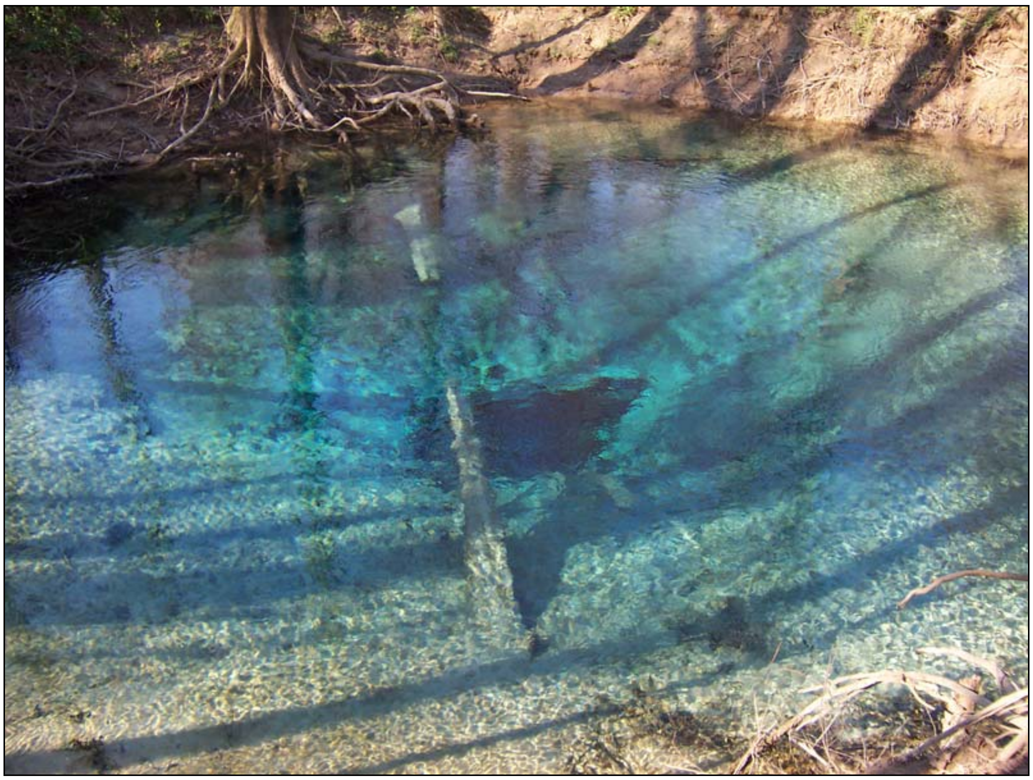
CHOCTAWHATCHEE RIVER SPRINGS INVENTORY
HOLMES, WALTON, AND WASHINGTON COUNTIES, FL

Water Resources Special Report 05-02



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INTRODUCTION

Purpose and Scope

In 2001, the Florida Legislature funded the first phase of the Florida Springs Initiative (FSI) to study and preserve the quality of Florida's springs. The Florida Department of Environmental Protection (FDEP), administrator of FSI funding, has contracted with the Northwest Florida Water Management District (NWFWMD) to monitor first magnitude springs within the District, delineate springsheds and perform other research regarding spring water quality and distribution. The 2004 Florida Legislature continued funding and FDEP requested project proposals for additional work. The NWFWMD proposed completion of a thorough spring inventory located in the Choctawhatchee River watershed. Although the basin was visited in the Florida Bureau of Geology (now the Florida Geological Survey) Bulletin 31 "Springs of Florida" (revised, 1977), local sources and the experience of NWFWMD and Florida Geological Survey (FGS) staff indicated the presence of many more springs discharging to the Choctawhatchee River or its tributaries.

The Choctawhatchee Springs inventory was performed under FDEP contract GW245 (amended July 2004) during the period of December 2004 through June 2005. The scope of work included researching a variety of sources for spring locations then visiting each spring to collect photographs, differentially corrected GPS position and field water quality measurements. NWFMWD staff also took instantaneous discharge measurements at springs appearing second magnitude or larger. Project deliverables consist of this report.

Area of Investigation

The Choctawhatchee River basin extends from Bullock County in southeast Alabama to the Choctawhatchee Bay in the Florida Panhandle. The Choctawhatchee River itself begins at the confluence of the East and West Forks in Dale County, AL thirty miles north of the Alabama-Florida border. Within Florida, the surface water drainage basin of the Choctawhatchee River covers approximately 1,529 square miles or 979,000 acres (**Figure 1**). The study area for this spring inventory was the portion of the drainage basin, excluding the Holmes Creek drainage basin, in Florida located within the Dougherty Karst Region (**Figure 2**).

Hydrologic Setting

The Choctawhatchee River flows through the Dougherty Karst Plain District which encompasses the northern portions of Bay and Calhoun counties, all of Jackson County, most of Washington and Holmes counties, and portions of Walton County. The Floridan Aquifer is recharged through the leaky confinement of the Intermediate System and discharges to springs and rivers throughout the Dougherty Karst Plain. The semi-confined condition of the Floridan Aquifer across the Dougherty Karst Plain allows for large amounts of local recharge, but also makes the Floridan Aquifer especially vulnerable to contamination from activities occurring on the land surface. The Apalachicola and Choctawhatchee rivers and Holmes and Econfina creeks all gain water from the portion of the Floridan Aquifer that is recharged through the Dougherty Karst Plain (Pratt et al. 1996). The physiography of the Choctawhatchee River basin in the Dougherty Karst Plain was originally described by R.O. Vernon as the River Valley Province, defined by an area of low elevations and wetlands, referred to as bays in this area, created by erosion and dissolution activity in the karst plain (Vernon, 1942). The region is now more commonly known as the Marianna Lowlands (Pratt et al. 1996).

