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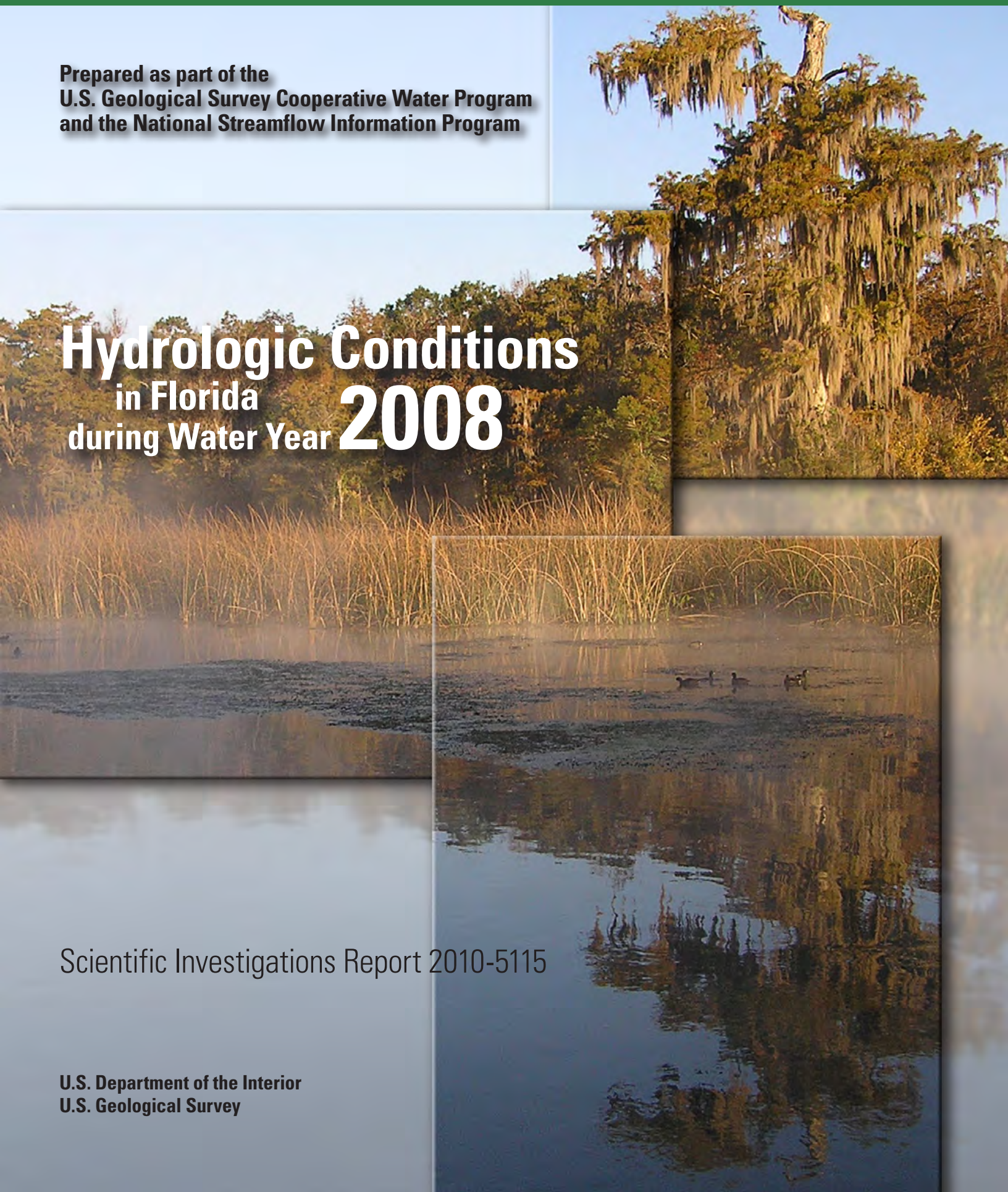

Hydrologic Conditions in Florida during Water Year 2008

Scientific Investigations Report 2010-5115

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

Cover. Wakulla River at Wakulla Springs State Park. Photograph by Hal Davis, U.S. Geological Survey.

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KEN SALAZAR, Secretary

U.S. Geological Survey
Marcia K. McNutt, Director

U.S. Geological Survey, Reston, Virginia: 2010

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Conversion factors, abbreviations, acronyms, and datums

Multiply	By	To obtain
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
square mile (mi^2)	2.590	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)

ADR	Annual Data Report
mg/L	milligrams per liter
NSIP	National Streamflow Information Program
NWISWeb	U.S. Geological Survey National Water Information System Webpage
SKTT	Seasonal Kendall Trend Test
USGS	U.S. Geological Survey

Vertical coordinate information is referenced to National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Elevation, as used in this report, refers to distance above the vertical datum.

Hydrologic Conditions in Florida during Water Year 2008

By Richard J. Verdi, Sandra L. Holt, Ronald B. Irvin, and David L. Fulcher

Abstract

Record-high and record-low hydrologic conditions occurred during water year 2008 (October 1, 2007-September 30, 2008). Record-low levels were caused by a continuation of the 2007 water year drought conditions into the 2008 water year and persisting until summer rainfall. The gage at the Santa Fe River near Fort White site recorded record-low monthly mean discharges in October and November 2007. The previous records for this site were set in 1956 and 2002, respectively. Record-high conditions in northeast and northwest Florida were caused by the rainfall and runoff associated with Tropical Storm Fay. For example, St. Mary's River near Macclenny recorded a new record-high monthly mean discharge in August 2008. The previous record for this site was set in 1945. Lake Okeechobee in south Florida reached new minimum monthly mean lake levels since monitoring began in 1912 from October to March during the 2008 water year. Some wells throughout northwest and south Florida registered period-of-record lowest daily maximum water levels.

Introduction

This report describes data and hydrologic conditions throughout Florida during the 2008 water year—a record-setting year for high and low precipitation, surface-water flows, lake elevations, and groundwater levels. Overall, the hydrologic conditions in Florida in 2008 varied from well below normal, caused by a continuation of the 2007 water year drought conditions, to above normal, caused by the landfall of Tropical Storm Fay in August. Record-low and record-high monthly mean discharge conditions were reported at several locations. Levels at Lake Okeechobee in south Florida reached record lows from October to March in the 2008 water year. Groundwater levels generally were below normal, although some sites were above normal during part of the year. Historically, Florida has been divided into four geographic monitoring regions (fig. 1): northwest, northeast, southwest, and south. The locations of the monitoring stations used in this report are identified in figure 2.

Prior to 1960, these data were published in various U.S. Geological Survey (USGS) water-supply papers and included water-related data collected by USGS during the water year (October 1 to September 30). In 1961, a series of annual reports, called "Water-Resources Data for Florida," was introduced that published only surface-water data. In 1964, a similar report was introduced for the purposes of publishing water-quality data. In 1975, the reports were changed to a single volume and expanded to publish data for surface water, water quality, and ground-water levels. These reports are listed at *http://fl.water.usgs.gov/publications/bibliography/bibliography.html#S* (within the alphabetical listing of entries that begin with "U.S. Geological Survey"). Formal publication of the annual report series was discontinued at the end of the 2005 water year upon activation of the Annual Data Report (ADR) database website. Reports for water years subsequent to 2005 are available at this website. This website facilitates the retrieval of data by hydrologic units or individual basins that cross State and county boundaries, and gives the user many options regarding the data and site locations of which they have interest. National data for discharge, lake and groundwater levels, and quality of water for the 2008 water year are accessible to the public on the USGS ADR website at *http://wdr.water.usgs.gov/*.

Current and historical data, including site information, daily values, statistics, and field measurements, are available for all monitoring sites on the National Water Information Webpage (NWISWeb) at *http://waterdata.usgs.gov/fl/nwis/nwis*. Incremental time-series data for past 10 to 15 years are available for many parameters (gage height, discharge, water temperature, specific conductance, and so forth) for many USGS stations since the evolution of electronic data loggers; computer systems have made it possible to store and provide access to such data. The Instantaneous Data Archive is available at: *http://ida.water.usgs.gov/ida/index_usgs.cfm*.

Funding for Data Collection in Florida

Funding to provide hydrologic data to the public primarily comes from three Federal sources: (1) the USGS Cooperative Water Program in which Federal, State, and local agencies share in the costs of the monitoring stations with the USGS; (2) other agency funds; and (3) the National Streamflow Information Program (NSIP). The NSIP provides some Federal funding for gages with the following critical interests:

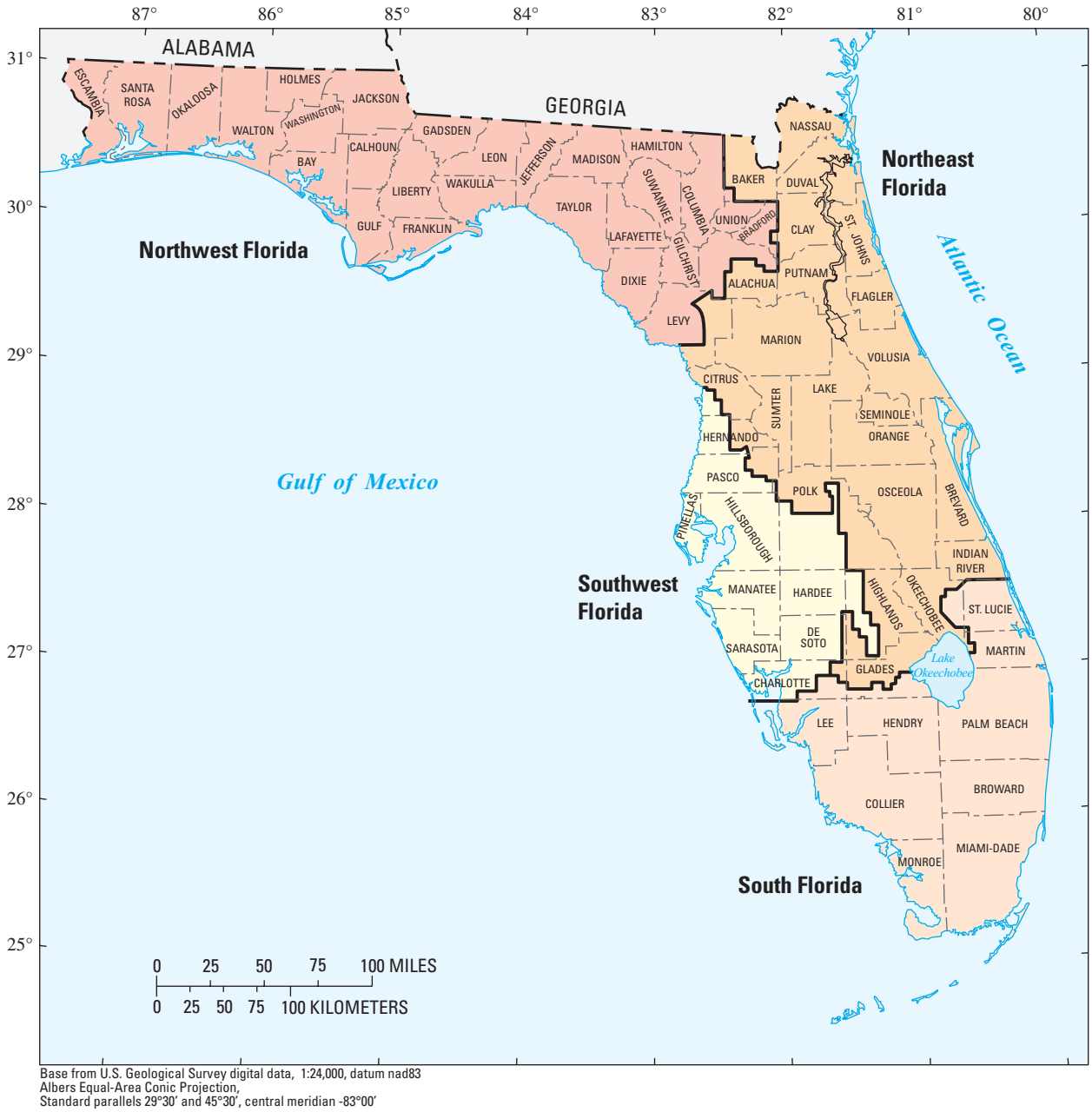
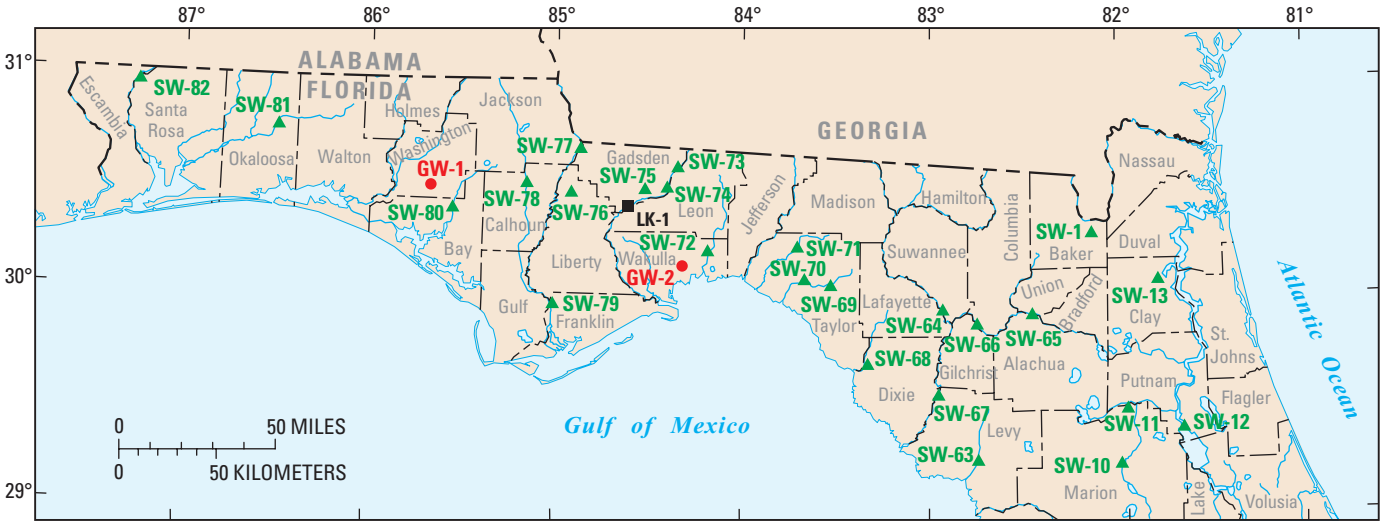
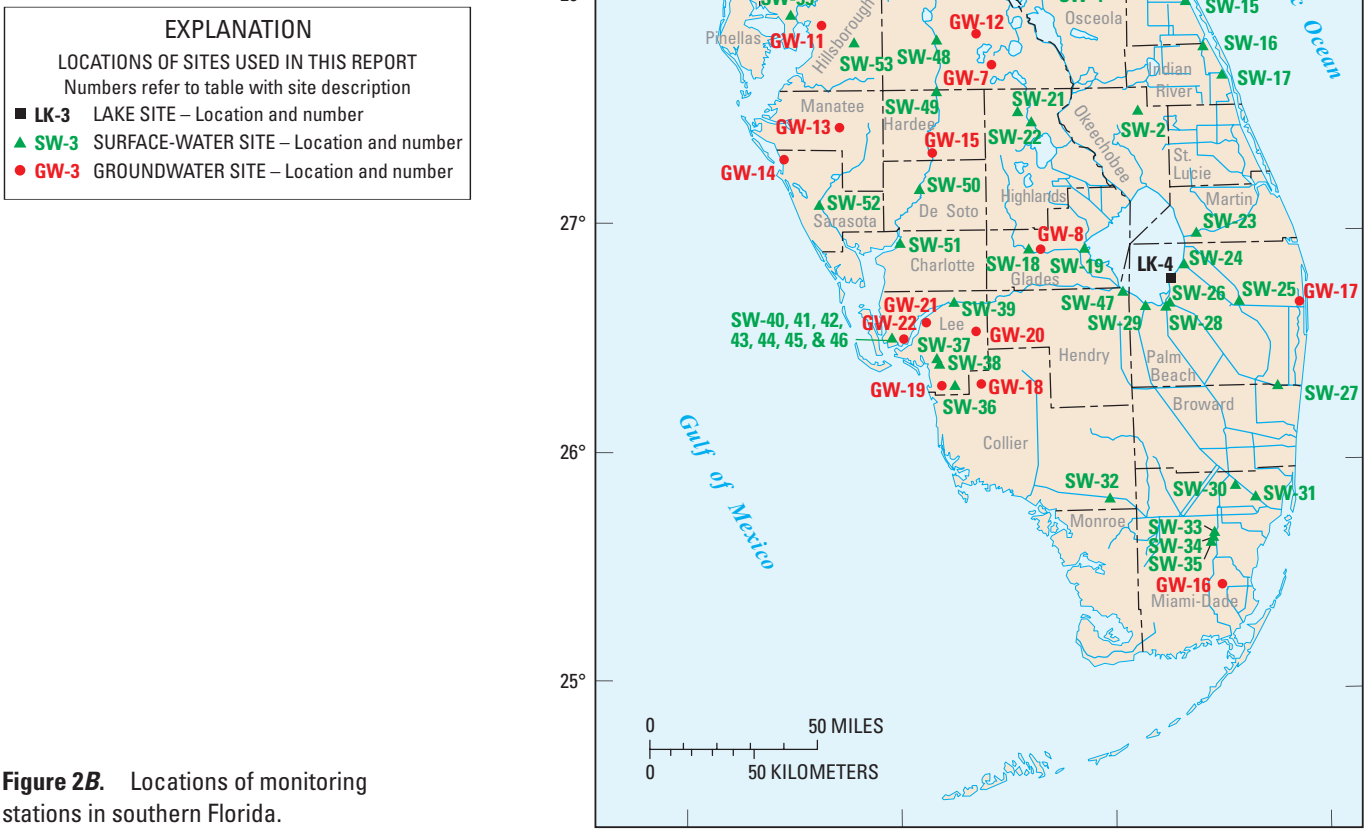


Figure 1. Delineation of geographic monitoring regions in Florida.



Base from U.S. Geological Survey digital data, 1:24,000, datum nad83
Albers Equal-Area Conic Projection,
Standard parallels 29°30′ and 45°30′, central meridian -83°00′

Figure 2*A*. Locations of monitoring stations in northern Florida.



Base from U.S. Geological Survey digital data, 1:24,000, datum nad83
Albers Equal-Area Conic Projection,
Standard parallels 29°30′ and 45°30′, central meridian -83°00′

Figure 2*B*. Locations of monitoring stations in southern Florida.

Surface-Water Sites

SW-1	02231000	St. Mary's River near MacClenny, Baker County, FL
SW-2	02231342	Fort Drum Creek near Fort Drum, Okeechobee County, FL
SW-3	02232000	St. John's River near Melbourne, Brevard County, FL
SW-4	02232155	Pennywash Creek near Deer Park, Osceola County, FL
SW-5	02232400	St. John's River near Cocoa, Brevard County, FL
SW-6	02232500	St. John's River near Christmas, Orange County, FL
SW-7	02234384	Soldier Creek near Longwood, Seminole County, FL
SW-8	02236000	St. John's River near De Land, Lake County, FL
SW-9	02236125	St. John's River at Astor, Volusia County, FL
SW-10	02240000	Ocklawaha River near Conner, Marion County, FL
SW-11	02243000	Orange Creek at Orange Springs, Marion County, FL
SW-12	02243960	Ocklawaha River at Rodman Dam, near Orange Springs, Putnam County, FL
SW-13	02246025	Black Creek near Doctor's Inlet, Clay County, FL
SW-14	02249500	Crane Creek at Melbourne, Brevard County, FL
SW-15	02250030	Turkey Creek at Palm Bay, Brevard County, FL
SW-16	02251000	South Prong St. Sebastian River near Sebastian, Indian River County, FL
SW-17	02253000	Main Canal at Vero Beach, Indian River County, FL
SW-18	02256500	Fisheating Creek at Palmdale, Glades County, FL
SW-19	02257000	Fisheating Creek at Lakeport, Glades County, FL
SW-20	02266300	Reedy Creek near Vineland, Osceola County, FL
SW-21	02270000	Carter Creek near Sebring, Highlands County, FL
SW-22	02270500	Arbuckle Creek near De Soto City, Highlands County, FL
SW-23	02276877	St. Lucie Canal below S-308 near Port Mayaca, Martin County, FL
SW-24	02278000	West Palm Beach Canal at S-352 at Canal Point, Palm Beach County, FL
SW-25	02278500	Diversion to Conservation Area at S-5A near Loxahatchee, Palm Beach County, FL
SW-26	02280500	Hillsboro Canal below S-351 near South Bay, Palm Beach County, FL
SW-27	02281400	Hillsboro Canal near Margate, Broward County, FL
SW-28	02283500	North New River Canal below S-2 and S-351 near South Bay, Palm Beach County, FL
SW-29	02286400	Miami Canal at S-354 and S-3 at Lake Harbor, Palm Beach County, FL
SW-30	02287497	Northwest Wellfield Canal near Dade Broward Levee, Miami-Dade County, FL
SW-31	02288600	Miami Canal at Northwest 36th Street, Miami, Miami-Dade County, FL
SW-32	02288900	Tamiami Canal Outlets, 40-Mile Bend to Monroe, Collier County, FL
SW-33	02290766	Levee 31 North Extension at 4 Mile near West Miami, Miami-Dade County, FL
SW-34	02290767	Levee 31 North Extension at 5 Mile near West Miami, Miami-Dade County, FL
SW-35	02290768	Levee 31 North Extension at 7 Mile near West Miami, Miami-Dade County, FL
SW-36	02291524	Spring Creek Headwater near Bonita Springs, Lee County, FL
SW-37	02291580	North Branch Estero River at Estero, Lee County, FL
SW-38	02291597	South Branch Estero River at Estero, Lee County, FL
SW-39	02292900	Caloosahatchee River at S-79 near Olga, Lee County, FL
SW-40	02293214	Meade Canal at Cape Coral, Lee County, FL
SW-41	02293240	Aries Canal at Cape Coral, Lee County, FL
SW-42	02293241	San Carlos Canal at Cape Coral, Lee County, FL
SW-43	02293264	Gator Slough at State Road 765 at Cape Coral, Lee County, FL
SW-44	02293345	Shadroe Canal at Cape Coral, Lee County, FL
SW-45	02293346	Horseshoe Canal at Cape Coral, Lee County, FL
SW-46	02293347	Hermosa Canal at Cape Coral, Lee County, FL
SW-47	264514080550700	Industrial Canal at Clewiston, Hendry County, FL
SW-48	02294650	Peace River at Bartow, Polk County, FL
SW-49	02295420	Payne Creek near Bowling Green, Hardee County, FL
SW-50	02296750	Peace River at Arcadia, De Soto County, FL
SW-51	02298202	Shell Creek near Punta Gorda, Charlotte County, FL
SW-52	02298830	Myakka River near Sarasota, Sarasota County, FL
SW-53	02301500	Alafia River at Lithia, Hillsborough County, FL
SW-54	02303000	Hillsborough River near Zephyrhills, Hillsborough County, FL
SW-55	02306000	Sulphur Springs at Sulphur Springs, Hillsborough County, FL
SW-56	02310000	Anclote River near Elfers, Pasco County, FL
SW-57	02310300	Pithlachascotee River near New Port Richey, Pasco County, FL
SW-58	02312000	Withlacoochee River at Trilby, Hernando County, FL
SW-59	02312200	Little Withlacoochee River at Rerdell, Hernando County, FL
SW-60	02312700	Outlet River at Panacoochee Retreats, Sumter County, FL
SW-61	02312720	Withlacoochee River at Wysong Dam, at Carlson, Sumter County, FL
SW-62	02313000	Withlacoochee River near Holder, Marion County, FL
SW-63	02313700	Waccasassa River near Gulf Hammock, Levy County, FL
SW-64	02320500	Suwannee River at Branford, Suwannee County, FL
SW-65	02321500	Santa Fe River at Worthington Springs, Alachua County, FL
SW-66	02322500	Santa Fe River near Fort White, Gilchrist County, FL
SW-67	02323500	Suwannee River near Wilcox, Levy County, FL
SW-68	02324000	Steinhatchee River near Cross City, Taylor County, FL
SW-69	02324400	Fenholloway River near Foley, Taylor County, FL
SW-70	02325000	Fenholloway River near Perry, Taylor County, FL
SW-71	02326000	Econfina River near Perry, Taylor County, FL
SW-72	02326900	St. Marks River near Newport, Wakulla County, FL
SW-73	02328522	Ochlockonee River near Concord, Leon County, FL
SW-74	02329000	Ochlockonee River near Havana, Leon County, FL
SW-75	02329600	Little River near Midway, Gadsden County, FL
SW-76	02330100	Telogia Creek near Bristol, Liberty County, FL
SW-77	02358000	Apalachicola River at Chatthoochee, Gadsden County, FL
SW-78	02359000	Chipola River near Altha, Calhoun County, FL
SW-79	02359170	Apalachicola River near Sumatra, Franklin County, FL
SW-80	02359500	Econfina Creek near Bennett, Bay County, FL
SW-81	02369000	Shoal River near Crestview, Okaloosa County, FL
SW-82	02375500	Escambia River near Century, Santa Rosa County, FL

Groundwater Sites

GW-1	303025085350501	Well 422A near Greenhead, Washington County, FL
GW-2	300740084293001	Benchmark Well near Crawfordville, Wakulla County, FL
GW-3	285102082204001	DOT-41 at Inverness, Citrus County, FL
GW-4	284842081533001	College Street Well at Leesburg, Lake County, FL
GW-5	282202081384601	Lake Oliver Deep well near Vineland, Orange County, FL
GW-6	283253081283401	OR-47 at Orlo Vista, Orange County, FL
GW-7	274812081190301	P-49 near Frostproof, Polk County, FL
GW-8	270157081203101	H-15A near Palmdale, Highlands County, FL
GW-9	283201082315601	Weeki Wachee Well near Weeki Wachee, Hernando County, FL
GW-10	281715082164401	HWY 577 Well near San Antonio, Pasco County, FL
GW-11	275627082150801	Turner Well near Brandon, Hillsborough County, FL
GW-12	275411081372001	ROMP 57 Well near Lake Wales, Polk County, FL
GW-13	272838082142201	Kibler Deep Well 26B near Bethany, Manatee County, FL
GW-14	271938082251801	Sarasota Well 9 near Sarasota, Sarasota County, FL
GW-15	272012081482501	Marshall Deep Well near Gardner, De Soto County, FL
GW-16	253029080295601	S-196A near Homestead, Miami-Dade County, FL
GW-17	263524080124301	PB-683 near West Palm Beach, Palm Beach County, FL
GW-18	260111081243901	C-496 at Corkscrew Sanctuary, Collier County, FL
GW-19	261957081432201	L-2194 near Bonita Springs, Lee County, FL
GW-20	263335081394301	L-729 near Lehigh Acres, Lee County, FL
GW-21	263251081452801	L-1993 near Fort Myers, Lee County, FL
GW-22	263526082010201	L-2434 near Cape Coral, Lee County, FL

Lake Sites

LK-1	02329900	Lake Talquin near Bloxham, Leon County, FL
LK-2	02236840	Lake Minnehaha at Clermont, Lake County, FL
LK-3	02310290	Moon Lake in Pasco County, FL
LK-4	02276400	Lake Okeechobee, Palm Beach County, FL

Figure 2. Location of monitoring stations in Florida.—Continued.

interstate and international waters, flood forecasts, large river-basin outflows, sentinel watersheds, and water quality. The USGS Cooperative Water Program funds the majority of the data-collection stations in Florida through cost-sharing agreements with water management districts, several State agencies, and many local county and municipal governments.

During the 2008 water year, these programs funded 450 continuous discharge stations, 235 stage-only stations, 405 continuous groundwater stations, 1,200 periodic groundwater stations, 145 continuous water-quality stations, and water-quality samples at 190 discharge and 200 groundwater stations. About 75 percent of the continuous record stations have real-time data available at *http://waterdata.usgs.gov/fl/nwis/rt/*.

Cooperative agreements between the USGS and Florida agencies for the collection of water-resources records have existed since 1930. Agencies that had cooperative agreements with the USGS during the 2008 water year are listed below. Funding for water-resources monitoring through the Jacksonville and Mobile Districts, U.S. Army Corp of Engineers, was obtained through a Military Interdepartmental Purchase Request.

