMD	Northwest Florida Water Management District
SJRWMD	St. Johns River Water Management District
SFWMD	South Florida Water Management District
SWFWMD	Southwest Florida Water Management District
SRWMD	Suwannee River Water Management District
USGS	U.S. Geological Survey

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By Richard L. Marella

Abstract

In 2000, the estimated amount of water withdrawn in Florida was 20,148 million gallons per day (Mgal/d), of which 59 percent was saline and 41 percent was fresh. Ground water accounted for 62 percent of freshwater withdrawals and surface water accounted for the remaining 38 percent. Ninety-two percent of the 15.98 million people in Florida relied on ground water for their drinking water needs in 2000. Almost all of the saline water withdrawals (99.9 percent) were from surface water.

Public supply accounted for 43 percent of ground water withdrawn in 2000, followed by agricultural self-supplied (39 percent), commercial-industrial self-supplied (including mining) (8.5 percent), recreational irrigation (4.5 percent), domestic self-supplied (4 percent), and power generation (1 percent). Agricultural self-supplied accounted for 62 percent of fresh surface water withdrawn in 2000, followed by power generation (20 percent), public supply (8 percent), recreational irrigation (6 percent), and commercial-industrial self-supplied (4 percent). Almost all of saline water withdrawn was used for power generation.

The largest amount of freshwater was withdrawn in Palm Beach County and the largest amount of saline water was withdrawn in Hillsborough County. Significant withdrawals (more than 200 Mgal/d) of fresh ground water occurred in Miami-Dade, Polk, Orange, Palm Beach, Broward, and Collier Counties. Significant withdrawals (more than 200 Mgal/d) of fresh surface water occurred in Palm Beach, Hendry, and Escambia Counties. The South Florida Water Management District accounted for the largest amount of freshwater withdrawn (49 percent).

About 62 percent of the total ground water withdrawn was from the Floridan aquifer system; 17 percent was from the Biscayne aquifer. Most of the surface water used in Florida was from managed and maintained canal systems or large water bodies. Major sources of fresh surface water include the Caloosahatchee River, Deer Point Lake, Hillsborough River, Lake Okeechobee and associated canals, and the canals associated with the headwaters of the Upper St. Johns River.

Freshwater withdrawals increased 46 percent and saline water withdrawals increased 25 percent in Florida between 1970 and 2000. Ground-water withdrawals increased 82 percent, and surface-water withdrawals increased 10 percent during this period. Between 1970 and 2000, total freshwater withdrawals increased for public supply by 176 percent and for agricultural self-supplied by 87 percent; withdrawals for commercial-industrial self-supplied decreased by 37 percent, and power generation (thermoelectric) decreased by 57 percent. Recreational irrigation withdrawals increased 127 percent between 1985 and 2000. Between 1995 and 2000, freshwater withdrawals increased 13 percent, and saline withdrawals increased 9 percent.

An estimated 52 percent of the freshwater withdrawn in Florida was consumed; the remaining 48 percent was returned for further use. Domestic wastewater discharged in 2000 totaled 1,495 Mgal/d, of which 44 percent was discharged to surface waters, 34 percent to the ground through land application systems, and 22 percent to deep injection wells. Domestic wastewater discharge increased by 33 percent between 1985 and 2000, but decreased by 3 percent between 1995 and 2000. An estimated 11.21 million people were served by domestic wastewater systems in 2000, whereas the remaining 4.77 million people discharged wastewater to more than 1.95 million septic tanks. Discharge from the septic tanks was estimated to be 263 Mgal/d in 2000.

Introduction

Water is among Florida's most valued resources. The State has more than 1,700 streams and rivers and 7,800 freshwater lakes, and the entire State is underlain by aquifers capable of yielding significant quantities of freshwater to wells. These water resources provide for human and environmental needs. However, these water resources are finite, and growth in population, tourism, and agriculture are placing an increasing demand on them.

The population of Florida in 2000 totaled nearly 15.98 million (University of Florida, 2001), ranking fourth in the Nation (U.S. Census Bureau, 2001). This represents an increase of about 480 percent from the 1950 population of 2.77 million (Dietrich, 1978), and a 23.5 percent increase from the 1990 population of 12.94 million (University of Florida, 2001) (fig. 1). Florida's population is projected to reach nearly 17.4 million by the year 2005, and 21.7 million by the year 2020 (Smith and Nogle, 2001) (fig. 1). In addition to the resident population in Florida, an estimated 72 million people visited the State in 2000 (University of Florida, 2002). Freshwater is vital for Florida's permanent and seasonal residents and demands will continue to increase.

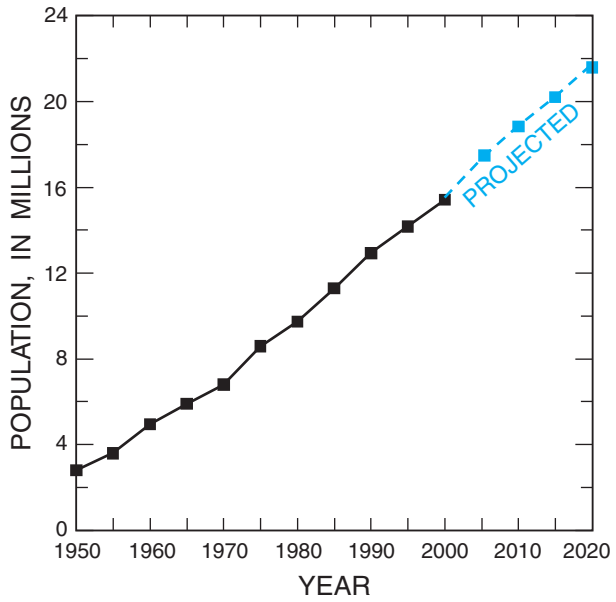


Figure 1. Historical and projected population of Florida, 1950-2020 (From Dietrich, 1978; Smith and Nogle, 2001; and University of Florida, 2001).

The agricultural sector in Florida also depends heavily on the State's water resources. In 2000, Florida accounted for 76 percent of the total citrus produced in the United States and was fourth in Nation net farm income (Florida Department of Agriculture and Consumer Services, 2002). Agricultural production should continue to flourish because of the subtropical climate and demands from the growing population. Information on the amount of water required to support future agricultural growth is needed.

To provide accurate information on water use and trends, the U.S. Geological Survey (USGS), in cooperation with the Florida Department of Environmental Protection (FDEP) and the Northwest Florida, St. Johns River, South Florida, Southwest Florida, and Suwannee River Water Management Districts, estimate water use in Florida at 5-year intervals. Water-use estimates for 2000 are presented in this report.

Purpose and Scope

This report summarizes the quantities of water withdrawn, consumed, and discharged in 2000, and indicates trends in water use. Overall, the report provides a basis for estimating water budgets and projecting future water needs. Data are presented on water withdrawals in Florida for each of the following water use categories: public supply, domestic self-supplied, commercial-industrial self-supplied (including mining uses), agricultural self-supplied (including irrigation and nonirrigation uses), recreational irrigation, and power generation. Information concerning instream (nonwithdrawal) water use such as hydroelectric power generation, navigation, water-based recreation, propagation of fish and wildlife, and dilution and conveyance of liquid or solid waste is not included.

Within each category, withdrawal data are presented by source (ground or surface water), and where sufficient data are available, seasonal and historical patterns of water use are described. Data also are presented by county and water management district (fig. 2) for each water use category. Information about specific public-supply water systems and domestic wastewater facilities can be obtained by contacting the USGS office in Tallahassee or by visiting the USGS web site at *http://fl.water.usgs.gov/WaterUse/Water_Use_web/index.htm*.

Previous Investigations

This report is the ninth in a series of reports documenting the results of water-use investigations in Florida. Statewide water-use data for Florida were published for 1965 and 1970 (Pride, 1973 and 1975); for 1975, 1977, and 1980 (Leach, 1978, 1983; and Leach and Healy, 1980) and for 1985, 1990, and 1995 (Marella, 1988, 1992, 1999). These reports included assessments of all water uses in Florida (including public-supply, domestic self-supplied, commercial-industrial self-supplied, agricultural irrigation and nonirrigation, recreational irrigation, and power generation water uses) by county. Historical water-use data for each county are presented in appendix 1. Individual county tables in appendix 1 detail freshwater withdrawals by category for all data collected between 1965 and 2000.

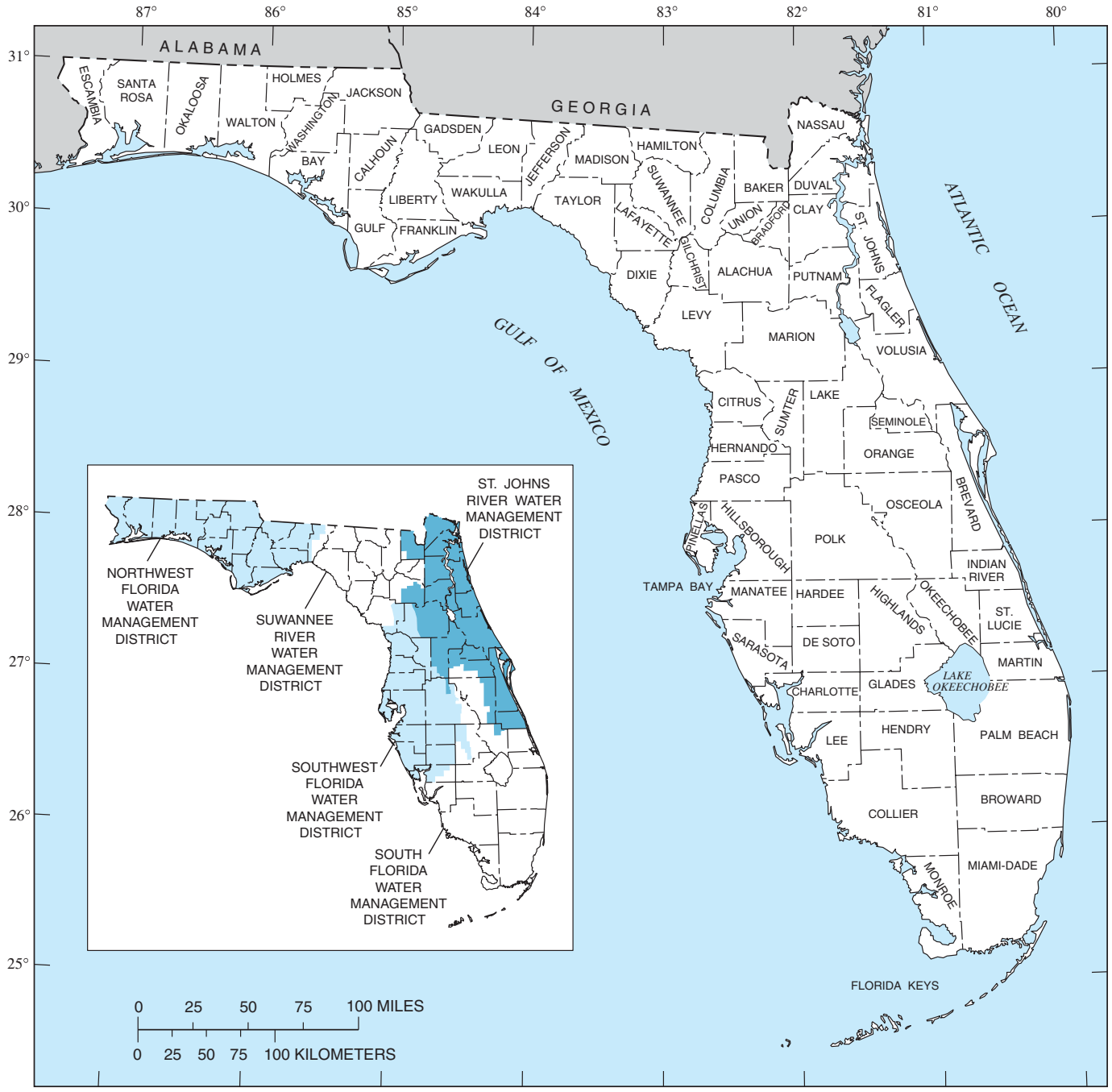


Figure 2. Counties and water management districts in Florida.

Prior to 1965, state water-use data were only published at the national level. Nationwide summaries of water-use data were published for 1950, 1955, and 1960 (MacKichan, 1951, 1957; and MacKichan and Kammerer, 1961). These reports included detailed water-use data at the state level, but did not include water-use data for counties. Nationwide summaries, including data for Florida, also were published by the USGS for 1965, 1970, 1975 (Murray, 1968; and Murray and Reeves, 1972, 1977); for 1980, 1985, 1990, 1995 (Solley and others, 1983, 1988, 1993, 1998), and for 2000 (Hutson and others, 2004).

Additional water-use reports have been published by selected water management districts between 1975 and 2000 (see water-use bibliography for Florida). The St. Johns River and the Southwest Florida Water Management Districts have published annual water-use reports since 1977; the Northwest Florida, South Florida, and the Suwannee River Water Management Districts have intermittently published reports between 1977 and 1985. Detailed water-use data for 2000 were pub-

lished by the Southwest Florida Water Management District (2002), and a summary fact sheet for 2000 was published by the St. Johns River Water Management District (2004). Historical water-use data for each water management district are presented in appendix 2. Individual district tables in appendix 2 detail freshwater withdrawals by category for all data collected between 1975 and 2000.

Data Sources and Limitations

As part of the USGS National Water-Use Information Program, water-use data are collected and compiled for each state every 5 years (Solley and others, 1988). Data are reported for each state by water-use category, county, hydrologic unit (basin), and aquifer. Water-use data for Florida were compiled through an ongoing cooperative program with the FDEP, as part of the 2000 National Water-Use Information Program. Data were obtained from the FDEP (Drinking Water and Wastewater Sections), the Northwest Florida Water Management District (NWFWMD), the St. Johns River Water Management District (SJRWMD), the South Florida Water Management District (SFWMD), the Southwest Florida Water Management District (SWFWMD), and the Suwannee River Water Management District (SRWMD), as well as from various utilities, industries, and power companies. Specific data sources for each category or source are listed below.

Public supply. Data for public-supply withdrawals were obtained from the FDEP's Drinking Water Section (monthly operating reports), the five water management districts (consumptive water-use permit files or annual reports), or directly from the water supplier. All water use values for this category are from metered data.

The population served value for each public supplier was determined by one of three sources: (1) estimated using the number of service connections (obtained from the FDEP monthly operating reports) multiplied by the number people per household per county (Smith and Cody, 2001); (2) estimated from published population studies for selected cities (University of Florida, 2001); and (3) estimated by the individual public suppliers and reported to FDEP (Drinking Water Quick Look Report, Florida Department of Environmental Protection, written commun., April 2000) or to their respective water management district. Population served values in the Northwest Florida, the South Florida, and the Suwannee River Water Management Districts were estimated by the USGS. Population served estimates for some counties within the South Florida Water Management District also were made by the district using housing counts from the 2000 Census data overlaid by utility service areas. Estimates for population served in the St. Johns River and the Southwest Florida Water Management Districts were made by the respective district (St. Johns River Water Management District, 2004; Southwest Florida Water Management District, 2002), however, values for the Southwest Florida Water Management District were modified to remove seasonal population estimates.

Domestic self-supplied. Domestic self-supplied populations are derived by subtracting the population served by public-supplied systems from the total county population. Domestic self-supplied withdrawals are calculated by multiplying the 2000 statewide domestic per capita use of 106 gallons per day by the self-supplied population served for each county. Withdrawal estimates for the counties within the Southwest Florida Water Management District were calculated by the district (Southwest Florida Water Management District, 2002). All water used for domestic self-supplied is assumed to be obtained from ground water. Values for this category are estimated.

Commercial-industrial self-supplied. Data for commercial, industrial, and mining withdrawals were obtained from the FDEP's Drinking Water Section (monthly operating reports), the five water management districts (consumptive water-use permit files or annual reports), or directly from the user. Most of the water-use values for this category are from metered data.

Agricultural self-supplied. Water withdrawn for irrigation was estimated by the water management districts based on crop acreage multiplied by a use coefficient (usually in inches per acre) generated from selected irrigation models for each crop. Only a small percentage (about 10-15) of the water-use estimates for 2000 were derived from actual metered data.

Acreage data were obtained by the water management districts from a variety of sources including, (1) the University of Florida, Institute of Food and Agriculture Science (IFAS), County Extension Offices; (2) the water management districts' consumptive water-use permit files; (3) the Florida Department of Agriculture and Consumer Services (FDACS); Agricultural Statistics Service, Commercial Citrus Inventory 2000, Field Crops Summary 2000, and the Vegetable Summary 1999-2000 (Florida Agricultural Statistics Service, 2000; 2001a; 2001b); (4) the FDACS, Division of Plant Industry, Annual Report (Florida Department of Agriculture and Consumer Services, 2000); and (5) the U.S. Department of Agriculture, 1997 Census of Agriculture, Florida (U.S. Department of Agriculture, 1999). The total number of acres for selected crops for each county was obtained using these sources, as well as the acreage that was irrigated. The method of irrigation was obtained from many of the same sources or was estimated by the individual water management districts.

The supplemental irrigation coefficient used to determine the amount of water needed per crop was obtained from several irrigation models and publications including (1) the modified Blaney-Criddle irrigation model; "Irrigation Water Requirements, 1970, revised" (U.S. Soil Conservation Service, 1970); (2) the University of Florida "AFSIRS" computer model (Smajstrla, 1986); and, (3) the "Florida Irrigation Guide" (U.S. Soil Conservation Service, 1982). These models or publications either use actual or long-term averages of rainfall, and temperature (Jones and others, 1984). Other sources of supplemental irrigation coefficients used for determining irrigation needs included actual metered data for selected crops, or those coefficients provided by agriculture authorities or the water management districts.

Supplemental irrigation application rates (in inches per acre) generated from these sources were multiplied by the number of irrigated acres to yield water use. From these values, estimates of the water sources (ground or surface) were made by local county extension service personnel or by using information from the water management district's consumptive water-use permit files. Supplemental irrigation rates include the amount of water needed to grow each crop, the amount of water necessary to overcome the inefficiency of the irrigation system, and water used for frost and freeze protection.

Withdrawals were estimated for livestock and fish farming by multiplying the total number of cattle (including dairy cattle), chickens, horses, and swine for each county by a water-use coefficient per animal type. The number of animals per county was obtained from the FDACS, Agricultural Statistics Service, Livestock Summary 2000 (Florida Agricultural Statistics Service, 2001c). Water-use coefficients were obtained from the University of Florida, IFAS (St. Johns River Water Management District, 1984). Livestock estimates were not made for those counties within the St. Johns River Water Management District for 2000.

Estimates of the quantity of ground or surface water used were provided by local county extension service personnel or were determined by using information from the water management district's consumptive water-use data base. If no information or data source was available, a ratio of 90 percent ground water and 10 percent surface water was used based on previous studies. The quantity of water withdrawn for fish farming was obtained from the water management district's consumptive water-use permit files or was estimated based on a coefficient of 50 inches per pond acre. Pond acreage was obtained from the water management districts or the U.S. Department of Agriculture, 1997 Census of Agriculture, Florida (U.S. Department of Agriculture, 1999).

Recreational irrigation. Water withdrawal values for recreational irrigation were estimated based on irrigated acreage multiplied by a coefficient (usually in inches per acre) generated from selected irrigation models for turf grass. Only a small percentage (about 10-15) of the water-use estimates for 2000 were derived from actual metered data.

The total number of acres and acres irrigated were obtained by the water management districts from a variety of sources that included: (1) the University of Florida, IFAS, County Extension Offices; (2) the water management districts' consumptive water-use permit files and the districts needs and sources documents; or were estimated from the number of golf courses or number of holes per county obtained from the Florida Sports Foundation (2000) or the National Golf Foundation (2001).

The supplemental irrigation coefficient used to determine the amount of water needed was obtained from several irrigation models or publications including: (1) the modified Blaney-Criddle irrigation model, and Irrigation Water Requirements, 1970, revised (U.S. Soil Conservation Service, 1970); (2) the University of Florida AFSIRS computer model (Smajstrla, 1986); and (3) the Florida Irrigation Guide (U.S. Soil Conservation Service, 1982). Other sources of supplemental irrigation coefficients were derived from metered data or were provided by turf-grass authorities.

Supplemental irrigation application rates (in inches per acre) generated from these sources were multiplied by the number of irrigated acres, and a water-use value was calculated. From this value, estimates of the water sources (ground or surface) were provided by the water management district's consumptive water-use permit files.

Power generation. Data for power generation withdrawals were obtained from the water management district's (consumptive water-use permit files or annual reports), or directly from the power companies. Withdrawal data were collected for ground and surface waters, both fresh and saline sources. Information on the amount of water purchased from public supplies was obtained from each facility along with the total gross power generated. Most of the water-use values for this category are from metered data.

Wastewater discharges. Data for domestic wastewater discharges were obtained from the FDEP's Domestic Wastewater Section, 2000 Reuse Inventory (Florida Department of Environmental Protection, 2001), or from data obtained from the monthly operating reports submitted to FDEP (Joseph Doker, Florida Department of Environmental Protection, written commun., October 2003). Most discharge values for this category are from metered data. The population served was estimated for each county by increasing the 1995 county population served (Marella, 1999) by the percent of growth by county between 1995 and 2000 (University of Florida, 2001), or by subtracting out the population served by septic tanks from the total county population. The population served by septic tanks in each county was estimated by multiplying the number of people per household (Smith and Cody, 2001) by the number of septic tanks per county. A few counties showed a decline in domestic wastewater population served between 1995 and 2000, most likely due to overestimating the 1995 population served.

Aquifer withdrawals. Estimates of water withdrawn by aquifer were made for each category. For public supply, commercial-industrial (including mining) self-supplied, and power generation information for the aquifer of withdrawal were obtained from water management district's consumptive water-use permits for each individual user. Estimates were made for domestic self-supplied, agricultural self-supplied, and recreational irrigation using information obtained from several ground-water studies recently conducted throughout the State that detailed estimates of withdrawals for selected aquifers in specific counties or areas (Duerr and others, 1988, Knowles and others, 2002, Sepulveda, 2002, and Shoemaker and Edwards, 2003) or were made from information obtained from local county agencies (County Health Departments) that regulate domestic wells. In counties with no information, estimates were made by assuming 90 percent of the water withdrawn was from the primary aquifer used for public supply and the remaining 10 percent from the local water table or shallow aquifer.

Accuracy. Water withdrawals and use data presented herein represent the average daily quantities used, as derived from annual data, and are expressed in million gallons per day (Mgal/d). Water-use values presented in the tables are reported to two places to the right of the decimal or to the nearest 10,000 gallons per day (gal/d). Water-use values in the text are rounded to the nearest million gallons per day, and percentages are rounded. Water-use data published herein report may not be identical to the water-use data published by the water management districts or FDEP because of differences in data-collection procedures, categories, and methodology.

The accuracy of these values varies from category to category. Public-supply values usually are more accurate because most public-supply systems meter water usage, whereas agricultural self-supplied or domestic self-supplied values usually are estimated. However, a small percentage of the irrigation values (agricultural and recreational) for 2000 were obtained from metered data.

Changes. Some changes in water-use categories have occurred in Florida between 1970 and 2000. Most categories have remained the same since 1970, with the following exceptions. During the 1970's, rural water use consisted of domestic self-supplied and livestock. In the 1980's, livestock was added to the agricultural, and domestic self-supplied became a separate category. For many reports, agricultural water use has included all irrigation, but in 1995, golf course and other recreational irrigation were removed from the agricultural water-use category and placed within a separate category (recreational irrigation). Because estimates of water use for golf courses was differentiated for 1985 and 1990, data for recreational irrigation was substracted from agriculture for those years. Agricultural self-supplied was called irrigation in the 1970's, then became agricultural irrigation in the 1980's, with the addition of livestock and removal of recreation irrigation. Commercial-industrial self-supplied was previously called industrial water use, and power generation was previously called thermoelectric power generation.

Miscellaneous water withdrawals and uses included in county totals presented in the 1985 water-use report (Marella, 1988) included water withdrawals for residential lawn irrigation, residential heat pumps and air-conditioning units, and water discharged from 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). Since 1985, some data on residential lawn watering for several counties have been updated and are included in the recreational irrigation section of this report under turf grass. Water used by residential heat pumps and air conditioning units and water discharged from free-flowing wells remain inconsistent between counties and are not included in this report.

Data for Miami-Dade County prior to 2000 are reported under Dade County. In 1997, Dade County officially changed to Miami-Dade County. All data presented herein are listed under Miami-Dade County.

Acknowledgments

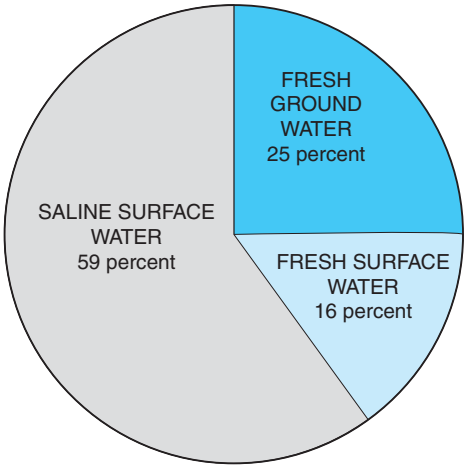
The author gratefully acknowledges the Florida Department of Environmental Protection--Office of Water Policy for its cooperation in the State water-use program, and extends a special thanks to the following individuals who provided program support or data and technical assistance; Joseph Doker, Lauren Walker-Coleman, Kathleen Greenwood, Kenna Study, and Thomas Swihart, (Tallahassee), as well as the many individuals in the Drinking Water and Wastewater Programs from the FDEP district offices in Ft. Myers, Jacksonville, Orlando, Pensacola, Tampa, and West Palm Beach.

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 participation and staff cooperation in providing water-use data. The participation of the following individuals is acknowledged for their data collection and tabulation efforts, and for their technical advice and support: Jeff Bonekemper, Francis Flores, and Tyler Macmillan at the Northwest Florida Water Management District in Havana; Bruce Florence, Jeanne Thompson, and Mary Beth Wilder at the St. Johns River Water Management District in Palatka; Chad Brcka, Lori Burke, Elizabeth Ellis, John Floyd, Sharon Fowler, Barbara Fronczek, David Gilpin-Hudson, Kurt Leckler, Richard March, William Rasperger, and Donna Rickabus at the South Florida Water Management District in West Palm Beach; Albert Bond, C. Donald Rome, and Kathleen Scott at the Southwest Florida Water Management District in Brooksville; Michael Fuller and Melanie Sardina at the Suwannee River Water Management District in Live Oak.

Additionally, special thanks are extended to the many utility operators, plant managers, and individuals who provided data vital to the completion of this effort. These include staff from: Bay County Public Utilities, Broward County Public Health Unit, Florida Power and Light Company, Florida Power Corporation (Progress Energy Company), Florida Rock Industries, Florida Water Services, Gainesville Regional Utilities, Gulf Power Company, Jacksonville Electric Authority (JEA), City of Key West, Lakeland Electric and Water, Lee County Public Health Unit, Miami-Dade Water and Sewer, Orlando Utilities Commission, Palm Beach County Public Health Unit, Polk County Public Health Unit, Sarasota County Public Health Unit, Tampa Electric, City of Tallahassee, University of Florida (Institute of Food and Agriculture Science), U.S. Department of Agriculture (Natural Resources Conservation Service), and the many others who provided data and technical guidance.

