EVALUATION OF THE SURFACE-WATER DATA NETWORK, SUWANNEE RIVER BASIN, FLORIDA, 1982

By Roger P. Rumenik and John E. Coffin

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CONVERSION FACTORS

For those readers who may prefer to use International System units (SI) rather than inch-pound units published herein, the conversion factors for the terms used in this report are listed below:

Multiply inch-pound units	By	To obtain SI units
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
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)

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ABSTRACT

In the 9,950 square-mile area of the Suwannee River basin in Florida and Georgia, a network of 33 surface-water gaging stations operated during 1927 to 1982 was evaluated for its capability to provide program information for flood-plain mapping, flood-plain management, forecasting of flow extremes, and defining the impact of changes in land use on surface-water quantity and quality.

Gaging stations are classified based on the type of data and number of years of record as current use, long-term trend, and planning and design. Goals are established for each classification.

Suggestions for program revision include establishing crest-stage gages for high-flow and flood-profile data, defining and establishing a low-flow network, and establishing two and discontinuing one daily discharge station.

INTRODUCTION

The first systematic streamflow investigations in the Suwannee River basin began in 1927. The current cooperative program with the Suwannee River Water Management District began in July 1974. The purpose of the program is to obtain and document stream and spring data from a network of gaging stations for use in developing and planning the management of the water resources within the Suwannee River basin (fig. 1).

The purpose of the report is to examine and evaluate a network of surface-water gaging stations in the Suwannee River basin relative to current program goals, and provide suggestions for program revision. A revised program would provide information for flood-plain mapping, flood-plain management, forecasting of flow extremes, and definition of the impact of changes in land use on surface-water quantity and quality. Some attention is directed to the hydrology of streams and springs relative to ground-water discharge and recharge.

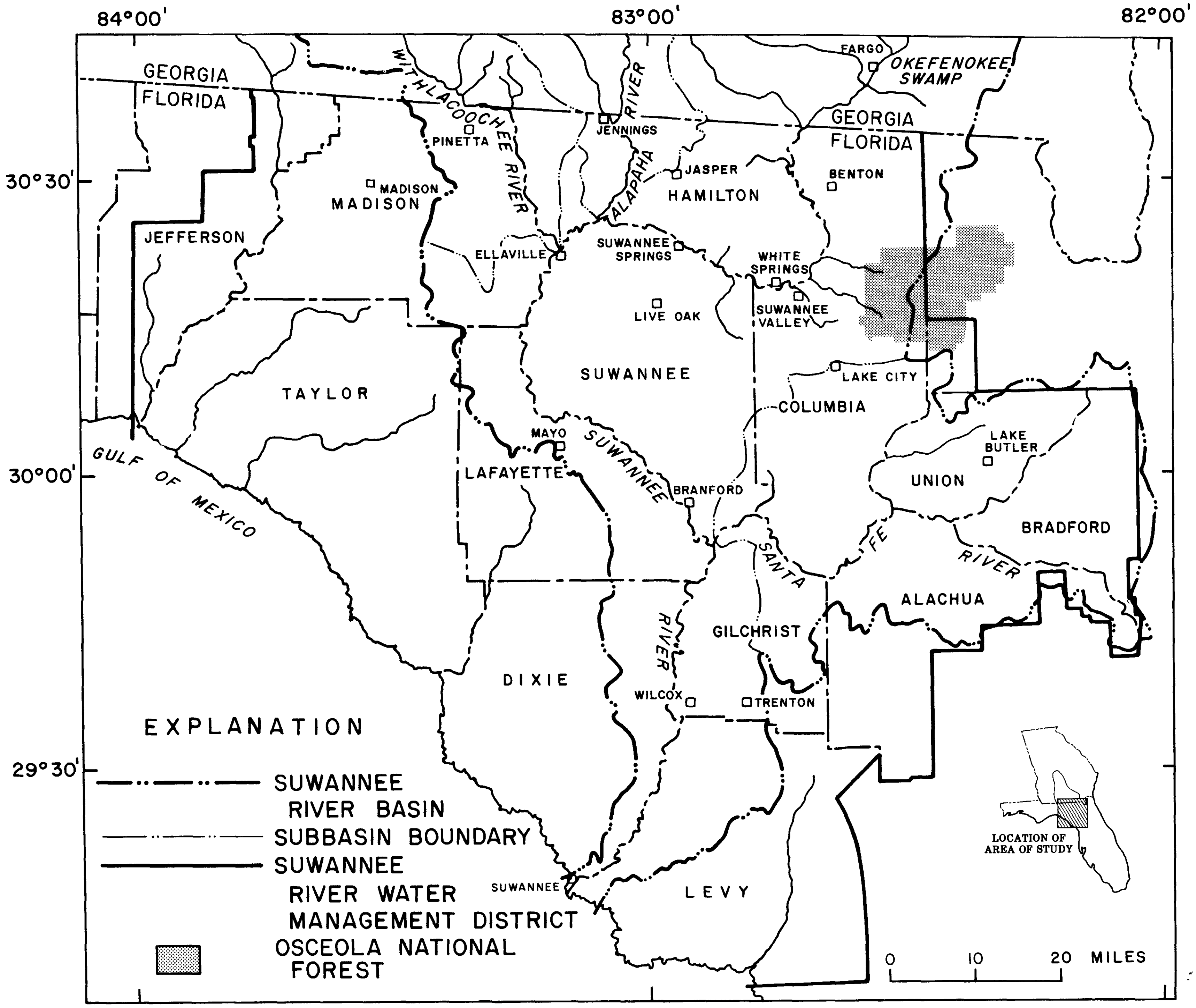

Figure 1. Location of area of investigation.

The scope of the report includes the evaluation of the type of data and period of record of 33 surface-water gaging stations operated during 1927 to 1982. In the 9,950 square-mile (mi^2) area of the Suwannee River basin in Florida and Georgia, 31 were operated in Florida and 2 in Georgia.

No program adjusts itself automatically to changes. Because objectives change, reexamination, reevaluation, and revision of programs at regular intervals is desirable. Only in this way can efficient and effective progress be maintained to meet immediate and future goals.

Background

From 1927 to 1941, the number of daily record gaging stations in the Suwannee River basin increased from 5 to 10. No additional changes were made until the 1950's when four stations were established in the Santa Fe River subbasin; two of these were discontinued after a 3-year period. In 1956, the Suwannee River at Bell station was discontinued after 25 years of operation.

