

FRESHWATER WITHDRAWALS AND WATER-USE TRENDS IN FLORIDA, 1985

By Richard L. Marella

Prepared by U.S. GEOLOGICAL SURVEY in cooperation with the FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION NORTHWEST FLORIDA WATER MANAGEMENT DISTRICT ST. JOHNS RIVER WATER MANAGEMENT DISTRICT SOUTH FLORIDA WATER MANAGEMENT DISTRICT SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT SUWANNEE RIVER WATER MANAGEMENT DISTRICT and the FLORIDA DEPARTMENT OF NATURAL RESOURCES, FLORIDA GEOLOGICAL SURVEY Tallahassee, Florida 1989 ISSN 0085-0624

INTRODUCTION

Freshwater use has increased substantially in Florida in response to demands from a rapidly growing population and an expanding tourist and agricultural economy. Freshwater withdrawals to meet these demands increased nearly 30 percent (excluding thermoelectric power generation withdrawals) in the 15 years between 1970 and 1985. Population increased nearly 70 percent, from 6.8 million in 1970 to 11.3 million in 1985, and is expected, using medium projections, to increase to 15 million by the year 2000 and to 17 million by the year 2010 (Shoemeyen and others, 1987) (fig. 1). In addition to population growth, an estimated 30 million tourists visited Florida in 1985 (Florida Division of Tourism, 1987). Additionally, agricultural production continues to be an important part of the State's economy, as Florida ranked ninth in the Nation in 1985 in agricultural production and was the largest producer of citrus in the United States (Florida Department of Agriculture and Consumer Services, 1986).

Although Florida's water resources are abundant, the demand from these sources is increasing and more water will be needed in the future to support the population growth, tourism, and agricultural activities. To meet the long-term demand for water, it is important to inventory current water use so that sound resource management decisions can be made. This report summarizes the quantities of freshwater withdrawals for 1985, by source, by county, and by the following categories: public supply, domestic self-supplied, commercial-industrial self-supplied, agricultural irrigation, and nonirrigation, and self-supplied thermoelectric power generation. Additional data for trends in water use and population for Florida are also presented.

DISTRIBUTION OF POPULATION AND WATER

Population distribution is a key component in managing water resources. Heavily populated areas often host a variety of environmental and hydrologic concerns. In Florida, these concerns are further complicated by urban and coastal areas that have complex and sensitive ground- and surface-water resources. Counties frequently have uneven distributions of population with both sparsely and densely populated areas. For example, in some counties, population is concentrated along coastal areas or in large cities (fig. 2). In 1985, 47 percent of Florida's 11.3 million people lived in the 13 counties that border the Atlantic Ocean. An estimated 85 percent of the population in those 13 counties live in the eastern half of the counties.

Because this population has created a high water demand in coastal areas throughout the State and because the water in some of these areas is not potable, water-supply sources are commonly located inland. The majority of these inland sources are well fields, some of which are located in counties different than the county of use. In 1985, 162 Mgal/d (million gallons per day) of public-supply water was withdrawn from counties and transferred to other counties for use. The six counties that import public-supply water are coastal counties. The largest importer of water, Pinellas County, is supplied with more than 100 Mgal/d from adjacent Hillsborough and Pasco Counties. Additionally, Key West in Monroe County pipes its public-supply water from Dade County, a distance of more than 150 miles. Other coastal counties with large demands for public-supply water and with limited water resources rely on inland surface-water sources. Surface water accounted for 11 percent of the total public-supply withdrawals in 1985, with 98 percent of it being utilized in coastal counties.

TOTAL WATER WITHDRAWALS

In 1985, the total water withdrawn for use in Florida was 17,057 Mgal/d of which 6,259 Mgal/d, or nearly 37 percent, was freshwater and 10,798 Mgal/d was saline. Ground water accounted for more than 64 percent (4,030 Mgal/d) of the freshwater withdrawn and surface water accounted for more than 99 percent of the saline withdrawals. An estimated 43 percent, or 2,730 Mgal/d, of freshwater withdrawals was consumed (no longer available for immediate reuse) in 1985. Freshwater refers to water containing less than 1,000 mg/L (milligrams per liter) of dissolved solids; however, water containing more than 500 mg/L of dissolved solids is generally undesirable for drinking and many other uses (Solley and others, 1988).