In Holmes, Walton and Washington counties, the Floridan Aquifer is comprised of the Chattahoochee Formation, the undifferentiated Marianna/Suwannee Limestone, and the Ocala Limestone (Scott 1993 and Campbell 1993). In this region the Floridan Aquifer itself is relatively thin, with a thickness of approximately 150 feet near the Alabama border, where it is composed of the Ocala Limestone only (Moore 1955). Continuing south, the Floridan plunges to approximately 700 feet in thickness with the addition of the younger Marianna, Suwannee, and Chattahootchee Formations. The Floridan Aquifer, though relatively thin and only semi-confined in this area, is the primary source of water for consumptive use (i.e. public supply, domestic supply, irrigation, etc.).

The region is characterized by a thin and inconsistent confining Intermediate System, composed of the Alum Bluff Formation. The Intermediate System generally thickens to the west and south through the Choctawhatchee River basin. Continuing south, the Alum Bluff Formation grades into the more carbonate Intracoastal Formation (Schmidt, 1984). The Alum Bluff is composed of sands, clays and shell beds. Contained within the Intermediate System may be a thin, minimally water-bearing surficial aquifer or minor, confined water-bearing zones. Because of the carbonate components of the Intermediate System, these water bearing zones at times may appear to have the characteristics of the carbonate Floridan Aquifer.

In the study area along the Choctawhatchee River, the top of the Floridan Aquifer lies approximately 100 feet above mean sea level and is thinly confined, if at all. Carbonates comprising the Floridan System are frequently exposed in the channel of the Choctawhatchee River near Alabama. As the river heads south, it becomes characterized by massive sandbars and exposed limestone becomes rare. The Floridan Aquifer potentiometric surface elevation drops from approximately 200 feet above sea level near the northern-most springs to approximately 10 feet above sea level at southern extent of the study area near the mouth of the Choctawhatchee (Mahoney, et al., 1998). It is logical to expect a ground water contribution to the Choctawhatchee River as the potentiometric surface elevation is fairly commensurate with topographic elevations in much of the Choctawhatchee River basin.

A ground water contribution zone for the Choctawhatchee River basin interpreted from the 1998 NWFWMD potentiometric surface map is depicted in **Figure 3** but is subject to change under different hydrologic conditions. It is bounded by ground water contribution zones for Holmes Creek and Econfina Creek to the east and a regional down-gradient ground water flow to the west.

