

## **Ichetucknee Spring Restoration Assessment Monitoring Plan**



*Picture from FloridaSprings.org*

Spring Systems

Final Exam

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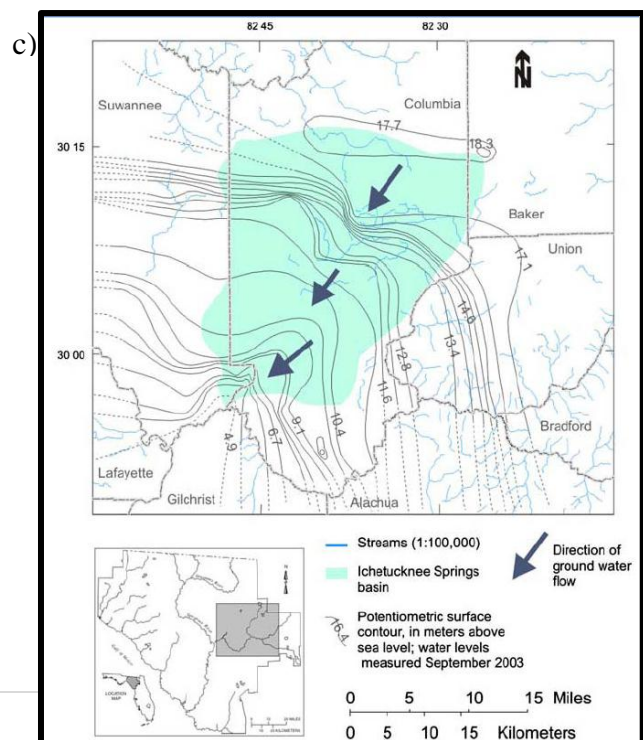
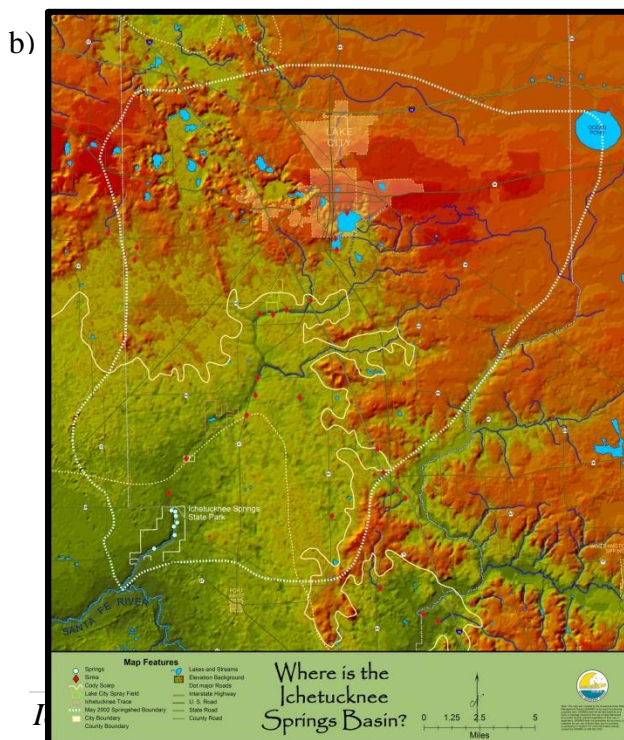
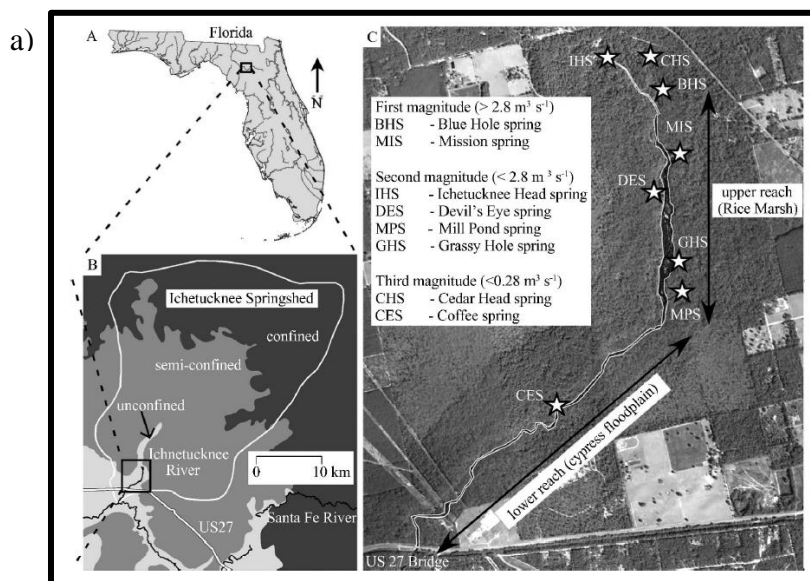
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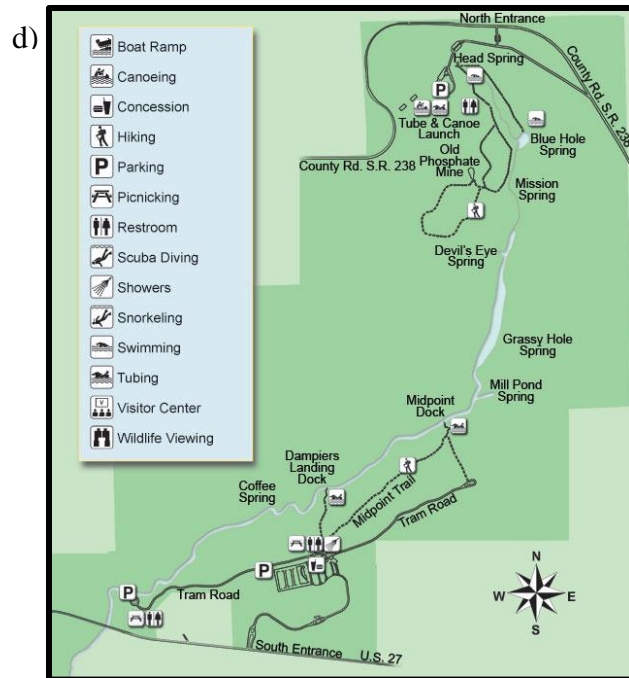
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## I. Introduction and Spring Location

