

2.2 Suwannee River

2.2.1 Surfacewater Hydrology

The hydrology of the Suwannee River Basin is driven by climate, and it is modified by the topography, physiography, geology, and land cover characteristics of the drainage area. This section of the report describes rainfall/runoff relationships and spatial and temporal patterns in river flow. These patterns are the primary driving forces that shape the ecological characteristics of the river and estuary (Poff et al., 1997).

2.2.1.1 Annual Yield

The annual yield of the Suwannee River is the amount of water discharged to the Gulf of Mexico. Discharge for the Suwannee is determined by river flow as measured by the U.S. Geological Survey (USGS) streamflow gaging program at the most downstream, long-term river gage (Suwannee River near Wilcox – USGS Station Number 02323500). Approximately 97 percent of the basin drainage area is upstream of this gage. Mean daily discharge at Wilcox is 10,166 cfs (Table 2-5), which is equivalent to 14.8 inches of annual runoff from the basin area (Franklin et al., 1995). Since the average annual rainfall across the basin is 53.35 inches (Section 2.2), about 28 percent of the mean annual rainfall is discharged as runoff to the Gulf of Mexico. Generally, the response of discharge lags behind rainfall by approximately four months. The remainder, about 39 inches annually, is utilized either as ET or consumptive use. This estimate corresponds well with the ET estimate of 40.8 inches presented in Section 2.1.2.

Table 2-5. Discharge Statistics of the Suwannee River at Wilcox (USGS Station Number 02323500), Levy County, Florida.

Metric	Annual (cfs)	Warm Season (cfs, May – October)	Cold Season (cfs, November – April)
Average	10,166	8,993	11,325
Standard Deviation	6,678	4,968	7,858
Maximum	84,700	40,400	84,700
75 th Percentile (P ₇₅)	12,600	11,300	14,600
Median	8,040	7,620	8,620
25 th Percentile (P ₂₅)	5,640	5,470	5,920
Minimum	1,070	1,970	1,070

Basin discharge varies over time as shown in Fig. 2-13, which shows annual mean flows superimposed over daily flows at the Wilcox gage. Year-to-year variability in the annual means is quite evident. During the wettest year on record (1948), discharge was about two to three times the long-term average. Conversely, the driest recorded year (2002) was about 3 times lower than the long-term average.

The frequency or return period of annual flow (also called the recurrence interval) is also of interest. The return period is defined as the average number of years between events for magnitudes equal to or greater than that specified. Figure 2-14 illustrates the flow duration curve from which exceedance probabilities were defined.

The annual median discharge (nonexceedance probability of 50 percent; 2 year return period) is about 8,040 cfs. The 10-year drought condition (nonexceedance probability of 10 percent) specified in Chapter 373.0361(2)(a)(1) as a level-of-certainty planning goal for water supply needs is 4,390 cfs, or about 55 percent of the annual median discharge. Inter-annual variability in discharge is largely a function of annual rainfall (Figure 2-15).

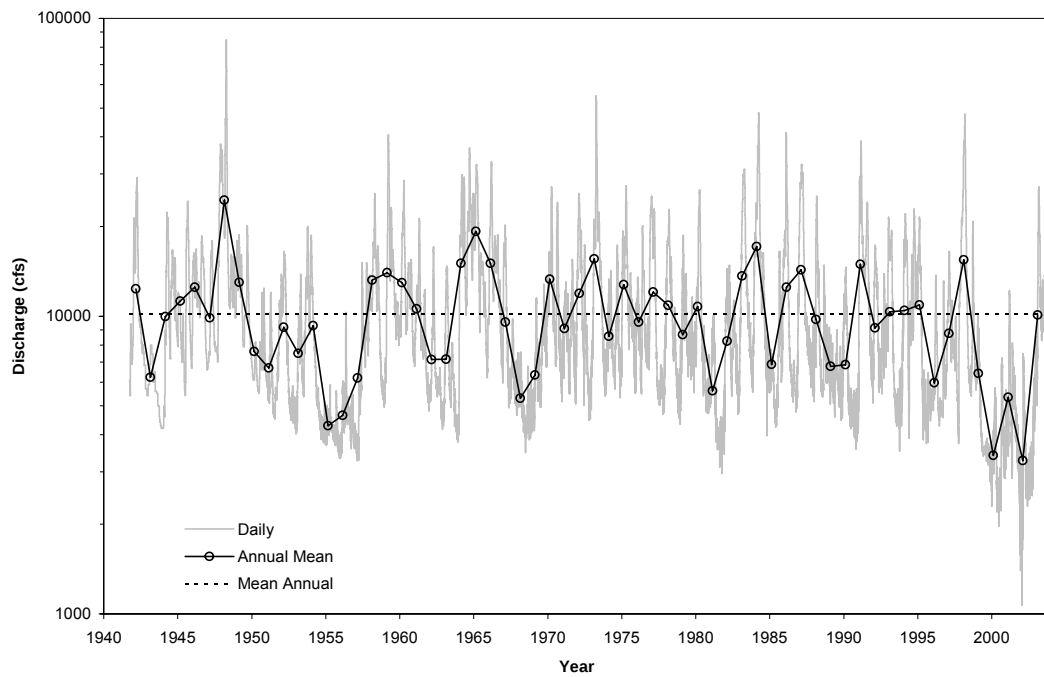


Figure 2-13. Daily and annual discharge (1942-2003) for the Suwannee River near Wilcox (USGS Station Number 02323500).

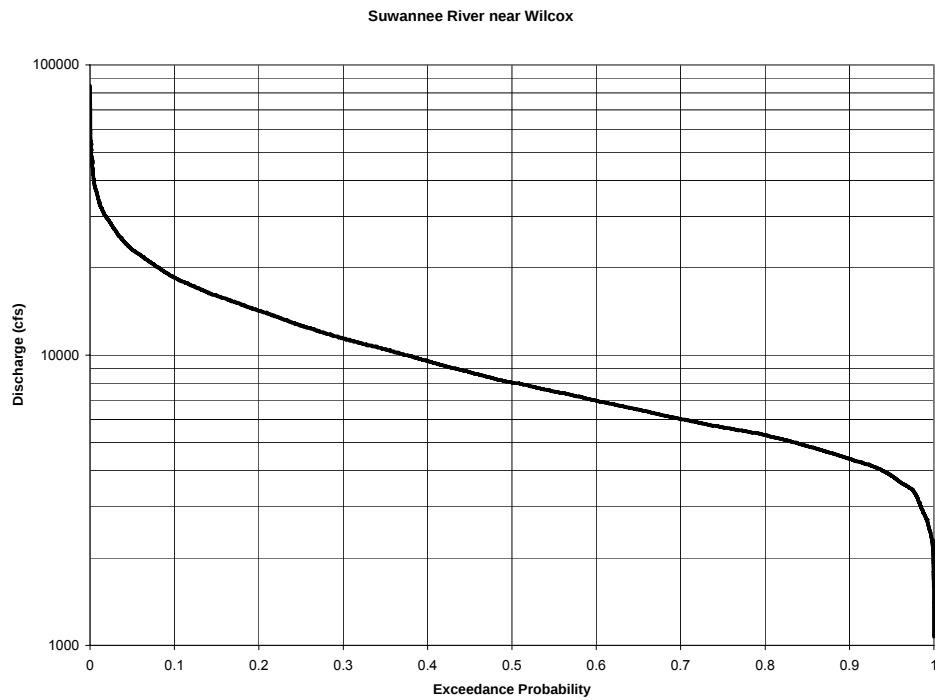


Figure 2-14. Discharge flow duration curve (1942-2003) for the Suwannee River near Wilcox (USGS Station Number 02323500).

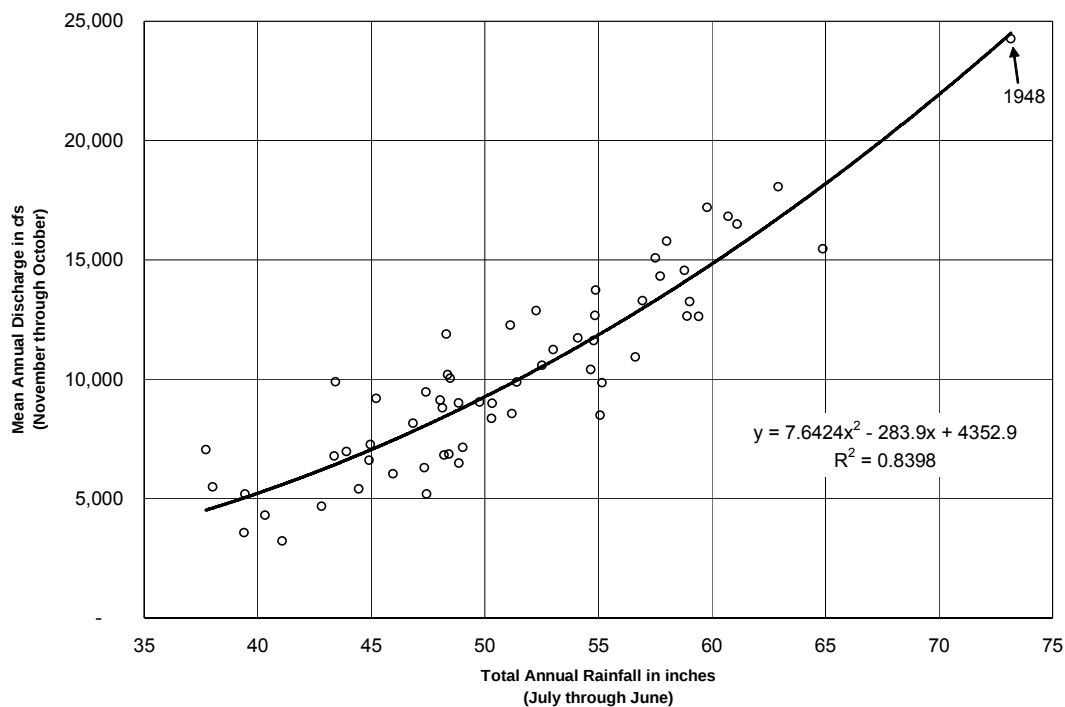


Figure 2-15. Relationship between annual rainfall and discharge for the Suwannee River near Wilcox (USGS Station Number 02323500).

