Ichetucknee Springs & River:
A Restoration Action Plan

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Causes of Impairment

Scientific Research from the Springshed

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Ichetucknee Springs

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Ichetucknee Springs – A Resource Worthy of Protection

Florida is the land of natural wonders and magic creations. From the Florida Keys to the Pensacola beaches, tourism is the largest economic driver in the state. The Magic Kingdom, Sea World, MGM Studios and other human creations also attract many tourists to Florida. While the beaches may be Florida's signature "natural" tourist attraction, many Floridians as well as savvy travelers frequent a less-publicized natural tourist attraction – the state's 1,000+ artesian springs (Figure 1).

Thousands of people flock to north Florida's springs to escape the long, hot, humid summer months. Tubers float down spring-fed rivers enjoying the refreshing and perpetual spring flows. Fishermen spy their wary prey in the transparent spring runs and rivers. Cave divers from around the world know more about the black ether of the Floridan Aquifer than most Floridians who live in the lighted world above. Kayaking and canoeing have become the preferred pastime for thousands who are attracted to Florida's wild rivers and fascinating springs. Springs are one of the most important economic engines in north Florida, and pure and abundant groundwater is the fuel that makes those engines run.

Figure 1. Each year, about 200,000 visitors enjoy Ichetucknee Springs' refreshing waters and are immersed in Florida's natural environment as they float down the spring run. This is an adventure that leaves a life-time memory for many.

Yet, in spite of their recognized recreational and economic importance, springs are threatened by a wide range of human activities. In an effort to raise public awareness of these issues, this Restoration Action Plan summarizes the evidence of the Ichetucknee System's decline and describes those activities that are causing these negative changes.

The Ichetucknee River, located in Florida's Springs Heartland, is formed by the cumulative groundwater discharge from nine named artesian springs (Figure 2). From upstream to downstream the named springs include: Ichetucknee (Head Spring), Cedar Head, Blue Hole (Jug), Mission Group (Roaring and Singing), Devil's Eye, Grassy Hole, Mill Pond and Coffee. Of these named springs, Blue Hole has the largest discharge.

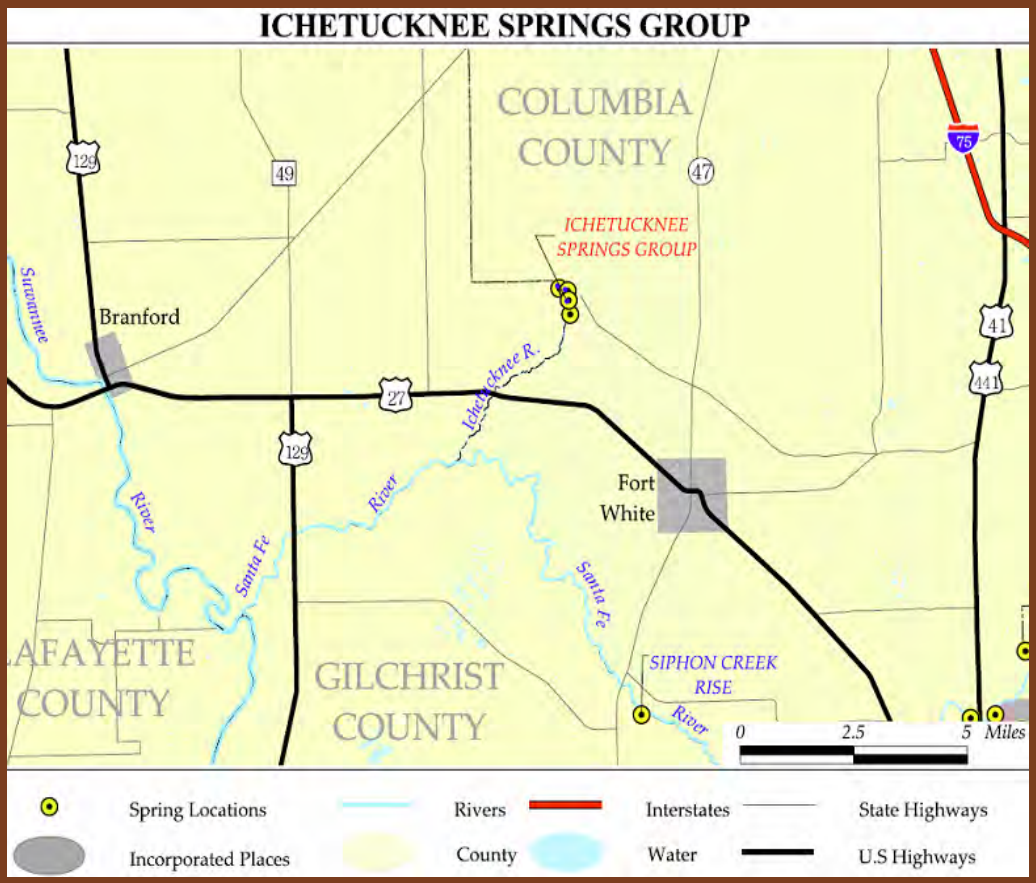
Agricultural and urban activities have been linked to declining groundwater levels, lower spring discharge rates and rising concentrations of nitrate nitrogen at Ichetucknee Springs and River (collectively referred to as "the Ichetucknee System"). Consequently, serious signs of degradation are increasingly observed in the springs and spring run.

Figure 2. (right)

Ichetucknee Springs geographic location (source: Florida Geological Survey).

Figure 3. (above)

The Ichetucknee Springs and River are quintessential north Florida. Sacred home of hundreds of generations of Native Americans; site of one of the first Spanish missions in "La Florida"; pioneer home site; baptism spring; tubing wonderland; portal into the Floridan Aquifer; and home to millions of animals from the extinct saber-toothed tiger, mastodon and giant armadillo, to the extant manatee, limpkin, wood stork and hundreds of other species of fish, turtles, snakes, birds and mammals.



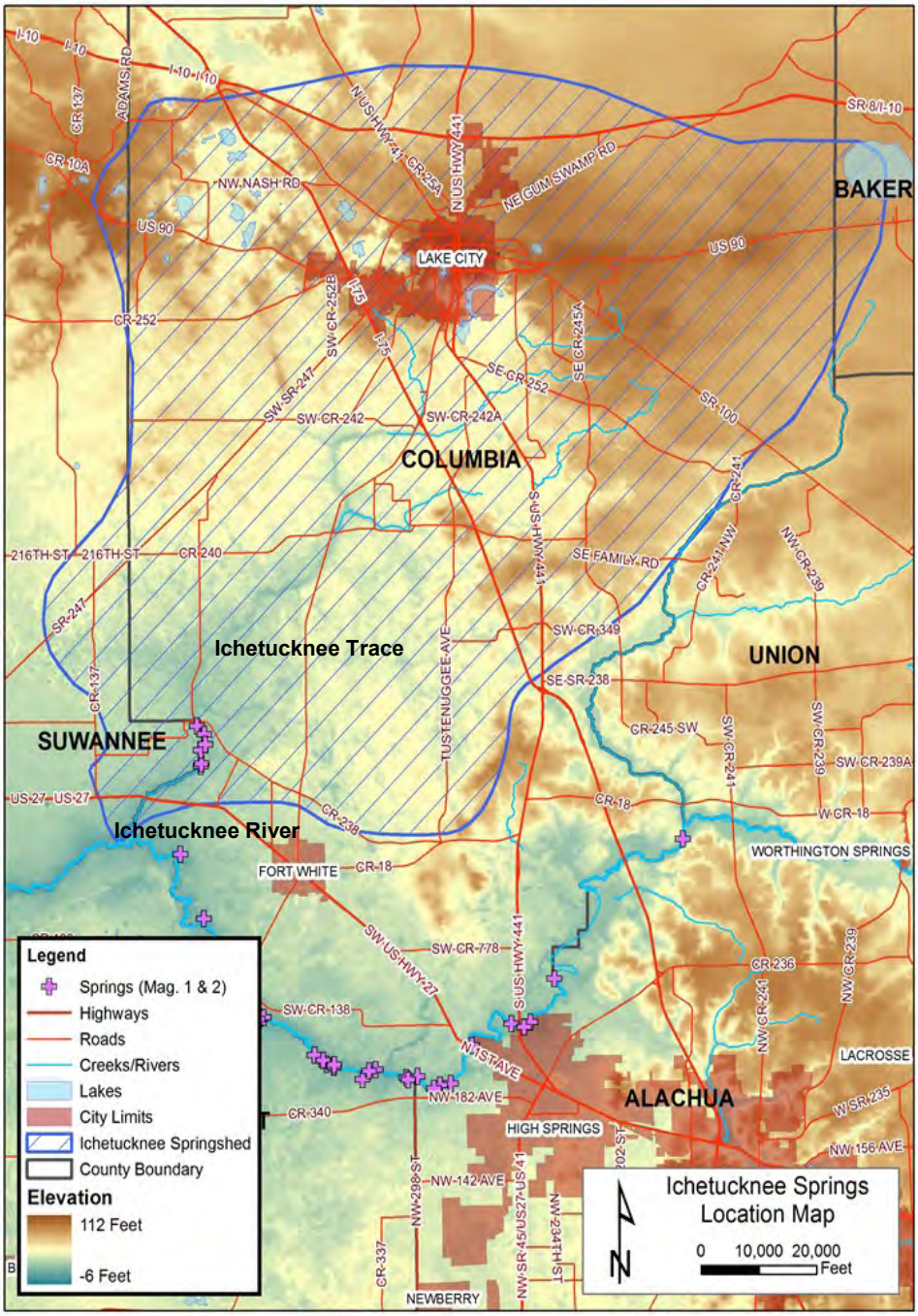
The Ichetucknee Springs Working Group was organized in 1995 to help educate the public and local stakeholders about the degradation occurring in the Ichetucknee Springs. During its 16 years of existence, the Working Group was successful at raising awareness of the threats affecting the Ichetucknee System and implementing multiple projects targeting specific restoration goals. However, state funding for the Working Group was discontinued in 2011 and the Ichetucknee System continued its decline.

