Wakulla Springs Dark Water:
Causes and Sources Phase III

Final Report

7/17/20

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This project was completed for the Wakulla Springs Alliance by McGlynn Laboratories, Inc. with financial assistance provided by the Fish and Wildlife Foundation of Florida, Inc. through the Protect Florida Springs Tag Grant Program, project PFS 1819-09. The analytical results contained within this report meet all National Environmental Laboratory Accreditation Program (NELAP) requirements for parameters for which NELAP accreditation is required or available. Any deviations from NELAP requirements are noted in this report.

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Acknowledgements

This project was completed for the Wakulla Springs Alliance with financial assistance provided by the Fish and Wildlife Foundation of Florida, Inc. through the Protect Florida Springs Tag Grant Program, projects PFS #1617-08 and 1819-09. We thank Wakulla Springs State Park staff who collected daily samples from the spring and provided boat access and assistance with weekly light measurements as well as the following individuals: Katy McGlynn, Julia McGlynn, Sophie Wacongne-Speer, Emily Speer, Ken Beattie, David Shepard, Brian Lupiani and Kevin Speer who assisted with weekly field work; Cal Susan Jamison who participated in all field work and played a major role in the design and execution of the dye studies, including oversight of deployment of charcoal packs; diver Andreas Hagberg who assisted with injecting dye into Porter Hole Sink and with placing and retrieving charcoal packs at several sites; divers Michael Barnette, Travis Kersting, and Brandon McWilliams who deployed and retrieved other charcoal packs; Sherry Carpenter who assisted with the Porter Hole Sink dye injection; Brendan McGlynn who assisted with injecting dye into Fallschase Sink at Upper Lake Lafayette; and Drs. Richard Long and Thomas Sawicki and their graduate student Kaylee Castle who devoted many hours to designing and implementing the environmental DNA study including analysis and presentation of the data and results. Thanks also to Park Biologist Patti Wilber, Park Manager Amy Conyers, Rangers Jeff Hugo and Jackie M. Turner, as well as retired ranger Robert Thompson for help with everything from boats to alligators. Thanks also to the following property owners for providing access to sinks and springs on or through their properties: Bob Brown, Don Fortner, the Harvey's, Norma Skaggs, Mitch and Barbara Spears, Teddy Tollett, and Wakulla Springs State Park. We would like to also acknowledge Robert Deyle for also driving the boat and the service he performed as Project Manager; Jim Stevenson; Doug Barr; Tom Taylor; Cristopher Werner; Hal Davis; Edward Chelette; Jim Davis and Gail Fishman.

Executive Summary (ES)

This Phase III investigation in the Wakulla Springshed, Wakulla Springs Dark Water: Causes and Sources, focused of the visibility problems at Wakulla Springs, particularly documenting the sources of chlorophyll "algae" that cause the green "dark water" conditions that occur when the spring has historically cleared after rain events. This was an extension of existing research by Dr. Sean McGlynn into the connection of Wakulla Springs with the Karst Lakes in its watershed. These subsequent studies were funded by the Fish and Wildlife Foundation. The first and second phase of our Dark Water study of Wakulla Springs was designed to extend to determine the causes and sources of "dark water" conditions at Wakulla Springs which have resulted in the nearly complete curtailment of glass bottom boat tours and the loss of most of the highly productive eelgrass and fish community that previously occupied the spring bowl.

Project Description

1. Collect daily grab samples at Spring Creek and analyze for specific conductance for 17 months.
2. Conduct daily stage readings at Upper Lake Lafayette for 17 months.
3. Daily collection and analyses of chlorophylls and visibility from the Wakulla Springs boil (includes in-kind services by Wakulla Springs State Park to collect samples and by McGlynn Laboratories, Inc. to conduct analyses).
4. Conduct weekly analyses of true color, specific conductance, and chlorophyll, plus color scans, and spectralradiometric absorbance scans at the Wakulla Springs boil for 17 months.
5. Conduct weekly analyses of true color, specific conductance, and chlorophyll, plus color scans, for samples from the Cathedral Room (L well) for 17 months.
6. Conduct sampling and analyses for 4 "green dark water" events at five sample sites: Wakulla Springs boil, L well, and lakes Iamonia, Jackson, Lafayette, and Munson for true color, specific conductance, and chlorophyll, plus color scans.
7. Conduct algal taxonomic analyses of samples for 4 "green dark water" events.
8. Conduct Next gen DNA sequencing analysis for 4 "green dark water events" (includes $8,700 of in-kind services from Drs. Richard Long and Thomas Sawicki for sample collection and preparation and data analysis and interpretation).
9. Enter water quality data into Florida Watershed Information Network (WIN) system.
10. Prepare final report.

Findings

From 06/30/16 to 06/11/20 we took 172 color readings on separate days. Forty-seven percent of the readings were numbers 17,18 and 19. A dark brown greenish hue.

Visibility at Wakulla Springs is highly variable but is definitely increasing. Since we started studying the visibility in Wakulla Springs in 2016 visibility is increasing at a rate of 3 feet per year. Clear episodes occur in the late spring, May, June and July. This project is called "Wakulla Springs Dark Water," not the "Wakulla Springs Photosynthetically Active Radiation (PAR) Aquatic Plant Depth Limit Study." While visibility and PAR are essentially the same (all measured in feet), every plant has a different depth limit and the scope of this study did not include any work on aquatic plants. Visibility is a measure of the aquatic light field three different way: LICOR radiometry; spectral radiometry: and secchi, each of which can be used by itself to determine the aquatic light field for plant growth. The visibility measurement can used, as reported, as an average depth limit for aquatic plant growth.

The Wakulla Springshed is a very complex system. All water in the Springshed winds up at either Wakulla Springs or Spring Creek. Spring Creek and Lost Creek both have major effects on the water balance and quality of Wakulla Springs. They have very different flow patterns with alternating lapses in flow while the Wakulla River, the sum of both flows, remains more constant. There is no direct measurement of the groundwater base flow into Wakulla Springs. That is predominantly clear water (lacking tannic color) and likely elevated with nitrates and chlorophylls that infiltrate through the soil above the aquifer or pass through a karst window directly into the aquifer. The sinking streams are loaded with rather pristine tea colored brown tannic water draining out of the extensive tracts of national forest. There is also flow into the cave system from the sinking lakes which contribute algae (chlorophylls) to the aquifer.

This study has contributed the longest dye study to date in the Wakulla Springshed; the dye traveled 29 miles underground, from Lake Iamonia to Wakulla Springs, with a speed of 1.7 miles per day. We also documented the flow from the sinkhole in Upper Lake Lafayette for 16 miles at a speed of 0.65 miles per day. At Lake Jackson the dye traveled 19 miles to Wakulla Springs, all in underground caverns at a speed of 0.55 miles per day. The Wakulla Springshed is riddled with caves. We don't know where most of them are, but we have mapped so many that the Wakulla Springshed has the longest mapped underwater cave system in the world.

The water quality in the caves was different and grouped. Caves C, D B and SW (for Sally Ward Spring) are clear water; it is not tannic and the water from these caves has good visibility. These caves flow from the north while Lost Creek dominates the flow of tannic or brown water, flowing into and through Spring Creek as well as the A and K caves which suffer poor visibility when Lost Creek is flowing. Lost Creek flow is flashy and very rain dependent. The L well and the Boil are very similar in tannic content. Chlorophylls varied from cave to cave too. Of the caves, Sally Ward was the highest chlorophylls and nitrates and this cave gets water directly from the sinking lakes. Nitrates were highest in the caves flowing from the north that flow under more populated areas, particularly in Tallahassee. The caves to the south have slightly lower conductivities when they receive the fresh water input of Lost Creek. Spring Creek is a marine system with very high conductance or salinity (they can be the same thing) from the salt water of the Gulf of Mexico and tidal mixing that occurs there.

There have been several salinity episodes at Wakulla Springs. These occur when the flows from Lost Creek and Spring Creek reverse and both flow towards Wakulla Springs (or if Lost Creek stops flowing). There have been 11 salinity spikes, which seem to have started around 2007 at Wakulla Springs. Spring Creek, the most likely source, had the highest salinity and Lost Creek the lowest.

- During the salinity episode the wells flowing from the north: B; D; SW; and C had the lowest salinities. Their salinity was basically background concentrations typical of the Floridan Aquifer and its lime rock matrix.
- During the salinity episode the AK, AD and K wells had the most salinity, and they flow into Wakulla Springs from the south, usually carrying the tannic water from Lost Creek, now they are carrying salt water from Spring Creek.

This is evidence of flow reversal in the caves in the southern end of the Springshed that run between Lost Creek, Spring Creek and Wakulla Springs.

Salt water was coming from the caves, from Spring Creek all the way to Wakulla Springs. These episodes are periodic. They are causing a change in the aquatic plant community at Wakulla Springs.

We have been using the fraction of Salinity Model, to calculate flow at Spring Creek, which better explains the behavior of the system than the USGS data. The USGS flows have problems. The gauge misses springs 12 and 13 which are in Stewart Cove. The gauge is in a backwater area on the other side of the channel from the springs. The gauge is too far out in the lagoon to accurately read the fresh water inflow at the north of the lagoon, which is considerably fresher than where the gauge is located, and causes the USGS gauge to be very accurate on high flows and not very accurate on low flows. Also, in the part of the Bay where the gauge is located the salinity is stratified with the fresh water flowing on top and the salt water on the bottom, usually flowing in opposite directions. We need multiple gauges to correctly monitor the flow at Spring Creek which is becoming important for the health of Wakulla Springs.

The average total chlorophyll at Wakulla Springs was 0.71 ug/L, this is considered healthy for Florida lakes. Chlorophylls do not normally occur in springs which by definition flow from underground.

The average visibility in Wakulla Springs was 19.5 feet. Florida Statutes for transparency state "The annual average value shall not be reduced by more than 10% as compared to the natural background value. Annual average values shall be based on a minimum of three samples, with each sample collected at least three months apart (62-302.530 Table: Surface Water Quality Criteria)." Every time the visibility goes below 18 feet this statute is violated at Wakulla Springs.

There is seasonality to the life cycle of the plankton in lentic aquatic systems. The blooms of algae and zooplankton are depicted in figure 3.5: Seasonality of algae blooms in surface waters in Wakulla Springs is a reflection of this seasonality in the sinking lakes of the Springshed with peaks in chlorophyll occurring in lake summer, coinciding with the blooms of blue and green algae in our lakes, and clearer episodes in the early springtime coinciding with minimal algae growth in the lakes.

Simple linear regression models for each of these parameters true color; turbidity; nitrate, the chlorophyll factor (chlorophylls measured in situ at Wakulla Springs with a spectral radiometer); specific conductance; Wakulla Springs flow; Spring Creek flow; Sopchoppy flow; and rainfall at Wakulla Springs based on the Phase I, II and III data were not statistically significant, except for true color which proved to be only slightly significant, explaining only 32% of the variation in visibility.

A multiple regression analysis of the Phase I data evaluating the effects of true color, corrected chlorophyll a, and phaeophytin on PAR depth limit conducted on the Phase I data did yield a statistically significant model explained 39% of the observed variance in visibility.

Our Phase III flow data set was subjected to statistical analysis using multiple regressions. A multiple regression of the Wakulla Springs, Sopchoppy and Spring Creek flows was only slightly significant explaining 24 % of the variability.

We also performed multiple regression analysis on the Phase III water quality constituents. Analysis of the variations of specific conductance, true color, nitrate, the chlorophyll factor and turbidity produced a much more significant coefficient of correlation. These variables explained 47 % of the variability in visibility.

With flows responsible for 24 % of the variability in visibility and water quality being responsible for 47 % that accounts for about 71% of the variability in visibility at Wakulla Springs.

The optical fingerprint of the visibility at Wakulla Springs is composed of tannins and chlorophylls, both from different sources. Spectralradiometric finger prints of the water were detailed in our Phase II Report. The term “finger print” is rarely, if ever, applied to water quality. This Phase III report seeks to determine the DNA fingerprint of the water.