Water Withdrawals and Use

In 2000, the total amount of water withdrawn in Florida was estimated at 20,148 Mgal/d (table 1), of which 59 percent was saline water and 41 percent was freshwater (fig. 3). Ground water accounted for nearly 62 percent of freshwater withdrawals, and surface water accounted for the remaining 38 percent. Almost all of the saline water withdrawals (99.9 percent) were from surface water (table 1), which was used for once-through cooling at 23 power generating plants. The saline water was withdrawn from bays or rivers along the coast, and then returned to those sources. Florida ranked second in the Nation after California in saline water withdrawals in 2000 (Hutson and others, 2004).



Note: Saline ground water was less than 0.1 percent

Figure 3. Total water withdrawals in Florida by source, 2000.

Table 1. Total water withdrawals in Florida by category, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day]

Florida 2000	Freshwater			Saline Water		
	Ground	Surface	Total	Ground	Surface	Total
Public Supply	2,199.36	237.43	2,436.79	0.00	0.00	0.00
Domestic self-supplied	198.68	0.00	198.68	0.00	0.00	0.00
Commercial-industrial self-supplied	430.70	132.60	563.30	0.00	1.18	1.18
Agricultural self-supplied	1,989.95	1,933.06	3,923.01	0.00	0.00	0.00
Recreational irrigation	230.45	181.28	411.73	0.00	0.00	0.00
Power generation	29.53	628.73	658.26	3.82	11,950.82	11,954.64
TOTALS	**5,078.67**	**3,113.10**	**8,191.77**	**3.82**	**11,952.00**	**11,955.82**

The amount of freshwater withdrawn monthly fluctuates because of variations in temperature, precipitation (rainfall), crop production, and tourism. More than one-half (54 percent) of the freshwater withdrawn in 2000 was between February and June (fig. 4). Seasonal variation in withdrawals is normal; however, severe drought conditions were still present in Florida during the first half of 2000 (University of Nebraska, 2004). The dry conditions were present throughout most of the State, and three of the five water management districts (SJRWMD, SFWMD, and SWFWMD) issued water shortage mandates to help curb water use during the spring. Due to the dry conditions, water demands for all irrigation purposes (agriculture, recreation, and residential lawns) were higher-than-normal in 2000.

Public supply (43 percent) and agricultural self-supplied (39 percent) were the largest uses of ground water in 2000, followed by commercial-industrial self-supplied (including mining) (8.5 percent), recreational irrigation (4.5 percent), domestic self-supplied (4 percent), and power generation (1 percent) (fig. 5 and table 1). Agricultural self-supplied (62 percent) was the largest user of fresh surface water in 2000, followed by power generation (20 percent), public supply (8 percent), and recreational irrigation (6 percent), and commercial-industrial self-supplied (4 percent) (fig. 5 and table 1). Overall, agricultural self-supplied accounted for 48 percent of the total freshwater withdrawn (ground and surface). Power generation accounted for nearly all (99.9 percent) of the saline water withdrawn.

The largest amount of freshwater was withdrawn in Palm Beach County, and the largest amount of saline water was withdrawn in Hillsborough County (table 2). Significant withdrawals (more than 200 Mgal/d) of fresh ground water were in Miami-Dade, Polk, Orange, Palm Beach, Broward, and Collier Counties. Significant withdrawals (more than 200 Mgal/d) of fresh surface water occurred in Palm Beach, Hendry, and Escambia Counties.

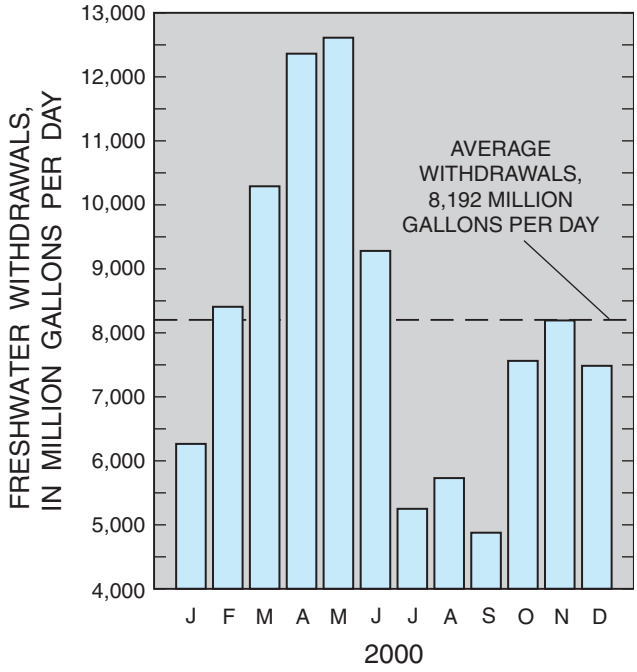


Figure 4. Average daily freshwater withdrawals by month in Florida, 2000.

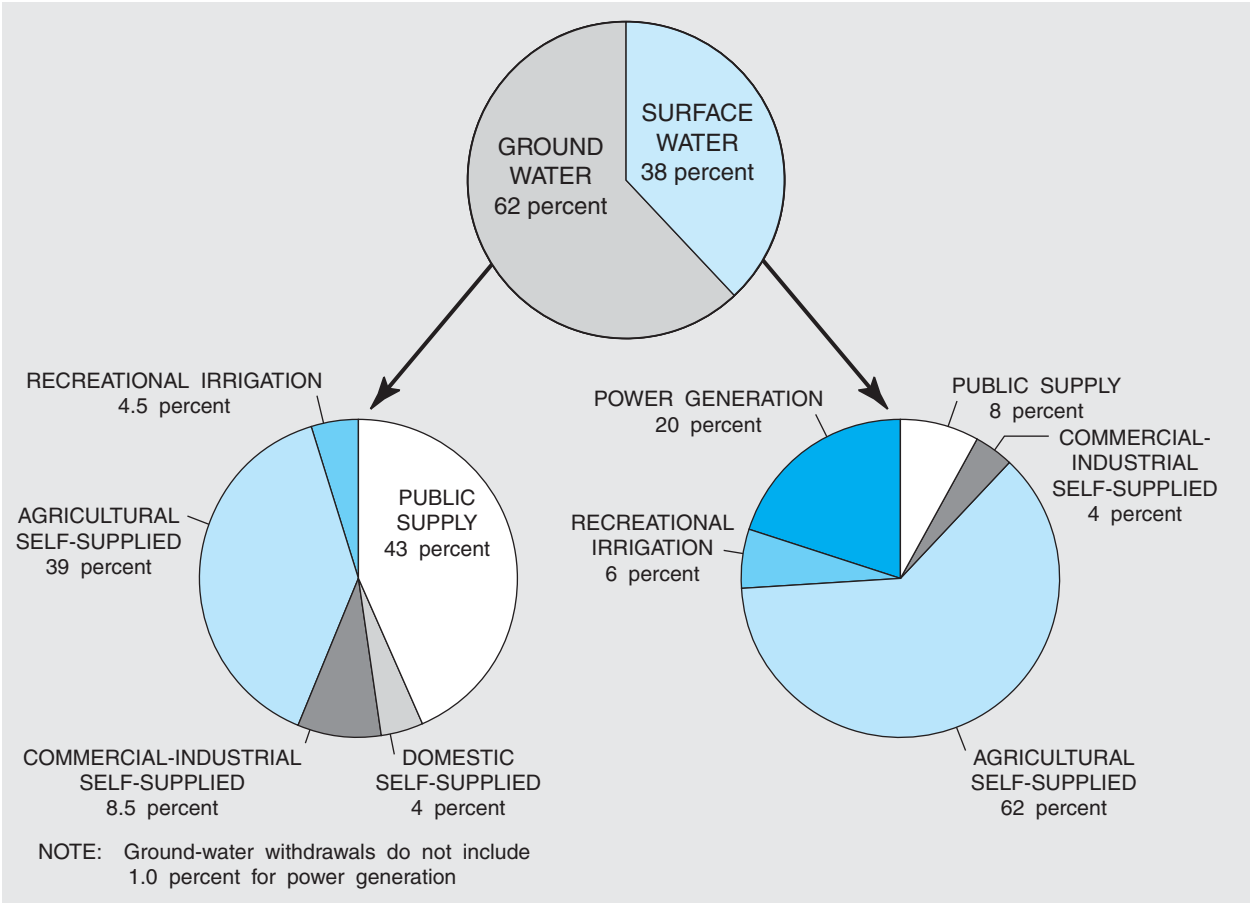


Figure 5. Fresh ground- and surface-water withdrawals in Florida by category, 2000.

Table 2. Total water withdrawals in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	59.58	0.00	59.58	0.57	0.00	0.57	60.15	0.00	60.15
Baker	6.15	0.00	6.15	1.73	0.00	1.73	7.88	0.00	7.88
Bay	12.22	0.00	12.22	45.68	265.05	310.73	57.90	265.05	322.95
Bradford	5.79	0.00	5.79	0.06	0.00	0.06	5.85	0.00	5.85
Brevard	143.53	0.00	143.53	39.20	1,079.28	1,118.48	182.73	1,079.28	1,262.01
Broward	273.46	0.00	273.46	28.35	1,512.39	1,540.74	301.81	1,512.39	1,814.20
Calhoun	4.34	0.00	4.34	1.79	0.00	1.79	6.13	0.00	6.13
Charlotte	35.95	0.00	35.95	28.04	0.00	28.04	63.99	0.00	63.99
Citrus	30.05	0.00	30.05	1.29	393.90	395.19	31.34	393.90	425.24
Clay	33.57	0.00	33.57	0.52	0.00	0.52	34.09	0.00	34.09
Collier	202.49	0.00	202.49	27.55	0.00	27.55	230.04	0.00	230.04
Columbia	13.88	0.00	13.88	0.21	0.00	0.21	14.09	0.00	14.09
DeSoto	123.87	0.00	123.87	9.51	0.00	9.51	133.38	0.00	133.38
Dixie	3.50	0.00	3.50	0.03	0.00	0.03	3.53	0.00	3.53
Duval	154.33	0.00	154.33	1.65	661.15	662.80	155.98	661.15	817.13
Escambia	91.94	0.00	91.94	225.31	0.00	225.31	317.25	0.00	317.25
Flagler	24.55	0.00	24.55	3.60	0.00	3.60	28.15	0.00	28.15
Franklin	2.25	0.00	2.25	0.00	0.00	0.00	2.25	0.00	2.25
Gadsden	8.93	0.00	8.93	7.40	0.00	7.40	16.33	0.00	16.33
Gilchrist	15.83	0.00	15.83	0.32	0.00	0.32	16.15	0.00	16.15
Glades	21.03	0.00	21.03	53.64	0.00	53.64	74.67	0.00	74.67
Gulf	3.10	0.00	3.10	1.65	0.00	1.65	4.75	0.00	4.75
Hamilton	41.61	0.00	41.61	0.11	0.00	0.11	41.72	0.00	41.72
Hardee	90.53	0.00	90.53	0.61	0.00	0.61	91.14	0.00	91.14
Hendry	197.12	0.00	197.12	314.99	0.00	314.99	512.11	0.00	512.11
Hernando	49.46	0.00	49.46	0.99	0.00	0.99	50.45	0.00	50.45
Highlands	157.29	0.00	157.29	17.26	0.00	17.26	174.55	0.00	174.55
Hillsborough	197.44	0.00	197.44	94.28	3,188.00	3,282.28	291.72	3,188.00	3,479.72
Holmes	3.77	0.00	3.77	0.32	0.00	0.32	4.09	0.00	4.09
Indian River	87.36	0.00	87.36	161.08	39.01	200.09	248.44	39.01	287.45
Jackson	21.87	0.00	21.87	91.23	0.00	91.23	113.10	0.00	113.10
Jefferson	8.39	0.00	8.39	0.17	0.00	0.17	8.56	0.00	8.56
Lafayette	6.78	0.00	6.78	0.16	0.00	0.16	6.94	0.00	6.94
Lake	90.84	0.00	90.84	9.77	0.00	9.77	100.61	0.00	100.61
Lee	120.80	0.00	120.80	39.77	492.27	532.04	160.57	492.27	652.84
Leon	45.36	0.00	45.36	0.30	0.00	0.30	45.66	0.00	45.66
Levy	28.44	0.00	28.44	2.63	0.00	2.63	31.07	0.00	31.07
Liberty	1.82	0.00	1.82	0.00	0.00	0.00	1.82	0.00	1.82
Madison	9.06	0.00	9.06	0.17	0.00	0.17	9.23	0.00	9.23
Manatee	122.30	0.00	122.30	64.65	0.00	64.65	186.95	0.00	186.95
Marion	67.68	0.00	67.68	2.10	0.00	2.10	69.78	0.00	69.78
Martin	43.60	0.00	43.60	155.27	0.00	155.27	198.87	0.00	198.87
Miami-Dade	537.91	3.68	541.59	28.68	33.19	61.87	566.59	36.87	603.46
Monroe	1.44	0.14	1.58	0.62	0.00	0.62	2.06	0.14	2.20
Nassau	46.53	0.00	46.53	0.48	1.18	1.66	47.01	1.18	48.19
Okaloosa	32.15	0.00	32.15	0.46	0.00	0.46	32.61	0.00	32.61
Okeechobee	59.80	0.00	59.80	12.03	0.00	12.03	71.83	0.00	71.83
Orange	281.36	0.00	281.36	16.72	0.00	16.72	298.08	0.00	298.08
Osceola	117.52	0.00	117.52	26.03	0.00	26.03	143.55	0.00	143.55
Palm Beach	273.70	0.00	273.70	1,005.48	433.02	1,438.50	1,279.18	433.02	1,712.20
Pasco	139.69	0.00	139.69	2.24	1,956.50	1,958.74	141.93	1,956.50	2,098.43
Pinellas	43.20	0.00	43.20	3.58	419.11	422.69	46.78	419.11	465.89
Polk	330.53	0.00	330.53	33.73	0.00	33.73	364.26	0.00	364.26
Putnam	40.35	0.00	40.35	48.92	0.00	48.92	89.27	0.00	89.27
St. Johns	52.55	0.00	52.55	3.16	0.00	3.16	55.71	0.00	55.71
St. Lucie	80.84	0.00	80.84	198.92	1,477.95	1,676.87	279.76	1,477.95	1,757.71
Santa Rosa	30.85	0.00	30.85	0.35	0.00	0.35	31.20	0.00	31.20
Sarasota	40.37	0.00	40.37	5.91	0.00	5.91	46.28	0.00	46.28
Seminole	88.47	0.00	88.47	1.78	0.00	1.78	90.25	0.00	90.25
Sumter	26.80	0.00	26.80	17.69	0.00	17.69	44.49	0.00	44.49
Suwannee	26.41	0.00	26.41	101.41	0.00	101.41	127.82	0.00	127.82
Taylor	46.79	0.00	46.79	3.02	0.00	3.02	49.81	0.00	49.81
Union	2.91	0.00	2.91	0.02	0.00	0.02	2.93	0.00	2.93
Volusia	97.02	0.00	97.02	137.72	0.00	137.72	234.74	0.00	234.74
Wakulla	4.79	0.00	4.79	28.38	0.00	28.38	33.17	0.00	33.17
Walton	10.51	0.00	10.51	1.81	0.00	1.81	12.32	0.00	12.32
Washington	4.32	0.00	4.32	0.00	0.00	0.00	4.32	0.00	4.32
State totals	**5,078.67**	**3.82**	**5,082.49**	**3,113.10**	**11,952.00**	**15,065.10**	**8,191.77**	**11,955.82**	**20,147.59**

Water Source and Use Category

Ground water was the source of drinking water for 14.75 million people (92 percent) in Florida during 2000. Florida, the largest user of ground water east of the Mississippi River, ranked fifth in the Nation in ground-water withdrawals in 2000 (Hutson and others, 2004). Ground water is available throughout the State, and generally needs little or no treatment prior to use. Florida accounted for about 78 percent of the total water withdrawn from the Floridan aquifer system (4,020 Mgal/d) in the southeastern United States (Marella and Berndt, 2005). About 62 percent of the ground water withdrawn in Florida was obtained from the Floridan aquifer system (3,125 Mgal/d), 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 (table 3). The Biscayne aquifer was the source for about 17 percent of ground water, whereas the remaining 21 percent was obtained from unnamed surficial aquifers, the intermediate aquifer, and the sand-and-gravel aquifer (fig. 6 and table 3). Surficial aquifers are primarily used for household wells (domestic self-supplied) or in areas where the Floridan aquifer system is nonpotable or too deep to be used economically.

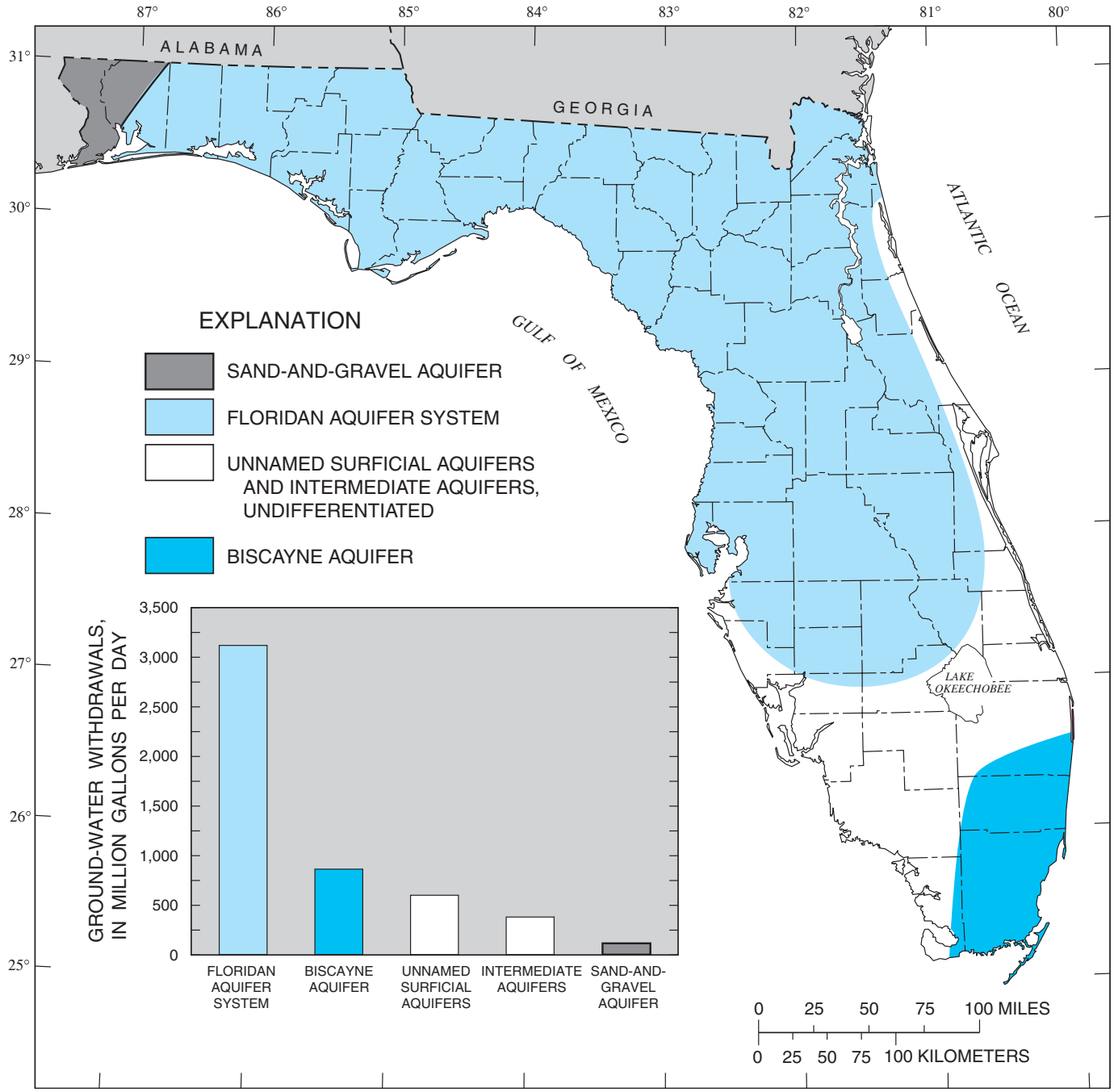


Figure 6. Approximate areal extent throughout which principal aquifers in Florida are the primary source of ground water and quantity of ground-water withdrawals, 2000. (Map modified from Vecchioli and Foose, 1985.)

Table 3. Total ground-water withdrawals by principal aquifer in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day]

County	Biscayne Aquifer	Floridan Aquifer	Intermediate Aquifer	Sand-Gravel Aquifer	Surficial Aquifer	Total
Alachua	0.00	59.16	0.00	0.00	0.42	59.58
Baker	0.00	5.95	0.00	0.00	0.20	6.15
Bay	0.00	12.02	0.00	0.00	0.20	12.22
Bradford	0.00	5.60	0.00	0.00	0.19	5.79
Brevard	0.00	123.55	0.00	0.00	19.98	143.53
Broward	273.37	0.09	0.00	0.00	0.00	273.46
Calhoun	0.00	4.25	0.00	0.00	0.09	4.34
Charlotte	0.00	7.32	27.11	0.00	1.52	35.95
Citrus	0.00	29.35	0.00	0.00	0.70	30.05
Clay	0.00	32.97	0.00	0.00	0.60	33.57
Collier	0.00	4.37	115.86	0.00	82.26	202.49
Columbia	0.00	13.51	0.00	0.00	0.37	13.88
DeSoto	0.00	110.01	13.86	0.00	0.00	123.87
Dixie	0.00	3.42	0.00	0.00	0.08	3.50
Duval	0.00	150.00	0.00	0.00	4.33	154.33
Escambia	0.00	0.00	0.00	91.94	0.00	91.94
Flagler	0.00	20.58	0.00	0.00	3.97	24.55
Franklin	0.00	2.23	0.00	0.00	0.02	2.25
Gadsden	0.00	8.75	0.00	0.00	0.18	8.93
Gilchrist	0.00	15.70	0.00	0.00	0.13	15.83
Glades	0.00	7.65	0.71	0.00	12.67	21.03
Gulf	0.00	2.57	0.00	0.00	0.53	3.10
Hamilton	0.00	41.54	0.00	0.00	0.07	41.61
Hardee	0.00	81.73	8.80	0.00	0.00	90.53
Hendry	0.00	0.25	126.17	0.00	70.70	197.12
Hernando	0.00	49.32	0.00	0.00	0.14	49.46
Highlands	0.00	133.77	23.43	0.00	0.09	157.29
Hillsborough	0.00	194.86	2.34	0.00	0.24	197.44
Holmes	0.00	3.64	0.00	0.00	0.13	3.77
Indian River	0.00	74.01	0.00	0.00	13.35	87.36
Jackson	0.00	21.55	0.00	0.00	0.32	21.87
Jefferson	0.00	8.31	0.00	0.00	0.08	8.39
Lafayette	0.00	6.72	0.00	0.00	0.06	6.78
Lake	0.00	90.41	0.00	0.00	0.43	90.84
Lee	0.00	19.40	32.71	0.00	68.69	120.80
Leon	0.00	44.93	0.00	0.00	0.43	45.36
Levy	0.00	28.04	0.00	0.00	0.40	28.44
Liberty	0.00	1.77	0.00	0.00	0.05	1.82
Madison	0.00	8.94	0.00	0.00	0.12	9.06
Manatee	0.00	118.25	4.05	0.00	0.00	122.30
Marion	0.00	66.04	0.00	0.00	1.64	67.68
Martin	0.00	5.79	0.00	0.00	37.81	43.60
Miami-Dade	537.91	3.68	0.00	0.00	0.00	541.59
Monroe	0.11	1.37	0.00	0.00	0.10	1.58
Nassau	0.00	43.62	0.00	0.00	2.91	46.53
Okaloosa	0.00	32.02	0.00	0.00	0.13	32.15
Okeechobee	0.00	47.76	0.00	0.00	12.04	59.80
Orange	0.00	280.48	0.00	0.00	0.88	281.36
Osceola	0.00	114.65	0.00	0.00	2.87	117.52
Palm Beach	63.24	6.45	0.00	0.00	204.01	273.70
Pasco	0.00	139.24	0.00	0.00	0.45	139.69
Pinellas	0.00	43.16	0.00	0.00	0.04	43.20
Polk	0.00	317.73	11.56	0.00	1.24	330.53
Putnam	0.00	39.85	0.00	0.00	0.50	40.35
St. Johns	0.00	46.69	0.00	0.00	5.86	52.55
St. Lucie	0.00	46.98	0.00	0.00	33.86	80.84
Santa Rosa	0.00	9.03	0.00	21.82	0.00	30.85
Sarasota	0.00	27.23	13.10	0.00	0.04	40.37
Seminole	0.00	88.20	0.00	0.00	0.27	88.47
Sumter	0.00	26.34	0.00	0.00	0.46	26.80
Suwannee	0.00	26.14	0.00	0.00	0.27	26.41
Taylor	0.00	46.70	0.00	0.00	0.09	46.79
Union	0.00	2.80	0.00	0.00	0.11	2.91
Volusia	0.00	96.72	0.00	0.00	0.30	97.02
Wakulla	0.00	4.79	0.00	0.00	0.00	4.79
Walton	0.00	10.49	0.00	0.00	0.02	10.51
Washington	0.00	4.18	0.00	0.00	0.14	4.32
State totals	**874.63**	**3,124.62**	**379.70**	**113.76**	**589.78**	**5,082.49**

Florida ranked twenty-seventh in the Nation in fresh surface-water withdrawals in 2000 (Hutson and others, 2004). The primary users of surface water throughout Florida are irrigators and power plants, which used about 82 percent of the fresh water. The majority of fresh surface water used is in the Southern Florida subregion (fig. 7) and is associated with Lake Okeechobee and the Everglades Agricultural Area of Glades, Hendry, and Palm Beach Counties (fig. 7). This area is intensively irrigated for sugarcane and vegetables and accounted for nearly two-thirds of the surface-water withdrawals during 2000.

Most of the surface water used in Florida is from managed and maintained canal systems or large water bodies. Major sources of fresh surface water for irrigation include Lake Okeechobee and associated canals (Glades, Hendry, Martin, Palm Beach, and St. Lucie Counties), the Caloosahatchee River (Glades, Hendry, and Lee Counties), and the headwaters of the Upper St. Johns River (Brevard, Indian River, Okeechobee, and St. Lucie Counties). Surface water from these sources is most often diverted through canals or ditches, then pumped or gravity-fed onto fields or groves. A large percentage of the water that is flooded onto fields or groves is unused and pumped back into the canals or ditches for further use. Throughout the remainder of Florida, surface water for irrigation is obtained from local canals, ditches, lakes, ponds, small rivers, creeks, or tributaries. Many of the canals, ditches, or ponds that are used for irrigation are augmented with ground water.

