

Biological and Water Quality Assessment of the

Wacissa River

Sampled October 2007

Bureau of Assessment and Restoration Support

June 2008

Executive Summary

Water quality and biological health of the Wacissa River and associated springs was assessed by the Florida Department of Environmental Protection (FDEP) on October 30, 2007. The purpose of the study was to document existing environmental conditions of the Wacissa River and to provide information relevant to future management decisions. Objectives of the study were to:

1) Establish baseline measurements of water quality, sediments, biological community health, and physical parameters,
2) Determine if human activities in the recharge basin are influencing water quality in the springs along the Wacissa River,
3) Determine if algal growth in the Wacissa River is causing impairment to the biological communities, and
4) Conduct biological sampling to support future Minimum Flows and Levels studies.



Figure 1: Wacissa River at boat ramp

In general, water quality and biological health of the Wacissa River were very good, meeting the designated use of this Class III waterbody (propagation of a healthy, well balanced population of fish and wildlife). Water from all sites complied with Class III water quality standards for pesticides, polycyclic aromatic hydrocarbons (PAH), and metals. While dissolved oxygen was somewhat low at certain spring vents (a natural condition), dissolved oxygen in the river met Class III standards.

Moderate nitrate-nitrite enrichment was found in some Wacissa River springs, likely related to nitrogen inputs from the recharge area. Nitrate-nitrite levels were highest (approximately 0.4 mg/L) in the four northernmost springs (Horsehead, Log, Thomas, and Wacissa Head Spring), exceeding the 80th percentile for typical Florida streams. Other nutrient concentrations were not problematic (*e.g.*, total phosphorus was below the practical quantitation limit (PQL)).

With only two exceptions, sediment contaminants (pesticides, organic contaminants, and metals) were not found. Dimethyl pthalate was detected at an environmentally benign concentration (below the practical quantitation limit) at the Wacissa Head Spring. This may be an artifact of the sampling or analysis process, since phthalates are commonly found in plastics. Sediment cadmium from Horsehead Spring was above the sediment quality guidelines Threshold Effects Level, but below the Probable Effects Level, meaning adverse effects on biota is not expected. It is possible that sediment near spring boils may be naturally enriched with some metals (leaching from limerock) which precipitate out of solution as the dissolved oxygen regime changes.

The Stream Condition Index scores for the Wacissa River were in the "healthy" category (40 and 65 at Biological Sites 1 and 2, respectively) indicating that macroinvertebrate communities were intact (SCI could not be sampled at Biological Site 3). Habitat Assessment scores for the three biological sites were all in the "optimal" range. Predominance of the exotic plant, *Hydrilla,* was an issue at the Wacissa headwaters, extending to Biological Site 1. Algal thickness was greatest at Biological Site 1, where filamentous algae (> 20 mm) dominated the periphyton community. Note that this level of algal coverage was not associated with significant declines in macroinvertebrate health (SCI score was 40, 6 points above the impairment threshold). Algae were considerably less abundant at Biological Site 2, where a roughly equal apportionment of filamentous algae and diatoms was found. Algae were least abundant at Biological Site 3, and diatoms predominated.

Introduction

The Wacissa River originates from a cluster of Floridan aquifer springs located just south of the town of Wacissa in Jefferson County. The Wacissa River flows south for approximately 12 miles before joining the Aucilla River between Nutall Rise and the U.S. Highway 98 Bridge. The upper Wacissa River consists of numerous springs and two surface water inputs, Caney Creek and Little River. The lower reaches of the river receive input from Welaunee Creek and Cow Creek. The river generally consists of a fairly wide channel (5 to 40 m) without prominent banks that flows through swamps and hardwood hammocks. Common vegetation along the river channel includes Sweet Bay (*Magnolia virginiana*), Cypress (*Taxodium distichum*), Red Maple (*Acer rubrum*), Tupelo (*Nyssa aquatica*), Wild Rice (*Zizania aquatica*) and a variety of oaks (*Quercus* sp.). Predominantly within the first river mile, a thick carpet of the exotic plant hydrilla (*Hydrilla verticillata)* has replaced much of the native eel grass (*Vallisneria americana*) and springtape (*Sagittaria kurziana*).

Most of the land along the river corridor consists of undisturbed forest. Silviculture is practiced occasionally. The river has been designated a State Recreational Canoe Trail and an Outstanding Florida Water by the Florida Department of Environmental Protection.

Study Sites

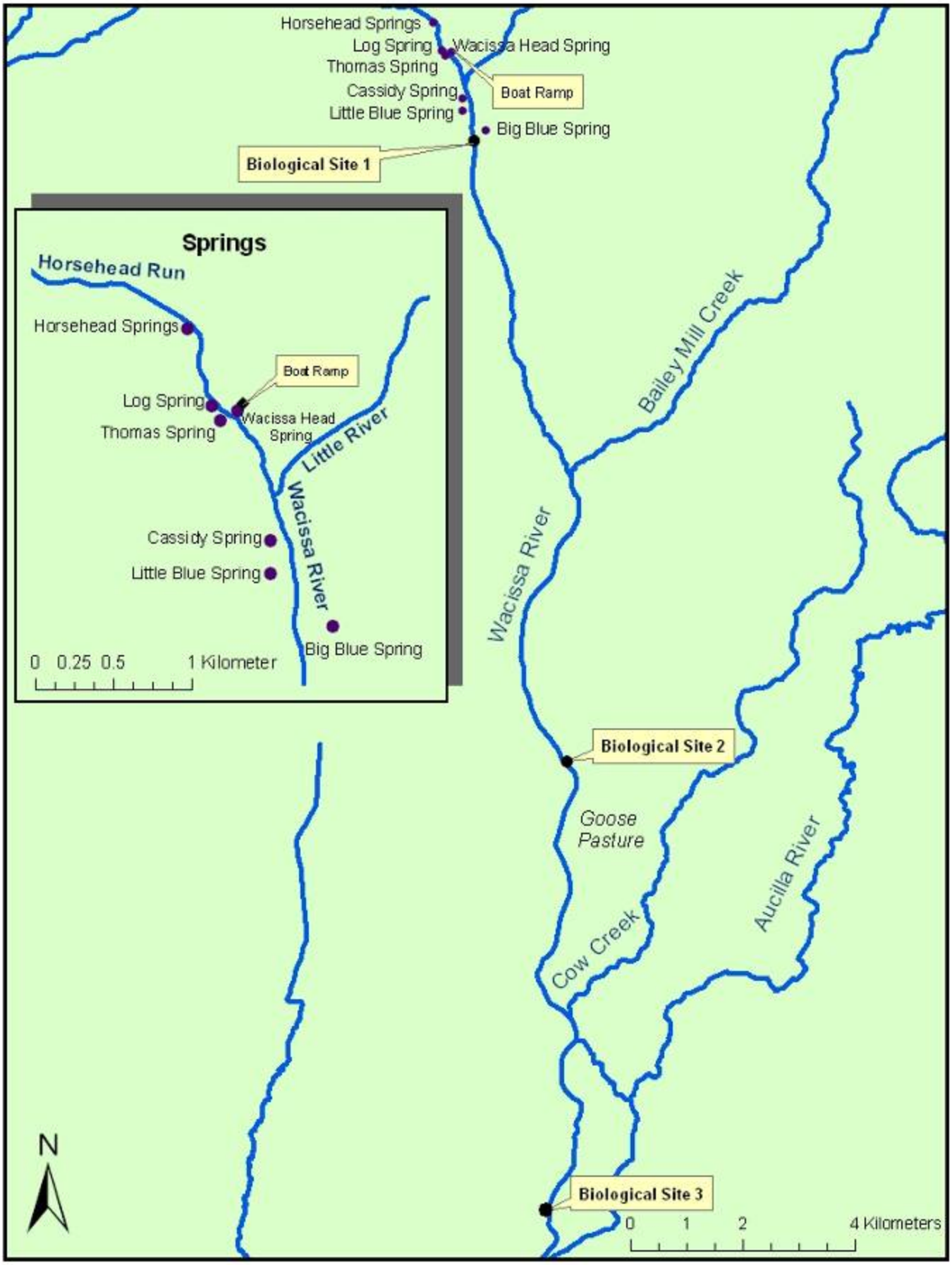
Sampling sites are shown below in Figure 2, followed by descriptions of the site locations.