Ichetucknee Springs System is located within Columbia County and Suwannee County of Florida, within the Suwannee River Florida Water Management District, and is composed of nine springs, including Blue Hole, Mission Group (Roaring and Singing), Devil’s Eye, Mill Pond, Grassy Hole, Cedar Head, Coffee, and the Ichetucknee Head spring as well as several smaller, unnamed springs (Figure 1a). The Ichetucknee Springshed is 100% fed by groundwater and is located in portions of Florida’s confined, semi-confined, and unconfined aquifers (Figure 1b and 1c). These areas are located within parts of the Florida’s geographic Northland Highlands region and parts of the Gulf Lowlands region. The adjacent areas are owned by the Florida State Park system which includes a system of trails and paths, an area for parking, rental and concession shops, and public facilities (Figure 1d). The Ichetucknee Head spring is adjacent to the park facilities and forms a pool that is measures 22.9 m by 32 m with depths to about 9.1 m (FSI, 2012) (Figure 1e).







**Figure 1.** Maps of Ichetucknee Springs System including a) delineation of the springshed within the state by aquifer type (*Source:* Heffernan et al., 2010), b) and c) potentiometric surface maps and respective delineation of the Ichetucknee springshed (*Sources:* SRWMD, 2008 and Katz and Griffin, 2008), d) recreational activities map of Ichetucknee State Park (*Source:* Florida State Park System, 2012), and e) satellite image of Ichetucknee Springs System and surrounding land uses as well as location of the head spring (*Source:* Google Earth).

## II. Condition and Need for Restoration

### *Current conditions*

The Ichetucknee Springs System has seen negative significant ecological and water quality changes within the past several decades. These changes include flow decline which has been estimated as 18 to 25% since the first period-of-record (FSI, 2012). Reasons for flow reduction include increasing groundwater uses (such as municipal use, agriculture, and industrial uses), re-allocation (i.e., water pumped is not returned to springshed), and reduced recharge rates.

Nitrogen loads have increased from historic records and it is estimated that a 50% reduction is needed in order to meet the nitrate water quality standard of 0.35 mg/L. Human activity is the main cause for increased nitrogen levels as the main sources of nitrogen include septic tank discharge, agricultural fertilizer, urban fertilizer, and other pollutant leaching. Much of the Ichetucknee Springshed is located in areas where the aquifer has moderate vulnerability to contamination due to sinkholes and depressions. This vulnerability with increased human activities and conversion of adjacent land to predominantly agricultural and urban are likely the main driving factors for increased nitrate levels within Ichetucknee Springs.