We traced chlorophyll algal species from the sinkhole in the Wakulla Springshed: Lake Iamonia; Lake Jackson; Lake Lafayette; and Lake Munson to Wakulla Springs using their DNA as markers. Several species of fresh water photosynthetic bluegreen algae occur in all the samples, at substantial numbers (as OTUs), in the springs, lakes and conduits. This indicates that these chlorophylls containing aquatic algae are in all four major sinkhole lakes and are also in Wakulla Springs and could only come from these lakes. These were: Cyanobacterium spp.; Cyanothece spp.; Prochlorococcus spp. and Synechococcus spp.

Several species of mixed fresh and marine photosynthetic green algae, at substantial numbers of OTUs, occurred in all the samples, springs, lakes and conduits (red type in Figure ??? indicts a potentially toxic species). This indicates that these chlorophyll containing aquatic algae are in all four major sinkhole lakes and are also in Wakulla Springs and also were traced by their DNA from the sinking lakes to Wakulla Springs. These were: Asterionella; Chrysosphaera; Dinophysis; Guillardia; Heterosigma; Nannochloropsis; Ochromonas; Rhodomonas; Stephanodiscus and Thalassiosira

The potentially toxic bluegreen nuisance algae, Microcystis spp. was also found in all samples, highest in Lake Munson, lower in the spring. Interestingly, the potentially toxic diatom, Nitzschia and unicellular flagellate algae Pelagomonas were both found at highest concentrations at the spring and associated L well. Both are marine species, indicating a connection with the sea.

Wakulla Springs receives its water from its Springshed. We examined all the major sinking streams in the Springshed and found they were the source of the tannic water at Wakulla Springs. We examined the major sinkhole lakes in the Springshed and they were the source of algae and chlorophyll in the spring boil and the caves leading to the spring boil. We also traced salt water from Spring Creek to Wakulla Springs and believe that will increase in the coming years with sea level rise and over pumping.

New Innovative Technology: Chlorophyll Factor. During this project MLI has developed a new analytical test for chlorophyll. This is a non-destructive insitu field measurement taken with the spectralradiometer. We use the water column scan we make for measuring the light intensity spectralradiometrically from 340nm-1024nm, three readings per nm. The water column is scanned at half meter intervals. From the wavelength scans we integrate over the visibly green chlorophyll absorbance in the water column. We calculate the extinction coefficient at 664nm to 691nm (pre-peak) and another extinction coefficient at 692nm to 719nm (post-peak). Then we subtract the post-peak extinction from the pre-peak extinction and we initially used a negative value to detect the presence of chlorophyll. The raw numbers we obtain, which we are calling a chlorophyll factor, prove to be slightly more significant, statistically, than our traditional chlorophyll measurements. We are currently working on calculating a chlorophyll concentration and method development with the Florida Department of Health Bureau of Laboratories, patent pending.

Future Investigations

- We will definitely keep trying to understand the complex and mysterious Wakulla Springshed.
- We will better characterize the effects on visibility at Wakulla Spring by trying different color analysis, like the tristimulous color used by the dye industry, designers and artists. There is a big difference between analytical color measurements and appearance. We will try to bridge this gap in technology.
- We will add Total Suspended Solids to our analysis chart for visibility measurements which will require a large volume of water and replace turbidity.
- We would like to do more dye studies under different weather conditions to examine travel time and destinations more closely.
- We would like to study the Ferrell property, recently acquired by the Park, as it sits astride the clear water high nitrate caves traveling south from Tallahassee to Wakulla Spring.
- We would like to explore the dynamics of Spring Creek and Lost Creek and their association with Wakulla Springs.
- We would like a better gauge at Spring Creek and flow meters in the various caverns.

Chapter 1
Initial Research (not funded by the Fish and Wildlife Foundation)

Section 1A, Proposed Phase III BMAP (future): Sinks, Fertilizers and Livestock (not funded by FWF, McGlynn, 2014).

MLIs research on the springs preceded these License Plate Grants and MLI is continuing this research effort when we currently have not had funding from the Fish and Wildlife Foundation of Florida, Inc. Figure 1.1 is a conceptual diagram of the Wakulla Springshed showing a lakes region; this is the region of concern in this report. *The Final Nutrient (Biology) TMDL for the Upper Wakulla River (WBID 1006)* (TMDL. Gilbert, 2012) and the Final Basin Management Action Plan for the Implementation of the *Total Maximum Daily Load for Nutrients (Biology) Protection in the Upper Wakulla River and Wakulla Springs Basin* (BMAP. FDEP, 2015) for Wakulla Springs do not include a 'Lakes' region as did the *Wakulla Springs Restoration Plan* (RAP. Knight, 2014).

There are a lot of lakes in the Wakulla Springshed. Table 1.1 lists the larger lakes. Most lakes have a karst connection to the aquifer or they just seep through the shallow sandy soils into the Floridan Aquifer and flow to Wakulla Springs.

In our proposal, *BMAP Comments, Wakulla Springshed*. (McGlynn, 2014) we increased the flow of groundwater, from karst features, to the aquifer by 36%, just by adding a few of the forgotten larger karst features (figure 1.2), mostly sinkhole lakes, that were omitted by the Revised Nitrogen Source Inventory and Loading Estimates for the Wakulla BMAP Area (NSILT. Lyon and Katz, 2017). Ironically, the NSILT did include one sinkhole lake, Lake Munson, but they called it a sinking stream. This is graphically depicted in figure 1.2. There are karst features that could be added but many do not have the data to evaluate seepage. We proposed a revision of the Sinking Streams chart of the NSILT to include all major karst features, sinking streams and sinking lakes (Figure 1.3). We revised the nitrogen loadings to the aquifer with current average quarterly nutrient data, reported in Florida STORET, and calculated seepage by measuring flows at sinkholes and seepage from lakes using the NOAA weather stations set up to monitor flooding which covers the stage on most of the sinking lakes and pan evaporation data from the department of agriculture. We were unable to estimate transpiration losses from the aquatic vegetation (Figure 1.4).

FDEP delivered a devastating blow to our Springshed when all the karst features, sinking lakes, sinking streams and sinkholes as well as karst depressions, were dropped from the official state cleanup plan for Wakulla Springs, the Wakulla BMAP (Figure 1.5) (NSILT Nitrogen Load Allocations by Source: 2013 adopted, Nov 2017, Jan 2018 draft). The pie charts below changed the loading of the NSILT increasing the sinking streams and lakes TN loading from 5% to 17%, making it a larger load in the Wakulla Springshed than the other Phase III BMAP categories. The septic tanks are a Phase II loading. Cleaning up the karst features would have been a priority of Phase III of the BMAP process. There was a subsequent revision of the BMAP that included these additional karst features and change the cleanup priorities of Phase III. Then FDEP decided to drop the sinking lakes and the sinking streams from the Phase III BMAP. WSA was not informed until later. Bob Deyle had discussions with FDEP, outside of his position as an OSTDS advisor on a Wakulla BMAP committee. He stated in an email that FDEP did not think the lakes could be cleaned up (email from Deyle Report to WSA re OSTDS Remediation Plan etc., dated 01/26/18). He was not representing the WSA in this discussion and the WSA was not informed of these decisions until after the fact. A major flaw in FDEP's reasoning is the claim that these lakes and streams are naturally polluted and thus cannot be cleaned up. This is not the case. Most of the waterbodies, particularly Lake Munson and Lake Lafayette have received sewage either inadvertently spilled or purposefully released in the past and this has made for a high sediment load of nutrients.

We also worked out a Water Budget for Wakulla Springs (Figure 1.6). We think there is a chance to save Wakulla Springs but the BMAP has significant problems including the omission of all the karst features. Problems with Wakulla BMAP: karst features excluded from cleanup; Georgia not included; water volume/flow ignored; brown tannic colored water not considered; restoration uncertain (Table 1.2).

Lake Munson is the poster child for the abuses of the Wakulla Springshed. It is directly connected to Wakulla Springs with very green water with algae, and is one of the major contributors of pollutants in our proposed *BMAP Comments, Wakulla Springshed*, however Lake Lafayette actually has a higher load to the aquifer (BCW. McGlynn, 2014. Figure 1.4). Lake Munson was formerly the end of the line for the City of Tallahassee's wastewater system (MLI, 09/02/14). The City of Tallahassee is currently under a consent order regarding the excessive number of inadvertent sewage releases. Initially the City was cited with FDEP's 2009 Consent Order due to massive volume and numbers of raw sewage spills in 2007-2008. However, in August 2010, the US EPA sent a standard 305 letter for mid-size cities to determine the health of the City's sewage collection system. The City's response and additional historical sewage spill information prompted US EPA to require FDEP to amend its 2009 Consent Order. Upon reviewing a proposed consent order at the end of 2010, US EPA was not satisfied with the lack of penalties to be incurred in the future, plus the need for a more robust rehab plan for its aging clay vitreous collection system. A final 2011 Amended Consent Order was signed in late 2011. Unfortunately, large volumes of sewage spills continued, some in large open water bodies around the City. In 2018 over 1.3 Million gallons of sewage spilled, which when compared to all other Florida cities ranked the city 15th in volume of spills, whereas it is ranked 25th in population size. Lastly, in September 2019, the City requested that the 2011 Amended Consent Order be closed since it felt all major defects had been repaired and other CO requirements had been met. It made repeated requests from September through February 2020. However, in March 2020, the City "discovered" that it still had 167 #5 defects still unrepaired, some dating back to 2013. As of April 2020, the City has requested that a Supplemental Plan be approved as part of the existing 2011 Amended Consent Order. The Tallahassee Sewage Advocacy Group, through its attorney, has requested FDEP consider a new and more robust Consent Order, using a new and stronger consent order template as of July 2020. A recent analysis of spills going back to 2008 indicates large volumes of spills are caused by broken pipes, storms, power outages, and defective equipment. On the other hand, the large numbers of sewage spills are caused by FRROG issues with citizens putting such things as handy-wipes and grease into the sewage collection system. The City is now working on a more robust FRROGG prevention program. Likewise, the City is in the middle of an extensive I/I study to address tremendous infiltration of stormwater during large rain events. A recent Wet vs Dry month comparison found an over 3-million-gallon difference between the two months. There continues to be concerns of exfiltration of sewage into the underlying sensitive environment.

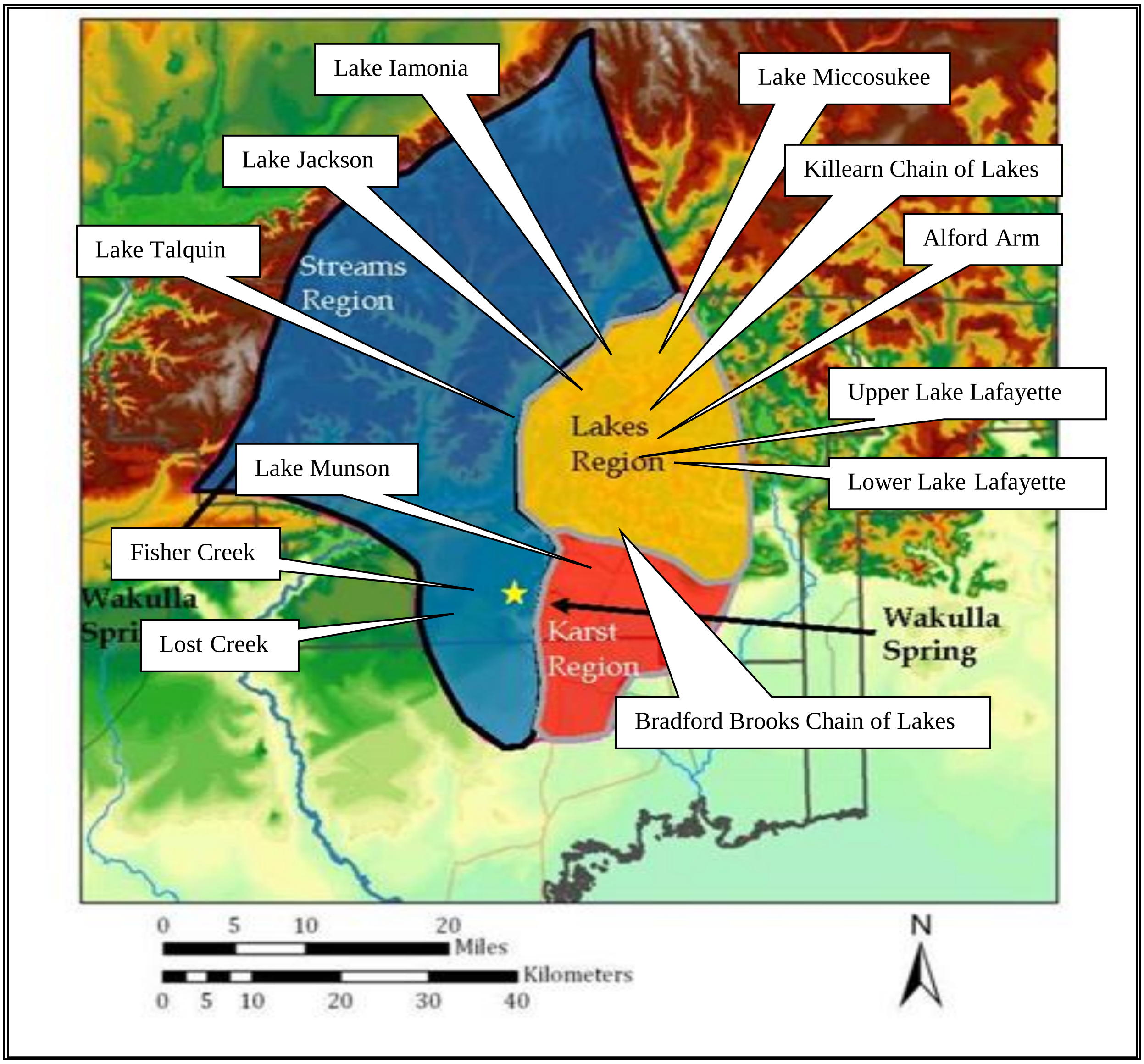

Figure 1.1: Conceptual diagram of the Wakulla Springshed (Knight).