Seven springs that feed the Wacissa River were chosen for water sample collection. Sediment samples were also taken from the Wacissa Head Spring and Horsehead Spring.

Three sites in the Wacissa River were chosen for biological community sampling. Algal and vegetative communities were evaluated at each biological site. Macroinvertebrate communities were sampled at Biological Sites 1 and 2. Conditions were not appropriate for macroinvertebrate sampling at Biological Site 3, due to low water levels (no flow with the majority of the benthic habitat exposed to air). Water and sediment samples were also taken at each biological site.

Figure 2: Wacissa River Sampling Sites

(with inset close-up view of springs)



Spring Site Locations

1. **Horsehead Spring** is located about 0.6 km upstream of the boat ramp.
2. **Wacissa Head Spring** is about 75 m southwest of the diving board in the Wacissa River.
3. **Log Spring** is about 150 m up Horsehead Run.
4. **Thomas Spring** is in the river about 100 m west-southwest of the boat ramp.
5. **Cassidy Spring** is about 800 m downstream of the boat ramp and on the west side of the river.
6. **Little Blue Spring** is about 275 m south of Cassidy Spring and also on the west side of the Wacissa River.
7. **Big Blue Spring,** also known as Big Spring, is approximately 0.5 km southeast of Little Blue Spring, and is on the East bank of the river. The spring has two runs: the larger flows approximately 365 m northwest and west to the Wacissa River; the other run flows southwest about 300 m to the Wacissa River.

Biological Site Locations

1. **Biological Site 1** is located in the river, directly below Big Blue Spring.
2. **Biological Site 2** is located in the river, above Goose Pasture.
3. **Biological Site 3** is located in the Slave Canal, above the confluence with the Aucilla River.

Methods

All field and laboratory biological methods followed FDEP Standard Operating Procedures (SOPs, see http://www.floridadep.org/labs/qa/sops.htm for details) and met FDEP quality assurance/quality control standards (see http://www.floridadep.org/labs/qa/index.htm).

Water and Sediment Quality

Water quality samples were collected for nutrients, turbidity, color, alkalinity, metals, pesticides, and polycyclic aromatic hydrocarbons (PAHs). Sediment samples were collected for pesticides, PAHs, and metals. (For the full suite of pesticides and PAHs, see Appendix C.) Water was sampled according to the FDEP field SOP FS 2100, Surface Water Sampling, for all parameters. The direct grab technique was used to collect water directly into bottles. Sediment samples were collected following the DEP SOP FS 4000, Sediment Sampling. Corers and dredges were used to collect sediment samples where applicable. The nutrient suite included analysis of total Kjeldahl nitrogen, ammonia, nitrate-nitrite, ortho-phosphate, and total phosphorus. Metals analysis for both water and sediment included arsenic, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, potassium, sodium, strontium, and zinc. Aluminum was also analyzed in the sediment samples, but not in the water samples.

Macroinvertebrate Communities

Macroinvertebrate sampling was performed at Biological Sites 1 and 2 using the Stream Condition Index (SCI) methodology (FS 7420). The SCI procedure involves sampling productive habitats using 20 sweeps of a US 30 mesh D-framed dip net. The sweeps are apportioned across productive habitats identified during the Habitat Assessment (see below) leaving some sweeps to be taken in "minor" habitats (*e.g.*, sand, silt).

In conjunction with the SCI sampling, a Habitat Assessment (FT 3100) was performed using the Bureau of Laboratories forms FD9000-04 and FD9000-05. The Habitat Assessment includes mapping and quantifying coverage of roots, vegetation, woody debris, leaf material and rock habitats. The Habitat Assessment also takes into consideration stream hydrology, bank stability, and riparian buffer.

Algal Communities

Periphyton community sampling was conducted at each of the three biological sites. The Qualitative Periphyton Sampling method (FS 7220) consists of collecting algae found on natural substrates in the river. Algae was collected from 10 separate "major" habitats, as identified during the Habitat Assessment, and then combined together into one composite sample, which was subsequently enumerated and identified to the species level (where practical).

Additionally, the Rapid Periphyton Survey (RPS) (FS 7230) was conducted at the biological sampling sites. The RPS is a modified version of the Rapid Habitat and Periphyton Assessment method developed by Stevenson *et al*. (2004) for EPA. At each site, 11 transects were run across the Wacissa River 10 m apart, arranged from upstream to downstream. Each of the eleven transects were separated into nine observation points where algal presence, thickness, and type (filamentous or diatoms) were assessed, for a total of 99 sampling points per site.

Vegetative Communities

A Linear Stream Vegetation Survey of aquatic macrophytes was conducted at each of the biological sites. In this method, the 100 meter stretch is divided into ten sections from downstream to upstream. All plants in the water and up to an approximation of the mean high water mark are identified to genus or species level (when possible) for each section. If a particular species has extensive coverage, it is assigned dominance or co-dominance.

Results and Discussion

Data are presented separately for the spring vent sites and the biological sites (within the river proper).