Big Cypress Park
City of Bradenton
City of Cocoa Utilities
City of North Port
City of Sanibel
City of Sarasota
City of Tallahassee
City of Tampa
County of Broward
County of Hillsborough
County of Lee
County of Manatee
County of Miami-Dade
County of Okaloosa
County of Pinellas
County of Santa Rosa
County of Sarasota
County of Seminole
County of Walton
Florida Department of Environmental Protection
Florida Department of Transportation
Jacksonville Electric Authority
Lake County Water Authority
Miami-Dade Water and Sewer
Northwest Florida Water Management District
Orange County Environmental Protection Division
Peace River Regional Water Supply Authority
Reedy Creek Improvement District
Seminole Tribe
South Florida Water Management District
Southwest Florida Water Management District
St. Johns Water Management District
Suwannee River Water Management District
Tampa Bay Water

Hydrologic Conditions in Florida

This section describes the hydrologic conditions in Florida during the 2008 water year. Analyses of data are made for precipitation, surface-water flows, lake elevations, and groundwater levels.

Precipitation

Precipitation quantity and timing affect the hydrologic conditions in streams, lakes, and aquifers in Florida. Although the USGS collects some meteorological data (primarily for project or operational needs), the National Oceanic and Atmospheric Administration, National Weather Service, combines this information with data collected by many other organizations and provides detailed summaries, including weekly and monthly maps depicting: (1) monthly observed precipitation, (2) monthly percentage of normal precipitation, and (3) the weekly drought monitor. Examples of these maps are provided in figures 3 to 5. For this report, the term *precipitation* refers to rainfall. These summaries of rainfall and drought data were used to provide the narrative of rainfall conditions for the 2008 water year, and to serve as background information for understanding changes in water levels and flow in Florida's streams, lakes, and aquifers. In this section, *long-term average* is defined as an average total rainfall for Florida from 1907 to 2007. *Statewide average daily rainfall* is defined as the average of all recorded precipitation values across the state for the given date.

The drought-intensity categories used in the text and figure 5 reflect input from several indicators with different scales of units. The indices used are Percent of Normal Precipitation, Standardized Precipitation Index, Palmer Drought Severity Index, Crop Moisture Index, Surface Water Supply Index, and the Reclamation Drought Index (Hayes, 2008). Generally, these indicators reflect a system of ranking percentiles to correlate with the different intensities (Fuchs, National Drought Mitigation Center, written commun. 2008). Abnormally dry reflects indices that mostly fall within the lowest 30 percent. Moderate drought reflects indices mostly in the lowest 20 percent. Severe drought reflects indices mostly in the lowest 10 percent. Extreme drought reflects indices mostly in the lowest 5 percent. Exceptional drought reflects indices mostly in the lowest 1–2 percent.

October 2007—Precipitation in Florida was slightly higher than normal during October. The long-term average for Florida in October is 3.83 in. (inches); the average for October in 2007 was greater than 5.50 in. The statewide average precipitation was 2.06 in. on October 24, thus setting a new daily record (*http://www.sercc.com/climateinfo_files/monthly/Florida_prcp.html*). The highest monthly total precipitation during October was 17.44 in., recorded at the Pensacola Regional Airport.

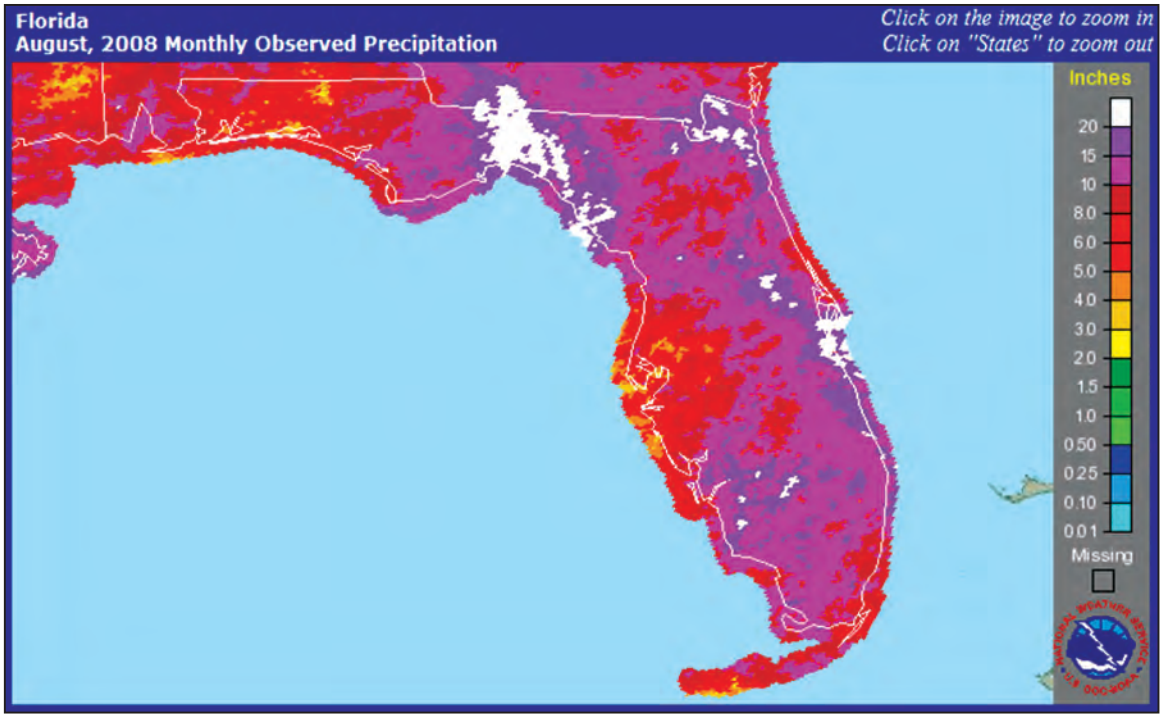


Figure 3. Example of the monthly observed precipitation maps provided by the National Oceanic and Atmospheric Administration, National Weather Service, August 2008.

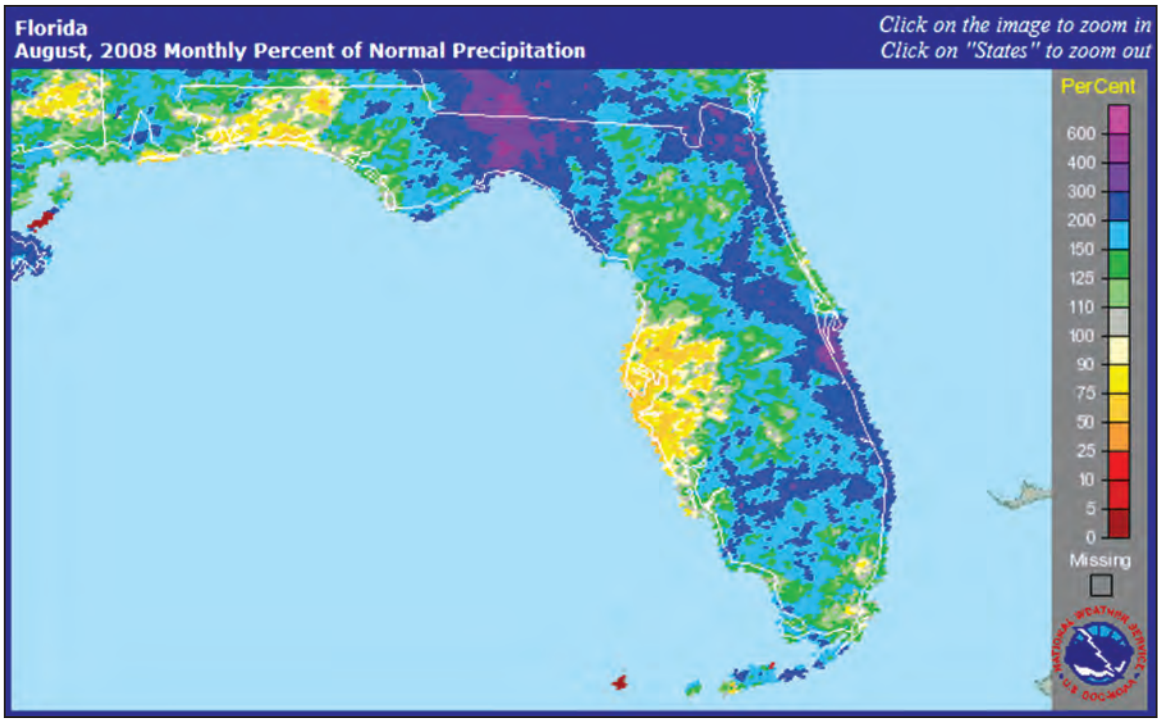
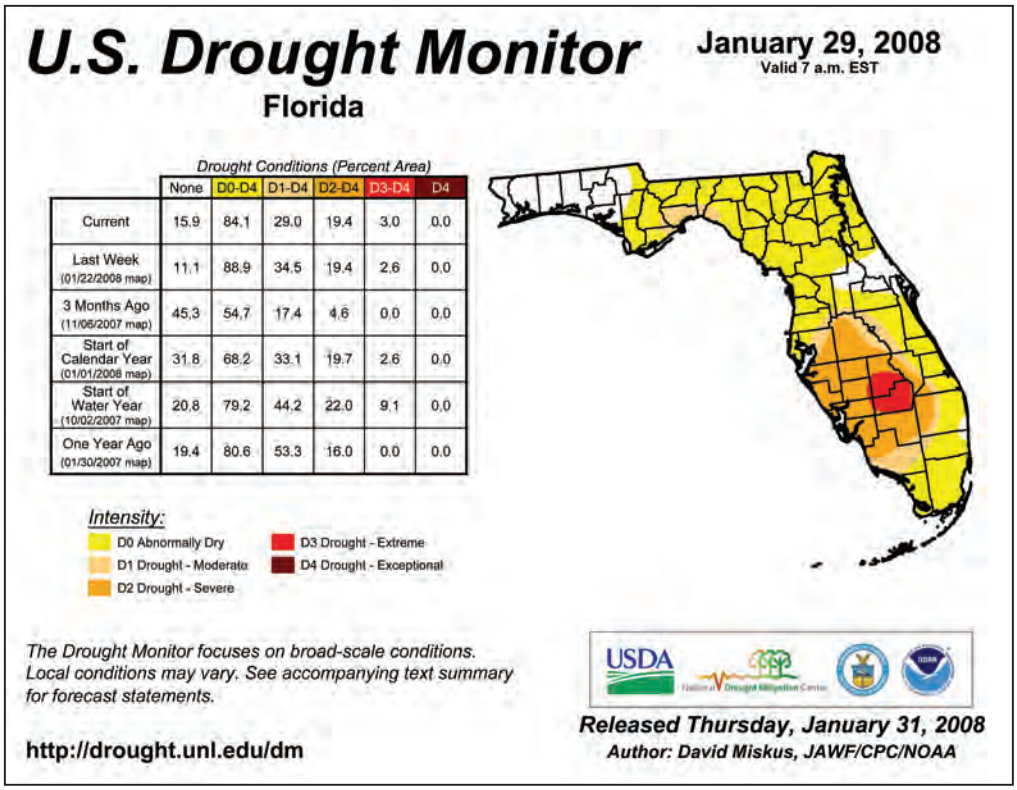


Figure 4. Example of the monthly percentage of normal precipitation maps provided by the National Oceanic and Atmospheric Administration, National Weather Service, August 2008.

A



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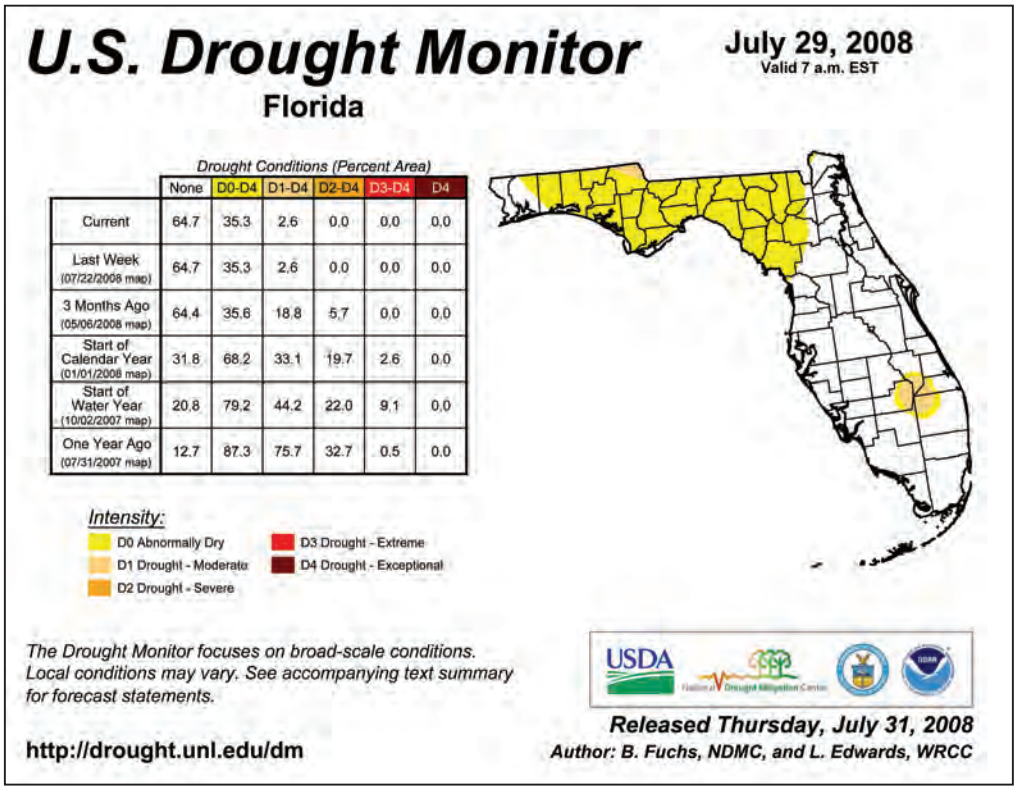

Figure 5. Example of the weekly drought monitor maps provided by the National Oceanic and Atmospheric Administration, National Weather Service, *A*, January 2008, and *B*, July 2008.

November 2007—Northwest Florida received below normal rainfall amounts during November. The south-central area, the southwest coast, and the Everglades received less than 1.0 in. of precipitation, on average. Ft. Myers, Bonita Springs, and surrounding areas were in moderate drought conditions. New Hope received the highest monthly total of 7.26 in. of precipitation. The statewide average precipitation was 1.37 in. for November, nearly 1 in. below the long-term average of 2.33 in.

December 2007—Statewide precipitation was below normal during December. Niceville had the highest amount of monthly total precipitation, with 9.09 in. On December 16, a cold front that stalled across the Gulf of Mexico brought significant rainfall to the northwest, north, and north-central parts of Florida. During this event, New Hope received 3.45 in., Cross City received 2.80 in., and De Land received 2.30 in. of precipitation. Although north Florida received near-normal amounts of rainfall in December, south Florida was unusually dry, causing severe drought conditions in south-central Florida.

January 2008—January rainfall was below normal throughout the State, continuing the drought conditions for most of Florida. Abnormally dry conditions extended from the panhandle into central Florida. Moderate to extreme drought conditions existed in southwest Florida. Big Cypress, the Everglades, Marco Island, and Naples Municipal Airport all received less than 1 in. of precipitation during January.

February 2008—Northwest and north Florida had two significant rainfall events that resulted in above normal average totals on February 17–18 and February 21–23. Panama City received 14.37 in., Clarksville received 11.68 in., and Marianna received 10.33 in. for February. Although the heavy rainfall alleviated the abnormally dry conditions across the panhandle, extreme drought conditions continued in south-central Florida. Most of this region received less than the long-term average of 3.19 in. for February. Arcadia, Avon Park, Bradenton, Ft. Pierce, Myakka River State Park, Parrish, Venice, and Vero Beach were a few of the locations that received less than 2 in. of precipitation for February.

March 2008—Statewide precipitation was below normal for March. South-central Florida and the lower east coast of Florida received on average 3.5 in. and 4.9 in., respectively. The D3—Extreme drought condition west of Lake Okeechobee improved to D1—Moderate drought condition. Stuart received the highest total amount of rainfall in the State (8.54 in.) during March.

April 2008—Rainfall was above normal in Florida as widespread rainfall events temporarily relieved most drought conditions. Naples received 7.50 in., Saint Leo 6.14 in., Plant City 5.49 in., and Tallahassee 4.02 in. However, D0-D1 drought conditions persisted along the southwest coast of Florida from Bradenton to the Everglades.

May 2008—Heavy rainfall during May in southeast Florida produced 2 to 6 in. of precipitation in some areas. However, statewide precipitation totals were still 2.18 in. below normal. Miami Beach received the highest total precipitation (6.05 in.), nearly doubling the long-term statewide average for May. The southeast coast of Florida was in normal to D0 abnormally dry conditions. D0-D2 drought conditions continued in southwest Florida. Normal to D0 conditions existed north of Rusk. Two stations in the Florida Keys, Islamorada and the Dry Tortugas, as the Kissimmee station recorded no precipitation for May.

June 2008—The southeast coast of Florida continued to receive above normal rainfall in June. Miami received more than 7 in. Despite the abundant rainfall in Miami and throughout the State, groundwater levels remained lower than normal. During June, most of Florida was at minimum D0 drought conditions. The precipitation in south Florida alleviated the D1 and D2 drought conditions.

July 2008—Precipitation for Florida was 0.83 in. above normal for July. Big Corkscrew received the highest total precipitation with 17.96 in. The highest 24-hour total precipitation occurred on July 17 at March Island, which received 6.13 in. Northwest Florida was below normal for July. Tallahassee was 3.77 in. below the long-term average. D0 drought conditions existed in northwest Florida and areas surrounding Lake Okeechobee. Most of Florida received abundant rainfall during July, thus alleviating the previous D0-D2 drought conditions.

August 2008—Due to the large amount of precipitation produced by Tropical Storm Fay, drought conditions were nonexistant in Florida during August. Due to the slow movement of this tropical system, precipitation exceeded 24 in. across parts of east-central Florida. Big Corkscrew station received the highest total precipitation for the second consecutive month with 32.35 in. of rainfall. Precipitation for Melbourne was 27.65 in. and the panhandle received 10 in. or more, on average.

September 2008—After the record-setting totals produced by Tropical Storm Fay during August, precipitation throughout Florida during September was much lower than normal. D0 drought conditions (fig. 5A) returned to the western part of the panhandle. Tampa Bay area had minimal effects from the Tropical Fay rainfall during August. St. Petersburg received only 1.20 in. of precipitation during September, thus causing a -6.39 in. departure from normal. The entire south-central region of the State was at least 24 in. below normal. Overall, water year 2008 concluded with near normal conditions throughout Florida.

Surface Water

Annual discharge rates varied across Florida during the 2008 water year and ranged from below normal across the State to near normal in parts of the panhandle. Several sites reached record-low monthly mean discharges during the year, while others reached record-high monthly mean discharges. Record-low discharges throughout the State were the result of below normal rainfall and runoff associated with drought conditions continuing from the 2007 water year. Record-high monthly mean discharges and instantaneous peak river elevations and/or discharges that occur in August and September were the direct result of heavy rainfall associated with the four Florida landfalls of Tropical Storm Fay beginning August 18 (Verdi and Holt, 2010).

Table 1 provides data from 29 representative streamgages across the State of Florida showing water years 2007 (as a comparison) and 2008 annual mean discharge and percent of mean for the period of record. Table 2 provides data showing record-low monthly mean discharges, month(s) of occurrence, and previous record and year of occurrence for streamgages across the State. Table 3 provides data showing record-high monthly mean discharges, month(s) of occurrence, and previous record and year of occurrence for streamgages across the State. Table 4 provides the peak discharge and gage height for sites reaching period of record instantaneous peak discharges caused by Tropical Storm Fay.

Discharge hydrographs for the representative streams in Florida are shown in figures 6 to 34. The upper graph *A* shows the 2008 water year monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period of record at that site. The lower graph *B* shows the monthly mean discharge for the 1999–2008 calendar years.

Northwest Florida

Annual mean discharge across northwest Florida was below normal to near normal during the 2008 water year, but was below normal during the previous year (table 1). For example, the annual discharge at Suwannee River at Branford (02320500) during water year 2008 was 4,270 ft^3/s, which is 62 percent of the period of record (1931–2008) average of 6,840 ft^3/s (table 1). The annual discharge at Santa Fe River at Worthington Springs (02321500) was 224 ft^3/s, which is 54 percent of the period of record (1932–2008) average of 411 ft^3/s. This is a significant increase from the previous year when annual discharge was less than 1 percent of the period of record average (table 1). The annual discharge at Shoal River near Crestview (02369000) was 1,010 ft^3/s during the 2008 water year, which is 92 percent of the period of record (1938–2008) average of 1,100 ft^3/s (table 1).

Monthly mean discharges averaged well below normal from October through July, but then averaged near normal to above normal during August and September. Streamgages throughout northwest Florida reached record-low or record-high monthly mean discharges during the year (tables 2 and 3). Some streamgage locations recorded peak of record discharge associated with the rainfall and runoff from Tropical Storm Fay (table 4). Figures 6 through 12 show the seven representative streams in northwest Florida.

The dry conditions throughout the analysis period from October to July were caused by less than normal rainfall that had persisted throughout the region. Several streamgage locations registered record-low monthly mean discharges during the year (table 2). For example, monthly mean discharges reached period of record (1928–1930 and 1932–2008) low levels during October (727 ft^3/s) and November (620 ft^3/s) at Santa Fe River near Fort White (02322500). The previous records were in 1956 (730 ft^3/s) and 2002 (636 ft^3/s), respectively (table 2). Econfina Creek near Bennett (02359500) reached period-of-record (1936–1994 and 1999–2008) low monthly mean discharges during November (312 ft^3/s). The previous record was 323 ft^3/s in 1956 (table 2).

Higher than normal monthly mean discharges during August and September were the direct result of Tropical Storm Fay moving through this part of Florida from August 22 to 24 (Verdi and Holt, 2010). A few streamgages in northwest Florida reached record-high monthly mean discharges during August or September. For example, the St. Marks River near Newport (02326900; period of record from 1957–1976; 1992–1994, and 1996–2008) gage reached a new September high monthly mean discharge of 1,660 ft^3/s. The previous record was 1,560 ft^3/s, set in 1957 (table 3). The Little River near Midway (02329600; period of record from 1986–2008) gage reached a new August high monthly mean discharge of 1,740 ft^3/s. The previous record there was 1,620 ft^3/s set in 1994 (table 3).

Instantaneous peak discharge and other notable discharge peaks associated with Tropical Storm Fay occurred during 2008. For example, the St. Mark's River near Newport streamgage (02326900; period of record from 1957–1976; 1992–1994, and 1996–2008) recorded a peak discharge of 5,890 ft^3/s on August 25 (table 4). A discharge event of this magnitude has an exceedance probability of less than 0.01, indicating the event has less than a 1 percent chance of occurring in any given year (table 4) (Verdi and Holt, 2010). The Ochlockonee River near Concord streamgage (02328522; period of record from 1999 to 2008) recorded a peak discharge of 54,400 ft^3/s on August 25 (table 4). The Ochlockonee River near Havana streamgage (02329000) recorded a peak discharge of 37,400 ft^3/s on August 25, which is the second highest recorded peak in its 83-year period of record from 1926 to 2008. A discharge event of this magnitude has an exceedance probability of 0.01 to 0.02, indicating the event size has a 1 to 2 percent chance of occurring in any given year. The record peak of 55,900 ft^3/s at the Havana gage occurred during the flood of April 4, 1948 (Verdi and Holt, 2010).

Table 1. Relation of period-of-record mean annual discharge to mean discharge for the 2007 and 2008 water years.

[Discharge values listed in cubic feet per second]

Station number	Station name	Mean annual discharge		Mean discharge for the 2007 water year		Mean discharge for the 2008 water year	
	Representative streams in Florida	Period of record	Value	Value	Percent of mean	Value	Percent of mean
	Northwest Florida						
02320500	Suwannee River at Branford, Florida	1931-2008	6,840	2,110	31	4,270	62
02321500	Santa Fe River at Worthington Springs, Florida	1932-2008	411	3.80	<1	224	54
02324000	Steinhatchee River near Cross City, Florida	1950-2008	300	25.5	8	65.6	22
02329000	Ochlockonee River near Havana, Florida	1926-2008	1,040	289	28	1,120	108
02359000	Chipola River near Altha, Florida	1913-2008	1,470	682	46	1,150	78
02369000	Shoal River near Crestview, Florida	1938-2008	1,100	502	46	1,010	92
02375500	Escambia River near Century, Florida	1934-2008	6,180	2,980	48	4,220	68
	Northeast Florida						
02231000	St. Mary's River near Macclenny, Florida	1927-2008	643	150	23	792	123
02232400	St. John's River near Cocoa, Florida	1954-2008	1,020	356	35	951	93
02236000	St. John's River near De Land, Florida	1934-2008	3,050	1,320	43	2,850	93
02240000	Ocklawaha River near Conner, Florida	1930-2008	1,040	565	54	601	58
02256500	Fisheating Creek at Palmdale, Florida	1931-2008	255	38.5	15	227	89
02266300	Reedy Creek near Vineland, Florida	1966-2008	45.2	14.5	32	30.1	67
02270500	Arbuckle Creek near De Soto City, Florida	1939-2008	306	89.7	29	193	63
02312000	Withlacoochee River at Trilby, Florida	1928-2008	323	9.57	3	42.6	13
02312200	Little Withlacoochee River at Rerdell, Florida	1958-2008	76.7	0.71	<1	9.89	13
02313000	Withlacoochee River near Holder, Florida	1928-2008	978	159	16	287	29
	Southwest Florida						
02296750	Peace River at Arcadia, Florida	1932-2008	1,070	184	17	413	38
02298830	Myakka River near Sarasota, Florida	1937-2008	254	48.8	19	133	52
02301500	Alafia River at Lithia, Florida	1933-2008	335	121	36	191	57
02303000	Hillsborough River near Zephyrhills, Florida	1940-2008	240	80.8	34	114	48
02310000	Anclote River near Elfers, Florida	1947-2008	63.3	3.19	5	38.8	61
	South Florida						
02276877	St. Lucie Canal below S-308 near Port Mayaca, Florida	1931-2008	874	-25.0	-3	([1])	([1])
02292900	Caloosahatchee River at S-79 near Olga, Florida	1966-2008	1,620	149	9	1,070	66
02278000	West Palm Beach Canal at S-352 at Canal Point, Florida	1940-2008	168	106	63	0.00	0
02280500	Hillsboro Canal below S-351 near South Bay, Florida	1957-2008	22.2	133	599	([1])	([1])
02283500	North New River Canal below S-2 and S-351 near South Bay, Florida	1957-2008	115	126	110	7.82	7
02286400	Miami Canal at S-354 and S-3 at Lake Harbor, Florida	1958-2008	81.3	150	184	77.0	95
2645140-80550700	Industrial Canal at Clewiston, Florida	1976-2008	49.4	14.5	29	-19.5	-39

[1]Insufficient data available to compute an annual mean discharge.

Table 2. Stations reaching record-low monthly mean discharge and month(s) of occurrence during the 2008 water year and their previous record and year of occurrence.