In concert with a committed group of stakeholders and with funding support from Three Rivers Trust, the Howard T. Odum Florida Springs Institute (FSI) finalized a comprehensive Ichetucknee Springs Restoration Plan started by the Working Group. The Ichetucknee Springs Restoration Plan is based on best available science and provides a foundation and blueprint for immediate and continuing actions needed to achieve comprehensive restoration and protection of the Ichetucknee System (see www.floridaspringsinstitute.org). This summary document provides a synopsis of the full Ichetucknee Springs Restoration Plan.

Groundwater sustains both the people of Florida and our natural environment (Figure 3). Consequently, a shared water ethic is needed – an ethic that articulates the environmental problems and provides solutions for reducing impacts on our springs. Specific actions that can reverse the impacts to the Ichetucknee Springs System are summarized in this report. As you read this document, please think about what you can do to help return our precious springs to their once pristine condition.

The Ichetucknee System - A Karst Landscape

The Ichetucknee System is located in north central Florida in the Suwannee River Water Management District (Figure 4). The Ichetucknee River travels through undeveloped riparian lands in the Ichetucknee River State Park for about 3.2 miles to US 27. The majority of the river in this segment is less than 6 feet deep. The Ichetucknee River exits the state park and flows for another 2.3 miles, where it joins the Santa Fe River. The Santa Fe then flows to the Suwannee River, which in turn flows to the Gulf of Mexico. On average, the Ichetucknee River contributes about 25% of the average flow in the Santa Fe River and about 4% of the average flow in the Suwannee River.



Land Use/Land Cover

In 2010, approximately 31,600 people lived in the Ichetucknee Springshed. The largest urban area in the Ichetucknee Springshed is Lake City, with a population of approximately 12,050 people. From 1995 to 2005 urban land uses increased from about 9 to 19% of the springshed area while agricultural land uses declined from about 47 to 23% and forest cover changed from about 34 to 44% (including more pine plantations). Land uses in the Ichetucknee Springshed are gradually changing from rural/agricultural to urban/residential.

Figure 4. (left)

Map of the Ichetucknee Springshed. The Northern Highlands are indicated in brown and are associated with land surface elevations above about 150 ft. mean sea level. The Gulf Coastal Lowlands include the lighter-colored areas less than about 100 ft. above mean sea level. The Ichetucknee Springshed is outlined in dark blue. The Ichetucknee Trace, a dry, relic stream channel dotted with sinkholes and underground cave systems, is a surface connection from Lake City to the Ichetucknee River.

Geology

The Ichetucknee System is underlain by limestone that comprises the Floridan Aquifer System. In the northeastern portion of the groundwater basin, sands and clays of the Hawthorn Group lie above the limestone and provide partial protection of the aquifer by absorbing some nutrients and pollutants before they reach the groundwater. The southwestern portion of the basin is classified as the Gulf Coastal Lowlands – an area of Florida where the Hawthorn sediments are absent, (washed away by Pleistocene seas), and karst features such as sinkholes, limestone outcrops and springs are near the surface. The Cody Escarpment marks the division between the Northern Highlands and Gulf Coastal Lowlands.

The Ichetucknee River once flowed overland from Lake City to the Santa Fe River. The dry river valley is now known as the Ichetucknee Trace (Figure 4). Cannon Creek, Clay Hole Creek and Rose Creek were once surface tributaries to the pre-historic Ichetucknee River, but now discharge directly into sinkholes. Dye tracer studies have shown that several sinkholes along the Ichetucknee Trace flow directly to Ichetucknee Springs. Consequently, pollutants draining into sinkholes within the Ichetucknee Springs Basin rapidly travel to Ichetucknee Springs.

Springshed

The Ichetucknee Springshed Basin covers about 400 square miles (256,000 acres) and encompasses the southern two-thirds of Columbia County (with Lake City at its center), and small portions of Suwannee, Baker and Union counties (Figure 4). The actual springshed boundary fluctuates depending on groundwater levels, rainfall, groundwater recharge patterns and groundwater pumping. Groundwater flow is largely from northeast to southwest in the Ichetucknee System.

Aquifer Vulnerability

Aquifer vulnerability is a measure of the potential for recharge of surface water and leaching of associated pollutants (such as fertilizer, herbicides, petroleum and other dissolved and particulate chemicals) into the underlying aquifer. The most vulnerable aquifer areas are within the Gulf Coastal Lowlands located in the southern portion of the Ichetucknee Springshed (Figure 4). The least vulnerable areas are located in the Northern Highlands where the Hawthorn Formation provides some protection of the Floridan Aquifer. Only about 15% of the Ichetucknee Springs Basin has low aquifer vulnerability, 53% is considered vulnerable and 32% of the springs basin is highly vulnerable.

Ichetucknee Springs State Park

General

The Ichetucknee Springs State Park is comprised of about 2,280 acres of uplands, wetlands, springs and river (Figure 5) and was acquired by the state in 1970. The Ichetucknee Head Spring is a designated National Natural Landmark. The Ichetucknee Spring State Park is administered by the Florida Department of Environmental Protection (FDEP)/Florida Park Service (FPS) for public outdoor recreation, and provides a popular swimming and tubing destination. Waters within the state park are designated as Outstanding Florida Waters, the highest level of water quality protection in Florida. The park facilities are well-developed and include boardwalks, paths, pavilions, playgrounds, restrooms and concessions. This site is a regionally popular tubing destination where visitors also enjoy picnicking, snorkeling, canoeing, swimming, hiking and wildlife viewing.

The Ichetucknee Springs Group is a first magnitude spring complex, comprised of nine named springs that discharge into the spring-fed Ichetucknee River. The Ichetucknee Springs and River have a long history of human usage, with 23 archeological sites identified in the state park. These archaeological sites span the entire range of Florida's pre-history, from Paleo-Indian (12,000 BC - 6,500 BC) to the Weeden Island culture (A.D. 200 - A.D. 1000). Remains of a mission from the Spanish period have also been discovered along the river and phosphate mining occurred in the uplands along the Ichetucknee River during the late 1800s.

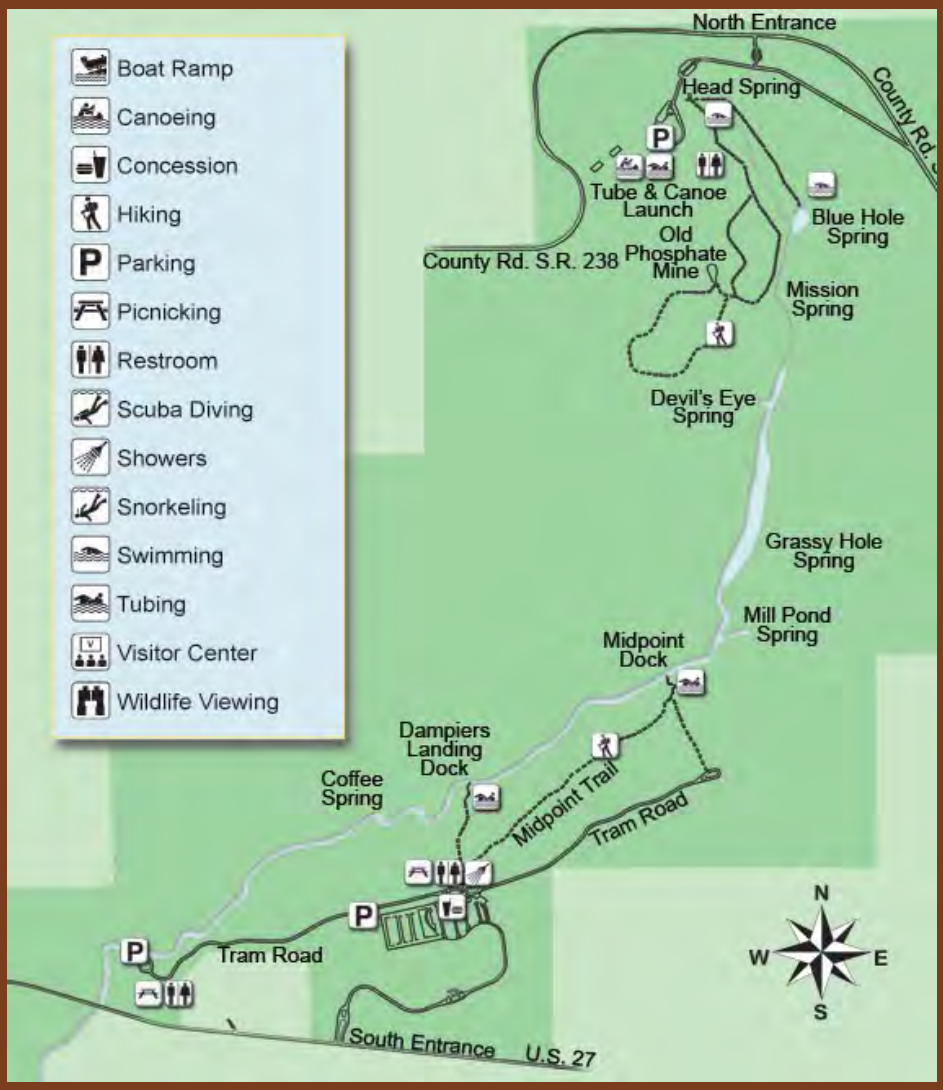


Figure 5. (above)

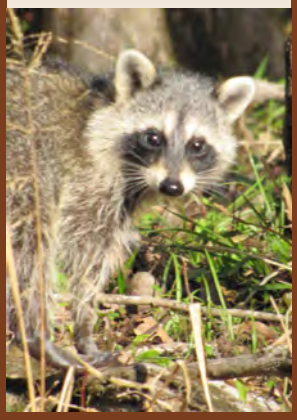
The Ichetucknee Springs State Park is located in Columbia and Suwannee counties west of Fort White, Florida. The main (south) park entrance is located off of US 27. The park also has a north public entry point, accessible by road from Fort White following US 47 north to CR 238, and then west to the north park entrance (phone: 386-497-1216) (source: Florida Park Service).

