USGS
science for a changing world

Prepared in cooperation with the Florida Department of Environmental Protection

Water Withdrawals, Use, and Trends in Florida, 2010

Scientific Investigations Report 2014–5088

U.S. Department of the Interior
U.S. Geological Survey

Graphic on the front cover depicts 2010 freshwater use (top right), saline water use (center), and total water use (bottom left) by county.

Water Withdrawals, Use, and Trends in Florida, 2010

By Richard L. Marella

Prepared in cooperation with the Florida Department of Environmental Protection

Scientific Investigations Report 2014–5088

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2014

Suggested citation:
Marella, R.L., 2014, Water withdrawals, use, and trends in Florida, 2010: U.S. Geological Survey Scientific Investigations Report 2014-5088, 59 p., http://dx.doi.org/10.3133/sir20145088.

ISSN 2328-0328 (online)

Contents

Figures

Tables

Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
acre	0.4047	hectare (ha)
acre	0.4047	square hectometer (hm^2)
acre	0.004047	square kilometer (km^2)
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)
	Energy	
gigawatt-hour (GWh)	2.778×10^{-13}	joule (J)

Abbreviations

AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation
ASR	aquifer storage and recovery
EIA	Energy Information Administration
ET	evapotranspiration
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
IFAS	Institute of Food and Agricultural Sciences
JEA	Jacksonville Electric Authority
NASS	National Agricultural Statistics Service
NRCS	Natural Resources Conservation Service (formerly the Soil Conservation Service)
NWFWMD	Northwest Florida Water Management District
MOR	monthly operating report
SFWMD	South Florida Water Management District
SJRWMD	St. Johns River Water Management District
SRWMD	Suwannee River Water Management District
SWFWMD	Southwest Florida Water Management District
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WMD	Water Management District

Acknowledgments

The author gratefully acknowledges the Florida Department of Environmental Protection (FDEP), 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: Janet Llewellyn and Carolyn Voyles (Tallahassee), as well as the many individuals in the Drinking Water Program from FDEP district offices in Fort Myers, Jacksonville, Orlando, Pensacola, Tampa, and West Palm Beach. Other State of Florida agencies that contributed assistance or data include the Florida Department of Agricultural and Consumer Services—Office of Agricultural Water Policy and the Florida Department of Health, County Environmental Offices.

Special appreciation is extended to the Executive Directors of the five Florida water management districts for their participation and staff cooperation in providing water-use data: Northwest Florida Water Management District (NWFWMD), St. Johns River Water Management District (SJRWMD), South Florida Water Management District (SFWMD), Southwest Florida Water Management District (SWFWMD), and the Suwannee River Water Management District (SRWMD). The participation of the following individuals is acknowledged for their data-collection and tabulation efforts or for their technical input and support: Leigh Brooks, Kenneth Busen, Angela Chelette, Kathleen Coates, and Lauren Connell at NWFWMD in Havana; Bruce Florence and Tammy Bader at SJRWMD in Palatka; Cynthia Gefvert, Ian R. Miller, Donna Rickabus, Chris Sweazy, and Robert Verrastro, at SFWMD in Orlando and West Palm Beach; Christina Jackson at SWFWMD in Brooksville; Clay Coarsey, Dale Jenkins, and Kevin Wright at SRWMD in Live Oak.

Appreciation is also extended to the many utility operators, plant managers, and individuals who provided data vital to the completion of this report. These contributors include staff from the following companies and government agencies: Florida Power and Light Company (Ronald Hix), Gainesville Regional Utilities, Gulf Power Company (a Southern Company), Jacksonville Electric Authority, Lakeland Electric and Water, Miami-Dade County Water and Sewer Department, Orlando Utilities Commission, Progress Energy (currently Duke Energy), Seminole Electric Cooperative, Tampa Bay Water, Tampa Electric Company, City of Tallahassee, and many others who provided data and technical guidance.

The author would also like to acknowledge Mike Deacon, Ron Spencer, and Joann Dixon of the USGS in Davie, Lutz, and Orlando, respectively, for there assistance in the review and preparation of this document for publication.

Water Withdrawals, Use, and Trends in Florida, 2010

By Richard L. Marella

Abstract

In 2010, the total amount of water withdrawn in Florida was estimated to be 14,988 million gallons per day (Mgal/d). Saline water accounted for 8,589 Mgal/d (57 percent) and freshwater accounted for 6,399 Mgal/d (43 percent). Groundwater accounted for 4,166 Mgal/d (65 percent) of freshwater withdrawals, and surface water accounted for the remaining 2,233 Mgal/d (35 percent). Surface water accounted for nearly all (99.9 percent) saline-water withdrawals. An additional 659 Mgal/d of reclaimed wastewater was used in Florida during 2010. Freshwater withdrawals were greatest in Palm Beach County (707 Mgal/d), and saline-water withdrawals were greatest in Hillsborough County (1,715 Mgal/d).

Fresh groundwater provided drinking water (public supplied and self-supplied) for 17.33 million people (92 percent of Florida's population), and fresh surface water provided drinking water for 1.47 million people (8 percent). The statewide public-supply gross per capita use for 2010 was 134 gallons per day, whereas the statewide public-supply domestic per capita use was 85 gallons per day. The majority of groundwater withdrawals (almost 62 percent) in 2010 were obtained from the Floridan aquifer system, which is present throughout most of the State. The majority of fresh surface-water withdrawals (56 percent) came from the southern Florida hydrologic unit subregion and is associated with Lake Okeechobee and the canals in the Everglades Agricultural Area of Glades, Hendry, and Palm Beach Counties, as well as the Caloosahatchee River and its tributaries in the agricultural areas of Collier, Glades, Hendry, and Lee Counties.

Overall, agricultural irrigation accounted for 40 percent of the total freshwater withdrawals (ground and surface), followed by public supply with 35 percent. Public supply accounted for 48 percent of groundwater withdrawals, followed by agricultural self-supplied (34 percent), commercial-industrial-mining self-supplied (7 percent), recreational-landscape irrigation and domestic self-supplied (5 percent each), and power generation (less than 1 percent). Agricultural self-supplied accounted for 51 percent of fresh surface-water withdrawals, followed by power generation (25 percent), public supply (11 percent), recreational-landscape irrigation (9 percent), and commercial-industrial-mining self-supplied (4 percent). Power generation accounted for nearly all (99.8 percent) saline-water withdrawals.

Of the 18.80 million people who resided in Florida during 2010, 41 percent (7.68 million people) resided in the South Florida Water Management District (SFWMD), 25 percent each resided in the Southwest Florida Water Management District (SWFWMD) and the St. Johns River Water Management District (SJRWMD) (4.73 and 4.70 million people, respectively), 7 percent (1.36 million people) resided in the Northwest Florida Water Management District (NWFWMD), and 2 percent (0.33 million people) resided in the Suwannee River Water Management District (SRWMD). The largest percentage of freshwater withdrawals was from the SFWMD (47 percent), followed by the SJRWMD (21 percent), SWFWMD (18 percent), NWFWMD (9 percent), and SRWMD (5 percent).

Between 1950 and 2010, the population of Florida increased by 16.03 million (580 percent), and the total water withdrawals (fresh and saline) increased by 12,334 Mgal/d (465 percent). More recently, total freshwater withdrawals decreased by more than 1,792 Mgal/d (22 percent) between 2000 and 2010, while the population increased by 2.82 million (18 percent), and total freshwater withdrawals decreased by more than 474 Mgal/d (7 percent) between 2005 and 2010, while the population increased by 0.88 million (8 percent). The recent trend of decreases in freshwater withdrawals is a result of increased rainfall during this period, the development and use of alternative water sources, water conservation efforts, more conservative regulations and mandates, changes in economic conditions, and losses of irrigated lands. Freshwater withdrawals for public supply, agricultural self-supplied use, and commercial-industrial-mining self-supplied use all decreased between 2000 and 2010 and between 2005 and 2010, whereas freshwater withdrawals for domestic self-supplied use, recreational-landscape irrigation use, and power generation use either remained the same or changed slightly during the decade.

The use of highly mineralized groundwater (referred to as nonpotable water) as a source of drinking water has increased in Florida. Nonpotable water use for public supply has increased from nearly 2 Mgal/d in 1970 to about 165 Mgal/d in 2010. Nonpotable water is either blended or treated to meet drinking-water standards and is mostly used along the east and west coasts of central and southern Florida. The use of reclaimed wastewater increased from about 206 Mgal/d in 1986 to nearly 659 Mgal/d in 2010. More than three-quarters (79 percent) of reclaimed wastewater in 2010 was used to supplement potable-quality water withdrawals for urban irrigation, agricultural irrigation, and industrial use.

Introduction

Water is among Florida's most valued resources. The State has more than 1,700 streams and rivers, 7,800 freshwater lakes, 700 springs, 11 million acres of wetlands, and underlying aquifers yielding substantial quantities of freshwater necessary for human and environmental needs (Fernald and Purdum, 1998). Although renewable, these water resources are limited and continued growth in population, tourism, and agriculture will place increased demands on these water sources.

The **population** (bold print denotes that the term is defined in the Glossary) of Florida totaled 18.80 million in 2010 (University of Florida, 2011), ranking fourth in the Nation (U.S. Census Bureau, 2011a). This population represents an increase of about 580 percent from the 1950 population of 2.77 million (Dietrich, 1978), and an 18 percent increase from the 2000 population of 15.98 million (U.S. Census Bureau, 2011a) (fig. 1). Florida's population is projected to reach nearly 20 million by 2015, and nearly 24 million by 2030 (Smith and Rayer, 2012) (fig. 1). In addition to the State's resident population, slightly more than 82 million people visited Florida in 2010 (http://www.visitflorida.com/en-us/media/research.html). Freshwater will remain a vital resource for Florida's residents and visitors, as population and tourism continue to increase statewide.

The agricultural sector in Florida depends heavily on the State's water resources. In 2010, Florida produced nearly two-thirds (63 percent) of the total citrus produced in the United States and ranked thirteenth in the Nation in total agricultural cash receipts (Florida Department of Agriculture and Consumer Services, 2012). Agriculture employed nearly 750,000 people in Florida and contributed about 100 billion dollars to the State economy in 2010 (Florida Department of Agriculture and Consumer Services, 2012). Agriculture is expected to remain important because the State's subtropical climate fosters the cultivation and growth of a wide variety of crops, and demands for locally produced food from the growing population have remained constant. Accurate and reliable information concerning the amount of water required to support future agriculture is essential to the development of the State economy and vital to the well-being of its residents and visitors.

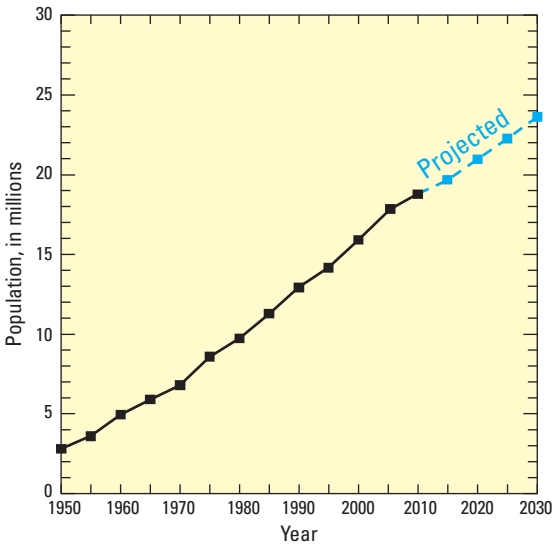


Figure 1. Historical and projected population of Florida, 1950–2030. From Dietrich (1978), University of Florida (2011), U.S. Census Bureau (2011a), and Smith and Rayer (2012).

Accurate estimates of current water use and projected trends in Florida are compiled by the U.S. Geological Survey (USGS), in cooperation with the Florida Department of Environmental Protection (FDEP), and in collaboration with the Northwest Florida Water Management District (NWFWMD), St. Johns River Water Management District (SJRWMD), South Florida Water Management District (SFWMD), Southwest Florida Water Management District (SWFWMD), and Suwannee River Water Management District (SRWMD). This coordinated effort provides the data and information needed to estimate future water needs and plan future resource management in Florida.

Purpose and Scope

The purpose of this report is to provide detailed information about the quantities of water withdrawn in 2010 in the State of Florida and increase understanding about water-use trends between 1950 and 2010. Overall, the report provides a basis for summarizing water withdrawals, understanding water use, and projecting future water needs. Water-use estimates for Florida are presented in this report by category, county, water source (surface and ground, including principal aquifers), and water management district (WMD).

Data are presented on water withdrawals in Florida for each of the following water-use categories: **public supply** (including deliveries), domestic self-supplied, commercial-industrial-mining self-supplied, agricultural self-supplied (including irrigation and nonirrigation uses), recreational-landscape irrigation (including golf-course irrigation), and power generation. Data are not presented for **instream uses** (nonwithdrawal), such as **hydroelectric power generation**, **navigation**, water-based recreation, propagation of fish and wildlife, and dilution and conveyance of liquid or solid waste.

This report also does not include data on the amount of water discharged from wastewater-treatment facilities, septic tanks, or retention ponds.

Within each withdrawal category, 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 WMD (fig. 2) for each water-use category. Additional information about current or historical water use can be obtained by contacting the USGS Florida Water Science Center offices in Lutz, Orlando, or Davie, or by visiting the USGS Web site at http://fl.water.usgs.gov/infodata/wateruse.html.

Previous Investigations

This report is the eleventh 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, 1975); for 1975, 1977, and 1980 (Leach, 1978, 1983; Leach and Healy, 1980); and for 1985, 1990, 1995, 2000, and 2005 (Marella, 1988, 1992, 1999, 2004, 2009). These ten reports include assessments of all water uses in Florida, by county, for the following categories: public supply, domestic self-supplied, commercial-industrial-mining self-supplied, agricultural self-supplied (including irrigation and nonirrigation), recreational-landscape irrigation, and power generation. Historical water-use data for the State and each county for all freshwater withdrawals by category between 1965 and 2010 are available from the USGS Florida Water Science Center, Florida water-use Web site at http://fl.water.usgs.gov/infodata/wateruse.html.

Prior to 1965, state water-use data were published only at the national level. Nationwide summaries of water-use data were published for 1950, 1955, and 1960 (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961). These reports include detailed water-use data at the state level, but do not include water-use data for counties. Nationwide summaries, including data for Florida, also were published by the USGS for 1965, 1970, and 1975 (Murray, 1968; Murray and Reeves, 1972, 1977); for 1980, 1985, 1990, and 1995 (Solley and others, 1983, 1988, 1993, 1998); for 2000 (Hutson and others, 2004); and for 2005 (Kenny and others, 2009). National and state data for 2010 and prior years are available from the USGS national water-use Web site at http://water.usgs.gov/watuse/.

Additional water-use reports in Florida were published by selected WMDs between 1975 and 2010. The SJRWMD and SWFWMD have published annual water-use reports since the late 1970s, and the NWFWMD, SFWMD, and SRWMD intermittently published reports between 1976 and 1985. Detailed water-use data for 2010 were published by Southwest Florida Water Management District (2012), and a fact sheet summarizing water use for 2010 was published by the St. Johns River Water Management District (2011). Historical freshwater-withdrawal data for each WMD between 1975 and 2010 are available at the USGS Florida Water Science Center Web site at http://fl.water.usgs.gov/infodata/wateruse.html. In addition, a complete water-use bibliography for Florida is available at this Web site.

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 for 2010 were collected under nationwide guidelines specified by the USGS (Hutson, 2007). Data for each state are reported by major water-use category and county; some states also report by hydrologic unit (basin) and aquifer. Water-use data for Florida were compiled through an ongoing cooperative program with the FDEP as part of the 2010 USGS National Water Cooperative Program. Data also were obtained from the FDEP (Drinking Water and Wastewater Sections), NWFWMD, SRWMD, SJRWMD, SFWMD, and SWFWMD, as well as from various utilities, industries, and power companies. Specific data sources for each water-use category or source are listed below.

Public supply—Data for public-supply withdrawals were obtained from (1) consumptive water-use permit compliance files or annual reports provided by the five WMDs, (2) the monthly operating reports (MORs) supplied to the FDEP Drinking Water Program (http://www.dep.state.fl.us/water/drinkingwater/flow.htm), or (3) directly from the water suppliers. Nearly all of the reported water-use values for this category are from metered data.

Population-served estimates for the counties within the NWFWMD, SFWMD, and SRWMD (fig. 2) were made at the county level using the statistical trend in previous population-served totals from 1985 to 2005. The population-served estimates were then compared to estimates produced by each WMD from their most recent water-supply plans to provide quality assurance. Estimates of the population served by the SJRWMD and SWFWMD were made and published by the respective WMDs (St. Johns River Water Management District, 2011; Southwest Florida Water Management District, 2012). Published values for the SWFWMD were modified to remove seasonal population estimates so that the county values would then be consistent with those from counties in the other four WMDs and represent the State's resident population.

Domestic self-supplied—Domestic self-supplied population estimates are derived by subtracting the county population served by the public-supply systems from the total county population. Domestic self-supplied withdrawals for the counties in the NWFWMD, SFWMD, and SRWMD (fig. 2) were calculated by multiplying the 2010 statewide public-supply domestic **per capita use** of 85 gallons per day (gal/d) by the self-supplied population served for each county (detailed in the Public Supply section). Withdrawal estimates for the counties within the SJRWMD and SWFWMD were calculated by the WMDs using the public-supply gross per capita use or an adjusted per capita use rate (St. Johns River

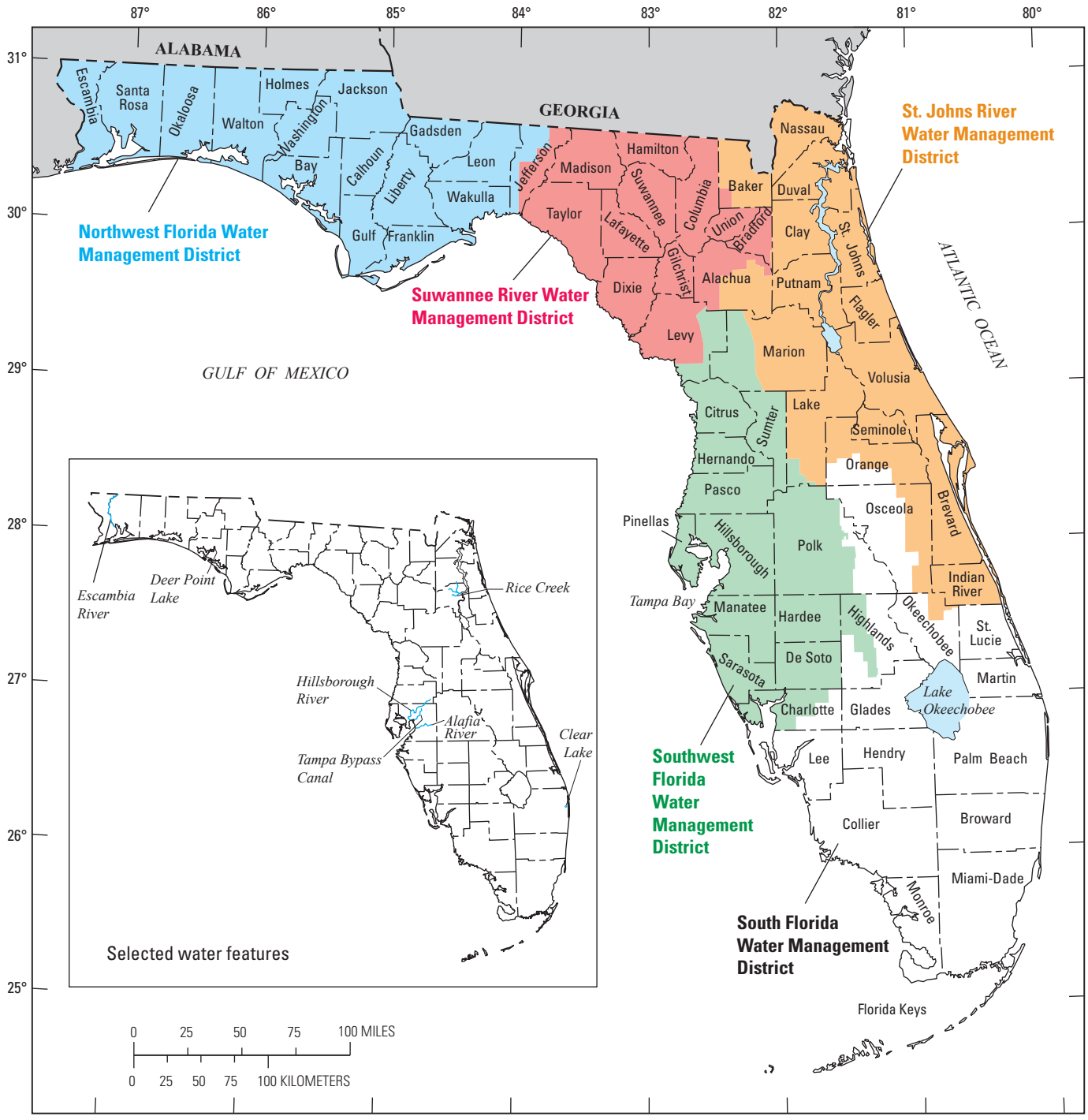


Figure 2. Counties and water management districts in Florida. From Fernald and Purdum (1998).

Water Management District, 2011; Southwest Florida Water Management District, 2012). All water used for domestic self-supply is assumed to be **groundwater**, and values for this category are estimated.

Commercial-industrial-mining self-supplied—Data for commercial, industrial, and mining self-supplied withdrawals were obtained from (1) consumptive water-use permit compliance files or annual reports provided by the five WMDs, (2) the MORs supplied to the FDEP Drinking Water Program (http://www.dep.state.fl.us/water/drinkingwater/flow.htm), or (3) from individual commercial-industrial-mining water users. Not all users in this use category are required to have a WMD consumptive water-use permit and often only have a general water-use permit. Furthermore, not all of these permitted users are required to submit annual withdrawal quantities as part of their permit conditions to their respective WMD. In addition, some industrial or mining water users are not required to submit MORs to the FDEP either. Therefore, some users were contacted directly for their withdrawal information. Nearly all of the reported water-use values for this category are from metered data.

Agricultural self-supplied—Water withdrawal estimates for **agriculture use** are mostly a composite of (1) estimates made by multiplying irrigated crop acreage by a calculated **net irrigation requirement** (NIR) coefficient (often referred to as an application rate), and (2) actual withdrawal totals from metered data. The majority of this category is estimated, because only a small percentage (12 percent) of the total agricultural self-supplied water withdrawals presented in this report were derived from metered data for 2010. Metered data alone cannot provide a cumulative total because not all users are metered and therefore estimates must be made in order to aggregate withdrawal totals for any county or region.

Irrigated crop acreage estimates were obtained by the USGS or the WMDs from a variety of sources, which include: (1) Florida Department of Agriculture and Consumer Services (FDACS) reports (Florida Department of Agriculture and Consumer Services, 2012); (2) the National Agricultural Statistics Service database (http://www.nass.usda.gov/Statistics_by_State/Florida/index.asp); and (3) U.S. Department of Agriculture (USDA) reports (2009, 2010, 2011a, b, c). Other data sources used to validate reported irrigated crop acreage include the WMD consumptive water-use permit files or water-supply plans, personnel at the University of Florida Institute of Food and Agriculture Science (IFAS), County Extension Offices (http://ifas.ufl.edu/), or county agents from the local USDA Natural Resource Conservation Service (http://www.fl.nrcs.usda.gov/).

The NIR coefficients calculated for crop production represent the amount of water, in addition to rainfall, that must be applied to meet the **evapotranspiration** (ET) needs for a specific crop or crop type (Smajstrla and Zazueta, 1995). The NIR coefficient does not include the water needed to overcome irrigation system inefficiencies and must be adjusted to account for irrigation system losses (U.S. Soil Conservation Service, 1982). Because few historical accounts of actual water use for selected crops are available in Florida, several numerical models are used to produce the NIR coefficient that can be used to calculate water demands for selected crops. The two most common models used by the WMDs are the USDA Natural Resource Conservation Service (NRCS)statistical regression method (U.S. Soil Conservation Service, 1970) and the Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS), a computer simulation model based on a daily water budget (Smajstrla, 1990; Smajstrla and Zazueta, 1995). Each WMD uses some form of these methods or similar models or programs that they have developed to estimate their NIR coefficients, which are then used to calculate water withdrawals for selected crops for any given period.

Water withdrawal estimates for the counties within the NWFWMD and SRWMD (fig. 2) were made by each WMD using estimated irrigated crop acreage and an NIR coefficient for selected crops based on climatic conditions. The NWFWMD developed estimates of irrigated acreage by crop and county based on data from consumptive water-use permit files, USDA reports (U.S. Department of Agriculture, 2009, 2010, 2011a, b, c), information obtained from personnel at selected IFAS county extension offices, and a review of recent aerial photography. The NIR coefficients developed for selected crops within the NWFWMD were obtained from the AFSIRS model (Smajstrla, 1990) using a 2-in-10 year return interval, which best approximated the slightly below-average rainfall conditions observed in the NWFWMD for the primary growing period within the WMD during 2010 (Kathleen Coates, Northwest Florida Water Management District, written commun., 2013). The NIR coefficients for the SRWMD were obtained by the WMD using the Florida Irrigation Guide (U.S. Soil Conservation Service, 1982) in conjunction with internal models based on average rainfall for a selected period of record (Kevin Wright, Suwannee River Water Management District, written commun., 2012).

Water withdrawal estimates for the counties within the SJRWMD and SWFWMD were obtained directly from published reports (St. Johns River Water Management District, 2011; Southwest Florida Water Management District, 2012). Estimates for the counties within the SFWMD were obtained from recently published or updated water-supply plans for their four designated water supply planning areas, namely the Lower East Coast (South Florida Water Management District, 2013), Lower West Coast (South Florida Water Management District, 2012), Upper East Coast (South Florida Water Management District, 2011), and Kissimmee Basin (South Florida Water Management District, 2009). Water withdrawal estimates for this category made by the SJRWMD, SFWMD, and the SWFWMD are mostly derived by using a model to generate an irrigation requirement coefficient for selected crops and multiplying that value by an estimated number of irrigated acres. The SWFWMD did have metered data for selected areas within their district, which reflected about 65 percent of their agricultural self-supplied water withdrawals in 2010 (Southwest Florida Water Management District, 2012). Detailed information on how irrigation values were derived for these three WMDs can be found in their published reports (cited above) or on their respective Web sites.

Many assumptions were made by the USGS and some of the WMDs for the 2010 agricultural self-supplied water withdrawal estimates, including the following:

- Statewide, 100 percent of the sugarcane acreage, 90 percent of the citrus acreage and 80 percent of the vegetable acreage (cabbage/lettuce, cucumbers/pickles, peppers, potatoes, sweet corn, tomatoes, and many other small vegetables) was assumed to be irrigated, with a few exceptions specific to selected vegetable or fruit crops. In addition, 90 percent of the acreage for non-citrus fruit crops (blueberries, grapes, peaches, strawberries, and other fruit-bearing crops or trees), sod, and nursery stock was assumed to be irrigated in 2010. The percentage of field crop acreage (cotton, field corn, peanuts, soybeans, tobacco, rice, wheat, and other field-based crops) irrigated ranged from 20 to 100 percent, depending on the crop type and location within the State, yielding an average of about 40 percent of the total acreage for 2010. For grasses (pasture, hay, and others) it was estimated that between 5 and 10 percent of the total acreage was irrigated in 2010. Many of these assumptions are based on the 2007 percentage irrigated for the specific or general crops found in the 2007 Census of Agriculture (U.S. Department of Agriculture, 2009, 2010, 2011a, b, c) and some of these assumptions may vary among the WMDs.

- The percentage of acres irrigated by the various irrigation system types (**flood**, **micro**, and **sprinkler irrigation**) and the percentage of water sources used for irrigation (groundwater or surface water) were assumed to reflect the information obtained from the WMDs consumptive water-use permits or other WMD sources. Some assumptions about irrigation systems or water sources were verified by personnel at selected IFAS county extension offices or by local growers. In some cases, percentages from previous years were used.

- Rainfall for 2010 was deemed normal even though it was above or below average in many areas of the State (Florida State University, 2013).

Estimates for nonirrigation withdrawals, such as those for livestock watering and fish farming, were made by the USGS (Lovelace 2009a, b) and used for counties within the NWFWMD, SFWMD, and SRWMD. Estimates for fish farming withdrawals were obtained from the WMDs consumptive water-use permits for counties within the NWFWMD, SFWMD, and SRWMD. Livestock and fish farming withdrawal estimates for the SWFWMD were obtained from their 2010 water-use report (Southwest Florida Water Management District, 2012, app. A). No withdrawal estimates for livestock were made or published for the parts of the counties within the SJRWMD for 2010.

Recreational-landscape irrigation—Water withdrawal estimates for **recreational-landscape use** are mostly a composite of (1) estimates made by multiplying irrigated crop acreage by a calculated NIR coefficient, and (2) actual withdrawal totals from metered data. Most of this category is estimated, because only a small percentage (12 percent) of the total recreational-landscape irrigation water withdrawals presented in this report were derived from actual metered data for 2010. Metered values cannot provide a cumulative total because not all users are metered and therefore estimates must be made in order to aggregate withdrawal totals for any county or region.

Acreage data for recreational (primarily golf course) and landscape irrigation (primarily commercial lawns and common/public areas) were obtained by the WMDs from a variety of sources, including their consumptive water-use permit files or their local or regional water-supply plans. Golf course acreage in some cases was calculated by using an estimate of 4.5 acres irrigated per golf-course hole (Marella and others, 1998) multiplied by the total number of such holes in a given county, obtained from the National Golf Foundation (2006). For many counties, the assumption was made that no acreage changes for this category occurred between 2005 and 2010 for both golf courses and landscape irrigation acreage, and therefore the 2005 acreage values were used.

The NIR coefficients calculated for golf course and landscape needs represent the amount of water, in addition to rainfall, that must be applied to meet the turfgrass and other landscape vegetation ET needs (Smajstrla and Zazueta, 1995). The NIR coefficient does not include the water needed to overcome irrigation system inefficiencies and must be adjusted to account for irrigation system losses (U.S. Soil Conservation Service, 1982). The two most common models used by the WMDs are the USDA NRCS statistical regression method (U.S. Soil Conservation Service, 1970) and the AFSIRS computer simulation model. Each WMD uses some variation of these methods or similar models or programs that they have developed to estimate the NIR coefficients they use to calculate water withdrawals for golf course and landscape irrigation for any given period.

Water withdrawal estimates for the counties within the NWFWMD and SRWMD (fig. 2) were made by each WMD using irrigated acreage from previous years and an irrigation requirement coefficient for golf course and landscape needs based on climatic conditions. Acreage data for the NWFWMD were verified against the consumptive water-use permits for any changes (newly permitted or recently closed facilities) between 2005 and 2010. The NIR coefficients developed by the NWFWMD were obtained from the AFSIRS model (Smajstrla, 1990) using a 2-in-10 year return interval, which best approximated the slightly below average rainfall conditions observed in the NWFWMD for the golf course and landscape growing periods within the district during 2010 (Kathleen Coates, Northwest Florida Water Management District, written commun., 2013). The NIR coefficients for the SRWMD were obtained by the WMD using the Florida Irrigation Guide (U.S. Soil Conservation Service, 1982) in conjunction with internal models based on average rainfall for a selected period of record (Kevin Wright, Suwannee River Water Management District, written commun., 2012).