[Discharge values listed in cubic feet per second]

Station number	Station name	Period of record	Month of record-low discharge in 2008	Discharge	Previous record discharge	Year of occurrence
			Northwest Florida			
02313700	Waccasassa River near Gulf Hammock, Florida	1963-1978;1981-1984; 1985-1992; 1999-2008	August	20.5	29.1	1991
02320500	Suwannee River at Branford, Florida	1931-2008	December	1,500	1,600	1991
02322500	Santa Fe River near Fort White, Florida	1928-1930; 1932-2008	October	727	730	1956
			November	620	636	2002
02323500	Suwannee River near Wilcox, Florida	1931; 1942-2008	October	2,480	3,010	2003
			November	2,110	3,210	2002
			December	1,880	2,580	2002
02324000	Steinhatchee River near Cross City, Florida	1950-2008	January	7.66	12.4	2000
			February	12.7	13.0	1957
			May	4.30	4.45	2001
02324400	Fenholloway River near Foley, Florida	1956-2008	November	0.55	0.70	1969
			December	0.55	0.58	2001
			June	0.31	0.32	2000
			July	0.33	0.36	2000
02325000	Fenholloway River near Perry, Florida	1952-1954; 1965-1984; 1986-2008	October	72.1	75.3	2002
			May	75.5	77.1	2001
			June	74.1	76.1	2001
			July	71.0	75.9	2004
02326000	Econfina River near Perry, Florida	1950-2008	October	0.81	6.26	1994
			November	0.04	8.18	1969
			December	0.00	6.22	1991
			January	0.13	9.47	1957
			June	3.80	4.80	1955
			July	2.39	4.49	1955
02330100	Telogia Creek near Bristol, Florida	1950-1971; 1975-1979; 1981-2008	November	46.5	46.9	1991
			December	64.0	69.3	1991
02358000	Apalachicola River at Chattahoochee, Florida	1929-2008	October	5,130	5,320	1955
			November	4,980	5,520	1932
			December	5,980	7,340	2002
02359000	Chipola River near Altha, Florida	1913-2008	November	309	370	1991
02359170	Apalachicola River near Sumatra, Florida	1978-2008	November	5,860	6,480	2002
			December	6,520	7,970	2002
			June	5,790	6,080	2000
02359500	Econfina Creek near Bennett, Florida	1936-1994; 1999-2008	November	312	323	1956
			Northeast Florida			
02232000	St. John's River near Melbourne, Florida	1940-2008	April	-22.3	0.00	1956
			May	-46.0	-23.5	2000
02232155	Pennywash Creek near Deer Park, Florida	1995-2008	May	0.02	0.10	2007
02232500	St. John's River near Christmas, Florida	1934-2008	June	5.43	8.45	2000
02236125	St. John's River at Astor, Florida	1994-2008	December	954	1,140	2001

Table 2. Stations reaching record-low monthly mean discharge and month(s) of occurrence during the 2008 water year and their previous record and year of occurrence.—Continued

[Discharge values listed in cubic feet per second]

Station number	Station name	Period of record	Month of record-low discharge in 2008	Discharge	Previous record discharge	Year of occurrence
		Northeast Florida—Continued				
02243000	Orange Creek at Orange Springs, Florida	1942-1951; 1956-1971; 1975-2008	June	2.16	2.31	2000
02243960	Ocklawaha River at Rodman Dam, near Orange Springs, Florida	1969-2008	March	388	421	2001
02246025	Black Creek near Doctor's Inlet, Florida	1982-1987; 1995-1997; 2001-2008	November	115	131	2007
			December	99.2	104	1983
			May	27.6	96.8	1982
			June	72.2	127	1984
02249500	Crane Creek at Melbourne, Florida	1951-1968; 2003-2008	March	4.98	5.49	1968
02250030	Turkey Creek at Palm Bay, Florida	1981-1983; 1987-2006; 2007-2008	May	26.7	30.5	2007
02251000	South Prong St. Sebastian River near Sebastian, Florida	1994-2008	January	28.6	33.8	2001
			February	25.2	29.2	2001
			May	9.04	23.4	2000
			June	7.49	18.4	1998
02253000	Main Canal at Vero Beach, Florida	1949-2008	December	3.64	5.39	1956
			January	4.04	15.8	2007
			February	4.15	15.2	2007
			March	4.11	6.62	2007
			May	0.21	1.46	2007
			June	0.00	24.4	2000
			July	13.6	14.7	1997
			September	0.83	27.2	2002
02257000	Fisheating Creek at Lakeport, Florida	1949-1950; 1997-2008	October	73.6	175	2007
			November	20.9	47.1	1998
			December	17.2	49.0	2007
			January	27.9	33.9	2001
02312700	Outlet River at Panacoochee Retreats, Florida	1963-2008	October	20.4	31.6	1964
02312720	Withlacoochee River at Wysong Dam, at Carlson, Florida	1966-1980; 1982-2008	October	43.5	55.8	2001
		Southwest Florida				
02270000	Carter Creek near Sebring, Florida	1955-2008	October	6.16	7.41	2007
			November	4.67	5.80	2001
			December	3.48	5.75	2001
			January	3.93	5.35	2001
			February	3.31	3.45	2001
			May	1.24	1.62	2007
02294650	Peace River at Bartow, Florida	1940-2008	December	5.19	6.67	2001
02295420	Payne Creek near Bowling Green, Florida	1964-2008	December	8.34	8.94	2001
02298202	Shell Creek near Punta Gorda, Florida	1965-2008	November	41.4	42.2	2001
02303000	Hillsborough River near Zephyrhills, Florida	1940-2008	September	90.2	91.9	1978

Table 2. Stations reaching record-low monthly mean discharge and month(s) of occurrence during the 2008 water year and their previous record and year of occurrence.—Continued

[Discharge values listed in cubic feet per second]

Station number	Station name	Period of record	Month of record-low discharge in 2008	Discharge	Previous record discharge	Year of occurrence
		Southwest Florida—Continued				
02306000	Sulphur Springs at Sulphur Springs, Florida	1960-2008	September	26.7	30.4	2006
02310300	Pithlachascotee River near New Port Richey, Florida	1964-2008	December	0.23	0.41	2000
		South Florida				
02276877	St. Lucie Canal below S-308 near Port Mayaca, Florida	1931-2008	November December February	-189 -223 -55.2	-120 -138 -24.1	1988 1986 1991
02278500	Diversions to Conservation Area at S-5A near Loxahatchee, Florida	1958-2008	March	-301	-181	2007
02281400	Hillsboro Canal near Margate, Florida	1976-2008	January	31.0	47.4	1992
02287497	Northwest Wellfield Canal near Dade Broward Levee, Florida	1991-2008	October, November December January February March	12.7 10.7 50.3 69.4 62.8 66.2	13.3 12.2 62.6 81.8 78.9 74.8	2007 2007 2006 2007 2005 2007
02288600	Miami Canal at Northwest 36th Street, Miami, Florida	1959-2008	September	54.4	76.6	1987
02290766	Levee 31 North Extension at 4 Mile near West Miami, Florida	1994-2008	December	207	241	2007
02290767	Levee 31 North Extension at 5 Mile near West Miami, Florida	1994-2008	December	196	242	2007
02290768	Levee 31 North Extension at 7 Mile near West Miami, Florida	1994-2008	December	195	252	2007
02291524	Spring Creek Headwater near Bonita Springs, Florida	1988-2008	October November December January	3.55 0.50 0.40 0.40	4.05 1.63 1.02 0.71	1990 1990 1993 1997
02291597	South Branch Estero River at Estero, Florida	1988-2008	October	2.34	4.87	1989
02292900	Caloosahatchee River at S-79 near Olga, Florida	1966-2008	November	7.25	17.2	2007
02293241	San Carlos Canal at Cape Coral, Florida	1987-2008	June	0.00	0.02	2001
02293264	Gator Slough at State Road 765 at Cape Coral, Florida	1984-1997; 2000-2008	October November	15.8 0.24	17.2 0.43	2007 2005
02293345	Shadroe Canal at Cape Coral, Florida	1987-2008	October November	0.00 0.00	2.56 0.50	1989 1991
02293346	Horseshoe Canal at Cape Coral, Florida	1987-2008	October	2.90	4.44	1990

Table 3. Stations reaching record-high monthly mean discharge and month(s) of occurrence during the 2008 water year and their previous record and year of occurrence.

[Discharge values listed in cubic feet per second]

Station number	Station name	Period of record	Month of record-high discharge in 2008	Discharge	Previous record discharge	Year of occurrence
		Northwest Florida				
02326900	St. Marks River near Newport, Florida	1957-1976; 1992-1994; 1996-2008	September	1,660	1,560	1957
02328522	Ochlockonee River near Concord, Florida	1999-2008	August	4,630	2,600	2003
02329600	Little River near Midway, Florida	1986-2008	August	1,740	1,620	1994
		Northeast Florida				
02231000	St. Mary's River near MacClenny, Florida	1927-2008	August	4,490	3,300	1945
02231342	Ft. Drum Creek at Sunshine State Parkway near Ft. Drum, Florida	1977-2008	August	363	222	1995
02231396	Blue Cypress Creek near Fellsmere, Florida	1969-1970; 1996-2008	August	559	487	2003
02231454	Sixmile Creek near Kenansville, Florida	1995-2008	August	44.1	42.4	2001
02231600	Jane Green Creek near Deer Park, Florida	1954-2008	August	1,530	1,430	1964
02232000	St. John's River near Melbourne, Florida	1940-2008	August	2,910	2,700	2002
02232400	St. John's River near Cocoa, Florida	1954-2008	September	5,410	5,050	1960
02233475	Little Econlockhatchee River at State Highway 434 near Oviedo, Florida	1997-2008	August	475	467	2004
02233500	Econlockhatchee River near Chuluota, Florida	1936-2008	August	1,900	1,440	2003
02234000	St. John's River above Lake Harney near Geneva, Florida	1982-2008	September	8,520	7,420	2004
02234308	Howell Creek near Altamonte Springs, Florida	1997-2008	August	76.0	72.3	2004
02234324	Howell Creek near Slavia, Florida	1972-1979; 1981-2008	August	147	144	1995
02234384	Soldier Creek near Longwood, Florida	1972-1975; 1987-2008	August September	90.6 93.4	44.0 80.2	2003 2004
02234400	Gee Creek near Longwood, Florida	1972-1979; 1985-2008	August	113	86.7	2003
02234435	Lake Jesup Outlet near Sanford, Florida	1993-2008	September	899	578	2002
02234500	St. John's River near Sanford, Florida	1987-1989; 1995-2008	September	11,400	8,750	2002
02235000	Wekiva River near Sanford, Florida	1936-2008	August	630	592	2003
02235200	Blackwater Creek near Cassia, Florida	1962-1967; 1968-1969; 1981-2008	August	236	166	2005
02236000	St. John's River near De Land, Florida	1934-2008	September	12,800	12,100	1960
02236125	St. John's River at Astor, Florida	1994-2008	September	13,600	9,460	2004
02244040	St. John's River at Buffalo Bluff near Satsuma, Florida	1993-2008	September	15,700	13,300	2004
02245260	Deep Creek at Spuds, Florida	1992-2008	August	345	343	2003
02246025	Black Creek near Doctor's Inlet, Florida	1982-1987; 1995-1997; 2001-2008	August	1,920	1,050	1995
02248000	Spruce Creek near Samsula, Florida	1951-2008	August	217	181	1976
02249007	Eau Gallie River at Heather Glen Circle at Melbourne, Florida	1991-2008	July August	31.5 83.7	30.5 52.5	2001 1995
02249500	Crane Creek at Melbourne, Florida	1951-1968; 2003-2008	August	146	49.0	1966

Table 3. Stations reaching record-high monthly mean discharge and month(s) of occurrence during the 2008 water year and their previous record and year of occurrence.—Continued

[Discharge values listed in cubic feet per second]

Station number	Station name	Period of record	Month of record-high discharge in 2008	Discharge	Previous record discharge	Year of occurrence
		Northeast Florida—Continued				
02250030	Turkey Creek at Palm Bay, Florida	1981-1983; 1987-2006; 2007-2008	August	874	725	1995
02251000	South Prong St. Sebastian River near Sebastian, Florida	1994-2008	August	378	319	1997
02251500	North Prong St. Sebastian River near Micco, Florida	1987-2008	August	258	152	1994
02251767	Fellsmere Canal near Micco, Florida	1992-2008	August	334	211	2003
02252500	North Canal near Vero Beach, Florida	1951-2008	August	168	119	1981
02253500	South Canal near Vero Beach, Florida	1951-2008	July August	186 226	143 208	1968 1981
02257000	Fisheating Creek at Lakeport, Florida	1949-1950; 1997-2008	August	1,890	1,530	2001
		South Florida				
02288900	Tamiami Canal Outlets, 40-Mile Bend to Monroe, Florida	1964-2008	September	2,520	2,320	2005
02291580	North Branch Estero River at Estero, Florida	1987-2008	May	3.28	0.31	2005
02293214	Meade Canal at Cape Coral, Florida	1987-2008	April September	9.17 36.9	5.06 22.9	2003 1995
02293240	Aries Canal at Cape Coral, Florida	1990-2008	July August	135 87.2	127 86.6	1999 2004
02293347	Hermosa Canal at Cape Coral, Florida	1987-2008	September	163	151	2006

Table 4. Peak discharges, river levels, and exceedance probabilities compared to period-of-record peak discharges, river levels, and exceedance probabilites for sites reaching period of record instantaneous peak discharges caused by Tropical Storm Fay.

[ft^3/s, cubic foot per second]

USGS station number	Streamflow-gaging station	Period of record through 2008	Peak of event					Period-of-record peak discharge				
			Peak discharge (ft^3/s)	Date	Peak river level (feet above NGVD 1929)	Date	Exceedance probability[1]	Magnitude (ft^3/s)	Date	Peak river level (feet above NGVD 1929)	Date	Exceedance probability[1]
02231342	Fort Drum Creek near Fort Drum, Florida	1977-2008	2,360	8/20/2008	39.88	8/20/2008	<0.01	1,470	9/27/2004	39.09	9/27/2004	0.1-0.04
02234384	Soldier Creek near Longwood, Florida	1972-1975; 1987-2008	762	8/21/2008	14.48	8/21/2008	--	605	11/25/1992	14.41	9/13/1973	--
02249500	Crane Creek at Melbourne, Florida	1951-1968; 2003-2008	1,550	8/20/2008	15.29	8/20/2008	<0.01	831	9/26/2004	13.98	10/24/2005	0.1-0.04
02250030	Turkey Creek at Palm Bay, Florida	1981-1983; 1987-2006; 2007-2008	[2]5,530	8/20/2008	9.05	8/20/2008	--	[2]4,050	9/26/2004	8.16	9/26/2004	--
02326900	St. Marks River near Newport, Florida	1957-1976; 1992-1994; 1996-2008	5,890	8/25/2008	17.39	8/25/2008	<0.01	4,750	4/7/1973	15.34	4/7/1973	0.04-0.02
02328522	Ochlockonee River near Concord, Florida	1999-2008	54,400	8/25/2008	115.52	8/25/2008	--	23,700	7/13/2005	111.31	7/13/2005	--

[1]Based on period of record data to 2006.

[2]Indicates value is a daily mean.

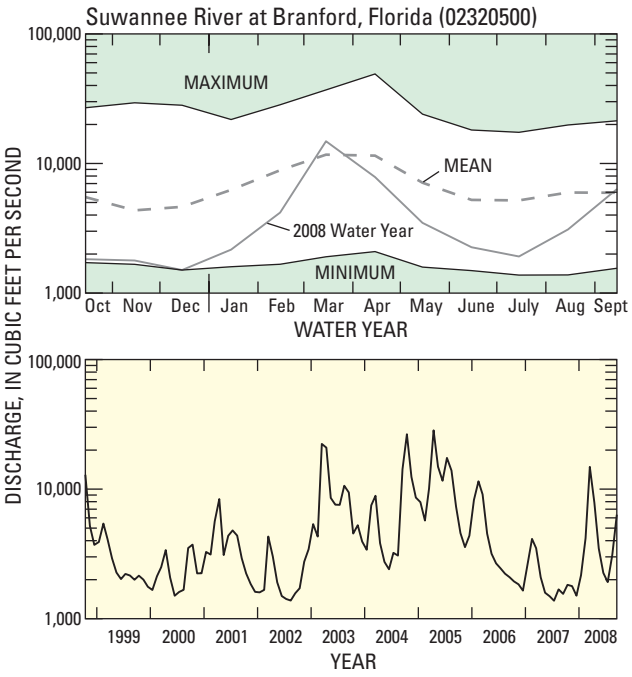

Figure 6. Suwannee River at Branford water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1931-2008, and the monthly mean discharge for the period October 1998 to September 2008.

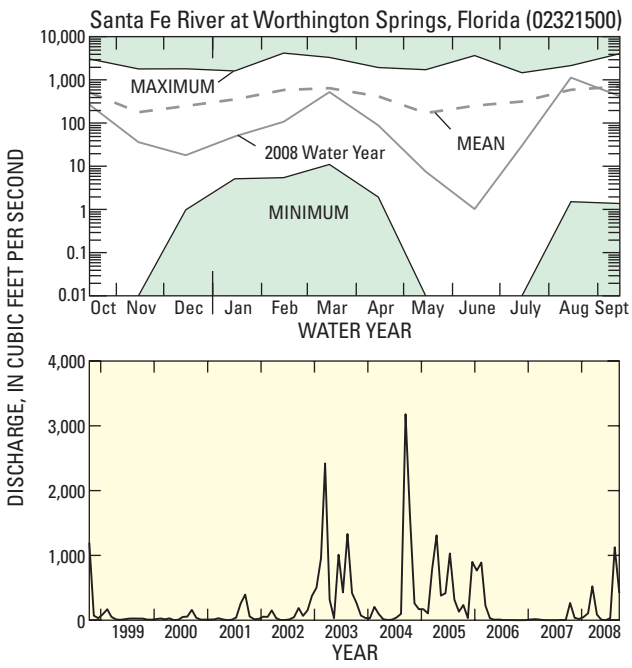

Figure 7. Santa Fe River at Worthington Springs water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1932-2008, and the monthly mean discharge for the period October 1998 to September 2008.

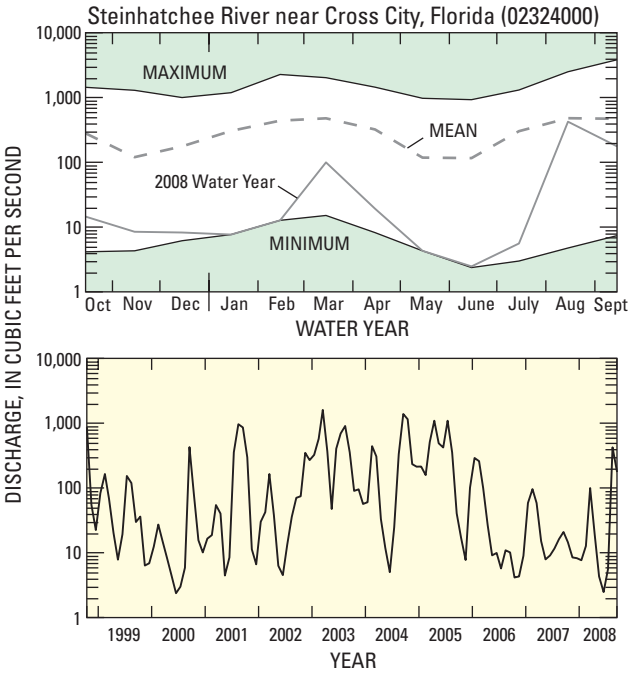

Figure 8. Steinhatchee River near Cross City water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1950-2008, and the monthly mean discharge for the period October 1998 to September 2008.

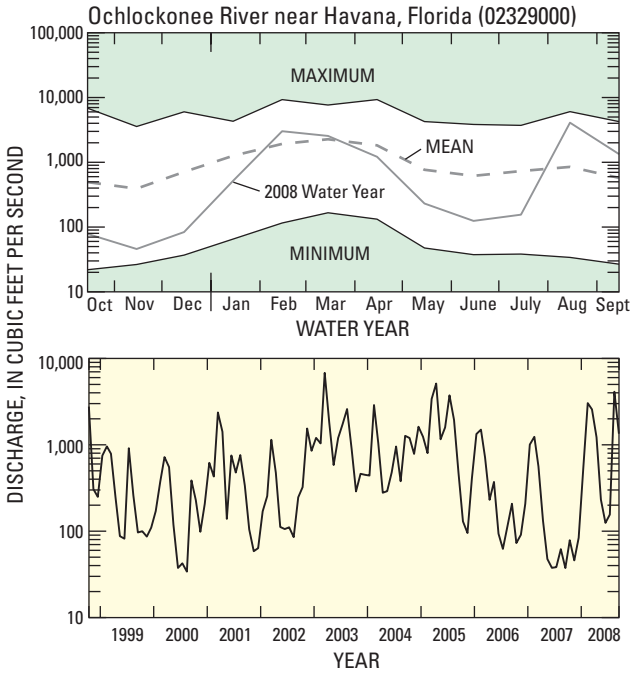

Figure 9. Ochlockonee River near Havana water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1926-2008, and the monthly mean discharge for the period October 1998 to September 2008.

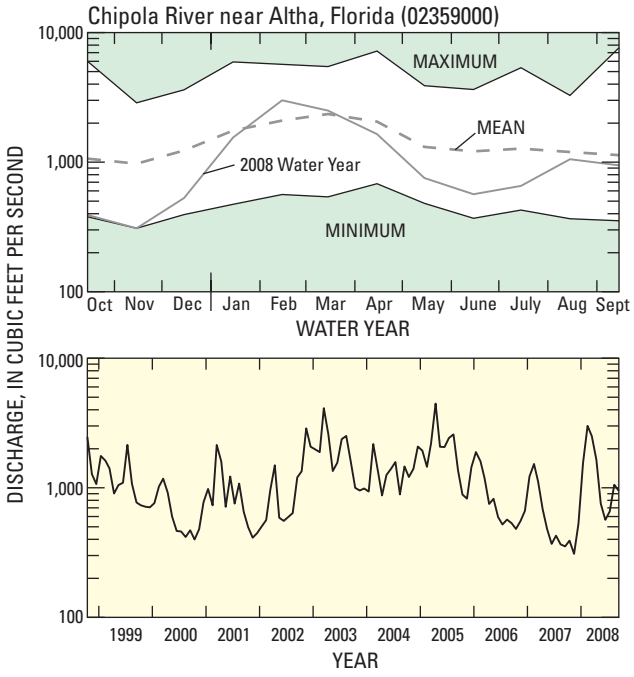

Figure 10. Chipola River near Altha water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1913-2008, and the monthly mean discharge for the period October 1998 to September 2008.

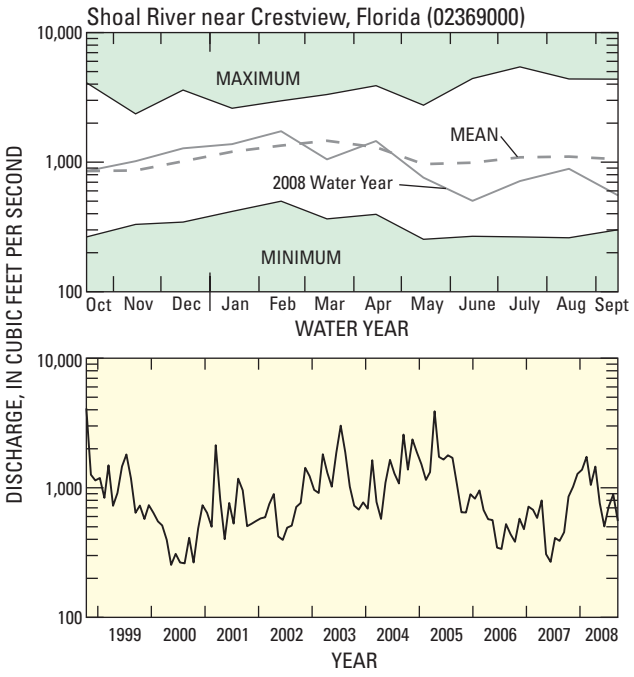

Figure 11. Shoal River near Crestview water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1938-2008, and the monthly mean discharge for the period October 1998 to September 2008.

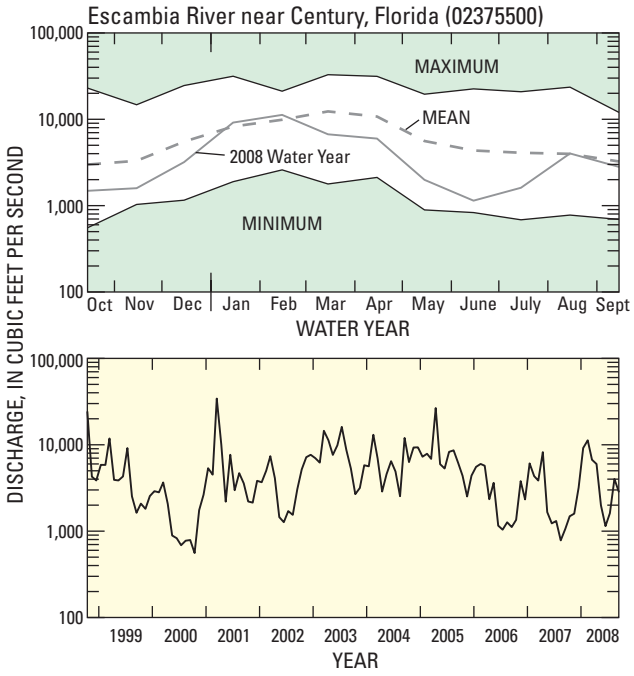

Figure 12. Escambia River near Century water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1934-2008, and the monthly mean discharge for the period October 1998 to September 2008.

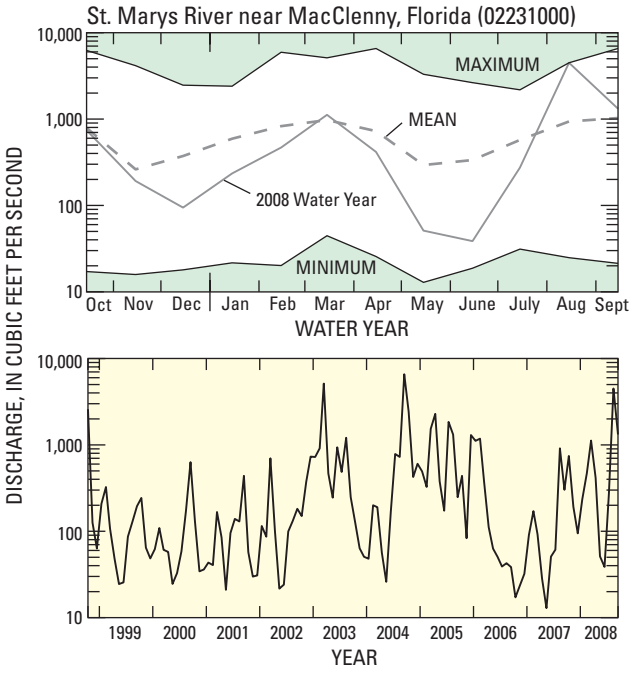

Figure 13. St. Mary's River near MacClenny water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1927-2008, and the monthly mean discharge for the period October 1998 to September 2008.

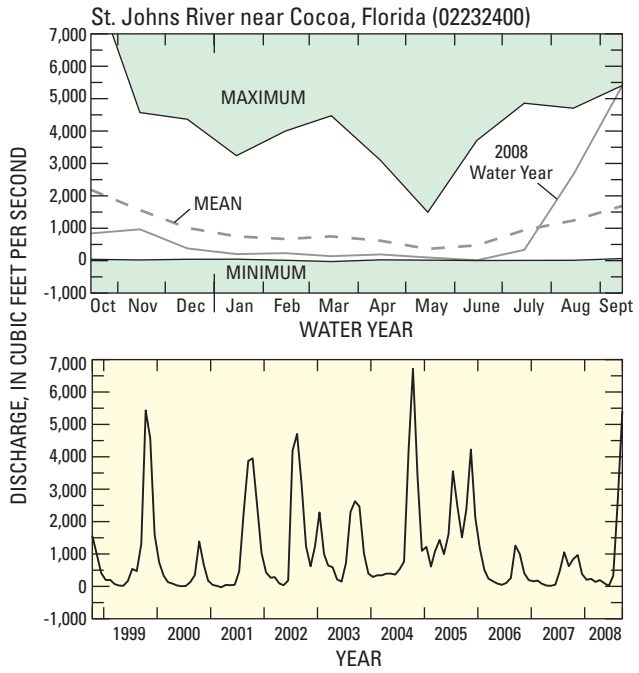

Figure 14. St. John's River near Cocoa water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1954-2008, and the monthly mean discharge for the period October 1998 to September 2008.

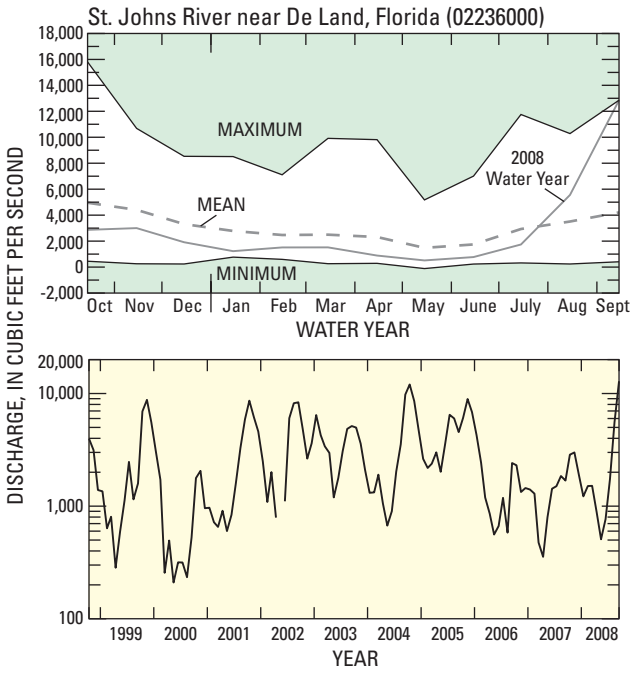

Figure 15. St. John's River near De Land water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1934-2008, and the monthly mean discharge for the period October 1998 to September 2008.