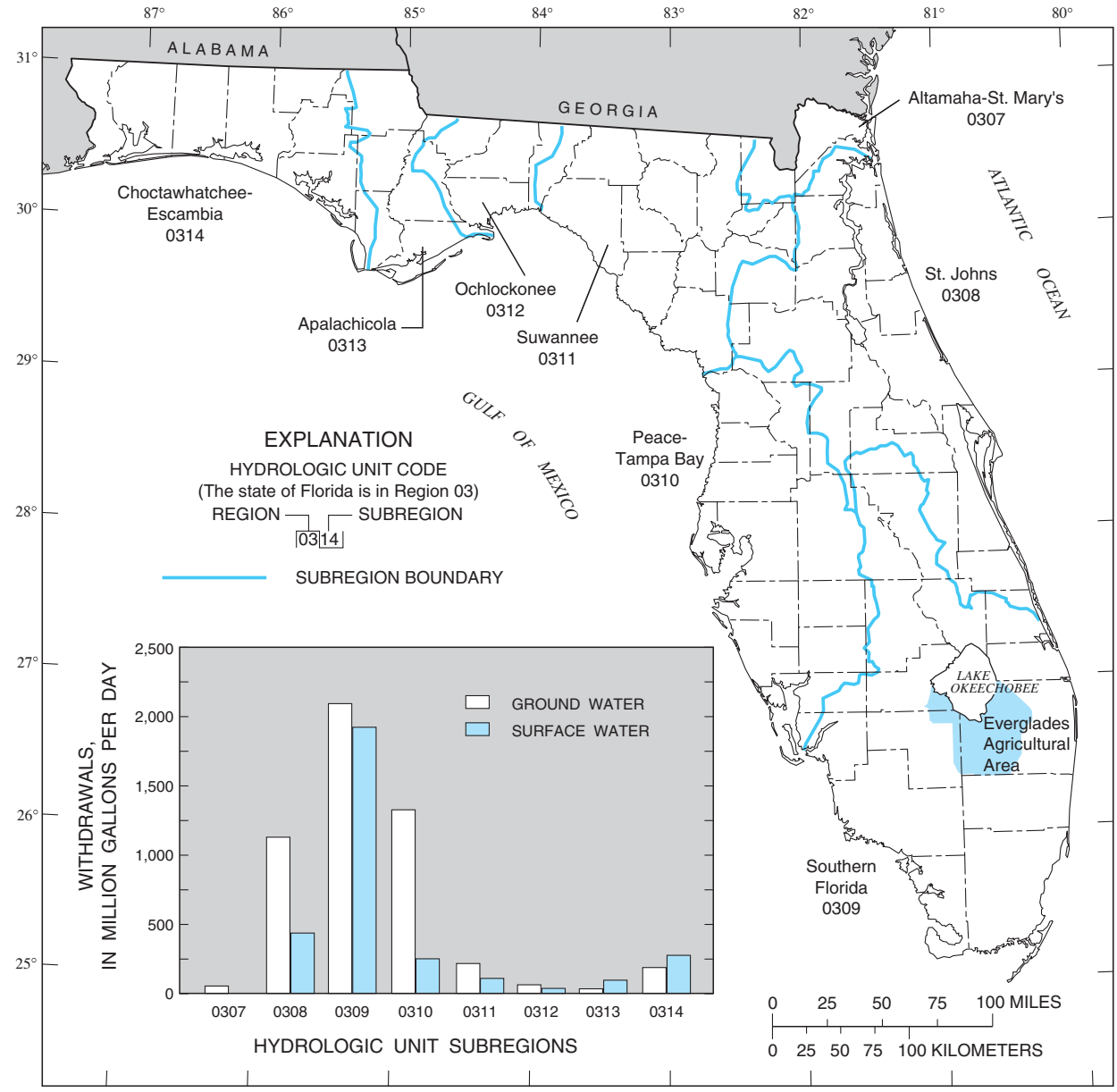


Figure 7. General location of hydrologic units in Florida and fresh ground- and surface-water withdrawals within these units, 2000. (Map from U.S. Geological Survey, 1975; and Seaber and others, 1984.)

Public Supply

The public-supply category refers to water distributed by a publicly- or privately-owned community water system to the public. A total of 2,030 community water systems in Florida met this criteria in 2000 (Kenna Study, Florida Department of Environmental Protection, written commun., 2004; and Drinking Water Quick Look Report, Florida Department of Environmental Protection, written commun., June 2000). For this report, water-use data were collected for 1,156 systems that either served 400 people or more, or withdrew 10,000 gal/d (0.01 Mgal/d) or more. Water withdrawals from the inventoried systems totaled 2,437 Mgal/d and accounted for an estimated 99.7 percent of total public-supply withdrawals in 2000. Water withdrawn by the uninventoried systems was estimated to be about 8 Mgal/d (874 systems multiplied by 0.009 Mgal/d) and is accounted for under domestic self-supplied.

Water withdrawals for public supply in Florida in 2000 totaled 2,437 Mgal/d, of which 90 percent was obtained from ground water and 10 percent from surface water (table 4). Nearly 88 percent (14.03 million) of the State's 15.98 million residents obtained their drinking water from a public-supply water system (table 4). Of those 14.03 million residents using public-supply drinking water, 91 percent (12.80 million) were supplied from ground-water sources, and the remaining 9 percent (1.23 million) received water from surface-water sources.

Florida ranked second in the Nation to California in ground-water withdrawals for public supply (Hutson and others, 2004). The Floridan aquifer system supplied nearly 53 percent of the total public-supply withdrawals (fig. 8) and served an estimated 6.9 million people. The Biscayne aquifer supplied 32 percent of the total public-supply withdrawals and served nearly 4 million people.

The Hillsborough River and Tampa Bypass Canal in Hillsborough County supplied 34 percent of the total surface water for public supply and Deer Point Lake in Bay County supplied 19 percent. Other significant surface-water sources of public supply water include the Braden and Manatee Rivers in Manatee County, Clear Lake in Palm Beach County, Lake Washington in Brevard County, and the Peace River and Shell Creek in Charlotte and De Soto Counties. Several of the public-supply water systems that use surface water also augment their water supply with ground water or stored surface water in an aquifer (Aquifer Storage and Recovery Systems) for later use.

Public-supply withdrawals in 2000 were smallest in September and largest in May (fig. 9). Seasonal differences in residential demands are caused by variations in temperature, precipitation, and tourism. Extreme dry conditions occurred between February and June of 2000 and the result was higher water demands from public supply primarily for lawn irrigation during these months. Lawn irrigation in central and south Florida occurs throughout the entire year.

Public suppliers provide water (deliveries) for domestic (residential), commercial, industrial, public, and other uses (see Glossary). The public-use category includes firefighting, system maintenance, and water that is lost to leakage or processing (for desalination or lime-softening). Domestic water use, which includes indoor and outdoor residential uses, accounted for

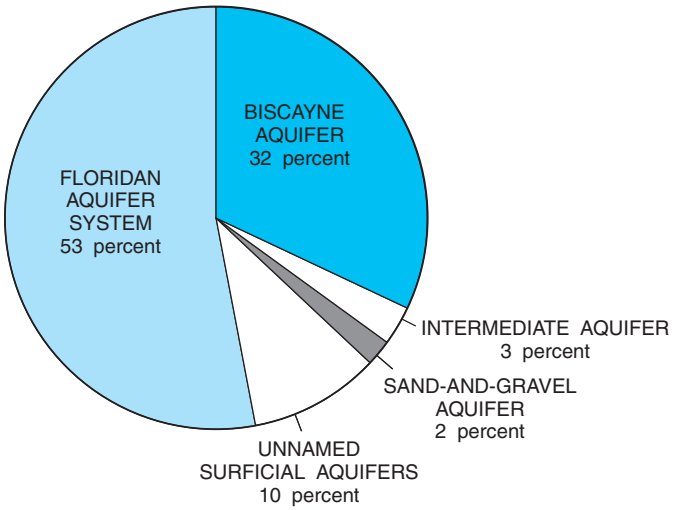


Figure 8. Public-supply ground-water withdrawals in Florida by principal aquifer, 2000.

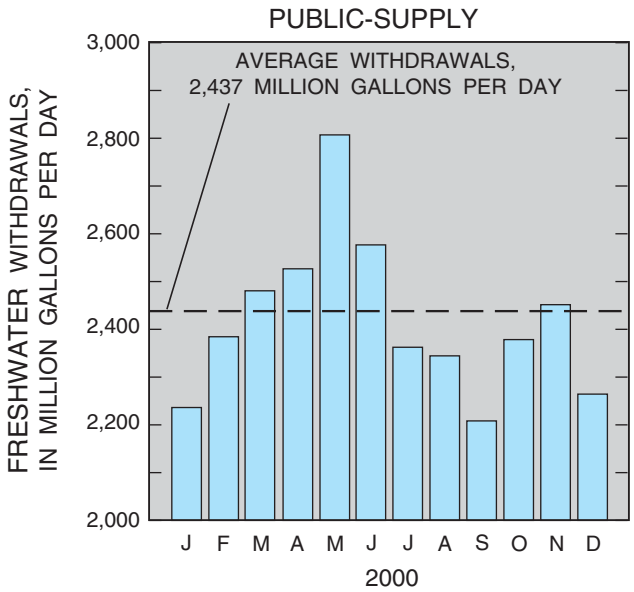


Figure 9. Average daily public-supply freshwater withdrawals by month in Florida, 2000.

Table 4. Public-supplied population, water use, withdrawals, transfers, and treated water in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; water values in million gallons per day; per capita in gallons per day]

County	Population		Use		Withdrawals			Transfers			Treated
	Total[1]	Public supply	Total	Per capita	Total	Ground	Surface	Imports	Exports	Losses	Water
Alachua	217,955	179,118	28.26	158	28.26	28.26	0.00	0.00	0.00	0.00	0.00
Baker	22,259	4,326	0.88	203	0.88	0.88	0.00	0.00	0.00	0.00	0.00
Bay	148,217	129,300	51.17	396	51.17	6.28	44.89	0.00	0.00	0.00	0.00
Bradford	26,088	8,338	1.38	166	1.38	1.38	0.00	0.00	0.00	0.00	0.00
Brevard	476,230	458,282	53.35	116	27.74	13.66	14.08	25.61	0.00	0.00	0.00
Broward	1,623,018	1,603,081	258.06	161	258.06	258.06	0.00	0.00	0.00	0.00	0.09
Calhoun	13,017	4,224	0.75	178	0.75	0.75	0.00	0.00	0.00	0.00	0.00
Charlotte	141,627	115,564	14.21	123	7.28	3.29	3.99	7.72	0.00	0.79	3.29
Citrus	118,085	66,234	13.97	211	13.97	13.97	0.00	0.00	0.00	0.00	0.00
Clay	140,814	100,785	14.77	147	14.77	14.77	0.00	0.00	0.00	0.00	0.00
Collier	251,377	226,175	52.40	232	52.40	47.17	5.23	0.00	0.00	0.00	22.46
Columbia	56,513	21,235	3.67	173	3.67	3.67	0.00	0.00	0.00	0.00	0.00
DeSoto	32,209	11,233	1.90	169	10.59	4.49	6.10	0.00	8.63	0.06	0.00
Dixie	13,827	4,622	0.67	145	0.67	0.67	0.00	0.00	0.00	0.00	0.00
Duval	778,879	736,838	119.12	162	119.12	119.12	0.00	0.00	0.00	0.00	0.00
Escambia	294,410	279,294	43.56	156	44.63	44.63	0.00	0.00	1.07	0.00	0.00
Flagler	49,832	43,953	6.22	142	6.22	6.22	0.00	0.00	0.00	0.00	0.00
Franklin	11,057	9,258	1.92	207	1.92	1.92	0.00	0.00	0.00	0.00	0.00
Gadsden	45,087	27,632	4.34	157	4.34	3.06	1.28	0.00	0.00	0.00	0.00
Gilchrist	14,437	1,850	0.27	146	0.27	0.27	0.00	0.00	0.00	0.00	0.00
Glades	10,576	4,782	0.55	115	0.55	0.55	0.00	0.00	0.00	0.00	0.00
Gulf	13,332	10,338	1.47	142	1.47	1.47	0.00	0.00	0.00	0.00	0.00
Hamilton	13,327	6,366	0.95	149	0.95	0.95	0.00	0.00	0.00	0.00	0.00
Hardee	26,938	13,571	1.78	131	1.78	1.78	0.00	0.00	0.00	0.00	0.00
Hendry	36,210	20,457	4.72	231	4.72	0.95	3.77	0.00	0.00	0.00	0.00
Hernando	130,802	116,025	20.27	175	20.27	20.26	0.01	0.00	0.00	0.00	0.00
Highlands	87,366	69,820	9.14	131	9.14	9.14	0.00	0.00	0.00	0.00	0.00
Hillsborough	998,948	854,750	155.07	181	166.39	85.51	80.88	0.02	11.30	0.04	0.00
Holmes	18,564	5,860	1.38	235	1.38	1.38	0.00	0.00	0.00	0.00	0.00
Indian River	112,947	95,337	13.93	146	13.93	13.93	0.00	0.00	0.00	0.00	6.23
Jackson	46,755	16,348	2.46	150	2.46	2.46	0.00	0.00	0.00	0.00	0.00
Jefferson	12,902	5,010	0.72	144	0.72	0.72	0.00	0.00	0.00	0.00	0.00
Lafayette	7,022	1,264	0.20	158	0.20	0.20	0.00	0.00	0.00	0.00	0.00
Lake	210,528	171,137	39.92	233	39.92	39.92	0.00	0.00	0.00	0.00	0.00
Lee	440,888	357,289	52.37	147	52.37	49.09	3.28	0.00	0.00	0.00	24.37
Leon	239,452	198,937	35.70	179	35.70	35.70	0.00	0.00	0.00	0.00	0.00
Levy	34,450	11,066	2.16	195	2.16	2.16	0.00	0.00	0.00	0.00	0.00
Liberty	7,021	2,764	0.39	141	0.39	0.39	0.00	0.00	0.00	0.00	0.00
Madison	18,733	7,166	1.65	230	1.65	1.65	0.00	0.00	0.00	0.00	0.00
Manatee	264,002	250,270	39.81	159	49.92	13.87	36.05	0.00	9.71	0.40	0.00
Marion	258,916	136,842	27.99	205	27.99	27.99	0.00	0.00	0.00	0.00	0.00
Martin	126,731	87,100	18.45	212	18.45	18.45	0.00	0.00	0.00	0.00	2.82
Miami-Dade	2,253,362	2,207,800	377.27	171	394.29	394.29	0.00	0.00	17.02	0.00	0.00
Monroe	79,589	78,885	17.02	216	0.00	0.00	0.00	17.02	0.00	0.00	0.00
Nassau	57,663	24,875	6.81	274	6.81	6.81	0.00	0.00	0.00	0.00	0.00
Okaloosa	170,498	158,504	22.97	145	22.97	22.97	0.00	0.00	0.00	0.00	0.00
Okeechobee	35,910	21,600	2.23	103	2.23	0.54	1.69	0.00	0.00	0.00	0.00
Orange	896,344	813,152	186.15	229	211.76	211.76	0.00	0.00	25.61	0.00	0.00
Osceola	172,493	128,932	30.00	233	30.00	30.00	0.00	0.00	0.00	0.00	0.00
Palm Beach	1,131,184	1,035,732	229.84	222	229.84	194.57	35.27	0.00	0.00	0.00	18.27
Pasco	344,765	275,800	35.23	128	102.67	102.67	0.00	0.00	67.44	0.00	0.00
Pinellas	921,482	914,110	116.02	127	39.88	39.88	0.00	78.74	0.00	2.60	0.00
Polk	483,924	396,543	75.49	190	75.49	75.43	0.06	0.00	0.00	0.00	0.00
Putnam	70,423	23,311	3.20	137	3.20	3.20	0.00	0.00	0.00	0.00	0.00
St. Johns	123,135	105,104	16.49	157	16.49	16.49	0.00	0.00	0.00	0.00	0.00
St. Lucie	192,695	122,960	17.95	146	17.95	17.95	0.00	0.00	0.00	0.00	5.65
Santa Rosa	117,743	110,108	14.54	132	13.47	13.47	0.00	1.07	0.00	0.00	0.00
Sarasota	325,957	277,065	36.09	130	28.71	27.86	0.85	10.62	0.00	3.24	12.11
Seminole	365,196	339,403	66.90	197	66.90	66.90	0.00	0.00	0.00	0.00	0.00
Sumter	53,345	28,243	4.44	157	4.44	4.44	0.00	0.00	0.00	0.00	0.00
Suwannee	34,844	9,393	1.40	149	1.40	1.40	0.00	0.00	0.00	0.00	0.00
Taylor	19,256	10,289	1.73	168	1.73	1.73	0.00	0.00	0.00	0.00	0.00
Union	13,442	3,155	0.36	114	0.36	0.36	0.00	0.00	0.00	0.00	0.00
Volusia	443,343	414,851	54.90	132	54.90	54.90	0.00	0.00	0.00	0.00	0.00
Wakulla	22,863	9,285	2.19	236	2.19	2.19	0.00	0.00	0.00	0.00	0.00
Walton	40,601	39,024	7.35	188	7.35	7.35	0.00	0.00	0.00	0.00	0.00
Washington	20,973	7,565	1.16	153	1.16	1.16	0.00	0.00	0.00	0.00	0.00
State totals	**15,982,378**	**14,029,530**	**2,429.68**	**174**	**2,436.79**	**2,199.36**	**237.43**	**140.80**	**140.78**	**7.11**	**95.29**

[1]University of Florida, 2001.

61 percent of the public-supply withdrawals (fig. 10 and table 5) in 2000. Domestic use was derived from the residual of the total public-supply net water use in each county minus the commercial, industrial, public, and other uses. Commercial (19 percent) and industrial (4 percent) water deliveries were estimated by multiplying county employment totals (U.S. Census Bureau, 2002) by a water-use coefficient based on average water use per employee (Davis and others, 1988) for various commercial and industrial employment sectors (Bucca and Marella, 1992). Deliveries to commercial and industrial users increased from 162 Mgal/d (Pride, 1973) in 1970, to 558 Mgal/d in 2000 (table 5), or more than 240 percent. The percentage of public-supplied water provided for public uses (including losses) in the southeastern United States (14 percent) and the percent of water provided for other uses (irrigation and power generation) in the southeastern United States (1 percent) were obtained from the American Water Works Association (1992). Some specific data for water losses were provided directly from the individual users, estimated from data provided by the water management districts, or obtained from the FDEP's monthly operating reports. Estimates of the use or deliveries of public-supply water for each county in Florida are presented in table 5.

The statewide public-supply per capita use for Florida was 174 gal/d. This value is the total public-supply water withdrawn (2,437 Mgal/d) divided by the total population served by public supply (14.03 million). Per capita use computed in this manner includes water delivered for residential, commercial, industrial, public and other uses. The public-supply per capita for 2000 is higher than previous years with the exception of 1980 (fig. 11). Both 1980 and 2000 are years that had dry conditions statewide that affected public-supply water demands primarily for residential lawn irrigation. The statewide public-supply per capita use was slightly lower than the national average for 2000 of 180 gal/d (Hutson and others, 2004). The national average is heavily influenced by the arid western states.

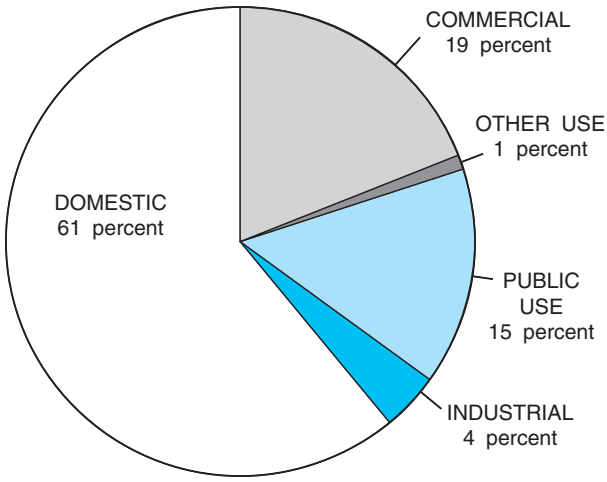


Figure 10. Public-supply water use (deliveries) in Florida, 2000.

Florida's average for domestic (residential) per capita use of 106 gal/d (table 5) in 2000 is slightly higher than the 103 gal/d in 1995 (Marella, 1999). The per capita use for domestic (residential) deliveries in Florida has been decreasing since the average of 144 gal/d in 1980 (Solley and others, 1983), primarily as a result of (1) conservation efforts and the use of more efficient water fixtures; (2) the use of reclaimed wastewater as a source of water for lawn irrigation; (3) the use of xeriscape landscaping; and (4) a change in the way domestic water use was derived between 1980 and 2000. The increase between 1995 and 2000 probably can be attributed to the dry conditions during 2000. It is estimated that between 25 and 75 percent of the domestic use in Florida is for outdoor purposes during certain times of the year.

The largest water withdrawals for public supply in 2000 were in Miami-Dade and Broward Counties (table 4). Miami-Dade Water and Sewer is the single largest water supplier in the State followed by Tampa Bay Water. Miami-Dade Water and Sewer withdrew 346 Mgal/d of water and served 2.0 million people; Tampa Bay Water withdrew 270 Mgal/d and served 1.7 million people (Southwest Florida Water Management District, 2002). Miami-Dade Water and Sewer obtains all of its water from the Biscayne aquifer (http://www.miamidade.gov) through several large wellfields within the county. Tampa Bay Water obtains about 70 percent of its water from 12 Floridan aquifer system wellfields (http://www.tampabaywater.org) located in three counties (Hillsborough, Pasco, and Pinellas)

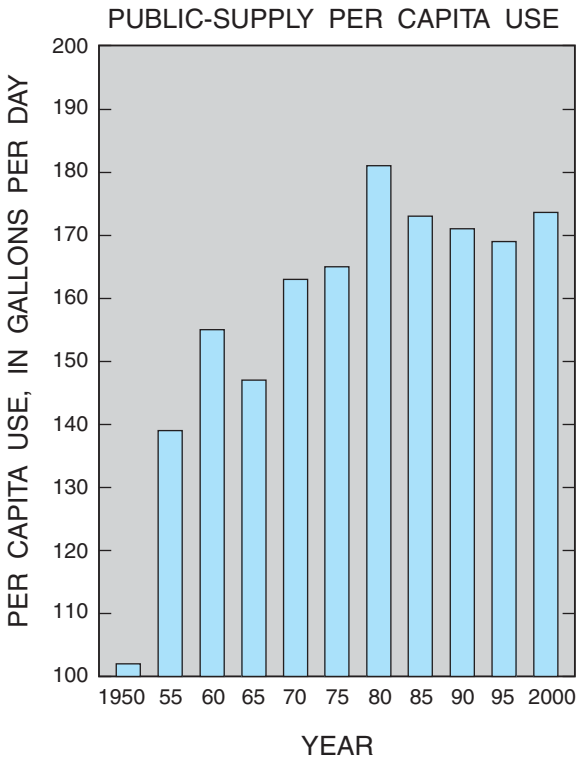


Figure 11. Historical public supply average daily per capita use in Florida, 1950-2000. (Modified from Marella, 1999.)

Table 5. Estimated public supply water use (deliveries), and per capita use in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; water values in million gallons per day; per capita in gallons per day]

County	Population served	Public supply water use (deliveries), in million gallons per day					Total use	Per capita use, in gallons per day	
		Domestic (residential)	Commercial	Industrial	Other uses	Public uses and losses		Public supply	Domestic (residential)
Alachua	179,118	15.18	8.03	0.81	0.28	3.96	28.26	158	85
Baker	4,326	0.37	0.33	0.05	0.01	0.12	0.88	203	86
Bay	129,300	13.73	4.74	25.03	0.51	7.16	51.17	396	106
Bradford	8,338	0.76	0.34	0.08	0.01	0.19	1.38	166	91
Brevard	458,282	31.82	11.64	1.89	0.53	7.47	53.35	116	69
Broward	1,603,081	167.93	45.18	6.24	2.58	36.13	258.06	161	105
Calhoun	4,224	0.43	0.16	0.04	0.01	0.11	0.75	178	102
Charlotte	115,564	8.59	2.45	0.19	0.14	2.84	14.21	123	74
Citrus	66,234	9.62	2.03	0.22	0.14	1.96	13.97	211	145
Clay	100,785	9.86	2.38	0.31	0.15	2.07	14.77	147	98
Collier	226,175	30.33	7.61	0.84	0.52	13.10	52.40	232	134
Columbia	21,235	1.74	1.20	0.18	0.04	0.51	3.67	173	82
DeSoto	11,233	1.15	0.42	0.04	0.02	0.27	1.90	169	102
Dixie	4,622	0.40	0.12	0.05	0.01	0.09	0.67	145	87
Duval	736,838	69.88	26.13	5.24	1.19	16.68	119.12	162	95
Escambia	279,294	28.13	8.17	0.72	0.44	6.10	43.56	156	101
Flagler	43,953	4.25	0.81	0.23	0.06	0.87	6.22	142	97
Franklin	9,258	1.40	0.21	0.02	0.02	0.27	1.92	207	151
Gadsden	27,632	2.78	0.74	0.17	0.04	0.61	4.34	157	101
Gilchrist	1,850	0.11	0.10	0.02	0.00	0.04	0.27	146	59
Glades	4,782	0.33	0.10	0.03	0.01	0.08	0.55	115	69
Gulf	10,338	1.05	0.17	0.03	0.01	0.21	1.47	142	102
Hamilton	6,366	0.55	0.25	0.01	0.01	0.13	0.95	149	86
Hardee	13,571	1.19	0.29	0.03	0.02	0.25	1.78	131	88
Hendry	20,457	2.06	0.40	1.55	0.05	0.66	4.72	231	101
Hernando	116,025	15.26	1.79	0.18	0.20	2.84	20.27	175	132
Highlands	69,820	5.04	2.59	0.14	0.09	1.28	9.14	131	72
Hillsborough	854,750	89.64	36.11	6.06	1.55	21.71	155.07	181	105
Holmes	5,860	0.80	0.33	0.05	0.01	0.19	1.38	235	137
Indian River	95,337	6.92	2.93	0.46	0.14	3.48	13.93	146	73
Jackson	16,348	1.10	0.87	0.13	0.02	0.34	2.46	150	67
Jefferson	5,010	0.43	0.16	0.02	0.01	0.10	0.72	144	86
Lafayette	1,264	0.09	0.07	0.01	0.00	0.03	0.20	158	71
Lake	171,137	29.36	3.96	0.62	0.39	5.59	39.92	233	172
Lee	357,289	26.04	11.27	1.45	0.52	13.09	52.37	147	73
Leon	198,937	20.34	9.36	0.64	0.36	5.00	35.70	179	102
Levy	11,066	1.35	0.40	0.09	0.02	0.30	2.16	195	122
Liberty	2,764	0.27	0.06	0.01	0.00	0.05	0.39	141	98
Madison	7,166	0.66	0.35	0.39	0.02	0.23	1.65	230	92
Manatee	250,270	27.40	5.39	1.05	0.40	5.57	39.81	159	109
Marion	136,842	17.25	5.03	1.52	0.27	3.92	27.99	205	126
Martin	87,100	10.77	3.69	0.49	0.18	3.32	18.45	212	124
Miami-Dade	2,207,800	245.18	66.16	9.34	3.77	52.82	377.27	171	111
Monroe	78,885	10.62	3.67	0.18	0.17	2.38	17.02	216	135
Nassau	24,875	4.03	1.39	0.37	0.07	0.95	6.81	274	162
Okaloosa	158,504	14.44	4.55	0.53	0.23	3.22	22.97	145	91
Okeechobee	21,600	1.32	0.54	0.04	0.02	0.31	2.23	103	61
Orange	813,152	103.95	48.53	5.75	1.86	26.06	186.15	229	128
Osceola	128,932	20.01	5.15	0.34	0.30	4.20	30.00	233	155
Palm Beach	1,035,732	151.64	34.78	4.35	2.30	36.77	229.84	222	146
Pasco	275,800	24.09	5.25	0.61	0.35	4.93	35.23	128	87
Pinellas	914,110	61.45	31.22	5.95	1.16	16.24	116.02	127	67
Polk	396,543	50.28	11.24	2.65	0.75	10.57	75.49	190	127
Putnam	23,311	1.63	0.93	0.16	0.03	0.45	3.20	137	70
St. Johns	105,104	10.07	3.56	0.39	0.17	2.30	16.49	157	96
St. Lucie	122,960	10.29	3.24	0.47	0.18	3.77	17.95	146	84
Santa Rosa	110,108	10.77	1.41	0.18	0.15	2.03	14.54	132	98
Sarasota	277,065	14.95	11.44	1.40	0.36	7.94	36.09	130	54
Seminole	339,403	46.38	9.09	1.39	0.67	9.37	66.90	197	137
Sumter	28,243	3.22	0.42	0.14	0.04	0.62	4.44	157	114
Suwannee	9,393	0.68	0.43	0.08	0.01	0.20	1.40	149	72
Taylor	10,289	0.98	0.36	0.13	0.02	0.24	1.73	168	95
Union	3,155	0.17	0.12	0.02	0.00	0.05	0.36	114	54
Volusia	414,851	34.21	10.90	1.55	0.55	7.69	54.90	132	82
Wakulla	9,285	1.59	0.25	0.02	0.02	0.31	2.19	236	171
Walton	39,024	5.20	1.00	0.05	0.07	1.03	7.35	188	133
Washington	7,565	0.54	0.37	0.08	0.01	0.16	1.16	153	71
State totals	**14,029,530**	**1,484.05**	**464.36**	**93.50**	**24.24**	**363.53**	**2,429.68**[1]	**174**	**106**

[1]Does not include 7.11 million gallons per day of transfer losses as reported in table 4.

and the remaining 30 percent from surface water sources in Hillsborough County. Other counties with significant withdrawals (more than 100 Mgal/d) of public-supply water are Palm Beach, Orange, Hillsborough, Duval, and Pasco (table 4). Several counties rely on water imported from other counties. Most of these transfers occur in Hillsborough, Pasco, and Pinellas Counties as Tampa Bay Water moves water from wellfields to suppliers (table 4). Miami-Dade County's water withdrawals also included water supplied (exported) to neighboring Monroe County (17 Mgal/d) for public supply throughout the Florida Keys.