Recreational-landscape irrigation water withdrawal estimates for the counties within the SJRWMD and SWFWMD were obtained directly from published reports (St. Johns River Water Management District, 2011; Southwest Florida Water Management District, 2012) and reflect information from their consumptive water-use permits for this category. Recreational-landscape irrigation water withdrawal estimates for the counties within the SFWMD were obtained from recently published or updated water-supply plans for their four designated water-supply planning areas. Water withdrawal estimates for this category made by the SJRWMD, SFWMD, and the SWFWMD were also derived by using a model to generate an NIR coefficient for turfgrass and landscape irrigation and multiplying the coefficient by the estimated number of acres irrigated. The SWFWMD did have metered data for selected areas within their WMD, which reflected about 79 percent of their recreational-landscape irrigation water withdrawals in 2010 (Southwest Florida Water Management District, 2012). Detailed information about how irrigation values were derived for these three WMDs can be found in their published reports (cited above) or on their respective Web sites.

Several assumptions were made by the USGS and the WMDs in developing the 2010 recreational-landscape irrigation water withdrawal estimates, including the following:

- One hundred (100) percent of all acreage was irrigated by sprinkler systems, unless specific information to the contrary was provided by the WMD.
- The percentage of water sources used for recreational-landscape irrigation (groundwater or surface water) was assumed to reflect information obtained from WMD consumptive water-use permits or other WMD sources.
- Rainfall for 2010 was deemed normal even though it was above or below average in many areas of the State (Florida State University, 2013).

In addition, the amount of reclaimed wastewater reported by the FDEP (Florida Department of Environmental Protection, 2011a) used for golf-course irrigation in each county was subtracted from the total water use calculated for this category in each county.

Power generation—Water withdrawals for **power generation use** were obtained by the USGS directly from the many power companies and municipally owned public utilities in the State, including Florida Power and Light, Gainesville Regional Utilities, Gulf Power, Jacksonville Electric Authority (JEA), Lakeland Electric, Orlando Utilities Commission, Progress Energy (Duke Energy as of 2012), Seminole Electric Cooperative, City of Tallahassee, Tampa Electric Company, and several others. Additional data were obtained from the WMD consumptive water-use permit files or annual reports and the Energy Information Administration (EIA) database of the U.S. Department of Energy (Susan Hutson, U.S. Geological Survey, written commun., 2012). Withdrawal data were collected for ground and surface water from fresh and saline sources. In many cases, the withdrawal amount reported represents the amount of water used to augment **cooling ponds** or **towers**, or other water bodies that retain water for cooling purposes, as opposed to the amount of water actually withdrawn for **once-through cooling**. The amount of water withdrawn to augment **cooling water** sources is often referred to as the amount of water consumed or **consumptive use**. The amount of water **recirculated** within a power plant is not accounted for in this report. Information about the amount of water purchased from public supplies was obtained from each power generation facility (if available) along with the total gross power generated. Most of the water-use values presented for this category are from metered or recorded data maintained by the power companies or public utilities.

Wastewater discharges—Data for domestic, industrial, and septic-tank wastewater discharges are not provided in this report. Detailed wastewater discharge totals for 2010 are available from the 2010 Florida Reuse Inventory, published annually by the FDEP Domestic Wastewater Section (Florida Department of Environmental Protection, 2011a; http://www.dep.state.fl.us/water/reuse/inventory.htm).

Aquifer withdrawals—Estimates of water withdrawals by aquifer were made for each withdrawal category. For public supply, commercial-industrial-mining self-supplied, and power generation, information for the primary aquifer used for each well field or facility was obtained from permits in the WMD consumptive water-use permit files. Estimates were made for domestic self-supplied, agricultural self-supplied, and recreational-landscape irrigation withdrawals by using information obtained from selected groundwater studies conducted throughout the State over the past 20 years that yielded detailed estimates of withdrawals for selected aquifers in specific counties. Other sources include information obtained from local agencies (county health departments and the WMDs) that regulate well construction or consumptive use. For some counties having little or no information, estimates were made by assuming that 90 percent of water withdrawals were from the primary aquifer used for public supply and the remaining 10 percent were from the local water table or shallow aquifer.

Accuracy—Water withdrawals and water-use data presented in this report represent the average daily quantities used, calculated from monthly totals or derived from annual totals, 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 (with a few exceptions) 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 in this report may not be identical to the water-use data published by the WMDs (St. Johns River Water Management District, 2011; Southwest Florida Water Management District, 2012) or FDEP because of differences in data-collection procedures, categories, and methodology. In addition, some values in this report may differ from those presented on the USGS Web page prior to the publication of this report.

Water-use values presented in this report reflect the amount of water withdrawn and do not represent quantities of water permitted or allocated. The accuracy of water-use values varies by category; public-supply, commercial-industrial-mining self-supplied, and power generation values tend to be more accurate than those for domestic self-supplied, agricultural self-supplied, and recreation-landscape irrigation because users in the first group of categories usually meter and record their usage, whereas users in the second group of categories generally do not meter and record their water use. In 2010, a small percentage of agricultural and recreational-landscape users statewide did meter and record their usage.

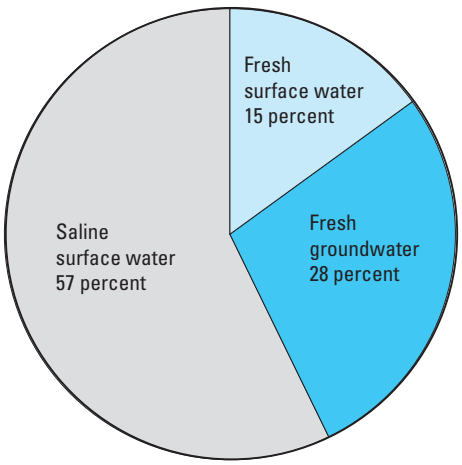
Changes—A change in water-source classification occurred between 2005 and 2010. Nonpotable groundwater withdrawn and treated for public supply is classified as s**aline water** by the USGS for 2010; however, in this report it will remain classified as **freshwater** to be consistent with what the WMDs report. In 2010, a small amount of surface water was withdrawn for public supply from a saline source and is reported herein as treated saline water. Additionally, monthly withdrawal data for some categories were not available for 2010, and therefore were estimated.

Most water-use categories remained unchanged for Florida between 1970 and 2010.Some changes that could affect the descriptions of trends have occurred, including the following:

- During the 1970s, rural water use consisted of domestic self-supplied and livestock. In the 1980s, livestock was added to the agricultural category, and domestic self-supplied became a separate category.
- Agricultural self-supplied was called irrigation in the 1970s, and then became agricultural irrigation in the 1980s with the addition of livestock and the removal of recreational irrigation.
- Through the 1970s and 1980s, agricultural water use included all irrigation, including golf course and landscape watering, but in 1995, golf-course and other recreational and landscape irrigation were removed from the agricultural water-use category and placed within a separate category called recreational irrigation.
- For 2010, landscape was added to the recreational irrigation category name, even though landscape acreage and withdrawals were included in the category in previous years. The new name, recreation-landscape irrigation, more accurately reflects what is included in this category for 2010.
- Commercial-industrial-mining self-supplied was previously called self-supplied industrial water use (which included self-supplied commercial and mining 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 withdrawal estimates for residential lawn irrigation, residential heat pumps and air-conditioning units, and water discharged from free-flowing wells. Because of the inconsistency in data among counties for these uses, they were not included in the 1985 statewide totals (Marella, 1988). Since 1985, no attempts have been made by USGS to collect or compile water withdrawal estimates for residential lawn watering or residential heat pumps and air-conditioning in Florida.
- Data for Miami-Dade County prior to 2000 are reported under Dade County. In 1997, Dade County officially became Miami-Dade County, and all data presented herein are listed under the new name. Polk County, which was divided among three WMDs (SJRWMD, SFWMD, and SWFWMD), was re-delineated into two WMDs in 2003, and the part of the county within the SJRWMD was officially relinquished to the SWFWMD in 2004. Therefore, all data after 2003 for Polk County reflect totals for SFWMD and SWFWMD only.

Water Withdrawals and Use

In 2010, the total water withdrawn in Florida was estimated to be 14,988 Mgal/d (table 1). Saline water accounted for 8,589 Mgal/d (57 percent) and freshwater accounted for 6,399 Mgal/d (43 percent) of total water withdrawals in 2010 (fig. 3). Groundwater accounted for 4,166 Mgal/d (65 percent) of freshwater withdrawals, and surface water accounted for the remaining 2,233 Mgal/d



Note: Saline groundwater was less than 0.1 percent

Figure 3. Total water withdrawals in Florida by source, 2010.

Table 1. Total water withdrawals in Florida by category, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

Florida 2010	Freshwater			Saline water			All water
	Ground	Surface	Total	Ground	Surface	Total	Total
Public supply	2,012.17	238.68	2,250.85	0.00	16.97	16.97	2,267.82
Domestic self-supplied	213.84	0.00	213.84	0.00	0.00	0.00	213.84
Commercial-industrial-mining self-supplied	294.67	83.68	378.35	0.00	0.00	0.00	378.35
Agricultural self-supplied	1,413.91	1,137.19	2,551.10	0.00	0.00	0.00	2,551.10
Recreational-landscape irrigation	188.38	203.55	391.93	0.00	0.00	0.00	391.93
Power generation	43.48	569.71	613.19	6.54	8,565.52	8,572.06	9,185.25
Totals	4,166.45	2,232.81	6,399.26	6.54	8,582.49	8,589.03	14,988.29

(35 percent). Surface water accounted for nearly all (99.9 percent) saline-water withdrawals (table 1). An additional 659 Mgal/d of reclaimed wastewater was used in Florida during 2010 (Florida Department of Environmental Protection, 2011a). More than three-quarters (79 percent) of the **reclaimed wastewater** flow in 2010 was used to reduce potable-quality water withdrawals for urban irrigation (public-access areas, including golf courses and residential lawns), agricultural irrigation, and industrial use, and the remaining 21 percent of the reclaimed wastewater was returned to the hydrologic system as aquifer recharge (14 percent) and wetland discharge (7 percent) (Florida Department of Environmental Protection, 2011a).

The freshwater withdrawn in 2010 is equivalent in volume to an estimated 2.5 inches of water cover across the 54,252 square miles of Florida land area (Fernald and Purdum, 1992) and to about 5 percent of the rainfall for 2010, which averaged 49.2 inches statewide (Florida State University, 2013). The relative importance of freshwater withdrawals within a local or regional water budget can vary temporally and spatially.

Overall, agricultural self-supplied was the largest user of freshwater in 2010, accounting for 40 percent of total freshwater withdrawals, followed by public supply at 35 percent (fig. 4 and table 1). For fresh groundwater withdrawal, public supply (48 percent) and agricultural self-supplied (34 percent) were the largest users in 2010, followed by commercial-industrial-mining self-supplied (7 percent), domestic self-supplied and recreational-landscape irrigation (5 percent each), and power generation (1 percent) (fig. 4 and table 1). For fresh surface water withdrawals, agricultural self-supplied (51 percent) was the largest user in 2010, followed by power generation (25 percent), public supply (11 percent), recreational-landscape irrigation (9 percent), and commercial-industrial-mining self-supplied (4 percent) (fig. 4 and table 1). Power generation accounted for nearly all (99.8 percent) of the saline-water withdrawals in 2010.

Water withdrawals varied seasonally for some water-use categories in 2010. Monthly withdrawals for agricultural self-supplied use varied more than any other category in 2010 (fig. 5); almost one-third (32 percent) of the annual withdrawals for this category occurred in April and May. The seasonality is a result of intense crop production during these 2 months, which are normally dry across the State. Public supply withdrawals show minimal seasonal variation in 2010 (fig. 5), even though water withdrawals for lawn watering and other outdoor uses are affected by the typically dry spring and hot summer months.

Freshwater withdrawals were greatest in Palm Beach County (707 Mgal/d), and saline water withdrawals were greatest in Hillsborough County (1,715 Mgal/d) (table 2). Substantial withdrawals (more than 200 Mgal/d) of fresh groundwater were made in Miami-Dade, Palm Beach, Polk, Orange, Broward, and Collier Counties. Substantial withdrawals (more than 200 Mgal/d) of fresh surface water occurred in Palm Beach, Hendry, and Escambia Counties.

Water Source and Use by Category

Florida consistently has been one of the largest users of groundwater in the Nation over the past decade (Hutson and others, 2004; Kenny and others, 2009). Fresh groundwater is available throughout the State and generally needs little or no treatment prior to use. Overall, groundwater sources provided drinking water to 92 percent of Florida's population (17.33 million people) from public-water supply systems and private domestic (household) wells.

Groundwater withdrawals in Florida for 2010 totaled 4,173 Mgal/d, of which 4,166 was freshwater and almost 7 Mgal/d was saline water (table 1). Of the fresh groundwater withdrawn, 148 Mgal/d (4 percent) was **nonpotable** and was either blended or treated to meet **potable** (drinking water) standards. This nonpotable water is considered **brackish** or

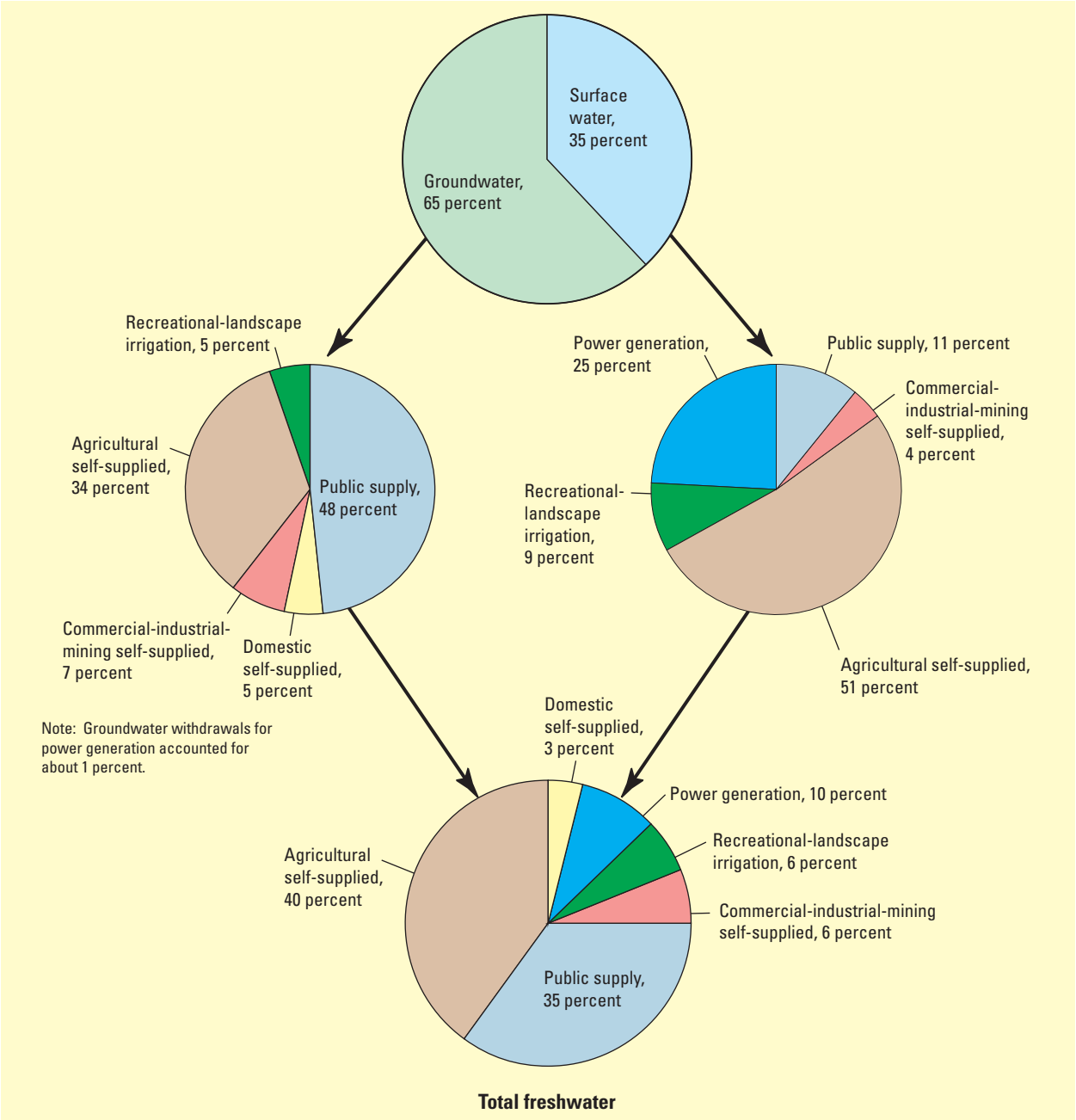


Figure 4. Freshwater withdrawals in Florida by category and water source, 2010.

may qualify as saline water at times. About 2,571 Mgal/d (almost 62 percent) of the groundwater withdrawn in 2010 was from the Floridan aquifer system (fig. 6 and table 3), which includes nearly 110 Mgal/d of brackish or saline groundwater. Orange and Polk Counties were the largest users of water from the Floridan aquifer system (table 3). The Floridan aquifer system, which underlies the entire State, is not the only source of groundwater throughout the State; in many areas of Florida other local aquifers can provide good quality groundwater (fig. 6). The Biscayne aquifer supplied 705 Mgal/d (17 percent) of the groundwater withdrawn, and the remaining 21 percent was obtained from the surficial aquifer system (525 Mgal/d), the intermediate aquifer system (263 Mgal/d), and the sand and gravel aquifer system (109 Mgal/d) (fig. 6 and table 3). The sand and gravel aquifer system is part of the Coastal Lowlands aquifer system that is present in Alabama, western Florida, Louisiana, Mississippi and Texas (Miller, 1990; Renken, 1998). The surficial aquifer system are primarily tapped by private domestic wells or by public-supply wells in areas where the Floridan aquifer system is nonpotable or is too deep to be tapped economically.

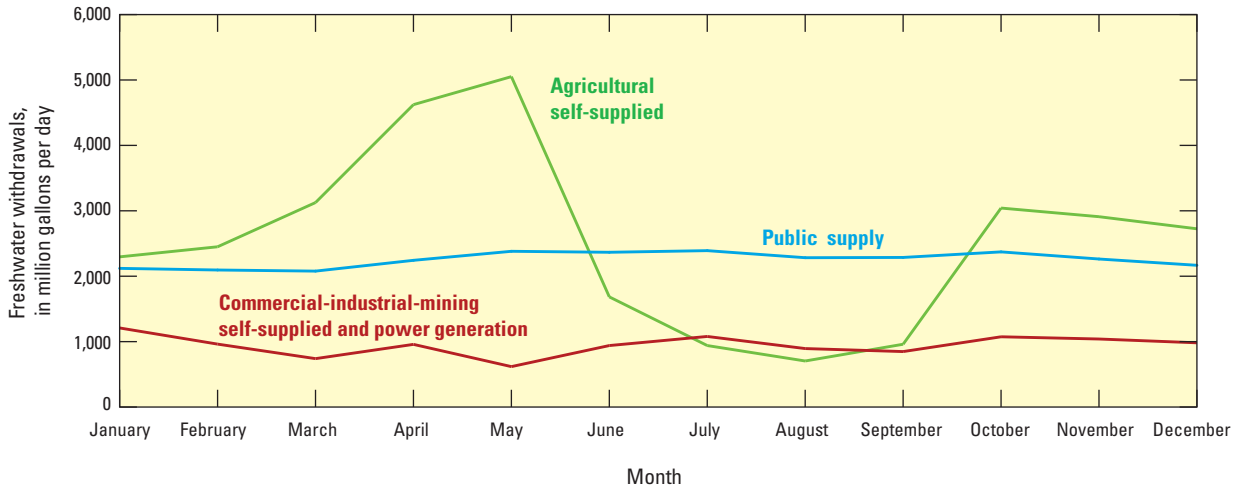


Figure 5. Monthly freshwater withdrawals by selected categories in Florida, 2010.

Saline surface water is abundant within the numerous coastal rivers and bays of Florida along its nearly 1,200-mile coastline (Fernald and Purdum, 1992), whereas fresh surface water is available throughout most of the State from rivers, lakes, or managed and maintained canal systems. A large percentage of all fresh surface water in Florida is considered nonpotable, however, and usually needs treatment of some sort for uses other than irrigation or cooling. Fresh surface water only provided drinking water to 8 percent of Florida's population (1.47 million people) from public-water supply systems in 2010.

Surface-water withdrawals in Florida totaled 10,815 Mgal/d (table 1). Saline surface water accounted for 8,582 Mgal/d (79 percent) and freshwater accounted for 2,233 Mgal/d (21 percent) of the total surface-water withdrawals in 2010. Nearly all saline withdrawals (99.8 percent) are used for once-through cooling water and are usually returned to the source. Fresh surface water in Florida is primarily used for irrigation and power generation, which together composed more than three-quarters (76 percent) of the fresh surface water withdrawn in 2010 (fig. 4 and table 1). Nearly all saline-water withdrawals in Florida are for power generation and were used as cooling water for generation of about 50 percent of the State's total electric power in 2010. The majority of fresh surface-water withdrawals (56 percent) occurred in the southern Florida hydrologic unit subregion (HUC0309) (fig. 7), which is associated with Lake Okeechobee and the canals in the Everglades Agricultural Area of Glades, Hendry, and Palm Beach Counties, as well as the Caloosahatchee River and its tributaries in the agricultural areas of Charlotte, Collier, Glades, Hendry, and Lee Counties (fig. 7). Surface water from these sources is most often diverted through canals or ditches and then pumped or gravity-fed onto fields or citrus groves for various flood irrigation systems. Throughout Florida, a large percentage of the surface water used for flood or seepage irrigation in fields or groves is not consumed and as such is pumped back into the canals or ditches whence it came for further use. In addition, many of the canals, ditches, or ponds that are used for flood irrigation throughout Florida often are augmented with groundwater from free-flowing or pumped wells to help maintain their water levels.

Public Supply

The public-supply category refers to water distributed by a publicly or privately owned water system. Florida had 1,725 community, 869 **nontransient noncommunity**, and 2,940 **transient noncommunity** active water systems in 2010 (Florida Department of Environmental Protection, 2011b). For this report, water-use data were collected for **community water systems** that either served at least 400 people or withdrew at least 10,000 gal/d (0.01 Mgal/d). Water withdrawals from the inventoried systems totaled 2,268 Mgal/d and supplied water to nearly 90 percent (16.89 million) of the State's 18.80 million residents in 2010 (table 4). The inventoried systems represent more than 99.8 percent of total public-supply withdrawals in 2010; the estimated withdrawals by the uninventoried systems total about 5 Mgal/d (about 600 uninventoried systems multiplied by 0.009 Mgal/d) and would be accounted for under the domestic self-supplied category. The public-supply category also does not include public-water systems that serve other transient populations such as correctional institutions, schools, and military facilities because these are included in the commercial-industrial-mining self-supplied category for this report. The nontransient noncommunity and transient noncommunity water systems include churches, restaurants, theme parks, and others that provide drinking water to a nonpermanent population.

Table 2. Total water withdrawals in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl .water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	53.68	0.00	53.68	0.55	0.00	0.55	54.23	0.00	54.23
Baker	5.22	0.00	5.22	0.20	0.00	0.20	5.42	0.00	5.42
Bay	8.23	0.00	8.23	47.17	246.06	293.23	55.40	246.06	301.46
Bradford	5.33	0.00	5.33	0.04	0.00	0.04	5.37	0.00	5.37
Brevard	72.04	0.00	72.04	42.73	142.01	184.74	114.77	142.01	256.78
Broward	250.96	0.00	250.96	23.84	1,005.82	1,029.66	274.80	1,005.82	1,280.62
Calhoun	3.90	0.00	3.90	0.21	0.00	0.21	4.11	0.00	4.11
Charlotte	21.36	0.00	21.36	37.47	0.00	37.47	58.83	0.00	58.83
Citrus	33.42	0.00	33.42	0.36	1,167.39	1,167.75	33.78	1,167.39	1,201.17
Clay	20.72	0.00	20.72	2.94	0.00	2.94	23.66	0.00	23.66
Collier	211.61	0.00	211.61	45.64	0.00	45.64	257.25	0.00	257.25
Columbia	13.74	0.00	13.74	0.15	0.00	0.15	13.89	0.00	13.89
DeSoto	73.87	0.00	73.87	23.51	0.00	23.51	97.38	0.00	97.38
Dixie	4.57	0.00	4.57	0.02	0.00	0.02	4.59	0.00	4.59
Duval	154.92	0.00	154.92	6.61	598.60	605.21	161.53	598.60	760.13
Escambia	80.78	0.00	80.78	233.06	0.00	233.06	313.84	0.00	313.84
Flagler	21.26	0.00	21.26	2.16	0.00	2.16	23.42	0.00	23.42
Franklin	2.02	0.00	2.02	0.28	0.00	0.28	2.30	0.00	2.30
Gadsden	11.35	0.00	11.35	7.03	0.00	7.03	18.38	0.00	18.38
Gilchrist	9.22	0.00	9.22	0.07	0.00	0.07	9.29	0.00	9.29
Glades	40.57	0.00	40.57	121.78	0.00	121.78	162.35	0.00	162.35
Gulf	1.36	0.00	1.36	1.30	0.00	1.30	2.66	0.00	2.66
Hamilton	37.41	0.00	37.41	0.08	0.00	0.08	37.49	0.00	37.49
Hardee	53.64	0.00	53.64	0.07	0.00	0.07	53.71	0.00	53.71
Hendry	111.06	0.00	111.06	313.24	0.00	313.24	424.30	0.00	424.30
Hernando	38.40	0.00	38.40	0.41	0.00	0.41	38.81	0.00	38.81
Highlands	93.85	0.00	93.85	14.01	0.00	14.01	107.86	0.00	107.86
Hillsborough	151.25	0.00	151.25	94.82	1,715.32	1,810.14	246.07	1,715.32	1,961.39
Holmes	4.36	0.00	4.36	0.14	0.00	0.14	4.50	0.00	4.50
Indian River	57.28	0.00	57.28	85.26	11.97	97.23	142.54	11.97	154.51
Jackson	23.63	0.00	23.63	40.69	0.00	40.69	64.32	0.00	64.32
Jefferson	7.39	0.00	7.39	0.14	0.00	0.14	7.53	0.00	7.53
Lafayette	6.62	0.00	6.62	0.05	0.00	0.05	6.67	0.00	6.67
Lake	92.60	0.00	92.60	12.43	0.00	12.43	105.03	0.00	105.03
Lee	130.53	0.00	130.53	55.70	560.62	616.32	186.23	560.62	746.85
Leon	36.86	0.00	36.86	0.74	0.00	0.74	37.60	0.00	37.60
Levy	31.94	0.00	31.94	0.62	0.00	0.62	32.56	0.00	32.56
Liberty	1.70	0.00	1.70	0.00	0.00	0.00	1.70	0.00	1.70
Madison	13.93	0.00	13.93	0.13	0.00	0.13	14.06	0.00	14.06
Manatee	98.65	0.00	98.65	27.85	0.00	27.85	126.50	0.00	126.50
Marion	69.18	0.00	69.18	2.09	0.00	2.09	71.27	0.00	71.27
Martin	29.58	0.00	29.58	71.69	0.00	71.69	101.27	0.00	101.27

Table 2. Total water withdrawals in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl .water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Miami-Dade	429.96	4.98	434.94	26.15	0.00	26.15	456.11	4.98	461.09
Monroe	0.75	0.00	0.75	0.45	0.00	0.45	1.20	0.00	1.20
Nassau	49.28	0.00	49.28	1.21	0.00	1.21	50.49	0.00	50.49
Okaloosa	28.55	0.00	28.55	0.00	0.00	0.00	28.55	0.00	28.55
Okeechobee	48.36	0.00	48.36	13.89	0.00	13.89	62.25	0.00	62.25
Orange	249.43	0.00	249.43	8.18	0.00	8.18	257.61	0.00	257.61
Osceola	91.06	0.00	91.06	6.94	0.00	6.94	98.00	0.00	98.00
Palm Beach	257.96	0.00	257.96	448.88	0.00	448.88	706.84	0.00	706.84
Pasco	94.28	0.00	94.28	0.97	1,563.67	1,564.64	95.25	1,563.67	1,658.92
Pinellas	19.59	0.00	19.59	0.91	472.46	473.37	20.50	472.46	492.96
Polk	251.51	0.00	251.51	47.28	0.00	47.28	298.79	0.00	298.79
Putnam	30.51	0.00	30.51	44.20	0.00	44.20	74.71	0.00	74.71
St. Johns	39.34	0.00	39.34	4.84	0.00	4.84	44.18	0.00	44.18
St. Lucie	41.29	1.56	42.85	59.95	1,098.57	1,158.52	101.24	1,100.13	1,201.37
Santa Rosa	25.54	0.00	25.54	0.98	0.00	0.98	26.52	0.00	26.52
Sarasota	28.45	0.00	28.45	2.82	0.00	2.82	31.27	0.00	31.27
Seminole	67.75	0.00	67.75	1.39	0.00	1.39	69.14	0.00	69.14
Sumter	31.65	0.00	31.65	0.35	0.00	0.35	32.00	0.00	32.00
Suwannee	30.00	0.00	30.00	108.34	0.00	108.34	138.34	0.00	138.34
Taylor	42.87	0.00	42.87	0.03	0.00	0.03	42.90	0.00	42.90
Union	3.12	0.00	3.12	0.01	0.00	0.01	3.13	0.00	3.13
Volusia	92.31	0.00	92.31	136.94	0.00	136.94	229.25	0.00	229.25
Wakulla	5.48	0.00	5.48	0.26	0.00	0.26	5.74	0.00	5.74
Walton	13.39	0.00	13.39	0.49	0.00	0.49	13.88	0.00	13.88
Washington	4.03	0.00	4.03	0.07	0.00	0.07	4.10	0.00	4.10
State totals	4,166.45	6.54	4,172.99	2,232.81	8,582.49	10,815.30	6,399.26	8,589.03	14,988.29

Groundwater supplied 2,012 Mgal/d (89 percent) of the public-supply water withdrawn in 2010 and provided drinking water to 15.42 million people. The Floridan aquifer system supplied nearly 56 percent (1,110 Mgal/d) of the total public-supply groundwater withdrawals and served an estimated 8.97 million people, whereas the Biscayne aquifer supplied 29 percent (594 Mgal/d) of the total public-supply groundwater withdrawals and served 4.40 million people. The remaining groundwater withdrawn for public supply was obtained from the surficial aquifer system (226 Mgal/d), the sand and gravel aquifer system (57 Mgal/d), and the intermediate aquifer system (25 Mgal/d). Surface water supplied nearly 256 Mgal/d (11 percent) of the public-supply water withdrawn in 2010 and provided drinking water to 1.47 million people. Of the surface water withdrawn, nearly 17 Mgal/d was saline water and was treated through a **desalination** process for public-supply use (Tampa Bay Water, 2013). The Hillsborough River, Tampa Bypass Canal, and the Alafia River in Hillsborough County combined supplied 39 percent of the total surface water for public supply (Southwest Florida Water Management District, 2012), followed by Deer Point Lake in Bay County (21 percent), and Clear Lake in Palm Beach County (13 percent) (water features shown in fig. 2). Several public-supply water systems in Florida that withdraw surface water also augment their water supply with groundwater, usually during periods of high demand or low surface-water levels. In addition, several water suppliers inject and store the excess surface water that becomes available during the wet season into a deep aquifer and then recover it during the dry season, if needed, to help offset peak demands (Reese, 2006). Values for the amount of water injected into groundwater sources for aquifer storage and recovery systems are not presented in this report.