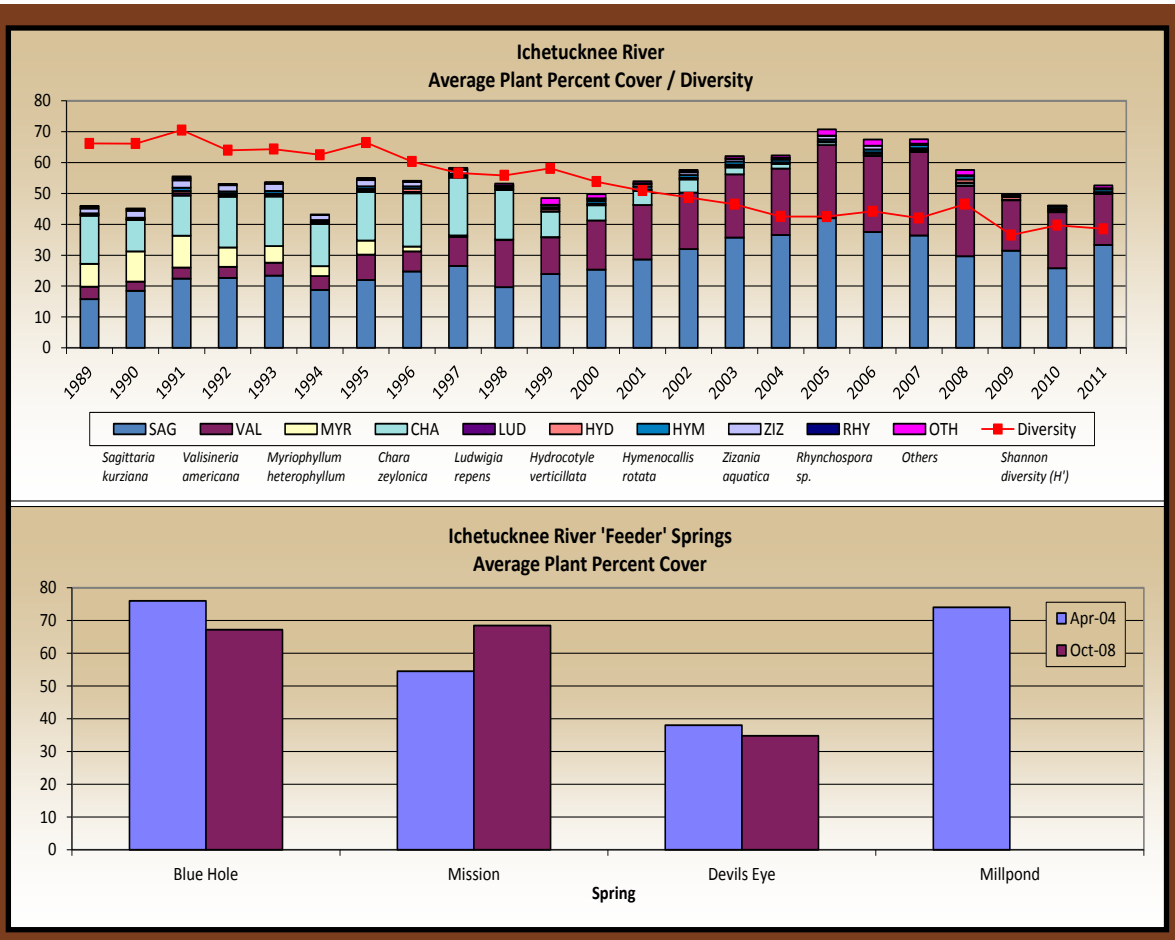
Biology

The submerged aquatic plants growing in the bottom of the Ichetucknee River represent the beginning of the aquatic food chain and are vital to the health and survival of the complex assemblage of aquatic organisms. Park biologists began monitoring the submerged aquatic vegetation in the Ichetucknee River in 1989 (Figure 6). Historically, the Ichetucknee River was vegetated by a diverse assemblage of submerged aquatic plants. However, during the past two decades, strap-leaf sagittaria and eelgrass have greatly increased in dominance while other submerged plants have declined, resulting in a notable loss of plant diversity.

Figure 6. (right)

Cover and diversity of submerged aquatic vegetation in the Ichetucknee River at four of the principal springs from 1989 through 2008 (data from FDEP; analysis by Wetland Solutions, Inc.).





Filamentous algae covers much of the submerged aquatic vegetation in the Ichetucknee River and has increased greatly over the past two decades. High coverage of filamentous algae is detrimental to the natural aquatic community by shading the plants, thereby reducing their vigor and reducing the food source for herbivores. The decline in diversity of submerged aquatic plants and a concomitant increase in filamentous algae are both signs of degradation to the Ichetucknee Springs and River.

The Ichetucknee Springs and River support a diverse and complex assemblage of insects, reptiles, amphibians, fish, mammals and birds. This complex food web is dependent on a healthy and vigorous aquatic plant community.

Many insect larvae important to the food chain occur in the Ichetucknee, including non-biting flies, stoneflies and mayflies. Crustaceans include freshwater shrimp, amphipods and crayfish. Seven species of clams and mussels have been documented in the Ichetucknee River, and aquatic snails are prolific.

A variety of aquatic turtle species are found in the Ichetucknee River. Loggerhead musk turtles are the most abundant species, followed by Suwannee cooters, yellow-bellied sliders, common musk turtles, Florida red-bellied turtles, common snapping turtles and Florida softshell.

An array of fish - 31 species, including 22 genera and 14 families - have been reported from the Ichetucknee River. Common fish species include several varieties of sunfish, Suwannee and largemouth bass, lake chubsucker, shiners and striped mullet.

Mammals that are often seen in the Ichetucknee River include river otters and beavers. Manatees are occasionally observed swimming in the Ichetucknee River; however a natural geologic formation on the lower river serves as an upstream barrier and restricts manatee passage during low water periods.

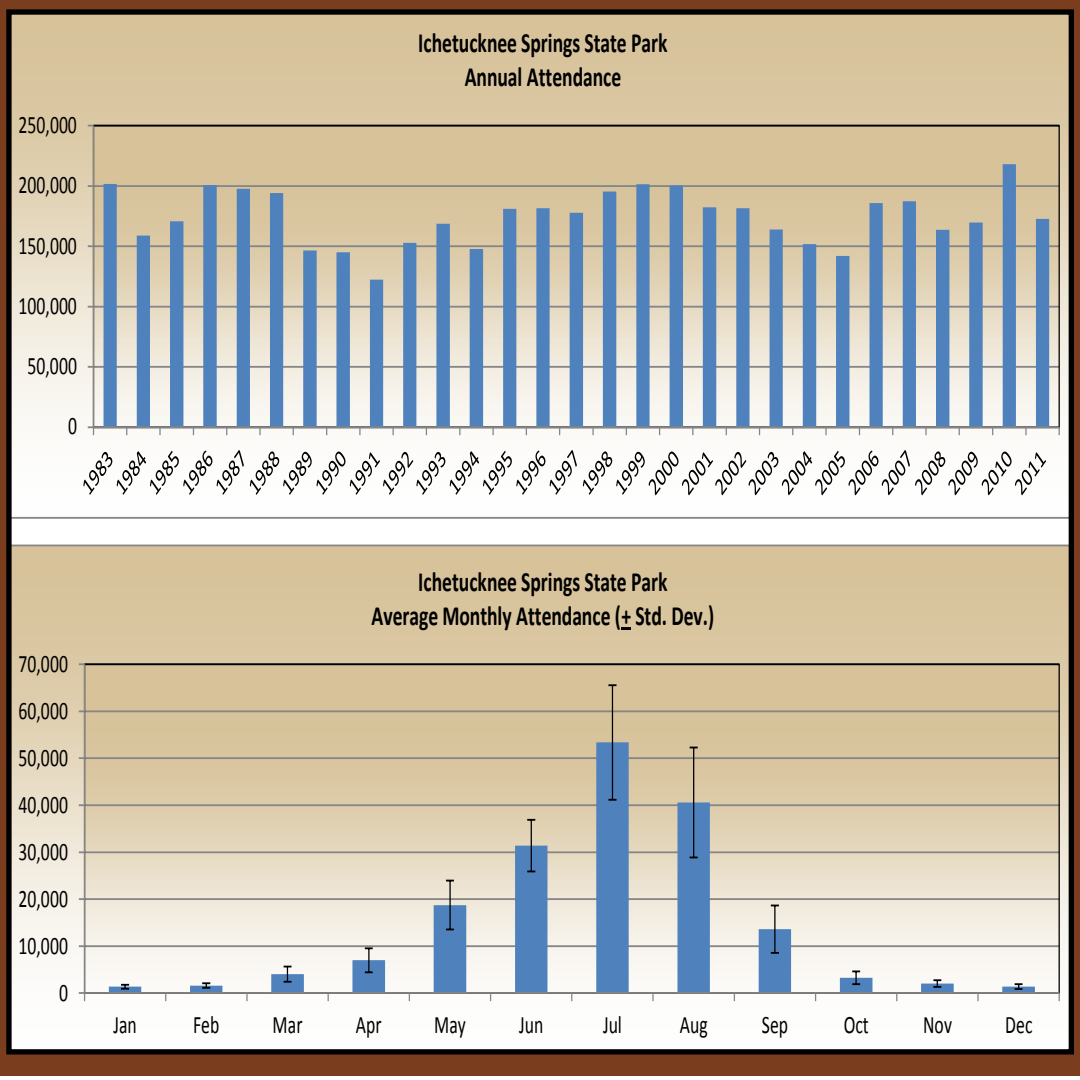
More than 170 species of birds have been recorded along the Ichetucknee River and surrounding uplands. Many of these bird species are dependent on a healthy aquatic environment. Some of the frequently observed species include wood ducks, white ibis, limpkins and herons.