Figure 1: Choctawhatchee River Basin in Florida

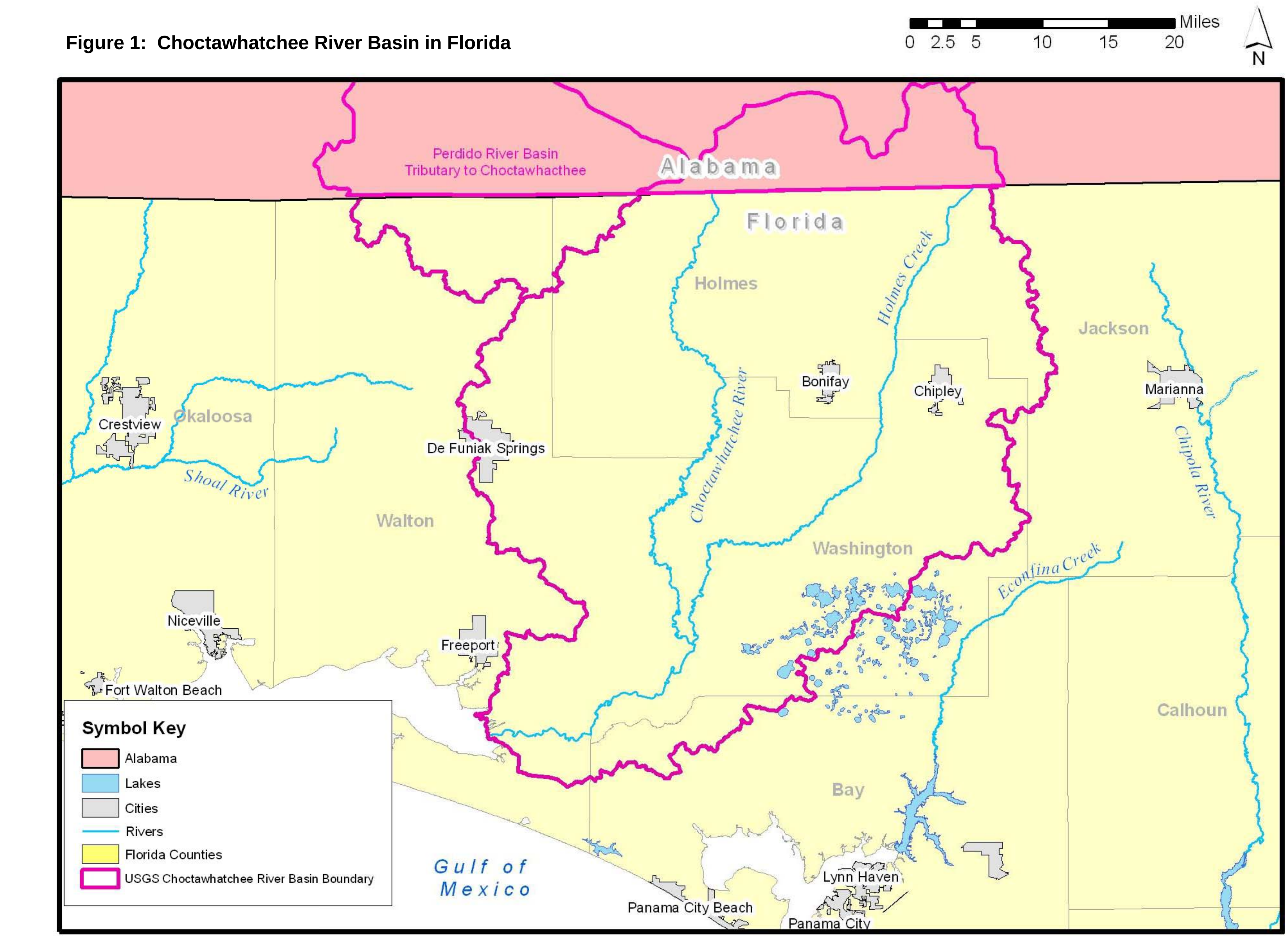


Figure 2: Dougherty Karst Region in Florida

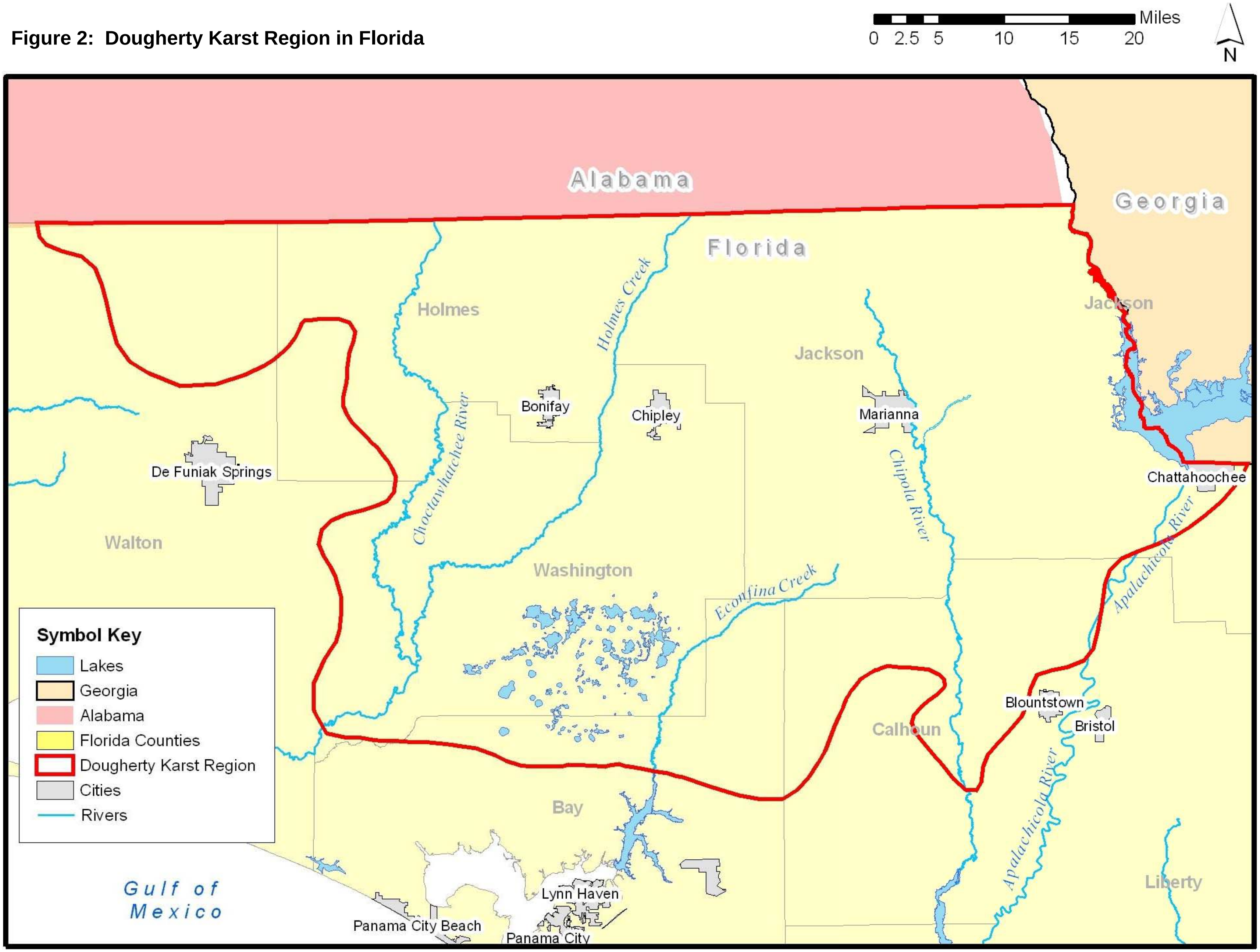
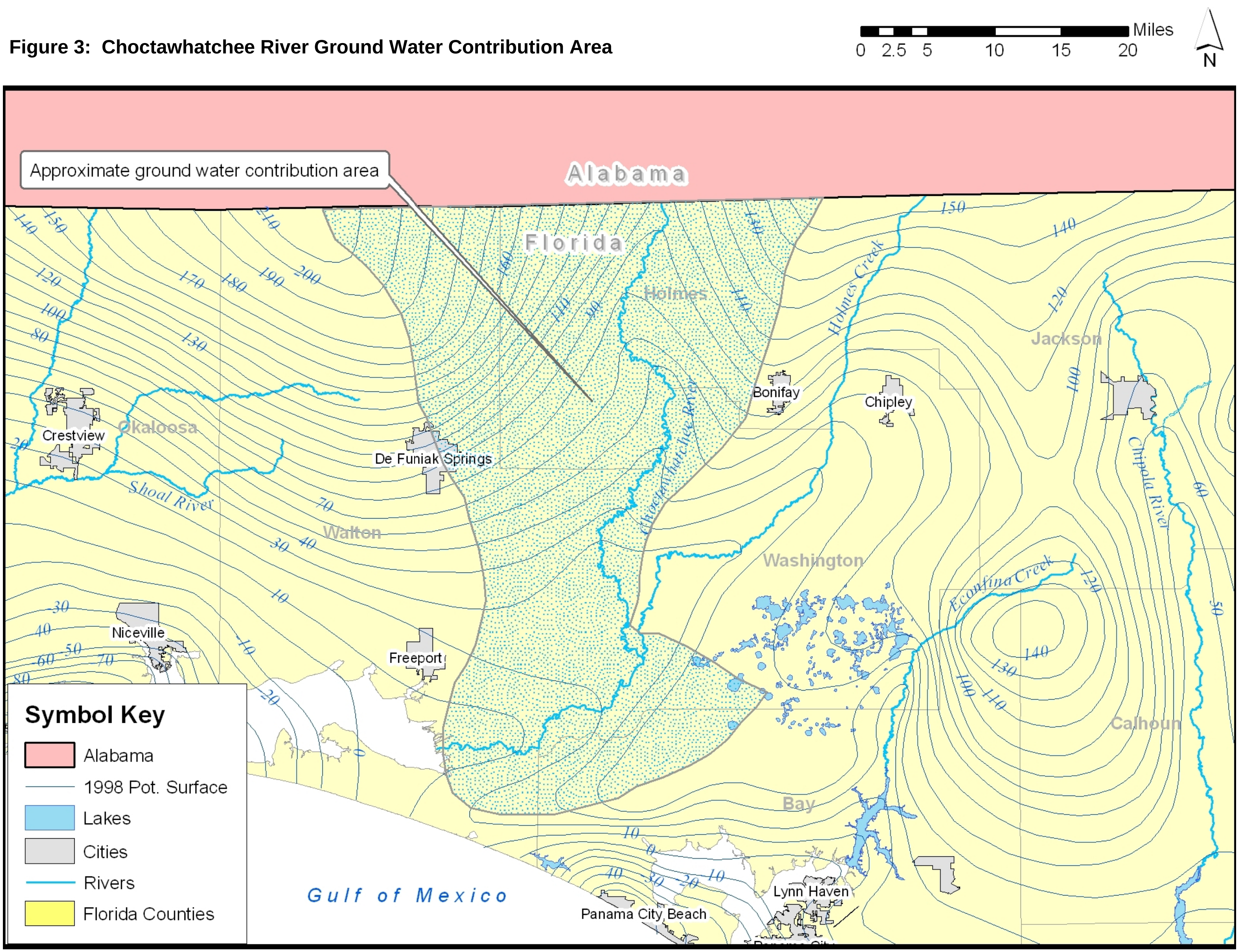