Rabon (1971) evaluated the streamflow-data program in Florida by regression analysis using stations operated for 20 years or more. Four stations in the Suwannee River basin were recommended for discontinuance as a result of the 1971 evaluation. These were Suwannee River at Ellaville, Santa Fe River near Fort White, New River near Lake Butler, and Santa Fe River near High Springs. Ellaville and Fort White remain in operation and New River and High Springs were discontinued. Since the beginning of the program with the Suwannee River Water Management District, changes in the records program have been made to provide more definitive areal coverage (or to suit fiscal limitations), but program structure and intent have been maintained. From 1974 to 1982, the network increased from 9 to 16 daily record stations.

Regional Setting

The Suwannee River basin from Fargo, Ga., to Suwannee, Fla., is the area of investigation (fig. 1). Major tributaries are the Alapaha, Withlacoochee, and Santa Fe Rivers. The flow of the Suwannee River is unregulated except for Mixons Ferry Damsite located about 12 miles upstream of the northernmost gaging station at Fargo, Ga. Numerous springs are dispersed in the Suwannee River basin.

There are no significant urban centers within the Suwannee River basin in Florida. The largest town in the basin in Florida is Lake City in Columbia County (fig. 1), which had a population of 9,257 in the 1980 census (University of Florida, 1980).

The primary economy of the area is agricultural, although much of the labor force is in construction, mining, manufacturing, transportation, utilities, and the wood industry (Florida Department of Environmental Regulation, 1975).

National Weather Service records (U.S. Department of Commerce, 1980) show 54 inches as the average annual rainfall at Lake City from 1941 to 1970. The range for 95 years of record is from a low of 29.83 inches in 1908 to a high of 84.47 inches in 1964. In Florida, average annual evapotranspiration is estimated to be about 39 inches (Miller and others, 1978). This value also is the difference between average annual rainfall and average annual runoff based on the long-term streamflow record collected at Suwannee River near Wilcox, where the average annual runoff is approximately 15 inches.

Regional Hydrologic System

The Suwannee River begins in the Okefenokee Swamp area of south Georgia and meanders 265 miles south and westward through Florida to the Gulf of Mexico. Above the town of White Springs, in Hamilton County, Fla., the riverflow consists of surface drainage from headwaters in wetland areas and ground-water discharge from the surficial aquifer (Miller and others, 1978). Recharge to the surficial aquifer is almost entirely from local rainfall. Recharge to the Floridan aquifer in this area is very low (Stewart, 1980).

Below White Springs the average annual flow of succeeding downstream stations in Florida for their respective periods of record through 1982 increases from 1,820 cubic feet per second (ft^3/s) at White Springs to 6,440 ft^3/s at Ellaville, to 6,880 ft^3/s at Branford, and to 10,400 ft^3/s at Wilcox. In the reach from White Springs to Branford, the flow of the river increases due to spring discharge and inflow from the Withlacoochee and Alapaha Rivers, although stretches of the river may gain or lose streamflow depending on the degree of interconnection with the Floridan aquifer and recent hydrologic conditions (Hull and others, 1981). This is an area of high recharge to the Floridan (Stewart, 1980).

The Alapaha River (1,840 mi^2 drainage area at the mouth), during base flow conditions, does not contribute flow directly to the Suwannee River. Alapaha River flow is captured by sinkholes located about 2 miles south of Jennings, Fla. South of the sinkholes the channel is dry except during medium and high flow conditions. However, Alapaha Rise, a spring located 0.5 mile upstream of the confluence of the Alapaha and Suwannee Rivers, produces a substantial flow to the Suwannee River ranging from 350 to 1,000 ft^3/s. The rise may be a resurgence of the Alapaha River.

The only major tributary to the Suwannee River downstream from the Withlacoochee River is the Santa Fe River (1,380 mi^2 drainage area), which derives most of its base flow and much of its average flow from discharge from the Floridan aquifer.

Suwannee River near Wilcox is the last station downstream in the Suwannee River basin; it is about 33 river miles above the Gulf of Mexico, and 42 river miles below Branford, Fla. The drainage area at Wilcox (9,640 mi^2) is 97 percent of the basin. Wilcox has an average annual discharge (42 years of record) of 10,400 ft^3/s, or about 2,000 ft^3/s more than the combined discharge at Branford and Santa Fe River at Fort White.

About 71 springs described in the report "Springs of Florida" by Rosenau and others (1977) are in the basin of the Suwannee River. Based on instantaneous discharge measurements, and assuming continuous flow, the nine first-magnitude springs (flow greater than 100 ft^3/s) account for a combined flow of about 2,100 ft^3/s. The other 62 springs are of second magnitude, that is, they have an average flow of 10 to 100 ft^3/s. Their contribution to the Suwannee River is about 1,900 ft^3/s.

Some of the first-magnitude springs and most of the second-magnitude springs backflow when the river stage exceeds aquifer head at a spring. Spring discharge, therefore, may vary with change in river stage (Rosenau and others, 1977). The river can simultaneously gain and lose flow in adjoining reaches, depending upon recent local hydrologic conditions relating to river stage and pressure head in the aquifer (Hull and others, 1981). Total spring discharge, therefore, is difficult to quantify. The effects of spring flow (ground-water discharge) on the river are pronounced during low river stages, in river reaches with the greatest degree of aquifer-river interconnection, and where surface-water inflow is comparatively small.

GOALS OF THE SURFACE-WATER DATA NETWORK

The overall goal of a surface-water data network is to provide information on flow characteristics at any point on any stream in the basin. Surface-water data may be used for management of flood plains; forecasting floods, droughts, and seasonal flows; design of highway bridges and culverts; development of recreational facilities; dilution of waste; and allocation of water for multipurpose uses.

In advance of the need to furnish data for one or more of these purposes, it is necessary that an effective data-collection system be in operation. The design of surface-water data programs is based on specific goals. Data collected to meet those goals are classified into three types:

1. Data for current use,
2. Data to define long-term trends, and
3. Data for planning and design.

The goal of collecting data for current use is to provide the information needed for a specific purpose at specified sites. Current-use data stations are placed in a separate classification category because (1) justification can be related to specific needs, (2) the data may have limited transfer value in a hydrologic sense, and (3) the location of the stations and the periods of operation can be specified by the user of the data. In the Suwannee River basin, a cooperative program between the Geological Survey and the Suwannee River Authority to monitor river water quality on a current basis has been in progress since 1968. The locations of current-use stations are shown in figure 2. A report (Hull and others, 1981) based on the results of that monitoring and data collected with and prior to establishment of the Suwannee River Water Management District, discusses the overall results of the water-quality program.

