WATER RESOURCES OF THE UPPER SUWANNEE RIVER WATERSHED

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Abstract. Situated in rural, south-central Georgia, the Alapaha, Little, Withlacoochee, and Suwannee Rivers of the Suwannee River watershed are important resources for the economy and health of the region. Groundwater is also an important resource in the region, as the Upper Floridan aquifer provides water for domestic, agricultural, and industrial supply. Declining water levels in the Upper Floridan aquifer in the northern part of the watershed, however, are indicative of overuse. Hydrologic monitoring is sparse in the watershed and studies conducted in other parts of the state, such as in the Flint River watershed, do not necessarily provide data or interpretations that are applicable to the Suwannee River watershed. Studies are necessary, therefore, to understand interactions between surface water and groundwater in this watershed and to develop effective regional water- management strategies.

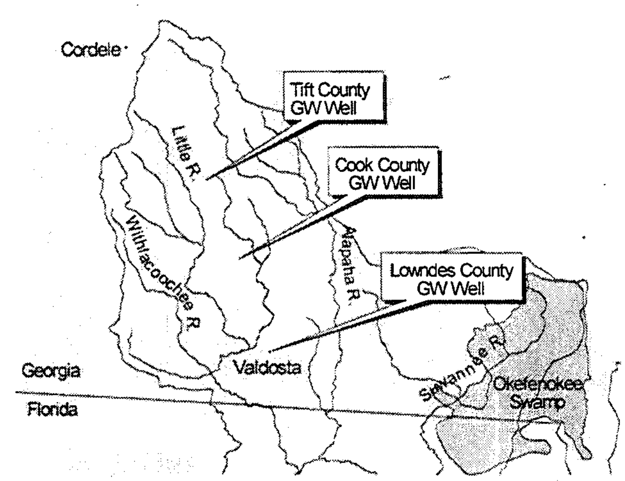

Figure 1. The Georgia portion of the Suwannee River watershed.

INTRODUCTION

The Suwannee River watershed (Figure 1) has no impoundments that alter river flows, which makes it the largest free-flowing source of freshwater to the Gulf of Mexico. Other than the Suwannee, all major rivers that flow into the Gulf are hydrologically altered. Of the water entering the Gulf from the Suwannee River, 40% of average flow comes from the Withlacoochee, Little, Alapaha, and Suwannee Rivers in Georgia. Therefore, the water resources of the upper Suwannee River watershed in Georgia are critical not only to support freshwater aquatic systems in Georgia and Florida, but for maintenance of a healthy estuary and saltwater fisheries in Florida as well.

Surface water and groundwater resources in the upper Suwannee River watershed, however, are not well understood, and maintenance of natural flows within the state and across the state line is not ensured. Demand for water is intensifying in the watershed, particularly for crop and turf irrigation. A 25-year water-level decline in the Upper Floridan aquifer near Tifton, Georgia, suggests that this region should not be dismissed as having "abundant water." The interstate Water Wars, that encompass the neighboring Flint River watershed, and prospects of increased water management statewide are raising ecological and economic water issues in the upper Suwannee River watershed. This paper presents a preliminary analysis of water-resource conditions in the Georgia portion of the Suwannee River watershed and some implications for water management.

HYDROLOGY

The Suwannee River watershed covers roughly 6,000 mi^2 in south-central Georgia and is the largest of the 14 basins in Georgia that begin in the Coastal Plain. The Withlacoochee, Little, Alapaha, and Suwannee Rivers

Table 1. Water Use in the Georgia Portion of the Suwannee River Watershed

Parameter	Suwannee River Watershed: Upper Suwannee River (No irrigation)	Suwannee River Watershed: Alapaha, Little, Withlacoochee Rivers (Irrigation)
Area (sq. mi.) [1]	2,678	4,206
1995 Population (x 1000) [2]	11	245
Average Daily Flow (MGD) [3]	562	1,730
Public Supply (MGD) [2]		
ground	1	27
surface	0	0
Estimated Irrigation Use (MGD) [2]		
ground	2	62
surface	0	55
Permitted Irrigation Use (MGD) [4]		
ground	NA	137
surface	NA	304

[1] US EPA 2000; [2] US GS 2000a; [3] US GS 2000b (See Figure 4 for gage locations); [4] Ga DNR-EPD

tgether with the western two-thirds of the Okefenokee Swamp are the major hydrologic features.

Although the entire watershed overlies the Floridan aquifer system, rainfall runoff, and surficial groundwater are the major water sources for the streams. Streamflow in the Withlacoochee, Little, and Alapaha Rivers is very responsive to rainfall events heavy enough to generate overland runoff. The area streams often decline to zero flow during dry summer and fall months. The headwaters of the Suwannee River lie in the Okefenokee Swamp, which slowly releases captured rainfall to the river and, thus, maintains baseflow in the stream during the summer and fall.