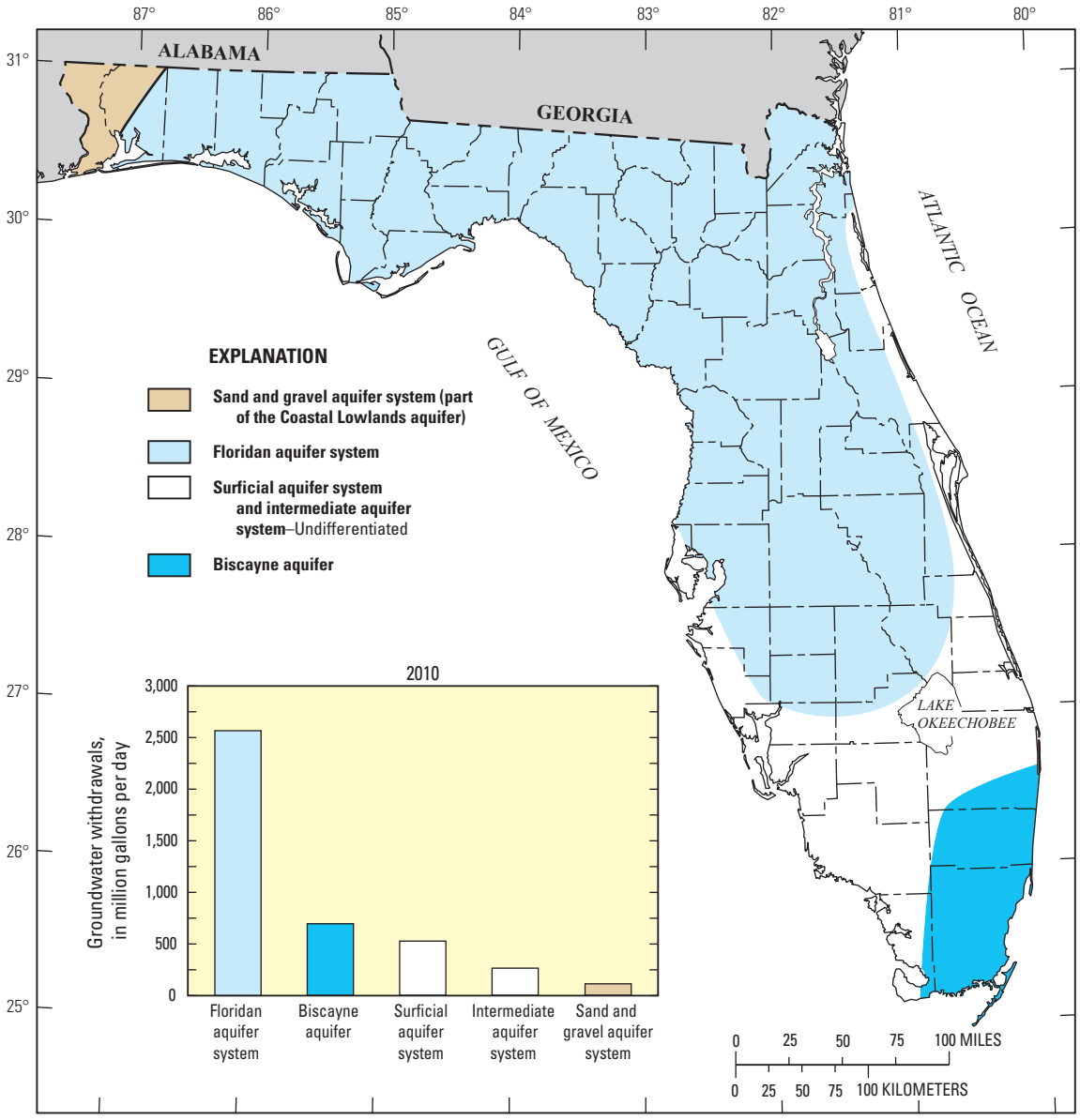


Figure 6. Approximate areal extent throughout which principal aquifers in Florida are the primary source of groundwater, and quantity of groundwater withdrawals, 2010. From Vecchioli and Foose (1985), Miller (1990), and Renken (1998).

Public-supply water withdrawals varied minimally by season in 2010, with a range of about 300 Mgal/d between minimum and maximum withdrawals (fig. 5). Withdrawals peaked during the months of May, June, and July in 2010 as demand for outdoor water uses, primarily for lawn irrigation, increased. The seasonal variation in public-supply withdrawals is often much greater during years of low rainfall compared to other years (Verdi and others, 2006).

Public suppliers deliver water for **domestic use** (**residential use**), **commercial use**, **industrial use**, **public uses** (including losses from processing to distribution), and **other uses**. Domestic water use, which includes indoor and outdoor residential uses, accounted for 63 percent (1,430 Mgal/d) of the public-supply withdrawals in 2010 (fig. 8 and table 5). Domestic water use was derived from the residual of the total public-supply net water use in each county (withdrawals plus imports or minus exports) minus the commercial, industrial, public uses, and other uses. Water deliveries to commercial and industrial users from public supply were estimated by multiplying county employment totals (U.S. Census Bureau, 2011b) 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 of public-supply water to commercial (22 percent) and industrial (3 percent) users in 2010 totaled 558 Mgal/d (490 Mgal/d for commercial and 68 Mgal/d for industrial users) (fig. 8 and table 5). Public uses include water used for firefighting and system maintenance,

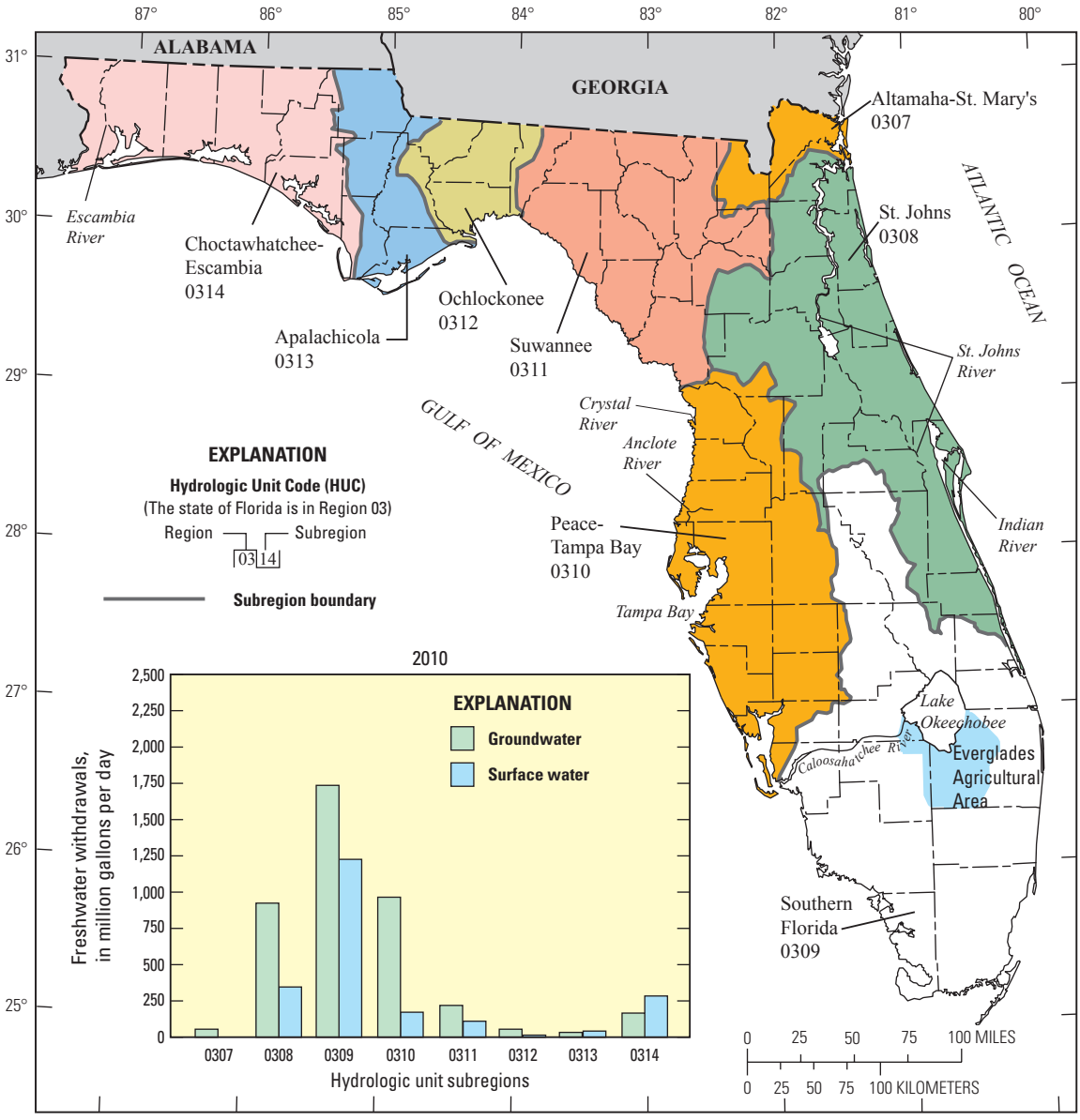


Figure 7. General location of hydrologic units in Florida and fresh groundwater and surface-water withdrawals within these units, 2010. From U.S. Geological Survey (1975), and Seaber and others (1984).

as well as all losses. For Florida, public uses were estimated at 1 percent (American Water Works Association, 1992) and losses were estimated at 10 percent (Friedman and Heaney, 2009). Combined public uses and losses totaled 11 percent, or 256 Mgal/d, of the total public-supply withdrawals in 2010 (fig. 8 and table 5). Losses include water lost during transmission and distribution, as well as losses that occur during water processing such as desalination or water softening. In previous years, losses were estimated at 14 percent (Marella, 2009), but water management permitting during the past 10 years has required that public-supply water systems lower their distribution losses to between 10 and 12 percent (Friedman and Heaney, 2009). Other uses include deliveries to a host of users not included in the commercial or industrial use category. These deliveries include direct metered uses for irrigation (for residential, commercial, and recreational), construction, parks, city common areas (including medians), augmenting air-conditioning cooling reservoirs, power generation, and other deliveries that do not fall within a specific category.

The statewide gross per capita water use for public supply in Florida was 134 gal/d in 2010 (fig. 9 and table 5). This value is calculated as the total public-supply water withdrawal (2,268 Mgal/d) divided by the total population served by public supply (16.89 million). Per capita water use calculated in this manner includes water delivered for all uses of public-supply water, as shown in table 5 (domestic, commercial, industrial, public uses and losses, and other uses). Florida's public-supply domestic per capita water use for

Table 3. Total groundwater withdrawals by principal aquifer in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Floridan aquifer system	Biscayne aquifer	Surficial aquifer system	Intermediate aquifer system	Sand and gravel aquifer system	Total
Alachua	53.64	0.00	0.04	0.00	0.00	53.68
Baker	5.19	0.00	0.03	0.00	0.00	5.22
Bay	8.16	0.00	0.07	0.00	0.00	8.23
Bradford	5.31	0.00	0.02	0.00	0.00	5.33
Brevard	66.69	0.00	5.35	0.00	0.00	72.04
Broward	1.93	249.03	0.00	0.00	0.00	250.96
Calhoun	3.89	0.00	0.01	0.00	0.00	3.90
Charlotte	10.78	0.00	0.09	10.49	0.00	21.36
Citrus	32.96	0.00	0.46	0.00	0.00	33.42
Clay	20.51	0.00	0.21	0.00	0.00	20.72
Collier	11.42	0.00	103.69	96.50	0.00	211.61
Columbia	13.70	0.00	0.04	0.00	0.00	13.74
DeSoto	64.74	0.00	0.00	9.13	0.00	73.87
Dixie	4.56	0.00	0.01	0.00	0.00	4.57
Duval	149.80	0.00	4.80	0.32	0.00	154.92
Escambia	0.00	0.00	0.00	0.00	80.78	80.78
Flagler	13.19	0.00	8.07	0.00	0.00	21.26
Franklin	2.02	0.00	0.00	0.00	0.00	2.02
Gadsden	11.34	0.00	0.01	0.00	0.00	11.35
Gilchrist	9.21	0.00	0.01	0.00	0.00	9.22
Glades	11.92	0.00	24.29	4.36	0.00	40.57
Gulf	1.36	0.00	0.00	0.00	0.00	1.36
Hamilton	37.40	0.00	0.01	0.00	0.00	37.41
Hardee	48.43	0.00	0.00	5.21	0.00	53.64
Hendry	5.23	0.00	41.66	64.17	0.00	111.06
Hernando	38.24	0.00	0.16	0.00	0.00	38.40
Highlands	83.15	0.00	0.12	10.58	0.00	93.85
Hillsborough	147.15	0.00	0.00	4.10	0.00	151.25
Holmes	4.35	0.00	0.01	0.00	0.00	4.36
Indian River	47.71	0.00	9.57	0.00	0.00	57.28
Jackson	23.60	0.00	0.03	0.00	0.00	23.63
Jefferson	7.38	0.00	0.01	0.00	0.00	7.39
Lafayette	6.61	0.00	0.01	0.00	0.00	6.62
Lake	92.24	0.00	0.36	0.00	0.00	92.60
Lee	35.99	0.00	58.83	35.71	0.00	130.53
Leon	36.82	0.00	0.04	0.00	0.00	36.86
Levy	31.92	0.00	0.02	0.00	0.00	31.94
Liberty	1.70	0.00	0.00	0.00	0.00	1.70
Madison	13.92	0.00	0.01	0.00	0.00	13.93
Manatee	88.26	0.00	0.00	10.39	0.00	98.65
Marion	69.05	0.00	0.13	0.00	0.00	69.18

Table 3. Total groundwater withdrawals by principal aquifer in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Floridan aquifer system	Biscayne aquifer	Surficial aquifer system	Intermediate aquifer system	Sand and gravel aquifer system	Total
Martin	11.16	0.00	18.42	0.00	0.00	29.58
Miami-Dade [a]	12.69	422.25	0.00	0.00	0.00	434.94
Monroe	0.45	0.30	0.00	0.00	0.00	0.75
Nassau	44.13	0.00	5.15	0.00	0.00	49.28
Okaloosa	27.99	0.00	0.00	0.00	0.56	28.55
Okeechobee	41.65	0.00	6.71	0.00	0.00	48.36
Orange	248.81	0.00	0.62	0.00	0.00	249.43
Osceola	90.83	0.00	0.23	0.00	0.00	91.06
Palm Beach	20.57	33.35	204.04	0.00	0.00	257.96
Pasco	93.75	0.00	0.53	0.00	0.00	94.28
Pinellas	19.52	0.00	0.07	0.00	0.00	19.59
Polk	242.38	0.00	0.00	9.13	0.00	251.51
Putnam	29.82	0.00	0.69	0.00	0.00	30.51
St. Johns	39.06	0.00	0.28	0.00	0.00	39.34
St. Lucie	21.67	0.00	21.18	0.00	0.00	42.85
Santa Rosa	1.53	0.00	0.00	0.00	24.01	25.54
Sarasota	17.73	0.00	8.20	2.52	0.00	28.45
Seminole	67.58	0.00	0.17	0.00	0.00	67.75
Sumter	31.12	0.00	0.53	0.00	0.00	31.65
Suwannee	29.97	0.00	0.03	0.00	0.00	30.00
Taylor	42.86	0.00	0.01	0.00	0.00	42.87
Union	3.11	0.00	0.01	0.00	0.00	3.12
Volusia	91.93	0.00	0.38	0.00	0.00	92.31
Wakulla	5.46	0.00	0.02	0.00	0.00	5.48
Walton	9.83	0.00	0.00	0.00	3.56	13.39
Washington	4.02	0.00	0.01	0.00	0.00	4.03
State totals	2,571.09	704.93	525.45	262.61	108.91	4,172.99

[a] Includes saline groundwater withdrawn for power generation (6.54 million gallons per day, total).

2010 was estimated to be 85 gal/d in 2010 (fig. 9 and table 5). This per capita use is calculated by dividing the deliveries for domestic use (1,430 Mgal/d) from public suppliers (table 5) by the population served (16.89 million), and excludes all other uses of public-supply water (commercial, industrial, public uses and losses, or other uses). Overall, per capita water use in Florida has been decreasing since 1985, with the exception of 2000 (Marella, 2009) (fig. 9). The long-term decrease is a result of factors such as more efficient appliances and plumbing fixtures; water conservation through improved education of users, changes in rate structures, and better loss-prevention programs; the availability of reclaimed wastewater as a lawn irrigation option; water management mandates and constraints; and smaller lot sizes for new single-family homes. The singular increase in 2000 was a direct result of the extremely low rainfall for that year (Verdi and others, 2006). Another possible factor that could result in public-supply per capita decreases across Florida would be a shift by commercial and residential public-supply customers from using purchased water for lawn or landscaping irrigation to obtaining water from a canal, lake, or individual well exclusively for this purpose. The water withdrawn by these users would not be accounted for in this report because the irrigation canals, lakes, or wells used for self-supplied lawn or landscape irrigation are not inventoried as part of this study.

Table 4. Public-supply population, water use, withdrawals, transfers, and treated water in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). Water values in million gallons per day; per capita values in gallons per day]

County	Population		Water use		Withdrawals			Transfers			Treated nonpotable water
	Total	Public supply	Total	Gross per capita	Total	Ground	Surface	Imports	Exports	Losses	
Alachua	247,336	204,719	26.31	129	26.31	26.31	0.00	0.00	0.00	0.00	0.00
Baker	27,115	5,053	0.91	180	0.91	0.91	0.00	0.00	0.00	0.00	0.00
Bay	168,852	152,250	49.13	323	49.13	1.98	47.15	0.00	0.00	0.00	0.00
Bradford	28,520	9,026	1.62	179	1.62	1.62	0.00	0.00	0.00	0.00	0.00
Brevard	543,376	516,207	54.12	105	30.66	16.32	14.34	23.46	0.00	0.00	2.40
Broward	1,748,066	1,742,822	231.40	133	231.40	231.40	0.00	0.00	0.00	0.00	1.83
Calhoun	14,625	4,360	0.67	154	0.67	0.67	0.00	0.00	0.00	0.00	0.00
Charlotte	159,978	135,501	16.54	122	7.09	2.28	4.81	9.45	0.00	0.00	2.26
Citrus	141,236	96,040	13.94	145	13.94	13.94	0.00	0.00	0.00	0.00	0.00
Clay	190,865	135,514	11.13	82	11.13	11.13	0.00	0.00	0.00	0.00	0.00
Collier	321,520	276,508	53.17	192	53.17	47.72	5.45	0.00	0.00	0.00	22.76
Columbia	67,531	24,875	3.70	149	3.70	3.70	0.00	0.00	0.00	0.00	0.00
DeSoto	34,862	12,097	2.42	200	23.48	1.75	21.73	0.00	21.06	0.00	0.00
Dixie	16,422	4,950	0.67	135	0.67	0.67	0.00	0.00	0.00	0.00	0.00
Duval	864,263	821,050	122.14	149	122.14	122.14	0.00	0.00	0.00	0.00	0.00
Escambia	297,619	284,750	38.53	135	40.23	40.23	0.00	0.00	1.70	0.00	0.00
Flagler	95,696	76,557	8.70	114	8.70	8.70	0.00	0.00	0.00	0.00	0.00
Franklin	11,549	10,750	1.92	179	1.92	1.92	0.00	0.00	0.00	0.00	0.00
Gadsden	46,389	31,250	4.44	142	4.44	4.44	0.00	0.00	0.00	0.00	0.00
Gilchrist	16,939	1,725	0.23	133	0.23	0.23	0.00	0.00	0.00	0.00	0.00
Glades	12,884	6,700	0.92	137	0.92	0.92	0.00	0.00	0.00	0.00	0.00
Gulf	15,863	14,750	1.89	128	1.89	0.59	1.30	0.00	0.00	0.00	0.00
Hamilton	14,799	6,125	0.85	139	0.85	0.85	0.00	0.00	0.00	0.00	0.00
Hardee	27,731	15,918	1.48	93	1.48	1.48	0.00	0.00	0.00	0.00	0.00
Hendry	39,140	26,224	4.59	175	4.59	4.59	0.00	0.00	0.00	0.00	0.00
Hernando	172,778	152,217	19.77	130	19.77	19.77	0.00	0.00	0.00	0.00	0.00
Highlands	98,786	81,431	7.77	95	7.77	7.77	0.00	0.00	0.00	0.00	0.00
Hillsborough[a]	1,229,226	1,204,641	116.16	96	170.21	65.75	104.46	0.02	54.07	0.00	16.97
Holmes	19,927	6,210	1.12	180	1.12	1.12	0.00	0.00	0.00	0.00	0.00
Indian River	138,028	120,084	14.78	123	14.78	14.78	0.00	0.00	0.00	0.00	10.14
Jackson	49,746	17,225	2.54	147	2.54	2.54	0.00	0.00	0.00	0.00	0.00
Jefferson	14,761	5,225	0.84	161	0.84	0.84	0.00	0.00	0.00	0.00	0.00
Lafayette	8,870	1,237	0.17	137	0.17	0.17	0.00	0.00	0.00	0.00	0.00
Lake	297,052	240,010	40.55	169	40.55	40.55	0.00	0.00	0.00	0.00	0.00

Table 4. Public-supply population, water use, withdrawals, transfers, and treated water in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). Water values in million gallons per day; per capita values in gallons per day]

County	Population		Water use		Withdrawals			Transfers			Treated nonpotable water
	Total	Public supply	Total	Gross per capita	Total	Ground	Surface	Imports	Exports	Losses	
Lee	618,754	525,941	60.89	116	60.89	57.94	2.95	0.00	0.00	0.00	31.46
Leon	275,487	232,625	30.31	130	30.41	30.41	0.00	0.00	0.10	0.00	0.00
Levy	40,801	12,355	1.48	120	1.48	1.48	0.00	0.00	0.00	0.00	0.00
Liberty	8,365	3,350	0.50	149	0.50	0.50	0.00	0.00	0.00	0.00	0.00
Madison	19,224	7,500	1.39	185	1.39	1.39	0.00	0.00	0.00	0.00	0.00
Manatee	322,833	317,668	27.76	87	33.04	10.28	22.76	0.00	5.28	0.00	0.00
Marion	331,298	200,390	29.88	149	29.88	29.88	0.00	0.00	0.00	0.00	0.00
Martin	146,318	122,907	18.28	149	18.28	18.28	0.00	0.00	0.00	0.00	10.17
Miami-Dade	2,496,435	2,463,981	322.41	131	339.11	339.11	0.00	0.00	16.70	0.00	7.71
Monroe	73,090	70,897	16.70	236	0.00	0.00	0.00	16.70	0.00	0.00	0.00
Nassau	73,314	35,924	7.41	206	7.41	7.41	0.00	0.00	0.00	0.00	0.00
Okaloosa	180,822	172,750	21.70	126	21.70	21.70	0.00	0.00	0.00	0.00	0.00
Okeechobee	39,996	24,078	2.16	90	2.16	0.65	1.51	0.00	0.00	0.00	0.00
Orange	1,145,956	1,050,899	169.40	161	192.86	192.86	0.00	0.00	23.46	0.00	0.00
Osceola	268,685	214,948	34.92	162	34.92	34.92	0.00	0.00	0.00	0.00	0.00
Palm Beach	1,320,134	1,203,962	227.11	189	227.11	199.17	27.94	0.00	0.00	0.00	30.53
Pasco	464,697	409,863	45.97	112	66.11	66.11	0.00	0.00	20.14	0.00	0.00
Pinellas	916,542	903,710	90.10	100	15.89	15.89	0.00	74.21	0.00	0.00	0.00
Polk	602,095	546,725	67.37	123	67.39	67.35	0.04	0.00	0.02	0.00	0.00
Putnam	74,364	13,386	2.56	191	2.56	2.56	0.00	0.00	0.00	0.00	0.00
St. Johns	190,039	152,031	13.49	89	13.49	13.49	0.00	0.00	0.00	0.00	0.00
St. Lucie	277,789	229,176	27.50	120	27.50	27.50	0.00	0.00	0.00	0.00	19.11
Santa Rosa	151,372	136,750	16.76	123	15.06	15.06	0.00	1.70	0.00	0.00	0.00
Sarasota	379,448	368,065	35.55	97	18.66	17.45	1.21	16.89	0.00	0.00	9.25
Seminole	422,718	405,809	54.97	135	54.97	54.97	0.00	0.00	0.00	0.00	0.00
Sumter	93,420	71,653	15.86	221	15.86	15.86	0.00	0.00	0.00	0.00	0.00
Suwannee	41,551	9,625	1.14	118	1.14	1.14	0.00	0.00	0.00	0.00	0.00
Taylor	22,570	11,925	2.03	170	2.03	2.03	0.00	0.00	0.00	0.00	0.00
Union	15,535	1,897	0.38	200	0.38	0.38	0.00	0.00	0.00	0.00	0.00
Volusia	494,593	455,026	52.47	115	52.47	52.47	0.00	0.00	0.00	0.00	0.00
Wakulla	30,776	12,875	2.52	196	2.42	2.42	0.00	0.10	0.00	0.00	0.00
Walton	55,043	52,290	10.62	203	10.62	10.62	0.00	0.00	0.00	0.00	0.00
Washington	24,896	8,725	1.11	127	1.11	1.11	0.00	0.00	0.00	0.00	0.00
State totals	18,801,310	16,893,707	2,267.82	134	2,267.82	2,012.17	255.65	142.53	142.53	0.00	164.59

[a]Includes 16.97 Mgal/d of saline surface water in withdrawals and treated nonpotable water totals.

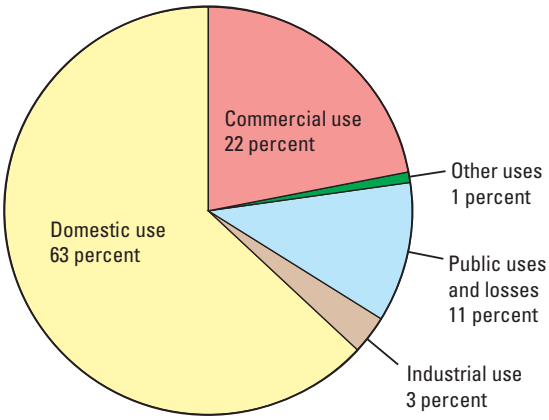


Figure 8. Public-supply water-use deliveries in Florida, 2010.

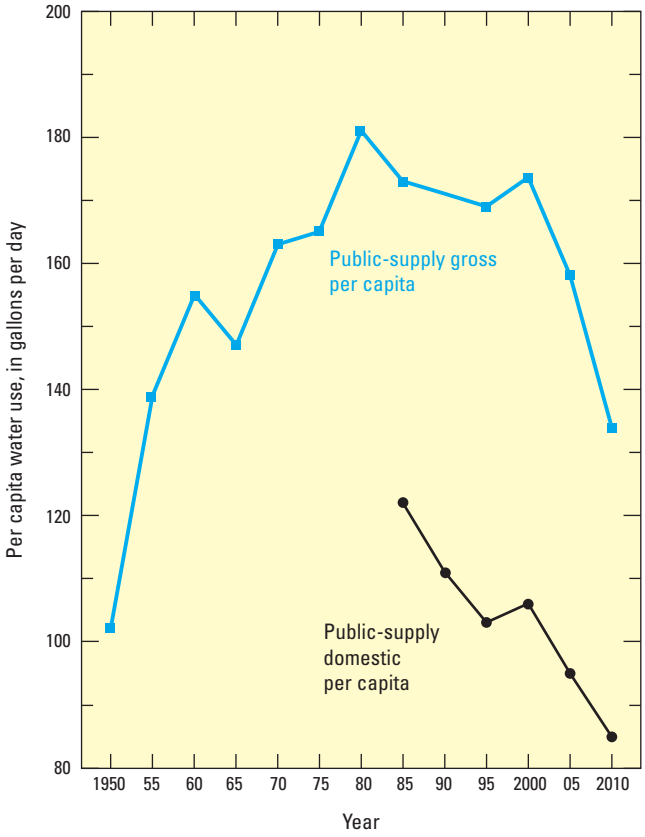


Figure 9. Historical public-supply gross and domestic per capita water use in Florida, 1950–2010.

The largest water withdrawals for public supply were in Miami-Dade, Palm Beach, and Broward Counties, where withdrawals exceeded 200 Mgal/d in 2010 (table 4). The Miami-Dade County Water and Sewer Department (http://www.miamidade.gov/water/) is the single largest water supplier in the State, followed by Tampa Bay Water (http://tampabaywater.org/) and Jacksonville Electric Authority JEA Water and Sewer (http://www.jea.com/). During 2010, the Miami-Dade County Water and Sewer Department withdrew about 280 Mgal/d of water (Donna Rickabus, South Florida Water Management District, written commun., 2011) and served about 2.0 million people, followed by Tampa Bay Water, which withdrew about 168 Mgal/d (Tampa Bay Water, 2013) and JEA, which withdrew about 117 Mgal/d (Tammy Bader, St. Johns River Water Management District, written commun., 2011). The Miami-Dade County Water and Sewer Department obtained 99.5 percent of its water from the Biscayne aquifer and 0.5 percent from the Floridan aquifer system as withdrawals from multiple well fields within the county. The Floridan water is brackish in this area and must be diluted with fresher water from the Biscayne aquifer. In 2010, Tampa Bay Water obtained 75 percent of its water from multiple well fields that tap the Floridan aquifer system in Hillsborough, Pasco, and Pinellas Counties and 25 percent of its water from surface sources in Hillsborough County (Tampa Bay Water, 2013) including 17 Mgal/d of saline water withdrawn from Tampa Bay (fig. 2) and treated through desalination. All of the water withdrawn by Tampa Bay Water is transferred to its member utilities within Hillsborough, Pasco, and Pinellas Counties as Tampa Bay Water moves water from the withdrawal source to the suppliers. JEA obtained all of its water from 135 wells that tap the Floridan aquifer system in Duval, Nassau, and St. Johns Counties (http://www.jea.com/). The Florida Keys Aqueduct Authority (http://www.fkaa.com) in 2010 obtained all of its water (17 Mgal/d) for public-supply distribution throughout Monroe County and the Florida Keys from a well field located in southern Miami-Dade County (Donna Rickabus, South Florida Water Management District, written commun., 2011).