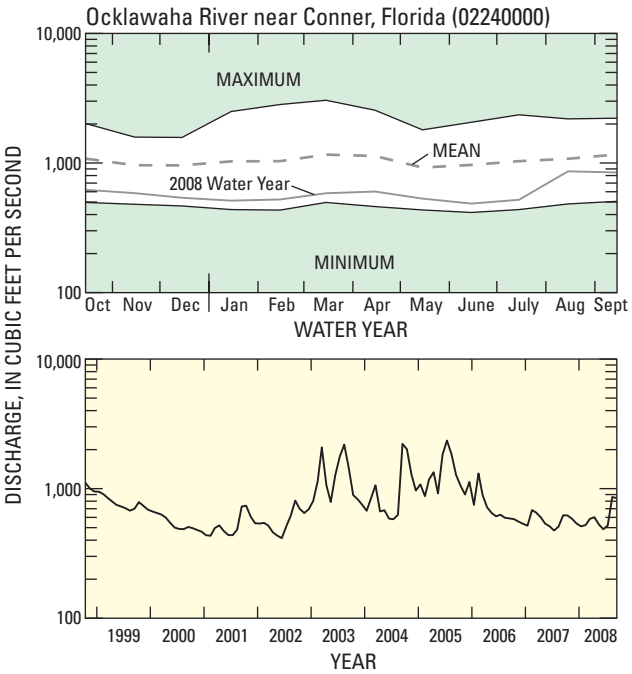

Figure 16. Ocklawaha River near Conner water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1930-2008, and the monthly mean discharge for the period October 1998 to September 2008.

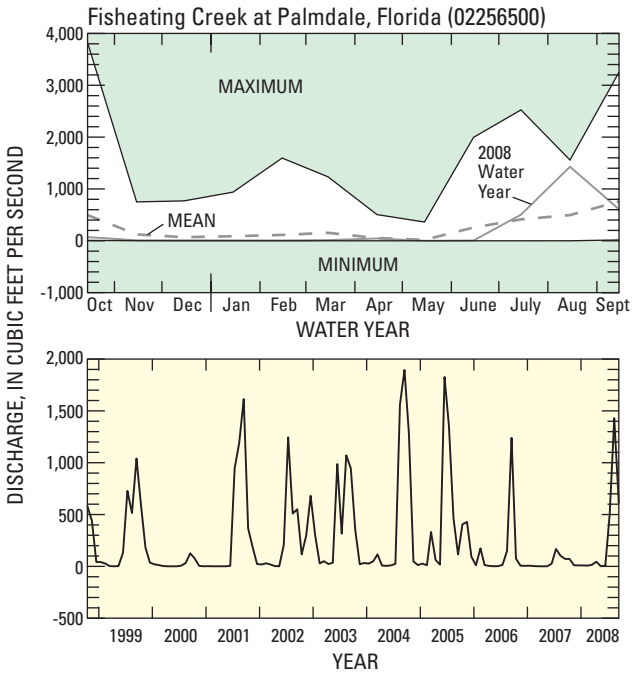

Figure 17. Fisheating Creek at Palmdale water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1931-2008, and the monthly mean discharge for the period October 1998 to September 2008.

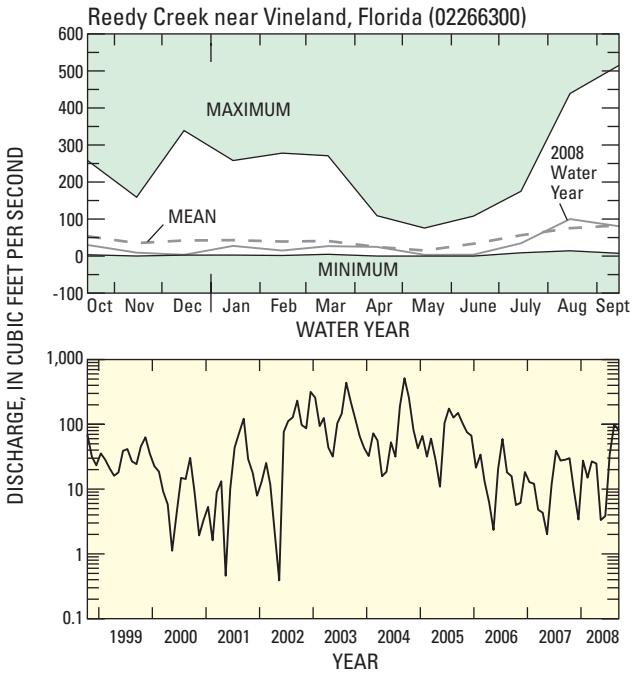

Figure 18. Reedy Creek near Vineland water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1966-2008, and the monthly mean discharge for the period October 1998 to September 2008.

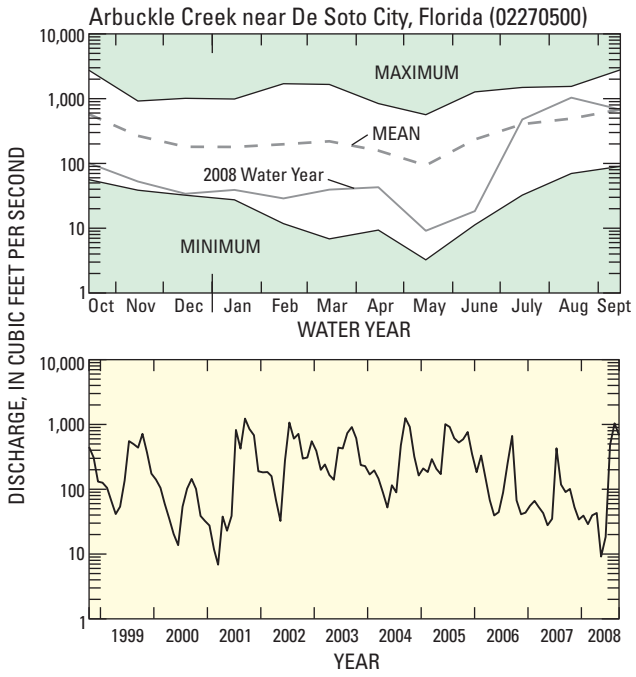

Figure 19. Arbuckle Creek near De Soto City water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1939-2008, and the monthly mean discharge for the period October 1998 to September 2008.

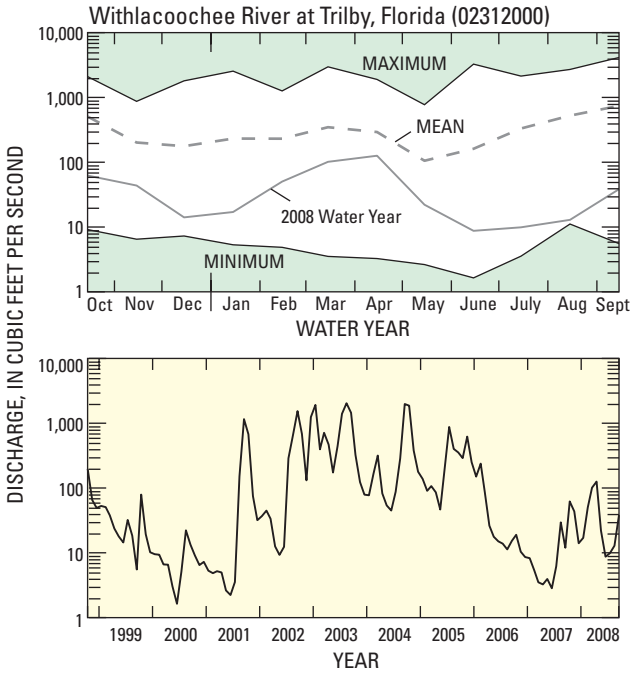

Figure 20. Withlacoochee River at Trilby water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1928-2008, and the monthly mean discharge for the period October 1998 to September 2008.

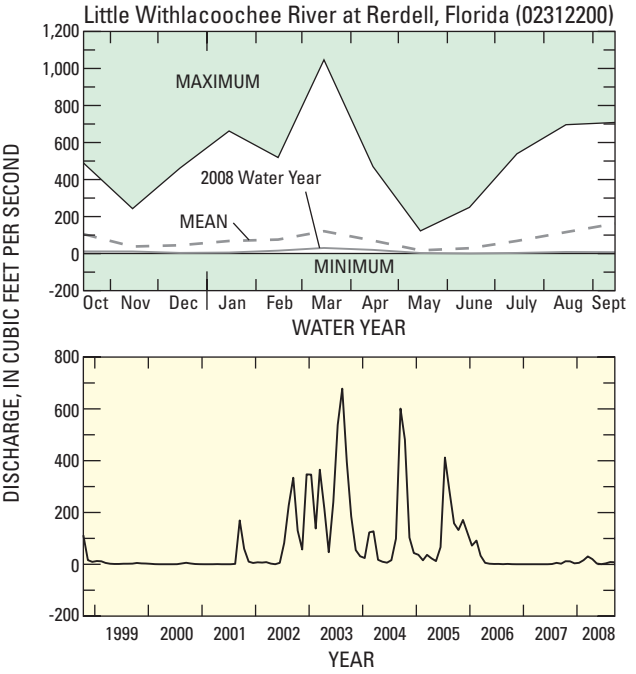

Figure 21. Little Withlacoochee River at Rerdell water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1958-2008, and the monthly mean discharge for the period October 1998 to September 2008.

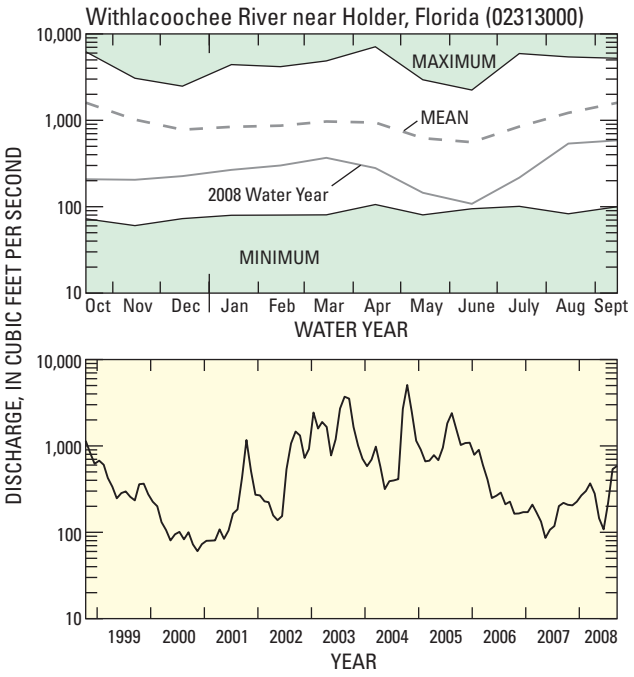

Figure 22. Withlacoochee River near Holder water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1928-2008, and the monthly mean discharge for the period October 1998 to September 2008.

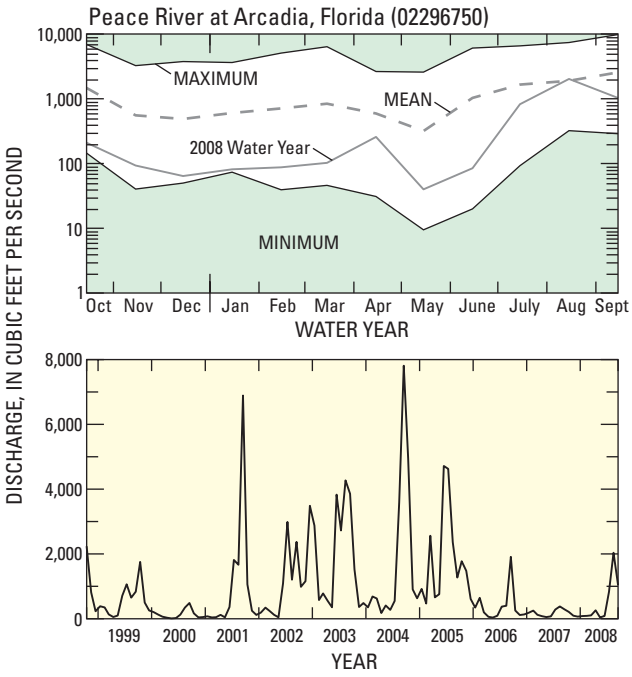

Figure 23. Peace River at Arcadia water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1932-2008, and the monthly mean discharge for the period October 1998 to September 2008.

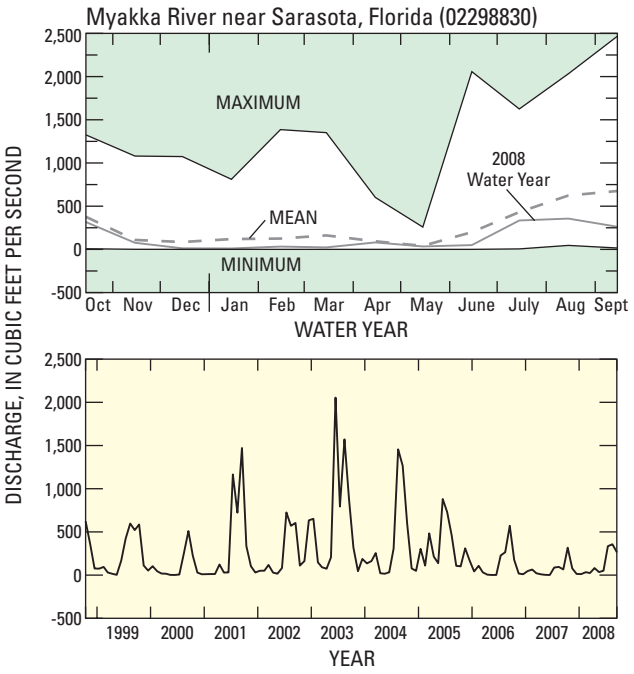

Figure 24. Myakka River near Sarasota water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1937-2008, and the monthly mean discharge for the period October 1998 to September 2008.

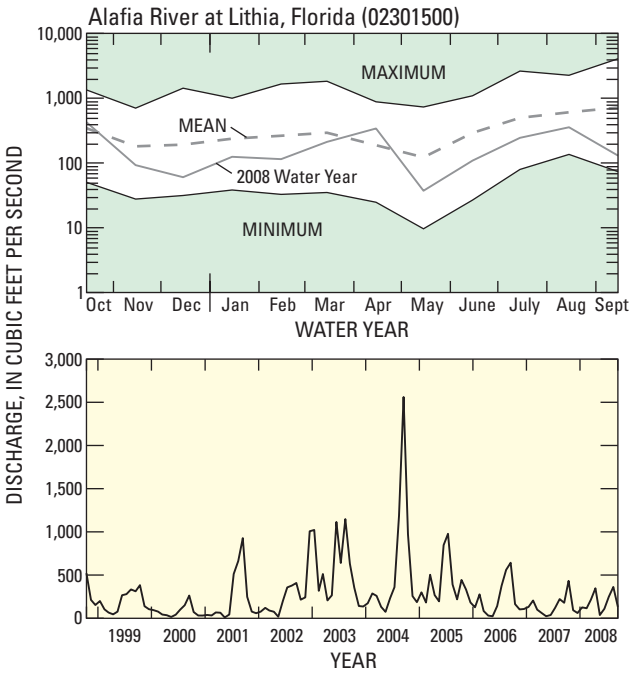

Figure 25. Alafia River at Lithia water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1933-2008, and the monthly mean discharge for the period October 1998 to September 2008.

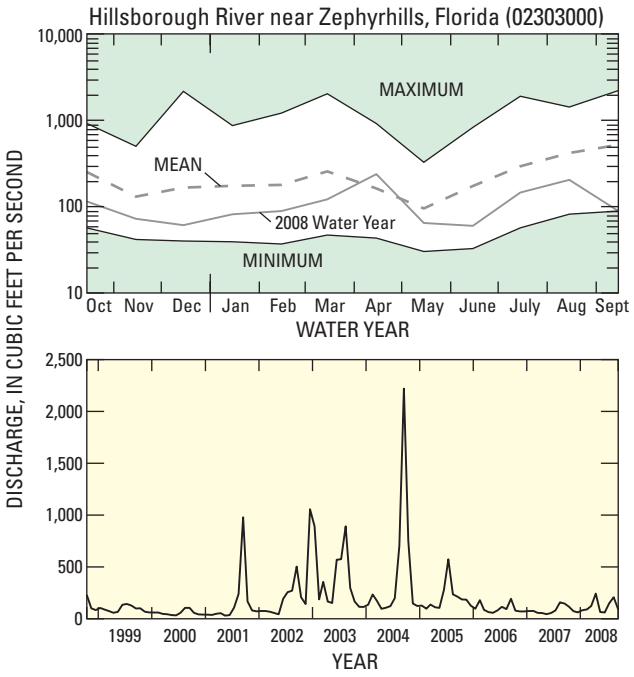

Figure 26. Hillsborough River near Zephyrhills water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1940-2008, and the monthly mean discharge for the period October 1998 to September 2008.

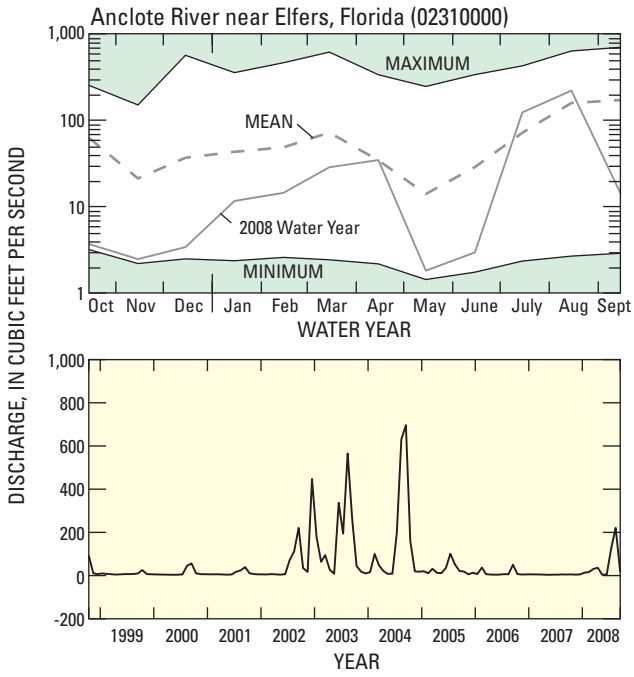

Figure 27. Anclote River near Elfers water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1947-2008, and the monthly mean discharge for the period October 1998 to September 2008.

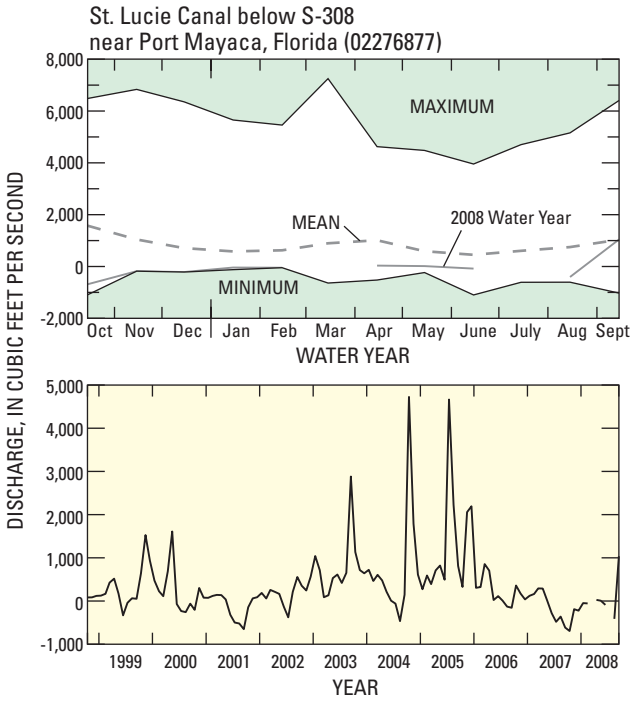

Figure 28. St. Lucie Canal below S-308 near Port Mayaca water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1931-2008, and the monthly mean discharge for the period October 1998 to September 2008.

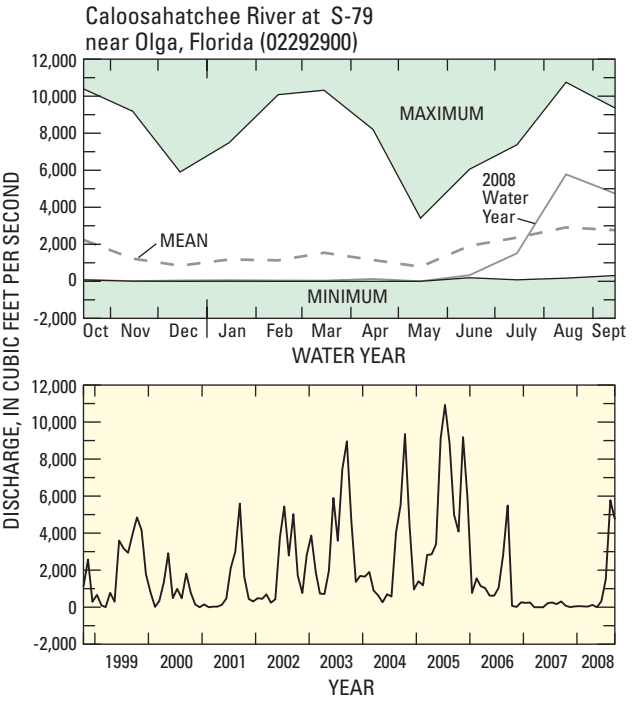

Figure 29. Caloosahatchee River at S-79 near Olga water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1966-2008, and the monthly mean discharge for the period October 1998 to September 2008.

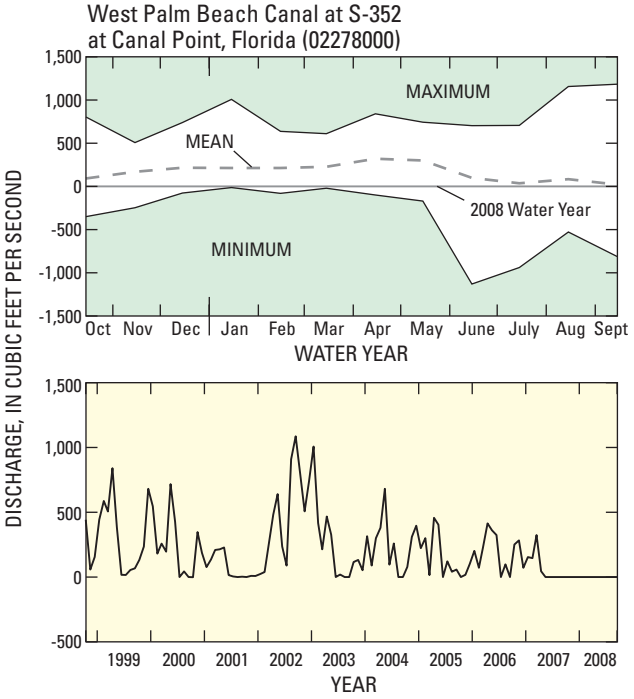

Figure 30. West Palm Beach Canal at S-352 at Canal Point water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1940-2008, and the monthly mean discharge for the period October 1998 to September 2008.

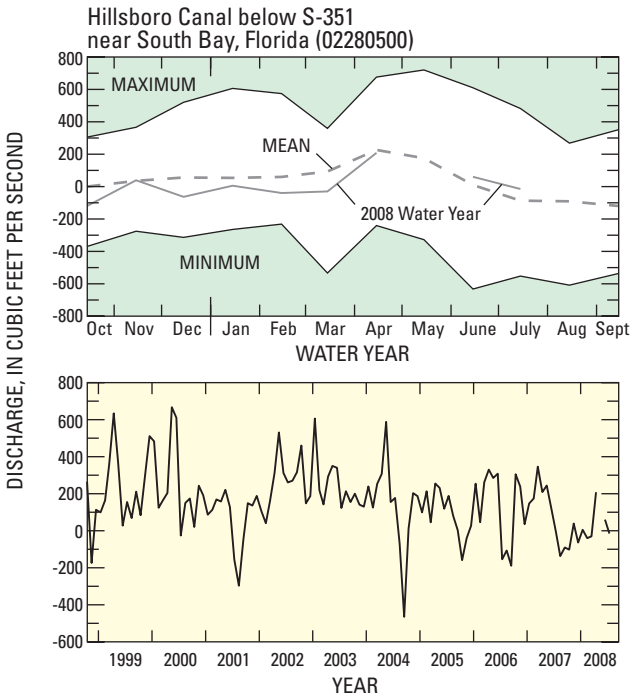

Figure 31. Hillsboro Canal below S-351 near South Bay water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1957-2008, and the monthly mean discharge for the period October 1998 to September 2008.

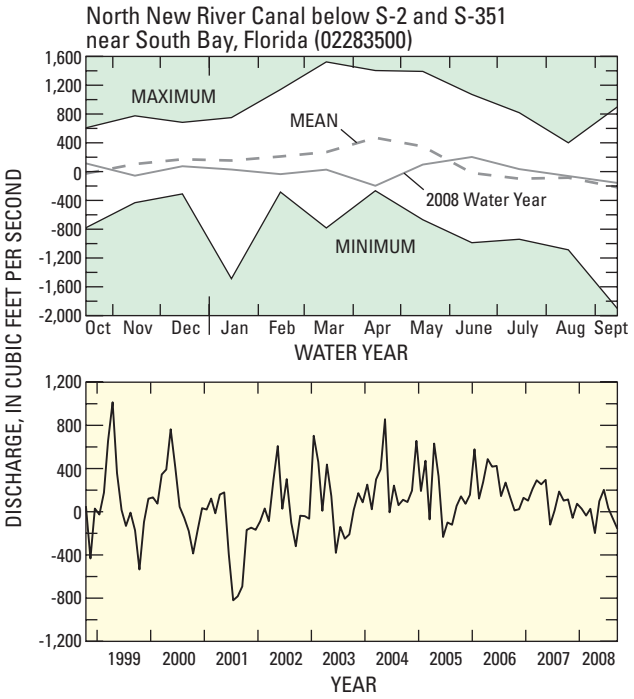

Figure 32. North New River Canal below S-2 and S-351 near South Bay water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1957-2008, and the monthly mean discharge for the period October 1998 to September 2008.

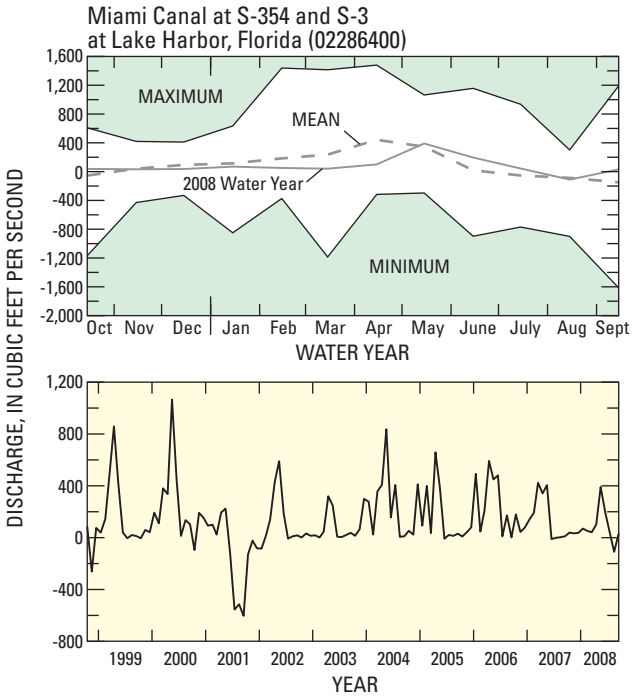

Figure 33. Miami Canal at S-354 and S-3 at Lake Harbor water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1958-2008, and the monthly mean discharge for the period October 1998 to September 2008.