A groundwater divide is created by a zone of low transmissivity limestone in the Upper Floridan aquifer that extends in a southwest to northeast direction across the watershed through southern Tift County (Bush and Johnston 1988). This geologic feature, called the Gulf Trough, affects the rate and direction of flow in, and availability of water from, the Upper Floridan aquifer (Peck et. al 1999). There is limited recharge of the Upper Floridan aquifer in the watershed north of the Gulf Trough due to the thick clay of the Hawthorne Formation (Bush and Johnston 1988). Recharge of the Upper Floridan aquifer in this region largely occurs farther north and west of the Suwannee River watershed.

In the southern portion of this watershed, the Hawthorn Formation thins and becomes shallow, allowing for recharge of the Upper Floridan aquifer through sink holes that have developed in the Withlacoochee streambed in Lowndes County (Bush and Johnston, 1988, McConnell and Hacke, 1993). Disappearance of the Withlacoochee River underground during much of the summer provides evidence of the significant groundwater recharge that occurs near Valdosta. The rapid recharge results in the development of a potientiometric high under Valdosta that causes water movement in the Upper Floridan aquifer to radiate out in all directions (Peck et. al 1999). Little groundwater in the Suwannee River watershed, however, moves across the state line into Florida. Fisk (1977) estimated that 80% of the water (surface water and groundwater inflow) entering the Florida portion of the Suwannee River watershed from Georgia was surface flows from rivers. This analysis suggests that a significant amount of the water in the Upper Floridan aquifer that is recharged in the Valdosta area remains in Georgia.

WATER USE AND LEVELS

Agriculture and forestry are the primary land uses in the Georgia portion of the Suwannee River watershed, with agriculture accounting for most water use. Agricultural operations are concentrated in the northern portion of the watershed, where irrigation is often required for row crops and turf production. In 1998, the major row crops in the watershed were cotton, peanuts, corn, and soybeans (USDA 2000). While the number and extent of farms in the Suwannee River watershed are decreasing, the number of irrigated acres has increased since the the mid-1970's, particularly since the inception of center-pivot irrigation. Forestry operations are concentrated in the southern portion of the watershed and do not use significant amounts of water. The Cities of Valdosta and Tifton provide the largest municipal public supplies of water, however, these account for less than 20% of groundwater withdrawn in the watershed (Table 1). The greatest amount of water use, therefore, is by

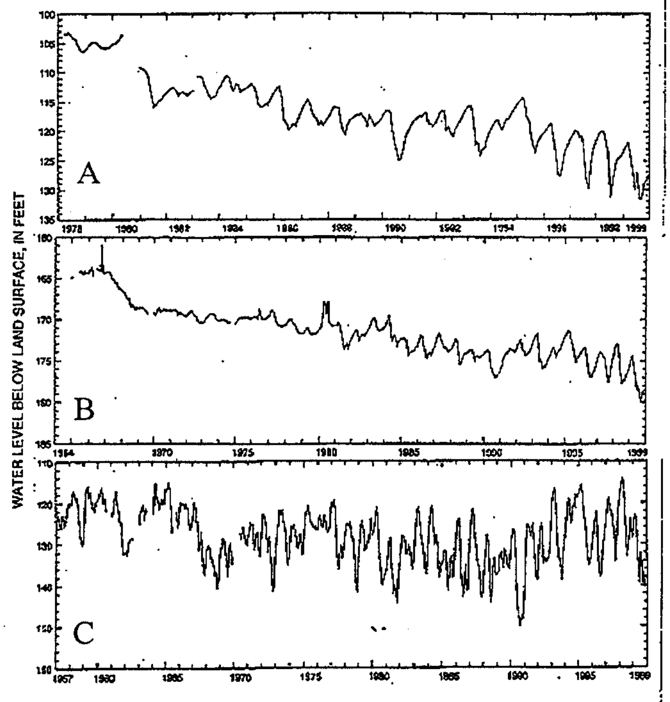

Figure 2. Historic trends in groundwater monthly mean levels at three locations in the Georgia portion of the Suwannee River watershed: A - Tift County, B - Cook County, and C - Lowndes County (Cressler 2000).

agriculture in the northern portion of the Suwannee River watershed.

Estimates of water use indicate that roughly equal amounts of surface water and groundwater are used for irrigation in this area (Table 1). Surface-water withdrawals are primarily from numerous farm ponds on small streams. Ponds typically cover 50 acres or less and are filled by surface runoff from their local watershed during the winter months. Water in these ponds is often depleted or lost to evaporation early in the growing season, making groundwater the most reliable irrigation source throughout the growing season.