Table 1.1: Larger lakes in the Wakulla Springshed which seep into the Floridan Aquifer flowing to Wakulla Springs.

- Andrew Lake
- Bradford Brooks Chain of Lakes
  - Lake Bradford
  - Grassy Lake
  - Lake Hiawatha
  - Lake Cascade
- Campbell Pond
- Carr Lake
- Cascade Lake
- Cascade Park Ponds
- Killearn Chain of Lakes
  - Lake Kinsail
  - Lake Killearney
  - Lake Kanturk
- Killearn Plantation Chain of Lake
  - Lake Arrowhead
  - Upper Lake Diane
  - Lower Lake Diane
  - Lake Blue Heron
  - Lake Monkey Business
- Lake Ellen
  - Little Lake Ellen
- Lake Elizabeth
- Lake Iamonia
- Lake Hall
- Lake Henrietta
- Lake Jackson
- Lake Lafayette
  - Upper Lake Lafayette
  - Lake Piney Z
  - Lower Lake Lafayette
  - Alford Arm
- Lake McBride
- Lake Miccosukee
- Lake Munson
- Lakes near Sprayfield
- Lakes in National Forest Lakes
- Lake Overstreet
- Lake Tom John
- Lake Tallavana
- Lake Talquin
- Moore Lake

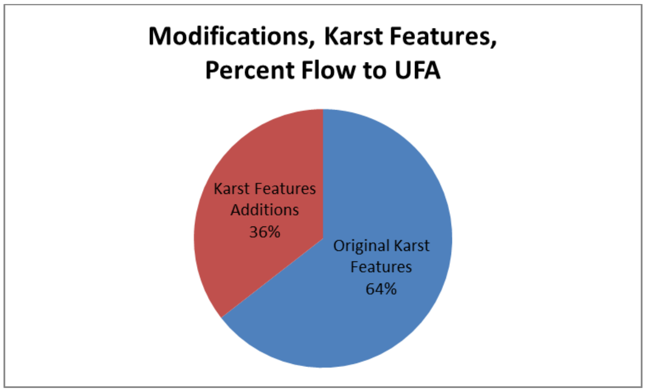

Figure 1.2: We increased the flow of water to the aquifer by 36% by adding a few of the larger karst features omitted by the NSILT. There are many more that could be added but we did not have the data to evaluate seepage.

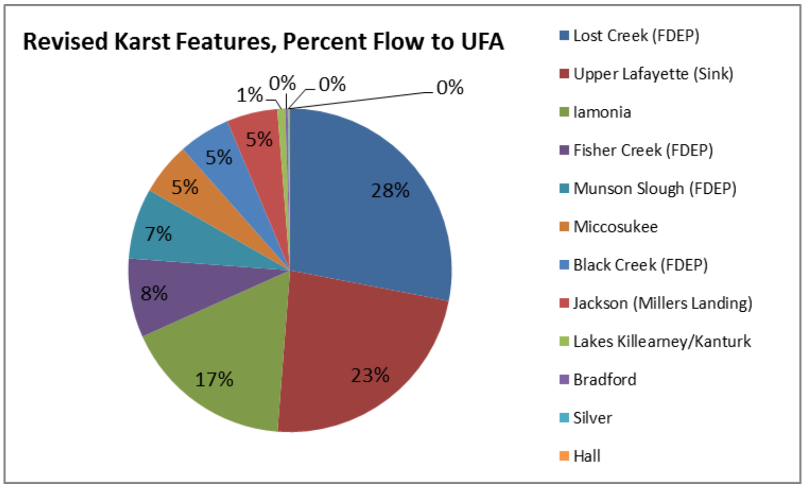

Figure 1.3: We proposed a revision of the Sinking Streams chart of the NSILT to include all major karst features, sinking streams and sinking lakes.

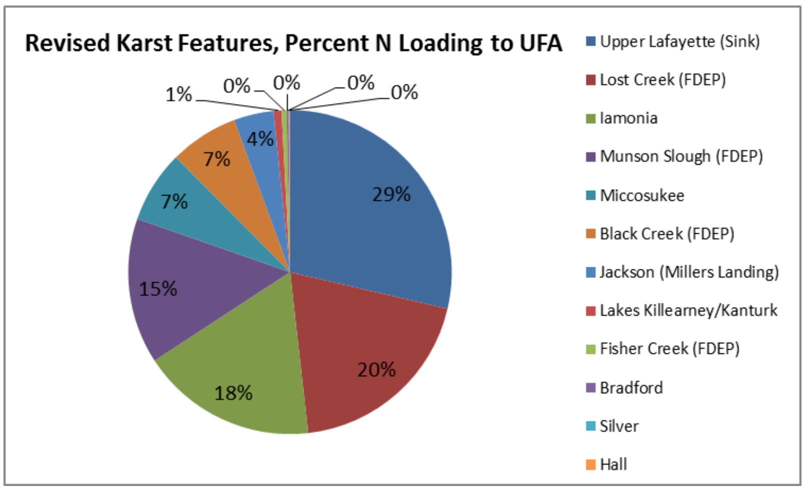

Figure 1.4: We revised the nitrogen loadings to the aquifer with current average quarterly nutrient data.

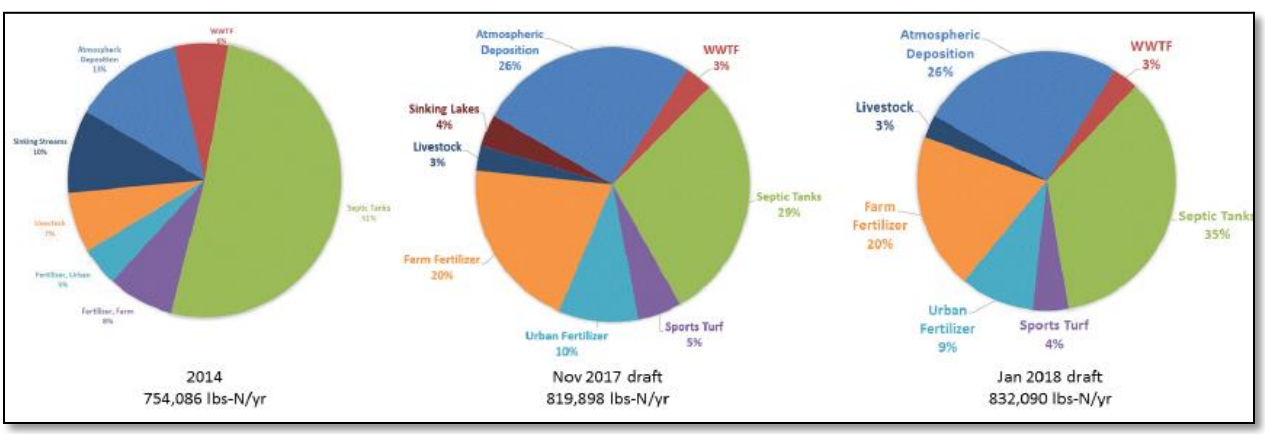

Figure 1.5: This is figure1 from the NSILT Nitrogen Load Allocations by Source: 2013 adopted, Nov 2017, Jan 2018 draft.

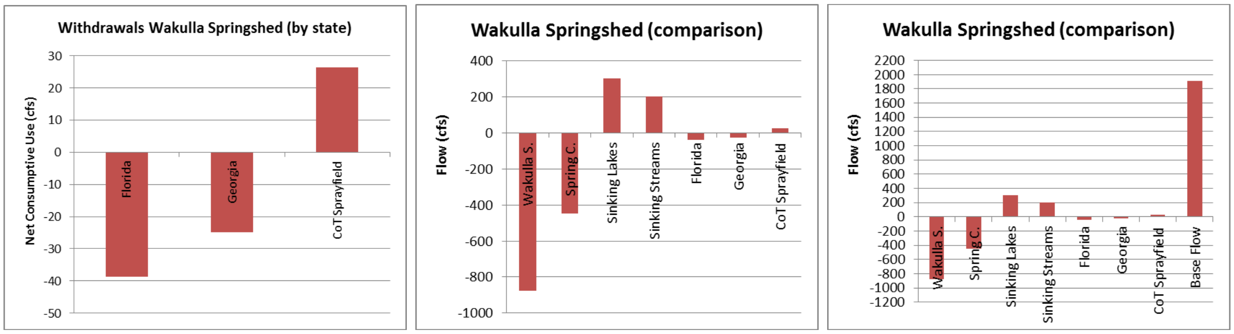

Figure 1.6: Water budget for Wakulla Springs

Table 1.2: Problems with Wakulla BMAP

1. Karst Features ignored
2. Georgia not included
3. Water volume/flow ignored
4. Brown water not considered
5. Restoration uncertain

Figure 1.6: Lake Lafayette is directly connected to Wakulla Springs with very green water with algae, this is a second new lake draining sinkhole that has recently opened up in Upper Lake Lafayette. It has been named Zoë’s Sink. Lake Lafayette was the major contributor of pollutants to the aquifer of all the karst features in our proposed Phase III plan. There is a video of a dive exploration and aerial observation of this new sink in Chapter 2 of this report (Section 2H, Diver and videographer, videos by the diver, Andreas Hagberg).

Section 1B, Visibility and Color Observations (not funded by FWF)

There has been a noticable decrease in visibility at Wakulla Springs. One of the best metrics to document the loss of visibility in the water is the Glass Bottom Boat (GBB) runs (figure 1). A rule at the park has been that the GBBs don't run unless there is at least 70 feet visibility because you cannot see many of the underwater features at the park without that much visibility. Henry's Pole is visibly at 30 feet, but the ledges to the spring vent are about 70 feet down as is the Creatures Hole, Mastadone Bones and Petrified Hollow Log. The spring basin is not visible at 70 feet as the caves are at about 200 feet.

From 06/30/16 to 06/11/20 we took 172 color readings on separate days, with mostly different people doing the readings each time. At least two people read the chart each time and recorded the color. These readings are taken on our weekly SpecRad run in the park on a boat supplied by the park, usually a GGB. 47% of the readings were numbers 17,18 and 19. A dark brown greenish hue.

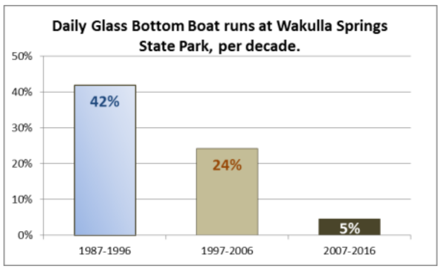

Figure 1.7: Glass Bottom Boat runs at Wakulla Springs 1987 to current (Data source, Edward Ball Wakulla Springs State Park).