Agricultural irrigation was the largest user of fresh ground water (41 percent) and fresh surface water (60 percent) in 1985. Public supply accounted for 36.5 percent of the fresh ground-water withdrawals, followed by commercial-industrial self-supplied (16 percent), domestic self-supplied (6 percent), and thermoelectric power generation (0.5 percent). Thermoelectric power generation accounted for 28 percent of the fresh surface-water withdrawals followed by public supply (8 percent) and commercial-industrial self-supplied (4 percent). Cooling water for thermoelectric power generation accounted for more than 99 percent of the saline-water withdrawals.

The largest amount of freshwater was withdrawn from Palm Beach County (708 Mgal/d) in 1985. Additionally, Broward, Dade, Escambia, Hillsborough, Orange, Polk, and St. Lucie Counties each withdrew more than 200 Mgal/d of freshwater in 1985, as shown on the large map. These eight counties accounted for about 48 percent of the State's freshwater withdrawals in 1985. The following counties withdrew the largest amounts of freshwater for each category, as shown in the table: Dade (public supply), Polk (domestic self-supplied and commercial-industrial self-supplied), Palm Beach (agricultural irrigation), and Escambia (thermoelectric power generation).

GROUND WATER

With more than 4,000 Mgal/d of ground water withdrawn, Florida ranked sixth in the Nation in ground-water withdrawals in 1985 (Solley and others, 1988). Ground water is the primary source of freshwater in Florida because it is readily available and is generally of good quality. In 1985, ground water provided 89 percent of the public supply and about 100 percent of domestic self-supplied needs. The Floridan aquifer system, which underlies the entire State, supplied 62 percent of the total ground water, and the Biscayne aquifer, which underlies southeastern Florida, accounted for 20 percent of the total ground water withdrawn in 1985. The areas of greatest fresh ground-water withdrawals are Dade and Broward Counties in southeastern Florida and Hillsborough and Polk Counties in central Florida (fig. 3). These four counties accounted for 32 percent of the State's fresh ground-water withdrawals in 1985. An additional 76.39 Mgal/d of saline ground water was withdrawn in Florida in 1985; 17.28 Mgal/d was used for public supply and the remaining for thermoelectric power generation cooling water.

SURFACE WATER

Total fresh surface-water withdrawals exceeded 2,220 Mgal/d in 1985. The areas of greatest fresh surface-water withdrawals are in southern Florida and include the following counties: Hendry, Indian River, Martin, Palm Beach, and St. Lucie Counties (fig. 4). Growers in these five counties heavily irrigate sugarcane, vegetables, and citrus. This irrigation accounts for 54 percent of the State's total fresh surface-water withdrawals. Significant fresh surface-water withdrawals also occur in Escambia County where withdrawals of more than 200 Mgal/d are used for industrial production and for cooling in thermoelectric power generation.

WATER-USE TRENDS

Freshwater withdrawals increased nearly 450 Mgal/d (excluding fresh surface-water withdrawals for thermoelectric power generation) from 1975 to 1985. Freshwater withdrawals increased from 48 percent of the freshwater withdrawn in 1975 to 51 percent in 1980 and to 64 percent of the total freshwater withdrawn in 1985. This increase amounts to more than 768 Mgal/d between 1975 and 1985 (fig. 5). This steady increase in ground-water withdrawals relates to improved technology involving the development of high-capacity deep wells and the reliability of both quantity and quality of water from these wells. Public-supply freshwater withdrawals increased 514 Mgal/d from 1975 to 1985; 96 percent of this water was from wells. In contrast, withdrawals of fresh surface water have declined (fig. 5). Fresh surface-water withdrawals decreased by 1,373 Mgal/d between 1975 and 1985. The increased recycling of water by the use of cooling ponds or cooling towers by thermoelectric powerplants accounts for about 75 to 80 percent of the reduced demand for surface water (Leach, 1983). In addition, low flows in streams and canals resulting from below normal rainfall have resulted in reduced reliability of the surface-water sources to meet irrigation demands.

Freshwater withdrawals for public supply increased 44 percent (514 Mgal/d), domestic self-supplied increased 28 percent (58 Mgal/d), and agricultural irrigation increased 4 percent (111 Mgal/d) between 1975 and 1985. In contrast, commercial-industrial self-supplied withdrawals decreased 33 percent (231 Mgal/d) and thermoelectric power generation withdrawals for cooling decreased 160 percent (1,044 Mgal/d) from 1975 to 1985 (fig. 6). Although self-supplied commercial-industrial withdrawals decreased during this period, deliveries to commercial and industrial users from public-supply systems increased 228 Mgal/d. Many industries that were formerly self-supplied now receive from and discharge water to public-supply systems due, in part, to cost.