With reduced discharge, increased nitrogen levels, and more recreational activity in recent years, there are significant threats to the ecological communities of Ichetucknee. Some observations include changes in biological and ecological health that coincide with decreased water quality. For example, significant shifts in dominant plant communities and decreases in vegetation diversity have been noted. Although macroinvertebrate communities have not declined along the run since 1975 (FSI, 2012), discharge levels are important for macroinvertebrate health and is likely to be especially important in the head spring where dissolved oxygen is low. Likewise, fish communities have tended to remain diverse and abundant; however, it is likely that continued changes in water quality and habitat may adversely influence fish populations as well. For these reasons, there is a significant need to restore Ichetucknee water quality and ecological health to near historic conditions, mainly by increasing discharge and reducing nitrogen levels.

### *Need for restoration*

There is a large need to focus efforts on improving the overall water quality and subsequent ecosystem services/functions of the Ichetucknee Springs System. The Ichetucknee Springs is a popular location for many recreational activities; it economically benefits the local communities, businesses, and the Florida Park System; and it provides many ecosystem functions that support wildlife and downstream communities. For these reasons, we must take responsibility and work to restore and continue to protect the Ichetucknee for current and future generations.

*Recreational activities.* The Ichetucknee Springs System is a National Natural Landmark that attracts approximately 200,000 tourists and residents every year (FSI, 2012). Many activities are supported within the spring run as well as in the park, including tubing, wading, canoeing, kayaking, picnicking, scuba diving, swimming, snorkeling, boating, and hiking. Great efforts have been taken to ensure protection from overcrowding due to the park's popular attraction. Management plans have greatly reduced human disturbance as park and water capacity limits

have been set and the some sections are closed off from certain activities for a portion of the year to decrease turbidity and allow vegetation to recover (WSI, 2011). Capacity is often reached in peak months as Ichetucknee Springs State Park is one of the most popular central Florida springs to visit. For this reason, it is necessary to ensure future uses by working to further protect this resource today.

*Economic benefits.* It is estimated that visitors to Ichetucknee Springs State Park spend approximately \$20 million a year (FSI, 2012). Many visitors are local residents; however, approximately 90% travel from outside counties. While park profits are the largest economic benefit, local municipalities, businesses, land owners, and residents also benefit from increased tourist travel to the region. As of date, there are no studies that have assessed the economic value of Ichetucknee Springs State Park, but it is likely to be a significant value. Due to its financial significance, the natural resources within Ichetucknee Springs State Park should be further protected and restored.

*Ecosystem functions/services.*

The Ichetucknee Springs System and River provide many ecosystem services ranging from substantial levels of primary production, nitrate reduction along the reach, and wildlife habitat. These services and functions are the basis for fish, invertebrate, macroinvertebrate, and other fauna survival. The water quality, primary production, and vegetation present provide fauna with habitat, oxygen, and a food source. Continued significant changes in water quality may have adverse effects on fauna communities. As described, the Ichetucknee River also greatly reduces the nitrogen loads while being transported down the reach. This process protects the downstream reaches from possible trophic changes and vegetational shifts; however, if nitrogen loads continue to increase, further downstream changes may occur. Lastly, the Ichetucknee River provides 4% of the Suwanee River baseflow and 25% of Santa Fe River baseflow (FSI, 2012). Continued decreases in spring discharge will not only influence the spring ecosystem, but also the downstream ecosystems that the spring supports.

Due to the many benefits and services Ichetucknee Springs provide, efforts to restore and further protect this important natural resource must be made.

### III. Comprehensive Restoration Assessment Plan

#### *Restoration goals*

It is proposed that a 10-year restoration initiative be developed in order to restore Ichetucknee Springs to ideal future conditions and to meet ecosystem and stakeholder goals. The proposed restoration actions are briefly described here (Note: Please refer to the Ichetucknee Restoration Action Plan (FSI, 2012) for more complete restoration goals and strategies).