Figure 1.8: Color chart used at Wakulla Springs

Color Readings	# Readings	% reading
Count (Total)	172	
Median (Total)	19	
Average (Total)	19	
Color # 4	8	5%
Color # 5	1	1%
Color # 12	8	5%
Color # 13	3	2%
Color # 17	40	23%
Color # 18	17	10%
Color # 19	55	32%
Color # 20	8	5%
Color # 21	1	1%
Color # 25	1	1%
Color # 26	1	1%
Color # 27	1	1%
Color # 28	10	6%
Color # 29	6	3%
Color # 30	8	5%

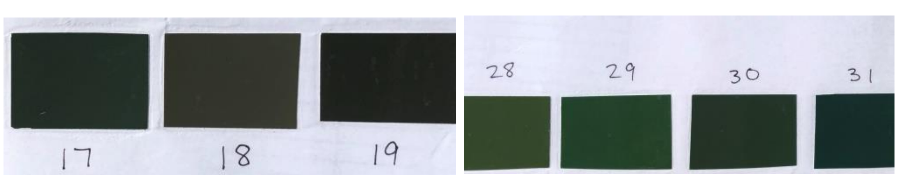

Figure 1.9: The water at Wakulla Spring,according to 47% of the readings was #17, #18 or #19, a dark brown greenish hue.

Section 1C, Previous Related Projects (funded in part)

PFS-1516-05: Wakulla Springs Dark Water: Causes and Sources
PFS-1617-08: Wakulla Springs Dark Water: Causes and Sources, Phase II

This project extended research conducted in Wakulla Springs Dark Water: Causes and Sources Phase I which was supported by funding from the Fish and Wildlife Foundation of Florida, Inc. through the Protect Florida Springs Tag Grant Program, project PFS #1516-05. Phase I demonstrated that dark water conditions experienced at Wakulla Springs are caused both by tannins and chlorophyll a including its degradation product, phaeophytin. We extended weekly sampling at the Wakulla Springs boil for an additional 88 weeks (8/11/16 – 3/29/18) for tannins (measured as true color), corrected chlorophyll a, and phaeophytin, plus spectral radiometric measurements of light attenuation with depth, to provide a more robust data set for identifying patterns of dark water conditions and associated water quality. We also designed Phase II to attempt to identify likely sources of the chlorophyll which we hypothesized was entering the spring in the ground water rather than being produced by algae inhabiting the vent and spring bowl. To this end, Phase II expanded weekly sampling of tannins and chlorophyll to seven wells that tap the major caverns flowing into Wakulla Springs (see figure 1.1). During Phase II we also conducted dye studies of two large karst lakes in the Wakulla Springshed, Lake Jackson and Upper Lake Lafayette, which we hypothesized, may be sources of the chlorophyll entering the spring. Both lakes receive urban stormwater inflows from the Tallahassee area and experience extensive algal blooms each year. Previous dye studies had documented the hydrologic connection of a third urban karst lake which also experiences extensive algal blooms, Lake Munson (Kincaid et al., 2007). In an effort to document specific linkages of chlorophyll at Wakulla Springs to one or more of these lakes, we collected samples from all three lakes for taxonomic and environmental DNA analyses in October 2017.

Our initial Dark Water investigation (PFS-1516-05) demonstrated for the first time that the "green dark water" conditions that have been experienced at Wakulla Springs since the late 1990s are caused by chlorophyll and phaeophytin. That project also documented for the first time the effects of the dynamics of the inter-connected Wakulla Springs and Spring Creek Spring complex hydrologic system on "brown dark water" conditions at the spring.

Our Dark Water Phase II Project, for which data collection and analysis concluded in November 2017, documented for the first time a hydrologic connection between one of the three suspected sources of the chlorophyll and phaeophytin responsible for the "green dark water" conditions at the spring - Lake Lafayette and Wakulla Springs. Previous dye trace studies had already established such a connection with Lake Munson, and a dye trace study in September 2017 did the same for the third possible source - Lake Jackson. Twelve months of Phase II sampling of water quality in the cavern complex that feeds Wakulla Springs also has proven that virtually all of the chlorophyll and phaeophytin responsible for the "green dark water" conditions in the spring originate from outside of the spring itself.

Our efforts during Phase II showed that all the sinking lakes in the Wakulla Springshed were sources of the chlorophyll. Open sinkholes in most of the lakes allowed the chlorophyll laden lake water to pass directly into the aquifer with negligible treatment. Our Phase II efforts also showed that the sinking streams were not a source of chlorophyll as their tannic stained water was dark brown and inhibited photosynthesis and the growth of algae that produce chlorophyll. Our dye trace studies, also in Phase II definitively proved that the water from these sinking lakes flows into the aquifer and through subterranean caves flows directly, by cavernous flow, into Wakulla Springs. By sampling wells drilled into the caverns flowing into Wakulla Springs we even showed which caves carried the various pollutants, including chlorophylls, to Wakulla Springs. We decided to use expanded analysis of the taxonomy, both the physical taxonomic identification of plankton with a microscope and sequencing the DNA we sampled in the Wakulla Springs water, to yield a more definitive taxonomic identification of the photosynthetic microflora and fauna in the Wakulla Springs water.

Additional analysis of the Wakulla Springs-Spring Creek Springs complex relationship during Phase II has revealed that the dynamics of the system are more variable than we first thought. Collecting and analyzing data for another 17 months, along with using newly-acquired Doppler rainfall data from the Northwest Florida Water Management District, should provide a more robust data set that will enable us to better explain when and why the sinking lakes, sinking streams and the Spring Creek Springs complex flows disrupt, stop or reverse flows causing increased flows of tannic "brown dark water, algae rich green water and unpotable saline water” to Wakulla Springs.

Chapter 2
Background, Water Quality in the Wakulla Springshed

Section 2A, Intro

This project was completed for the Wakulla Springs Alliance by McGlynn Laboratories, Inc. with financial assistance provided by the Fish and Wildlife Foundation of Florida, Inc. through the Protect Florida Springs Tag Grant Program, project PFS #1617-08. The analytical results contained within this report meet all NELAP requirements for parameters for which NELAP accreditation is required or available. Any deviations from NELAP requirements are noted in this report. Dr. Seán E. McGlynn (Laboratory Manager) and Kathleen A. McGlynn (Quality Assurance Officer) implemented the sampling program and laboratory analysis of the environmental parameters addressed in this report, concerning the authenticity, precision, limits of detection and accuracy of the data, except for the taxonomy and environmental DNA analysis which were run under the auspices of Dr. Akshinthala Prasad of Florida State University and Drs. Thomas Sawicki, Richard Long and Graduate Student Kaylee Castle, of the Florida A&M University, Department of Biology who are responsible for the authenticity, precision, limits of detection and accuracy of the data in Chapter 5.

Section 2B: Water Quality, Visibility

Visibility at Wakulla Springs is highly variable but is definitely increasing. Since we started studying the visibility in Wakulla Springs in 2016 visibility is increasing at a rate of 3 feet per year. Clear episodes occur in the late spring, May, June and July, a dry season here in the Florida Panhandle. Wakulla's dry spring weather causes minimum tannic flows from the sinking streams and clearer water seeping from the sinking lakes, because of the winter seasons low growth of algae. The clear water of spring gradually morphs into our wet season, and tropical weather of the summer Hurricane Season, with a dramatic loss of visibility, due to maximum flows of tannins from the pristine wetlands in the National Forrest drained by the sinking streams and the greening of our lakes as they fill with urban stormwater causing the dark water associated with the Hurricane season. Wakulla Springs even cleared enough during the COVID-19 Pandemic, when the Park was closed, to run the Glass Bottom Boats again, though the park has run them under lesser visibility before (Figure 2.1).

Wakulla Springs visibility was measured weekly at the Spring Boil, from a boat and driver supplied by the Park Service and MLI staff (Sean and Julia McGlynn) and volunteers (Cal Jamison, Sophie Speer, Emily Speer, Brian Lupiani, David Sheppard and Ken Beattie). Visibility is the average of three different optical measurement, all expressed in feet. The three measurements are averaged: secchi; photosynthetically active radiation (PAR); and spectral radiometry. Field and laboratory methodology are detailed in our Phase I Report (McGlynn and Deyle, 2019, chapter 2).

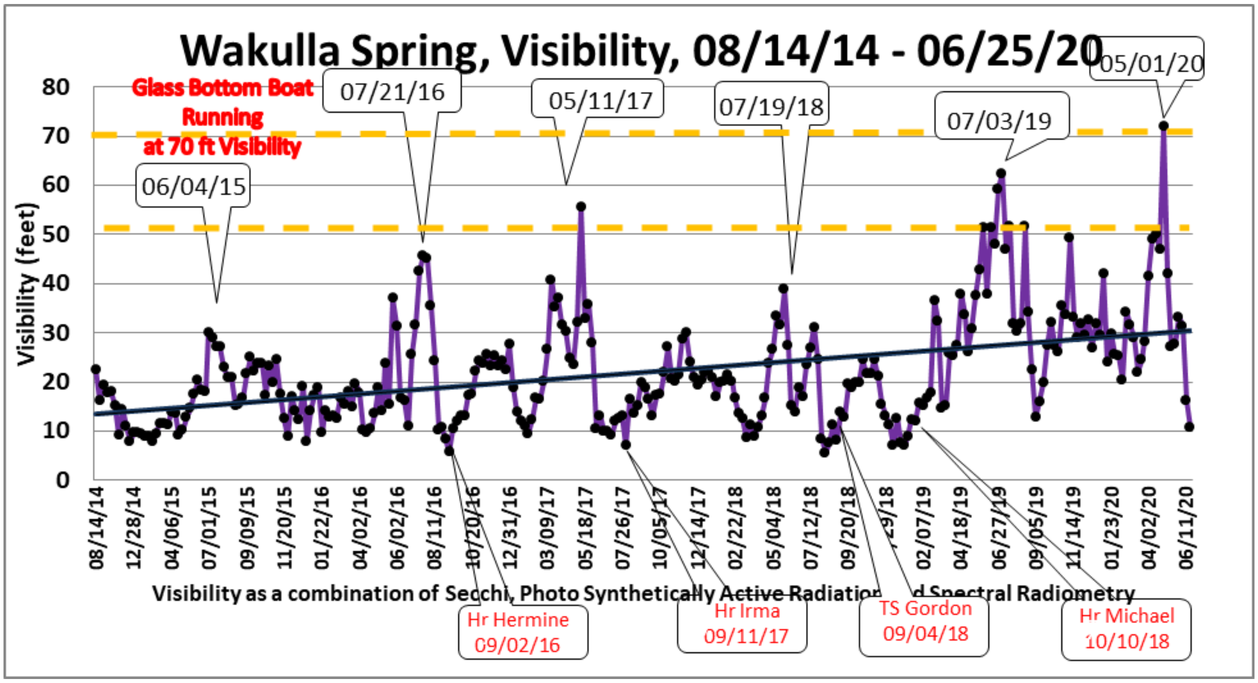

Figure 2.1: Visibility at Wakulla Springs (MLI data).

Section 2C, Water Quality, Sinking Streams

The Wakulla Springshed is a very complex system. All water in the Springshed winds up at either Wakulla Springs or Spring Creek. Spring Creek and Lost Creek both have major effects on the water balance and quality of Wakulla Springs and they have very different flow patterns with alternating lapses in flow. The Wakulla River, the sum of both flows, remains more constant. There is no direct measurement of the groundwater base flow into Wakulla Springs. It is predominantly clear water (lacking tannic color) and likely elevated with nitrates and chlorophylls that infiltrate through the soil above the aquifer or pass through a karst window directly into the aquifer. The sinking streams are loaded with rather pristine tea colored brown tannic water draining out of the extensive tracts of national forest in the Wakulla Springshed (approximately 40%, figure 2.7). There is also flow into the cave system from the sinking lakes which contribute algae (chlorophylls) to the aquifer (figure 2.8).