During the 1980's, saline ground water and treated wastewater have become important sources of water supply in Florida. Public supply withdrawals from saline ground water increased nearly 17 Mgal/d and irrigation use from treated wastewater sources increased nearly 51 Mgal/d from 1975 to 1985. Saline ground water or marginally fresh ground water (dissolved solids between 500 and 1,000 mg/L) is diluted with freshwater or treated by reverse osmosis. This use has increased from less than 1 Mgal/d in 1980 to more than 17 Mgal/d in 1985. During 1985, 1,122 Mgal/d of treated wastewater was discharged from municipal wastewater plants, and 4.5 percent (51 Mgal/d) of this was reused for irrigation. As demand for water increases in the coastal counties, saline or marginally fresh ground water and treated wastewater will continue as important supplemental sources of supply.

SELECTED REFERENCES

- Conover, C.S., Vecchioli, John, and Foote, D.W., in press, Ground-water resources of Florida: Florida Geological Survey Map Series 124, 1 sheet.
Fernald, E.A., and Patton, D.J., 1984, Water resources atlas of Florida: Tallahassee, Florida State University, 291 p.
Florida Department of Agriculture and Consumer Services, 1986, Citrus summary 1985: Florida Agricultural Statistics, 45 p.
Florida Division of Tourism, 1987, Florida visitor study 1986, executive summary: Tallahassee, Office of Marketing Research, 46 p.
Leach, S.D., 1978, Source, use, and disposition of water in Florida, 1975: U.S. Geological Survey Water-Resources Investigations Report 78-17, 90 p.
-----, 1982, Estimated water use in Florida, 1980: Florida Bureau of Geology Map Series 103, 1 sheet.
-----, 1983, Source, use, and disposition of water in Florida, 1980: U.S. Geological Survey Water-Resources Investigations Report 82-4090, 337 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.
Pride, R.W., 1973, Estimated use of water in Florida, 1970: Florida Bureau of Geology Information Circular No. 83, 31 p.
Shoemeyen, A.H., Floyd, S.S., and Drexel, L.L., 1987, Florida statistical abstract (21st ed.): Gainesville, University of Florida, Bureau of Economic and Business Research, 706 p.
Solley, W.B., Merk, C.F., and Pierce, R.R., 1988, Estimated use of water in the United States, 1985: U.S. Geological Survey Circular 1004, 82 p.
University of Florida, 1986, Florida estimates of population, April 1, 1985, states, counties, and municipalities: Gainesville, University of Florida, Bureau of Economic and Business Research, 48 p.

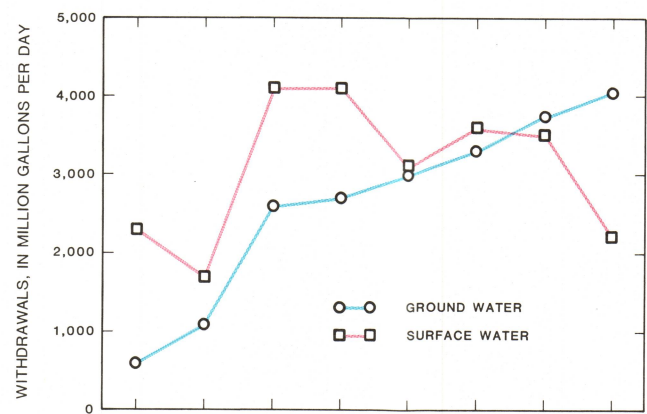


Figure 5.—Graph showing historical freshwater withdrawals, by source.

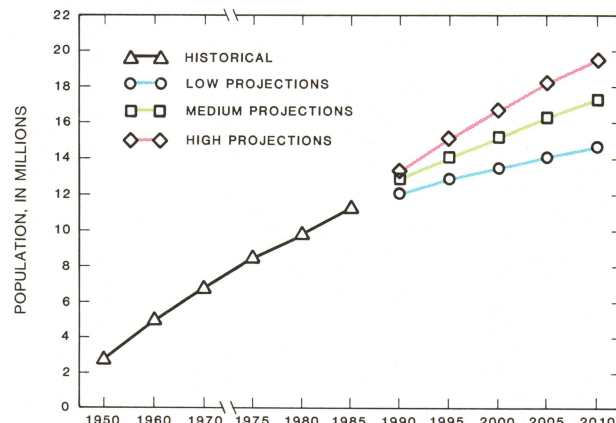


Figure 1.—Graph showing historical and projected population for Florida, 1950-2010.