Figure 3: Choctawhatchee River Ground Water Contribution Area



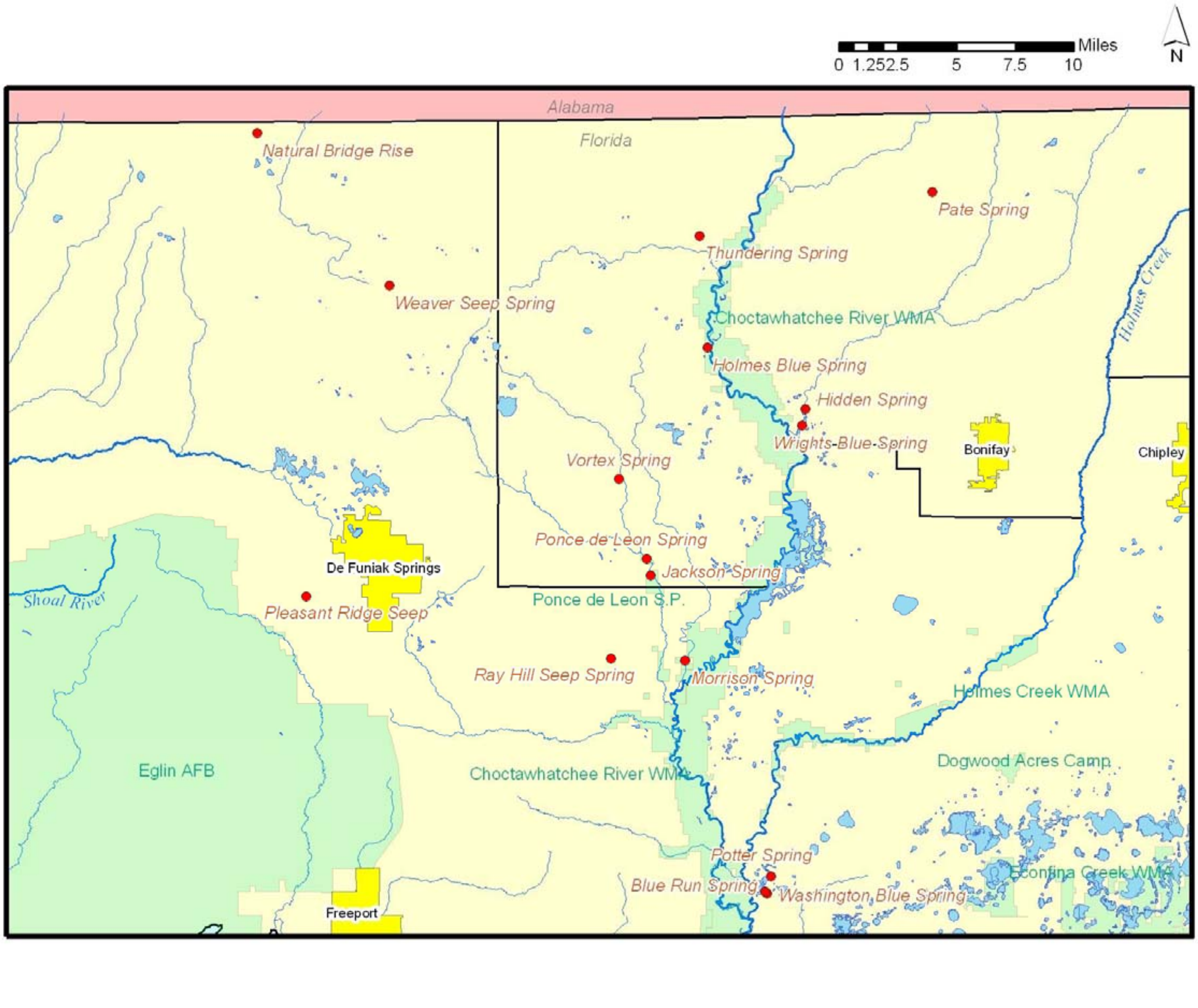
Note: Ground water contribution area is derived from the 1998 NWFWMD Floridan Aquifer Potentiometric Surface (elevation in feet, NGVD29) and is subject to change with varying hydrologic conditions.

