



Monitoring Report for Eighteen State and Federally Managed Spring Systems in Florida Year 2000 to 2007

Florida Department of Environmental Protection
Environmental Assessment Section
February 2008





Table of Contents

Table of Contents i

Executive Summary 1
Introduction 2
Methods 4
Discussion 7
Conclusions 12

Alexander Springs 13
Blue Hole Spring 22
De Leon Springs 31
Fanning Springs 38
Ichetucknee Springs 45
Juniper Springs 54
Manatee Springs 61
Peacock Spring and Orange Grove Sink 70
Ponce De Leon Springs 81
Rainbow Springs 89
Rock Springs 97
Silver Glen Springs 108
Silver Springs 116
Troy Spring 124
Volusia Blue Spring 130
Wakulla Springs 138
Wekiwa Springs 147

References 156

Executive Summary

This report summarizes the water quality, habitat, and biological community data collected in 18 major springs, from the beginning of the Springs Monitoring Program in 2000 to the present, spanning approximately 7 years. The sampled springs include Wekiwa, Ichetucknee, Volusia Blue, Rainbow, Fanning, Manatee, Wakulla, Ponce de Leon, Alexander, Rock, De Leon, Silver Glen, Juniper, Troy, Orange Grove, Peacock, Silver, and Blue Hole. Temporal trends for each spring are depicted in figures and tables, and the data from each spring are summarized and compared to the other systems sampled.

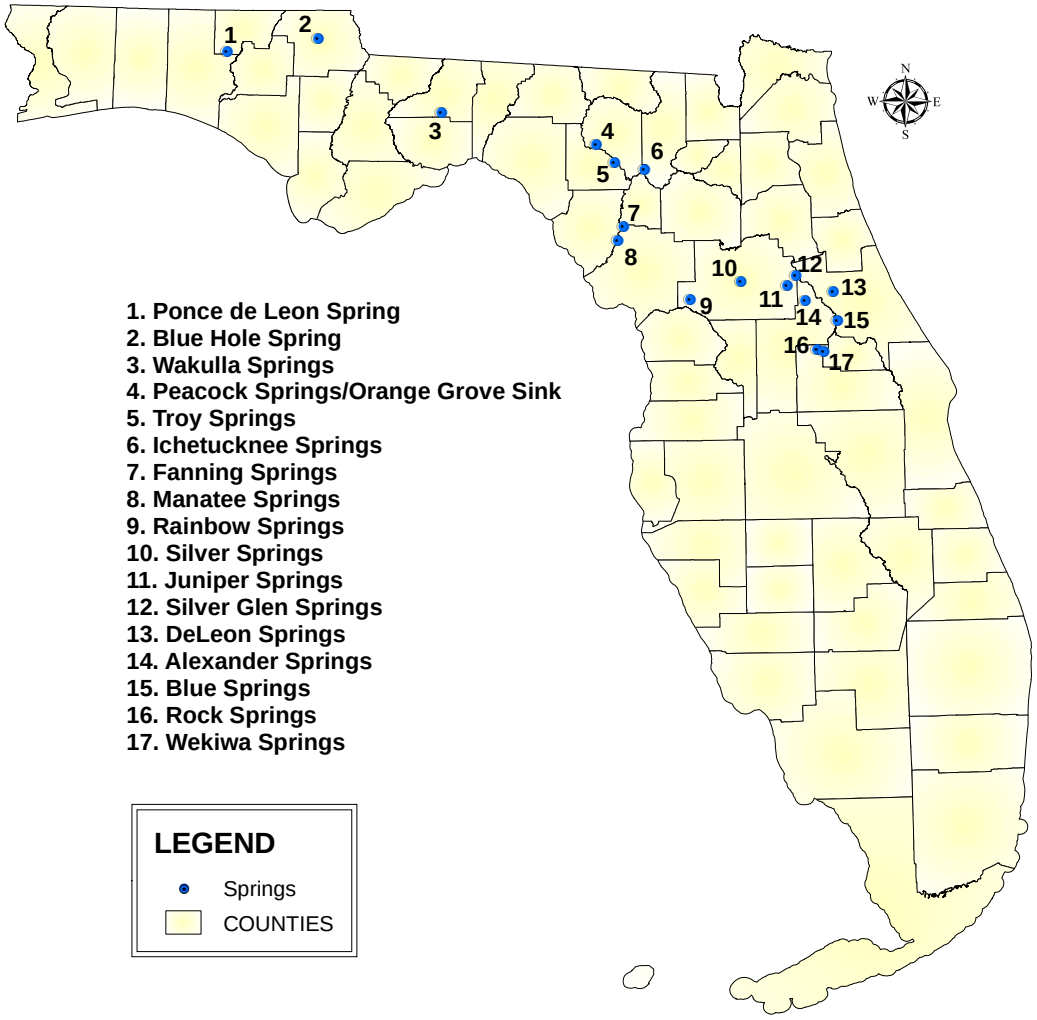
Generally, water from the spring systems in this study:

- was very high in transparency (low in color and turbidity);
- contained relatively low levels of bacteria (except for Juniper Spring);
- had moderate to high levels of dissolved ions (moderate to high specific conductance); and
- with few exceptions, had high to very high nitrate-nitrite concentrations. The elevated nitrate-nitrite concentrations at the majority of the springs appeared to be related to anthropogenic nitrogen loading in the respective recharge areas (springsheds).

Natural factors that limited biological health (benthic invertebrates) at many of the springs included low dissolved oxygen, moderate to high specific conductance, and lack of habitat diversity. Algal smothering was an issue at many springs, yet the role of human activities (*e.g.*, high nitrate levels) contributing to high periphyton biomass is insufficiently understood for DEP to propose a nitrate criterion.

Introduction

The Florida Department of Environmental Protection has conducted regular water quality monitoring for 18 springs in the State of Florida since the year 2000. Springs were originally selected for included Wekiwa, Ichetucknee, Volusia Blue, Rainbow, Fanning, Manatee, Wakulla and Ponce de Leon. Springs that were subsequently added include Alexander, Rock, De Leon, Silver Glen, Juniper, Troy, Orange Grove, Peacock, Silver, and Blue Hole. Each spring was monitored 2 to 4 times per year by the Bureau of Laboratories and State Parks staff. Water chemistry samples were collected for ammonia, nitrate-nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, turbidity, color, *Escherichia coli*, *Enterococci*, fecal coliform, and total coliform analyses. Field testing of pH, dissolved oxygen, specific conductivity, and temperature was performed *in situ*. Habitat assessment and benthic macroinvertebrate stream condition index (SCI) sampling were conducted. Periphyton was collected using the Qualitative Periphyton method (DEP-SOP 001/01 FS7220).



Human influences, in the form of non-point source pollution, are one of the factors potentially affecting Florida's springs. Nutrients (predominantly nitrogen)

associated with urban and agricultural activities (including fertilization and waste disposal), seep through soils and are transported to springs by way of underground pathways. Nutrients, under natural conditions, are essential to the growth of native plants and wildlife. However, excess nutrients can be harmful to the environment, leading to eutrophication and potentially allowing periphyton (algae) and invasive plant species to displace native plants, which results in an ecological imbalance. This may reduce habitat and food sources for native wildlife and create an optimum environment for algal growth, which can affect the overall health and aesthetics of Florida's springs.

Bacteria in the form of *E. coli*, *Enterococci*, fecal and total coliforms are present in all natural water bodies. When present in excess they are often used as indicators of fecal contamination. Potential anthropogenic sources of bacteria include septic tank leachate and waste from pets and livestock. The use of *Enterococci* as a human waste indicator may not be appropriate in relatively warm-water systems, such as springs. Studies have found that *Enterococci* sources include plant material and soil, and therefore, the *Enterococci* densities found in springs may be a natural phenomenon.

Loss and disturbance of habitat can also impact the overall health of springs. Macroinvertebrates are used as indicators of stream health because of their sensitivity to water quality and habitat stressors. They are also an important component of the food web, serving as food for many other organisms and breaking down detritus themselves. Macroinvertebrates depend on regular inputs of organic matter to the system in the form of snags, roots, leaves, and plant material for food and shelter. Substrates with large surface area and stable structure such as rocks or large logs provide more area for macroinvertebrates to cling to and colonize. Human activities, such as removal of riparian zone vegetation, soil disturbance (resulting in increased sediment delivery), and modification of system hydrology will all adversely affect habitat quality.

Physical properties of water including pH, specific conductivity, dissolved oxygen and temperature can affect the health of living organisms in springs, particularly aquatic macroinvertebrate communities. Prolonged exposure to unfavorable conditions will cause displacement of sensitive macroinvertebrates from the system resulting in lower species diversity. These sensitive macroinvertebrates require adequate dissolved oxygen and low specific conductivity as well as favorable and stable temperature and pH. In spring systems, groundwater discharge is naturally low in dissolved oxygen with a high specific conductivity. Temperature and pH are relatively stable year-round. Naturally low dissolved oxygen and high conductivity can have the effect of displacing sensitive macroinvertebrates.

Methods

Water quality, habitat, and biological monitoring was conducted for 18 springs throughout the State of Florida from October 2000 through 2006. All of the springs in the study were located within state or federally owned lands (most were Florida State Parks). Each spring was monitored 2 to 4 times per year for nutrients, physical water properties, microbiology, macroinvertebrates, and periphyton in order to assess the long-term health of the springs. Table 1 shows each spring, its annual sampling frequency and parameter groups sampled.

Spring	Sampling Frequency (per year)	Monitoring Parameters
Alexander Springs	2	Chemistry, Periphyton, SCI
Blue Hole Springs	4*	Chemistry, Periphyton, SCI
De Leon Springs	4*	Chemistry, Periphyton
Fanning Springs	2	Chemistry, Periphyton, SCI
Ichetucknee Springs	4	Chemistry, Periphyton, SCI
Juniper Springs	2	Chemistry, Periphyton, SCI
Manatee Springs	4	Chemistry, Periphyton, SCI
Orange Grove Sink	4*	Chemistry, Periphyton
Peacock Springs	4*	Chemistry, Periphyton
Ponce de Leon Springs	4*	Chemistry, Periphyton, SCI
Rainbow Springs	2	Chemistry, Periphyton, SCI
Rock Springs (upper and lower)	2	Chemistry, Periphyton, SCI
Silver Glen Springs	2	Chemistry, Periphyton, SCI
Silver Springs	2	Chemistry, Periphyton, SCI
Troy Springs	2	Chemistry, Periphyton
Volusia Blue Springs	2	Chemistry, Periphyton, SCI
Wakulla Springs	4	Chemistry, Periphyton, SCI
Wekiwa Springs	4*	Chemistry, Periphyton, SCI

Table 1: Springs sampled for the monitoring program. *Two additional samples for chemistry were collected annually by the Parks Service in summer and winter.

Water chemistry samples were collected from each spring for ammonia, nitrate-nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, turbidity, color, *Escherichia coli*, *Enterococci*, fecal coliform, and total coliform analyses. Field testing of pH, dissolved oxygen, specific conductivity, and temperature was performed *in situ* using a hand-held multi-meter. Water samples were collected according to DEP-SOP 001/01, using the direct grab method.

Habitat quality and physical chemical data were collected according to DEP-SOP 001/01. These data are useful in determining the possible cause for a particular poor biological result. The Habitat Assessment is made up of 8 components:

Substrate diversity refers to how many different productive habitats (snags, roots, rock, vegetation, leaf packs/mats) that are present in the 100 m sampling reach.

Substrate availability is determined from the habitat sketch and is an estimate of the percentage of available productive habitat in the stream reach.

Water velocity is observed at a transect that is typical of the overall stream velocity. The optimal water velocity for stream macroinvertebrates is greater than 0.25 m/sec, but less than 1 m/sec. Poor water velocity includes very sluggish flow (<0.05m/sec) or extremely rapid flow (>1m/sec).

Habitat smothering refers to the observed estimate of the percentage of total habitat that is smothered by sand, silt, or algae accumulation.

Artificial channelization takes into account whether channelization is occurring in the sampling reach and how much a previously channelized area has recovered to a more natural condition.

Bank stability includes observation of the bank's potential for erosion, armoring, and ability for flood waters to spread naturally into the flood plain.

Riparian buffer zone width refers to the width of native vegetation along the stream banks, with an optimal width of greater than 18m.

Riparian buffer zone vegetation quality is an estimate of the percentage of the riparian zone that consists of a native assemblage of trees, shrubs understory and herbaceous macrophytes. Vegetation removal, cropping, and introduction of non-native plants will negatively affect this score.

Each of the 8 components is given a score ranging from 1 to 20 based on observational criteria from four categories (optimal, suboptimal, marginal, or poor). An estimate of available productive habitat is determined by sketching the 100 m stretch, noting the area of productive habitat throughout. Physical/chemical characteristics were recorded for each spring including observations about the watershed including land-use, erosion, evidence of non-point source pollution and condition of the riparian zone. Physical stream features were recorded including high water mark, stream width, canopy cover, water velocity, evidence of channelization and presence of artificial impoundments. Features of the water were recorded including clarity, color, water surface oils and odors. Any evidence of sediment oils, odors, and smothering were also recorded as well as the type and percent coverage of available substrate. Abundance of periphyton, fish, aquatic macrophytes, and iron/sulfur bacteria were recorded. Weather conditions were recorded to determine any unusual conditions during each sampling event.

Benthic macroinvertebrate communities were sampled and evaluated using the Stream Condition Index (SCI) (FS 7420). The Stream Condition Index is a multimetric tool used to assess macroinvertebrate community health. Macroinvertebrate samples were collected in the field using 20 dip net sweeps in optimal flow areas, apportioned over the best available habitats including leaf packs and mats, snags, roots, rock and aquatic vegetation. This ensures that all available types of macroinvertebrates were represented in the sample to produce the most accurate SCI score. Samples were preserved and transported back to the lab, then processed and taxonomically identified to acquire an SCI score.

Ten metrics, known to be well correlated to human disturbance, are used for determination of the current SCI score (see below), and include the total number of taxa, the number of Trichoptera species, the number of Ephemeroptera species, the percentage of filter feeders, the number of long-lived taxa, the number of clinger taxa, the percentage

of dominant taxa, the percentage of Tanytarsini, the number of sensitive taxa, and the percentage of very tolerant taxa (Fore, 2007). The combination of these metrics into a multimetric tool serves to strengthen the overall SCI result.

The SCI was recalibrated in June 2004. Scores calculated prior to 2004 were based on only seven metrics (total taxa, number of ephemeroptera plus plecoptera plus trichoptera, percent filer feeders, Florida Index, number of chironomidae, percent dominant taxon and percent diptera) and evaluated on a 33 point scale, with scores of 21 and higher indicating healthy conditions. The recalibrated SCI scores are based on a 100 point scale consisting of three aquatic life use categories for Florida streams. Category 1 (68-100) and Category 2 (35-67) streams are considered "Exceptional" and "Healthy", respectively, and streams scoring 34 and below on the SCI are considered "Impaired" A more detailed explanation of the recalibration of the SCI can be found in Leska Fore's paper *Development and Testing of Biomonitoring Tools for Macroinvertebrates in Florida Streams: The statistical basis for SCI and Biorecon calculation SOPs* (Fore *et al*., 2007). Each of the springs sampled for macroinvertebrates contain SCI scores which straddle the time period of the recalibration of the SCI. Therefore, two metrics, number of sensitive taxa and total number of taxa, are presented in the individual spring reports for comparisons of the macroinvertebrate community over the entire sampling period (2001-2007).

Periphyton was collected using the Qualitative Periphyton Sampling method (DEP-SOP 001/01 FS7220). This method consists of collection of a composite sample of algae species taken from 10 separate natural habitats within the 100 meter sampling stretch of the spring run. Major habitats to sample are determined from the Habitat Assessment and apportioned evenly over the 10 aliquots. The periphyton data are presented only for selected springs because an interpretation framework for the periphyton is not yet sufficiently developed to allow for an accurate determination of spring impairment. These data are routinely collected for development of a future periphyton index for streams.

Discussion

For an overview assessment of the data, we focused on 6 measurements which best summarized the condition of each spring and highlighted the differences between springs. The results for these parameters, which include nitrate-nitrite, total phosphorus, specific conductance, dissolved oxygen, Stream Condition Index scores, and habitat assessment scores, are shown in Figures 1 through 6 below.

Nitrate-nitrite was consistently high in the majority of the monitored springs, averaging higher than the values found in 80% to 95% of typical Florida streams (Figure 1). Only Silver Glen, Alexander, Juniper, and Ponce de Leon Springs had nitrate-nitrite concentrations thought to represent background or near background conditions. Springs in the Suwannee basin, including Troy, Manatee, Peacock, Orange Grove, and Fanning had the highest nitrate-nitrite levels in the study. Currently, the relationship between the elevated nitrate levels and nuisance algal or plant growth is not sufficiently understood to enable DEP to propose a criterion.

Average total phosphorus concentrations in the springs monitored were generally lower than those found in typical Florida streams (Figure 2). Based on the hydrogeology of the Floridan Aquifer, it is believed that the phosphorus concentration in spring water generally reflects the influence of the surrounding aquifer rock, not human inputs (Gary Maddox, FDEP, personal communication). The lowest average total phosphorus levels were found in Juniper, Wakulla, Ponce de Leon, and Rainbow Springs. Rock and Wekiwa Springs (geographically close) had the highest phosphorus concentrations, yet these were still about average for Florida streams.

Of the physical parameters, specific conductance was particularly high for some springs due to naturally occurring salt deposits (relict seawater) influencing the groundwater in certain parts of the state (Figure 3). The springs with elevated conductivities were De Leon, Alexander, Volusia Blue, Silver Glen, Manatee, Fanning and Silver. It is thought that the ionic content of the water in these systems (*circa* 400 umhos/cm and above) made them sufficiently "salty" to limit the ability of many sensitive freshwater macroinvertebrates to inhabit them (see Levings and Niu 2004). This is a natural condition, not caused by human activities.

Dissolved oxygen was consistently low at many of the springs, which was another source of stress for macroinvertebrates, many of which require moderate to high dissolved oxygen concentrations for reproduction, growth, and survival (Figure 4). Low dissolved oxygen in the headwaters of deep aquifer springs is a natural phenomenon, because the oxygen has been depleted during the long period of time (often greater than 20 years) the water has been underground. Low dissolved oxygen (below 3 mg/L) was of particular concern at Troy, Volusia Blue, Manatee, Wekiva, and Alexander Springs, where it would consistently limit invertebrate success. In Rock, Orange Grove, Peacock, and Silver Springs, fluctuating low dissolved oxygen was sometimes a limiting factor to biological success.

Six of the springs that were monitored using the Stream Condition Index averaged scores well below the impairment threshold of 34 (Figure 5). Sites with SCI scores below a score of 34 are characterized as having a notable loss of taxonomic diversity; low numbers of Ephemeroptera, Trichoptera, long-lived, clinger, and sensitive taxa; half the

number of filterers than expected; an assemblage dominated by a tolerant taxon; and very tolerant individuals representing a large proportion of the individuals collected.

The most likely factors responsible for these low SCI scores are as follows:

- Alexander- naturally elevated conductivity, naturally low dissolved oxygen, and algal smothering of habitat. Note that this reference site was very low in nitrate-nitrite;
- Silver Glen- naturally elevated conductivity, lack of suitable substrate, and algal smothering. Note that this reference site was also very low in nitrate-nitrite;
- Volusia Blue- naturally elevated conductivity and naturally low dissolved oxygen, lack of suitable substrate, and algal smothering;
- Manatee- naturally elevated conductivity and naturally low dissolved oxygen, lack of suitable substrate, and algal smothering. Note that manatee grazing obliterated the submerged aquatic vegetation beds at this site;
- Fanning- naturally elevated conductivity and naturally low dissolved oxygen, lack of suitable substrate, and algal smothering;
- Wakulla- primarily habitat smothering by *Hydrilla*, some smothering by algae, somewhat naturally elevated conductivity and occasionally low dissolved oxygen.

Over half of the springs monitored had average habitat assessment scores in the optimal category, with the remaining six springs averaging in the suboptimal category (Figure 6). As state above, many of the springs that scored below the impairment threshold for the SCI or scored suboptimal in the habitat assessment had issues concerning habitat availability and habitat smothering (generally algal smothering). Manatee, Peacock, Troy, and Fanning springs in particular showed signs of algal smothering on habitat and aquatic vegetation. *Hydrilla* invasion and smothering are an additional concern for Wakulla Springs.

Juniper Spring was healthy with regard to habitat, biology, and water chemistry, although it occasionally had elevated bacterial concentrations (of *E. coli* and *Enterococci*, but not fecal or total coliforms) over the sampling period, due to either natural (wildlife) or anthropogenic bacterial inputs within the watershed. A directed study would be needed to determine the source of the bacteria.

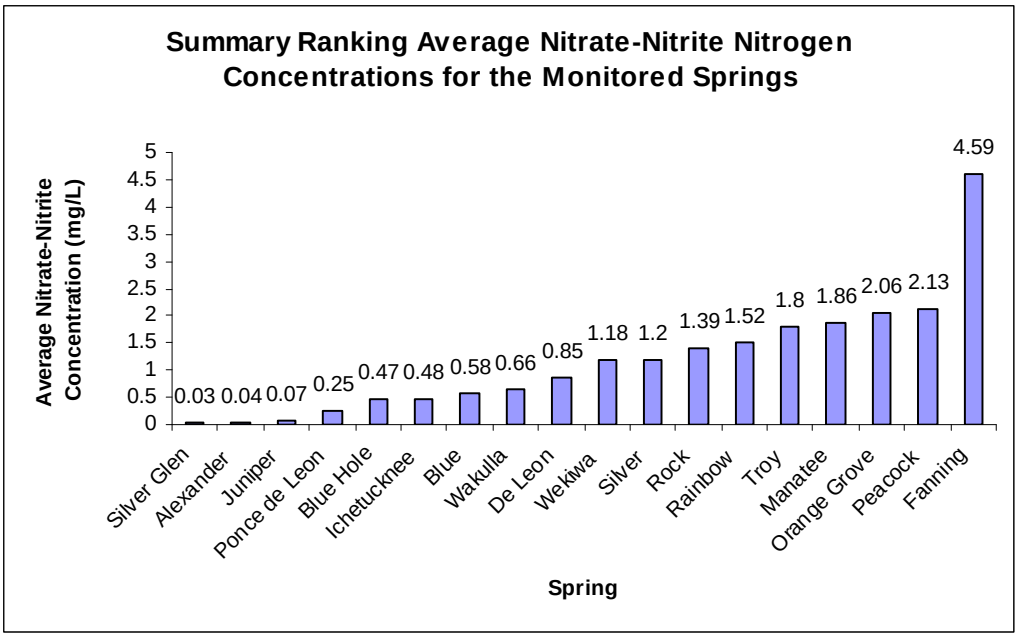


Figure 1: Summary of the average nitrate-nitrite nitrogen concentrations for each of the monitored springs, ranked in order from lowest to highest concentration.

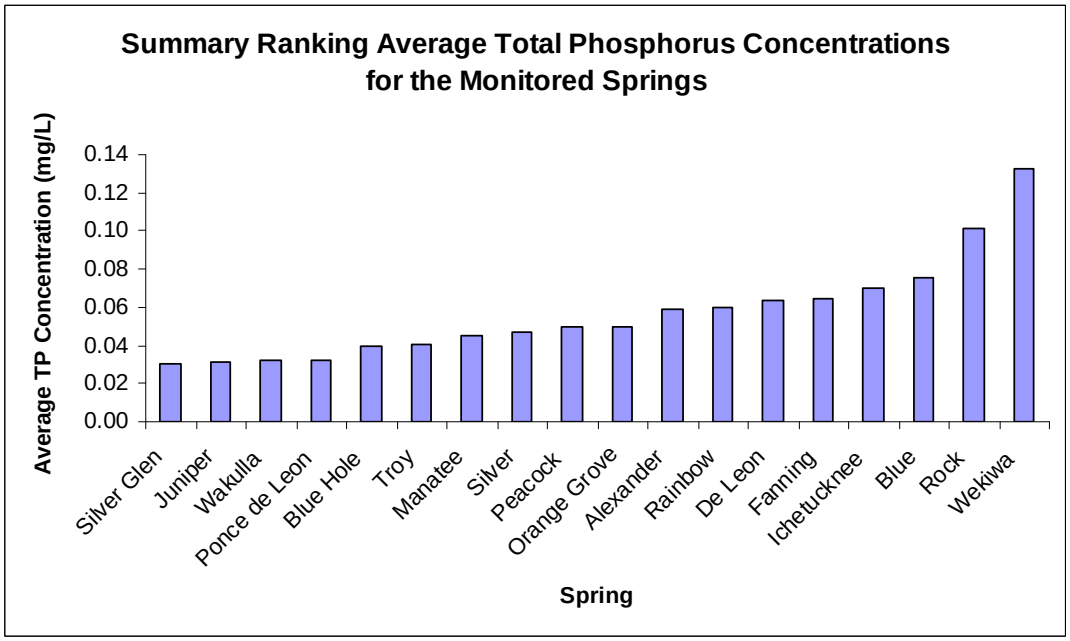


Figure 2. Summary of the average total phosphorus concentrations for each of the monitored springs, ranked in order from lowest to highest concentration.

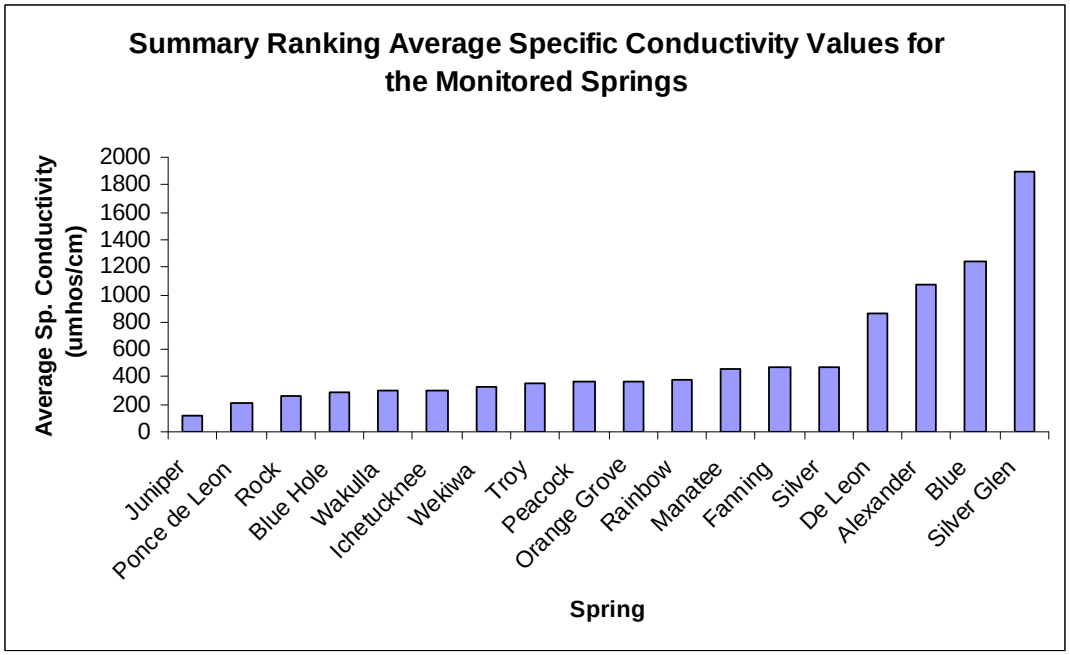


Figure 3. Summary of the average specific conductivity for each of the monitored springs, ranked in order from lowest to highest value.

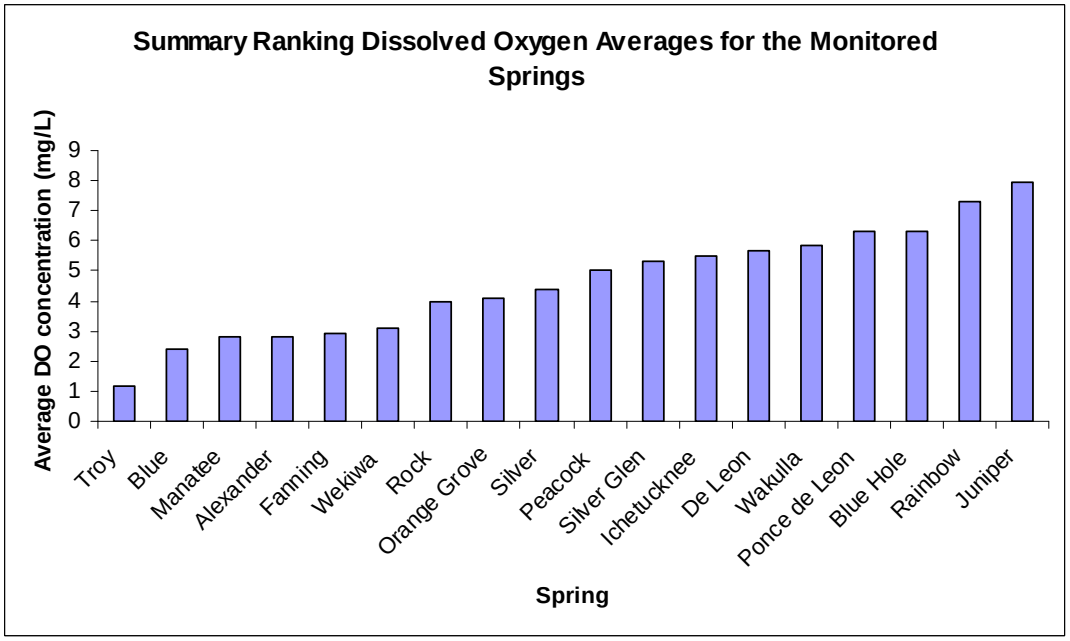


Figure 4. Summary of the average dissolved oxygen concentrations for each of the monitored springs, ranked in order from lowest to highest concentration.

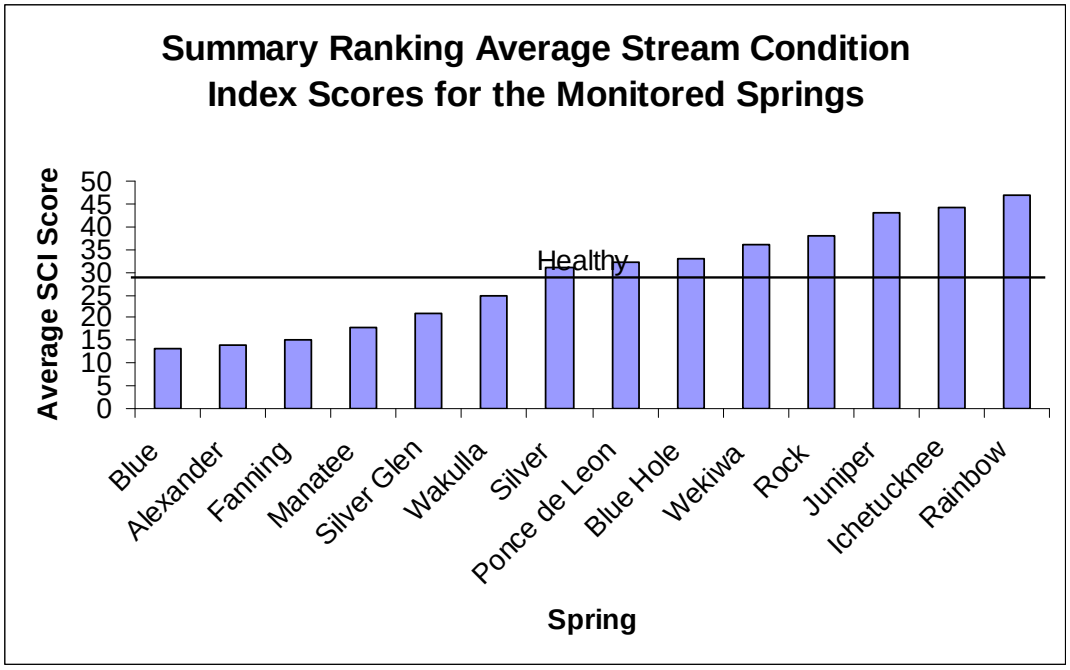


Figure 5. Summary of the average Stream Condition Index scores for each of the monitored springs, ranked in order from lowest to highest score. The impairment line is drawn at 34.

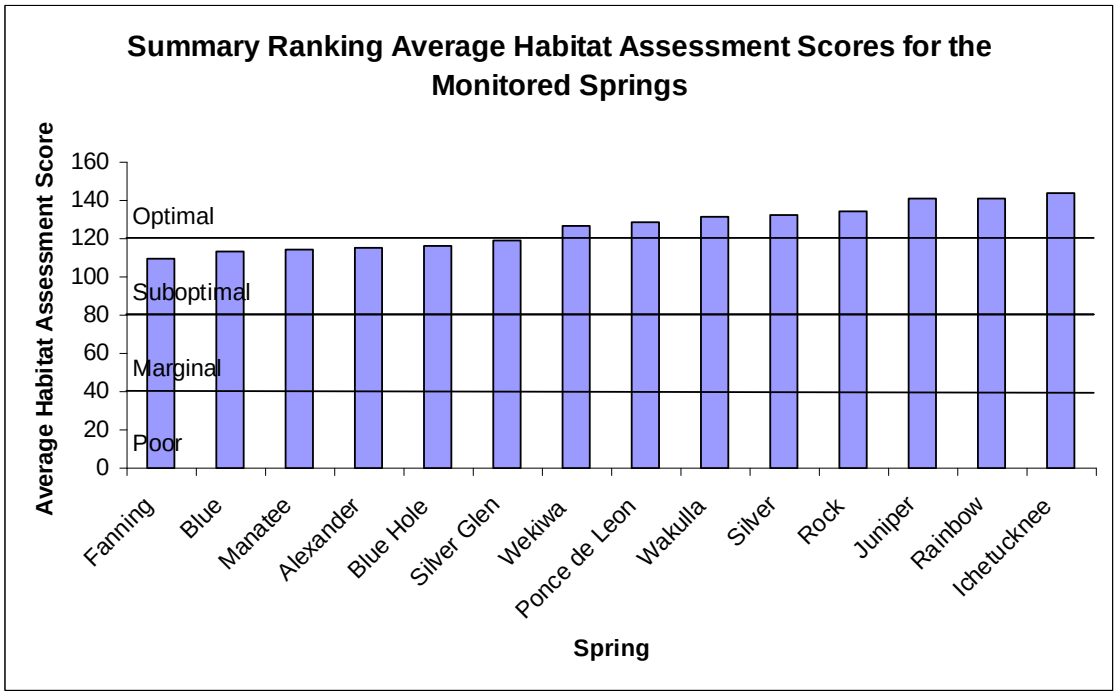


Figure 6. Summary of the average Habitat Assessment scores for each of the monitored springs, ranked in order from lowest to highest score. Lines are drawn showing the optimal, suboptimal, marginal and poor categories.

Conclusions

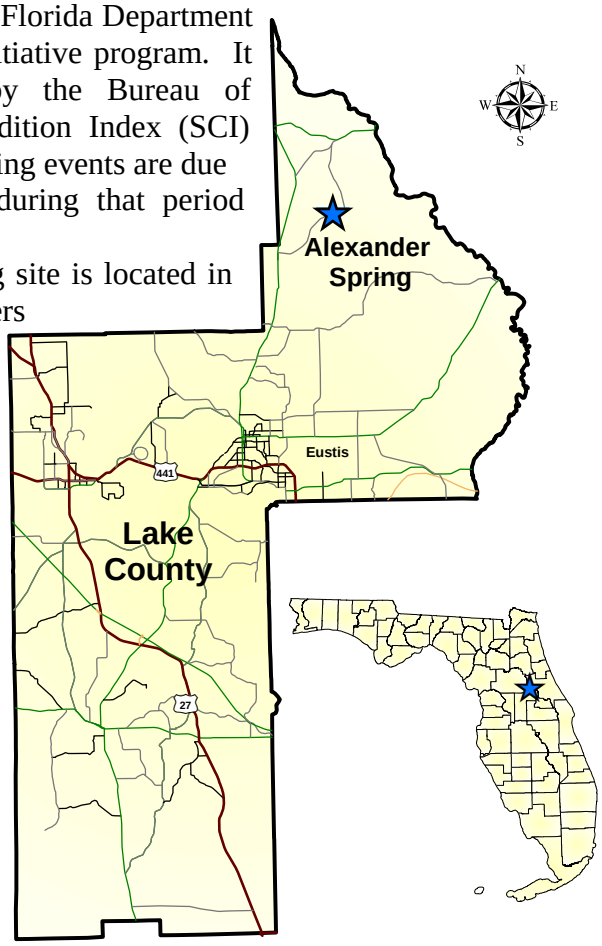
Generally, water from the spring systems in this study:

- was very high in transparency (low in color and turbidity);
- contained relatively low levels of bacteria (except for Juniper Spring);
- had moderate to high levels of dissolved ions (moderate to high specific conductance); and
- had high to very high nitrate-nitrite concentrations (with a few exceptions). The elevated nitrate-nitrite concentrations at the majority of the springs appeared to be related to anthropogenic nitrogen loading in the respective recharge areas (springsheds).

Natural factors that limited biological health (benthic invertebrates) at many of the springs included low dissolved oxygen, moderate to high specific conductance, and lack of habitat diversity. Algal smothering was an issue at many springs, yet the role of human activities (*e.g.*, high nitrate levels) contributing to high periphyton biomass is still poorly understood.

Alexander Springs

Alexander Springs is a first magnitude spring located in the Ocala National Forest in Lake County. The spring run, which is a popular recreational area for swimming and boating, flows into Lake Woodruff. Alexander Springs was incorporated into the Springs Monitoring Program in April 2002 by the Florida Department of Environmental Protection's Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (e.g., hurricanes).



The Alexander Springs monitoring site is located in the spring run, approximately 100 meters downstream of the headspring. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.

Water chemistry nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia concentrations have remained either below the detection limit or below the practical quantitation limit for the sampling period. TKN was below the practical quantitation limit for the sampling period with the exception of two samples taken in 2002 and 2007 that were just above the limit. Four of the ten total phosphorus samples were above the practical quantitation limit and have remained low, below the 40th percentile compared to typical Florida streams. Total phosphorus data is plotted over the sampling period in Figure 1. A trend could not be determined because detections between the practical quantitation limit and the method detection limit are considered qualitative, making determination of a statistical trend difficult. Concentrations of nitrate-nitrite were plotted over the approximately five-year sampling period from 2002-2007 (Figure 2). Nitrate-nitrite concentrations have ranged from 0.02 to 0.05 mg/L over the sampling period, among the lowest found in Florida springs.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
April 9, 2002	0.01	U	0.24		0.072		0.045	
October 15, 2002	0.01	U	0.14	I	0.068		0.043	
April 15, 2003	0.01	U	0.1	I	0.049		0.034	A
October 14, 2003	0.01	U	0.11	I	0.056	I	0.045	
May 4, 2004	0.01	U	0.14	I	0.086		0.028	
November 9, 2004	0.01	U	0.12	I	0.052	I	0.042	
April 19, 2005	0.01	U	0.088	I	0.04	I	0.04	
June 7, 2006	0.01	U	0.13	I	0.046	I	0.036	
November 29, 2006	0.01	U	0.094	I	0.047	I	0.034	
May 16, 2007	0.01	U	0.23		0.038	I	0.017	
Average	**0.01**		**0.14**		**0.06**		**0.04**	
Standard Deviation	**0.00**		**0.05**		**0.02**		**0.01**	
Median	**0.01**		**0.13**		**0.05**		**0.04**	

Table 1: Nutrient data including qualifier codes and summary statistics. “A”= Value reported is the arithmetic mean (average) of two or more determinations; “I” = Below practical quantitation limit; “U” = Below detection limit.

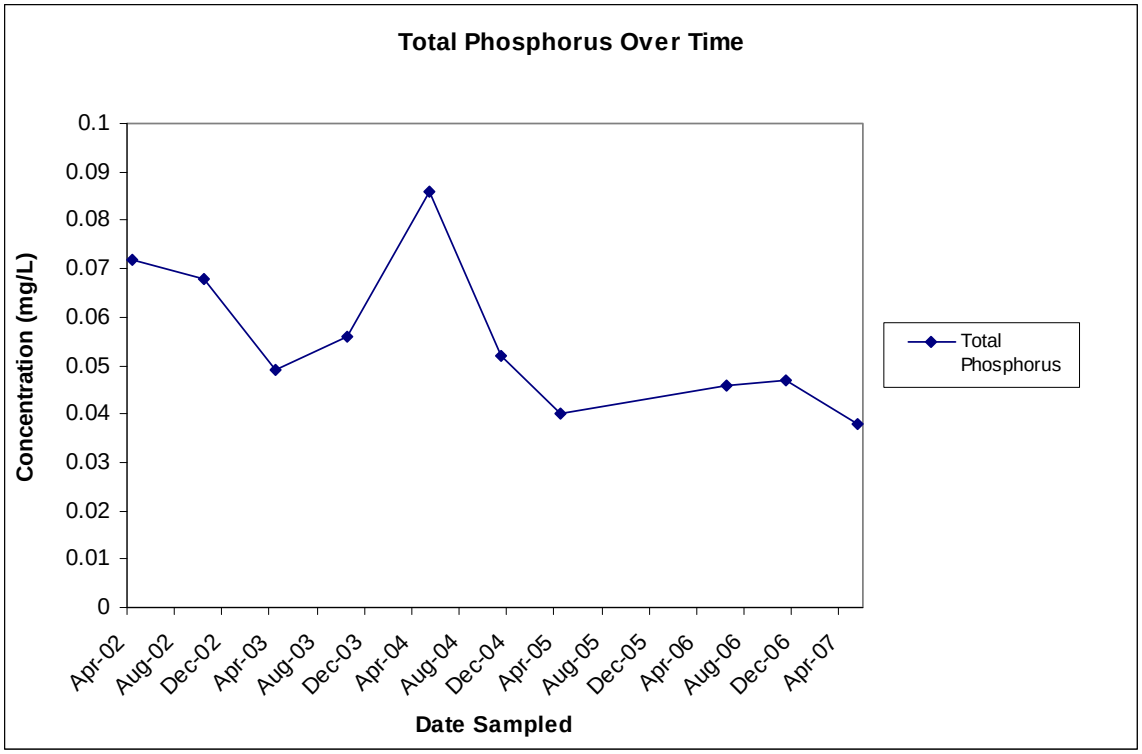


Figure 1: Total phosphorous concentrations plotted over time.

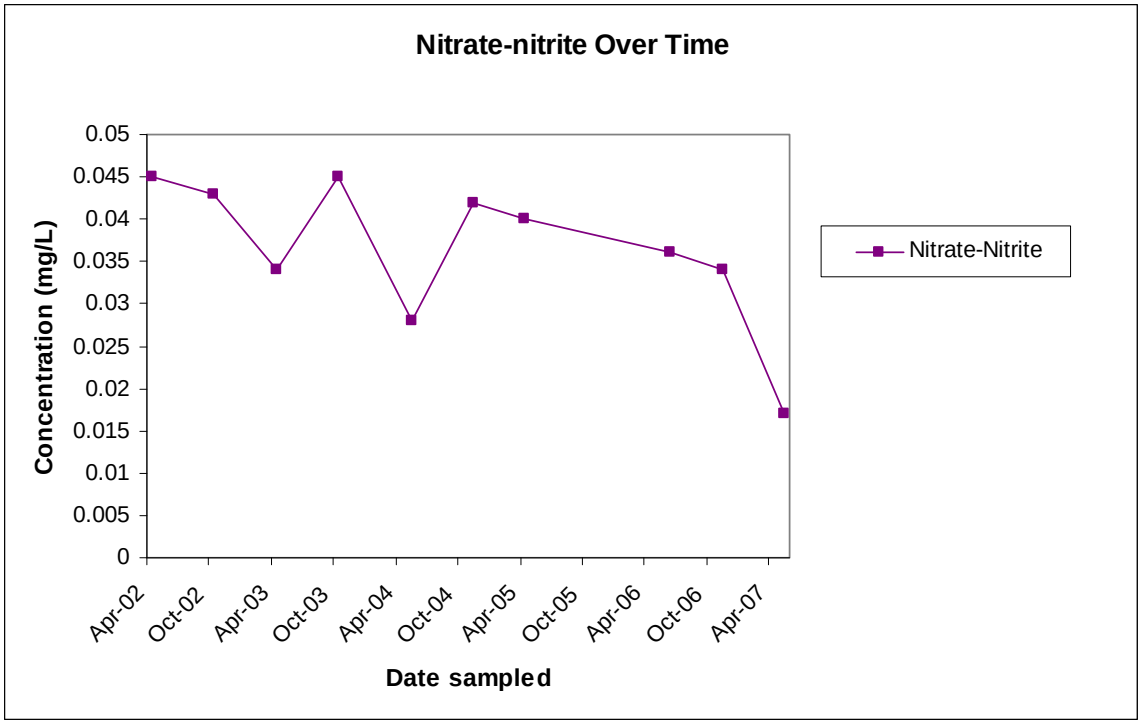


Figure 2: Nitrate-nitrite concentrations plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the "single-sample" standard considered safe for "designated beach areas" (235 CFU/100 mL) throughout the sampling period, with a median of 6 CFU/100 mL. *Enterococci* data have ranged from 1 to 38 CFU/100 mL over the sampling period, with a median of 6 CFU/100 mL. The median is lower than the "single sample" freshwater criterion of 61 CFU/100 mL for designated beach areas. Fecal coliform data have continuously complied with Class III water quality standard, ranging from 1 to 24 CFU/100 mL, with a median of 6 CFU /100 mL. Total coliforms have ranged from 1 to 130 CFU/100 mL, consistently in compliance with the standard of 2,400 CFU/100 mL. The median total coliform value for the sampling period was 20 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
April 9, 2002	26	Q	12	Q	22	Q	130	Q
October 15, 2002	6	Q	14	Q	4	Q	100	Q
April 15, 2003	1	KQ	1	KQ	1	KQ	1	KQ
October 14, 2003	12	BQ	6	BQ	8	BQ	20	BQ
May 4, 2004	No Result		No Result		No Result		No Result	
November 9, 2004	38	BQ	12	BQ	14	BQ	44	Q
April 19, 2005	2	BQ	2	KQ	2	BQ	2	BQ
June 7, 2006	2	BQ	2	BQ	6	BQ	6	BQ
November 29, 2006	26	BQ	14	BQ	24	BQ	44	Q
May 16, 2007	2	BQ	2	UQ	4	BQ	14	BQ
Average	**13**		**7**		**9**		**40**	
Standard Deviation	**14**		**6**		**9**		**46**	
Median	**6**		**6**		**6**		**20**	

Table 2: Bacteriological data including qualifier codes and summary statistics. “B” = Results based on colony counts outside the acceptable range; “K”= Off-scale low; “Q” = Outside of holding time.

Water was analyzed *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data, including qualifier codes and data for turbidity and color, are shown in Table 3. Average, standard deviation, and median values were determined for each of these parameters. Over the sampling period from April 2002-May 2007, dissolved oxygen averaged 2.8 mg/L, ranging from 0.39 to 5.4 mg/L. Only one of the measurements was above the Class III water quality standard of 5 mg/L. This low DO regime (a natural condition for headwater spring systems) can eliminate DO sensitive taxa from the system. Temperature was stable, averaging 23.5 degrees Celsius. Specific conductivity remained consistently high, averaging 1066 umhos/cm, reaching a maximum value of 1148 umhos/cm. The high conductivity appears to be a natural characteristic, associated with salt deposits in this portion of the aquifer. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.9 SU, ranging from 7.6 to 8.2 SU. Turbidity averaged 0.2 NTU ranging from 0.05 to 0.55. Color values were below the detection limit the entire sampling period, indicating very transparent water.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
April 9, 2002	1.9	7.9	1064	23.8	5	U	0.1	A
October 15, 2002	2.6	7.62	1148	23.26	5	U	0.1	
April 15, 2003	2.3	8	1059	23.5	5	U	0.2	A
October 14, 2003	4	7.7	1053	23.6	5	U	0.4	
May 4, 2004	3.3	8.2	1116	23.2	5	UQ	0.05	Q
November 9, 2004	2.91	7.84	1061	23.3	5	U	0.1	A
April 19, 2005	5.43	8.24	1046	23.9	5	UQ	0.1	Q
June 7, 2006	3.69	7.7	974	23.7	5		0.55	
November 29, 2006	1.72	7.9	1054	23.4	5	U	0.15	
May 16, 2007	0.39	8	1087	23.5	5	U	0.2	
Average	**2.82**	**7.91**	**1066.20**	**23.52**	**5.00**		**0.20**	
Standard Deviation	**1.39**	**0.21**	**45.85**	**0.23**	**0.00**		**0.16**	
Median	**2.76**	**7.90**	**1060.00**	**23.50**	**5.00**		**0.13**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics. “A”= Value reported is the arithmetic mean (average) of two or more determinations; “Q” = Outside of holding time; “U”= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from April 9, 2002 to May 16, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores from November 9, 2004 to June 8, 2006 are plotted over time in Figure 3. All SCI samples scored in the impaired category, probably due to the high specific conductivity and frequent low DO observed at this site. Both factors would reduce the number of sensitive organisms, and potentially lead to shifts in community structure. The total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa were variable over all the sampling dates, ranging from 8 to 24. The total number of sensitive taxa found in Alexander Springs remained low throughout the sampling period, with at most only one sensitive taxon found for a single sampling event (Figure 5). Habitat Assessments scored in the suboptimal category with one sampling event reaching into the optimal category (Figure 6). Issues of concern for Alexander Springs with regard to habitat assessment included lack of substrate diversity (mostly plants available as substrate) and habitat smothering from algae.

Old SCI Scores	
April 9, 2002	23
October 15, 2002	21
April 15, 2003	17
October 14, 2003	15
May 4, 2004	17

Recalibrated SCI Scores	
November 9, 2004	11
April 19, 2005	11
June 7, 2006	17
November 29, 2006	19
May 16, 2007	14

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

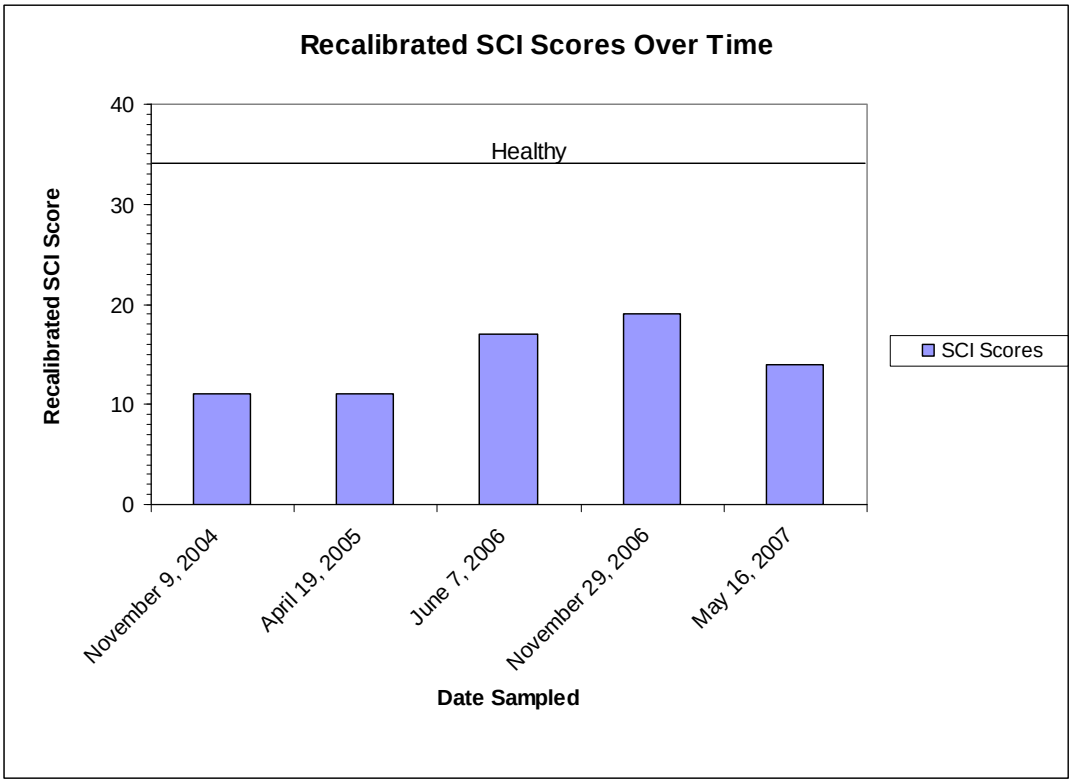


Figure 3: Recalibrated SCI scores over the period showing the impairment line at 34.

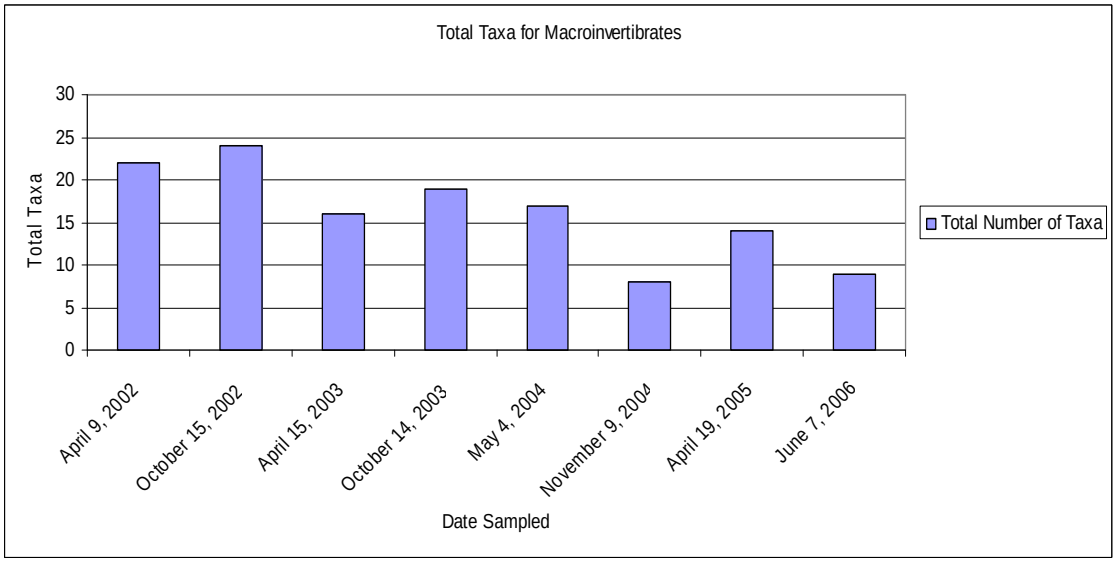


Figure 4: Total macroinvertebrate taxa plotted over time.

Date	Sensitive Taxa
4/9/2002	1
10/15/2002	0
4/15/2003	0
10/14/2003	0
5/4/2004	0
11/9/2004	1
4/19/2005	0
6/7/2006	0

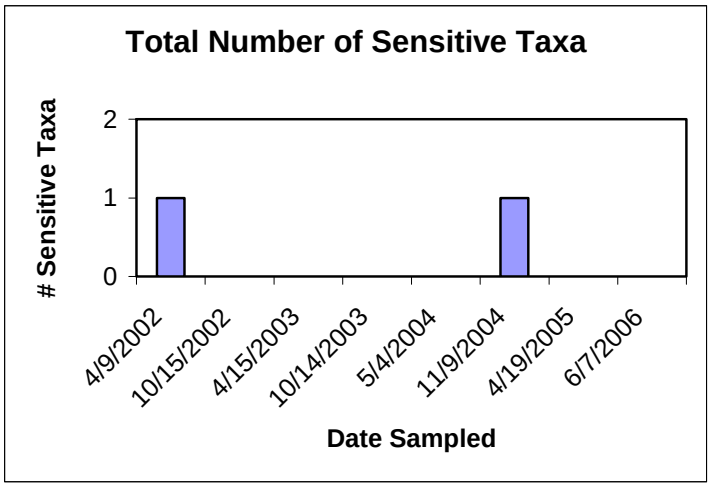


Figure 5: Total number of sensitive taxa over the sampling period.

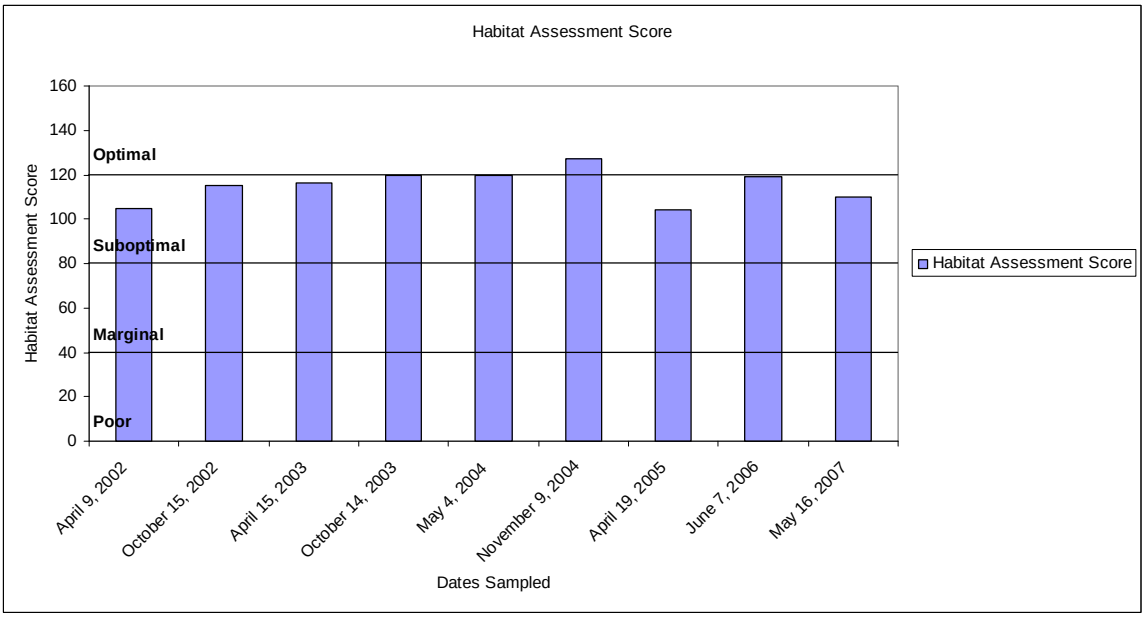


Figure 6: Habitat assessment scores over time.

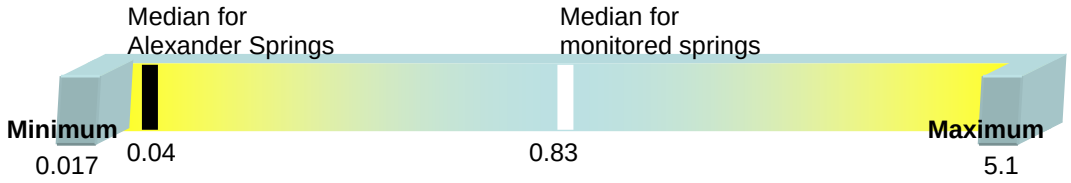
Over the roughly five year sampling period from April 9, 2002 to May 16, 2007, data indicate the following:

- Water quality, as measured by nutrients, water clarity, and bacterial densities suggested excellent conditions.
- Low dissolved oxygen and elevated conductivity (both natural conditions) appeared to be related to the poor quality invertebrate community present.
- SCI scores have remained below the impairment threshold, characterized by a paucity of sensitive taxa. This condition is probably mostly related to the DO and conductivity issues, but lack of substrate diversity and algal smothering may have also played a role.