Groundwater Levels

Comparisons of water levels in observation wells in Tift, Cook, and Lowndes Counties (Figure 2) illustrate apparent interactions of water use with the Upper Floridan aquifer. Monthly mean water levels in Lowndes County have remained at similar levels since the records were begun in 1957. Recharge of the Upper Floridan aquifer in this area is adequate to meet demands. This is not the case throughout the watershed. The Cook County area has experienced a 10-12 foot decline in water levels since 1965. Moreover, Tift County, which is located in the northern portion of the Suwannee River watershed where the Upper Floridan aquifer receives minimal local recharge, has experienced a 25-foot decline in water level since 1978. Clearly, availability of groundwater in this portion of the Upper Floridan aquifer in Tift and Cook Counties is exceeded by demands.

A disturbing seasonal trend in groundwater levels in the Georgia portion of the Suwannee River watershed, however, is an increasingly large drawdown observed during the summer since the late 1970's (Figure 2). This pattern is observed at the Tift and Cook County locations and correlates with local irrigation demands.

Most groundwater withdrawals in Lowndes County are for public supply (USGS 2000a). The Valdosta wellfield withdraws up to 14 MGD for sustained periods of time (Leon Weeks, City of Valdosta, personal commun.). This level of pumping stress contributes in part to the observed summer groundwater drawdown. Reduced local recharge of the Upper Floridan aquifer as streamflow declines, however, contributes to the degree of drawdown.

Long-term patterns of rainfall and stream stage indicate that the groundwater levels in the Upper Floridan aquifer in the Lowndes County area can be directly correlated with stream-stage increases following periods of heavy rainfall. Rainfall generally increased from the 1950's through the 1970's, decreased in the 1980's, and increased again in the 1990's (Figure 3). This rainfall pattern can be correlated with the spring and summer streamflow in the Suwannee River watershed (Figure 4). A pattern of declining summer rainfall since the 1970's (Figure 3), however, corresponds more closely with the summer groundwater level declines in the Lowndes County area than river flows. This indicates that rainfall in the Valdosta area may also result in local recharge in addition to the vertical infiltration in the river corridor which is the major source of recharge to the Upper Floridan aquifer in this part of the watershed.

Streamflow

As with groundwater resources of the upper Suwannee River watershed, assessments of surface water are site specific. Stream withdrawals near the headwaters have a profoundly greater affect on available streamflow than similar amounts of withdrawals made lower in the watershed where the streamflow is larger. It is for this reason, that it is important that water-resource planners

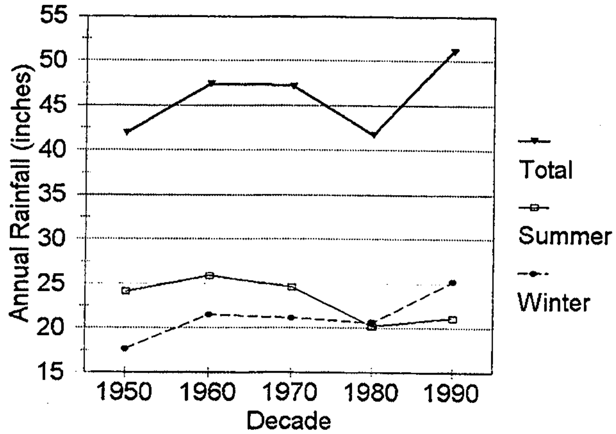

Figure 3. Example of long-term rainfall patterns (1952-1997) in the Georgia portion of the Suwannee River watershed at Fitzgerald.

and regulators evaluate the site-specific capacity of the stream prior to the expansion of withdrawal allocations or construction of in-stream ponds. The sustainability of the streamflow is of paramount concern when evaluating the impacts of withdrawals on the health of the aquatic habitat.

Long-term streamflow data in the upper Suwannee River watershed are limited to studies conducted by the U.S. Department of Agriculture, Agricultural Research Service (ARS). Long-term U.S. Geological Survey gaging stations are located only in the lower reaches of the watershed. Assessment of streamflow in the northern portion of the watershed is based solely on the ARS studies and an evaluation of current and potential withdrawals.

A preliminary comparison of average spring and summer daily streamflow in the Suwannee River watershed (Figure 4) indicates that flows at the Georgia-Florida state line have not had observable reductions due to increased demands. Long-term patterns of average spring and summer flow in the Alapaha and Withlacoochee Rivers, both of which have irrigation in their watersheds (Table 1), are similar to the Suwannee River, which has little irrigation. While this suggests that flows at the state line have not been severely impacted, greater impacts are expected further upstream where withdrawals are proportionately greater to streamflow.