Human Use

Visitation at the Ichetucknee Springs State Park is high and has averaged 172,048 visitors annually since 1983 (Figure 7). Tubing and swimming in the Ichetucknee River are the most popular forms of recreation within the state park, especially during the summer months. Motorboats and fishing are not allowed in the segment of the Ichetucknee River that is within the state park (i.e., upstream of US 27), but are popular forms of recreation below US 27.

The Ichetucknee Springs State Park is open year-round but operates a tram shuttle service, concessions and allows tubing on the north section of the river only during the summer season between

Memorial Day and Labor Day. High numbers of people on the Ichetucknee River inevitably uproot aquatic plants and cause elevated turbidity that further impacts the plants. Therefore, tubing on the river during the summer is limited to 750 people per day at the North Entrance and 2,250 people at the Mid-Point Tube Launch. To allow the aquatic plants to recover, no tubing is allowed during the winter on the shallower portion of the river upstream of the Mid-Point Tube Launch.



Funding Strategies

Many of the actions that are essential for springs' restoration are free because they encourage reducing or eliminating excessive and wasteful water consumption and nitrate pollution. However, some of the actions in this restoration action plan will be expensive to implement. If everyone who is responsible for these problems shares in the costs, it is expected that the cost per person will be minimal. Everyone living and working in north central Florida contributes to the problem of reduced spring flows and increased nitrate levels, and everyone should be part of the effort needed to reverse the degradation of the area's springs and groundwater resources. This recovery is long overdue. The benefits of preserving our precious springs to maintain a vibrant economy are clear. *The time for action is now.*

Figure 7. (left)

Ichetucknee State Park attendance trends from 1983 through 2008 and monthly average attendance figures for the same period (data from Florida Park Service; analysis by Wetland Solutions, Inc.).

Water – The Lifeblood of the Ichetucknee

Precipitation

Rainfall and subsequent groundwater recharge in the Ichetucknee Springshed is the primary source of water that feeds Ichetucknee Springs. The long-term average rainfall in the springshed is about 51 inches per year (Figure 8). There are visible trends in the rainfall record, including a steady increase of rainfall of about 12% from 1930 through 1970 and a steady decline of about 16% over the past 40 years. Declines in groundwater levels, spring flows and river levels in the Ichetucknee System have been blamed on low rainfall; however, the range of annual rainfall totals has not changed in the Ichetucknee Springshed during the past 110 years.

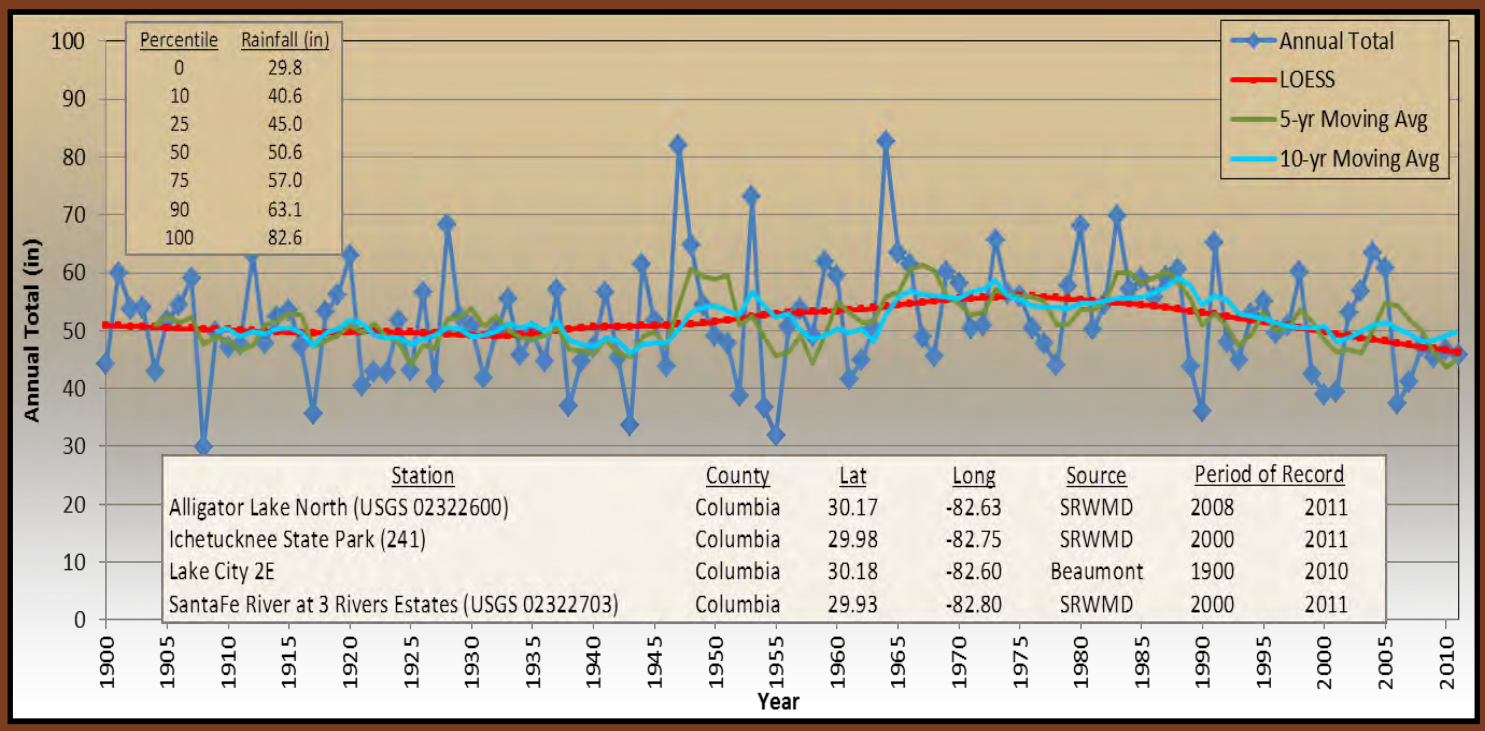
Figure 8. (below)

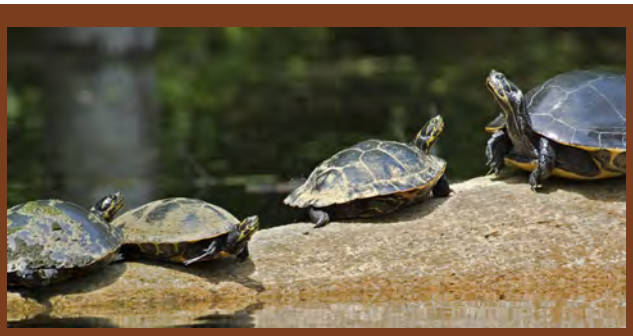
Total annual rainfall measured at four weather stations located in the watershed of the Ichetucknee River between 1900 and 2010. The median annual rainfall during this period was 51 inches with a variation between 30 and 83 inches. The five-year and 10-year moving averages are overlaid on the annual trend chart. LOESS refers to a locally-weighted trend line that illustrates a smoothed long-term average of annual rainfall totals (data from Texas A&M University).

Evapotranspiration and Recharge

A large portion of rainfall is returned to the atmosphere through evaporation and transpiration of water by plants – collectively called evapotranspiration (ET). The exact amount of ET is dependent upon season, climatic factors, land use and geology, and varies less than year-to-year rainfall amounts. Average ET rates in the Ichetucknee Springshed are estimated to be about 35 inches per year or about 69% of the average annual rainfall total.

Rainfall in the Ichetucknee Springshed that does not return to the atmosphere by ET (an average of about 16 inches per year) recharges the Floridan Aquifer or drains to creeks and ditches. Runoff and recharge rates are highly dependent on land use (e.g., paved or natural ground cover), soil permeability and subsurface geology. The pre-development water balance for the Ichetucknee System (when it was less affected by groundwater pumping), had an estimated average aquifer recharge rate of about 12.9 inches per year over the estimated 400 mile^2 springshed. This recharge rate resulted in an average Ichetucknee River flow of about 360 cfs (232 million gallons per day, MGD) at US 27.





Stream Flows

The long-term (1917-2011) median Ichetucknee River flow at the US 27 flow gauge on the Ichetucknee River was 347 cfs (224 MGD). The smoothed data summarized in Figure 9 indicates declining spring flows starting as early as the 1970s. During the past decade (2000-2010), five out of ten annual average flows in the Ichetucknee River are lower than ever recorded during the previous 83 years.

The U.S. Geological Survey conducted a detailed analysis of the Ichetucknee flow data for periods with similar rainfall totals. Their analysis concluded that average flows in the Ichetucknee River declined by 60 cfs (39 MGD) between 1900 and 1980 and an additional 32 cfs (21 MGD) between 1980 and 2009, a net reduction of about 25% due to causes other than declining rainfall.

Groundwater Withdrawals and Floridan Aquifer System Levels

Groundwater is pumped from the Floridan Aquifer for many purposes, including private, municipal, agricultural and industrial uses. The SRWMD requires Consumptive Use Permits (CUPs) for all groundwater wells over 6 inches in diameter and/or any groundwater use of at least 100,000 gallons per day. According to the SRWMD database, there are 1,078 active CUPs that allow groundwater withdrawals in Columbia, Suwannee and Union counties (Figure 10). The allocated pumping from those active permits is currently 170 cfs (110 MGD). Wells smaller than 6 inches do not require a CUP from the SRWMD or from any other agency. The number of these smaller supply wells in the Ichetucknee Springshed is not reported by the District but is assumed to be in the tens of thousands.

Figure 9. (below)

Period-of-record summary of annual average flows in the Ichetucknee River at the US 27 stream gauging station. The long-term median flow for 1917-2011 was 347 cfs (224 MGD). The lowest recorded annual average flow during this period was 195 cfs (126 MGD) in 2002 and the highest annual flow was 509 cfs (329 MGD) in 1948. The LOESS line indicates a declining trend in spring flows starting as early as the 1970s and an estimated average flow reduction of about 90 cfs (58 MGD) or 25% over the period-of-record (data from USGS).