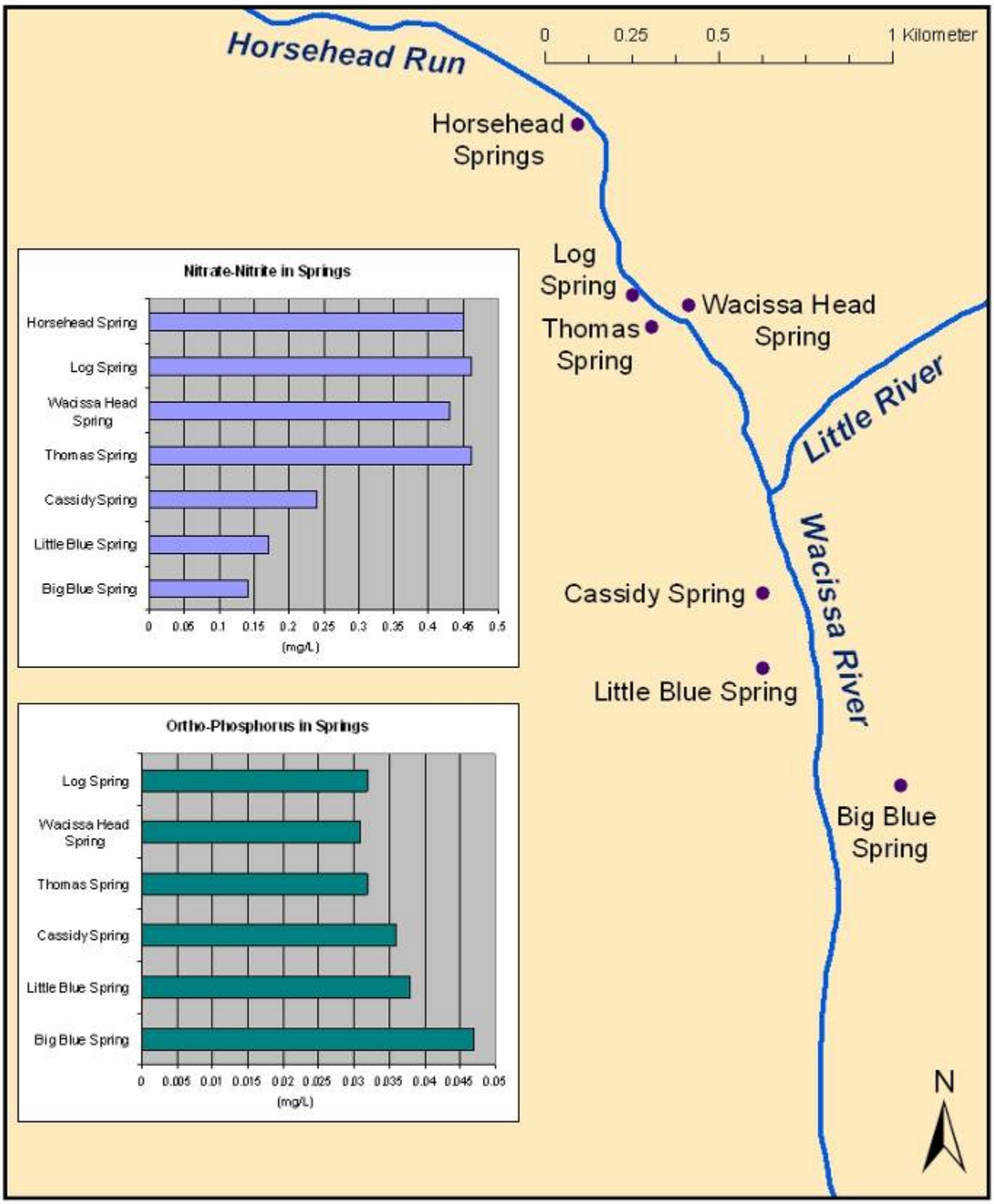
Water Quality of Spring Sites

Nutrients

Total phosphorus concentrations for each of the springs were below the Practical Quantitation Limit (PQL). Ortho-phosphate levels, which ranged from 0.031 to 0.044 mg/L, were all lower than the 40th percentile for typical Florida streams (Figure 3) (see Appendix B for percentile distributions). Ortho-phosphate was not measured at Horsehead Spring.

Ammonia levels for each of the springs were either below the PQL or undetected. Nitrate-nitrite levels were highest in the four northernmost springs (Figure 3). These values ranged from 0.43 to 0.46 mg/L, and were higher than values found in 80% of typical Florida streams (0.32 mg/L or less). The nitrate-nitrite levels in the lower three springs (0.24 mg/L in Cassidy Spring, 0.17 mg/L in Little Blue Spring, and 0.14 mg/L in Big Blue Spring), were somewhat higher than average for Florida Streams (see Appendix B). Total Kjeldahl nitrogen levels were at or below the Method Detection Limit (MDL) for each of the springs.

Figure 3: Nitrate-Nitrite and Ortho-phosphorus Concentrations in Springs



Physical/Chemical Parameters

Conductivity (ranging from 266 to 325 µmhos/cm) and pH (ranging from 7.4 to 8.0 SU) measurements met Class III Water Quality standards for each of the springs (Table 1). Turbidity was low (>1 NTU) at all the sites. Except for at Log and Thomas Springs, dissolved oxygen (DO) measurements were below 5 mg/L. Low DO is typical in most springs due to the long subterranean residence time (generally >20 years) of spring water (no contact with atmospheric sources of oxygen).

Metals

Metals in the water samples from all of the springs complied with Class III water quality standards (F.A.C. 62-302.530). Zinc, cadmium, lead, copper, iron, and arsenic were undetected in the all of the water samples (Table 1).

Pesticides and Polycyclic Aromatic Hydrocarbons

Diethyl phthalate, a synthetic chemical commonly used to make plastics more flexible, was detected in the water sample from Log Spring at an environmentally benign concentration (below the PQL). This potentially was due to a sampling artifact. No pesticides or PAHs were found in the water samples from any of the other springs.

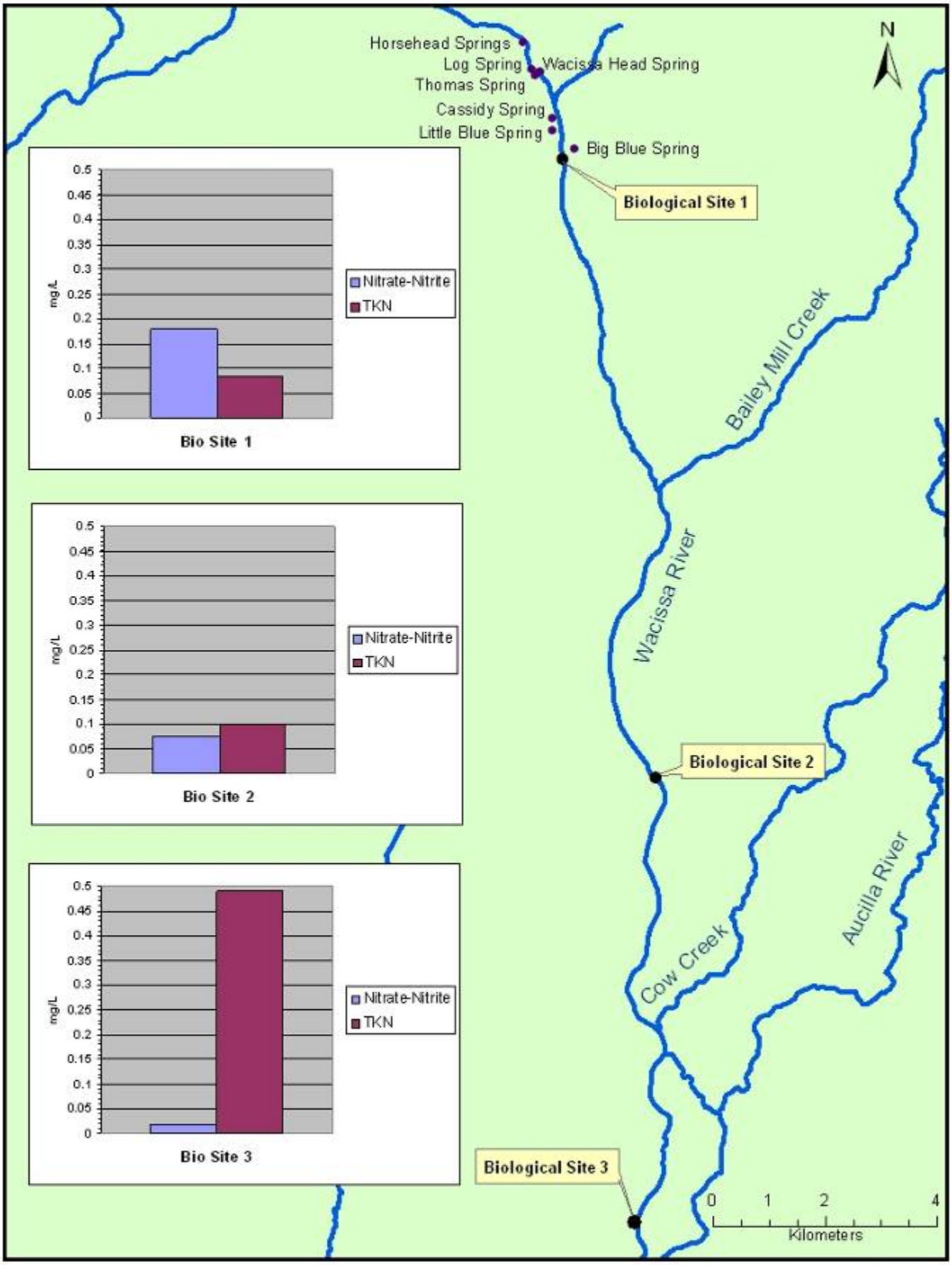
Water Quality of Biological Sites

Nutrients

Total phosphorus concentrations at all of the biological sites were below the PQL (Table 2). Ortho-phosphate levels, which ranged from 0.016 to 0.033 mg/L, were all lower than the 30th percentile for typical Florida Streams (see Appendix B).