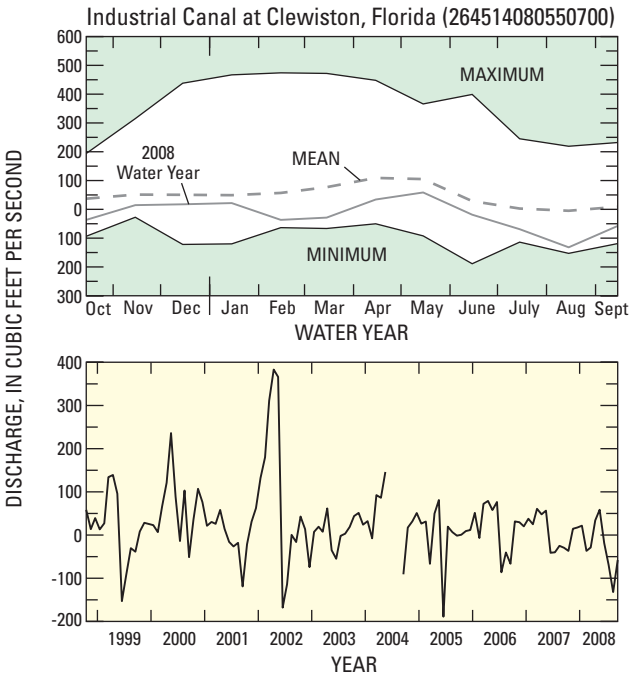

Figure 34. Industrial Canal at Clewiston water year 2008 monthly mean discharge compared to the maximum, minimum, and mean monthly mean discharge for the period 1976-2008, and the monthly mean discharge for the period October 1998 to September 2008.

Northeast Florida

Annual mean discharge across northeast Florida varied from well below normal to above normal during the 2008 water year, but well above the extremely dry conditions experienced during the previous water year (table 1). For example, the annual discharge at St. John's River near De Land (02236000) was 2,850 ft^3/s, which is 93 percent of the period of record (1934–2008) average of 3,050 ft^3/s (table 1). Annual discharge at Withlacoochee River at Trilby (02312000) was 42.6 ft^3/s, which is 13 percent of the period of record average of 323 ft^3/s (table 1). Annual discharge at Reedy Creek near Vineland (02266300) was 30.1 ft^3/s, which is 67 percent of the period of record (1966–2008) average of 45.2 ft^3/s (table 1).

Monthly mean discharges averaged well below normal during the months from October through July, but were near normal to above normal during August and September. Several streamgages throughout northeast Florida registered record-low or record-high monthly mean discharges during the year (tables 2 and 3). Many streamgage locations recorded peak-of-record discharges associated with the rainfall and runoff from Tropical Storm Fay (table 4). Figures 13–22 show the 10 representative streams in northeast Florida.

The dry conditions observed from October to July of the analysis period were caused by less than normal rainfall that had persisted throughout the region continuing from the 2007 water year. Several streamgage locations registered record-low monthly mean discharges during the year (table 2). For example, Crane Creek at Melbourne (02249500; period of record from 1951–1963 and 2003–2008) reached a record-low monthly mean discharge of 4.98 ft^3/s in March. The previous record there was 5.49 ft^3/s in 1968 (table 2). Outlet River at Panacoochee Retreats (02312700; period of record from 1963 to 2008) reached a new low in October (20.4 ft^3/s). The previous record was 31.6 ft^3/s set in 1964 (table 2).

Higher than normal monthly mean discharges during August and September were the direct result of Tropical Storm Fay moving through this part of Florida from August 19 to 22 (Verdi and Holt, 2010). Many streamgages in northeast Florida reached record-high monthly mean discharges during August or September, including some with a period of record greater than 70 years. For example, the St. John's River streamgage near De Land (02236000; period of record from 1934–2008), reached a new record-high monthly mean discharge of 12,800 ft^3/s in September (table 3). The previous record was 12,100 ft^3/s set in 1960 (table 3). The St. Mary's River near MacClenny (02231000; period of record from 1927–2008) reached a new record-high monthly mean discharge of 4,490 ft^3/s in August (table 3). The previous record was 3,300 ft^3/s set in 1945 (table 3).

Several stations in northeast Florida recorded instantaneous peak of record, or other notable peak river levels and/or discharge as a direct result of Tropical Storm Fay. For example, Crane Creek at Melbourne (02249500; period of record from 1951–1968 and 2003–2008) recorded a peak discharge of 1,550 ft^3/s on August 20. A discharge event of this magnitude has an exceedance probability of less than 0.01, indicating the event has less than a one percent chance of occurring in any given year (table 4) (Verdi and Holt, 2010). The gage on Fort Drum Creek near Fort Drum (02231342; period of record from 1977–2008) recorded a peak discharge of 2,360 ft^3/s on August 20. A discharge event of this magnitude has an exceedance probability of less than 0.01, indicating the event has less than a 1 percent chance of occurring in any given year (table 4) (Verdi and Holt, 2010). The Wekiva River near Sanford (02235000; period of record from 1936–2008) recorded its fourth highest peak discharge of 1,800 ft^3/s on August 22. A discharge event of this magnitude has an exceedance probability of 0.02, indicating the event size has a 2 percent chance of occurring in any given year. The record peak of 2,060 ft^3/s at the Wekiva gage was set during the flood of September 17, 1945 (Verdi and Holt, 2010).

Southwest Florida

Annual mean discharge across southwest Florida was below the normal for the majority of the 2008 water year (table 1), although discharge generally increased with respect to the previous year. The Peace River at Arcadia (02296750) recorded an annual mean discharge of 413 ft^3/s, which is 38 percent of the 1932–2008 period of record average of 1,070 ft^3/s. The Myakka River near Sarasota (02298830) reached an annual discharge of 133 ft^3/s, which is 52 percent

of the 1937–2008 period-of-record average discharge. The Anclote River near Elfers (02310000) registered an annual mean discharge of 38.8 ft^3/s which represents 61 percent of the 1947–2008 period-of-record mean, an increase from 5 percent in water year 2007. Figures 23–27 show the five representative streams in southwest Florida.

Several streamgages reached new monthly minimum mean discharges for the year (table 2). For example, the Peace River at Bartow (02294650) reached a new minimum discharge for the month of December of 5.19 ft^3/s. The previous record minimum for the month of December was 6.67 ft^3/s during the 2001 water year. Another example is the Hillsborough River near Zephyrhills (02303000) which reached a new minimum monthly discharge of 90.2 ft^3/s for September. The previous record was 91.9 ft^3/s during the 1978 water year.

The Weeki Wachee River near Brooksville (02310525) is used to determine spring flow from Weeki Wachee Springs, a first order magnitude spring located in western Hernando County. Spring flow is determined from the relationship between measured discharge and the elevation of a nearby artesian well. The annual mean discharge for the 2008 water year was 137 ft^3/s, which was 87 percent of the mean flow, 157 ft^3/s. Monthly mean discharge stayed well above the minimum during the water year.

South Florida

The drainage system below Lake Okeechobee in south Florida is almost completely controlled by locks and dams, thus making the computation and interpretation of statistical hydrologic information difficult. The St. Lucie Canal below S-308 and the Caloosahatchee River at S-79 are both gaged to monitor the release of water from Lake Okeechobee to the Atlantic Ocean and the Gulf of Mexico, respectively. The streamgages at the West Palm Beach Canal at S-352, Hillsboro Canal below S-351, North New River Canal below S-2 and S-351, Miami Canal at S-354 and S-3, and Industrial Canal at Clewiston monitor the release of water from Lake Okeechobee into the Everglades Agricultural Area.

Annual mean discharge in south Florida varied from well below normal to near normal for the year (table 1). For example, annual discharge at North New River Canal below S-2 and S-351 near South Bay (02283500) was 7.82 ft^3/s, which is 7 percent of the period of record (1957–2008) average of 115 ft^3/s (table 1). Annual discharge at Miami Canal at S-354 and S-3 at Lake Harbor (02286400) was 77.0 ft^3/s, which is 95 percent of the period of record (1958–2008) average of 81.3 ft^3/s (table 1).

Monthly mean discharges varied throughout the analysis period from below normal to above normal. Several streamgages reached record-low or record-high monthly mean discharges throughout the year (tables 2 and 3). Figures 28–34 show the seven representative streams in south Florida.

The dry conditions in the area are attributed to below normal rainfall leading up to and during the analysis period, causing some streamgages to reach record-low monthly mean discharges (table 2). For example, the St. Lucie Canal below S-308 near Port Mayaca (02276877; period of record from 1931–2008) reached record-low monthly discharges in November (-189 ft^3/s), December (-223 ft^3/s), and February (-55.2 ft^3/s). The previous records were set in 1988 (-120 ft^3/s), 1986 (-138 ft^3/s), and 1991 (-24.1 ft^3/s), respectively (table 2). The Caloosahatchee River at S-79 near Olga (02292900; period of record from 1966–2008) reached a record-low monthly discharge of 7.25 ft^3/s in November. The previous record was 17.2 ft^3/s set in 2007 (table 2). The Miami Canal at Northwest 36th Street in Miami (02288600; period of record 1959–2008) reached a new record-low monthly mean discharge in September (54.4 ft^3/s), indicating little to no impact from the landfall of Tropical Storm Fay. The previous record was 76.6 ft^3/s, set in 1987 (table 2).

A few streamgages in south Florida reached record-high monthly mean discharges during the year (table 3). For example, the monthly mean discharge at North Branch Estero River at Estero (02291580; period of record from 1987–2008) reached 3.28 ft^3/s in May (table 3). The previous record was 0.31 ft^3/s in 2005 (table 3). Hermosa Canal at Cape Coral (02293347) reached a period of record (1987–2008) maximum monthly discharge of 163 ft^3/s in September. The previous record was 151 ft^3/s set in 2006 (table 3).

Lake Elevations

Lake-water elevations in Florida averaged below normal throughout the year, even setting period-of-record low elevations in south (each month from October to March) and southwest (each month from October to April) Florida. Figures 35–38 show four representative lakes in Florida.

Northwest Florida

Water elevations for Lake Talquin are controlled by the C.H. Corn Hydroelectric Dam located on the Ochlockonee River. The dam also regulates the flow into the Ochlockonee River near Bloxham. Monthly mean lake levels were very stable for the entire water year, ranging from 68.30 ft in October to 68.57 ft in December and April (fig. 35). The maximum instantaneous water level at Lake Talquin near Bloxham (02329900) for the water year was 69.29 ft on February 23. The minimum instantaneous water level was 67.32 ft on August 22. No new extremes were reached during the year.

Northeast Florida

Lake Minnehaha at Clermont (02236840; fig. 36) is a long-term station that represents lake levels in the Orlando area of northeast Florida. Water levels generally declined from October to June and steadily increased from June to September due to the lack of rainfall during the year and runoff

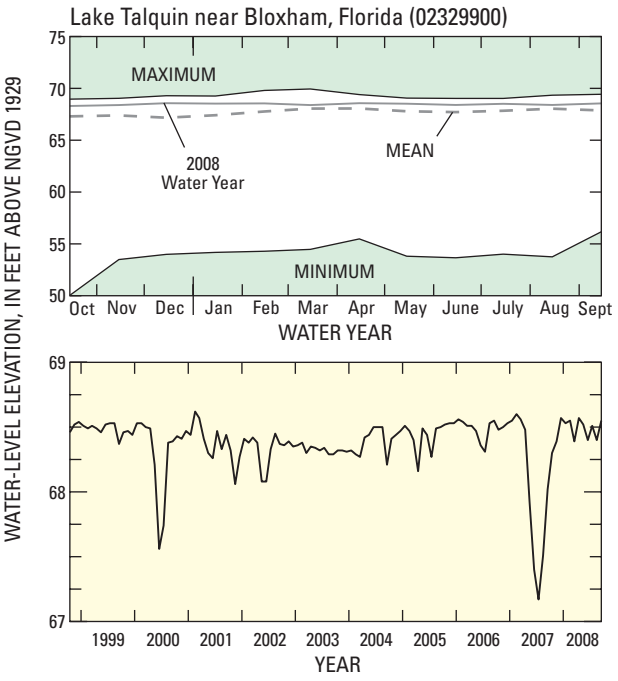

Figure 35. Lake Talquin near Bloxham water year 2008 monthly mean elevation compared to the maximum, minimum, and mean monthly mean elevation for the period 1930-2008, and the monthly mean elevation for the period October 1998 to September 2008.

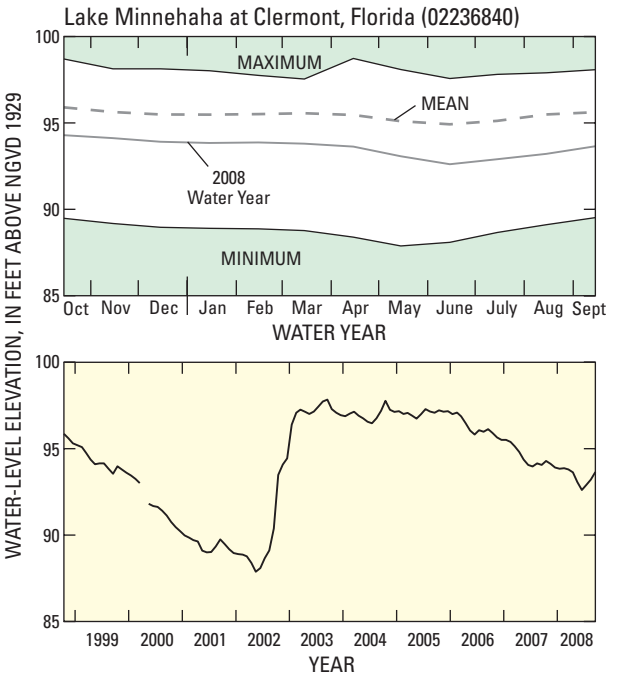

Figure 36. Lake Minnehaha at Clermont water year 2008 monthly mean elevation compared to the maximum, minimum, and mean monthly mean elevation for the period 1947-2008, and the monthly mean elevation for the period October 1998 to September 2008.

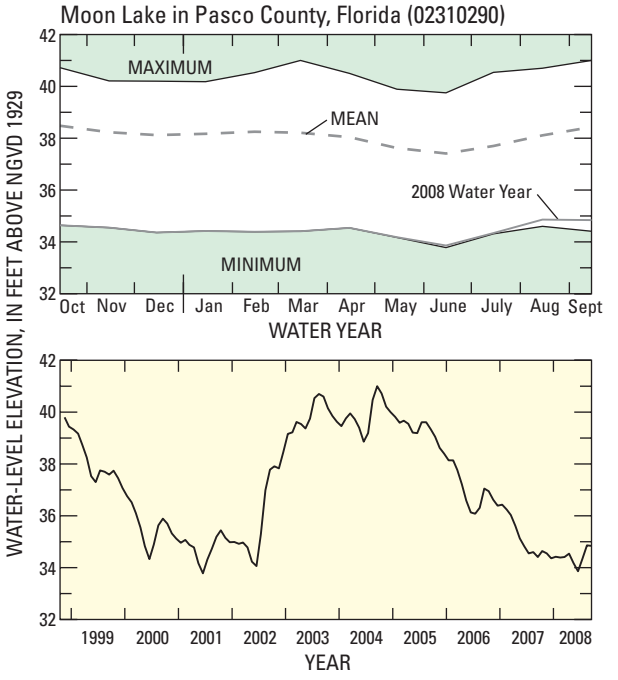

Figure 37. Moon Lake in Pasco County water year 2008 monthly mean elevation compared to the maximum, minimum, and mean monthly mean elevation for the period 1965-2008, and the monthly mean elevation for the period October 1998 to September 2008.

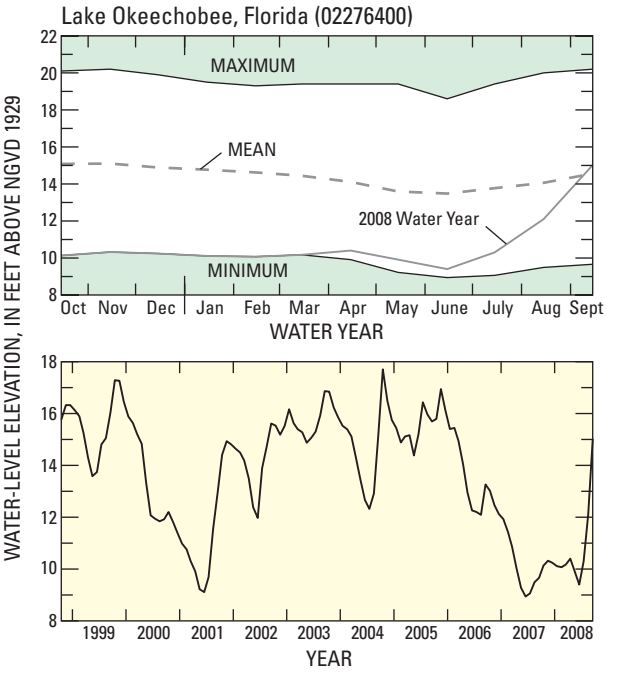

Figure 38. Lake Okeechobee water year 2008 monthly mean elevation compared to the maximum, minimum, and mean monthly mean elevation for the period 1912-2008, and the monthly mean elevation for the period October 1998 to September 2008.

associated with the landfall of Tropical Storm Fay in August. The maximum instantaneous water level recorded during the year was 94.48 ft on October 21. The minimum instantaneous water level recorded was 92.45 ft on June 15. No new extremes were reached during the year.

Southwest Florida

Moon Lake in Pasco County (02310290) is a long-term station used to monitor variation in lake levels in the southwest-central Florida region. Lake elevations are determined from instantaneous readings by USGS personnel and outside observers. Monthly mean elevations for the 2008 water year represented new monthly minimum elevations from October to April. Lake elevations began to increase slightly in June, but remained well below normal for the remainder of the water year. A new 1965–2008 period of record minimum elevation of 33.49 ft was observed on June 13 (fig. 37). The previous record minimum was 33.60 ft June 20, 2001.

South Florida

Lake levels in south Florida are mostly represented by the 730-mi^2 (square mile) Lake Okeechobee (02276400; fig. 38), which has been monitored since 1912 and is managed by the U.S. Army Corps of Engineers. Lake Okeechobee monthly mean water levels varied within a 1.00-ft range from October to July, ranging from 9.40 ft in June to 10.40 ft in April. New minimum monthly mean lake levels were recorded each month from October through March (fig. 38). However, extensive rainfall and runoff in the Kissimmee River Valley, and direct rainfall in the lake, associated with the landfall of Tropical Storm Fay in the middle of August recharged lake levels to above 15.00 ft by the middle of September (fig. 38) (Stewart and Beven, 2009; Verdi and Holt, 2010). The maximum instantaneous elevation during the year was 15.16 ft on September 15–17. The minimum instantaneous elevation was 9.25 ft on June 17.

Groundwater

Groundwater levels across the State varied throughout the year from well below normal to above normal. Figures 39–60 show hydrographs from 22 representative wells throughout Florida showing historical water-level summary and observed daily maximum water levels (top graph) during the 2008 water year and historical daily maximum water levels, annual means of daily maximum water levels, and results of Seasonal Kendall Trend Test (bottom graph).

The nonparametric Mann-Kendall test (Kendall, 1938) is commonly used for hydrologic data analysis (Hirsch and Slack, 1984; Helsel and Hirsch, 1992). However, a different or modified version of the standard test is required to evaluate water-elevation data in which a significant seasonal component exists. In response to this need, Hirsch and others (1982) developed the Seasonal Kendall Trend Test (SKTT).

The initial step in the SKTT requires that the Kendall score be computed separately for each month of the period of record. A period of 25 years, through water year 2008, was selected for this report. The separate monthly scores were summed to obtain the test statistic. The variance of the test statistic was obtained by summing the variances of the Kendall score statistic for each month. In this test, the null hypothesis is that the time series is of the form $zt = \mu m + et$, where et is white noise error and μm represents the mean for period m.

The SKTT is advantageous because it is a rank-based procedure especially suitable for non-normally distributed data, censored data, data containing outliers, and non-linear trends. The null hypothesis of randomness H_0 states that the data (x_1, .., x_n) are a sample of n independent and identically distributed random variables. Although the trend test statistic Z is not a direct quantification of trend magnitude, it can be used as a measure of trend magnitude, or of its significance.

Northwest Florida

Groundwater data in northwest Florida are collected from two wells as part of the Climate Response Network *http://groundwaterwatch.usgs.gov/* that are equipped with data recorders that measure 60-minute interval water elevations. The daily maximum water-level elevations presented in the online annual data reports are derived from these measurements.

Water levels in the Floridan aquifer system at the USGS observation well 422A near Greenhead (303025085350501; fig. 39) remained below normal the entire water year. Daily maximum water levels at the well reached a new period of record (1963–1989 and 1998–2008) low of 44.25 ft on January 18 and 20. The maximum daily water level recorded was 52.30 ft on September 5–6. Water levels in the Floridan aquifer system at the USGS benchmark well near Crawfordville (300740084293001; fig. 40) varied from below to above normal during the year. The maximum daily water level recorded was 35.04 ft on August 25, whereas the minimum daily water level was 29.18 ft on June 10.

Northeast Florida

Groundwater levels in northeast Florida ranged from below normal to above normal at four of the six representative sites, and below normal at the two other representative sites during the year. The USGS DOT-41 observation well at Inverness (285102082204001; fig. 41), College Street well at Leesburg (284842081533001; fig. 42), Lake Oliver deep well near Vineland (282202081384601; fig. 43), and OR-47 at Orlo Vista (283253081283401; fig. 44) all report water levels in the Upper Floridan aquifer system. Water levels in the DOT-41 well (fig. 41) were below normal the entire year (minimum water level of 23.54 ft occurred on June 24) with a significant rise in August and continued increasing water levels to its water year maximum on September 30 (27.83 ft). Water levels in the College Street well (fig. 42) varied from below normal from October to August to above normal in August and September.

EXPLANATION FOR PLOTS (FIGURES 39 TO 60) OF SUMMARY STATISTICS AND 2008 WATER YEAR DAILY MAXIMUM WATER LEVELS

Daily maximum water level, recorded during 2008 water year

Monthly mean curve of daily maximum water levels collected, during the month displayed, for the January 1975 to September 2008 period.

One standard deviation (above or below) the monthly mean of daily maximum water levels collected, during the month displayed, for the January 1975 to September 2008 period.

EXPLANATION FOR PLOTS (FIGURES 39 TO 60) OF DAILY MAXIMUM WATER LEVELS, ANNUAL MEANS OF DAILY MAXIMUM WATER LEVELS, AND RESULTS OF THE SEASONAL KENDALL TREND TEST

Annual mean of daily maximum water levels collected, during the year displayed, for the October 1983 to September 2008 period, wherein no one month is missing more than 15 days of water level record

Annual mean of daily maximum water levels collected, during the year displayed, for the October 1983 to September 2008 period, wherein one or more months is missing 15 or more days of water level record.

Daily maximum water level. Breaks in line represent missing measurements, or measurements that failed quality assurance review.

SKSE — The Seasonal Kendall Slope Estimator (SKSE) represents the median slope of the set of slopes obtained by computing the slope, in feet per year, of all unique pairs of monthly mean daily maximum water levels computed for the site shown.

p-value — The p-value represents a measure of the significance level of the Seasonal Kendall Trend Test statistic, computed concurrently with the SKSE, used to determine if there is a trend in the data examined. A p-value less than 0.05 indicates a statistically significant trend.

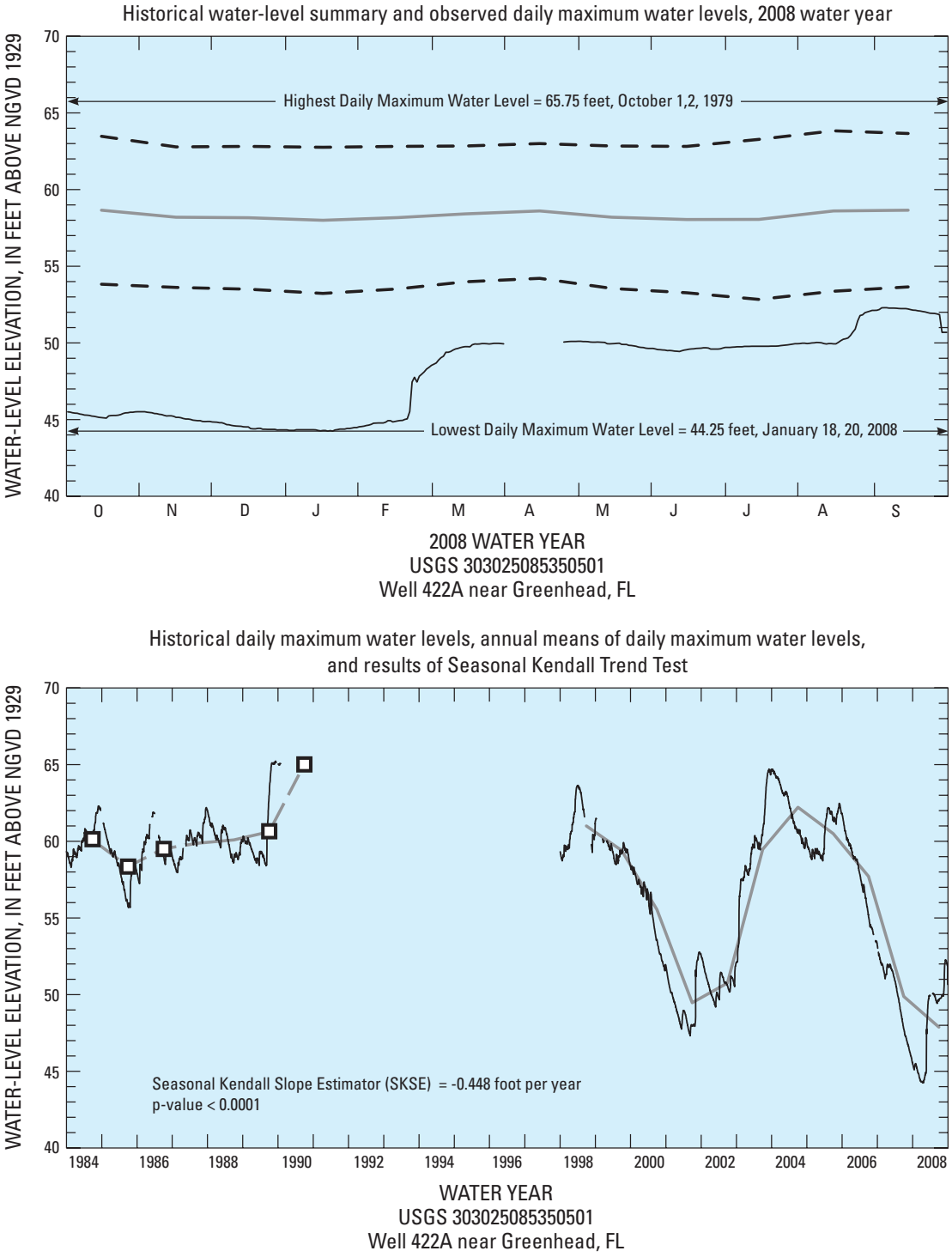

Figure 39. USGS observation well 422A near Greenhead water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