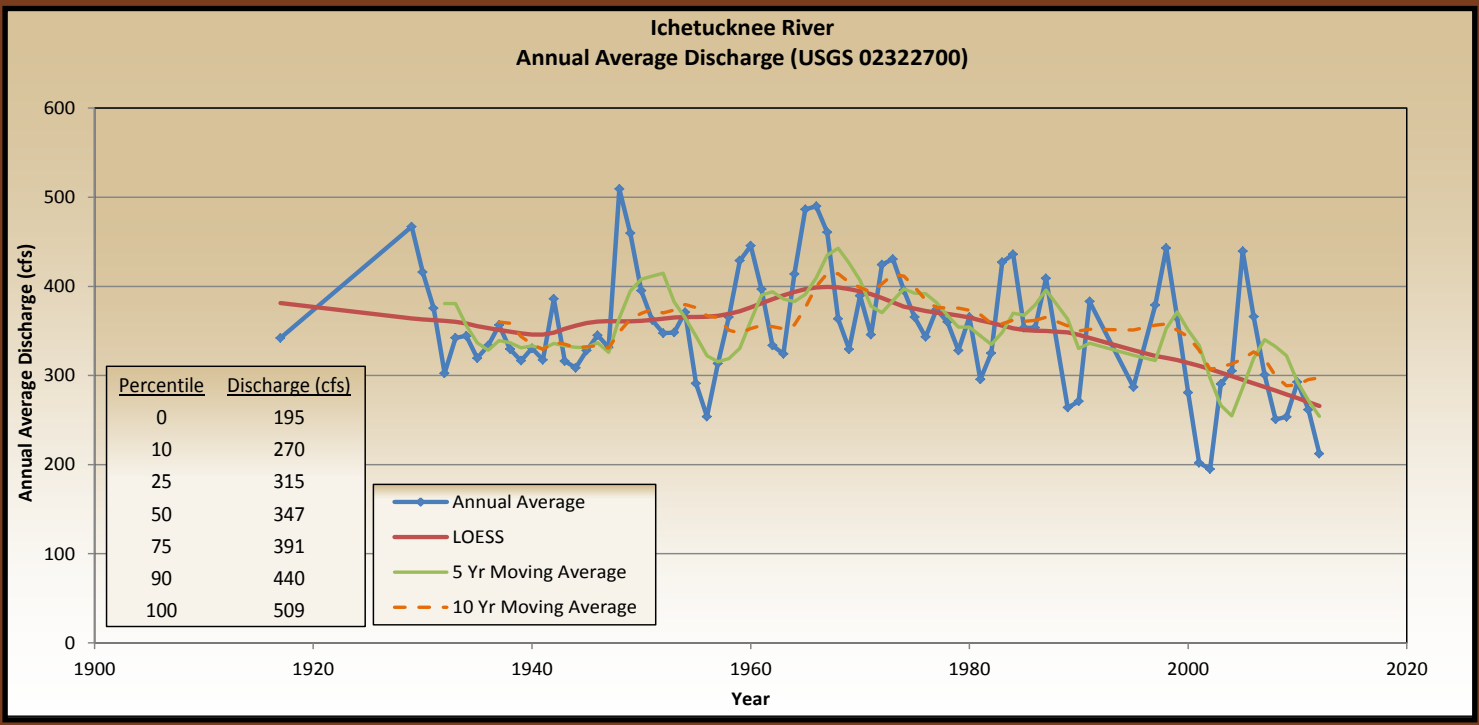
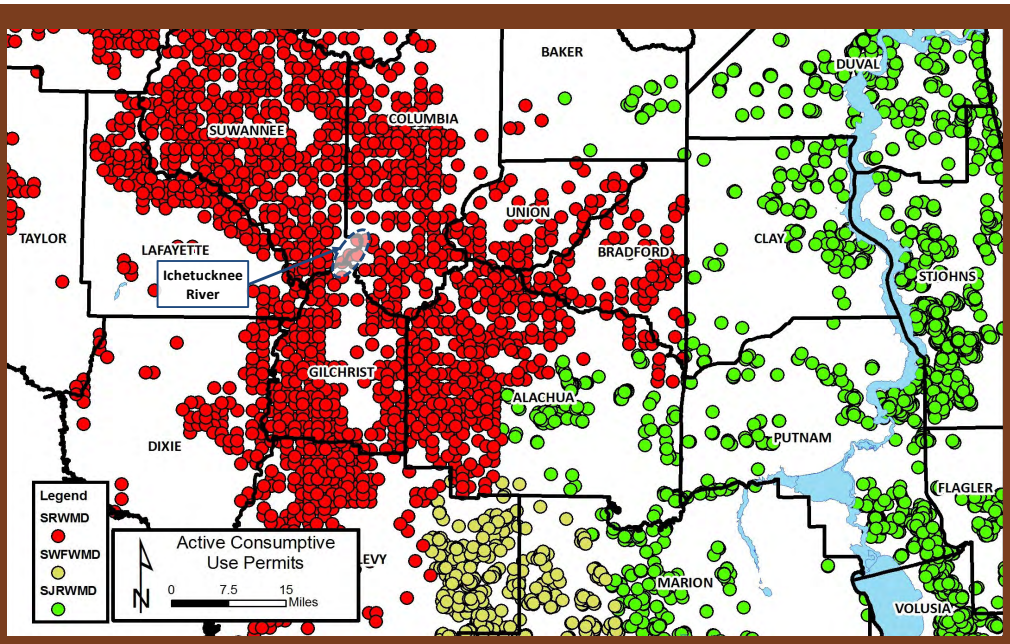


Figure 10. (top right)

Active Consumptive Use Permits for groundwater withdrawals in the Suwannee River Water Management District (red dots), St. Johns River Water Management District (green dots), and Southwest Florida Water Management District (yellow dots). Individual wells less than 6 inches in diameter are not shown on this map and are estimated to be in the tens of thousands (source: data from Water Management Districts).

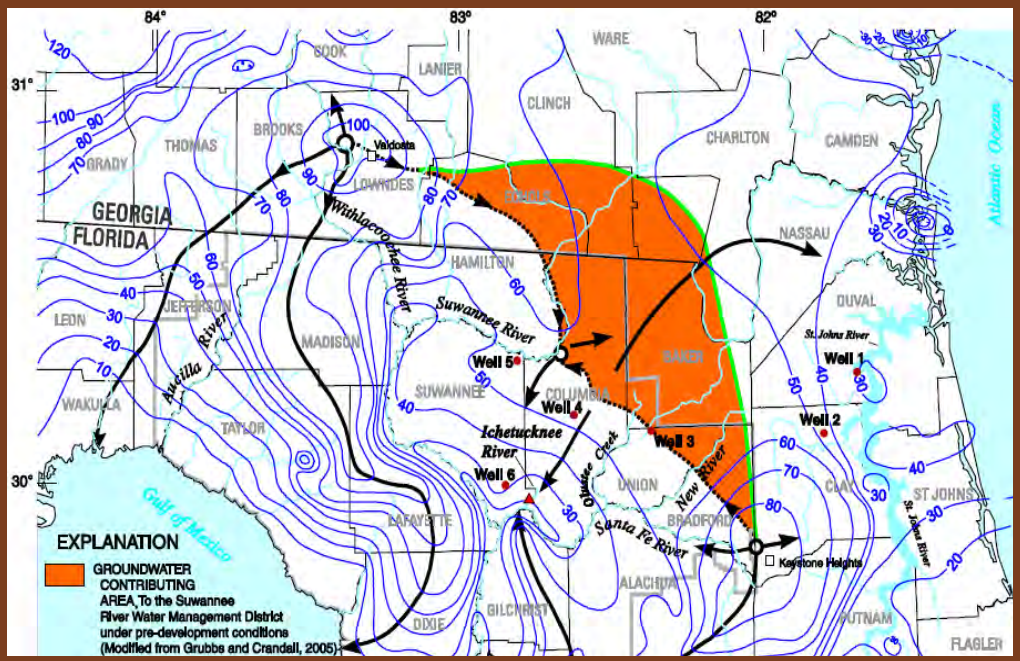


Average water withdrawals (primarily groundwater) within the Ichetucknee Springshed have increased from about 28 cfs (18 MGD) in the 1960s to about 65 cfs (42 MGD) in the most recent decade, a 132% increase. Agriculture represents the highest estimated groundwater withdrawal with 63%, followed by public/domestic supply with 30% of the total. Industrial, commercial and recreational uses (e.g., golf courses) add up to about 6% of the total groundwater withdrawals within the Ichetucknee Springshed. A portion of this pumped groundwater (estimated as about one half) is returned to the aquifer as recharge.

There are more than 26,000 active groundwater CUPs in north central Florida that pump water from the same Floridan Aquifer that feeds groundwater to the Ichetucknee System. The 2010 estimated pumping from those large wells is more than 4,025 cfs (2.6 billion gallons per day, BGD). In addition to these larger wells operating with CUPs, there are literally hundreds of thousands of smaller private supply wells located throughout north central Florida and southeast Georgia that are collectively lowering the level of groundwater in the Floridan Aquifer.

Figure 11. (bottom right)

Potentiometric surface (blue lines represent groundwater levels in wells) of the Upper Floridan Aquifer in May 1980 illustrating: (1) key groundwater flow lines, (2) movement of the northeastern flow-line boundary, and (3) the estimated area where groundwater flow has been diverted away from the Suwannee, Ichetucknee and Santa Fe rivers (source: USGS).



As early as 1940, high rates of groundwater pumping in northeast Florida and south Georgia resulted in significant declines in the level of groundwater in the Floridan Aquifer. These changes resulted in reduction of the groundwater basin feeding the entire Suwannee River, including the Ichetucknee Springshed. Groundwater that historically flowed towards the Ichetucknee Springs (and Santa Fe and Suwannee River springs) now flows toward the high pumping areas of northeast Florida and south Georgia. Figure 11 illustrates the estimated loss of the groundwater recharge area to the springs of the Suwannee, Santa Fe and Ichetucknee rivers in 1980 as a result of intensive pumping practices (primarily coastal paper mills and urban centers). The estimated reduction in recharge area for all of the springs in the SRWMD, including the Ichetucknee Springs, in 2005 was about 1,900 square miles for an estimated reduction in groundwater recharge of about 190 cfs (123 MGD).