CHOCTAWHATCHEE RIVER BASIN SPRINGS

A total of 13 springs were identified in the Choctawhatchee River basin (**Figure 4**). Springs in the Choctawhatchee River basin include those with typical fissure-type vents and those that incorporate areas of diffuse, upward percolation of ground water into pools and runs. Springs discharging via diffuse percolation are termed seep springs (Copeland 2003). Specific data, photographs and descriptions of individual springs are provided in **Appendix A**.

In addition, the District visited three sites historically documented as springs that are actually Surficial Aquifer seeps. Discharge, if possible, and water quality measurements were recorded at these seeps as well. Weaver Spring, Ray Hill Spring, and Pleasant Ridge Spring all have water quality characteristics consistent with a surficial-siliciclastic aquifer.

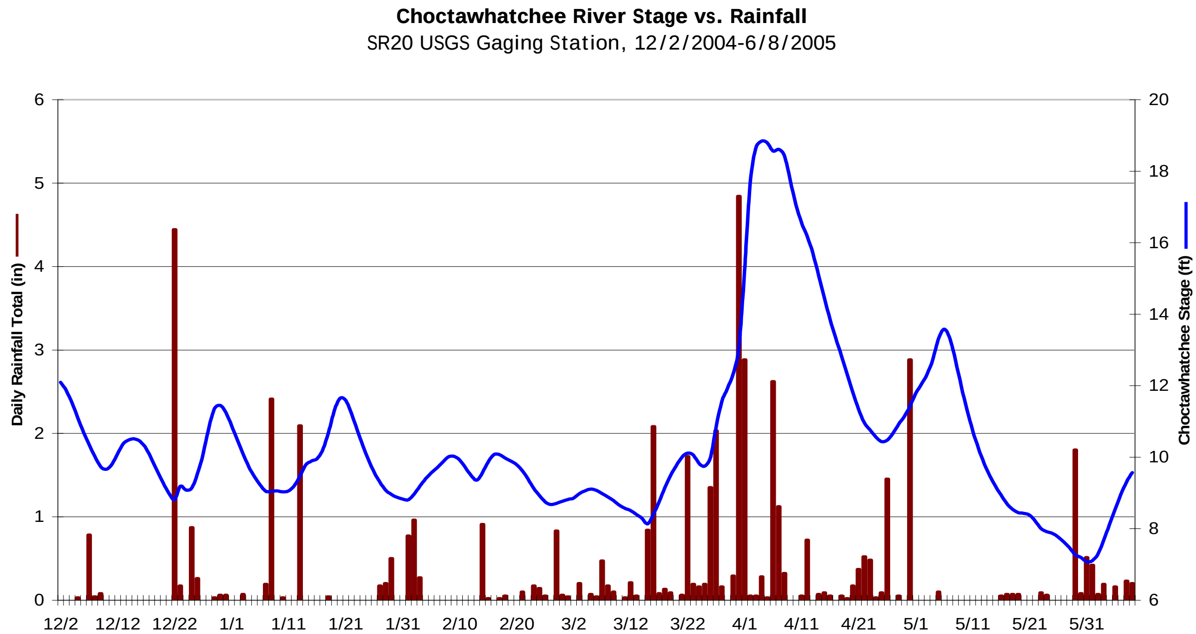
Figure 4: Choctawhatchee River Spring Locations



Precipitation and Discharge

During the period of the spring inventory along the Choctawhatchee River, surface water flow conditions played a significant role. During times of even average stage, the springs located within or adjacent to the river channel were difficult to locate. Part of the purpose of the inventory was to provide accurate position data so springs can be relocated, even under unfavorable conditions. The study period (12/2/2004 to 6/8/2005) was a period of above average precipitation and stage conditions. **Figure 5** illustrates the Choctawhatchee River stage and precipitation measured at the USGS SR20 recorder station near Bruce, FL.

Figure 5: Precipitation and Stage Conditions During Study Period



Discharge measurements recorded during the study period show that the Choctawhatchee River discharge increased from an average flow of approximately 8600 cubic feet per second (cfs) at US Highway 90 to 10400 cfs at State Road 20 to the south (**Figures 6a and 6b**). The majority of the increase in flow is attributable to the major tributaries of the Choctawhatchee along this section: Reedy Creek, Sandy Creek, and Holmes Creek. In addition to the 160 cfs contributed by measured springs, the remaining sources for ground water flow contribution are the springs along Holmes Creek and diffuse sources such as seeps and sand boils located within the Choctawhatchee River and its tributaries.