The goal of collecting data to define long-term trends is to obtain a long-term record of the highest accuracy achievable on natural flow streams by operating a few carefully selected gaging stations indefinitely. A long continuing series of consistent observations on streamflow is needed (1) for analysis of the statistical structure of the hydrologic time series, and (2) as a reference or comparative base for noting changes in the flow regime of streams that become increasingly regulated with time. The gages should be well distributed areally and located in subbasins of different physical characteristics. The number of such gages can be small relative to the number of total gages. The locations of stations recording long-term trends are shown in figure 3.

The goal of collecting data for planning and design is to define the statistical flow characteristics of streams. Examples are determination of flood peaks, low flows, and seasonal flows and the probability of occurrence. In setting goals for planning and design purposes, it is necessary to specify not only the scope and type of information to be furnished, but also the accuracy requirements of such information. Streams are identified by size of drainage area, that is, as principal streams (greater than 500 square miles) and secondary streams (less than 500 square miles). According to Benson and Carter (1973) the accuracy goal for principal streams is the equivalent of 25 years of record, and for secondary streams the equivalent of 10 years of record. The location of stations used in planning and design are shown in figure 4.

Table 1 summarizes the goals of the surface-water data network in relation to the classification of the data and the accuracy required to meet those goals.

Table 1.--Goals of the surface-water data network

Requirements	Classification			
			Planning and design	
	Current use	Long-term trends	Principal streams	Secondary streams
Goals	To provide current data on streamflow needed for day-by-day decisions on water management as required.	To provide a long-term data base of homogeneous records on natural flow streams.	To provide information on statistical characteristics of flow at any site on any stream to the specified accuracy.	
Drainage area limits.	None	None	Greater than 500 square miles.	Less than 500 square miles.
Accuracy	As required.	Highest obtainable.	Equivalent to 25 years of record.	Equivalent to 10 years of record.

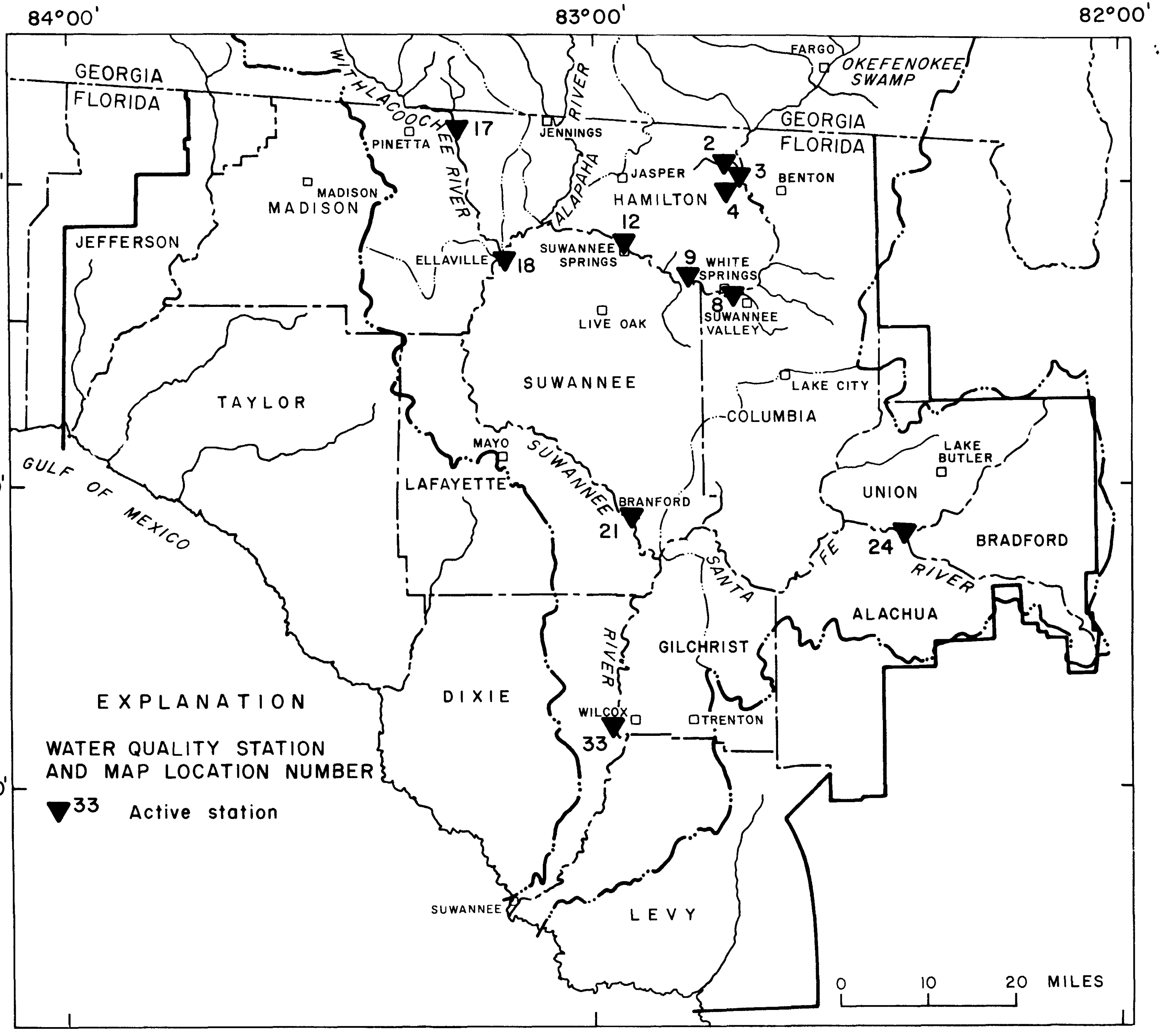

Figure 2. Locations of current-use stations.