Table 1.—Total freshwater withdrawals for all uses, by county, 1985 [All values in million gallons per day]

County	Ground water					Surface water				
	Public	Domestic	Commer-	Irriga-	Thermo-	Public	Domestic	Commer-	Irriga-	Thermo-
Alachua	21.25	7.78	3.61	15.52	3.26	51.42	0.00	0.00	0.04	0.04
Baker	6.0	1.86	.66	2.95	.00	6.07	.00	.00	2.19	.00
Bay	3.85	5.56	.61	1.28	.74	12.04	28.07	.22	.89	.29
Broward	1.34	2.60	4.34	.97	.00	9.25	.00	.00	.00	.00
Broward	9.21	5.62	.34	10.32	.31	115.70	14.09	.25	.70	.39
Broward	187.95	2.96	1.36	37.84	.07	230.18	.00	.51	.00	.51
Calhoun	.39	.92	.34	.00	.00	1.65	.00	.03	.03	.03
Charlotte	1.57	2.08	.00	43.12	.00	47.67	.00	3.77	.00	6.49
Citrus	6.55	7.83	.85	8.60	1.37	25.20	.00	.70	.00	.70
Clay	1.40	2.70	.73	2.85	.00	21.26	.00	4.43	.80	.03
Collier	25.38	3.32	4.67	84.85	.00	118.22	.00	.54	.00	.54
Colman	1.99	4.86	.00	2.87	.00	9.81	.00	.05	.00	.05
Dade	339.77	13.32	15.78	117.18	.00	486.05	.00	4.50	.00	4.50
DeSoto	.68	1.68	.37	72.20	.00	74.93	6.58	.00	2.27	.88
Dixie	.64	.66	.94	1.83	.00	4.06	.00	.00	.15	.15
Duval	84.86	15.50	38.08	18.80	2.66	159.30	.00	1.37	.00	.93
Escambia	37.62	4.71	34.54	5.23	2.30	84.29	16.89	.48	241.40	258.77
Flagler	2.22	.31	.10	.63	.00	8.94	.00	.93	.00	.93
Franklin	1.20	.15	.00	1.63	.00	2.98	.00	.00	.00	.00
Gadsden	1.60	2.30	1.96	2.59	.00	8.45	.00	.00	.00	.00
Gilchrist	.34	1.16	.08	3.83	.00	5.41	.00	.00	.00	.00
Glades	.56	.56	1.48	13.67	.00	15.96	.00	.66	.12	.66
Gulf	.98	.74	.42	1.89	.00	4.03	31.68	2.17	.00	33.85
Hamilton	.73	.95	38.79	2.91	.00	43.38	.00	.00	.00	.00
Hardee	1.32	1.82	4.83	86.21	.00	94.18	.00	.00	.00	.00
Hendry	.50	.89	.78	.50	.00	29.77	.00	.33	.00	.33
Hernando	7.88	.96	26.74	5.28	.00	40.86	.00	.58	.00	158.06
Hillsborough	7.88	2.77	.51	.69	.00	100.40	.00	14.16	9.11	23.27
Hillsborough	100.94	6.05	34.36	107.70	.00	249.30	64.46	.34	.00	67.91
Holmes	.82	2.02	.00	2.20	.00	5.04	.00	.00	.43	.43
Indian River	8.84	7.29	12	28.43	.31	44.99	.00	107.18	.00	107.18
Jackson	2.44	4.10	.81	10.35	.74	18.44	.00	100.00	100.89	110.89
Jefferson	.60	1.29	.00	6.31	.00	8.20	.00	1.36	.00	1.36
Lafayette	.15	.58	.00	.00	.00	7.31	.00	.26	.00	.26
Lake	15.34	8.52	12.24	28.78	.00	64.88	.00	3.41	4.89	8.30
Lee	25.45	8.81	6.87	27.04	.12	68.29	.68	.00	5.07	.11
Leon	22.06	4.42	.33	3.36	4.27	34.44	.00	.00	2.17	.00
Levy	1.19	2.17	.00	10.37	.00	14.14	.00	2.28	2.17	.00
Liberty	.25	.40	.00	.44	.00	1.09	.00	.00	.00	.00
Madison	1.18	.90	.00	.46	2.46	6.00	.00	.00	.00	.00
Manatee	1.89	15.26	.95	21.06	.00	49.14	.00	1.93	1.96	.38
Marion	9.33	7.30	.17	38.80	.40	46.29	.00	118.54	24.50	142.93
Monroe	.00	.00	1.60	.00	1.60	.00	.00	.00	.00	.00
Nassau	3.14	.97	37.40	1.75	.00	46.14	.00	.93	.00	.93
Okaloosa	17.36	2.19	5.82	2.50	.00	27.67	.00	.00	.00	.00
Okeechobee	.00	1.58	.12	22.78	.00	24.44	.00	1.02	52.90	.00
Orange	122.60	6.07	15.23	47.92	.00	191.82	.00	.00	.00	.00
Osceola	5.69	4.76	3.20	40.04	.00	53.69	.00	.58	.00	.58
Palm Beach	117.39	5.56	2.22	28.76	.00	153.93	29.16	.44	524.58	554.28
Pasco	75.44	8.25	19.91	22.42	.00	126.02	.00	.87	.00	.87
Pinellas	9.45	3.72	.05	10.25	.00	23.47	.00	.55	.00	.55
Polk	54.90	18.17	135.93	109.86	1.38	320.36	.00	1.14	8.33	68.97
Putnam	2.97	6.35	43.07	17.20	.68	70.27	.00	9.98	.96	21.07
St. Johns	7.01	2.13	.08	41.00	.00	50.22	.00	.00	1.07	.00
St. Lucie	10.83	6.40	2.25	48.80	.00	68.28	.00	.00	.00	.00
Santa Rosa	7.60	.82	6.59	1.67	.00	16.68	.00	.15	.00	.15
Seminole	17.09	3.14	.49	19.64	.00	40.36	.00	.47	.00	.47
Seminole	34.86	3.63	.96	23.21	.00	66.66	.00	2.06	.00	2.06
Sumter	1.31	2.41	57.76	16.79	.00	78.27	.00	.35	.00	.35
Suwannee	1.33	2.45	.95	16.49	.08	21.30	.00	1.43	.22	64.95
Taylor	1.58	1.13	45.21	.61	.00	48.53	.00	1.63	.00	1.63
Union	.52	.86	.02	.71	.00	2.11	.00	.00	.00	.00
Volusia	36.40	5.32	.54	36.56	.16	79.08	.00	6.50	111.25	117.75
Wakulla	.59	.63	.00	.04	.01	1.29	.00	.00	.00	.00
Washington	1.03	1.15	.00	.89	.00	3.07	.00	.14	.00	.14
Totals	1,491.80	259.29	631.53	1,646.31	18.74	4,047.67	185.31	77.28	1,332.99	632.71