2.2.1.2 Spatial Flow Patterns

Annual discharge from a basin is related to drainage area (Linsley et al., 1982) and assists in understanding spatial patterns in stream flow. Figure 2-16 shows data from gages on the Suwannee River and tributaries with 10 or more years of record, and illustrates that long term annual streamflow throughout the basin varies linearly with drainage area. For main-stem river sites, annual discharge per unit area (unit discharge) varies from 0.76 to 1.58 cubic feet per second per square mile (cfs/m), with an average of 1.09 cfs/m for the entire basin as represented by the Wilcox gage (Table 2-6).

Flow is more variable in the upper portions of the Suwannee and Santa Fe basins (Figure 2-17A). Flow may vary by 2-3 orders of magnitude in these areas, which are primarily fed by runoff. Flow is higher but less variable in the lower reaches of these rivers (Figure 2-17B), varying generally within one order of magnitude. Part of this is a function of increasing drainage area contributing to flows at the downstream gage sites. For the Suwannee system, however the reduced variability also results from the increased importance of groundwater inflow from the unconfined Floridan aquifer system adjoining the middle and lower river reaches.

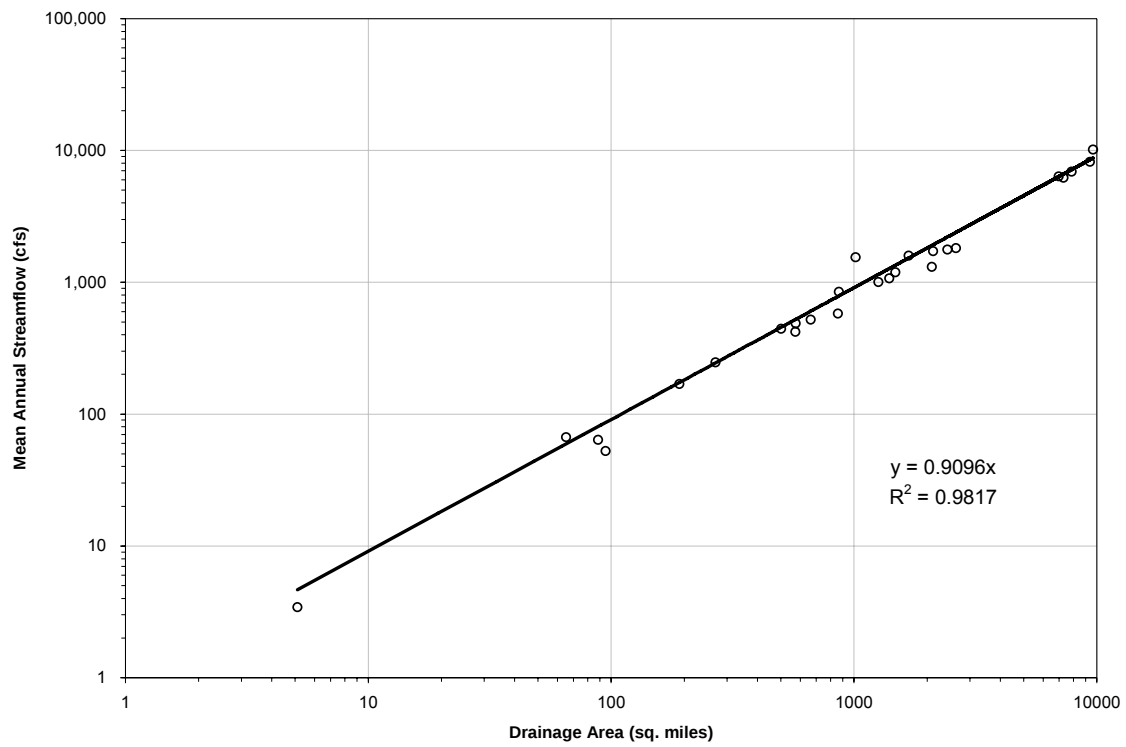
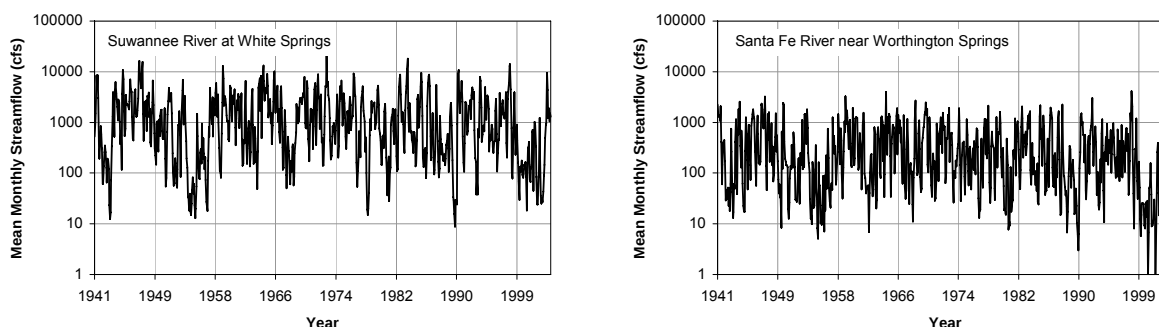


Figure 2-16. Relationship of drainage area and mean annual streamflow for the Suwannee Basin for gages with 10 or more years of systematic record. Data source: USGS.

Table2-6. Summary of hydrologic characteristics at flow gaging sites along the Suwannee River and its major tributaries (from Franklin et al., 1995 and Water Resources Data, GA, 1996). Data are annual summaries.

Station Name	Mean (cfs)	Median (cfs)	Max. (cfs)	Min. (cfs)	Unit Discharge (cfs/m)
Suwannee River at Fargo, GA	1,041	450	3,512	60	0.83
Suwannee River at White Springs, FL	1,840	727	6,810	155	0.76
Alapaha River at Statenville, GA	1,082	392	3,280	127	0.77
Withlacoochee River near Pinetta, FL	1,720	620	5,360	236	0.81
Suwannee River at Ellaville, FL	6,530	3,950	19,700	1,300	0.94
Suwannee River at Branford, FL	7,050	5,010	19,300	1,950	0.89
Santa Fe River at Worthington Springs, FL	437	143	1,160	55	0.76
Santa Fe River near Ft. White, FL	1,600	1,330	3,110	724	1.58
Suwannee River near Wilcox, FL	10,540	8,430	24,600	4,290	1.09

A. Stream hydrology - Upper Suwannee Drainage (above Cody Escarpment)



B. Stream hydrology - Lower Suwannee Drainage (below Cody Escarpment)

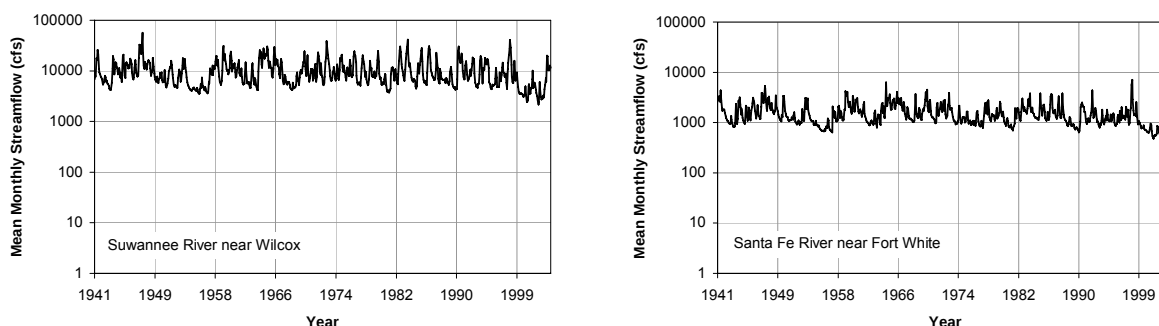


Figure 2-17. Mean monthly streamflow at four USGS gaging sites on the upper (A) and lower (B) Suwannee and Santa Fe Rivers, reflecting stream hydrology in the upper and lower portions of the drainage (after Mattson et al., 1995).

2.2.1.3 Seasonal Flow Patterns

Heath and Conover (1981) recognized the existence of a “climatic river basin divide” in Florida that approximates the sub-basin boundaries of the lower Suwannee and Santa Fe Rivers (Figure 2-18). Streams north and west of the climatic divide exhibit high flows in the late winter/early spring, with late spring and fall low flows. Streams south of the climatic divide exhibit high flows in the late summer/fall, with spring low flows. Streams lying along the climatic divide tend to exhibit a mix of both of these patterns (a “bimodal” pattern of floods in the spring and fall). More recently, Kelly (2004) reconfirmed these hydrologic patterns in streams in Florida, which he termed the “northern river” pattern (spring flooding), the “southern river” pattern (fall flooding), and the “bimodal” pattern (both spring and fall flooding).