Water withdrawals for public supply in Florida have increased steadily since water-use data were first collected. Total public-supply withdrawals increased 1,330 percent between 1950 and 2000 (fig. 12). Over this same period, the population of Florida increased approximately 475 percent, from 2.77 million in 1950 (Dietrich, 1978) to 15.98 million in 2000 (University of Florida, 2001). In addition to the increase in the State's population, the percentage of the population that relies on public supply for drinking water increased. In 1950, about 60 percent of the State's population was served by a public supplier; this percentage increased to 86 percent in 1985 (Marella, 1988), and has increased to 88 percent in 2000. Public-supply withdrawals increased 175 percent between 1970 and 2000, and 17 percent between 1995 and 2000. A significant part of the recent increase is a result of higher demands primarily for lawn watering caused by dry conditions during the Spring of 2000.

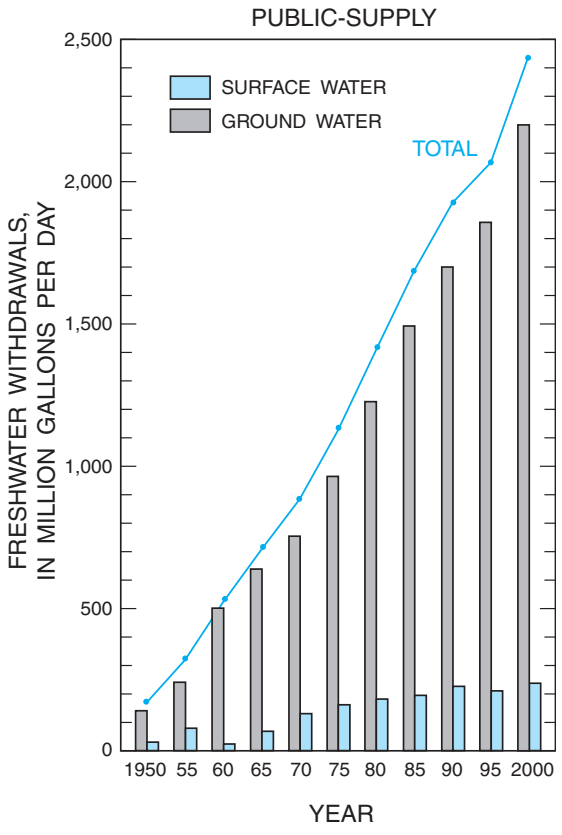


Figure 12. Historical public-supply freshwater withdrawals in Florida by source, 1950-2000. (Modified from Marella, 1999.)

The use of nonpotable water (treated water) for public supply has increased steadily in Florida since 1985 (Dykes and Conlon, 1989; Marella, 1995). In 2000, about 95 Mgal/d of nonpotable ground water was treated using desalination techniques or diluted with freshwater to meet the FDEP drinking-water standards for potable water (see glossary). The use of desalination or dilution of ground water for public supply was documented in nine counties (Broward, Charlotte, Collier, Indian River, Lee, Martin, Palm Beach, St. Lucie, and Sarasota) (table 4). This nonpotable water (sometimes referred to as brackish water) is included in the freshwater category for this report, thus water withdrawn for public supply in 2000 was freshwater. Future use of treated water will increase because several large desalination plants are currently being constructed that will utilize surface water.

Domestic Self-Supplied

The domestic self-supplied category comprises users that withdraw small quantities of potable water without need of a permit from the water management districts. Domestic self-supplied use includes water withdrawn by individual households (domestic wells) and by the 874 small public-supply systems (with a daily average pumpage of less than 0.01 Mgal/d) not inventoried under public supply. For this report, it was assumed that all people not served by the 1,156 inventoried public suppliers are self-supplied. Of the 199 Mgal/d withdrawn for domestic self-supplied use in 2000, an estimated 96 percent (191 Mgal/d) was from domestic wells and 4 percent (8 Mgal/d) was from the 874 small public supply systems not inventoried. Withdrawals of more than 10 Mgal/d for domestic self-supplied use in 2000 occurred in Marion, Polk, and Palm Beach Counties (table 6). It is assumed that water withdrawals for this category were derived exclusively from ground water because of its good quality and its widespread availability. About 62 percent of the domestic self-supplied water was obtained from the Floridan aquifer system (fig. 13); the remaining 38 percent was obtained from local water table or shallow aquifers (Biscayne, intermediate, sand-and-gravel, and the unnamed surficial aquifers). In many areas of Florida, the shallow or water table aquifers yield sufficient water for domestic purposes, especially where the Floridan aquifer system is relatively deep or has poor water quality.

In 2000, an estimated 1.95 million people in Florida were included in the domestic self-supplied category (table 6). According to the U.S. Census Bureau (1993), 795,560 households in Florida used an individual well as their primary source of drinking water in 1990, however the Census did not compile this data for 2000. Based on a statewide population growth rate of 23.5 percent between 1990 and 2000 (University of Florida, 2001), the number of households in 2000 with domestic wells would be nearly 982,500 (table 6). Estimated water used per well would be slightly less than 200 gal/d in 2000. Many additional households in Florida have individual wells or pump from canals for irrigation purposes only, and these withdrawals are not included in this category.

Table 6. Domestic self-supplied population and water withdrawals in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee]

County	Population			People per household[2]	Households with wells	Withdrawals, in million gallons per day		
	Total[1]	Public supply	Self-supplied			Total	Ground	Surface
Alachua	217,955	179,118	38,837	2.34	18,503	4.12	4.12	0.00
Baker	22,259	4,326	17,933	2.86	5,472	1.90	1.90	0.00
Bay	148,217	129,300	18,917	2.43	14,599	2.01	2.01	0.00
Bradford	26,088	8,338	17,750	2.58	6,321	1.89	1.89	0.00
Brevard	476,230	458,282	17,948	2.35	22,458	1.90	1.90	0.00
Broward	1,623,018	1,603,081	19,937	2.45	7,778	2.11	2.11	0.00
Calhoun	13,017	4,224	8,793	2.53	3,465	0.93	0.93	0.00
Charlotte	141,627	115,564	26,063	2.18	6,670	3.55	3.55	0.00
Citrus	118,085	66,234	51,851	2.20	33,424	7.20	7.20	0.00
Clay	140,814	100,785	40,029	2.77	19,055	4.24	4.24	0.00
Collier	251,377	226,175	25,202	2.39	11,382	2.67	2.67	0.00
Columbia	56,513	21,235	35,278	2.56	12,812	3.74	3.74	0.00
DeSoto	32,209	11,233	20,976	2.70	7,235	2.16	2.16	0.00
Dixie	13,827	4,622	9,205	2.44	4,881	0.98	0.98	0.00
Duval	778,879	736,838	42,041	2.51	45,073	4.46	4.46	0.00
Escambia	294,410	279,294	15,116	2.45	1,460	1.60	1.60	0.00
Flagler	49,832	43,953	5,879	2.32	2,606	0.62	0.62	0.00
Franklin	11,057	9,258	1,799	2.28	1,647	0.19	0.19	0.00
Gadsden	45,087	27,632	17,455	2.69	6,226	1.85	1.85	0.00
Gilchrist	14,437	1,850	12,587	2.61	4,200	1.33	1.33	0.00
Glades	10,576	4,782	5,794	2.51	1,252	0.61	0.61	0.00
Gulf	13,332	10,338	2,994	2.42	2,927	0.32	0.32	0.00
Hamilton	13,327	6,366	6,961	2.60	2,566	0.74	0.74	0.00
Hardee	26,938	13,571	13,367	3.06	5,394	0.64	0.64	0.00
Hendry	36,210	20,457	15,753	3.09	3,717	1.67	1.67	0.00
Hernando	130,802	116,025	14,777	2.32	13,499	1.41	1.41	0.00
Highlands	87,366	69,820	17,546	2.30	14,284	1.68	1.68	0.00
Hillsborough	998,948	854,750	144,198	2.51	70,947	4.71	4.71	0.00
Holmes	18,564	5,860	12,704	2.43	5,528	1.35	1.35	0.00
Indian River	112,947	95,337	17,610	2.25	18,773	1.87	1.87	0.00
Jackson	46,755	16,348	30,407	2.44	12,129	3.22	3.22	0.00
Jefferson	12,902	5,010	7,892	2.53	3,722	0.84	0.84	0.00
Lafayette	7,022	1,264	5,758	2.66	2,228	0.61	0.61	0.00
Lake	210,528	171,137	39,391	2.34	29,839	4.27	4.27	0.00
Lee	440,888	357,289	83,599	2.31	29,384	8.86	8.86	0.00
Leon	239,452	198,937	40,515	2.34	12,576	4.29	4.29	0.00
Levy	34,450	11,066	23,384	2.44	9,829	3.95	3.95	0.00
Liberty	7,021	2,764	4,257	2.51	1,657	0.45	0.45	0.00
Madison	18,733	7,166	11,567	2.57	4,593	1.23	1.23	0.00
Manatee	264,002	250,270	13,732	2.29	7,388	0.17	0.17	0.00
Marion	258,916	136,842	122,074	2.36	59,723	16.42	16.42	0.00
Martin	126,731	87,100	39,631	2.23	19,247	4.20	4.20	0.00
Miami-Dade	2,253,362	2,207,800	45,562	2.84	19,193	4.83	4.83	0.00
Monroe	79,589	78,885	704	2.23	1,255	0.08	0.08	0.00
Nassau	57,663	24,875	32,788	2.59	13,059	3.48	3.48	0.00
Okaloosa	170,498	158,504	11,994	2.49	3,360	1.27	1.27	0.00
Okeechobee	35,910	21,600	14,310	2.69	6,915	1.52	1.52	0.00
Orange	896,344	813,152	83,192	2.61	26,115	8.82	8.82	0.00
Osceola	172,493	128,932	43,561	2.79	13,375	4.61	4.61	0.00
Palm Beach	1,131,184	1,035,732	95,452	2.34	43,021	10.12	10.12	0.00
Pasco	344,765	275,800	68,965	2.30	43,376	4.50	4.50	0.00
Pinellas	921,482	914,110	7,372	2.17	4,385	0.41	0.41	0.00
Polk	483,924	396,543	87,381	2.52	45,174	12.45	12.45	0.00
Putnam	70,423	23,311	47,112	2.48	27,959	4.99	4.99	0.00
St. Johns	123,135	105,104	18,031	2.44	14,286	1.91	1.91	0.00
St. Lucie	192,695	122,960	69,735	2.47	29,577	7.39	7.39	0.00
Santa Rosa	117,743	110,108	7,635	2.63	3,062	0.81	0.81	0.00
Sarasota	325,957	277,065	48,892	2.13	28,710	0.43	0.43	0.00
Seminole	365,196	339,403	25,793	2.59	14,963	2.73	2.73	0.00
Sumter	53,345	28,243	25,102	2.27	11,287	4.57	4.57	0.00
Suwannee	34,844	9,393	25,451	2.54	9,970	2.70	2.70	0.00
Taylor	19,256	10,289	8,967	2.51	5,150	0.95	0.95	0.00
Union	13,442	3,155	10,287	2.76	2,275	1.10	1.10	0.00
Volusia	443,343	414,851	28,492	2.32	28,813	3.02	3.02	0.00
Wakulla	22,863	9,285	13,578	2.57	4,584	1.44	1.44	0.00
Walton	40,601	39,024	1,577	2.35	9,308	0.17	0.17	0.00
Washington	20,973	7,565	13,408	2.46	6,870	1.42	1.42	0.00
State totals	**15,982,378**	**14,029,530**	**1,952,848**	**2.46**	**982,511**	**198.68**	**198.68**	**0.00**

[1] University of Florida (2001).

[2] Smith and Cody (2001).

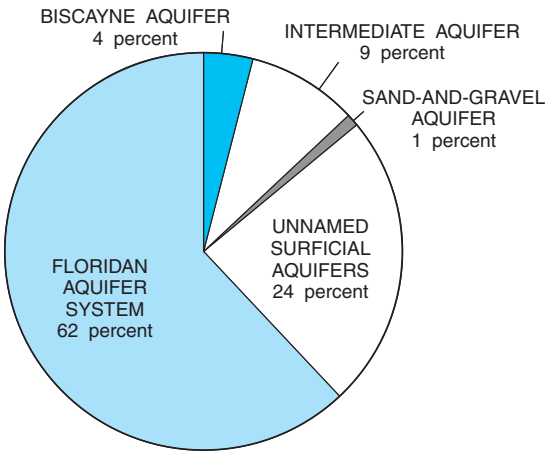


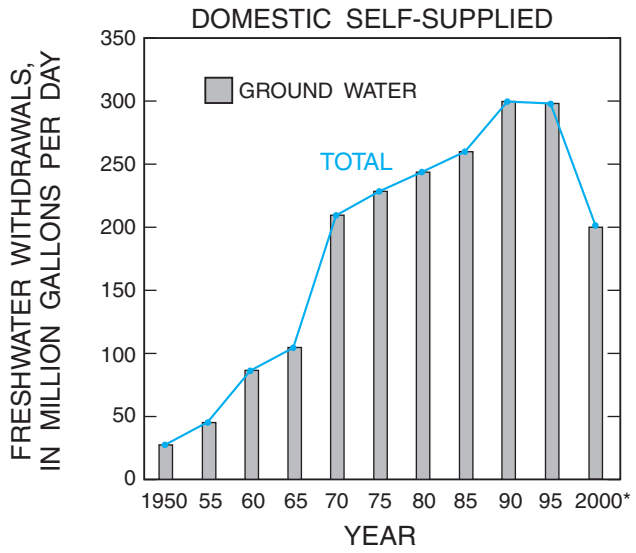
Figure 13. Domestic self-supplied ground-water withdrawals in Florida by principal aquifer, 2000.

Withdrawals for domestic self-supplied use in Florida were about 200 Mgal/d in 1970 and 2000 (fig. 14). For these two years, the same methodology was used to calculate domestic self-supplied withdrawals. In 1970, a statewide domestic per capita of 120 gal/d was used to estimate water withdrawals for all counties (Pride, 1973), while for 2000, a statewide domestic per capita of 106 gal/d was used for all counties (excluding those within the Southwest Florida Water Management District). The 2000 domestic per capita was derived from public supply withdrawals minus deliveries to commercial and industrial users and system losses as shown in table 5. This differs from 1975, 1980, 1985, 1990, and 1995 when the public supply per capita for each county was used to estimate domestic self-supplied withdrawals. After 1970, the method was changed because the public supply per capita was easily calculated and the higher per capita helped account for small nonpublic supply users in rural areas (such as campgrounds, churches, convenience stores, restaurants, and others). However, because the water use at these unaccounted-for systems is far less than believed, the higher per capita overestimated the water withdrawals for this category. The domestic per capita includes only what is used for households, and therefore provides a better estimate of water withdrawals for this category.

Commercial-Industrial Self-Supplied

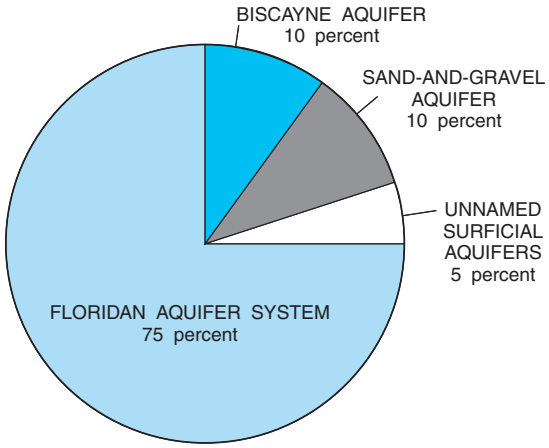
Commercial-industrial self-supplied use is water withdrawn at commercial and industrial facilities. Commercial users include government and military facilities, schools, prisons, hospitals, recreational (non-irrigation), and nonmanufacturing facilities. Industrial users include mining, processing, and manufacturing facilities. Data were obtained for those systems having withdrawals of more than 0.01 Mgal/d; water used by the smaller commercial-industrial (non-community and non-transient non-community) water systems is insignificant and therefore is not accounted for in this report. There were 248 self-supplied commercial users and 200 self-supplied industrial users (including mines) inventoried in Florida in 2000.

Total freshwater withdrawals by commercial-industrial self-supplied systems in 2000 was 563 Mgal/d, of which 76 percent was ground water and 24 percent was surface water (table 7). The Floridan aquifer system supplied 75 percent of ground water withdrawals for this category (fig. 15). Major surface-water sources for commercial-industrial self-supplied use include Etonia and Simms Creeks in Putnam County (23 percent) and the Escambia River in Escambia County (19 percent). However, a large amount of surface water used for this category was withdrawn from unnamed mining pits or ponds for dewatering and mining operations.



* Methodology used for 2000 to estimate withdrawals was modified from previous years

Figure 14. Historical domestic self-supplied freshwater withdrawals in Florida, 1950-2000. (Modified from Marella, 1999.)



Note: Intermediate aquifer equaled less than 1 percent

Figure 15. Commercial-industrial self-supplied groundwater withdrawals in Florida by principal aquifer, 2000.

Table 7. Commercial-industrial self-supplied water withdrawals in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day; includes mining withdrawals]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	2.50	0.00	2.50	0.00	0.00	0.00	2.50	0.00	2.50
Baker	0.43	0.00	0.43	0.00	0.00	0.00	0.43	0.00	0.43
Bay	0.30	0.00	0.30	0.00	0.00	0.00	0.30	0.00	0.30
Bradford	1.25	0.00	1.25	0.00	0.00	0.00	1.25	0.00	1.25
Brevard	1.04	0.00	1.04	0.01	0.00	0.01	1.05	0.00	1.05
Broward	0.54	0.00	0.54	0.00	0.00	0.00	0.54	0.00	0.54
Calhoun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charlotte	0.15	0.00	0.15	2.34	0.00	2.34	2.49	0.00	2.49
Citrus	0.80	0.00	0.80	0.29	0.00	0.29	1.09	0.00	1.09
Clay	6.87	0.00	6.87	0.00	0.00	0.00	6.87	0.00	6.87
Collier	0.19	0.00	0.19	5.62	0.00	5.62	5.81	0.00	5.81
Columbia	0.34	0.00	0.34	0.00	0.00	0.00	0.34	0.00	0.34
DeSoto	0.06	0.00	0.06	1.33	0.00	1.33	1.39	0.00	1.39
Dixie	0.26	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.26
Duval	12.51	0.00	12.51	0.00	0.00	0.00	12.51	0.00	12.51
Escambia	35.77	0.00	35.77	24.65	0.00	24.65	60.42	0.00	60.42
Flagler	0.20	0.00	0.20	0.07	0.00	0.07	0.27	0.00	0.27
Franklin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gadsden	0.92	0.00	0.92	0.00	0.00	0.00	0.92	0.00	0.92
Gilchrist	0.26	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.26
Glades	0.14	0.00	0.14	3.93	0.00	3.93	4.07	0.00	4.07
Gulf	0.90	0.00	0.90	1.65	0.00	1.65	2.55	0.00	2.55
Hamilton	34.39	0.00	34.39	0.00	0.00	0.00	34.39	0.00	34.39
Hardee	5.93	0.00	5.93	0.00	0.00	0.00	5.93	0.00	5.93
Hendry	0.72	0.00	0.72	0.00	0.00	0.00	0.72	0.00	0.72
Hernando	19.70	0.00	19.70	0.07	0.00	0.07	19.77	0.00	19.77
Highlands	0.55	0.00	0.55	0.03	0.00	0.03	0.58	0.00	0.58
Hillsborough	14.17	0.00	14.17	5.50	0.00	5.50	19.67	0.00	19.67
Holmes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian River	0.12	0.00	0.12	0.00	0.00	0.00	0.12	0.00	0.12
Jackson	1.50	0.00	1.50	0.00	0.00	0.00	1.50	0.00	1.50
Jefferson	0.20	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.20
Lafayette	0.20	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.20
Lake	10.44	0.00	10.44	0.60	0.00	0.60	11.04	0.00	11.04
Lee	8.76	0.00	8.76	7.19	0.00	7.19	15.95	0.00	15.95
Leon	0.12	0.00	0.12	0.00	0.00	0.00	0.12	0.00	0.12
Levy	0.06	0.00	0.06	1.96	0.00	1.96	2.02	0.00	2.02
Liberty	0.82	0.00	0.82	0.00	0.00	0.00	0.82	0.00	0.82
Madison	0.15	0.00	0.15	0.00	0.00	0.00	0.15	0.00	0.15
Manatee	0.47	0.00	0.47	0.53	0.00	0.53	1.00	0.00	1.00
Marion	2.08	0.00	2.08	0.00	0.00	0.00	2.08	0.00	2.08
Martin	1.20	0.00	1.20	1.95	0.00	1.95	3.15	0.00	3.15
Miami-Dade	41.65	0.00	41.65	0.00	0.00	0.00	41.65	0.00	41.65
Monroe	0.10	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.10
Nassau	32.46	0.00	32.46	0.00	1.18	1.18	32.46	1.18	33.64
Okaloosa	4.14	0.00	4.14	0.00	0.00	0.00	4.14	0.00	4.14
Okeechobee	0.36	0.00	0.36	0.00	0.00	0.00	0.36	0.00	0.36
Orange	24.21	0.00	24.21	0.00	0.00	0.00	24.21	0.00	24.21
Osceola	0.84	0.00	0.84	0.00	0.00	0.00	0.84	0.00	0.84
Palm Beach	5.76	0.00	5.76	13.21	0.00	13.21	18.97	0.00	18.97
Pasco	4.72	0.00	4.72	0.81	0.00	0.81	5.53	0.00	5.53
Pinellas	0.09	0.00	0.09	0.55	0.00	0.55	0.64	0.00	0.64
Polk	71.20	0.00	71.20	6.39	0.00	6.39	77.59	0.00	77.59
Putnam	19.14	0.00	19.14	31.12	0.00	31.12	50.26	0.00	50.26
St. Johns	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
St. Lucie	6.35	0.00	6.35	2.53	0.00	2.53	8.88	0.00	8.88
Santa Rosa	5.57	0.00	5.57	0.00	0.00	0.00	5.57	0.00	5.57
Sarasota	0.31	0.00	0.31	0.33	0.00	0.33	0.64	0.00	0.64
Seminole	0.08	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08
Sumter	0.36	0.00	0.36	16.98	0.00	16.98	17.34	0.00	17.34
Suwannee	1.54	0.00	1.54	0.00	0.00	0.00	1.54	0.00	1.54
Taylor	42.15	0.00	42.15	2.96	0.00	2.96	45.11	0.00	45.11
Union	0.40	0.00	0.40	0.00	0.00	0.00	0.40	0.00	0.40
Volusia	0.49	0.00	0.49	0.00	0.00	0.00	0.49	0.00	0.49
Wakulla	0.62	0.00	0.62	0.00	0.00	0.00	0.62	0.00	0.62
Walton	0.92	0.00	0.92	0.00	0.00	0.00	0.92	0.00	0.92
Washington	0.22	0.00	0.22	0.00	0.00	0.00	0.22	0.00	0.22
State totals	**430.70**	**0.00**	**430.70**	**132.60**	**1.18**	**133.78**	**563.30**	**1.18**	**564.48**

Monthly withdrawals for commercial-industrial self-supplied systems fluctuated less than 200 Mgal/d during 2000 (fig. 16). Withdrawals were highest in February, May, and October and lowest in January, March, and November. Fluctuation in withdrawals occur because of increased water demand when citrus and vegetables are harvested and processed, whereas withdrawals for mining and pulp and paper usually remain fairly steady throughout the year.

Withdrawals by industrial facilities accounted for 90 percent and commercial accounted for 10 percent of the freshwater withdrawals. Mining accounted for the largest amount of water used in this category (33 percent) followed by pulp and paper manufacturing (27 percent) (fig. 17). Of the water withdrawn from the 49 inventoried mining facilities, 56 percent (103 Mgal/d) was for mining limestone and sand, 41 percent (75 Mgal/d) for phosphate mining, and 3 percent (7 Mgal/d) for mineral mining. Mining operations are located throughout Florida, but are mostly concentrated in the central part of the State. Water withdrawn in the mining industry is used primarily for material washing and conveyance, but includes water pumped to dewater the area being mined. The pulp and paper industry is located in the heavily forested areas of northern and western Florida. A small amount (8 Mgal/d) of the water withdrawn for food production and manufacturing was for the bottled water industry.

The largest amount of freshwater withdrawn for commercial-industrial self-supplied purposes was in Polk County, followed by Escambia, Putnam, Taylor, and Miami-Dade Counties (table 7). These five counties accounted for nearly one-half (49 percent) of the water withdrawn in this category during 2000.

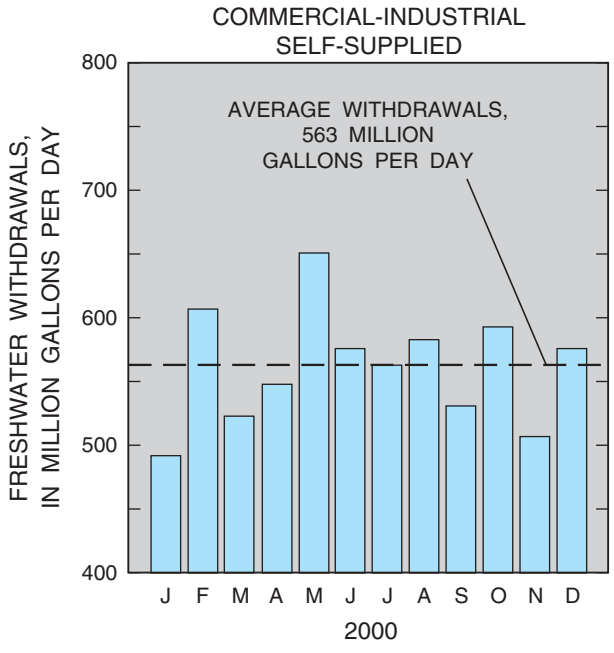


Figure 16. Average daily commercial-industrial self-supplied freshwater withdrawals by month in Florida, 2000.