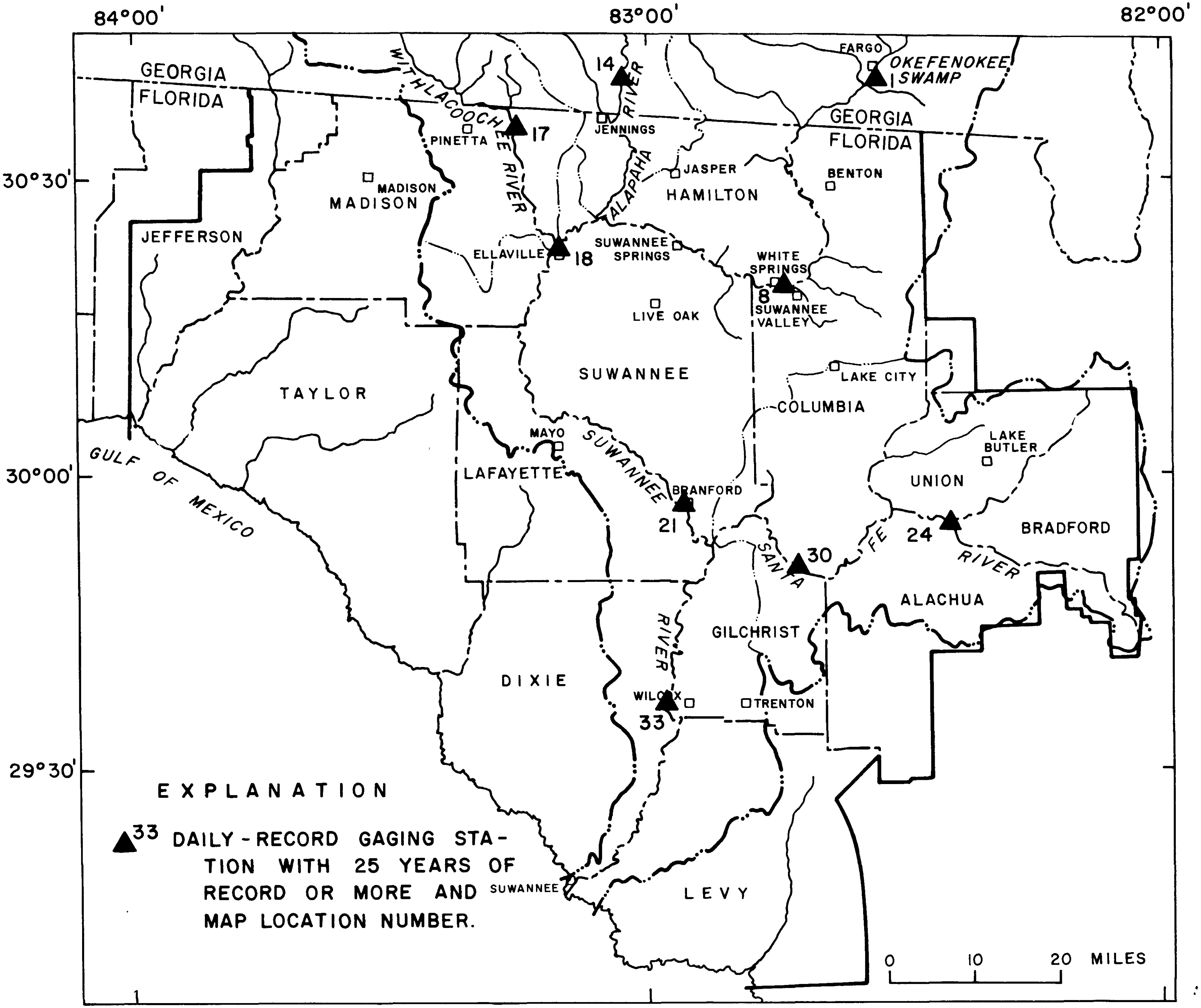

Figure 3. Locations of long-term trend stations.

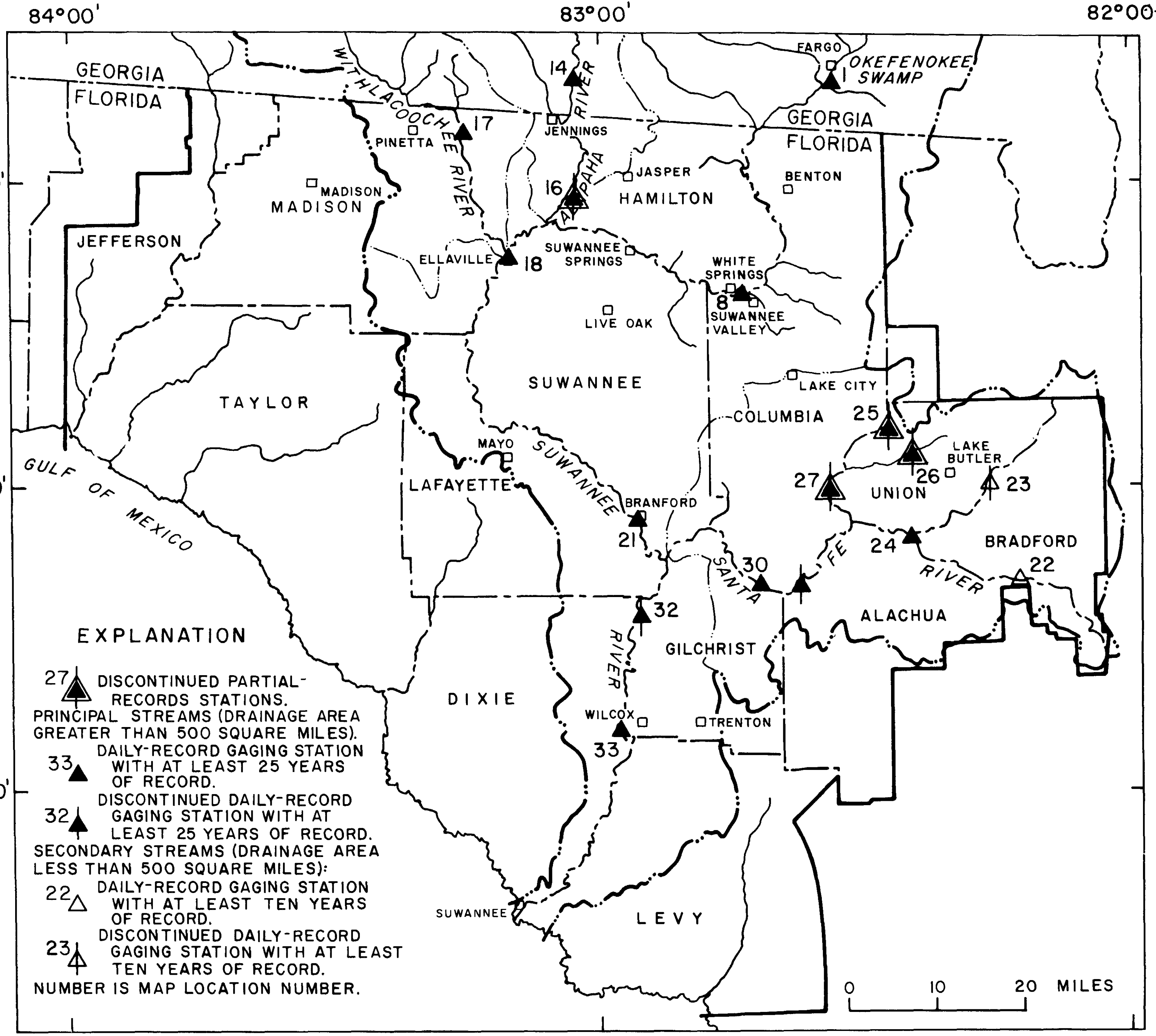

Figure 4. Locations of stations used in planning and design.