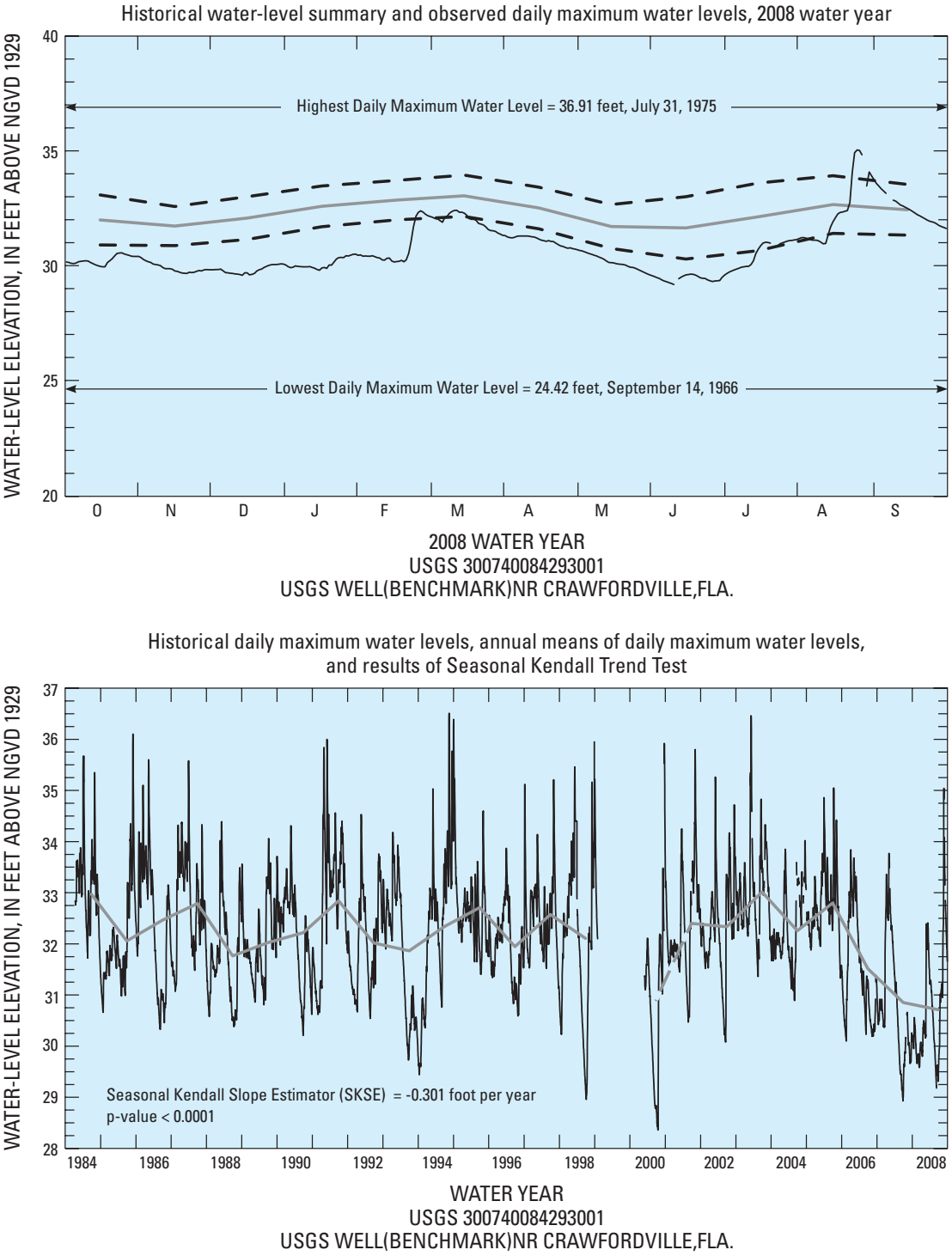

Figure 40. USGS benchmark well near Crawfordville water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

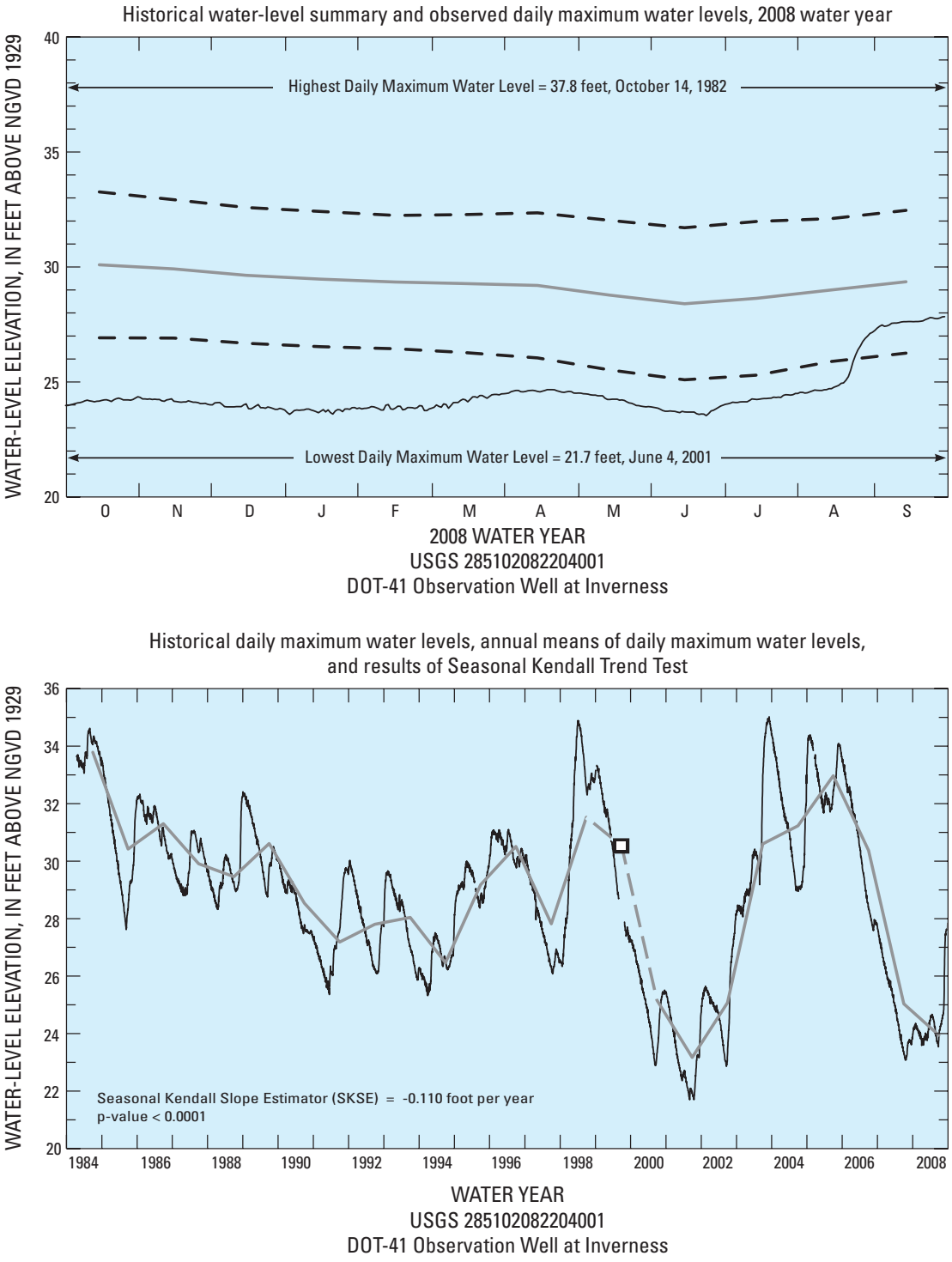

Figure 41. DOT-41 observation well at Inverness water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

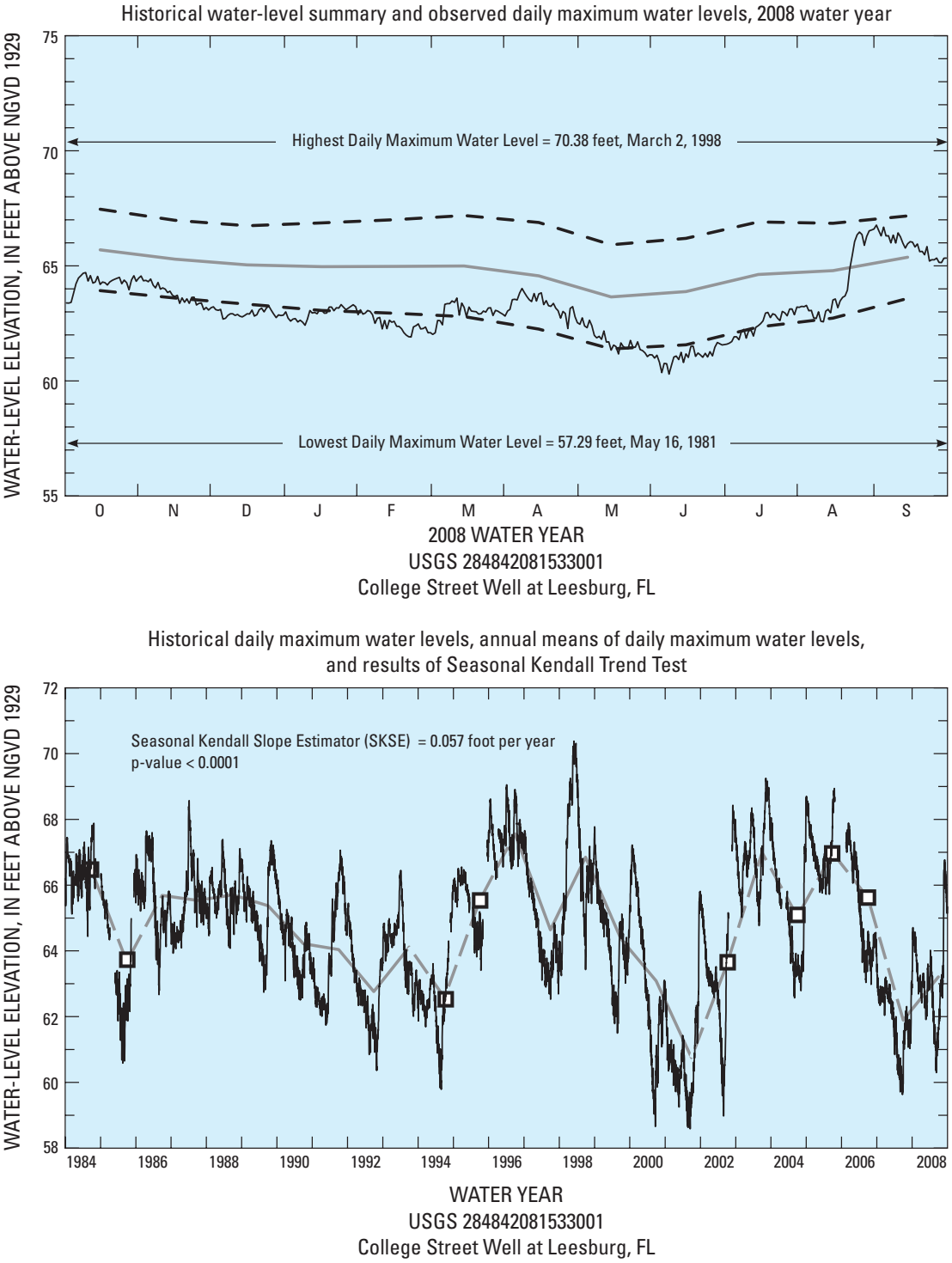

Figure 42. College Street well at Leesburg water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

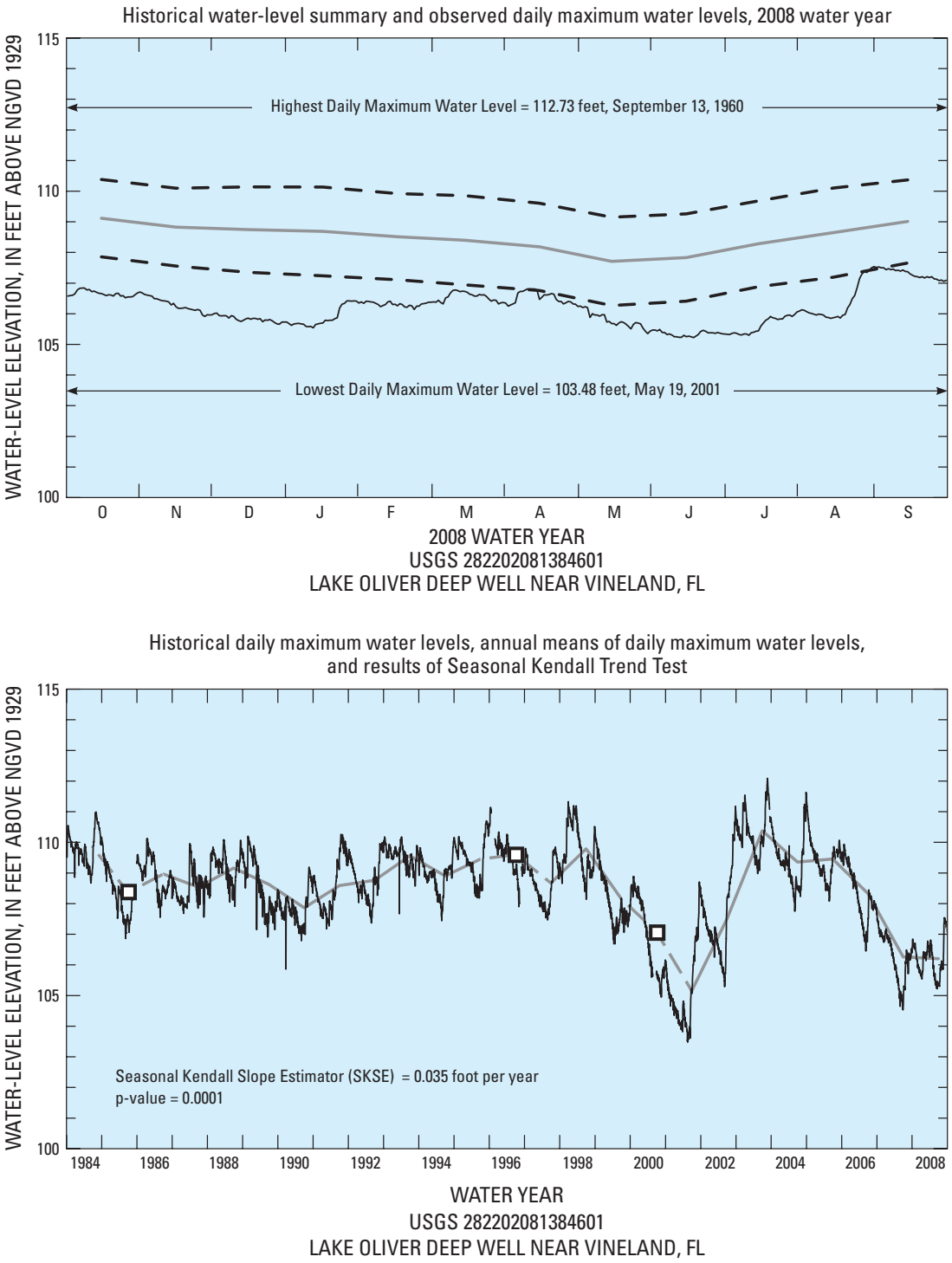

Figure 43. Lake Oliver deep well near Vineland water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

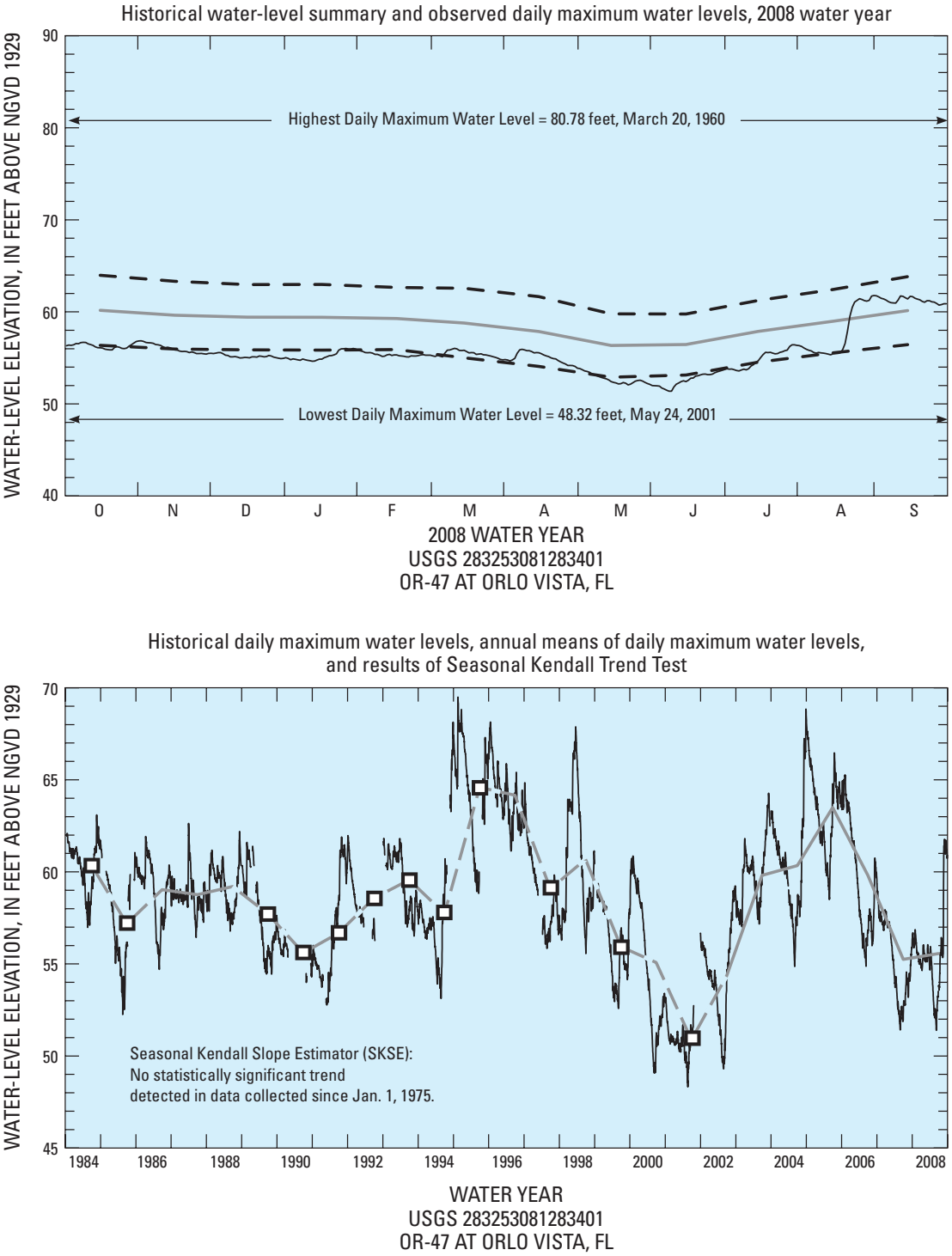

Figure 44. OR-47 at Orlo Vista water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

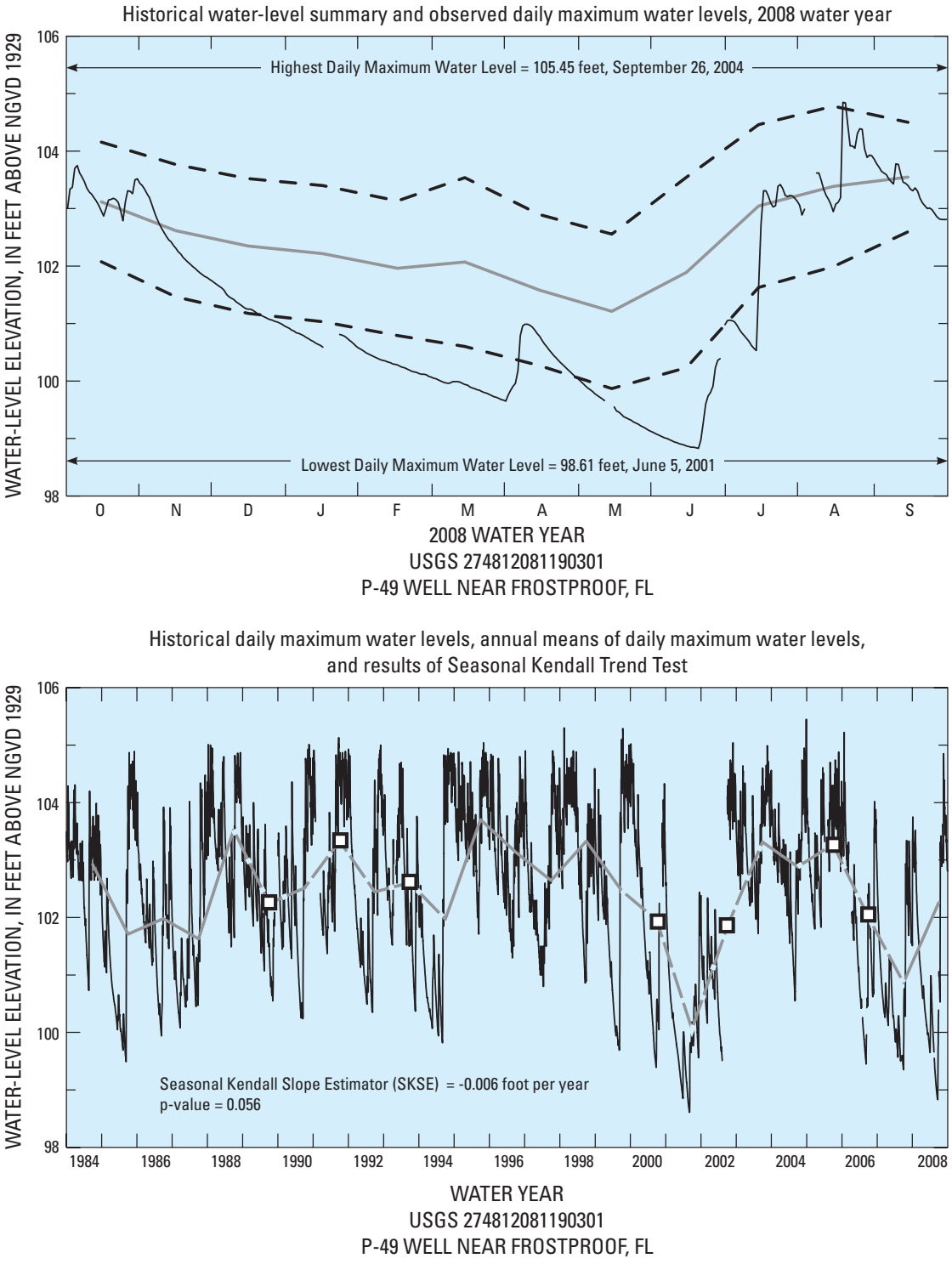

Figure 45. P-49 well near Frostproof water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

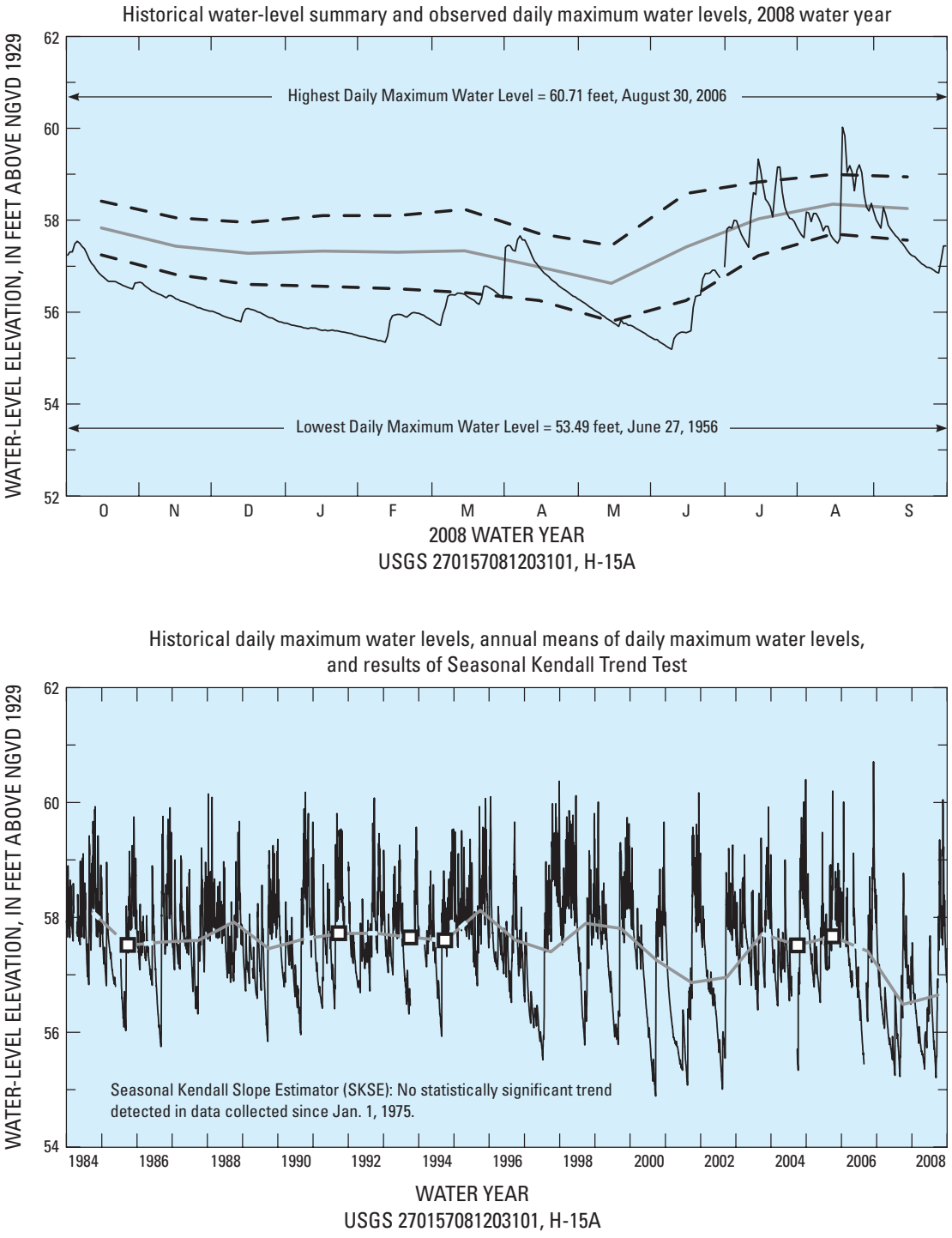

Figure 46. USGS observation well H-15A near Palmdale water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

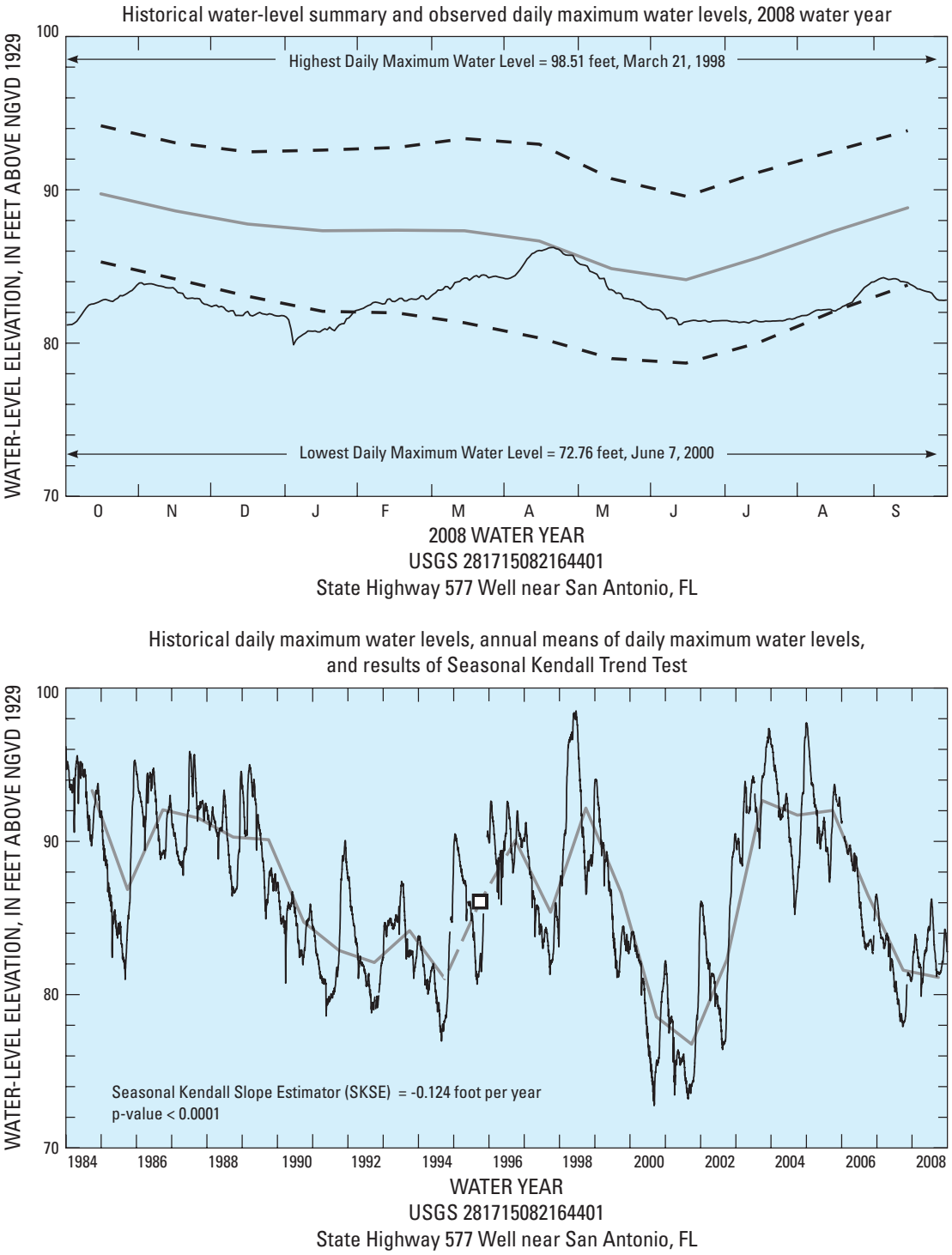

Figure 47. State Highway 577 well near San Antonio water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