These temporal flow patterns are driven in part by climatic characteristics. The Suwannee drainage lies in the transitional climatic area between the warm, temperate climate of the southeastern U.S. and the subtropical climate of the Florida peninsula. Higher, late winter/early spring rainfall and lower ET in the northern part of the basin (Section 2.1) drives the spring flooding, while high summer rainfall in combination with tropical weather events creates the southern river flooding pattern in peninsular Florida.

Figure 2-19 shows mean monthly discharge for several long-term gages with at least 60 years of record in the Suwannee Basin. The data are expressed as a proportion of the mean total annual discharge. The distinct late winter/spring flood is evident, particularly at the sites in the northern portion of the basin. The two gauging sites in the Santa Fe River drainage basin (Worthington Springs and Ft. White) exhibit more of the “bimodal” pattern, as they lie along the climatic divide discussed above.

Temporal patterns in discharge are also affected by geologic characteristics. Downgradient of the Cody Escarpment (Figure 2-2), the Suwannee and its tributaries receive increasing amounts of groundwater discharge from the Floridan aquifer. This groundwater inflow results in substantially higher base flow, which proportionally “dampens” the more pronounced spring flood peak seen in the upper basin. This dampening effect results in a more uniform hydrograph (Figure 2-19; the Santa Fe River near Ft. White and Suwannee River near Wilcox gages).

2.2.1.4 Tidal River and Estuary

The Suwannee estuary consists of the lower reach of the river, two major branches (East and West Passes), Suwannee Sound, and the adjacent coastal waters stretching from Horseshoe Beach to the Cedar Keys (Figure 2-20). The approximate upstream boundary of the estuary extends about 10 miles upstream from the river mouth. Moreover, the tidally-influenced reach of the river (the “tidal river”) extends further upstream. During 2002, when record low discharges occurred in the lower river, daily stage at the Suwannee River near Bell (USGS Station Number 02323000) at River Mile 55, varied by as much one foot, depending on tidal phase and wind. More typically, the tidal range at Bell is 0.25 to 0.5 feet. McPherson and Hammett (1991) indicated that the normal tidal reach of the Suwannee extended upstream 26.7 miles (43 km) from the river mouth, or about 12% of the total length of the river.

Mean tidal range in the estuary is about 3.4 feet (McNulty et al., 1972; Tiner, 1993). Tides are mixed semi-diurnal, typically with two unequal high and two unequal low tides occurring each day, separated in time by approximately 6.2 hours (Leadon, 1985). Low tide in the estuary occurs first near Cedar Key with the result that typical Suwannee fresh-water plumes flow southward along the coast (Leadon, 1985).

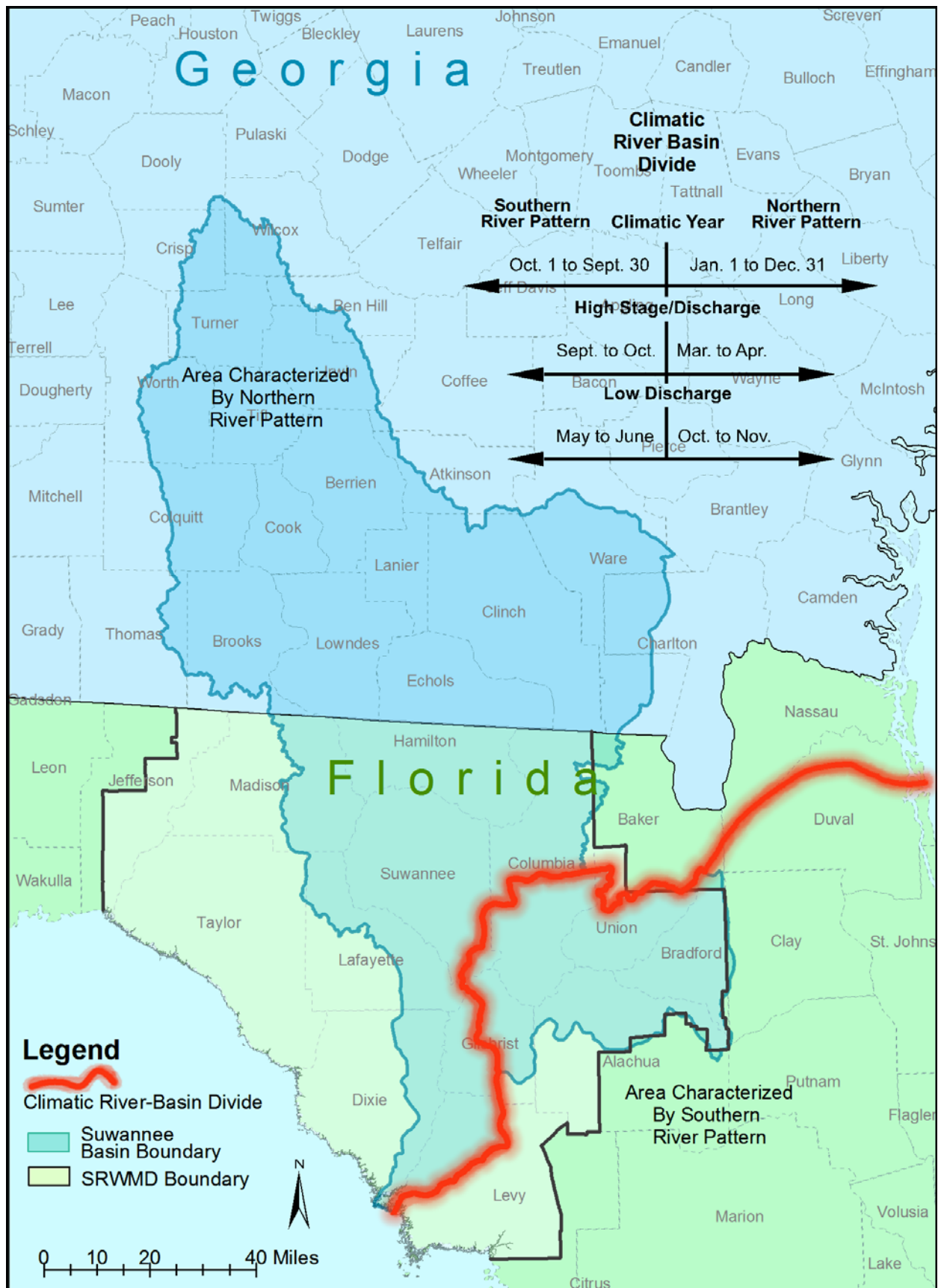


Figure 2-18. Climatic river-basin divide of Heath and Conover (1981). River pattern data from Kelly (2004).

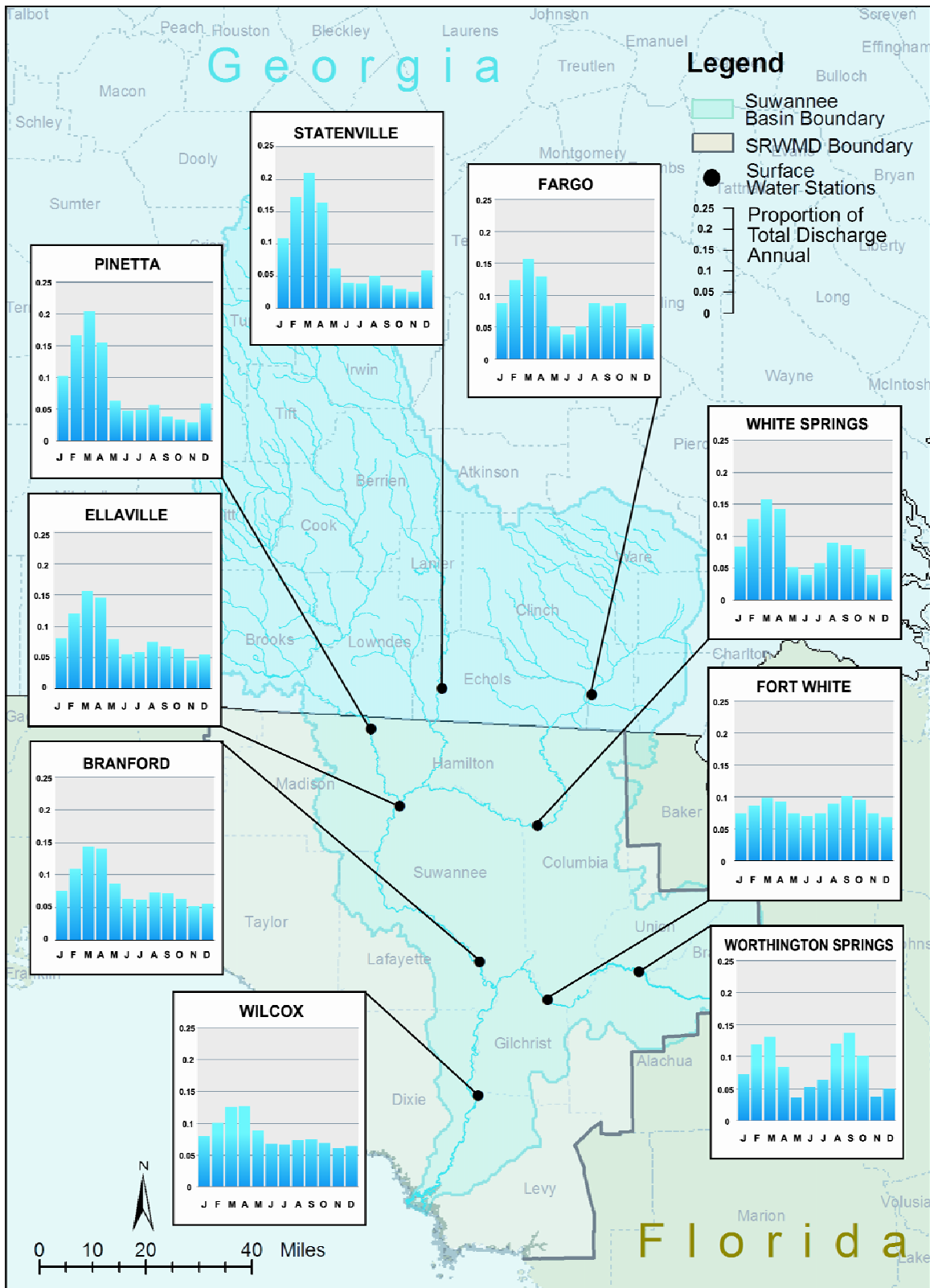


Figure 2-19. Gage locations and mean monthly discharge patterns at selected long-term surface water gages in the Suwannee River Basin. Discharge expressed as a proportion of mean annual discharge at each gage. Data source: USGS flow data.