Figure 12 provides a long-term record of annual average groundwater levels across northeast Florida. Groundwater levels in the Ichetucknee Springshed were falling as early as 1960 and observed declines are more severe with proximity to the northeast pumping centers. Groundwater levels in northern Union County fell by approximately 10-12 feet, 34 feet in eastern Duval County and 90 feet near Fernandina Beach.

When aquifer levels are lowered due to increased withdrawals or decreased groundwater recharge, the effect is a reduction in spring flows. The Floridan Aquifer is analogous to a "bucket" with a "hose" (rainfall) filling the bucket, "straws" (wells) in the top removing water and "holes" (springs) drilled at various levels on its side. Springs are openings in the aquifer where there is adequate pressure or "head" to discharge water to the surface of the earth. Although the freshwater portion of the Floridan Aquifer is hundreds of feet thick, a change in groundwater levels of only a few feet in the vicinity of Ichetucknee Springs can result in a significant flow decline. Cessation of spring flows inevitably occurs with excessive groundwater pumping.

An estimated 35% of the observed flow reduction in the Ichetucknee Springs is due to groundwater pumping in the springshed and 65% of the reduction is due to the regional drawdown in the Floridan Aquifer from pumping centers located as far away as Jacksonville. The average flows in the Ichetucknee Springs and River can be expected to remain lower than historical flows for the foreseeable future unless local and regional groundwater pumping rates are reduced.

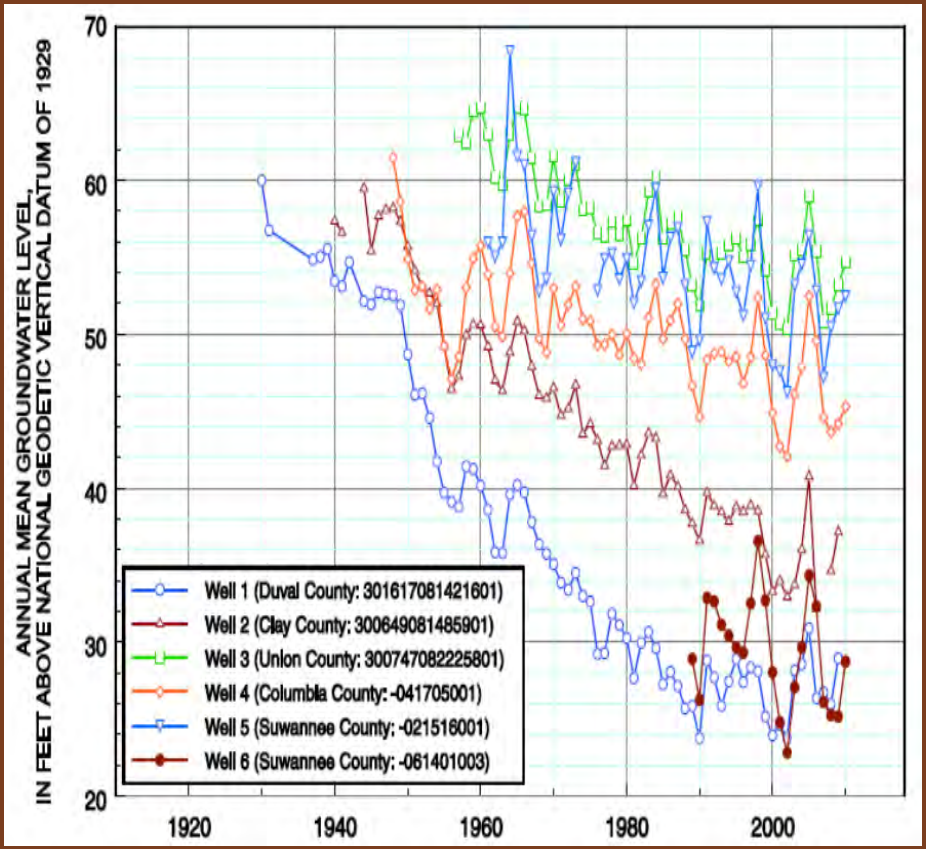


Figure 12. (above)

Groundwater levels in long-term monitoring wells located on an east-to-west transect from Duval County to Suwannee County. The average levels of the groundwater in these wells have declined about ten feet in Suwannee County and about 34 feet in Duval County over a 70-year period. The large aquifer drawdowns being observed near pumping centers in northeast Florida are reducing the size of the groundwater basin that provides recharge to Ichetucknee Springs (source: USGS).

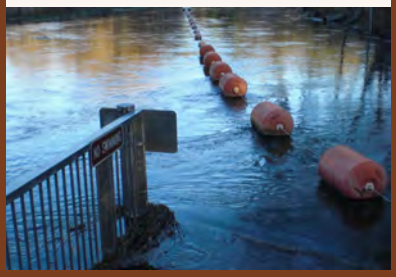
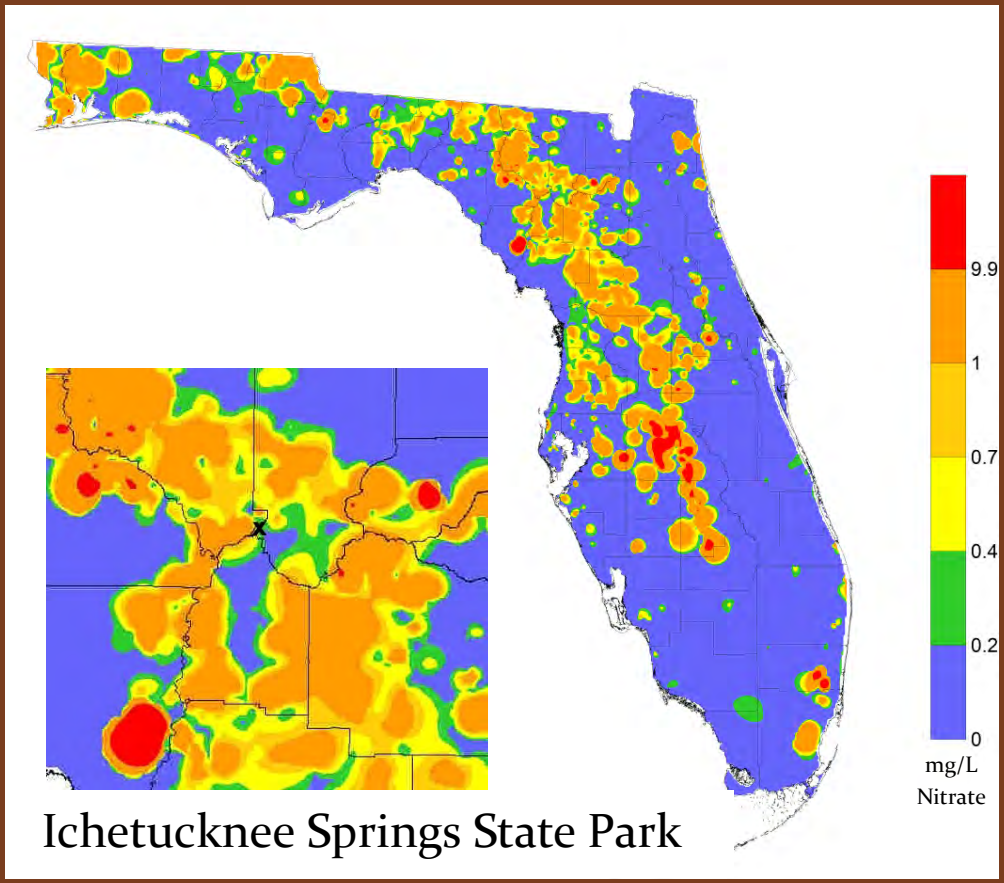


Figure 13. (right)

Recent groundwater nitrate nitrogen (mg/L) concentrations throughout Florida and in the vicinity of the Ichetucknee System. All colored areas other than blue indicate anthropogenic pollution of the groundwater. The inset provides a blowup of the area of the Ichetucknee Springshed. The area of the Floridan Aquifer feeding groundwater to the Ichetucknee System has nitrate concentrations between about 0.4 and 1.0 mg/L (data for 2000-2004 from the USGS and Water Management Districts; map prepared by Wetland Solutions, Inc.).



Impaired Waters – Swimming Holes or Algal Bowls?

Nitrogen Sources

The U.S. Geological Survey estimates that every year up to 1,430 tons of nitrogen leaches down to the Floridan Aquifer underlying the Ichetucknee Springshed. The principal sources of nitrogen to the groundwater (with percent contribution in parentheses) were estimated as:

- inorganic fertilizers on croplands, lawns and pine plantations (51%);
- animal waste (27%);
- septic tanks (12%);
- atmospheric deposition (12%); and
- land application of treated wastewater and biosolids (2%).

Figure 13 depicts the elevated groundwater nitrate concentrations throughout Florida and in the area of the Ichetucknee System. Groundwater nitrate concentrations in the most vulnerable areas of the state have typically increased from a pre-development level less than about 0.05 mg/L (milligrams per liter or parts per million) to more than 1 mg/L due to human land use alterations.