Ammonia levels at all of the biological sites were below the MDL (Table 2). Nitrate-nitrite at the downstream-most Biological Site 3 (0.018 mg/L) was lower than that at Biological Site 1 (0.18 mg/L) probably due to longitudinal assimilation by aquatic plants. Concurrently, the total Kjeldahl nitrogen concentration at Biological Site 3 (0.49 mg/L) was higher than that found at Biological Site 1 (0.084 mg/L), most likely due to decomposing leaf litter inputs from the extensive Wacissa floodplain.

Figure 4: Nitrate-Nitrite and Total Kjeldahl Nitrogen Concentrations in Biological Sites



Physical/Chemical Parameters

Conductivity (ranging from 288 to 300 umhos/cm), dissolved oxygen (ranging from 7.1 to 8.8 mg/L), and pH (ranging from 7.7 to 8.4 SU) measurements met Class III Water Quality standards (Table 2). Turbidity was very low (1.5 NTU) at all of the biological sites.

Metals

Metals (Table 2) in the water samples from each of the biological sites complied with Class III water quality standards (F.A.C. 62-302.530). Zinc, cadmium, lead, copper, and arsenic were undetected in the water samples.

Pesticides and Polycyclic Aromatic Hydrocarbons

No pesticides or PAHs were found in the water samples from any of the biological sites.

Sediment Quality of Selected Spring Sites and Biological Sites

Metals

Horsehead Spring generally had higher levels of sediment metals compared with the other sites where sediment samples were taken (Wacissa Head Spring and the three biological sites). The cadmium concentration at Horsehead Spring (0.81 mg/Kg) was above the sediment quality guidelines Threshold Effects Level, but below the Probable Effects Level, meaning adverse effects on biota are not expected (MacDonald *et al* 1984). It is possible that sediment near some spring boils may be naturally enriched with some metals (leaching from limerock) which precipitate out as the dissolved oxygen regime changes. All other sediment metals were below their respective sediment quality guidelines Threshold Effects Levels (MacDonald *et al* 1984) (see Appendix A, Table 3).

Pesticides and Polycyclic Aromatic Hydrocarbons

Dimethyl phthalate, used in solid rocket propellants, plastics, and insect repellants (US EPA 1987), was detected in the sediment sample from Wacissa Head Spring at a concentration of 430 µg/Kg, which is 90 µg/Kg above the PQL. It is possible that this phthalate detection was an artifact of sampling or laboratory analysis (inadvertent contamination from contact with plastic). No other pesticides or PAHs were found in any of the sediment samples.

Biological Community Health

Macroinvertebrates

The Stream Condition Index scores at Biological Sites 1 and 2 were 40 and 65, respectively. Both were classified as Category 2, "healthy". Biological Site 3 was not sampled, as conditions were determined inappropriate for SCI sampling upon arrival at the site (low water level, majority of habitat was exposed).

Differences in the two SCI scores reflect differences in the individual metrics used to calculate the final score: Biological Site 2 had higher counts of Ephemeroptera, Trichoptera, and clinger taxa, and a greater percentage of suspension feeders and filterers, whereas Biological Site 1 had a higher percentage of dominant taxa, Tanytarsini individuals, and very tolerant individuals. (See Appendix A, Table 4 for a breakdown of the SCI scores.)

The dominant taxa for Biological Sites 1 and 2 were *Hyalella azteca* and *Hydropsyche*, respectively. (See Appendix A, Table 5 for a list of all macroinvertebrate taxa indentified.)

Habitat Assessment scores were in the "optimal" range (≥120) for each of the sites: 138 for Biological Site 1; 143 for Biological Site 2; and123 for Biological Site 3.

Vegetative Communities

The invasive exotic macrophyte, *Hydrilla verticillata* was dominant at Biological Site 1, where 28 plant taxa were found. The dominant species at Biological Site 2 was *Zizania aquatica* (wild rice), with a total of 25 taxa. No submersed or emergent plants were found in the vegetation survey at Biological Site 3 (very shaded, only floodplain forest species were present). (See Appendix A, Table 6 for a list of all vegetative taxa identified.)

Algal Communities

Qualitative Periphyton Sampling

Diatoms dominated the algal communities in the qualitative periphyton samples from each of the three biological sites (Biological Site 1: 85.4% of individuals; Biological Site 2: 86.8%; Biological Site 3: 91.1%). (See Appendix A, Table 7)

Rapid Periphyton Survey

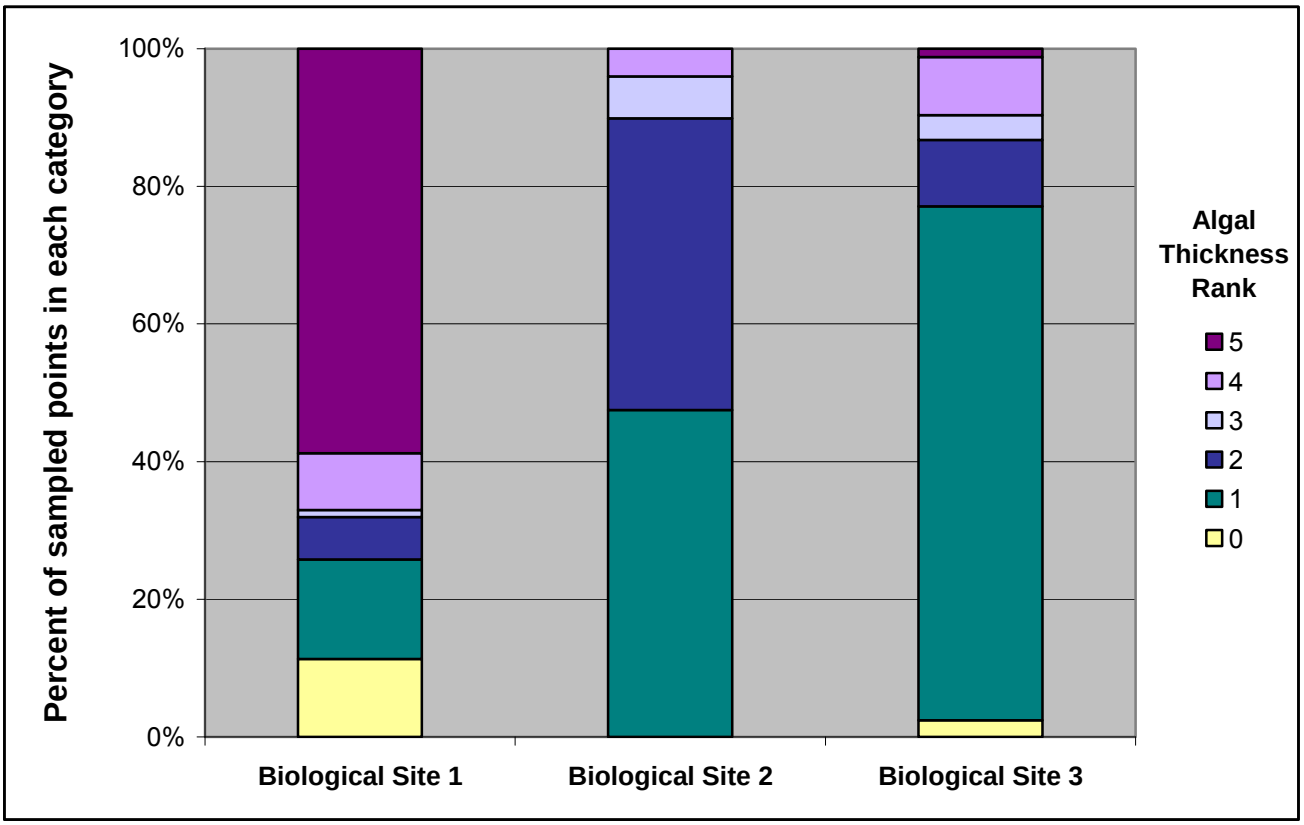
Algal thickness was greatest at Biological Site 1, where approximately 59% of the points sampled had filamentous algae at least 20 mm long. About 30% of points had algae that were less