Figure 2-20. Major features of the Suwannee estuary. Data sources: USGS aerial imagery and SRWMD map data.

Depths in the Suwannee Sound average 6.6 feet, with depths to about 20 feet in the river channels of East and West passes (Figure 2-20).

East and West passes divide the flow from the Basin with about 64 percent discharging through West Pass and 36 percent through East Pass. In fact, flow in the passes is dominated by tidal effects, superimposed on net fresh-water discharge.

2.2.1.5 Chemical Characteristics

Physiographic characteristics exert a strong influence on river hydrology and water chemistry in Florida. Because of the geologic and physiographic changes the Suwannee experiences in its course through north central Florida, the river exhibits important longitudinal changes in water chemistry (Ceryak et al., 1983; FDER, 1985). The changes in these characteristics may best be described by recognizing five regions or “ecological reaches” of the Suwannee in Florida (Figure 2-21):

Reach 1. Upper River Blackwater
Reach 2. Cody Scarp Transitional
Reach 3. Middle River Calcareous

Reach 4. Lower River Calcareous
Reach 5. Tidal Riverine

Water chemistry in the Suwannee changes in a unique way from upstream to downstream (Bass and Cox, 1985). The upper river (Reaches 1 and 2) is an acidic, blackwater stream, with waters of low mineral content (low hardness) and high color (Figures 2-22 and 2-23). As the river progresses downstream (Reaches 3, 4, and 5), it receives increasing amounts of water from the Floridan aquifer, which changes river water quality to a clear, slightly colored, alkaline stream (Figures 2-22 and 2-23).

These natural chemical gradients influence the ecology of the river in many ways. In terms of overall biological production, the upper river tends to be more oligotrophic, while the lower river is more productive.

Total organic carbon concentrations are higher in the upper reaches of the river (Hornsby et al., 2000), largely due to the dissolved and total organic carbon associated with the high water color. Nutrient concentrations (dissolved nitrogen and phosphorus) are low, generally near detection limits (Hornsby et al., 2000 and SRWMD data), in the uppermost reach (Reach 1). The low levels of nutrients in the upper reach contribute to its low biological productivity.

Dissolved nitrogen and phosphorus levels generally increase going downstream. Peak phosphorus levels are seen in Reach 2, partly as a result of the river crossing the phosphatic Hawthorn Group exposures and partly due to wastewater discharges from phosphate mining and processing.

Highest nitrogen levels are seen in the middle and lower reaches (Reaches 3, 4, and 5). A historical trend of increasing nitrogen has been identified in the middle and lower Suwannee and lower Santa Fe Rivers (Ham and Hatzell, 1996; SRWMD data). Much of this increase comes from groundwater discharging via springs along the river corridor (Pittman et al., 1997; Katz et al., 1999;). Areas of elevated nitrate nitrogen have been identified in the upper Floridan aquifer in these regions (Hornsby and Ceryak, 2004). Sources of this nitrogen are diverse and include agricultural operations, wastewater sprayfields, areas with dense concentrations of septic tanks, and storm-water runoff to sinkholes.

The 2004 Florida Water Quality Assessment 305(b) Report (FDEP, 2004) indicates generally “good” water quality in the Suwannee Basin. Portions of the lower river and most of the estuary were designated as “impaired” and candidates for total maximum daily load (TMDL)

establishment. Portions of the upper Suwannee and Santa Fe sub-basins were indicated to be “potentially impaired”. These assessments appear to have been based on low dissolved oxygen (which is partly natural due to groundwater discharge), nutrients (discussed above), or elevated fecal coliform levels.

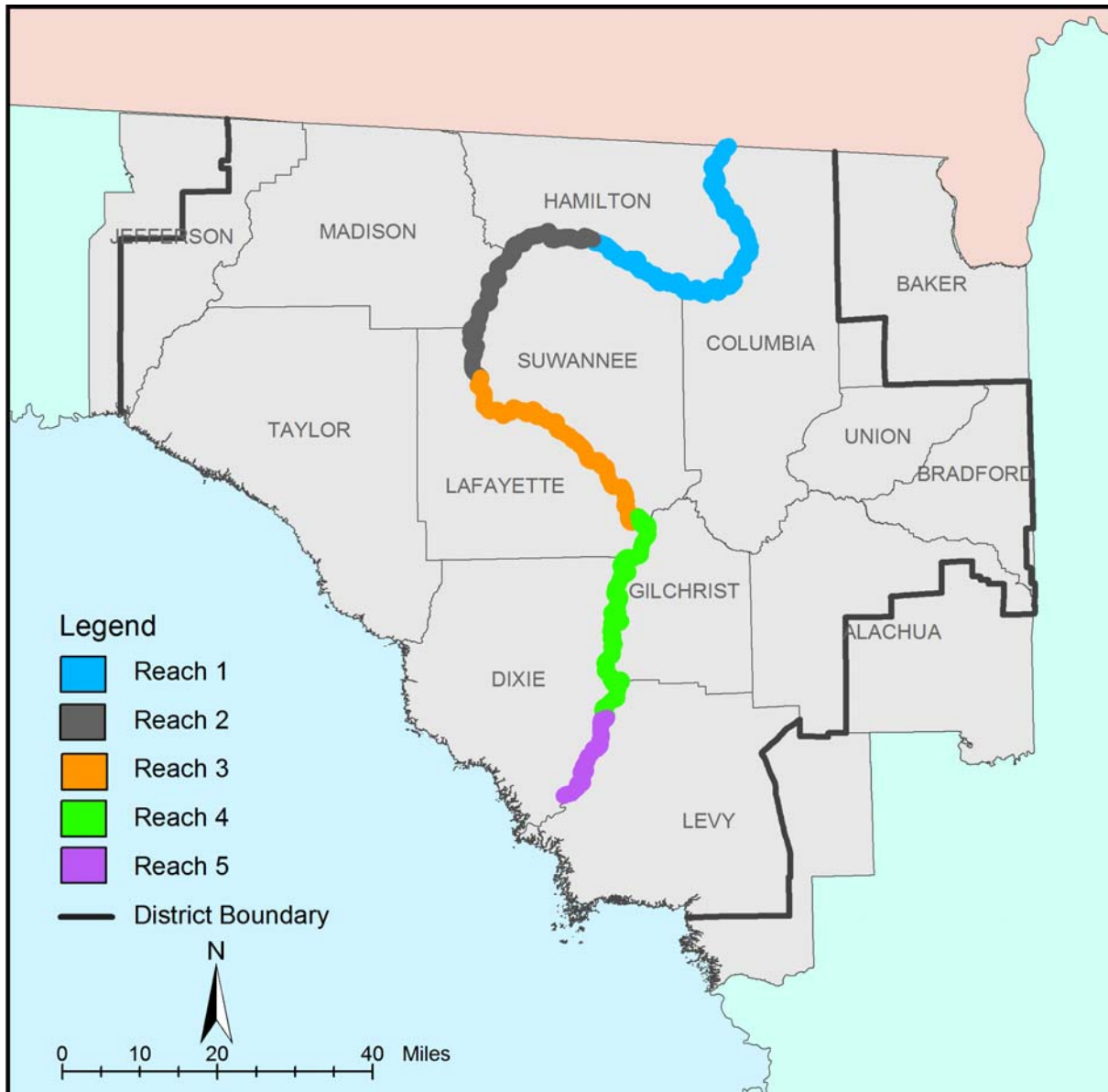


Figure 2-21. Map showing the “ecological reaches” of the Suwannee River in Florida. Source: SRWMD data and Hornsby et al. (2000).