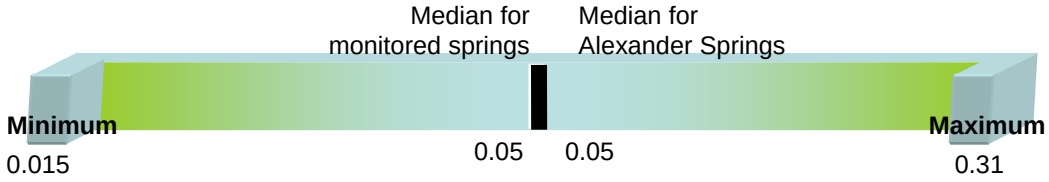
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Alexander Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Alexander Springs

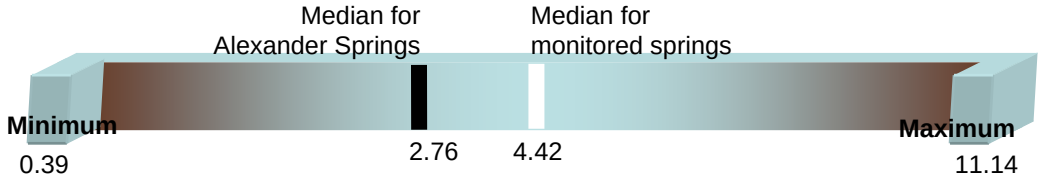
Nitrate-Nitrite (mg/L)



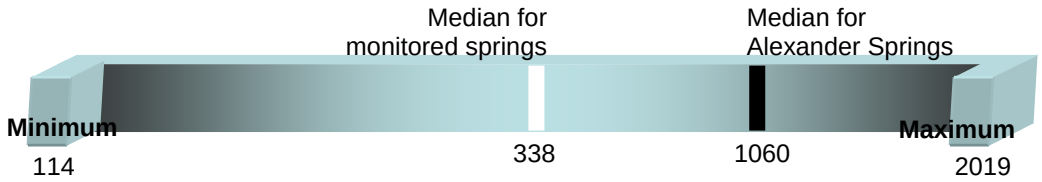
Total Phosphorus (mg/L)



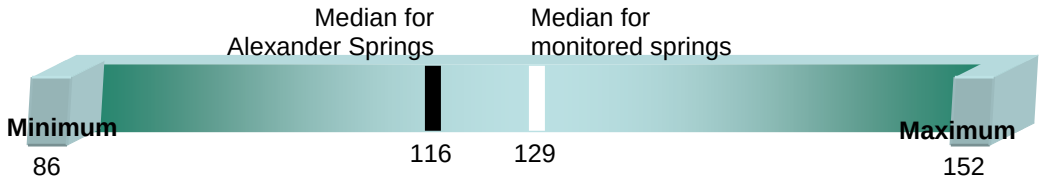
Dissolved Oxygen (mg/L)



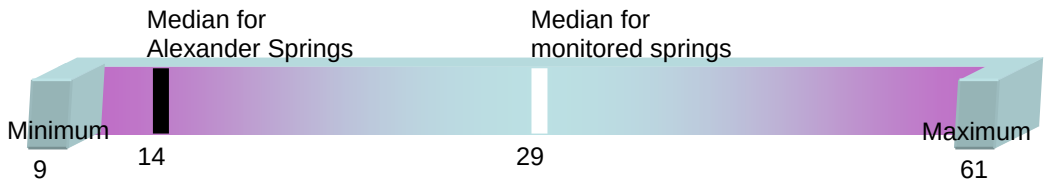
Specific Conductance (umhos/cm)



Habitat Assessment Score

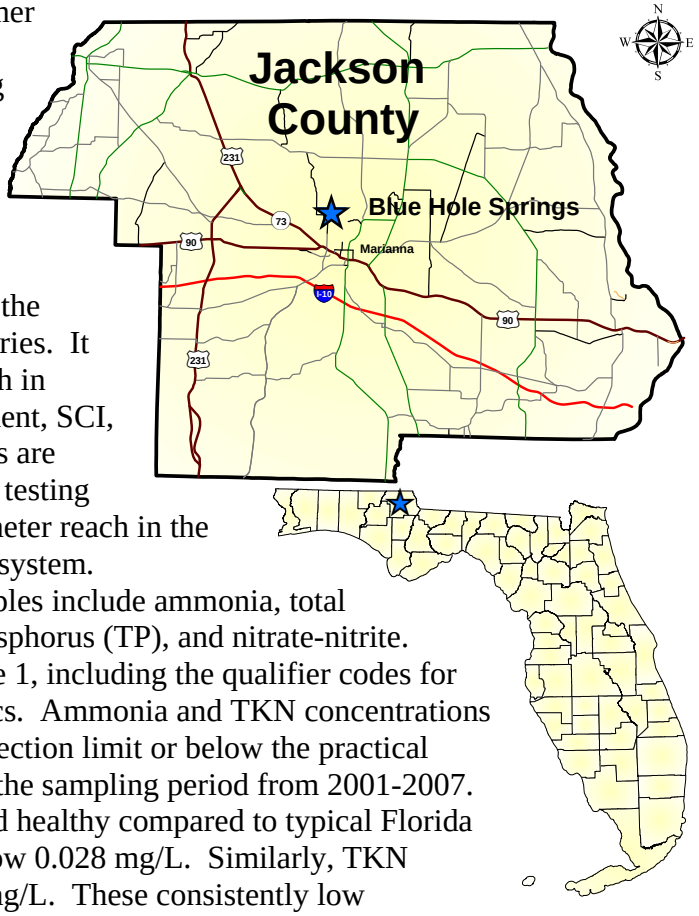


Stream Condition Index



Blue Hole Spring

Blue Hole Spring is located in Jackson County within the Florida Caverns State Park. It is a second magnitude spring which flows into the Chipola River. Blue Hole Spring was incorporated into the Springs Monitoring Program in October 2001 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. It is sampled additionally in the summer and winter by the Parks Service for water chemistry. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The Blue Hole monitoring site is located in the spring run, approximately 100 meters south of the headspring, within the park boundaries. It consists of a 100 meter stream reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter reach in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN concentrations have remained either below the detection limit or below the practical quantitation limit for a majority of the sampling period from 2001-2007. Ammonia detections have remained healthy compared to typical Florida streams with all measurements below 0.028 mg/L. Similarly, TKN concentrations were less than 0.6 mg/L. These consistently low concentrations indicate no organic nitrogen enrichment. Of the total phosphorus data, 14 of the 20 samples (70%) were either below the practical quantitation limit or below the detection limit. Total phosphorus detections remained low, at or below the 30th percentile of typical Florida streams. Total phosphorus data is plotted over the sampling period in figure 1. A trend could not be determined because detections between the practical quantitation limit and the method detection limit are considered qualitative, making determination of a statistical trend difficult. Concentrations of nitrate-nitrite were plotted over the sampling period (Figure 2). A visual inspection of the plotted data indicates variability over time but no obvious trend. However, nitrate-nitrite concentrations were consistently elevated, ranging from 0.15 to 0.86 mg/L throughout the sampling period, the majority of which represent levels near the upper 80th percentile when compared with typical Florida streams. Consistent elevations in nitrate-nitrite nitrogen concentrations are most likely due to non-point sources of pollution within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 4, 2001	0.013	I	0.073	IY	0.02	I	0.41	
January 28, 2002	0.023		0.06	U	0.024		0.42	J
July 24, 2002	0.01	U	0.131	Y	0.047	Y	0.4	JY
October 8, 2002	0.017	I	0.08	U	0.033	I	0.48	
January 23, 2003	0.014	I	0.11	I	0.021	I	0.76	
May 14, 2003	0.01	U	0.06	U	0.048		0.43	
August 13, 2003	0.017	I	0.34		0.04	I	0.36	
October 9, 2003	0.01	U	0.26		0.033	I	0.44	
Febuary 3, 2004	0.01	U	0.12	I	0.039	I	0.66	
April 13, 2004	0.01	U	0.12	U	0.045	I	0.47	
July 20, 2004	0.028		0.44		0.078		0.22	
November 4, 2004	0.014	I	0.06	U	0.064	Y	0.59	
January 27, 2005	0.011	I	0.24		0.071		0.86	
August 8, 2005	0.028		0.6		0.053	I	0.15	
January 30, 2006	0.017	I	0.24		0.02	U	0.73	
June 22, 2006	0.022		0.06	U	0.037	I	0.42	
July 26, 2006	0.017	I	0.16	U	0.02	U	0.36	
October 31, 2006	0.013	I	0.08	U	0.023	I	0.32	
January 30, 2007	0.01	U	0.26		0.02	U	0.49	
May 10, 2007	0.05	U	0.12	I	0.032	I	0.32	
Average	**0.02**		**0.18**		**0.04**		**0.46**	
Standard Deviation	**0.01**		**0.14**		**0.02**		**0.18**	
Median	**0.01**		**0.12**		**0.04**		**0.43**	

Table 1: Nutrient data including qualifier codes and summary statistics. “I” = Below practical quantitation limit; “J”= Estimated value; “U” = Below detection limit; “Y”= Improperly preserved.

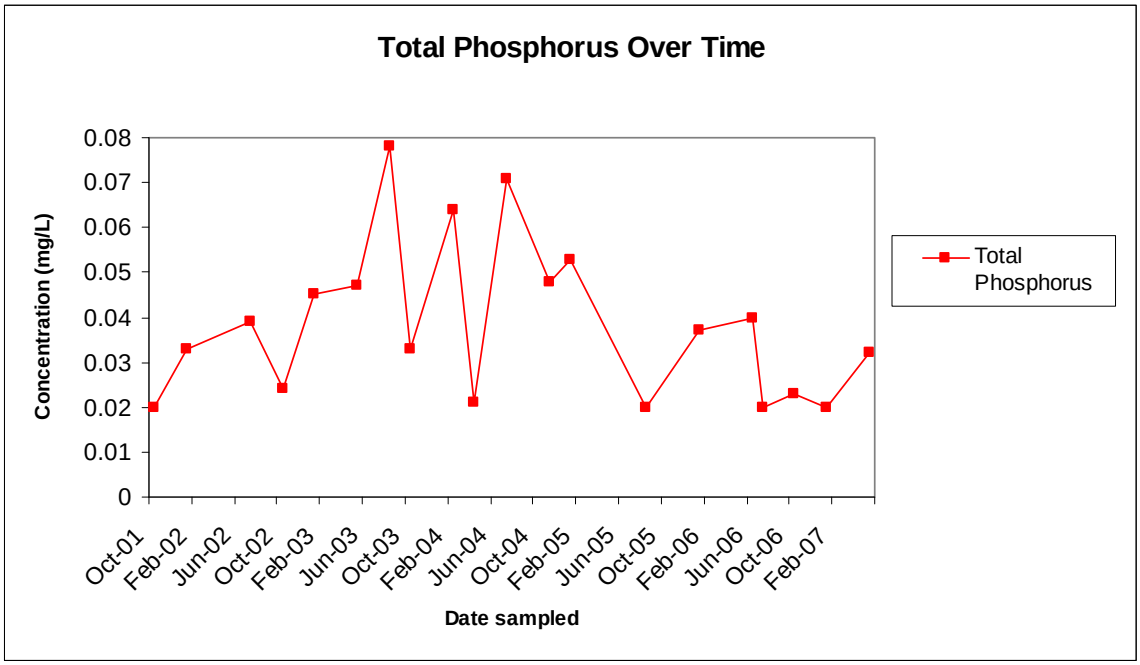


Figure 1: Total phosphorus concentrations plotted over time.

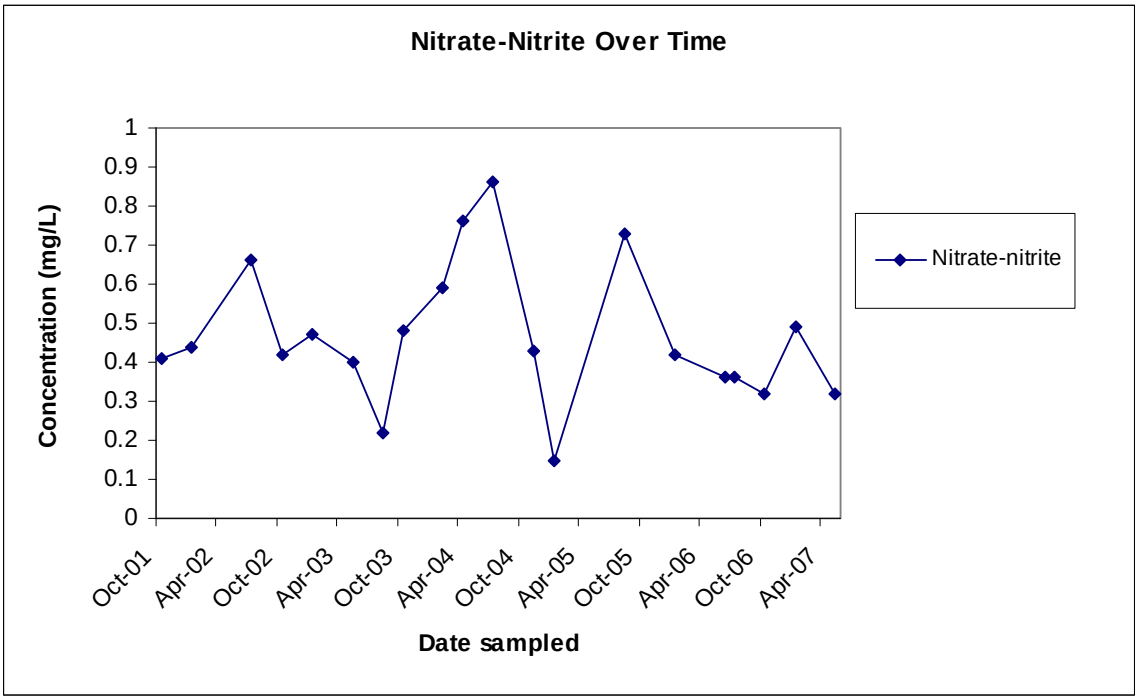


Figure 2: Nitrate-nitrite concentrations plotted over time.

Water column samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the "single sample" standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 42 CFU/100 mL. *Enterococci* data have ranged from 2 to 460 CFU/100 mL over the sampling period, with a median of 42 CFU/100 mL. This value complies with the freshwater standard of 61 CFU/100 mL for designated beach areas. The occasional high values for *Enterococci* are unexplained, but another study by the Bureau of Laboratories has indicated that *Enterococci* levels such as these may be a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standard, ranging from 2 to 92 CFU/100 mL, with a median of 30 CFU/100 mL. Total coliform data have ranged from 32 to 700 CFU/100 mL. The median total coliform value for the approximately five year sampling period was 108 CFU/100 mL, well below the standard of 2,400 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 4, 2001	2	Q	6	Q	2	Q	150	Q
January 28, 2002	12	Q	6	Q	6	Q	310	Q
July 24, 2002	42	AQ	63	AQ	77	AQ	64	AQ
October 8, 2002	18		16		16		100	
January 23, 2003	24	Q	34	Q	40	Q	90	Q
May 14, 2003	2	Q	44	Q	2	Q	140	Q
August 13, 2003	280	Q	60	Q	56	Q	450	Q
October 9, 2003	40	Q	2	BQ	6	BQ	700	Q
Febuary 3, 2004	60		42		92		250	
April 13, 2004	33	BQ	7	BQ	8	BQ	32	Q
July 20, 2004	460		102		76		520	
November 4, 2004	30	B	42		28	B	108	
January 27, 2005	32		48		30	B	76	
August 8, 2005	250		68	AQ	67	A	810	B
January 30, 2006	No Result		No Result		No Result	Q	No Result	Q
June 22, 2006	46	Q	16	BQ	10	BQ	70	Q
July 26, 2006	82	Q	22	BQ	56	Q	70	Q
October 31, 2006	58		6	BQ	8	B	102	
January 30, 2007	52	Q	92	Q	46	Q	80	Q
May 10, 2007	42		76		92		198	Q
Average	**82**		**40**		**38**		**227**	
Standard Deviation	**118**		**31**		**32**		**229**	
Median	**42**		**42**		**30**		**108**	

Table 2: Microbiology data including qualifiers. “B” = Results based on colony counts outside the acceptable range; “Q” = Outside of holding time; “A” = Value reported is the arithmetic mean (average) of two or more determinations.

Field parameters were collected *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) as well as data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period dissolved oxygen averaged 6.32 mg/L, ranging from 0.7 to 9.7 mg/L. The DO consistently complied with the Class III water quality standard of 5 mg/L, except for the measurement of 0.7 mg/L taken on October 31, 2006. Temperature was stable, averaging 20.6 degrees Celsius, ranging from 18.3 degrees C to 22.5 degrees C. Specific conductivity was slightly elevated throughout the sampling period averaging 293 umhos/cm and ranging from 264 umhos/cm to 309 umhos/cm. The elevated conductivity appears to be a natural characteristic, associated with inorganic dissolved solids in the groundwater. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.2 SU, ranging from 6.7 to 7.8 SU. Turbidity and color data were variable, with turbidity ranging from 0.4 to 23 NTU and color values ranging from 5 to 80 PCU. The high turbidity and color values were probably natural occurrences related to storm events in which sediment and leaf tannins from the surrounding floodplain were washed into the system.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 4, 2001	9.68	7.17	264	21.9	5	U	1	
January 28, 2002	No Result	No Result	No Result	No Result	5	U	1.1	
July 24, 2002	No Result	No Result	No Result	No Result	5		1.9	
October 8, 2002	5.21	7.65	271	22.52	20		1.5	
January 23, 2003	No Result	No Result	No Result	No Result	10	A	2.1	
May 14, 2003	6.6	7.4	309	20.4	5	U	1.1	
August 13, 2003	No Result	No Result	No Result	No Result	40		6	
October 9, 2003	7.2	6.8	308	20.2	5	U	2.2	
Febuary 3, 2004	No Result	No Result	No Result	No Result	10		3	
April 13, 2004	6.5	6.7	289	19.5	5	U	0.4	
July 20, 2004	No Result	No Result	No Result	No Result	50		9	
November 4, 2004	5.1	7.8	282	20.5	10		1.5	
January 27, 2005	No Result	No Result	No Result	No Result	30		2.9	A
August 8, 2005	No Result	No Result	No Result	No Result	80		23	
January 30, 2006	No Result	No Result	No Result	No Result	10	Q	2.1	Q
June 22, 2006	6.9	6.8	300	20	10		4.6	
July 26, 2006	No Result	No Result	No Result	No Result	10		4	
October 31, 2006	0.7	7.15	305	18.3	5		1	
January 30, 2007	No Result	No Result	No Result	No Result	30		2.4	
May 10, 2007	9.03	6.98	308	21.7	20		3.6	
Average	**6.32**	**7.16**	**292.89**	**20.56**	**18.25**		**3.72**	
Standard Deviation	**2.60**	**0.39**	**17.18**	**1.31**	**19.49**		**4.97**	
Median	**6.60**	**7.15**	**300.00**	**20.40**	**10.00**		**2.15**	

Table 3: Field parameters, color, and turbidity data with qualifiers and summary statistics. "U" = Below detection limit; "Q" = Outside of holding time; "A" = Value reported is the arithmetic mean (average) of two or more determinations.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from October 4, 2001 to May 10, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores from November 4, 2004 to May 10, 2007 are plotted over time in Figure 3. Six of the eight total samples (75%) scored in the "healthy" range, with the sample taken most recently falling below the impairment line. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa for each sampling date over the entire sampling period are displayed in Figure 4. Total taxa varied over the entire sampling period, ranging from 15 to 27 taxa. The number of sensitive taxa varied over the sampling period, but was somewhat below average for a northwest Florida stream (Figure 5). Sensitive taxa tend to be excluded from higher conductivity sites, and the average conductivity of 289 umhos/cm at Blue Hole (a natural condition) may have been responsible for this phenomenon. Habitat Assessments over time generally scored within the "suboptimal" or "optimal" categories (Figure 6). The lowest habitat assessment score on October 31, 2006 was still within the suboptimal category, scoring especially low for water velocity due to low water conditions on that sampling date. Habitat concerns that cause Blue Hole Springs to periodically score in the "suboptimal" category for habitat assessment include lack of abundance and variety of productive habitats as well as smothering of habitats.

Old SCI Scores	
Oct 4, 2001	25
Oct 8, 2002	21
May 14, 2003	21
Oct 9, 2003	23
Apr 13, 2004	17

Recalibrated SCI Scores	
Nov 4, 2004	38
Jun 22, 2006	36
May 10, 2007	26

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

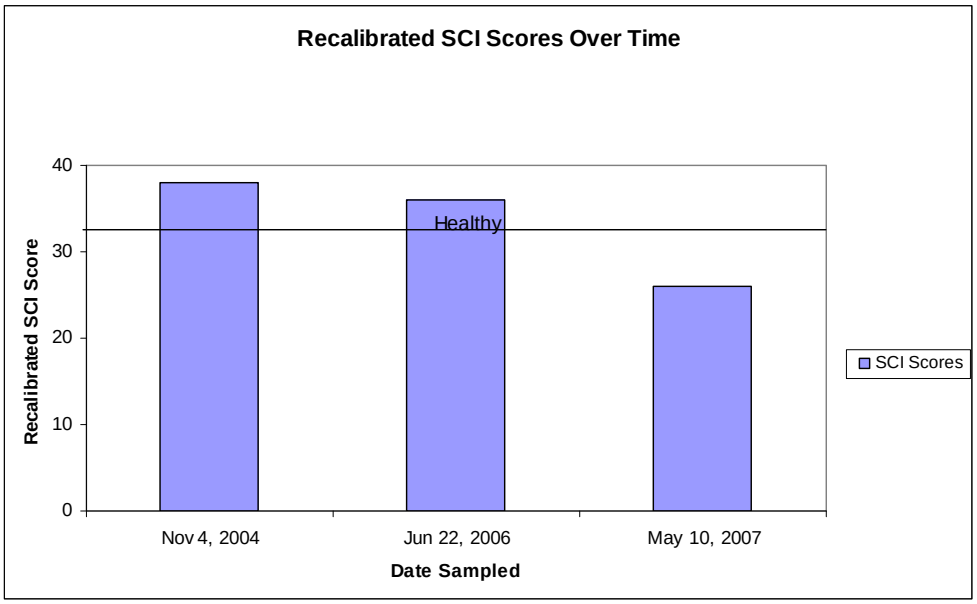


Figure 3: Recalibrated SCI scores over the period showing the impairment line at 34.

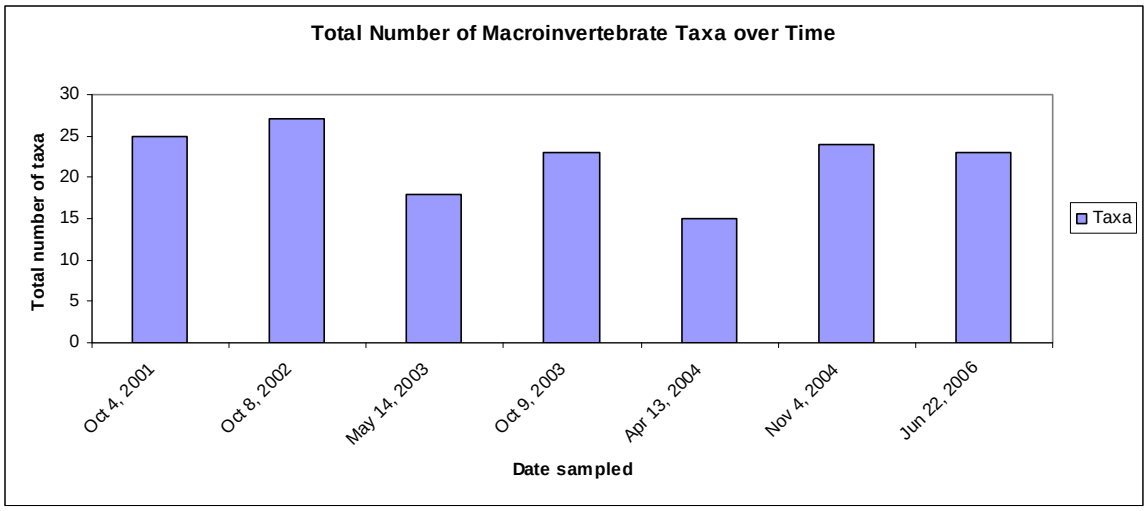


Figure 4: Total macroinvertebrate taxa plotted at each sampling event.

Date	Sensitive Taxa
10/4/2001	4
10/8/2002	3
5/14/2003	5
10/9/2003	3
4/13/2004	2
11/4/2004	2
6/22/2006	3

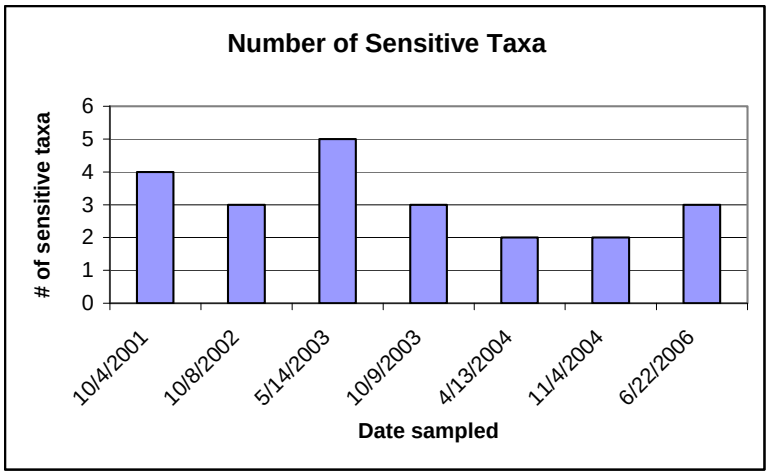


Figure 5: Number of sensitive taxa over the sampling period.

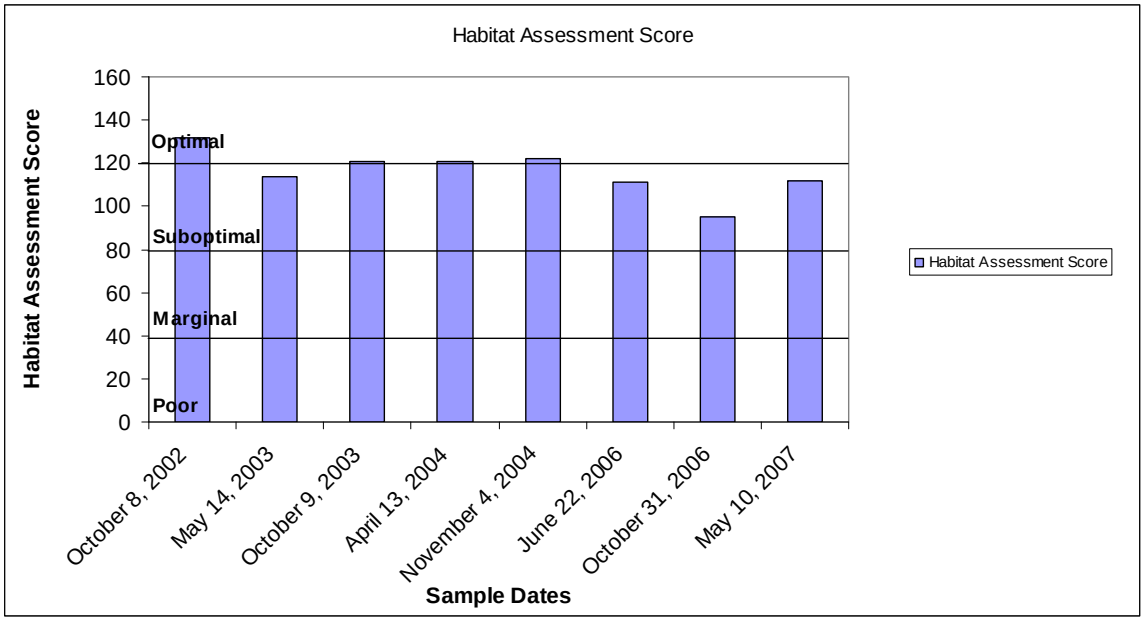


Figure 6: Habitat assessment scores plotted at each sampling event.

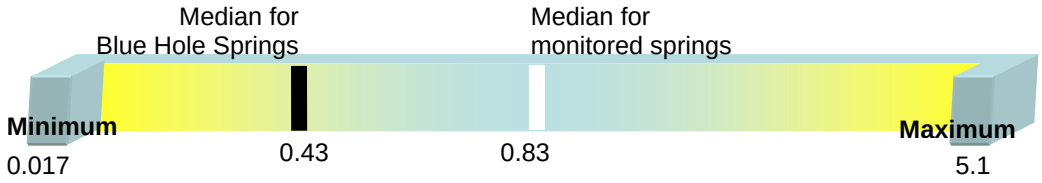
Over the roughly six-year sampling period from October 4, 2001 to May 10, 2007, data indicate the following:

- Water quality, as measured by nutrients (except nitrate-nitrite), water clarity, and bacterial densities generally suggested healthy conditions.
- Nitrate-nitrite concentrations were consistently elevated, the majority of which represent levels near the upper 80th percentile when compared with typical Florida streams. Consistent elevations in nitrate-nitrite nitrogen concentrations are most likely resulting from introduction of nutrients through human activity in the springshed.
- The most recent SCI scores fell below the impairment threshold of 34 points. Lack of abundance and variety of productive habitats as well as smothering within the system may have contributed to the lower SCI score.

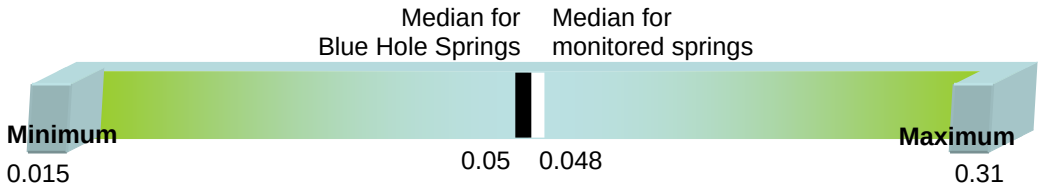
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Blue Hole Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Blue Hole Springs

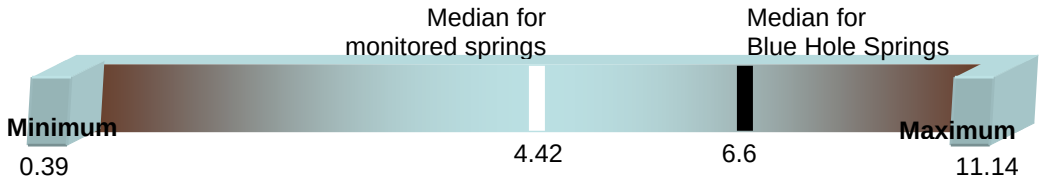
Nitrate-Nitrite (mg/L)



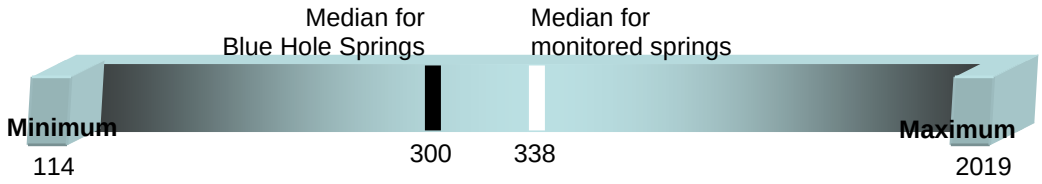
Total Phosphorus (mg/L)



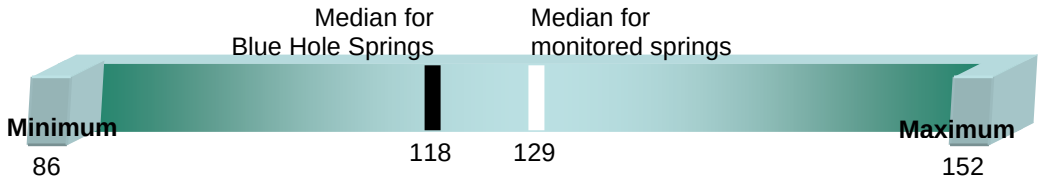
Dissolved Oxygen (mg/L)



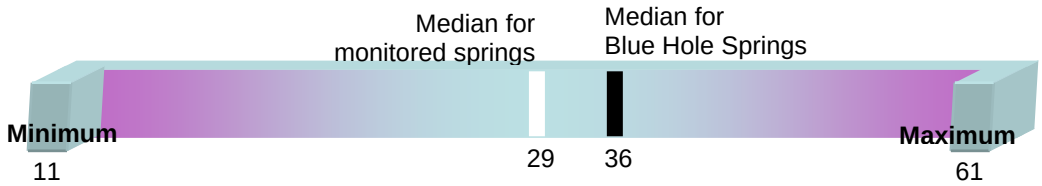
Specific Conductance (umhos/cm)



Habitat Assessment Score

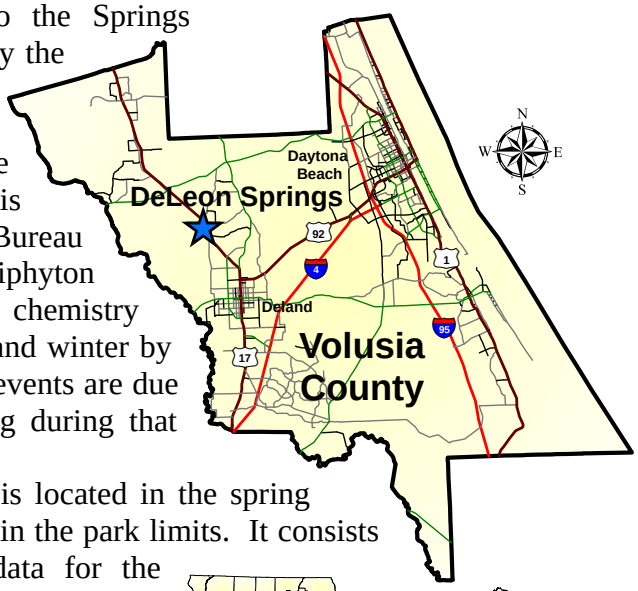


Stream Condition Index

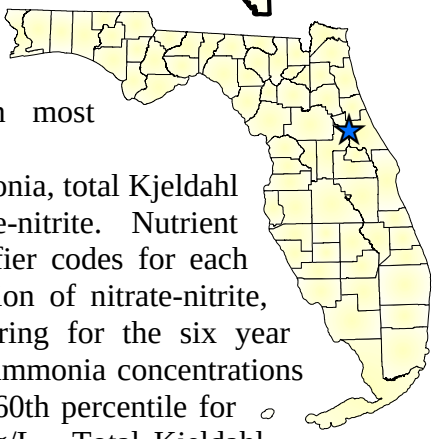


De Leon Springs

De Leon Springs is located in Volusia County within De Leon Springs State Recreation Area. It is a second magnitude spring, discharging into Lake Woodruff. De Leon Springs was incorporated into the Springs Monitoring Program in March 2001 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry and periphyton collections. Two additional water chemistry samples are collected in the summer and winter by the Parks Service. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The De Leon monitoring site is located in the spring run, very close to the headspring, within the park limits. It consists of a 100 meter stretch in which data for the qualitative periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.



Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. With the exception of nitrate-nitrite, nutrients have remained relatively low in the spring for the six year sampling period from March 2001 to May 2007. Ammonia concentrations have averaged 0.04 mg/L and remained below the 60th percentile for typical Florida streams, ranging 0.017 to 0.091 mg/L. Total Kjeldahl nitrogen (TKN) have averaged 0.28 mg/L and remained below the 20th percentile for typical Florida streams, ranging 0.16 to 0.46 mg/L. Concentrations of total phosphorus and nitrate-nitrite were plotted over the sampling period (Figures 1 and 2). Total phosphorus averaged 0.06 mg/L and remained below the 40th percentile values compared to typical Florida streams with a range of 0.044 to 0.081 mg/L. A visual inspection of the plotted data does not indicate an increasing or decreasing trend in TP over time. Nitrate-nitrite concentrations have consistently exceeded the values found in approximately 85% of Florida streams, ranging from 0.4 to 1.3 mg/L with an average of 0.85 mg/L. A visual inspection of the plot appears to suggest a slightly decreasing trend in nitrate-nitrite over time; however the data are not sufficient to determine statistically whether this is a truly significant trend. Consistently elevated nitrate-nitrite concentrations are probably due to anthropogenic nutrient inputs within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
March 21, 2001	No Result		0.34		0.068		0.86	
December 6, 2001	0.042		0.32		0.077	J	1.1	
January 17, 2002	0.021		0.18	I	0.046		1.3	J
April 17, 2002	0.025	A	0.25		0.061		1.1	J
July 23, 2002	0.054		0.33	IY	0.08	Y	0.82	J
October 21, 2002	0.038		0.41		0.061	J	1	
January 8, 2003	0.029		0.24	A	0.061		0.49	
May 19, 2003	0.028		0.18	I	0.063		1.1	
August 20, 2003	0.04		0.27		0.075		0.92	A
October 14, 2003	0.024		0.46	A	0.059	I	0.74	
February 4, 2004	0.027		0.26		0.06		0.84	
April 20, 2004	0.051		0.23		0.081		0.62	
July 28, 2004	0.077		0.28		0.048	I	0.74	
November 8, 2004	0.043		0.29		0.06		1.2	
January 20, 2005	0.017	I	0.16	I	0.044		1.1	
April 25, 2005	0.036		0.29		0.058	I	0.82	
July 25, 2005	0.041		0.32		0.072		1	A
January 18, 2006	0.017	I	0.24	I	0.053	I	0.97	A
May 24, 2006	0.044	Q	0.26	I	0.056	I	0.71	
July 19, 2006	0.048		0.25		0.061		0.71	
November 1, 2006	0.055		0.32		0.051	I	0.49	
January 25, 2007	0.091		0.16	I	0.058	I	0.47	
May 8, 2007	0.075		0.36	J	0.048	I	0.39	
Average	**0.04**		**0.28**		**0.06**		**0.85**	
Standard Deviation	**0.02**		**0.08**		**0.01**		**0.25**	
Median	**0.04**		**0.27**		**0.06**		**0.84**	

Table 1:Nutrient data including qualifiers and summary statistics. “A”= Value reported is the arithmetic mean of two or more determinations; “I” = Below practical quantitation limit; “J”= Estimated value; “Q”= Sample held beyond accepted holding time; “Y” = The laboratory analysis was from an improperly preserved sample.

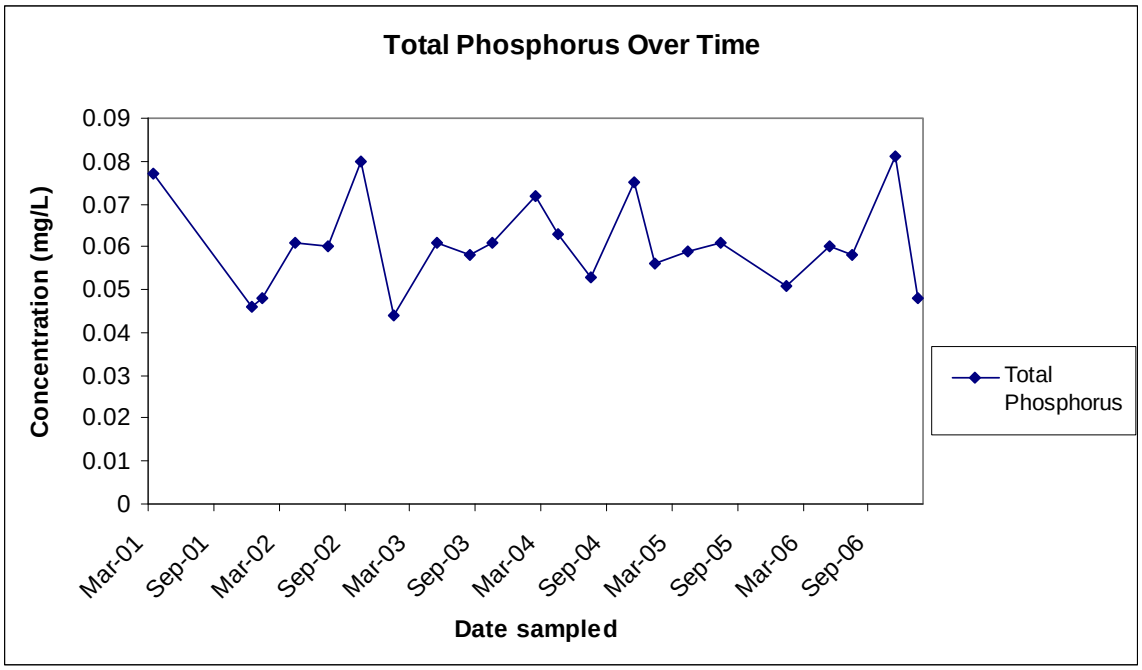


Figure 1: Total Phosphorus values plotted over time

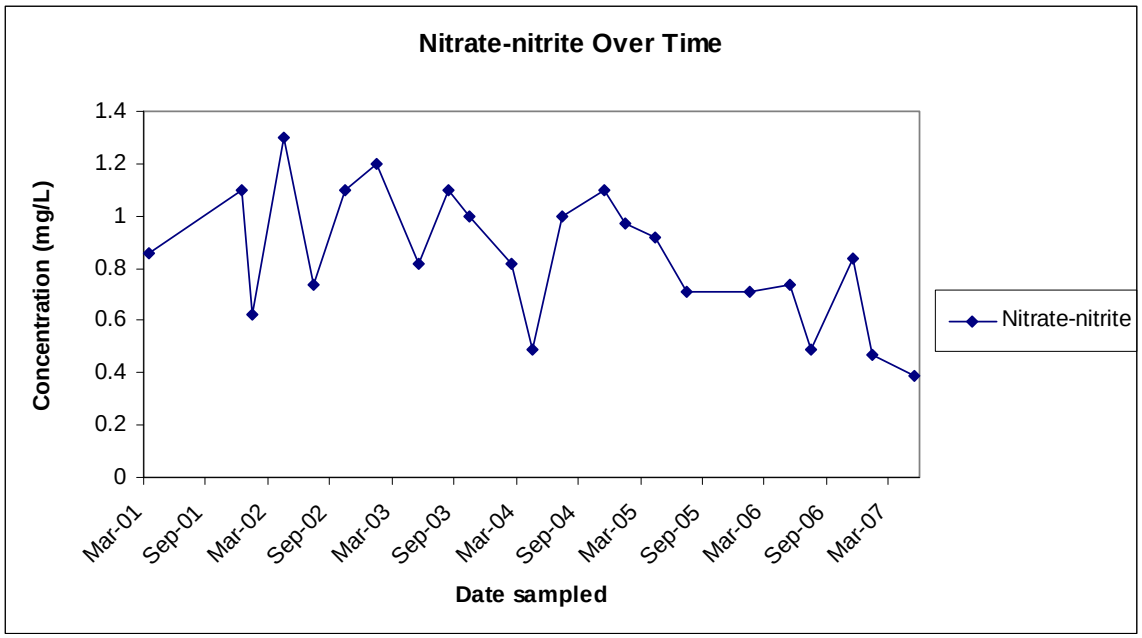


Figure 2: Nitrate-nitrite values plotted over time.

Water column samples were collected and analyzed for *Escherichia coli*, *Enterococci,* fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the "single sample" criterion considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median value of 4 CFU/100 mL. *Enterococci* data have ranged from 1 to 160 CFU/100 mL over the sampling period, with a median value of 20 CFU/100 mL. Thirteen of the eighteen *Enterococci* samples taken remained below the standard of 61 CFU/100 mL. The use of *Enterococci* as a human waste indicator may not be appropriate in relatively warm-water systems, such as springs. Studies have found that *Enterococci* sources include plant material and soil, and therefore, the *Enterococci* densities in the De Leon Spring may be a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 1 to 200 CFU/100 mL, with a median of 4 CFU/100 mL. Total coliform data have ranged from 2 to 385 CFU/100 mL with a median of 50 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
March 21, 2001	42	Q	24	Q	24	Q	200	Q
December 6, 2001	62	AQ	2	AQ	3	AQ	14	AQ
January 17, 2002	1	KQ	1	KQ	1	KQ	10	KQ
April 17, 2002	64	Q	56	Q	64	Q	180	Q
July 23, 2002	160	AQ	83	AQ	150	AQ	385	AQ
October 21, 2002	6	Q	1	KQ	2	Q	100	Q
January 8, 2003	2	Q	No Result		1	KQ	No Result	
May 19, 2003	134	Q	158	BQ	200	Q	370	Q
August 20, 2003	20	BQ	1	KQ	4	BQ	30	BQ
October 14, 2003	40	Q	4	BQ	6	BQ	80	BQ
February 4, 2004	2	BQ	1	KQ	1	KQ	50	BQ
April 20, 2004	No Result		No Result		No Result		No Result	
July 28, 2004	12	BQ	23	BQ	110	Q	290	Q
November 8, 2004	No Result	Q	No Result	Q	No Result	Q	No Result	Q
January 20, 2005	No Result		No Result		No Result			
April 25, 2005	No Result	Q	No Result	Q	No Result	Q	No Result	Q
July 25, 2005	6	BQ	4	BQ	8	BQ	14	BQ
January 18, 2006	2	KQ	2	KQ	2	KQ	8	BQ
May 24, 2006	20	BQ	2	BQ	2	BQ	12	BQ
July 19, 2006	110	BQ	10	BQ	20	BQ	10	BQ
November 1, 2006	36	BQ	10	BQ	2	BQ	56	Q
January 25, 2007	2	UQ	2	UQ	2	UQ	2	BQ
May 8, 2007	No Result	Q	No Result	Q	No Result	Q	No Result	Q
Average	**40**		**23**		**33**		**107**	
Standard Deviation	**49**		**42**		**59**		**130**	
Median	**20**		**4**		**4**		**50**	

Table 2: Microbiology data including qualifiers and summary statistics. “A”= Value reported is the arithmetic mean of two or more determinations; “B” = Results based on colony counts outside the acceptable range; “K” = Off scale low. Actual value is known to be less than the value given. “Q” = Outside of holding time; “U”= Below detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, minimum and maximum values were determined for each of these parameters. Over the sampling period from March 2001-May 2007, dissolved oxygen averaged 5.7 mg/L, ranging from 2.8 to 7.9 mg/L. Eleven of the twelve dissolved oxygen measurements complied with the Class III water quality standard of 5 mg/L. Temperature was stable, averaging 23.0 degrees Celsius. Specific conductivity averaged 885 umhos/cm, and ranged from 722 to 1113 umhos/cm. The mean pH was 7.5 SU, with a range from 7.0 to 8.1 SU. Turbidity was very low, averaging 0.4 NTU. Color values were below the detection limit with the exception of 2 samples taken on March 21, 2001 and November 8, 2004, having color values of 15 PCU of 10 PCU, respectively. The color detections may have been associated with high water levels of the St. Johns River.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
March 21, 2001	6.25	7.8	722	21.6	15		0.55	
October 16, 2001	2.8	7.3	843	22.8	No Result		No Result	
December 6, 2001	5.05	7.53	894	22.61	5	U	0.3	
January 17, 2002	No Result	No Result	No Result	No Result	5	U	0.2	
April 17, 2002	5.7	7.5	No Result	22.9	5	U	0.4	
July 23, 2002	No Result	No Result	No Result	No Result	5	U	0.5	
October 21, 2002	3.5	7.2	904	22.8	5	Q	0.25	Q
January 8, 2003	No Result	No Result	No Result	No Result	5	UQ	0.2	Q
May 19, 2003	5.7	7.8	937	23	5	U	0.5	
August 20, 2003	No Result	No Result	No Result	No Result	5	U	0.35	
October 14, 2003	6.32	7.46	1050	23.8	5	Q	0.6	Q
February 4, 2004	No Result	No Result	No Result	No Result	5		1.2	
April 20, 2004	No Result	7.22	879	23.59	5	Q	0.45	Q
July 28, 2004	No Result	No Result	No Result	No Result	5	U	0.3	
November 8, 2004	3.4	7.26	1112	22.3	10	Q	0.2	Q
January 20, 2005	No Result	No Result	No Result	No Result	5	U	0.4	
April 25, 2005	7.4	8.1	907	23.3	5	Q	0.3	Q
July 25, 2005	No Result	No Result	No Result	No Result	5	U	0.3	
January 18, 2006	No Result	No Result	No Result	No Result	5		0.4	
May 24, 2006	7.86	6.98	736	24.1	5	Q	0.35	Q
July 19, 2006	No Result	No Result	No Result	No Result	5		0.45	
November 1, 2006	6.4	7.9	750	22.8	5		0.5	
January 25, 2007	No Result	No Result	No Result	No Result	5	U	0.3	
May 8, 2007	7.6	7.7	668	22.4	5	A	0.4	A
Average	**5.67**	**7.52**	**866.83**	**22.92**	**5.65**		**0.41**	
Standard Deviation	**1.69**	**0.33**	**132.91**	**0.66**	**2.29**		**0.21**	
Median	**5.98**	**7.50**	**886.50**	**22.80**	**5.00**		**0.40**	

Table 3: Field parameters, color, and turbidity data including qualifiers. “A”= Value reported is the arithmetic mean of two or more determinations; “Q”= Sample held beyond accepted holding time; “U” = Below detection limit.

Qualitative periphyton data was collected from October 17, 2000 through May 24, 2006. Total taxa for periphyton (Figure 3), ranged from approximately 20 taxa to about 50 taxa, however no summary index is currently available to assess the condition of the periphyton community. These data are presented as background information to be used in future analyses.

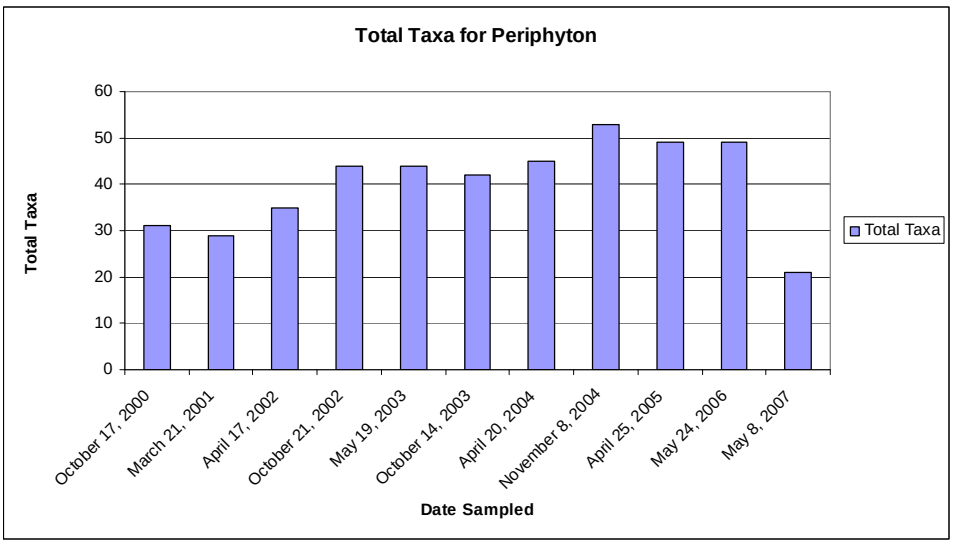


Figure 3: Total number of taxa for periphyton for each sampling event.

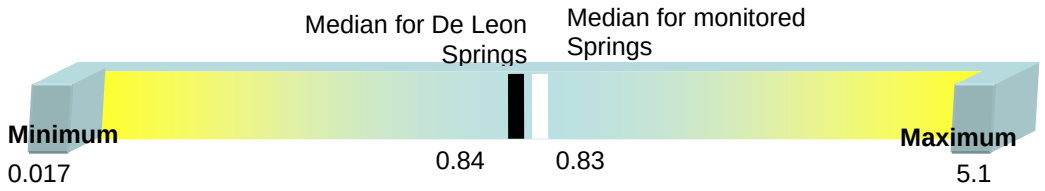
Over the roughly six year sampling period from March 21, 2001 to May 8, 2007, data indicate that:

- Water quality, as measured by transparency, nutrients (except nitrate-nitrate), field parameters and bacteria, was generally good.
- Nitrate-nitrite concentrations have consistently exceeded the values found in approximately 85% of Florida streams, ranging from 0.4 to 1.3 mg/L during the sampling period

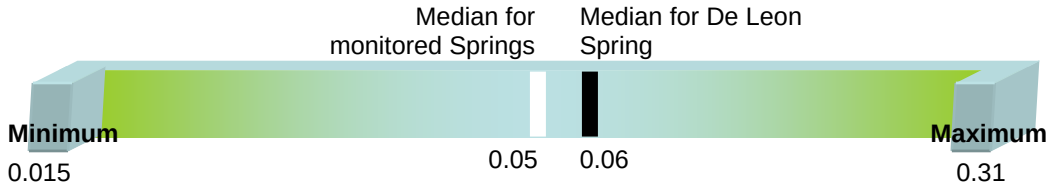
Results for four of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how De Leon Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for De Leon Springs

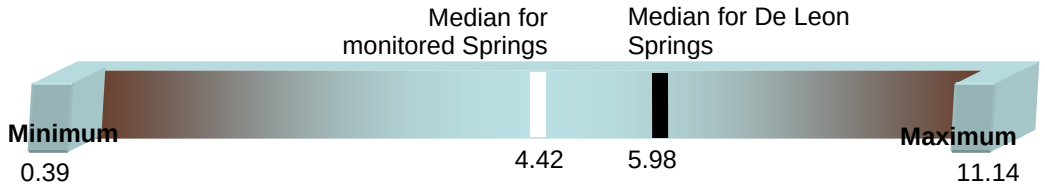
Nitrate-Nitrite



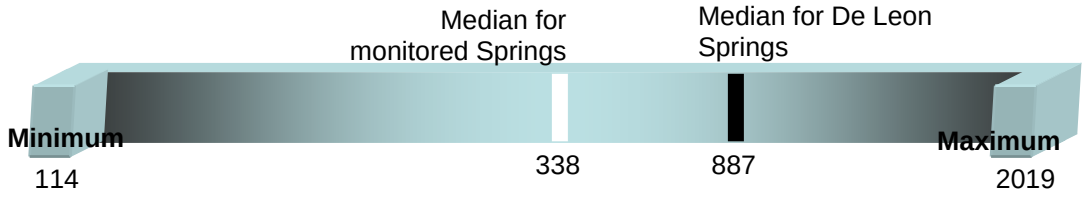
Total Phosphorus



Dissolved Oxygen

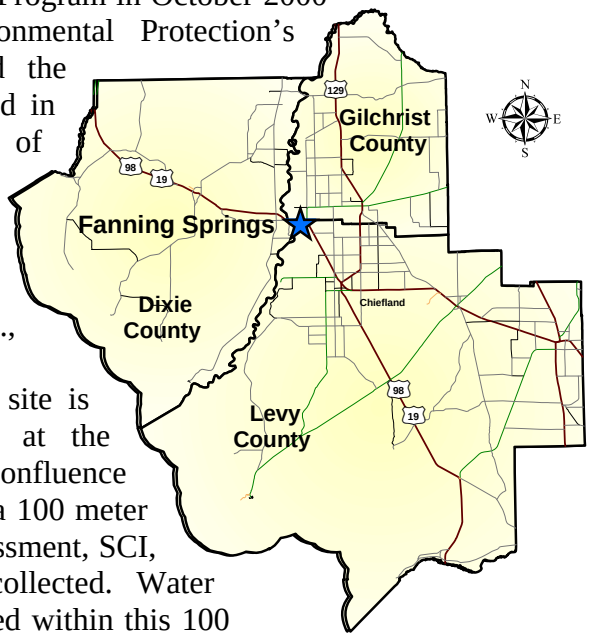


Specific Conductance

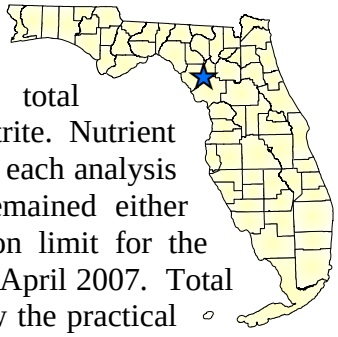


Fanning Springs

Fanning Springs is located in Levy County within Fanning Springs State Park. It is a first magnitude spring, discharging into the Suwannee River. Fanning Springs was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The Fanning Springs monitoring site is located in the spring run, beginning at the headspring, and extending close to the confluence with the Suwannee River. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.



Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia concentrations have remained either below the detection limit or below the practical quantitation limit for the approximately six year sampling period from October 2000 to April 2007. Total Kjeldahl nitrogen remained below the detection limit or below the practical quantitation limit throughout the sampling period as well. Total phosphorus averaged 0.06 mg/L and was less than the 40th percentile compared to typical Florida streams. Total phosphorus concentrations were plotted over time (Figure 1). A visual inspection of the plotted data does not indicate an increase or decrease in total phosphorus over time. Nitrate-nitrite concentrations were extremely elevated, averaging 4.59 mg/L and ranging from 4.0 to 5.1 mg/L over the sampling period. A visual inspection of the plotted data does not indicate any obvious trend in the nitrate-nitrite data over time. These concentrations of nitrate-nitrite (greatly exceeding 95% of other Florida streams) are probably a result of anthropogenic nutrient loading within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 4, 2000	0.01	U	0.06	U	0.065		4	
May 15, 2002	0.01	U	0.06	U	0.065		4.3	
November 7, 2002	0.012	I	0.1	I	0.074		4.9	
May 20, 2003	0.01	U	0.084	I	0.077		4.7	
October 28, 2003	0.01	U	0.07	I	0.06		5.1	
April 23, 2004	0.01	U	0.089	I	0.09		4.7	
November 14, 2006	0.01	U	0.097	I	0.02	U	4.8	
April 25, 2007	0.01	U	0.08	U	0.066		4.2	
Average	**0.01**		**0.08**		**0.06**		**4.59**	
Standard Deviation	**0.00**		**0.02**		**0.02**		**0.38**	
Median	**0.01**		**0.08**		**0.07**		**4.70**	

Table 1: Nutrient data including qualifier codes and summary statistics. “I” = Below practical quantitation limit; “U” = Below detection limit.

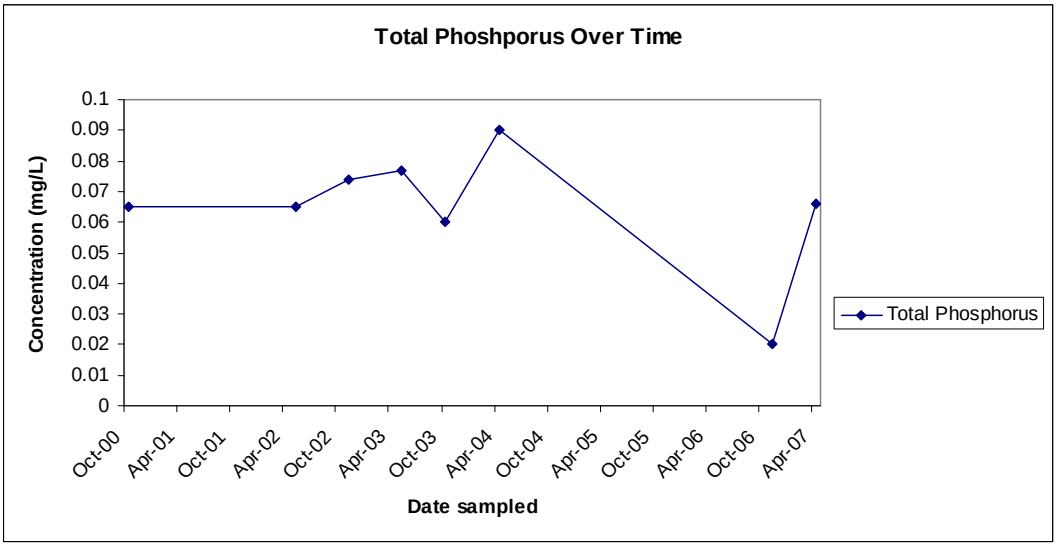


Figure 1: Total Phosphorus values plotted over time.