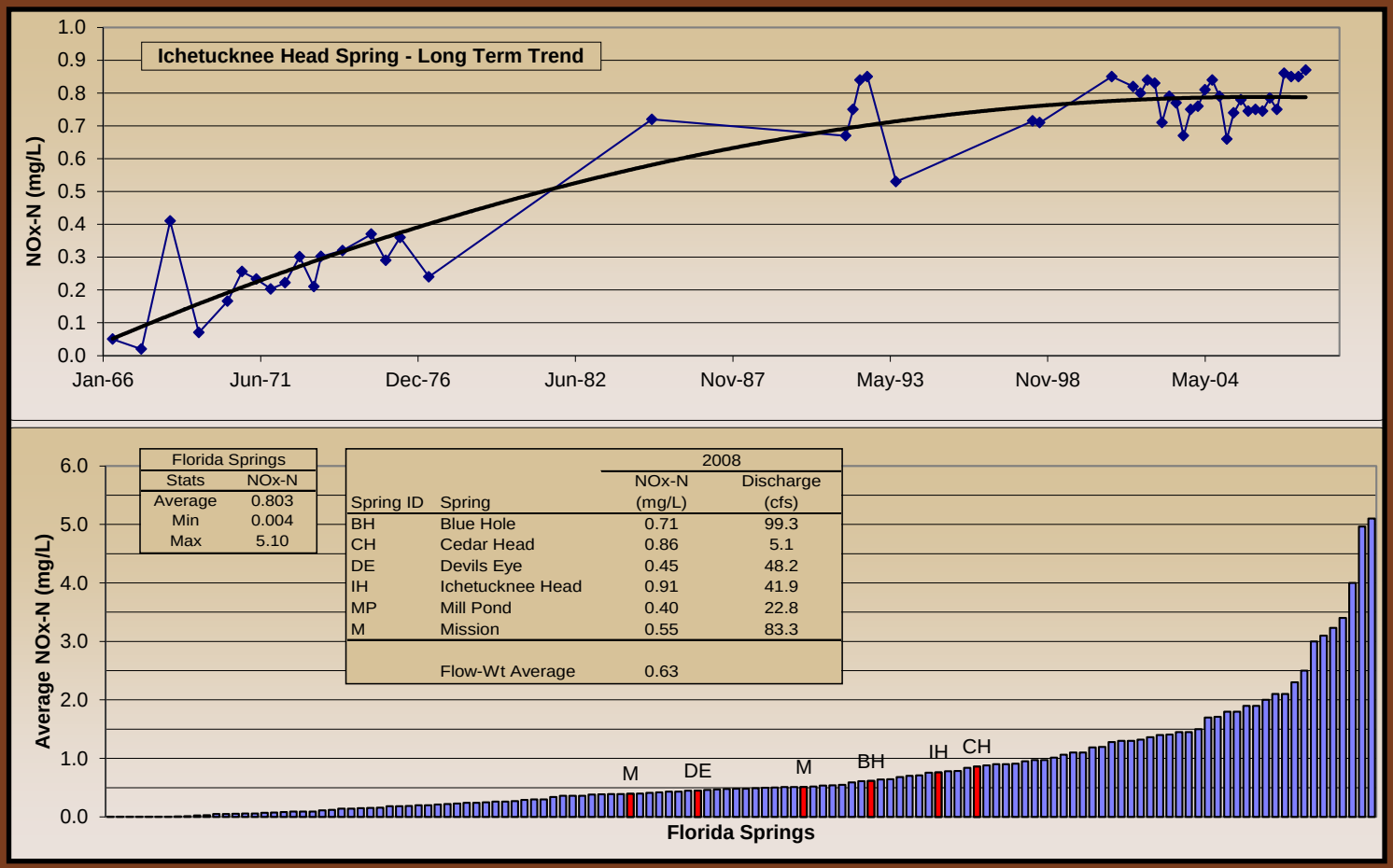
Average nitrate concentrations in the Ichetucknee Head Spring have been increasing over the period-of-record (Figure 14) from about 0.05 mg/L before the 1960s to about 0.78 mg/L during the most recent decade, an increase of more than 1,500%. This trend is not surprising since groundwater nitrate concentrations are elevated throughout the most vulnerable portions of the Ichetucknee Springshed.

Ichetucknee Environmental Health Report Card

An Environmental Health Report Card for the Ichetucknee Springs and River was prepared in 2008 (Figure 15). The ecological health of the Ichetucknee Springs and River was evaluated using six quantitative criteria: spring discharge, water clarity, nitrate concentrations, allergic reactions of recreational users, submerged aquatic vegetation and algae cover. The spring was graded on these criteria using historic data from the Ichetucknee System and compared to data from similar spring ecosystems. Water clarity was found to be good, a B+, when compared to similar springs. It was noted that the submerged aquatic plants had continuously increased over a 20-year period-of-record but that plant species diversity had declined, resulting in a B grade. The spring received a D grade for nitrate levels and attached algae. The overall 2008 environmental health grade for the Ichetucknee Springs and River was a B-.

Figure 14. (below)

Summary of nitrate-nitrogen concentrations in the Ichetucknee Springs over the entire period-of-record and at individual springs in 2008 (source: Wetland Solutions, Inc.).



Recreational and Economic Resources - A North-Central Florida Playground

The Ichetucknee Springs are an important part of the "Springs Heartland" – over 200 individual springs in the drainage area of the Suwannee River that are the heart and lifeblood of the aquatic systems in north-central Florida. Without flowing springs there is no opportunity for groundwater to supply surface water environments in this karst region.

Without surface water systems, this part of Florida would become a dry, barren land. Non-irrigated uplands with lowered groundwater tables could not support forest communities, and rather would transition to dry grasslands seasonally burnt by wildfires. Today's farming and timber production practices could only be continued by unsustainable "mining" of the remaining groundwater in the underground aquifer, similar to what is occurring throughout the drier western portions of the U.S. North Florida's familiar forests, wetlands, lakes and rivers would vanish along with the diverse wildlife dependent upon them. The economy and quality of life of north-central Florida would suffer tremendously as a result.

Ecosystem Services

Natural environments such as springs and rivers provide a variety of services to residents and visitors – services that cannot easily be quantified. These services include production and maintenance of fish and wildlife populations, water quality purification, temperature stabilization and maintenance of the aquifer.

The value of these natural resources is not easily measured in terms of dollars but is priceless to the people who frequent and enjoy the Ichetucknee River and its springs.

Economic Value

Springs represent an important part of the local economy, especially in rural communities. An economic analysis was performed at four springs in Florida State Parks - Ichetucknee, Wakulla, Homosassa and Volusia Blue - to quantify their economic impact on the surrounding communities and the characteristics of visitor usage. Total estimated spending by visitors at Ichetucknee Springs State Park was approximately $23 million per year ($34/visitor) and 90% of the visitors to the park were from locations outside of Columbia and Suwannee counties.

Of the four springs-based state parks studied, visitors at Ichetucknee Springs State Park contributed the most money to the local economy. High visitation at Ichetucknee Springs State Park translated into higher cumulative wages and salaries for park staff, concession vendors, tube rentals, stores, campgrounds and other visitor-related businesses at $5.1 million per year.

This study also concluded that increasing environmental problems (such as increased algae, low flows and turbid water) translates into fewer visitors and lower activity for the local economy.

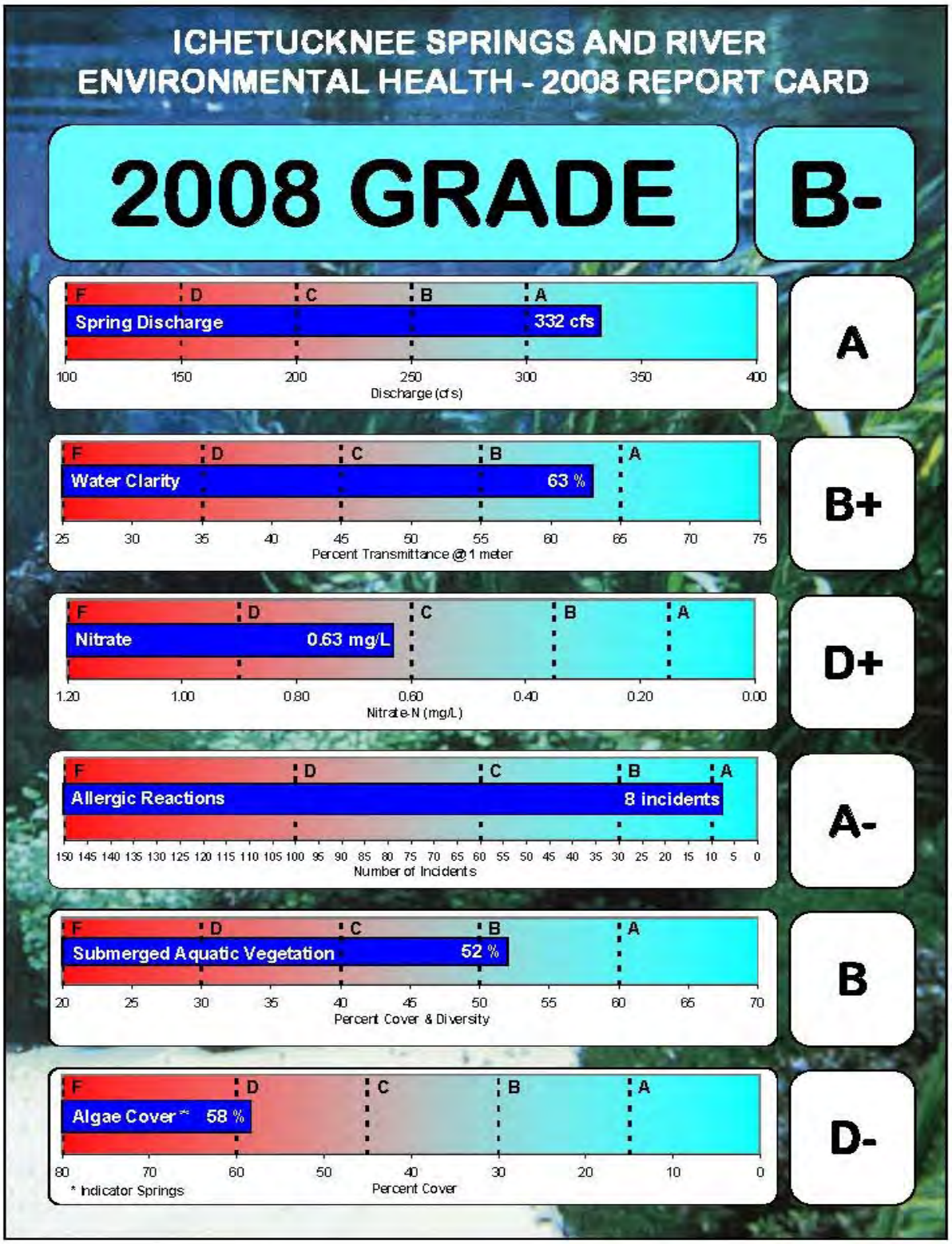


Figure 15. (above)

Ichetucknee Springs and River 2008 Environmental Health Report Card (source: Wetland Solutions, Inc.).