than 20 mm long, and about 11% had no detectable algae at all. At this site, the stream is wide and the canopy is very open.

Algae were less abundant at Biological Site 2; approximately 42% of the points sampled had visible algae less than 1 mm long, and almost 48% were covered only in a thin film of diatoms, with no visible algae. About 10% of points had algae between 1 and 20 mm long. Here, the stream is lightly shaded, mostly open to sun.

Algae were least abundant at Biological Site 3; approximately 75% of the points sampled had only a thin film of diatoms, with no visible algae present. Filamentous algae greater than 0.5 mm were found on approximately 23% of the sampled points, and about 2% had no algae. The stream is heavily shaded at this site (See Appendix A, Table 8, and graph below).

Rapid Periphyton Survey Results for Biological Sites



Algal Thickness Ranks

0	1	2	3	4	5
0 mm, rough	<0.5 mm or slimy	0.5-1 mm	>1 to <6 mm	6-20 mm	>20 mm

Conclusions

In general, water quality and biological health of the Wacissa River was very good, meeting the designated use of this Class III waterbody (propagation of a healthy, well balanced population of fish and wildlife). Water from all sites complied with Class III water quality standards for pesticides, polycyclic aromatic hydrocarbons (PAH), and metals. While dissolved oxygen was somewhat low at certain spring vents (a natural condition), dissolved oxygen in the river met Class III standards.

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Citations

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Appendix A

Table 1: Springs Water Quality Data

	Class III Criteria	Horsehead Spring	Wacissa Head Spring	Big Blue Spring	Cassidy Spring	Little Blue Spring	Log Spring	Thomas Spring
General Physical/Chemical Parameters								
Dissolved Oxygen (mg/L)	≥ 5.0	3.87	4.70	1.60	2.24	4.07	5.03	7.25
pH (SU)	6.0 - 8.5	7.7	8.00	7.48	7.53	7.53	7.67	7.87
Conductivity (µmhos/cm)	≤ 1,275	266	283	325	304	311	272	274
Temperature °C		20.51	20.7	20.32	20.47	20.57	20.63	20.57
Turbidity (NTU)		0.90	0.40	0.55	0.25	0.20	0.20	0.25
Alkalinity (mg CaCO3/ L)		136	138	168	155	158	139	139
Nutrients (Water)								
Ammonia-N (mg/L)		0.05 U	0.01 U	0.01 UJ	0.01 U	0.014 I	0.01 U	0.019 I
Nitrate-Nitrite (mg/L)		0.45	0.43	0.14	0.24	0.17	0.46	0.46
Ortho-Phosphorus (mg/L)		-	0.031	0.047	0.036	0.038	0.032	0.032
Total Kjeldahl Nitrogen (mg/L)		0.08 U	0.08 U	0.08 U	0.08 UJ	0.08 U	0.08 U	0.08 U
Total Phosphorus (mg/L)		0.038 I	0.033 I	0.051 I	0.042 I	0.038 I	0.037 I	0.029 I
Metals (Water)								
Potassium (mg/L)		0.33 I	0.42 I	0.44 I	0.45 I	0.44 I	0.43 I	0.4 I
Iron (µg/L)	≤ 1,000	30 U	30 U	30	30 U	30 U	30 U	30 U
Sodium (mg/L)		2.9	3.3	3.5	3.7 A	3.5	3.2	3.2
Zinc (µg/L)		5 U	5 U	5 U	5 U	5 U	5 U	5 U
Calcium (mg/L)		39.9	46.8	58.7	54 A	53.5	45.2	45.7
Magnesium (mg/L)		7.7	9	8.9	8.9 A	8.7	8.6	8.7
Strontium (µg/L)		80 U	80 U	82 I	80 U	84 I	80 U	93 I
Cadmium (µg/L)	≤ 0.4 b	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Lead (µg/L)		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Copper (µg/L)		0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
Arsenic (µg/L)	≤ 50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chromium (µg/L)		1.4 I	1.3 I	1 U	1 U	1 U	1.3 I	1.3 I
Mercury (ng/L)	≤ 12	0.36 I	0.46 A	0.57	0.37 I	0.56 A	0.39 I	0.68

"U"= Below Method Detection Limit; "I"= Below Practical Quantitation Limit; "A"= Value reported is the mean of two or more determinations; "J"= Estimated value; "b"= Value is calculated based on hardness

Table 2: Biological Sites Water Quality Data

	Class III Criteria	Bio Site 1	Bio Site 2	Bio Site 3
General Physical/Chemical Parameters				
Dissolved Oxygen (mg/L)	≥ 5.0	7.1	8.8	8.7
pH (SU)	6.0 - 8.5	7.7	8.1	8.4
Conductivity (µmhos/cm)	≤ 1,275	300	300	288
Temperature °C		19.5	17.7	17.5
Turbidity (NTU)		1.1	0.6	1.4
Hardness (mg $CaCO_3$) (calculated)		167.58	167.07	167.41
Alkalinity (mg CaCO3/ L)		152	151	153
Nutrients (Water)				
Ammonia-N (mg/L)		0.01 U	0.01 U	0.01 U
Nitrate-Nitrite (mg/L)		0.18	0.074	0.018
Ortho-Phosphorus (mg/L)		0.033	0.020	0.016
Total Kjeldahl Nitrogen (mg/L)		0.084 I	0.1 I	0.49
Total Phosphorus (mg/L)		0.04 I	0.032 I	0.056 I
Metals (Water)				
Potassium (mg/L)		0.41 I	0.44 I	0.42 I
Iron (µg/L)	≤ 1,000	34 I	32 I	180
Sodium (mg/L)		3.4	3.5	3.6
Zinc (µg/L)		5 U	5 U	5 U
Calcium (mg/L)		52.6	51.9	52.2
Magnesium (mg/L)		8.8	9.1	9.0
Strontium (µg/L)		80 U	99 I	91 I
Cadmium (µg/L)	≤ 0.4 b	0.02 U	0.02 U	0.02 U
Lead (µg/L)		0.2 U	0.2 U	0.2 U
Copper (µg/L)		0.25 U	0.25 U	0.25 U
Arsenic (µg/L)	≤ 50	0.5 U	0.5 U	0.5 U
Chromium (µg/L)		1 U	1 U	1.4 I
Mercury (ng/L)	≤12	0.35 I	0.45	1.10