Lost Creek is connected to both Wakulla Springs and Spring Creek between which flow reversal in the cave system occurs. According to Hal Davis, a respected geologist and expert on Wakulla Springs, the Sopchoppy and Lost Creek were almost identical, in color and flow patterns. Therefore, the Sopchoppy River Flow was used as a surrogate for Lost Creek. Figure 2.2 depicts Spring Creek and Lost Creek (substituting the Sopchoppy flows), rainfall in the Wakulla Springs State Park as well as the flow of Wakulla Springs at the Shadeville Bridge (the southern boundary of the Park). The flows of other sinking streams in the Wakulla Springshed are rather inconsequential when compared to Lost Creek. Lost Creek comprises 84.2% of the creek flow within its banks (Figure 2.3). Lost Creek, like the other smaller creeks in the Wakulla Springshed has a lot of data gaps. Lost Creek (in red) and the Sopchoppy River (in blue) are depicted in Figure 2.4. For extended time periods there is no data for Lost Creek while the Sopchoppy River has a nearly continuous record of flow. The data for the two streams shows their remarkable similarity. The Sopchoppy flows are 95.7% proportional to the Lost Creek flows (Figure 2.5). The Sopchoppy flows are 95.7% proportional to the Lost Creek flows (Figure 2.6). Therefore, we assumed, in this study, that the Sopchoppy River is a good surrogate for the sinking stream or subterranean creek flows into Wakulla Springs. The sinking streams and major mapped caves are mapped in a Wakulla Springs basin map (Figure 2.7, Davis and Verdi, 2014).

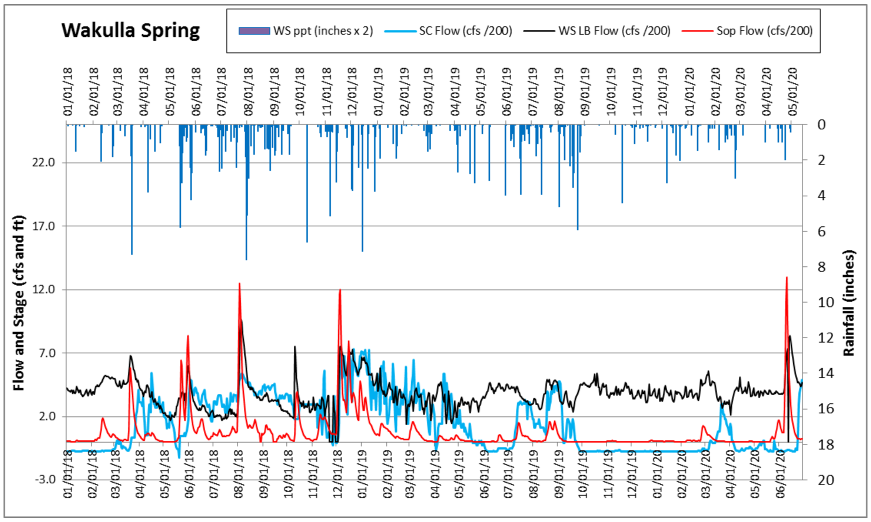

Figure 2.2: Spring Creek and Lost Creek flow (we are using the Sopchoppy River Flow as a surrogate) and rainfall. Rainfall data from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL. SC flow by MLI. Wakulla Spring flow from USGS gauge 02327022 Wakulla River near Crawfordville, FL. The Sopchoppy flow data is from the USGS gauge 02327100, Sopchoppy River near Sopchoppy, FL.

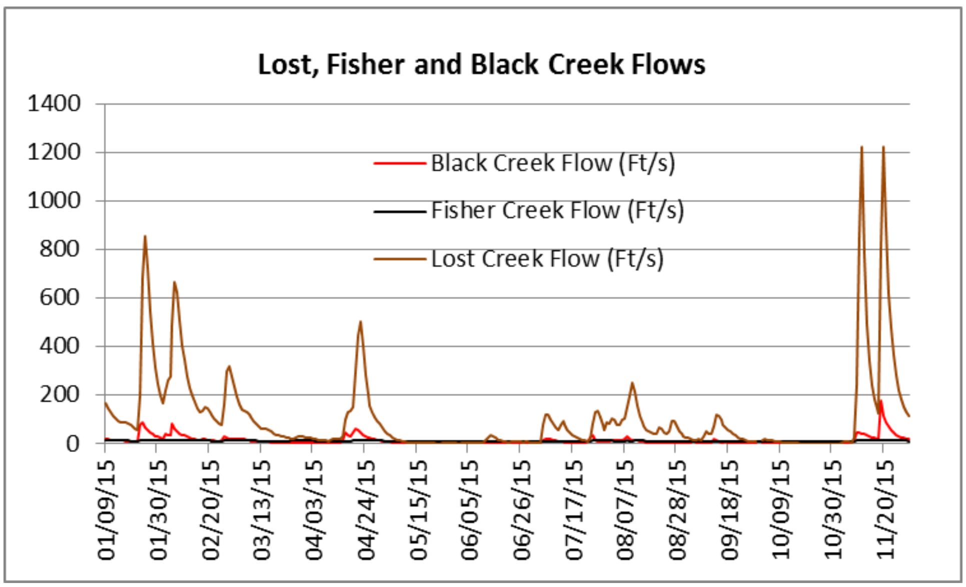

Figure 2.3: Black, Fisher and Lost Creeks flow data (USGS data, gauges no longer in service).

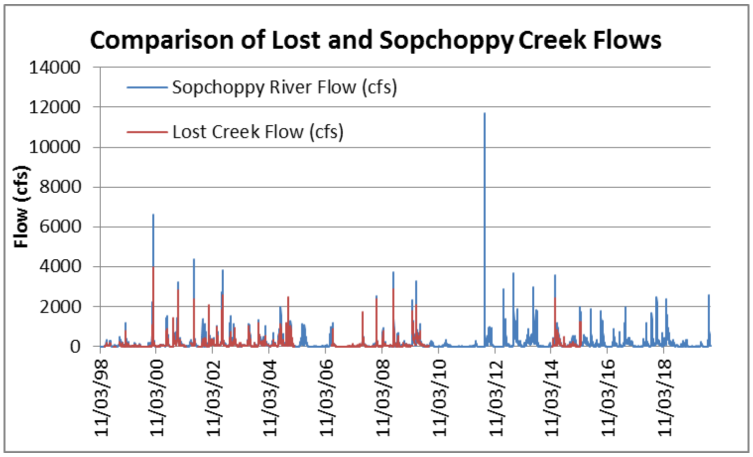

Figure 2.4: Data gaps in Lost Creek (in red) and the Sopchoppy River (in blue). USGS 02327033 Lost Creek at Arran FL. The Sopchoppy flow data is from the USGS gauge 02327100, Sopchoppy River near Sopchoppy, FL.

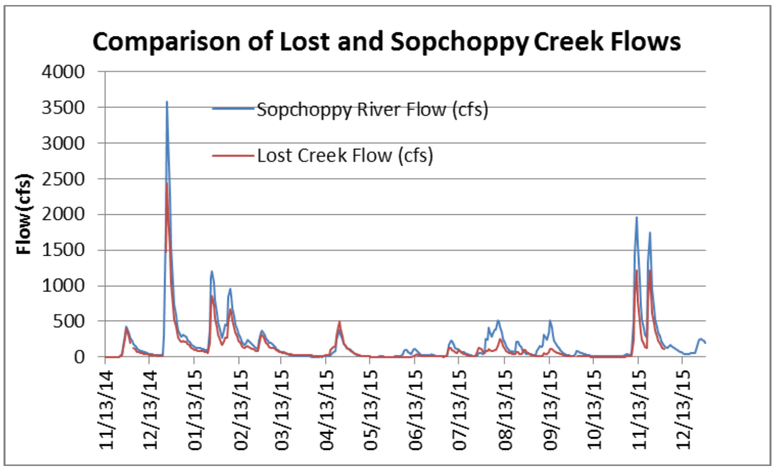

Figure 2.5: A year of data for the two streams and their remarkable similarity. Data source as in figure 2.4

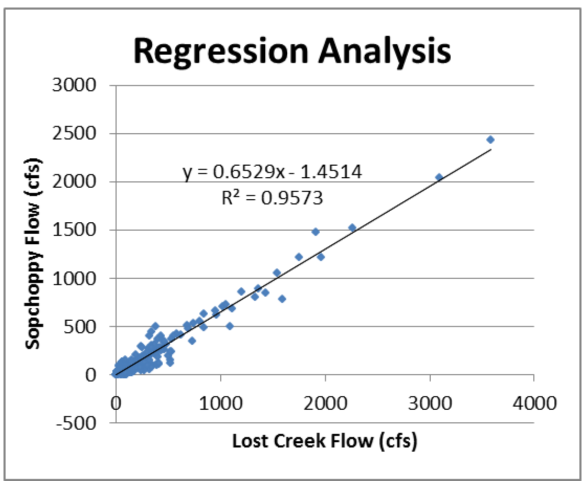

Figure 2.6: The Sopchoppy flows are 95.7% proportional to the Lost Creek flows. Data source as in figure 2.4

Section 2D, Water Quality, Dye Studies

This study has contributed the longest dye study to date in the Wakulla Springshed, the dye traveled 29 miles underground, from Lake Iamonia to Wakulla Springs, with a speed of 1.7 miles per day. We also documented the flow from the sinkhole in Upper Lake Lafayette for 16 miles at a speed of 0.65 miles per day. At Lake Jackson the dye traveled 19 miles to Wakulla Springs, all in underground caverns at a speed of 0.55 miles per day. The Wakulla Springshed is riddled with caves, we don't know where most of them are, but we have mapped so many that the Wakulla Springshed has the longest mapped underwater cave system in the world.

This section presents the results of dye studies from previous phases of this grant as well as the work of other researchers: the Florida Geological Society; GeoHydros; and by Professor Ming Ye in the Department of Earth, Ocean, and Atmospheric Science FSU. Figure 2.8 shows the Sinking Lakes and dye studies run in Phase II: Lake Jackson, Upper Lake Lafayette (2x) and Lake Iamonia as well as the Lake Munson Dye studies previously run by GeoHydros, LLC and Cambrian Ground Water, Inc. with support from the Florida Geological Survey.

Most of the dye studies applicable to the Wakulla Springshed are listed in Table 2.1. Two studies were performed in Lake Miccosukee; in the first, the dye was never found again, so it is not included in this table. However, a different dye study in nearby Bird Sink went to Wakulla and later to St Marks. Likewise, Lost Creek water was found to go to either St. Marks or Wakulla at different times. Figure 2.9 details the Wakulla Springs cave system (Map from Karst Hydrogeology of the Woodville Karst Plain, Wakulla & St. Marks River Basins, Todd R. Kincaid, Ph.D., 2006) with Google Pro cave map (Wakulla_Leon_cavern_080810).