Except for the period from 2005 to 2010, total withdrawals for public supply in Florida have increased steadily since water-use data were first collected in 1950 (fig. 10). Total public-supply withdrawals increased by 155 percent between 1970 and 2010 but decreased by 8 percent between 2000 and 2010 and by 12 percent between 2005 and 2010 (fig. 10). The population of Florida increased by 12 million people (177 percent) between 1970 and 2010, increased by 2.82 million people (17 percent) between 2000 and 2010, and increased by 1.02 million people (6 percent) between 2005 and 2010 (University of Florida, 2011; U.S. Census Bureau, 2011a). As the population of Florida increased during the 1970–2010 period, the percentage of the population that relies on public supply increased from 80 percent in 1970 to 90 percent by 2000, and remained at about 90 percent thereafter. These data indicate that the long-term (1970–2000) increase in public-supply withdrawals is a result of an increase in the total population and population served, and the water demands associated with these increases. The recent (2000–2010) trend of decreasing withdrawals is most likely the result of changes in economic conditions, use of alternative water sources (primarily for lawn watering), and water conservation, regulations, and mandates, along with other factors.

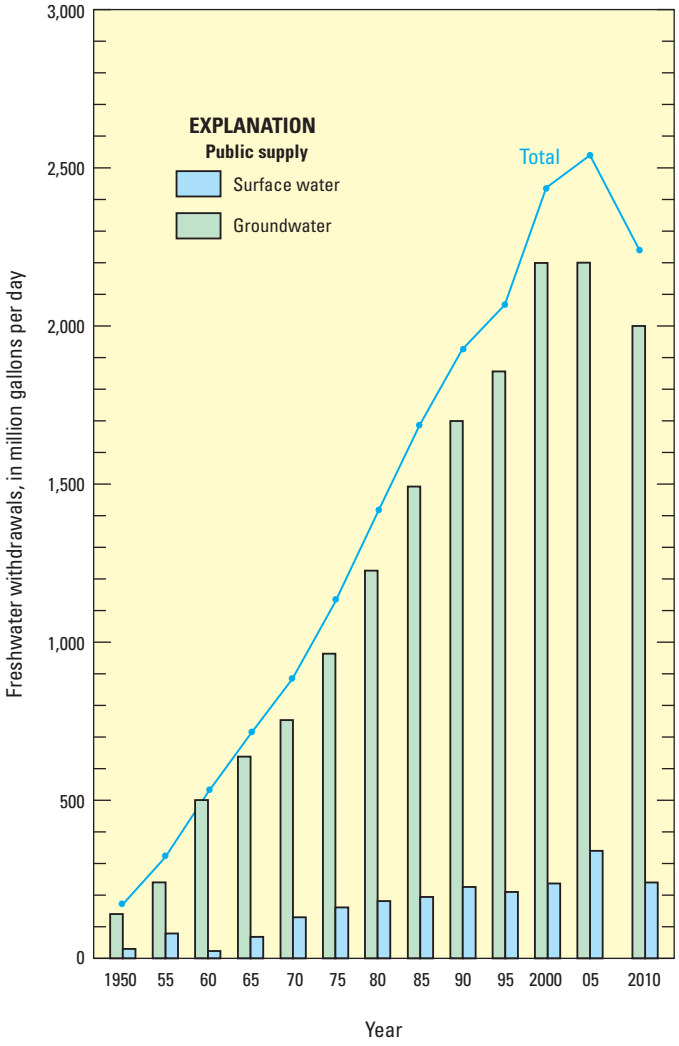


Figure 10. Historical public-supply freshwater withdrawals in Florida by source, 1950–2010. Modified from Marella (2009).

During the period between 2000 and 2010, a substantial number of housing units in the State became vacant, lowering both the population served as well as water demands in many areas. The number of vacant housing units in Florida was estimated to be nearly 18 percent in 2010, or an estimated 1.6 million out of 9.0 million housing units (U.S. Census Bureau, 2012). This 2010 estimate represents a substantial (0.65-million-unit) increase in vacancies compared to 2000, when 0.95 million of 7.3 million total housing units (13 percent) were vacant in Florida (U.S. Census Bureau, 2002). Using an average water use per housing unit of 193 gal/d in 2010, which is equal to the public-supply domestic use (1,427 Mgal/d) divided by the total number of occupied housing units (7.3 million), there would have been nearly 125 Mgal/d less water used (0.65 million housing units multiplied by 193 gal/d) because of vacant housing across Florida between 2000 and 2010. This decrease in water use does not account for the additional decrease in commercial, industrial, and public uses of public-supply water associated with the decrease in occupied housing units.

Use of alternative water sources, such as reclaimed wastewater, has helped lower demands for potable water in several areas of the State, and it is estimated that the statewide reuse per capita for 2010 was 35 gal/d (Florida Department of Environmental Protection, 2011a). The use of reclaimed wastewater in 2010 for residential irrigation and public access uses totaled 240 Mgal/d in 2010, which helped offset potable water withdrawals (Florida Department of Environmental Protection, 2011a). In addition, the availability of groundwater and surface water throughout Florida provides many homeowners and commercial properties within public supply service areas the opportunity to drill a private well or tap a local canal or lake to irrigate lawns and landscaping. These alternative sources also help lower water demands from public-supply water systems as less public-supply water is used to irrigate commercial and (or) residential lawns. To date, there is no estimate of the number of lawn-irrigation wells in the State, although it is believed to be substantial. According to a water-well industry report, more than 0.795 million wells were drilled in Florida between 2002 and 2011, with the vast majority used for individual purposes (The Gale Group, 2013); the report does not differentiate between household (domestic) water supply or irrigation use.

In addition to the use of alternative water sources just described, more comprehensive water conservation regulations or mandates imposed by both the water management districts and utilities between 2005 and 2010 have helped lower public supply water withdrawals and per capita water-use estimates (figs. 9 and 10). These regulations or mandates (often associated with water shortage declarations) include mandatory restrictions, such as a maximum allowance of 1 day per week for lawn watering, as imposed by the South Florida Water Management District in March of 2007 (Ian Miller, South Florida Water Management District, written commun, 2013). Other WMDs also instituted similar regulations for periods of time between 2000 and 2010. Overall, it is nearly impossible to determine the magnitude of the individual effects of changes in economic conditions, use of alternative sources, conservation, regulation, and mandates on reducing public-supply withdrawals between 2000 and 2010, in addition to other factors not mentioned that may have occurred locally.

The use of highly mineralized groundwater (referred to as nonpotable or brackish water) and saline surface water for public supply has increased from 2 Mgal/d in 1970 (Marella, 2009) to nearly 165 Mgal/d in 2010. Nearly 90 percent (148 Mgal/d) of this treated water was from groundwater and 10 percent (17 Mgal/d) was from saline surface water. The nonpotable water is either treated using demineralization or desalination techniques (mostly desalination) or is diluted with freshwater to meet FDEP drinking-water standards (Florida Department of Environmental Regulation, 1990) for potable water. The use of desalination or dilution of nonpotable water for public supply in 2010 occurred in 12 counties along the Florida coast, namely Brevard, Broward, Charlotte, Collier, Hillsborough, Indian River, Lee, Martin, Miami-Dade, Palm

Table 5. Estimated public-supply water use (deliveries), and per capita use in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://tl.water.usgs.gov/)]

County	Population served	Public-supply water use (deliveries), in million gallons per day						Per capita use, in gallons per day	
		Domestic (residential) use	Commercial use	Industrial use	Other uses	Public uses and losses	Total	Gross	Domestic (residential)
Alachua	204,719	14.34	8.25	0.57	0.26	2.89	26.31	129	70
Baker	5,053	0.36	0.42	0.03	0.00	0.10	0.91	180	71
Bay	152,250	14.90	5.09	23.25	0.49	5.40	49.13	323	98
Bradford	9,026	1.00	0.40	0.03	0.01	0.18	1.62	179	111
Brevard	516,207	32.90	12.29	2.44	0.54	5.95	54.12	105	64
Broward	1,742,822	145.11	47.79	3.79	2.31	32.40	231.40	133	83
Calhoun	4,360	0.41	0.18	0.01	0.00	0.07	0.67	154	94
Charlotte	135,501	11.57	2.90	0.10	0.15	1.82	16.54	122	85
Citrus	96,040	10.13	2.04	0.10	0.14	1.53	13.94	145	105
Clay	135,514	6.70	2.89	0.20	0.12	1.22	11.13	82	49
Collier	276,508	36.55	9.60	0.64	0.53	5.85	53.17	192	132
Columbia	24,875	1.74	1.35	0.16	0.04	0.41	3.70	149	70
DeSoto	12,097	1.78	0.33	0.04	0.00	0.27	2.42	200	147
Dixie	4,950	0.35	0.19	0.06	0.00	0.07	0.67	135	71
Duval	821,050	76.71	26.53	4.25	1.21	13.44	122.14	149	93
Escambia	284,750	24.96	8.51	0.42	0.40	4.24	38.53	135	88
Flagler	76,557	6.19	1.33	0.13	0.09	0.96	8.70	114	81
Franklin	10,750	1.38	0.32	0.01	0.00	0.21	1.92	179	128
Gadsden	31,250	2.98	0.75	0.18	0.04	0.49	4.44	142	95
Gilchrist	1,725	0.10	0.09	0.01	0.00	0.03	0.23	133	58
Glades	6,700	0.67	0.13	0.02	0.00	0.10	0.92	137	100
Gulf	14,750	1.48	0.19	0.01	0.00	0.21	1.89	128	100
Hamilton	6,125	0.43	0.32	0.01	0.00	0.09	0.85	139	70
Hardee	15,918	0.96	0.34	0.02	0.00	0.16	1.48	93	60
Hendry	26,224	2.57	0.42	1.05	0.05	0.50	4.59	175	98
Hernando	152,217	14.91	2.39	0.10	0.20	2.17	19.77	130	98
Highlands	81,431	5.20	1.58	0.06	0.08	0.85	7.77	95	64
Hillsborough	1,204,641	62.11	37.26	2.81	1.20	12.78	116.16	96	52
Holmes	6,210	0.68	0.30	0.02	0.00	0.12	1.12	180	110
Indian River	120,084	9.67	3.01	0.32	0.15	1.63	14.78	123	81
Jackson	17,225	1.37	0.78	0.08	0.03	0.28	2.54	147	80
Jefferson	5,225	0.54	0.19	0.02	0.00	0.09	0.84	161	103
Lafayette	1,237	0.07	0.07	0.01	0.00	0.02	0.17	137	57
Lake	240,010	29.90	5.37	0.41	0.41	4.46	40.55	169	125

Table 5. Estimated public-supply water use (deliveries), and per capita use in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://tl.water.usgs.gov/)]

County	Population served	Public-supply water use (deliveries), in million gallons per day						Per capita use, in gallons per day	
		Domestic (residential) use	Commercial use	Industrial use	Other uses	Public uses and losses	Total	Gross	Domestic (residential)
Lee	525,941	38.64	14.33	0.61	0.61	6.70	60.89	116	73
Leon	232,625	16.83	9.55	0.30	0.30	3.33	30.31	130	72
Levy	12,355	0.87	0.43	0.01	0.01	0.16	1.48	120	70
Liberty	3,350	0.38	0.06	0.00	0.00	0.06	0.50	149	113
Madison	7,500	0.86	0.34	0.03	0.01	0.15	1.39	185	115
Manatee	317,668	16.74	5.95	1.67	0.35	3.05	27.76	87	53
Marion	200,390	19.62	5.77	0.90	0.30	3.29	29.88	149	98
Martin	122,907	11.90	3.78	0.41	0.18	2.01	18.28	149	97
Miami-Dade	2,463,981	209.12	69.30	5.30	3.22	35.47	322.41	131	85
Monroe	70,897	11.34	3.28	0.07	0.17	1.84	16.70	236	160
Nassau	35,924	5.03	1.40	0.09	0.07	0.82	7.41	206	140
Okaloosa	172,750	13.16	5.43	0.50	0.22	2.39	21.70	126	76
Okeechobee	24,078	1.37	0.51	0.04	0.00	0.24	2.16	90	57
Orange	1,050,899	93.59	51.08	4.17	1.93	18.63	169.40	161	89
Osceola	214,948	24.64	5.78	0.31	0.35	3.84	34.92	162	115
Palm Beach	1,203,962	160.10	37.39	2.37	2.27	24.98	227.11	189	133
Pasco	409,863	33.71	6.30	0.47	0.43	5.06	45.97	112	82
Pinellas	903,710	48.51	26.74	4.05	0.89	9.91	90.10	100	54
Polk	546,725	46.64	11.69	0.96	0.67	7.41	67.37	123	85
Putnam	13,386	1.17	0.96	0.12	0.03	0.28	2.56	191	87
St. Johns	152,031	7.35	4.28	0.25	0.13	1.48	13.49	89	48
St. Lucie	229,176	19.61	4.18	0.40	0.28	3.03	27.50	120	86
Santa Rosa	136,750	12.87	1.81	0.09	0.15	1.84	16.76	123	94
Sarasota	368,065	20.59	9.87	0.89	0.29	3.91	35.55	97	56
Seminole	405,809	36.75	10.33	1.29	0.55	6.05	54.97	135	91
Sumter	71,653	12.65	1.13	0.18	0.16	1.74	15.86	221	177
Suwannee	9,625	0.45	0.51	0.04	0.01	0.13	1.14	118	47
Taylor	11,925	1.28	0.43	0.08	0.02	0.22	2.03	170	107
Union	1,897	0.12	0.19	0.03	0.00	0.04	0.38	200	63
Volusia	455,026	33.95	11.21	1.02	0.52	5.77	52.47	115	75
Wakulla	12,875	1.46	0.72	0.04	0.02	0.28	2.52	196	113
Walton	52,290	7.66	1.60	0.08	0.11	1.17	10.62	203	146
Washington	8,725	0.57	0.35	0.07	0.00	0.12	1.11	127	65
Florida	16,893,707	1,430.25	490.28	68.20	22.70	256.39	2,267.82	134	85

Beach, St. Lucie, and Sarasota Counties (fig. 2 and table 4). Values reported as nonpotable in this report are the amount of water withdrawn for the removal of salt through a desalination process (**reverse osmosis**, electro-dialysis, or another membrane-treatment method) or dilution. Nonpotable groundwater withdrawals presented in this report are accounted for as freshwater; however, the USGS classifies this water as saline for 2010, and henceforth the USGS will report it on the national level as saline water. Additionally, water withdrawals for public supply are often treated to reduce hardness or remove particulates and other compounds using various methods, such as lime-softening, nanofiltration, or other processes. These amounts are not differentiated in the totals for public supply, nor are they included in the nonpotable treated totals.

Domestic Self-Supplied

The domestic self-supplied category is composed of users that withdraw small quantities of potable water for drinking-water purposes without the need for a permit from the WMDs. Domestic self-supplied use includes water withdrawals from individual private domestic wells that serve one or more households and by the small community water systems not inventoried under public supply, each having a daily average pumpage of less than 0.01 Mgal/d or serving fewer than 400 people. For this report, it was assumed that all people not served by the inventoried public suppliers are **self-supplied**. Of the 214 Mgal/d withdrawn for domestic self-supplied use in 2010 (table 6), an estimated 98 percent (209 Mgal/d) was from

Table 6. Domestic self-supplied population and water withdrawals in Florida by county, 2010.

[Source: U.S. Geological Survey, Florida Water Science Center (http://fl.water.usgs.gov/). Water values in million gallons per day]

County	Population			Water withdrawals		
	Total	Public supply	Self-supplied	Ground	Surface	Total
Alachua	247,336	204,719	42,617	3.52	0.00	3.52
Baker	27,115	5,053	22,062	3.01	0.00	3.01
Bay	168,852	152,250	16,602	1.41	0.00	1.41
Bradford	28,520	9,026	19,494	1.67	0.00	1.67
Brevard	543,376	516,207	27,169	1.90	0.00	1.90
Broward	1,748,066	1,742,822	5,244	0.45	0.00	0.45
Calhoun	14,625	4,360	10,265	0.87	0.00	0.87
Charlotte	159,978	135,501	24,477	0.69	0.00	0.69
Citrus	141,236	96,040	45,196	9.24	0.00	9.24
Clay	190,865	135,514	55,351	4.11	0.00	4.11
Collier	321,520	276,508	45,012	3.83	0.00	3.83
Columbia	67,531	24,875	42,656	3.63	0.00	3.63
DeSoto	34,862	12,097	22,765	2.02	0.00	2.02
Dixie	16,422	4,950	11,472	0.98	0.00	0.98
Duval	864,263	821,050	43,213	6.40	0.00	6.40
Escambia	297,619	284,750	12,869	1.09	0.00	1.09
Flagler	95,696	76,557	19,139	2.09	0.00	2.09
Franklin	11,549	10,750	799	0.07	0.00	0.07
Gadsden	46,389	31,250	15,139	1.29	0.00	1.29
Gilchrist	16,939	1,725	15,214	1.29	0.00	1.29
Glades	12,884	6,700	6,184	0.53	0.00	0.53
Gulf	15,863	14,750	1,113	0.09	0.00	0.09
Hamilton	14,799	6,125	8,674	0.74	0.00	0.74
Hardee	27,731	15,918	11,813	0.64	0.00	0.64
Hendry	39,140	26,224	12,916	1.10	0.00	1.10
Hernando	172,778	152,217	20,561	3.15	0.00	3.15
Highlands	98,786	81,431	17,355	2.42	0.00	2.42
Hillsborough	1,229,226	1,204,641	24,585	10.96	0.00	10.96

Table 6. Domestic self-supplied population and water withdrawals in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey, Florida Water Science Center (http://fl.water.usgs.gov/). Water values in million gallons per day]

County	Population			Water withdrawals		
	Total	Public supply	Self-supplied	Ground	Surface	Total
Holmes	19,927	6,210	13,717	1.17	0.00	1.17
Indian River	138,028	120,084	17,944	0.84	0.00	0.84
Jackson	49,746	17,225	32,521	2.76	0.00	2.76
Jefferson	14,761	5,225	9,536	0.81	0.00	0.81
Lafayette	8,870	1,237	7,633	0.65	0.00	0.65
Lake	297,052	240,010	57,042	7.14	0.00	7.14
Lee	618,754	525,941	92,813	7.89	0.00	7.89
Leon	275,487	232,625	42,862	3.64	0.00	3.64
Levy	40,801	12,355	28,446	1.94	0.00	1.94
Liberty	8,365	3,350	5,015	0.43	0.00	0.43
Madison	19,224	7,500	11,724	1.00	0.00	1.00
Manatee	322,833	317,668	5,165	1.37	0.00	1.37
Marion	331,298	200,390	130,908	13.38	0.00	13.38
Martin	146,318	122,907	23,411	1.99	0.00	1.99
Miami-Dade	2,496,435	2,463,981	32,454	2.76	0.00	2.76
Monroe	73,090	70,897	2,193	0.19	0.00	0.19
Nassau	73,314	35,924	37,390	6.87	0.00	6.87
Okaloosa	180,822	172,750	8,072	0.69	0.00	0.69
Okeechobee	39,996	24,078	15,918	1.37	0.00	1.37
Orange	1,145,956	1,050,899	95,057	12.34	0.00	12.34
Osceola	268,685	214,948	53,737	4.59	0.00	4.59
Palm Beach	1,320,134	1,203,962	116,172	9.87	0.00	9.87
Pasco	464,697	409,863	54,834	10.58	0.00	10.58
Pinellas	916,542	903,710	12,832	1.49	0.00	1.49
Polk	602,095	546,725	55,370	12.95	0.00	12.95
Putnam	74,364	13,386	60,978	6.87	0.00	6.87
St. Johns	190,039	152,031	38,008	2.80	0.00	2.80
St. Lucie	277,789	229,176	48,613	4.13	0.00	4.13
Santa Rosa	151,372	136,750	14,622	1.24	0.00	1.24
Sarasota	379,448	368,065	11,383	2.19	0.00	2.19
Seminole	422,718	405,809	16,909	1.71	0.00	1.71
Sumter	93,420	71,653	21,767	5.34	0.00	5.34
Suwannee	41,551	9,625	31,926	2.71	0.00	2.71
Taylor	22,570	11,925	10,645	0.90	0.00	0.90
Union	15,535	1,897	13,638	1.16	0.00	1.16
Volusia	494,593	455,026	39,567	3.77	0.00	3.77
Wakulla	30,776	12,875	17,901	1.52	0.00	1.52
Walton	55,043	52,290	2,753	0.23	0.00	0.23
Washington	24,896	8,725	16,171	1.37	0.00	1.37
State totals	18,801,310	16,893,707	1,907,603	213.84	0.00	213.84

private domestic wells and 2 percent (5 Mgal/d) was from the estimated 600 small public-supply systems that were not inventoried. Withdrawals of more than 10 Mgal/d for domestic self-supplied use in 2010 occurred in Marion, Polk, Orange, Hillsborough, and Pasco Counties (fig. 2 and table 6). It is assumed that water withdrawals for this category were derived exclusively from groundwater because of its good quality and widespread availability throughout the State. About 68 percent of the domestic self-supplied water withdrawn was obtained from the Floridan aquifer system; the remaining 32 percent was obtained from the shallower aquifers, namely the surficial aquifer system, Biscayne aquifer, intermediate aquifer system, and sand and gravel aquifer system. In many areas of Florida, these shallow aquifers yield sufficient water for domestic purposes, especially in areas where the Floridan aquifer system is relatively deep or has poor water quality (fig. 6). In 2010, an estimated 1.91 million people in Florida were self-supplied (table 6). An estimated 1.20 million people obtain their self-supplied well water from the Floridan aquifer system and the remaining 0.71 million obtained their water from the shallow aquifers.

Few data exist concerning the number of private domestic wells in Florida that are used for drinking water purposes, even though the local county health departments and WMDs manage programs to document the construction, completion, and abandonment of such wells. According to the U.S. Census Bureau (1993), 0.796 million households in Florida used an individual well as their primary source of drinking water in 1990; however, the census did not compile these data for 2000 or 2010. Assuming that the majority of new households in Florida are connected to public supply, and that a small percentage of homes that used a private domestic well in the past may have connected to a public-supply water systems as public suppliers expanded their service areas, a modest statewide growth rate of 1 percent annually between 1990 and 2010 would increase the number of households that have a private domestic well to 0.878 million in 2000 and to 0.971 million in 2010. According to a water-well industry report (The Gale Group, 2013), more than 0.795 million new wells were drilled in Florida between 2002 and 2011, with most intended for individual uses such as domestic drinking water or landscape irrigation. Based on the estimated increase of 0.093 million new domestic wells between 2000 and 2010 (from 0.878 million to 0.971 million), about 11 percent of the new wells drilled during this period are for individual household water supply. The estimated water use per well would be nearly 215 gal/d in 2010 (209 Mgal/d divided by 0.971 million wells) or 87 gal/d per person (which coincides with the statewide public-supply domestic per capita of 85 gal/d per person) if divided by the statewide average household size of 2.48 individuals in 2010 (Smith and Cody, 2012). Many additional households in Florida have private wells exclusively for lawn irrigation use, and these withdrawals are neither included in this category nor in this report.

Withdrawals for domestic self-supplied use in Florida ranged from about 240 Mgal/d in 1980 (Leach, 1983) to about 214 Mgal/d in 2010 (fig. 11), while the number of people that rely on domestic wells did not change appreciably during the period (Leach, 1983; Marella, 1988, 1992, 1999, 2004, and 2009). Between 1980 and 2010, two different methods were used to calculate domestic self-supplied withdrawals. In 1980, 1985, 1990, and 1995, the self-supplied population in each county was multiplied by the public-supply gross per capita water use, which ranged from 120 to 250 gal/d, for each county to estimate water withdrawals. For 2000, 2005, and 2010, the statewide public-supply domestic per capita water use was multiplied by the self-supplied population for all counties except those within the SJRWMD and SWFWMD; these two WMDs used either the public-supply gross or an adjusted per capita value in 2010 (as well as in 2000 and 2005). The public-supply domestic per capita water use values used in 2000 (106 gal/d) (Marella, 2004), 2005 (95 gal/d) (Marella, 2009), and 2010 (85 gal/d) were derived from public-supply withdrawals minus deliveries to commercial, industrial, public uses, and other users (2010 data shown in table 5). The methodology was changed because the public-supply gross per capita values accounted for commercial, industrial, and public uses (including losses) and other uses (table 5), thus tending to overestimate the water withdrawals for this category. The revised public-supply domestic per capita water use includes only what is used for households (including both indoor and outdoor uses) and, therefore, provides a better estimate of water withdrawals for this category.

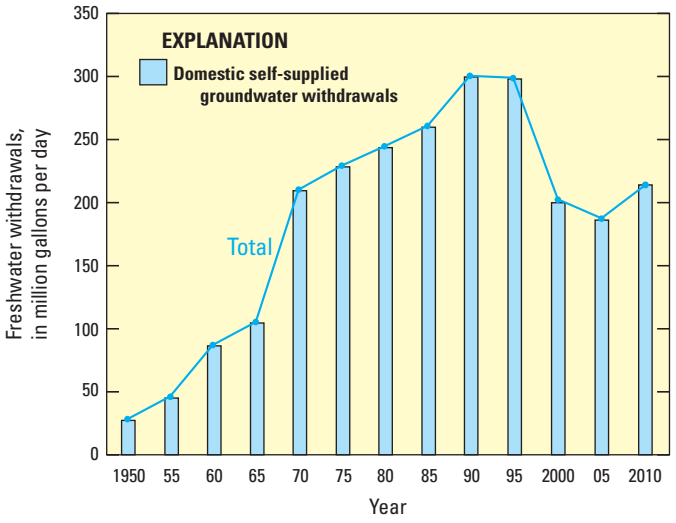


Figure 11. Historical domestic self-supplied groundwater withdrawals in Florida, 1950–2010. Modified from Marella (2009).

Commercial-Industrial-Mining Self-Supplied

Commercial-industrial-mining self-supplied use refers to water withdrawn directly by commercial, industrial, and mining facilities. Commercial users include some self-supplied community water systems, such as government and military facilities, schools, prisons, hospitals, and recreational facilities (nonirrigation), as well as nontransient noncommunity and transient noncommunity water systems that include places such as churches, restaurants, theme parks, and nonmanufacturing facilities. Industrial users include processing and manufacturing facilities, whereas **mining use** includes conveyance, extraction, milling, washing, and sometimes **dewatering**. Data for this report were obtained for those self-supplied commercial, industrial, or mining users having withdrawals of more than 0.01 Mgal/d. Most nontransient noncommunity and transient noncommunity water systems do not meet this minimum threshold.

Freshwater withdrawals by the inventoried commercial-industrial-mining self-supplied systems in Florida totaled 378 Mgal/d in 2010 (table 7). Groundwater supplied 295 Mgal/d (78 percent) and surface water supplied 84 Mgal/d (22 percent) of freshwater withdrawals. In addition, another 558 Mgal/d was delivered to commercial (490 Mgal/d) and industrial (68 Mgal/d) users from public-supply water systems in 2010 (table 5). The Floridan aquifer system supplied 79 percent of groundwater withdrawals for this category, followed by the sand and gravel aquifer system (11 percent), Biscayne aquifer (8 percent), and the intermediate aquifer system and surficial aquifer system (1 percent each). Major surface-water sources for commercial-industrial-mining self-supplied use include tributaries to Rice Creek in Putnam County and the Escambia River in Escambia County (each at 32 percent; water features shown in fig. 2). A large proportion of the remaining surface-water withdrawals in this category were from unnamed mining pits or ponds used for dewatering and mining operations. The largest total freshwater withdrawals for commercial-industrial-mining self-supplied purposes were from Escambia County, followed by Polk, Taylor, Miami-Dade, and Nassau Counties (table 7). These five counties accounted for more than half (53 percent) of the water withdrawals in this category during 2010. Monthly withdrawals for commercial-industrial-mining self-supplied use fluctuated little in 2010 (fig. 5), largely because the water demands for mining and pulp and paper manufacturing remain fairly constant throughout the year.

Pulp and paper manufacturing accounted for the largest percentage of freshwater water used in the commercial-industrial-mining self-supplied category (32 percent), followed by mining (30 percent) (fig. 12). The pulp and paper industry is located in northern and western Florida where the State is heavily forested, whereas mining operations are located throughout Florida but mostly concentrated in the central and extreme southeastern and southwestern parts of the State. Water withdrawals by the mining industry are primarily for material washing and conveyance, but often include water pumped to dewater the area being mined. Food production accounted for 4 percent (15 Mgal/d) of the freshwater withdrawals in this category in 2010 (fig. 12), of which about one-quarter (4 Mgal/d) was withdrawn for water-bottling. Many water bottlers statewide obtain their water for bottling from a public supply water system, and are not accounted for in this self-supplied total. Water withdrawals from the inventoried self-supplied commercial users, such as hospitals, prisons, schools, and theme parks accounted for 14 percent (55 Mgal/d) of the freshwater withdrawals in this category in 2010.

By 2010, freshwater withdrawals for commercial-industrial-mining self-supplied use in Florida had decreased by 49 percent since 1990 and by 23 percent since 2005 (fig. 13). Manufacturing employment decreased in Florida from 0.511 million in 1990 to 0.415 million in 2005, and to 0.309 million in 2010 (U.S. Bureau of Labor Statistics, 2013). Between 1990 and 2010, several large chemical plants, pulp mills, and other manufacturing facilities in Florida closed or scaled down their operations. Recently, mining of lime rock and sand has slowed because of the decline in new home or road construction between 2005 and 2010. Another trend in the data indicates that while self-supplied withdrawals for this category are decreasing overall, deliveries from public supply to commercial users have increased over time while deliveries to industrial users have decreased over time. From 1990 to 2010, deliveries of public-supply water to commercial users increased from 282 Mgal/d (Marella, 1992) to 490 Mgal/d while deliveries to industrial users decreased from 183 Mgal/d (Marella, 1992) to 68 Mgal/d. The statewide trend of increasing employment in the service industries, mainly commercial establishments, has helped increase commercial deliveries, whereas decreasing employment in manufacturing has helped decrease industrial deliveries. Most new commercial establishments, such as hotels, restaurants, and hospitals, are being built in areas throughout the State that are most likely served by a public-supply water system.

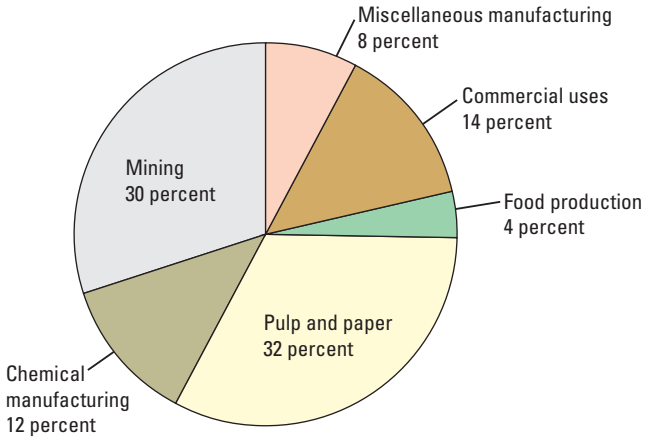


Figure 12. Commercial-industrial-mining self-supplied freshwater use in Florida by major industrial type, 2010.