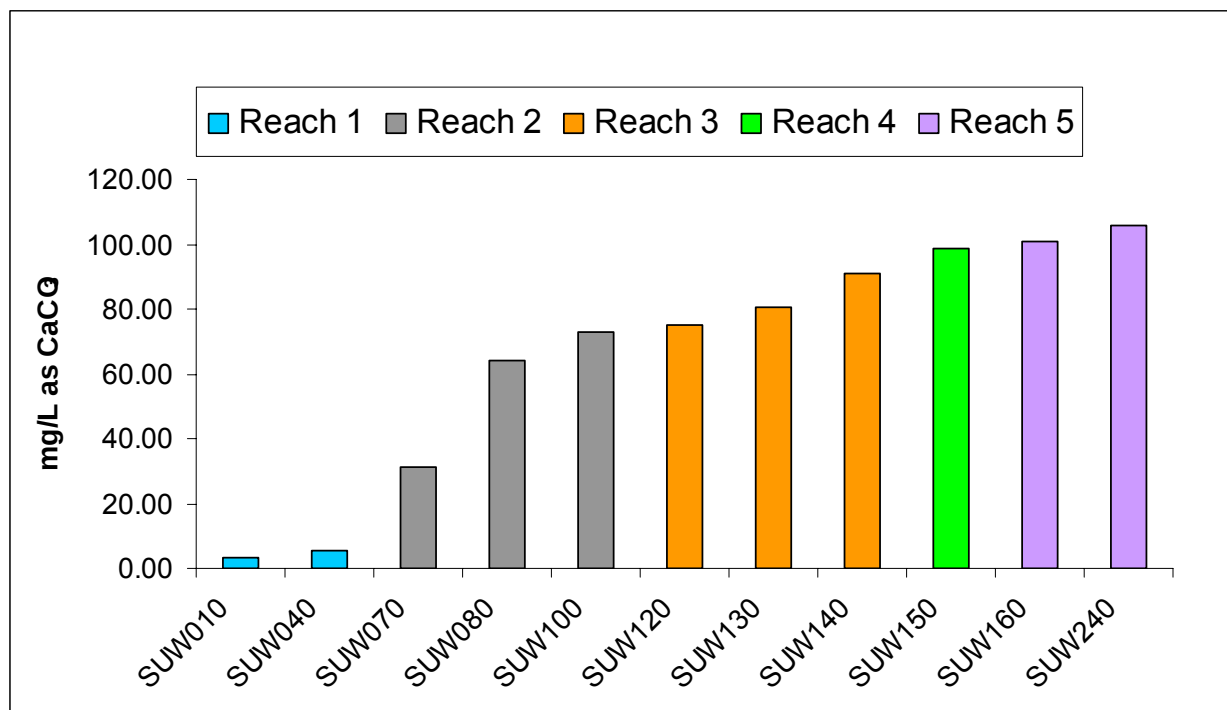


Figure 2-22. Plot of mean alkalinity (mg/L as CaCO₃) in the five reaches of the Suwannee River in Florida.

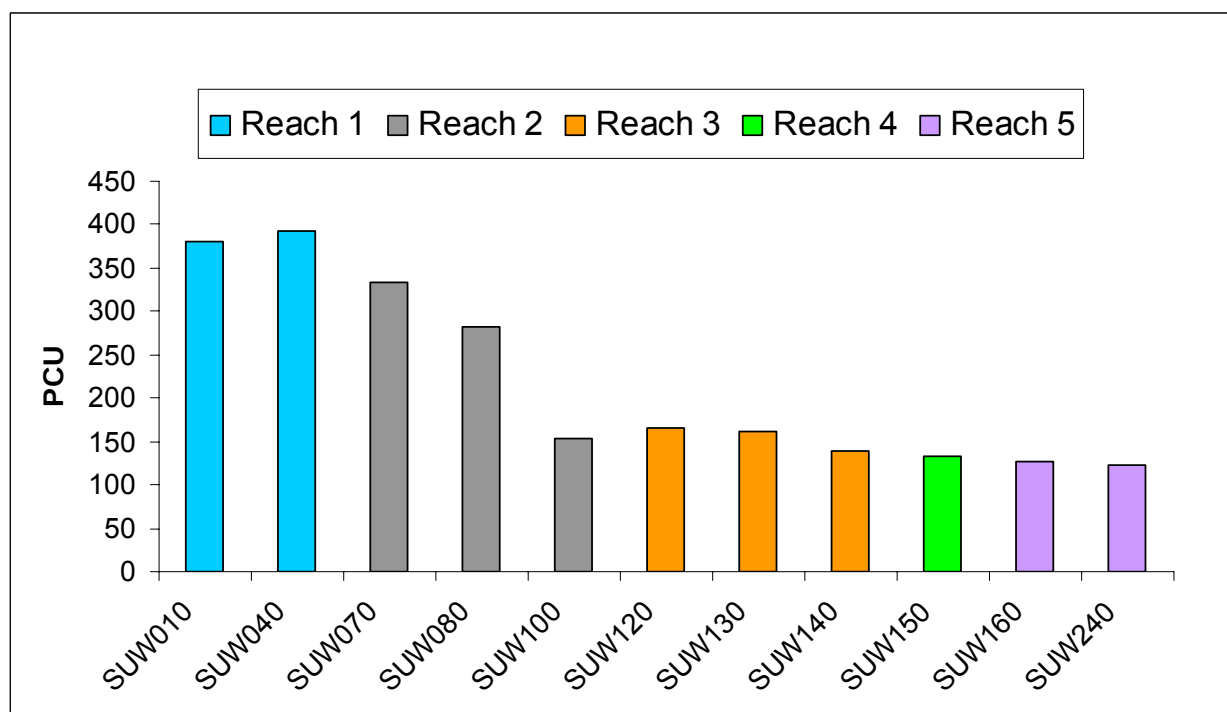


Figure 2-23. Plot of mean color (platinum cobalt units; PCU) in the five reaches of the Suwannee River in Florida.

2.2.2 Ecology

2.2.2.1 Aquatic and Wetland Communities

The physical setting described in the previous section is the framework that structures the ecological communities of the river ecosystem, including those communities in the river channel and on the adjacent floodplain. On a landscape scale, this linkage is recognized by delineating stream “ecoregions” (Griffith et al., 1994), which are regions within which lotic ecosystems exhibit generally similar morphology, hydrology, and water chemistry and thus support similar biological communities. The Suwannee River Basin in Florida lies within the following Florida ecoregions (Griffith et al., 1994):

- Southeastern Plains Ecoregion
 - Tifton Upland/Tallahassee Hills subregion
- Southern Coastal Plain Ecoregion
 - Okefenokee Swamps and Plains subregion
 - Central Florida Ridges and Uplands subregion
 - Gulf Coast Flatwoods subregion
 - Eastern Florida Flatwoods subregion
 - Sea Island Flatwoods subregion

These ecoregions and subregions influence, and are influenced by, the hydrology, water chemistry, and biota of the major ecological reaches of the Suwannee and its tributaries (as shown in Fig. 2-21). An overview of each of these follows.

2.2.2.2 River Reach Ecology

2.2.2.2.1 Suwannee River Mainstem

Reach 1. Upper River Blackwater Reach. This reach lies within the Okefenokee Swamps and Plains sub-region. The river channel in this reach (Figure 2-24) is more deeply incised into the landscape, as compared to downstream reaches, and varies from 100-160 ft. in width. At base flows, depths in the channel are mostly < 3 ft. Shoals of exposed clay and shallow sandy runs are a prominent habitat feature in the river channel along this reach, and the river channel bottom is generally coarse sand or exposed clay. Because surficial drainage is better developed in this part of the Basin, numerous small tributary creeks branch off the river channel. The river floodplain is inundated only by larger floods (i.e., floods with 5-10 year recurrence intervals), and flooding duration is often less than 30 continuous days. Plant communities in the floodplain are mostly upland forests, dominated by natural or planted pine, oaks, magnolia and hickory. Wetlands in the floodplain are mainly associated with the tributary creeks branching off the main channel, and consist of cypress and deciduous hardwoods (swamp tupelo, river birch, ogeeche tupelo, and others). The Suwannee in this reach is a classic, southeastern “blackwater” stream (see prior section). Benthic invertebrate communities are dominated by caddisflies and chironomids. Highest invertebrate densities are found in the shoal habitats (Bass and Cox, 1985).

Reach 2. Cody Scarp Transitional Reach. In this reach, the river is mostly within the Tifton Uplands/Tallahassee Hills subregion. The river channel is still incised into the landscape, and varies from 130-260 ft. in width (Figure 2-24). The channel bottom is still dominated by shallow water habitat, with depths 3-6 ft. or less and numerous areas of sandy or rocky shoals. Channel

bottom substrates include medium to coarse sand, exposed clay, and rock (limestone, chert, dolostone). Some of these shoal areas in the region of the Alapaha Rise and confluence are critical spawning habitat for the Gulf sturgeon (Sulak et al., 2001). In this region, the river crosses the Cody Scarp (Ceryak et al., 1983). This is a region, with numerous sinkholes. Karst features are evident in the river floodplain, which produces high plant diversity due to the topographic variation. This reach includes the confluences of the Alapaha and Withlacoochee rivers with the Suwannee River mainstem. Limestone outcrops are prominent along the river channel throughout this reach, and springs discharge ground water to the river. Major springs include White Springs, Suwannee Springs, Holton Spring, Alapaha Rise, Ellaville Spring, and Lime Spring.

Reach 3. Middle River Calcareous Reach. The third reach of the river exhibits a number of changes reflecting greater flows and a larger drainage area. This reach crosses the Central Florida Ridges and Uplands subregion and the Gulf Coast Flatwoods subregion. The river channel is wider (260-330 ft. or more), with alternating deeper pool areas interspersed with rocky shoals. Some limestone crops out along the river channel. The floodplain is inundated more frequently, and in some areas alluvial features indicating this are seen (e.g., berm and swale topography; Fig. 2-27). Floodplain plant communities are largely high terrace bottomland hardwood communities, with live oak, laurel oak, blue beech, American elm, swamp chestnut oak, and bald cypress. Benthic invertebrate communities are dominated by chironomids, mayflies, caddisflies and snails. Major springs include Troy Spring, Charles Spring, Telford Spring, Peacock Springs, Lafayette Blue Spring, Royal Spring, and Little River Spring.