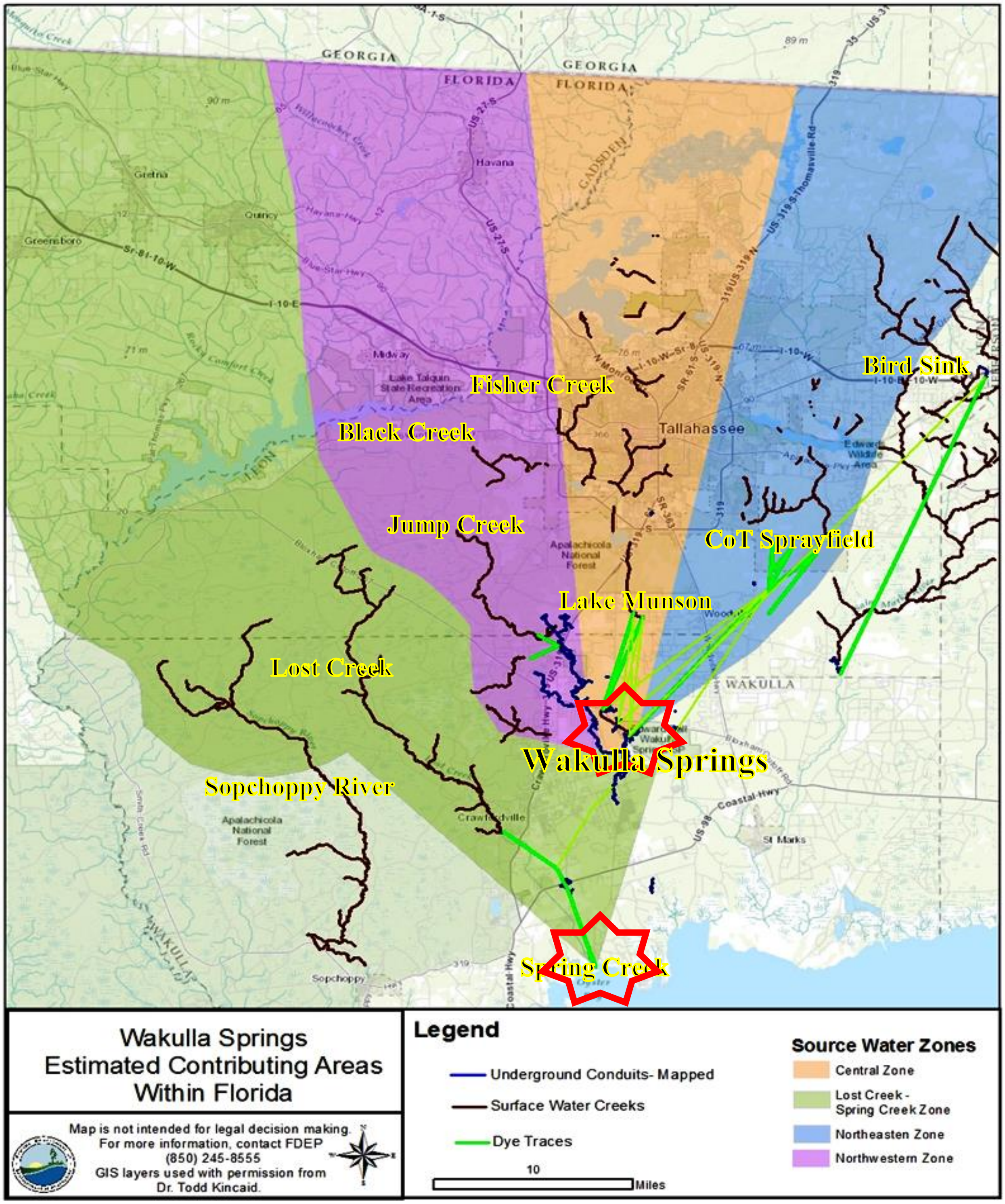

Figure 2.7. Sinking streams and major mapped caves in Wakulla Springs basin (Davis and Verdi, 2014).

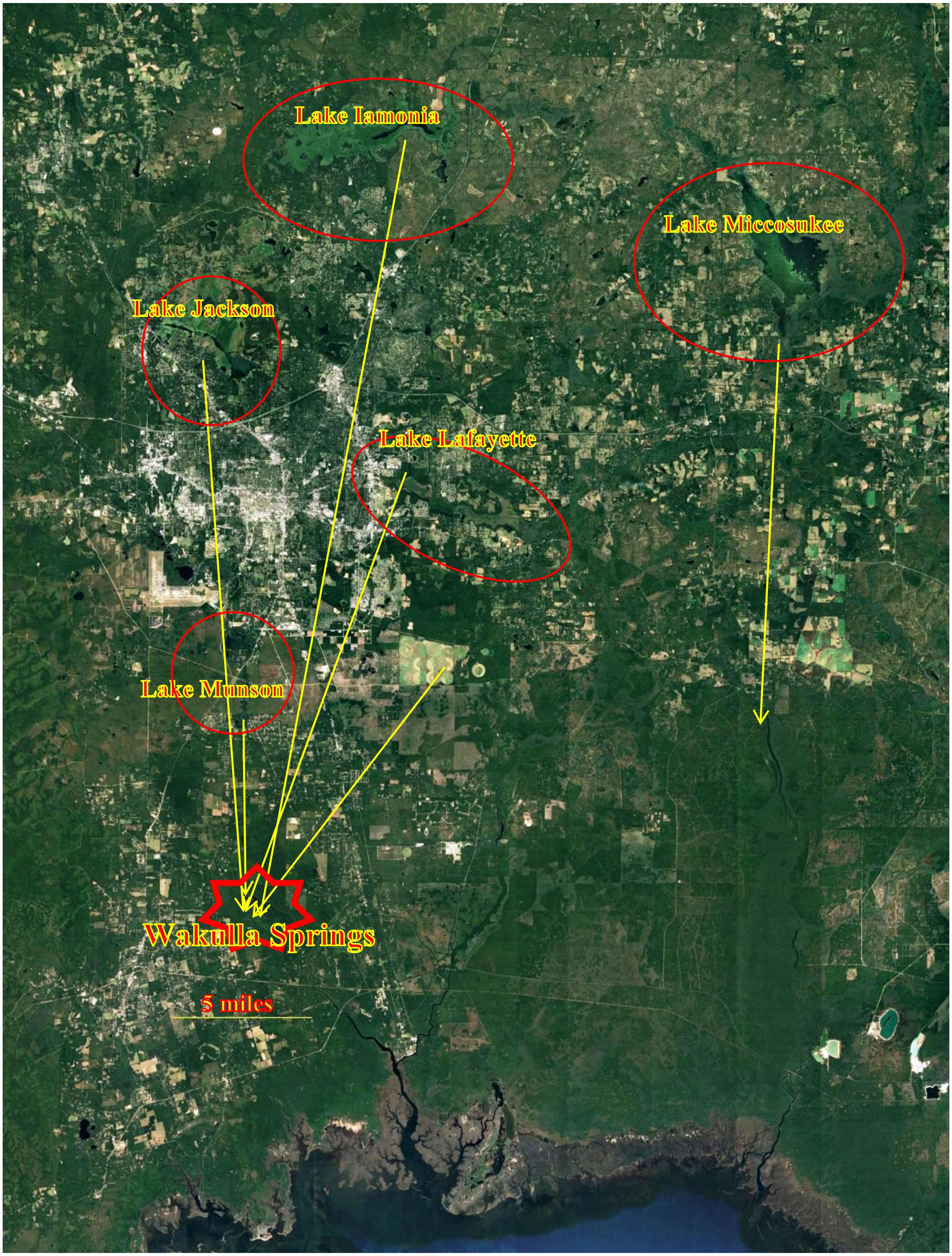

Figure 2.8: Sinking lakes and dye studies run in Phase II: Lake Jackson, Upper Lake Lafayette (2x) and Lake Iamonia.

Table 2.1: Most of the dye studies applicable to the Wakulla Springshed.

GROUNDWATER TRACING RESULTS FROM THE WOODVILLE KARST PLAIN, NORTH FLORIDA

YEAR	FROM	TO	Organization	Dye Type	DISTANCE (MILES)	QUANTITY (KG)	PEAK TRAVEL TIME (DAYS)	VELOCITY (FEET/DAY)	VELOCITY (MILES/DAY)
2004	Ames Sink	Indian Spring (min)	Note 1	Fluorescein (FITC)	5.2	7	15.99	1720	0.326
2004	Ames Sink	Indian Spring (max)	Note 1	Fluorescein (FITC)	5.2	7	19.78	1390	0.263
2004	Ames Sink	Wakulla Spring (min)	Note 1	Fluorescein (FITC)	5.73	7	21.98	1380	0.261
2004	Ames Sink	Wakulla Spring (max)	Note 1	Fluorescein (FITC)	5.73	7	22.73	1330	0.252
2005	Ames Sink	Indian Spring	Note 1	Fluorescein (FITC)	5.2	7	16.6	1650	0.313
2012	Bird Sink	Rhodes Spring	Note 1	Fluorescein (FITC)	15.2	100	13.01	6170	1.169
2012	Bird Sink	Natural Bridge Sink	Note 1	Fluorescein (FITC)	15.2	100	13	6170	1.169
2012	Bird Sink	St. Marks River Rise	Note 1	Fluorescein (FITC)	15.5	100	13.65	6000	1.136
2012	Bird Sink	Horn Spring	Note 1	Fluorescein (FITC)	12.5	100	11.78	5600	1.061
2012	Bird Sink	Wakulla Spring	Note 1	Fluorescein (FITC)	23.2	100	52.11	2350	0.445
2003	Black Creek	Emerald Sink	Note 1	Fluorescein (FITC)	1.6	2	3.18	2660	0.504
2005	Black Creek at Bird Sink	St. Marks River Rise	LEON/MLI	Rhodamine (WT)	16.00	0.25	28.00	3017	0.57
2005	Burnt Mill Creek	St. Marks River Rise	LEON/MLI	Rhodamine (WT)	10.00	0.25	22.00	2400	0.45
2004	Emerald Sink	Wakulla Spring via Fish Hole	Note 1	Fluorescein (FITC)	10.46	3	7.09	7790	1.475
2004	Emerald Sink	Wakulla Spring via Clear Cut	Note 1	Fluorescein (FITC)	10.19	3	7.09	7590	1.438
2002	Fisher Creek	Emerald Sink	Note 1	Fluorescein (FITC)	1.2	2	2.37	2680	0.508
2005	Indian Spring	Wakulla Spring	Note 1	Fluorescein (FITC)	6.29	5	5.9	5630	1.066
2005	Kelly Sink (Ames)	Indian Spring	Note 1	Fluorescein (FITC)	5.2	7	13.5	2030	0.384
2018	Lake Iamonia (Sink)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	29.00	15.00	17.00	9007	1.71
2017	Lake Jackson (Porter Hole)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	19.10	15.00	35.00	2881	0.55
2017	Lake Lafayette (ULL)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	16.30	15.00	35.00	2459	0.47
2018	Lake Lafayette (ULL)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	16.30	15.00	25.00	3442	0.65
2018	Lake Miccosukee (South Sink)	St Marks Rise	FSU/Ming	Fluorescein (FITC)	20.80	20.00	20.00	5491	1.04
2004	Lake Munson (Ames)	Wakulla Spring	Note 1	Fluorescein (FITC)		7.00	21.98	0	0.00
2004	Lake Munson (Ames)	Wakulla Spring	Note 1	Fluorescein (FITC)	5.73	7.00	22.73	1331	0.25
2008/2009	Lost Creek	Spring Creek	Note 1	Fluorescein (FITC)	7.5	15	5	7920	1.500
2008/2009	Lost Creek	Wakulla Spring	Note 1	Fluorescein (FITC)	7.75	15	47	870	0.165
2005	Natural Bridge Sink	Rakestraw Gate Swalette	LEON/MLI	Rhodamine (WT)	0.03	0.25	0.024	6517	1.23
2005	Natural Bridge Sink	Rakestraw Middle Swallette	LEON/MLI	Rhodamine (WT)	0.10	0.25	0.067	7920	1.50
2005	Natural Bridge Sink	St. Marks River Rise	LEON/MLI	Rhodamine (WT)	0.62	0.25	0.312	10499	1.99
2005	Rhodes #2	St. Marks River Rise	LEON/MLI	Rhodamine (WT)	1.00	0.25	1.06	4981	0.94
2006	Spray field Turf Pond Sink	Wakulla Spring	Note 1	Fluorescein (FITC)	10.9	60	56	1030	0.195
2006	Spray Field Wells (max)	Wakulla Spring	Note 1	Fluorescein (FITC)	10.4	60	66.5	830	0.157
2006	Spray Field Wells (min)	Wakulla Spring	Note 1	Fluorescein (FITC)	10.4	60	56	980	0.186
2001	Sullivan Sink	Cheryl Sink	Note 1	Fluorescein (FITC)	1.58	0.75	0.96	8680	1.644

Note 1: Tracing performed by GeoHydros, LLC and Cambrian Ground Water, Inc. with support from the Florida Geological Survey

Table 2.2: Most of the dye studies applicable to the sinking lakes in the Wakulla Springshed.