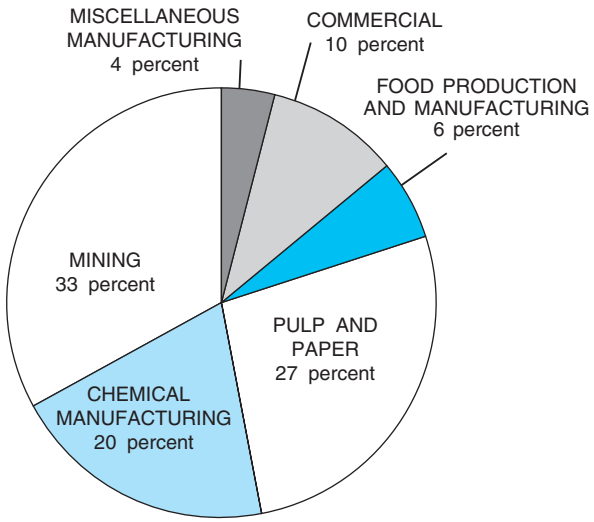


Figure 17. Commercial-industrial self-supplied freshwater use in Florida by major industrial type, 2000.

Freshwater withdrawn for commercial-industrial self-supplied use in Florida decreased 37 percent between 1970 and 2000 (fig. 18). The increase in deliveries mentioned previously and the decrease in withdrawals indicate that most new commercial or industrial users obtained water from a public-supply water system, and many self-supplied users have either converted to public supply as their water source or have become

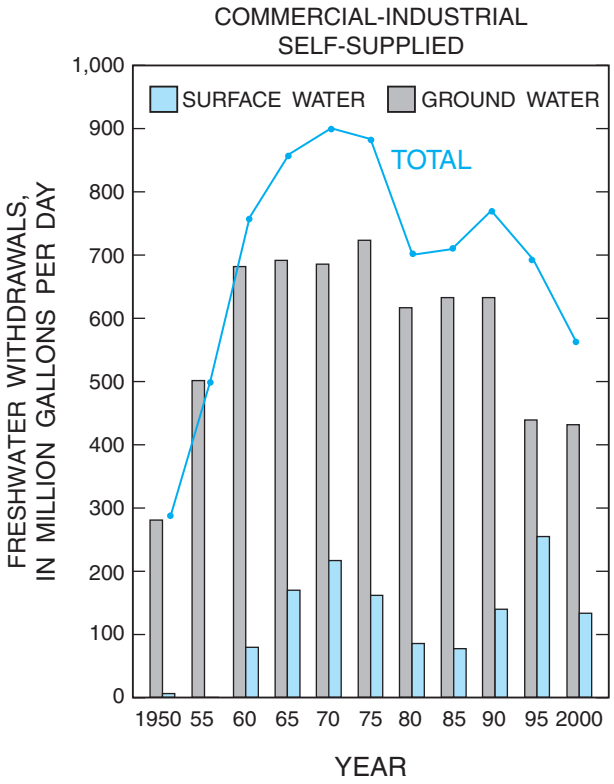


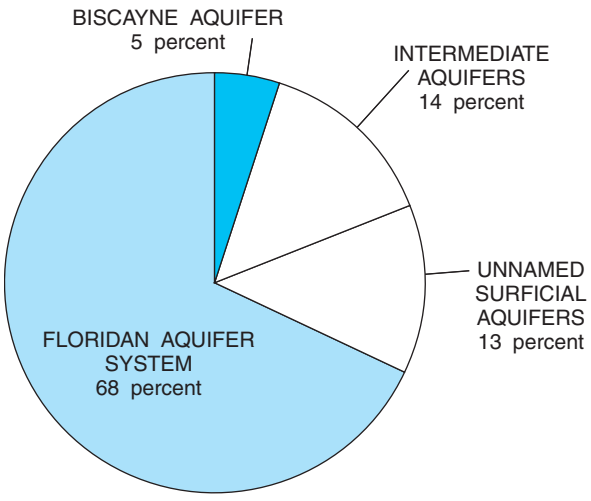
Figure 18. Historical commercial-industrial self-supplied freshwater withdrawals in Florida by source, 1950-2000. (Modified from Marella, 1999.)

more water efficient. The conversion to public supply occurred because of the increasing cost of producing potable water and treating and discharging wastewater. Many self-supplied industries have become more water efficient in an effort to reduce discharge volumes. Between 1995 and 2000, freshwater withdrawals for this category decreased 18 percent. A large portion of this recent decrease is the result of several large industrial facilities closing in Duval and Gulf Counties.

Agricultural Self-Supplied (Irrigation and Nonirrigation)

Agricultural self-supplied use consists of water withdrawn for the irrigation of crops and for nonirrigation uses associated with farming operations. Irrigation includes the application of water on lands to assist in the growing of crops or to prevent damage to crops due to harsh climatic conditions. Nonirrigation uses include water withdrawn for livestock watering, washing dairy and farm equipment, fish farming (augmenting ponds), and other farm uses. The agricultural self-supplied category no longer includes water withdrawals for irrigation of turf grasses (golf courses and urban landscape), which is now included in the category of recreational irrigation.

Agricultural self-supplied was the largest user of freshwater in Florida, accounting for 48 percent of the State's total freshwater withdrawn in 2000. Water withdrawals totaled 3,923 Mgal/d, of which 51 percent was ground water and 49 percent was surface water (table 8). Florida ranked eleventh in the Nation for irrigation and nonirrigation withdrawals in 2000, but accounted for the largest amount of irrigation withdrawals in the eastern United States (Hutson and others, 2004).



Note: Sand-and-gravel aquifer equaled less than 1 percent

Figure 19. Agricultural self-supplied ground-water withdrawals in Florida by principal aquifer, 2000.

All water withdrawn for irrigation in Florida was assumed to be freshwater.

The Floridan aquifer system supplied 68 percent of the ground water withdrawn for agricultural self-supplied use in 2000 (fig. 19). Major sources of surface water for irrigation purposes include Lake Okeechobee and canals associated the Everglades Agricultural Area (Glades, Hendry, Martin, Palm Beach, and St. Lucie Counties), and the canals associated with the headwaters of the Upper St. Johns River (Brevard, Indian River, Okeechobee, and St.Lucie Counties). South Florida is intensively irrigated for sugarcane, citrus, and vegetables, and accounted for about 63 percent of the State's surface-water withdrawals.

Monthly withdrawals for agricultural self-supplied use had the largest seasonal variation of any water-use category. Irrigation withdrawals followed a normal seasonal pattern: they were greatest in March, April, May, and June (accounting for 54 percent of the water used) and were at a seasonal low in July, August, and September (fig. 20). A seasonal fluctuation of more than 5,000 Mgal/d in 2000 was the result of intense crop production and extreme dry conditions during the spring months, and above normal rainfall during the summer months.

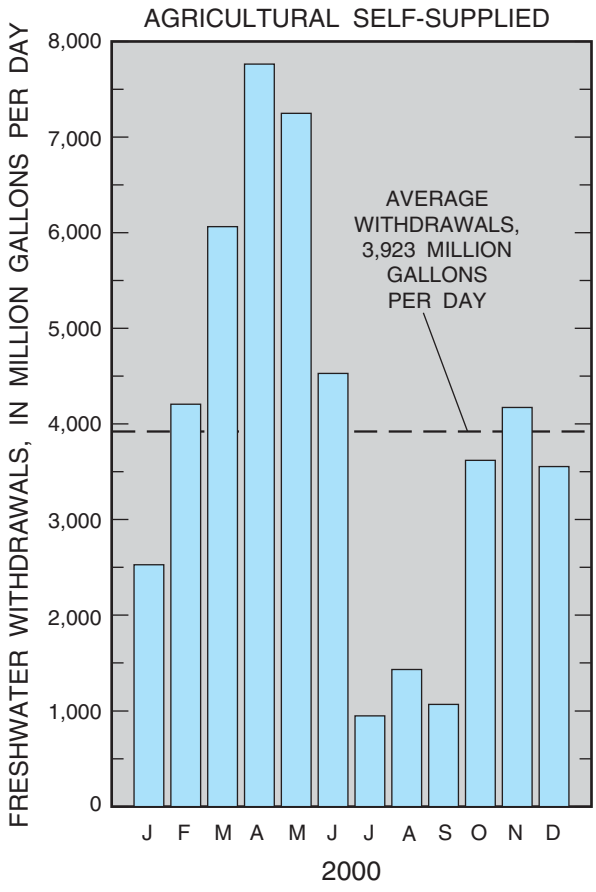


Figure 20. Average daily agricultural self-supplied freshwater withdrawals by month in Florida, 2000.

Table 8. Agricultural self-supplied water withdrawals in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	17.91	0.00	17.91	0.27	0.00	0.27	18.18	0.00	18.18
Baker	2.80	0.00	2.80	1.64	0.00	1.64	4.44	0.00	4.44
Bay	1.28	0.00	1.28	0.00	0.00	0.00	1.28	0.00	1.28
Bradford	1.00	0.00	1.00	0.02	0.00	0.02	1.02	0.00	1.02
Brevard	118.79	0.00	118.79	18.03	0.00	18.03	136.82	0.00	136.82
Broward	0.89	0.00	0.89	3.21	0.00	3.21	4.10	0.00	4.10
Calhoun	2.66	0.00	2.66	1.79	0.00	1.79	4.45	0.00	4.45
Charlotte	28.17	0.00	28.17	19.02	0.00	19.02	47.19	0.00	47.19
Citrus	2.76	0.00	2.76	0.59	0.00	0.59	3.35	0.00	3.35
Clay	5.92	0.00	5.92	0.04	0.00	0.04	5.96	0.00	5.96
Collier	137.18	0.00	137.18	5.81	0.00	5.81	142.99	0.00	142.99
Columbia	5.79	0.00	5.79	0.10	0.00	0.10	5.89	0.00	5.89
DeSoto	116.95	0.00	116.95	1.92	0.00	1.92	118.87	0.00	118.87
Dixie	1.59	0.00	1.59	0.03	0.00	0.03	1.62	0.00	1.62
Duval	3.74	0.00	3.74	0.33	0.00	0.33	4.07	0.00	4.07
Escambia	2.73	0.00	2.73	0.00	0.00	0.00	2.73	0.00	2.73
Flagler	15.67	0.00	15.67	0.03	0.00	0.03	15.70	0.00	15.70
Franklin	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
Gadsden	2.95	0.00	2.95	5.97	0.00	5.97	8.92	0.00	8.92
Gilchrist	13.97	0.00	13.97	0.32	0.00	0.32	14.29	0.00	14.29
Glades	19.71	0.00	19.71	49.31	0.00	49.31	69.02	0.00	69.02
Gulf	0.21	0.00	0.21	0.00	0.00	0.00	0.21	0.00	0.21
Hamilton	5.53	0.00	5.53	0.11	0.00	0.11	5.64	0.00	5.64
Hardee	81.16	0.00	81.16	0.57	0.00	0.57	81.73	0.00	81.73
Hendry	193.37	0.00	193.37	310.54	0.00	310.54	503.91	0.00	503.91
Hernando	4.26	0.00	4.26	0.03	0.00	0.03	4.29	0.00	4.29
Highlands	143.24	0.00	143.24	17.07	0.00	17.07	160.31	0.00	160.31
Hillsborough	83.84	0.00	83.84	3.31	0.00	3.31	87.15	0.00	87.15
Holmes	0.78	0.00	0.78	0.19	0.00	0.19	0.97	0.00	0.97
Indian River	64.63	0.00	64.63	157.86	0.00	157.86	222.49	0.00	222.49
Jackson	14.00	0.00	14.00	1.70	0.00	1.70	15.70	0.00	15.70
Jefferson	6.43	0.00	6.43	0.10	0.00	0.10	6.53	0.00	6.53
Lafayette	5.77	0.00	5.77	0.16	0.00	0.16	5.93	0.00	5.93
Lake	30.85	0.00	30.85	5.30	0.00	5.30	36.15	0.00	36.15
Lee	42.51	0.00	42.51	18.00	0.00	18.00	60.51	0.00	60.51
Leon	1.27	0.00	1.27	0.00	0.00	0.00	1.27	0.00	1.27
Levy	21.82	0.00	21.82	0.63	0.00	0.63	22.45	0.00	22.45
Liberty	0.16	0.00	0.16	0.00	0.00	0.00	0.16	0.00	0.16
Madison	5.83	0.00	5.83	0.11	0.00	0.11	5.94	0.00	5.94
Manatee	104.37	0.00	104.37	1.35	0.00	1.35	105.72	0.00	105.72
Marion	16.31	0.00	16.31	0.90	0.00	0.90	17.21	0.00	17.21
Martin	15.02	0.00	15.02	125.00	0.00	125.00	140.02	0.00	140.02
Miami-Dade	86.55	0.00	86.55	23.80	0.00	23.80	110.35	0.00	110.35
Monroe	0.03	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.03
Nassau	0.68	0.00	0.68	0.02	0.00	0.02	0.70	0.00	0.70
Okaloosa	0.75	0.00	0.75	0.00	0.00	0.00	0.75	0.00	0.75
Okeechobee	57.29	0.00	57.29	9.75	0.00	9.75	67.04	0.00	67.04
Orange	19.67	0.00	19.67	7.32	0.00	7.32	26.99	0.00	26.99
Osceola	80.47	0.00	80.47	25.49	0.00	25.49	105.96	0.00	105.96
Palm Beach	42.07	0.00	42.07	904.09	0.00	904.09	946.16	0.00	946.16
Pasco	22.37	0.00	22.37	0.36	0.00	0.36	22.73	0.00	22.73
Pinellas	0.43	0.00	0.43	0.03	0.00	0.03	0.46	0.00	0.46
Polk	157.53	0.00	157.53	9.33	0.00	9.33	166.86	0.00	166.86
Putnam	11.69	0.00	11.69	3.50	0.00	3.50	15.19	0.00	15.19
St. Johns	28.59	0.00	28.59	0.00	0.00	0.00	28.59	0.00	28.59
St. Lucie	45.16	0.00	45.16	192.18	0.00	192.18	237.34	0.00	237.34
Santa Rosa	5.00	0.00	5.00	0.00	0.00	0.00	5.00	0.00	5.00
Sarasota	6.88	0.00	6.88	0.66	0.00	0.66	7.54	0.00	7.54
Seminole	11.06	0.00	11.06	0.02	0.00	0.02	11.08	0.00	11.08
Sumter	14.08	0.00	14.08	0.54	0.00	0.54	14.62	0.00	14.62
Suwannee	20.64	0.00	20.64	0.38	0.00	0.38	21.02	0.00	21.02
Taylor	1.89	0.00	1.89	0.04	0.00	0.04	1.93	0.00	1.93
Union	1.05	0.00	1.05	0.02	0.00	0.02	1.07	0.00	1.07
Volusia	29.03	0.00	29.03	3.88	0.00	3.88	32.91	0.00	32.91
Wakulla	0.28	0.00	0.28	0.00	0.00	0.00	0.28	0.00	0.28
Walton	1.80	0.00	1.80	0.29	0.00	0.29	2.09	0.00	2.09
Washington	1.13	0.00	1.13	0.00	0.00	0.00	1.13	0.00	1.13
State totals	**1,989.95**	**0.00**	**1,989.95**	**1,933.06**	**0.00**	**1,933.06**	**3,923.01**	**0.00**	**3,923.01**

About 4.618 million acres of agricultural lands were farmed in Florida in 2000, of which 1.866 million acres (40 percent) were irrigated (table 9). Improved pasture accounted for more than one-half of the agricultural acres (54 percent); however, only 5 percent of the improved pasture was irrigated in 2000. Excluding improved pasture acreage, more than 80 percent of the acreage farmed in Florida during 2000 was irrigated. Most of the acreage was irrigated by flood systems (45 percent), followed by micro systems (38 percent), and sprinkler systems (17 percent) (table 9).

Table 9. Acres irrigated, irrigation system type, and water use in Florida by crop type, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; --- no or partial data were available]

Crop and acreage			Irrigation system type			Water use, in million gallons per day				Water withdrawn
Crop type	Total	Irrigated	Micro	Sprinkler	Flood	Ground	Surface	Reclaimed	Total	
Vegetable crops	**239,674**	**209,925**	**21,025**	**69,951**	**118,949**	**282.35**	**118.69**	**3.30**	**404.34**	**401.04**
Cabbage	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Carrots	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Cucumbers	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Peppers	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Tomatoes	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Sweet corn	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
Melons	---	---	---	---	---	0.00	0.00	0.00	0.00	0.00
All vegetables[1]	239,674	209,925	21,025	69,951	118,949	282.35	118.69	3.30	404.34	401.04
Fruit crops	**863,757**	**843,703**	**658,267**	**77,690**	**107,746**	**1,091.67**	**773.16**	**19.02**	**1,883.83**	**1,864.83**
Blueberries	1,010	913	163	720	30	1.20	0.03	0.00	1.23	1.23
Citrus	834,802	824,602	650,726	66,548	107,328	1,056.16	769.02	19.02	1,844.18	1,825.18
Grapes	310	214	131	83	0	0.32	0.05	0.00	0.37	0.37
Peaches	5	5	5	0	0	0.01	0.00	0.00	0.01	0.01
Pecans	2,264	569	416	153	0	0.83	0.10	0.00	0.93	0.93
Strawberries	6,601	6,588	6,124	400	64	13.10	0.50	0.00	13.60	13.60
Miscellaneous	11,509	9,523	429	8,770	324	18.50	3.34	0.00	21.84	21.84
Fruit crops nonspecific	7,256	1,289	273	1,016	0	1.55	0.12	0.00	1.67	1.67
Field crops	**882,313**	**533,683**	**1,031**	**80,648**	**452,004**	**132.93**	**871.91**	**18.08**	**1,022.92**	**1,004.84**
Cotton	93,895	14,018	0	14,018	0	8.26	0.79	0.00	9.05	9.05
Field corn	89,204	28,967	72	23,484	5,411	33.87	1.87	0.63	36.37	35.74
Peanuts	84,646	25,036	0	25,036	0	20.10	1.26	0.00	21.36	21.36
Potatoes	34,132	33,196	949	2,326	29,921	25.58	6.59	0.00	32.17	32.17
Rice	12,335	12,335	0	0	12,335	0.00	33.24	0.00	33.24	33.24
Sorghum	1,658	1,480	0	1,280	200	0.91	0.13	0.00	1.04	1.04
Soybeans	39,235	2,246	0	2,246	0	0.99	0.08	0.00	1.07	1.07
Sugarcane	436,452	404,123	0	72	404,051	31.05	825.81	0.00	856.86	856.86
Tobacco	5,886	5,049	0	5,049	0	5.31	0.10	0.00	5.41	5.41
Wheat	5,757	244	0	244	0	0.29	0.03	0.00	0.32	0.32
Miscellaneous	79,113	6,989	10	6,893	86	6.57	2.01	17.45	26.03	8.58
Ornamentals and grasses	**2,632,607**	**278,840**	**21,835**	**96,646**	**160,359**	**444.23**	**167.58**	**49.51**	**661.52**	**611.81**
Field grown	25,579	24,190	4,484	13,946	5,760	54.49	11.41	2.99	68.89	65.90
Greenhouse grown	598	564	278	286	0	1.40	0.79	0.00	2.19	2.19
Container grown	38,449	36,387	17,062	19,023	302	104.28	26.37	1.48	132.13	130.65
Pasture hay (alfalfa/tame)	2,478,577	130,028	11	28,541	101,476	161.11	41.83	1.47	204.41	202.94
Sod	77,954	76,221	0	23,400	52,821	122.95	87.18	0.00	210.13	210.13
Other crops and grasses that utilize reclaimed water	11,450	11,450	0	11,450	0	0.00	0.00	43.57	43.77	0.00
Irrigation totals[2]	4,618,351	1,866,151	702,158	324,935	839,058	1,951.18	1,931.52	89.91	3,972.61	3,882.70
Livestock						30.96	1.51	0.00	32.47	32.47
Fish farming						7.81	0.21	0.00	8.02	8.02
Miscellaneous						0.00	0.00	0.00	0.00	0.00
Nonirrigation totals						**38.77**	**1.72**	**0.00**	**40.49**	**40.49**
State totals	**4,618,351**	**1,866,151**	**702,158**	**324,935**	**839,058**	**1,989.95**	**1,933.06**	**89.91**	**4,013.10**	**3,923.01**

[1]Includes miscellaneous vegetables and those listed above.
[2]Includes vegetable crops, fruit crops, field crops, and ornamentals and grasses.

Agricultural irrigation data were compiled for 28 specific crop types in 4 main categories: vegetable, fruit, field, and ornamentals and grasses. Of the four major crop types, fruit was the largest user of water for irrigation, accounting for 47 percent of the agricultural water withdrawn (fig. 21). Citrus accounted for 98 percent of the irrigated acreage and water withdrawn for fruit crops. Total citrus acreage in 2000 was 834,800 (Florida Agricultural Statistics Service, 2000), with nearly 99 percent of the acres irrigated (table 9). Field crops, including sugarcane, was the second largest user of water, accounting for nearly 26 percent (fig. 21). Total sugarcane acreage in 2000 was 436,450 (Florida Agricultural Statistics Service, 2001a), with nearly 93 percent of the acres irrigated (table 9). Citrus and sugarcane combined accounted for 66 percent of the acres irrigated and 68 percent of the water withdrawn for agriculture self-supplied in 2000.

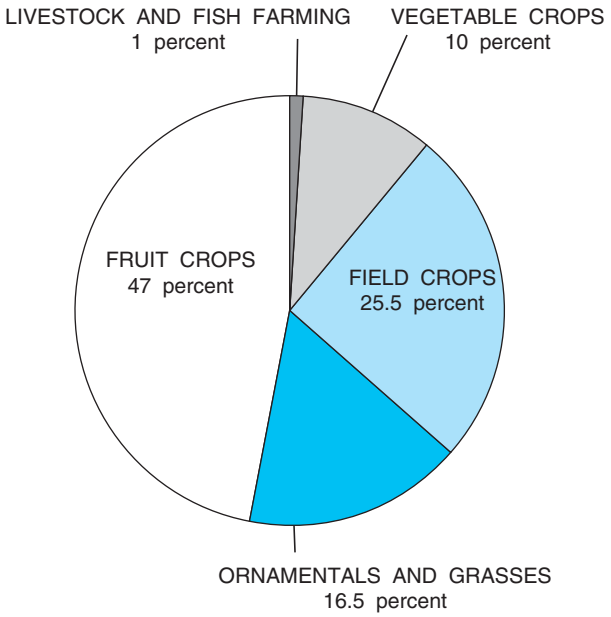


Figure 21. Agricultural self-supplied freshwater use in Florida by major crop type, 2000.

Palm Beach, Hendry, St. Lucie, and Indian River Counties accounted for nearly one-half (49 percent) of the total water withdrawn for agricultural self-supplied use (table 8). Palm Beach County was the largest user of surface water, and Hendry County used the most ground water. Palm Beach County had nearly 460,000 total acres irrigated, of which 330,000 were sugarcane. St. Lucie, Indian River, and Polk Counties each had more than 100,000 acres of irrigated citrus with Hendry County at just under 99,400 acres.

Water withdrawn for agricultural self-supplied use increased 88 percent between 1970 and 2000 and increased 21 percent between 1995 and 2000 (fig. 22). The long-term trend can be attributed to an increase in acres irrigated caused by the development of irrigation technology coupled with the availability of freshwater for irrigation, Florida's subtropical climate and mild winters, which allow for early spring crop production and the potential to harvest multiple crops per year, and the State's close proximity to east coast markets and the capability to ship perishable products in a timely fashion (Marella, 1997). The more recent trend is a result of different climatic conditions between 1995 and 2000. Since irrigation is heavily dependent upon rainfall, above or below normal rainfall during peak growing seasons in Florida (usually between February and June) can dramatically change annual water demands (Marella, 1997). Severe dry conditions across most of Florida during the first part of 2000 caused water demands to be higher-than-normal especially compared to 1995, which had above-normal rainfall during the same period causing water demands to be lower-than-normal (fig. 22). A similar trend occurred between 1985 and 1990.

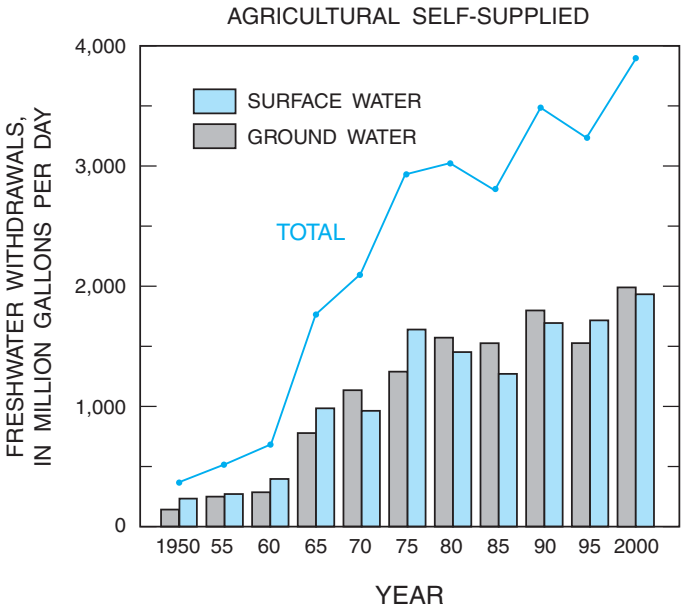


Figure 22. Historical agricultural self-supplied freshwater withdrawals in Florida by source, 1950-2000. (Modified from Marella, 1999.)

Total irrigated acreage increased by 17 percent between 1970 and 2000 despite crop loss to freezes, disease, insect infestation, wetland restoration, and encroaching urbanization in agricultural areas. Total citrus acreage has decreased by more than 108,000 acres between 1970 and 2000 (fig. 23); however, actual irrigated acreage increased by nearly 200,000 acres during this time. In addition, the density of citrus trees per acre has changed between 1970 and 2000 to help increase production while decreasing citrus acreage. About 80 orange trees were in production per acre in 1970 compared to 130 trees per acre in 2000 (Florida Agricultural Statistics Service, 2000). Sugar cane acreage increased by more than 250,000 acres between 1970 and 2000 (fig. 23); however, most of the increase occurred between 1970 and 1994 (Florida Department of Agriculture and Consumer Services, 1996). Harvested sugarcane acreage has remained between 400,000 and 440,000 acres since 1994 (Florida Department of Agriculture and Consumer Services, 2002).

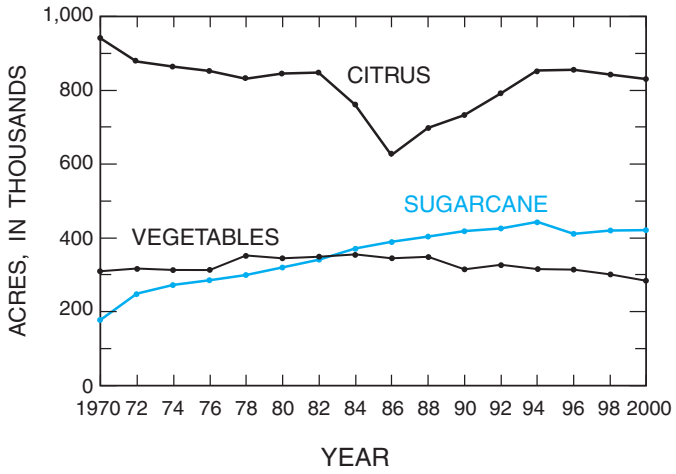


Figure 23. Historical agricultural acreage in Florida for selected crops, 1970-2000. (Modified from Florida Agricultural Statistics Service, 2000, 2001a, 2001b, and Marella, 1997.)