Reach 4. Lower River Calcareous Reach. Reach 4 of the Suwannee begins at the Santa Fe River confluence and lies entirely within the Gulf Coast Flatwoods subregion. In this reach, the river channel is wide (400-500 ft.) with a deep-water channel. No shoals occur in this reach. The river channel substratum includes coarse sand and exposed limestone. The floodplain has numerous topographic features caused by fluvial action, including relict levees, oxbow lakes, and high and low terraces (Figure 2-24). Floodplain plant communities include a diversity of types, ranging from swamps to bottomland hardwoods. Swamps are dominated by bald cypress, water tupelo, planer elm, swamp privet, and pop ash. Bottomland hardwood forests include some of the above, plus live oak, laurel oak, american elm, water hickory, overcup oak, blue beech, and other broadleaf deciduous hardwoods. Major springs include Rock Bluff Spring, Hart Spring, Guaranto Spring, and Otter Spring. Benthic invertebrate communities are similar to those in Reach 3.

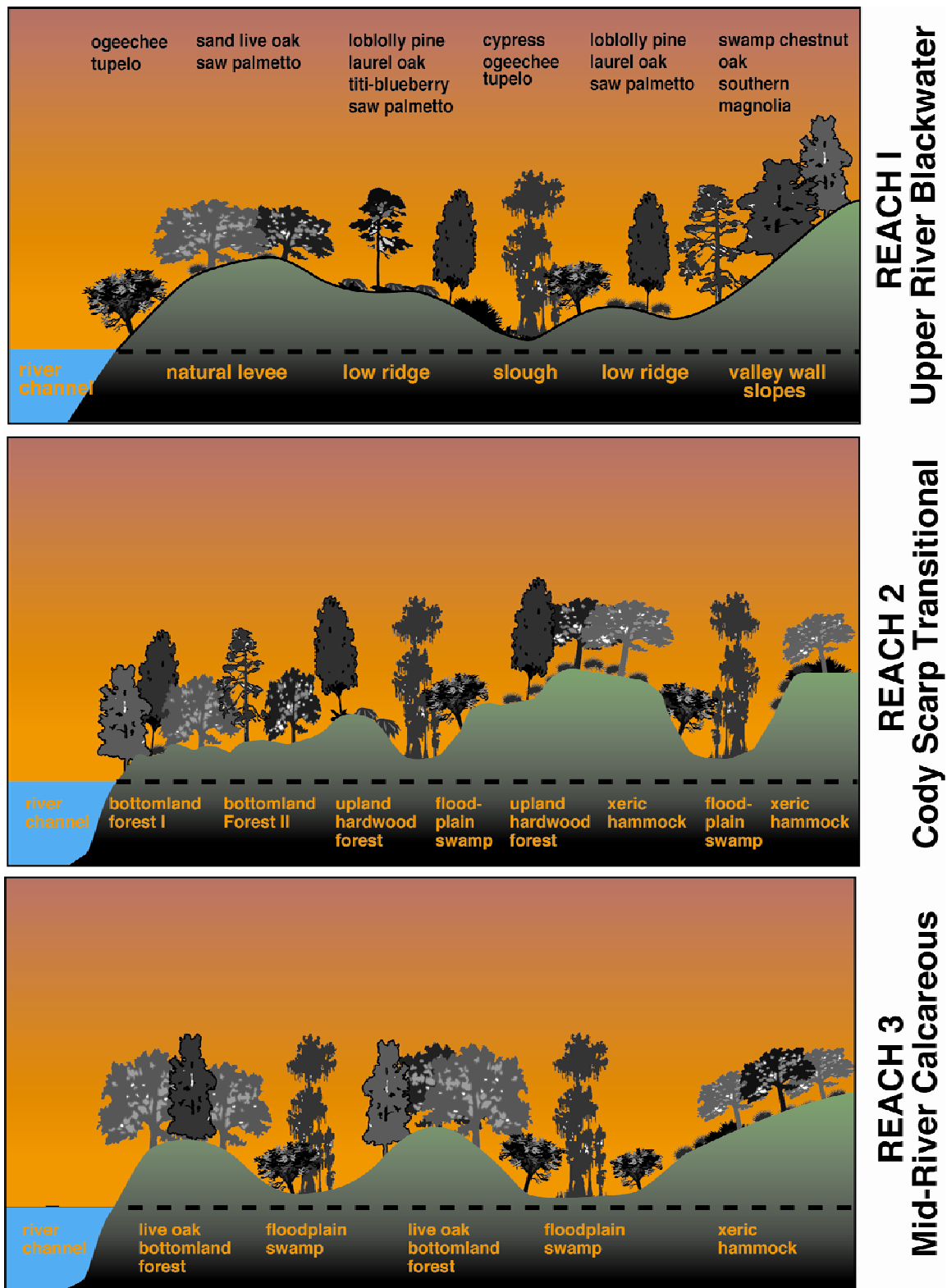


Figure 2-24. Basic geomorphology of the river channel and floodplain and typical plant communities in each of the five ecological reaches (Figure 2-20) of the Suwannee River. Adapted from Lynch, 1984.

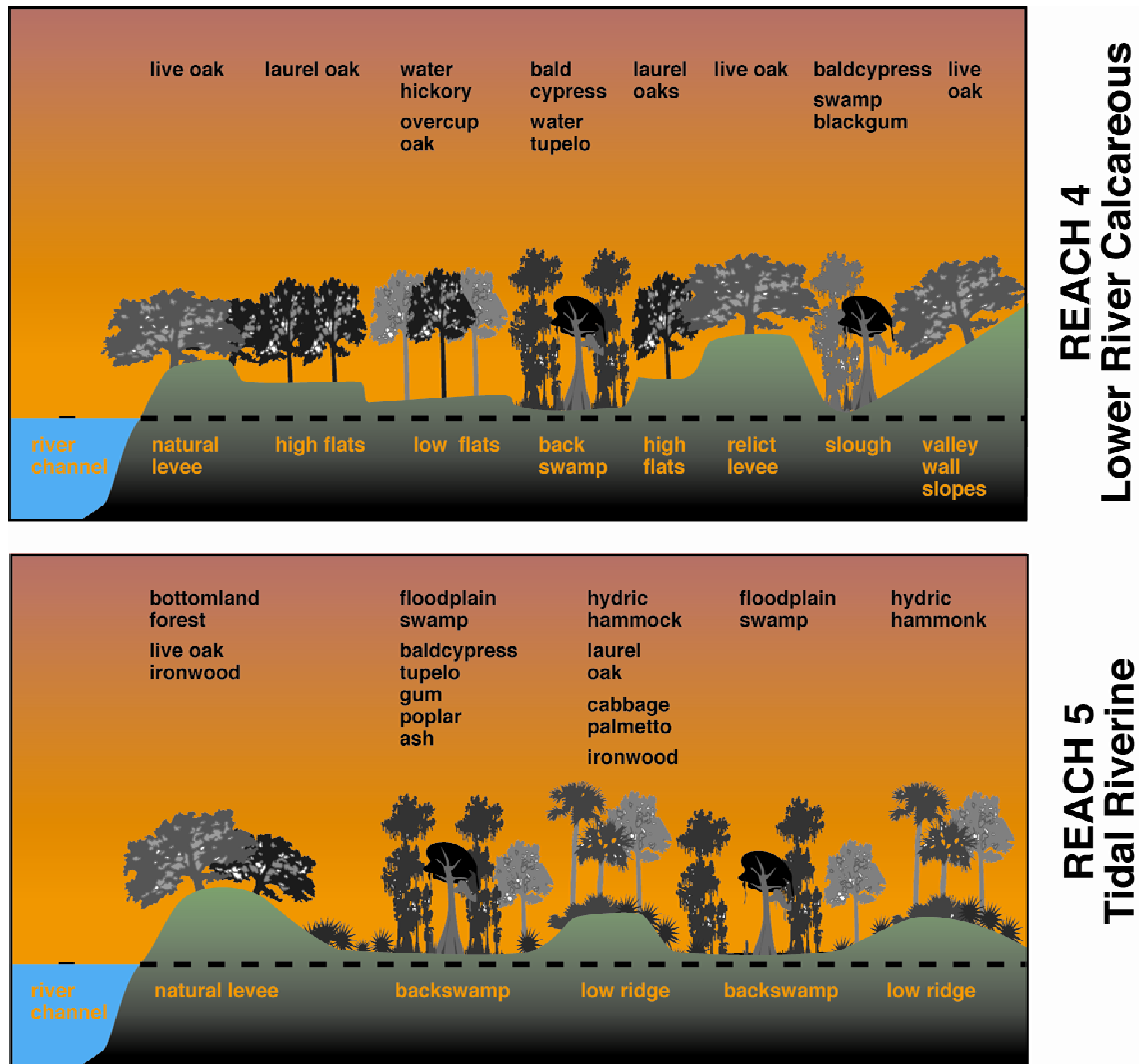


Figure 2-24. Continued.