"U"= Below Method Detection Limit; "I"= Below Practical Quantitation Limit; "b"= Value is calculated based on hardness

Table 3: Sediment Data

Sediment Metals (mg/Kg)	TEL (mg/Kg)	PEL (mg/Kg)	Horsehead Spring	Wacissa Head Spring	Bio Site 1	Bio Site 2	Bio Site 3
Aluminum	–	–	6820	989	940	848	2710 AJ
Arsenic	7.24	41.6	1.75	0.24 I	0.61	0.42 I	0.35 I
Cadmium	0.676	4.21	0.81	0.075 I	0.33	0.11 I	0.09 I
Calcium	–	–	36300	19700	65000	21000	15300 A
Chromium	52.3	160	51.3	4.6	21.6	14.2	11.6 AJ
Copper	18.7	108	4.1 I	5.6	3.65	1 I	1.1 I
Iron	–	–	13500	764	1650	1620	1890 AJ
Lead	30.2	112	12.4	1.91	3.6	1.54	1.78 AJ
Magnesium	–	–	1780	444	799	450	1420 AJ
Mercury	0.13	0.696	0.082	0.0068 I	0.022	0.028 I	0.017
Potassium	–	–	270	52 I	34 I	61 I	40 I
Sodium	–	–	77 I	67 U	55 U	63 U	66 I
Strontium	–	–	51	22 I	49	15 I	30 A

"U"= Below Method Detection Limit; "I"= Below Practical Quantitation Limit; "A"= Value reported is the mean of two or more determinations; "J"= Estimated value

Table 4: Macroinvertebrate Summary

	Biological Site 1		Biological Site 2	
Summary Statistics				
Stream Condition Index 2007 (value)	40		65	
Stream Condition Index 2007 (category) *	Category 2 (Healthy)		Category 2 (Healthy)	
Stream Condition Index Metrics	Rep 1	Rep 2	Rep 1	Rep 2
Number of Total Taxa	34	29	34	33
Number of Ephemeroptera Taxa	2	1	6	5
Number of Trichoptera Taxa	3	2	5	7
Number of Clinger Taxa	3	2	8	7
Number of Long-lived Taxa	2	1	3	0
Number of Sensitive Taxa	4	3	6	6
Percent of Dominant Taxon	26.4	28.2	15.5	15.5
Percent Suspension Feeders and Filterers	8.2	9.5	23.7	29.2
Percent of Tanytarsini Individuals	8.6	10.6	2.0	2.8
Percent of Very Tolerant Individuals	5.7	5.6	3.4	1.4
Total Number of Individuals	140	142	148	142
Community Composition: Percent of total				
Amphipoda	26.4	28.2	15.5	13.4
Coleoptera	0.7	0.0	8.8	12.0
Decapoda	2.1	2.8	2.0	0.0
Diptera	25.7	23.9	25.0	19.7
Ephemeroptera	1.4	0.7	16.2	18.3
Gastropoda	29.3	27.5	6.8	4.9
Isopoda	0.0	0.0	0.0	0.0
Odonata	0.7	1.4	2.0	2.1
Oligochaeta	1.4	3.5	0.0	0.0
Pelecypoda	0.0	0.0	0.7	0.0
Plecoptera	0.0	0.0	0.0	0.0
Polychaeta	0.0	0.0	0.0	0.0
Trichoptera	4.3	4.9	20.3	28.9
Trombidiformes	4.3	4.9	2.0	0.7
Other	3.57	2.12	0.66	0.01
Functional Feeding Groups: Percent of total				
Browser-Grazers	1.1	1.4	1.0	0.0
Burrowing Deposit Feeders	1.4	3.5	0.0	0.0
Piercers	1.4	3.9	1.4	2.1
Predators	5.7	7.4	4.4	2.8
Scavengers	1.1	1.4	1.0	0.0
Scrapers	28.6	22.9	15.9	15.9
Shredders	13.9	15.1	17.2	14.8
Surface Deposit Feeders	33.6	33.5	34.8	34.5
Suspension Feeders	8.2	9.5	23.7	29.2
Unknown	4.3	1.4	0.7	0.7

* SCI_2007 categories from Table LT 7200-2 of Draft DEP-SOP-002/01 as referenced in Draft Quality Assurance Rule (62-160 F.A.C.), September 17, 2007: Values 0 ≤ 34 are Category III; Values 35 < 67 are Category II; Values 68 ≤ 100 are Category I

Table 5: Macroinvertebrate Taxa List

		Wacissa Bio Site 1			Wacissa Bio Site 2		
Order	***Taxon Name***	***Rep 1***	***Rep 2***	***1 Total***	***Rep 1***	***Rep 2***	***2 Total***
Acariformes	Atractides	-	-	**-**	2	-	***2***
	Geayia	2	1	***3***	1	1	***2***
	Hydrodroma	-	2	***2***	-	-	**-**
	Lebertia	4	4	***8***	-	-	**-**
Amphipoda	Amphipoda	-	-	**-**	10	-	***10***
	Hyalella azteca	37	40	***77***	13	19	***32***
Basommatophora	Ancylidae	2	3	***5***	-	-	**-**
	Micromenetus	-	1	***1***	-	-	**-**
	Physidae	-	-	**-**	1	1	***2***
	Planorbella	2	1	***3***	-	-	**-**
Bivalvia	Bivalvia	-	-	**-**	1	-	***1***
Coleoptera	Dubiraphia vittata	-	-	**-**	-	1	***1***
	Macronychus glabratus	-	-	**-**	3	5	***8***
	Microcylloepus pusillus	-	-	**-**	9	9	***18***
	Stenelmis	1	-	***1***	1	2	***3***
Decapoda	Palaemonetes	3	4	***7***	3	-	***3***
Diptera	Ablabesmyia mallochi	1	-	***1***	-	-	**-**
	Beardius	4	2	***6***	-	-	**-**
	Chironomidae	1	3	***4***	2	2	***4***
	Chironomus	2	-	***2***	-	-	**-**
	Clinotanypus	-	1	***1***	-	-	**-**
	Cricotopus absurdus	1	-	***1***	-	-	**-**
	Cricotopus or orthocladius	-	-	**-**	7	5	***12***
	Dicrotendipes	2	4	***6***	-	-	**-**
	Dicrotendipes sp. a epler	8	5	***13***	-	-	**-**
	Odontomyia	1	-	***1***	-	-	**-**
	Paralauterborniella nigrohalterale	1	-	***1***	-	-	**-**
	Paratanytarsus	-	-	**-**	-	2	***2***
	Polypedilum flavum	-	-	**-**	11	10	***21***
	Polypedilum halterale grp.	-	1	***1***	-	-	**-**
	Polypedilum illinoense grp.	-	-	**-**	5	2	***7***
	Polypedilum scalaenum grp.	-	-	**-**	1	-	***1***
	Pseudochironomus	3	3	***6***	-	-	**-**
	Rheotanytarsus pellucidus	-	-	**-**	-	1	***1***
	Simulium	-	-	**-**	5	3	***8***
	Stempellinella fimbriata	2	4	***6***	-	-	**-**
	Tanytarsus sp. a epler	1	1	***2***	-	-	**-**
	Tanytarsus sp. c epler	2	5	***7***	2	-	***2***
	Tanytarsus sp. k epler	1	-	***1***	-	-	**-**
	Tanytarsus sp. l epler	-	-	**-**	1	1	***2***
	Tanytarsus sp. t epler	6	5	***11***	-	-	**-**
	Thienemanniella lobapodema	-	-	**-**	1	-	***1***
	Tribelos fuscicornis	-	-	**-**	1	1	***2***
	Xestochironomus	-	-	**-**	1	1	***2***
Ephemeroptera	Acerpenna pygmaea	-	-	**-**	1	-	***1***
	Baetidae	-	-	**-**	8	6	***14***
	Baetis intercalaris	-	-	**-**	2	3	***5***
	Caenis	1	-	***1***	-	-	**-**
	Isonychia	-	-	**-**	1	1	***2***
	Maccaffertium	-	-	**-**	1	1	***2***
	Pseudocloeon	-	-	**-**	2	4	***6***
	Stenacron	-	1	***1***	-	-	**-**
	Tricorythodes albilineatus	1	-	***1***	9	11	***20***