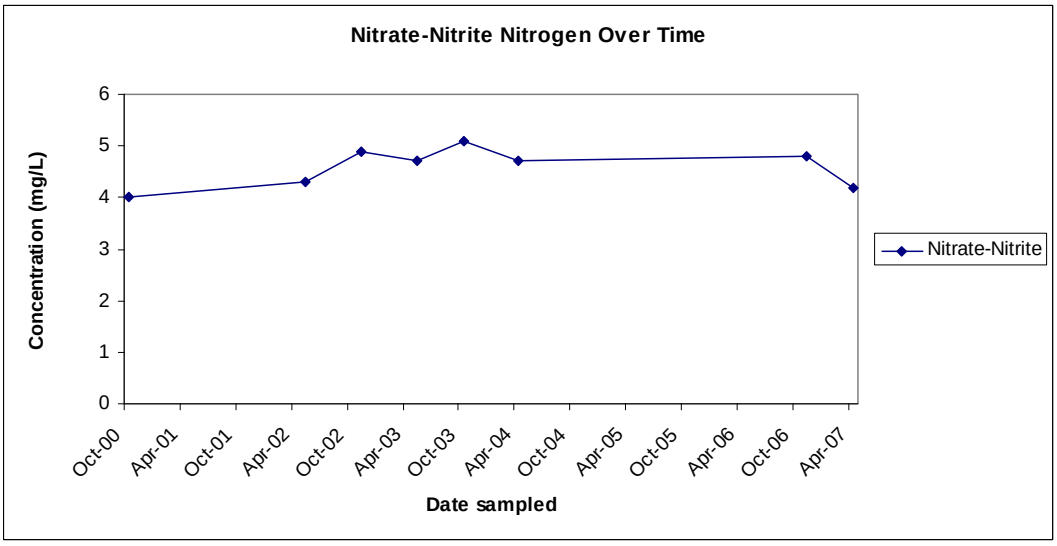


Figure 2: Nitrate-nitrite values plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci,* fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have complied with the "single sample" standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, ranging from 1 to 88 CFU/100 mL with a median of 2 CFU/100 mL. *Enterococci* data have ranged from 1 to 74 CFU/100 mL over the sampling period, with a median of 4 CFU/100 mL. The median is lower than the freshwater standard of 61 CFU/100 mL for designated beach areas. The *Enterococci* value of 74 CFU/100 mL recorded on October 4, 2000 exceeded the standard for designated beach areas. However, this sample exceeded the holding time, making the results suspect. Additionally, *Enterococci* concentrations such as these may be the result of a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 1 to 76 CFU/100 mL, with a median of 2 CFU/100 mL. Total coliform data have ranged from 10 to 310 CFU/100 mL with a median of 22 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 4, 2000	74	Q	88	Q	76	Q	310	Q
May 15, 2002	1	K	2		1	K	10	
November 7, 2002	1	KQ	12	Q	14	Q	20	Q
May 20, 2003	2		1	K	1	K	10	
October 28, 2003	6	BQ	1	KQ	2	BQ	10	BQ
April 23, 2004	40		40		25	B	60	
November 14, 2006	2	KQ	2	KQ	2	KQ	56	Q
April 25, 2007	6	BQ	2	BQ	2	BQ	24	BQ
Average	**17**		**19**		**15**		**63**	
Standard Deviation	**27**		**31**		**26**		**102**	
Median	**4**		**2**		**2**		**22**	

Table 2: Microbiology data including qualifier codes and summary statistics. "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given. "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) as well as data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from October 2000 to April 2007, dissolved oxygen was consistently less than the Class III water quality standard (5.0 mg/L), averaging 3.0 mg/L, and ranging from 2.1 to 4.2 mg/L. This low DO regime (a natural condition for headwater spring systems) can eliminate sensitive taxa from the system. Temperature was stable, averaging 22.4 degrees Celsius with a range of 0.2 degrees C. Specific conductivity was somewhat elevated, averaging 467 umhos/cm, ranging from 437 umhos/cm to 486 umhos/cm. Many sensitive macroinvertebrate taxa are adversely affected at conductivities in this range and higher. The mean pH was 6.9 SU, ranging from 6.3 to 7.2 SU. Turbidity was consistently low (averaging 0.2 NTU) and color values were below the detection limit with the exception of 10 PCU measured on October 4, 2000. This color detection is likely due to tannic inputs from Suwannee River at the time the sample was collected.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 4, 2000	No Result	No Result	No Result	No Result	10	Q	0.35	Q
May 15, 2002	2.07	7.06	458	22.5	5	U	0.05	U
November 7, 2002	3	6.8	472	22.5	5	U	0.05	U
May 20, 2003	2.7	7	469	22.3	5	U	0.2	
October 28, 2003	2.7	6.3	486	22.4	5	U	0.1	
April 23, 2004	4.21	7.21	437	22.4	5		0.35	
November 14, 2006	3.03	7.08	479	22.41	5	U	0.1	
April 25, 2007	No Result	No Result	No Result	No Result	5	U	0.55	
Average	**2.95**	**6.91**	**466.83**	**22.42**	**5.63**		**0.22**	
Standard Deviation	**0.71**	**0.33**	**17.41**	**0.07**	**1.77**		**0.18**	
Median	**2.85**	**7.03**	**470.50**	**22.41**	**5.00**		**0.15**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics. “Q” = Outside of holding time; “U”= Below detection limit.

Habitat Assessments and Stream Condition Index (SCI) were performed from October 4, 2000 to April 25, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. All SCI samples scored in the impaired category, probably due to the high specific conductivity and frequent low DO observed at this site. Both factors would reduce the number of sensitive organisms, and potentially lead to shifts in community structure. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa were variable over the sampling period, ranging from 8 to 32 taxa. The number of sensitive taxa was zero for most of the sampling period, but two sensitive taxa were found in 2003-2004 (Figure 5). Habitat Assessment scores over time have remained in the suboptimal category with one sample (April 25, 2007) scoring in the optimal category (Figure 6). Suboptimal Habitat Assessment scores were predominantly due to lack of a variety and availability of productive habitats, low water velocity, and some algal smothering. These factors reduce the numbers and types of macroinvertebrates found in the system.

Old SCI Scores	
October 4, 2000	19
May 15, 2002	9
November 7,2002	15
May 20, 2003	15
October 28, 2003	17
April 23, 2004	9

Recalibrated SCI Scores	
November 14, 2006	14
April 25, 2007	16

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

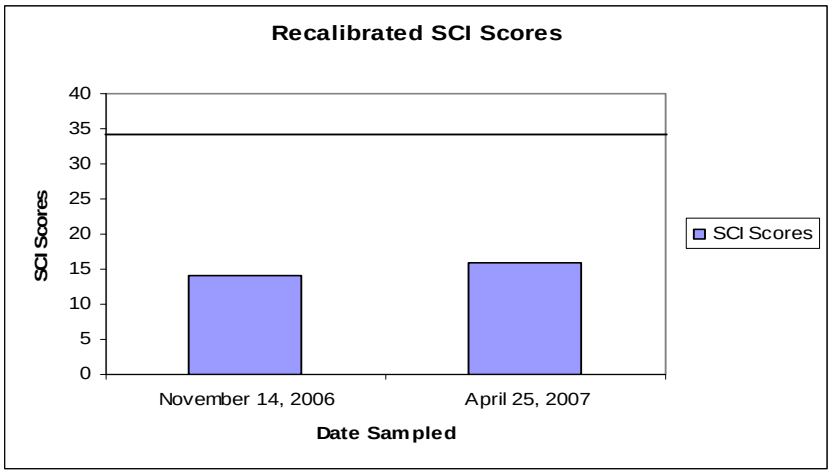


Figure 3: Recalibrated SCI scores.

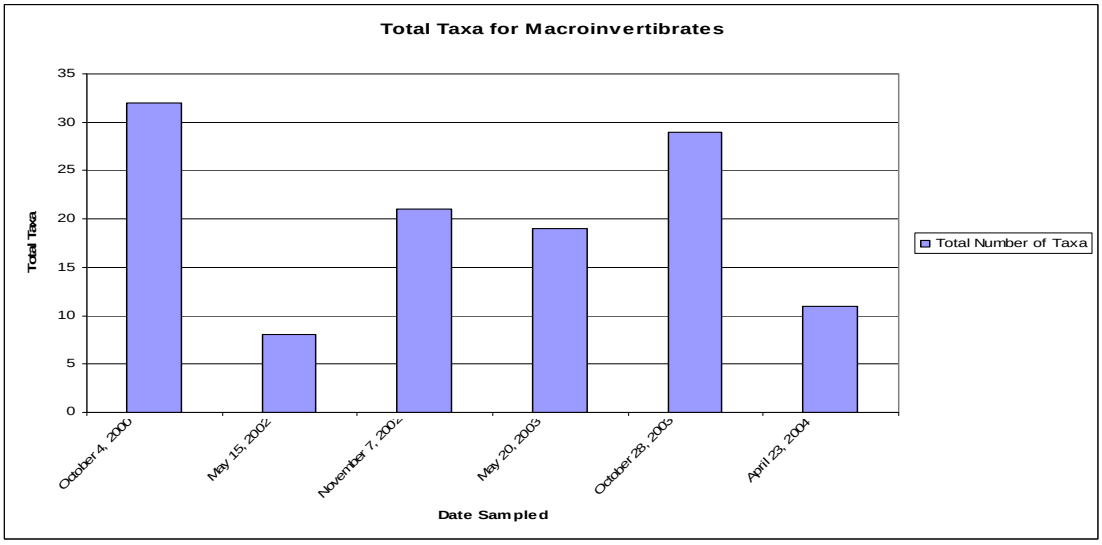


Figure 4: Total number of macroinvertebrate taxa for each sampling event.

Date	Sensitive Taxa
8/4/2000	0
5/15/2002	0
11/7/2002	0
5/20/2003	1
10/28/2003	2
4/23/2004	2

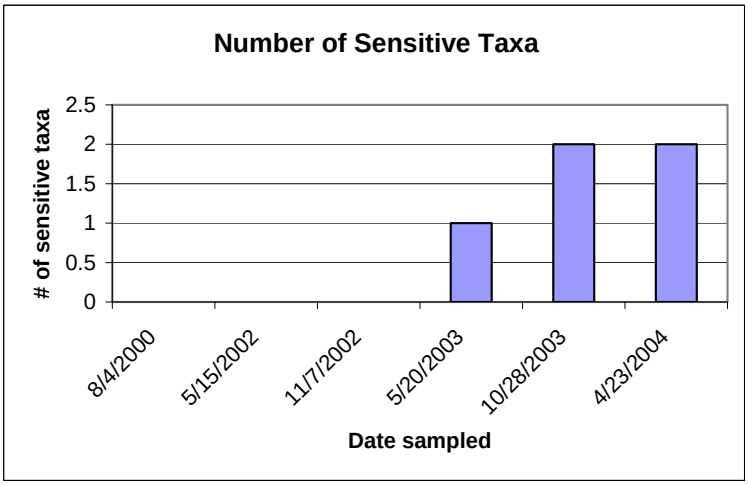


Figure 5: Chart and graph of the number of sensitive taxa over the sampling period.

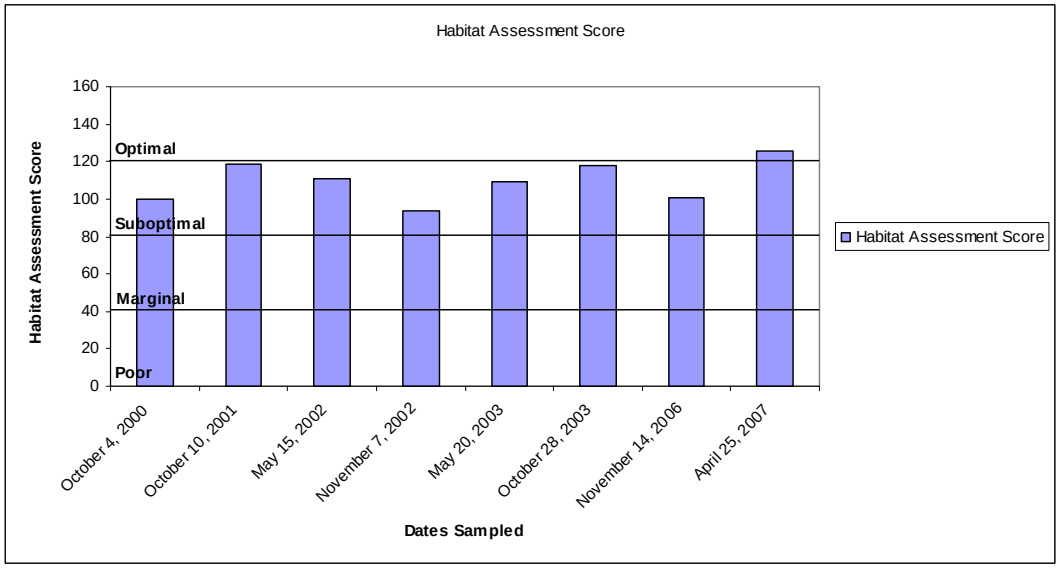


Figure 6: Habitat assessment score for each sampling event.

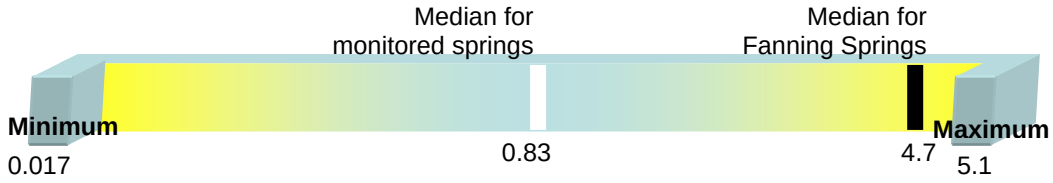
Over the roughly six year sampling period from October 4, 2000 to April 25, 2007 data indicate the following:

- Water quality, as measured by nutrients (except nitrate-nitrite), water clarity, and bacterial densities suggested excellent conditions.
- Nitrate-nitrite nitrogen concentrations were extremely elevated, ranging from 4.0 to 5.1 mg/L over the sampling period (levels which greatly exceed 95% of other Florida streams), likely due to anthropogenic activities.
- Low dissolved oxygen and somewhat elevated conductivity (both natural conditions) appeared to be related to the poor quality invertebrate community present.
- SCI scores have remained below the impairment threshold, characterized by a paucity of sensitive taxa. This condition is probably mostly related to the DO and conductivity issues, but lack of substrate diversity and algal smothering may have also played a role.

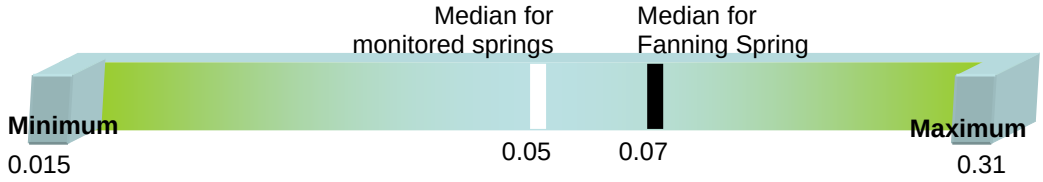
Results for five of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Fanning Springs compares with the median score for the 18 springs in the monitoring program.

Monitoring Summary for Fanning Springs

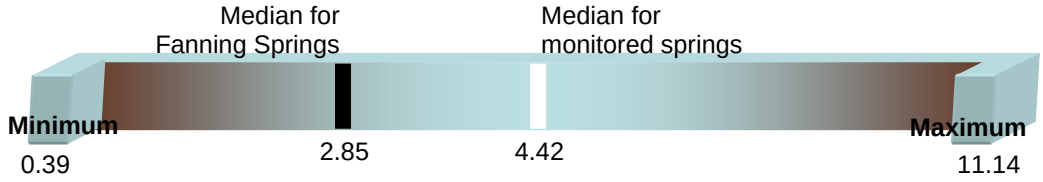
Nitrate-Nitrite (mg/L)



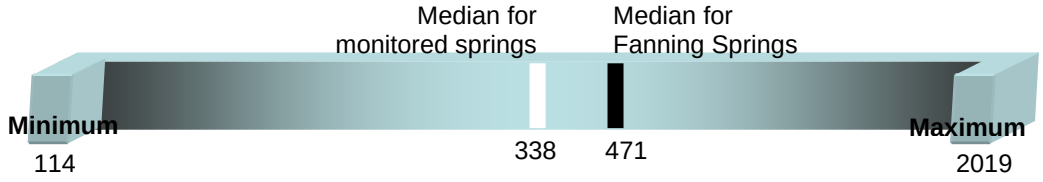
Total Phosphorus (mg/L)



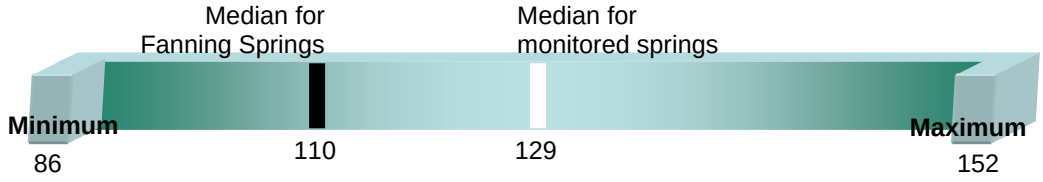
Dissolved Oxygen (mg/L)



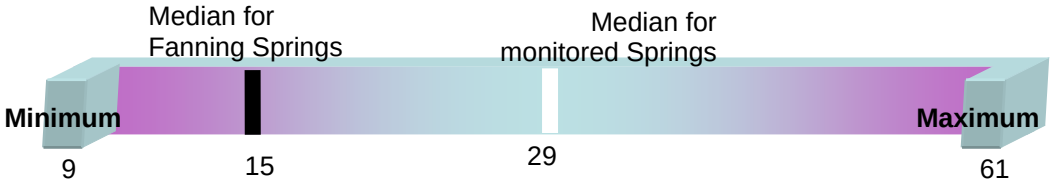
Specific Conductance (umhos/cm)



Habitat Assessment Score

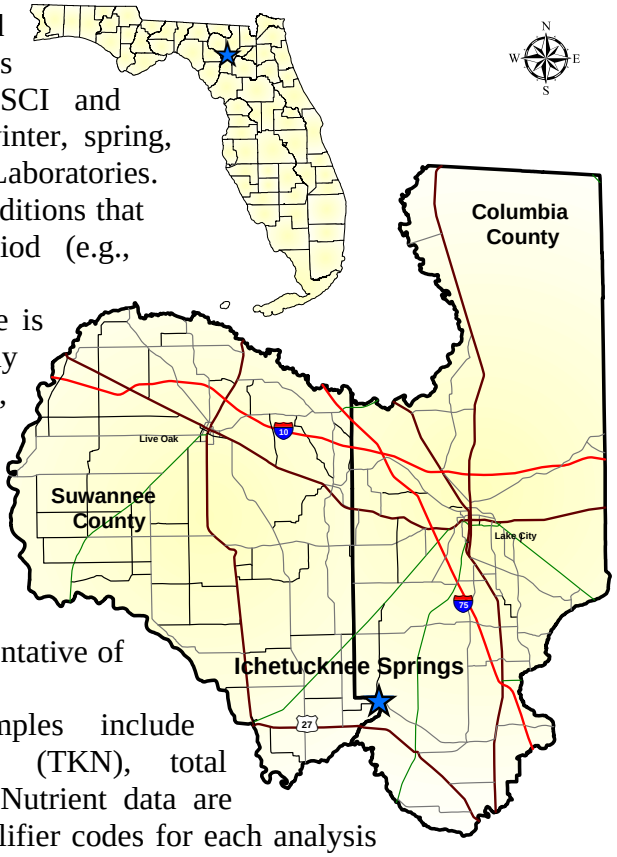


Stream Condition Index



Ichetucknee Springs

The spring-dominated Ichetucknee River, located in Columbia and Suwannee Counties, begins within Ichetucknee Springs State Park. The system, which flows into the Santa Fe River, is fed by several large springs, some of which are first magnitude springs. The Ichetucknee River was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled quarterly, with chemistry, SCI and periphyton collections performed in winter, spring, summer and fall by the Bureau of Laboratories. Missing sampling events are due to conditions that prohibited sampling during that period (e.g., hurricanes).



The Ichetucknee monitoring site is located in the spring run, approximately two miles south of the headspring, within the park limits. It consists of a 100 meter reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter reach in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia detections have generally remained low compared to other Florida streams, and the values were mostly below the detection limit or below the practical quantitation limit. Total Kjeldahl nitrogen remained below the detection limit or below the practical quantitation limit for the sampling period. These consistently low concentrations indicate no organic nitrogen enrichment. Total phosphorus averaged 0.07 mg/L throughout the sampling period, with values ranging from the 20th to 50th percentile values compared to typical Florida streams. A visual inspection of the plotted total phosphorus data does not suggest an increase or decrease of TP over time (Figure 1). The phosphorus concentrations present probably reflect the leaching of natural phosphate deposits in this groundwater-fed spring system. Nitrate-nitrite concentrations have ranged from 0.34 to 0.6 mg/L over the sampling period and are generally higher than the values found in 80% to 90% of typical Florida streams. A visual inspection of the data suggests a sinusoidal pattern in nitrate-nitrite over time, however the data are not sufficient to determine statistically any significant trends (Figure 2). These consistently elevated nitrate-nitrite concentrations are probably due to anthropogenic nutrient inputs within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 5, 2000	0.01	U	0.073	I	0.075		0.54	
October 15, 2001	0.01	U	0.06	U	0.056		0.43	
April 9, 2002	0.01	U	0.06	U	0.056		0.45	
August 28, 2002	0.013	I	0.06	U	0.073		0.41	
June 5, 2003	0.012	I	0.095	I	0.068		0.34	
July 31, 2003	0.072	Y	0.13	IY	0.068	Y	0.39	Y
September 30, 2003	0.01	U	0.079	I	0.066	A	0.38	
April 27, 2004	0.01	U	0.06	U	0.07		0.39	
August 25, 2004	0.01	U	0.06	U	0.081		0.52	
November 18, 2004	0.03		0.074	I	0.051	I	0.46	
January 28, 2005	0.011	I	0.06	I	0.086		0.48	
January 25, 2006	0.01	U	0.08	U	0.076		0.58	
April 18, 2006	0.01	U	0.08	U	0.055	I	0.57	
July 19, 2006	0.01	U	0.08	U	0.12		0.55	
December 13, 2006	0.01	U	0.08	U	0.058	I	0.6	
January 31, 2007	0.01	U	0.08	U	0.058	I	0.57	
May 1, 2007	0.01	U	0.08	U	0.043	I	0.49	
Average	**0.02**		**0.08**		**0.07**		**0.48**	
Standard Deviation	**0.02**		**0.02**		**0.02**		**0.08**	
Median	**0.01**		**0.08**		**0.07**		**0.48**	

Table 1: Nutrient data for Ichetucknee Springs including qualifier codes and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "I" = Below practical quantitation limit; "U" = Below detection limit; "Y"= Improperly preserved.

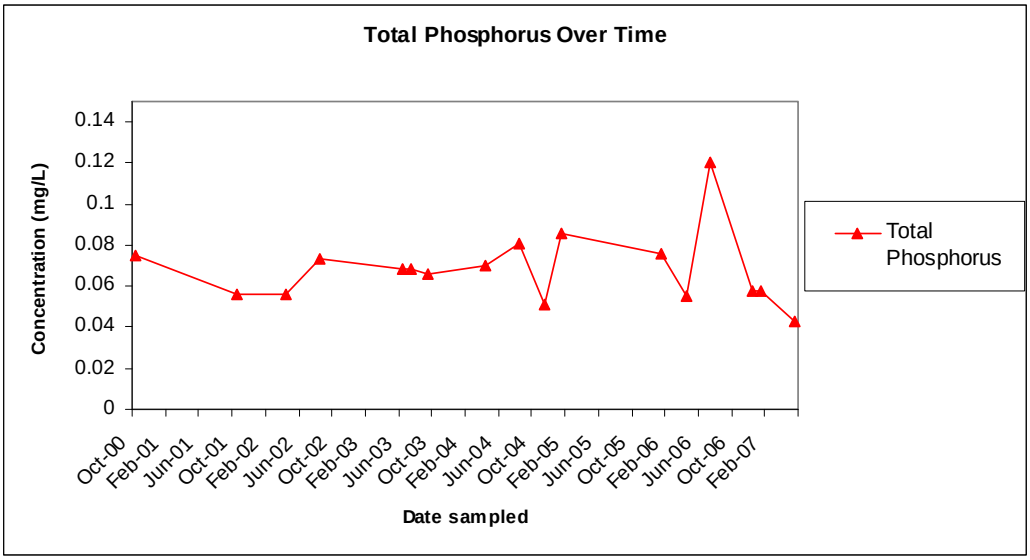


Figure 1: Total Phosphorus data plotted over time for Ichetucknee Springs.

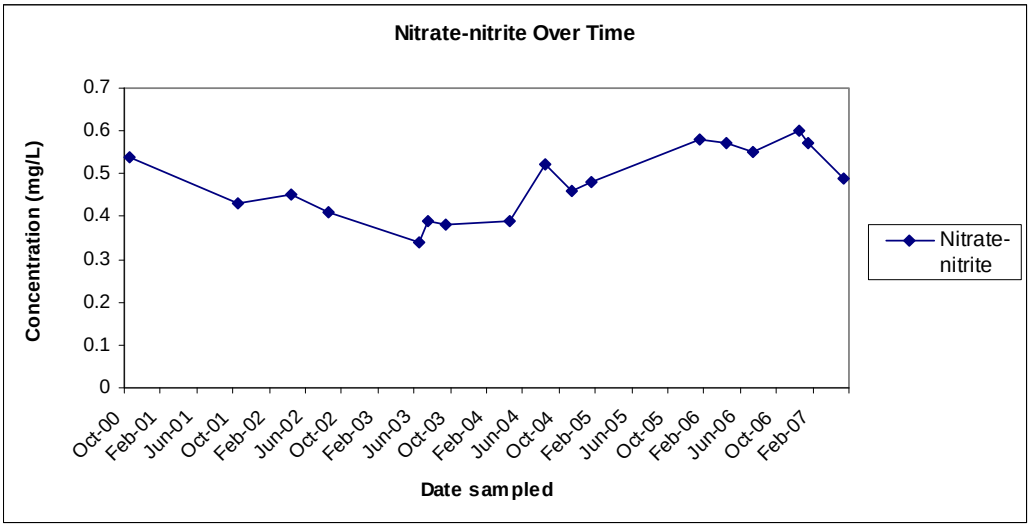


Figure 2: Nitrate-nitrite data plotted over time for Ichetucknee Springs.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 65 CFU/100 mL. *Enterococci* data have ranged from 26 to 188 CFU/100 mL over the sampling period, with a median of 81 CFU/100 mL. This median is higher than the freshwater "designated beach" criterion of 61 CFU/100 mL. The use of *Enterococci* as a human waste indicator may not be appropriate in relatively warm-water systems, such as springs. Other studies, including one by the Bureau of Laboratories, have found that *Enterococci* sources include plant material and soil, and therefore, the *Enterococci* densities in the Ichetucknee may be a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 10 to 242 CFU/100 mL, with a median of 61 CFU/100 mL. Total coliform data have ranged from 58 to 1200 CFU/100 mL. The median total coliform value was 222 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 5, 2000	180	Q	70	Q	72	Q	690	Q
March 14, 2001	180		76		100		470	
October 15, 2001	130		170		210		540	
April 9, 2002	102		122		130		1100	
August 28, 2002	80	Q	34	Q	30	Q	1200	Q
June 5, 2003	67	AQ	56	AQ	41	AQ	58	AQ
July 31, 2003	82	Q	70	Q	66	Q	760	Q
September 30, 2003	82	Q	60	Q	110	Q	500	Q
April 27, 2004	70	Q	8	BQ	10	BQ	200	Q
August 25, 2004	48		54		46		320	
November 18, 2004	31	AB	44	AB	42	A	197	AB
January 28, 2005	40		70		56		200	
January 25, 2006	26	BQ	232	BQ	242	BQ	244	BQ
April 18, 2006	76		74		80		152	
July 19, 2006	28	ABQ	50	AQ	46	AQ	70	AQ
December 13, 2006	188	B	74		70		96	
January 31, 2007	88	Q	48	Q	36	BQ	82	Q
May 1, 2007	98	Q	20	BQ	12	BQ	68	Q
Average	**89**		**74**		**78**		**386**	
Standard Deviation	**51**		**53**		**63**		**353**	
Median	**81**		**65**		**61**		**222**	

Table 2: Bacteriological data including qualifier codes for Ichetucknee Springs and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes), and data for turbidity and color are shown in Table 3. Average, standard deviation, and median values were determined for each of these parameters. Over the sampling period from October 2000 to May 2007, dissolved oxygen averaged 5.5 mg/L, ranging from 4.0 to 7.3 mg/L. Six of the fifteen measurements (40%) were below the Class III water quality standard of 5 mg/L. This periodically low DO can have a negative affect on DO sensitive macroinvertebrates. Temperature was stable, averaging 21.4 degrees Celsius. Specific conductivity was slightly elevated, averaging 306 umhos/cm and ranging from 269 to 324 umhos/cm. The slightly elevated conductivity appears to be a natural characteristic, associated with inorganic dissolved solids in the groundwater. However, this naturally higher conductivity may exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.4 SU, ranging from 6.8 to 7.8 SU. Turbidity was very low, averaging 0.4 NTU, and color values were below the detection limit with the exception of 10 PCU measured on January 28, 2005 (potentially due to tannic input from the floodplain).

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 5, 2000	No Result	7.5	299	22	5		0.15	
March 14, 2001	6.5	7.8	299	20.9	No Result		No Result	
October 15, 2001	4.03	7.53	284	21.07	5	U	0.2	
April 9, 2002	4.5	7.3	322	21.2	5	U	0.3	
August 28, 2002	4.35	7.56	303	21.82	5	U	0.2	
June 5, 2003	6	7.47	269	21.7	5		0.4	
July 31, 2003	6.7	7.4	324	21.8	5	UQ	0.55	Q
September 30, 2003	6.26	7.38	315	21.27	5	Q	0.2	Q
April 27, 2004	5.8	7.8	296	21.2	5		0.3	
August 25, 2004	No Result	7.47	321	21.8	5	U	0.2	
November 18, 2004	5.5	7.7	307	20.6	5	U	0.25	
January 28, 2005	7.3	7.6	288	20.7	10		0.25	
January 25, 2006	No Result	No Result	No Result	No Result	5		1.1	
April 18, 2006	4.55	7.1	309	21.6	5	U	0.65	
July 19, 2006	5.95	7.11	312	22.3	5		0.6	
December 13, 2006	4.14	7.27	313	21.29	5	U	0.4	
January 31, 2007	4.97	7.03	320	20.37	5	U	0.2	
May 1, 2007	6	6.8	318	21.25	5	U	0.2	
Average	**5.50**	**7.40**	**305.82**	**21.35**	**5.29**		**0.36**	
Standard Deviation	**1.02**	**0.28**	**15.22**	**0.53**	**1.21**		**0.24**	
Median	**5.80**	**7.47**	**309.00**	**21.27**	**5.00**		**0.25**	

Table 3: Field parameters, color, and turbidity data including qualifier codes for Ichetucknee Springs and summary statistics. "Q" = Outside of holding time; "U"= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from October 5, 2000 to May 1, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores are plotted over time in Figure 3. In 13 of the 16 samplings (81%) SCI scores indicated that a healthy macroinvertebrate community was present in the Ichetucknee River. The cause for the most recent dip in SCI score is not currently known. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macro-invertebrate community has not. Total taxa for each sampling date over the entire sampling period are displayed in Figure 6. Total taxa over all the dates ranged from 16 to 43 taxa. The number of sensitive taxa varied over the sampling period, ranging from 1 to 6 sensitive taxa. The average number of sensitive taxa was 4, reflecting the overall healthy macroinvertebrate community. Habitat Assessment scores consistently remained within the optimal category, suggesting adequate habitat for macroinvertebrate communities (Figure 8).

Old SCI Scores	
Oct 5, 2000	31
Mar 14, 2001	33
Oct 15, 2001	17
Apr 9, 2002	23
Aug 28, 2002	17
Jun 5, 2003	29
Jul 31, 2003	33
Sep 30, 2003	29
Apr 27, 2004	23

Recalibrated SCI Scores	
Aug 25, 2004	36
Nov 18, 2004	44
Jan 28, 2005	57
Jan 25, 2006	56
Apr 18, 2006	40
Jul 19, 2006	43
May 1, 2007	30

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

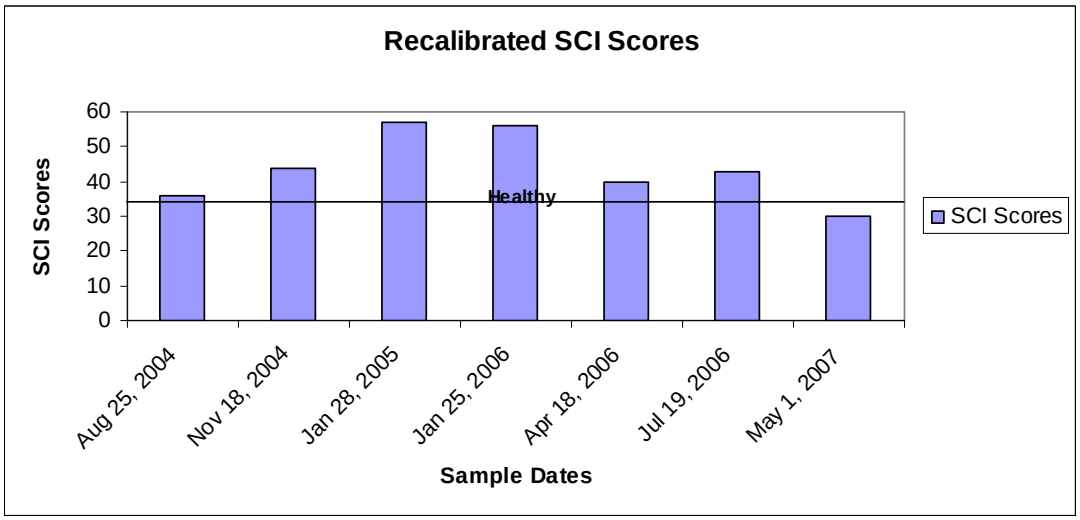


Figure 3: Recalibrated SCI scores over the period from August 25, 2004 to July 19, 2006 showing the impairment line at 34.

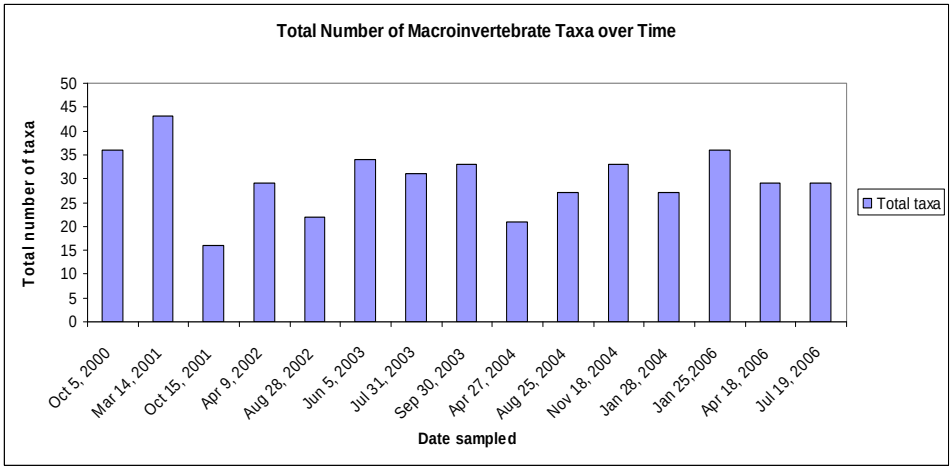


Figure 4: Total macroinvertebrate taxa plotted over time for Ichetucknee Springs.

Date	Sensitive Taxa
10/5/2000	4
3/14/2001	5
10/15/2001	1
4/9/2002	3
8/28/2002	1
6/5/2003	2
7/31/2003	6
9/30/2003	5
4/27/2004	4
8/25/2004	4
11/18/2004	3
1/28/2005	6
1/25/2006	4
4/18/2006	4
7/19/2006	5

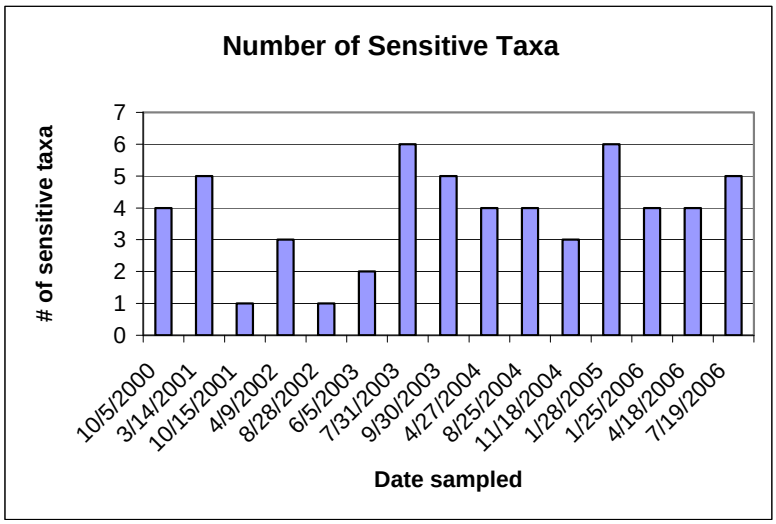


Figure 5: Chart and table showing number of sensitive taxa over the sampling period.

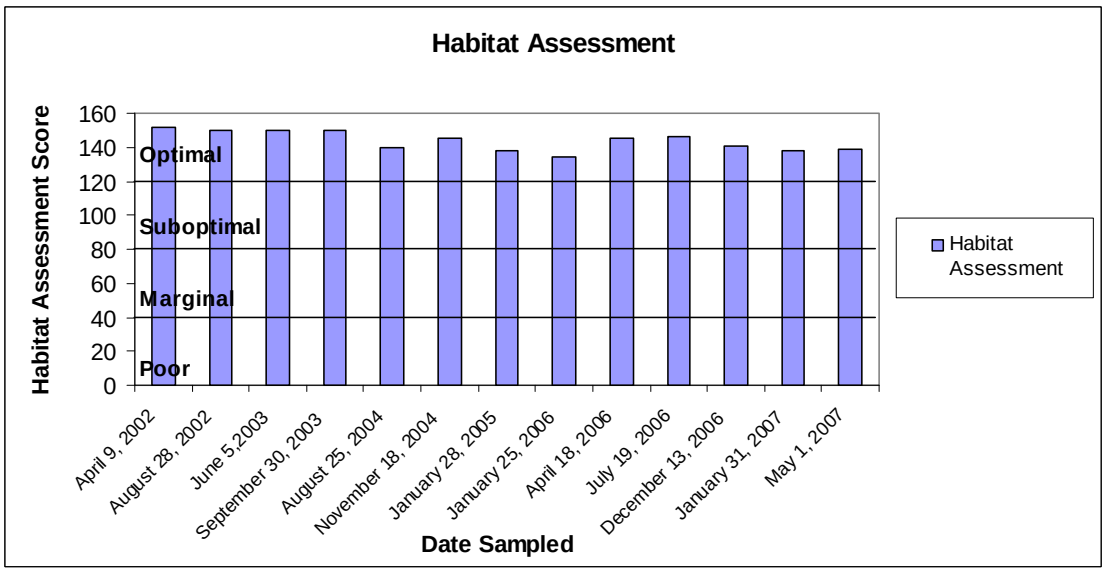


Figure 6: Habitat assessment scores over time.

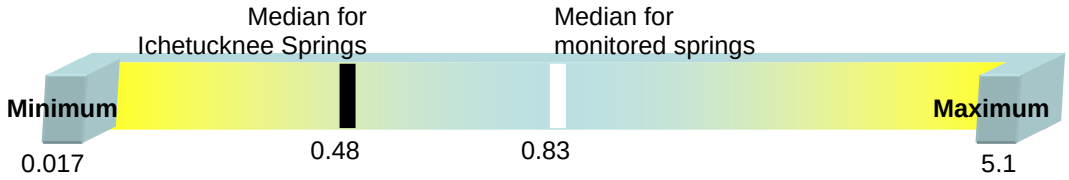
During the sampling period from October 5, 2000 to January 31, 2007, data indicate that:

- Water quality, as measured by transparency, nutrients (except nitrate-nitrate), field parameters and bacteria, was generally good.
- Nitrate-nitrite concentrations have ranged from 0.34 to 0.6 mg/L over the sampling period, and are generally higher than the values found in 80% to 90% of typical Florida streams.
- The vast majority of Stream Condition Index biological samples indicate that healthy conditions prevail in the system.
- Habitat scores are consistently within the optimal range.

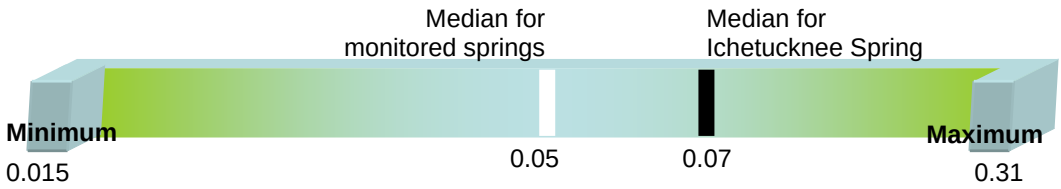
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Ichetucknee Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Ichetucknee Springs

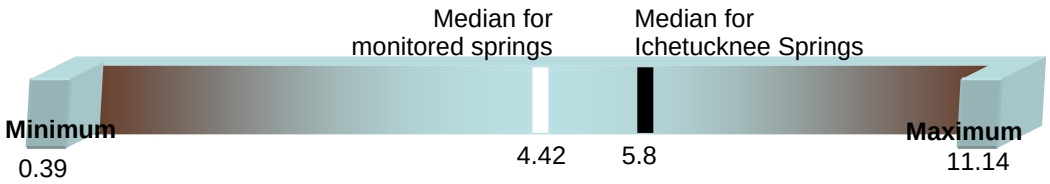
Nitrate-Nitrite (mg/L)



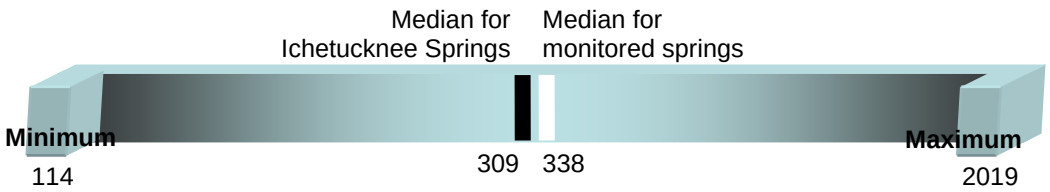
Total Phosphorus (mg/L)



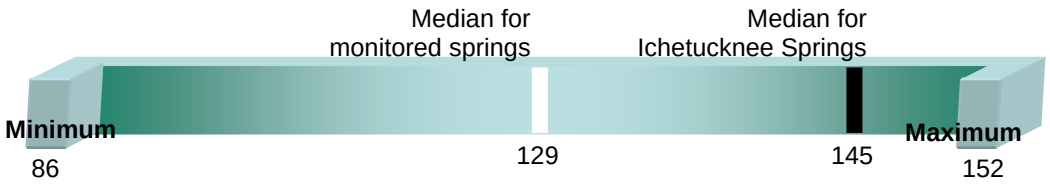
Dissolved Oxygen (mg/L)



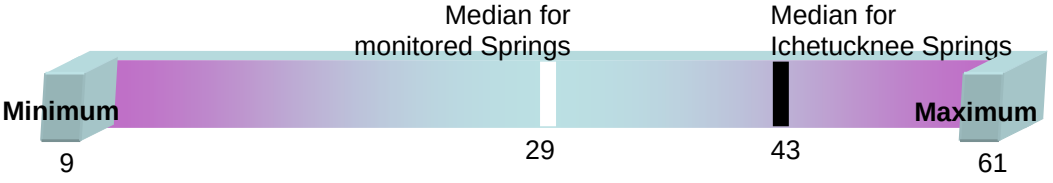
Specific Conductance (umhos/cm)



Habitat Assessment Score

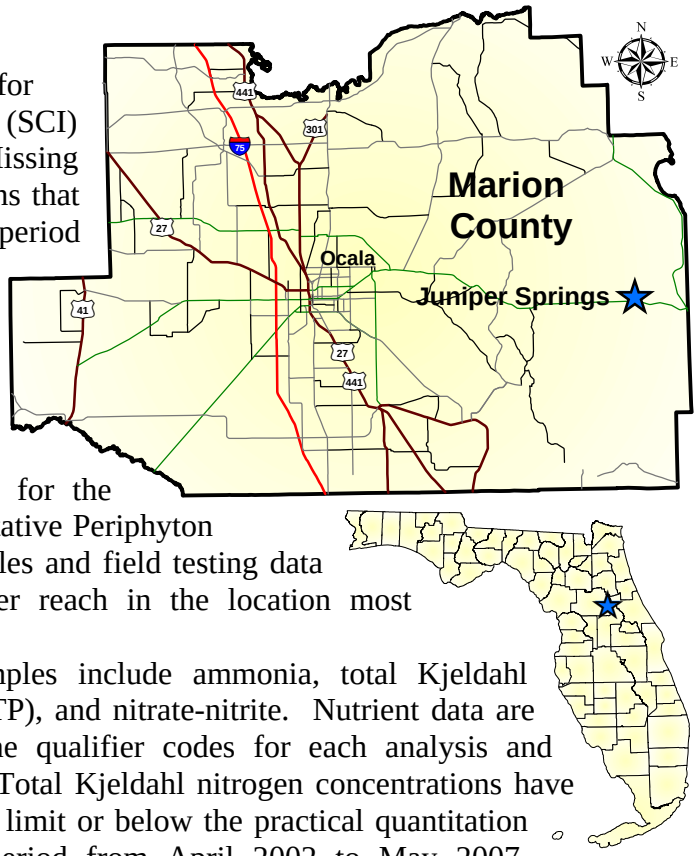


Stream Condition Index



Juniper Springs

Juniper Springs is located in Marion County, within the Ocala National Forest. It is a second magnitude spring which flows (via Juniper Creek) into Lake George. Juniper Springs was incorporated into the Springs Monitoring Program in April 2002 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (e.g., hurricanes).



The Juniper Spring monitoring site is located in Juniper Creek, just below the confluence of Fern Hammock Spring Run. It consists of a 100 meter stream reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter reach in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and Total Kjeldahl nitrogen concentrations have remained either below the detection limit or below the practical quantitation limit for the five-year sampling period from April 2002 to May 2007. Similarly, total phosphorus has remained below the practical quantitation limit throughout the sampling period. Total phosphorus data is plotted over time in Figure 1. A trend could not be determined because detections between the practical quantitation limit and the method detection limit are considered qualitative, making determination of a statistical trend difficult. Nitrate-nitrite concentrations have remained relatively low throughout the sampling period, ranging from 0.06 to 0.08 mg/L. A visual inspection of the data plotted over the sampling period does not suggest an increase or decrease in nitrate-nitrite over time. These concentrations are thought to be part of the natural background condition, and are among the lowest in Florida springs.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
April 9, 2002	0.01	U	0.06	U	0.036	I	0.072	
October 14, 2002	0.01	U	0.071	I	0.029	I	0.075	
April 15, 2003	0.01	U	0.06	U	0.029		0.073	
October 13, 2003	0.01	U	0.06	U	0.035	I	0.075	
May 4, 2004	0.01	U	0.06	U	0.056	I	0.077	
April 20, 2005	0.01	U	0.06	U	0.021	I	0.067	
June 8, 2006	0.01	U	0.08	U	0.021	I	0.062	
November 30, 2006	0.01	U	0.08	U	0.02	U	0.069	
May 16, 2007	0.01	U	0.08	U	0.036	I	0.077	
Average	**0.01**		**0.07**		**0.03**		**0.07**	
Standard Deviation	**0.00**		**0.01**		**0.01**		**0.01**	
Median	**0.01**		**0.06**		**0.03**		**0.07**	

Table 1: Nutrient data including qualifier codes and summary statistics. "I" = Below practical quantitation limit; "U" = Below detection limit.

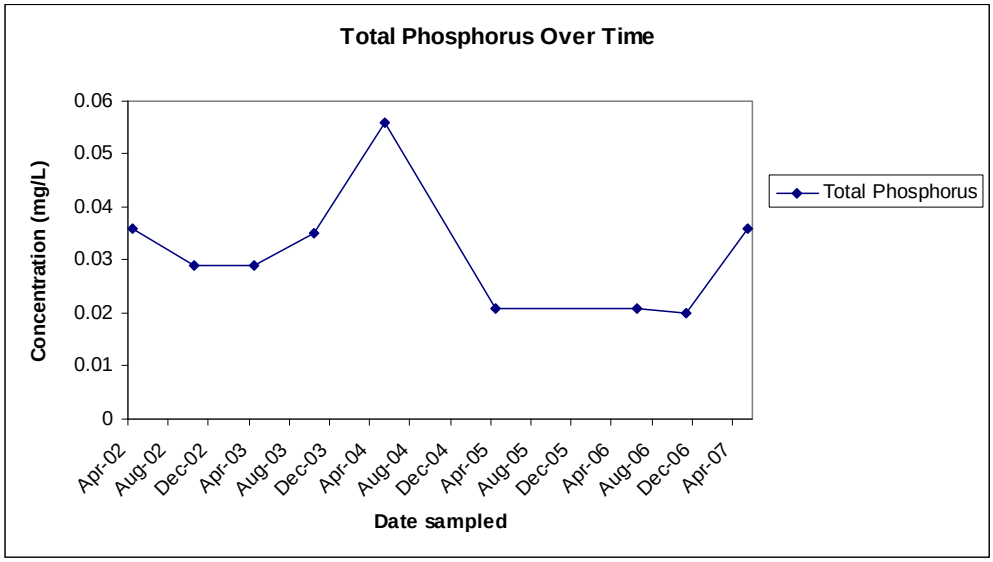


Figure 1: Total Phosphorus concentrations plotted over time.

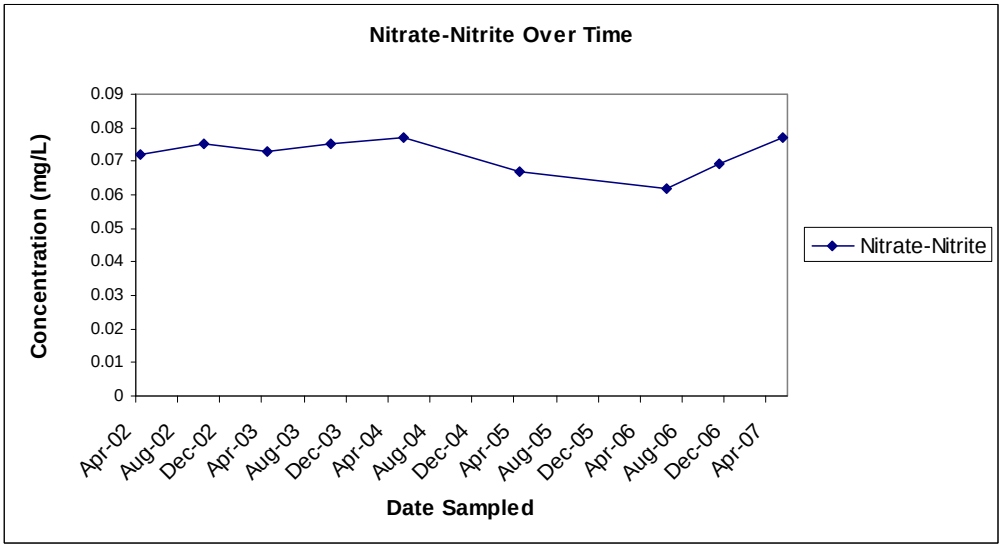


Figure 2: Nitrate-nitrite concentrations plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci,* fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have ranged from 20 to 440 CFU/100 mL, with a median of 203 CFU/100 mL. Some of these values have exceeded the standard of 235 CFU/100 mL for "designated freshwater beach areas". The source of the *E. coli* is not known. *Enterococci* data have ranged from 8 to 1300 CFU/100 mL over the sampling period, with a median of 265 CFU/100 mL. This median is considerably higher than the freshwater standard of 61 CFU/100 mL for designated beach areas. Although the source of the *Enterococci* in Juniper Creek is not known, use of *Enterococci* as a human waste indicator may not be appropriate in relatively warm-water systems, such as springs. Studies have found that *Enterococci* sources include plant material and soil, and therefore, the *Enterococci* densities in Juniper Creek may be a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standards ranging from 12 to 450 CFU/100 mL over the sampling period with a median of 124 CFU/100 mL. Total coliform data have ranged from 82 to 1200 CFU/100 mL, with a median of 350 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
April 9, 2002	270	Q	112	Q	112	Q	310	Q
October 14, 2002	200	Q	440	Q	450	Q	1200	Q
April 15, 2003	8	Q	206	Q	128	Q	320	Q
October 13, 2003	1300	BQ	200	Q	280	Q	1200	BQ
May 4, 2004	No Result		No Result		No Result		No Result	
April 20, 2005	16	BQ	20	BQ	12	BQ	82	Q
June 8, 2006	300	Q	380	Q	118	Q	660	Q
November 30, 2006	472	BQ	336	BQ	376	BQ	380	BQ
May 16, 2007	260	Q	128	BQ	120	Q	290	Q
Average	**353**		**228**		**200**		**555**	
Standard Deviation	**411**		**145**		**152**		**428**	
Median	**265**		**203**		**124**		**350**	

Table 2: Bacteriological data including qualifier codes and summary statistics: "B" = Results based on colony counts outside the acceptable range; "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from April 2002-May 2007, dissolved oxygen was consistently higher than the Class III water quality standard of 5 mg/L, averaging 8.0 mg/L and ranging from 6.5 to 9.7 mg/L. Temperature was stable, averaging 22.1 degrees Celsius. Specific conductivity was low, averaging 124 umhos/cm and ranging from 144 to 128 umhos/cm. The mean pH was 8.0 SU, ranging from 7.5 to 8.4 SU. Transparency was excellent throughout the sampling period, with turbidity averaging 0.3 NTU and color measurements remaining below the detection limit.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
April 9, 2002	8.4	8.3	124	22.29	5	U	0.15	
October 14, 2002	9.72	8	127	22.41	5		0.4	
April 15, 2003	7.72	8.3	118	21.88	5	U	0.3	
October 13, 2003	7.1	7.5	114	22.3	5	Q	0.42	Q
May 4, 2004	7.65	8.3	128	21.9	5	UQ	0.4	Q
April 20, 2005	7.7	8.3	126	21.8	5	U	0.25	
June 8, 2006	8.67	7.9	124	22.63	5		0.25	AQ
November 30, 2006	6.5	7.7	127	21.6	5	U	0.25	
May 16, 2007	8.25	7.9	130	21.75	5	U	0.2	
Average	**7.97**	**8.02**	**124.22**	**22.06**	**5.00**		**0.29**	
Standard Deviation	**0.93**	**0.30**	**5.12**	**0.35**	**0.00**		**0.10**	
Median	**7.72**	**7.97**	**126.00**	**21.90**	**5.00**		**0.25**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics: "Q" = Outside of holding time; "U"= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from April 9, 2002 to May 16, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores are plotted over time in Figure 3. The SCI scores for Juniper Spring have indicated that healthy conditions prevailed in 7 out of 8 samplings. The low score of 16 on May 16th, 2007 is uncharacteristic of Juniper Springs, and it appears to an isolated event associated with high numbers of Hydrobiid snails in the sample. Many Hydrobiid snails are taxa endemic to Florida springs, and they are not generally indicative of stressed conditions. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. The total taxa metric over all the dates was high, ranging from 29 to 35 taxa. The number of sensitive taxa varied over the sampling period, ranging from 3 to 9 taxa. The abundance of sensitive taxa over the entire sampling period indicates a very stable and healthy macroinvertebrate community. Habitat Assessment scores are plotted over the sampling period in Figure 6. All habitat assessments scored consistently in the in the optimal category.

Old SCI Scores	
April 9, 2002	29
October 14, 2002	29
April 15, 2003	31
October 13, 2003	27
May 4, 2004	27

Recalibrated SCI Scores	
April 20, 2005	61
June 8, 2006	51
May 16, 2007	16

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates.

Stream condition Index (SCI) scores calculated previous to the SCI recalibration,

implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

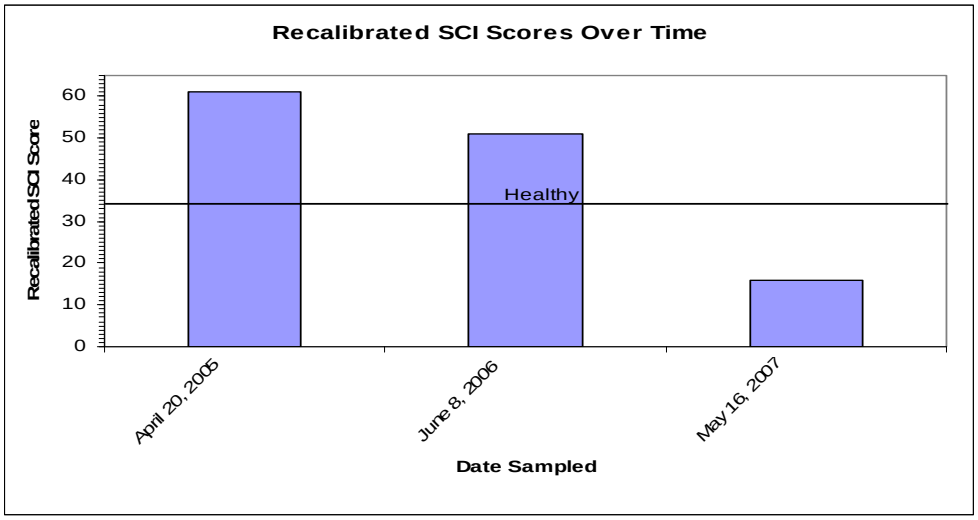


Figure 3: Recalibrated SCI scores with the impairment line at 34.

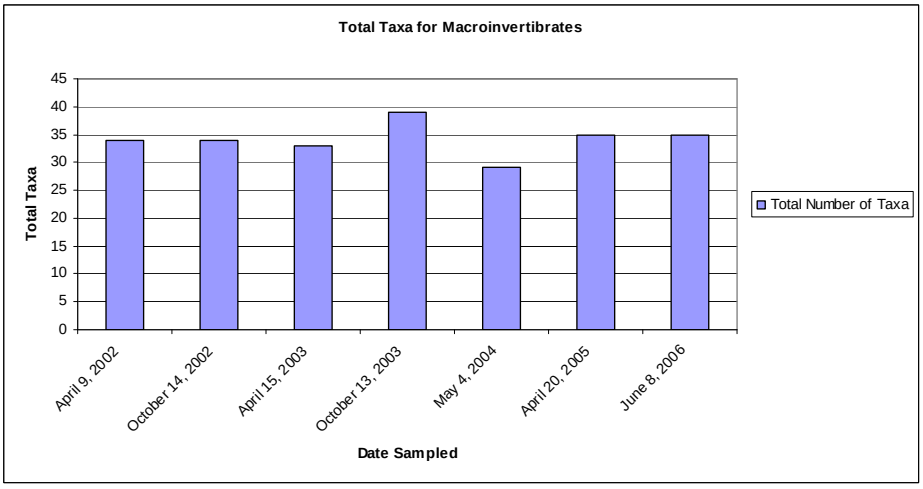


Figure 4: Total macroinvertebrate taxa plotted over time for Juniper Springs.

Date	Sensitive Taxa
4/9/2002	3
10/14/2002	7
4/15/2003	9
10/13/2003	3
5/4/2004	6
4/20/2005	5
6/8/2006	6

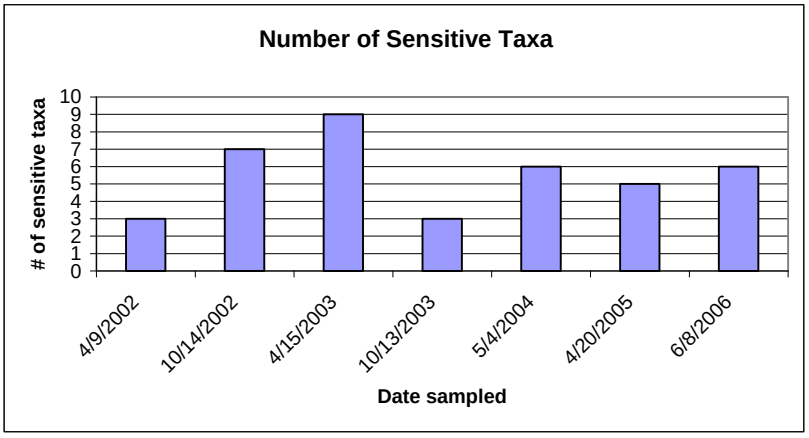


Figure 5: Table and chart showing the number of sensitive taxa over the sampling period.

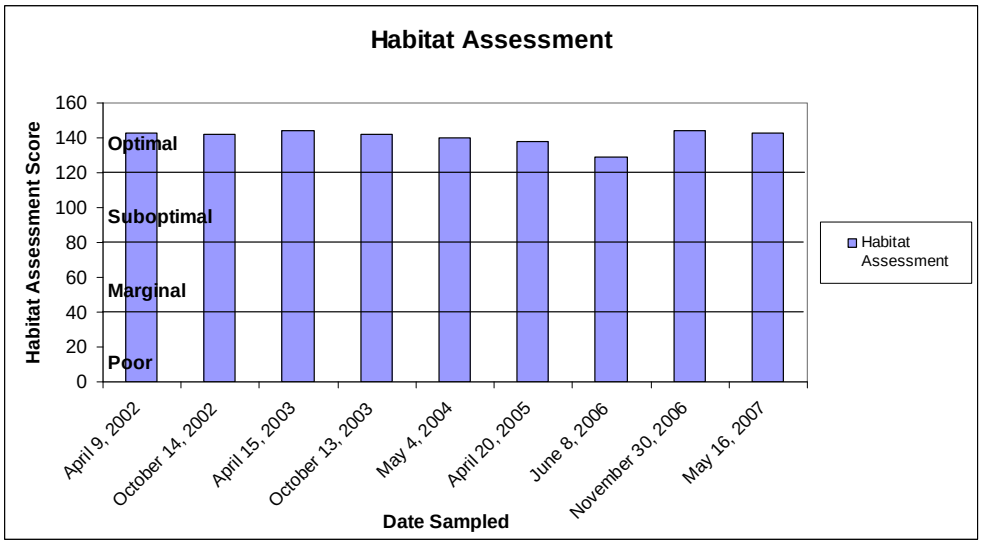


Figure 6: Habitat assessment scores over time.