EVALUATION OF THE SURFACE-WATER DATA NETWORK

This section evaluates the current and historical surface-water network in the Suwannee River basin. The evaluation was made to determine if the network adequately provides the information needed to meet program goals based on the three classifications of data. Table 2 lists all stations, active and discontinued, used in the evaluation of the surface-water data network in the Suwannee River basin. Figure 5 shows the location of these stations. Some stations collect multitype data and may appear in all three classifications.

Table 2.--Streamflow gaging stations in the Suwannee River basin

[Classification of data: cu, current use; lt, long-term trend; pd, planning and design. Frequency of record: D, daily; P, periodic]

Map location No.	Station No.	Name and location	Drainage area (mi^2)	Period and frequency of record	Classification of data
1	02314500	Suwannee River at Fargo, Ga.	1,260	1927-31, D 1937-82, D	lt, pd
2	02314986	Rocky Creek near Belmont, Fla.	50	1970-76, P 1976-82, D	cu
3	02315000	Suwannee River near Benton, Fla.	2,090	1934-75, P 1975-82, D	cu
4	02315005	Hunter Creek near Belmont, Fla.	25.4	1970-79, P 1979-82, D	cu
5	02315200	Deep Creek near Suwannee Valley, Fla.	88.6	1976-81, D	
6	02315392	Robinson Creek near Suwannee Valley, Fla.	27.4	1976-81, D	
7	02315470	Falling Creek near Winfield, Fla.	52.9	1977-81, P	
8	02315500	Suwannee River at White Springs, Fla.	2,430	1927-82, D	cu, lt, pd
9	02315520	Swift Creek at Facil, Fla.	65.3	1969-76, P 1976-82, D	cu

Table 2.--Streamflow gaging stations in the Suwannee River basin--Continued

Map location No.	Station No.	Name and location	Drainage area (mi^2)	Period and frequency of record	Classification of data
10	02315532	Rocky Creek near Houston, Fla.[1]	25.4	1978-82, P	
11	02315542	Camp Branch near Genoa, Fla.[1]	6.1	1978-82, P	
12	02315550	Suwannee River at Suwannee Springs, Fla.	2,630	1960-74, P 1974-82, D	cu
13	02315648	Alapaha Rise near Fort Union, Fla.[1]	--	1977-79, P 1981-82, P	
14	02317500	Alapaha River at Statenville, Ga.	1,400	1931-82, D	lt, pd
15	02317620	Alapaha River near Jennings, Fla.	1,680	1976-82, D	(not classified)
16	02317630	Alapaha River near Jasper, Fla.[1]	1,720	1966-82, P	pd
17	02319000	Withlacoochee River near Pinetta, Fla.	2,120	1931-82, D	cu, lt, pd
18	02319500	Suwannee River at Ellaville, Fla.	6,970	1927-82, D	cu, lt, pd
19	02319800	Suwannee River at Dowling Park, Fla.[1]	7,190	1950-55, P 1975-82, P	
20	02320000	Suwannee River at Luraville, Fla.[1]	7,330	1927-37, D 1976-82, P	
21	02320500	Suwannee River at Branford, Fla.	7,880	1931-82, D	cu, lt, pd
22	02320700	Santa Fe River near Graham, Fla.	94.7	1957-82, D	pd

[1] Discontinued effective September 30, 1982.

Table 2.--Streamflow gaging stations in the Suwannee River basin--Continued

Map location No.	Station No.	Name and location	Drainage area (mi^2)	Period and frequency of record	Classification of data
23	02321000	New River near Lake Butler, Fla.	191	1950-71, D 1975-77, P	pd
24	02321500	Santa Fe River at Worthington Springs, Fla.	575	1931-82, D	cu, lt, pd
25	02321600	Olustee Creek near Lulu, Fla.[1]	49.1	1964-82, P	pd
26	02321700	Swift Creek near Lake Butler, Fla.[1]	46.0	1957-60, D 1961-82, P	pd
27	02321800	Olustee Creek near Providence, Fla.	163	1957-60, D 1964-75, P	pd
28	02321898	Santa Fe River at Oleno State Park, Fla.[1]	820	1977-82, P	
29	02322000	Santa Fe River near High Springs, Fla.	868	1931-71, D	pd
30	02322500	Santa Fe River near Fort White, Fla.	1,020	1927-30, D 1932-82, D	lt, pd
31	02322700	Ichetucknee Springs near Hildreth, Fla.[1]	--	1929-82, P	
32	02323000	Suwannee River near Bell, Fla.	9,390	1932-56, D	pd
33	02323500	Suwannee River near Wilcox, Fla.	9,640	1930-31, D 1941-82, D	cu, lt, pd

[1]Discontinued effective September 30, 1982.