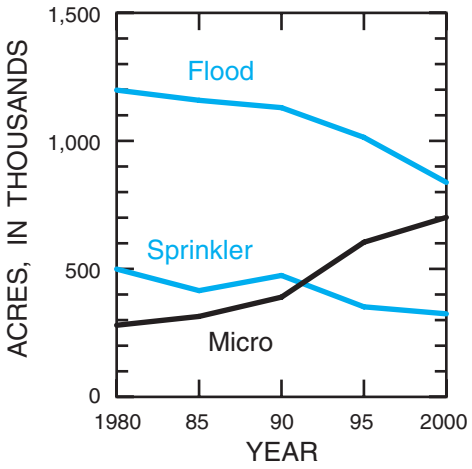


Figure 24. Historical agricultural acreage irrigated in Florida by irrigation system type, 1980-2000. (Modified from Marella, 1997 and 1999.)

Vegetable acreage (including berries, potatoes, and watermelons) has decreased by less than 10 percent between 1970 and 2000, but has remained about 300,000 acres for this period (fig. 23). Large gains in acreage for ornamentals and grasses has occurred over the past 20 years. Floriculture crops associated with nurseries or greenhouses (flowers, foliage and woody ornamentals) increased from 35,700 acres in 1985 to 61,000 acres in 2000, and sod production increased from 32,600 acres in 1985 to 76,000 acres in 2000 (Marella, 1988). The demand for ornamentals and grass (sod) has increased because of the growth in housing and commercial establishments and the need for landscaping. Sod and many landscape plants require large amounts of water to grow and maintain.

Another significant irrigation trend in Florida is the move to more efficient irrigation systems. More than 60 percent of the acres irrigated statewide in 1980 used less-efficient flood systems, whereas only 16 percent of the acres irrigated used more-efficient micro systems. By 2000, 38 percent of the acres irrigated used micro systems compared to 45 percent using flood systems (fig 24). The increase in micro-irrigation is particularly significant for citrus, as nearly all of the newly replanted acreage is being irrigated by these more-efficient systems, and many of the older groves are being converted from flood or sprinkler systems. Many other crops are utilizing these more efficient micro-irrigation systems as farmers statewide are moving from flood or sprinkler systems to help conserve water.

In addition, the use of reclaimed wastewater, captured rainfall, and unused irrigation water (tailwater runoff) as alternative water sources has helped offset additional freshwater demands on ground- and surface-water sources. Nearly 108 Mgal/d of reclaimed wastewater was used for agricultural crop irrigation purposes in 2000 (Florida Department of Environmental Protection, 2001).

Recreational Irrigation

Recreational irrigation includes the application of water on lands to assist in the growing of turf grass and landscape vegetation for lawns or recreation purposes, and also includes water used for aesthetic purposes. Turf grass recreation includes the irrigation of golf courses (including all grass and landscape associated with golf courses); turf grass lawns relates to the irrigation of all grass and landscape associated with athletic fields, cemeteries, common public or highway areas, parks, playgrounds, and lawns (primarily nonresidential, but does include some residential). Aesthetic uses include water used to fill or maintain nonagricultural ponds. Recreational irrigation is a relatively new category beginning with the 1995 compilation; however, these data have been collected since 1985 and were included under the agricultural irrigation category for 1985 and 1990. Water used for recreational irrigation may be obtained from a public water supplier, reclaimed wastewater, or self-supplied. Acreage and water-use values reported herein are for reclaimed wastewater or self-supplied withdrawals only.

Approximately 412 Mgal/d of freshwater was withdrawn (table 10) for recreational irrigation purposes in 2000, with use of an additional 227 Mgal/d obtained from reclaimed wastewater (Florida Department of Environmental Protection, 2001). Nearly 56 percent was from ground water and the remaining 44 percent was from surface water. The Floridan aquifer system supplied 62 percent and the surficial aquifer supplied 18 percent of the ground-water withdrawals for this purpose (fig. 25). Ponds, lakes and canals are the major source of surface water for irrigation purposes, and for most golf courses are usually on-site and designed to catch unused irrigation water and rainfall runoff, as well as to provide aesthetic value for the golf course. Often, these ponds or lakes are augmented with ground water or reclaimed wastewater to maintain water levels and provide storage for irrigation supplies. About 108 Mgal/d of reclaimed wastewater was used in 2000 for golf course irrigation directly or indirectly by augmenting irrigation ponds.

Table 10. Recreational irrigation water withdrawals in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	4.16	0.00	4.16	0.30	0.00	0.30	4.46	0.00	4.46
Baker	0.14	0.00	0.14	0.09	0.00	0.09	0.23	0.00	0.23
Bay	1.46	0.00	1.46	0.79	0.00	0.79	2.25	0.00	2.25
Bradford	0.27	0.00	0.27	0.04	0.00	0.04	0.31	0.00	0.31
Brevard	7.75	0.00	7.75	7.08	0.00	7.08	14.83	0.00	14.83
Broward	11.86	0.00	11.86	25.14	0.00	25.14	37.00	0.00	37.00
Calhoun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charlotte	0.79	0.00	0.79	2.69	0.00	2.69	3.48	0.00	3.48
Citrus	3.77	0.00	3.77	0.41	0.00	0.41	4.18	0.00	4.18
Clay	1.77	0.00	1.77	0.48	0.00	0.48	2.25	0.00	2.25
Collier	15.28	0.00	15.28	10.89	0.00	10.89	26.17	0.00	26.17
Columbia	0.34	0.00	0.34	0.11	0.00	0.11	0.45	0.00	0.45
DeSoto	0.21	0.00	0.21	0.16	0.00	0.16	0.37	0.00	0.37
Dixie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Duval	6.17	0.00	6.17	1.32	0.00	1.32	7.49	0.00	7.49
Escambia	4.79	0.00	4.79	0.77	0.00	0.77	5.56	0.00	5.56
Flagler	1.84	0.00	1.84	3.50	0.00	3.50	5.34	0.00	5.34
Franklin	0.13	0.00	0.13	0.00	0.00	0.00	0.13	0.00	0.13
Gadsden	0.15	0.00	0.15	0.15	0.00	0.15	0.30	0.00	0.30
Gilchrist	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glades	0.02	0.00	0.02	0.40	0.00	0.40	0.42	0.00	0.42
Gulf	0.20	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.20
Hamilton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hardee	0.21	0.00	0.21	0.04	0.00	0.04	0.25	0.00	0.25
Hendry	0.41	0.00	0.41	0.68	0.00	0.68	1.09	0.00	1.09
Hernando	3.83	0.00	3.83	0.88	0.00	0.88	4.71	0.00	4.71
Highlands	2.60	0.00	2.60	0.16	0.00	0.16	2.76	0.00	2.76
Hillsborough	9.21	0.00	9.21	4.59	0.00	4.59	13.80	0.00	13.80
Holmes	0.26	0.00	0.26	0.13	0.00	0.13	0.39	0.00	0.39
Indian River	6.81	0.00	6.81	3.22	0.00	3.22	10.03	0.00	10.03
Jackson	0.39	0.00	0.39	0.00	0.00	0.00	0.39	0.00	0.39
Jefferson	0.20	0.00	0.20	0.07	0.00	0.07	0.27	0.00	0.27
Lafayette	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lake	5.36	0.00	5.36	3.87	0.00	3.87	9.23	0.00	9.23
Lee	11.36	0.00	11.36	11.30	0.00	11.30	22.66	0.00	22.66
Leon	1.24	0.00	1.24	0.30	0.00	0.30	1.54	0.00	1.54
Levy	0.45	0.00	0.45	0.04	0.00	0.04	0.49	0.00	0.49
Liberty	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Madison	0.20	0.00	0.20	0.06	0.00	0.06	0.26	0.00	0.26
Manatee	3.42	0.00	3.42	1.62	0.00	1.62	5.04	0.00	5.04
Marion	4.88	0.00	4.88	1.20	0.00	1.20	6.08	0.00	6.08
Martin	4.19	0.00	4.19	3.69	0.00	3.69	7.88	0.00	7.88
Miami-Dade	8.51	0.00	8.51	4.88	0.00	4.88	13.39	0.00	13.39
Monroe	1.23	0.00	1.23	0.62	0.00	0.62	1.85	0.00	1.85
Nassau	3.10	0.00	3.10	0.46	0.00	0.46	3.56	0.00	3.56
Okaloosa	3.02	0.00	3.02	0.46	0.00	0.46	3.48	0.00	3.48
Okeechobee	0.09	0.00	0.09	0.59	0.00	0.59	0.68	0.00	0.68
Orange	16.14	0.00	16.14	9.40	0.00	9.40	25.54	0.00	25.54
Osceola	1.57	0.00	1.57	0.54	0.00	0.54	2.11	0.00	2.11
Palm Beach	21.18	0.00	21.18	52.91	0.00	52.91	74.09	0.00	74.09
Pasco	5.29	0.00	5.29	1.07	0.00	1.07	6.36	0.00	6.36
Pinellas	2.39	0.00	2.39	3.00	0.00	3.00	5.39	0.00	5.39
Polk	9.65	0.00	9.65	2.29	0.00	2.29	11.94	0.00	11.94
Putnam	0.64	0.00	0.64	0.40	0.00	0.40	1.04	0.00	1.04
St. Johns	5.55	0.00	5.55	3.16	0.00	3.16	8.71	0.00	8.71
St. Lucie	3.99	0.00	3.99	4.21	0.00	4.21	8.20	0.00	8.20
Santa Rosa	6.00	0.00	6.00	0.35	0.00	0.35	6.35	0.00	6.35
Sarasota	4.89	0.00	4.89	4.07	0.00	4.07	8.96	0.00	8.96
Seminole	7.70	0.00	7.70	1.76	0.00	1.76	9.46	0.00	9.46
Sumter	3.35	0.00	3.35	0.17	0.00	0.17	3.52	0.00	3.52
Suwannee	0.07	0.00	0.07	0.02	0.00	0.02	0.09	0.00	0.09
Taylor	0.07	0.00	0.07	0.02	0.00	0.02	0.09	0.00	0.09
Union	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volusia	9.04	0.00	9.04	3.21	0.00	3.21	12.25	0.00	12.25
Wakulla	0.20	0.00	0.20	0.00	0.00	0.00	0.20	0.00	0.20
Walton	0.27	0.00	0.27	1.52	0.00	1.52	1.79	0.00	1.79
Washington	0.39	0.00	0.39	0.00	0.00	0.00	0.39	0.00	0.39
State totals	**230.45**	**0.00**	**230.45**	**181.28**	**0.00**	**181.28**	**411.73**	**0.00**	**411.73**

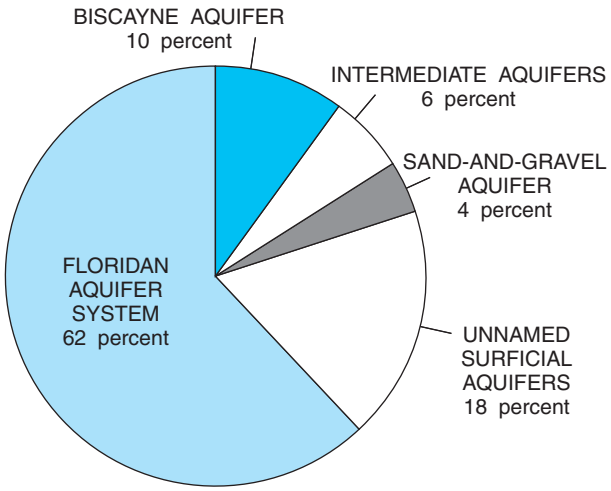


Figure 25. Recreational irrigation ground-water withdrawals in Florida by principal aquifer, 2000.

Monthly withdrawals for recreational irrigation had a large seasonal variation. Irrigation withdrawals in 2000 were greatest in February through June during drier conditions, and lowest in July, August, September, when summer rains occurred (fig. 26). Nearly 40 percent of the water withdrawn for recreational irrigation was in Palm Beach and Broward Counties (table 10). Pinellas and Palm Beach Counties were the largest user of reclaimed wastewater for recreational irrigation.

Golf course irrigation was the largest use of water in this category, accounting for 72 percent of the water withdrawn and 48 percent of the reclaimed wastewater used. Of the nearly 192,000 acres irrigated for recreational purposes, 61 percent was for golf courses and the remaining 39 percent was for other turf grass or landscape uses. In 2000, about 1,100 golf courses were located in Florida (Florida Sports Foundation, 2000), covering an estimated 134,400 acres, of which nearly 88 percent (116,600 acres) was irrigated. According to a statewide inventory of golf courses by the National Golf Foundation (2001), an estimated 5.5 acres per golf course hole in Florida was irrigated.

Water withdrawals for recreational irrigation increased 126 percent between 1985 and 2000 (fig. 27), and golf course acreage increased 58 percent. Golf course irrigation is heavily dependent upon rainfall; normal rainfall deviations during the year can dramatically change annual water demands. In addition, golf courses in central and south Florida irrigate all year, and those along the coast must deal with high evaporation rates due to the sea breeze. These all contribute to water demands and due to the dry conditions across most of Florida during the first part of 2000, water demands were higher than normal for this year. Some of this demand is offset by the use of reclaimed water as the primary water source and the use of on-site irrigation ponds that depend on runoff. However, when rainfall does not provide enough water to maintain levels in the ponds, wells are often used to augment water to maintain ponds as an irrigation source.

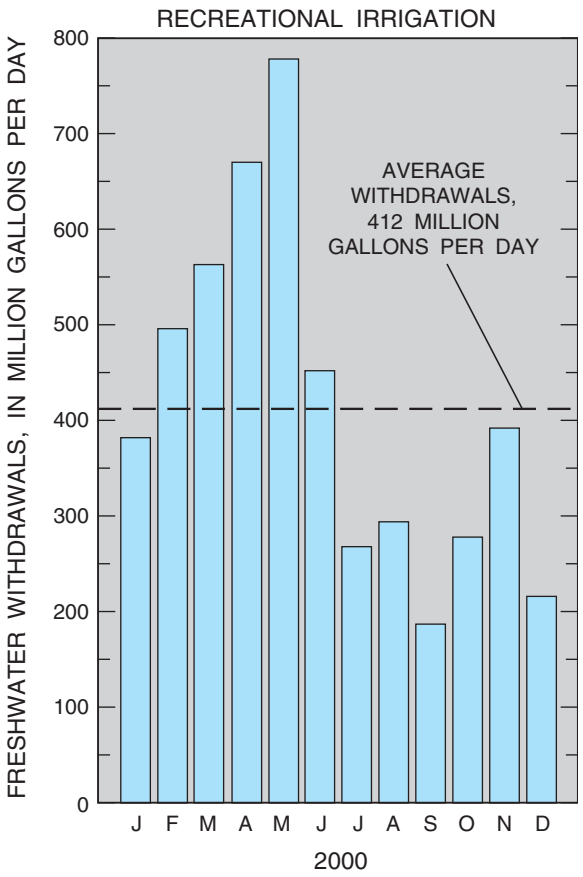


Figure 26. Average daily recreational irrigation freshwater withdrawals by month in Florida, 2000.

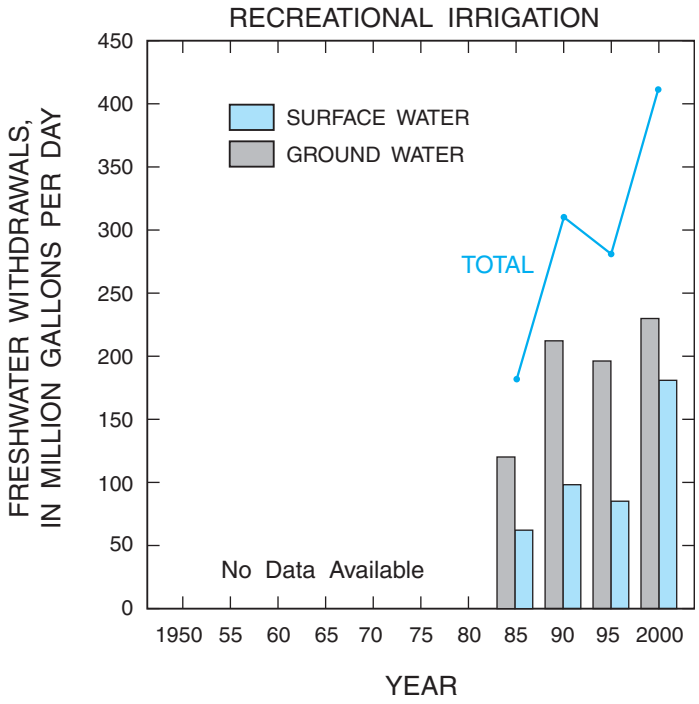


Figure 27. Historical recreational irrigation freshwater withdrawals in Florida by source, 1985-2000. (Modified from Marella, 1999.)

Power Generation

Power generation use includes water withdrawn at thermoelectric power generation facilities (fossil fuel or nuclear) and water used at hydroelectric facilities. A total of 56 active thermoelectric power generation facilities were inventoried in 2000. An additional five thermoelectric power plants were on standby use only (used only during extreme peak demands times or while primary plants are down due to maintenance). Small private secondary power generating facilities are not included in these estimates along with the two hydroelectric power generating facilities located in Florida.

Nearly 12,613 Mgal/d of water was withdrawn for power generation purposes in 2000, of which 95 percent was saline and 5 percent was freshwater (table 11). Of the total freshwater withdrawn, 96 percent was surface water and 4 percent was ground water. More than 99 percent of the total water withdrawn (fresh and saline) for power generation is used for once-through cooling, and is returned to its source immediately after use. More than 170,000 gigawatts of total gross power was generated from the 56 inventoried facilities for 2000.

The Floridan aquifer system was the source of 84 percent (28 Mgal/d) of fresh ground-water withdrawals for power generation in 2000. Most of the surface water was withdrawn from bays or rivers along the coast, and most was returned to these sources. Major surface water sources included the Caloosahatchee River (Lee County), Crystal River and the Gulf of Mexico (Citrus County), Escambia River (Escambia County), the Indian River (Brevard, Indian River, and St. Lucie Counties), the St. Johns River (Duval and Putnam Counties), and Tampa Bay (Hillsborough and Pinellas Counties). Although several of these rivers are freshwater, the point of power plant withdrawal is often tidally influenced, and the water may be fresh, brackish, or saline due to tidal flows (McPherson and Hammett, 1991). The water withdrawn and reported herein is considered saline at most of these plants unless they are permitted by the water management district as freshwater. Public-supply deliveries to thermoelectric power plants used for domestic purposes or as boiler make-up water totaled nearly 9 Mgal/d. Additionally, 13 Mgal/d of reclaimed wastewater was used directly for cooling purposes; however, a much larger amount of cooling water was obtained from lakes or ponds supplemented by reclaimed wastewater.

Table 11. Power generation water withdrawals in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	2.63	0.00	2.63	0.00	0.00	0.00	2.63	0.00	2.63
Baker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay	0.89	0.00	0.89	0.00	265.05	265.05	0.89	265.05	265.94
Bradford	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brevard	0.39	0.00	0.39	0.00	1,079.28	1,079.28	0.39	1,079.28	1,079.67
Broward	0.00	0.00	0.00	0.00	1,512.39	1,512.39	0.00	1,512.39	1,512.39
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	1.55	0.00	1.55	0.00	393.90	393.90	1.55	393.90	395.45
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
DeSoto	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	8.33	0.00	8.33	0.00	661.15	661.15	8.33	661.15	669.48
Escambia	2.42	0.00	2.42	199.89	0.00	199.89	202.31	0.00	202.31
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	0.81	0.00	0.81	0.00	0.00	0.00	0.81	0.00	0.81
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	0.08	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08
Hillsborough	0.00	0.00	0.00	0.00	3,188.00	3,188.00	0.00	3,188.00	3,188.00
Holmes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Indian River	0.00	0.00	0.00	0.00	39.01	39.01	0.00	39.01	39.01
Jackson	0.30	0.00	0.30	89.53	0.00	89.53	89.83	0.00	89.83
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	0.22	0.00	0.22	0.00	492.27	492.27	0.22	492.27	492.49
Leon	2.74	0.00	2.74	0.00	0.00	0.00	2.74	0.00	2.74
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	25.10	0.00	25.10	25.10	0.00	25.10
Marion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Martin	0.54	0.00	0.54	24.63	0.00	24.63	25.17	0.00	25.17
Miami-Dade	2.08	3.68	5.76	0.00	33.19	33.19	2.08	36.87	38.95
Monroe	0.00	0.14	0.14	0.00	0.00	0.00	0.00	0.14	0.14
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	0.76	0.00	0.76	0.00	0.00	0.00	0.76	0.00	0.76
Osceola	0.03	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.03
Palm Beach	0.00	0.00	0.00	0.00	433.02	433.02	0.00	433.02	433.02
Pasco	0.14	0.00	0.14	0.00	1,956.50	1,956.50	0.14	1,956.50	1,956.64
Pinellas	0.00	0.00	0.00	0.00	419.11	419.11	0.00	419.11	419.11
Polk	4.27	0.00	4.27	15.66	0.00	15.66	19.93	0.00	19.93
Putnam	0.69	0.00	0.69	13.90	0.00	13.90	14.59	0.00	14.59
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	1,477.95	1,477.95	0.00	1,477.95	1,477.95
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
Suwannee	0.06	0.00	0.06	101.01	0.00	101.01	101.07	0.00	101.07
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	0.54	0.00	0.54	130.63	0.00	130.63	131.17	0.00	131.17
Wakulla	0.06	0.00	0.06	28.38	0.00	28.38	28.44	0.00	28.44
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
State totals	**29.53**	**3.82**	**33.35**	**628.73**	**11,950.82**	**12,579.55**	**658.26**	**11,954.64**	**12,612.90**

Monthly freshwater withdrawals for power generation fluctuated seasonally during 2000—the highest withdrawals were from May through August, as power demands increase due to hotter weather (fig. 28). The largest amount of freshwater withdrawn was in Escambia County, and the largest amount of saline water withdrawn was in Hillsborough County (table 11). Several power plants in Duval, Hillsborough, Indian River, Orange, Osceola and Polk Counties used reclaimed wastewater to augment cooling water.

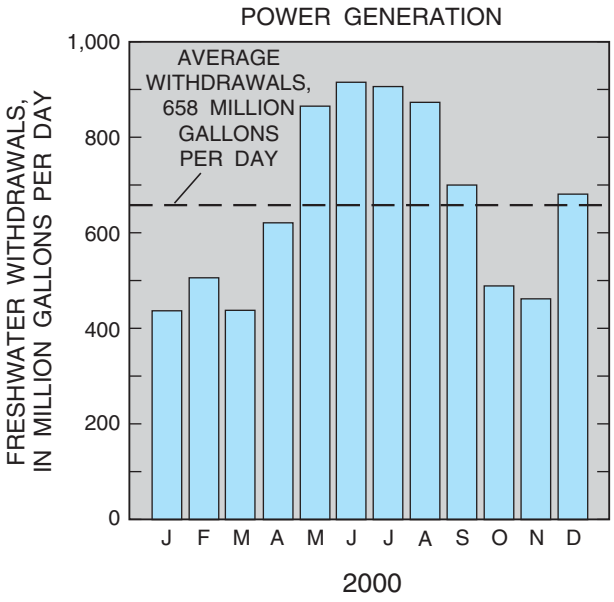


Figure 28. Average daily power generation freshwater withdrawals by month in Florida, 2000.

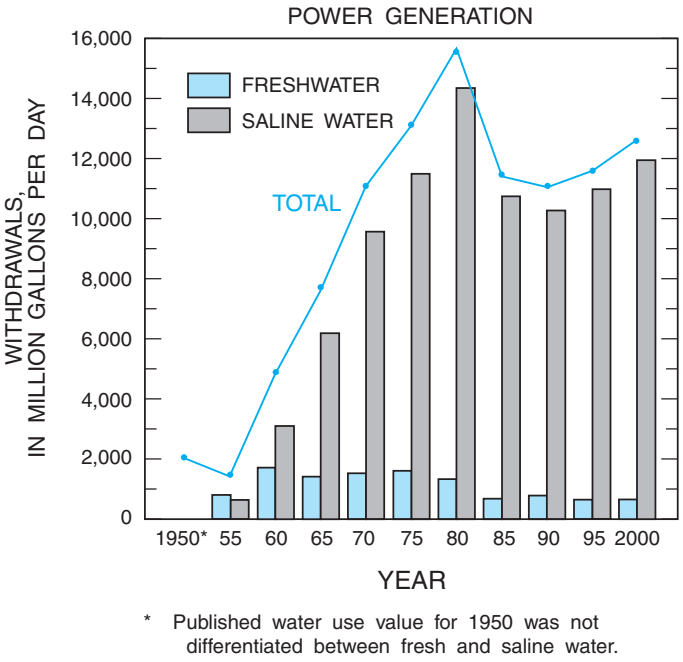


Figure 29. Historical power generation water withdrawals in Florida by source, 1950-2000. (Modified from Marella, 1999.)

Total water withdrawals for power generation increased steadily between 1955 and 1980, when withdrawals peaked at 15,500 Mgal/d (fig. 29). Between 1970 and 2000, saline water withdrawals for power generation increased 25 percent, whereas freshwater withdrawals decreased 57 percent. Between 1995 and 2000, saline water withdrawals increased 9 percent, whereas freshwater withdrawals increased 3 percent. The reduction in freshwater withdrawals over the past 20 years is due to the increase in water efficiency of new or modernized facilities, and in part to increased recycling of cooling water after routing the water to cooling ponds or cooling towers, or the reclassification of a plant's water source from freshwater to saline water. Water withdrawals at many plants are now made only to augment or replenish the water in the cooling ponds. Because of these factors, water withdrawals increased only 15 percent between 1970 and 2000, whereas total gross power generated in Florida increased 200 percent. Furthermore, differences between years could have occurred due to facility downtime caused by plant maintenance or modernization. Significant downtime can substantially reduce the annual average water withdrawn at power plant, and is particularly evident when data are collected only every 5 years.

Water Management Districts

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 Environmental Protection (formerly the Florida Department of Natural Resources) (Fernald and Patton, 1984). These five water management districts, which encompass the entire State, are the Northwest Florida (NWFWMD), the St. Johns River (SJRWMD), the South Florida (SFWMD), the Southwest Florida (SWFWMD), and the Suwannee River (SRWMD) (fig. 2).

Of the 2000 total population in Florida, 6.60 million people (41 percent) resided in the SFWMD, followed by the SWFWMD with 3.99 million people (25 percent), the SJRWMD with 3.89 million people (24 percent), the NWFWMD with 1.22 million people (8 percent), and the SRWMD with 0.25 million people (2 percent) (fig. 30). The SFWMD included the largest number of residents (6.11 million people) served by public-supply water systems (fig. 30).

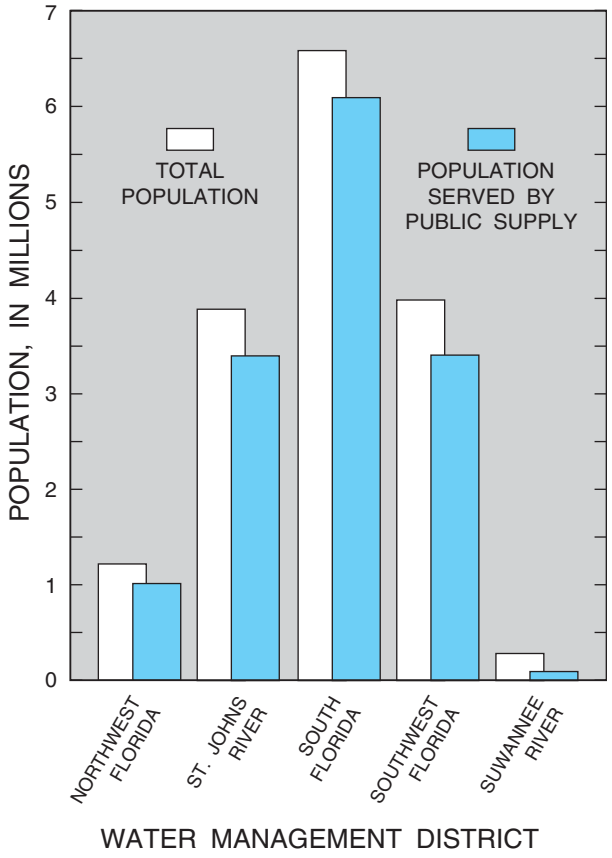


Figure 30. Population and population served by public supply in Florida by water management district, 2000.