YEAR	FROM	TO	Organization	Dye Type	DISTANCE (MILES)	QUANTITY (KG)	PEAK TRAVEL TIME (DAYS)	VELOCITY (FEET/DAY)	VELOCITY (MILES/DAY)
2004	Lake Munson (Ames)	Wakulla Spring	Note 1	Fluorescein (FITC)	5.73	7.00	21.98	1376	0.26
2004	Lake Munson (Ames)	Wakulla Spring	Note 1	Fluorescein (FITC)	5.73	7.00	22.73	1331	0.25
2017	Lake Lafayette (ULL)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	16.30	15.00	34.83	2471	0.47
2018	Lake Lafayette (ULL)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	16.30	15.00	30.00	2869	0.54
2018	Lake Iamonia (Sink)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	29.00	15.00	17.00	9007	1.71
2018	Lake Miccosukee (South Sink)	St Marks Rise	FSU/Ming	Fluorescein (FITC)	20.80	20.00	20.00	5491	1.04
2017	Lake Jackson (Porter Hole)	Wakulla Spring	WSA/MLI	Rhodamine (WT)	19.10	15.00	35.21	2864	0.54

Note 1: Tracing performed by GeoHydros, LLC and Cambrian Ground Water, Inc. with support from the Florida Geological Survey

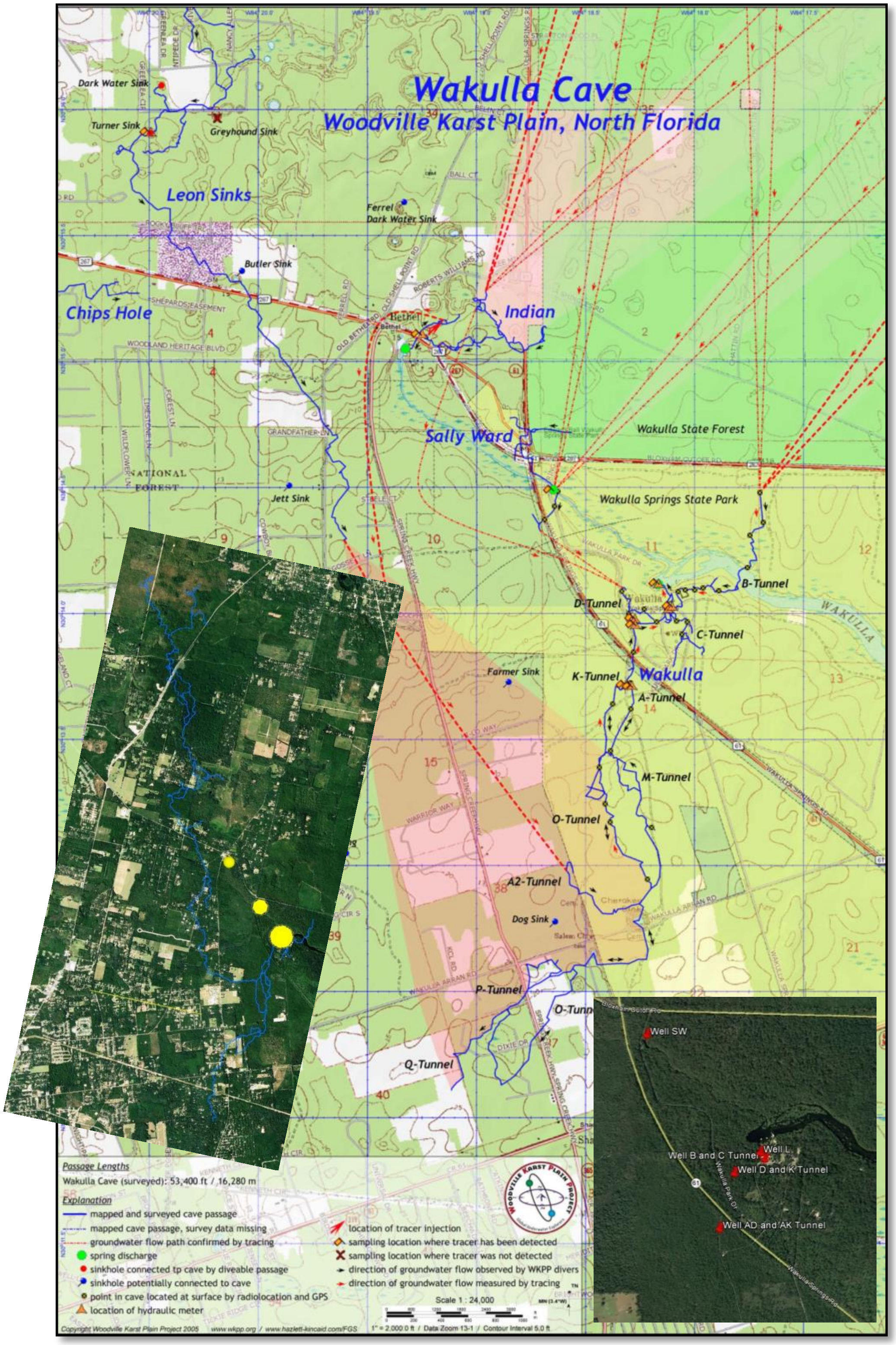

Figure 2.9: Wakulla Springs cave system (Map from Karst Hydrogeology of the Woodville Karst Plain, Wakulla & St. Marks River Basins, Todd R. Kincaid, Ph.D., 2006) with Google Pro cave map, Wakulla_Leon_cavern_080810.

Section 2E, Water Quality, Caves and Creek Water Quality, 08/06/16 – 04/06/17

The caves flowing to Wakulla Springs were sampled from pre-existing wells as part of Phase II (Cave Wells: B, C, D, K, L AK, AD and SW, please see insert in Figure 2.9). The water quality in the caves was different and grouped. Caves C, D B and SW (for Sally Ward Spring) are clear water; it is not tannic and the water from these caves has good visibility. These caves flow from the north while Lost Creek dominates the flow of tannic or brown water, flowing into and through Spring Creek as well as the A and K caves which suffer poor visibility when Lost Creek is flowing. Lost Creek flow is flashy and very rain dependent. The L well and the Boil are very similar in tannic content (Figure 2.10).

Chlorophylls varied from cave to cave too. Chlorophylls are the green photosynthetic pigments of plants and algae. They were highest in Spring Creek because that is a marine system, which harbors a great diversity of plankton naturally. Of the wells SW, Sally Ward, was the highest and this cave gets water directly from the sinking lakes. We were able to track major traces of dye in both Wakulla Springs and Sally Ward Spring, usually during the same dye study, indicating that there are multiple subterranean paths the water can take flowing south to Wakulla Springs. The L well and the Wakulla Boil are a mixture of all these cave waters and did have low but appreciable concentrations of chlorophylls in their flows (Figure 2.11).

Nitrates were highest in the caves flowing from the north that flow under more populated areas, particularly in Tallahassee. The C, D, B and of course, SW were the highest, and probably flow under the most septic tanks as well as lakes. The other wells and creeks that flow to the less populated south of the Springshed were significantly lower. Nitrates were rather low in all the wells sampled, probably due to weather and hydrological conditions during the study (Figure 2.12)

Specific Conductance is a measure of salts in the water used more for fresh water. In salt water salinity is measured which is directly interconvertible with Specific Conductance which is about 1000 times higher than salinity and the two different scales are used to minimize the amount of numbers. Lost Creek's brown tannic water flowing from the National Forest is very fresh without conductance. The ground water in their limestone caves absorbs conductivity from the lime rock and is usually at an equilibrium concentration with the lime rock at about 300 units. The caves to the south have slightly lower conductivities because of the fresh water input of Lost Creek. Spring Creek is a marine system with very high conductance from the salt water and tidal mixing that occurs there. As we will see next, Spring Creek is a source of salty water loading at Wakulla Springs occasionally (this did not occur during our well sampling during Phase II, Figure 2.13).

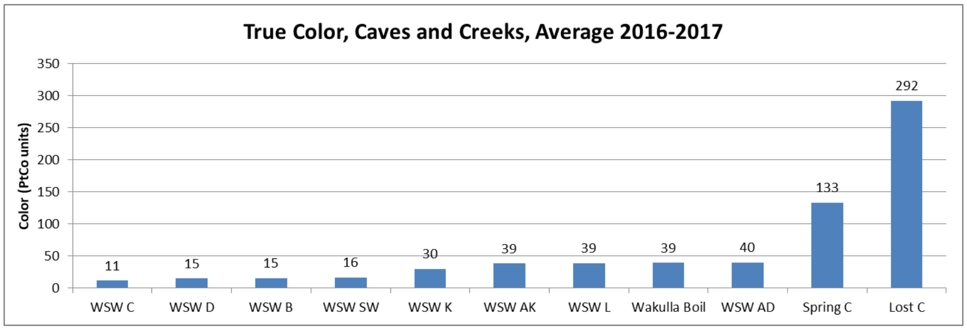

Figure 2.10: True Color was sampled for the caves flowing to Wakulla Springs as part of Phase II. MLI data.

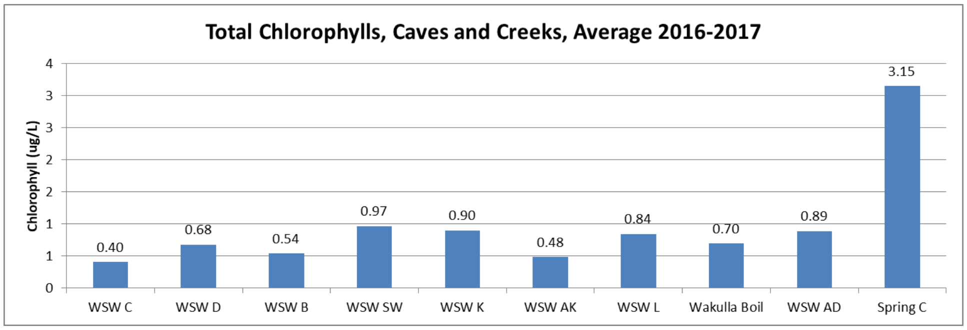

Figure 2.11: Chlorophylls, the green photosynthetic pigments of plants and algae, were sampled for the caves flowing to Wakulla Springs as part of Phase II. MLI data.

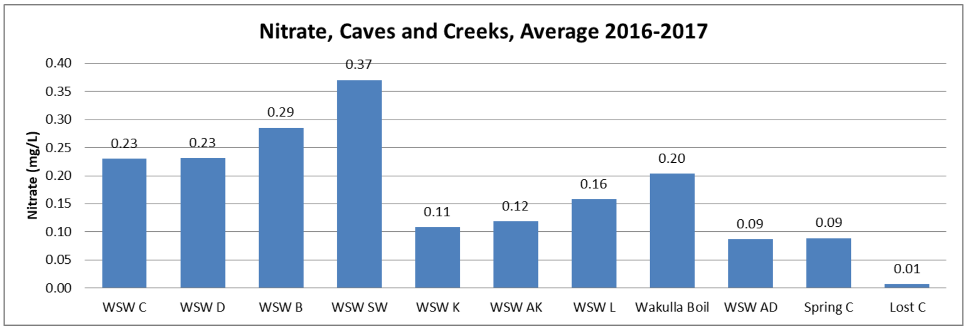

Figure 2.12: Nitrates were sampled for the caves flowing to Wakulla Springs as part of Phase II. MLI data.

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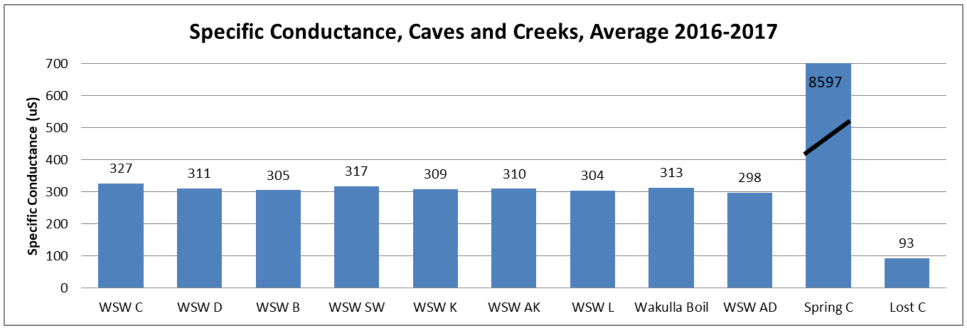

Figure 2.13: Specific Conductance was sampled for the caves flowing to Wakulla Springs as part of Phase II. MLI data.

Section 2F, Water Quality, Salinity Episodes

There have been several salinity episodes at Wakulla Springs. There have been 11 episodes of high conductivity or low salinity* which are called salinity spikes and seem to have started around 2007 at Wakulla Springs (figure 2.14). We sampled various stations in the Wakulla Springshed during a salt episode, a time when salinity was detected in Wakulla Springs, to determine where it came from. The type of salt in the salinity was chloride, so it came from the marine environment. Spring Creek, the most likely source, had the highest salinity and Lost Creek the lowest.

- The wells flowing from the north: B; D; SW; and C had the lowest salinities. Their salinity was basically background concentrations typical of the Floridan Aquifer and its lime rock matrx.
- The AK, AD and K wells had the most salinity, and they flow into Wakulla Springs from the South, usually carrying the tannic water from Lost Creek, now they are carrying salt water from Spring Creek.