Figure 6a: Discharge at USGS US90 Station

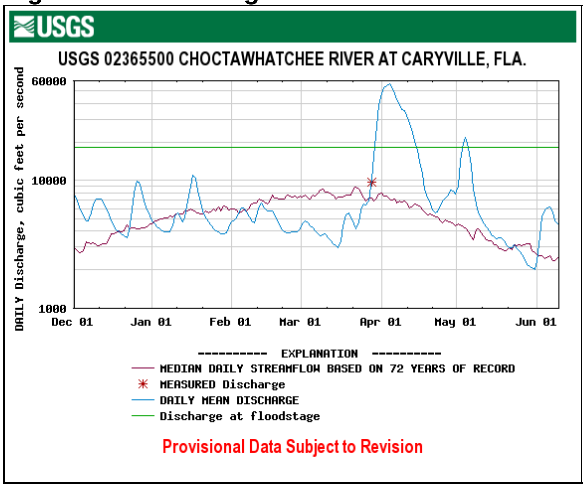
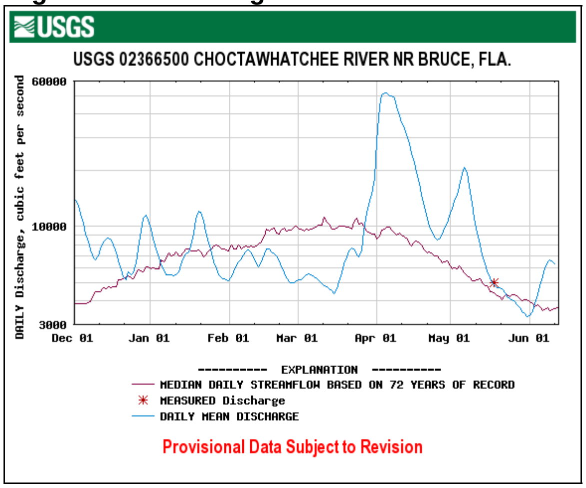


Figure 6b: Discharge at USGS SR20 Station



NWFWMD Ground Water Bureau staff made site visits to the 13 springs and made discharge and field water quality measurements where possible. The discharge measurements are presented in **Table 1**.

Table 1 – Springs Discharge Measurements.

Spring	Date	Discharge (cfs)
Morrison Spring	11/3/2004	49.2
Vortex Spring	1/12/2005	11.5
Ponce de Leon Spring	1/12/2005	11.3
Thundering Spring	1/19/2005	0.02
Natural Bridge Creek below rise	2/23/2005	18.7
Pate Spring	3/3/2005	0.42
Holmes Blue Spring	3/10/2005	9.59
Potter Spring	6/3/2005	25.1
Washington Blue Spring	6/3/2005	34.3
Weaver Spring (Surficial Aq.)	2/23/2005	0.07

The system has seven second magnitude springs (>10 to 100 cfs discharge). Holmes Blue Spring is classified as second magnitude because the average of historical flow measurements is over 10 cfs. One spring is classified as fourth magnitude (>0.22 to 1 cfs) and one is classified as sixth magnitude (1 to 10 gpm). Weaver Seep Spring, a Surficial Aquifer seep, is classified as fifth magnitude (>10 to 100 gpm). Some of the springs not measured may also fall into the third or fourth magnitude category. Jackson Spring was influenced by flow from Sandy Creek and was not measured. Wrights Blue Spring was flooded by Wrights Creek and could not be measured. Hidden Spring appeared to have a subterranean connection to Wrights Creek and could not be measured. Blue Run Spring discharges directly to the Washington Blue Spring run and could not be measured. Future discharge measurements may have some effect on the ratings of individual springs. The estimated total discharge for springs inventoried in the Choctawhatchee River basin is 160 cfs.

Water Quality

As part of the spring inventory process, field water quality measurements were made during site visits where possible. Measurements were made for water temperature (degrees C), dissolved oxygen (mg/L), pH (standard units), and specific conductivity (umhos/cm). The results of these measurements are presented in **Table 2**.

Table 2 – Field Water Quality Measurements of Springs in the Choctawhatchee River Basin.

Spring Name	Date Sampled	Temperature (degrees C)	Specific Conductivity (mhos/cm)	Dissolved Oxygen (mg/L)	pH (standard units)
Morrison Spring	11/3/2004	20.24	225	3.14	7.64
Vortex Spring	1/12/2005	19.91	212	5.04	7.37
Ponce de Leon Spring	1/12/2005	20.03	219	3.73	7.36
Jackson Spring	1/12/2005	19.95	212	2.29	7.25
Thundering Spring	1/19/2005	16.80	136	8.80	7.07
Natural Bridge Rise	2/23/2005	17.77	87	5.52	7.26
Pate Spring	3/3/2005	15.64	187	7.80	7.61
Holmes Blue Spring	3/10/2005	20.02	212	5.76	7.82
Wrights Blue Spring	3/10/2005	13.63	121	9.98	7.60
Hidden Spring	3/10/2005	17.94	291	2.67	7.57
Potter Spring	6/3/2005	20.80	156	1.17	7.33
Washington Blue Spring	6/3/2005	20.97	138	0.96	7.34
Blue Run Spring	6/3/2005	20.65	162	4.00	7.13
Weaver Spring (Surficial Aq.)	2/23/2005	15.80	18	5.45	4.92
Ray Hill Spring (Surficial Aq.)	3/15/2005	20.21	31	5.86	4.97
Pleasant Ridge Spring (Surficial Aq.)	3/15/2005	20.17	24	3.84	5.12

Temperature can be highly variable in surface water dependent on atmospheric conditions. Ground water temperatures tend to be much more stable. For instance, long-term water temperature readings at Wakulla Springs — a first magnitude Floridan Aquifer spring in Wakulla County—reveal that the temperature typically has a median value of 20.79 degrees C (n=4120, mean=20.77, stdev=0.11). The median temperature of the Choctawhatchee River springs, 19.95 degrees C (n=13, mean=18.80, stdev=2.28) compares well with this typical Floridan Aquifer value.