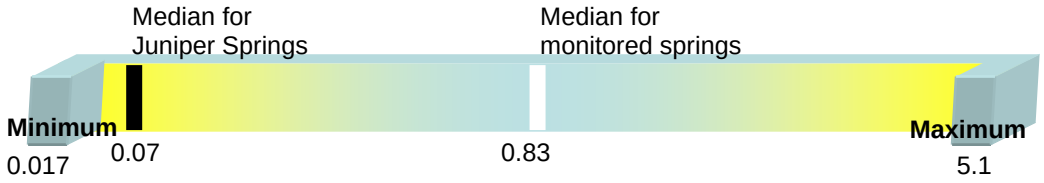
Over the roughly five year sampling period from April 9, 2002 to May 16, 2007, data indicate that:

- Water quality, as measured by transparency, nutrients (including nitrate-nitrate), and field parameters, was consistently good.
- Elevated *E. coli* and *Enterococci* densities were occasionally observed, but it is currently unknown if this is due to a natural or anthropogenic source.
- The majority of Stream Condition Index biological samples indicate that healthy conditions prevail in the system.
- Juniper Spring continues to function as a minimally disturbed reference site regarding habitat, nutrients and invertebrate health.

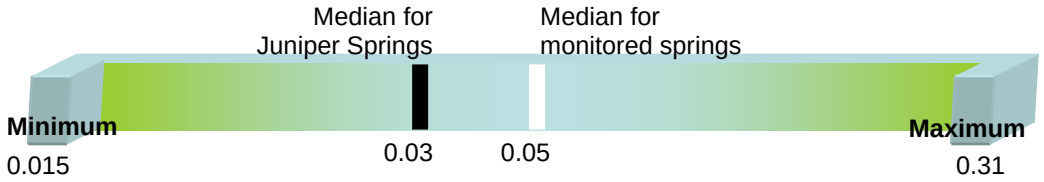
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Juniper Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Juniper Springs

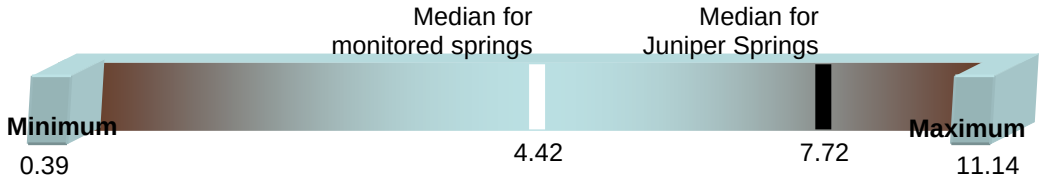
Nitrate-Nitrite (mg/L)



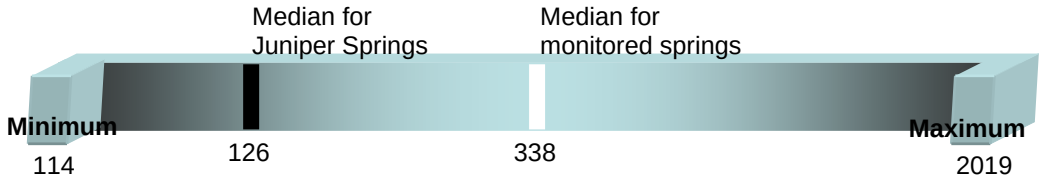
Total Phosphorus (mg/L)



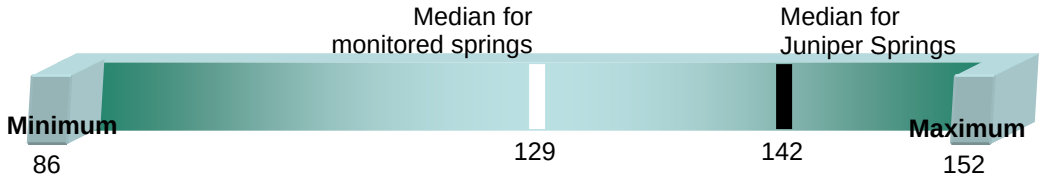
Dissolved Oxygen (mg/L)



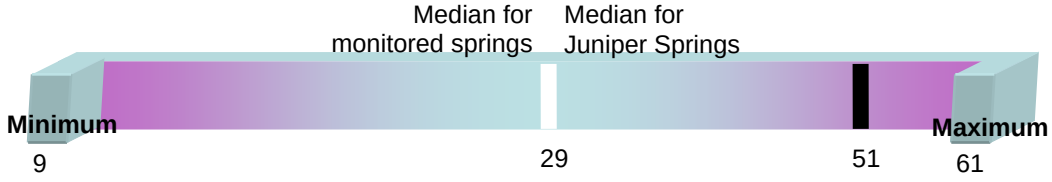
Specific Conductance (umhos/cm)



Habitat Assessment Score

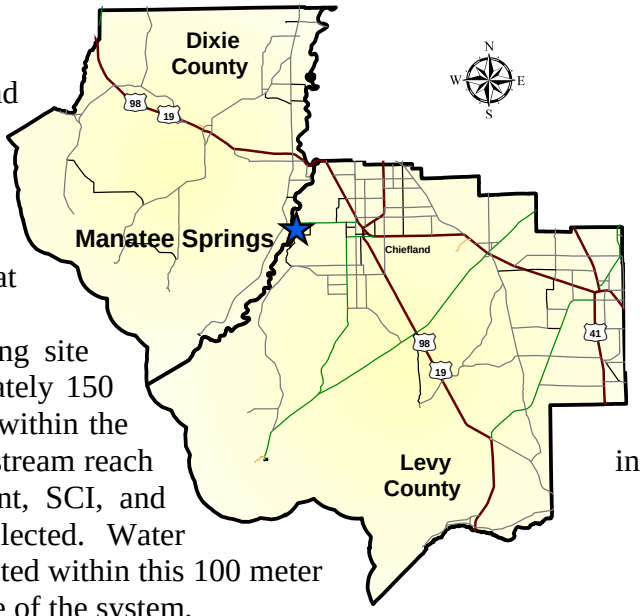


Stream Condition Index

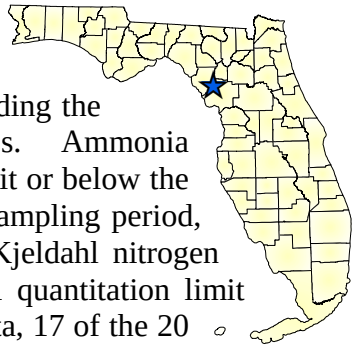


Manatee Springs

Manatee Springs is located in Levy County within Manatee Springs State Park. It is a first magnitude spring discharging into the Suwannee River. Manatee Springs was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled quarterly, with chemistry, Stream Condition Index (SCI) and periphyton collections performed in winter, spring, summer and fall by the Bureau of Laboratories. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The Manatee Springs monitoring site is located in the spring run, approximately 150 meters downstream of the headspring, within the park limits. It consists of a 100 meter stream reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter reach in the location most representative of the system.



Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia concentrations have remained either below the detection limit or below the practical quantitation limit for the approximately six-year sampling period, with one exception (0.024 mg/L) in July of 2006. Total Kjeldahl nitrogen remained below the detection limit or below the practical quantitation limit throughout the sampling period. Of the total phosphorus data, 17 of the 20 samples (85%) were below the practical quantitation limit. Total phosphorus detections remained low, at or below the 30th percentile of typical Florida streams, except for a somewhat elevated value (0.2 mg/L) in July, 2006. Total phosphorus data is plotted over the sampling period in Figure 1. A trend could not be determined because detections between the practical quantitation limit and the method detection limit are considered qualitative, making determination of a statistical trend difficult. Nitrate-nitrite concentrations have ranged from 1.3 to 3.6 mg/L over the sampling period, values which exceed 95 % of other Florida streams. A visual inspection of the data does not suggest an increase or decrease in nitrate-nitrite over the sampling period. High nitrate-nitrite is probably related to anthropogenic nutrient inputs throughout the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 12, 2000	0.01	U	0.06	U	0.035	I	1.6	
October 10, 2001	0.01	U	0.06	U	0.033	I	1.9	J
April 16, 2002	0.012	I	0.06	U	0.031	I	1.3	J
August 28, 2002	0.012	I	0.06	U	0.028	I	1.7	
November 5, 2002	0.01	U	0.065	I	0.038	I	1.7	
January 17, 2003	0.01	U	0.064	I	0.034	I	1.7	
June 5, 2003	0.01	U	0.13	I	0.037	I	1.7	
July 31, 2003	0.01	UY	0.12	UY	0.041	Y	1.8	Y
October 1, 2003	0.01	U	0.12	I	0.04	I	1.7	
January 29, 2004	0.01	U	0.069	I	0.035	I	1.8	
April 29, 2004	0.01	U	0.092	I	0.037	I	1.8	
August 25, 2004	0.01	U	0.06	U	0.026	I	2	
December 7, 2004	0.01	U	0.077	I	0.057	I	1.9	
January 28, 2005	0.01	U	0.069	I	0.068		2	
January 25, 2006	0.01	U	0.08	U	0.028	I	2	
June 21, 2006	0.01	U	0.1	I	0.031	I	1.9	
July 19, 2006	0.024		0.11	I	0.2		1.9	
November 8, 2006	0.01	U	0.16	U	0.027	I	3.6	
January 31, 2007	0.01	U	0.081	I	0.024	I	1.8	
May 14, 2007	0.01	U	0.08	U	0.022	I	1.4	
Average	**0.01**		**0.09**		**0.04**		**1.86**	
Standard Deviation	**0.00**		**0.03**		**0.04**		**0.45**	
Median	**0.01**		**0.08**		**0.03**		**1.80**	

Table 1: Nutrient data including qualifier codes and summary statistics. “I” = Below practical quantitation limit; “J” = Estimated value; “U” = Below detection limit; “Y”= Improperly preserved.

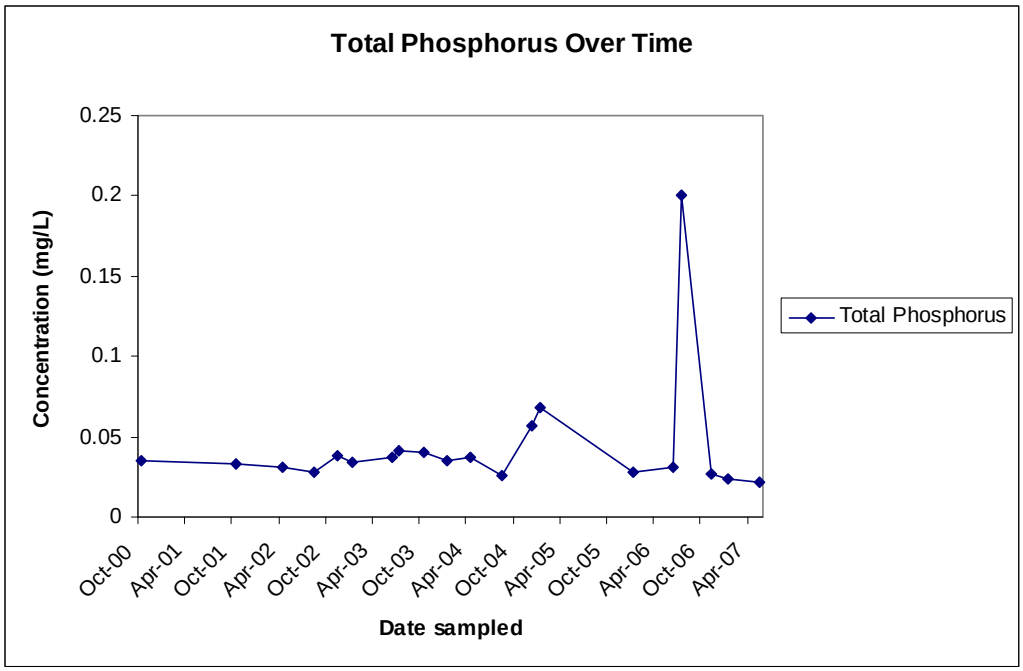


Figure 1: Total Phosphorus values plotted over time.

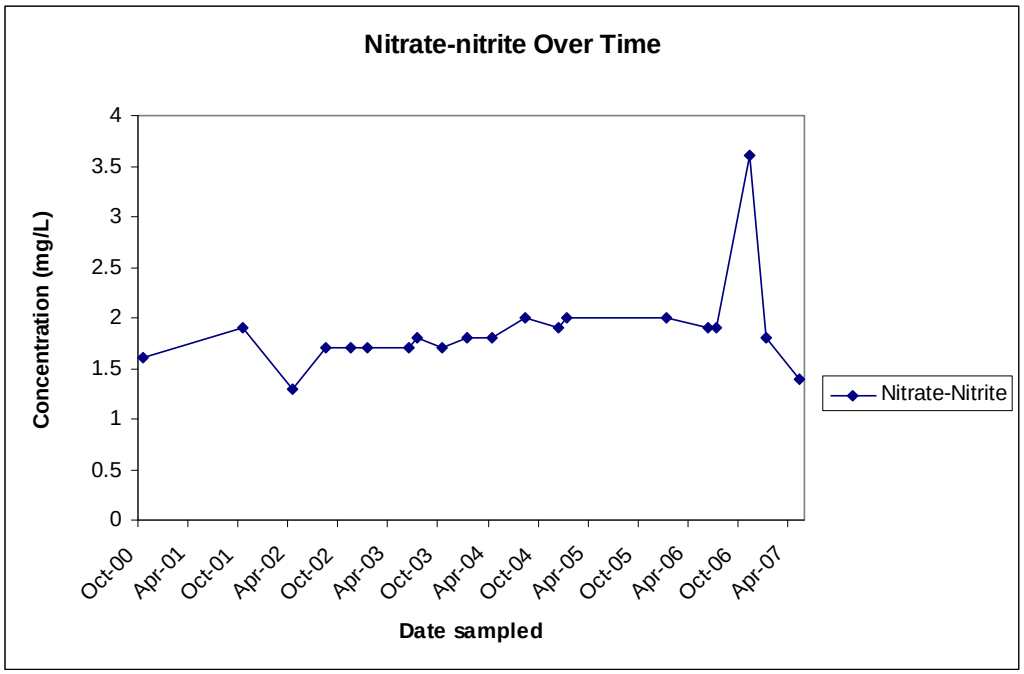


Figure 2: Nitrate-Nitrite values plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have complied with the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 16 CFU/100 mL. *Enterococci* data have ranged from 1 to 730 CFU/100 mL over the sampling period, with a median of 12 CFU/100 mL. The use of *Enterococci* as a human waste indicator may not be appropriate in relatively warm-water systems, such as springs. Studies have found that *Enterococci* sources include plant material and soil, and therefore, the occasionally elevated *Enterococci* densities in Manatee Spring Run may be a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 2 to 128 CFU/100 mL, with a median of 14 CFU/100 mL. Total coliform data have ranged from 2 to 250 CFU/100 mL. The median total coliform value was 80 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 12, 2000	16	Q	6	Q	14	Q	100	Q
March 27, 2001	2		1	K	4		30	
October 10, 2001	44	Q	16	Q	20	Q	100	Q
April 16, 2002	12	Q	62	Q	106	Q	30	Q
August 28, 2002	11	AQ	16	AQ	9	AQ	20	AQ
November 5, 2002	32	Q	22	Q	28	Q	120	Q
January 17, 2003	1	AKQ	14	AQ	21	AQ	95	AQ
June 5, 2003	730	BQ	16	BQ	128	BQ	170	BQ
July 31, 2003	40	Q	26	BQ	68	Q	200	Q
October 1, 2003	14	BQ	24	BQ	36	BQ	290	Q
January 29, 2004	1	KQ	2	BQ	60	Q	100	BQ
April 29, 2004	56	Q	3	BQ	7	BQ	250	Q
August 25, 2004	6	B	28	B	16	B	54	
December 7, 2004	2	KQ	2	KQ	2	KQ	15	BQ
January 28, 2005	2	K	44		64		84	
January 25, 2006	32	B	2	B	6	B	68	
June 21, 2006	34	BQ	22	BQ	10	BQ	58	Q
July 19, 2006	6	BQ	14	BQ	8	BQ	80	Q
November 8, 2006	14	BQ	28	BQ	14	BQ	58	Q
January 31, 2007	2	BQ	12	BQ	8	BQ	10	BQ
May 14, 2007	12	BQ	4	BQ	4	BQ	2	UQ
Average	**51**		**17**		**30**		**92**	
Standard Deviation	**156**		**15**		**35**		**78**	
Median	**12**		**16**		**14**		**80**	

Table 2: Microbiology data including qualifier codes and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given. "Q" = Outside of holding time; "U" = Below detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data with qualifier codes as well as data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from October 2000 to May 2007, dissolved oxygen averaged 2.8 mg/L, ranging from 0.7 to 5.3 mg/L. This low DO regime (a natural condition for headwater spring systems) can eliminate sensitive taxa from the system. Temperature was stable, averaging 22.5 degrees Celsius. Specific conductivity was slightly elevated, averaging 462 umhos/cm and ranging from 388 umhos/cm to 534 umhos/cm. The elevated conductivity appears to be a natural characteristic, associated with inorganic dissolved solids in the groundwater. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.0, ranging from 6.5 to 7.3 SU. Turbidity averaged 0.5 NTU, with a high value of 1.3 NTU. Color was below the detection limit with the exception of 10 PCU measured on January 28, 2005. This measurement was likely a natural result of tannins entering the system from the surrounding basin during a rain event.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 12, 2000	2.5	6.46	430	22.46	5	U	0.2	
March 27, 2001	2.38	7.3	457	22.37	No Result		No Result	
October 10, 2001	1.4	7.01	534	22.4	5	U	0.3	
April 16, 2002	4.3	7.3	466	22.9	5	U	0.45	
August 28, 2002	2.83	7.26	432	22.5	5	U	0.1	
November 5, 2002	2.88	7.15	460	22.5	5	U	0.5	
January 17, 2003	2.2	7.1	484	22.2	5	UQ	0.35	Q
June 5, 2003	2.93	7.2	388	22.7	5	U	0.65	
July 31, 2003	4.6	7.1	478	22.5	5	UQ	0.5	Q
October 1, 2003	2.96	6.97	462	22.2	5	U	1	
January 29, 2004	No Result	No Result	No Result	No Result	5	U	0.35	
April 29, 2004	5.3	7.3	436	22.5	5	U	0.5	
August 25, 2004	No Result	7.16	478	22.8	5	U	0.45	
December 7, 2004	1.7	7.22	496	22.2	5		0.4	
January 28, 2005	1.8	7	436	22.1	10		0.4	
January 25, 2006	No Result	No Result	No Result	No Result	5		0.25	
June 21, 2006	2.62	6.6	423	22.43	5		0.3	
July 19, 2006	3.99	6.49	475	22.5	5		0.45	
November 8, 2006	2.78	7.26	473	22.24	5	U	0.15	
January 31, 2007	0.68	6.63	497	22.28	5		1.3	
May 14, 2007	2.66	6.79	481	22.93	5	U	0.75	
Average	**2.81**	**7.02**	**462.42**	**22.46**	**5.25**		**0.47**	
Standard Deviation	**1.15**	**0.28**	**32.94**	**0.24**	**1.12**		**0.28**	
Median	**2.72**	**7.10**	**466.00**	**22.46**	**5.00**		**0.43**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics. “Q”= Outside of holding time; “U”= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from October 12, 2000 to May 14, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores from August 25, 2004 to May 14, 2007 are plotted over time in Figure 3. Seventeen out of eighteen SCI samples indicated impaired biological conditions at Manatee Spring, mostly likely related to the low DO regime, somewhat elevated specific conductance, and lack of habitat. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa over all sampling dates ranged from 13 to 30 taxa (Figure 4). The number of sensitive taxa has remained very low over the sampling period, averaging 1 sensitive taxon (Figure 5). Habitat assessment scores have remained mostly within the suboptimal category (Figure 6), mostly due to lack of available productive habitat and algal smothering. A substantial decrease in habitat was recorded in October of 2001, with loss of submerged aquatic vegetation (due to observed manatee grazing) and subsequent increases in algal mats in the formerly vegetated areas. Based on observations in July, 2006, the aquatic vegetation in Manatee Spring remains very sparse.

Old SCI Scores	
October 12, 2000	17
March 27, 2001	15
October 10, 2001	13
April 16, 2002	11
August 28, 2002	17
November 5, 2002	11
January 17, 2003	23
June 5, 2003	17
July 31, 2003	17
January 29, 2004	17
April 29, 2004	15

Recalibrated SCI Scores	
August 25, 2004	22
December 7, 2004	13
January 28, 2005	17
January 25, 2006	29
June 21, 2006	16
July 19, 2006	16
May 14, 2007	10

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

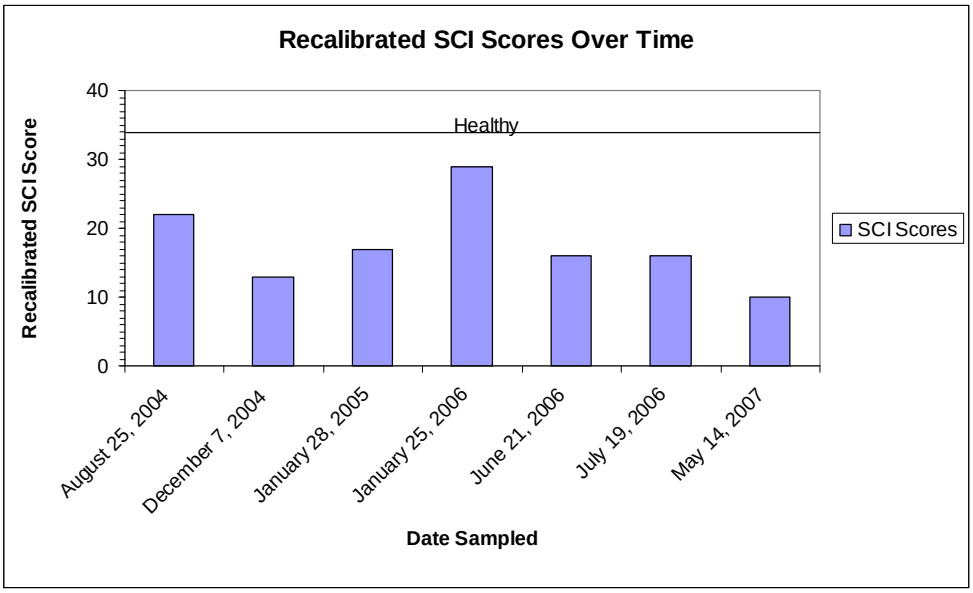


Figure 3: Recalibrated SCI scores plotted for each sampling event.

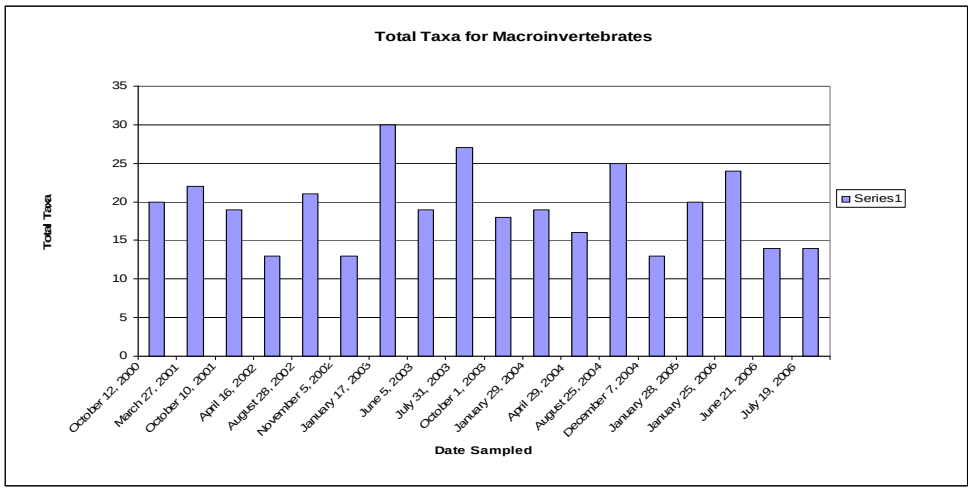


Figure 4: Total macroinvertebrate taxa for each sampling event.

Date	Sensitive taxa
10/12/2000	1
3/27/2001	1
10/10/2001	1
4/16/2002	0
8/28/2002	1
11/5/2002	0
1/17/2003	0
6/5/2003	1
7/31/2003	1
10/1/2003	1
1/29/2004	1
4/29/2004	1
8/25/2004	2
12/7/2004	1
1/28/2005	2
1/25/2006	2
6/21/2006	0
7/19/2006	1

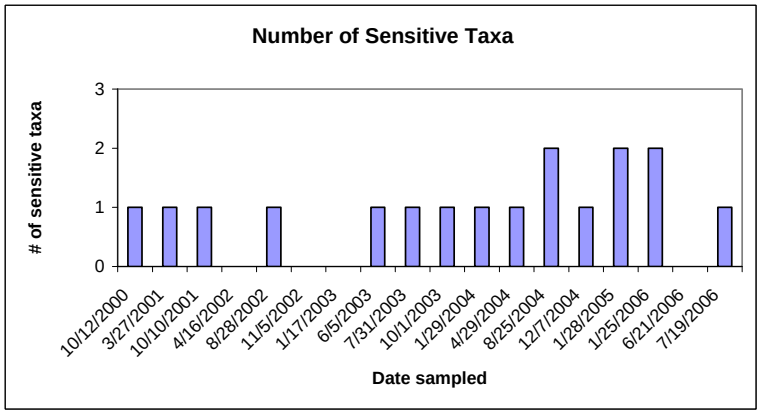


Figure 5: Table and chart showing number of sensitive taxa over time.

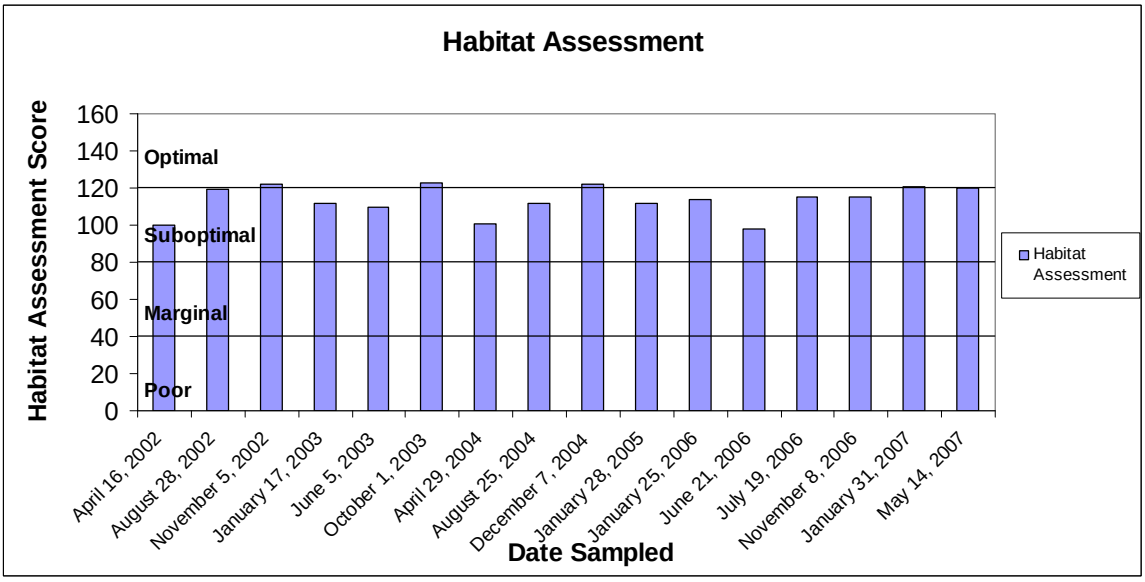


Figure 6: Habitat assessment scores plotted for each sampling event.

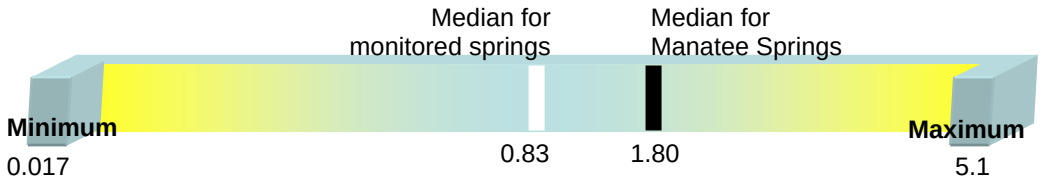
Over the roughly six year sampling period from October 12, 2000 to May 14, 2007, data indicate:

- Some water quality parameters, as measured by nutrients (except for nitrate-nitrite), water clarity, and bacterial densities suggested good conditions.
- Manatee Spring has exhibited high nitrate-nitrite concentrations (usually greater than 95% of other Florida streams), probably due to non-point sources of nitrogen within the springshed.
- Low dissolved oxygen and somewhat elevated conductivity (both natural conditions) appeared to be related to the poor quality invertebrate community present.
- SCI scores have remained below the impairment threshold, characterized by a paucity of sensitive taxa. This condition is probably mostly related to the DO and conductivity issues, but lack of substrate diversity and algal smothering may have also played a role.

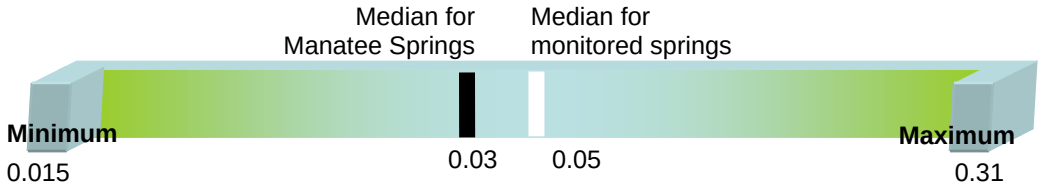
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Manatee Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Manatee Springs

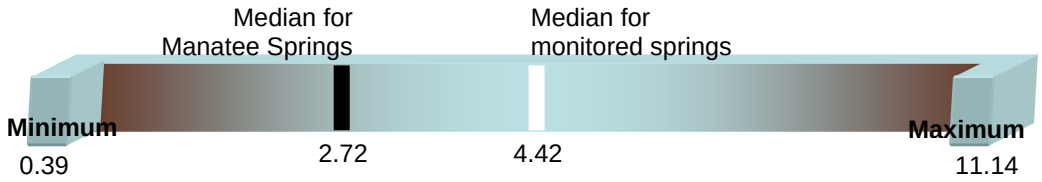
Nitrate-Nitrite (mg/L)



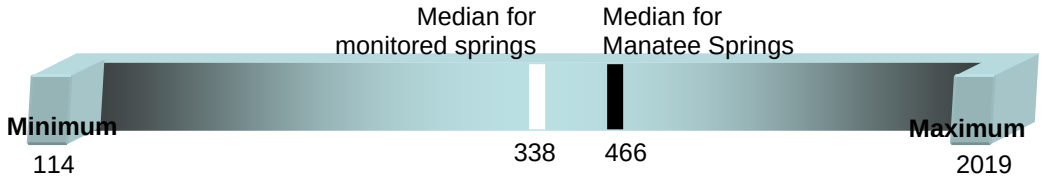
Total Phosphorus (mg/L)



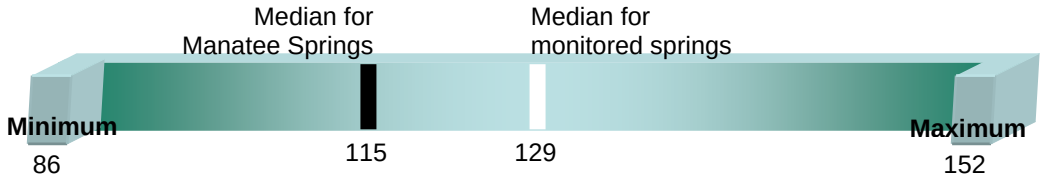
Dissolved Oxygen (mg/L)



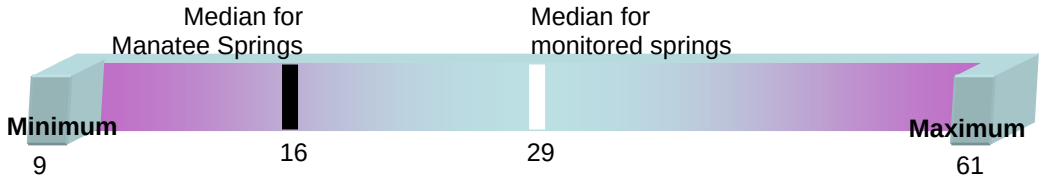
Specific Conductance (umhos/cm)



Habitat Assessment Score

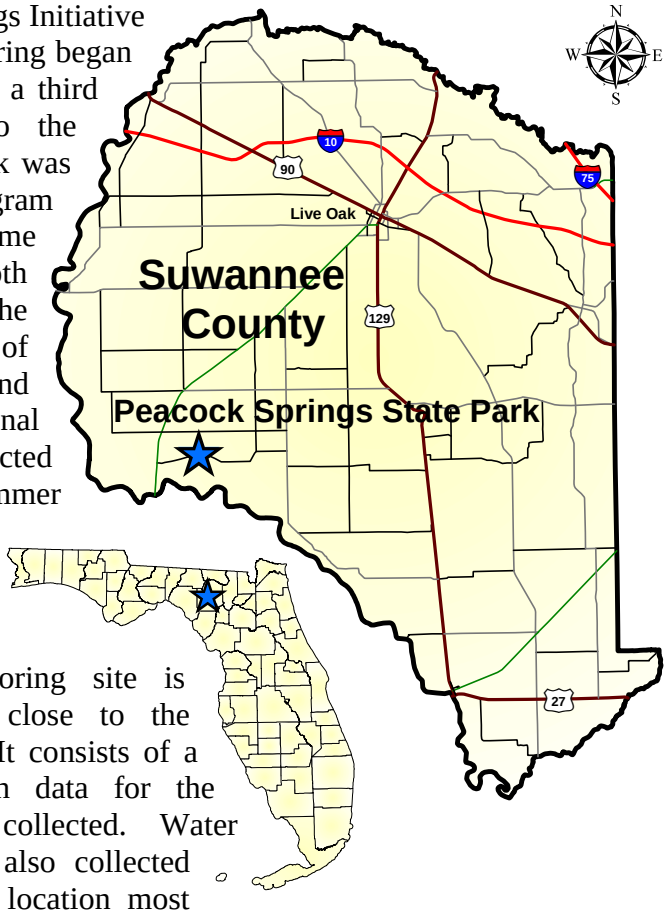


Stream Condition Index



Peacock Spring and Orange Grove Sink

Peacock Springs State Park is located in Suwannee County. Two karst features in the state park, Peacock Spring and Orange Grove Sink, were chosen for the Springs Monitoring Program by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. Monitoring for Peacock Spring began in October 2001. Peacock Spring is a third magnitude spring, discharging into the Suwannee River. Orange Grove Sink was incorporated into the monitoring program in May 2002, and is linked to the same aquifer system as Peacock Spring. Both monitoring locations are sampled in the spring and fall by the Bureau of Laboratories for chemistry and periphyton collections. Two additional samples for chemistry are collected annually by the Parks Service in summer and winter. Missing sampling events are due to conditions that prohibited sampling during that period (e.g., hurricanes).



The Peacock Spring monitoring site is located in the spring run, very close to the headspring, within the park limits. It consists of a 100 meter stream reach in which data for the Qualitative Periphyton methods are collected. Water samples and field testing data are also collected within this 100 meter reach in the location most representative of the system. The Orange Grove Sink monitoring site is located at the swimming platform at the opening of the sinkhole. Water samples and field testing data are collected at this monitoring location as well as algae collections for the Qualitative Periphyton method.

Peacock Spring

Water column nutrient samples for Peacock Spring include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia concentrations have remained either below the detection limit or below the practical quantitation limit for the approximately five year sampling period from October 2001 to April 2007. Total Kjeldahl nitrogen remained below the detection limit or below the practical quantitation limit for the sampling period with the exception of three samples. All three of these samples were still very low, below the 5th percentile for typical Florida streams. These consistently low concentrations indicate no organic

nitrogen enrichment. Nine of the seventeen total phosphorus samples were below the practical quantitation limit and detections were relatively low, below the 40th percentile values compared to typical Florida streams. A visual inspection of the plotted data does not suggest any increase or decrease in TP over the sampling period (Figure 1). Nitrate-nitrite concentrations were consistently high ranging from 1.0 to 2.5 mg/L over the sampling period. These values are greater then the 95th percentile values compared to typical Florida streams. A visual inspection of the plotted data suggests a very slight increase in nitrate-nitrite over the sampling period. However, the data are not appropriate to determine statistically if this slight increase is a truly significant trend. Elevated nitrate-nitrite concentrations are probably due to anthropogenic nutrient inputs from the surrounding springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 23, 2001	0.013	I	0.2		0.03	I	1	
January 31, 2002	0.01	U	0.06	U	0.04		2.3	
July 24, 2002	0.034	Y	0.18	IY	0.041	Y	1.6	J
February 10, 2003	0.01	U	0.06	U	0.049	A	2.4	
May 20, 2003	0.01	U	0.097	I	0.059		2.2	
August 21, 2003	0.01	U	0.1	I	0.054	I	2.2	
October 28, 2003	0.01	U	0.095	I	0.051	I	2.3	
February 16, 2004	0.01	U	0.06	U	0.027	I	2.4	J
April 23, 2004	0.01	U	0.06	U	0.074		2.1	
February 24, 2005	0.01	U	0.076	I	0.035	I	2	A
May 25, 2005	0.011	I	0.25		0.071		2.5	
July 28, 2005	0.01	U	0.17	I	0.066		1.9	A
January 19, 2006	0.01	U	0.08	U	0.064		2.4	
July 28, 2006	0.015	IY	0.08	UY	0.039	IY	2.2	Y
November 14, 2006	0.017	I	0.29		0.039	I	2.2	
February 6, 2007	0.01	U	0.08	U	0.025	I	2.4	
April 25, 2007	0.01	U	0.08	U	0.038	I	2.1	
Average	**0.01**		**0.12**		**0.05**		**2.13**	
Standard Deviation	**0.01**		**0.07**		**0.02**		**0.37**	
Median	**0.01**		**0.08**		**0.04**		**2.20**	

Table 1: Nutrient data including qualifier codes and summary statistics for Peacock Spring. "A"= Value reported is the arithmetic mean of two or more determinations; "I" = Below practical quantitation limit; "J"= Estimated value; "U" = Below detection limit; "Y"= Improperly preserved sample.

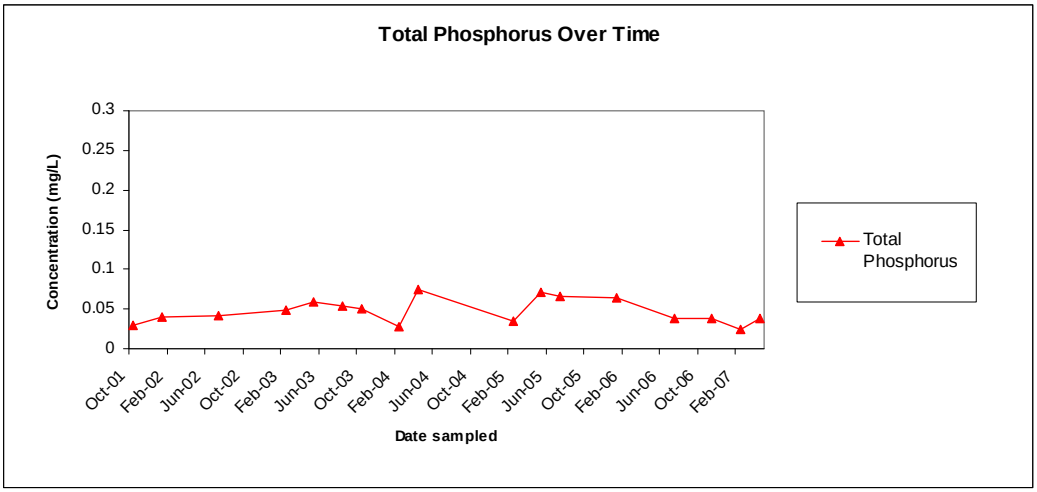


Figure 1: Total Phosphorus values plotted over time for Peacock Spring.

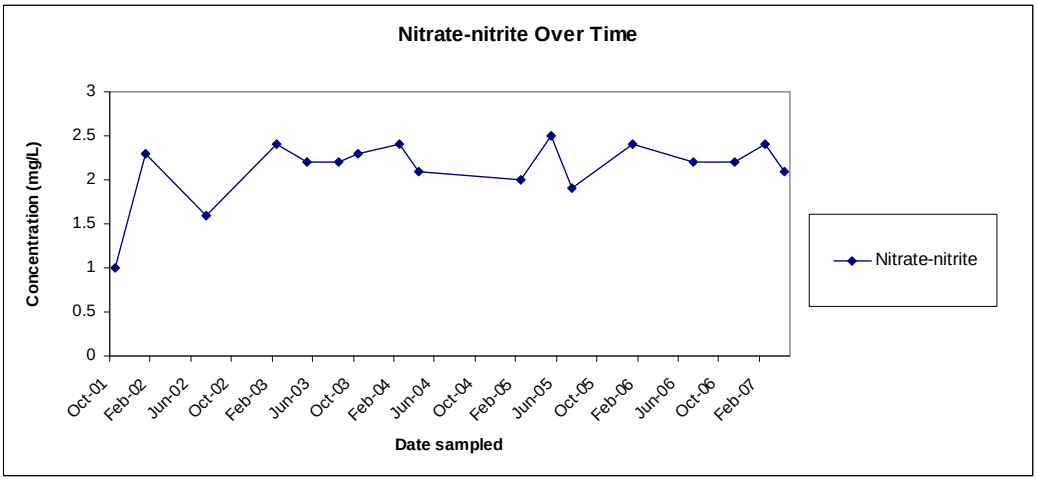


Figure 2: Nitrate-nitrite values plotted over time for Peacock Spring.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have complied with the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 10 CFU/100 mL. *Enterococci* data have ranged from 1 to 58 CFU/100 mL over the sampling period, with a median of 24 CFU/100 mL. Fecal coliform data have continuously complied with the Class III water quality standard, ranging from 1 to 48 CFU/ 100 mL, with a median of 4 CFU/100 mL. Total coliform data have ranged from 1 to 510 CFU/100 mL. The median total coliform value was 52 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 23, 2001	20	Q	12	Q	14	Q	500	Q
January 31, 2002	1	KQ	1	KQ	1	KQ	1	KQ
July 24, 2002	12	Q	10	Q	12	Q	200	Q
February 10, 2003	50	Q	10	Q	4	Q	30	Q
May 20, 2003	6		8		4		50	
August 21, 2003	4	BQ	1	KQ	30	BQ	100	BQ
October 28, 2003	58		32	B	48		510	
February 16, 2004	24	BQ	32	BQ	24	BQ	90	BQ
April 23, 2004	42		10	B	17	B	80	
February 24, 2005	10	BQ	10	BQ	2	BQ	16	BQ
May 25, 2005	24	BQ	2	BQ	2	KQ	38	BQ
July 28, 2005	40	Q	42	Q	2	BQ	40	Q
January 19, 2006	14	BQ	2	KQ	2	BQ	2	KQ
July 28, 2006	No Result		No Result		No Result		No Result	
November 14, 2006	26	BQ	12	BQ	2	KQ	74	Q
February 6, 2007	No Result	Q	No Result	Q	No Result	Q	No Result	Q
April 25, 2007	24	BQ	12	BQ	4	BQ	52	Q
Average	**24**		**13**		**11**		**119**	
Standard Deviation	**17**		**12**		**14**		**164**	
Median	**24**		**10**		**4**		**52**	

Table 2: Microbiology data including qualifier codes and summary statistics for Peacock Spring. "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given. "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from October 2001 to April 2007, dissolved oxygen was variable, averaging 5 mg/L, ranging from 1.7 to 11.1 mg/L. Four of the seven DO measurements were below the Class III water quality standard of 5 mg/L. Temperature was stable, averaging 21.9 degrees Celsius. Specific conductivity averaged 360 umhos/cm, ranging from 298 umhos/cm to 384 umhos/cm. The mean pH was 7.4. Turbidity was low (averaging 0.4 NTU) and color was below the detection limit throughout the sampling period with the exception of the sample taken on July 28, 2005 which had a value of 15 PCU, which was likely a result of tannins entering the system from the basin during a rain event.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 23, 2001	7.84	7.23	298	22.33	5	U	1.8	
January 31, 2002	No Result	No Result	No Result	No Result	5	U	0.05	U
July 24, 2002	No Result	No Result	No Result	No Result	5	U	0.8	
February 10, 2003	No Result	No Result	No Result	No Result	5	U	0.55	
May 20, 2003	2.3	7.3	363	21.4	5		0.15	
August 21, 2003	No Result	No Result	No Result	No Result	5	U	0.15	
October 28, 2003	2.61	7.4	381	21.7	5	U	0.55	
February 16, 2004	No Result	No Result	No Result	No Result	5	U	0.1	
April 23, 2004	4.35	7.55	350	21.9	5		0.1	
February 24, 2005	No Result	No Result	No Result	No Result	5	U	0.15	
May 25, 2005	5.36	7.22	384	21.7	5	U	0.3	
July 28, 2005	No Result	No Result	No Result	No Result	15		0.3	
January 19, 2006	No Result	No Result	No Result	No Result	5		0.15	
July 28, 2006	No Result	No Result	No Result	No Result	5	Q	0.2	Q
November 14, 2006	11.14	7.6	366	21.85	5	U	0.2	
February 6, 2007	No Result	No Result	No Result	No Result	5	UQ	0.15	Q
April 25, 2007	1.7	7.3	378	22.1	5	U	0.55	
Average	**5.04**	**7.37**	**360.00**	**21.85**	**5.59**		**0.37**	
Standard Deviation	**3.42**	**0.15**	**29.80**	**0.30**	**2.43**		**0.42**	
Median	**4.35**	**7.30**	**366.00**	**21.85**	**5.00**		**0.20**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics for Peacock Spring. “Q” = Outside of holding time; “U” = Below detection limit.

Qualitative periphyton data was collected from October 23, 2001 through May 25, 2005. Total taxa for periphyton were plotted in Figure 3 for each sampling event. While the total taxa have ranged from approximately 25 taxa to about 45 taxa, no summary index is currently available to assess the condition of the periphyton community. These data are presented as background information to be used in future analyses.

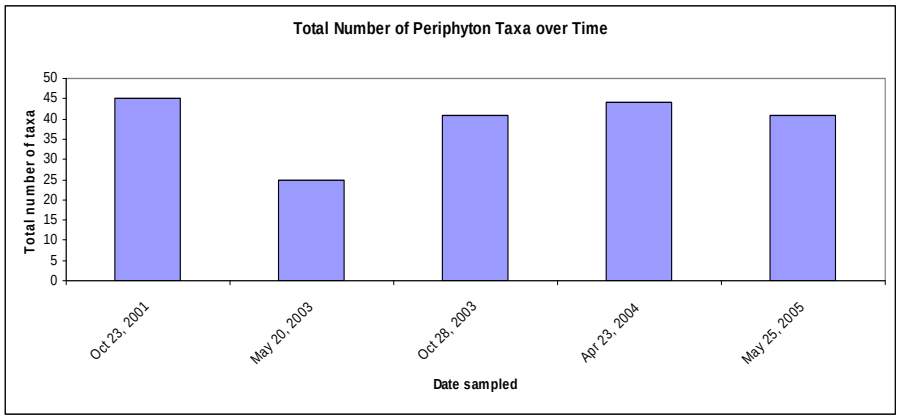


Figure 3: Total number of taxa for periphyton for each sampling event for Peacock Spring.

Orange Grove Sink

Total Phosphorus and Nitrate-nitrite concentrations for Orange Grove Sink were plotted over the approximately five year period from May 2002 to April 2007 (Figures 4 and 5). Nutrient data are presented in Table 4, including the qualifier codes and summary statistics for each analysis. Ammonia and TKN concentrations have remained either

below the detection limit or below the practical quantitation limit throughout the sampling period, with the exception of one ammonia sample collected on July 28, 2006 which was still very low compared to typical Florida streams. Total phosphorus has been below the 20th and 40th percentile values compared to typical Florida streams. A visual inspection of the data does not suggest an increase or decrease in TP over the sampling period (Figure 4). Nitrate-nitrite concentrations were consistently elevated, ranging from 0.61 to 2.8 mg/L over the sampling period. Although the data do not appear to suggest a trend over time (Figure 5), these values are greater then the 95th percentile values compared to typical Florida streams.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
May 15, 2002	0.019	I	0.15	I	0.035	I	1.9	
November 7, 2002	0.01	U	0.06	U	0.049		2.2	
May 20, 2003	0.015	I	0.12	I	0.069		2.4	
October 28, 2003	0.01	U	0.13	I	0.069		2.1	
February 16, 2004	0.01	U	0.06	U	0.035	I	2.3	J
April 23, 2004	0.01	U	0.16	I	0.076		2.2	
February 25, 2005	0.01	U	0.13	I	0.049	I	2.2	
July 28, 2005	0.01	U	0.15	I	0.063		1.8	
January 19, 2006	0.01	U	0.08	U	0.067		2.8	
July 28, 2006	0.028		0.19	I	0.045	I	0.61	
November 14, 2006	0.01	U	0.08	U	0.032	I	2	
April 25, 2007	0.01	U	0.08	U	0.042	I	2.2	
Average	**0.01**		**0.12**		**0.05**		**2.06**	
Standard Deviation	**0.01**		**0.04**		**0.02**		**0.52**	
Median	**0.01**		**0.13**		**0.05**		**2.20**	

Table 4: Nutrient data including qualifier codes and summary statistics for Orange Grove Sink. "I" = Below practical quantitation limit; "J" = Estimated value; "U" = Below detection limit.

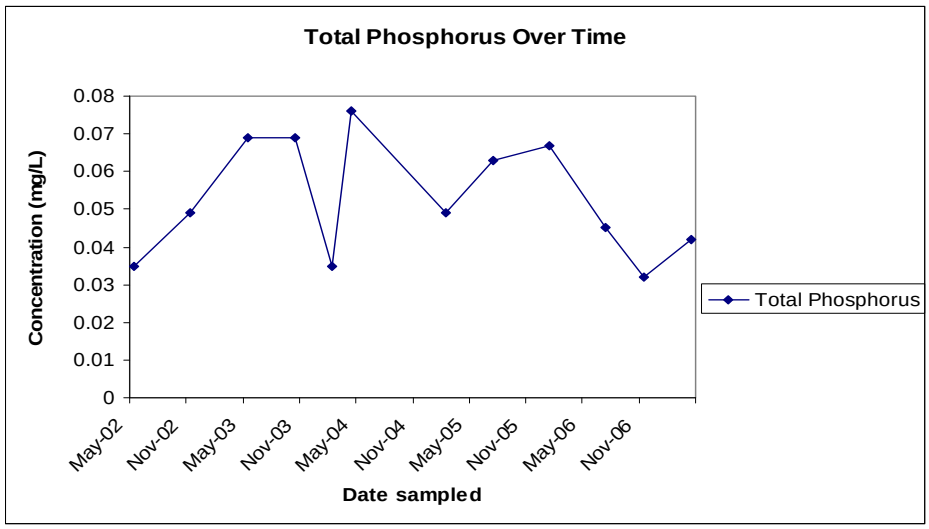


Figure 4: Total Phosphorus values plotted over time for Orange Grove Sink.

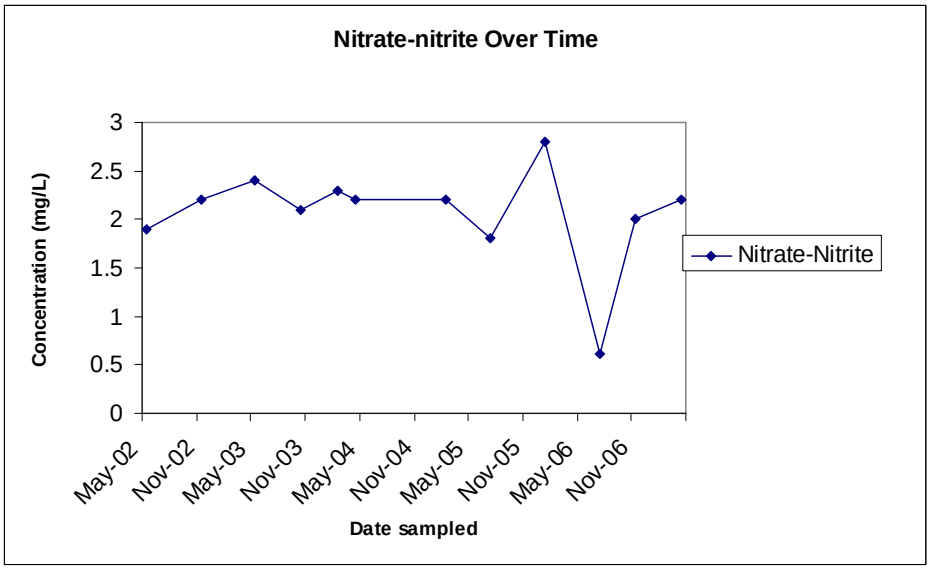


Figure 5: Nitrate-nitrite values plotted over time for Orange Grove Sink.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 5. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 28 CFU/100 mL. *Enterococci* data have ranged from 2 to 86 CFU/100 mL over the sampling period, with a median of 14 CFU/100 mL. All of the *Enterococci* data have remained below the standard of 61 CFU/100 mL except for the sample collected on May 20, 2003 of 86 CFU/100 mL. The use of *Enterococci* as a human waste indicator may not be appropriate in relatively warm-water systems, such as springs. Studies have found that *Enterococci* sources include plant material and soil, and therefore, the *Enterococci* densities in the Orange Grove Sink may be a natural phenomenon. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 2 to 100 CFU/100 mL, with a median of 34 CFU/100 mL. Total coliform data have ranged from 28 to 520 CFU/100 mL, with a median of 86 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
May 15, 2002	8		12		16		240	
November 7, 2002	10	Q	42	Q	34	Q	280	Q
May 20, 2003	86		62		100		520	
October 28, 2003	44		28	B	54		330	
February 16, 2004	50	Q	22	BQ	26	BQ	130	BQ
April 23, 2004	52		17	B	12	B	62	
February 25, 2005	12	ABQ	51	AQ	42	ABQ	62	AQ
July 28, 2005	12	BQ	52	Q	2	KQ	86	Q
January 19, 2006	14	AQ	50	AQ	56	AQ	75	AQ
July 28, 2006	No Result		No Result		No Result		No Result	
November 14, 2006	2	BQ	2	KQ	12	BQ	28	BQ
April 25, 2007	14	BQ	20	BQ	34	BQ	70	Q
Average	**28**		**33**		**35**		**171**	
Standard Deviation	**26**		**20**		**28**		**154**	
Median	**14**		**28**		**34**		**86**	

Table 5: Microbiology data including qualifier codes and summary statistics for Orange Grove Sink. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low; Actual value is known to be less than the value given; "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data with qualifier codes as well as data for turbidity and color are shown in Table 6. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from May 2002 to April 2007, dissolved oxygen averaged 4.1 mg/L, ranging from 1.5 to 6.3 mg/L. Temperature was stable, averaging 21.9 degrees Celsius. Specific conductivity averaged 371 umhos/cm, and the mean pH was 7.3 SU. Turbidity was low (averaging 0.4 NTU) and color values were at or below the detection limit throughout the sampling period with the exception of a few samples that were likely higher as a result of tannins entering the system from the surrounding basin.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
May 15, 2002	6.29	7.2	370	23.2	5	U	0.6	
November 7, 2002	4.7	7.4	370	21.8	5	U	0.1	
May 20, 2003	4.8	7.2	378	21.5	5		0.35	
October 28, 2003	2.2	7.7	379	21.6	5		0.85	
February 16, 2004	No Result	No Result	No Result	No Result	5	U	0.1	
April 23, 2004	4.81	7.5	348	21.9	5		0.45	
February 25, 2005	No Result	No Result	No Result	No Result	10		0.5	
July 28, 2005	No Result	No Result	No Result	No Result	10		0.45	
January 19, 2006	No Result	No Result	No Result	No Result	5	U	0.25	
July 28, 2006	No Result	No Result	No Result	No Result	10	Q	0.65	Q
November 14, 2006	4.4	7.18	376	21.67	5	U	0.1	
April 25, 2007	1.5	7.1	374	21.4	5	U	0.15	
Average	**4.10**	**7.33**	**370.71**	**21.87**	**6.25**		**0.38**	
Standard Deviation	**1.66**	**0.21**	**10.63**	**0.61**	**2.26**		**0.25**	
Median	**4.70**	**7.23**	**374.00**	**21.67**	**5.00**		**0.40**	

Table 6: Field parameters, color, and turbidity data including codes including summary statistics for Orange Grove Sink. "Q"= Sample held beyond the accepted holding time; "U" = Below detection limit.

Qualitative periphyton data were collected from May 15, 2002 to April 23, 2004. Total taxa for periphyton were plotted in Figure 6 for each sampling event. While the total taxa have ranged from approximately 25 taxa to about 55 taxa, no summary index is currently available to assess the condition of the periphyton community. These data are presented as background information to be used in future analyses.

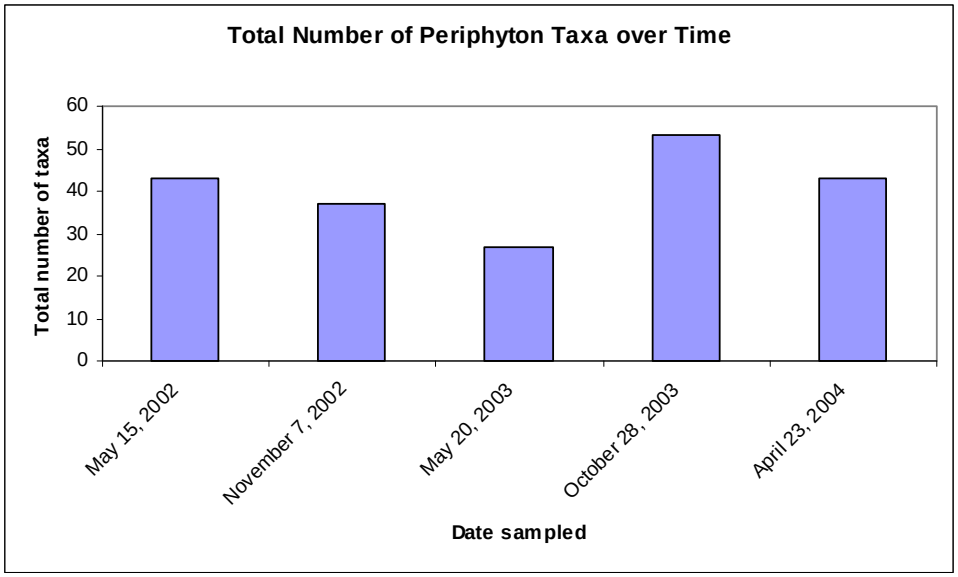


Figure 6: Total number of taxa for periphyton for each sampling event for Orange Grove Sink.

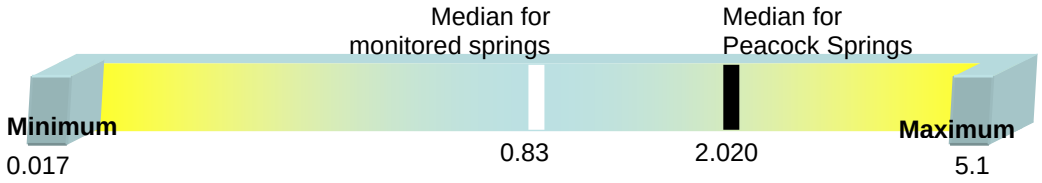
During the sampling period, data indicate that:

- Water quality, as measured by transparency, nutrients (except nitrate-nitrate), field parameters and bacteria, was generally good.
- Nitrate-nitrite concentrations have mostly been measured to be in excess of 2.0 mg/L, and these values are higher than those found in 95% of typical Florida streams.
- The great similarity in water quality between Orange Grove Sink and Peacock Springs suggest these systems are closely connected, and that Peacock Springs alone could be monitored in the future with little information loss.