Legal and Regulatory Protections for Ichetucknee Springs

The Ichetucknee River and springs are stressed by decreasing water flow and increasing pollutant loads – primarily nitrate nitrogen. The visual signs of degradation are an increased cover of filamentous algae, reduced plant diversity and greater turbidity. However, existing water laws have been adopted to protect aquatic systems like the Ichetucknee Springs. In fact, an impressive number of existing Federal, State and local laws and policies have been adopted to protect groundwater, springs and springsheds. Given the continued degraded condition of these water resources, it is clear that these laws have not been adequately enforced. Whether existing and new protections will be enough to reverse the decline in the Ichetucknee Springs remains to be seen.

Water Quality

The Ichetucknee River was designated an "Outstanding Florida Water" in 1984 under Florida Administrative Code Chapter 62-302. Outstanding Florida Waters are intended to be "protected under all circumstances." This protection was not evident in 2008 when the FDEP determined that the Santa Fe River Basin (including the Ichetucknee River) was impaired for nitrate and dissolved oxygen concentrations. FDEP adopted a nitrate Total Maximum Daily Load (TMDL) of 0.35 mg/L for the basin – a standard designed to protect the long-term water quality in the river. According to FDEP, achieving the annual average nitrate target will require that nitrate loads from nonpoint sources affecting the Santa Fe and Ichetucknee rivers (i.e., farms, residential communities and industries) be reduced by more than 35%.

To implement this TMDL, the Santa Fe River Basin Management Action Plan (BMAP) was finalized by FDEP in early 2012. The BMAP has a narrow focus on achieving reduced nitrogen loads. Since the Santa Fe River Basin is rural, agricultural and lacking in major point sources of pollution, nitrogen load reduction will need to be voluntarily conducted by many individual sources. Without mandatory cooperation from agricultural interests and an accelerated BMAP schedule it is unrealistic to expect that water quality in the Santa Fe and Ichetucknee rivers will be restored in the next 20 years.

Water Quantity

The Water Management Districts are responsible, through the Minimum Flows and Levels (MFL) program, to ensure that there is enough water in the Floridan Aquifer to protect the integrity of lakes, rivers and springs. The establishment of MFLs is required by Florida statute. MFLs apply to decisions affecting water withdrawal permits, declaration of water shortages, environmental resource permitting and assessment of water supply sources.

The Water Management Districts are required to develop recovery or prevention strategies in those cases where a water body does not or will not meet an established MFL. The SRWMD is currently developing rule-making for MFLs on the Ichetucknee and Lower Santa Fe Rivers.

Figure 16. (above)

"Then and Now" pictures from Devil's Eye Spring, Ichetucknee River, 1995 and 2006

"I have stood on the banks of the Ichetucknee and I have grieved for my loss--*our loss*--as I consider that with each passing year my collection of springs photographs seems less a reflection of the real Florida than a catalog of what once was." *John Moran*

Photos left and above by John Moran/JohnMoranPhoto.com

Developing a Restoration Road Map

The Ichetucknee Springs and River are suffering from the same stresses faced by the majority of springs in Florida. They have lost an estimated 18 to 25% of their historic average flows due to increasing groundwater withdrawals and lower rainfall totals, and they have experienced an increase in nitrate nitrogen concentrations of more than 1,500%. Since clean and abundant water is the lifeblood of these springs, they are experiencing a striking decline in their environmental health.

This Restoration Action Plan provides a roadmap for actions that must be taken to reverse the degradation that is occurring in the Ichetucknee Springs and River. These actions need to include a buy-in by stakeholders that the Ichetucknee System is important and can be protected. Voluntary actions need to provide as much relief as possible, but strong enforcement of existing laws intended to prevent these impacts in the first place is essential. A sustainable Ichetucknee System and a prosperous local economy depend on following this plan to its completion.

Educating and Engaging Stakeholders

All residents in north central Florida share some responsibility for the problems facing the Ichetucknee System. Greatest impacts on groundwater quantity occur where groundwater pumping is highest and natural recharge is lowest, typically in coastal areas with the highest population densities (*e.g.* Jacksonville) and where intensive farming and industrial practices occur throughout north Florida. Highest nitrogen loads result from local land use practices where agricultural and residential fertilizer use and human and animal waste disposal create high nitrogen loading to the groundwater. Stakeholder education of the issues and necessary steps for springs protection are essential for successful restoration of the Ichetucknee System.

Governmental entities provide regulatory control regarding water use, land use and polluting activities that negatively affect the Floridan Aquifer and Ichetucknee Springs. The local, state and federal agencies who can directly affect the future health of Ichetucknee Springs include city governments (especially Lake City and Jacksonville), county governments (e.g., Columbia, Suwannee, Union, Duval, etc.), the Florida Department of Agricultural and Consumer Services, the SRWMD and SJRWMD, FDEP, the Florida Legislature and an array of federal agencies. These public agencies and the lawmakers who direct them must be convinced to enforce existing laws and develop additional regulations needed to move the Ichetucknee System towards recovery.

Figure 17. (above) Ichetucknee Head Spring, Ichetucknee Springs State Park, 2012.

What can you do to support the restoration of the Ichetucknee Springs and River?

- Reduce your personal groundwater consumption– curb activities that are wasteful of water- such as irrigating the lawn and washing cars.
- Cut back or eliminate fertilizer use to prevent fertilizer waste and entry of these potential pollutants in the vulnerable Ichetucknee Springshed.
- Get involved and stay educated. This local problem requires local attention and interest before restoration can be reached. Attend springs meetings and write to your elected representatives.
- A companion document provides a comprehensive list of necessary actions and their responsible parties to achieve a restored Ichetucknee, and can be found online on the Florida Springs Institute website:

  www.floridaspringsinstitute.org

Findings and Recommendations

This Ichetucknee Springs Restoration Action Plan concludes:

- The Ichetucknee River and its associated springs are important to the economy of north central Florida with an estimated average annual direct economic impact of over $20 million. As a natural resource and attraction, the Ichetucknee Springs are pivotal for the economic and environmental health of north central Florida.
- The Ichetucknee River and its associated springs are a significant natural resource of importance for their ecosystem services and maintenance of habitat for fish and wildlife.
- Average flows in the Ichetucknee River and in its springs have declined significantly (about 18 to 25% reduction independent of rainfall variation) over the period-of-record. Additional flow declines over the last several decades (since the 1970s) appear to be driven at least in part by a multi-year drought. Increasing consumptive uses of groundwater throughout north Florida and south Georgia are the primary contributors to long-term declining spring flows.
- Human groundwater uses that affect the Ichetucknee System include public supply, agriculture, private wells and mining/industrial. Future increases in groundwater use will further impact spring and river flows.
- Groundwater feeding the Ichetucknee Springs is contaminated by nitrate nitrogen derived principally from human activities. Dominant controllable sources of this nitrate include fertilizers, human and animal waste disposal practices and increased nutrient loads to the groundwater from various agricultural, commercial and urban land uses.
- Observed nitrate concentrations in the Ichetucknee Springs and River are well above levels considered by the State of Florida to cause nutrient impairment. Increased amounts of filamentous algae and loss of natural plant communities provide visible evidence of this impairment.
- Nitrogen loads resulting from human activities in the Ichetucknee Springshed will need to be reduced by at least 50% to meet the adopted nitrate water quality criterion of 0.35 mg/L.
- It is critical that a better understanding of the sources and impacts of pumping and nutrient enrichment on Ichetucknee Springs be developed so that steps can be taken to avoid future impacts and to reverse the current unacceptable impacts due to man-made causes. Additional data and studies are needed to monitor success with achieving restoration of the Ichetucknee System.

The Solutions

- Educate the public and local, state and federal leaders on the importance of restoring the Ichetucknee System and its natural biodiversity;
- Develop a phased plan to restore Ichetucknee Spring and River flows by cutting back on consumptive uses of groundwater within and outside of the Ichetucknee Springshed;
- Improve fertilization and wastewater disposal practices in the Ichetucknee Springshed in order to reduce the load of nitrate nitrogen leaching into the Floridan Aquifer; and
- Assess the costs and benefits of restoration efforts, develop a phased restoration timeline and establish adequate monitoring of the Ichetucknee System in order to document whether these efforts are resulting in improved springs health.

These changes will require a regionally significant undertaking, including effective collaboration and public and private expenditures. While additional scientific study and analysis are important to justify and implement the more costly projects, there are many actions that can be taken immediately to help reverse the deteriorating water quantity and quality trends visible in these springs.

Implementation of these solutions will require significant public will-power. Ichetucknee Springs restoration will require a shift from focusing on short-term needs of individuals and businesses, towards the long-term community benefit of conservation and protection of clean and abundant groundwater. Currently, the groundwater that feeds the Ichetucknee System is neither clean nor abundant. As evidenced so clearly by the deteriorating condition of Ichetucknee Springs, north Florida's groundwater resources are on a declining trajectory. Fortunately, groundwater is a renewable resource, and hope for the future health of the Ichetucknee System is in the hands of the people who have learned to appreciate its unique value.

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in cooperation with the Ichetucknee Springs Working Group and Three Rivers Trust

and with financial support from the sale of the Protect Florida Springs license plate administered by the Wildlife Foundation of Florida

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The mission of the Florida Springs Institute is to provide a focal point for improving the understanding of springs ecology and to foster the development of science-based education and management actions needed to restore and protect springs throughout Florida.

November 2012

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