A surface water body with a dissolved oxygen (DO) value of less than 5.0 mg/L is considered impaired. The longer ground water remains in the aquifer, however, the DO concentration becomes lower due to oxidation reactions with the matrix material and the lack of re-aeration from the atmosphere or biologic sources. DO values in Floridan Aquifer wells recently sampled in this area have a median value of 0.14 mg/L (n=27, mean=1.58, stdev=2.21). The median DO value for the Choctawhatchee River springs is 4.00 mg/L (n=13, mean=4.68, stdev=2.84). The higher DO values measured for the springs indicate a much shorter average residence time in the aquifer for the spring discharge compared to ground water in the Floridan Aquifer wells.

The spring pH values indicate that the water is well buffered. This is typical of water that has remained in the Floridan Aquifer for any length of time. The dissolution of limestone by acidic rain water raises the pH of the water and creates the characteristic karst topography of the Dougherty Karst Plain. The median pH value for Floridan Aquifer wells recently sampled in this area is 7.80 standard units (n=27, mean=7.88, stdev=0.85). The median value of the Choctawhatchee River Springs is 7.36 standard units (n=13, mean=7.41, stdev=0.22).

Specific conductivity is a measure of the ion content of water. Rain water and surface water not influenced by ground water input usually have a specific conductivity value less than 50 mhos/cm when not impaired by non-point sources. The median specific conductivity value for Floridan Aquifer wells recently sampled in this area is 260 mhos/cm (n=27, mean=338, stdev=224). The median specific conductivity of the Choctawhatchee River Springs is 187 mhos/cm (n=13, mean=181, stdev=54.5).

The elevated DO values and lower pH and specific conductivity values in comparison to the Floridan Aquifer wells are probably the result of an influx of lower residence time, less mineralized and more acidic ground water into the Floridan Aquifer before it discharges from the springs. Because of this high local recharge and the significant surface water – ground water interaction within this highly karstic environment, the springs along the Choctawhatchee River are particularly vulnerable to proximate land use activities.

CONCLUSIONS

Under low to average flow conditions ground water contributes a significant portion of the Choctawhatchee River's discharge and water quality.

Under average to high flow conditions, the Choctawhatchee River contains more surface water and the ground water component is diluted.

The quality of water discharged from the Choctawhatchee River springs is predominantly determined by the quality of ground water in the Floridan Aquifer.

Water quality in the Floridan Aquifer and the springs' discharge is vulnerable to land use activities in the contribution zone. The springs are particularly vulnerable to those activities proximal to them.

There are at least 13 Floridan Aquifer springs located in the Choctawhatchee River basin. There may be more springs that can be distinguished under lower stage conditions.

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APPENDIX A: CHOCTAWHATCHEE RIVER SPRINGS INVENTORY

Table 3. Choctawhatchee Springs Location Coordinates (WGS84)

Spring Name	Latitude	Longitude
Morrison Spring	30.657928611	-85.903931667
Vortex Spring	30.770843056	-85.950056667
Ponce de Leon Spring	30.721214167	-85.930780000
Jackson Spring	30.710866667	-85.928033333
Thundering Spring	30.920800000	-85.890866667
Natural Bridge Rise	30.986750000	-86.207533333
Pate Spring	30.946483333	-85.723300000
Holmes Blue Spring	30.851430000	-85.885850000
Wrights Blue Spring	30.802566667	-85.818891667
Hidden Spring	30.812883333	-85.816200000
Potter Spring	30.523832778	-85.844026111
Washington Blue Spring	30.513258333	-85.847186111
Blue Run Spring	30.514433889	-85.848428889
Weaver Seep Spring	30.891650000	-86.113183333
Ray Hill Seep Spring	30.659480000	-85.957180000
Pleasant Ridge Seep Spring	30.699460000	-86.174820000

Table 4. Spring Descriptions

Spring Name	Description
Morrison Spring 	Morrison Spring is a second magnitude spring located 0.7 miles west of the Choctawhatchee River at the head of a broad spring run. The spring vent is located in the center of a pool approximately 250 feet wide, dropping dramatically to a depth of about 46 feet. The spring mouth is approximately 25 feet wide and leads to several caverns popular with divers, eventually attaining a depth of about three hundred feet. The spring is located adjacent to a recreation area currently managed by Walton County.
Vortex Spring 	Vortex Spring is a second magnitude spring currently operated as a private recreation area offering swimming and diving. The spring appears to discharge from a 10-foot wide crevasse in limestone located near the center of a 150-foot wide bowl shaped pool. Maximum depth recorded at the spring vent was 47 feet. Several fissures permeate the limestone surrounding the vent and may also discharge ground water. A narrow spring run issues from the spring pool and continues 0.40 mile to a control structure at the confluence with Blue Creek. There is no access from Blue Creek.