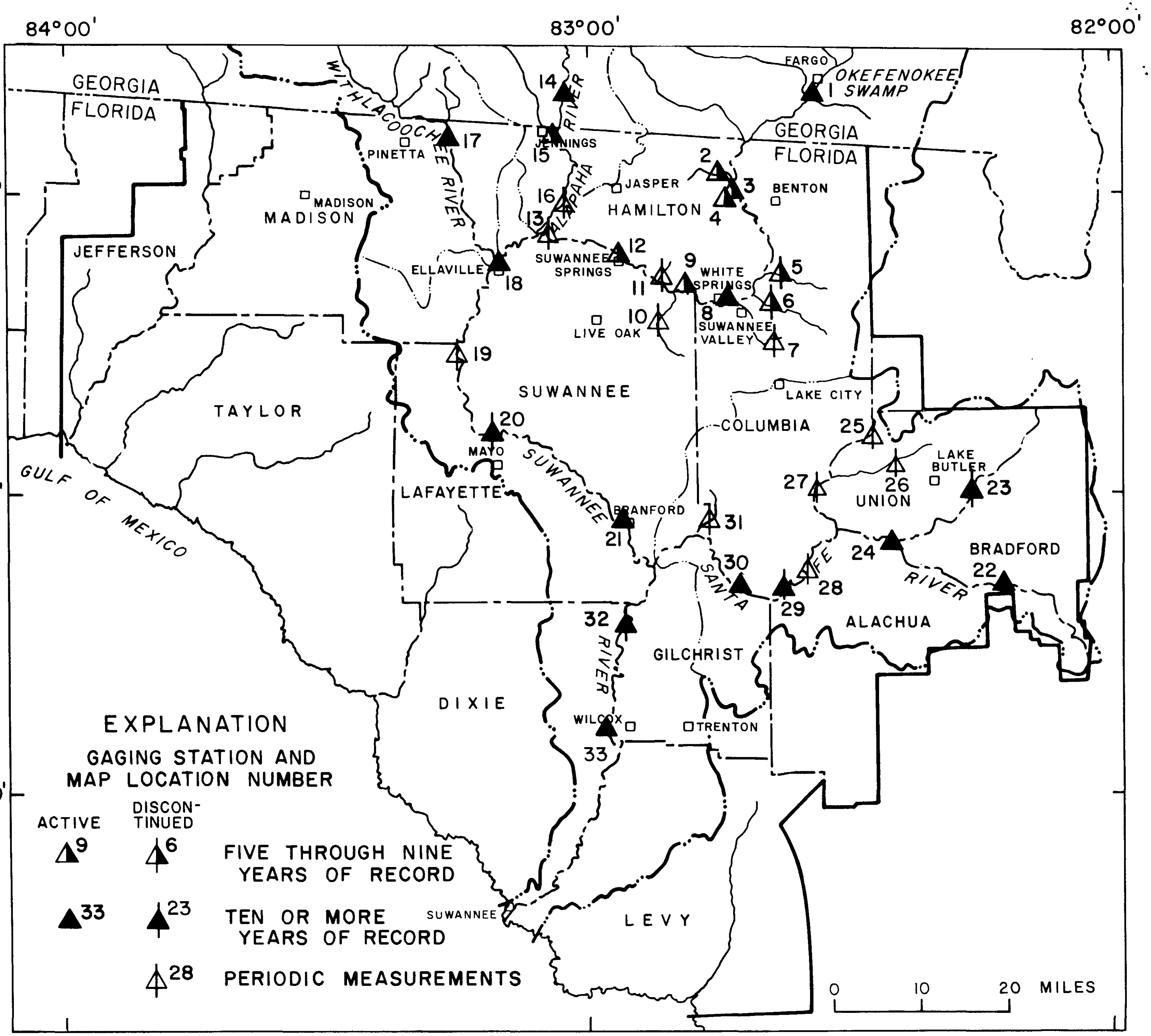

Figure 5. Locations of gaging stations in the Suwannee River basin.

Suwannee River at Fargo, Ga., (map location 1) is the upstream most station on the Suwannee River and is classified as a long-term trend, and planning and design station. The 49 years of record are rated good (daily discharge within 10 percent accuracy) for providing high-flow data for planning and design purposes. The station is operated by the U.S. Geological Survey, Georgia District.

Rocky Creek near Belmont (map location 2) is the upstream most station in the Suwannee River basin in Florida. It is classified as a current-use station for the collection of water-quality data on a periodic basis. Periodic discharge measurements made since 1970 and daily discharge record collected from 1976 to 1982 could provide information useful in low- and high-flow frequency analysis. Subsequent years record to 1986 would meet the required accuracy for 10-years record for planning and design.

Suwannee River near Benton (map location 3) is the northernmost station on the Suwannee River in Florida. Classified as a current-use station for water-quality purposes, it has also monitored the quantity of water entering the basin in Florida on a daily basis since 1975. Continued operation as a daily discharge station would increase the accuracy for use in low- and high-flow frequency analysis for planning and design purposes.

Hunter Creek near Belmont (map location 4) is also classified as a current-use station for water-quality purposes. This station is maintained on a daily basis to monitor the releases from phosphate mining operations upstream. Stage-discharge records at this station are considered only fair (daily discharge within 15 percent accuracy) and have no transfer value due to regulation upstream.

Deep Creek and Robinson Creek near Suwannee Valley (map locations 5 and 6) were operated as short-term, current-use stations from 1976 to 1981 to determine the impact of potential phosphate mining on the hydrology of Osceola National Forest. Reactivation as daily discharge stations for an additional 5 years would provide low- and high-flow frequency data for planning and design purposes on natural-flow streams in small basins. The range in drainage area between Deep Creek (88.6 mi^2) and Robinson Creek (27.4 mi^2) would have excellent transfer value to other natural-flow streams in the upper part of the basin.

Falling Creek near Winfield (map location 7) was operated as a current-use station from 1977 to 1981 as a part of the Osceola National Forest study. Periodic discharge measurements and water-quality samples are available as a result of that study. Due to the poor (daily discharges less then "fair") stage-discharge relation at the site, a result of flow entering a sinkhole downstream, the data has no transfer value.

Suwannee River at White Springs (map location 8) is classified as a current-use, long-term trend, and planning and design station. Changes in water quality due to mining activities north of White Springs and below Benton can be determined for this station. The 56 years of daily discharge record (1927-82) are considered good for defining long-term trends and noting changes in the flow regime. Adequate data exist to

make it an important index station for planning and design and for flood forecasting purposes in the upper quarter of the basin. Continued operation of the station at White Springs would not necessarily improve the accuracy of the available data, but infinite operation would aid in development of long-term trend data, a benchmark, in a part of the basin that has undergone little development.

Swift Creek at Facil (map location 9) is classified as a current-use station for water-quality purposes. The station is operated to provide daily discharge data on mining operations upstream. Discharge records are considered fair but have no transfer value due to regulation upstream.

Rocky Creek near Houston and Camp Branch near Genoa (map locations 10 and 11) were operated as current-use water-quality stations for 4 years to provide background information in the event of mining operations north of the stations. For current-use purposes, there is no need to reactivate either station at this time. However, if a regional frequency analysis were initiated, Rocky Creek near Houston would be useful due to its drainage basin characteristics.