Table 7. Commercial-industrial-mining self-supplied water withdrawals in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	0.43	0.00	0.43	0.00	0.00	0.00	0.43	0.00	0.43
Baker	0.73	0.00	0.73	0.00	0.00	0.00	0.73	0.00	0.73
Bay	0.26	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.26
Bradford	1.30	0.00	1.30	0.00	0.00	0.00	1.30	0.00	1.30
Brevard	5.09	0.00	5.09	0.91	0.00	0.91	6.00	0.00	6.00
Broward	1.48	0.00	1.48	0.00	0.00	0.00	1.48	0.00	1.48
Calhoun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charlotte	0.08	0.00	0.08	0.64	0.00	0.64	0.72	0.00	0.72
Citrus	0.75	0.00	0.75	0.03	0.00	0.03	0.78	0.00	0.78
Clay	0.25	0.00	0.25	0.10	0.00	0.10	0.35	0.00	0.35
Collier	0.33	0.00	0.33	1.65	0.00	1.65	1.98	0.00	1.98
Columbia	0.19	0.00	0.19	0.00	0.00	0.00	0.19	0.00	0.19
DeSoto	0.49	0.00	0.49	0.01	0.00	0.01	0.50	0.00	0.50
Dixie	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Duval	16.03	0.00	16.03	0.55	0.00	0.55	16.58	0.00	16.58
Escambia	31.78	0.00	31.78	22.53	0.00	22.53	54.31	0.00	54.31
Flagler	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Franklin	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
Gadsden	0.61	0.00	0.61	0.00	0.00	0.00	0.61	0.00	0.61
Gilchrist	0.34	0.00	0.34	0.00	0.00	0.00	0.34	0.00	0.34
Glades	0.31	0.00	0.31	6.97	0.00	6.97	7.28	0.00	7.28
Gulf	0.42	0.00	0.42	0.00	0.00	0.00	0.42	0.00	0.42
Hamilton	25.82	0.00	25.82	0.00	0.00	0.00	25.82	0.00	25.82
Hardee	1.72	0.00	1.72	0.00	0.00	0.00	1.72	0.00	1.72
Hendry	0.69	0.00	0.69	0.00	0.00	0.00	0.69	0.00	0.69
Hernando	7.54	0.00	7.54	0.00	0.00	0.00	7.54	0.00	7.54
Highlands	0.08	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08
Hillsborough	6.68	0.00	6.68	5.05	0.00	5.05	11.73	0.00	11.73
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	0.00	0.00	0.00	0.00	0.00
Jackson	1.51	0.00	1.51	0.00	0.00	0.00	1.51	0.00	1.51
Jefferson	0.22	0.00	0.22	0.00	0.00	0.00	0.22	0.00	0.22
Lafayette	0.27	0.00	0.27	0.00	0.00	0.00	0.27	0.00	0.27
Lake	4.16	0.00	4.16	1.23	0.00	1.23	5.39	0.00	5.39

Table 7. Commercial-industrial-mining self-supplied water withdrawals in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Lee	1.55	0.00	1.55	7.31	0.00	7.31	8.86	0.00	8.86
Leon	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
Levy	0.15	0.00	0.15	0.00	0.00	0.00	0.15	0.00	0.15
Liberty	0.19	0.00	0.19	0.00	0.00	0.00	0.19	0.00	0.19
Madison	0.56	0.00	0.56	0.00	0.00	0.00	0.56	0.00	0.56
Manatee	3.51	0.00	3.51	0.16	0.00	0.16	3.67	0.00	3.67
Marion	6.52	0.00	6.52	0.10	0.00	0.10	6.62	0.00	6.62
Martin	0.78	0.00	0.78	0.00	0.00	0.00	0.78	0.00	0.78
Miami-Dade	22.11	0.00	22.11	11.26	0.00	11.26	33.37	0.00	33.37
Monroe	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
Nassau	31.78	0.00	31.78	0.00	0.00	0.00	31.78	0.00	31.78
Okaloosa	2.29	0.00	2.29	0.00	0.00	0.00	2.29	0.00	2.29
Okeechobee	0.33	0.00	0.33	0.00	0.00	0.00	0.33	0.00	0.33
Orange	19.70	0.00	19.70	0.01	0.00	0.01	19.71	0.00	19.71
Osceola	0.37	0.00	0.37	0.00	0.00	0.00	0.37	0.00	0.37
Palm Beach	2.61	0.00	2.61	1.06	0.00	1.06	3.67	0.00	3.67
Pasco	0.36	0.00	0.36	0.54	0.00	0.54	0.90	0.00	0.90
Pinellas	0.05	0.00	0.05	0.00	0.00	0.00	0.05	0.00	0.05
Polk	42.83	0.00	42.83	0.20	0.00	0.20	43.03	0.00	43.03
Putnam	2.71	0.00	2.71	22.22	0.00	22.22	24.93	0.00	24.93
St. Johns	0.30	0.00	0.30	0.74	0.00	0.74	1.04	0.00	1.04
St. Lucie	0.08	0.00	0.08	0.00	0.00	0.00	0.08	0.00	0.08
Santa Rosa	1.22	0.00	1.22	0.00	0.00	0.00	1.22	0.00	1.22
Sarasota	0.08	0.00	0.08	0.04	0.00	0.04	0.12	0.00	0.12
Seminole	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sumter	0.39	0.00	0.39	0.09	0.00	0.09	0.48	0.00	0.48
Suwannee	1.78	0.00	1.78	0.00	0.00	0.00	1.78	0.00	1.78
Taylor	39.51	0.00	39.51	0.00	0.00	0.00	39.51	0.00	39.51
Union	0.48	0.00	0.48	0.00	0.00	0.00	0.48	0.00	0.48
Volusia	1.27	0.00	1.27	0.28	0.00	0.28	1.55	0.00	1.55
Wakulla	1.12	0.00	1.12	0.00	0.00	0.00	1.12	0.00	1.12
Walton	0.03	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.03
Washington	0.42	0.00	0.42	0.00	0.00	0.00	0.42	0.00	0.42
State totals	294.67	0.00	294.67	83.68	0.00	83.68	378.35	0.00	378.35

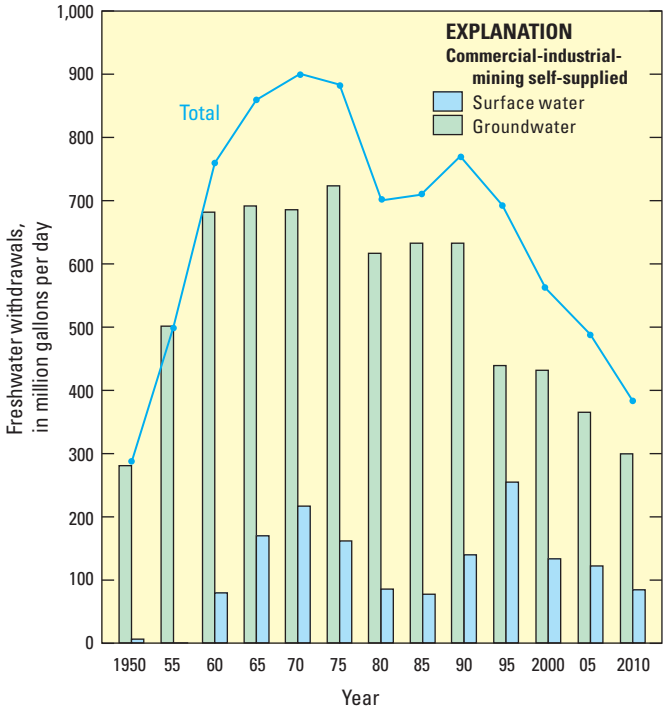


Figure 13. Historical commercial-industrial-mining self-supplied freshwater withdrawals in Florida by source, 1950–2010. Modified from Marella (2009).

Agricultural Self-Supplied (Irrigation and Nonirrigation)

Agricultural self-supplied use refers to water withdrawn for crop irrigation and for nonirrigation uses associated with agricultural and farming operations. Crop irrigation includes the application of water on lands to assist in cultivation of crops or to prevent crop damage caused by harsh weather conditions. Nonirrigation uses include withdrawals for livestock watering, washing of dairy and farm equipment, augmenting ponds used for fish farming, and other farm uses. About 12 percent of the total agricultural self-supplied water withdrawals presented in this report were derived from actual metered data for 2010. The water withdrawals for the remaining 88 percent of this water use category are estimated by multiplying irrigated crop acreage by a calculated NIR coefficient.

Agricultural self-supplied was the largest freshwater use category in Florida, accounting for 40 percent of the statewide total freshwater withdrawals in 2010 (fig. 4). Water withdrawals for agricultural self-supplied use in Florida totaled 2,551 Mgal/d for 2010 (table 8). All water withdrawals for irrigation in Florida were assumed to be freshwater. Groundwater supplied 55 percent (1,414 Mgal/d) and surface water supplied 45 percent (1,137 Mgal/d) of the water withdrawn for this category (table 8). An additional 73 Mgal/d of reclaimed wastewater was used for irrigation purposes in Florida during 2010 (Florida Department of Environmental Protection, 2011a). Overall, the water used for crop irrigation accounted for 99 percent (2,528 Mgal/d) of the water withdrawn in this category for 2010, and the nonirrigation uses (livestock and fish farming) accounted for the remaining 1 percent (23 Mgal/d).

The Floridan aquifer system supplied 67 percent of the groundwater withdrawn for agricultural self-supplied use in 2010. The remaining 33 percent was obtained from local sources, such as the surficial aquifer system and the intermediate aquifer system, which each accounted for 14 percent, and the sand and gravel aquifer system at 5 percent of the groundwater withdrawals. Major sources of surface water for irrigation purposes include the canals associated with the Caloosahatchee River (Glades and Hendry Counties), the St. Johns River (Brevard and Indian River Counties), Lake Okeechobee (Hendry, Martin, Palm Beach, and St. Lucie Counties), and the many unnamed canals in these counties (figs. 1 and 7). Southern Florida, which includes the Everglades Agricultural Area (figs. 1 and 7), is intensively irrigated for sugarcane, citrus, and vegetables and the above-named seven counties accounted for 87 percent of the surface-water withdrawals for irrigation (table 8).

Monthly withdrawals for agricultural self-supplied use had the largest seasonal variation of any water-use category in 2010 (fig. 5). The seasonal fluctuation of more than 4,200 Mgal/d between May and August 2010 is a result of intense crop production and the usual dry weather conditions during spring months, coupled with a decrease in crop production and increases in rainfall during the summer months. This seasonal pattern of withdrawals for agricultural self-supplied use is typical for Florida, and monthly variation is usually greatest during extremely dry years (Marella, 1997; Verdi and others, 2006).

During 2010, nearly 47,500 commercial farms cultivated 9.25 million acres of land in Florida (Florida Department of Agriculture and Consumer Services, 2012). An estimated 3.731 million acres of this land were used for agricultural crop production during 2010 (Florida Department of Agriculture and Consumer Services, 2012), with about 1.734 million acres irrigated (46.5 percent). About 42 percent of the 1.734 million acres were irrigated by flood irrigation systems, followed by micro irrigation systems (40 percent), and sprinkler irrigation systems (18 percent). The availability and reporting of agricultural acreage data are often inconsistent throughout Florida, especially over time. The most recent complete set of county data for all crops is provided by the USDA, 2007 Census of Agriculture for Florida (U.S. Department of Agriculture, 2009). Statewide acreage data for each year, including 2010, are updated only for selected crops (citrus, some field, and some vegetable) by the USDA National Agricultural Statistics Service (NASS) but often do not include county data (U.S. Department of Agriculture, 2009, 2010, 2011a, b, and c). Excluding pasture, estimates for citrus and other fruit crops (such as blueberries and strawberries) accounted for the most crop acreage (0.600 million) and irrigated acreage (0.550 million) in 2010, followed by sugarcane (0.400 million), which is assumed to all be irrigated (fig. 14). Excluding pasture, citrus (including other fruit crops) and sugarcane

combined accounted for 55 percent of the total crop acreage and 63 percent of the irrigated acreage in Florida for 2010. Estimated acreage changes between 2007 and 2010 indicate a decline in citrus acreage (17 percent), and increases in the acreage of field crops, vegetables, and nursery and sod (fig. 14). Figure 14 also shows a large increase in total pasture acreage between 2007 and 2010, which is most likely a consequence of using multiple data sources to estimate the 2010 acreage totals compared to 2007, which was published by the USDA (U.S. Department of Agriculture, 2009). Water-use estimates specifically for citrus, sugarcane, field crops, vegetables, nursery and sod, and pasture were not available for 2010.

Hendry, Palm Beach, Collier, Glades, Polk, and Indian River Counties all withdrew more than100 Mgal/d in 2010, and these combined withdrawals accounted for more than half (53 percent) of the total water withdrawals for agricultural self-supplied use statewide (table 8). Palm Beach County was the largest user of surface water, and Collier County was the largest user of groundwater. Palm Beach County had nearly 0.414 million acres of irrigated land in 2010, of which 74 percent was planted in sugarcane. Polk, Hendry, De Soto, and Highlands Counties had the most irrigated citrus acreage, and when combined, these five counties accounted for 50 percent of the State's citrus acreage in 2010 (U.S. Department of Agriculture, 2011c).

Water withdrawals for agricultural self-supplied use for 2010 were substantially lower than for most of the previous 30 years (fig. 15). During the 1980s, water withdrawals for agricultural irrigation averaged about 2,900 Mgal/d; in the 1990s, withdrawals averaged about 3,400 Mgal/d; for 2000, withdrawals peaked at nearly 4,000 Mgal/d before decreasing to about 2,800 Mgal/d in 2005 and 2,551 Mgal/d in 2010. Overall, agricultural self-supplied withdrawals in Florida decreased by 16 percent between 1980 and 2010, by 35 percent between 2000 and 2010, and by 8 percent between 2005 and 2010 (fig. 15). The decrease in groundwater withdrawals in the 1980s and 1990s can be attributed to the development of more efficient irrigation technology, coupled with the ability to access large quantities of freshwater for irrigation relatively inexpensively (Mulkey and Clouser, 1990). In addition, the State's subtropical climate and mild winters allow for early spring crop production and the potential to harvest multiple crops per year, coupled with Florida's close proximity to east coast markets and a capability to ship perishable products in a timely fashion (Mulkey and Clouser, 1990).

The large withdrawals in 2000 were the result of severe drought (Verdi and others, 2006) that created above average irrigation demands. Annual average rainfall statewide in 2000 was 43.2 inches (in.), compared to nearly 62.7 in. for 2005 and 49.2 in. for 2010 (Florida State University, 2013). The sharp decline in withdrawals between 2000 and 2010 is a result of large losses of irrigated acreage for selected crops, higher rainfall for 2005 and 2010 compared to 2000, and many water restrictions and conservation practices implemented during the 2000 drought that remain in place. In addition, between 2000 and 2010, many agencies (FDACS, IFAS, USDA, and others) worked with the agricultural community on better management practices and irrigation efficiencies to increase water conservation and promote better water quality throughout the State. Another factor in the change in withdrawals between 2000 and 2010 could be that irrigation requirement coefficients used to calculate withdrawals are more accurate today than they were 10 years ago because of the increased quality and quantity of readily available input data, such as rainfall and soil type, among others, especially at a local level.

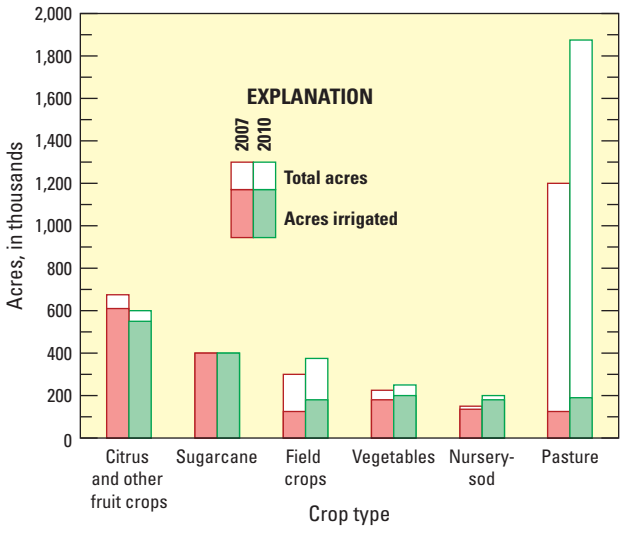


Figure 14. Agricultural acres and acres irrigated in Florida by selected crop type, 2007 and 2010. Modified from U.S. Department of Agriculture (2009, 2010, 2011a, b, c), and Florida Department of Agricultural and Consumer Services (2012).

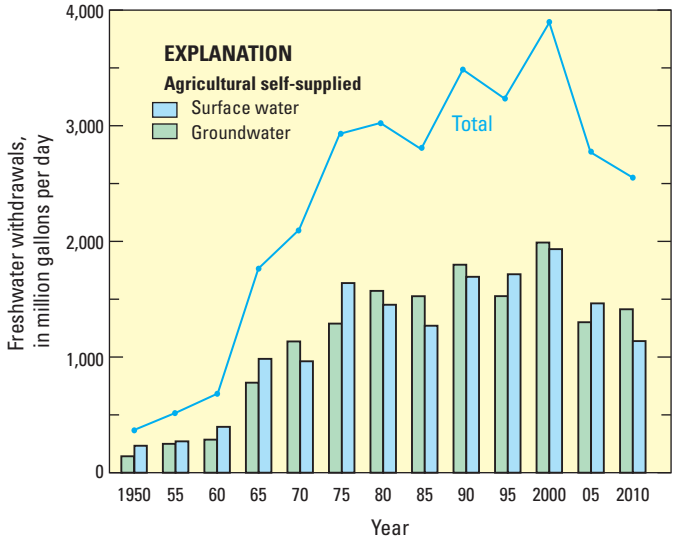


Figure 15. Historical agricultural self-supplied freshwater withdrawals in Florida by source, 1950–2010. Modified from Marella (2009).

Table 8. Agricultural self-supplied water withdrawals in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	19.70	0.00	19.70	0.34	0.00	0.34	20.04	0.00	20.04
Baker	0.57	0.00	0.57	0.20	0.00	0.20	0.77	0.00	0.77
Bay	2.25	0.00	2.25	0.00	0.00	0.00	2.25	0.00	2.25
Bradford	0.68	0.00	0.68	0.02	0.00	0.02	0.70	0.00	0.70
Brevard	46.92	0.00	46.92	21.57	0.00	21.57	68.49	0.00	68.49
Broward	2.08	0.00	2.08	0.23	0.00	0.23	2.31	0.00	2.31
Calhoun	2.36	0.00	2.36	0.21	0.00	0.21	2.57	0.00	2.57
Charlotte	17.55	0.00	17.55	30.83	0.00	30.83	48.38	0.00	48.38
Citrus	2.09	0.00	2.09	0.00	0.00	0.00	2.09	0.00	2.09
Clay	4.58	0.00	4.58	0.20	0.00	0.20	4.78	0.00	4.78
Collier	140.04	0.00	140.04	15.56	0.00	15.56	155.60	0.00	155.60
Columbia	5.93	0.00	5.93	0.06	0.00	0.06	5.99	0.00	5.99
DeSoto	69.30	0.00	69.30	1.71	0.00	1.71	71.01	0.00	71.01
Dixie	2.92	0.00	2.92	0.02	0.00	0.02	2.94	0.00	2.94
Duval	0.95	0.00	0.95	2.57	0.00	2.57	3.52	0.00	3.52
Escambia	2.57	0.00	2.57	0.00	0.00	0.00	2.57	0.00	2.57
Flagler	10.18	0.00	10.18	1.12	0.00	1.12	11.30	0.00	11.30
Franklin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gadsden	5.01	0.00	5.01	6.81	0.00	6.81	11.82	0.00	11.82
Gilchrist	7.36	0.00	7.36	0.07	0.00	0.07	7.43	0.00	7.43
Glades	38.46	0.00	38.46	114.46	0.00	114.46	152.92	0.00	152.92
Gulf	0.15	0.00	0.15	0.00	0.00	0.00	0.15	0.00	0.15
Hamilton	10.00	0.00	10.00	0.08	0.00	0.08	10.08	0.00	10.08
Hardee	46.83	0.00	46.83	0.07	0.00	0.07	46.90	0.00	46.90
Hendry	104.58	0.00	104.58	313.14	0.00	313.14	417.72	0.00	417.72
Hernando	2.45	0.00	2.45	0.00	0.00	0.00	2.45	0.00	2.45
Highlands	81.04	0.00	81.04	13.84	0.00	13.84	94.88	0.00	94.88
Hillsborough	59.35	0.00	59.35	1.98	0.00	1.98	61.33	0.00	61.33
Holmes	1.91	0.00	1.91	0.14	0.00	0.14	2.05	0.00	2.05
Indian River	38.00	0.00	38.00	74.22	0.00	74.22	112.22	0.00	112.22
Jackson	16.24	0.00	16.24	0.00	0.00	0.00	16.24	0.00	16.24
Jefferson	5.36	0.00	5.36	0.05	0.00	0.05	5.41	0.00	5.41
Lafayette	5.53	0.00	5.53	0.05	0.00	0.05	5.58	0.00	5.58
Lake	35.28	0.00	35.28	5.19	0.00	5.19	40.47	0.00	40.47

Table 8. Agricultural self-supplied water withdrawals in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Lee	42.04	0.00	42.04	10.48	0.00	10.48	52.52	0.00	52.52
Leon	0.38	0.00	0.38	0.04	0.00	0.04	0.42	0.00	0.42
Levy	27.99	0.00	27.99	0.58	0.00	0.58	28.57	0.00	28.57
Liberty	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
Madison	10.81	0.00	10.81	0.07	0.00	0.07	10.88	0.00	10.88
Manatee	76.12	0.00	76.12	0.69	0.00	0.69	76.81	0.00	76.81
Marion	13.86	0.00	13.86	0.44	0.00	0.44	14.30	0.00	14.30
Martin	4.62	0.00	4.62	41.58	0.00	41.58	46.20	0.00	46.20
Miami-Dade	59.61	0.00	59.61	6.63	0.00	6.63	66.24	0.00	66.24
Monroe	0.10	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.10
Nassau	1.47	0.00	1.47	0.00	0.00	0.00	1.47	0.00	1.47
Okaloosa	0.76	0.00	0.76	0.00	0.00	0.00	0.76	0.00	0.76
Okeechobee	45.66	0.00	45.66	12.03	0.00	12.03	57.69	0.00	57.69
Orange	20.25	0.00	20.25	2.42	0.00	2.42	22.67	0.00	22.67
Osceola	47.33	0.00	47.33	3.19	0.00	3.19	50.52	0.00	50.52
Palm Beach	19.84	0.00	19.84	376.80	0.00	376.80	396.64	0.00	396.64
Pasco	13.25	0.00	13.25	0.26	0.00	0.26	13.51	0.00	13.51
Pinellas	0.10	0.00	0.10	0.04	0.00	0.04	0.14	0.00	0.14
Polk	109.14	0.00	109.14	3.35	0.00	3.35	112.49	0.00	112.49
Putnam	17.49	0.00	17.49	4.34	0.00	4.34	21.83	0.00	21.83
St. Johns	21.28	0.00	21.28	0.06	0.00	0.06	21.34	0.00	21.34
St. Lucie	5.91	0.00	5.91	53.19	0.00	53.19	59.10	0.00	59.10
Santa Rosa	4.19	0.00	4.19	0.00	0.00	0.00	4.19	0.00	4.19
Sarasota	3.48	0.00	3.48	0.29	0.00	0.29	3.77	0.00	3.77
Seminole	10.45	0.00	10.45	0.23	0.00	0.23	10.68	0.00	10.68
Sumter	7.51	0.00	7.51	0.26	0.00	0.26	7.77	0.00	7.77
Suwannee	24.16	0.00	24.16	0.26	0.00	0.26	24.42	0.00	24.42
Taylor	0.37	0.00	0.37	0.01	0.00	0.01	0.38	0.00	0.38
Union	1.10	0.00	1.10	0.01	0.00	0.01	1.11	0.00	1.11
Volusia	33.73	0.00	33.73	14.99	0.00	14.99	48.72	0.00	48.72
Wakulla	0.26	0.00	0.26	0.00	0.00	0.00	0.26	0.00	0.26
Walton	1.45	0.00	1.45	0.14	0.00	0.14	1.59	0.00	1.59
Washington	0.97	0.00	0.97	0.07	0.00	0.07	1.04	0.00	1.04
State totals	1,413.91	0.00	1,413.91	1,137.19	0.00	1,137.19	2,551.10	0.00	2,551.10

The acreage of Florida's major crops changed between 1970 and 2010 (fig. 16). Citrus acreage statewide decreased from 0.832 million acres in 2000 (U.S. Department of Agriculture, 2011c) to 0.734 million acres in 2005 (Marella, 2009), and to 0.541 million acres in 2010 (U.S. Department of Agriculture, 2011c) (fig. 16). This 35 percent decrease of nearly 0.290 million acres in citrus acreage between 2000 and 2010 is a result of crop losses to hurricane damage, disease (such as canker and greening), and encroaching urbanization (White and van Blokland, 2006; U.S. Department of Agriculture, 2006). During this 10-year period the largest acreage losses of citrus occurred in Indian River, Martin, St. Lucie, and Polk Counties (White and van Blokland, 2006). Sugarcane acreage (with the exception of 2001) remained relatively constant between 2000 and 2010 (fig. 16). Vegetable acreage decreased between 2000 and 2010, with acreage being the lowest in 2004 and 2006, but acreage has increased slightly in 2008 and 2010 (fig. 16). Total acreage and irrigated acreage for field crops (such as corn, cotton, and peanuts) in Florida has increased, particularly between 2007 and 2010 (fig. 14). The demand for nursery crops for landscaping and sod has increased substantially during the past 35 years, because of statewide growth in population, housing, and commercial establishments. Irrigated acreage for commercial flowers, foliage and woody ornamentals, as well as sod, has increased from less than 0.070 million acres in 1985 (Marella, 1988) to an estimated 0.200 million acres in 2010, and typically, these crops are heavily irrigated throughout the State.

Another important irrigation trend in Florida is the increasing use of more efficient irrigation systems, such as micro irrigation (fig. 17). In 1980, about 16 percent of the acreage irrigated statewide used micro irrigation systems (0.300 million acres), and more than 60 percent used less efficient flood irrigation systems (1.200 million acres). By 2010, an estimated 39 percent of the irrigated acreage used micro irrigation systems (0.685 million acres), 42 percent used flood irrigation systems (0.731 million acres), and 18 percent used sprinkler irrigation systems (0.318 million acres) (fig. 17). The increased use of micro irrigation is particularly important for citrus, because nearly all of the newly replanted acreage is being irrigated by these more efficient systems. Many other crops are using micro irrigation systems and farmers statewide are moving away from flood or sprinkler irrigation systems where possible to help conserve water and energy and improve local water quality.

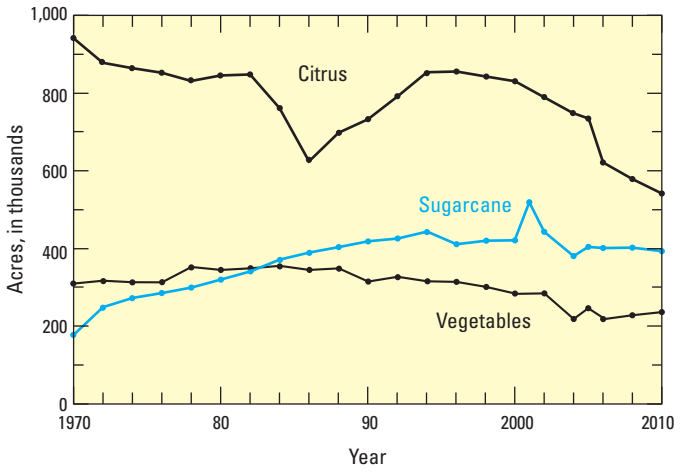


Figure 16. Historical agricultural acreage in Florida for selected crops, 1970–2010. Modified from Marella (2009), U.S. Department of Agriculture (2009, 2010, 2011a, b, c), and Florida Department of Agricultural and Consumer Services (2012).

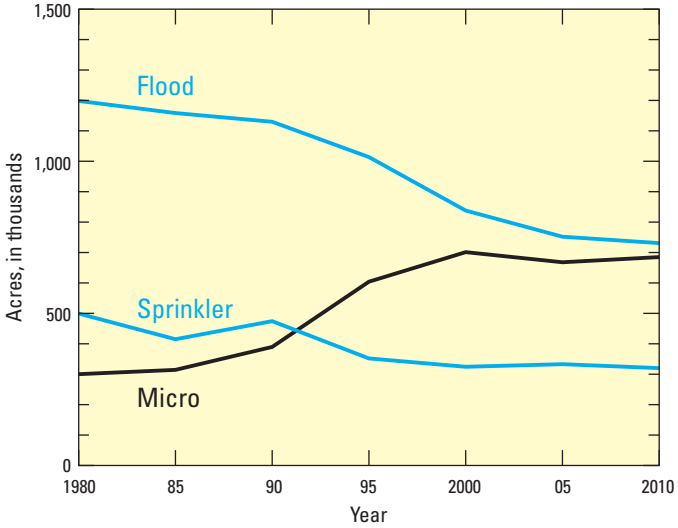


Figure 17. Historical agricultural acreage irrigated in Florida by irrigation system type, 1980–2010. Modified from Marella (2009).

Recreational-Landscape Irrigation

Recreational-landscape irrigation includes the application of water on lands to assist in growing turfgrass and landscape vegetation for lawns or recreation purposes but also includes water used for aesthetic purposes. Recreational irrigation includes golf-course irrigation, including all grass and landscape associated with golf courses; and landscape irrigation includes the irrigation of turfgrass and other vegetation associated with athletic fields, cemeteries, common public or highway areas, parks, playgrounds, school grounds, and nonresidential lawns and grasses primarily associated with commercial establishments. Aesthetic uses are associated with water used to fill or maintain nonagricultural lakes, ponds, and fountains. Recreational-landscape irrigation is a relatively new category first used in the 1995 compilation; however, data for the category have been collected since 1985 and were included under the agricultural irrigation category for the 1985 and 1990 compilations. Water used for recreational-landscape irrigation may be obtained from a public water supplier, reclaimed wastewater, or self-supplied. About 12 percent of the total recreational-landscape irrigation water withdrawals presented in this report was derived from actual metered data for 2010. The water withdrawals for the remaining 88 percent of this water use category are estimated by multiplying irrigated acreage by a calculated NIR coefficient.

Water withdrawals for recreational-landscape irrigation in Florida totaled 392 Mgal/d in 2010 (table 9). All water withdrawals for recreational-landscape irrigation in Florida were assumed to be freshwater. Surface water supplied 52 percent (204 Mgal/d) of the water withdrawn for recreational-landscape irrigation and groundwater supplied the remaining 48 percent (188 Mgal/d). An additional 197 Mgal/d of reclaimed wastewater was used for recreational-landscape irrigation purposes in 2010 (Florida Department of Environmental Protection, 2011a). The Floridan aquifer system supplied 47 percent of the groundwater withdrawals, the surficial aquifer system supplied 27 percent, and the remainder was supplied by the Biscayne (11 percent), intermediate aquifer system (11 percent), and sand and gravel aquifer system (4 percent). Surface-water sources for this category include local ponds, lakes, and canals. In many cases, surface-water sources are augmented with groundwater or reclaimed wastewater, or they are designed to capture **on-site runoff** from unused irrigation water and rainfall in an effort to maintain water levels or storage for future irrigation needs (Golf Course Superintendents Association of America, 2009). Nearly 51 percent of water withdrawals for recreational-landscape irrigation occurred in Palm Beach, Lee, Collier, and Broward Counties (table 9). For these counties and others in central and southern Florida, recreational-landscape irrigation typically occurs year-round. Pinellas and Palm Beach Counties were the largest users of reclaimed wastewater for recreational-landscape irrigation in 2010 (Florida Department of Environmental Protection, 2011a).