(Macroinvertebrate Taxa List continued)

Haplotaxida	Limnodrilus hoffmeisteri	-	1	***1***	-	-	**-**
	Naididae	1	-	***1***	-	-	**-**
	Tubificidae	1	4	***5***	-	-	**-**
Heteroptera	Corixidae	-	1	***1***	-	-	**-**
	Mesovelia	1	-	***1***	-	-	**-**
Lepidoptera	Lepidoptera	-	1	***1***	-	-	**-**
Megaloptera	Corydalus cornutus	-	-	**-**	1	-	***1***
Mesogastropoda	Amnicola	-	-	**-**	6	3	***9***
	Elimia	32	25	***57***	3	3	***6***
	Hydrobiidae	4	8	***12***	-	-	**-**
	Melanoides	-	1	***1***	-	-	**-**
	Pomacea bridgesi	1	-	***1***	-	-	**-**
Odonata	Argia	-	1	***1***	2	1	***3***
	Calopteryx	-	-	**-**	-	1	***1***
	Coenagrionidae	-	-	**-**	1	-	***1***
	Enallagma	1	1	***2***	-	-	**-**
	Libellulidae	-	-	**-**	-	1	***1***
Platyhelminthes	Platyhelminthes	3	1	***4***	-	-	**-**
Rhynchobdellida	Desserobdella phalera	1	-	***1***	-	-	**-**
Trichoptera	Cheumatopsyche	-	-	**-**	3	10	***13***
	Hydropsyche	-	-	**-**	17	16	***33***
	Hydropsychidae	-	-	**-**	6	9	***15***
	Hydroptila	2	5	***7***	2	2	***4***
	Hydroptilidae	1	-	***1***	-	-	**-**
	Micrasema	-	-	**-**	1	-	***1***
	Oecetis	-	-	**-**	-	1	***1***
	Orthotrichia	-	-	**-**	-	1	***1***
	Oxyethira	2	2	***4***	-	1	***1***
	Polycentropodidae	-	-	**-**	1	-	***1***
	Triaenodes	1	-	***1***	-	1	***1***

Table 6: Linear Stream Vegetation Survey Results

	Bio Site 1	Bio Site 2
Herbaceous Species	*# of transects where found*	
Aster carolinianus	1	-
Bidens laevis	10	1
Boehmeria cylindrica	-	7
Cabomba caroliniana	6	-
Ceratophyllum demersum	5	-
Chara spp.	-	11
Cicuta mexicana	8	8
Cornus foemina	-	3
Crinum americanum	-	2
Decodon verticillatus	-	2
Hydrilla verticillata *	10	-
Hydrocotyle umbellata	8	-
Lemna minor	8	-
Limnobium spongia	8	-
Lobelia cardinalis	7	1
Ludwigia repens	1	-
Mikania scandens	9	11
Najas guadalupensis	1	-
Parthenocissus quinquefolia	-	1
Peltandra virginica	-	1
Physostegia leptophylla	2	-
Pistia stratioides	3	3
Polygonum punctatum	4	-
Pontederia cordata	4	6
Potamogeton illinoensis	2	1
Rhynchospora nitens	1	-
Sagittaria kurziana	9	3
Sagittaria lancifolia	-	3
Saururus cernuus	-	1
Vallisneria americana	8	-
Zizania aquatica **	-	11
Woody Species		
Acer rubrum	4	5
Fraxinus caroliniana	6	-
Ilex cassine	6	8
Magnolia virginiana	6	8
Myrica cerifera	7	9
Nyssa sylvatica var. biflora	3	1
Persea palustris	-	2
Taxodium distichum	8	1

* Dominant at Biological Site 1

** Dominant at Biological Site 2

Table 7: Qualitative Periphyton Sampling Summary

Order	Taxon Name	Bio Site 1	Bio Site 2	Bio Site 3
Bacillariophyta	Bacillariophyta	258	262	276
Chlorococcales	Characium	1	-	-
	Chlorella	5	-	-
	Chlorococcum	-	2	-
	Gloeocystis gigas	-	1	-
	Scenedesmus dimorphus	1	-	-
Chroococcales	Aphanocapsa	-	3	-
	Cyanobium parvum	2	16	3
	Cyanothece aeruginosa	-	-	2
	Synechocystis	8	3	-
Nostocales	Anabaena	1	-	-
	Calothrix	-	1	-
	Microchaete	1	-	-
Oscillatoriales	Geitlerinema acutissimum	-	-	1
	Hydrococcus rivularis	-	1	-
	Jaaginema	15	1	2
	Komvophoron	2	-	-
	Oscillatoria hamelii	1	2	4
	Oscillatoria limosa	2	-	3
	Oscillatoria tenuis	3	4	4
	Phormidium	-	1	2
	Planktothrix	-	-	1
	Pseudanabaena	1	4	-
	Schizothrix calcicola	-	-	3
Zygnematales	Actinotaenium diplosporum diplosporum	-	-	2
	Debarya	1	-	-
	Mougeotia	-	1	-

Table 8: Frequencies of Algal Thickness Rank in Biological Site Transects

		Algal Thickness Rank					
Biological Site 1	**Transect (m)**	**0**	**1**	**2**	**3**	**4**	**5**
		0 mm, rough	<0.5 mm or slimy	0.5-1 mm	>1 to <6 mm	6-20 mm	>20 mm
	0	0	3	2	0	2	2
	10	0	3	0	0	0	6
	20	0	3	0	0	0	5
	30	1	0	2	0	0	5
	40	1	0	1	1	1	5
	50	0	2	1	0	1	5
	60	0	0	0	0	0	9
	70	2	2	0	0	2	3
	80	2	0	0	0	0	7
	90	1	1	0	0	2	5
	100	4	0	0	0	0	5
	Total	11	14	6	1	8	57
	% of total	**11.3**	**14.43**	**6.19**	**1.03**	**8.25**	**58.76**
Biological Site 2	0	0	6	1	1	1	0
	10	0	3	4	0	2	0
	20	0	0	9	0	0	0
	30	0	5	3	1	0	0
	40	0	2	6	1	0	0
	50	0	4	5	0	0	0
	60	0	7	2	0	0	0
	70	0	5	4	0	0	0
	80	0	5	4	0	0	0
	90	0	5	2	1	1	0
	100	0	5	2	2	0	0
	Total	0	47	42	6	4	0
	% of Total	**0.0**	**47.5**	**42.4**	**6.1**	**4.0**	**0.0**
Biological Site 3	0	1	2	0	0	0	0
	10	0	3	0	0	0	0
	20	0	8	0	1	0	0
	30	0	8	1	0	0	0
	40	0	6	3	0	0	0
	50	1	6	0	1	1	0
	60	0	5	2	0	2	0
	70	0	5	1	0	0	1
	80	0	4	0	0	3	0
	90	0	7	1	0	1	0
	100	0	8	0	1	0	0
	Total	2	62	8	3	7	1
	% of Total	**2.4**	**74.7**	**9.6**	**3.6**	**8.4**	**1.2**