Suwannee River at Suwannee Springs (map location 12) is classified as a current-use station for water-quality studies. Records collected at the station include daily gage heights from 1960 to 1974, from which daily discharge could be computed, and daily discharge from 1974 to 1982. Discharge records are considered good except at high stages when the stage-discharge relation may be affected by backwater from the Withlacoochee River and the Alapaha River. Installation of an auxiliary gage to record the extent of backwater conditions would help to better define the stream's high-flow rating for use in flood-frequency analysis. The Suwannee River at Suwannee Springs gaging station would be important in low-flow studies to identify gains and losses from White Springs (map location 8) to Suwannee Springs (map location 12), identified by Hull and others (1981) during seepage runs in 1977 and 1978.

Alapaha Rise near Fort Union (map location 13) does not fit into any of the three classifications of data. Periodic discharge measurements are made to determine the amount of flow entering the Suwannee River at what is thought to be a reemergence of the Alapaha River. Due to the poor stage discharge relation caused by backwater from the Suwannee River, the data have no transfer value.

Alapaha River at Statenville, Ga., (map location 14) is classified as a long-term trend, and planning and design. The station is operated by the U.S. Geological Survey, Georgia District, and the records are considered good. This is a good index station during low-flow studies, and adequate data are available to generate low- and high-flow frequencies.

Alapaha River near Jennings (map location 15) does not fit into any of the three classifications. Located about 8 miles south of the Statenville station (map location 14), drainage area 1,400 mi^2, there is only a 280-mi^2 increase in drainage area. Benson and Carter (1973) recommend that the drainage area be at least doubled between stations on principal streams. Hydrograph comparison of the two stations indicates similar trends with only a slightly higher discharge at Jennings. If converted to a crest-stage partial-record station, data could be correlated with the Statenville, Ga., station and produce data as useful as that now being collected, at less cost.

Alapaha River near Jasper (map location 16) is classified as a planning and design station. Operated as a crest-stage gage until it was discontinued in September 1982, the station provides information useful in defining flood profiles in the basin. Should the station at Jennings be discontinued, Jasper would need to be reestablished to provide the necessary information for defining flood profiles.

Withlacoochee River near Pinetta (map location 17) is useful under all three classifications. Water-quality data for current-use purposes are collected to monitor the effects of pulp and paper mill industries upstream. The 52 years of daily discharge record are considered good for defining long-term trends and noting changes in the flow regime. It is the only long-term, daily-record station on the Withlacoochee River in Florida, thus making it a critical index station for planning and design purposes. Installation of a crest-stage gage 10 miles downstream (at State Highway 6) would help to better define flood profiles.

Suwannee River at Ellaville (map location 18) is classified as a current-use, long-term trend, and planning and design station. Current-use data are available from a Data-Collection Platform equipped with satellite relay equipment, thus allowing for current access to data during critical periods such as low and high flows. The 56 years of daily discharge records are considered good for defining long-term trends. Located 200 feet downstream from the Withlacoochee River, it is an important station for planning and design and flood forecasting purposes. In view of the good long-term record, consideration could be given to discontinuing operation as a daily streamflow station, but continuing operation as a stage-only station for backwater computations during periods of high flow at Pinetta (map location 17) and Suwannee Springs (map location 12).

Suwannee River at Dowling Park and Luraville (map locations 19 and 20) stations are not classified. Low-flow measurements made at these stations could be correlated with index stations for planning and design purposes. Installation of crest stage indicators would be useful in defining flood profiles between Ellaville (map location 18) and Branford (map location 21). The Luraville station was operated as a crest stage flood-profile station during 1950-72. However, flood peaks reached a recorded elevation in only 3 of 23 years.

Suwannee River at Branford (map location 21) is classified as a current-use, long-term trend, and planning and design station. Streamflow data are collected on a daily basis and reported monthly to assess current conditions in the basin. Water-quality samples are collected as part of the Survey's National Stream Quality Accounting Network that is designed to depict areal variability of conditions nationwide and to detect and assess long-term changes in stream quality. The station has been previously designated as a long-term trend benchmark station. The 52 years of record are rated good for providing low- and high-flow data for planning and design purposes.

Santa Fe River near Graham (map location 22) is located near the headwaters of the third major tributary to the Suwannee River. The 25 years of record are considered fair to good for planning and design. Conditions at the station are poor at low stages due to an unstable channel control. Discharge measurements are required every 5 days to maintain a record with 10 percent accuracy (Marvin A. Franklin, U.S. Geological Survey, oral commun., 1983). Should this station remain in operation, consideration should be given to construction of an artificial control which would upgrade the quality of the record collected.

New River near Lake Butler (map location 23) is not an active site. However, 22 years of data provide information for planning and design purposes. Reactivation of the station as a crest stage gage would provide useful flood-profile data in the New River basin. Periodic measurements made at low flows would improve the accuracy of low-flow frequency data in the basin.

Santa Fe River at Worthington Springs (map location 24) is classified as a current-use, long-term trend, and planning and design station. Water-quality samples are collected as part of the Survey's National Stream Quality Accounting Network. The station has been previously designated a long-term station. The 52 years of record are considered good. During low flows, it is a key index station in conjunction with Santa Fe River near Graham (map location 22) and New River near Lake Butler (map location 23).

Olustee Creek near Lulu, Swift Creek near Lake Butler, and Olustee Creek near Providence (map locations 25, 26, and 27) are discontinued crest stage gages. In addition, Swift Creek near Lake Butler and

Olustee Creek near Providence have 3 years each of daily discharge data. Unless a small basin study is implemented, reestablishment of these stations would serve no purpose. However, Swift Creek (map location 26) could be considered for reactivation as a crest stage gage to increase the accuracy of flood-frequency data used for planning and design purposes.

Santa Fe River at O'Leno State Park (map location 28) does not fit into any of the three classifications of data. Periodic discharge measurements were made to determine the amount of flow entering a sinkhole 0.5 mile below the gage.

Santa Fe River near High Springs (map location 29) is a discontinued planning and design station. The 41 years of record (1931-71) provide adequate data for defining low- and high-flow frequencies. Unless required for a specific study, there is no need to reactivate this station.

Santa Fe River near Fort White (map location 30) is classified as a long-term trend, and planning and design station. The 55 years of record are rated good for defining low- and high-flow frequencies. This is the last point Santa Fe River flow conditions are monitored before entering the Suwannee River.