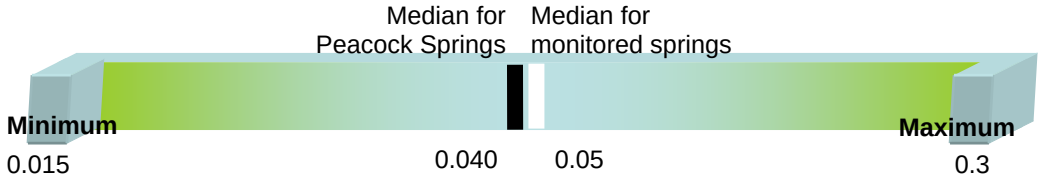
Results for four of the most significant water quality indicators are graphically represented in appendix A for Peacock Springs and appendix B for Orange Grove Sink. These parameters summarize how Peacock Springs and Orange Grove Sink compare with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Peacock Springs

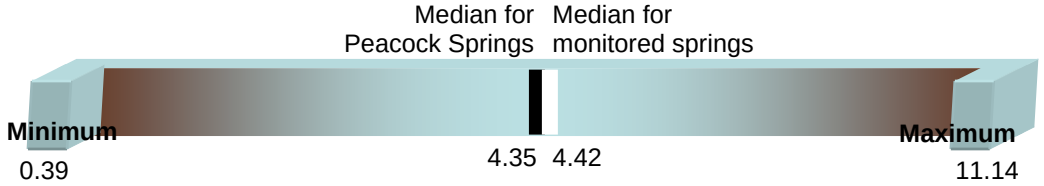
Nitrate-Nitrite (mg/L)



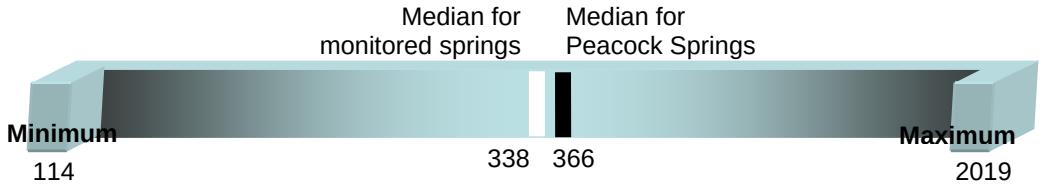
Total Phosphorus (mg/L)



Dissolved Oxygen (mg/L)

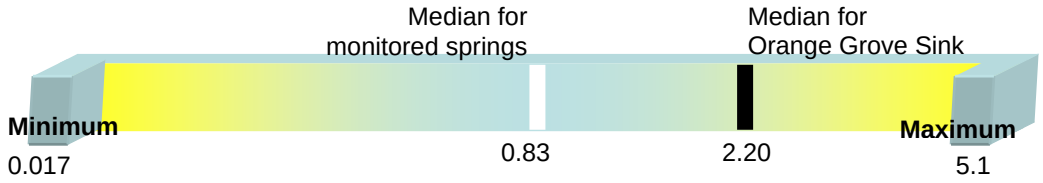


Specific Conductance (umhos/cm)

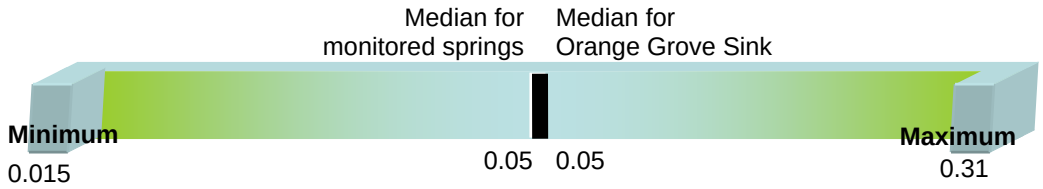


Appendix B: Monitoring Summary for Orange Grove Sink

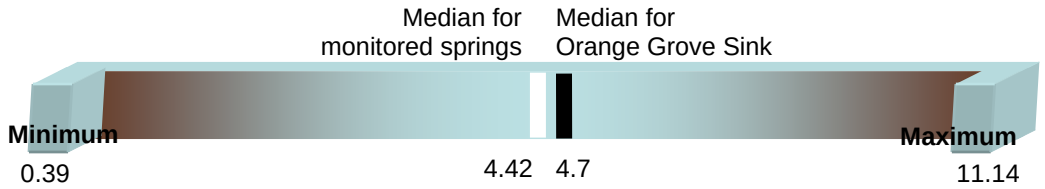
Nitrate-Nitrite (mg/L)



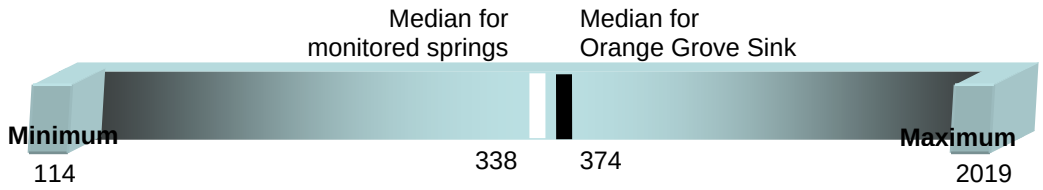
Total Phosphorus (mg/L)



Dissolved Oxygen (mg/L)

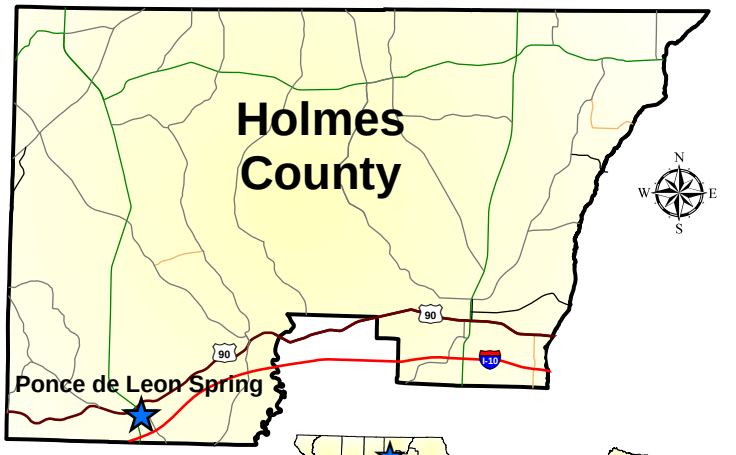


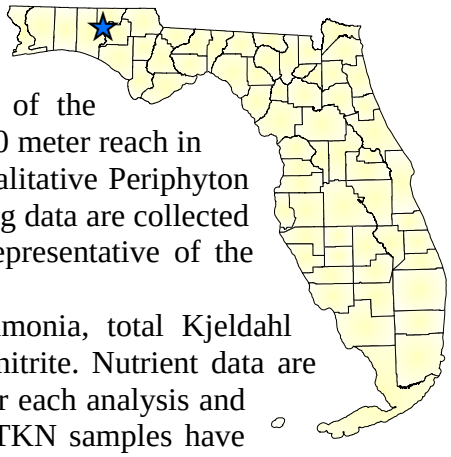
Specific Conductance (umhos/cm)



Ponce de Leon Springs

Ponce de Leon Springs is located in Holmes County within Ponce de Leon Springs State Recreation Area. It is a second magnitude spring, discharging into Sandy Creek, which then flows into the Choctawhatchee River. Ponce de Leon Springs was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, SCI and periphyton collections. Chemistry is sampled additionally by the Florida Park Service in the winter and summer. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).





The Ponce de Leon monitoring site is located in the spring run, approximately 50 meters south of the headspring, within the park limits. It consists of a 100 meter reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter reach in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. The majority of ammonia and TKN samples have remained either below the detection limit or below the practical quantitation limit (PQL) for the approximately six-year sampling period. Ammonia was detected in one sample above the PQL at 0.025 mg/L on January 24th 2006, but this value remained low, below the 20th percentile compared to typical Florida streams. Seventeen of the twenty one total phosphorus samples (81%) have remained either below the practical quantitation limit or below the detection limit over the sampling period. The data plotted over time show no visually apparent increase or decrease in TP concentrations (Figure 1). Total phosphorus detections remained below the 30th percentile compared to typical Florida streams. Nitrate-nitrite concentrations have ranged from 0.23 to 0.33 mg/L over the sampling period and are lower than 90% of other Florida streams, suggesting that Ponce de Leon Spring may be used as a nutrient reference site. Concentrations of nitrate-nitrite plotted over the sampling period show no visually apparent increase or decrease over time.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 4, 2000	0.01	U	0.06	U	0.027	I	0.23	
October 4, 2001	0.01	U	0.06	U	0.021	I	0.24	A
January 28, 2002	0.01	U	0.06	U	0.022		0.23	J
May 28, 2002	0.01	U	0.06	U	0.025	A	0.23	
July 24, 2002	0.01	UY	0.06	UY	0.034	IY	0.24	JY
October 8, 2002	0.01	U	0.06	U	0.044		0.23	
January 23, 2003	0.01	U	0.06	U	0.024	I	0.25	
May 14, 2003	0.011	I	0.12	U	0.048		0.25	
August 13, 2003	0.01	UY	0.06	UY	0.031	IY	0.26	Y
October 9, 2003	0.01	U	0.06	U	0.035	I	0.27	
February 2, 2004	0.01	U	0.06	U	0.027	I	0.29	
April 13, 2004	0.01	U	0.06	U	0.046	I	0.25	
July 28, 2004	0.013	I	0.06	U	0.025	I	0.26	
January 27, 2005	0.01	U	0.06	U	0.056	I	0.26	
July 26, 2005	0.01	U	0.06	U	0.023	I	0.33	
January 24, 2006	0.025		0.16	U	0.025	I	0.28	
June 22, 2006	0.01	U	0.08	U	0.026	I	0.25	
September 12, 2006	0.026	Q	0.08	U	0.02	U	0.26	
October 31, 2006	0.01	U	0.08	U	0.021	I	0.23	
February 6, 2007	0.01	U	0.16	U	0.02	U	0.24	
May 10, 2007	0.05	U	0.08	U	0.021	I	0.25	
Average	**0.01**		**0.08**		**0.03**		**0.25**	
Standard Deviation	**0.01**		**0.03**		**0.01**		**0.02**	
Median	**0.01**		**0.06**		**0.03**		**0.25**	

Table 1: Nutrient data for Ponce de Leon Springs including qualifier codes and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "I" = Below practical quantitation limit; "J"= Estimated value; "Q" = Outside of holding time; "U" = Below detection limit; "Y"= Improperly preserved.

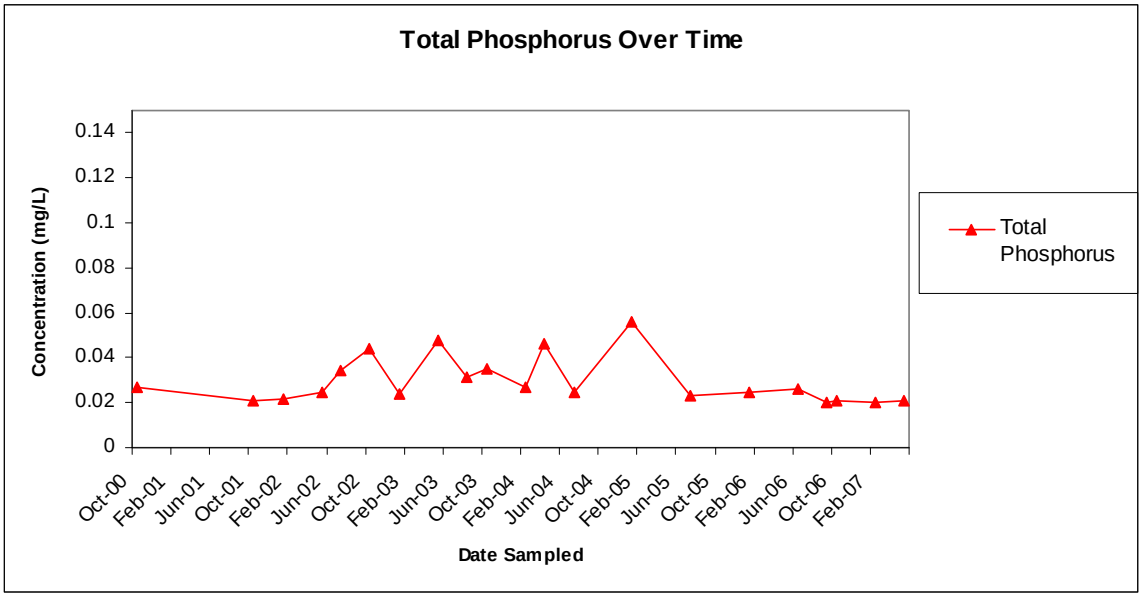


Figure 1: Total Phosphorus concentrations plotted over time for Ponce de Leon Springs.

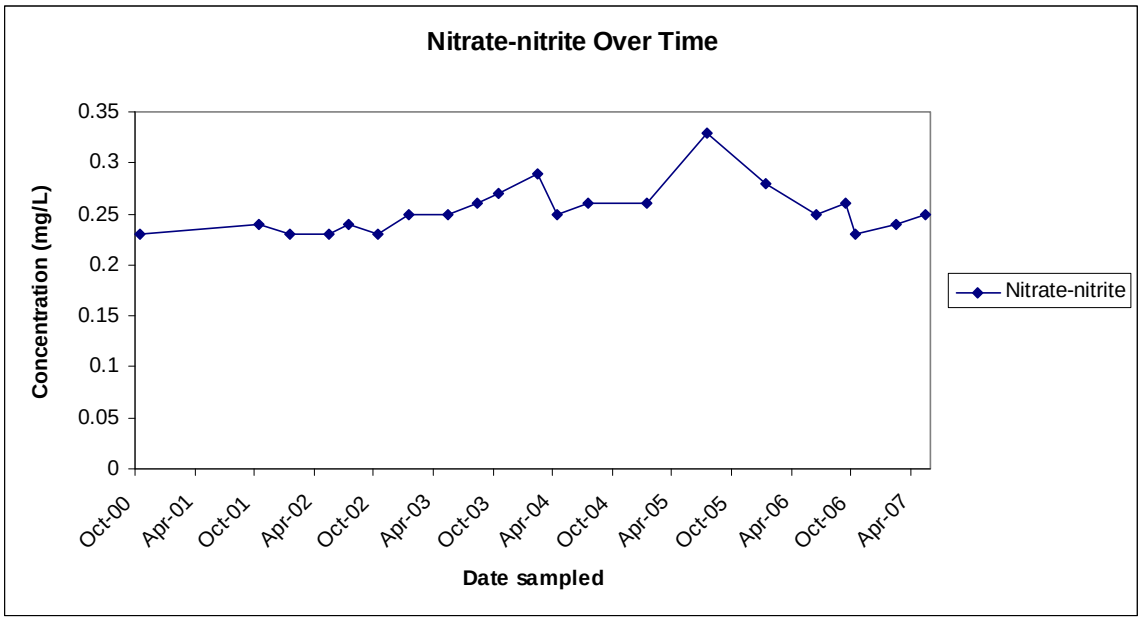


Figure 2: Nitrate-nitrite data plotted over time for Ponce de Leon Springs.

Water chemistry bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 2 CFU/100 mL. *Enterococci* data have ranged from 1 to 62 CFU/100 mL over the sampling period, with a median of 10 CFU/100 mL. This median is lower than the freshwater standard of 61 CFU/100 mL for designated beach areas. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 1 to 33 CFU/100 mL, with a median of 2 coloneis/100mL. Total coliform data have ranged from 1 to 220 CFU/100 mL. The median total coliform value was 60 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 4, 2000	30	Q	10	Q	1	KQ	90	Q
October 4, 2001	2	Q	8	Q	12	Q	70	Q
January 28, 2002	1	KQ	1	KQ	1	KQ	1	KQ
May 28, 2002	34	Q	12	Q	6	Q	150	Q
July 24, 2002	2	Q	2	Q	2	Q	60	Q
October 8, 2002	4	Q	2	Q	8	Q	50	Q
January 23, 2003	1	K	1	K	1	K	1	K
May 14, 2003	2	Q	22	Q	2	Q	30	Q
August 13, 2003	62	A	28	AB	33	AB	220	A
October 9, 2003	10	BQ	2	BQ	4	BQ	16	BQ
February 2, 2004	10	BQ	1	KQ	2	BQ	14	BQ
April 13, 2004	30	BQ	12	BQ	7	BQ	42	BQ
July 28, 2004	2	BQ	2	BQ	18	BQ	72	Q
January 27, 2005	2	BQ	4	BQ	2	KQ	88	Q
July 26, 2005	20	BQ	4	BQ	12	BQ	106	Q
January 24, 2006	2	KQ	2	KQ	2	KQ	94	Q
June 22, 2006	26	ABQ	2	AKQ	2	AKQ	86	AQ
September 12, 2006	10	ABQ	2	AKQ	2	AKQ	21	ABQ
October 31, 2006	62		2	B	2	K	60	
February 6, 2007	2	UQ	4	BQ	4	BQ	10	BQ
May 10, 2007	14	BQ	6	Q	2	UQ	44	Q
Average	**16**		**6**		**6**		**63**	
Standard Deviation	**19**		**7**		**8**		**53**	
Median	**10**		**2**		**2**		**60**	

Table 2: Bacteriological data including qualifier codes for Ponce de Leon Springs and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given. "Q" = Outside of holding time; "U" = Below detection limit.

Field testing parameters were collected for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data with qualifier codes as well as data for turbidity and color are shown in Table 3. Over the sampling period from October 2000-May 2007, dissolved oxygen consistently complied with the Class III water quality standard of 5 mg/L averaging 6.3 mg/L and ranging from 5.5 to 7.6 mg/L. Temperature was stable, averaging 20.2 degrees Celsius. Specific conductivity averaged 210 umhos/cm, ranging from 189 to 219 umhos/cm. The mean pH was 7.2, ranging from 5.6 to 7.8 SU. Turbidity was consistently low, averaging 0.5 NTU, and color values were below the detection limit, indicating very transparent water.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 4, 2000	6.95	7.1	189	20.2	5		0.1	
October 4, 2001	6.7	7.59	192	19.95	5	U	0.25	
January 28, 2002	No Result	No Result	No Result	No Result	5	U	0.1	
May 28, 2002	6.4	7.6	214	20.5	5	U	0.4	
July 24, 2002	No Result	No Result	No Result	No Result	5	U	0.15	
October 8, 2002	5.55	7.7	216	20.11	5	U	0.1	
January 23, 2003	No Result	No Result	No Result	No Result	5	U	0.1	
May 14, 2003	7.6	5.6	216	20.4	5	U	0.75	
August 13, 2003	No Result	No Result	No Result	No Result	5	U	0.55	
October 9, 2003	6	6.8	216	20.1	5	U	0.4	
February 2, 2004	No Result	No Result	No Result	No Result	5	Q	0.55	Q
April 13, 2004	5.5	7.1	207	19.8	5	U	0.2	
July 28, 2004	No Result	No Result	No Result	No Result	5	U	0.3	
January 27, 2005	No Result	No Result	No Result	No Result	5	U	0.15	
July 26, 2005	No Result	No Result	No Result	No Result	5		0.2	
January 24, 2006	No Result	No Result	No Result	No Result	5		0.2	
June 22, 2006	7	7.2	213	20.7	5		1.4	
September 12, 2006	No Result	No Result	No Result	No Result	5		0.15	
October 31, 2006	5.55	7.22	219	20.05	5	U	0.15	
February 6, 2007	No Result	No Result	No Result	No Result	5	U	3	
May 10, 2007	5.95	7.81	217	20.3	5	U	0.25	
Average	**6.32**	**7.17**	**209.90**	**20.21**	**5.00**		**0.45**	
Standard Deviation	**0.73**	**0.64**	**10.73**	**0.27**	**0.00**		**0.66**	
Median	**6.20**	**7.21**	**215.00**	**20.16**	**5.00**		**0.20**	

Table 3: Field parameters, color, and turbidity data with qualifier codes and summary statistics. “Q” = Outside of holding time; “U” = Below detection limit.

Habitat Assessments and Stream Condition Index (SCI) were performed from October 4, 2000 to May 10, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores are plotted over time in Figure 3. Only one of the nine SCI scores taken over the entire sampling period was in the healthy category with regard to macroinvertebrate community. Since habitat and water quality did not appear to be an issue at this the site, the reason for low SCI scores is currently not known. One hypothesis concerns the potential lack of recruitment of invertebrates from upstream sources. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. A mean of 4 sensitive taxa (a good score) was found over the sampling period, displayed in Figure 4. Total taxa for each sampling date over the entire sampling period are displayed in Figure 5. Total taxa over all the dates ranged from 14 to 28 taxa. Habitat Assessments scored mainly in the optimal category, with two samples scoring in the suboptimal category (Figure 6).

Old SCI Scores	
Oct 4, 2000	17
Oct 4, 2001	19
May 28, 2002	13
Oct 8, 2002	19
May 14, 2003	17
Oct 9, 2003	23
Apr 13, 2004	19

Recalibrated SCI Score	
June 22, 2006	32
May 10, 2007	32

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

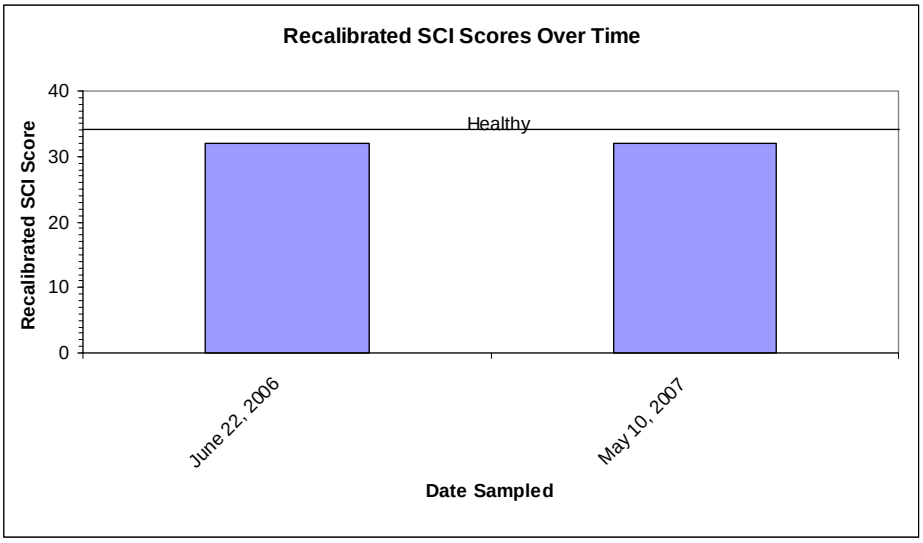


Figure 3: Recalibrated SCI scores with the impairment line drawn at 34.

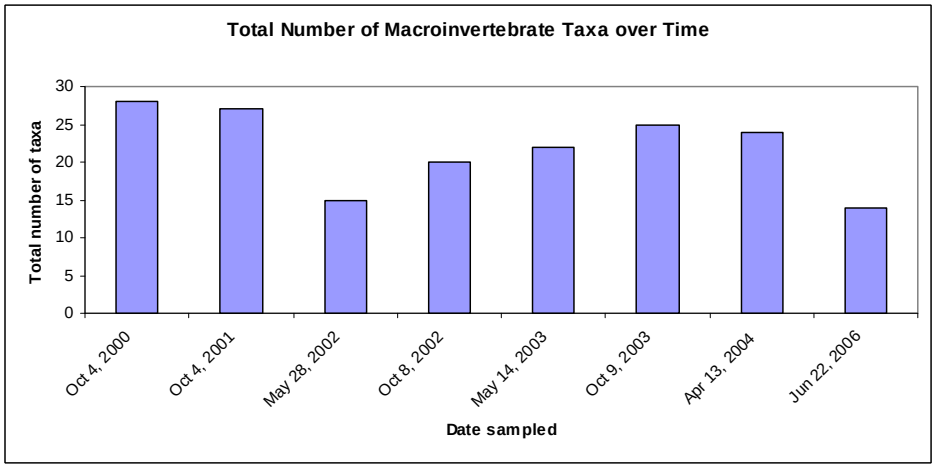


Figure 4: Total macroinvertibrate taxa for each sampling event.

Date	Sensitive taxa
10/4/2000	4
10/4/2001	4
5/28/2002	2
10/8/2002	2
5/14/2003	4
10/9/2003	6
4/13/2004	4
6/13/2004	4

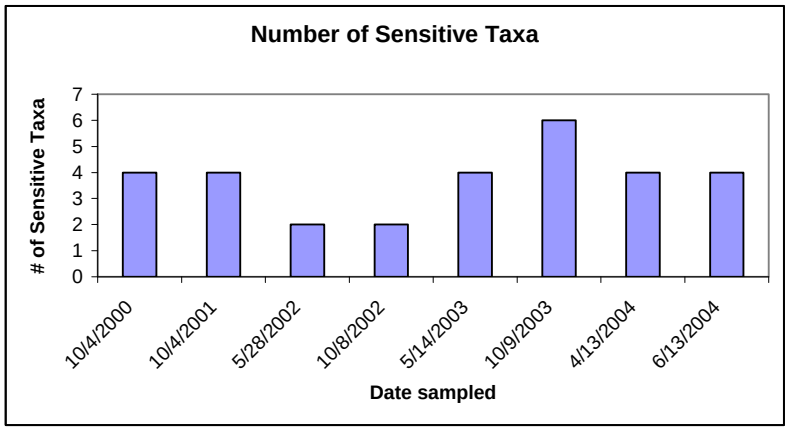


Figure 5: Table and chart showing the number of sensitive taxa over the sampling period.

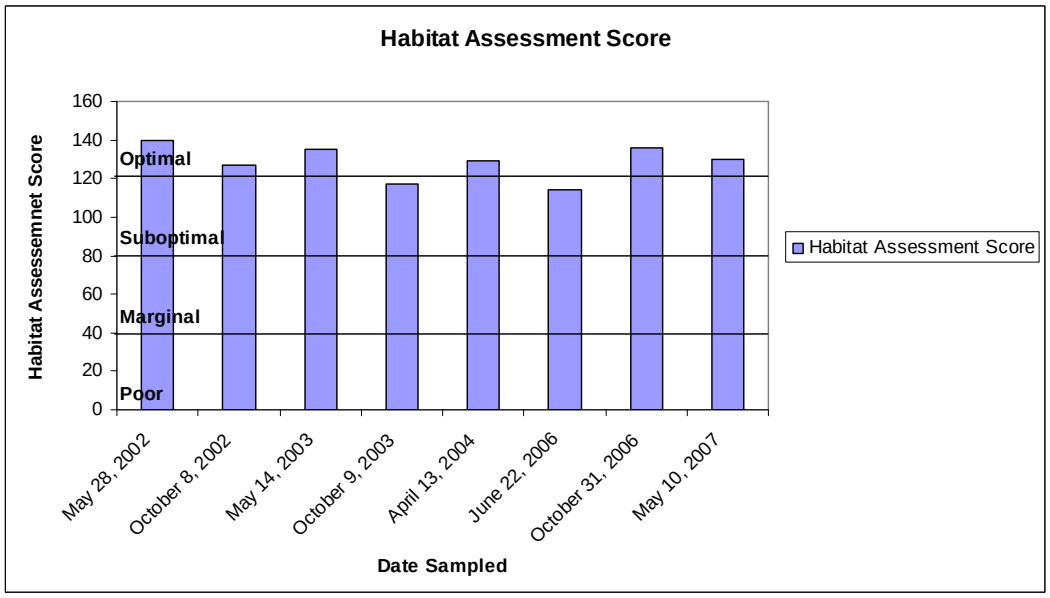


Figure 6: Habitat assessment scores plotted for sampling events.

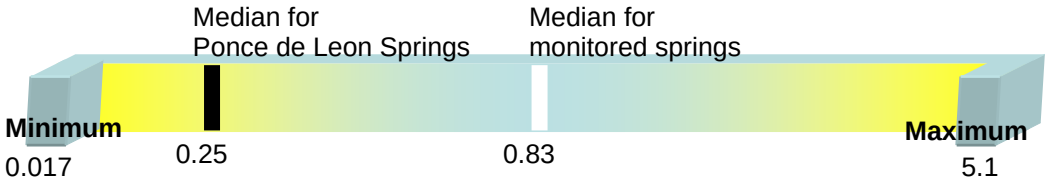
Over the roughly six year sampling period from October 2000 to May 2007, data indicate that:

- Water quality, as measured by nutrients (including nitrate-nitrite), water clarity, and bacterial densities suggested excellent conditions.
- Stream Condition Index biological samples indicate that the system does not meet its biological potential. The reason for these results is not understood, since water quality and habitat conditions were generally good.

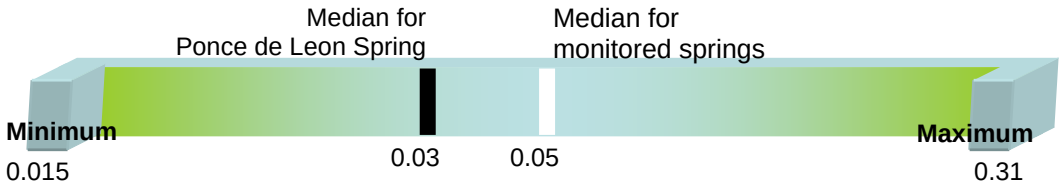
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Ponce de Leon Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Ponce de Leon Springs

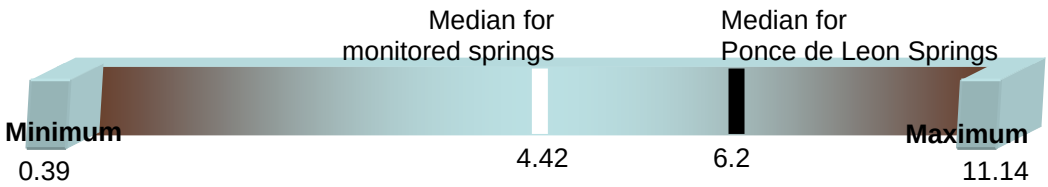
Nitrate-Nitrite (mg/L)



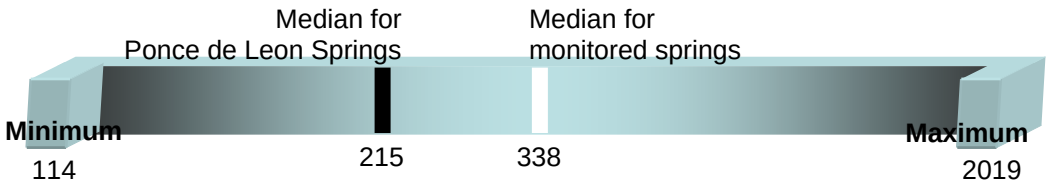
Total Phosphorus (mg/L)



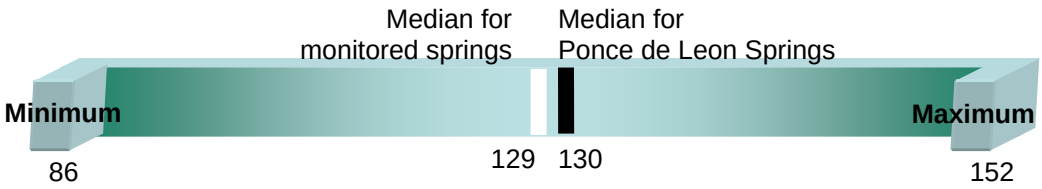
Dissolved Oxygen (mg/L)



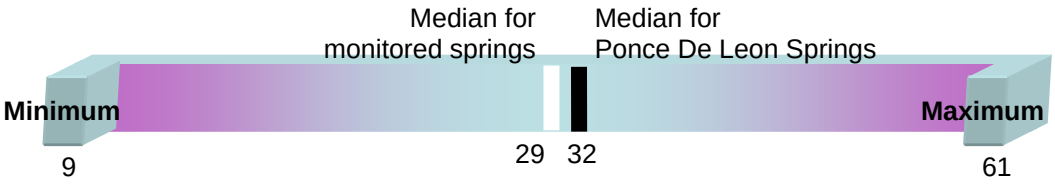
Specific Conductance (umhos/cm)



Habitat Assessment Score



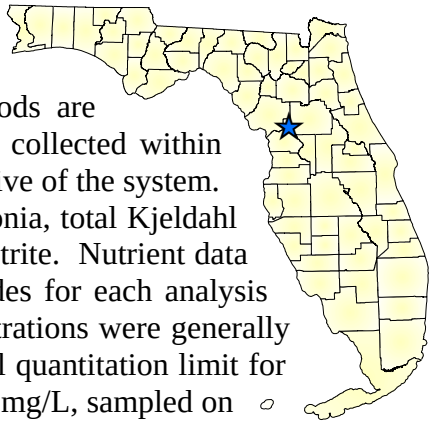
Stream Condition Index



Rainbow Springs

Rainbow Springs is located in Marion County, within Rainbow Springs State Park. The system which receives groundwater from several spring vents, is a first magnitude spring that flows into the Withlacoochee River. Rainbow Springs was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).





The Rainbow River monitoring site is located in the spring run, approximately 100 meters south of the headspring, within the park limits. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN concentrations were generally either below the detection limit or below the practical quantitation limit for the sampling period. The TKN concentration of 0.25 mg/L, sampled on April 29, 2004 remained in a healthy percentile of values compared to typical Florida streams. Total phosphorus and Nitrate-nitrite concentrations were plotted over the approximately six-year period from 2000-2007 (Figures 1 and 2). Total phosphorus concentrations have remained below the practical quantitation limit for nine of the twelve samples (75%). Total phosphorus detections remained below the 30th percentile compared to typical Florida streams except for the sample taken on May 14th, 2007 (0.31 mg/L) which was considerably higher than any of the other samples taken over the sampling period. This unusually high TP concentration is unexplained, but it could have been caused by a sampling or laboratory artifact. More samples collected after this date would be needed to determine if it is a true occurrence in the water body. Nitrate-nitrite concentrations have ranged from 1.1 to 3.4 mg/L over the sampling period, all of which exceed 95% of other Florida streams. Visual inspection of the data suggests a slight increase in the nitrate-nitrite concentrations over time, in part because of an unusually high sample taken on November 8, 2006. This sample remains unexplained since the subsequent sample taken on May 14, 2007 did not continue to increase. Consistently

high nitrate-nitrite concentrations are probably due anthropogenic nutrient inputs from the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 4, 2000	0.01	U	0.06	U	0.036	I	1.1	
November 2, 2001	0.01	U	0.06	U	0.025	I	1.1	
April 16, 2002	0.018	I	0.06	U	0.035	I	1.2	J
November 5, 2002	0.012	I	0.14	I	0.047		1.2	
May 6, 2003	0.013	I	0.06	U	0.031	I	1.3	
October 1, 2003	0.01	U	0.06	U	0.039	I	1.3	
April 29, 2004	0.01	U	0.25		0.033	I	1.2	
December 7, 2004	0.01	U	0.06	U	0.061		1.4	A
May 25, 2005	0.01	U	0.06	U	0.028	I	1.6	
June 21, 2006	0.01	U	0.08	U	0.033	I	1.7	
November 8, 2006	0.01	U	0.16	U	0.034	I	3.4	
May 14, 2007	0.01	U	0.08	U	0.31		1.7	
Average	**0.01**		**0.09**		**0.06**		**1.52**	
Standard Deviation	**0.00**		**0.06**		**0.08**		**0.63**	
Median	**0.01**		**0.06**		**0.03**		**1.30**	

Table 1: Nutrient data including qualifier codes. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "I" = Below practical quantitation limit; "J"= Estimated value; "U" = Below detection limit.

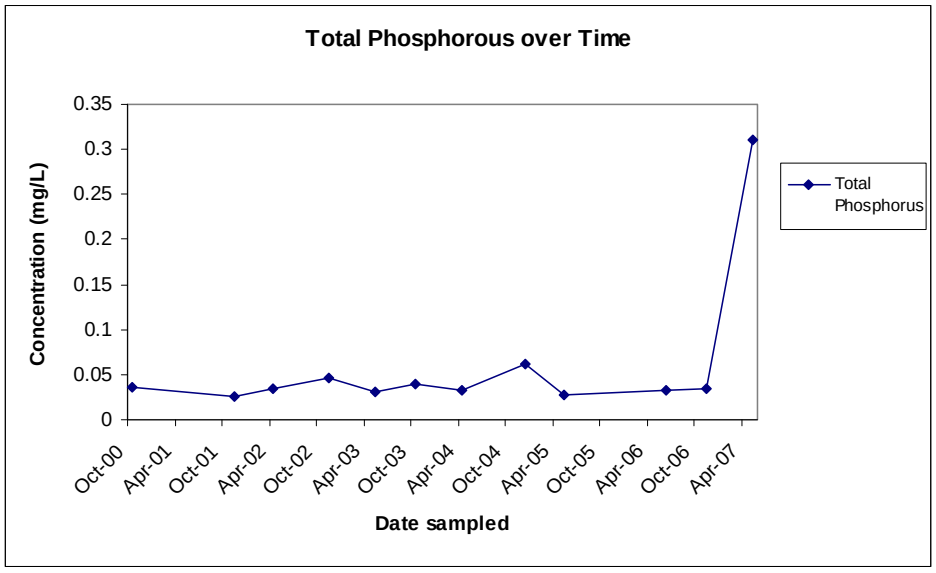


Figure 1: Total phosphorus concentrations plotted over time.

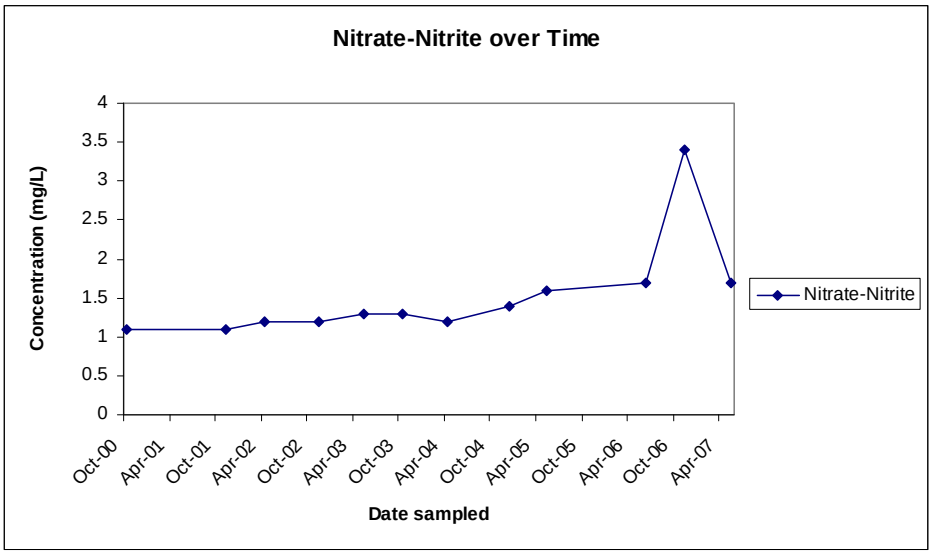


Figure 2: Nitrate-nitrite data plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. Variability in the bacteria data suggests that the median is a better measure of the central tendency. *E. coli* data have consistently complied with the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 8 CFU/100 mL. *Enterococci* data have ranged from 2 to 92 CFU/100 mL over the sampling period, with a median of 10 CFU/100 mL. The median is lower than the "single sample" freshwater criterion of 61 CFU/100 mL for designated beach areas. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 2 to 117 CFU/100 mL, with a median of 4 CFU/100 mL. Total coliform data have ranged from 11 to 210 CFU/100 mL. The median total coliform value for the sampling period was 60 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 4, 2000	92	Q	2	Q	4	Q	60	Q
March 22, 2001	20	Q	14	Q	34	Q	90	Q
November 2, 2001	6	AQ	67	AQ	117	AQ	210	AQ
April 16, 2002	12	Q	6	Q	4	Q	30	Q
November 5, 2002	19	AQ	24	AQ	11	AQ	85	AQ
May 6, 2003	8	Q	1	KQ	2	Q	20	Q
October 1, 2003	16	BQ	20	BQ	18	BQ	170	BQ
April 29, 2004	28	BQ	2	BQ	2	BQ	200	Q
December 7, 2004	5	ABQ	2	AKQ	4	ABQ	11	ABQ
May 25, 2005	4	BQ	2	KQ	2	BQ	28	BQ
June 21, 2006	8	BQ	76	Q	10	BQ	34	BQ
November 8, 2006	10	BQ	18	BQ	10	BQ	60	Q
May 14, 2007	2	UQ	8	BQ	4	BQ	48	Q
Average	**18**		**19**		**17**		**80**	
Standard Deviation	**24**		**25**		**31**		**69**	
Median	**10**		**8**		**4**		**60**	

Table 2: Bacteriological data including qualifier codes and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given; "Q" = Outside of holding time; "U" = Below detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from October 2000-November 2007, dissolved oxygen averaged 7.31 mg/L, ranging from 5.1 to 9 mg/L. Temperature was stable, averaging 23 degrees Celsius. Specific conductivity was close to or below 300 umhos/cm, except for a single high value of 1879 umhos/cm. This was an unusual occurrence which cannot be explained, as quality control records suggested valid measurements. The average pH was 7.4, ranging from 6.7 to 8.0 SU. Turbidity was consistently low, with the highest value of 0.1 NTU. Color values were below the detection limit except for one sample collected on October 4, 2000, which had a value of 20 PCU. This detection may have occurred during a rain event due to tannic inputs from the floodplain.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 4, 2000	No Result	No Result	No Result	No Result	20	Q	0.1	Q
March 21, 2001	7.9	7.9	208	22.5	5	U	No Result	
October 15, 2001	8.96	7.55	219	22.94	No Result		No Result	
November 2, 2001	7	7.19	267	23.2	5	UQ	0.05	UQ
April 16, 2002	9.3	7.7	260	23.4	5	U	0.1	
November 5, 2002	5.75	7.22	296	22.8	5	U	0.05	U
May 6, 2003	7.3	7.6	301	23.4	5	U	0.05	
October 1, 2003	7.01	6.74	225	22.9	5	U	0.2	
April 29, 2004	7.4	7.6	273	22.9	5	U	0.55	
December 7, 2004	6.9	6.67	212	22.8	5	U	0.1	
May 25, 2005	No Result	7.6	221	23.2	5	U	0.2	
June 21, 2006	7.27	7.27	1875	23.32	5		0.35	
November 8, 2006	7.93	7.98	196	23.13	5	U	0.1	
May 14, 2007	5.05	6.68	304	23.04	5	U	0.1	
Average	**7.31**	**7.36**	**373.62**	**23.04**	**6.15**		**0.16**	
Standard Deviation	**1.18**	**0.45**	**452.68**	**0.27**	**4.16**		**0.15**	
Median	**7.29**	**7.55**	**260.00**	**23.04**	**5.00**		**0.10**	

Table 3: Field parameters, color, and turbidity data with qualifier codes. "U" = Below detection limit; "Q" = Outside of holding time.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from October 2000 to May 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores are plotted over time in Figure 3. All SCI scores for each of the dates sampled were above the impairment threshold, indicating a healthy macroinvertebrate community. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 5 and 6 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa for each sampling date over the entire sampling period are displayed in Figure

4. Total taxa over all the dates ranged from 16 to 34 taxa. The number of sensitive taxa varied over the sampling period with an average of 3 sensitive taxa present (Figure 5). Habitat Assessments were consistently within the optimal scoring range throughout the sampling period, suggesting adequate habitat conditions for macroinvertebrate communities (figure 6).

Old SCI Scores	
October 4, 2000	31
March 22, 2001	29
October 15, 2001	27
April 16, 2002	29
November 5, 2002	19
May 6, 2003	25
October 1, 2003	27
April 29, 2004	23

Recalibrated SCI Scores	
December 7, 2004	48
May 25, 2005	47
June 21, 2006	36
May 14, 2007	56

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. SCI scores calculated previous to the SCI recalibration, implemented June 8, 2004. Scores calculated prior to 2004 were based on a 33 point scale, with scores of 21 and higher indicating healthy conditions.

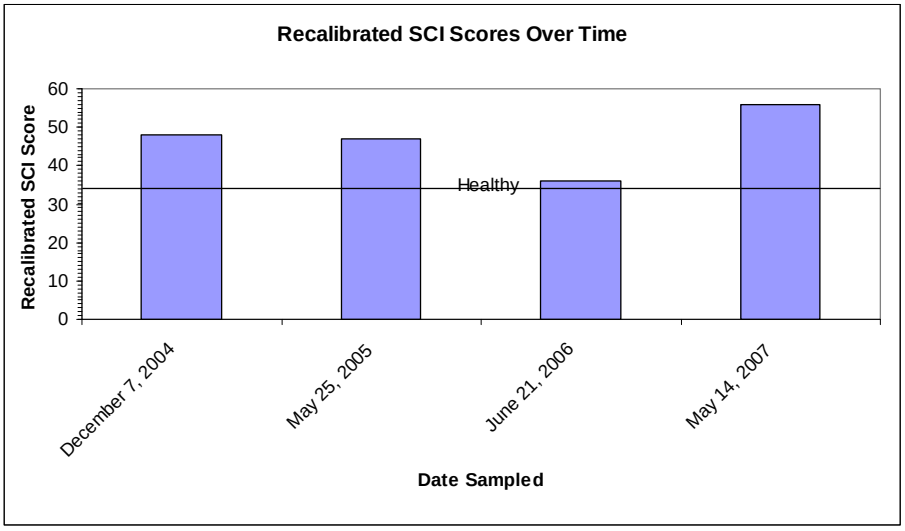


Figure 3: Recalibrated SCI scores with the impairment threshold at 34.

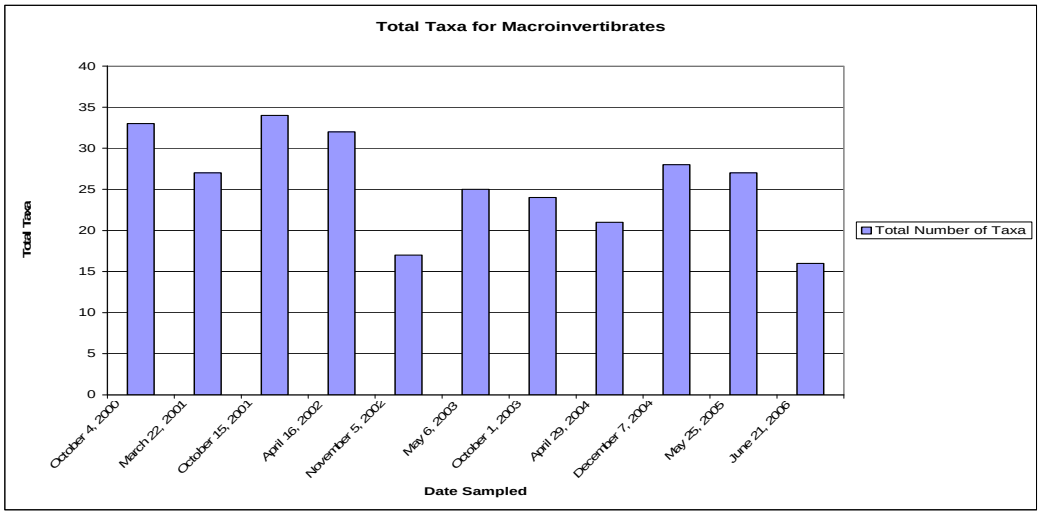


Figure 4: Total macroinvertibrate taxa for each sampling event.

Date	Sensitive Taxa
10/4/2000	5
3/22/2001	3
10/15/2001	2
4/16/2002	4
11/5/2002	0
5/6/2003	2
10/1/2003	4
4/29/2004	2
12/7/2004	4
5/25/2005	1
6/21/2006	2

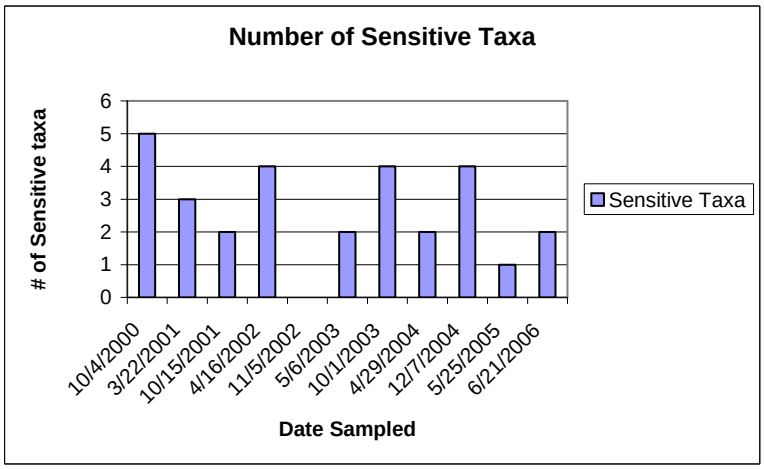


Figure 5: Table and chart showing number of sensitive taxa over the sampling period.

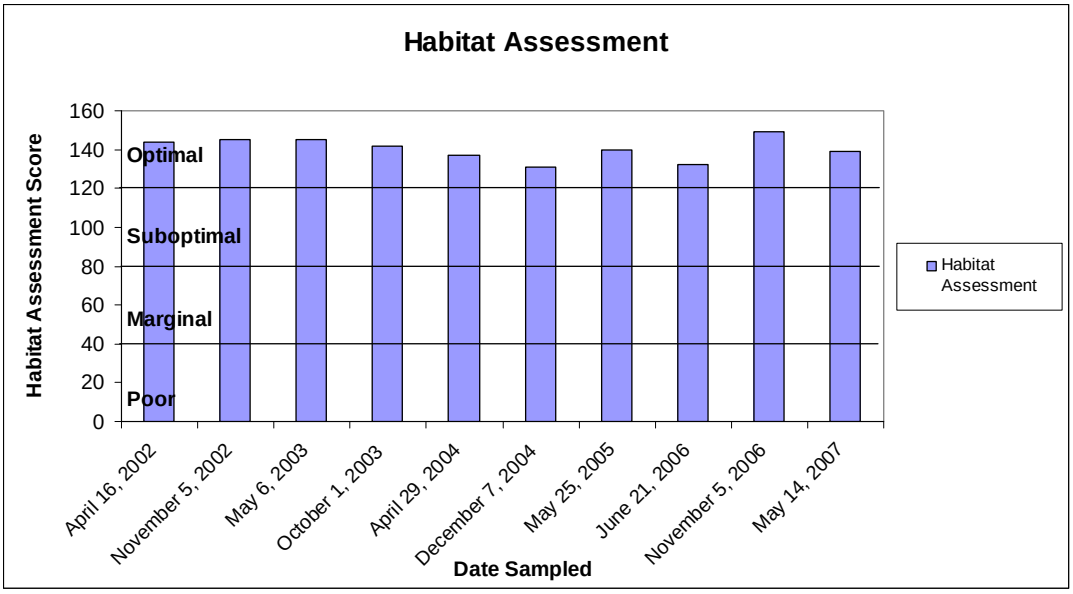


Figure 6: Habitat assessment scores plotted for sampling events.

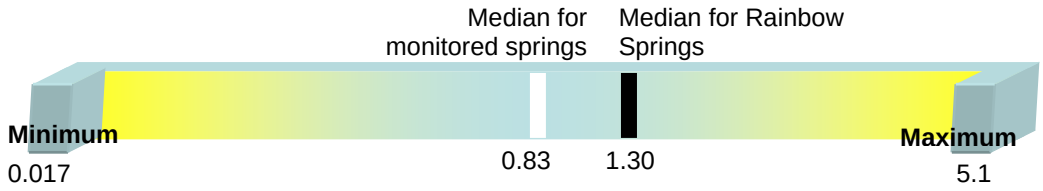
Over the roughly six year sampling period from October 4, 2000 to May 14, 2007, data indicate that:

- Water quality, as measured by transparency, nutrients (except nitrate-nitrate), field parameters and bacteria, was generally good.
- Nitrate-nitrite concentrations have ranged from 1.1 to 3.4 mg/L over the sampling period, and are higher than the values found in 95% of typical Florida streams.
- Stream Condition Index biological samples consistently indicate that healthy conditions prevail in the system.

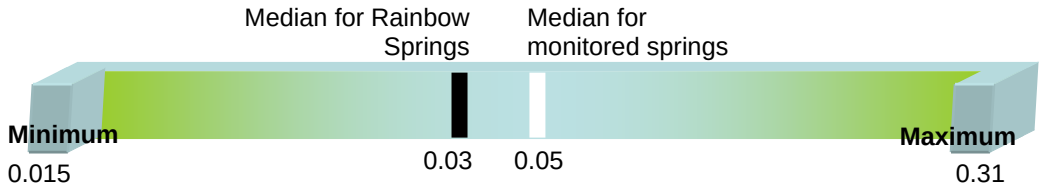
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Rainbow Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Rainbow Springs

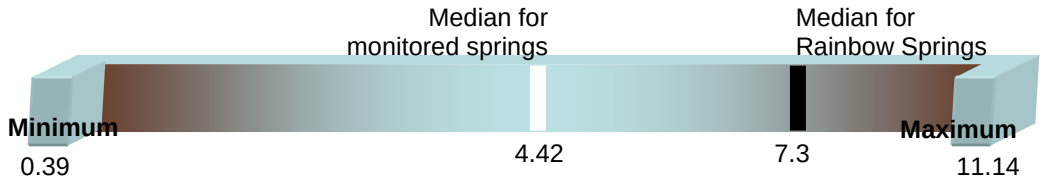
Nitrate-Nitrite



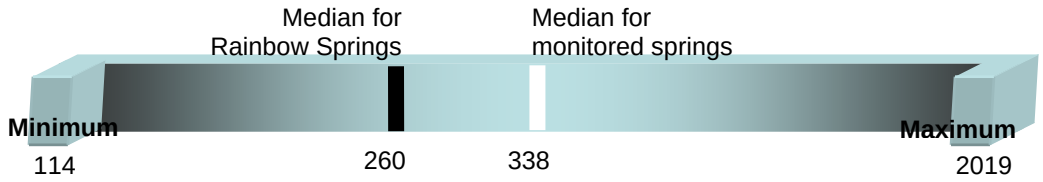
Total Phosphorous



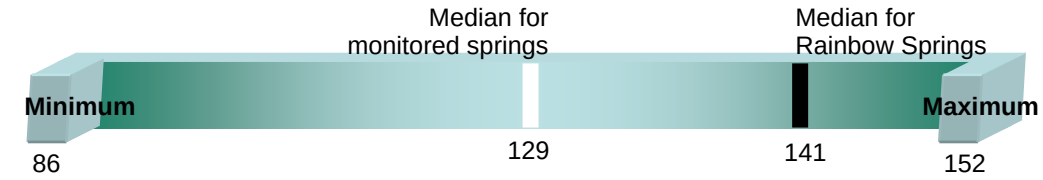
Dissolved Oxygen



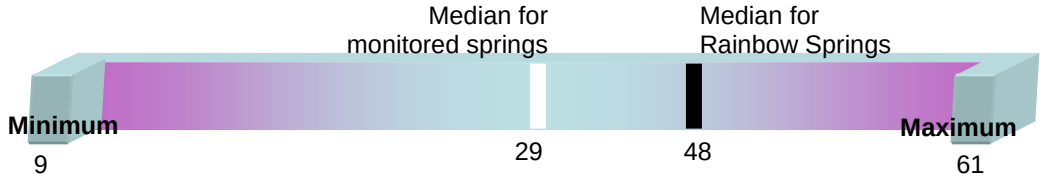
Specific Conductance



Habitat Assessment Score

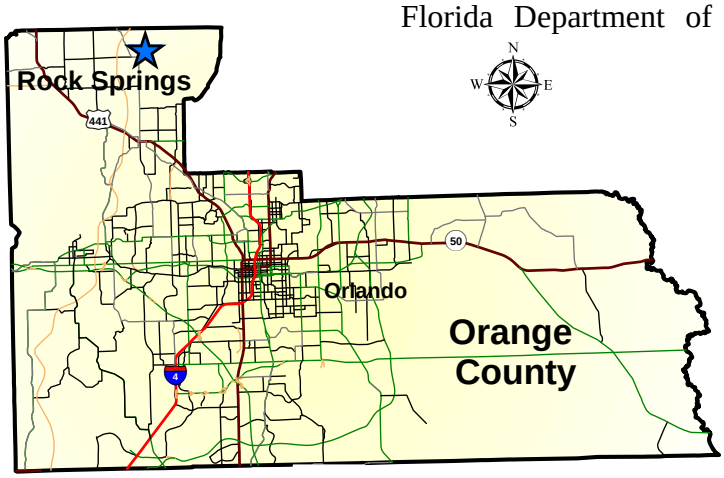


Stream Condition Index

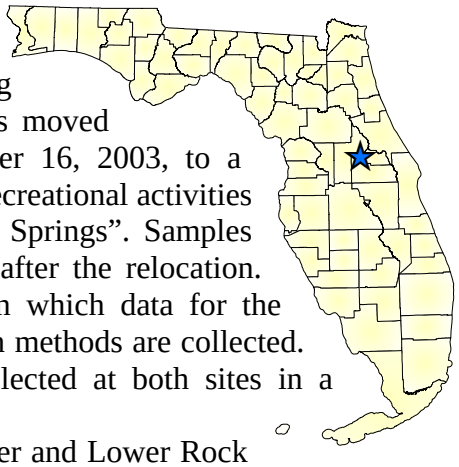


Rock Springs

Rock Springs is located in Orange County, within Kelly Park and is the headwaters to Rock Springs Run. It is a second magnitude spring. Rock Springs Run flows into the Wekiva River. Rock Springs was incorporated into the Springs Monitoring Program in April 2002 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The Rock Springs monitoring site has been relocated from the headsprings to a downstream location in the spring run. The first location, "Upper Rock Springs", lies close to the head spring and next to the swimming area. The location was moved downstream about a quarter of a mile, on October 16, 2003, to a location less affected by physical disruption due to recreational activities at the swimming area, and is called "Lower Rock Springs". Samples were taken at both locations each sampling event after the relocation. They both consist of a 100 meter stream reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are also collected at both sites in a location that is most representative of the system.



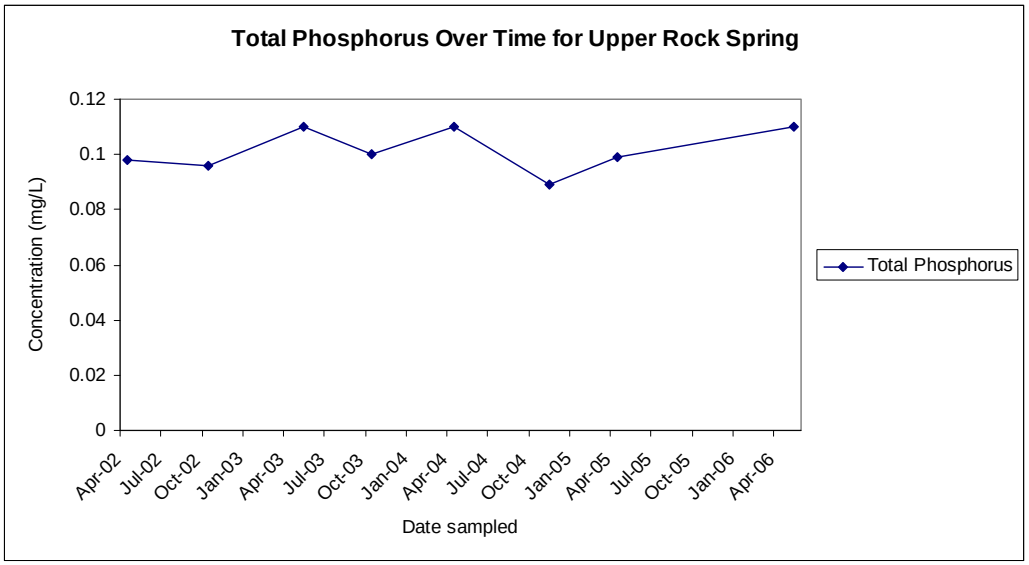
Water column nutrient samples taken at Upper and Lower Rock Springs included ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN concentrations at both sites have been very low, generally below the detection limit or below the practical quantitation limit (PQL) throughout the sampling period. One TKN sample taken at Upper Rock Springs was above the PQL, and this sample was very low when compared to typical Florida streams. Total phosphorus at both Upper and Lower Rock Springs was below the 50th percentile compared with typical Florida streams. A visual inspection of the plotted total phosphorus data over time does not suggest an increase or decrease of TP over the sampling period (Figure 1). The phosphorus concentrations present probably reflect the leaching of natural phosphate deposits in this groundwater-fed spring system. Conversely, nitrate-nitrite concentrations have ranged from 1.3 to 1.7 mg/L over the sampling period for Upper Rock Springs and between 1.2 and 1.6 mg/L for Lower Rock Springs, but plotted results do not appear upon visual inspection to be increasing or

decreasing over time (Figure 2). These concentrations are higher than 95% of typical Florida streams. The higher values for nitrate-nitrite are probably due to non-point source nutrient inputs from within the springshed. The results demonstrate a high degree of similarity in nutrient concentrations at the upper and lower Rock Springs sampling sites throughout the sampling period.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
Upper Rock Springs								
April 17, 2002	0.01	U	0.06	U	0.098	A	1.4	J
October 22, 2002	0.018	I	0.23		0.096	J	1.5	
May 20, 2003	0.011	I	0.06	U	0.11		1.7	
October 16, 2003	0.01	U	0.084	I	0.1		1.5	
April 21, 2004	0.01	U	0.06	U	0.11		1.3	
November 9, 2004	0.01	U	0.06	U	0.089		1.7	
April 27, 2005	0.01	U	0.06	U	0.099	A	1.5	
May 25, 2006	0.01	U	0.16	U	0.11		1.4	
Average	**0.01**		**0.10**		**0.10**		**1.50**	
Standard Deviation	**0.00**		**0.06**		**0.01**		**0.14**	
Median	**0.01**		**0.06**		**0.10**		**1.50**	
Lower Rock Springs								
October 16, 2003	0.01	U	0.098	I	0.099		1.5	
April 21, 2004	0.01	U	0.06	U	0.11		1.3	
November 9, 2004	0.01	U	0.06	U	0.084	A	1.6	
April 27, 2005	0.01	U	0.088	I	0.093		1.4	
May 25, 2006	0.01	U	0.16	U	0.1		1.4	
November 2, 2006	0.01	U	0.08	U	0.094	A	1.3	
May 9, 2007	0.01	U	0.08	U	0.089		1.2	
Average	**0.01**		**0.09**		**0.10**		**1.39**	
Standard Deviation	**0.00**		**0.03**		**0.01**		**0.13**	
Median	**0.01**		**0.08**		**0.09**		**1.40**	

Table 1: Nutrient data including qualifier codes and summary statistics for Upper and Lower Rock Springs. "A"= Value reported is the arithmetic mean (average) of two or more determinations; "I" = Below practical quantitation limit; "J"= Estimated value; "U" = Below detection limit.