The largest amount of freshwater withdrawn was from the SFWMD, which was nearly one-half (49 percent) of the State's total freshwater withdrawn (fig. 31 and table 12). The percentage of the total freshwater withdrawn in the other water management districts were: SJRWMD, 20 percent; SWFWMD, 19 percent; NWFWMD, 8 percent; and SRWMD, 4 percent. The SFWMD accounted for the largest amount of freshwater withdrawn for public supply use (46 percent), agricultural self-supplied use (63 percent), and recreational irrigation use (51 percent). The SWFWMD accounted for the largest amount of freshwater withdrawn for commercial-industrial self-supplied use (26 percent); and the NWFWMD accounted for the largest amount of freshwater withdrawn for power generation use (49 percent) (table 12). The largest amount (50 percent) of saline water withdrawn was from the SWFWMD and was used for cooling purposes at several power generation facilities located along Tampa Bay or the Gulf of Mexico (fig. 32 and table 12).

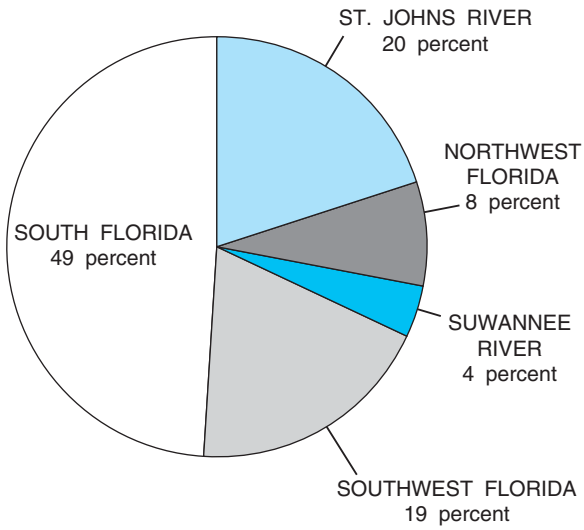


Figure 31. Freshwater withdrawals in Florida by water management district, 2000.

Table 12. Water withdrawals by category in Florida by water management district, 2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day; district totals 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; general locations of water management districts are shown in figure 2]

	Fresh ground water	Fresh surface water	Total freshwater	Total saline water	Total water
Northwest Florida					
Public Supply	145.90	46.17	192.07	0.00	192.07
Domestic self-supplied	21.75	0.00	21.75	0.00	21.75
Commercial-industrial self-supplied	51.86	26.30	78.16	0.00	78.16
Agricultural self-supplied	36.32	9.94	46.26	0.00	46.26
Recreational irrigation	18.57	4.50	23.07	0.00	23.07
Power generation	6.41	317.80	324.21	265.05	589.26
Totals	**280.81**	**404.71**	**685.52**	**265.05**	**950.57**
St. Johns River[1]					
Public Supply	558.51	14.08	572.59	0.00	572.59
Domestic self-supplied	51.70	0.00	51.70	0.00	51.70
Commercial-industrial self-supplied	90.64	31.80	122.44	1.18	123.62
Agricultural self-supplied	392.33	214.20	606.53	0.00	606.53
Recreational irrigation	72.66	31.94	104.60	0.00	104.60
Power generation	10.86	144.53	155.39	1,779.44	1,934.83
Totals	**1,176.70**	**436.55**	**1,613.25**	**1,780.62**	**3,393.87**
South Florida					
Public Supply	1,070.28	49.24	1,119.52	0.00	1,119.52
Domestic self-supplied	52.43	0.00	52.43	0.00	52.43
Commercial-industrial self-supplied	88.83	35.18	124.01	0.00	124.01
Agricultural self-supplied	784.37	1,682.22	2,466.59	0.00	2,466.59
Recreational irrigation	86.21	123.68	209.89	0.00	209.89
Power generation	2.95	24.63	27.58	3,952.64	3,980.22
Totals	**2,085.07**	**1,914.95**	**4,000.02**	**3,952.64**	**7,952.66**
Southwest Florida[2]					
Public Supply	408.88	127.94	536.82	0.00	536.82
Domestic self-supplied	52.74	0.00	52.74	0.00	52.74
Commercial-industrial self-supplied	117.52	34.40	151.92	0.00	151.92
Agricultural self-supplied	683.06	24.83	707.89	0.00	707.89
Recreational irrigation	51.95	20.79	72.74	0.00	72.74
Power generation	6.77	40.76	47.53	5,957.51	6,005.04
Totals	**1,320.92**	**248.72**	**1,569.64**	**5,957.51**	**7,527.15**
Suwannee River					
Public Supply	15.79	0.00	15.79	0.00	15.79
Domestic self-supplied	20.06	0.00	20.06	0.00	20.06
Commercial-industrial self-supplied	81.85	4.92	86.77	0.00	86.77
Agricultural self-supplied	93.87	1.87	95.74	0.00	95.74
Recreational irrigation	1.06	0.37	1.43	0.00	1.43
Power generation	2.54	101.01	103.55	0.00	103.55
Totals	**215.17**	**108.17**	**323.34**	**0.00**	**323.34**
State Totals	**5,078.67**	**3,113.10**	**8,191.77**	**11,955.82**	**20,147.59**

[1]St. Johns River Water Management District, 2004.
[2]Southwest Florida Water Management District, 2002.

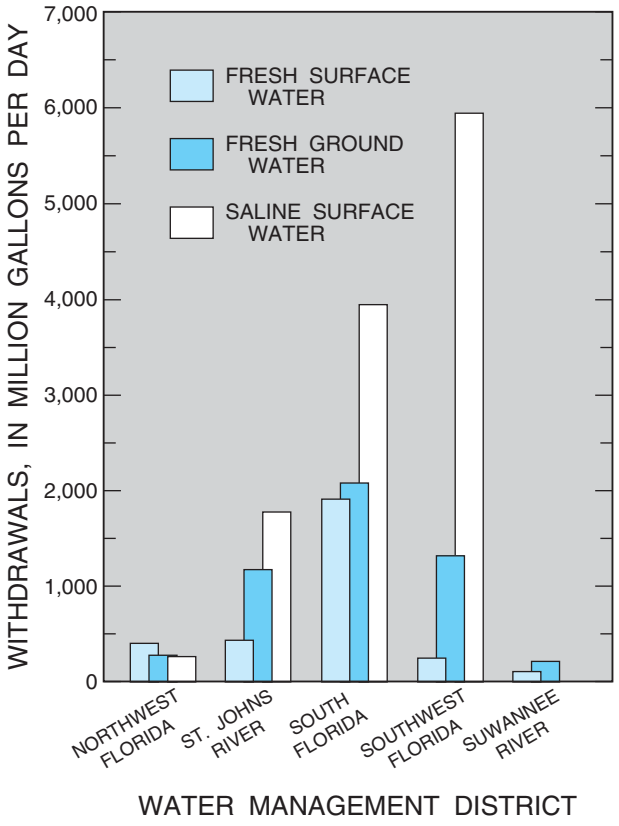


Figure 32. Fresh and saline water withdrawals in Florida by water management district, 2000.

Freshwater withdrawals in all districts except the SFWMD have remained about the same or decreased slightly between 1975 and 2000. However, excluding power generation, water withdrawals in all five water management districts increased between 1975 and 2000 as a result of increases in irrigated acreage, population, and tourism (fig. 33). Excluding freshwater withdrawals for power generation, the SRWMD had the largest percent increase in withdrawals between 1975 and 2000 (61 percent), followed by the SFWMD (57 percent), the SJRWMD (37 percent), and the NWFWMD and SWFWMD (29 percent each). The SFWMD had the largest increase in total water withdrawals (1,440 Mgal/d) between 1975 and 2000 (fig. 33). Since 1975, fresh ground-water withdrawals increased in all five water management districts (fig.34) while fresh surface-water withdrawals decreased in all but the SFWMD (fig. 35). The decrease in fresh surface water is a result of the decrease in power generation withdrawals between 1975 and 2000.

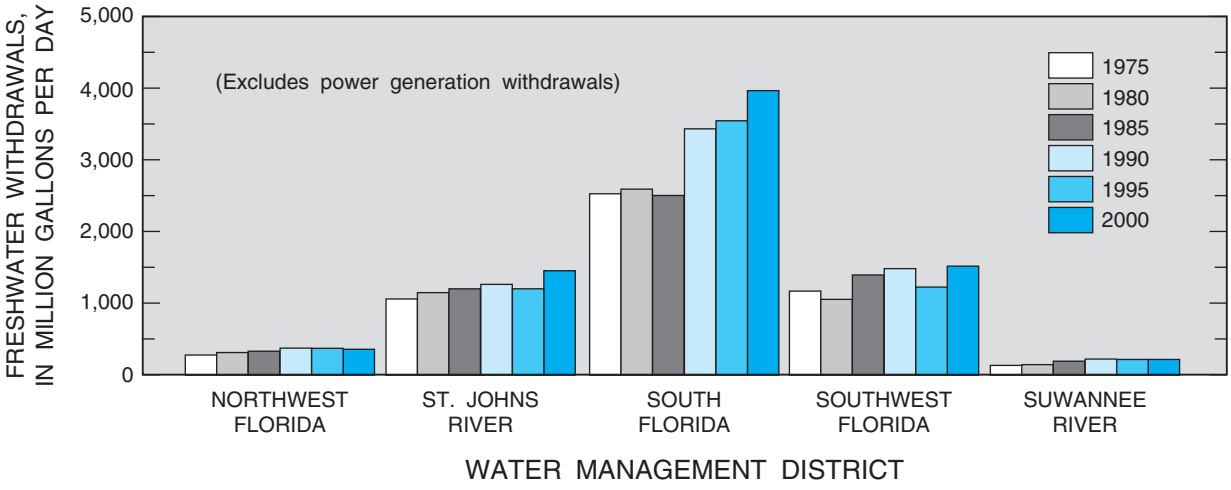


Figure 33. Historical freshwater withdrawals in Florida by water management district, 1975-2000. (Modified from Marella, 1995 and 1999.)

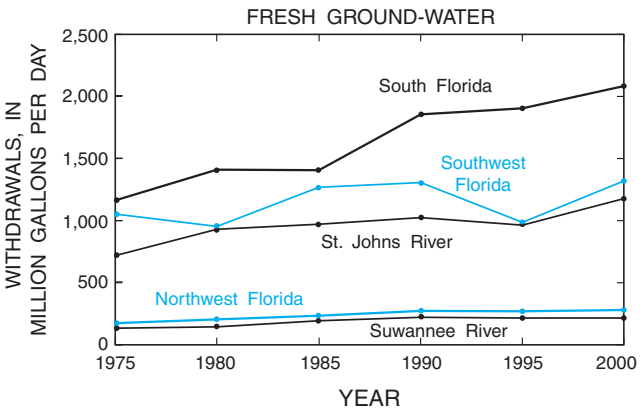


Figure 34. Historical fresh ground-water withdrawals in Florida by water management district, 1975-2000. (Modified from Marella, 1995 and 1999.)

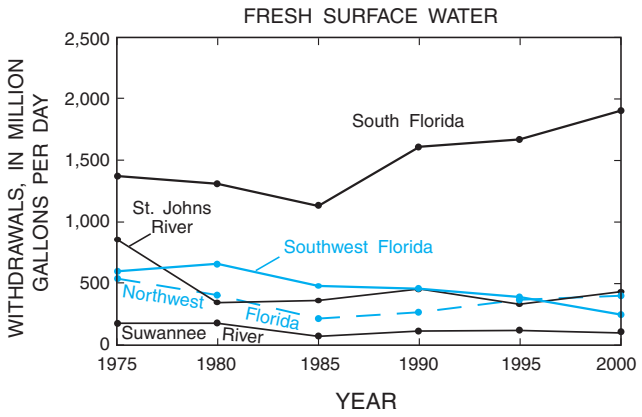


Figure 35. Historical fresh surface-water withdrawals in Florida by water management district, 1975-2000. (Modified from Marella, 1995 and 1999.)

Water Consumption and Discharges

In 2000, an estimated 52 percent (table 13) of the freshwater withdrawn in Florida was consumed (evaporated, transpired, incorporated into products or crops, or otherwise removed from the immediate water environment); the remaining 48 percent was returned to the hydrologic system as wastewater. Less than 0.1 percent (5 Mgal/d) of the saline water was consumed. The greatest consumption of freshwater in Florida was in agricultural self-supplied (irrigation and nonirrigation) and recreational irrigation, primarily due to high evapotranspiration during hot and dry periods when irrigation demands are high (fig. 36). Water consumed ranges from 80 percent for recreational irrigation to 9 percent for power generation (freshwater only) (table 13). Nearly all (99 percent) of the total water withdrawn for power generation (fresh and saline) was returned to its source. The estimated percentage of freshwater consumed varied during the past 25 years, ranging from 33 percent in 1975 and 1980 (Leach, 1978, 1983); 43 percent in 1985 (Marella, 1988); 42 percent in 1990 (Solley and others, 1993); and 39 percent in 1995 (Marella, 1999). Estimates for 2000 are higher than past years because of prolonged drought conditions throughout the State (University of Nebraska, 2004) lead to an increase in water demands for all irrigation purposes (agriculture, recreational, and residential lawns), allowing for higher evaporation over a longer period of time. All consumption values are estimated from irrigation coefficients, industry standards, or published sources.

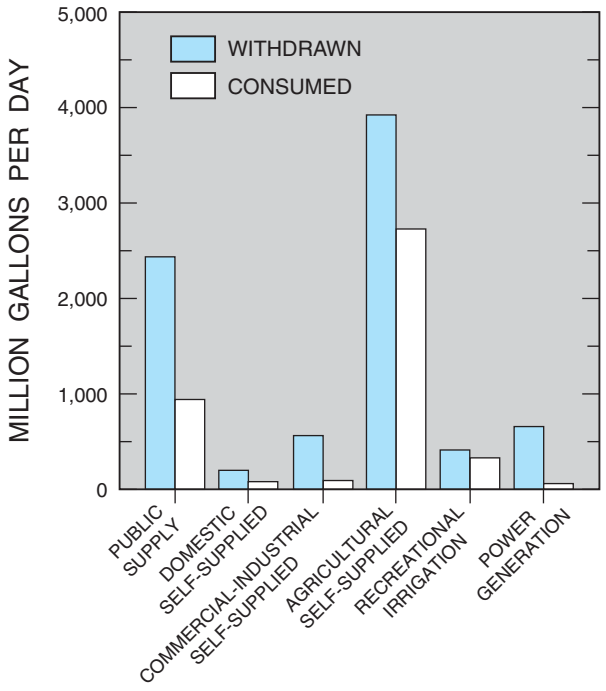


Figure 36. Freshwater withdrawals and estimated water consumption in Florida by category, 2000.

Table 13. Estimated freshwater consumed by category in Florida, 2000

[Freshwater consumed in million gallons per day]

	Freshwater consumed	Percent consumed
Public supply	942.9	38.7
Domestic self-supplied	76.9	38.7
Commercial-industrial self-supplied	107.6	19.1
Agricultural self-supplied	2,720.5	69.5
Recreational irrigation	328.8	80.0
Power generation	59.3	9.0
State totals	**4,236.0**	**51.7**

Wastewater discharge includes water that was released from treatment facilities, septic tanks, or runoff from agricultural or urban lands. Discharge data for domestic (municipal) and industrial facilities are usually regulated and metered, whereas records of the amount of water released from septic tanks or that runs off agricultural or urban lands are usually not available. For this report, wastewater values were reported for domestic facilities that discharged 0.10 Mgal/d or more, and estimates of water released by septic tanks were made. No industrial wastewater discharge values were collected for 2000.

Domestic Wastewater

Domestic wastewater facilities (includes municipal and privately owned) are those systems that receive or dispose of wastewater derived principally from residential dwellings, businesses or commercial establishments, institutions and some industrial facilities (Florida Department of Environmental Regulation, 1991). According to the FDEP, there were 2,789 domestic wastewater systems in operation during 2000 (Joseph Doker, Florida Department of Environmental Protection, written commun., 2004). Total discharge from the 2,789 domestic wastewater systems for 2000 was 1,515 Mgal/d. Domestic wastewater discharge data were collected for 571 systems as reported to FDEP. Discharge from the inventoried systems totaled nearly 1,495 Mgal/d and accounted for 99 percent of the total domestic wastewater discharge. Discharge from the 2,218 uninventoried systems was estimated to be 20 Mgal/d (2,218 systems multiplied by 0.009 Mgal/d) or slightly more than 1 percent of the total discharge. Of the domestic wastewater discharged from the 571 inventoried systems, 44 percent was discharged to surface water, 34 percent was discharged to the ground through land application systems (drain fields, percolation ponds, spray fields) and reuse systems, and 22 percent was discharged to deep aquifers through injection wells (fig. 37).

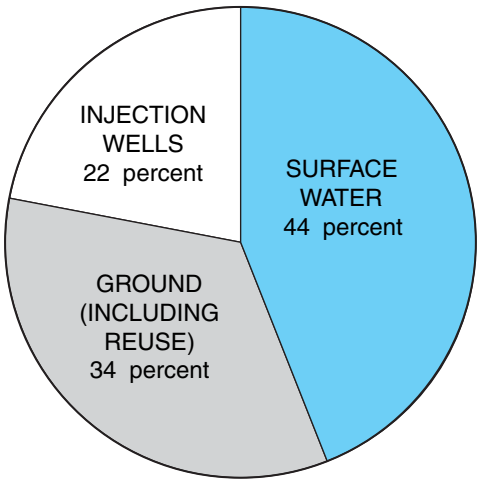


Figure 37. Treated domestic wastewater discharges in Florida by primary disposal method, 2000.

The estimated population served by the inventoried systems in 2000 was 11.07 million (table 14), and the population served by the uninventoried systems was about 0.14 million, for a total of 70 percent (11.21 million) of the State's population. The remaining 30 percent of the State's population discharged domestic wastewater to septic tanks.

Table 14. Treated domestic wastewater population served, discharge, and capacity in Florida by county, 2000

[Compiled by the U.S. Geological Survey and Florida Department of Environmental Protection; discharge and capacity values in million gallons per day]

County	Population		Wastewater discharge by source				Total number of systems	Systems inventoried	
	Total	Served	Total	Ground	Injection	Surface		Number	Capacity
Alachua	217,955	151,450	17.06	2.12	7.79	7.15	36	8	22.43
Baker	22,259	4,000	0.69	0.17	0.00	0.52	6	2	1.89
Bay	148,217	86,775	33.89	0.55	0.00	33.34	18	7	64.50
Bradford	26,088	6,850	1.93	1.60	0.00	0.33	7	2	4.15
Brevard	476,230	308,500	37.63	14.58	17.40	5.65	70	21	62.90
Broward	1,623,018	1,476,300	190.28	11.47	101.24	77.57	23	17	240.88
Calhoun	13,017	2,100	0.47	0.00	0.00	0.47	1	1	0.60
Charlotte	141,627	70,700	7.46	4.46	3.00	0.00	36	10	11.82
Citrus	118,085	18,500	2.81	2.81	0.00	0.00	80	8	5.33
Clay	140,814	73,450	7.33	1.10	0.00	6.23	29	12	14.36
Collier	251,377	164,100	28.84	26.01	1.46	1.37	36	9	34.77
Columbia	56,513	17,500	2.06	2.06	0.00	0.00	24	2	3.35
DeSoto	32,209	9,600	0.98	0.29	0.00	0.69	20	3	2.70
Dixie	13,827	3,350	0.25	0.00	0.00	0.25	3	2	0.65
Duval	778,879	592,300	84.06	0.78	0.00	83.28	67	25	123.79
Escambia	294,410	160,500	19.49	3.47	0.00	16.02	13	6	35.19
Flagler	49,832	40,750	5.79	4.83	0.00	0.96	19	8	11.46
Franklin	11,057	3,100	1.07	0.43	0.00	0.64	10	4	1.58
Gadsden	45,087	14,400	2.23	0.37	0.00	1.86	13	5	3.95
Gilchrist	14,437	1,000	0.18	0.18	0.00	0.00	6	2	0.32
Glades	10,576	0	0.12	0.12	0.00	0.00	28	1	0.14
Gulf	13,332	4,650	0.36	0.16	0.00	0.20	5	3	0.62
Hamilton	13,327	5,375	0.86	0.11	0.00	0.75	14	3	1.52
Hardee	26,938	10,525	1.17	0.38	0.00	0.79	16	4	1.73
Hendry	36,210	14,500	1.50	1.50	0.00	0.00	16	4	2.33
Hernando	130,802	38,000	4.65	4.56	0.00	0.09	46	11	9.27
Highlands	87,366	23,100	2.33	2.33	0.00	0.00	73	8	4.96
Hillsborough	998,948	720,100	92.93	29.42	0.00	63.51	144	16	144.50
Holmes	18,564	2,750	0.70	0.00	0.00	0.70	4	1	1.40
Indian River	112,947	60,325	7.37	6.99	0.00	0.38	17	6	11.56
Jackson	46,755	11,350	2.77	0.75	0.00	2.02	10	5	4.84
Jefferson	12,902	2,200	0.55	0.12	0.00	0.43	5	2	1.16
Lafayette	7,022	1,000	0.23	0.23	0.00	0.00	2	2	0.36
Lake	210,528	94,000	9.78	9.78	0.00	0.00	133	20	16.00
Lee	440,888	296,050	39.19	22.93	1.25	15.01	103	32	65.29
Leon	239,452	154,725	18.29	18.29	0.00	0.00	19	4	33.26
Levy	34,449	6,300	0.47	0.47	0.00	0.00	13	3	0.87
Liberty	7,021	0	0.13	0.13	0.00	0.00	2	1	0.20
Madison	18,733	3,400	0.92	0.92	0.00	0.00	8	2	1.12
Manatee	264,002	228,075	26.27	15.51	5.56	5.20	11	5	39.10
Marion	258,916	90,000	7.79	7.79	0.00	0.00	158	16	14.81
Martin	126,731	61,075	6.86	3.66	3.20	0.00	75	13	13.68
Miami-Dade	2,253,362	1,828,500	311.10	14.21	89.82	207.07	27	5	358.70
Monroe	79,589	35,700	7.05	0.27	0.94	5.84	306	9	12.88
Nassau	57,663	21,975	3.68	1.64	0.00	2.04	27	6	5.76
Okaloosa	170,498	110,525	16.71	16.71	0.00	0.00	17	12	27.56
Okeechobee	35,910	4,200	0.74	0.74	0.00	0.00	26	3	1.40
Orange	896,344	695,875	73.15	70.89	0.00	2.26	84	21	114.44
Osceola	172,493	120,225	16.00	15.79	0.00	0.21	48	14	23.66
Palm Beach	1,131,184	945,550	108.07	25.78	57.43	24.86	71	12	160.44
Pasco	344,765	148,925	18.04	14.94	0.00	3.10	89	15	27.27
Pinellas	921,482	874,600	106.08	48.55	33.41	24.12	28	17	179.25
Polk	483,924	213,100	28.10	17.86	0.00	10.24	198	31	50.07
Putnam	70,423	10,000	2.62	0.00	0.00	2.62	33	2	3.25
St. Johns	123,135	68,900	9.01	3.16	0.00	5.85	44	14	15.89
St. Lucie	192,695	103,400	10.84	2.04	8.63	0.17	47	16	17.58
Santa Rosa	117,743	33,100	3.93	2.26	0.00	1.67	13	5	7.43
Sarasota	325,957	219,000	21.60	12.87	1.93	6.80	71	19	33.05
Seminole	365,196	278,200	48.95	36.97	0.00	11.98	29	15	77.21
Sumter	53,345	4,000	1.84	1.84	0.00	0.00	40	4	3.20
Suwannee	34,844	6,000	0.87	0.87	0.00	0.00	13	3	1.54
Taylor	19,256	4,700	0.97	0.11	0.00	0.86	7	2	1.65
Union	13,442	4,800	0.47	0.00	0.00	0.47	1	1	0.70
Volusia	443,343	284,700	31.49	16.60	0.00	14.89	126	18	56.49
Wakulla	22,863	2,100	0.29	0.29	0.00	0.00	9	2	1.00
Walton	40,601	16,000	2.77	2.77	0.00	0.00	10	6	7.19
Washington	20,973	3,200	0.75	0.14	0.00	0.61	6	3	1.57
State totals	**15,982,377**	**11,070,000**	**1,494.86**	**510.73**	**333.06**	**651.07**	**2,789**	**571**	**2,204.52**

The largest domestic wastewater discharges in 2000 were in Miami-Dade and Broward Counties. Miami-Dade County discharged more than 200 Mgal/d to surface water (Atlantic Ocean) and Broward County discharged more than 100 Mgal/d to injection wells (table 14). Both Miami-Dade and Broward Counties each had more than 1 million people served by domestic wastewater systems (table 14). Miami-Dade Water and Sewer in Miami-Dade County had the single largest discharge of domestic wastewater (308 Mgal/d), which was treated and discharged at 3 facilities during 2000. Orange County discharged more than 70 Mgal/d of water to the ground through land application or reuse systems (table 14).

Domestic wastewater discharge increased 33 percent between 1985 and 2000, but decreased 3 percent between 1995 and 2000 (fig. 38). The trend between 1985 and 2000 can be attributed to increases in population served by wastewater, as many municipalities expanded service areas and treatment plant capacities. The more recent trend between 1995 and 2000 can be attributed to wet conditions in 1995, increasing infiltration into wastewater return systems directly from rainfall runoff or indirectly from ground-water seepage into underground pipes, and to dry conditions in 2000 during which little infiltration or seepage occurred. Another important trend in domestic wastewater is the decrease in the amount of water discharged to surface water bodies and the increase in the amount of water discharged to the ground through land application systems (drain fields, percolation ponds, and spray fields) and irrigation reuse systems. In 1990, about 58 percent of the domestic wastewater was discharged to surface water (Marella, 1994) compared to 44 percent in 2000 (fig. 38). This is an ongoing declining trend as restrictions on the quality and quantity of water that is discharged to surface waters has increased and the discharge of wastewater through reuse or ground-water recharge is highly encouraged. The use of wastewater discharge for irrigation and ground-water recharge has increased from 200 Mgal/d in 1986 to more than 450 Mgal/d in 2000 (Florida Department of Environmental Protection, 2001). Statewide domestic waste-water discharge values were not available prior to 1985 and the quantity of water discharged to surface water, injection wells, or ground water was not determined for 1985.

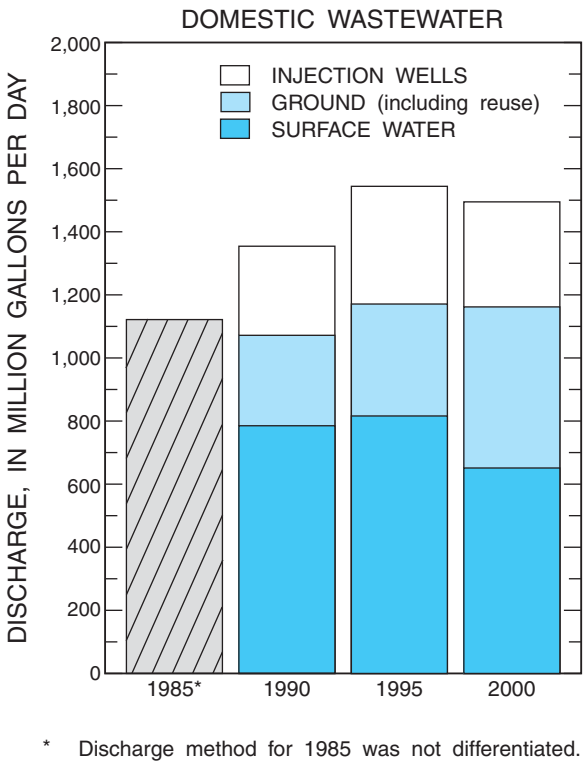


Figure 38. Historical treated domestic wastewater discharges in Florida, 1985-2000 (Modified from Marella, 1994 and 1999.)