Ichetucknee Springs near Hildreth (map location 31) does not fit any of the three classifications of data. Sufficient discharge measurements were made from 1929 to 1982 to adequately define gross discharge of the springs which contribute to the Ichetucknee River.

Suwannee River near Bell (map location 32) is classified as a planning and design station. The 25 years of record would adequately define low- and high-flow frequencies. This station may serve as an auxillary station for computing potential backwater at the Branford (map location 21) station.

Suwannee River near Wilcox (map location 33) is classified as a current-use, long-term trend, and planning and design station. It is the most downstream station used for collecting water-quality data on a periodic basis. The 42 years of record are good for determining long-term trends and low- and high-flow frequencies. The drainage area, 9,640 mi^2, represents 97 percent of the Suwannee River basin, and the flow recorded at this station is most indicative of total flow to the Gulf.

DISCUSSION OF THE EVALUATION

This evaluation indicates an abundance of hydrologic data are available on principal streams for analysis but lacking on secondary streams in the basin. The development of the optimum surface-water network to meet the needs of the water manager requires a balance between data collection and analysis. Continual interaction between the two elements is needed for a better understanding of the hydrologic system and to evaluate the adequacy of the network to meet short- and long-term goals.

Current-use stations presently in operation are used to assess the water quality of the Suwannee, Withlacoochee, and Santa Fe Rivers. The justification for these stations is related to the interest of the Geological Survey and Suwannee River Authority to monitor the changes in water quality of streams that may result from phosphate mining and other industrial operations. The overall evaluation of the current-use network finds it adequate for meeting the needs of Federal and State agencies, and local planners and managers.

The long-term network in the Suwannee River basin consists of nine daily discharge stations. All have 50 or more years of record with the exception of Suwannee River at Wilcox, which has 42 years. Statistical evaluation of these stations is needed to determine if additional data will improve the accuracy of the record. The present long-term trend network is meeting the goals of providing data for analysis of the statistical structure of the hydrologic time series and as a comparative base for noting changes in the flow regime with time.

The most immediate need in the basin is the establishment of a complete network for planning and design purposes to provide information for defining flood profiles. This can best be accomplished by establishing crest stage gages at selected points in the basin. From Suwannee Springs north to Fargo, an adequate number of daily discharge stations exist to supply flood-profile information.

Stations on the Alapaha River, through modifications, would provide more meaningful flood-profile data. This could be accomplished by using data from the daily discharge station at Statenville, Ga., converting the daily discharge station at Jennings to a crest stage gage, and reestablishing the crest stage gage at Jasper for more areal coverage in the basin. Daily discharge at Jennings could be determined by using the 6 years of record available there in conjunction with Statenville to develop an equation through regression analysis that could be used to compute daily discharge at Jennings.

The flood profiles of the Withlacoochee River could be better defined by establishing a crest stage gage near Madison to be used in conjunction with the daily discharge station upstream at Pinetta. Installation of a wire weight gage near Madison for short-term operation could be considered to help define backwater occurrences at Pinetta.

Flood-profile information in the 52 miles between Ellaville and Branford would be better defined by installation of crest stage gages at Dowling Park and Luraville.

In the Santa Fe River basin, daily discharge stations at Graham and Worthington Springs would supply needed flood-profile information. However, data are needed east and west of Lake Butler. This could be accomplished by reestablishing crest stage gages on New River near Lake Butler and Swift Creek near Lake Butler. Daily record collected at Fort White and its auxillary gage at Hildreth would complete the flood-profile network in the Santa Fe River basin.

Establishment of a crest stage gage at Suwannee River at Bell would better define flood profiles in the 42-mile reach between Branford and Wilcox. Installation of a wire weight gage at Bell for short-term operation would provide flood-profile information and be useful in determining if backwater exists at Branford during high stages. The auxillary gage for Wilcox, located at Old Town, would complete the planning and design network for defining flood profiles.

Planning and design data are also needed in the basin to predict the probable magnitude and frequency of low flows. These data would be essential to the appraisal of the adequacy of streamflow for dilution and transport of wastes and as a source of water for municipal, industrial, and agricultural uses during critical dry periods. These data are also useful to water managers in the administration of water laws. A report by Hughes (1981) represents the most recent effort to compile statewide low-flow frequency data for streams in Florida. The scope of that report does not encompass efforts to provide estimates of recurrence intervals of low flows at partial record stations or at stations having less than 7 years of continuous record. Nor does it extend low-flow frequency data of gaged sites to ungaged sites or establish relations between low streamflow and physiographic factors or other features that influence streamflow. Of the 161 stations for which data are presented, 11 are in the Suwannee River basin. These stations provide an adequate data base of index stations for a regional low-flow study. The next step would be to initiate a long-term, partial-record, low-flow network to be correlated with these index stations followed by a regional low-flow analysis of the basin. Relations of low flow to water levels in the Floridan aquifer need to be investigated to regionalize estimates of low flow within acceptable accuracy.

CONCLUSIONS

The surface-water data network in the Suwannee River basin provides an abundance of hydrologic data for analysis. Based on current and future goals determined jointly by the U.S. Geological Survey and the Suwannee River Water Management District, the following revisions to the present program are worthy of consideration.

1. Establish a network of crest stage gaging stations to increase the accuracy of high-flow data and to supplement flood-profile data:

    Alapaha River near Jennings
    Alapaha River near Jasper
    Withlacoochee River at State Highway 6
    Suwannee River at Dowling Park
    Suwannee River at Luraville
    New River near Lake Butler
    Swift Creek near Lake Butler
    Suwannee River near Bell

2. Establish a long-term, partial-record, low-flow network designed to regionalize low-flow frequency in the basin.

3. Increase the number of continual-record gaging stations on unregulated secondary streams to determine the effects of land use on streamflow characteristics. The initial step of this plan would be to reestablish the gaging stations in the following streams:

Deep Creek near Suwannee Valley
Robinson Creek near Suwannee Valley

4. Discontinue those stations that do not fit the current use, long-term trend, or planning and design classification. The following streamflow station is suggested to be discontinued as a daily record station and converted to a crest stage, partial-record station:

Alapaha River near Jennings

The Suwannee River basin is in the early stages of land development. Additional analyses of the surface-water data network, coordinated with changes in data-collection activities, should be implemented as their need becomes apparent. Periodic monitoring of network analyses and data collection is needed for a better understanding of the hydrologic system and for judging the adequacy of the network to meet the needs of water managers and others.

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