Of the total water withdrawn for recreational-landscape irrigation, water used for golf-course irrigation totaled about 197 Mgal/d in 2010, of which 51 percent was from surface water and 49 percent was from groundwater. For 2010, it was estimated that about 1,100 golf courses were located in Florida (modified from the National Golf Foundation, 2006) and had 0.122 million irrigated acres. An additional 118 Mgal/d of reclaimed wastewater was used at nearly half (525) of Florida's golf courses during 2010 (Florida Department of Environmental Protection, 2011a). Much of the reclaimed wastewater was directly applied for irrigation, and some of it was used to augment golf-course irrigation ponds. The remaining recreational-landscape irrigation withdrawals (195 Mgal/d) and reclaimed wastewater (79 Mgal/d) were used to irrigate an estimated 0.135 million acres of landscaped areas, including commercial lawns, highway medians, parks, schools, and public common areas. This estimate only includes the larger landscape irrigators that are permitted, because most of the users in this category do not require a consumptive water-use permit and their withdrawals are not accounted for herein. Actual landscape water withdrawals and acreage in Florida are much larger than the values reported here for 2010, because most of the users in this category are not accounted for through consumptive water-use permits.

Total freshwater withdrawals for recreational-landscape irrigation increased 115 percent between 1985 and 2010 (fig. 18). Recently, total freshwater withdrawals for recreational-landscape irrigation decreased 4 percent between 2000 and 2010, but increased 27 percent between 2005 and 2010. It was assumed that the number of golf courses and acres irrigated did not change appreciably between 2005 and 2010 as a result of the economic conditions in Florida during this time. One reason for the variation in golf-course irrigation is the dependency of irrigation needs upon rainfall; normal rainfall deviations during a given year can greatly affect the annual water demand. In addition, most golf courses in central and southern Florida irrigate all year and many golf courses along the coast must contend with sandy soils and high evaporation rates caused by onshore winds. Some of the irrigation demand was offset by the use of reclaimed wastewater as the primary water source and the use of onsite irrigation ponds that are replenished by runoff. When rainfall does not provide enough water to maintain adequate water levels in the ponds, however, wells are often used to augment the water levels. More recently, increases in water costs and restrictions associated with obtaining water from public supply to irrigate large commercial landscaped areas have resulted in an increase in the number of wells drilled and (or) the number of canals, lakes, and ponds tapped for such irrigation. Many of these new users would be included in this category if they were large enough to require a consumptive water-use permit from the WMD; however, most do not meet this criterion. Therefore, the amount of water withdrawn for this category may be larger than what is estimated.

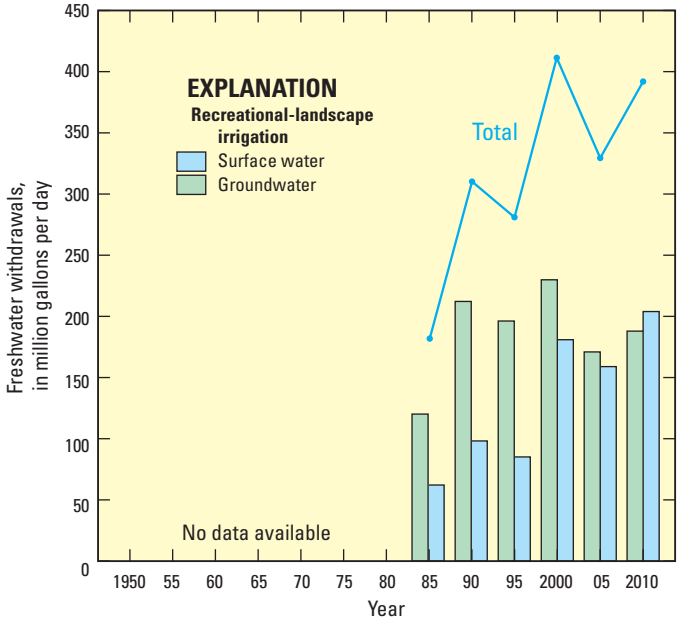


Figure 18. Historical recreational-landscape irrigation freshwater withdrawals in Florida by source, 1985–2010. Modified from Marella (2009).

Table 9. Recreational-landscape irrigation water withdrawals in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Alachua	1.22	0.00	1.22	0.21	0.00	0.21	1.43	0.00	1.43
Baker	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay	1.07	0.00	1.07	0.02	0.00	0.02	1.09	0.00	1.09
Bradford	0.06	0.00	0.06	0.02	0.00	0.02	0.08	0.00	0.08
Brevard	1.76	0.00	1.76	5.91	0.00	5.91	7.67	0.00	7.67
Broward	15.55	0.00	15.55	23.61	0.00	23.61	39.16	0.00	39.16
Calhoun	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Charlotte	0.76	0.00	0.76	1.19	0.00	1.19	1.95	0.00	1.95
Citrus	4.31	0.00	4.31	0.33	0.00	0.33	4.64	0.00	4.64
Clay	0.65	0.00	0.65	2.64	0.00	2.64	3.29	0.00	3.29
Collier	19.69	0.00	19.69	22.98	0.00	22.98	42.67	0.00	42.67
Columbia	0.29	0.00	0.29	0.09	0.00	0.09	0.38	0.00	0.38
DeSoto	0.31	0.00	0.31	0.06	0.00	0.06	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	2.43	0.00	2.43	3.49	0.00	3.49	5.92	0.00	5.92
Escambia	2.90	0.00	2.90	1.01	0.00	1.01	3.91	0.00	3.91
Flagler	0.29	0.00	0.29	1.04	0.00	1.04	1.33	0.00	1.33
Franklin	0.02	0.00	0.02	0.28	0.00	0.28	0.30	0.00	0.30
Gadsden	0.00	0.00	0.00	0.22	0.00	0.22	0.22	0.00	0.22
Gilchrist	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Glades	0.35	0.00	0.35	0.35	0.00	0.35	0.70	0.00	0.70
Gulf	0.11	0.00	0.11	0.00	0.00	0.00	0.11	0.00	0.11
Hamilton	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hardee	0.10	0.00	0.10	0.00	0.00	0.00	0.10	0.00	0.10
Hendry	0.10	0.00	0.10	0.10	0.00	0.10	0.20	0.00	0.20
Hernando	4.84	0.00	4.84	0.41	0.00	0.41	5.25	0.00	5.25
Highlands	2.54	0.00	2.54	0.17	0.00	0.17	2.71	0.00	2.71
Hillsborough	8.51	0.00	8.51	0.30	0.00	0.30	8.81	0.00	8.81
Holmes	0.16	0.00	0.16	0.00	0.00	0.00	0.16	0.00	0.16
Indian River	3.66	0.00	3.66	11.04	0.00	11.04	14.70	0.00	14.70
Jackson	0.30	0.00	0.30	0.02	0.00	0.02	0.32	0.00	0.32
Jefferson	0.16	0.00	0.16	0.09	0.00	0.09	0.25	0.00	0.25
Lafayette	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lake	4.73	0.00	4.73	6.01	0.00	6.01	10.74	0.00	10.74

Table 9. Recreational-landscape irrigation water withdrawals in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Ground water			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Lee	20.46	0.00	20.46	34.96	0.00	34.96	55.42	0.00	55.42
Leon	0.72	0.00	0.72	0.70	0.00	0.70	1.42	0.00	1.42
Levy	0.38	0.00	0.38	0.04	0.00	0.04	0.42	0.00	0.42
Liberty	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Madison	0.17	0.00	0.17	0.06	0.00	0.06	0.23	0.00	0.23
Manatee	7.36	0.00	7.36	1.23	0.00	1.23	8.59	0.00	8.59
Marion	5.54	0.00	5.54	1.55	0.00	1.55	7.09	0.00	7.09
Martin	3.79	0.00	3.79	3.79	0.00	3.79	7.58	0.00	7.58
Miami-Dade	4.85	0.00	4.85	8.26	0.00	8.26	13.11	0.00	13.11
Monroe	0.45	0.00	0.45	0.45	0.00	0.45	0.90	0.00	0.90
Nassau	1.75	0.00	1.75	1.21	0.00	1.21	2.96	0.00	2.96
Okaloosa	3.11	0.00	3.11	0.00	0.00	0.00	3.11	0.00	3.11
Okeechobee	0.35	0.00	0.35	0.35	0.00	0.35	0.70	0.00	0.70
Orange	3.84	0.00	3.84	5.75	0.00	5.75	9.59	0.00	9.59
Osceola	3.76	0.00	3.76	3.75	0.00	3.75	7.51	0.00	7.51
Palm Beach	20.77	0.00	20.77	40.90	0.00	40.90	61.67	0.00	61.67
Pasco	3.60	0.00	3.60	0.17	0.00	0.17	3.77	0.00	3.77
Pinellas	2.06	0.00	2.06	0.87	0.00	0.87	2.93	0.00	2.93
Polk	8.66	0.00	8.66	0.60	0.00	0.60	9.26	0.00	9.26
Putnam	0.26	0.00	0.26	0.15	0.00	0.15	0.41	0.00	0.41
St. Johns	1.47	0.00	1.47	4.04	0.00	4.04	5.51	0.00	5.51
St. Lucie	3.67	0.00	3.67	6.76	0.00	6.76	10.43	0.00	10.43
Santa Rosa	3.83	0.00	3.83	0.98	0.00	0.98	4.81	0.00	4.81
Sarasota	5.25	0.00	5.25	1.28	0.00	1.28	6.53	0.00	6.53
Seminole	0.62	0.00	0.62	1.16	0.00	1.16	1.78	0.00	1.78
Sumter	2.55	0.00	2.55	0.00	0.00	0.00	2.55	0.00	2.55
Suwannee	0.06	0.00	0.06	0.02	0.00	0.02	0.08	0.00	0.08
Taylor	0.06	0.00	0.06	0.02	0.00	0.02	0.08	0.00	0.08
Union	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Volusia	0.74	0.00	0.74	2.56	0.00	2.56	3.30	0.00	3.30
Wakulla	0.16	0.00	0.16	0.00	0.00	0.00	0.16	0.00	0.16
Walton	1.06	0.00	1.06	0.35	0.00	0.35	1.41	0.00	1.41
Washington	0.16	0.00	0.16	0.00	0.00	0.00	0.16	0.00	0.16
State totals	188.38	0.00	188.38	203.55	0.00	203.55	391.93	0.00	391.93

Power Generation

Water used for power-generation includes water withdrawals for **thermoelectric power generation** facilities (fossil fuel or nuclear) and water used at hydroelectric facilities. A total of 63 active power-generation facilities in Florida were inventoried for this report. Several of these facilities were used for standby purposes only (used only during extreme peak demand or while primary plants are down for maintenance) and several others are secondary power-generating facilities that generate electricity as a byproduct of their main function. Two hydroelectric power-generating facilities were in operation in Florida (in Gadsden and Leon Counties) in 2010 and the amount of power generated or the amount of water that passed through their turbines is not reported herein. Water withdrawal data for power generation were collected for fresh and saline sources of groundwater and surface water. In many cases, the withdrawal amount reported represents the amount of water used to augment cooling canals, ponds, or lakes, as opposed to the amount of water actually used for once-through cooling. The amount withdrawn for augmentation is often referred to as the amount of water consumed because it is not returned to the original source.

Water withdrawals for power generation in Florida totaled 9,185 Mgal/d in 2010 (table 10), of which saline water composed of 8,572 Mgal/d (93 percent) and freshwater composed of 613 Mgal/d (7 percent) (table 10). Nearly all (99.9 percent) of the saline-water withdrawals were from surface-water sources; of the freshwater withdrawals, 93 percent were from surface-water sources and 7 percent were from groundwater sources. Overall, nearly 98 percent (8,990 Mgal/d) of the total surface-water (fresh and saline) withdrawn for power generation in 2010 was used for once-through cooling purposes and nearly all of this water was returned to its source after use. More than 205,000 **gigawatt-hours** (GWh) of total gross power was generated by the 63 inventoried facilities in Florida during 2010. Fresh- and saline-water withdrawals for power generation represent 61 percent of all water withdrawals in Florida for 2010 (table 1).

Most of the surface water used for power generation was withdrawn from bays or rivers along the coast, which included the Anclote River (Pasco County), Caloosahatchee River (Lee County), Crystal River and the Gulf of Mexico (Citrus County), Escambia River (Escambia County), the Indian River (also referred to as the Intracoastal Waterway, in Brevard, Indian River, and St. Lucie Counties), the St. Johns River (Duval and Putnam Counties), and Tampa Bay (Hillsborough and Pinellas Counties) (figs. 1 and 7). Although several of these bays or rivers are considered freshwater, the point of withdrawal is commonly tidally influenced, and the water may be fresh, brackish, or saline because of tidal flow (McPherson and Hammett, 1991). Water withdrawals reported herein are considered saline at most of the plants unless they are permitted by the WMDs as freshwater (not all power generation facilities have, or are required to have, a consumptive water-use permit from a WMD). The Floridan aquifer system was the source of 80 percent (40 Mgal/d) of the groundwater withdrawals (fresh and saline) for power generation in 2010. Another 20 Mgal/d of reclaimed wastewater was used directly for cooling purposes (Florida Department of Environmental Protection, 2011a); in addition, cooling water was also obtained from many lakes, ponds, or wetlands that are supplemented by reclaimed wastewater. Escambia County accounted for the largest amount of freshwater withdrawn for power generation in 2010 and Hillsborough County accounted for the largest amount of saline water withdrawn (table 10).

Total water withdrawals for power generation increased steadily between 1955 and 1980, when withdrawals peaked at nearly 16,000 Mgal/d (fig. 19), and withdrawal amounts have fluctuated or decreased since then. In the mid-1970s as a result of increased oil prices, population growth, and the availability of new technology, the power industry in Florida began to build predominately gas-fired **combined-cycle** power plants. Beginning in the early 1990s many power providers started to build new facilities or repower their conventional power plants using this technology. Repowering involves changing the power generation method from old and less efficient systems to systems that have newer technology (combined-cycle), are more efficient, and use fuels that emit fewer pollutants (Ron Hix, Florida Power and Light, written commun, 2014). As a by-product of this conversion, electrical output is increased substantially, while using the same, or a lesser volume of water. As a result, water withdrawals generally began to decrease statewide after 1990 while the amount of power generated continued to increase.

Between 2000 and 2010, freshwater withdrawals decreased by 7 percent and saline water withdrawals decreased by 28 percent (Marella, 2004). Between 2005 and 2010,

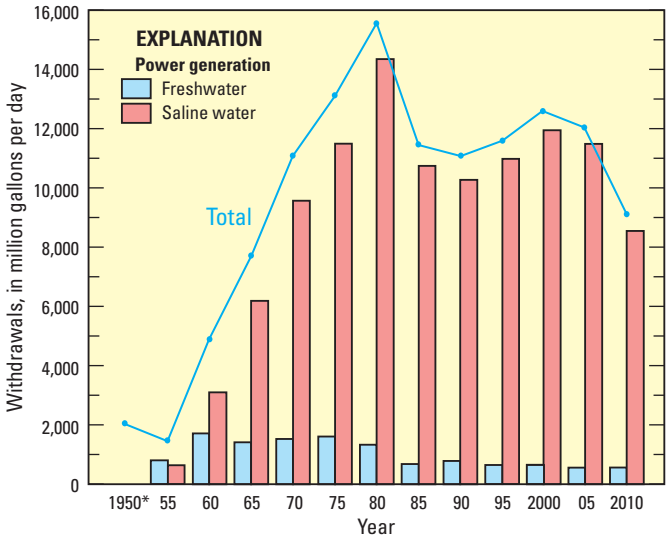


Figure 19. Historical power-generation water withdrawals in Florida by source, 1950–2010. Modified from Marella (2009).

freshwater withdrawals increased by 10 percent while saline water withdrawals decreased by 25 percent (Marella, 2009). However, the total amount of gross power generated statewide increased nearly 21 percent (35,000 GWh) between 2000 and 2010 (Marella, 2004) and less than 1 percent (1,200 GWh) between 2005 and 2010 (Marella, 2009). As a result of more efficient combined-cycle technology, water demands continued to decrease between 2000 and 2010, and this trend of increased power production and decreased water demands statewide is expected to continue (Ron Hix, Florida Power and Light, written commun, 2014). Additionally, differences between years could be a consequence of facility downtime caused by plant maintenance or repowering. Prolonged downtime can substantially reduce the annual average water withdrawals at power generation facilities, which is particularly evident when data are collected only every 5 years.

Water Source and Use by Water Management District

The Florida Water Resources Act of 1972 established authority for management of the State's water resources through five WMDs that operate under the general supervision of the FDEP (formerly the Florida Department of Natural Resources and Florida Department of Environmental Regulation) (Fernald and Patton, 1984). The five WMDs (fig. 2), which encompass the entire State, vary considerably in population. Of the 18.80 million people who resided in Florida during 2010, nearly 41 percent (7.68 million) resided in the SFWMD; 25 percent resided in each of the SWFWMD and SJRWMD (4.73 million and 4.70 million, respectively); 7 percent (1.36 million) resided in the NWFWMD; and the remaining 2 percent (0.33 million) resided in the SRWMD (fig. 20). The SFWMD included the largest number of residents served by public-supply water systems (7.20 million) (fig. 20), and the SJRWMD has the largest self-supplied population (0.62 million) in 2010.

The SFWMD accounted for the largest percentage of freshwater withdrawals (47 percent) in 2010 (fig. 21 and table 11), followed by the SJRWMD (21 percent), SWFWMD (18 percent), NWFWMD (9 percent), and SRWMD (5 percent). The SFWMD accounted for the largest percentage of freshwater withdrawals for public-supply use (47 percent), agricultural self-supplied use (59 percent), and recreational-landscape irrigation use (63 percent). The SJRWMD accounted for the largest percentage of freshwater withdrawn for commercial-industrial-mining self-supplied use (26 percent), the NWFWMD accounted for the largest percentage of freshwater withdrawals for power-generation use (42 percent), and the SWFWMD accounted for the largest percentage of saline-water withdrawals for power-generation use (57 percent) (table 11). The SWFWMD accounted for the largest amount of saline-water withdrawals, and the SFWMD accounted for the largest amount of fresh groundwater and surface-water withdrawals in 2010 (fig. 22 and table 11).

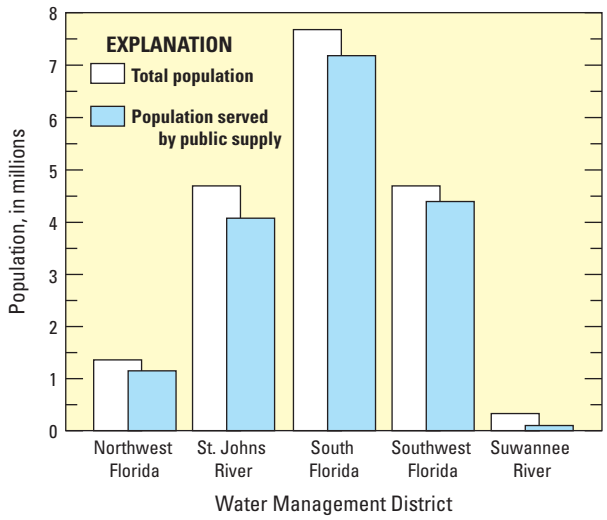


Figure 20. Total population and population served by public supply in Florida by water management district, 2010.

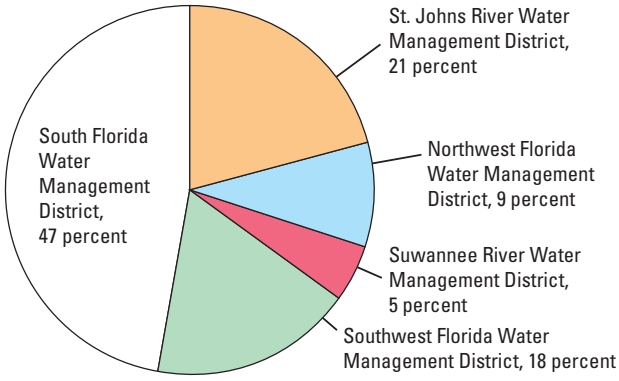


Figure 21. Freshwater withdrawals in Florida by water management district, 2010.

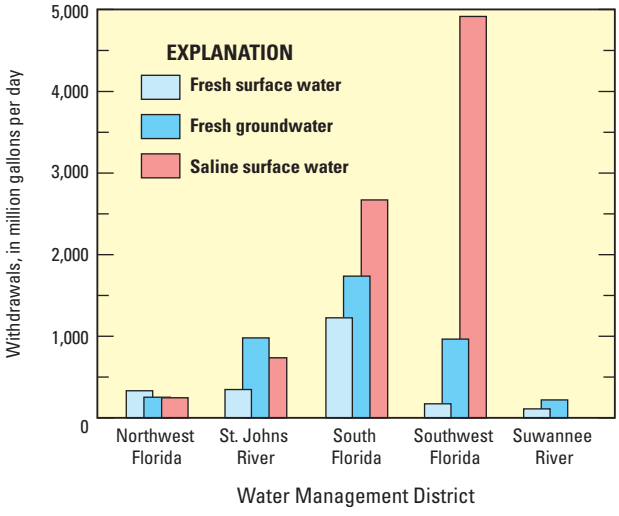


Figure 22. Freshwater and saline-water withdrawals in Florida by water management district, 2010.

Table 10. Power generation water withdrawals in Florida by county, 2010.

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Groundwater			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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bay	1.26	0.00	1.26	0.00	246.06	246.06	1.26	246.06	247.32
Bradford	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brevard	0.05	0.00	0.05	0.00	142.01	142.01	0.05	142.01	142.06
Broward	0.00	0.00	0.00	0.00	1,005.82	1,005.82	0.00	1,005.82	1,005.82
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	3.09	0.00	3.09	0.00	1,167.39	1,167.39	3.09	1,167.39	1,170.48
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	6.97	0.00	6.97	0.00	598.60	598.60	6.97	598.60	605.57
Escambia	2.21	0.00	2.21	209.52	0.00	209.52	211.73	0.00	211.73
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	2.87	0.00	2.87	0.00	0.00	0.00	2.87	0.00	2.87
Hendry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hernando	0.65	0.00	0.65	0.00	0.00	0.00	0.65	0.00	0.65
Highlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hillsborough	0.00	0.00	0.00	0.00	1,698.35	1,698.35	0.00	1,698.35	1,698.35
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	11.97	11.97	0.00	11.97	11.97
Jackson	0.28	0.00	0.28	40.67	0.00	40.67	40.95	0.00	40.95
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	0.74	0.00	0.74	0.00	0.00	0.00	0.74	0.00	0.74

Table 10. Power generation water withdrawals in Florida by county, 2010.—Continued

[Source: U.S. Geological Survey Florida Water Science Center (http://fl.water.usgs.gov/). All values in million gallons per day]

County	Groundwater			Surface water			Total water		
	Fresh	Saline	Total	Fresh	Saline	Total	Fresh	Saline	Total
Lee	0.65	0.00	0.65	0.00	560.62	560.62	0.65	560.62	561.27
Leon	1.70	0.00	1.70	0.00	0.00	0.00	1.70	0.00	1.70
Levy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Liberty	0.57	0.00	0.57	0.00	0.00	0.00	0.57	0.00	0.57
Madison	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Manatee	0.01	0.00	0.01	3.01	0.00	3.01	3.02	0.00	3.02
Marion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Martin	0.12	0.00	0.12	26.32	0.00	26.32	26.44	0.00	26.44
Miami-Dade	1.52	4.98	6.50	0.00	0.00	0.00	1.52	4.98	6.50
Monroe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.44	0.00	0.44	0.00	0.00	0.00	0.44	0.00	0.44
Osceola	0.09	0.00	0.09	0.00	0.00	0.00	0.09	0.00	0.09
Palm Beach	5.70	0.00	5.70	2.18	0.00	2.18	7.88	0.00	7.88
Pasco	0.38	0.00	0.38	0.00	1,563.67	1,563.67	0.38	1,563.67	1,564.05
Pinellas	0.00	0.00	0.00	0.00	472.46	472.46	0.00	472.46	472.46
Polk	10.58	0.00	10.58	43.09	0.00	43.09	53.67	0.00	53.67
Putnam	0.62	0.00	0.62	17.49	0.00	17.49	18.11	0.00	18.11
St. Johns	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
St. Lucie	0.00	1.56	1.56	0.00	1,098.57	1,098.57	0.00	1,100.13	1,100.13
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	0.15	0.00	0.15	108.06	0.00	108.06	108.21	0.00	108.21
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	0.33	0.00	0.33	119.11	0.00	119.11	119.44	0.00	119.44
Wakulla	0.00	0.00	0.00	0.26	0.00	0.26	0.26	0.00	0.26
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	43.48	6.54	50.02	569.71	8,565.52	9,135.23	613.19	8,572.06	9,185.25

Table 11. Water withdrawals by category in Florida by water management district, 2010.

[Sources: U.S. Geological Survey, Florida Water Science Center (http://fl.water.usgs.gov/), St. Johns River Water Management District (2011), and Southwest Florida Water Management District (2012). All values in million gallons per day. District totals may not be identical to data reported or published by the water management districts because of 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]

Category	Fresh ground	Fresh surface	Total freshwater	Total saline water	Total all water
Northwest Florida Water Management District					
Public supply	136.13	48.45	184.58	0.00	184.58
Domestic self-supplied	18.34	0.00	18.34	0.00	18.34
Commercial-industrial-mining self-supplied	39.90	22.53	62.43	0.00	62.43
Agricultural self-supplied	39.81	7.41	47.22	0.00	47.22
Recreational-landscape irrigation	13.65	3.63	17.28	0.00	17.28
Power generation	6.02	250.45	256.47	246.06	502.53
Totals	253.85	332.47	586.32	246.06	832.38
St. Johns River Water Management District					
Public supply	523.90	14.34	538.24	0.00	538.24
Domestic self-supplied	67.76	0.00	67.76	0.00	67.76
Commercial-industrial-mining self-supplied	70.48	26.14	96.62	0.00	96.62
Agricultural self-supplied	285.61	128.11	413.72	0.00	413.72
Recreational-landscape irrigation	21.74	41.97	63.71	0.00	63.71
Power generation	9.48	136.60	146.08	752.58	898.66
Totals	978.97	347.16	1,326.13	752.58	2,078.71
South Florida Water Management District					
Public supply	1,023.94	37.85	1,061.79	0.00	1,061.79
Domestic self-supplied	40.83	0.00	40.83	0.00	40.83
Commercial-industrial-mining self-supplied	49.89	28.82	78.71	0.00	78.71
Agricultural self-supplied	529.72	981.49	1,511.21	0.00	1,511.21
Recreational-landscape irrigation	97.12	151.49	248.61	0.00	248.61
Power generation	8.08	28.50	36.58	2,671.55	2,708.13
Totals	1,749.58	1,228.15	2,977.73	2,671.55	5,649.28
Southwest Florida Water Management District					
Public supply	313.13	138.04	451.17	16.97	468.14
Domestic self-supplied	68.09	0.00	68.09	0.00	68.09
Commercial-industrial-mining self-supplied	63.79	6.19	69.98	0.00	69.98
Agricultural self-supplied	447.82	18.94	466.76	0.00	466.76
Recreational-landscape irrigation	54.78	6.10	60.88	0.00	60.88
Power generation	17.58	46.10	63.68	4,901.87	4,965.55
Totals	965.19	215.37	1,180.56	4,918.84	6,099.40
Suwannee River Water Management District					
Public supply	15.07	0.00	15.07	0.00	15.07
Domestic self-supplied	18.82	0.00	18.82	0.00	18.82
Commercial-industrial-mining self-supplied	70.61	0.00	70.61	0.00	70.61
Agricultural self-supplied	110.95	1.24	112.19	0.00	112.19
Recreational-landscape irrigation	1.09	0.36	1.45	0.00	1.45
Power generation	2.32	108.06	110.38	0.00	110.38
Totals	218.86	109.66	328.52	0.00	328.52
State totals	4,166.45	2,232.81	6,399.26	8,589.03	14,988.29

Since water-use data were first compiled by the WMDs in 1975, freshwater withdrawals in the SFWMD (excluding those for power generation) have changed more than in any other WMD (fig. 23). Freshwater withdrawals in the SJRWMD, SFWMD, and SWFWMD (excluding those for power generation) peaked in 2000, primarily as a result of extreme dry conditions for the year, whereas withdrawals in the NWFWMD and the SRWMD remained fairly constant (fig. 23). Total freshwater withdrawals (excluding those for power generation) have generally declined in all five WMDs since 2000, and freshwater withdrawals for 2010 are nearly the same as they were in 1975, except in the SFWMD (fig. 23). Data aggregated by water-use category, however, indicate substantial changes in water withdrawal trends for all five WMDs during this period (fig. 24). For the SJRWMD, SFWMD, and SWFWMD, agricultural self-supplied withdrawals were the largest water withdrawal category in 1975; however, by 2010 public-supply withdrawals were either similar to agricultural self-supplied withdrawals or had surpassed them (fig. 24). Between 1975 and 2010, agricultural self-supplied and commercial-industrial-mining self-supplied withdrawals declined in the SJRWMD, SFWMD, and SWFWMD, even though intervals of high agricultural self-supplied withdrawals did occur during the period, and the population increased within these three WMDs. During the 35-year period between 1975 and 2010, the population in the SFWMD increased by more than 4.3 million and the population in the SJRWMD and the SWFWMD increased by more than 2.6 million each. For the NWFWMD and SRWMD, commercial-industrial-mining self-supplied was the largest water withdrawal category in 1975. By 2010, however, the largest water-use categories were public-supply in the NWFWMD and agricultural self-supplied in the SRWMD (fig. 24).

Another noticeable trend within the WMDs is the steady decrease in the public-supply gross per capita use. All five WMDs worked with the public suppliers within their jurisdiction to promote water conservation during the latter part of the 1990s through 2010. Conservation, coupled with permitting constraints and water shortage mandates, has resulted in a substantial decrease in the public-supply gross per capita use in all five WMDs since 2000 (fig. 25). In 2010, the NWFWMD had the highest public-supply gross per capita use and the SWFWMD had the lowest. The NWFWMD gross per capita use includes a large industrial user, however, that obtains its water from a public supplier, inflating the value by about 15-20 gal/d for this WMD. This inflated value for the NWFWMD dates back to 1995. In addition, the NWFWMD receives a large influx of visitors (relative to the total resident population in the WMD) during the summer months in coastal communities that also inflates the public-supply gross per capita use (Marella and others, 1995).

Water Withdrawal and Use Trends, 1950–2010

Statewide water-withdrawal and water-use estimates have been compiled for Florida every 5 years since 1950; however, trends in historical water-use values are sometimes difficult to assess because of differences in data-collection techniques and methods and changing sources of information through the years (Marella, 2004, 2009). Since 1970, statewide water-use data for all withdrawal categories have been collected, tabulated, and published nine times at 5-year intervals by many agencies (the five WMDs, Florida Geological Survey, FDEP, and USGS). When water-use data are only compiled at 5-year intervals, any unique circumstance occurring within a single year can substantially affect the values for a 5-year interval, and therefore, caution should be used when comparing data. For example, water withdrawals for 2000 were very large, primarily because of extremely dry conditions that led to higher irrigation demands for agricultural self-supplied use, recreational-landscape irrigation, and public supply (primarily from residential lawn watering) (fig. 26).