*Public-supply ground-water withdrawals include 17.28 Mgal/d of saline ground water used in reverse osmosis or distillation for use as fresh potable water.

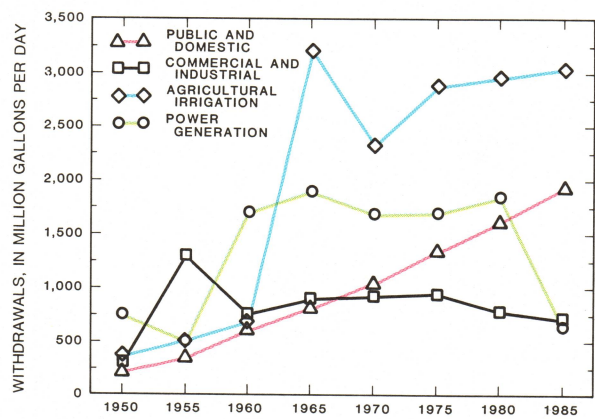


Figure 6.—Graph showing historical freshwater withdrawals, by category.

Figure 3.—Map showing fresh ground-water withdrawals.

NOTE: For figures 3 and 4 see explanation in upper right corner.

Figure 4.—Map showing fresh surface-water withdrawals.

EXPLANATION

- less than 10,000
 - 10,000 to 49,999
 - 50,000 to 99,999
 - 100,000 to 499,999
 - 500,000 to 1,000,000
 - greater than 1,000,000
- One dot represents 1,000 persons.

Figure 2.—Map showing the distribution of population in 1980.