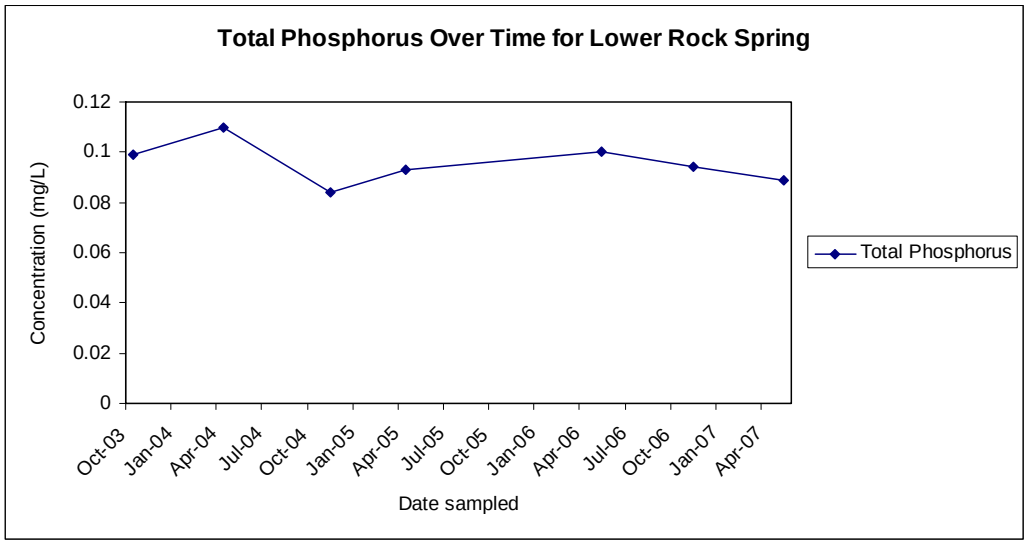
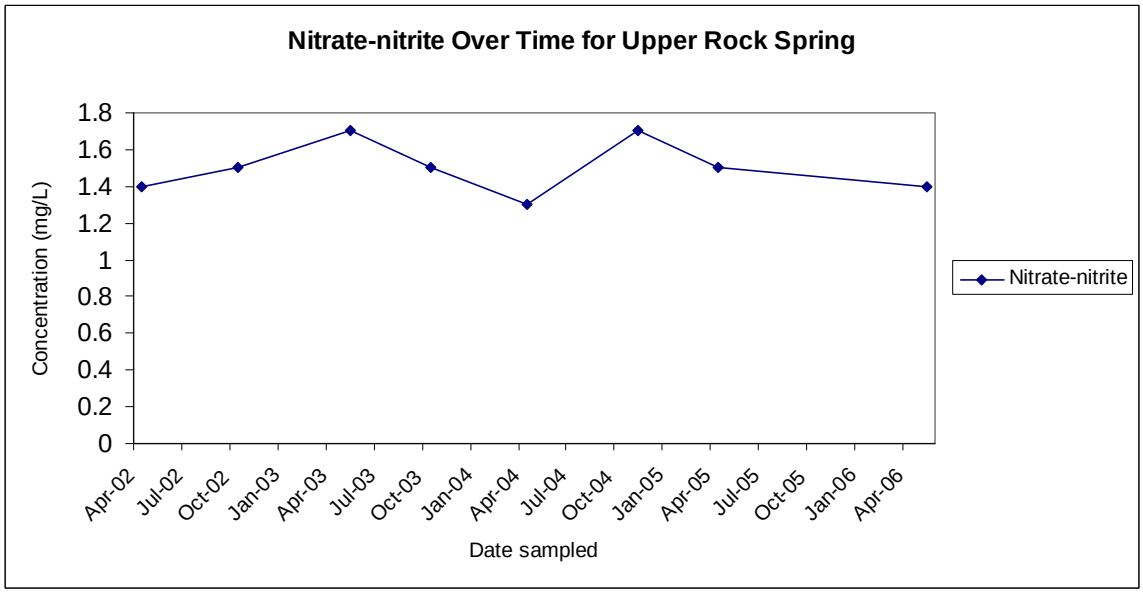


Figure 1: Total Phosphorus concentrations plotted over time for Upper and Lower Rock Springs.



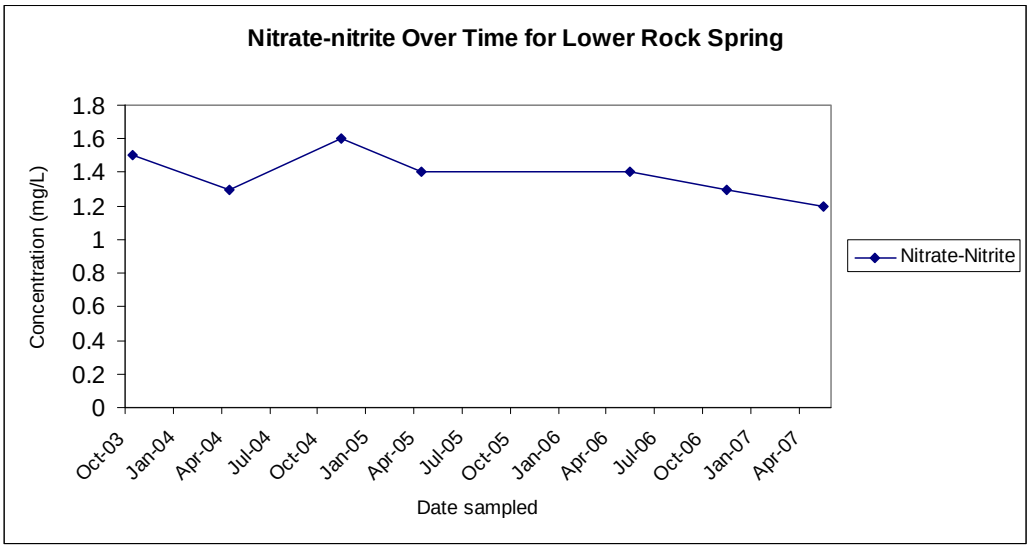


Figure 2: Nitrate-Nitrite Nitrogen levels plotted over time for Upper and Lower Rock Springs.

Water column bacteria samples taken at Upper and Lower Rock Springs were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have complied with the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 2 CFU/100 mL for Upper Rock Springs and 40 CFU/100 mL for Lower Rock Springs. *Enterococci* data for Upper Rock Springs have remained below the standard of 61 CFU/100 mL for "Designated Freshwater Beach Areas" ranging from 2 to 30 CFU/100 mL with a median of 7 CFU/100 mL. Lower Rock Springs, while having slightly higher values, also complied with the standard, ranging 20 to 56 CFU/100 mL. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 1 to 20 CFU/100 mL with a median of 2 CFU/100 mL at the upper site. Fecal coliforms at the lower site ranged from 15 to 88 CFU/100 mL with a median of 23 CFU/100 mL. Total coliform data for the upper site have ranged 1 to 42 CFU/100 mL, with a median of 20 CFU/100 mL. At the lower site, total coliforms ranged from 86 to 250 CFU/100 mL, with a median of 120 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
Upper Rock Springs								
April 17, 2002	12	Q	1	KQ	1	KQ	1	KQ
October 22, 2002	30	Q	1	KQ	20	Q	20	Q
May 20, 2003	6	BQ	2	BQ	2	BQ	10	BQ
October 16, 2003	2	ABQ	1	ABQ	1	AKQ	25	ABQ
April 21, 2004	3	BQ	1	KQ	1	KQ	20	BQ
November 9, 2004	26	BQ	26	BQ	16	BQ	34	BQ
April 27, 2005	8	BQ	4	BQ	2	KQ	6	BQ
May 25, 2006	6	BQ	2	KQ	6	BQ	42	Q
Average	**12**		**5**		**6**		**20**	
Standard Deviation	**11**		**9**		**8**		**14**	
Median	**7**		**2**		**2**		**20**	
Lower Rock Springs								
October 16, 2003	42	Q	40	Q	30	BQ	250	Q
April 21, 2004	23	BQ	18	BQ	15	BQ	120	Q
November 9, 2004	34	BQ	14	BQ	20	BQ	86	Q
April 27, 2005	20	BQ	114	Q	20	BQ	120	Q
May 25, 2006	54	AQ	11	ABQ	23	ABQ	94	AQ
November 2, 2006	56	Q	82	Q	42	Q	208	BQ
May 9, 2007	36	BQ	96	Q	88	Q	96	Q
Average	**38**		**54**		**34**		**139**	
Standard Deviation	**14**		**43**		**25**		**64**	
Median	**36**		**40**		**23**		**120**	

Table 2: Bacteriological data including qualifier codes and summary statistics for Upper and Lower Rock Springs. "A"= Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K"= Off scale low; "Q" = Outside of holding time.

Field parameters were tested *in situ* at Upper and Lower Rock Springs for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from 2002 to 2007, dissolved oxygen at the upper sampling site was low, averaging 1.9 mg/L and ranging from 1.1 to 4.2 mg/L. DO at the lower site was higher, averaging 4.0 mg/L and ranging from 3.0 to 5.4 mg/L. This difference is likely due atmospheric re-aeration of the low dissolved oxygen groundwater between the two sites. The DO at the lower site was frequently below the Class III water quality standard of 5 mg/L, and was always below the standard at the upper site. This low DO regime (a natural condition for headwater spring systems) can eliminate DO sensitive taxa from the system. Temperature was stable, averaging about 24 degrees Celsius at both the upper and lower sampling sites. Specific conductivity was similar at both the upper and lower sites, averaging around 260 umhos/cm. The mean pH was 7.5 SU at both sites. Water at both locations was low in turbidity (averaging about 0.2 NTU) and color (which was below the detection limit the entire sampling period).

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
Upper Rock Springs								
April 17, 2002	1.5	7.6	259	23.8	5	U	0.1	
October 22, 2002	1.47	7.37	267	23.8	5	U	0.05	U
May 20, 2003	1.12	7.66	263	23.6	5	U	0.25	
October 16, 2003	2	7.3	259	23.7	5	U	0.15	
April 21, 2004	1.74	7.58	257	23.7	5	Q	0.1	Q
November 9, 2004	1.8	7.35	266	23.6	5	U	0.1	
April 27, 2005	1.2	7.9	248	23.6	5	U	0.1	
May 25, 2006	4.18	6.77	275	23.75	5	U	0.25	
Average	**1.88**	**7.44**	**261.75**	**23.69**	**5.00**		**0.14**	
Standard Deviation	**0.98**	**0.34**	**8.01**	**0.09**	**0.00**		**0.07**	
Median	**1.62**	**7.48**	**261.00**	**23.70**	**5.00**		**0.10**	
Lower Rock Springs								
October 16, 2003	3.2	7.64	258	23.9	5	U	0.1	A
April 21, 2004	5.24	7.65	256	23.92	5	Q	0.2	Q
November 9, 2004	2.97	7.82	266	23.6	5	U	0.15	
April 27, 2005	3.1	8.1	249	23.7	5	U	0.3	
May 25, 2006	5.4	7.01	264	24.5	5	U	0.55	
November 2, 2006	No Result	7.8	258	23.9	5		0.2	
May 9, 2007	No Result	No Result	No Result	No Result	5	U	0.2	
Average	**3.98**	**7.67**	**258.50**	**23.92**	**5.00**		**0.24**	
Standard Deviation	**1.23**	**0.36**	**6.06**	**0.31**	**0.00**		**0.15**	
Median	**3.20**	**7.73**	**258.00**	**23.90**	**5.00**		**0.20**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics for Upper and Lower Rock Springs. “A”= Value reported is the arithmetic mean of two or more determinations; “Q” = Outside of holding time; “U”= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from April 2002 to May 2006 at Upper Rock Springs and from April 2004 to May 2007 for Lower Rock Springs (Table 4). SCI scores before and after the June 8, 2004 recalibration of the SCI for both sites are presented in Table 4. Recalibrated SCI scores are plotted over time for each site in Figure 3. The recalibrated SCI scores for the less physically disturbed Lower Rock Springs site were much higher than those at the upper site, where swimmers routinely come into contact with substrates, probably dislodging organisms. SCI scores for the lower Rock Springs site were in the “healthy” category for three of the four sampling events. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented over the sampling period in Figures 4 and 5. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. The total taxa present over the sampling period for the upper and lower sites are displayed in Figure 4. Total taxa for the lower site averaged 38 taxa, compared to only 14 taxa at the upper site, near the swimming area. One to seven sensitive taxa were present at lower Rock Spring throughout the sampling period, and only three at the highest for the upper site (Figure 5). Habitat Assessment scores over time are shown in Figure 6. Habitat assessments for Upper and Lower Rock Springs scored consistently in the optimal category, suggesting adequate habitat for macroinvertebrate communities.

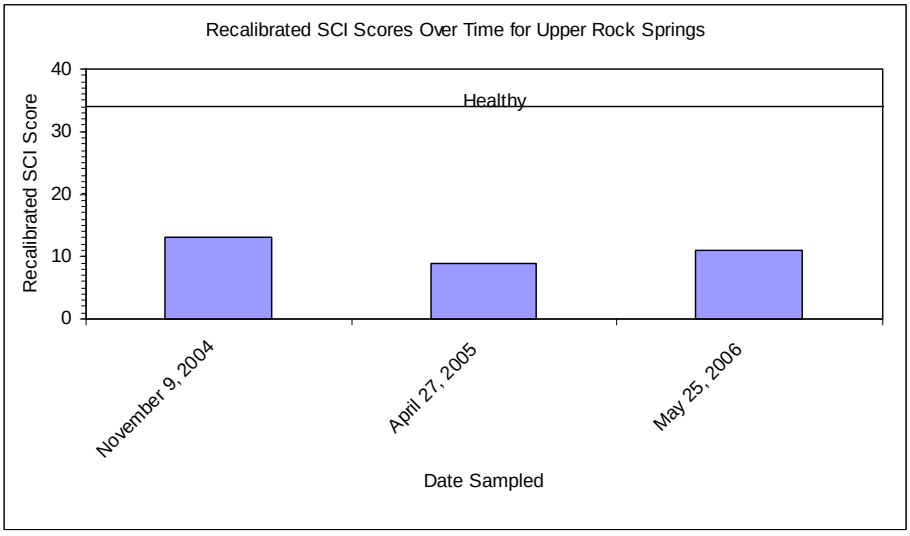
Upper Rock Springs

Old SCI Scores	
April 17, 2002	11
October 22, 2002	15
May 20, 2003	21
October 16, 2003	21
April 21, 2004	17
Recalibrated SCI Scores	
November 9, 2004	13
April 27, 2005	9
May 25, 2006	11

Lower Rock Springs

Old SCI Scores	
April 21, 2004	29
Recalibrated SCI Scores	
April 27, 2005	39
May 25, 2006	47
May 9, 2007	28

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates for both Upper and Lower Rock Springs. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.



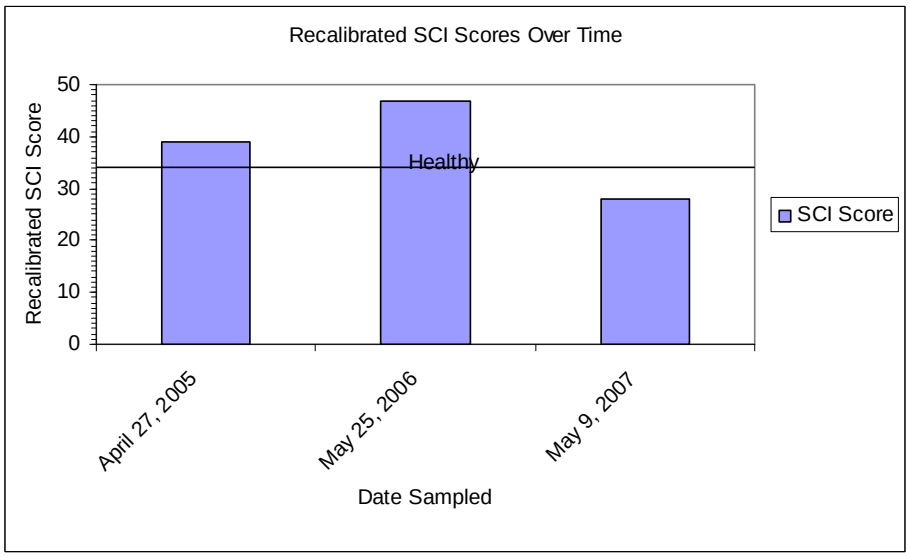


Figure 3: Recalibrated SCI scores with the impairment line drawn at 34 for Upper and Lower Rock Springs.

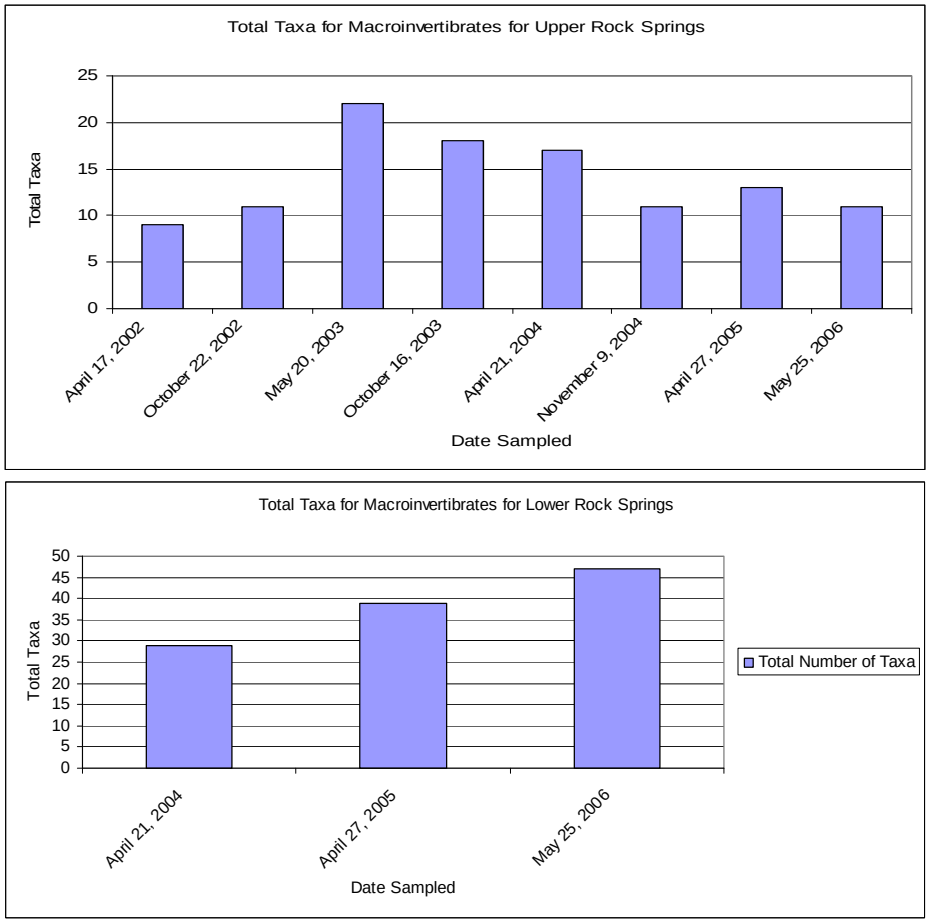
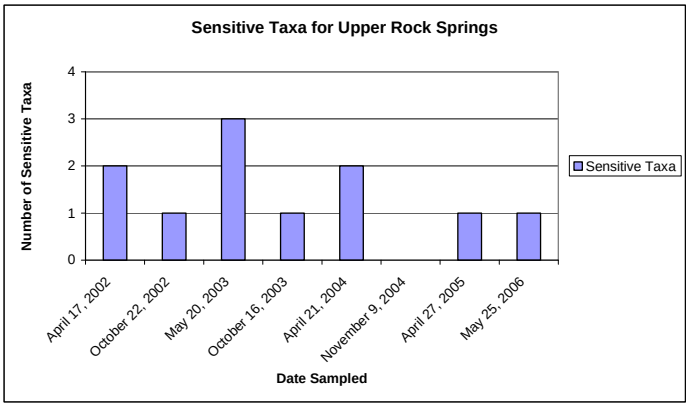


Figure 4: Total macroinvertebrate taxa plotted over time for Upper and Lower Rock Springs.

Sensitive Taxa for Upper Rock Springs

Date	Number of Sensitive Taxa
April 17, 2002	2
October 22, 2002	1
May 20, 2003	3
October 16, 2003	1
April 21, 2004	2
November 9, 2004	0
April 27, 2005	1
May 25, 2006	1



Sensitive Taxa for Lower Rock Springs

Date	Number of Sensitive Taxa
4/21/2004	7
4/27/2005	1
5/25/2006	3

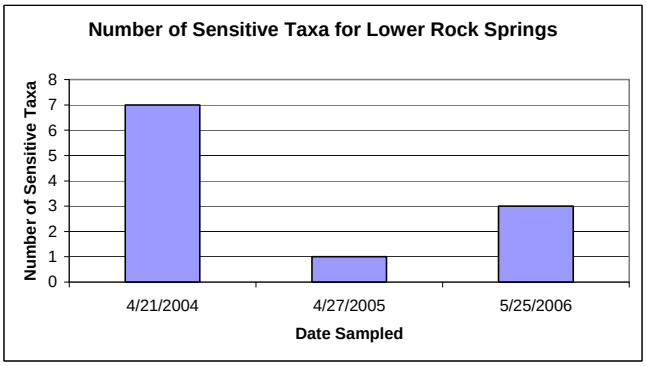
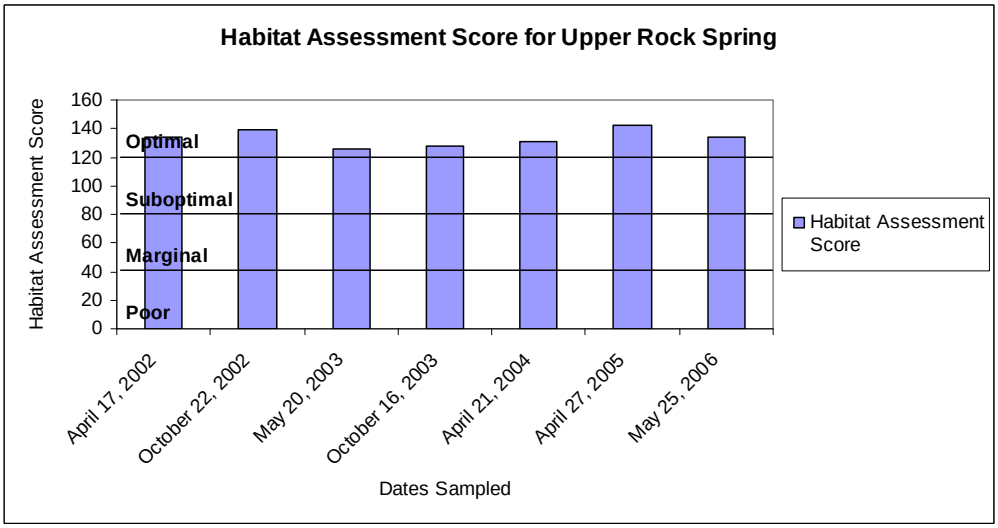


Figure 5: Table and chart showing sensitive taxa over the dates available for the sampling period at Upper and Lower Rock Spring.



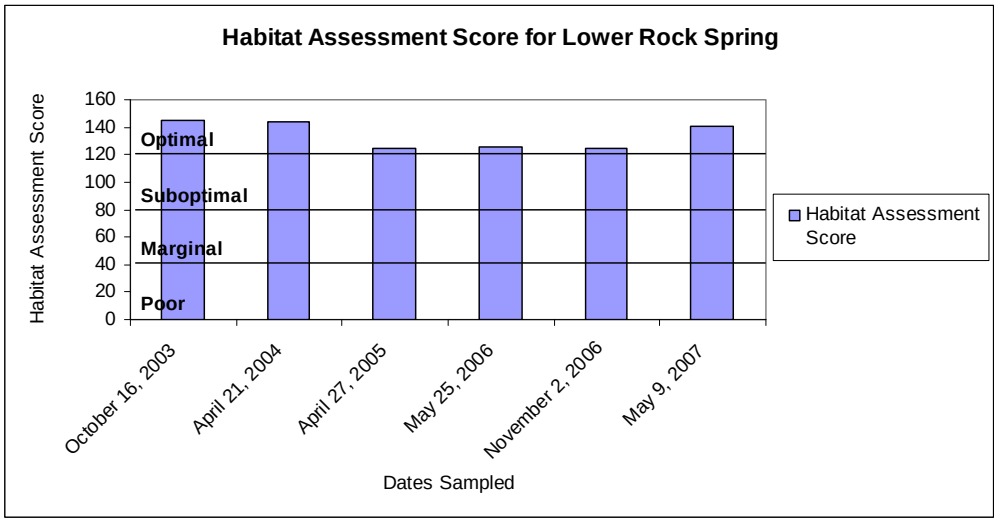


Figure 6: Habitat assessment scores over time for Upper and Lower Rock Springs.

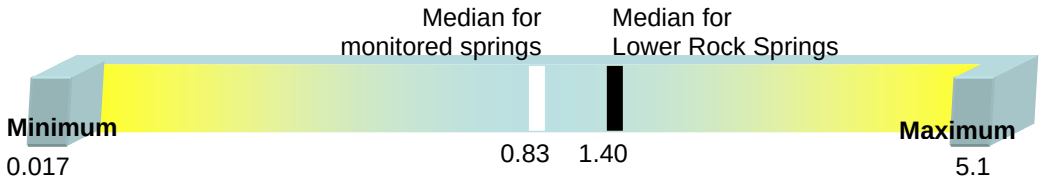
During the sampling period from April 2002 to November 2006, data from both monitoring sites indicate that:

- Water quality, as measured by transparency, nutrients (except nitrate-nitrate), field parameters and bacteria, was generally good for both monitoring sites.
- Nitrate-nitrite concentrations for both sites have ranged from 1.3 to 1.7 mg/L over the sampling period, and are generally higher than the values found in 95% of typical Florida streams.
- Stream Condition Index biological samples in the Lower Rock Springs monitoring site indicate that healthy conditions prevail in the system. The Lower Rock Springs site was established as a more representative location in response to observations of physical disturbance from swimmers at the upper location.
- Habitat scores were consistently within the optimal range.

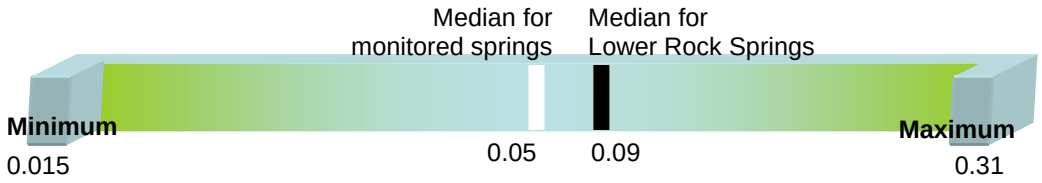
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Lower Rock Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Lower Rock Springs

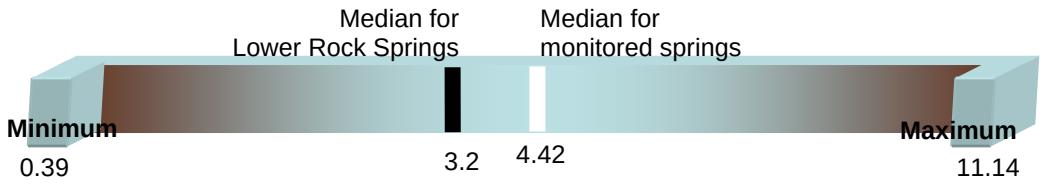
Nitrate-Nitrite (mg/L)



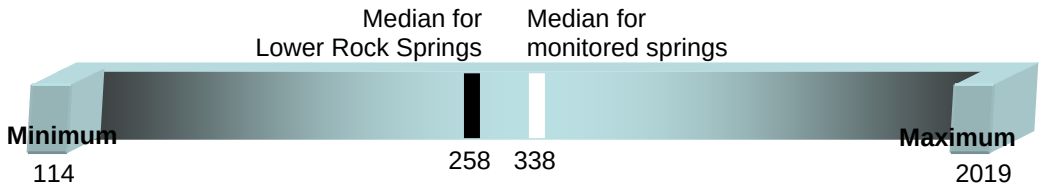
Total Phosphorus (mg/L)



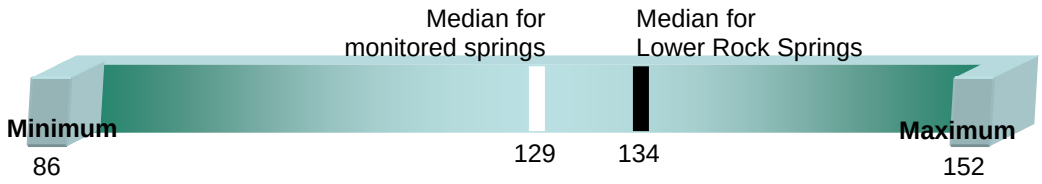
Dissolved Oxygen (mg/L)



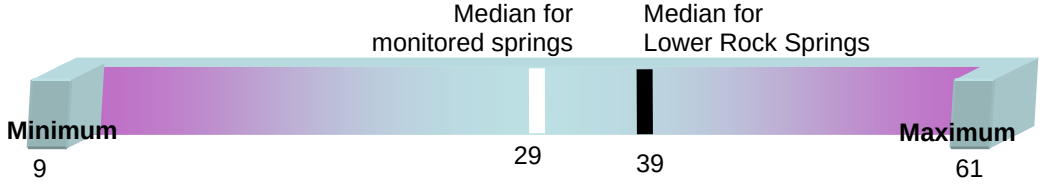
Specific Conductance (umhos/cm)



Habitat Assessment Score

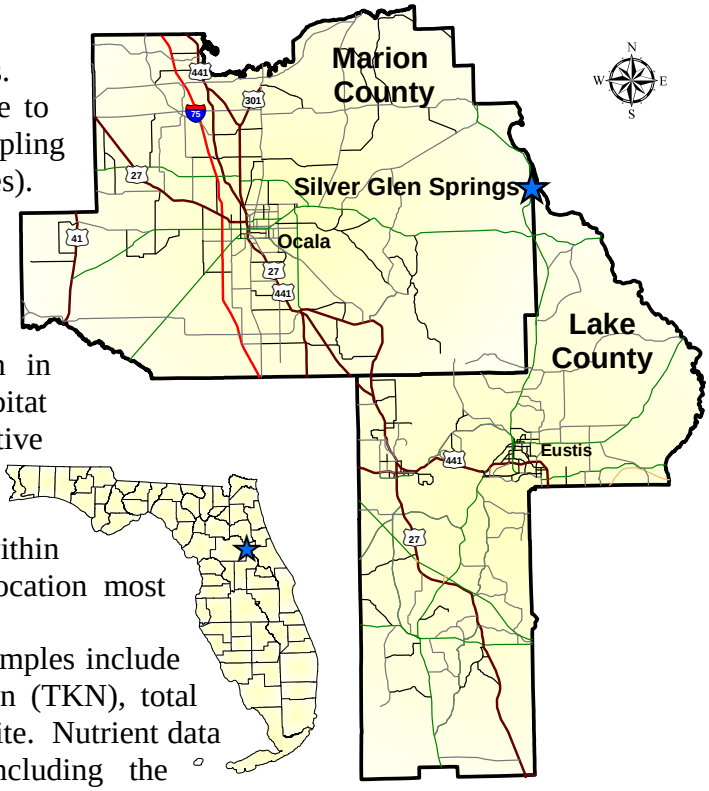


Stream Condition Index



Silver Glen Springs

Silver Glen Springs is located on the border of Marion and Lake Counties in the Ocala National Forest. It is a first magnitude spring discharging into Lake George. Silver Glen was incorporated into the Springs Monitoring Program in April 2002 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The Silver Glen monitoring site is located in the spring run, approximately 100 meters east of the headspring. It consists of a 100 meter reach in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN concentrations have generally remained either below the detection limit or below the practical quantitation limit for the five-year sampling period from April 2002 to May 2007. Three of the nine TKN samples were slightly above the practical quantitation limit, with concentrations that were very low compared to typical Florida streams. Concentrations of total phosphorus were plotted over time and were generally low, with detections remaining lower than 20% of typical Florida streams (Figure 1). A trend could not be determined because detections between the practical quantitation limit and the method detection limit are considered qualitative, making a determination of a statistical trend difficult. Nitrate-nitrite concentrations are plotted in Figure 2 over the sampling period. A visual inspection of the plotted data does not indicate an upward or downward trend. Nitrate-nitrite concentrations have ranged from 0.04 to 0.02 mg/L over the sampling period, levels that are among the lowest of Florida springs.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
April 10, 2002	0.01	U	0.21		0.054		0.027	
October 15, 2002	0.016	I	0.22		0.045		0.041	
October 14, 2003	0.01	U	0.13	I	0.041	I	0.034	
May 4, 2004	0.01	U	0.09	I	0.053	I	0.021	
November 9, 2004	0.01	U	0.14	I	0.029	I	0.038	
April 20, 2005	0.01	U	0.16	I	0.02	U	0.026	
June 8, 2006	0.01	I	0.16	I	0.02	U	0.024	
November 29, 2006	0.01	U	0.13	I	0.02	U	0.034	
May 16, 2007	0.01	U	0.23		0.02	U	0.033	
Average	**0.01**		**0.16**		**0.03**		**0.03**	
Standard Deviation	**0.00**		**0.05**		**0.01**		**0.01**	
Median	**0.01**		**0.16**		**0.03**		**0.03**	

Table 1: Nutrient data including qualifier codes and summary statistics. "I" = Below practical quantitation limit; "U" = Below detection limit.

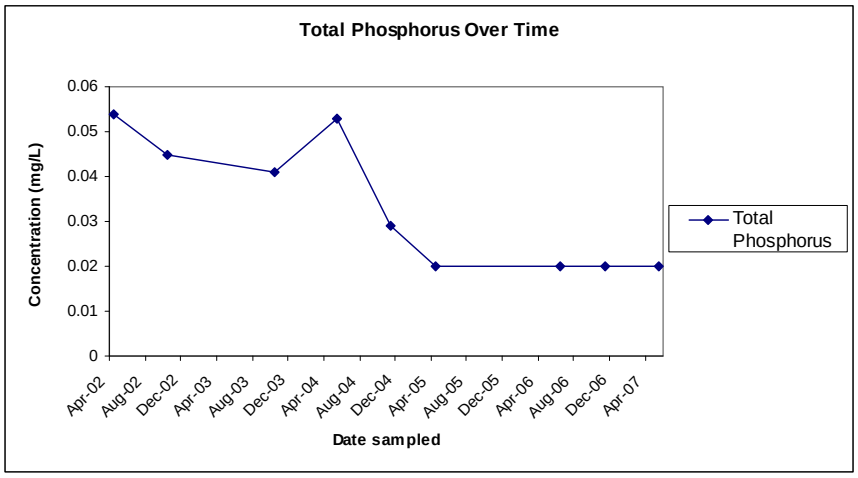


Figure 1: Total Phosphorus concentrations plotted over time.

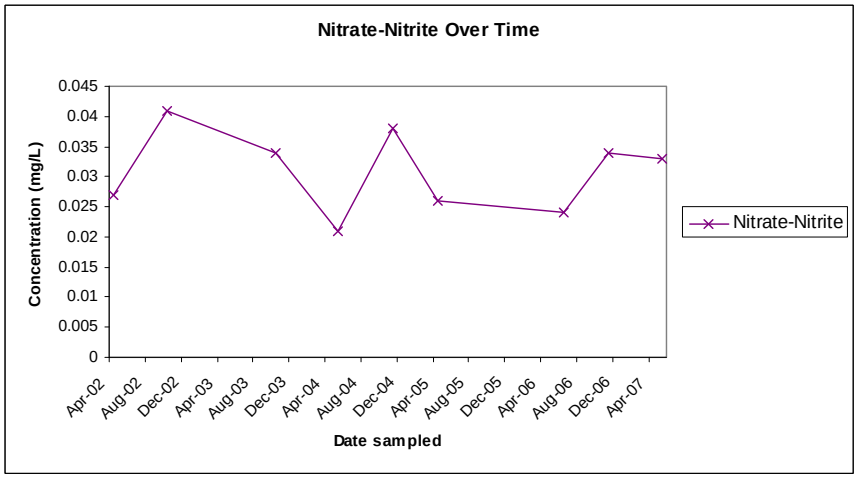


Figure 2: Nitrate-nitrite concentrations plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci,* fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 8 CFU/100 mL. *Enterococci* data have ranged from 1 to 164 CFU/100 mL over the sampling period, with a median of 15 CFU/100 mL. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 2 to 76 CFU/100 mL, with a median of 13 CFU/100 mL. Total coliform data have ranged from 2 to 800 CFU/100 mL. The median total coliform value was 83 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
April 10, 2002	1	K	1	K	12		20	
October 15, 2002	14	Q	18	Q	14	Q	130	Q
October 14, 2003	40	Q	80	Q	76	Q	800	Q
May 4, 2004	No Result		No Result		No Result		No Result	
November 9, 2004	2	ABQ	2	B	3	ABQ	35	ABQ
April 20, 2005	2	BQ	2	KQ	2	KQ	10	BQ
June 8, 2006	20	BQ	14	BQ	44	Q	162	BQ
November 29, 2006	164	BQ	20	BQ	58	Q	134	Q
May 16, 2007	16	ABQ	2	UQ	2	UQ	2	BQ
Average	**32**		**17**		**26**		**162**	
Standard Deviation	**55**		**27**		**29**		**266**	
Median	**15**		**8**		**13**		**83**	

Table 2: Bacteriological data including qualifier codes and summary statistics. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K"= Off-scale low; "Q" = Outside of holding time; "U"= Below the detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation, and median values were determined for each of these parameters. Over the sampling period from April 2002-May 2007, dissolved oxygen averaged 5.3 mg/L, ranging from 3.3 to 8.3 mg/L. Five of the nine DO measurements (56%) were below the Class III water quality standard of 5 mg/L. This periodically low DO (a natural condition for headwater spring systems) can eliminate DO sensitive taxa from the system. Temperature remained stable, averaging 23.5 degrees Celsius. Specific conductivity was very high, averaging 1892 umhos/cm and ranging from 1781 to 1961 umhos/cm. The high conductivity appears to be a natural characteristic, associated with salt deposits in this portion of the aquifer. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.7 SU, ranging from 6.8 to 8.6 SU. Turbidity was very low, averaging 0.2 NTU, and color values were below the detection limit for the entire sampling period, indicating very transparent water.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
April 10, 2002	3.6	7.79	1925	22.96	5	U	0.1	
October 15, 2002	3.32	7.7	1929	23.32	5	U	0.15	
October 14, 2003	5.9	7.8	1812	23.4	5	U	0.15	
May 4, 2004	8.3	8.6	1961	24.1	5	UQ	0.25	Q
November 9, 2004	4.35	7.76	1948	22.77	5	U	0.15	
April 20, 2005	7.34	8.13	1845	23.9	5	U	0.15	
June 8, 2006	6.83	6.83	1781	23.75	5		0.4	
November 29, 2006	4	7.85	1895	23.1	5	U	0.1	
May 16, 2007	4.46	7.24	1930	24.24	5		0.25	
Average	**5.34**	**7.74**	**1891.78**	**23.50**	**5.00**		**0.19**	
Standard Deviation	**1.80**	**0.50**	**63.97**	**0.52**	**0.00**		**0.10**	
Median	**4.46**	**7.79**	**1925.00**	**23.40**	**5.00**		**0.15**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics. “Q” = Outside of holding time; “U”= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from April 10, 2002 to May 16, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores from November 9, 2004 to June 8, 2006 are plotted over time in Figure 3. Five of the eight SCI scores (63%) for the entire sampling period did not score in the “healthy” category with regard to stream impairment. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa for each sampling date over the sampling period are displayed in Figure 4 and ranged from 13 to 32 taxa. Sensitive taxa were low for the entire sampling period, with only one or zero sensitive taxa present at any sampling event (Figure 5). High conductivity and frequently low DO were probably the major causes for this lack of sensitive organisms. Habitat Assessment scores over time are shown in Figure 6. Most of the habitat assessment scores fell into the suboptimal category, with three of the eight samples scoring in the optimal category. Lack of substrate diversity and habitat smothering were two issues of concern for the habitat at Silver Glen Springs.

Old SCI Scores	
April 10, 2002	15
October 15, 2002	21
October 14, 2003	27
May 4, 2004	21

Recalibrated SCI Scores	
November 9, 2004	23
April 20, 2005	11
June 8, 2006	32
May 16, 2007	19

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

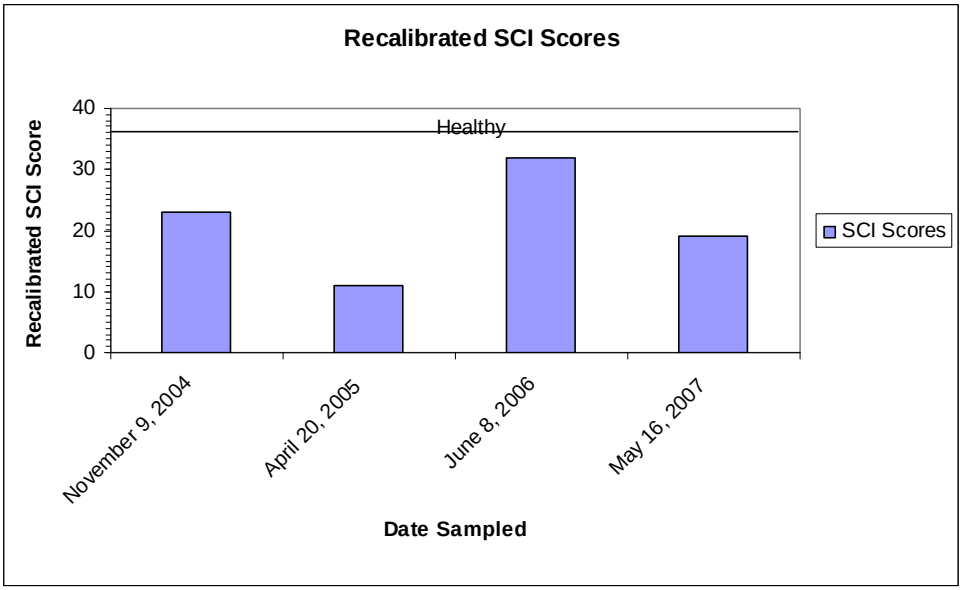


Figure 3: Recalibrated SCI scores over the period showing the impairment line at 34.

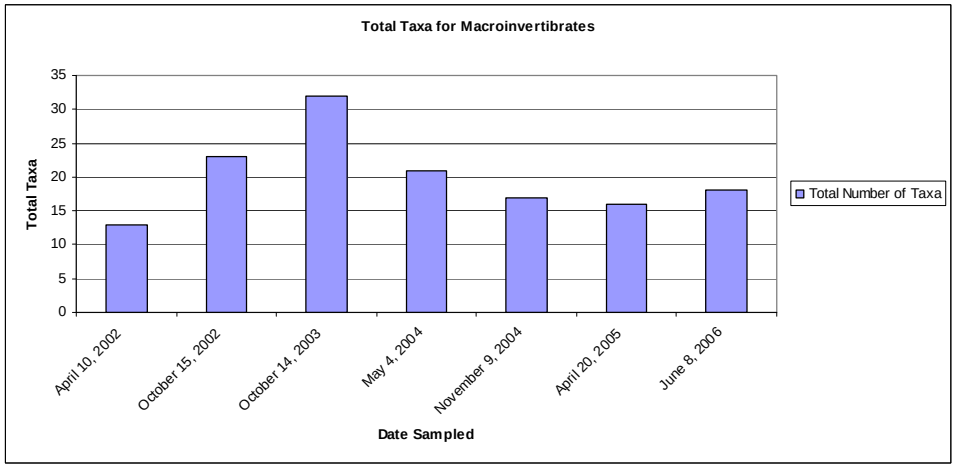


Figure 4: Total macroinvertebrate taxa plotted over time.

Date	Sensitive Taxa
4/10/2002	1
10/15/2002	1
10/14/2003	1
5/4/2004	1
11/9/2004	0
4/20/2005	1
6/8/2006	1

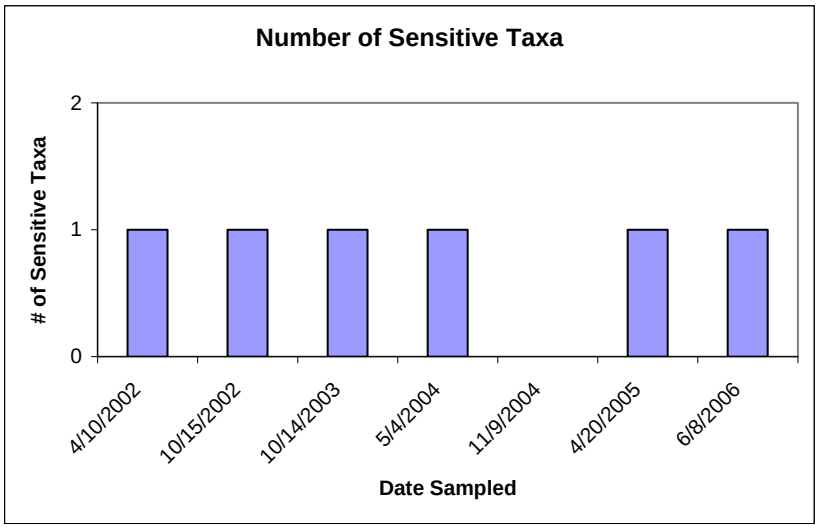


Figure 5: Table and chart showing the number of sensitive taxa over the sampling period.

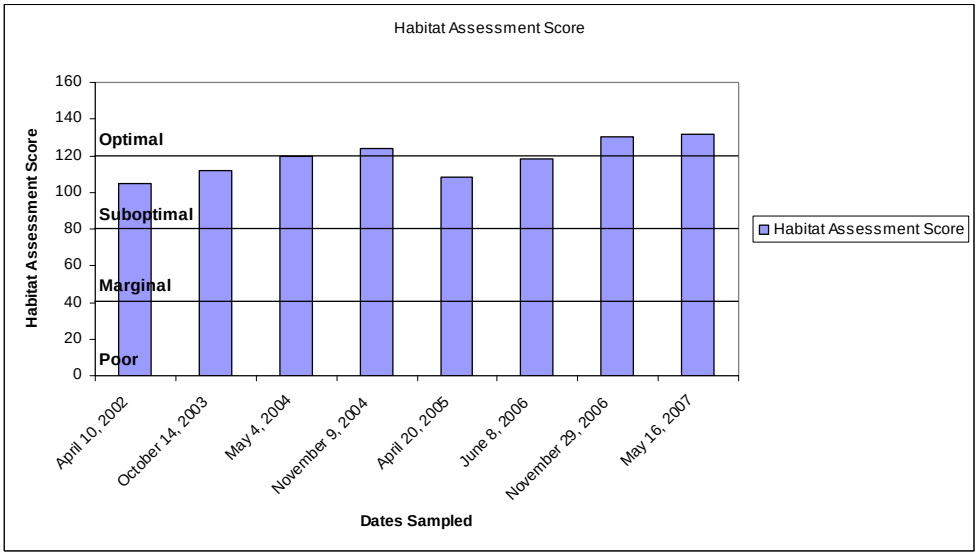


Figure 6: Habitat assessment scores over time.

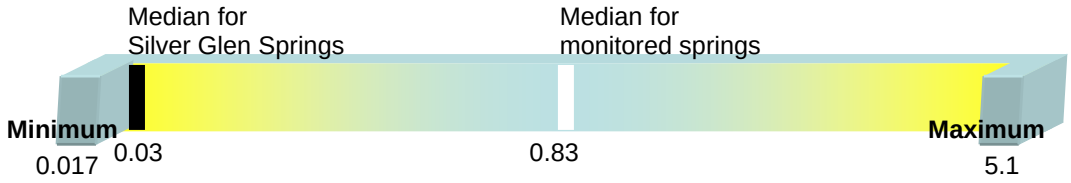
Over the approximate five year sampling period from April 10, 2002 to May 16, 2007, data indicate the following:

- Water quality, as measured by nutrients, water clarity, and bacterial densities suggested excellent conditions.
- Occasionally low dissolved oxygen and routinely elevated conductivity (both natural conditions) appeared to be related to the poor quality invertebrate community present.
- SCI scores have remained below the current impairment threshold, characterized by a paucity of sensitive taxa. This condition is probably mostly related to the DO and conductivity issues, but lack of substrate diversity and algal smothering may have also played a role.

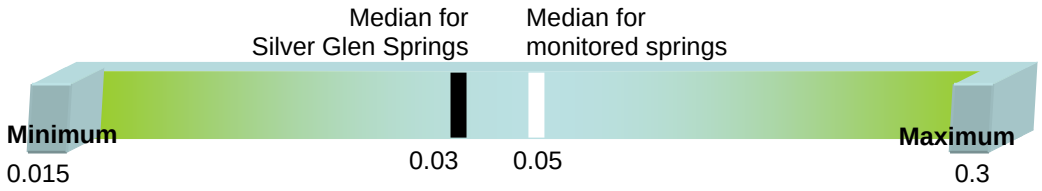
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Silver Glen Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Silver Glen Springs

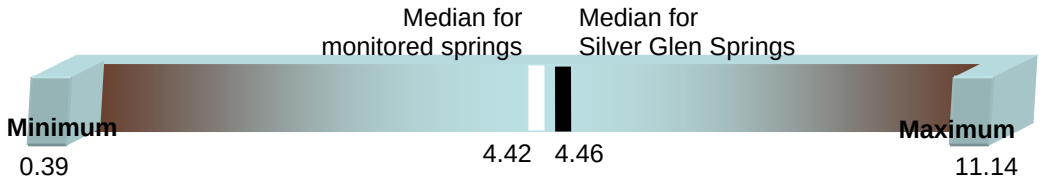
Nitrate-Nitrite (mg/L)



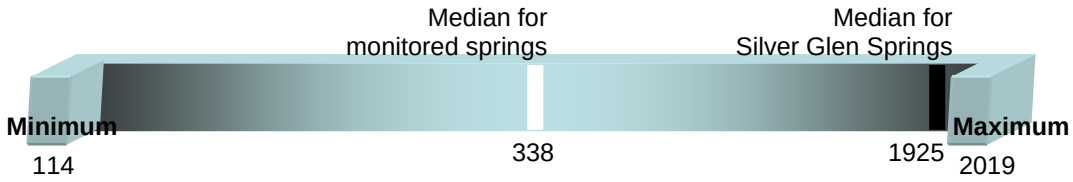
Total Phosphorus (mg/L)



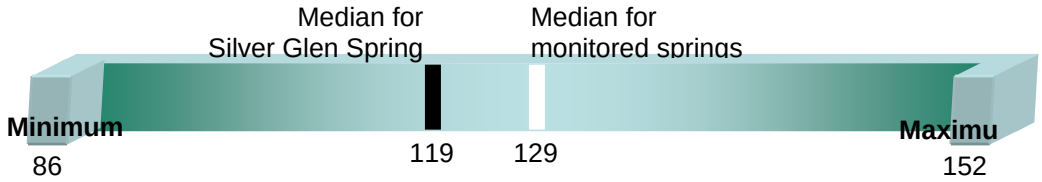
Dissolved Oxygen (mg/L)



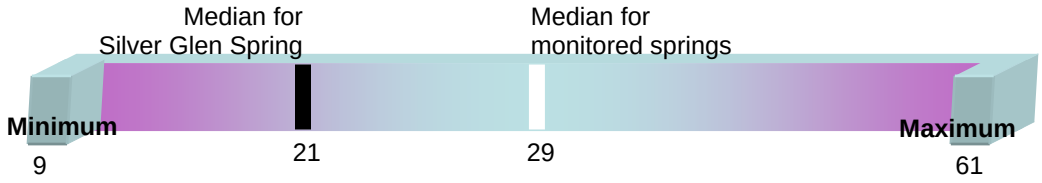
Specific Conductance (umhos/cm)



Habitat Assessment Score



Stream Condition Index

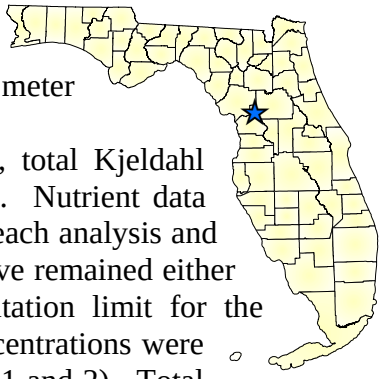


Silver Springs

Silver Springs, located in Marion County, is a first magnitude spring. The spring forms the headwaters of the Silver River, which flows into the Oklawaha River. Silver Springs was incorporated into the Springs Monitoring Program in April 2002 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (e.g., hurricanes).



The Silver Springs monitoring site is located in the spring run, approximately 200 meters east of the headspring. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.



Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN concentrations have remained either below the detection limit or below the practical quantitation limit for the sampling period. Total phosphorus and nitrate-nitrite concentrations were plotted over the five-year period from 2002-2007 (Figures 1 and 2). Total phosphorus concentrations have remained below the 30th percentile compared to typical Florida streams and were below the practical quantitation limit for seven of ten samples (70%). Total phosphorus data is plotted over the sampling period in Figure 1. A visual inspection of the plot seems to indicate a decreasing trend in TP values over the sampling period. However, detections between the practical quantitation limit and the method detection limit are considered qualitative and can not be used to determine relationships in the data. Nitrate-nitrite concentrations were consistently elevated ranging from 1.0 to 1.4 mg/L over the sampling period, exceeding the values found in 95% of typical Florida streams. Nitrate-nitrite is plotted over time in Figure 2, and visual inspection of the plot indicates a slight increase in concentration over time. However, the increase over time is very small and more samples would be necessary to determine if there is a truly significant trend in the data. Consistently high nitrate-nitrite concentrations are probably due to anthropogenic nutrient inputs throughout the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
April 9, 2002	0.01	U	0.064	I	0.057		1	
October 14, 2002	0.01	U	0.06	U	0.063		1.1	
April 15, 2003	0.01	U	0.06	U	0.044		1.1	
October 13, 2003	0.01	U	0.096	I	0.047	I	1.2	
May 5, 2004	0.01	U	0.06	U	0.059	I	1.2	
November 8, 2004	0.01	U	0.06	U	0.039	I	1.4	
April 20, 2005	0.01	U	0.06	U	0.037	I	1.3	
June 7, 2006	0.01	U	0.095	I	0.037	I	1.3	
November 30, 2006	0.01	U	0.08	U	0.033	I	1.3	
May 15, 2007	0.01	U	0.08	UJ	0.036	I	1.1	
Average	**0.01**		**0.07**		**0.05**		**1.20**	
Standard Deviation	**0.00**		**0.01**		**0.01**		**0.12**	
Median	**0.01**		**0.06**		**0.04**		**1.20**	

Table 1: Nutrient data including qualifier codes. “I” = Below practical quantitation limit; “J”= Estimated value; “U” = Below detection limit.

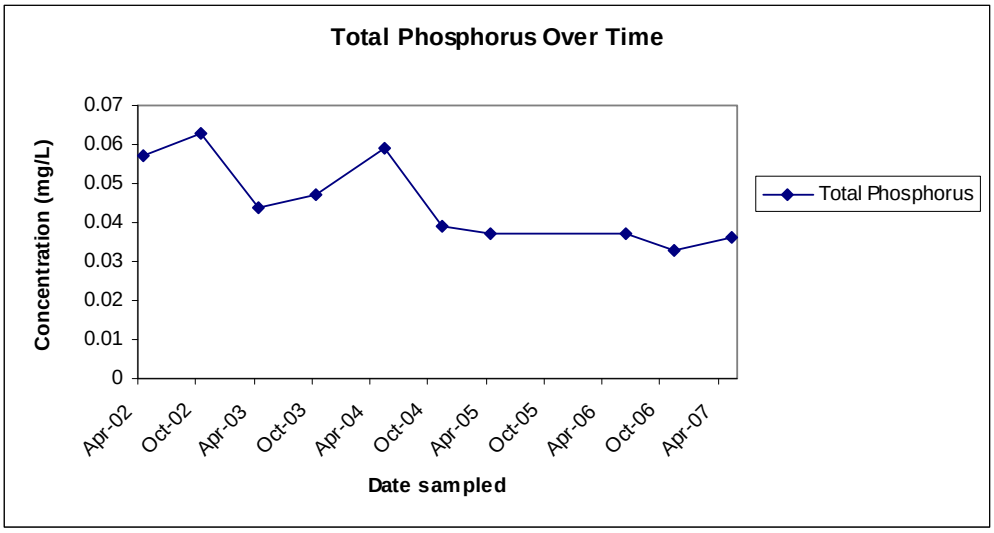


Figure 1: Total Phosphorus data plotted over time.

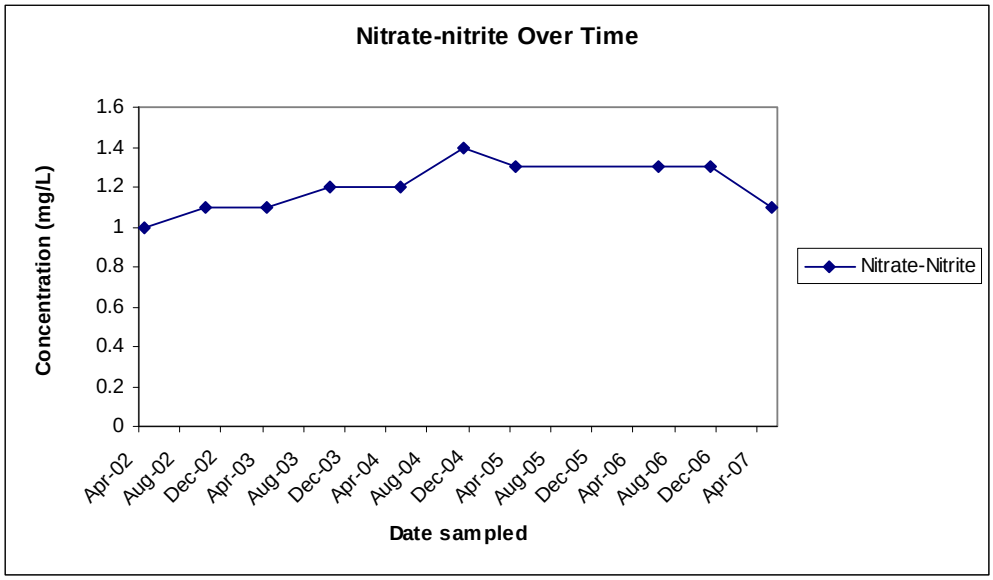


Figure 2: Nitrate-nitrite data plotted over time.