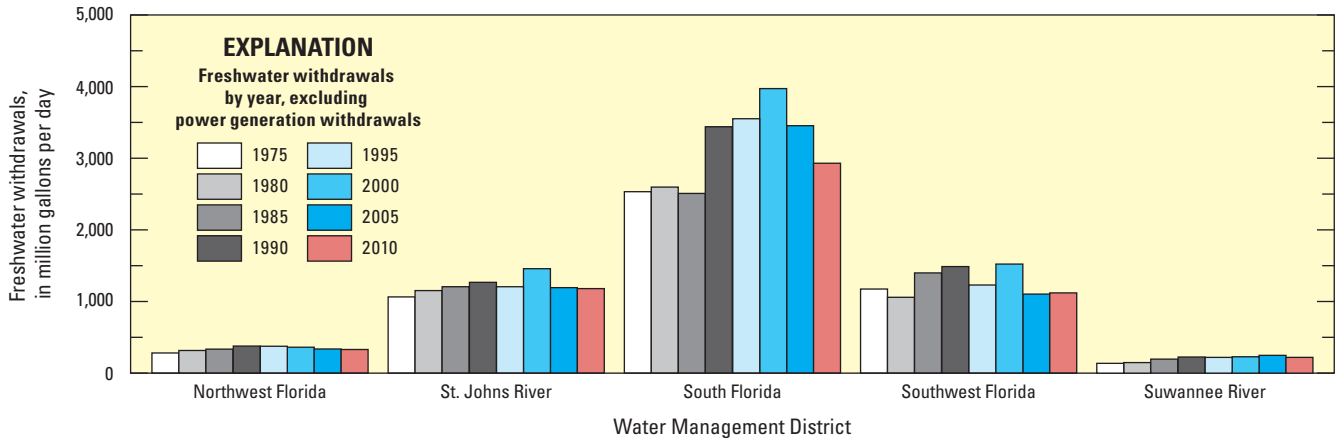


Figure 23. Historical freshwater withdrawals (excluding power generation) in Florida by water management district, 1975–2010. Modified from Marella (2009).

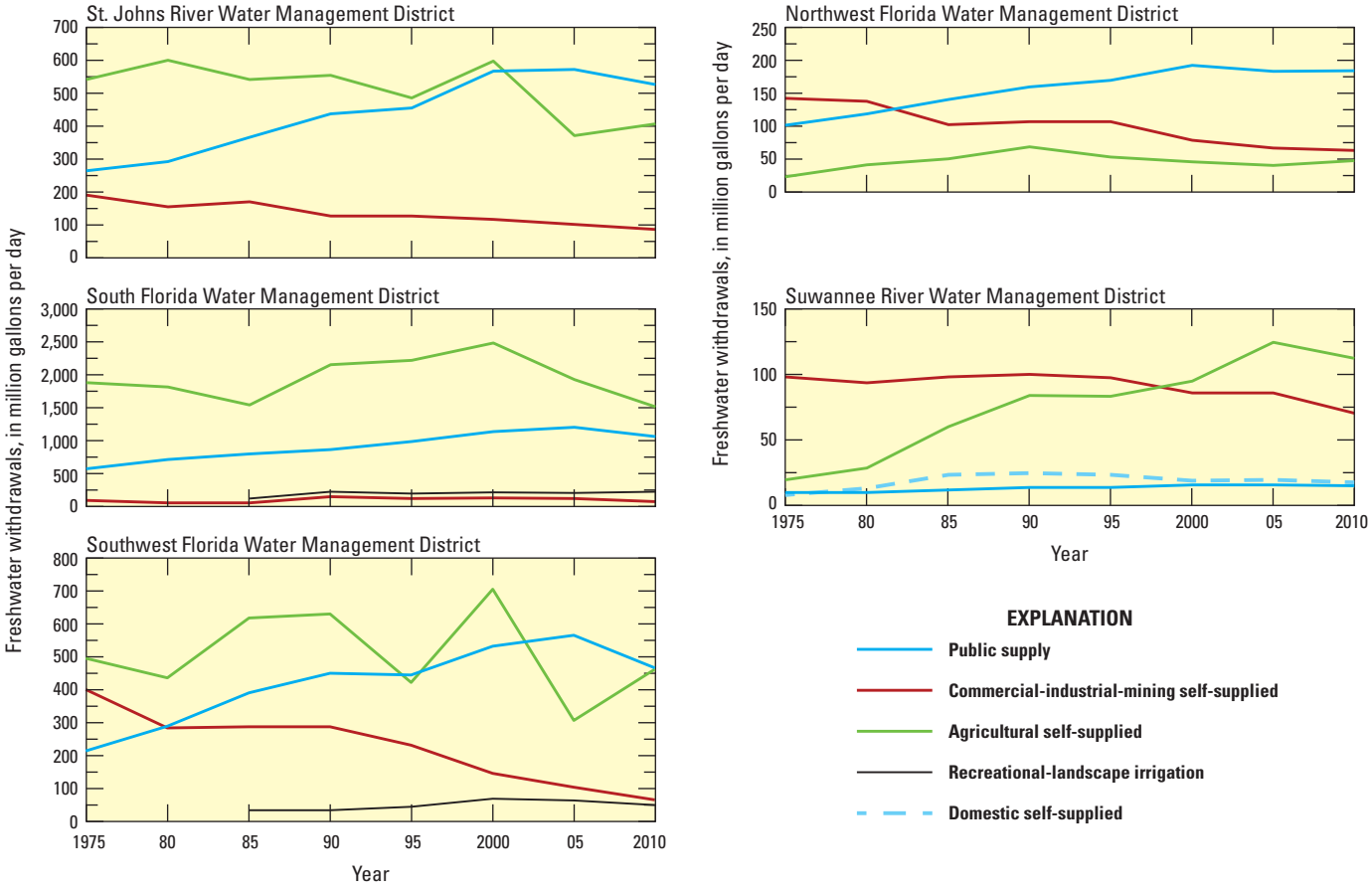


Figure 24. Historical freshwater withdrawals by water-use category in Florida by water management district, 1975–2010. Modified from Marella (2009).

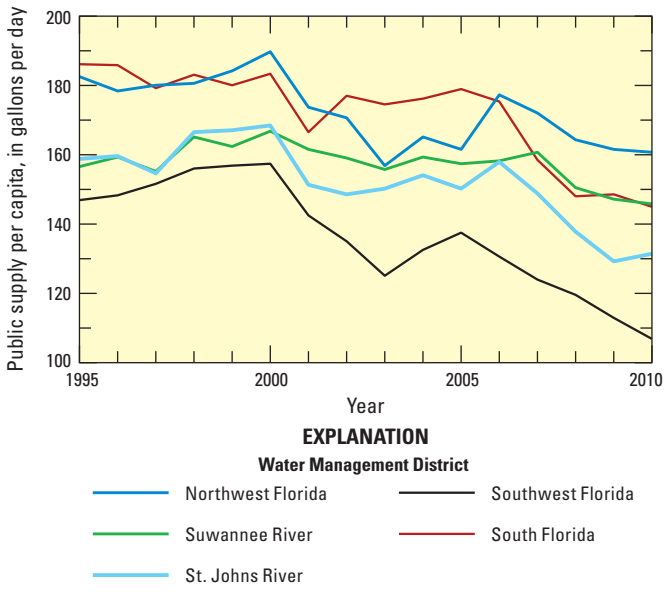


Figure 25. Historical public-supply gross per capita water use in Florida by water management district, 1975–2010. Modified from Marella (2009).

The large withdrawals in 2000 resulted in a trend between 1995 and 2000 that, in effect, shows a large increase in water withdrawals. Under normal rainfall conditions, water withdrawals might have changed very little between these years. To further illustrate the limitations of 5-year data trends, when data for 5-year intervals are compared to annual data, such as for public-supply withdrawals (for which estimates of annual statewide totals are available from 1985 to 2010), it is evident that not all of the unusually high or low public-supply withdrawals occurred at 5-year intervals (fig. 27). Therefore, trends based solely on 5-year intervals could be misleading. Overall, it would be difficult to determine if the general decreasing trend between 2005 and 2010 is likely to continue because this period is more likely influenced by many factors (economic, weather, management and conservation, better methodologies and techniques used to estimate withdrawals, among others). In contrast, the notably large public-supply withdrawal that occurred in 2000 was predominantly attributable to one factor (low rainfall totals).

Combined fresh and saline water withdrawals increased by 12,334 Mgal/d (465 percent) between 1950 and 2010, while the population of Florida increased by 16.03 million (580 percent) during this 60-year period (fig. 28 and table 12).

Total freshwater withdrawals decreased by 1,792 Mgal/d (22 percent) between 2000 and 2010, while the population increased by 2.82 million (18 percent), and total freshwater withdrawals decreased by 474 Mgal/d (7 percent) between 2005 and 2010, while the population increased by 0.88 million (8 percent) (fig. 28). Total saline water withdrawals decreased by nearly 3,367 Mgal/d (28 percent) between 2000 and 2010, and by nearly 2,897 Mgal/d (25 percent) between 2005 and 2010.

Overall, saline-water withdrawals, which were nearly all for power generation, were highest in 1977 (table 12) and 1980 (fig. 28). Since the late 1970s and early 1980s, the power industry in Florida has built more efficient facilities or repowered existing facilities that produce more power and use less water. More recently, the gross power generated in Florida increased by 35,000 GWh (21 percent) between 2000 and 2010, despite a decrease in water withdrawals of 28 percent during this time.

Freshwater withdrawals remained nearly the same for 1975, 1980, and 1985, increasing in 1990, peaking in 2000, and decreasing in 2005 and 2010 (fig. 28 and table 12). Total freshwater withdrawals for 2000 were 1,419 Mgal/d (21 percent) higher than those in 1975, while values for 2010 were 1,792 Mgal/d (22 percent) lower than those in 2000. In 1975, agricultural self-supplied accounted for 43 percent of the total freshwater withdrawals, followed by power generation (24 percent) and public supply (17 percent). By 2000, agricultural self-supplied represented 47 percent of the total freshwater withdrawals followed by public supply at 29 percent, and by 2010 agricultural self-supplied represented 40 percent and public supply 35 percent (fig. 4). Over the 35-year period between 1975 and 2010, increases in freshwater withdrawals due to large gains in population and irrigated acreage were offset by decreases in power generation and commercial-industrial-mining self-supplied withdrawals. Over the past 10 years (2000-10), water conservation measures, the development and use of alternative water sources, water management constraints and mandates, and changes in economic conditions coupled with higher rainfall totals and losses of irrigated acreage caused by storms and diseases have helped offset freshwater needed for the State's increases in population and tourism.

Fresh groundwater withdrawals increased relatively steadily between 1950 and 2000 and declined thereafter (fig. 29 and table 13). This long-term overall trend in groundwater withdrawals is a result of many factors, the most prominent being the availability of large quantities of high-quality freshwater underlying most areas of the State, coupled with the ability to pump large volumes of water economically from deep wells. In addition, increases in demand posed by population growth, tourism, and crop irrigation have increased the importance of groundwater use during the past 60 years. Groundwater has been the primary source of freshwater in Florida since 1980 (fig. 29), supplying about 60 percent of the total freshwater withdrawals between 1980 and 2010.

Fresh surface-water withdrawals increased substantially between 1950 and 1975, peaking in 1965; more recently, they declined between 2000 and 2010 (fig. 29 and table 13). The early increasing trend in fresh surface-water withdrawals was caused by an increase in power generation during the 1950s and 1960s when many facilities were built. In addition, the draining of land for crop production in southern Florida through a series of canals, levees, and pump stations built between the 1950s and 1960s made surface water available

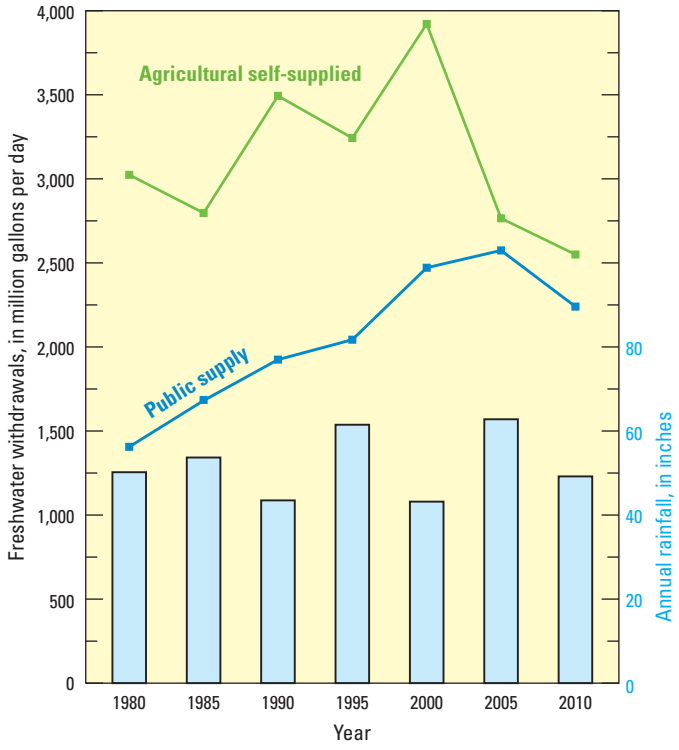


Figure 26. Freshwater withdrawals for agricultural self-supplied and public supply with statewide average annual rainfall in Florida, 1980–2010. Modified from Marella (2009) and Florida State University (2013).

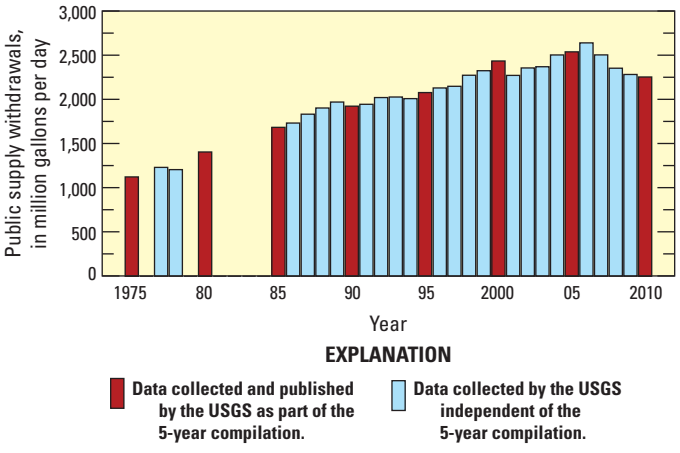


Figure 27. Historical public-supply annual withdrawals in Florida, 1975–2010. Modified from Marella (2009).

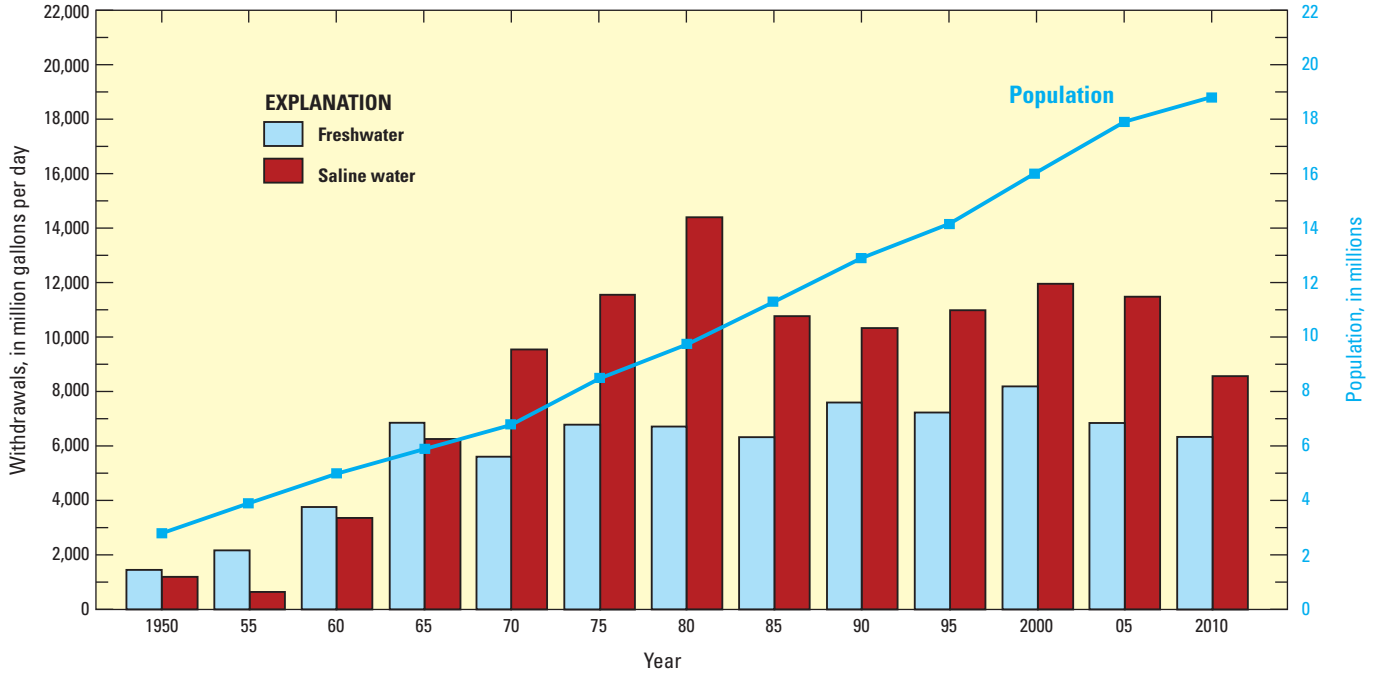


Figure 28. Historical total population, freshwater, and saline-water withdrawals in Florida, 1950–2010. Modified from Dietrich (1978), Marella (2009), and University of Florida (2011).

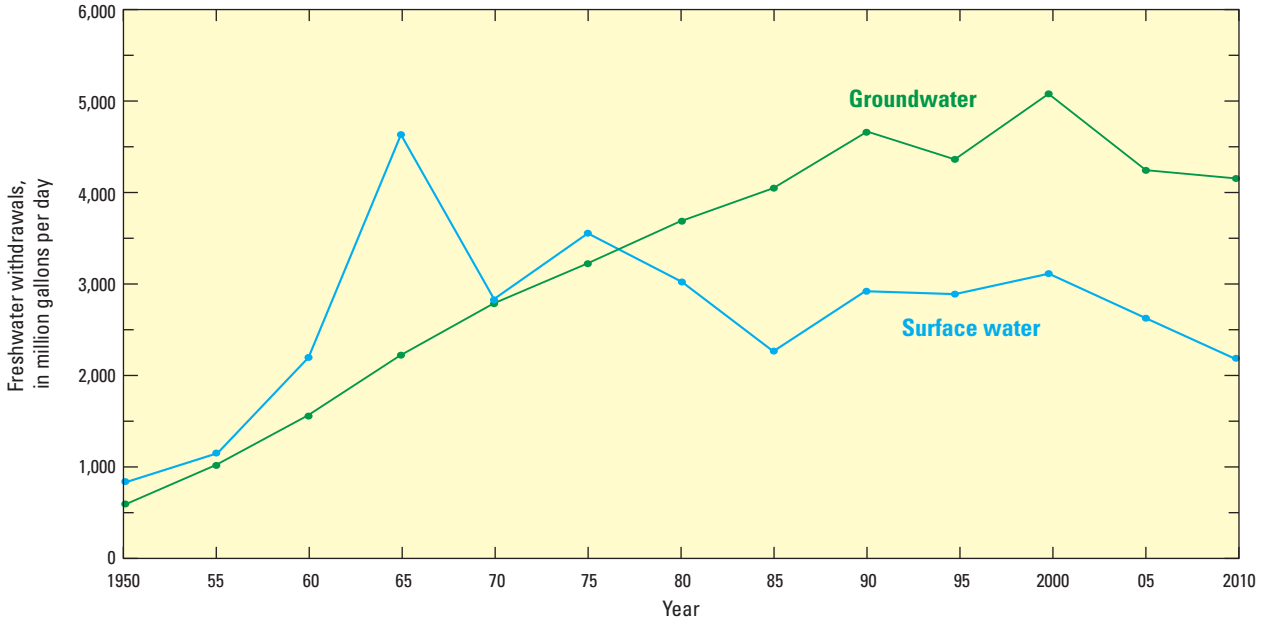


Figure 29. Historical freshwater withdrawals in Florida by source, 1950–2010. Modified from Marella (2009).

Table 12. Historical population and water withdrawals by water source in Florida, 1950–2010.

[Source: U.S. Geological Survey, Florida Water Science Center (http://fl.water.usgs.gov/). Water values in million gallons per day; N/A, data not available]

Year	Population, in millions		Water withdrawals, in million gallons per day					Treated	
			Freshwater			Saline-water total	Total water	Nonpotable water[a]	Reclaimed wastewater[b]
	Total	Public supply	Ground	Surface	Total				
1950[c]	2.77	1.66	614.0	840.0	1,454.0	1,200.0	2,654.0	—	—
1955	3.86	2.30	1,017.0	1,150.0	2,167.0	645.0	2,812.0	—	—
1960	4.95	3.37	1,560.0	2,200.0	3,760.0	3,360.0	7,120.0	—	—
1965	5.87	4.81	2,218.5	4,633.5	6,852.0	6,261.0	13,113.0	—	—
1970	6.79	5.42	2,786.7	2,825.6	5,612.3	9,545.0	15,157.3	1.6	N/A
1975	8.48	6.81	3,214.6	3,558.1	6,772.7	11,502.0	18,274.7	1.7	N/A
1977	8.72	6.99	3,429.5	3,116.8	6,546.3	14,812.0	21,358.3	1.2	N/A
1980	9.75	7.79	3,677.2	3,024.0	6,701.2	13,897.0	20,598.2	2.5	N/A
1985	11.32	9.74	4,047.7	2,265.7	6,313.4	10,798.3	17,111.7	17.3	206.0
1990	12.94	11.23	4,664.7	2,918.9	7,583.6	10,366.1	17,949.7	47.9	266.0
1995	14.15	12.21	4,348.8	2,881.1	7,229.9	10,965.7	18,195.6	57.9	402.0
2000	15.98	14.03	5,078.7	3,113.1	8,191.8	11,955.8	20,147.6	95.3	575.0
2005	17.92	16.13	4,247.3	2,625.8	6,873.1	11,485.6	18,358.7	141.7	659.7
2010	18.80	16.89	4,166.5	2,232.8	6,399.3	8,589.0	14,988.3	164.6	658.5

[a] Treated nonpotable water includes water treated through desalination or diluted with fresher water to meet secondary drinking water standards (Florida Department of Environmental Regulation, 1990)

[b] Reclaimed wastewater includes all water reported by Florida Department of Environmental Protection as all types of reuse. Values shown for 1985 are reported for 1986 and shown for 1995 are reported for 1996 (Florida Department of Environmental Protection, 2011a).

Data sources; Population
- 1950–1970: University of Florida (Dietrich, 1978).
- 1975–2010: United States Statistical Abstract (U.S. Census Bureau, 2011a).

Data sources; 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).
- 2000: USGS Scientific Investigations Report 2004-5151 (Marella, 2004).
- 2005: USGS Scientific Investigations Report 2009-5125 (Marella, 2009).

Data sources; Reclaimed water
- 1985–2010: Florida Reuse Inventory (Florida Department of Environmental Protection, 2011a)

[c] Data for 1950 did not show fresh or saline totals (values shown are estimated).

Table 13. Historical freshwater withdrawals in Florida by category, 1970–2010.

[Data sources:1970–2005: Marella (2009); 2006–2009: compiled by the USGS, Florida Water Science Center, Orlando, Florida (http://fl.water.usgs.gov/) from published and unpublished data provided by the water management districts and Florida Department of Environmental Protection. All values in million gallons per day. —, no data or partial data were available; N/A, totals not available]

Year	Public supply			Domestic self-supplied[c]		Commercial-industrial-mining		Agricultural self-supplied[d]		Recreational-landscape irrigation[e]		Power generation		Total freshwater withdrawn		
	Ground	Surface[a]	Treated nonpotable[b]	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Totals
1970	753.10	130.30	1.6	209.20	0.00	683.60	215.90	1,136.35	964.35	0.00	0.00	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	0.00	0.00	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	0.00	0.00	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	0.00	0.00	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	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	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

Table 13. Historical freshwater withdrawals in Florida by category, 1970–2010.—Continued

[Data sources:1970–2005: Marella (2009); 2006–2009: compiled by the USGS, Florida Water Science Center, Orlando, Florida (http://fl.water.usgs.gov/) from published and unpublished data provided by the water management districts and Florida Department of Environmental Protection. All values in million gallons per day. —, no data or partial data were available; N/A, totals not available]

Year	Public supply			Domestic self-supplied[c]		Commercial-industrial-mining		Agricultural self-supplied[d]		Recreational-landscape irrigation[e]		Power generation		Total freshwater withdrawn		
	Ground	Surface[a]	Treated nonpotable[b]	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Totals
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
2001	2,047.31	226.38	99.4	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2002	2,109.54	248.50	105.6	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2003	2,095.34	276.37	113.9	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2004	2,185.78	319.47	135.0	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2005	2,201.26	339.26	141.7	190.38	0.00	365.56	122.77	1,301.57	1,464.61	171.03	158.61	17.56	540.52	4,247.36	2,625.77	6,873.13
2006	2,405.48	236.46	N/A	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2007	2,263.49	242.38	N/A	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2008	2,127.90	232.65	N/A	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2009	2,090.15	205.05	N/A	—	—	—	—	—	—	—	—	—	—	N/A	N/A	N/A
2010	2,012.17	255.65	164.6	213.84	0.00	294.67	83.68	1,413.91	1,137.19	188.38	203.55	43.48	569.71	4,166.45	2,249.78	6,416.23

[a]Beginning in 2006, public supply and total fresh surface water withdrawals include saline surface water withdrawals used for public supply desalination. For 2010, a total of 16.97 Mgal/d of saline surface water was withdrawn for this purpose.

[b]Public supply treated nonpotable water includes brackish water treated through a desalination process or diluted with fresher water to meet public drinking water standards.

[c]The estimation procedure for domestic self-supplied withdrawals changed after 1995 as the domestic per capita was used to calculate withdrawals compared to previous years when the public supply gross per capita was used.

[d]Agricultural self-supplied includes water withdrawn for crop irrigation, livestock, and fish farming purposes.

[e]Recreational-landscape irrigation includes water used for all turf grass (golf, commercial, industrial, and public) purposes. This category was accounted for under Agricultural self-supplied from 1965 through 1984.

to irrigate thousands of acres of vegetables and sugarcane (Renken and others, 2005). Overall, demands for both fresh groundwater and surface-water withdrawals have declined because of changes in economic conditions, water conservation and management, and the use of reclaimed wastewater.

Freshwater withdrawals for public supply, agricultural self-supplied use, and commercial-industrial-mining self-supplied use all decreased between 2000 and 2010, and 2005 and 2010 (fig. 30 and table 13), whereas freshwater withdrawals for domestic self-supplied use, recreational-landscape irrigation, and power generation either remained the same or changed only slightly (fig. 30 and table 13). As described previously, withdrawals for public supply, agricultural self-supplied use, and commercial-industrial-mining self-supplied use decreased because of economic conditions and technological changes, acts of nature (such as storms, disease, and drought), and improved water conservation and management practices. In addition, withdrawals or deliveries from alternative water sources increased between 2000 and 2010. The use of reclaimed wastewater increased from 575 Mgal/d in 2000 to nearly 659 Mgal/d in 2010 (Florida Department of Environmental Protection, 2006, 2011a). Nearly 520 Mgal/d (79 percent) of the reclaimed wastewater flow in 2010 was used to reduce potable-quality water withdrawals for urban irrigation (such as for golf courses, parks, schools, and residential lawns), agricultural irrigation, and industrial use, while the remaining 139 Mgal/d of reclaimed wastewater was returned to the hydrologic system as aquifer recharge (14 percent) and through wetland discharge (7 percent) (Florida Department of Environmental Protection, 2011a). Increases in the use and value of reclaimed wastewater are expected to continue statewide. Additionally, the use of private irrigation wells is widespread throughout Florida, and it is believed that the number of wells constructed for this purpose increased substantially from 2000 to 2010. The number of private irrigation wells statewide, or for any given county, is not readily available or easily determined, nor has any attempt been made to estimate how much water is withdrawn by these water users. Other alternative sources of water include aquifer storage and recovery systems, whereby water suppliers inject and store excess surface water that becomes available during the wet season into a deep aquifer and then recover it during the dry season (if needed) to help offset peak demands (Reese, 2006).

Many factors that affect water demands in Florida are detailed in this report (economic, regulatory, land use, population, weather, among others); many other factors not mentioned (socioeconomic factors, international trade, commodity and fuel prices, climate change, among others) may also affect water demands within a given period or geographical area. Because it is difficult to determine or measure the direct effect of any single factor, it is assumed that these factors have a cumulative effect on current and historical water use in Florida and that their influence will continue to vary from year to year.

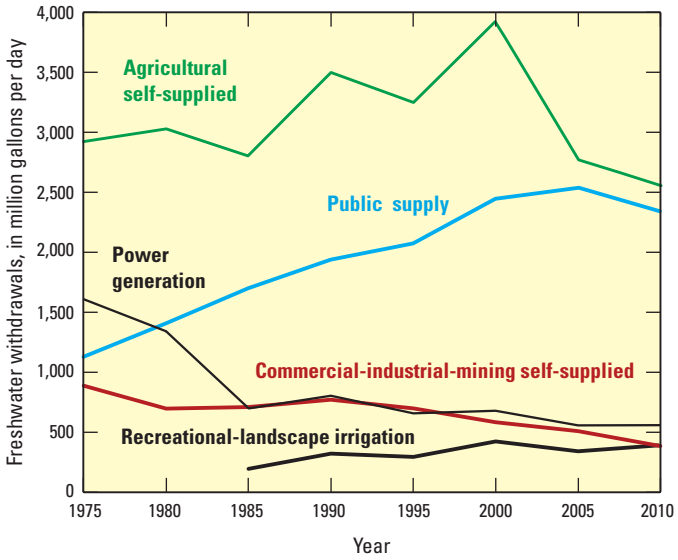


Figure 30. Historical freshwater withdrawals in Florida by selected water-use category, 1975–2010. Modified from Marella (2009).

Selected References

American Water Works Association, 1992, Water industry data base—Utility profiles: Denver, Co., American Water Works Association, 80 p.

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

Buros, O.K., 1989, Desalting practices in the United States: American Water Works Association Journal, v. 81, no. 11, p. 38–42.

Campbell, K.M., 1986, The industrial minerals of Florida: Tallahassee, Fla., Florida Bureau of Geology Information Circular 102, 94 p.

Davis, W.Y., Rodrigo, D.M., Opitz, E.M., and others, 1988, IWR-Main water use forecasting system, version 5.1—User's manual and system description: Fort Belvoir, Va., U.S. Army Corps of Engineers, Institute for Water Resources, IWR-Main Report 88–R–6, 273 p.