Reach 5. Tidal River Reach. This reach, begins at the U.S. 19 bridge at the town of Fanning Springs. As indicated in the section on hydrology, tidal variation in river stage is evident here at low flows. This reach also lies entirely within the Gulf Coast Flatwoods subregion. The river channel approaches 800-1000 ft. in width. River channel substrata include exposed limestone, medium and coarse sand, and sandy mud in areas of reduced current velocity. The channel is fringed by tidal, freshwater marsh, which becomes more evident downstream. These marshes are dominated by wild rice, bulrushes, cattail, pickerelweed, spatterdock, and water hemlock. Along the outer edge of these marshes, where water depth and sediment conditions permit, beds of submerged vegetation dominated by eelgrass and spring tape may grow. The floodplain in the upper portions of this reach includes forest types similar to those seen in Reach 4. As the river nears the Gulf, tidal freshwater swamps (Wharton et al., 1982) and hydric hammock (Vince et al., 1989) become the dominant forest types. The tidal swamps are dominated by bald cypress, pumpkin ash, swamp and sweet bay, cabbage palm, red maple, and swamp tupelo. Hydric hammocks are a wetland forest type unique to Florida, with the greatest extent occurring in this region of the Florida coast (Vince et al., 1989). These forests are characterized by a diverse tree canopy. Characteristic species include cabbage palm, laurel

and live oak, sweetgum, sweet bay, swamp bay, southern red cedar, red maple and blue beech. Two major springs, Fanning Springs and Manatee Springs, occur on this reach. Benthic invertebrate communities are similar to those in Reaches 3 and 4, although as the river nears the Gulf, estuarine species begin to appear (i.e., olive nerite snail, red-joint fiddler crab, wharf crab).

2.2.2.2.2 Santa Fe River

The Santa Fe River drainage encompasses more sub-ecoregions (6) than any other river basin in Florida. The river drainage lies within portions of the Tifton Uplands/Tallahassee Hills, Central Florida Ridges and Uplands, Okefenokee Swamps and Plains, Sea Islands Flatwoods, Eastern Florida Flatwoods, and Gulf Coast Flatwoods subecoregions. This landscape diversity accounts for the high overall biological diversity exhibited in this river system. The upper portion of the river includes numerous shallow runs, with a sand-bottomed channel, which may become braided and diffuse in some reaches. Flow in the upper Santa Fe is dominated by surfacewater runoff. The river is captured by a sink at O'Leno State Park, and re-emerges about 3 miles downgradient as the Santa Fe Rise. The lower Santa Fe River is heavily influenced by spring inflow, and is typically clear and alkaline. The upper portions of this lower reach are mostly shallow and include numerous shoal areas of exposed limestone and beds of submerged aquatic vegetation (SAV). The lower portion is wider and deeper, with SAV beds confined to the channel margins. In terms of channel morphology, the lower Santa Fe somewhat resembles Reach 3 of the Suwannee, although with a narrower river channel. The channel bottom substrata are mostly coarse sand and exposed limestone. Major springs include the Ichetucknee Springs group, the Ginnie Springs group, Hornsby Spring, Gilchrist Blue Spring group, Poe Spring, and Rum Island Spring. Benthic invertebrate communities are characterized by mayflies, caddisflies, chironomids, amphipods and snails.

2.2.2.2.3 Withlacoochee River

The Withlacoochee River drainage lies mostly within Georgia, in the Southeastern Plains Ecoregion. The river's general morphology is that of a low gradient, eastern, coastal plain stream with a sand-bed channel (Brussock et al., 1985). Using Beck's (1965) classification, the Withlacoochee is a "sand-bottom stream". In Florida, the river channel is incised in the underlying Suwannee and Ocala limestones, and numerous limestone shoals are found in the channel. Other channel bottom substrata are medium and coarse sand. Water chemistry in the river is moderately to highly colored, somewhat alkaline, and highly turbid on occasion. Because of the somewhat higher relief and clay soils found primarily in the Georgia portion of the watershed, the Withlacoochee carries a higher sediment load than other streams in the Suwannee drainage (USDA, 1977). Consequently, the river is more of a "muddy" river than the Suwannee during higher flows. This sediment load is obvious when viewing the confluence of the Withlacoochee and Suwannee at higher flows (generally average flow and greater). At baseflow, the river water is substantially less turbid and more reflective of a southeastern coastal plain, blackwater stream. The inflow of hard, carbonate-rich ground water from the Floridan aquifer at baseflow (via springs and diffuse inflow) contributes to the higher pH and alkalinity of the water in Florida. Major springs include Blue, Pot, and Suwannacoochee. Benthic invertebrate communities are dominated by chironomids. Other dominants in the benthic community include crustaceans (the amphipod *Hyaella* and grass shrimp, *Palaemonetes paludosus*), blackflies (*Simulium* spp.), aquatic beetles (Coleoptera), caddisflies (Trichoptera) and mayflies (Ephemeroptera).

2.2.2.2.4 Alapaha River

The third major tributary of the Suwannee is the Alapaha River. Its drainage, like the Withlacoochee, lies mostly within Georgia. The physiography and soils of the drainage are more like those of the upper Suwannee, and it lies almost entirely within the Southern Coastal Plain Ecoregion. Consequently, the river may be characterized as a southeastern coastal plain, blackwater stream. When river flows are below average, much of the river flow is captured by sinkholes about 4 miles south of the Florida-Georgia state line, and the remainder of the river channel in Florida is dry for a substantial portion of a typical year (Ceryak, 1977). The river re-emerges at the Alapaha Rise (Ceryak, 1977), and possibly at Holton Spring, both are characterized as blackwater springs. Benthic invertebrate communities in the upper, perennial reach of the river in Florida (above the sinks) are dominated by chironomids, mayflies, stoneflies, and caddisflies.

2.2.2.2.5 Suwannee Estuary

The estuary of the Suwannee River is deltaic (Day et al., 1989), with extensive intertidal areas ranging from tidal fresh water to polyhaline portions of the estuary. About 6 miles before it reaches the gulf, the Suwannee branches into West Pass and East Pass (Figure 2-20). These distributaries flow through a broad delta area, which includes Hog Island, Bradford Island, Little Bradford Island, and the area around Dan May Creek at the mouth of East Pass. The river empties into a shallow embayment called Suwannee Sound, which is partially enclosed by Suwannee Reef; a complex of oyster reefs and sand bars extending from north of Wadley Pass south to near Cedar Key.

The Suwannee River accounts for 60% of the total fresh-water inflow into the Big Bend region of the Florida coast (Montague and Odum, 1997), which makes it the largest estuary in the Big Bend. The intertidal wetlands and submerged habitats found throughout this area provide primary production and habitat for a great many animal species with ecological and economic value (i.e., those caught commercially or for sport). Spatial and temporal variation in salinity due to river flow variation is a major environmental influence, which structures the plant and animal community composition of the wetlands on the river delta and the submerged habitats in the estuary.

2.2.2.2.6 Species and Habitats of Interest

Because the Suwannee Basin coincides, in part, with a climatic transition zone, it is a significant biogeographic transition zone in Florida. Many species of flora and fauna reach their southernmost limits of distribution in the U.S. in the Suwannee region. Over half of the native fresh-water fishes found in Florida river systems occur only in, or west of, the Suwannee (Bass and Cox, 1985; Bass, 1991). A number of plant species reach the southern limits of their distribution in the southeastern U.S. in the Suwannee region (Clewell, 1985).

Key species of interest (e.g., listed taxa, rare or endemic species) dependent upon aquatic and wetland habitats in the lower Suwannee are shown in Table 2-7. These are listed as either (1) endangered or threatened by the U.S. Fish and Wildlife Service (USFWS), (2) endangered, threatened, or a species of special concern by the Florida Fish and Wildlife Conservation Commission (FWCC), or (3) "Rare and Endangered Biota of Florida" published by the Florida Committee on Rare and Endangered Plants and Animals (FCREPA), or (4) as S1, S2, or S3 by the Florida Natural Areas Inventory (FNAI).

Additional species of interest that occur in the Suwannee estuary are shown in Table 2-8. These are listed by the National Oceanic and Atmospheric Administration as important "Estuarine Living Marine Resources" (ELMR), chosen based on four criteria (Nelson, 1992): 1 -

commercial value (harvested commercially), 2 - recreational value (sportfish), 3 - indicator of environmental stress, and 4 - ecological value (important forage or food base organisms). Many are also listed by the Florida Fish and Wildlife Research Institute (FWRI) as "Selected Taxa" because of their commercial, recreational or ecological value.

Table 2-7. Aquatic and wetland-dependent species of interest in the lower Suwannee River study area.