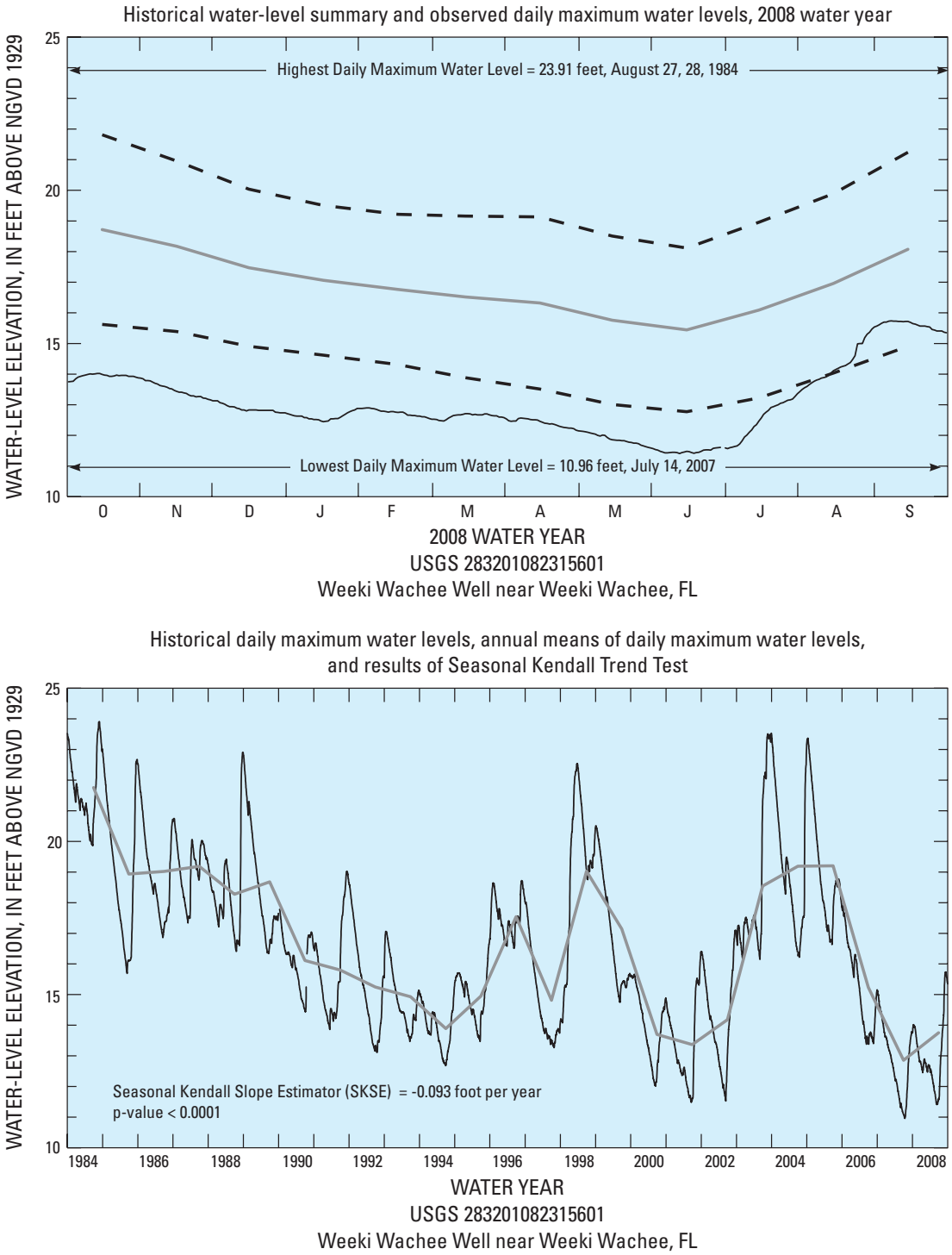

Figure 48. Weeki Wachee well near Weeki Wachee water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

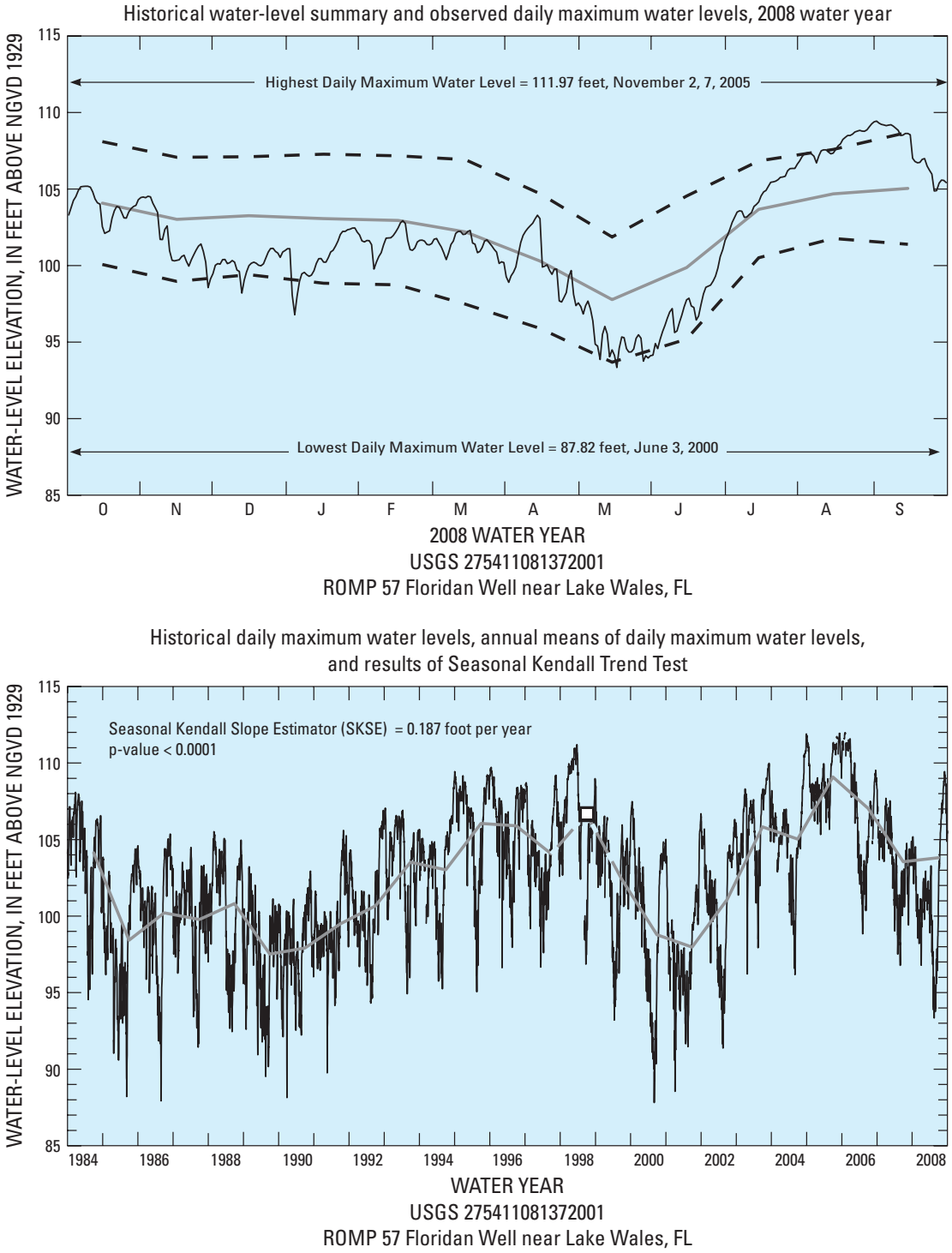

Figure 49. ROMP 57 Floridan well near Lake Wales water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

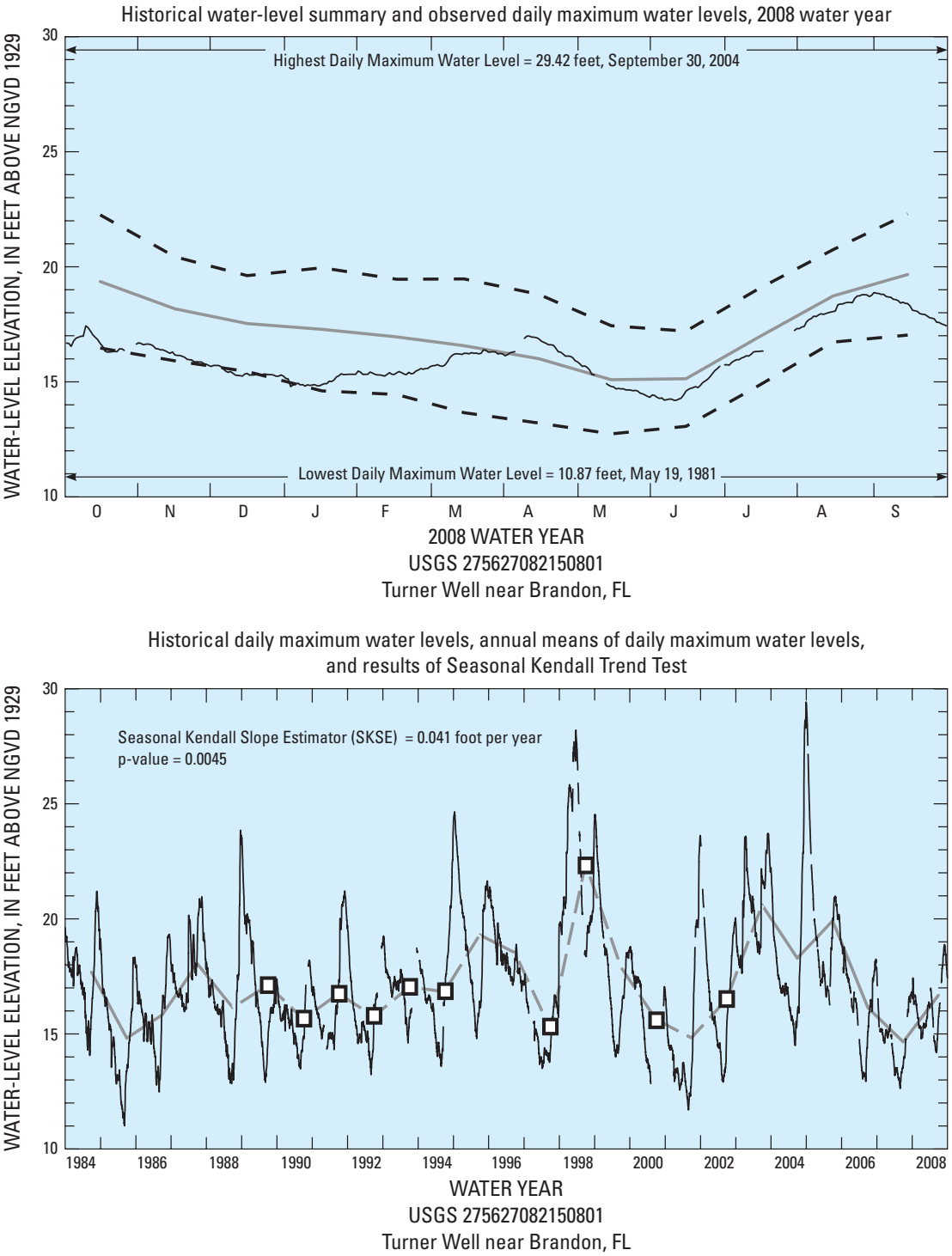

Figure 50. Turner well near Brandon water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

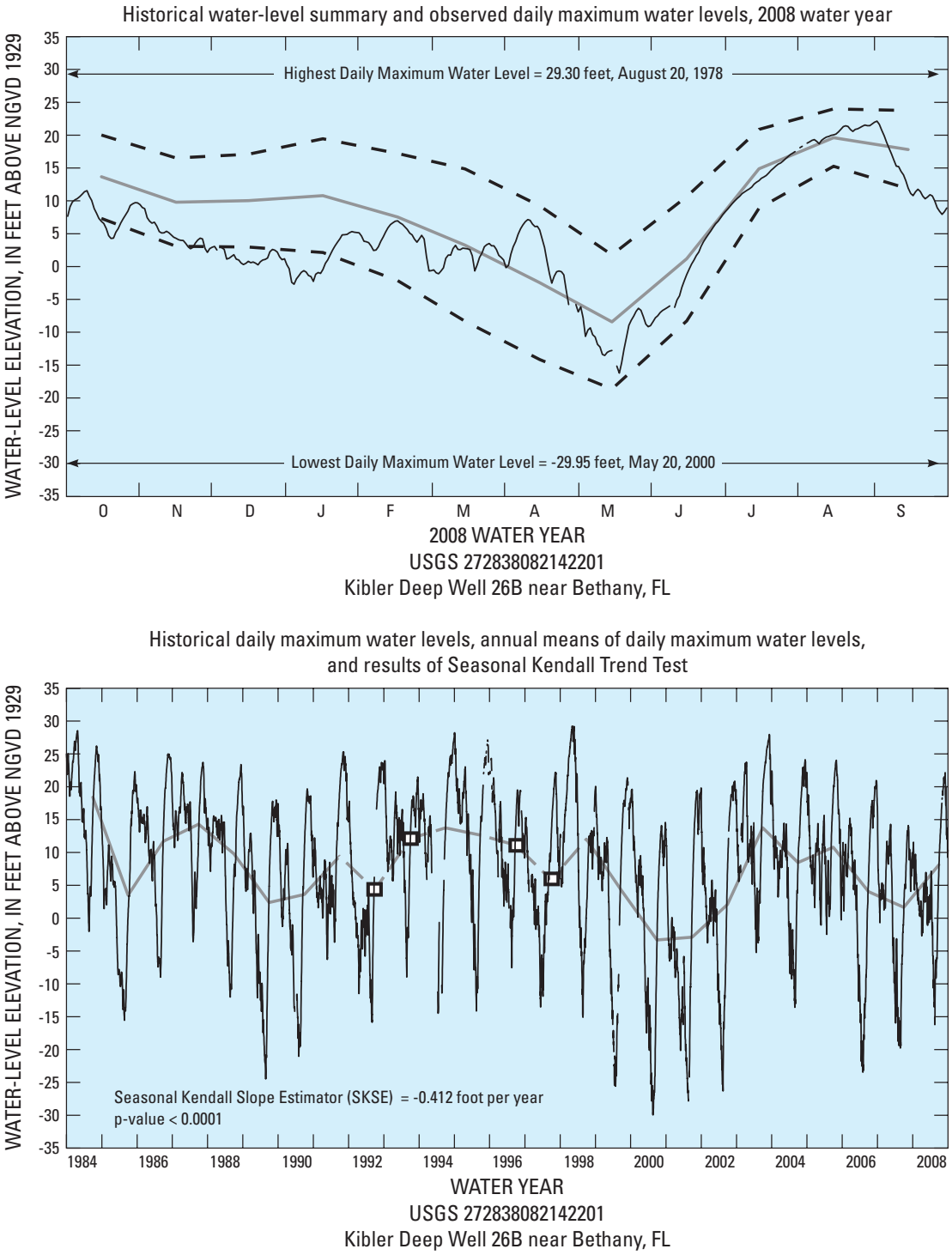

Figure 51. Kibler deep well 26B near Bethany water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

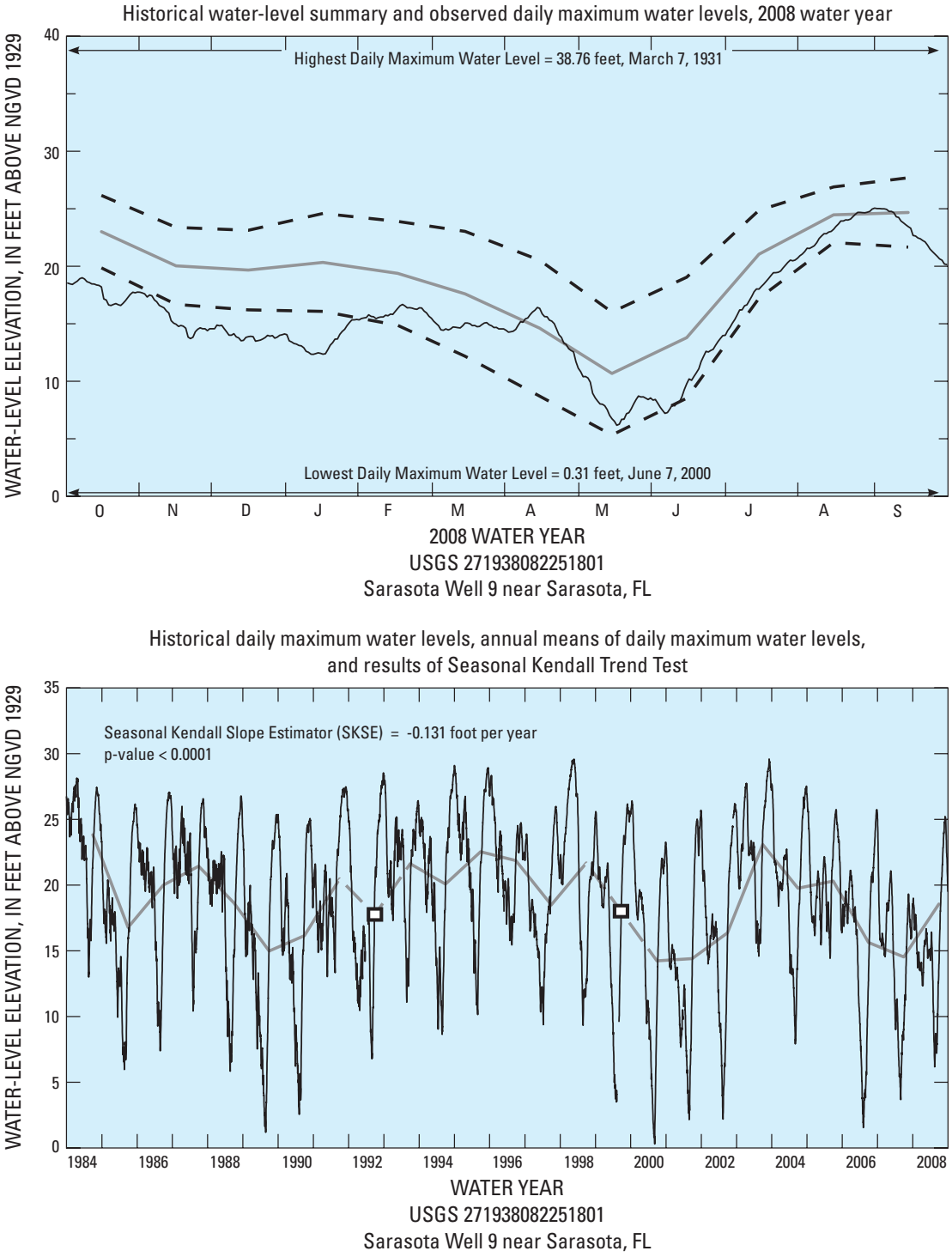

Figure 52. Sarasota well 9 near Sarasota water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

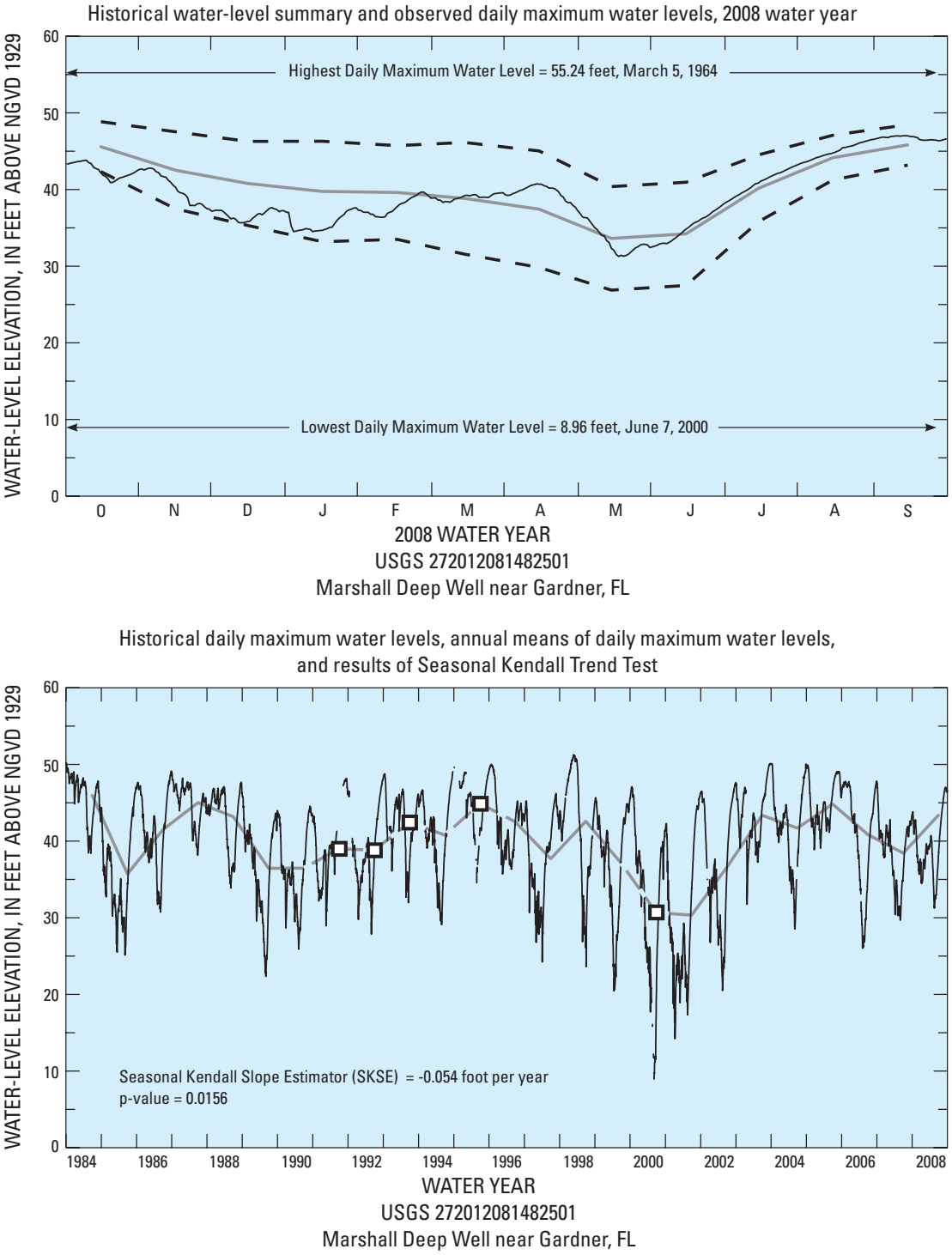

Figure 53. Marshall deep well near Gardner water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

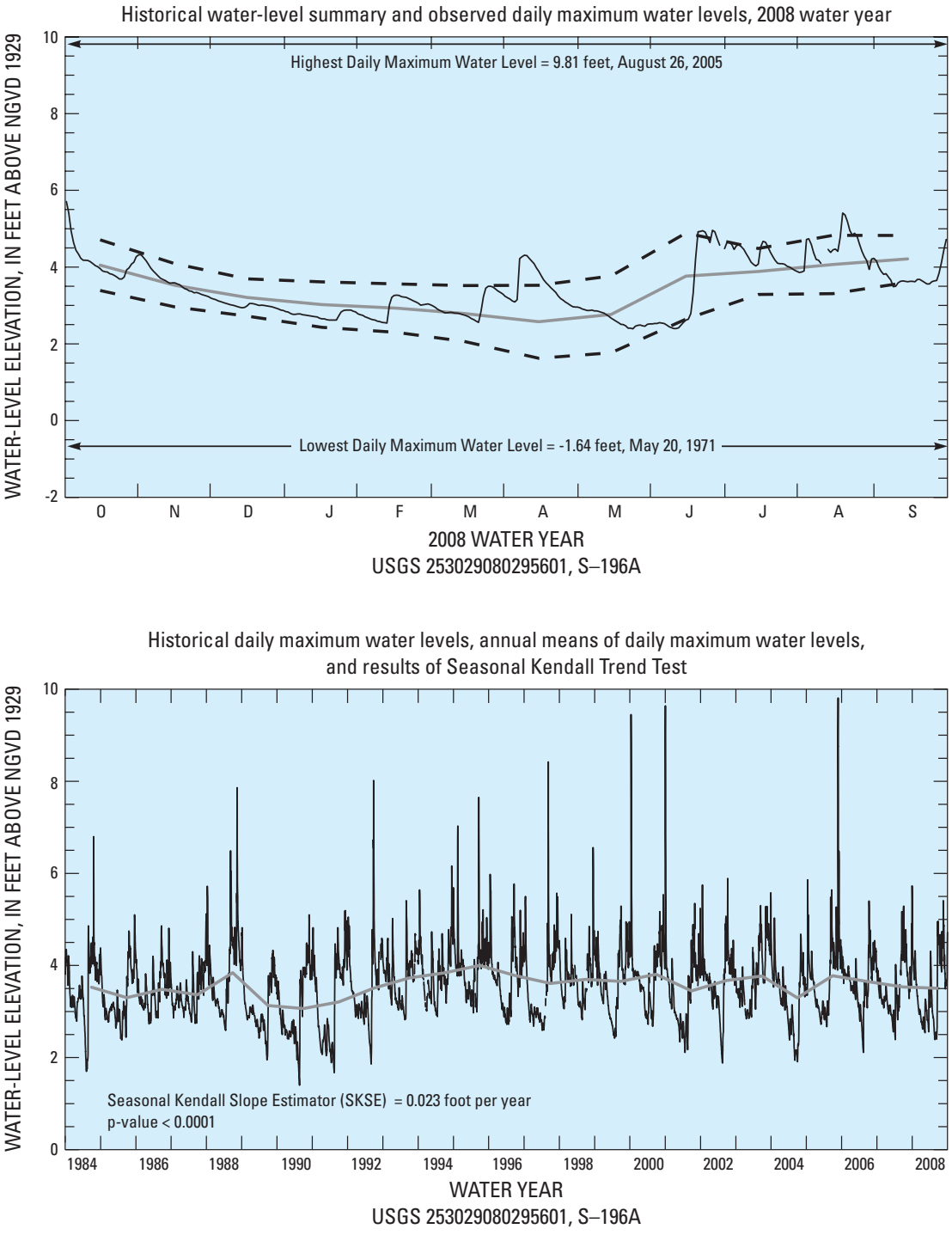

Figure 54. USGS observation well S-196A near Homestead water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