Septic Tanks

Septic tanks (also referred to as on-site disposal systems) are buried watertight receptacles constructed to promote the separation of solids, grease, and liquid components of waste-water in the absence of oxygen. The liquid fraction from the septic tank is discharged to the ground through a subsurface drain field for further treatment, and then either transpires to the atmosphere through surface vegetation or percolates into the shallow water table (Marella, 1994 and 1998). Septic tanks are most commonly used for individual households or small commercial establishments (campgrounds, churches, convenience stores, restaurants, small motels, and facilities alike) that are in rural or remote areas, or are in urban areas that are not served by a domestic wastewater system. In 2000, nearly 1.95 million septic tanks were in use for the treatment and disposal of wastewater in Florida (Dale Holcomb, Florida Department of Health, written commun., 2003). Miami-Dade and Polk Counties each had over 100,000 septic tanks (table 15).

Based on 55 gal/d of discharge per person (Tchobanoglous, 1991) and 2.46 people per household in Florida (Smith and Cody, 2001), discharge from each tank would be about 135 gal/d. Estimated discharge from the 1.95 million septic tanks in Florida in 2000 would be about 263 Mgal/d, an increase of 24 percent from the 210 Mgal/d discharged in 1990 (Marella, 1994). The number of septic tanks in Florida has increased from 0.94 million in 1970, 1.17 million in 1980, and 1.56 million in 1990 (Marella, 1994). The number of people who relied on septic tanks increased to 4.77 million in 2000 (table 15).

Table 15. Treated domestic wastewater and septic tank population served and discharge in Florida by county, 2000

[Compiled by the U.S. Geological Survey, Florida Department of Environmental Protection, and the Florida Department of Health. Discharge values in million gallons per day]

County	Total systems	Domestic wastewater systems						Septic tanks		
		Inventoried			Non-inventoried					
		Systems	Discharge	Population	Systems	Discharge	Population	Number	Discharge	Population
Alachua	36	8	17.06	151,450	28	0.25	1,852	26,362	3.56	64,653
Baker	6	2	0.69	4,000	4	0.04	296	5,925	0.80	17,963
Bay	18	7	33.89	86,775	11	0.10	741	25,169	3.40	60,701
Bradford	7	2	1.93	6,850	5	0.04	296	7,502	1.01	18,942
Brevard	70	21	37.63	308,500	49	0.44	3,259	63,068	8.51	164,471
Broward	23	17	190.28	1,476,300	6	0.05	370	59,899	8.09	146,348
Calhoun	1	1	0.47	2,100	0	0.00	0	4,503	0.61	10,917
Charlotte	36	10	7.46	70,700	26	0.23	1,704	37,230	5.03	69,223
Citrus	80	8	2.81	18,500	72	0.64	4,741	46,272	6.25	94,844
Clay	29	12	7.33	73,450	17	0.15	1,111	23,731	3.20	66,253
Collier	36	9	28.84	164,100	27	0.24	1,778	28,435	3.84	85,499
Columbia	24	2	2.06	17,500	22	0.20	1,481	19,160	2.59	37,532
DeSoto	20	3	0.98	9,600	17	0.15	1,111	7,770	1.05	21,498
Dixie	3	2	0.25	3,350	1	0.01	74	7,609	1.03	10,403
Duval	67	25	84.06	592,300	42	0.37	2,741	71,258	9.62	183,838
Escambia	13	6	19.49	160,500	7	0.06	444	52,768	7.12	133,466
Flagler	19	8	5.79	40,750	11	0.10	741	3,893	0.53	8,341
Franklin	10	4	1.07	3,100	6	0.05	370	4,191	0.57	7,587
Gadsden	13	5	2.23	14,400	8	0.07	519	13,029	1.76	30,168
Gilchrist	6	2	0.18	1,000	4	0.04	296	5,629	0.76	13,141
Glades	28	1	0.12	0	27	0.24	1,778	4,780	0.65	8,798
Gulf	5	3	0.36	4,650	2	0.02	148	4,493	0.61	8,534
Hamilton	14	3	0.86	5,375	11	0.10	741	3,209	0.43	7,211
Hardee	16	4	1.17	10,525	12	0.11	815	5,363	0.72	15,598
Hendry	16	4	1.50	14,500	12	0.11	815	7,029	0.95	20,895
Hernando	46	11	4.65	38,000	35	0.31	2,296	37,752	5.10	90,506
Highlands	73	8	2.33	23,100	65	0.58	4,296	28,407	3.83	59,970
Hillsborough	144	16	92.93	720,100	128	1.14	8,444	88,675	11.97	270,404
Holmes	4	1	0.70	2,750	3	0.03	222	7,210	0.97	15,592
Indian River	17	6	7.37	60,325	11	0.10	741	26,292	3.55	51,881
Jackson	10	5	2.77	11,350	5	0.04	296	14,772	1.99	35,109
Jefferson	5	2	0.55	2,200	3	0.03	222	4,442	0.60	10,480
Lafayette	2	2	0.23	1,000	0	0.00	0	2,498	0.34	6,022
Lake	133	20	9.78	94,000	113	1.01	7,481	54,556	7.37	109,047
Lee	103	32	39.19	296,050	71	0.63	4,667	72,815	9.83	140,171
Leon	19	4	18.29	154,725	15	0.13	963	30,306	4.09	83,764
Levy	13	3	0.47	6,300	10	0.09	667	15,199	2.05	27,482
Liberty	2	1	0.13	0	1	0.01	74	2,777	0.37	6,947
Madison	8	2	0.92	3,400	6	0.05	370	6,244	0.84	14,963
Manatee	11	5	26.27	228,075	6	0.05	370	14,294	1.93	35,557
Marion	158	16	7.79	90,000	142	1.26	9,333	81,253	10.97	159,583
Martin	75	13	6.86	61,075	62	0.55	4,074	25,436	3.43	61,582
Miami-Dade	27	5	311.10	1,828,500	22	0.20	1,481	125,654	16.96	423,381
Monroe	306	9	7.05	35,700	297	2.64	19,556	25,575	3.45	24,333
Nassau	27	6	3.68	21,975	21	0.19	1,407	14,508	1.96	34,281
Okaloosa	17	12	16.71	110,525	5	0.04	296	19,373	2.62	59,677
Okeechobee	26	3	0.74	4,200	23	0.20	1,481	11,916	1.61	30,229
Orange	84	21	73.15	695,875	63	0.56	4,148	82,234	11.10	196,321
Osceola	48	14	16.00	120,225	34	0.30	2,222	20,402	2.75	50,046
Palm Beach	71	12	108.07	945,550	59	0.53	3,926	60,930	8.23	181,708
Pasco	89	15	18.04	148,925	74	0.66	4,889	64,572	8.72	190,951
Pinellas	28	17	106.08	874,600	11	0.10	741	13,820	1.87	46,141
Polk	198	31	28.10	213,100	167	1.49	11,037	100,359	13.55	259,787
Putnam	33	2	2.62	10,000	31	0.28	2,074	30,050	4.06	58,349
St. Johns	44	14	9.01	68,900	30	0.27	2,000	24,376	3.29	52,235
St. Lucie	47	16	10.84	103,400	31	0.28	2,074	39,357	5.31	87,221
Santa Rosa	13	5	3.93	33,100	8	0.07	519	33,971	4.59	84,124
Sarasota	71	19	21.60	219,000	52	0.46	3,407	48,942	6.61	103,550
Seminole	29	15	48.95	278,200	14	0.12	889	32,268	4.36	86,107
Sumter	40	4	1.84	4,000	36	0.32	2,370	14,701	1.98	46,975
Suwannee	13	3	0.87	6,000	10	0.09	667	12,862	1.74	28,177
Taylor	7	2	0.97	4,700	5	0.04	296	7,231	0.98	14,260
Union	1	1	0.47	4,800	0	0.00	0	2,960	0.40	8,642
Volusia	126	18	31.49	284,700	108	0.96	7,111	74,430	10.05	151,532
Wakulla	9	2	0.29	2,100	7	0.06	444	7,812	1.05	20,319
Walton	10	6	2.77	16,000	4	0.04	296	17,244	2.33	24,305
Washington	6	3	0.75	3,200	3	0.03	222	7,952	1.07	17,551
State totals	**2,789**	**571**	**1,494.86**	**11,070,000**	**2,218**	**19.75**	**146,291**	**1,944,704**	**262.56**	**4,766,086**

Water Withdrawal Trends, 1970-2000

Statewide withdrawal and 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, tabulated, and published seven times by many agencies (five water management districts, the Florida Geological Survey, the Florida Department of Environmental Protection, and the U.S. Geological Survey).

Total water (fresh and saline) withdrawn in Florida increased by 4,990 Mgal/d or 33 percent between 1970 and 2000 (fig. 39 and table 16), during which time the population increased by 9.2 million people (135 percent) (fig. 1 and table 16). During this period, freshwater withdrawals increased nearly 46 percent (2,580 Mgal/d), and saline water withdrawals increased 25 percent (2,410 Mgal/d) (fig. 39 and table 16). Overall, water withdrawals were highest in 1975 and 1980 as power generation demands peaked during this time. Since then, power generation demands have decreased due to the increase in water efficiency of new or modernized facilities and the recycling of cooling water after routing the water to cooling ponds or cooling towers. Between 1990 and 1995, freshwater withdrawals decreased by about 4 percent and saline withdrawals increased by 6 percent (Marella, 1999). In contrast, freshwater withdrawals increased 13 percent and saline withdrawals increased 9 percent between 1995 and 2000. This decrease in freshwater withdrawals between 1990 and 1995 as well as the increase between 1995 and 2000, can be attributed to significantly drier conditions (lower rainfall) in 1990 and 2000 during key times of the year coupled with significant wetter conditions (higher rainfall) during 1995. Since 1990, water-conservation and the use of alternative water sources such as reclaimed wastewater have helped offset some of the increase in water demands. It is difficult to determine how much effect these measures have had on water use nor how much rainfall changes water demands.

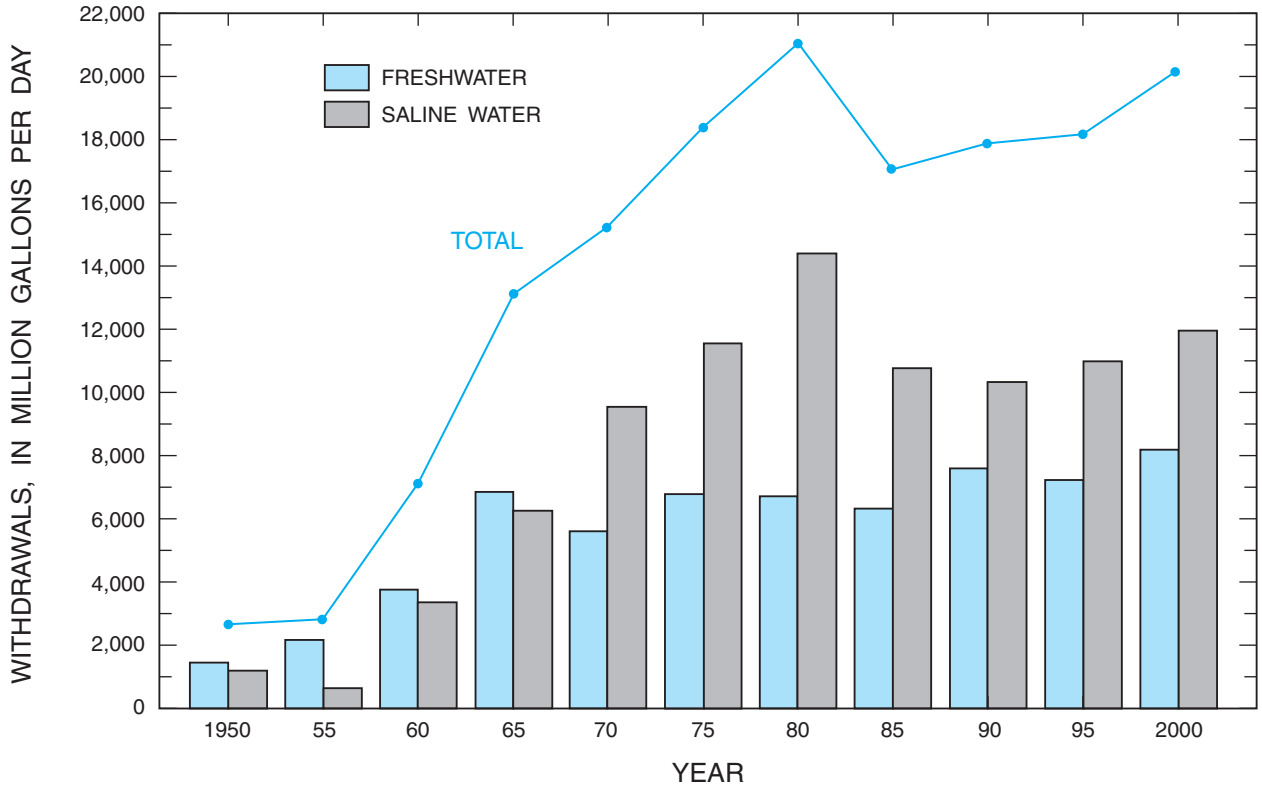


Figure 39. Historical fresh and saline water withdrawals in Florida, 1950-2000. (Modified from Marella, 1999.)

Table 16. Historical population and water withdrawals in Florida by source, 1950-2000

[Compiled by the U.S. Geological Survey, Tallahassee; values in million gallons per day; ----, data not available]

Year	Population, in millions		Water withdrawals, in million gallons per day						
	Total	Served by public supply	Fresh Total	Fresh Ground	Fresh Surface	Saline water	Total all water	Non-potable water[2]	Reclaimed water[3]
1950	2.77	1.66	1,454.0	614.0	840.0[1]	1,200.0[1]	2,654.0		
1955	3.86	2.30	2,167.0	1,017.0	1,150.0	645.0	2,812.0	----	----
1960	4.95	3.37	3,760.0	1,560.0	2,200.0	3,360.0	7,120.0	----	----
1965	5.87	4.81	6,852.0	2,218.5	4,633.5	6,261.0	13,113.0	----	----
1970	6.79	5.42	5,612.3	2,786.7	2,825.6	9,545.0	15,157.3	1.6	----
1975	8.48	6.81	6,772.7	3,214.6	3,558.1	11,502.0	18,274.7	1.7	----
1977	8.72	6.99	6,546.3	3,429.5	3,116.8	----	----	1.2	----
1980	9.75	7.79	6,701.2	3,677.2	3,024.0	13,897.0	20,598.2	2.5	----
1985	11.32	9.74	6,313.4	4,047.7	2,265.7	10,798.3	17,111.7	17.3	206.0[4]
1990	12.94	11.23	7,583.6	4,664.7	2,918.9	10,366.1	17,949.7	47.9	266.0
1995	14.15	12.21	7,229.9	4,348.8	2,881.1	10,965.7	18,195.6	57.9	402.0
2000	15.98	14.03	8,191.8	5,078.7	3,113.1	11,955.8	20,147.6	95.3	575.0

[1] Data for 1950 power generation did not show fresh or saline totals, but estimates were made using percentages from 1955.

[2] Nonpotable water includes water treated through desalination or diluted with fresher water to meet drinking water standards.

[3] Reclaimed (waste) water includes all water reported by DEP as all types of reuse and wastewater disposal.

[4] Value is reported for 1986, no data was compiled for 1985.

Data sources: Population

1950-1970 - University of Florida (Dietrich, 1978).

1975-2000 - Florida Statistical Abstracts and United States Statistical Abstracts.

Population served and water withdrawals

1950 - Modified from U.S. Geological Survey Circular 115 (MacKichan, 1951).

1955 - Modified from U.S. Geological Survey Circular 398 (MacKichan, 1957).

1960 - Modified from U.S. Geological Survey Circular 456 (MacKichan and Kammerer, 1961).

1965 - Modified from U.S. Geological Survey Circular 556 (Murray, 1968).

1970 - Modified from U.S. Geological Survey Circular 676 (Murray and Reeves, 1972).

1975 - USGS Water-Resources Investigations Report 78-17 (Leach, 1978).

1977 - USGS Water-Resources Investigations Report 79-112 (Leach and Healy, 1980).

1980 - USGS Water-Resources Investigations Report 82-4090 (Leach, 1983).

1985 - USGS Water-Resources Investigations Report 88-4103 (Marella, 1988).

1990 - USGS Water-Resources Investigations Report 92-4140 (Marella, 1992).

1995 - USGS Water-Resources Investigations Report 99-4002 (Marella, 1999).

Reclaimed water

1985-2000 - 2000 Reuse Inventory (Florida Department of Environmental Protection, 2001)

Ground-water withdrawals increased 2,292 Mgal/d or 82 percent between 1970 and 2000 (fig. 40 and table 16). This long-term trend in ground-water withdrawals is a result of: (1) improvements in drilling techniques; (2) the ability to pump large quantities of high-quality water more economically from large, deep wells; and (3) increases in demand posed by population growth and crop irrigation. Since 1980, ground water has been the primary source of freshwater in Florida, supplying about 60 percent of the total freshwater withdrawn during this period.

Fresh surface-water withdrawals have increased 288 Mgal/d or 10 percent between 1970 and 2000 (fig. 40 and table 16). Fresh surface-water withdrawals peaked in 1975, primarily due to power generation demands; however, since then many plants converted to more efficient closed systems and newer plants rely on saline surface water. Increases in fresh surface-water demands posed by increased irrigated agricultural acreage in South Florida during 1970 through 2000 helped offset the large decrease in withdrawals for power generation. Between 1950 and 1980, surface water was the primary source of freshwater in Florida, supplying more than half of the total freshwater withdrawn during this period. Surface water supplies about 40 percent of the State's freshwater withdrawn since 1980.

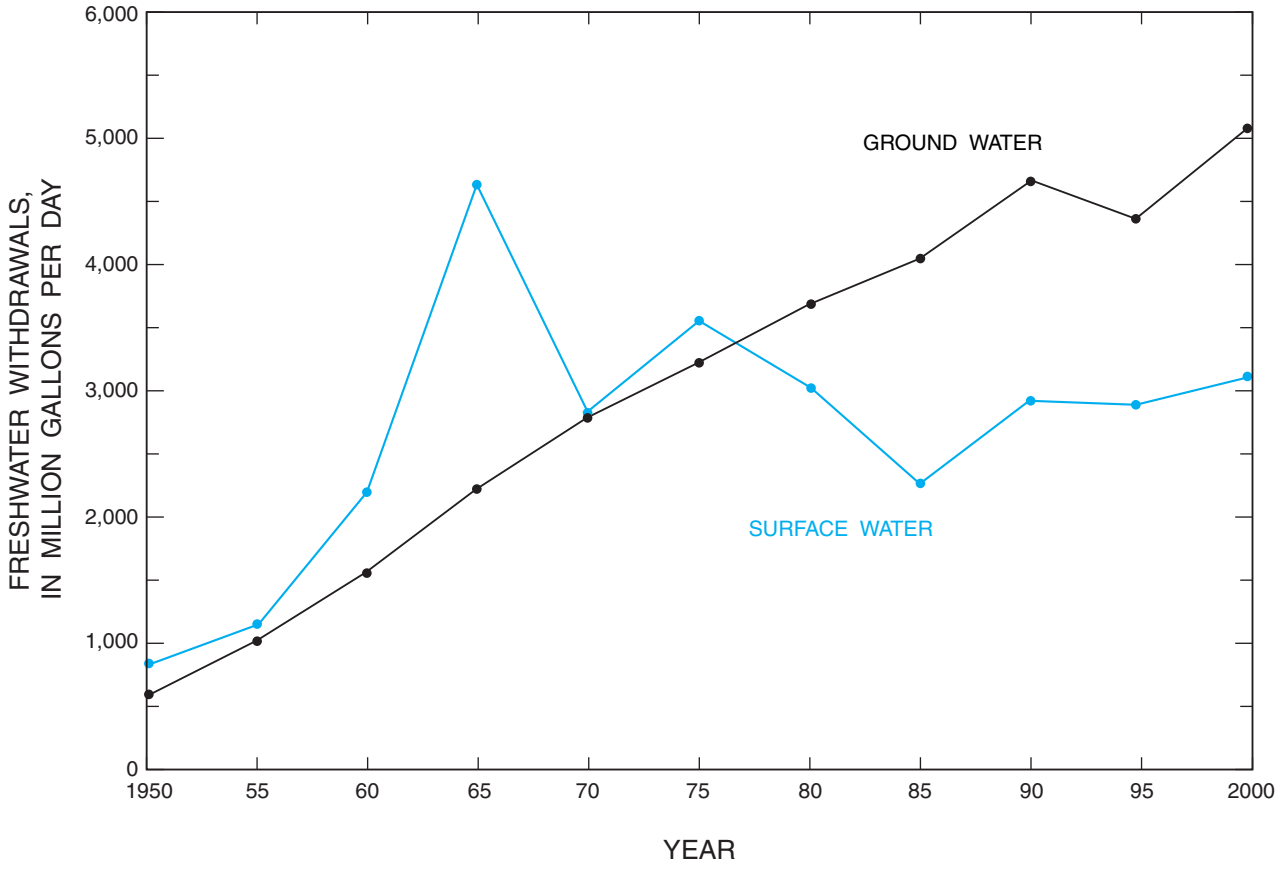


Figure 40. Historical freshwater withdrawals in Florida by source, 1950-2000. (Modified from Marella, 1999.)

Between 1970 and 2000, total freshwater withdrawals increased for public supply by 176 percent, for agricultural self-supplied by 87 percent, and domestic self-supplied remained nearly the same (table 17). However, during this period, withdrawals for commercial-industrial self-supplied decreased by 37 percent, and power generation decreased(thermoelectric) by 57 percent. Recreational irrigation withdrawals increased 127 percent between 1985 and 2000; prior to 1985 recreational irrigation water use was included in the agricultural self-supplied category. Increases in public-supply withdrawals are a result of population growth and tourism during this time period, along with higher demands posed by commercial and industrial facilities that are on public-supply water systems. Agricultural self-supplied increases during this period are a result of irrigation development and the availability of water for irrigation, which allowed farmers to increase crop production while decreasing the risk of crop damage due to prolonged dry conditions. Commercial-industrial self-supplied withdrawals decreased because self-supplied users began using public supply as a water source, many facilities began recirculating more water (primarily to lower their discharge amount), and the closure of several large paper mills and phosphate facilities. Power generation decreased between 1970 and 1990, as many of the facilities changed to more modern and efficient cooling systems.

The use of nonpotable ground water as a source of supply, primarily for public supply, also has increased in Florida. Nonpotable implies that water does not meet driking-water standards set by the FDEP and thus needs some form of desalination treatment (see Glossary) or dilution to meet set standards. The amount of nonpotable water treated to meet drinking-water standards increased from 17 Mgal/d in 1985 (Marella, 1995) to 95 Mgal/d in 2000 (table 16). Several public-supply water systems depend on nonpotable treated water, but most use this source to augment existing sources.

The use of reclaimed wastewater also has increased in Florida since the mid 1980's. According to the FDEP, nearly 575 Mgal/d of reclaimed wastewater was used in 2000, compared to 206 Mgal/d used in 1986 (Florida Department of Environmental Protection, 2001) (table 16). However, a large portion of this reported value is for the sole purpose of disposing treated wastewater, and not to offset freshwater demands. Only about one-third of this reclaimed water is used to replace or offset a freshwater source. The use of reclaimed wastewater reduces the demand for freshwater, and is expected to continue to increase statewide.

Table 17. Historical freshwater withdrawals in Florida by category, 1970-2000

[Compiled by the U.S. Geological Survey, Tallahassee; all values in million gallons per day; ----, no or partial data were available; N/A, totals not available]

	Public supply			Domestic self-supplied		Commercial-industrial self-supplied		Agricultural self-supplied		Recreational irrigation		Power Generation		Total freshwater withdrawals		
Year	Ground	Surface	Treated	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Total
1970	753.10	130.30	1.6	209.20	0.00	683.60	215.90	1,136.35	964.35	----	----	4.50	1,515.00	2,786.75	2,825.55	5,612.30
1971	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1972	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1973	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1974	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1975	962.80	161.30	1.7	225.75	2.05	721.85	160.70	1,289.90	1,640.70	----	----	14.30	1,593.40	3,214.60	3,558.15	6,772.75
1976	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1977	1,059.10	172.80	1.2	213.00	1.01	703.68	153.54	1,437.29	1,479.50	----	----	16.43	1,309.93	3,429.50	3,116.78	6,546.28
1978	1,052.60	154.10	2.0	239.30	1.00	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1979	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1980	1,225.95	180.45	2.5	243.40	0.10	615.24	85.08	1,572.80	1,452.60	----	----	19.80	1,305.80	3,677.19	3,024.03	6,701.22
1981	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1982	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1983	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1984	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
1985	1,491.80	193.64	17.3	259.29	0.00	631.53	77.28	1,526.66	1,271.15	119.65	61.84	18.74	661.76	4,047.67	2,265.67	6,313.34
1986	1,542.77	191.28	----	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1987	1,634.68	199.73	37.4	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1988	1,693.21	211.29	----	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1989	1,754.10	217.80	42.4	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1990	1,698.82	226.33	47.9	299.38	0.00	630.88	139.06	1,800.19	1,695.03	212.31	97.72	23.14	760.72	4,664.72	2,918.86	7,583.58
1991	1,701.31	245.04	46.3	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1992	1,780.05	242.61	47.5	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1993	1,810.38	218.47	53.4	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1994	1,800.06	210.64	58.4	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1995	1,868.77	210.47	57.9	296.74	0.00	438.12	253.71	1,527.52	1,716.58	196.38	84.50	21.25	615.88	4,348.78	2,881.14	7,229.92
1996	1,922.40	208.98	65.5	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1997	1,929.16	221.04	66.0	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1998	2,057.04	218.38	75.1	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
1999	2,087.59	239.07	88.5	----	----	----	----	----	----	----	----	----	----	N/A	N/A	N/A
2000	2,199.36	237.43	95.3	198.68	0.00	430.70	132.60	1,989.95	1,933.06	230.45	181.28	29.53	628.73	5,078.67	3,113.10	8,191.77

Public supply treated includes water that does not meet public drinking water standards and is either treated through a desalination process or diluted with fresher water to meet standards.
Domestic self-supplied withdrawals differ for 2000 as a revised procedure was used to calculate withdrawals compared to the previous years (1975-1995).
Commercial-industrial self-supplied includes water withdrawals for all mining purpose, as well as golf course irrigation from 1970-1984.
Agricultural self-supplied includes water withdrawn for crop irrigation, livestock, and fish farming purposes.
Recreational irrigation includes water used for all turf grass irrigation (golf, commercial, industrial, and public) purposes. This category was accounted for under Agricultural self-supplied from 1970 through 1984.
Data sources; 1970-1990 - Modified from USGS Open-File Report 94-521 (Marella, 1995).
1991-1994, 1996-2000 - USGS unpublished water-use data files, Tallahassee, Florida.
1995 - USGS Water-Resources Investigations Report 99-4002 (Marella, 1999).
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