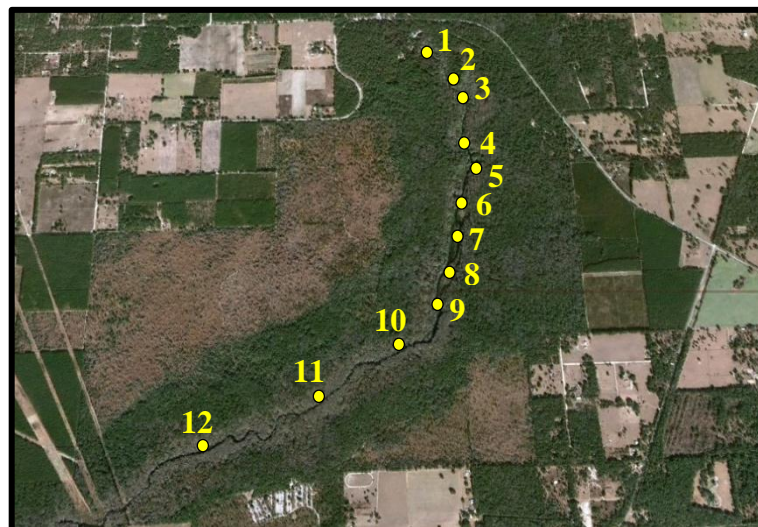
- 1. Future conditions.** It is expected that upon completion of the restoration actions, future conditions within the Ichetucknee Springs System will more closely reflect historic discharge, water transparency, nutrient level, and biological health.

2. **Ecosystem goals.** Anticipated improvements in ecosystem health, due to restoring water quality and quantity, include more diverse invertebrate groups, larger proportion of macrophyte communities, larger vertebrate (i.e., fish) communities, improved water clarity (i.e., aesthetics), and more diverse flora and fauna populations overall.
3. **Stakeholder goals.** As described, the Ichetucknee provides many economic benefits to the Park, surrounding municipalities, and land owners as well as recreational opportunities for Florida residents as well as out-of-state tourists. One of the overall goals of restoration is to ensure these benefits and opportunities remain in future years. Restoration efforts will work to improve overall ecosystem quality which is directly related to the use of Ichetucknee.

**Proposed restoration actions.** The overall proposed restoration goals include comprehensive assessment monitoring, restrictions on consumptive uses, reduction of fertilizer use (i.e., decrease nitrate levels), and alternative land management approaches (FSI, 2012). The proposed assessment monitoring is the focus of this plan which will aid in determining if overall restoration goals for Ichetucknee Springs are met.

### *Sampling locations*

Sampling locations were chosen based on the discharge points of the small spring groups in order to sample just downstream of all nine named springs connection points (Figure 1a). Sites were also chosen along the main reach, in areas where no springs joined the channel, in order to monitor changes across the range of substrates and ecosystem types that are present within the Ichetucknee River (i.e., slow-moving, wide sections vs. small, deeper sections; mucky bottom vs. sandy bottom areas; etc.) (Figure 2).



**Figure 2.** Satellite image of Ichetucknee Springs System with twelve proposed sampling locations for monitoring and assessment.

### ***Proposed parameters and schedule of sampling***

The time line for monitoring and assessment was created based on the following assumptions: a restoration approval date is to occur in the near future; the brief restoration goals mentioned are feasible and fully supported; there is unlimited funding and analytical resources available; and a monitoring start date will occur in spring 2013. The monitoring plan was also created in order to be adjusted in the future. It is assumed that a working group of various stakeholders (such as the Ichetucknee Working Group) are the people responsible for monitoring, reviewing, assessing, and reporting on both the monitoring and restoration components.

Sampling will occur monthly or bi-monthly in Year 1 and Year 2, bi-monthly for Year 3 and Year 4, and then seasonal monitoring throughout the remaining six years is proposed (Table 1; Appendix 1). It is expected that changes to this timeline will be made as needed. All parameters will be measured at each sampling location except human activity, which will be surveyed at the head spring and downstream site only, and metabolic rates will be measured in the head spring, a mid-section site, and the downstream site based on the two-station method over 24 hours.

At each site, a transect perpendicular to flow will be delineated with measuring tape; flow measurements will be taken at each sub-section; the substrate will be characterized with underwater viewing windows and use of snorkel gear; the plant community will be characterized by type and percent cover; macroinvertebrate populations will be measured using standard dip-net methods; fish counts will be passively observed; water quality measurements will be taken along several sub-sections across all depths; and soil cores will be taken in the main section of the channel to further characterize the substrate and soil profile.

**Table 1.** Proposed parameters to be measured along the Ichetucknee Springs System as well as proposed schedule of sampling -- either monthly or bi-monthly samplings are proposed for Year 1 and Year 2. The site numbers are given where the parameter will be measured. The parameters will be measured at all sites unless otherwise noted.