Scientific Name	Common Name	Federal	State	FCREPA	FNAI	TNC
<u>Plants</u>						
<i>Lobelia cardinalis</i>	Cardinal flower		T			
<i>Matelea gonocarpa</i>	Angle pod		T			
<i>Peltandra sagittifolia</i>	Spoonflower			R		
<i>Ulmus crassifolia</i>	Cedar elm			R	S1	
<i>Zephyranthes atamasco</i> **	Zephyr lily					
<u>Invertebrates</u>						
<i>Caecidotea hobbsi</i>	Florida cave isopod				S2	
<i>Chimarra florida</i>	Florida finger-net caddisfly				S1	
<i>Cincinnatia mica</i>	Ichetucknee silt snail			SSC	S1	
<i>Crangonyx hobbsi</i>	Hobb's cave amphipod			SSC	S2-S3	
<i>Dolania americana</i>	Sand-burrowing mayfly			T	S1-S2	
<i>Medionidus walkeri</i>	Suwannee moccasinshell			T	S?	
<i>Poanes viator zizaniae</i>	Rice skipper			R		
<i>Polygonia comma</i>	(skipper)			R		
<i>Pleurobema reclusum</i>	Florida pigtoe			T		
<i>Procambarus erythrops</i>	Red-eye cave crayfish		SSC	R	S1	
<i>Procambarus lucifugus alachua</i>	Alachua light-fleeing cave crayfish			R	S2-S3	
<i>Procambarus pallidus</i>	Pallid cave crayfish			R	S2-S3	
<i>Satyrodes appalachia appalachia</i>	(butterfly)			R		
<i>Troglocambarus maclanei</i>	MacLane's cave crayfish			R	S2	
<u>Fishes</u>						
<i>Acipenser oxyrhynchus desotoi</i>	Gulf sturgeon	T	SSC	T	S2	Im
<i>Agonostomus monticola</i>	Mountain mullet			R	S3	
<i>Ameiurus serracanthus</i>	Spotted bullhead				S3	

Scientific Name	Common Name	Federal	State	FCREPA	FNAI	TNC
<i>Ameiurus serracanthus</i>	Spotted bullhead				S3	
<i>Cyprinella leedsi</i>	Bannerfin shiner				S3	
<i>Micropterus notius</i>	Suwannee bass		SSC		S2-S3	
<i>Notropis harperi</i> **	Redeye chub					
<u>Reptiles</u>						
<i>Alligator mississippiensis</i>	American alligator	T	SSC		S4	
<i>Caretta caretta</i>	Loggerhead sea turtle	T	T	T	S3	
<i>Chelonia mydas</i>	Green sea turtle	E	E	E	S2	
<i>Lepidochelys kemp</i>	Kemp's Ridley sea turtle	E	E	E	S1	Im
<i>Macrolemys temmincki</i>	Alligator snapping turtle		SSC	SSC	S3	
<i>Malaclemys terrapin</i>	Diamondback terrapin					Im
<i>Clemmys guttata</i>	Spotted turtle			R		
<i>Pseudemys concinna suwanniensis</i>	Suwannee cooter		SSC	SSC	S3	
<i>Drymarchon corais couperi</i>	Eastern indigo snake	T	T	SSC		
<i>Nerodia clarkii clarkii</i>	Gulf salt marsh snake			R	S3?	
<i>Eumeces egregius insularis</i>	Cedar Key mole skink			R		
<u>Birds</u>						
<i>Ajaia ajaja</i>	Roseate spoonbill		SSC	R	S2-S3	
<i>Aramus guarauna</i>	Limpkin		SSC	SSC	S3	
<i>Casmerodius albus</i>	Great egret			SSC	S4	
<i>Egretta caerulea</i>	Little blue heron		SSC	SSC	S4	
<i>Egretta rufescens</i>	Reddish egret		SSC	R	S2	
<i>Egretta thula</i>	Snowy egret		SSC	SSC	S4	
<i>Egretta tricolor</i>	Tricolor heron		SSC	SSC	S4	
<i>Nycticorax nycticorax</i>	Black-crowned night heron			SSC	S3?	
<i>Nycticorax violacea</i>	Yellow-crowned night heron			SSC	S3?	

Scientific Name	Common Name	Federal	State	FCREPA	FNAI	TNC
<i>Ixobrychus exilis</i>	Least bittern			SSC	S4	
<i>Eudocimus albus</i>	White ibis		SSC	SSC	S4	
<i>Mycteria americana</i>	Wood stork	E	E	E	S2	
<i>Grus canadensis pratensis</i>	Florida sandhill crane		T	T	S2-S3	
<i>Haliaeetus leucocephalus</i>	American bald eagle	T	T	T	S3	
<i>Elanoides forficatus</i>	Swallow-tailed kite			T	S2-S3	
<i>Pandion haliaetus</i>	Osprey			SSC	S3-S4	
<i>Pelecanus occidentalis</i>	Eastern brown pelican		SSC	T	S3	
<i>Haematopus palliatus</i>	American oystercatcher		SSC	T	S3	
<i>Recurvirostrata americana</i>	American avocet			SSC	S1-S2	
<i>Rynchops niger</i>	Black skimmer		SSC	SSC	S3	
<i>Sterna antillarum</i>	Least tern		T	T	S3	
<i>Sterna caspia</i>	Caspian tern			SSC	S2?	
<i>Sterna maxima</i>	Royal tern			SSC	S3	
<u>Mammals</u>						
<i>Trichechus manatus latirostris</i>	Florida manatee	E	E	E	S2	Im
<i>Ursus americanus floridanus</i>	Florida black bear		T	T	S2	
<i>Microtus pennsylvanicus dukecampbelli</i>	Florida saltmarsh vole	E	E	E	S1	

Federal and State are species officially listed by the U.S. or State of Florida (respectively); FCREPA=species listed by the Florida Committee on Rare and Endangered Plants and Animals; FNAI=species listed by the Florida Natural Areas Inventory; TNC=species listed in Beck et al. (2000). E=endangered; T=threatened; SSC=species of special concern; R=rare; S1=critically imperiled in Florida because of extreme rarity; S2=imperiled in Florida because of rarity; S3=rare, restricted, or otherwise vulnerable to extinction in Florida; S4=apparently secure in Florida; S?=status unknown; Im=imperiled. ** - included due to restricted distribution in north central Florida or narrow habitat requirements.

Table 2-8. FWRI "Selected Taxa" and NOAA "Estuarine Living Marine Resources" (ELMR) taxa found in the Suwannee estuary.

	FWRI taxa	ELMR taxa
American oyster		XX
Common Rangia		XX
Bay squid		XX
Penaid shrimp (<i>Farfantepenaeus</i> spp.)	XX	XX
Grass shrimp		XX
Blue crab	XX	XX
Stone crabs (<i>Menippe</i> spp.)	XX	XX
Bull shark		XX
Tarpon	XX	XX
Ladyfish	XX	
Alabama shad		XX
Gulf menhaden		XX
Gizzard shad		XX
Bay anchovy		XX
Hardhead catfish		XX
Sheepshead minnow		XX
Gulf killifish		XX
Silversides		XX
Bluefish	XX	XX
Crevalle jack		XX
Grey snapper	XX	XX
Red snapper	XX	XX
Red grouper	XX	
Gag	XX	
Sheepshead	XX	XX
Pinfish		XX
Silver perch		XX
Sand seatrout	XX	XX
Spotted seatrout	XX	XX
Spot	XX	XX
Atlantic croaker		XX
Black drum	XX	XX
Red drum	XX	XX
Mulletts (<i>Mugil</i> spp.)	XX	XX
Code goby		XX
Pompano	XX	
Spanish mackerel	XX	XX
King mackerel	XX	
Cobia	XX	
Gulf flounder	XX	XX
Southern flounder		XX
Whiting/kingfish (<i>Menticirrhus</i> spp.)	XX	

Communities or habitats of conservation interest in the Suwannee basin are listed in Table 2-9. These are listed as endangered or threatened by Noss et al. (1995), as imperiled or rare by the Florida Natural Areas Inventory (FNAI and FDNR, 1990), as a “Primary Habitat Target” for the northern Gulf of Mexico by Beck et al. (2000), or as Essential Fish Habitat by the National Marine Fisheries Service (NMFS, 1999).

Table 2-9. Aquatic and wetland habitats of conservation interest in the lower Suwannee study area.

	USGS	FNAI	TNC	NMFS
Large, intact river systems	E			
Spring-run stream*		S2		
Aquatic cave		S2		
Intact floodplain wetlands*	T	S3-S4		
Tidal freshwater swamp*		S3	PT	
Tidal freshwater SAV beds*			PT	efh
Seagrass beds		S2	PT	efh
Tidal marshes*		S4	PT	efh
Oyster reefs & bars*		S3	PT	efh

USGS=ecosystems listed in Noss et al. (1995); FNAI=Florida Natural Areas Inventory listed habitats; TNC=habitats listed in Beck et al. (2000); NMFS=National Marine Fisheries Service designated Essential Fish Habitat (efh). E= endangered; T=threatened; S2=imperiled in Florida because of rarity; S3=rare or uncommon in Florida; S4=apparently secure in Florida; PT=listed as “Primary Habitat Target” for biodiversity conservation; *=target habitat identified for development of MFL in this report.

2.3 Lower Suwannee Drainage Basin and Springs

2.3.1 Introduction

The Lower Suwannee River watershed, including Manatee and Fanning Springs, is an important recreational and ecologic resource. Much like the river, the springs are important to the natural and scenic beauty of the area. The springs are also important thermal refuges for manatees, which frequent the springs throughout the year, especially during the cold, winter months of November through April.

That portion of the Suwannee River Basin downstream of the Wilcox Gage at Fanning Springs comprises the drainage basin associated with the study area. This portion of the basin includes, in part, the groundwater basins for Manatee and Fanning Springs. This section of the report describes the springs and their springsheds.

The Manatee-Fanning springshed lies to the east of the Suwannee River and encompasses approximately 450 square miles of northwestern Levy and southwestern Gilchrist counties (Figure 2-25). The groundwater basins were delineated by Upchurch and Champion (2003a), who used geostatistical analysis to define the basin boundaries. The District is currently monitoring the Manatee-Fanning springshed, which will greatly improve refinement of the basin delineations (Upchurch and others, 2001). Because of their close proximity and uncertainties as to the location of the divide between the individual spring basins for Manatee and Fanning Springs, these two basins are treated as one basin in this report.

Most of the surfacewater portion of the springshed appears to lie within the surface- and groundwater basins (Figure 2-25) of the Suwannee River.