Ponce de Leon Spring 	Ponce de Leon Spring is located on the grounds of Ponce de Leon Springs State Park just south of Ponce de Leon, FL. The banks near the spring have been stabilized with limestone, mortar and concrete and a concrete control structure has been constructed to raise the water elevation in the pool. After the control structure, the spring flows 660 feet to Sandy Creek. Under high stage levels, Sandy Creek overflows its banks and discharges into the spring run. Two spring vents discharge into this swimming area. A prominent surface boil is visible issuing from the northwestern of the two vents.
Jackson Spring 	Jackson Spring is located in the southern extent of the Ponce de Leon Springs State Recreation Area, just south of I-10. The spring is surrounded by the low floodplain of Sandy Creek and can be difficult to locate under average to high stage levels. Jackson Spring can be found at the head of a 400-foot run in between the I-10 rest area and Sandy Creek. The vent is currently covered with sediments; however, discharge can still be observed issuing from several distinct sand boil groups.
Thundering Spring 	Thundering Spring is located in northern Holmes County on the west bank of the Windmill Branch, 0.70 mile north of West Pittman Creek. The spring consists of a group of small sand boils in a shallow, six foot wide circular pool.
Natural Bridge Rise 	Natural Bridge Creek emerges from an 8-foot wide opening in the Bridgeboro/Marianna Limestone (FGS - OFMS 17) on the east side of Natural Bridge Road. The diameter of the spring pool is approximately 20 feet. Maximum depth at the vent is 9.8 feet. A 30-foot wide karst window is located on the west side of Natural Bridge Road with a visible flow from boil to swallet. During high flow conditions, it appears that the discharge from the window overwhelms the swallet and floods Natural Bridge Road. Natural Bridge Creek enters a series of sandy swallets about 0.2 mile upstream from the rise. The area in between the swallets and the rise is marked with karst features, including windows and sinks. Based on flow measurements collected before the swallet and after the rise, the Floridan Aquifer contribution to the rise discharge was 6.9 cfs - with a calculated conductivity of 189 umhos/cm.

Pate Spring 	Spring discharge emerges from three sand boil groups, each approx. 3 feet across, at the eastern end of the spring pond. The spring run has been impounded to form a small lake 200 feet across. From there the spring discharge flows through a culvert into wetlands, eventually joining Little Creek 0.25 mile from the spring.
Holmes Blue Spring 	Holmes Blue Spring discharges from a triangular opening in limestone at the center of its 40-foot wide pool and continues along a short run to the Choctawhatchee River. The limestone cavity is approximately 6 feet wide and extends at least 5 feet below the bottom of the pool. Apart from the cavity, the bottom of the pool is covered with sandy silt and a handful of snags and logs. A prominent surface boil is visible except under flood conditions. The best time to visit the spring is when the stage at the USGS recorder at Caryville measures 6 feet or less.
Wrights Blue Spring 	Wrights Blue Spring is located in the low floodplain of Wrights Creek 0.6 mile from its confluence with the Choctawhatchee River. According to locals, the spring is usually flooded by flow from Wrights Creek and is only clear blue at very low stages. The vent is located at the southern end of a 200-foot wide shallow pool on the north side of Wrights Creek. Maximum depth recorded was 15 feet. Outcrops of Ocala Limestone can be seen scattered throughout the surrounding cypress and tupelo hammock.
Hidden Spring 	Hidden Spring appears to have a subterranean discharge to Wrights Creek but is visible as a karst window in line with two sinkholes forming a linear feature in the limestone bank of Wrights Creek. The karst window is approximately 20' wide and has a maximum depth of 12 feet. A small limestone opening is visible beneath the woody debris at the bottom of the window. The spring is located in an outcropping of the Ocala Limestone on the east bank of Wrights Creek, approximately 0.75 mile north of the landing at Wrights Blue Spring, adjacent to private property.
Potter Spring 	Potter Spring is located off Mill Branch north of Mill Lake. Spring vent is an opening in limestone approximately 10 feet in width in the center of a circular 50-foot pool. Maximum depth recorded in the spring vent was 29 feet. The sides of the spring pool consist of a steep grade of sediments and woody debris. A slight surface boil was visible at the time. Located adjacent to private property.

Washington Blue Spring 	This popular spring is located 0.8 miles up Spring Run from the Choctawhatchee River just south of the confluence with Holmes Creek. The spring discharges from a 10-foot wide opening beneath a limestone ledge at the west edge of 60-foot wide bowl-shaped pool. Steep sandy clay banks rise to approximately 20 feet to the south and west while the east and north consist of low cypress and tupelo wetlands. The spring discharge pushes a prominent surface boil. Located adjacent to private property.
Blue Run Spring 	The spring vent is located at the edge of a shallow pool on the north side of the Washington Blue Spring run. The vent sides consist of sediments and woody debris with a maximum recorded depth of 13 feet. No flow was observed issuing from the spring however field parameters are distinctive from that measured in Washington Blue Spring run.
Weaver Seep Spring 	Weaver Seep Springs consists of an area of visible Surficial Aquifer seepage and a seep-fed bowl shaped pool bordering forested uplands. Because of the pool, this group of seeps may be confused with a Floridan Aquifer spring. The water in the pool is crystal clear but its chemistry is that of the Surficial Aquifer. The pool itself is approx. 100 feet wide with a 6.8-foot maximum depth.
Ray Hill Seep Spring 	A collection of springs seeping from the base of an 80-foot steep grade in the Citronelle Formation. Joins with other, smaller seep springs in the locality to form Camp Branch.
Pleasant Ridge Seep Spring 	This seep spring is located approximately 2.6 miles southwest of De Funiak Springs, FL. The seeps emerge from the base of a 25-foot bluff in the Citronelle Formation just below the grade for Hewitt Road.