Parameter	Schedule of Sampling		Site #	
	Monthly	Bi-monthly	All	Other
Ecosystem metabolism (GPP, CR)	X			1, 6, 12
Secchi depths (horizontal and vertical)	X		X	
Flow/discharge	X		X	
Dissolved oxygen	X		X	
Nitrogen/phosphorus levels	X		X	
Light - PAR	X		X	
pH	X		X	
Specific conductivity	X		X	
Turbidity	X			
Human activity survey		X		1, 12
Vegetation survey		X	X	
Macroinvertebrate and invertebrate sampling		X	X	
Substrate survey; soil core		X	X	



A database of monitoring data will be created and initially analyzed upon retrieval. The data will be assessed in full after each year of collection and submitted within a larger report.

### **Reporting**

An initial timeline for reporting progress and changes is proposed. As with the sampling procedures, adaptive management will be used for reporting as well. Reports will be written and reviewed on a quarterly basis for the first two years, coinciding with the sampling schedule. It is proposed that quarterly meetings be held in order to review progress, discuss data, suggest new plan changes, and to set or change future goals. Data and analysis reports will be written by the monitoring team and reviewed by all involved parties. An initial suggested timeline for the first two years of meetings and coinciding reports are given (Table 2). Although not indicated, each meeting will also review the monitoring data and analysis (i.e., whether monitoring plan or restoration actions are the primary objectives of the meeting). It is suggested that either quarterly or bi-annual meetings/reports should be followed for year 2 and year 3 as needed. Annual meetings will be held for the following six years unless changes are made. A larger report of all collected data will be created and reviewed annually throughout the entire project.

**Table 2.** Schedule for reporting which is consistent with proposed meeting schedule. Reports will be prepared prior to quarterly meetings for review and discussion of future adjustments.

<b>Meeting # – Report type</b>	<b>Date</b>	<b>Goal</b>
1 – Monitoring Plan	Spring 2013	Finalize and approve monitoring plan; initiate monitoring steps
2 – Initial Plan Assessment	Summer 2013	Assess plan and make changes as necessary
3 – Determine Restoration Actions	Fall 2013	Based on previous and current data, finalize order and timeline of actions; initiate primary actions
4 – Primary Action Assessment	Winter 2014	Report on primary action progress; determine secondary actions; initiate
5 – Secondary Action Assessment	Spring 2014	Report on secondary action progress; initiate
6 – Yearly Plan Review	Summer 2014	Assess annual data collected and monitoring strategies; determine changes necessary
7 – Primary Action Review	Fall 2014	Review primary restoration actions; determine changes necessary
8 – Secondary Action Review	Winter 2015	Review secondary actions; determine changes necessary

A complete timeline of all goals and actions in regards to the monitoring plan, restoration actions, and analysis/reporting schedule was created for the entirety of the 10-year restoration initiative (Appendix 1). Although the restoration plan is only proposed for 10-years, it should be noted that continued monitoring and future goals should be determine within the last two years.

In summary, the Ichetucknee Springs System is an invaluable environmental and water resource that is important for the local economy, wildlife communities, and ecosystem services it provides. It is proposed that a monitoring assessment plan be adopted and adapted based on restoration goals deemed necessary. Monthly and bi-monthly sampling within the next two years will establish a basis for comparison during and after restoration goals are complete. A 10-year initiative is suggested with future, continued long-term monitoring. With active monitoring, an adaptive management approach, and effective assessment and restoration goals, the Ichetucknee Springs ecosystem will be restored to previous conditions and protected for future generations.

**IV. Appendix 1.** Complete timeline of monitoring plan, restoration actions, and report/analysis schedule for entirety of 10-year initiative.

<b>Goal</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>	<b>Year 6</b>	<b>Year 7</b>	<b>Year 8</b>	<b>Year 9</b>	<b>Year 10</b>
Finalize monitoring plan	<b>X</b>									
Finalize restoration goals	<b>X</b>									
Monthly sampling	<b>X</b>	<b>X</b>								
Quarterly meetings and reports	<b>X</b>	<b>X</b>								
Complete restoration actions		<b>X</b>								
Bi-monthly sampling			<b>X</b>	<b>X</b>						
Quarterly or bi-annual meetings and report			<b>X</b>	<b>X</b>						
Restoration follow-ups			<b>X</b>	<b>X</b>						
Seasonal monitoring					<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Annual review and reports					<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
Determine future needs/goals									<b>X</b>	<b>X</b>

## V. Literature Cited

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