Diehl, T.H., Harris, M.A., Murphy, J.C., Hutson, S.S., and Ladd, D.E., 2013, Methods for estimating water consumption for thermoelectric power plants in the United States: Reston, Va., U.S. Geological Survey, Scientific Investigations Report 2013–5188, 78 p.

Dietrich, T.S., 1978, The urbanization of Florida's population—An historical perspective of county growth 1830–1970: Gainesville, Fla., University of Florida, College of Business Administration, Bureau of Economic and Business Research, 211 p.

Dykes, G.M., and Conlon, W.J., 1989, Use of membrane technology in Florida: American Water Works Association Journal, v. 81, no. 11, p. 43–46.

Fernald, E.A., and Patton, D.J., eds., 1984, Water resource atlas of Florida: Tallahassee, Fla., Florida State University, Institute of Science and Public Affairs, 291 p.

Fernald, E.A., and Purdum, E.D., eds., 1992, Atlas of Florida: Tallahassee, Fla., Florida State University, Institute of Science and Public Affairs, 280 p.

Fernald, E.A., and Purdum, E.D., eds., 1998, Water resource atlas of Florida: Tallahassee, Fla., Florida State University, Institute of Science and Public Affairs, 312 p.

Florida Department of Agriculture and Consumer Services, 2012, Florida Agriculture by the numbers 2012: Tallahassee, Fla., Division of Marketing and Development, October 2012, DACS–P–01304, 163 p.

Florida Department of Environmental Protection, 2006, 2005 Reuse inventory: Tallahassee, Fla., Florida Department of Environmental Protection, Water Reuse Program, 21 p.

Florida Department of Environmental Protection, 2011a, 2010 Reuse inventory: Tallahassee, Fla., Florida Department of Environmental Protection, Water Reuse Program, May 2011, 24 p.

Florida Department of Environmental Protection, 2011b, 2010 Annual report on violations of the U.S. Safe Drinking Water Act in the State of Florida: Tallahassee, Fla., Florida Department of Environmental Protection, Drinking Water Program, 11 p.

Florida Department of Environmental Regulation, 1990, Drinking water standards, monitoring, and reporting: Tallahassee, Fla., chap. 17–550, 48 p.

Florida Department of Environmental Regulation, 1991, Domestic wastewater facilities: Tallahassee, Fla., chap. 17–600, 70 p.

Florida State University, 2013, Florida statewide averaged precipitation data: Tallahassee, Fla., Florida Climate Center, Office of the State Climatologist, accessed April 2, 2013, at http://climatecenter.fsu.edu/products-services/data/statewide-averages/precipitation.

Friedman, K.R., and Heaney, J.P., 2009, Water loss management—Conservation option in Florida's urban water systems: Florida Water Resources Journal, August 2009, p. 24–32.

The Gale Group, 2013, Industrial report: Farmington Hills, Mi., The Gale Group Inc., accessed May 2013 at http://business.highbeam.com/industry-reports/mining/water-well-drilling.

Golf Course Superintendents Association of America, 2009, Golf course environmental profile—Volume II, Water use and conservation practices on U.S. Golf Courses: The Environmental Institute for Golf and Toro Foundation, 49 p.

Hughes, G.H., 1975, Perspective on use of freshwater for cooling systems of thermoelectric power plants in Florida: U.S. Geological Survey Water-Resources Investigations 43–75, 30 p.

Hutson, S.S., 2007, Guidelines for preparation of State water-use estimates for 2005: U.S. Geological Survey Techniques and Methods, book 4, chap. E1, 28 p.

Hutson, S.S., Barber, N.L., Kenny, J.F., and others, 2004, Estimated use of water in the United States in 2000: Reston, Va., U.S. Geological Survey Circular 1268, 46 p.

Izuno, F.T., and Haman, D.Z., 1987, Basic irrigation terminology: Gainesville, Fla., University of Florida, Institute of Food and Agricultural Sciences, Agricultural Engineering Fact Sheet AE–66, 4 p.

Kenny, J.F., Barber, N.L., Hutson, S.S., Linsey, K.S., Lovelace, J.K., and Maupin, M.A., 2009, Estimated use of water in the United States in 2005: Reston, Va., U.S. Geological Survey Circular 1344, 52 p.

Knochenmus, L.A., and Swenson, E.S., 1996, Assessment of the fresh- and brackish-water resources underlying Dunedin and adjacent areas of northern Pinellas County, Florida, 1996: U.S. Geological Survey Water-Resources Investigations Report 96–4164, 47 p.

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

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

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

Lovelace, J.K., 2009a, Method for estimating water withdrawals for livestock in the United States, 2005: U.S. Geological Survey Scientific Investigations Report 2009–5041, 7 p.

Lovelace, J.K., 2009b, Methods of estimating water withdrawals for aquaculture in the United States, 2005: U.S. Geological Survey Scientific Investigations Report 2009–5042, 13 p.

MacKichan, K.A., 1951, Estimated use of water in the United States, 1950: U.S. Geological Survey Circular 115, 13 p.

MacKichan, K.A., 1957, Estimated use of water in the United States, 1955: U.S. Geological Survey Circular 398, 18 p.

MacKichan, K.A., and Kammerer, J.C., 1961, Estimated use of water in the United States, 1960: U.S. Geological Survey Circular 456, 44 p.

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

Marella, R.L., 1992, Water withdrawals, use, and trends in Florida, 1990: U.S. Geological Survey Water-Resources Investigations Report 92–4140, 38 p.

Marella, R.L., 1994, Estimated discharge of treated wastewater in Florida, 1990: U.S. Geological Survey Open-File Report 93–364, 53 p.

Marella, R.L., 1997, Irrigated crop acreage and water withdrawals in Florida, 1990: Florida Department of Environmental Protection, Tallahassee, Fla., Florida Geological Survey Map Series 143, 1 sheet.

Marella, R.L., 1999, Water withdrawals, use, discharge, and tends in Florida, 1995: U.S. Geological Survey Water-Resources Investigations Report 99–4002, 90 p.

Marella, R.L., 2004, Water withdrawals, use, discharge, and trends in Florida, 2000: U.S. Geological Survey Scientific Investigations-Report 2004–5151, 136 p.

Marella, R.L., 2009, Water withdrawals, use, and trends in Florida, 2005: U.S. Geological Survey, Scientific Investigations-Report 2009–5125, 50 p.

Marella, R.L., Mokray, M.M., and Hallock-Solomon, M., 1998, Water use trends and demand projections in the Northwest Florida Water Management District: U.S. Geological Survey Open-File Report 98–269, 35 p.

McPherson, B.F., and Hammett, K.M., 1991, Tidal rivers of Florida, *in* Livingston, R.J., ed., The rivers of Florida: New York, Springer-Verlag, Ecological Studies, v. 83, p. 31–46.

Miller, J.A., 1990, Ground water atlas of the United States—Segment 6, Alabama, Florida, Georgia, and South Carolina: U.S. Geological Survey Hydrologic Investigation Atlas 730–G, 28 p.

Mulkey, David, and Clouser, R.L., 1990, Agriculture (Chapter 7): Denslow, D.A., Pierce, A.C., and Shermyen, A.H., The economy of Florida: Gainesville, Fla., University of Florida, Bureau of Economic and Business Research, p. 129-151.

Murray, C.R., 1968, Estimated use of water in the United States, 1965: U.S. Geological Survey Circular 556, 53 p.

Murray, C.R., and Reeves, E.B., 1972, Estimated use of water in the United States, 1970: U.S. Geological Survey Circular 676, 37 p.

Murray, C.R., and Reeves, E.B., 1977, Estimated use of water in the United States, 1975: U.S. Geological Survey Circular 765, 37 p.

National Golf Foundation, 2006, Golf course directory—2006 edition: Jupiter, Fla., v. I, Alabama-Idaho, 414 p.

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

Pride, R.W., 1975, Estimated water use in Florida, 1965 (2d ed.): Tallahassee, Fla., Florida Bureau of Geology Map Series 36, 1 sheet.

Renken, R.A., 1998, Ground water atlas of the United States—Segment 5, Arkansas, Louisiana, Mississippi: U.S. Geological Survey Hydrologic Investigation Atlas 730–F, 28 p.

Renken, R.A., Dixon, Joann, Koehmstedt, John, Ishman, Scott, Lietz, A.C., Marella, R.L., Telis, Pamela, Rodgers, Jeff, and Memberg, Steve, 2005, Impact of anthropogenic development on coast ground-water hydrology in southern Florida, 1900–2000: Reston, Va., U.S. Geological Survey Circular 1275, 77 p.

Reese, R.S., 2006, Review of aquifer storage and recovery performance in the Upper Floridan aquifer in southern Florida: U.S. Geological Survey Fact Sheet 2006–3126, 2 p.

Seaber, P.R., Kapinos, F.P., and Knapp, G.L., 1984, State hydrologic unit maps: U.S. Geological Survey Open-File Report 84–708, 63 p.

Smajstrla, A.G., 1990, Agricultural field scale irrigation requirements simulation model (AFSIRS): Technical manual, version 5.5: Gainesville, Fla., University of Florida, Agricultural Engineering Department, 52 p.

Smajstrla, A.G., Boman, B.J., Clark, G.A., Haman, D.Z., Harrison, D.S., Izuno, F.T., and Zazueta, F.S., 1988, Efficiencies of Florida agricultural irrigation systems: Gainesville, Fla., University of Florida, Institute of Food and Agricultural Sciences, Bulletin 247, 15 p.

Smajstrla, A.G., and Zazueta, F.S., 1995, Estimating crop irrigation requirements for irrigation system design and consumptive use permitting: Gainesville, Fla., University of Florida, Agricultural and Biological Engineering Department, Document AE257, 4 p.

Smajstrla, A.G., and others, 1993, Micro irrigation in Florida—Systems, acreage and cost: Gainesville, Fla., University of Florida, Institute of Food and Agricultural Sciences, Bulletin 276, 12 p.

Smith, S.K., and Cody, Scott, 2012, Number of households and average household size in Florida—April 1, 2011: Gainesville, Fla., University of Florida, Bureau of Economic and Business Research, v. 45, Bulletin 161, 4 p.

Smith, S.K., and Rayer, Stefan, 2012, Projections of Florida population by county 2011–2040—March 2012: Gainesville, Fla., University of Florida, Bureau of Economic and Business Research, Bulletin 162 (revised), 8 p.

Solley, W.B., Chase, E.B., and Mann, W.B., 1983, Estimated use of water in the United States in 1980: Reston, Va., U.S. Geological Survey Circular 1001, 56 p.

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

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

Solley, W.B., Pierce, R.R., and Perlman, H.A., 1998, Estimated use of water in the United States in 1995: Reston, Va., U.S. Geological Survey Circular 1200, 78 p.

South Florida Water Management District, 1990, Desalination—An additional water source for South Florida: West Palm Beach, Fla., South Florida Water Management District, Office of Communications, PIO 276 290 5M, 4 p.

South Florida Water Management District, 2009, Kissimmee Basin Water Supply Plan, 2005–2006 update: West Palm Beach, Fla., South Florida Water Management District, 119 p.

South Florida Water Management District, 2011, Appendices, Upper East Coast Water Supply Plan Update, 2011: West Palm Beach, Fla., South Florida Water Management District, p. 1–68.

South Florida Water Management District, 2012, Appendices, Lower West Coast Water Supply Plan Update 2012: West Palm Beach, Fla., South Florida Water Management District, p. 1–42.

South Florida Water Management District, 2013, Draft appendices—Lower East Coast Water Supply Plan Update 2013: West Palm Beach, Fla., South Florida Water Management District, p. 1–68.

Southwest Florida Water Management District, 1992, AGMOD, Agricultural water use model, Version 2.0: Brooksville, Fla., 51 p.

Southwest Florida Water Management District, 2012, 2010 Estimated water use in the Southwest Florida Water Management District: Brooksville, Fla., Southwest Florida Water Management District, Water Resource Bureau, Water Supply Section, 439 p.

St. Johns River Water Management District, 2011, 2010 Survey of estimated annual water use for the St. Johns River Water Management District: Palatka, Fla., St. Johns River Water Management District Technical Fact Sheet SJ2011–FS, 24 p.

Tampa Bay Water, 2013, Tampa Bay Water Works 2010 Annual Report: Clearwater, Fla., 8 p.

U.S. Census Bureau, 1993, 1990 Census of housing, detailed housing characteristics—Florida: Washington, D.C., U.S. Department of Commerce, Bureau of the Census, Ch-2-11, 793 p.

U.S. Census Bureau, 2002, Summary population and housing characteristics, Florida—2000, 2000 Census of Population and Housing: Washington, D.C., U.S. Department of Commerce, Bureau of the Census, PCH01–11.

U.S. Census Bureau, 2011a, Statistical abstract of the United States 2012 (131st ed.): Washington D.C., U.S. Department of Commerce, Bureau of the Census, accessed March 28, 2013 at http://www.census.gov/compendia/statab/.

U.S. Census Bureau, 2011b, County business patterns, 2010, Florida: Washington D.C., U.S. Department of Commerce, Bureau of the Census, CBP–10–11, accessed August 21, 2012, at http://censtats.census.gov/cgi-bin/cbpnaic/cbpsect.pl

U.S. Census Bureau, 2012, Summary population and housing characteristics, Florida: 2010, 2000 Census of Population and Housing: Washington, D.C., U.S. Department of Commerce, Bureau of the Census, PCH01–11.

U.S. Bureau of Labor Statistics, 2013, State and area employment, hours, and earnings, Florida, manufacturing: Washington D.C., 990 Census of housing, detailed housing characteristics—Florida: Washington, D.C., accessed June 5, 2013, at http://data.bls.gov/pdq/SurveyOutpitServlet/.

U.S. Department of Agriculture, 2006, Commercial citrus inventory, preliminary report: Orlando, Fla., U.S. Department of Agriculture, National Agricultural Statistics Service, Citrus, September 15, 2006, 8 p.

U.S. Department of Agriculture, 2009, 2007 Census of Agriculture—Florida state and county data: Washington D.C., U.S. Department of Agriculture, National Agricultural Statistics Service, Geographic Area Series, part 9 [AC 07–A–9], v. 1, 485 p.

U.S. Department of Agriculture, 2010, Cotton: Acreage, yield, and production, by district and county, Florida, 2008 and 2009: Maitland, Fla., U.S. Department of Agriculture, National Agricultural Statistics Service, Field Crops, County Estimates, May 20, 2010, 1 p.

U.S. Department of Agriculture, 2011a, Peanuts—Acreage, yield, and production, by district and county, Florida, 2009 and 2010: Maitland, Fla., U.S. Department of Agriculture, National Agricultural Statistics Service, Field Crops, County Estimates, June 15, 2011, 1 p.

U.S. Department of Agriculture, 2011b, Florida sugarcane for sugar—Acreage, yield, and production, by county, Florida, 2009 and 2010: Maitland, Fla., U.S. Department of Agriculture, National Agricultural Statistics Service, Field Crops, County Estimates, July 15, 2011, 1 p.

U.S. Department of Agriculture, 2011c, Commercial citrus inventory, preliminary report: Maitland, Fla., U.S. Department of Agriculture, National Agricultural Statistics Service, Citrus, September 22, 2011, 6 p.

U.S. Geological Survey, 1975, State of Florida hydrologic unit map, 1974: U.S. Geological Survey, 1 sheet, scale 1:500,000.

U.S. Soil Conservation Service, 1970, Irrigation water requirement (Blaney-Criddle revised): Washington D.C., U.S. Department of Agriculture, Soil Conservation Service, Technical Release 21, 88 p.

U.S. Soil Conservation Service, 1982, Florida irrigation guide: Gainesville, Fla., U.S. Department of Agriculture, Soil Conservation Service, 300 p.

University of Florida, 2011, Florida Estimates of Population, 2010: Gainesville, Fla., University of Florida, Bureau of Economic and Business Research, 59 p.

Vecchioli, John, and Foose, D.W., 1985, Florida ground-water resources, *in* The national water summary, 1984—Hydrologic events, selected water quality trends and ground-water resources: Reston, Va., U.S. Geological Survey Water-Supply Paper 2275, p. 173–178.

Verdi, R.J., Tomlinson, S.A., and Marella, R.L., 2006, The drought of 1998–2002— Impacts of Florida's hydrology and landscape: U.S. Geological Survey Circular 1295, 34 p.

White, J.K., and van Blokland, P.J., 2006, Trends in Florida citrus with emphasis on Indian River, St. Lucie, Martin, and Palm Beach Counties: Gainesville, Fla., University of Florida, Food and Resource Economics Department, EDIS FE636, 9 p.

Glossary

A

agriculture use Includes water used for agricultural irrigation and nonirrigation purposes. Irrigation water use includes the artificial application of water on lands to assist in the growing of crops, plants, and pasture. Nonirrigation water use includes water used for livestock, fish farming, and other farm needs. Livestock water use includes water used for stock watering, feedlots, and dairy operations. The water can be obtained from a public supply or be self-supplied.

B

brackish water Water that has dissolved-solids concentrations between 500 and 10,000 milligrams per liter (mg/L) (Knochenmus and Swenson, 1996). Brackish water needs some form of treatment before it meets potable standards set by the Florida Department of Environmental Protection and can be made available for human consumption (Florida Department of Environmental Regulation, 1990). Brackish water can be used for irrigation purposes without treatment, with some limitations.

C

combined-cycle Refers to a power generating system that produces both electricity and heat from a single heat source (Diehl and others, 2013). The waste heat is then used to generate steam which turns a steam turbine-generator to produce additional electricity resulting in significantly more efficient power production (Ron Hix, Florida Power and Light, written commun, 2014).

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

community water system A public-water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents (Florida Department of Environmental Regulation, 1990).

consumptive use That part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment. Sometimes called water consumed or water depleted.

cooling pond Usually a manmade water body used by power plants for heat exchange of once-through cooling water generated by steam condensers. The water levels in the pond are usually maintained by rainfall or augmented by pumping (withdrawal of) water from another source (fresh, saline, or reclaimed) as some water is lost (consumed) through evaporation. See cooling water or once-through cooling water.

cooling tower A large tower or stack that is used for heat exchange of once-through cooling water generated by steam condensers. Hot water from the plant is sprayed into the top of the tower and exchanges heat with the passing air as it falls. The water is then collected at the bottom of the tower and used again. A small amount of water is lost (consumed) through evaporation in this process. See cooling water or once-through cooling water.

cooling water Water used for cooling purposes by electric generators, steam condensers, large machinery or products at power or industrial plants. Water used for cooling purposes can be either fresh, saline, or reclaimed and may be used only once or recirculated multiple times. See cooling pond, cooling tower, or once-through cooling water.

D

desalination The removal of salts from highly mineralized water. Desalination is primarily used for public-supply water to ensure that it meets Florida Department of Environmental Protection secondary drinking-water standards. The primary types of desalination used in Florida are (1) distillation, (2) electrodialysis processes, and (3) reverse osmosis processes (Buros, 1989, South Florida Water Management District, 1990). The reverse osmosis processes are the most commonly used in Florida, followed by electrodialysis (Dykes and Conlon, 1989). In addition to these three desalination processes, many public suppliers also dilute or blend nonpotable or brackish water with fresher water to produce potable water. Also see reverse osmosis.

dewatering The deliberate attempt to lower the ground-water level in or below land surface for selected purposes, such as agricultural, construction, mining, or other activities. For mining operations, dewatering usually is accomplished by pumping the water out of the ground and discharging to a surface-water body. However, some dewatering involves gravity feeding water from the surficial aquifer system into a deeper aquifer (usually the Floridan aquifer system) through recharge wells (Campbell, 1986).

domestic use Water for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and other indoor uses. It also includes outdoor uses, such as car washing and watering household lawns and gardens. Domestic water use is sometimes referred to as residential water use. The water can be obtained from a public supply or be self-supplied.

E

evapotranspiration (ET) ET is the term used to define the amount of water needed to grow a healthy and productive plant. Evaporation is the change of water from liquid to vapor, and transpiration is the evaporation from a plants leaves, and both occur in response to weather (Smajstrla and Zazueta, 1995). Rainfall and irrigation must be sufficient to meet the crop's ET requirement.

F

flood irrigation (including seepage) Irrigation systems that control the water table with lateral supply ditches. These include open-field ditch systems (furrows), semi-closed conveyance systems, subsurface conduit systems, crown flood systems, and continuous (paddy) flood systems. The efficiencies of these flood irrigation systems range from 20 to 80 percent (Smajstrla and others, 1988); however, an average of 60 percent is commonly used for estimating water requirements. May also be referred to as subsurface irrigation.

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

G

gigawatt-hour (GWh) A measure of electricity, one billion watt hours.

groundwater That part of the subsurface water that is in the saturated zone (a zone in which all voids are filled with water).

H

hydroelectric power generation The use of water in the generation of electricity at plants where the turbine generators are driven by falling water. This is considered an instream use of water.

I

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

instream uses Water use taking place within a stream channel for such purposes as hydroelectric power generation, navigation, water-quality improvement, fish and wildlife propagation, and recreation. Instream use is sometimes referred to as nonwithdrawal use or in-channel use.

M

micro irrigation Irrigation systems that are low pressure, low flow rate systems which distribute water through relatively small diameter pipes directly to, or very near, the soil surface, either above the ground, in discrete drops, continuous drops, small streams, mist, or sprays. These include drip systems, spray systems, jet systems, and bubbler systems. Micro irrigation systems may also be referred to as drip, low-pressure, or low-volume irrigation. The efficiencies of these micro irrigation systems range from 75 to 95 percent (Smajstrla and others, 1988, 1993); however, an average of 80 percent is commonly used for estimating water requirements.

mining use Water used for the extraction of minerals and liquids. Mining also includes water used for milling (such as crushing, screening, washing, and flotation), environmental purposes (such as dust control and wetland restoration or maintenance), material conveyance, dewatering, and domestic uses

on the premises. Generally, most of the water used at a mining operation is self-supplied.

N

navigation use Water utilized as a means of commercial (and sometimes recreational) transportation. Includes water used to lift a vessel in a lock or maintain a navigable channel level. Navigational water use is considered a nonconsumptive instream use of water and is generally not measured.

net irrigation requirement (NIR) The NIR coefficient is the calculated amount of water, in addition to rainfall, that must be applied to meet the evapotranspiration (ET) needs of a specific crop (Smajstrla and Zazueta, 1995). The NIR coefficient does not include the water needed to overcome irrigation system inefficiencies and must be adjusted to account for irrigation system losses (U.S. Soil Conservation Service, 1982). The NIR coefficient may also be referred to as irrigation crop coefficient or an application rate.

net water use Water withdrawals plus or minus water transfers. In most counties, the net water use and water withdrawals are equal; however, in counties involved in water transfers (imports and exports), the net water use represents the actual amount of water used regardless of the amount of water withdrawn. In Florida, most water transfers occur in the public-supply category. Also see water transfers.

nonpotable water Water that is highly mineralized and needs some form of treatment before it meets standards set by the Florida Department of Environmental Protection and can be made available for human consumption (Florida Department of Environmental Regulation, 1990). In Florida, chloride and dissolved-solids concentrations in potable water must be less than or equal to 250 and 500 mg/L, respectively. Nonpotable water exceeds these concentrations consistently or periodically and is either diluted with fresher water or treated through a desalination or filtration process to meet potable-water standards for public supply (see desalination). This water is considered saline by the USGS for 2010 but is retained within the freshwater category for this report.

nontransient noncommunity water system A public-water system that is not a community water system and that regularly serves at least 25 of the same individuals during a 6-month period (Florida Department of Environmental Regulation, 1990).

O

on-site runoff Runoff collected from unused irrigation water or rainwater that is retained in a canal, ditch, pond, or impoundment on the user's fields or land. This water is typically used again for irrigation purposes or used to maintain water levels in lakes or ponds for aesthetic purposes. It may also be left to evaporate, percolate into the ground, receive treatment, and (or) be discharged to other surface-water bodies.

once through cooling Fresh or saline water that is withdrawn from a river, stream or other water body (manmade or natural), or a well, passed through a steam condenser once, and then returned to the surface-water source some distance from the intake (Hughes, 1975). Once-through cooling water is used to exchange heat from the steam condensers to the cooler water. This method of cooling is commonly used in power production throughout Florida and usually results in no consumption.

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

P

per capita use The average amount of water used per person during a standard time period, generally per day. For this report, two per capita estimates are calculated. Public-supply gross per capita is the total public-supply water withdrawn divided by the total population served by public supply. Per capita water use computed in this manner includes water delivered for all uses of public-supply water (domestic, commercial, industrial, public uses and other uses). Public-supply domestic per capita is calculated by dividing the deliveries to domestic use from public suppliers by the population served. Per capita use computed in this manor represents the amount of water used at a household level (both indoor and outdoor) because it excludes all other uses of public-supply water (commercial, industrial, public uses, or other uses).

population The number of people that live in a state (or county) who consider that state (or county) their permanent residence. This number is usually estimated by the U.S. Bureau of Census or some other Federal or State agency delegated to compile such data on a designated timeframe. College students, military personnel, and inmates of penal institutions are counted as permanent residents. According to this definition, tourist, seasonal, or part-time residents are considered part of the nonresident population. All population values presented in this report represent the resident population, unless otherwise noted.

potable water Water that meets the quality standards set by the Florida Department of Environmental Protection (Florida Department of Environmental Regulation, 1990). Potable water is considered safe for human consumption and is often referred to as drinking water. In Florida, chloride and dissolved-solids concentrations in potable water must be less than or equal to 250 and 500 mg/L, respectively. Freshwater that exceeds these chloride and dissolved-solids concentrations is often referred to as nonpotable or brackish water and is either diluted with fresher water or treated through a desalination or filtration process to meet potable-water standards for public supply.

power generation use Water used in the process of electric power generation by a thermoelectric or hydroelectric facility. The majority of water used for this category is for cooling purposes (much of which is once-through cooling). Water also is used for boiler makeup or domestic purposes throughout the plant. Boiler makeup water and water used for domestic purposes are generally obtained from public supply; however, for power plants located in remote areas, this water can be self-supplied. Cooling water is generally self-supplied, although some smaller power plants use public-supply water for cooling purposes.

public supply Water withdrawn by public or private water suppliers and delivered to users who do not supply their own water. Water suppliers provide water for a variety of uses, such as domestic, commercial, industrial, thermoelectric power (domestic and cooling purposes), and public-water use. Any water system that serves more than 25 people or has 15 year-round service connections is considered a community public supplier (Florida Department of Environmental Regulation, 1990). For this report, public supply includes those systems that serve more than 400 people or withdrawal more than 10,000 gallons per day.

public uses Water provided from a public-water supply and used for such purposes as firefighting, street washing, and municipal parks and swimming pools. Public-water use also includes system losses during distribution, processing (including water discharge from desalination or lime-softening facilities), or transmission between wholesalers. Public-water use is sometimes referred to as utility use.

R

recirculated water Water that is used more than once before it returns to the natural hydrologic system or is discharged into a wastewater system. Also referred to as recycled water.

reclaimed wastewater Water that has received primary, secondary, or advanced treatment and is released from a wastewater facility after treatment for use again through a reuse system.

recreational-landscape irrigation use The application of water on lands to assist in growing turfgrass (primarily grasses associated with golf courses) and landscape vegetation for commercial lawns, recreation areas, common areas, and other grasses, as well as vegetation in nonagricultural areas, such as cemeteries, playgrounds, and school grounds. This category also includes water withdrawn and used for aesthetic purposes (filling of nonagricultural lakes, ponds, and fountains).

residential use See domestic use.

reuse system The deliberate application of reclaimed wastewater for a beneficial or other useful purpose. Reuse may encompass landscape irrigation (such as golf courses, cemeteries, highway medians, parks, playgrounds, schoolyards, nurseries, and residential properties), agricultural irrigation (such as food and fruit crops, wholesale nurseries, sod farms and pasture grass), aesthetic uses, ground-water recharge, environmental enhancement of surface water and wetland restoration, fire protection, cooling water, and other useful purposes.

reverse osmosis The process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, and the salt waste (brine) is removed and disposed. This differs from electrodialysis in which the salts are extracted from the feed water by using a membrane with an electrical current to separate the ions. During electrodialysis, the positive ions flow through one membrane while the negative ions flow through a different membrane, leaving freshwater as the end product. In this report, reverse osmosis includes any water treated through both reverse osmosis and electrodialysis, and any water diluted or blended with fresher water that was used to obtain potable water. Also see desalination.

S

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

self-supplied water Water withdrawn by an individual user (such as private domestic household or a farmer) or by a facility (such as a factory or power plant) for a use. A self-supplied user generally, but not always, does not receive any water from a public supply water system.

sprinkler irrigation A pressurized irrigation system in which water is distributed through pipes to the field and applied through a variety of sprinkler heads or nozzles. Pressure is used to spread water droplets above the crop canopy to simulate rainfall (Izuno and Haman, 1987). These systems include portable and traveling guns, solid or permanent fixtures (overhead or pop ups), center pivots, and periodic moving systems. The efficiencies of these sprinkler irrigation systems range from 15 to 85 percent (Smajstrla and others, 1988); however, an average of 70 percent is commonly used for estimating water requirements. Also referred to as overhead irrigation.

T

thermoelectric power generation Electrical power generated by using fossil fuel (coal, oil, natural gas, or biomass), geothermal, or nuclear energy.

transient noncommunity water system A public-water system that provides piped water for human consumption to at least 15 service connections or that serves at least 25 individuals at least 60 days out of the year but which is not a community water system. The difference between a community water system and a noncommunity water system is that the former serves inhabitants, whereas the latter serves transients or nonresidents who otherwise do not inhabit the building served by the system (Florida Department of Environmental Regulation, 1990).

W

wastewater A combination of liquid and water-borne pollutants from residential or commercial buildings, industrial plants, and institutions. Wastewater receives treatment (primary, secondary, or advanced) before it is released back to the environment as treated effluent (Florida Department of Environmental Regulation, 1991). Treated effluent can be directly discharged into a surface-water bodies (including marshes or wetlands), disposed of in the ground either by injection or seepage (including absorption beds, injection wells, drainfields, percolation ponds, rapid infiltration basins, spray fields, and land application systems), or reused in some form or way (including irrigation, cooling water, industrial processes, and others) (Marella, 1994).

water transfer Artificial conveyance of water from one area to another across a political or hydrological boundary. Also referred to as an import or export of water from one basin or county to another.

water use In a restrictive sense, the term refers to water that is actually used for a specific purpose, such as domestic use, irrigation, or industrial processing. More broadly, water use pertains to human interaction with, and influence on, the hydrologic cycle and includes elements such as water withdrawals, deliveries, consumptive use, wastewater releases, reclaimed wastewater, return flow, and instream use.

withdrawal Water removed from the ground or diverted from a surface-water source. The amount of water withdrawn may not equal the amount of water used because of water transfers or the recirculation or recycling of the same water. For example, a power plant may use the same water multiple times but withdraw a substantially different amount.

Manuscript approved May 6, 2014

Prepared by:
USGS Science Publishing Network
Raleigh Publishing Service Center
3916 Sunset Ridge Road
Raleigh, NC 27607

For additional information about this publication, contact:
Center Director
USGS Florida Water Science Center
4446 Pet Lane, Suite 108
Lutz, FL 33559
1–813–498-5000

Or visit the Florida Water Science Center Web site:
http://fl.water.usgs.gov

ISSN 2328-0328 (online)
http://dx.doi.org/10.3133/sir20145088