Appendix B

Typical Values for Selected Parameters in Florida Waters

STREAMS (1617 Stations) — Percentile Distribution

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
Total Kjeldahl Nitrogen	0.30	0.39	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80
Total Ammonia	0.02	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60
Nitrate + Nitrite	0.01	0.01	0.03	0.05	0.07	0.10	0.14	0.20	0.32	0.64	1.05
Total Phosphorus	0.02	0.03	0.05	0.06	0.10	0.13	0.18	0.25	0.39	0.74	1.51
Ortho-phosphorus	0.01	0.01	0.03	0.04	0.05	0.08	0.11	0.17	0.27	0.59	1.37
Turbidity (NTU)	0.60	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30

"NTU"= Nephelometric turbidity units

Adapted from Joe Hand, FDER, personal communication, 1991 (data was collected between 1980 and 1989).

Biological Site values compared to typical Florida stream values

Biological Site 1

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Total Kjeldahl Nitrogen	***0.30***	0.39	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.084 I**
Total Ammonia	***0.02***	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.01 U**
Nitrate + Nitrite	0.01	0.01	0.03	0.05	0.07	0.10	0.14	***0.20***	0.32	0.64	1.05	**0.18**
Total Phosphorus	0.02	***0.03***	***0.05***	0.06	0.10	0.13	0.18	0.25	0.39	0.74	1.51	**0.04 I**
Ortho-phosphorus	0.01	0.01	***0.03***	0.04	0.05	0.08	0.11	0.17	0.27	0.59	1.37	**0.033**
Turbidity (NTU)	0.60	0.90	***1.20***	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**1.1**

Biological Site 2

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Total Kjeldahl Nitrogen	***0.30***	0.39	0.56	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.1 I**
Total Ammonia	***0.02***	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.01 U**
Nitrate + Nitrite	0.01	0.01	0.03	0.05	***0.07***	0.10	0.14	0.20	0.32	0.64	1.05	**0.074**
Total Phosphorus	0.02	***0.03***	0.05	0.06	0.10	0.13	0.18	0.25	0.39	0.74	1.51	**0.032 I**
Ortho-phosphorus	0.01	***0.01***	***0.03***	0.04	0.05	0.08	0.11	0.17	0.27	0.59	1.37	**0.02**
Turbidity (NTU)	***0.60***	0.90	1.20	1.45	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**0.6**

Biological Site 3

Parameter	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%	Measured
Total Kjeldahl Nitrogen	0.30	0.39	***0.56***	0.73	0.87	1.00	1.11	1.26	1.49	1.93	2.80	**0.49**
Total Ammonia	***0.02***	0.02	0.04	0.05	0.06	0.08	0.11	0.14	0.20	0.34	0.60	**0.01 U**
Nitrate + Nitrite	0.01	***0.01***	0.03	0.05	0.07	0.10	0.14	0.20	0.32	0.64	1.05	**0.018**
Total Phosphorus	0.02	0.03	0.05	***0.06***	0.10	0.13	0.18	0.25	0.39	0.74	1.51	**0.056 I**
Ortho-phosphorus	0.01	***0.01***	0.03	0.04	0.05	0.08	0.11	0.17	0.27	0.59	1.37	**0.016**
Turbidity (NTU)	0.60	0.90	1.20	***1.45***	2.10	2.80	3.60	4.50	6.65	10.45	16.30	**1.4**

Appendix C

Suite of pesticides and polycyclic aromatic hydrocarbons (water samples)

1,2,4-Trichlorobenzene
2,4,5-T
2,4,6-Trichlorophenol
2,4-D
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
2-Chloronaphthalene
2-Chlorophenol
2-Methyl-4,6-dinitrophenol
2-Nitrophenol
3,3'-Dichlorobenzidine
4,4'-DDD
4,4'-DDE
4,4'-DDT
4-Bromophenyl phenyl ether
4-Chloro-3-methylphenol
4-Chlorophenyl phenyl ether
4-Nitrophenol
Acenaphthene
Acenaphthylene
Acifluorfen
Alachlor
Aldrin
Alpha-BHC
Ametryn
Anthracene
Atrazine
Atrazine Desethyl
Atrazine Desisopropyl
Azinphos Methyl
Benzidine
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
Beta-BHC
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
Bromacil
Butyl benzyl phthalate
Butylate
Carbophenothion
Chlordane
Chlorothalonil
Chlorpyrifos Ethyl
Chlorpyrifos Methyl
Chrysene
Cypermethrin
DDD-p,p'
DDE-p,p'
DDT-p,p'
Delta-BHC
Demeton
Diazinon
Dibenzo(a,h)anthracene
Dicofol
Dieldrin
Diethyl phthalate
Dimethyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Disulfoton
Diuron
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Ethion
Ethoprop
Fenamiphos
Fluoranthene
Fluorene
Fonofos
Gamma-BHC
Heptachlor
Heptachlor Epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Hexazinone
Imidacloprid
Indeno(1,2,3-cd)pyrene
Isophorone
Linuron
Malathion
Metalaxyl
Methoxychlor
Metolachlor
Metribuzin
Mevinphos
Mirex
Naled
Naphthalene
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine/ Diphenylamine
Norflurazon
Parathion Ethyl
Parathion Methyl
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Pentachlorophenol
Permethrin
Phenanthrene
Phenol
Phorate
Prometon
Prometryn
Pyrene
Silvex
Simazine
Toxaphene
Trifluralin

(note- of these water sample analytes, only diethyl phthalate was detected at Log Spring in a concentration below the PQL)

Suite of pesticides and PAHs (sediment samples)

1,2,4-Trichlorobenzene
2,4,6-Trichlorophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
2,6-Dinitrotoluene
2-Chloronaphthalene
2-Chlorophenol
2-Methyl-4,6-dinitrophenol
2-Nitrophenol
3,3'-Dichlorobenzidine
4,4'-DDD
4,4'-DDE
4,4'-DDT
4-Bromophenyl phenyl ether
4-Chloro-3-methylphenol
4-Chlorophenyl phenyl ether
4-Nitrophenol
Acenaphthene
Acenaphthylene
Aldrin
alpha-BHC
Anthracene
Azobenzene/1,2-Diphenylhydrazine
Benzidine
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(g,h,i)perylene
Benzo(k)fluoranthene
beta-BHC
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Bis(2-chloroisopropyl)ether
Bis(2-ethylhexyl)phthalate
Butyl benzyl phthalate
Chrysene
delta-BHC
Dibenzo(a,h)anthracene
Dieldrin
Diethyl phthalate
Dimethyl phthalate
Di-n-butyl phthalate
Di-n-octyl phthalate
Endosulfan I
Endosulfan II
Endosulfan sulfate
Endrin
Endrin aldehyde
Fluoranthene
Fluorene
gamma-BHC
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Indeno(1,2,3-cd)pyrene
Isophorone
Naphthalene
Nitrobenzene
N-Nitrosodimethylamine
N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine/ Diphenylamine
Pentachlorophenol
Phenanthrene
Phenol
Pyrene

(note- dimethyl phthalate was the only analyte detected in any of the sediment samples, and was only found at Wacissa Head Spring)