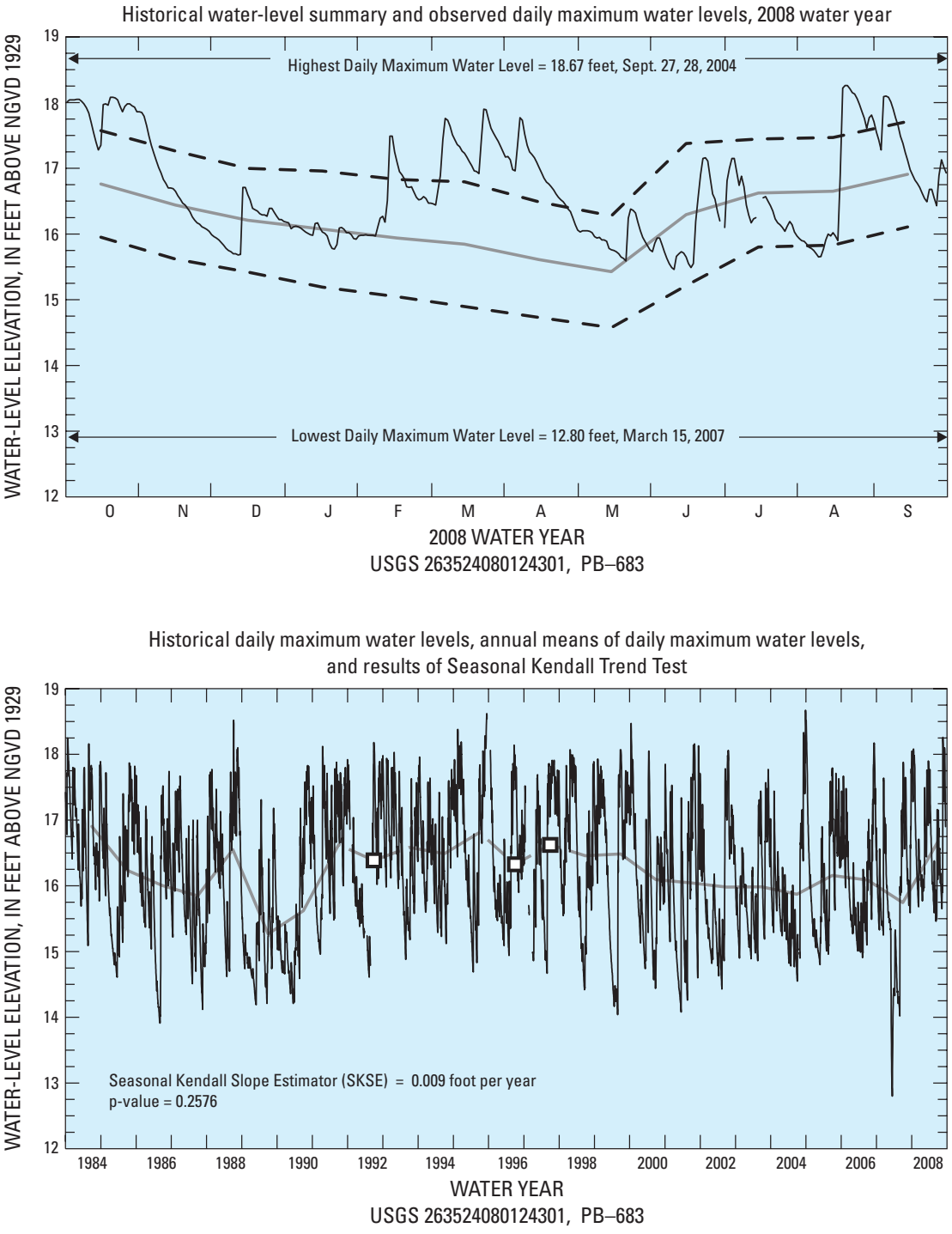

Figure 55. USGS observation well PB-683 near West Palm Beach water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

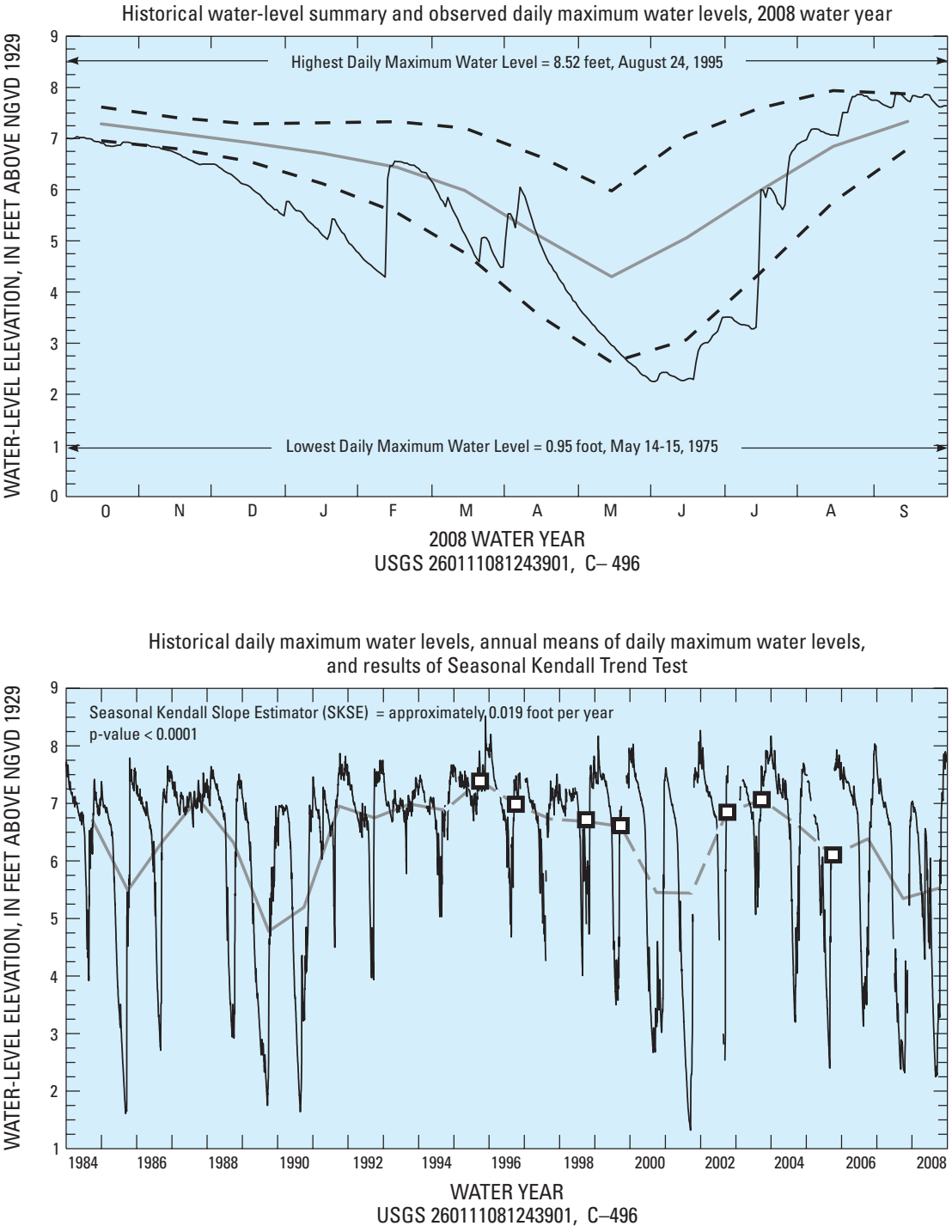

Figure 56. USGS observation well C-496 water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

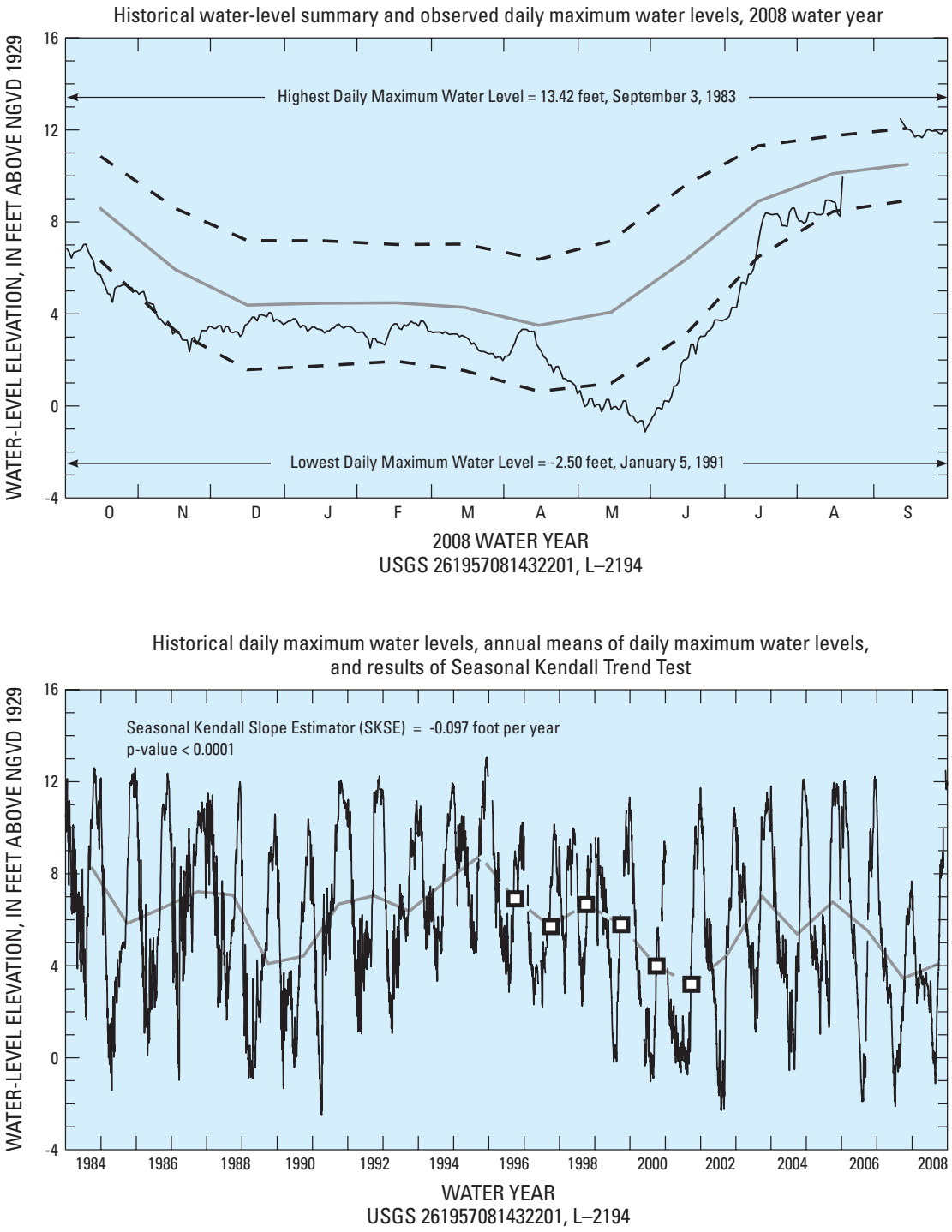

Figure 57. USGS observation well L-2194 water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

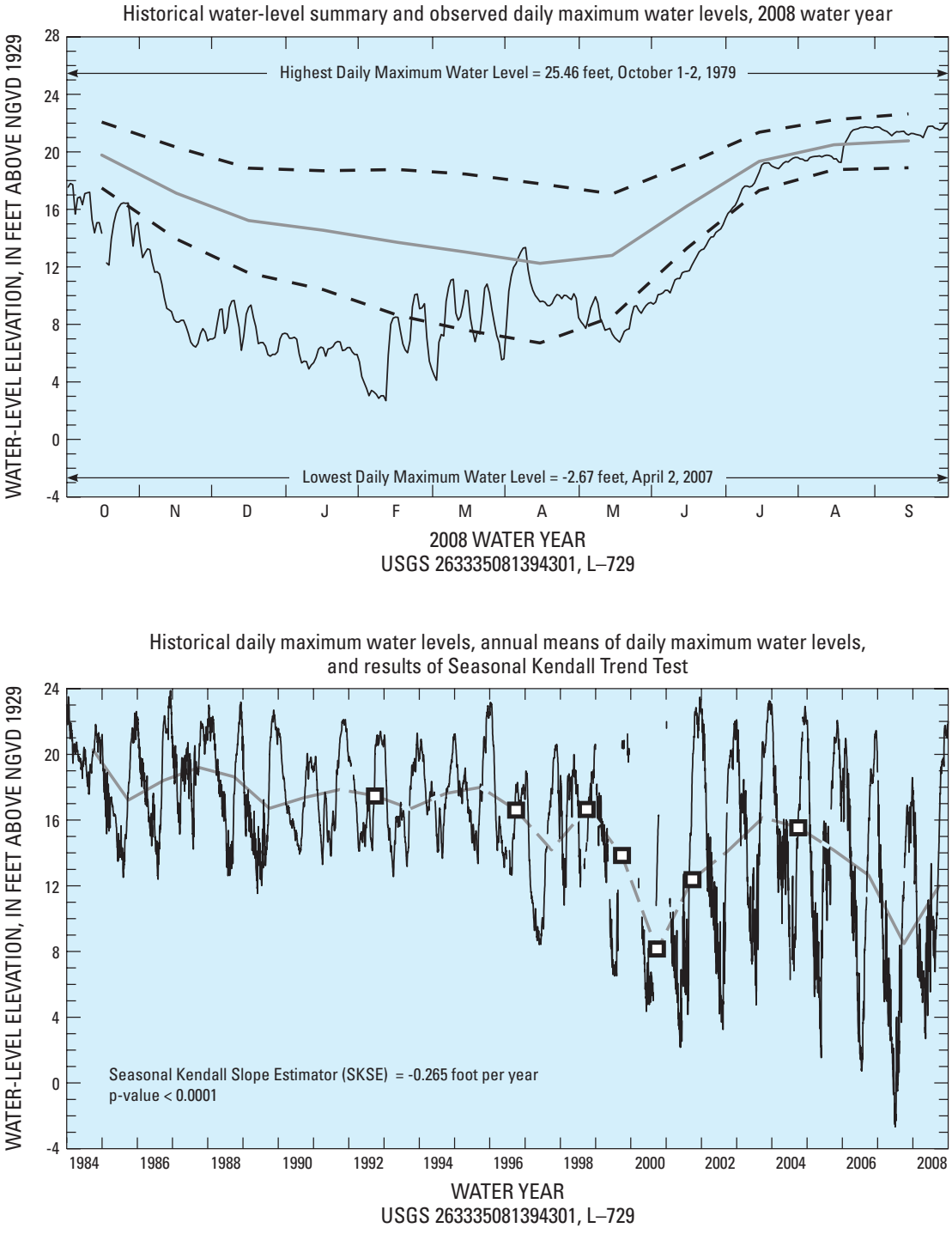

Figure 58. USGS observation well L-729 water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

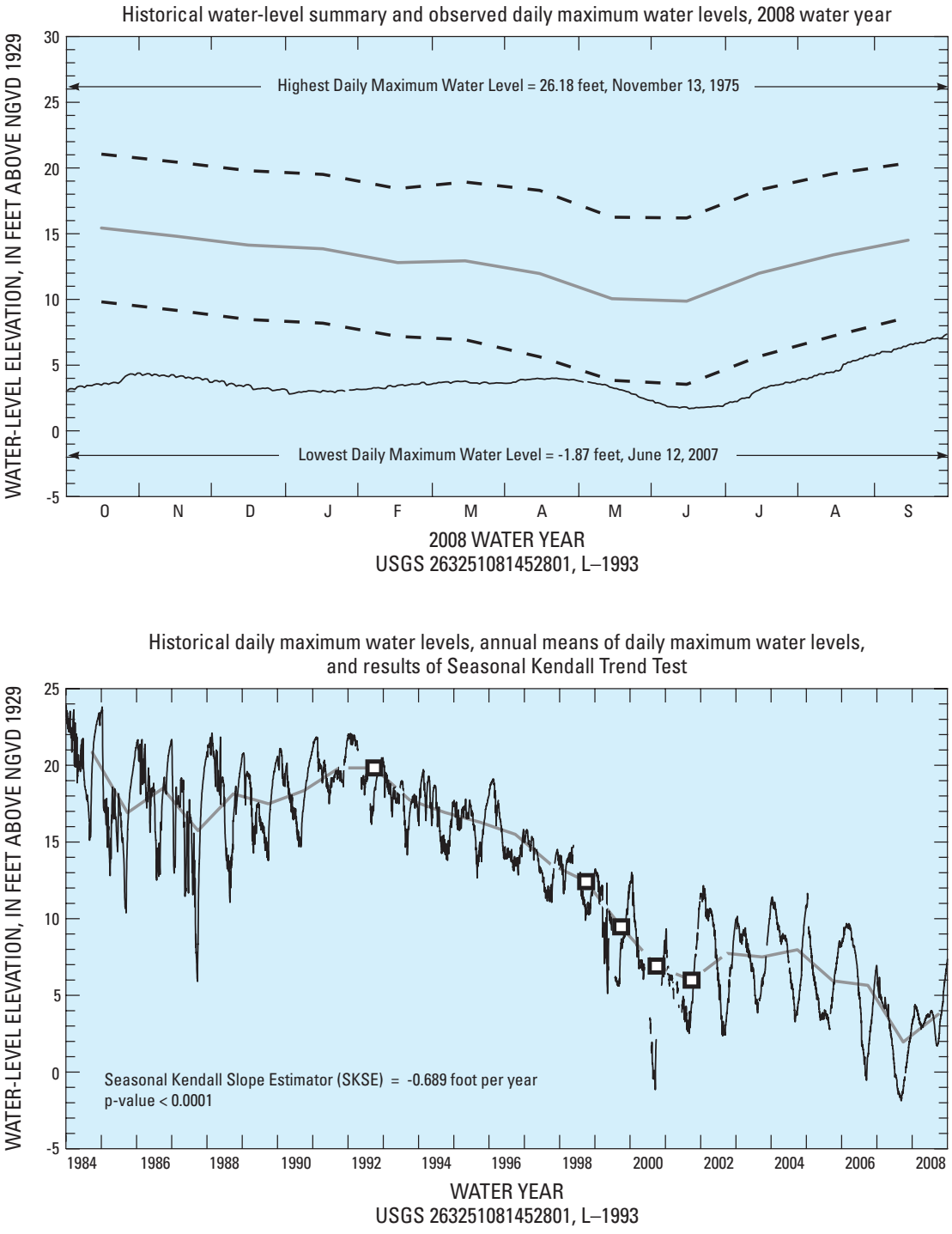

Figure 59. USGS observation well L-1993 water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

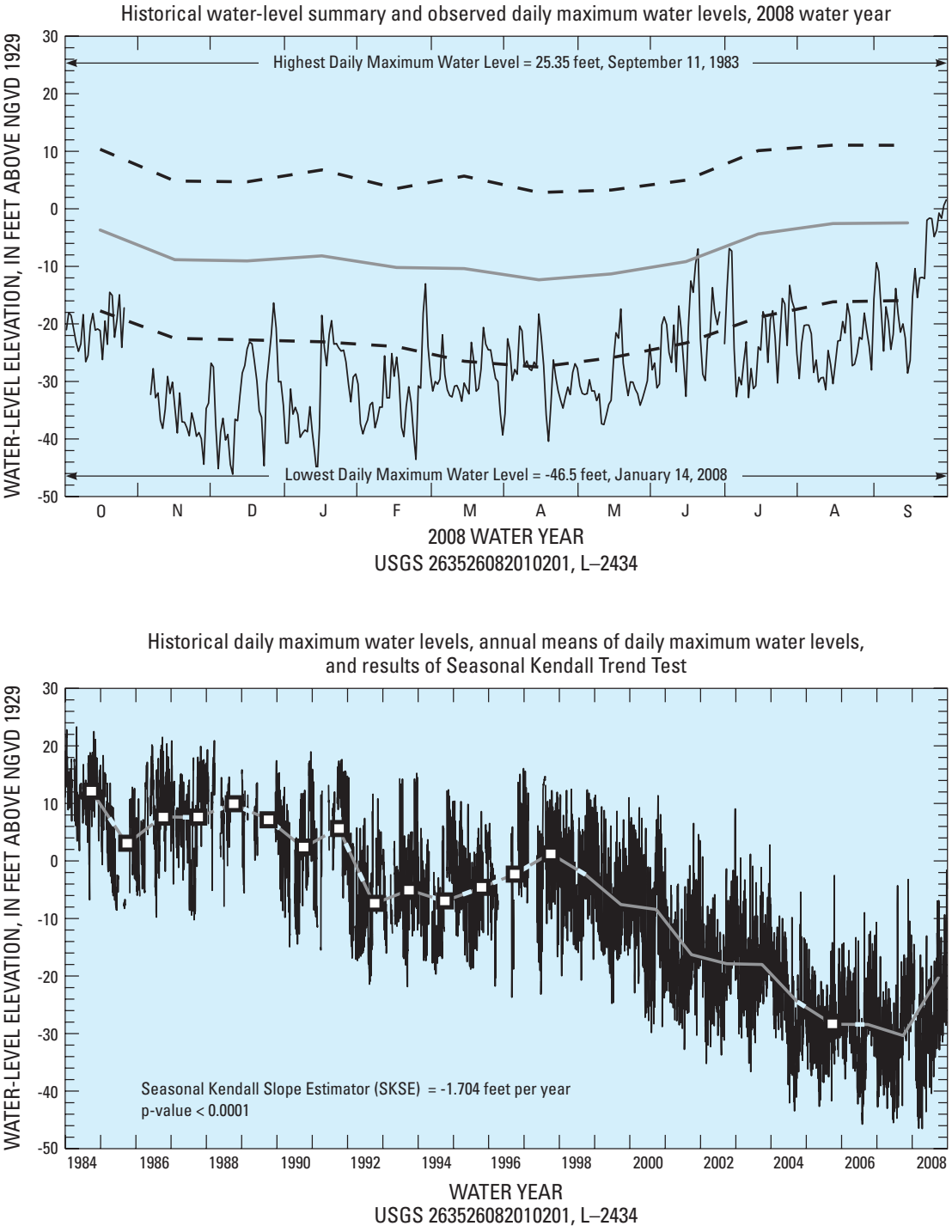

Figure 60. USGS observation well L-2434 water year 2008 daily maximum water level compared to historical water levels for the period October 1983 to September 2008, and the Seasonal Kendall Trend Test for the period October 1983 to September 2008.

The minimum daily water level for the year was recorded June 7 (60.30 ft). The maximum daily water level was recorded September 2 (66.77 ft). Water levels at the Lake Oliver well (fig. 43) remained below normal throughout the entire year. The minimum daily level was recorded on June 18 (105.22 ft) and a maximum daily water level was recorded on September 1 (107.54 ft). Water-levels at the OR-47 well (fig. 44) averaged below normal from October to August, and were at a minimum on June 8–9 (51.39 ft). A significant rise in water levels in August brought levels to about normal for the remainder of the year. The maximum daily water level was recorded on September 1 (61.77 ft).

Two representative wells, P-49 well near Frostproof (274812081190301; fig. 45) and H-15A well near Palmdale (270157081203101; fig. 46), each reporting water levels in the surficial aquifer system (nonartesian sand aquifer), recorded water levels below normal to above normal. Water levels in well P-49 (fig. 45) generally trended downward from about normal conditions in October and November to a minimum of 98.83 ft on June 20, and then increased significantly to an annual maximum on August 19 of 104.85 ft, which is about normal. Well H-15A (fig. 46) water levels were below normal from October to February, and then steadily trended upward to about normal conditions in April before declining to its minimum on June 9 (55.21 ft). Water levels then rose to above normal conditions during the remainder of the year with the maximum occurring on August 19 (60.05 ft).

The significant rise in groundwater levels reported throughout northeast Florida during August and September was caused by the rainfall associated with the landfall of Tropical Storm Fay moving through the area August 19–22 (Verdi and Holt, 2010).

Southwest Florida

Groundwater levels in representative wells in southwest Florida are monitored in the Floridan aquifer system and ranged from below normal to above normal during the 2008 water year. Water levels in wells in the area were at their annual maximums in late August or early September, following the minimum levels in May or June. However, the State Highway 577 well near San Antonio (281715082164401; fig. 47) reached its minimum in January and maximum in April.

The well reporting the most daily values below normal levels was the Weeki Wachee well near Weeki Wachee (283201082315601; fig. 48), which remained below normal the entire year. The minimum daily maximum was recorded June 12 (11.41 ft). The maximum daily water level occurred September 8 (15.74 ft).

ROMP 57 Floridan well near Lake Wales (275411081372001; fig. 49) reported water levels varying from below normal to above normal. The minimum daily water level at the well occurred on May 17 (93.34 ft). Maximum daily water levels occurred on September 2 (109.44 ft), and were the result of rising groundwater levels in the aquifer due to the rainfall associated with Tropical Storm Fay in August.

Water levels at the remaining five wells—State Highway 577 well near San Antonio (281715082164401; fig. 47), Turner well near Brandon (275627082150801; fig. 50), Kibler deep well 26B near Bethany (272838082142201; fig. 51), Sarasota well 9 near Sarasota (271938082251801; fig. 52), and Marshall deep well near Gardner (272012081482501; fig. 53) all reported water levels below normal to about normal for each well. The State Highway 577 well (fig. 47) averaged below normal water levels from October through March and from late May through September. Water levels throughout April and early to mid-May were near normal. The minimum daily water level recorded during the year was on January 4 (79.89 ft). The maximum daily water level recorded during the year was on April 21 (86.24 ft). Turner well (fig. 50) water levels varied from below normal from October through February to about normal the remainder of the year. The maximum water level recorded occurred on September 1 (18.88 ft). The minimum daily recorded water level was on June 10–11 (14.20 ft). Kibler deep well (fig 51) reported below to about normal levels during the year, with the minimum occurring in May 4 (-1.09 ft). The maximum water level during the year was recorded on September 2 (22.15 ft) (fig. 51). Sarasota well 9 (fig. 52) averaged below normal levels most of the year, but recorded near normal levels throughout periods in April and August through September. The minimum daily water level was on May 17 (6.17 ft). The maximum water level recorded during 2008 was on September 1 (25.05 ft). Marshall deep well (fig. 53) averaged near normal all year. The minimum daily water level was on May 18 (31.26 ft). The maximum water level recorded was on September 13–15 (47.01 ft).

South Florida

Groundwater levels across south Florida varied from slightly above normal to below normal, even setting new period of record lowest daily maximums at one site (figs. 54–60). Water levels at USGS observation well S-196A near Homestead (253029080295601; fig. 54) are monitored in the Biscayne limestone aquifer and were about normal during the 2008 water year. The minimum daily water level was 2.39 ft on May 24. The maximum daily water level during the year was 5.73 ft on October 1. Water levels in the surficial aquifer system are monitored in USGS observation well PB-683 near West Palm Beach (263524080124301; fig. 55). The minimum daily water level was below normal at 15.46 ft on June 10. The maximum daily water level was 18.26 ft on August 20–21. Well C-496 (260111081243901; fig. 56), which monitors water levels in the nonartesian sand aquifer of the surficial aquifer system, reported levels from below normal to near normal throughout the year. The minimum daily water level was 2.25 ft on June 1–2. The maximum daily water level was 7.90 ft on September 10–11.

Water levels in the Tamiami Formation were monitored by four representative wells that recorded below normal to near normal levels during the year. USGS observation wells L-2194 (261957081432201; fig. 57), well L-729 (263335081394301; fig. 58), well L-1993 (263251081452801; fig. 59), and well L-2434 (263526082010201; fig. 60) monitor water levels in various parts of the intermediate aquifer system in south Florida. Well L-2194 (fig. 57) monitors water levels in the Tamiami Formation and recorded below normal to near normal levels during the year. The minimum daily water level was -1.12 ft on May 29. The maximum daily water level was 12.31 ft on September 13. Water levels in L-729 (fig. 58), which records water levels in the sandstone aquifer, ranged from below normal to near normal throughout the year. The minimum daily maximum level was 2.70 ft on February 11. The maximum daily level of 21.88 ft was recorded on September 30. Well L-1993 (fig. 59), which records water levels in the Hawthorn limestone aquifer, were below normal the entire water year. The minimum daily maximum water level was 1.69 ft on June 16. The highest daily water level of 7.26 ft was recorded on September 30. Water levels in the limestone aquifer in well L-2434 (fig. 60) were below normal during the year, reaching a period-of-record lowest daily water level of -46.50 ft on January 14. Levels spiked to near normal conditions for a brief period in June, July, and September, recording its maximum water level of 0.60 ft on September 30.

Summary

This report describes hydrologic conditions for the State of Florida during the 2008 water year, including data analyses for precipitation, surface-water flow, lake elevations, and groundwater levels. Many streams in Florida recorded their record-low monthly mean discharge during the year for their periods of record, caused by a continuation of ongoing drought conditions throughout the State. For example, the Santa Fe River near Fort White, a station continuously monitored from 1927 to 1930 and 1932 to 2008, registered record-low monthly discharges in October and November. Several streams in Florida recorded their record-high monthly mean discharge during the year for their periods of record, caused by the landfall of Tropical Storm Fay. For example, the St. Marys River near MacClenny, a station continuously monitored since 1927, registered record-high monthly discharges in August. Lake Okeechobee, a lake monitored since 1912, reached its record-low monthly mean levels each month from October to March. Some wells across the State in various aquifers reached record-low daily maximum water levels. Well L-2434 in south Florida, which monitors the limestone aquifer, recorded its record-lowest daily maximum of -46.50 ft on January 14.

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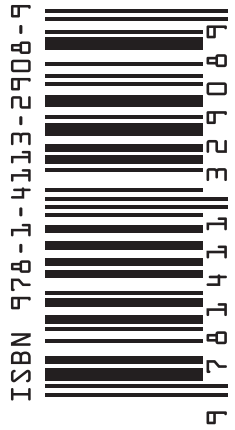
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