The greatest demand for water in the Suwannee River watershed in Georgia is in the northern half of the watershed, thus, streamflow in this area is most likely to be affected by agricultural withdrawals. Effects of the numerous constructed ponds and stream withdrawals for irrigation, however, are not well studied, yet the cumulative impacts may be substantial. Constructed ponds, for example, occupy about 3% of the land surface in the Little River watershed (R. Lowrance, USDA-ARS, unpublished data) and are usually located on low-order streams. Because low-order streams comprise roughly 95% of stream channels (J. Meyer, UGA, personal commun.), a significant portion of the winter runoff from the watershed may be captured.

Because evaporation loses from open ponds can be higher than from other landscapes, it is important to understand the implications of creating additional ponds in the basin. Evaporation (40 inches per year) from the roughly 84 mi^2 of pond surface in the Alapaha, Little, and Withlacoochee River watersheds (2% of 4,206 mi^2 watershed where irrigation is concentrated; Table 1) results in about 7 inches per year more water loss than evapotranspiration (33 inches per year) from the land surface, is equivalent to 28 MGD or about 2% of the average daily flow of these rivers at the state line. In addition, more than 3% of the average daily flow of these rivers is withdrawn for irrigation during the growing season (Table 1). When the total of 5% of water removed from the area streams is adjusted for seasonal use, it represents a significant part of the spring and summer average daily streamflow. Furthermore, this amount is proportionately greater in the northern portion of the watershed than at the state line.

Moreover, the Georgia Environmental Protection Division has permitted at least twice as much surface-water withdrawals than are currently being utilized (Table 1). In light of the declining groundwater levels in the northern part of the watershed, there is likely to be an increase in surface-water withdrawals and pond construction in the future. For these reasons it is necessary to develop a better understanding of the effects of current and potential irrigation withdrawals on streamflow in the region.

IMPLICATIONS FOR WATER MANAGEMENT

Although the analyses presented herein are preliminary, there is a clear indication that a water-management strategy is necessary in the upper Suwannee River watershed. Groundwater availability from the Upper Floridan aquifer is not adequate to meet irrigation demands and public supplies are under pressure from

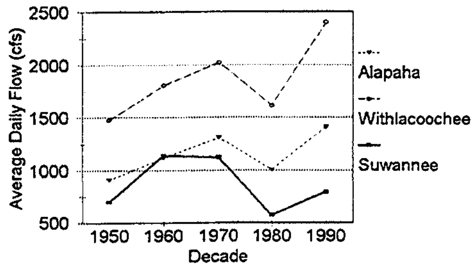

Figure 4. Spring and summer average daily flow rates (April 1 - September 30) at the Florida state line of the largest rivers in the Suwannee River watershed (USGS gage data from 1952-1997 for the Alapaha River at Statenville, Withlacoochee River at Pinetta, FL, and Suwannee River at Fargo).

increasing population growth. Effects of surface-water withdrawals and impoundments are likely to be felt more by downstream users as the proportion of irrigation water use shifts from the potentially over stressed Upper Floridan aquifer to more surface water. Adequate data are not available, however, to understand the water resources of the upper Suwannee watershed for effective management to ensure adequate supplies of water for domestic, economic, and environmental needs.

At present, the state of Georgia is focusing limited research funds in the Flint River watershed in response to the requirements of determining the Allocation Formula for water flowing into Florida from the Chattahoochee and Flint River basins. The hydrogeology within the Dougherty Plain is markedly different than in other areas of the state. In this area, the Upper Floridan aquifer is largely unconfined, and thus interacts dynamically with area streams. Whereas in other Coastal Plain areas where there is significant irrigation water use, the Upper Floridan aquifer is confined and does not interact significantly with area streams. Results from the groundwater flow models and other studies describing interactions between surface water and groundwater in the Flint River watershed have little applicability in other parts of the state and will not contribute to an understanding of effective water management in other areas.

Limited funds are available for research projects in other watersheds in Georgia such as are currently underway in the Flint River watershed. It is clear that the state must prioritize use of its resources to meet the most pressing demands. It is also clear, however, that other areas of the state, such as the Suwannee River watershed, have emerging water supply problems. The state has made it clear, however, in the restriction of Flint River Drought Protection funds to surface-water users that a gallon of water taken out of the river is a gallon of water that does not reach the state line. At a minimum, to avoid another contentious situations over minimum flows, and to maintain adequate supplies of water for the future of Georgia's citizens and wildlife, funds for expanded water- level monitoring and stream gaging must be dedicated to all parts of the state so that data will be available to support the studies necessary for the development of effective water-management strategies.

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