Water chemistry bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have complied with the "single sample" standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 21 CFU/100 mL. *Enterococci* data have ranged from 2 to 44 CFU/100 mL over the sampling period, with a median of 15 CFU/100 mL. This median is lower than the freshwater criterion of 61 CFU/100 mL for designated beach areas. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 2 to 242 CFU/100 mL, with a median of 12 CFU/100 mL. Total coliform data have ranged from 50 to 4400 CFU/100 mL. The cause for the single elevated total coliform value is not currently known. The median total coliform value for the approximately five-year sampling period was 66 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
April 9, 2002	2	Q	1	KQ	2	Q	70	Q
October 14, 2002	22	Q	42	Q	40	Q	200	Q
April 15, 2003	8	Q	4	Q	2	Q	50	Q
October 13, 2003	42	Q	126	BQ	114	Q	4400	Q
May 5, 2004	3	BQ	70	Q	13	BQ	56	Q
November 8, 2004	28	BQ	34	BQ	22	BQ	68	Q
April 20, 2005	18	BQ	8	BQ	10	BQ	64	Q
June 7, 2006	12	BQ	4	BQ	8	BQ	50	Q
November 30, 2006	44	Q	148	BQ	242	BQ	306	BQ
May 15, 2007	12	BQ	6	BQ	6	BQ	18	BQ
Average	**19**		**44**		**46**		**528**	
Standard Deviation	**15**		**54**		**77**		**1363**	
Median	**15**		**21**		**12**		**66**	

Table 2: Microbiology data including qualifier codes and summary statistics. "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given. "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from April 2002-May 2007, dissolved oxygen averaged 4.4 mg/L, ranging from 2.8 to 6.3 mg/L. Temperature was stable, averaging 24 Degrees C. Specific conductivity averaged 471 umhos/cm, ranging from 426 umhos/cm to 511 umhos/cm. Conductivity values in this range may exert an adverse effect on sensitive aquatic macroinvertebrates. The average pH was 7.2 SU. Water clarity was consistently good, with turbidity averaging 0.32 NTU and all color measurements below the detection limit.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
April 9, 2002	4.4	7.4	471	23.5	5	U	0.05	
October 14, 2002	5.32	7.2	480	23.65	5	U	0.05	U
April 15, 2003	3.9	7.4	446	23.4	5	U	0.45	
October 13, 2003	4	7.1	426	23.5	5	UQ	1.8	Q
May 5, 2004	4.2	7.6	476	23.2	5	U	0.1	
November 8, 2004	5.77	7.18	511	23.63	5	UQ	0.1	Q
April 20, 2005	4.18	7.64	466	23.1	5	U	0.1	
June 7, 2006	6.25	6.96	469	23.94	5		0.15	
November 30, 2006	3.3	7.2	488	23.6	5	U	0.15	
May 15, 2007	2.79	6.53	479	23.7	5	UQ	0.25	
Average	**4.41**	**7.22**	**471.20**	**23.52**	**5.00**		**0.32**	
Standard Deviation	**1.08**	**0.32**	**22.94**	**0.24**	**0.00**		**0.53**	
Median	**4.19**	**7.20**	**473.50**	**23.55**	**5.00**		**0.13**	

Table 3: Field parameters, color, and turbidity data with qualifier codes. "Q" = Outside of holding time; "U" = Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from April 2002 to May 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores are plotted over time in Figure 3. The SCI scores for Silver Springs have indicated that healthy conditions prevailed in 6 of 9 samplings (67%). Somewhat elevated conductivity and lower than optimal DO (both natural factors) are stressors that may be associated with the occasional poor SCI scores. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented over the sampling period in Figures 4 and 5. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa for each sampling date over the entire sampling period are displayed in Figure 4 and ranged from 18 to 27 taxa. Sensitive taxa remained relatively low over the sampling period, with a maximum of 3 sensitive taxa present (Figure 5). Habitat Assessment scores remained in the optimal category over the sampling period and indicate adequate habitat for macroinvertebrate communities (Figure 6).

Old SCI Scores	
April 9, 2002	25
October 14, 2002	23
April 15, 2003	19
October 13, 2003	27
May 5, 2004	21

Recalibrated SCI Scores	
November 8, 2004	34
April 20, 2005	22
June 7, 2006	46
May 15, 2007	23

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

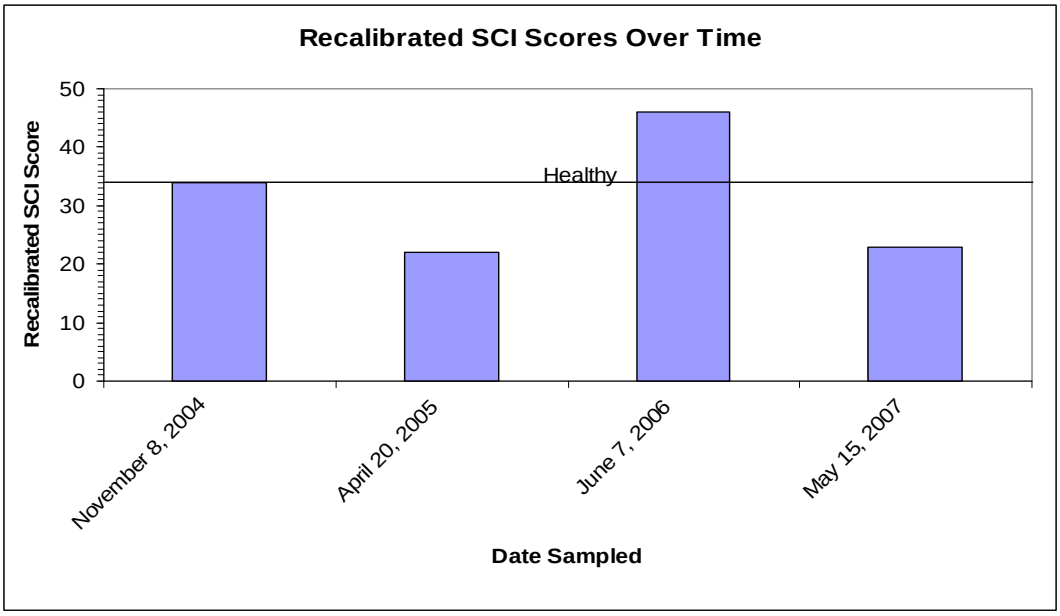


Figure 3: Recalibrated SCI Scores with a line drawn at the impairment threshold of 34.

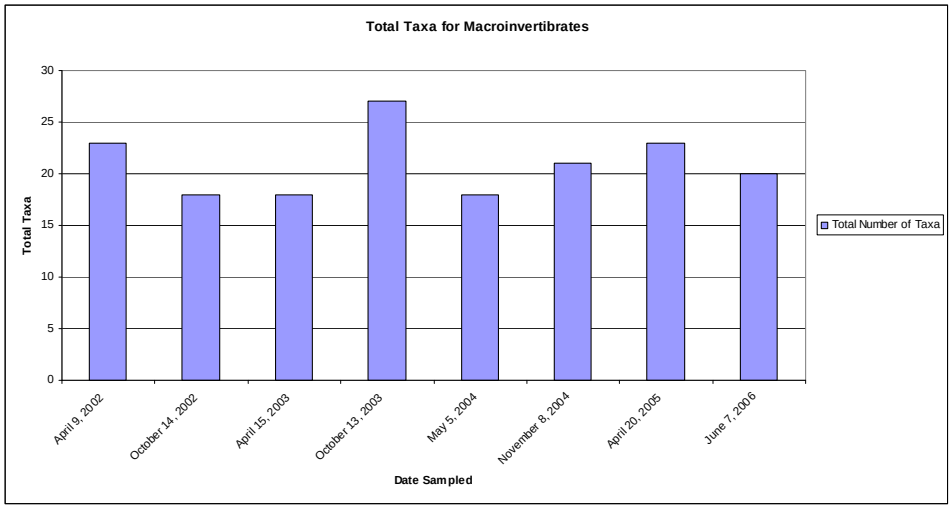


Figure 4: Total macroinvertebrate taxa for each sampling event.

Date	Sensitive Taxa
4/9/2002	0
10/14/2002	2
4/15/2003	1
10/13/2003	3
5/5/2004	1
11/8/2004	0
4/20/2005	1
6/7/2006	2

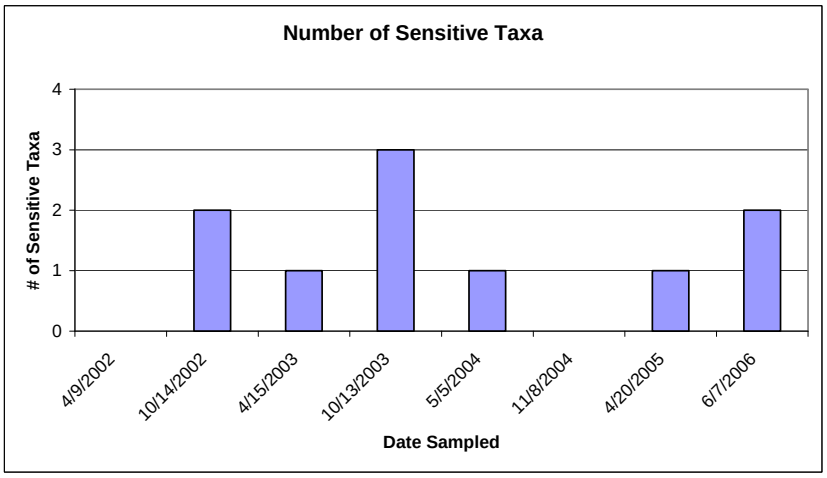


Figure 5: Table and chart showing the number of sensitive taxa over the sampling period.

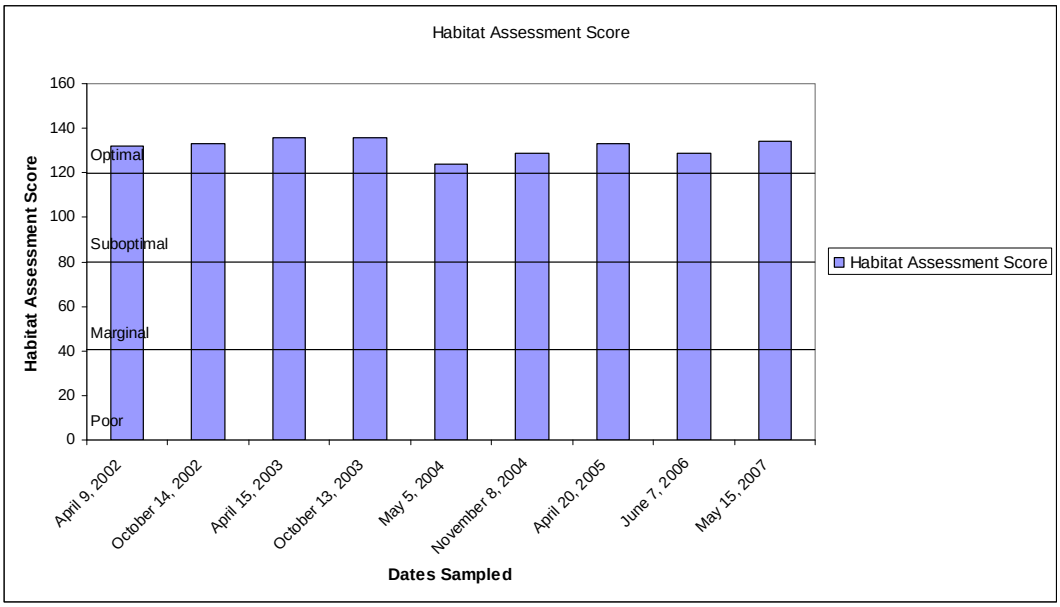


Figure 6: Habitat assessment scores plotted for sampling events.

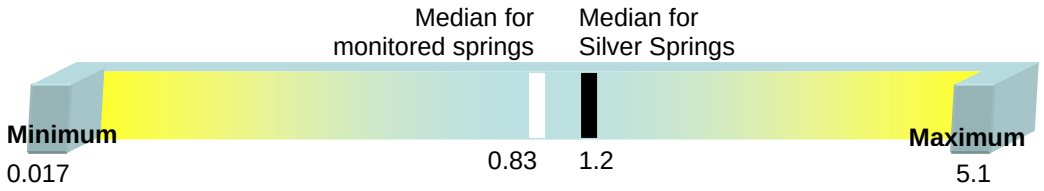
Over the approximately five year sampling period from April 9, 2002 to May 15, 2007, data indicate:

- Some water quality parameters, as measured by nutrients (except for nitrate-nitrite), water clarity, and bacterial densities suggested excellent conditions.
- Silver Springs has exhibited high nitrate-nitrite concentrations (usually greater than 95% of other Florida streams), probably due to non-point sources of nitrogen within the springshed.
- Moderately low dissolved oxygen and somewhat elevated conductivity (both natural conditions) appeared to be related to the occasional poor SCI scores.
- Habitat scores were consistently in the optimal category.

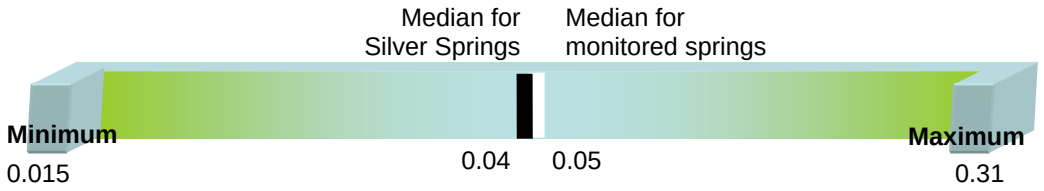
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Silver Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Silver Springs

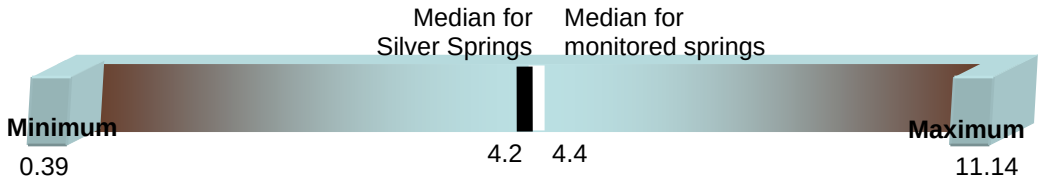
Nitrate-Nitrite (mg/L)



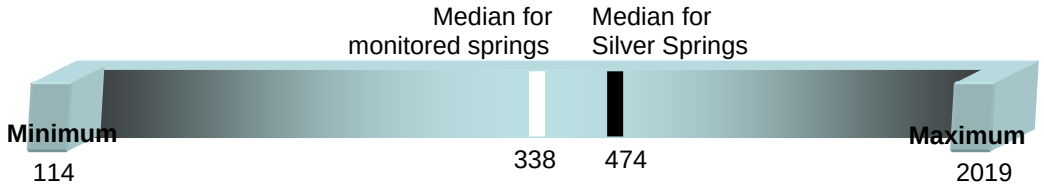
Total Phosphorus (mg/L)



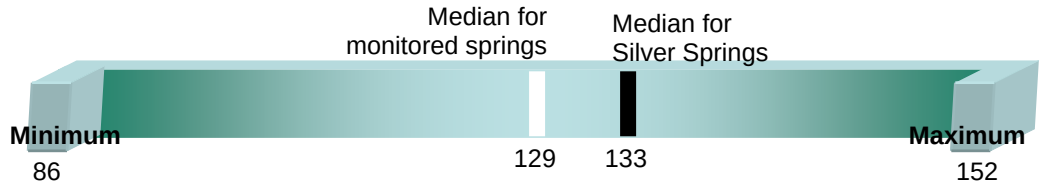
Dissolved Oxygen (mg/L)



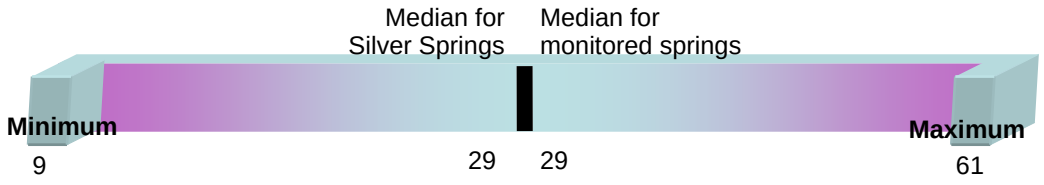
Specific Conductance(umhos/cm)



Habitat Assessment Score

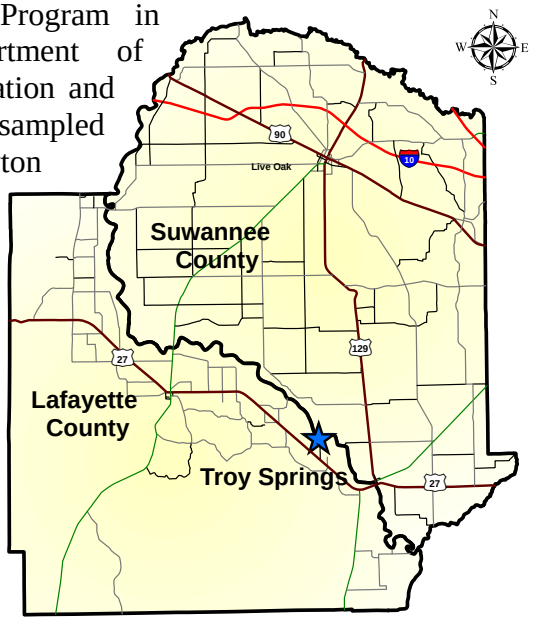


Stream Condition Index



Troy Spring

Troy Spring is located in Lafayette County, within Troy Spring State Park. It is a first magnitude spring discharging into the Suwannee River. Troy Spring was incorporated into the Springs Monitoring Program in December 2001 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled semi-annually, with chemistry and periphyton collections performed in spring and fall by the Bureau of Laboratories.



The Troy Spring monitoring site is located in the 75 meter long spring run, within the park limits. It consists of a 75 meter stretch in which data for the Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this stretch in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN concentrations have remained either below the detection limit or below the practical quantitation limit for the approximately five-year sampling period from December 2001 to May 2007. These consistently low TKN concentrations indicate no organic nitrogen enrichment. Of the total phosphorus data, 6 of the 8 samples (75%) were below the practical quantitation limit. The total phosphorus detections were low, below the 50th percentile compared to typical Florida streams. Concentrations of total phosphorus were plotted over the sampling period (Figure 1). However, detections between the practical quantitation limit and the method detection limit are considered qualitative and can not be used to determine relationships in the data. Concentrations of nitrate-nitrite were plotted over the sampling period (Figure 2). A visual inspection of the plotted data does not indicate an upward or downward trend in nitrate-nitrite over time. However, nitrate-nitrite concentrations have ranged from 1.2 to 2.4 mg/L over the sampling period, values higher than 95 percent of typical Florida streams. This condition is probably due to non-point source nutrient inputs from within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
December 6, 2001	0.01	U	0.06	U	0.052	J	1.6	
April 9, 2002	0.01	U	0.14	I	0.055		1.2	
October 17, 2002	0.01	U	0.11	I	0.028	I	1.6	
September 30, 2003	0.01	U	0.13	I	0.042	I	2.4	
April 27, 2004	0.01	U	0.06	U	0.051	I	1.8	
April 18, 2006	0.01	U	0.08	U	0.03	I	2.3	
December 13, 2006	0.01	U	0.08	U	0.028	I	1.8	
May 1, 2007	0.01	U	0.092	I	0.032	I	1.7	
Average	**0.01**		**0.09**		**0.04**		**1.80**	
Standard Deviation	**0.00**		**0.03**		**0.01**		**0.39**	
Median	**0.01**		**0.09**		**0.04**		**1.75**	

Table 1: Nutrient data including qualifiers and summary statistics. “I” = Below practical quantitation limit; “J”= Estimated value; “U” = Below detection limit.

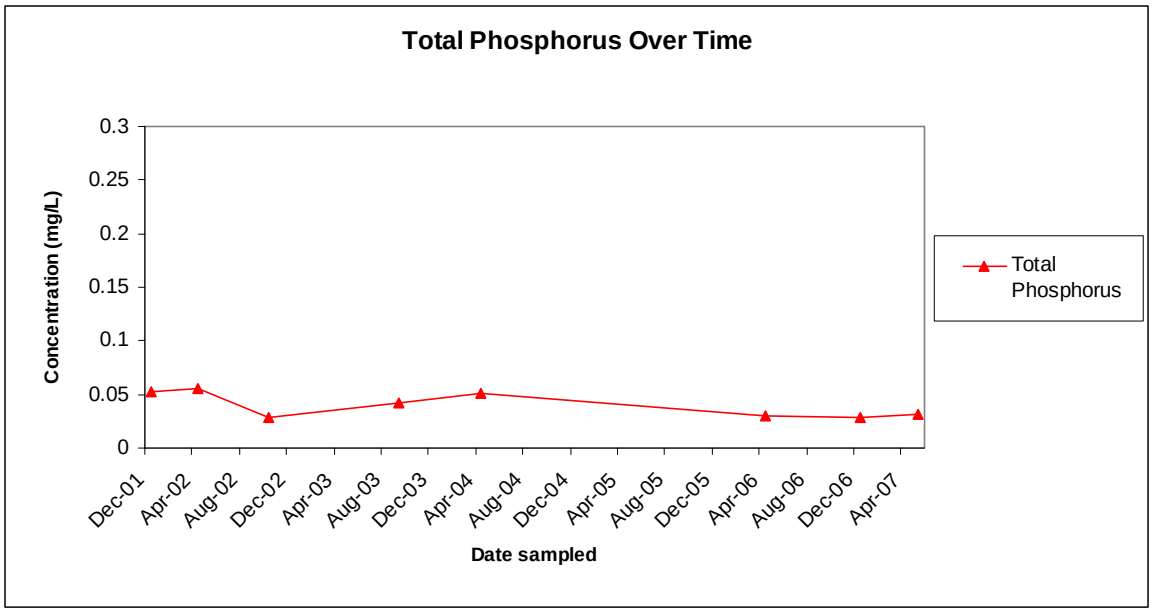


Figure 1: Total Phosphorus values plotted over time.

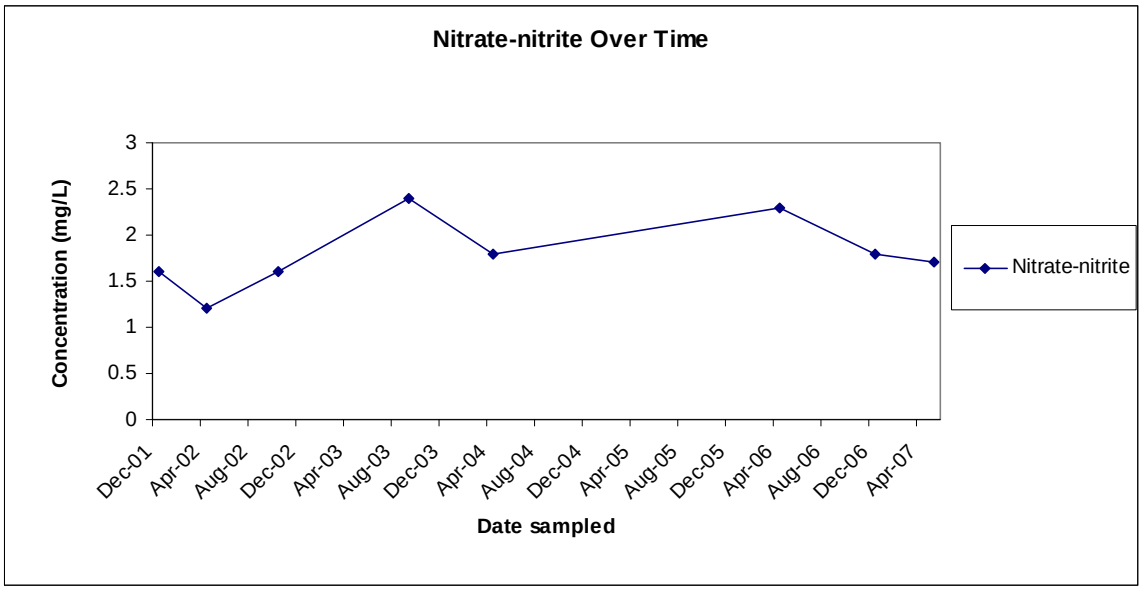


Figure 2: Nitrate-nitrite values plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, averaging 2 CFU/100 mL. *Enterococci* data have ranged from 1 to 34 CFU/100 mL over the sampling period, averaging 7 CFU/100 mL (median 2 CFU/100 mL). . Fecal coliform data have continuously complied with Class III water quality standards, ranging from 1 to 6 CFU/100 mL, with an average of 2 CFU/100 mL. The average total coliform value for the sampling period was 10 CFU/100 mL (median 5 CFU/100 mL), ranging from 1 to 30 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
December 6, 2001	1	KQ	1	KQ	1	KQ	1	KQ
April 9, 2002	2		2		1	K	16	
October 17, 2002	2	Q	4	Q	6	Q	30	Q
September 30, 2003	2	BQ	1	KQ	1	KQ	20	BQ
April 27, 2004	1	KQ	1	KQ	1	KQ	3	BQ
April 18, 2006	14	B	2	K	2	K	6	B
December 13, 2006	34	B	2	U	2	U	4	B
May 1, 2007	2	UQ	2	UQ	2	UQ	2	BQ
Average	**7**		**2**		**2**		**10**	
Standard Deviation	**12**		**1**		**2**		**11**	
Median	**2**		**2**		**2**		**5**	

Table 2: Microbiology data including qualifiers and summary statistics. "B" = Results based on colony counts outside the acceptable range; "K" = Off scale low. Actual value is known to be less than the value given. "Q" = Outside of holding time; "U" = Below detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were

determined for each of these parameters. Over the sampling period, dissolved oxygen averaged 1.2 mg/L, ranging from 0.4 to 2.1 mg/L. Temperature was stable, averaging 21.5 degrees Celsius. Specific conductivity averaged 355 umhos/cm and ranged from 330 to 376 umhos/cm. The mean pH was 6.5 SU. Turbidity was low, averaging 0.3 NTU and color values were below the detection limit, indicating very transparent water.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
December 6, 2001	1.44	2.4	330	21.56	5	U	0.15	
April 9, 2002	1.3	7.2	336	21.4	5	U	0.5	A
October 17, 2002	2.1	6.77	375	21.7	5	U	0.1	
September 30, 2003	0.85	7.02	357	21.38	5	UQ	0.8	Q
April 27, 2004	1.1	7.5	335	21.2	5		0.25	
April 18, 2006	1.1	7.1	369	21.5	5		0.25	
December 13, 2006	0.44	6.87	361	21.61	5		0.15	
May 1, 2007	0.89	7.17	376	21.65	5	U	0.15	
Average	**1.15**	**6.50**	**354.88**	**21.50**	**5.00**		**0.29**	
Standard Deviation	**0.49**	**1.67**	**18.76**	**0.17**	**0.00**		**0.24**	
Median	**1.10**	**7.06**	**359.00**	**21.53**	**5.00**		**0.20**	

Table 3: Field parameters, color, and turbidity data including qualifiers. . "A" = Value reported is the arithmetic mean (average) of two or more determinations; "Q" = Outside of holding time; "U" = Below detection limit.

Qualitative periphyton data was collected from April 9, 2002 through May 1, 2007. Total taxa for periphyton were plotted in Figure 3 for each sampling event. While the total taxa have ranged from approximately 18 taxa to about 50 taxa, no summary index is currently available to assess the condition of the periphyton community. These data are presented as background information to be used in future analyses.

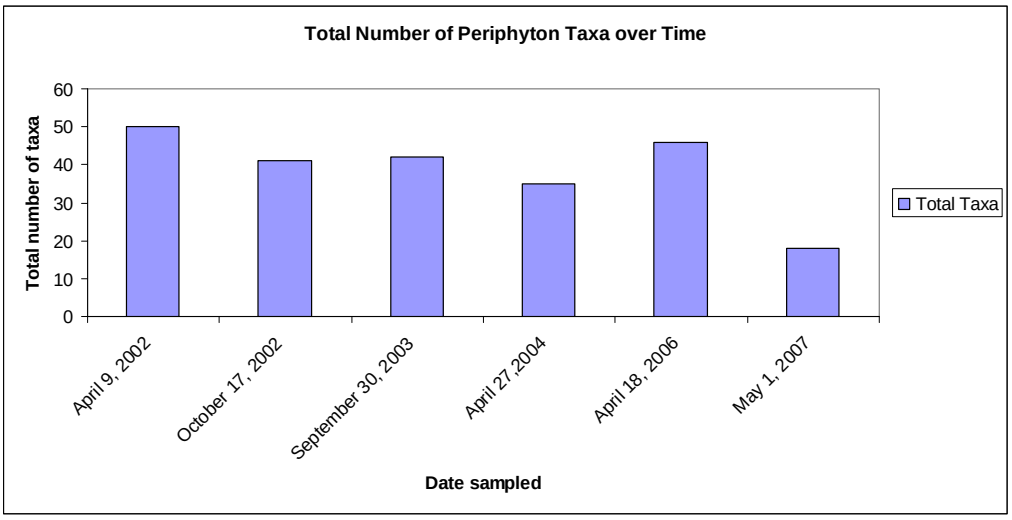


Figure 3: Total number of periphyton taxa plotted for each sampling event.

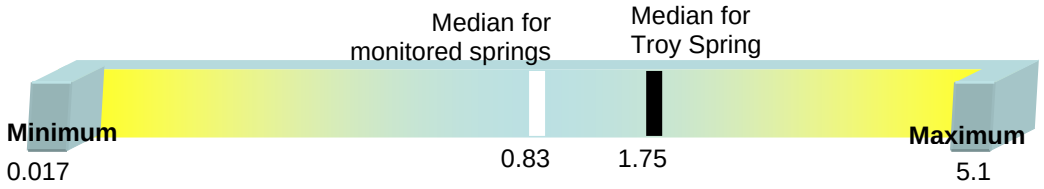
Over the approximately six-year sampling period from December 6, 2001 to May 1, 2007, data indicate the following:

- Some water quality parameters, as measured by nutrients (except for nitrate-nitrite), water clarity, and bacterial densities suggested excellent conditions.
- Troy Springs has exhibited high nitrate-nitrite concentrations (usually greater than 95% of other Florida streams), probably due to non-point sources of nitrogen within the springshed.
- Repeated visit visual observations indicate algal smothering is an issue at Troy Spring.

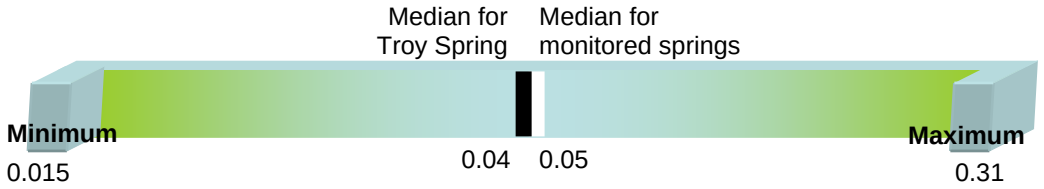
Results for four of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Troy Spring compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Troy Spring

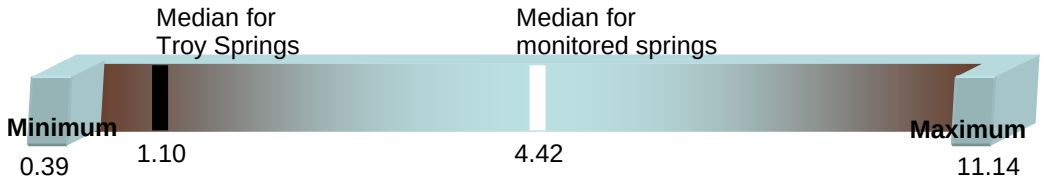
Nitrate-Nitrite



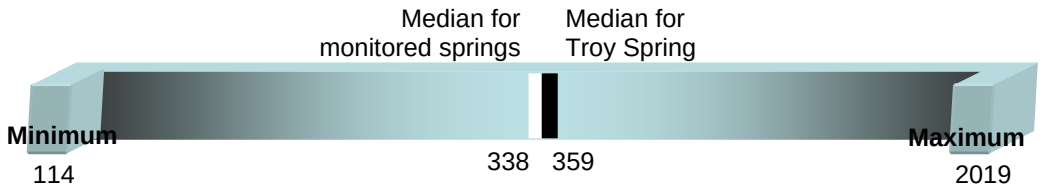
Total Phosphorus



Dissolved Oxygen

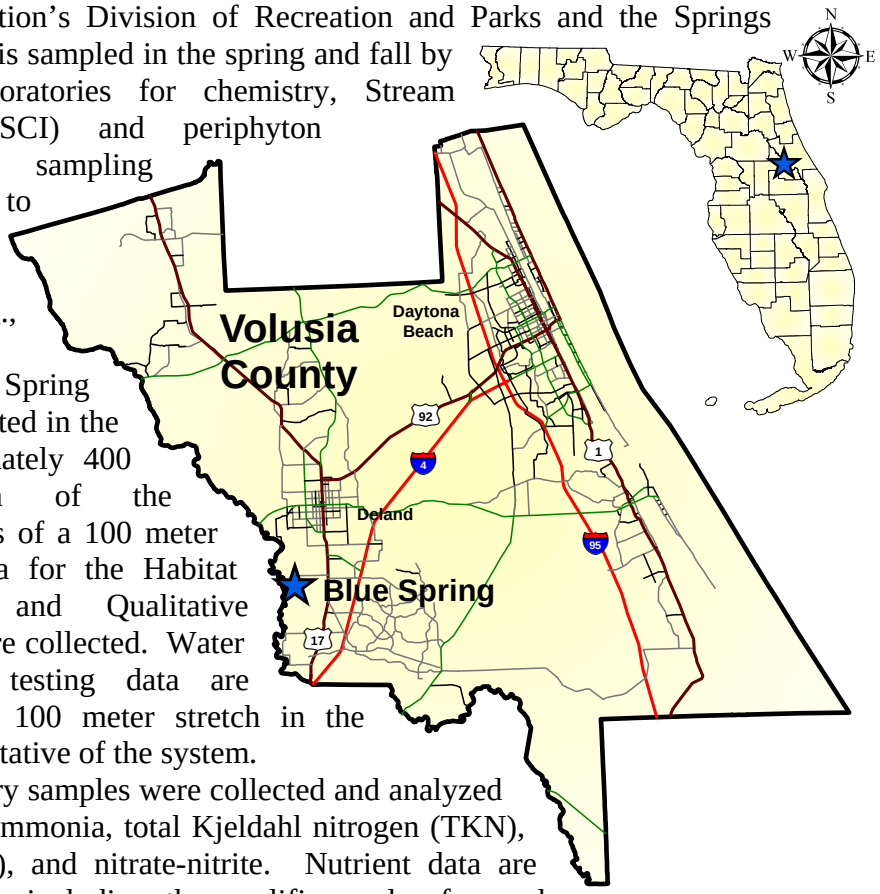


Specific Conductance



Volusia Blue Spring

Blue Spring is located within Blue Spring State Park in Volusia County. It is a first magnitude spring that discharges into Lake Beresford. Blue Spring was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Missing sampling events are due to conditions that prohibited sampling during that period (e.g., hurricanes).



The Blue Spring monitoring site is located in the spring run, approximately 400 meters downstream of the headspring. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.

Water chemistry samples were collected and analyzed for nutrients include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia concentrations have remained below the detection limit or below the practical quantitation limit for seven of the twelve (58%) samples. Ammonia detections were variable, with most values less than the 40th percentile compared to typical Florida streams. Two samples taken in October 2000 (0.093 mg/L) and May 2007 (0.075 mg/L) were slightly higher, with ammonia concentrations slightly greater than average compared to typical Florida streams. Total Kjeldahl nitrogen (TKN) remained low throughout the sampling period. Total phosphorus concentrations were plotted over the sampling period (Figure 1). Total phosphorus was below the 40th percentile compared with typical Florida streams. A visual inspection of the total phosphorus plot does not suggest any increase or decrease of total phosphorus over time. Nitrate-nitrite concentrations are plotted over the sampling period in Figure 2. Nitrate-nitrite concentrations were generally higher than the values found in 90% of typical Florida streams, ranging from 0.11 to 1.1 mg/L over the sampling period. However, a visual inspection of the plotted data indicates variability in the measurements, but no obvious trend over time. These consistently high concentrations are probably due to non-point source nutrient inputs within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 17, 2000	0.093	AJ	0.3		0.093		0.11	
November 8, 2001	0.01	U	0.14	I	0.069	JQ	0.64	
April 17, 2002	0.018	I	0.25		0.072		0.58	J
October 21, 2002	0.022		0.21		0.067	J	0.9	
May 19, 2003	0.01	U	0.13	I	0.069	A	0.78	
October 14, 2003	0.01	U	0.24		0.076		0.5	
April 20, 2004	0.041		0.2		0.098		0.39	
November 8, 2004	0.015	I	0.2	I	0.059	I	1.1	
April 26, 2005	0.011	I	0.19	I	0.076		0.57	
May 24, 2006	0.01	UQ	0.24	I	0.069		0.65	
November 1, 2006	0.058		0.32		0.078		0.42	
May 8, 2007	0.075		0.35		0.08		0.34	
Average	**0.03**		**0.23**		**0.08**		**0.58**	
Standard Deviation	**0.03**		**0.07**		**0.01**		**0.26**	
Median	**0.02**		**0.23**		**0.07**		**0.58**	

Table 1: Nutrient data including qualifier codes and summary statistics. "A"= Value reported is the arithmetic mean (average) of two or more determinations; "I" = Below practical quantitation limit; "J" = Estimated value; "U" = Below detection limit; "Q" = Outside of holding time.

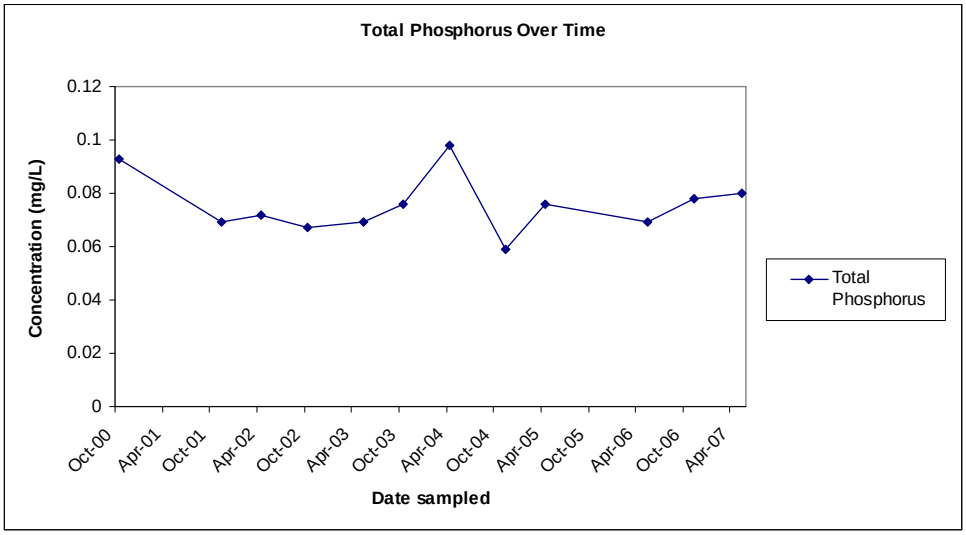


Figure 1: Total Phosphorus concentrations plotted over time.

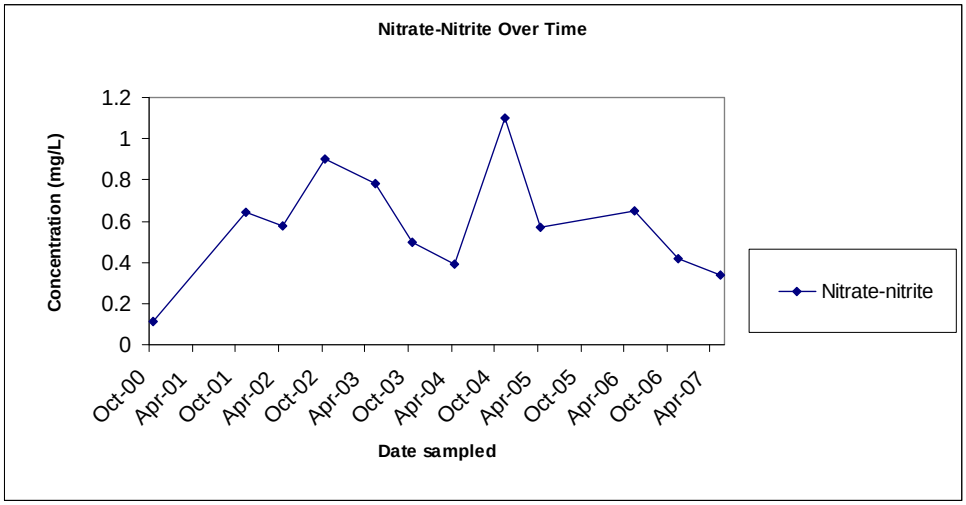


Figure 2: Nitrate-nitrite concentrations plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. Throughout the sampling period, *E. coli* data have remained below the "single sample" criterion considered safe for "designated beach areas" (235 CFU/100 mL), with a median value of 4 CFU/100 mL. *Enterococci* data have remained below the safe criterion of 61 CFU/100 mL, ranging from 6 to 40 CFU/100 mL over the sampling period, with a median of 23 CFU/100 mL. Fecal coliform data have continuously complied with the Class III water quality standard, ranging from 1 to 16 CFU/100 mL, with a median of 2 CFU/100 mL. Total coliform data have ranged from 10 to 90 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 17, 2000	26	Q	2	Q	10	Q	40	Q
March 21, 2001	20	Q	4	Q	1	KQ	10	Q
November 8, 2001	40	Q	8	Q	2	Q	20	Q
April 17, 2002	32	Q	12	Q	2	Q	90	Q
October 21, 2002	6	Q	1	KQ	1	KQ	40	Q
May 19, 2003	6	BQ	4	BQ	1	KQ	20	BQ
October 14, 2003	10	BQ	2	BQ	2	BQ	50	BQ
April 20, 2004	40	Q	23	BQ	8	BQ	54	Q
November 8, 2004	6	BQ	2	KQ	4	BQ	16	BQ
April 26, 2005	No Result	Q	No Result	Q	No Result	Q	No Result	Q
May 24, 2006	30	BQ	10	BQ	16	BQ	64	Q
November 1, 2006	30	BQ	18	BQ	2	KQ	50	Q
May 8, 2007	10	BQ	2	BQ	2	BQ	16	BQ
Average	**21**		**7**		**4**		**39**	
Standard Deviation	**13**		**7**		**5**		**24**	
Median	**23**		**4**		**2**		**40**	

Table 2: Bacteriological data including qualifier codes and summary statistics. "B" = Results based on colony counts outside the acceptable range; "K"= Off-scale low; "Q" = Outside of holding time.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data with qualifier codes as well as data for

turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period DO was consistently lower than the Class III water quality standard of 5 mg/L, averaging 2.4 mg/L and ranging from 1.4 to 4.6 mg/L. This low DO regime (a natural condition for headwater spring systems) can eliminate DO sensitive taxa from the system. Temperature was stable, averaging 23.1 degrees Celsius. Specific conductivity was elevated for a freshwater system, averaging 1243 umhos/cm, ranging from 198 to 2019 umhos/cm. The high conductivity appears to be a natural characteristic, associated with relict seawater in the Floridan aquifer system from past higher sea level stands which inundated major river corridors, notably the St. Johns River valley. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.3 SU, ranging from 6.4 to 8.0 SU. Turbidity was very low, averaging 0.3 NTU and color was below the detection limit the entire sampling period, indicating very transparent water.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 17, 2000	2.3	7.6	198	22.8	5	A	0.15	
March 21, 2001	2.2	7.5	2019	23	No Result		No Result	
November 8, 2001	1.5	6.4	1365	22.9	5	U	0.1	
April 17, 2002	2.6	7.1	1381	23.2	5	U	0.1	
October 21, 2002	1.43	7.07	878	23.2	5	UQ	0.15	Q
May 19, 2003	1.38	7.7	1098	23.02	5	U	0.35	A
October 14, 2003	3.34	7.33	1396	23.13	5	UQ	0.2	Q
April 20, 2004	3.22	7.5	1705	23.36	5	Q	0.7	Q
November 8, 2004	1.9	7.3	861	22.9	5	UQ	0.1	Q
April 26, 2005	2.5	8	1280	23	5	Q	0.15	Q
May 24, 2006	4.61	6.52	1055	23.4	5	Q	0.95	Q
November 1, 2006	No Result	No Result	1597	23	5		0.2	
May 8, 2007	1.56	7.25	1321	23.2	5	U	0.25	
Average	**2.38**	**7.27**	**1242.62**	**23.09**	**5.00**		**0.28**	
Standard Deviation	**0.97**	**0.46**	**450.30**	**0.18**	**0.00**		**0.27**	
Median	**2.25**	**7.32**	**1321.00**	**23.02**	**5.00**		**0.18**	

Table 3: Field parameters, color, and turbidity data including qualifier codes and summary statistics. “A”= Value reported is the arithmetic mean (average) of two or more determinations; “Q” = Outside of holding time; “U”= Below detection limit.

The Stream Condition Index (SCI) sampling was performed from October 17, 2000 to May 8, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. SCI scores collected after the June 8, 2004 recalibration of the SCI tool are plotted over time in Figure 3. The SCI scores, both before and after the recalibration, consistently indicated impaired conditions in Volusia Blue Run, probably due to the high specific conductivity and frequent low DO observed at this site. Both factors would reduce the number of sensitive organisms, and potentially lead to shifts in community structure. The total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa over the sampling period ranged from 9 to 22. The number of sensitive taxa was zero for the sampling period, with the exception of March 2001, with 2 sensitive taxa, and May 2006 when 1 sensitive taxon was recorded (Figure 5). Habitat Assessment scores over time are shown in Figure 6. Most of the habitat assessments scored in the suboptimal category, with lack of variety

and availability of productivity habitats, and algal smothering constituting the main contributions to lower habitat assessment scores for Blue Spring.

Old SCI Scores	
October 17, 2000	15
March 21, 2001	15
October 16, 2001	15
April 17, 2002	15
October 21, 2002	15
May 19, 2003	17
October 14, 2003	11
April 20, 2004	11

Recalibrated SCI Scores	
April 26, 2005	17
May 24, 2006	14
May 8, 2007	9

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

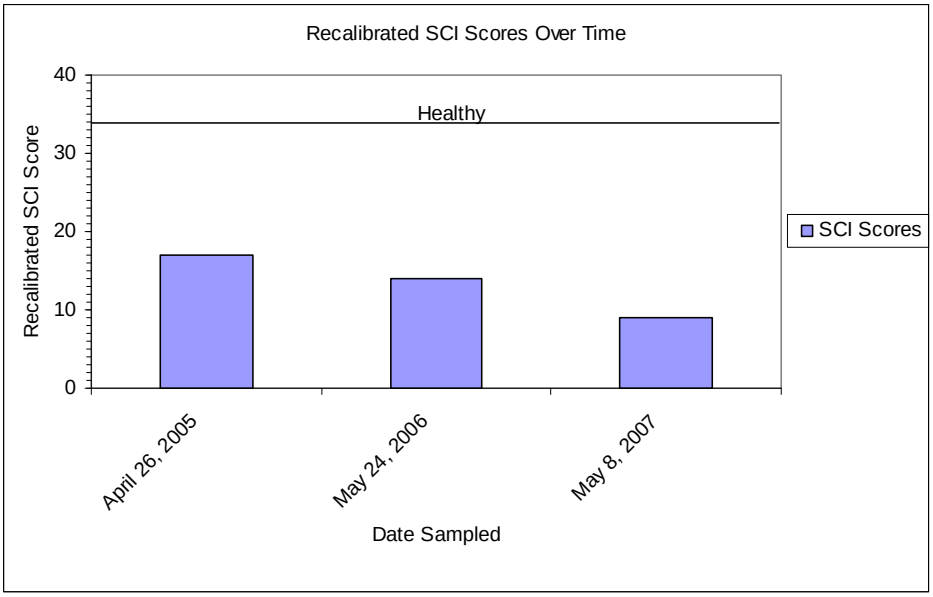


Figure 3: Recalibrated SCI scores over time.

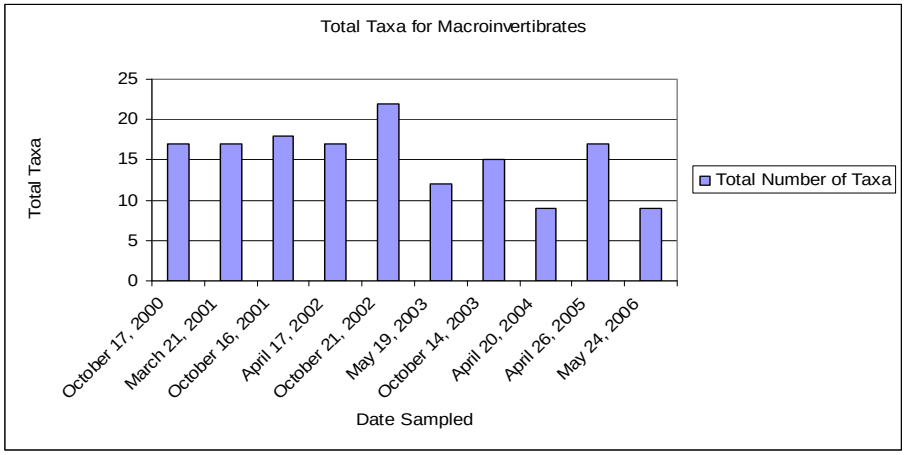


Figure 4: Total macroinvertibrate taxa plotted over time.

Date	Sensitive Taxa
10/17/2000	0
3/21/2001	2
10/16/2001	0
4/17/2002	0
10/21/2002	0
5/19/2003	0
10/14/2003	0
4/20/2004	0
4/26/2005	0
5/24/2006	1

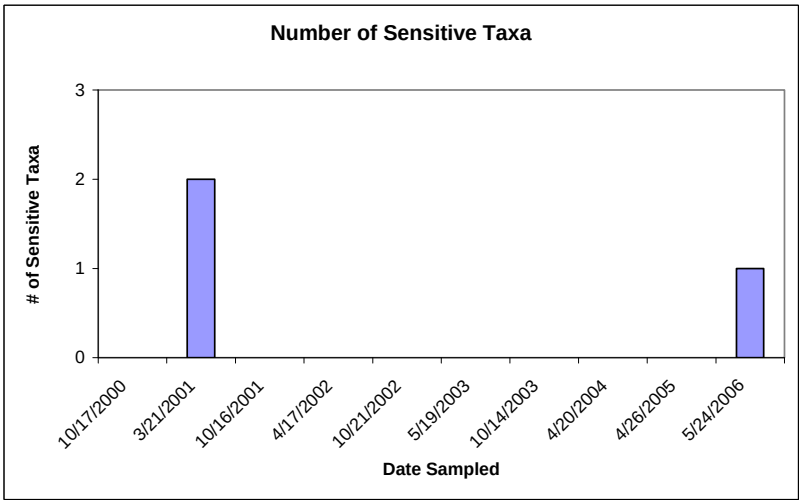


Figure 5: Table and chart showing the number of sensitive taxa over the sampling period.

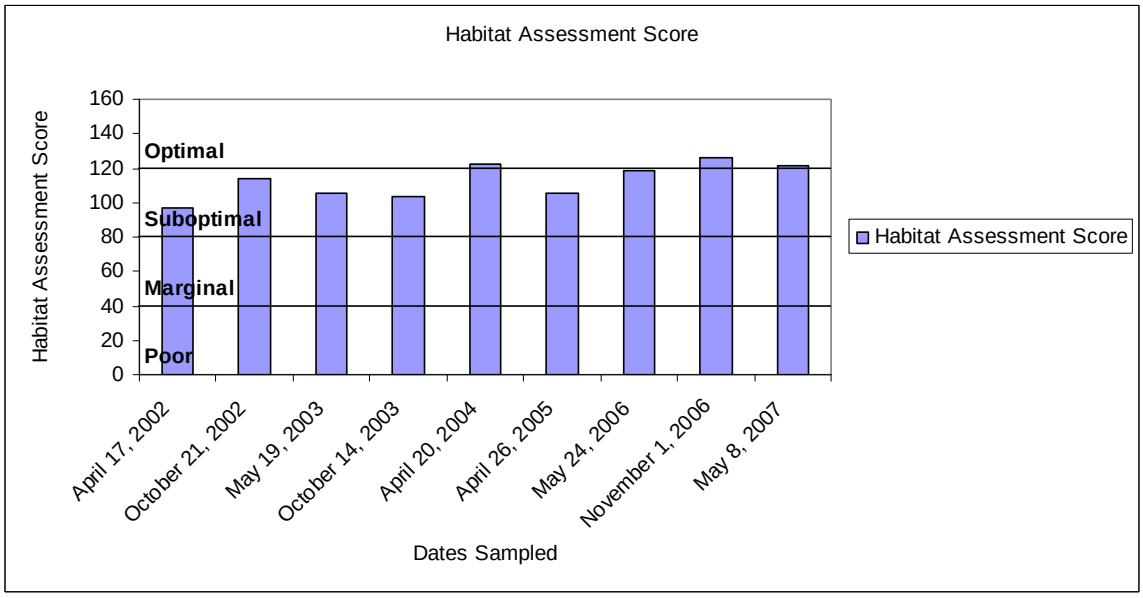


Figure 6: Habitat assessment scores over time.

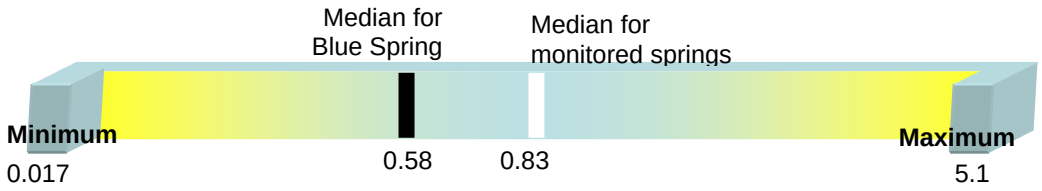
Over the roughly six year sampling period from October 17, 2000 to May 8, 2007, data indicate the following:

- Some water quality parameters, as measured by nutrients (except for nitrate-nitrite), water clarity, and bacterial densities suggested excellent conditions.
- Blue Spring has exhibited high nitrate-nitrite concentrations (usually greater than 90% of other Florida streams), probably due to non-point sources of nitrogen within the springshed.
- Low dissolved oxygen and elevated conductivity (both natural conditions) appeared to be related to the poor quality invertebrate community present.
- SCI scores have remained below the impairment threshold, characterized by a paucity of sensitive taxa. This condition is probably mostly related to the DO and conductivity issues, but lack of substrate diversity and algal smothering may have also played a role.

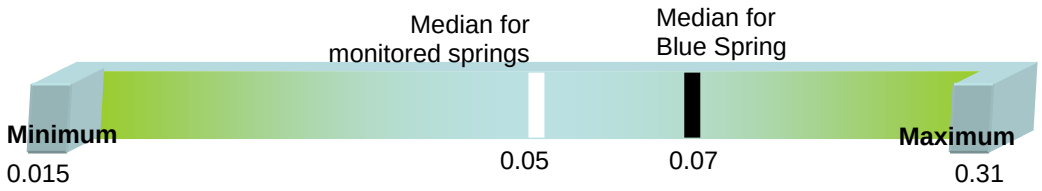
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Blue Spring compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Blue Spring

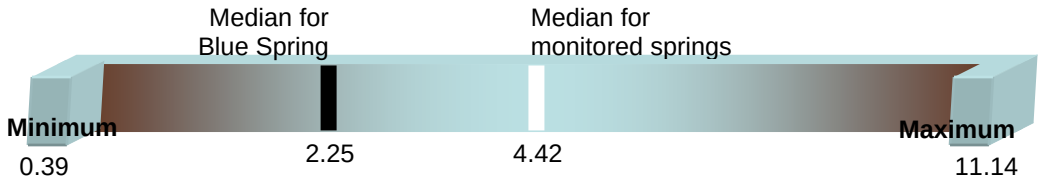
Nitrate-Nitrite (mg/L)



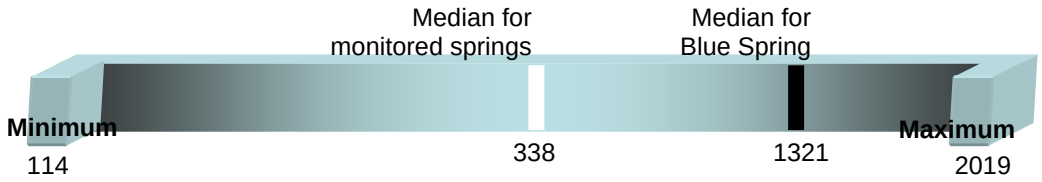
Total Phosphorus (mg/L)



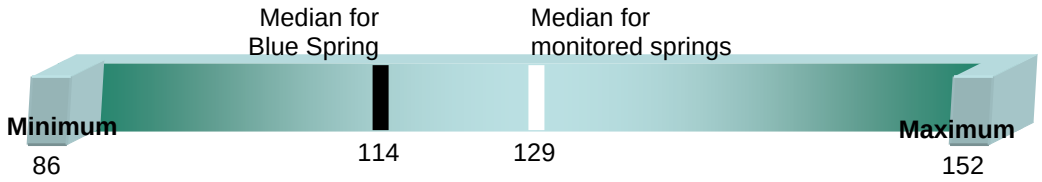
Dissolved Oxygen (mg/L)



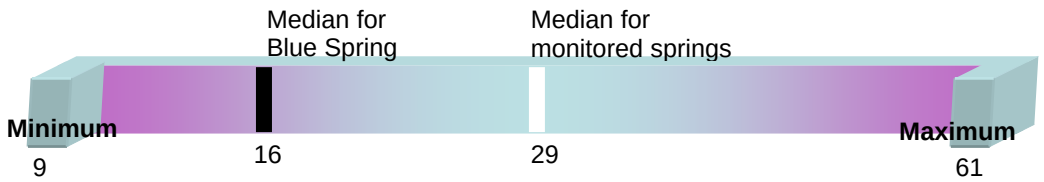
Specific Conductance (umhos/cm)



Habitat Assessment Score

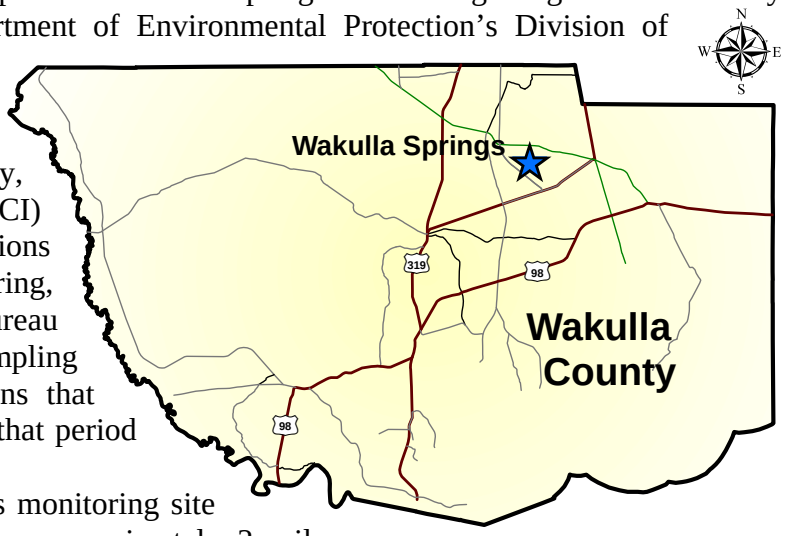


Stream Condition Index

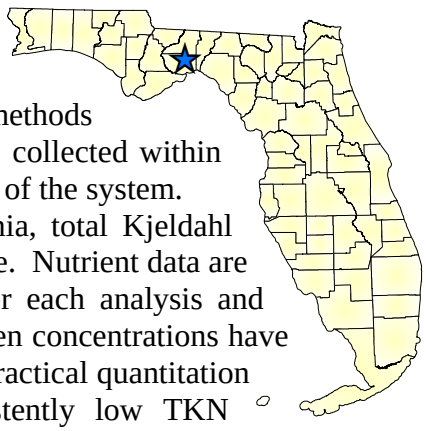


Wakulla Springs

Wakulla Springs is located in Wakulla County within the Wakulla Springs State Park. It is a first magnitude spring, forming the headwater of the Wakulla River. Wakulla Springs was incorporated into the Springs Monitoring Program in February 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled quarterly, with chemistry, Stream Condition Index (SCI) and periphyton collections performed in winter, spring, summer and fall by the Bureau of Laboratories. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).



The Wakulla Springs monitoring site is located in the spring run, approximately 2 miles south of the headspring, within the park limits. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.



Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and total Kjeldahl nitrogen concentrations have remained either below the detection limit or below the practical quantitation limit for the 7 year sampling period. These consistently low TKN concentrations indicate no organic nitrogen enrichment. Total phosphorus was also low, with only one sample above the practical quantitation limit. Detections between the practical quantitation limit and the method detection limit are considered qualitative and can not be used to determine relationships in the data. Concentrations of nitrate-nitrite were plotted over the seven-year period from 2000-2007 (Figure 1). A visual inspection of the nitrate-nitrite data over time appears to suggest a very slight downward trend; however, the data are not sufficient to statistically determine whether this is a truly significant trend. Nitrate-nitrite concentrations have remained high ranging from 0.47 to 0.84 mg/L and have generally exceeded 80 percent of values found in typical Florida streams. Consistently elevated nitrate-nitrite concentrations are probably due to anthropogenic nutrient inputs within the springshed.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
February 28, 2000	0.01	U	0.06	U	0.036		0.77	
May 22, 2000	0.01	U	0.076	I	0.032	I	0.84	
August 22, 2000	0.012	I	0.06	U	0.015	U	0.77	
November 29, 2000	0.01	U	0.083	I	0.037	I	0.84	J
February 27, 2001	0.01	I	0.091	I	0.037	I	No Result	
September 18, 2001	0.01	U	0.096	I	0.027	I	0.62	
November 27, 2001	0.012	I	0.078	I	0.036	I	0.51	J
April 4, 2002	0.01	U	0.06	U	0.039	I	0.73	
May 6, 2002	0.019	I	0.06	U	0.032	I	0.79	J
October 7, 2002	0.013	I	0.11	I	0.022	I	0.59	
January 16, 2003	0.01	U	0.096	I	0.04	I	0.54	
May 13, 2003	0.013	I	0.087	I	0.027	I	0.61	
August 5, 2003	0.01	U	0.06	U	0.04	I	0.7	
October 8, 2003	0.01	U	0.06	U	0.027	I	0.78	
February 3, 2004	0.01	U	0.065	I	0.028	I	0.52	
April 15, 2004	0.01	U	0.06	U	0.047	I	0.65	
July 26, 2004	0.01	U	0.12	U	0.025	I	0.6	
October 26, 2004	0.01	U	0.071	I	0.045	I	0.74	
January 31, 2005	0.01	U	0.06	U	0.02	U	0.61	
May 16, 2005	0.01	U	0.1	I	0.031	I	0.58	
January 31, 2006	0.01	U	0.08	U	0.036	I	0.66	
April 11, 2006	0.01	UY	0.08	U	0.026	I	0.73	Y
August 10, 2006	0.01	U	0.08	U	0.036	I	0.47	
November 6, 2006	0.01	U	0.08	U	0.039	I	0.47	
February 1, 2007	0.01	U	0.08	U	0.023	I	0.68	
May 3, 2007	0.015	I	0.08	U	0.024	I	0.6	
Average	**0.01**		**0.08**		**0.03**		**0.66**	
Standard Deviation	**0.00**		**0.02**		**0.01**		**0.11**	
Median	**0.01**		**0.08**		**0.03**		**0.65**	

Table 1: Nutrient data including qualifier codes and summary statistics."I" = Below practical quantitation limit; "J"= Estimated value; "U" = Below detection limit; "Y"= Improperly preserved.

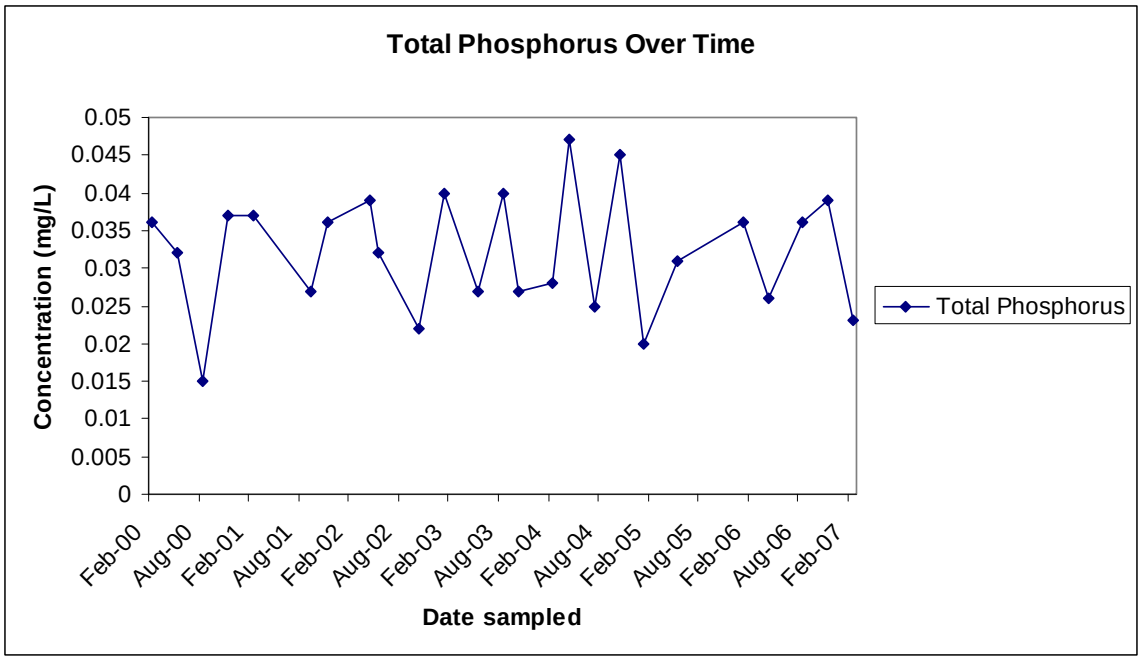


Figure 1: Total phosphorus values plotted over time.

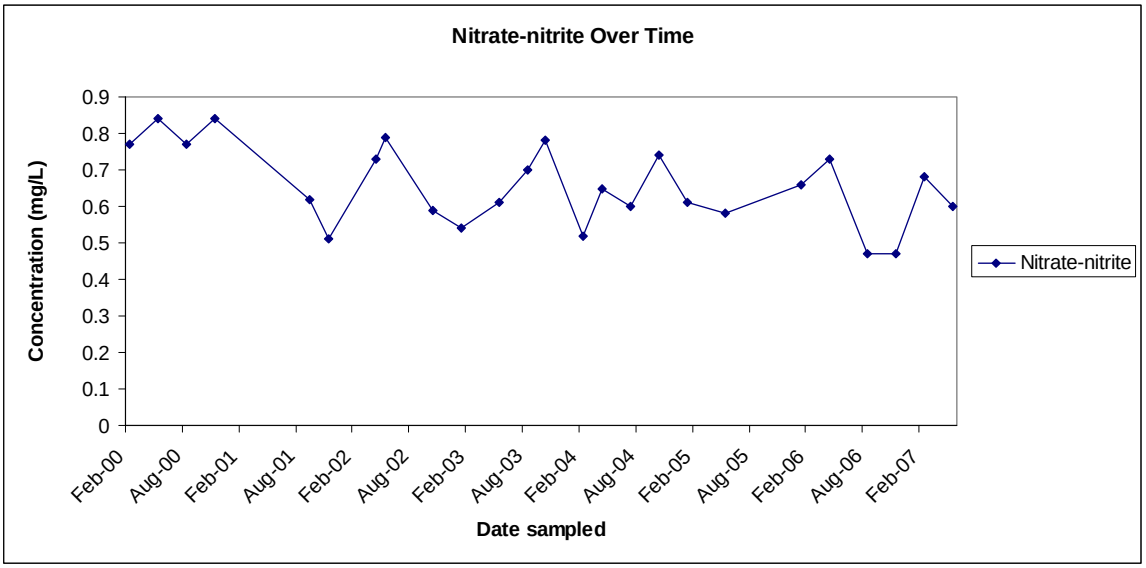


Figure 2: Nitrate-nitrite values plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci,* fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 31 CFU/100 mL. *Enterococci* data have ranged from 1 to 240 CFU/100 mL over the sampling period, with a median of 18 CFU/100 mL. This value complies with the freshwater standard of 61 CFU/100 mL for designated beach areas. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 4 to 136 CFU/100 mL, with a median of 40 CFU/100 mL. Total coliform data have ranged from 2 to 380 CFU/100 mL. The median total coliform value for the sampling period was 130 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100 mL)	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
February 28, 2000	14	Q	No Result		18	Q	100	Q
May 22, 2000	240		No Result		4		90	
August 22, 2000	60	Q	No Result		50	Q	130	Q
November 29, 2000	60		32		32		150	
February 27, 2001	1	K	8		14		40	
September 18, 2001	16		16		24		370	
November 27, 2001	16		38		44		300	
April 4, 2002	18		22		42		300	
May 6, 2002	No Result		No Result		No Result		No Result	
October 7, 2002	14	A	43	A	21	A	150	A
January 16, 2003	6		24		40		90	
May 13, 2003	10		2		12		120	
August 5, 2003	60		120		136	B	150	B
October 8, 2003	40		30	B	48		380	
February 3, 2004	4	BQ	2	BQ	4	BQ	10	BQ
April 15, 2004	7	B	2	B	7	B	72	
July 26, 2004	17	B	15	B	18	B	250	
October 26, 2004	72		120		68		110	
January 31, 2005	48		118		90		136	
May 16, 2005	200	Q	56	Q	42	Q	230	Q
January 31, 2006	34	B	160	B	88		156	
April 11, 2006	12	AB	34	AB	67	A	120	A
August 10, 2006	2	K	2	B	14	B	32	B
November 6, 2006	58		124	B	116		122	B
February 1, 2007	54		104		112		172	B
May 3, 2007	20	B	2	B	8	B	2	U
Average	**43**		**49**		**45**		**151**	
Standard Deviation	**58**		**50**		**38**		**102**	
Median	**18**		**31**		**40**		**130**	

Table 2: Microbiology data including qualifiers and summary statistics. “A” = Value reported is the arithmetic mean (average) of two or more determinations; “B” = Results based on colony counts outside the acceptable range; “K” = Off scale low. Actual value is known to be less than the value given. “Q” = Outside of holding time; “U”= Below the detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from February 2000 to May 2007, dissolved oxygen averaged 5.9 mg/L, ranging from 3.8 to 9.1 mg/L. The DO complied with the Class III water quality standard of 5 mg/L for most measurements. Low DO is a natural condition for headwater spring systems, but can have the effect of eliminating sensitive taxa from the system. Temperature averaged 21.1 degrees Celsius, ranging from 19.4 to 23.0 degrees C. Specific conductivity was slightly elevated throughout the sampling period averaging 300 umhos/cm and ranged from 242 to 338 umhos/cm. The elevated conductivity appears to be a natural characteristic, associated with inorganic dissolved solids in the groundwater. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.6 SU, ranging from 6.3 to 8.4 SU. Turbidity was very low, averaging 0.3 NTU. Color was variable, but sometimes high for a Florida spring, averaging 7.1 PCU and ranging as high as 15 PCU. The higher color values are associated with tannins entering the aquifer from three “sink captured” streams, including Fisher Creek, Munson Slough, and Black Creek.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
February 28, 2000	8.55	8	273	21.04	No Result		0.15	
May 22, 2000	No Result	7.7	242	22.2	No Result		0.15	
August 22, 2000	9.16	8.3	258	23.03	No Result		0.25	Q
November 29, 2000	6.6	6.3	274	19.9	No Result		0.2	
February 27, 2001	No Result	8.4	338	21.4	No Result		0.25	
June 6, 2001	No Result	7.51	300	21.64	No Result		No Result	
September 18, 2001	9.1	7.1	272	21.8	No Result		0.5	
November 27, 2001	6.6	7.32	318	21.24	No Result		0.17	
April 4, 2002	5	7.45	320	20.58	5	U	0.6	
May 6, 2002	4.74	7.58	316	21.5	5	U	0.35	
October 7, 2002	4.42	7.5	305	21.2	15		0.3	
January 16, 2003	3.21	7.49	276	19.37	15		0.65	
May 13, 2003	8.92	7.89	312	22.64	5	U	0.35	
August 5, 2003	6.1	7.2	306	21.3	5		0.25	
October 8, 2003	4.2	7.1	322	20.9	5	U	0.35	
February 3, 2004	4.1	7.36	292	20.78	5	A	0.25	
April 15, 2004	7.4	8	312	21.2	5		0.2	
July 26, 2004	4.38	7.7	300	21.5	10		0.4	
October 26, 2004	3.75	7.8	331	20.6	5	U	0.25	
January 31, 2005	5.4	7.7	278	19.9	10		0.2	
May 16, 2005	4.26	7.52	294	21.04	15		0.45	
January 31, 2006	7.5	7.8	307	20.4	5		0.25	
April 11, 2006	6.57	7.65	317	20.2	5	U	0.25	
August 10, 2006	5.3	7.5	296	21.6	5		0.2	
November 6, 2006	4.73	7.59	314	20.76	5		0.5	
February 1, 2007	No Result	7.75	309	20.18	5		0.3	
May 3, 2007	5.08	7.18	305	21.03	5		0.1	
Average	**5.87**	**7.57**	**299.52**	**21.07**	**7.11**		**0.30**	
Standard Deviation	**1.82**	**0.41**	**22.66**	**0.82**	**3.84**		**0.14**	
Median	**5.30**	**7.58**	**305.00**	**21.04**	**5.00**		**0.25**	

Table 3: Field parameters, color, and turbidity data including qualifiers. "A" = Value reported is the arithmetic mean (average) of two or more determinations; "Q" = Outside of holding time; "U"= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from February 28, 2000 to May 3, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores from July 26, 2004 to May 3, 2007 are plotted over time in Figure 3. Only seven out of 27 SCI scores (26%) indicated a healthy invertebrate community in Wakulla springs. Occasionally depressed dissolved oxygen levels, habitat smothering by the invasive aquatic plant *Hydrilla*, and somewhat elevated conductivity were factors which appeared to contribute to the low SCI scores. The number of sensitive taxa and the total number of taxa, two of the ten metrics that go into the calculation of the SCI, are presented over the sampling period in figures 4 and 5. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa over all the dates (Figure 4) ranged of 11 to 28 total taxa. The numbers of sensitive taxa over the sampling period remained low, averaging 1 sensitive taxon present (Figure 5). Sensitive taxa tend to be excluded from higher conductivity sites, and the average conductivity of 300 umhos/cm at Wakulla Springs (a natural condition) may have been responsible for this phenomenon. Habitat Assessment scores over time are shown in Figure 6. Scores for habitat assessment remained mostly in the optimal category, with some falling into the suboptimal category.

Old SCI Scores	
Feb 28, 2000	19
May 22, 2000	21
Aug 22, 2000	13
Nov 29, 2000	19
Feb 27, 2001	15
Jun 6, 2001	15
Sep 18, 2001	17
Nov 27, 2001	15
Apr 4, 2002	17
May 6, 2002	21
Aug 23, 2002	17
Oct 7, 2002	23
Jan 16, 2003	17
May 13, 2003	27
Aug 5, 2003	9
Oct 8, 2003	11
Feb 3, 2004	25
Apr 15, 2004	21

Recalibrated SCI Scores	
Jul 26, 2004	25
Oct 26, 2004	18
Jan 31, 2005	19
May 16, 2005	31
Jan 31, 2006	36
Apr 11, 2006	20
Nov 6, 2006	14
Feb 1, 2007	28
May 3, 2007	33

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

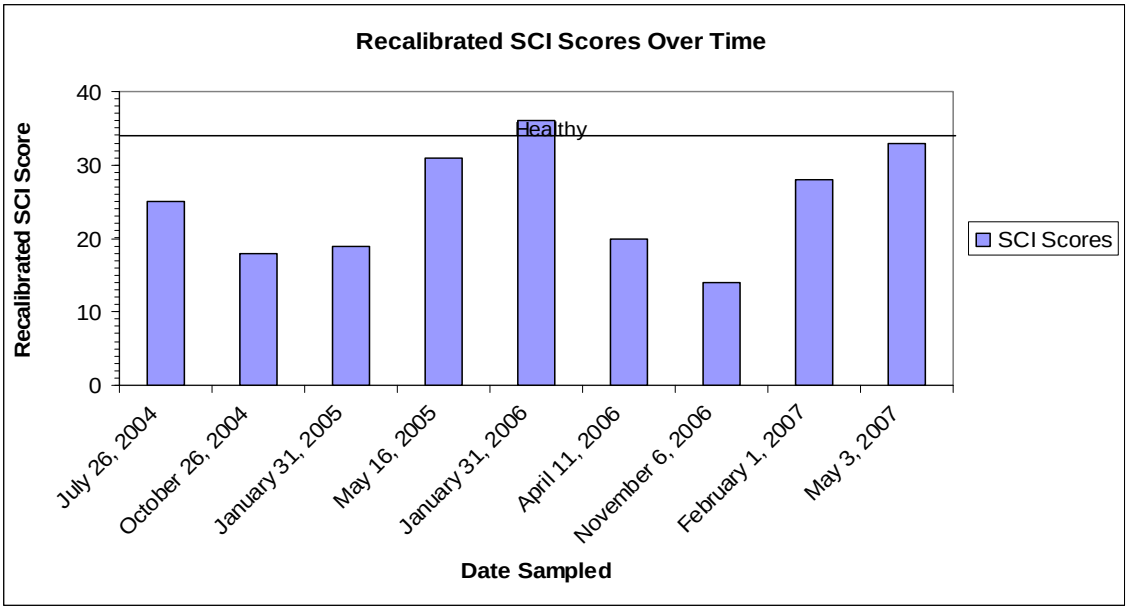


Figure 3: Recalibrated SCI scores for each sampling event, showing the impairment line at 34.

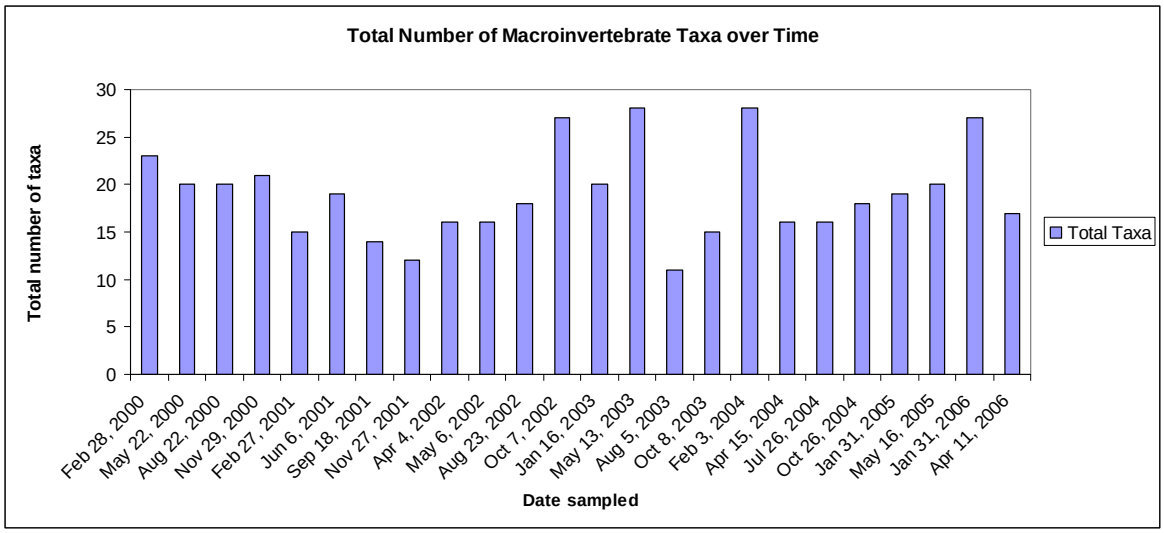


Figure 4: Total macroinvertebrate taxa for each sampling event.

Date	Sensitive Taxa
2/28/2000	1
5/22/2000	1
8/22/2000	0
11/29/2000	1
2/27/2001	0
6/6/2001	1
9/18/2001	1
11/27/2001	1
4/4/2002	0
5/6/2002	0
8/23/2002	1
10/7/2002	2
1/16/2003	1
5/13/2003	3
8/5/2003	1
10/8/2003	1
2/3/2004	3
4/15/2004	1
7/26/2004	2
10/26/2004	0
1/31/2005	1
5/16/2005	2
1/31/2006	1
4/11/2006	0

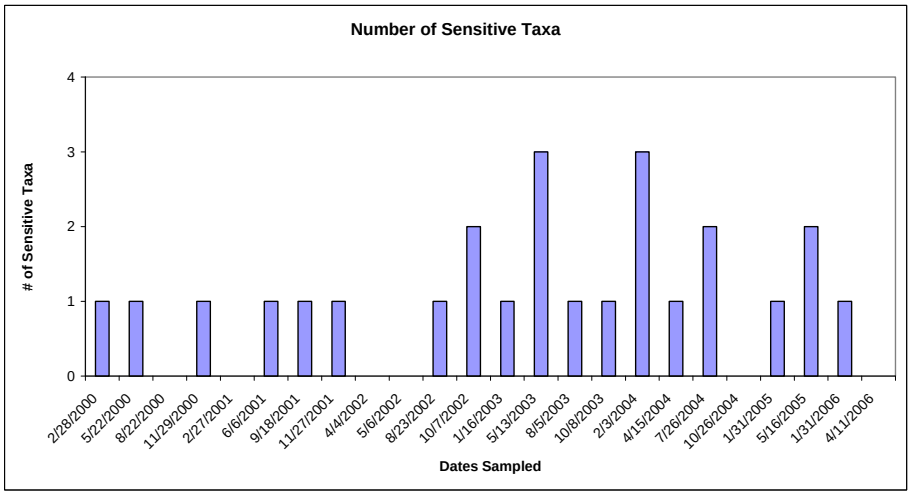


Figure 5: Table and Chart showing the number of sensitive taxa over the sampling period.

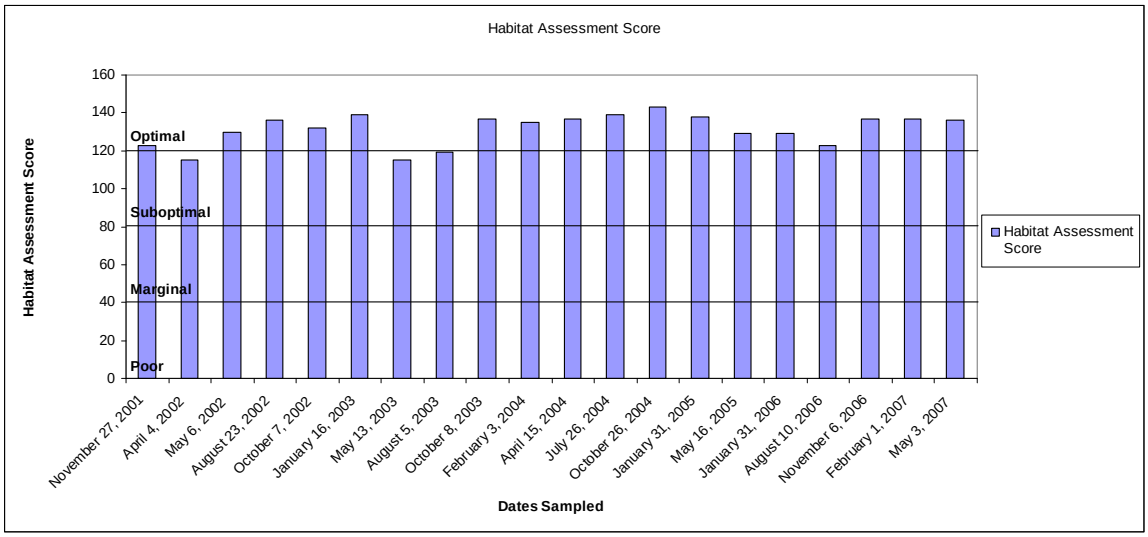


Figure 6: Habitat Assessment scores for each sampling event.

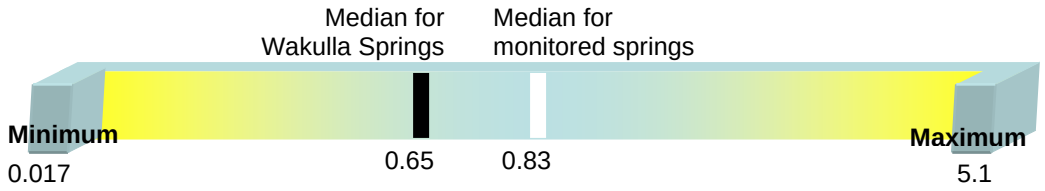
Over the approximately seven year sampling period from February 28, 2000 to February 1, 2007, data indicate the following:

- Water quality parameters, as measured by nutrients (except for nitrate-nitrite) and bacterial densities suggested excellent conditions.
- Wakulla Springs has exhibited high nitrate-nitrite concentrations (usually greater than 80% of other Florida streams), due to anthropogenic sources of nitrogen within the springshed.
- SCI scores have indicated healthy conditions in only seven out of 27 SCI scores (26%), with the community generally being characterized by a paucity of sensitive taxa. The smothering of substrates by *Hydrilla*, occasional low dissolved oxygen, and slightly elevated conductivity (the latter two are natural conditions) appeared to be related to the issues with invertebrate community.

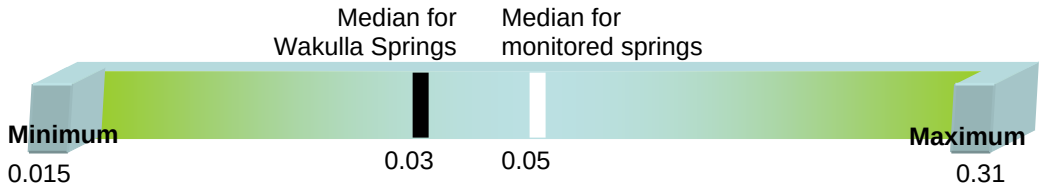
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Wakulla Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Wakulla Springs

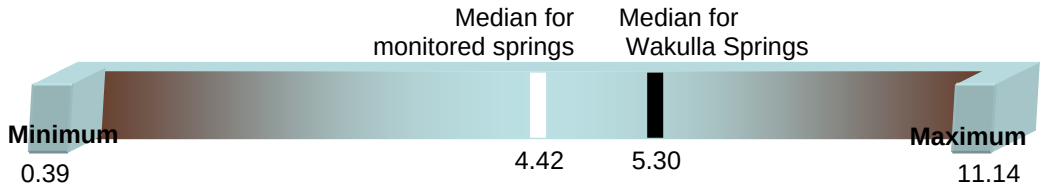
Nitrate-Nitrite (mg/L)



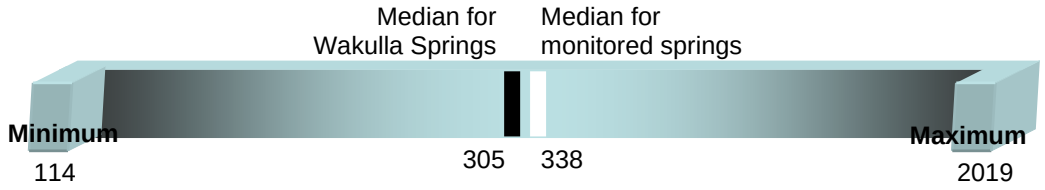
Total Phosphorus (mg/L)



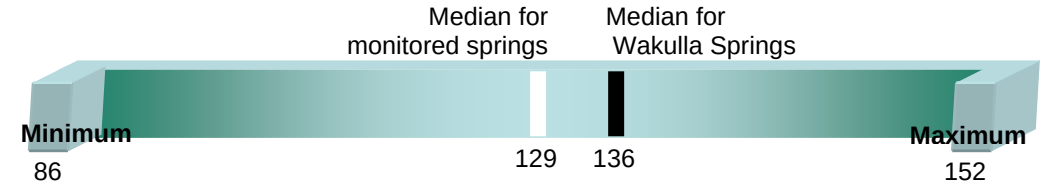
Dissolved Oxygen (mg/L)



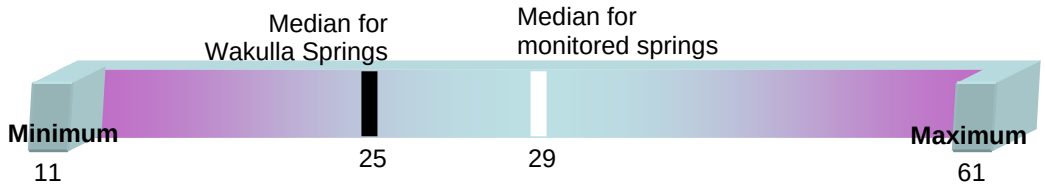
Specific Conductance (umhos/cm)



Habitat Assessment Score

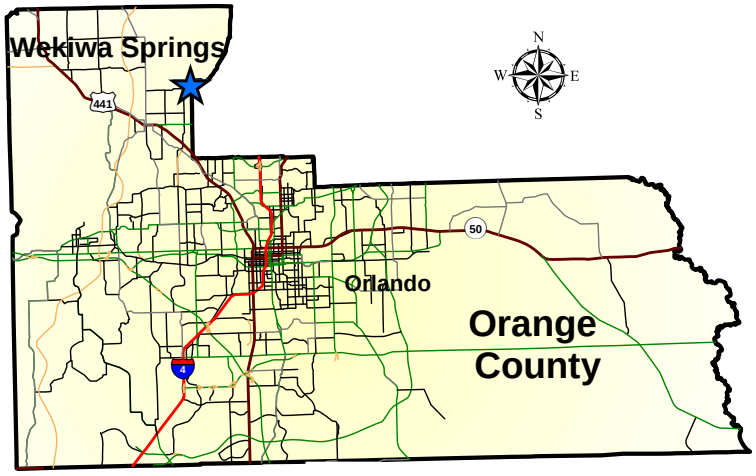


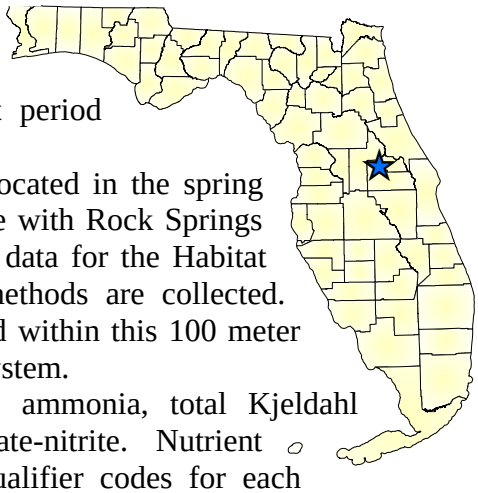
Stream Condition Index



Wekiwa Springs

Wekiwa Springs is located in Wekiwa Springs State Park on the border of Orange and Seminole Counties. It is a second magnitude spring discharging into the headwaters for the Wekiwa River, which eventually flows into the St. Johns River. Wekiwa Springs was incorporated into the Springs Monitoring Program in October 2000 by the Florida Department of Environmental Protection's Division of Recreation and Parks and the Springs Initiative program. It is sampled in the spring and fall by the Bureau of Laboratories for chemistry, Stream Condition Index (SCI) and periphyton collections. Two additional samples for chemistry are collected annually by the Parks Service in summer and winter. Missing sampling events are due to conditions that prohibited sampling during that period (*e.g.*, hurricanes).





The Wekiwa Springs monitoring site is located in the spring run, a hundred meters upstream of the confluence with Rock Springs Run. It consists of a 100 meter stretch in which data for the Habitat Assessment, SCI, and Qualitative Periphyton methods are collected. Water samples and field testing data are collected within this 100 meter stretch in the location most representative of the system.

Water column nutrient samples include ammonia, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and nitrate-nitrite. Nutrient data are presented in Table 1, including the qualifier codes for each analysis and summary statistics. Ammonia and TKN have remained either below the detection limit or below the practical quantitation limit for most of the approximately six year sampling period from October 2000 to May 2007. Ammonia detections were low, below the 20th percentile compared to typical Florida streams. Total phosphorus concentrations averaged 0.13 mg/L over the sampling period and remained below the 60th percentile compared to typical Florida streams (Figure 1). A visual inspection of the total phosphorus data does not appear to suggest any obvious trends over time. Additionally, the data are not sufficient to statistically determine any significant trend. Total phosphorus levels probably originate from natural sources of phosphorus in the groundwater in this area of Florida. Nitrate-nitrite concentrations have ranged from 0.7 to 1.6 mg/L over the sampling period, values which exceed those found in approximately 90 to 95% of typical Florida streams (Figure 2). These consistently elevated nitrate-nitrite concentrations are probably due to anthropogenic nutrient inputs within the

springshed. However, a visual inspection of the plotted data does not indicate an upward or downward trend in the nitrate-nitrite data over the sampling period.

Nutrient Data

Date	Ammonia (mg/L)	Qualifier	TKN (mg/L)	Qualifier	Total Phosphorus (mg/L)	Qualifier	Nitrate-Nitrite (mg/L)	Qualifier
October 16, 2000	0.015	I	0.1	I	0.12	A	1.1	
December 6, 2001	0.022	A	0.12	I	0.14	J	0.92	
January 28, 2002	0.025		0.06	U	0.1		0.9	J
April 17, 2002	0.015	I	0.1	I	0.11		0.84	J
July 23, 2002	0.023		0.12	IY	0.1	Y	0.97	J
October 21, 2002	0.041		0.15	I	0.13	J	1.4	
January 27, 2003	0.01	U	0.071	I	0.11	A	1.5	
May 20, 2003	0.018	I	0.19	I	0.13		1.4	
August 19, 2003	0.01	U	0.093	I	0.14		1.6	
February 3, 2004	0.01	U	0.11	I	0.12		1.5	
April 21, 2004	0.01	U	0.067	I	0.15		1.1	
July 26, 2004	0.01	U	0.06	U	0.11		1.2	
November 9, 2004	0.013	I	0.19	I	0.13		1.5	
January 24, 2005	0.01	U	0.14	I	0.1		1.5	
April 26, 2005	0.011	I	0.14	I	0.13		1.1	
July 27, 2005	0.01	U	No Result	O	No Result	O	1.5	
January 24, 2006	0.01	U	0.08	U	0.14		1.4	
May 25, 2006	0.01	UQ	0.16	U	0.14		1.1	
August 16, 2006	0.013	I	0.1	I	0.14		1	
November 2, 2006	0.01	U	0.088	I	0.15		0.89	
February 12, 2007	0.01	U	0.08	U	0.14		0.84	
May 9, 2007	0.01	U	0.14	I	0.13		0.71	
Average	**0.01**		**0.11**		**0.13**		**1.18**	
Standard Deviation	**0.01**		**0.04**		**0.02**		**0.28**	
Median	**0.01**		**0.10**		**0.13**		**1.10**	

Table 1: Nutrient data including qualifier codes and summary statistics. “A”= Value reported is the arithmetic mean (average) of two or more determinations; “I” = Below practical quantitation limit; “J”= Estimated value; “O”= Sampled, but analysis lost or not performed; “Q”= Sample held beyond the accepted holding time; “U” = Below detection limit; “Y”= Improperly preserved sample.

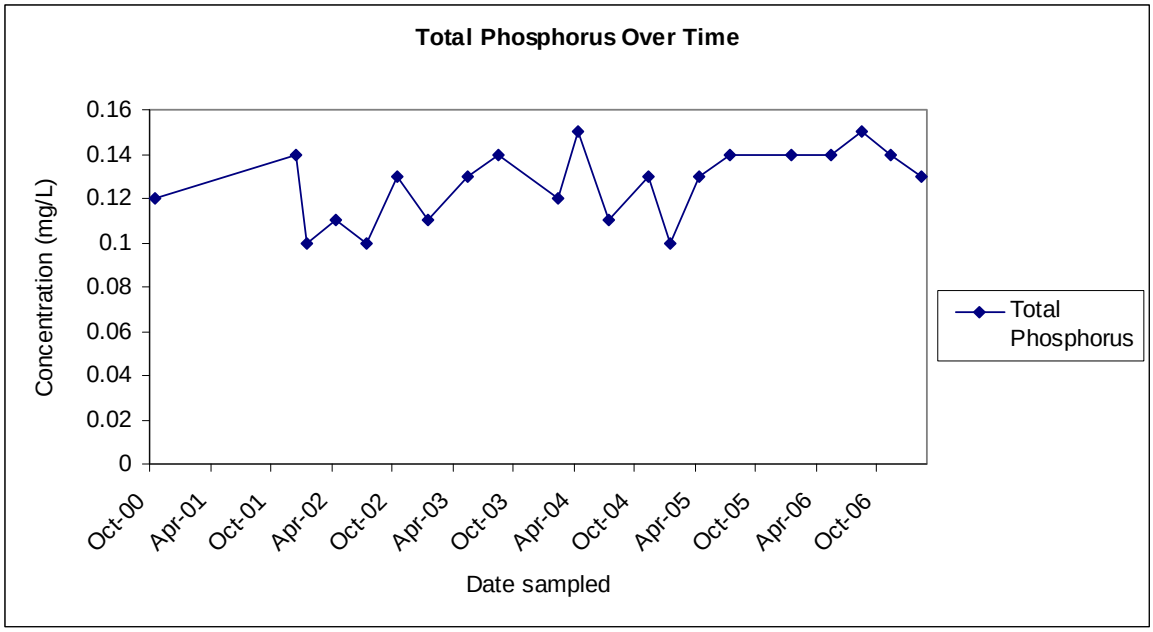


Figure 1: Total Phosphorus concentrations plotted over time.

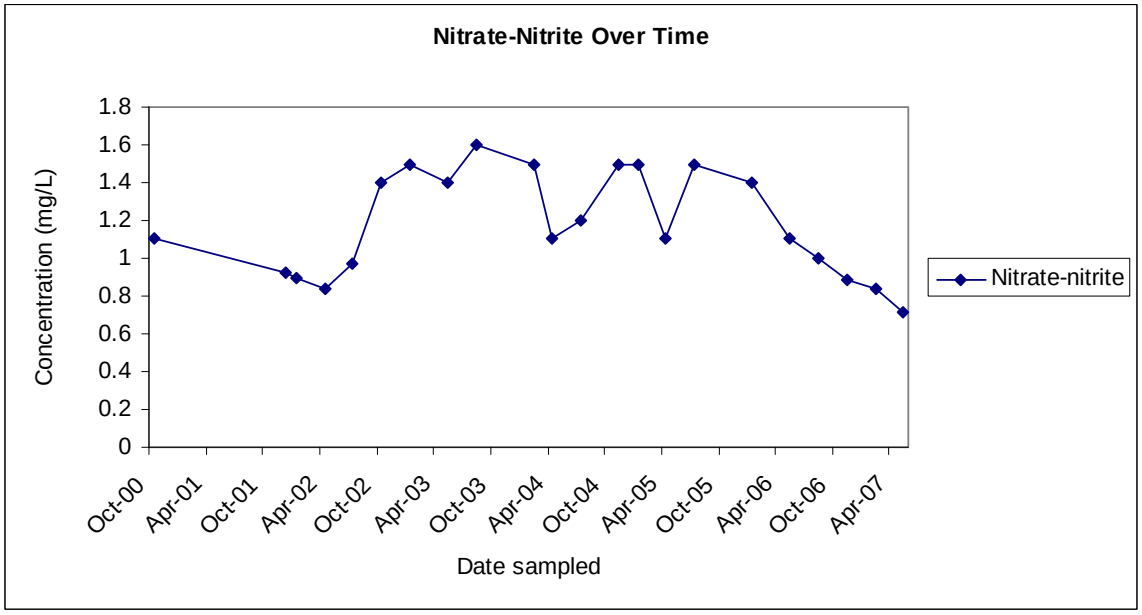


Figure 2: Nitrate-nitrite values plotted over time.

Water column bacteria samples were collected and analyzed for *Escherichia coli*, *Enterococci*, fecal coliform bacteria, and total coliform bacteria. Bacteria data, including the qualifier codes and summary statistics, are presented in Table 2. The variability of the bacteria results suggests that the median is a better measure of the central tendency of the data. *E. coli* data have remained below the standard considered safe for "designated beach areas" of 235 CFU/100 mL over the sampling period, with a median of 8 CFU/100 mL. *Enterococci* data have ranged from 1 to 250 CFU/100 mL over the sampling period, with a median of 35 CFU/100 mL. The median value is lower than the freshwater

"designated beach" criterion of 61 CFU/100 mL. Fecal coliform data have continuously complied with Class III water quality standards, ranging from 1 to 78 CFU/100 mL, with a median of 8 CFU/100 mL. Total coliform data have ranged from 1 to 520 CFU/100 mL. The median total coliform value was 70 CFU/100 mL.

Microbiology Data

Date	*Enterococci* (CFU/100	Qualifier	*Escherichia coli* (CFU/100 mL)	Qualifier	Fecal Coliforms (CFU/100 mL)	Qualifier	Total Coliforms (CFU/100 mL)	Qualifier
October 16, 2000	68	Q	16	Q	12	Q	200	Q
March 21, 2001	80	Q	20	Q	30	Q	260	Q
December 6, 2001	46	Q	8	Q	10	Q	170	Q
January 28, 2002	1	KQ	1	KQ	1	KQ	1	KQ
April 17, 2002	210	Q	4	Q	4	Q	70	Q
July 23, 2002	1	KQ	14	Q	18	Q	130	Q
October 21, 2002	100	Q	10	Q	10	Q	400	Q
January 27, 2003	1	KQ	1	KQ	1	KQ	20	Q
May 20, 2003	250	Q	28	BQ	40	Q	520	Q
August 19, 2003	1	KQ	1	KQ	2	BQ	30	BQ
February 3, 2004	1	KQ	1	KQ	1	KQ	10	BQ
April 21, 2004	74	Q	20	BQ	17	BQ	104	Q
July 26, 2004	No Result		No Result		No Result		No Result	
August 4, 2004	2	KQ	2	KQ	2	KQ	2	KQ
November 9, 2004	74	BQ	4	BQ	8	BQ	16	BQ
January 24, 2005	10	BQ	10	BQ	2	KQ	12	BQ
April 26, 2005	35	ABQ	116	ABQ	11	ABQ	89	AQ
July 27, 2005	9	ABQ	2	ABQ	2	ABQ	43	AQ
January 24, 2006	2	BQ	2	KQ	2	KQ	4	BQ
May 25, 2006	103	Q	16	BQ	10	BQ	174	BQ
August 16, 2006	20	BQ	2	KQ	2	KQ	18	BQ
November 2, 2006	132	BQ	102	Q	26	BQ	230	BQ
February 12, 2007	2	UQ	2	BQ	2	UQ	2	UQ
May 9, 2007	48	Q	42	Q	78	Q	114	Q
Average	**55**		**18**		**13**		**114**	
Standard Deviation	**68**		**30**		**18**		**136**	
Median	**35**		**8**		**8**		**70**	

Table 2: Bacteriological data including qualifier codes and summary statistics. "A"= Value reported is the arithmetic mean (average) of two or more determinations; "B" = Results based on colony counts outside the acceptable range; "K"= Off-scale low; "Q" = Outside of holding time; "U"= Below detection limit.

Field parameters were tested *in situ* for dissolved oxygen (DO), temperature, specific conductivity, and pH. These data (with qualifier codes) and data for turbidity and color are shown in Table 3. Average, standard deviation and median values were determined for each of these parameters. Over the sampling period from October 2000-May 2007, dissolved oxygen was consistently lower than the Class III water quality standard of 5 mg/L, averaging 3.1 mg/L, and ranging from 1.6 to 4.4 mg/L. This low DO regime (a natural condition for headwater spring systems) can eliminate sensitive taxa from the system. Temperature was stable, averaging 23.5 degrees Celsius. Specific conductivity averaged 333 umhos/cm and ranged from 276 to 367 umhos/cm. The elevated conductivity appears to be a natural characteristic, associated with inorganic dissolved solids in the groundwater. However, this naturally high conductivity can exert a negative influence on many sensitive freshwater organisms. The mean pH was 7.3 SU, ranging from 6.7 to 7.9 SU. Turbidity was low, averaging 0.2 NTU. Color values were generally below the detection limit, except for two samples taken in May of 2003 (15 PCU) and November of 2004 (10 PCU). These samples suggest tannic inputs from the surrounding floodplain.

Field Testing and Physical Parameters

Date	Dissolved Oxygen (mg/L)	pH (SU)	Specific Conductance (umhos/cm)	Temperature (C°)	Color (PCU)	Qualifier	Turbidity (NTU)	Qualifier
October 16, 2000	3.8	7.45	328	23.6	5	Q	0.1	Q
March 21, 2001	4.1	7.5	348	22.4	No Result		No Result	
October 16, 2001	3.7	6.9	276	23.6	No Result		No Result	
December 6, 2001	2.2	7.28	307	23.2	5	U	0.25	
January 28, 2002	No Result	No Result	No Result	No Result	5	U	0.2	
April 17, 2002	3.9	7.5	330	23.7	5		0.25	
July 23, 2002	No Result	No Result	No Result	No Result	5	U	0.2	
October 21, 2002	2	6.87	338	23.6	5	Q	0.25	Q
January 27, 2003	No Result	No Result	No Result	No Result	5	U	0.1	
May 20, 2003	1.6	7.2	345	23.6	15		0.2	
August 19, 2003	0.4	7.25	331	23.7	5	U	0.2	
October 15, 2003	1.93	7.01	322	23.9	No Result		No Result	
February 3, 2004	No Result	No Result	No Result	No Result	5	U	0.1	
April 21, 2004	4.4	7.92	340	23.2	5	Q	0.5	Q
July 26, 2004	No Result	No Result	No Result	No Result	5		0.15	
November 9, 2004	3.48	7.55	349	22.92	10		0.2	
January 24, 2005	No Result	No Result	No Result	No Result	5	U	0.1	
April 26, 2005	3.6	7.6	328	24.2	5	Q	0.15	Q
July 27, 2005	No Result	No Result	No Result	No Result	5	U	0.15	
January 24, 2006	No Result	No Result	No Result	No Result	5		0.2	
May 25, 2006	3.95	6.66	367	23.6	5	U	0.7	
August 16, 2006	No Result	No Result	No Result	No Result	5		0.2	
November 2, 2006	No Result	7.6	338	23.6	5		0.25	
February 12, 2007	No Result	No Result	No Result	No Result	5	U	0.2	
May 9, 2007	3.9	7.5	342	23.7	5	U	0.25	
Average	**3.07**	**7.32**	**332.60**	**23.50**	**5.68**		**0.22**	
Standard Deviation	**1.20**	**0.34**	**20.82**	**0.43**	**2.34**		**0.14**	
Median	**3.65**	**7.45**	**338.00**	**23.60**	**5.00**		**0.20**	

Table 3: Field parameters, color, and turbidity data including qualifier codes. "A"= Value reported is the arithmetic mean (average) of two or more determinations; "Q" = Outside of holding time; "U"= Below detection limit.

Habitat Assessment and Stream Condition Index (SCI) sampling was performed from October 16, 2000 to May 9, 2007. SCI scores before and after the June 8, 2004 recalibration of the SCI are presented in Table 4. Recalibrated SCI scores are plotted over time in Figure 3. The SCI scores for the Wekiwa River have indicated that healthy conditions prevailed in 11 of 12 samplings. It is possible that the November 9, 2004 SCI failed as a result of high water levels caused by hurricane activities during the summer of 2004. Total number of taxa and number of sensitive taxa, two of the ten metrics that go into the calculation of the SCI, are presented in Figures 4 and 5 for the sampling period. The pattern of these two metrics over the sampling period are presented to show that while the SCI numerical scores have changed due to the recalibration, the macroinvertebrate community has not. Total taxa over all the dates (Figure 4) ranged from 20 to 34. The number of sensitive taxa was low over the sampling period, averaging about 2 sensitive taxa present per event (Figure 5). Sensitive taxa tend to be excluded from higher conductivity, low DO sites, and the average conductivity of 333 umhos/cm combined with the average DO of 3.1 mg/L at Wekiwa Springs (both natural conditions) may have been responsible for this phenomenon. Habitat Assessment scores over time remained mostly in the optimal category, suggesting adequate habitat conditions for macroinvertebrate communities (Figure 6).

Old SCI Scores	
October 16, 2000	23
March 21, 2001	33
October 16, 2001	25
April 17, 2002	25
October 22, 2002	25
May 20, 2003	25
October 15, 2003	25
April 21, 2004	29

Recalibrated SCI Scores	
November 9, 2004	20
April 26, 2005	35
May 25, 2006	43
May 9, 2007	47

Table 4: Old and recalibrated Stream Condition Index (SCI) scores and sampling dates. Stream condition Index (SCI) scores calculated previous to the SCI recalibration, implemented June 8, 2004 were based on a 33 point scale, with scores of 21 and above indicating healthy conditions.

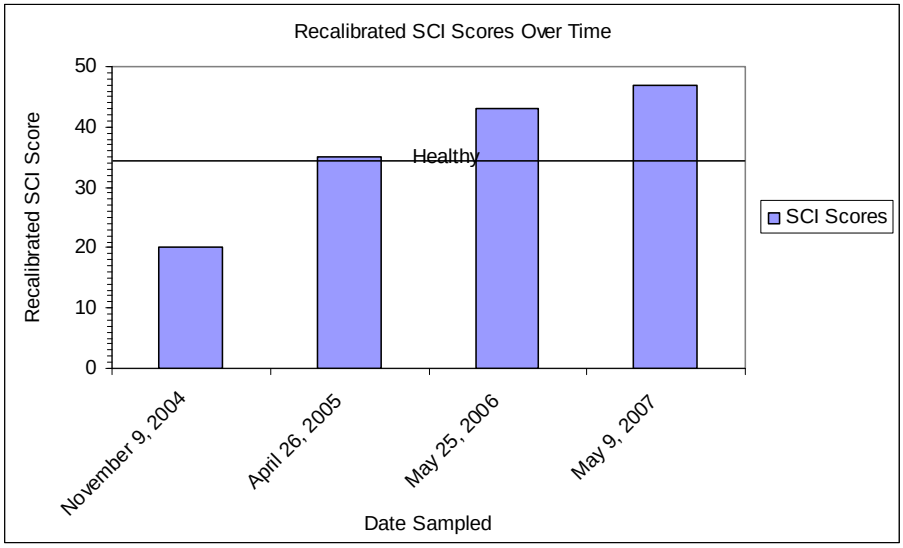


Figure 3: Recalibrated SCI scores with the impairment line drawn at 34.

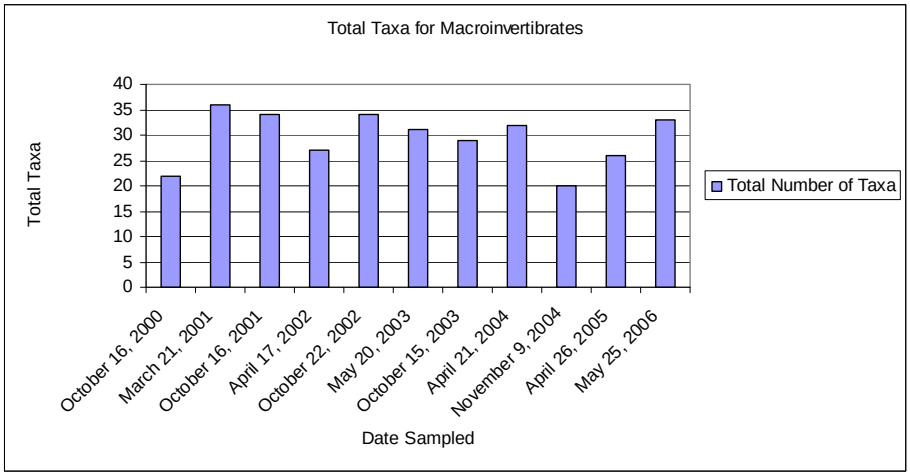


Figure 4: Total macroinvertebrate taxa plotted over time.

Date	Sensitive Taxa
10/16/2000	3
3/21/2001	3
10/16/2001	3
4/17/2002	1
10/22/2002	1
5/20/2003	2
10/15/2003	0
4/21/2004	3
11/9/2004	0
4/26/2005	2
5/25/2006	1

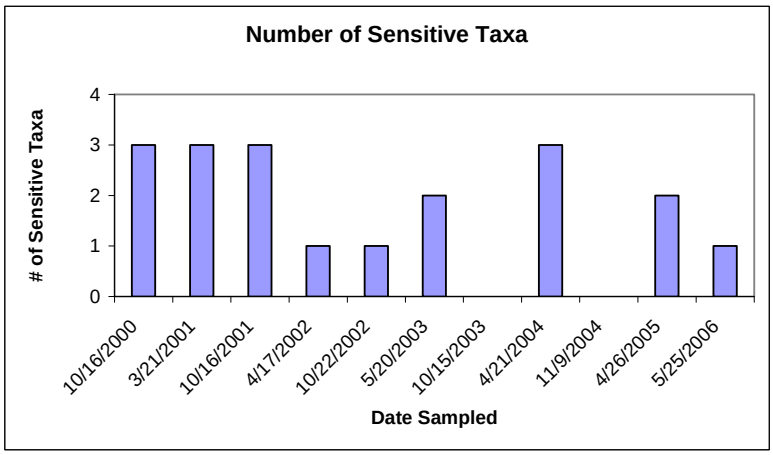


Figure 5: Table and chart showing the number of sensitive taxa over the sampling period.

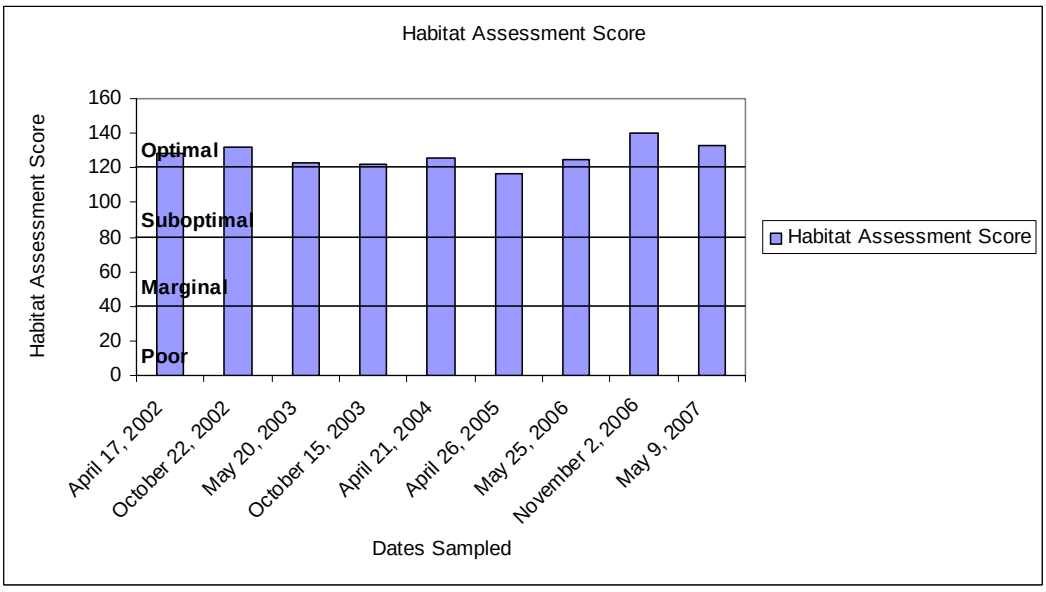


Figure 6: Habitat assessment scores over time.

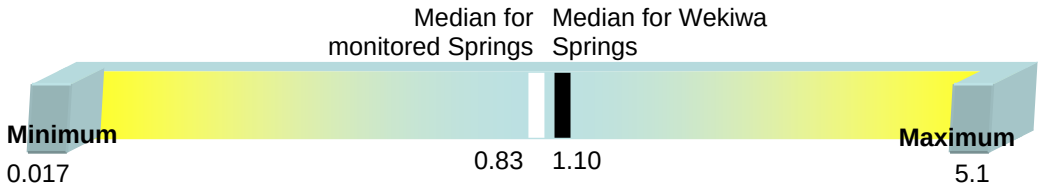
Over the roughly six-year sampling period from October 16, 2000 to May 9, 2007, data indicate that:

- Water quality, as measured by transparency, nutrients (except nitrate-nitrate), and bacteria, was generally good.
- Low dissolved oxygen and elevated conductivity (both natural conditions) appeared to be related to the lack of sensitive taxa in the invertebrate community.
- Nitrate-nitrite concentrations have ranged from 0.7 to 1.6 mg/L over the sampling period, values which exceed those found in approximately 90 to 95% of typical Florida streams.
- The vast majority of Stream Condition Index biological samples indicate that healthy conditions prevail in the system (one failed SCI may have been due to hurricane effects).
- Habitat scores are generally within the optimal range.

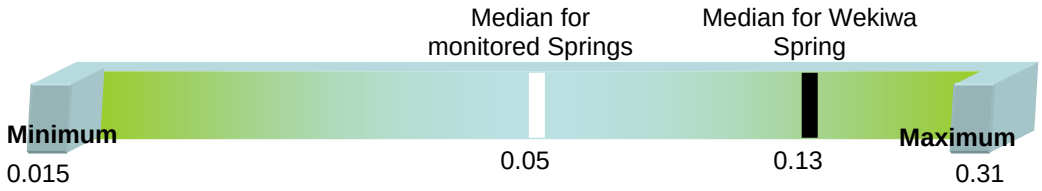
Results for six of the most significant water quality indicators are graphically represented in appendix A. These parameters summarize how Wekiwa Springs compares with the median score for the 18 springs in the monitoring program.

Appendix A: Monitoring Summary for Wekiwa Springs

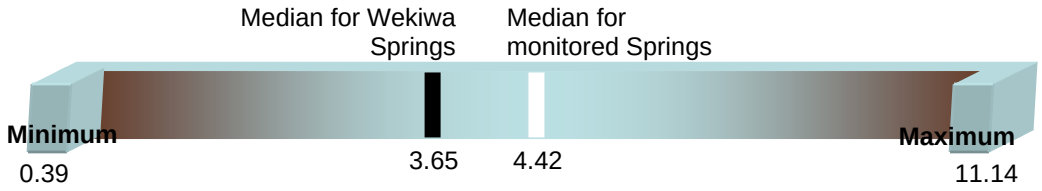
Nitrate-Nitrite (mg/L)



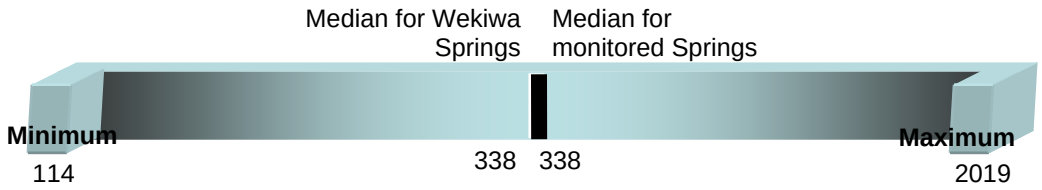
Total Phosphorus (mg/L)



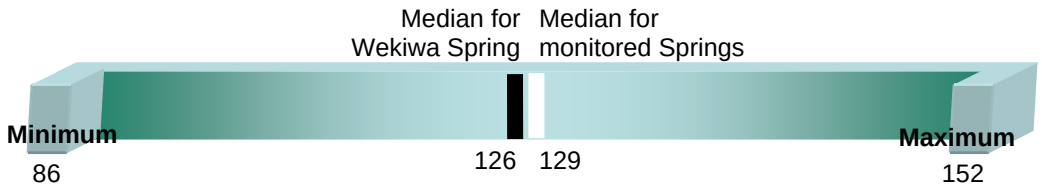
Dissolved Oxygen (mg/L)



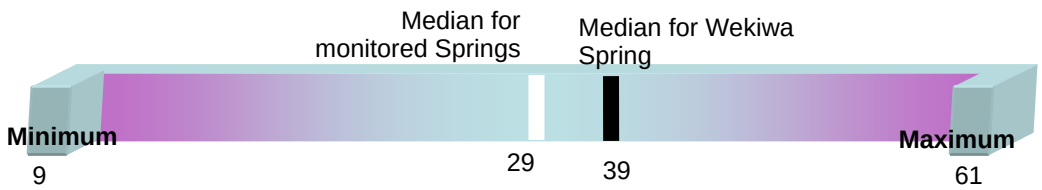
Specific Conductance (umhos/cm)



Habitat Assessment Score



Stream Condition Index



References

Florida Department of Environmental Protection, Environmental Assessment Section. 2007. Sampling and Use of the Stream Condition Index for Assessing Flowing Waters: A Primer.

Fore, L. 2004. Development and Testing of Biomonitoring Tools for Macroinvertebrates in Florida Streams. The statistical basis for SCI and Biorecon calculation SOPs (.pdf, 475 kb) http://www.floridadep.org/labs/library/index.htm#SOP

Fore, L., R. Frydenborg, D. Miller, T. Frick, D. Whiting, J. Espy and L. Wolfe. 2007. Development and Testing of Biomonitoring Tools for Macroinvertebrates in Florida Streams. The statistical basis for SCI and Biorecon calculation SOPs (.pdf, 1.01 MB) http://www.floridadep.org/labs/library/index.htm#SOPs

Levings, S. and X. Niu. 2004. Statistical Analysis of Surface Water Quality Specific Conductance Data. FDEP Biology Section.

Springs Ecosummaries. http://www.floridadep.org/labs/library/springs.htm

Florida Department of Environmental Protection, Bureau of Laboratories, Environmental Assessment Section. 2004. Department of Environmental Protection Standard Operating Procedures for Field Activities. DEP-SOP-001/01. http://www.floridadep.org/labs/sop/index.htm.