This is evidence of flow reversal in the caves in the southern end of the Springshed that run between Lost Creek, Spring Creek and Wakulla Springs. Dye studies have already shown that they are connected and reverse flow. Divers have experienced it. Graduate students have studied it (Dyer, 2015). This is additional evidence. The Boil and L well were at median concentrations between the north and south wells indicating that they were a mixture of both sets of caverns (Figure 2.15)

We also measured the tannic brown water, measured as true color, during a saline episode in Wakulla Springs, wells and creeks. True color was low and randomly dispersed through the Springshed. Wakulla Springs had good visibility, as did Spring Creek, and we took the opportunity to explore that cave system. The entire Springshed was rather clear. Lost Creek was barely flowing (Figure 2.16).

Nitrates were measured during a saline episode in Wakulla Springs, wells and creeks. Nitrates were not detected in the southern caves, Spring Creek or Lost Creek. They are not coming from the south, but the northern caves, the boil and the L well all had high nitrates, higher than average, due to the lack of clean Lost Creek water, which tends to dilute the nitrate in the water in the Springshed (Figure 2.17).

We did a Spring Watch run down the Wakulla River at this time too. This is a series of transects taken (beginning at the boil), as we flowed downstream through the park. This is evidence that the salty water was not flowing up the river to the park, but was flowing out of the boil and downstream and actually was getting diluted as it flowed down the river, mostly diluted by the multitudes of small springs along the river as well as lateral seepage from the banks of the river (Figure 2.18).

*Specific conductance, salinity and total dissolved solids (TDS) are all measures of the same thing, dissolved ions in water. Since ions have charge and carry currents they can be measured as a conductance (specific conductance) a concentration (salinity) or a weight (TDS) and these results can be converted from one to another.

This data set proves that salt water was coming from the caves, from Spring Creek all the way to Wakulla Springs. These episodes are periodic. They are causing a change in the aquatic plant community at Wakulla Springs.

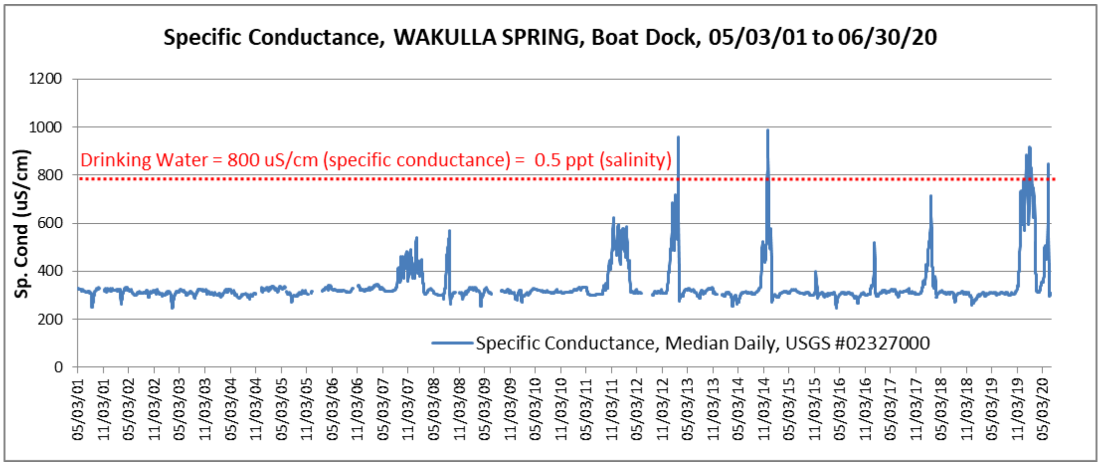

Figure 2.14: Specific conductance in the Wakulla Springshed. This data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL.

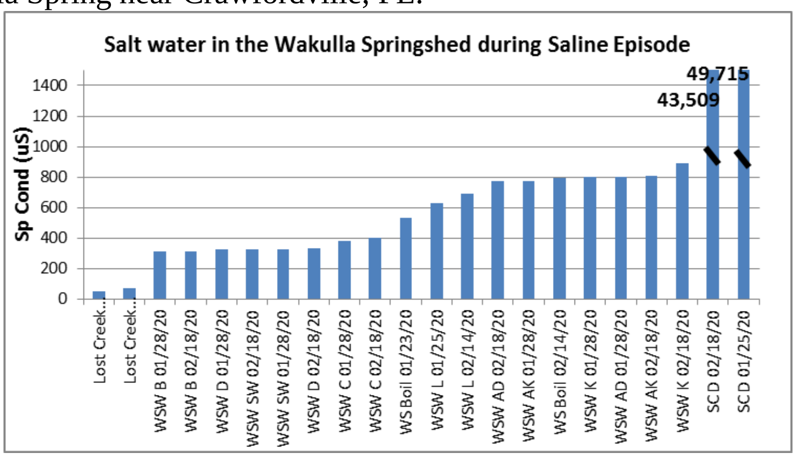

Figure 2.15: The samples results for specific conductance during the salt water event. MLI data.

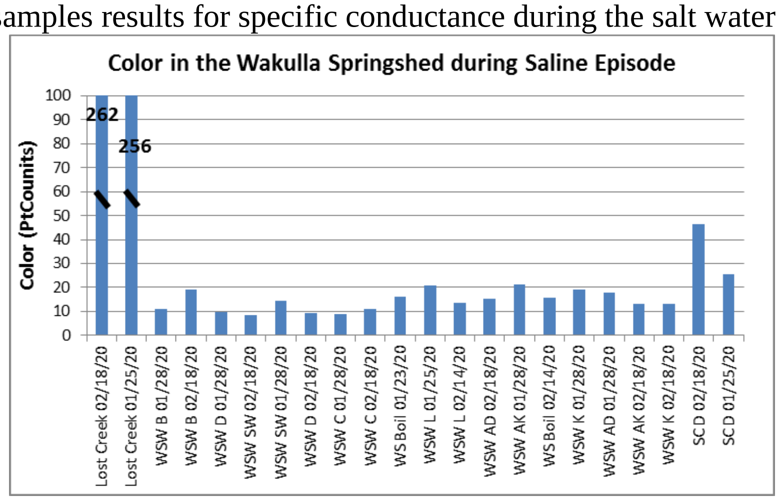

Figure 2.16: Color or tannic stained brown water was measured as color during a saline episode in Wakulla Springs, wells and creeks. MLI data.

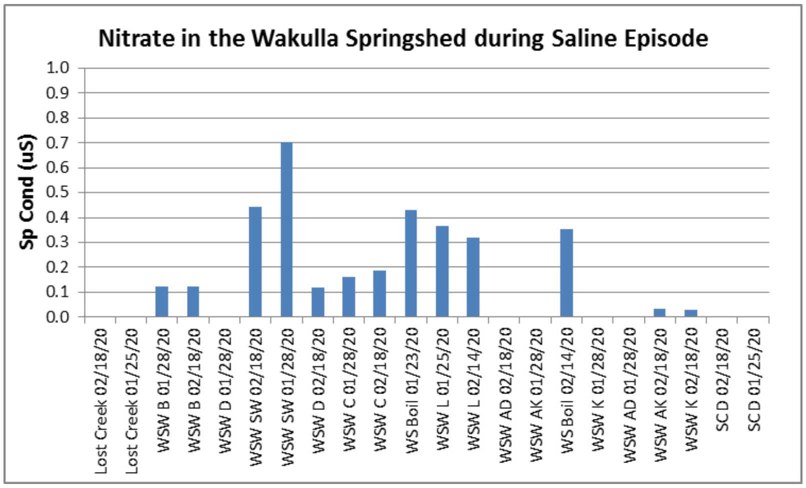

Figure 2.17: Nitrates were measured during a saline episode in Wakulla Springs, wells and creeks. MLI data.

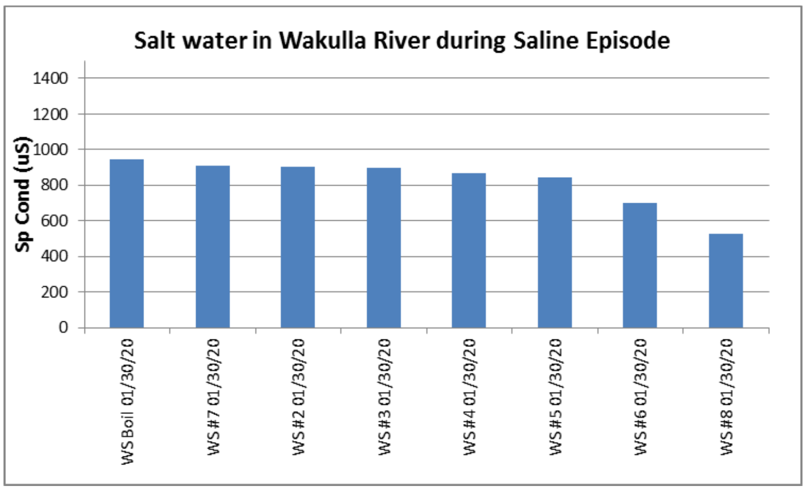

Figure 2.18: A series of transects taken (beginning at the boil), and measured for specific conductance as we flowed downstream through the park. MLI data.

Section 2G, Water Quality, Spring Creek Flow Inconsistencies

We have been using the fraction of Salinity Model, to calculate flow at Spring Creek. This is detailed in our Wakulla Springs Dark Water: Causes and Sources, Phase I Final Report, Chapter 4, Discharge in the Coupled Springsheds: Wakulla and Spring Creek (McGlynn, S.E. and R.E. Deyle, 2019, Davis and Verdi, 2014, Dyer, 2015). In this section we will compare the USGS flows with our calculated flows trying to explain the various aspects relating to water quality and in particular visibility and salinity at Wakulla Springs.

The first graph in this section shows the past year of flow data from Spring Creek, to clearly show the problems encountered trying to use the USGS data (Figure 2.19). The USGS tidally corrected flow data and MLI Fraction of Salinity model flows were in fairly good agreement, until 10/20/19, when it becomes more erratic. Outflow at Spring Creek ceased and a saline episode began to occur at Wakulla Springs. The USGS data stops on 01/20/20. I have been taking weekly water quality sampling at Spring Creek during this project witnessing the flows first hand. It was obvious that the USGS gauge data was no longer accurate and soon they removed the data which has not reappeared since (Figure 2.19).

The next graph shows all of the data from the USGS gauge at Spring Creek (07/25/07-06/30/20) has been plagued by numerous malfunctions and has multiple periods of missing data (highlighted in yellow, Figure 2.20). The USGS is currently rebuilding the platform higher so that it is above the surge level experienced during Michael (10/10/18). After hurricane Michael the USGS gauge in Spring Creek suffered severe damage as did the homes and local businesses in the area. The USGS data for the year 2020 is missing and cannot be recovered.

Now we are looking at the USGS flow data from Spring Creek (10/03/13-06/30/20) with USGS and NWFWMD specific conductance data from the Wakulla River. Notice that the USGS data overlaps the salinity/conductance spikes, which typically occur when Spring Creek is in a reverse flow mode (10/03/13-06/30/20) (Figure 2.21). This does not seem possible.

MLI and USGS flow data from Spring Creek (10/03/13-06/30/20) modeled by the fraction of salinity method, with USGS and NWFWMD specific conductance data from the Wakulla River; notice that the MLI data brackets the salinity/conductance spikes, which typically occur when Spring Creek is in a reverse flow mode. This model cannot adequately predict the magnitude of reverse flow in Spring Creek because when Spring Creek is in reverse flow, without any fresh water input, the salt content of the water does not change (Figure 2.22).

USGS flow data from Spring Creek (10/03/13-06/30/20) with USGS and NWFWMD specific conductance data from the Wakulla River; notice that the USGS data overlaps the salinity/conductance spikes, which typically occur when Spring Creek is in a reverse flow mode (Figure 2.23).

MLI flow data from Spring Creek (10/03/13-06/30/20), modeled by the fraction of salinity method, with USGS and NWFWMD specific conductance data from the Wakulla River; notice that the MLI data brackets the salinity/conductance spikes, which typically occur when Spring Creek is in a reverse flow mode. This model cannot adequately predict the magnitude of reverse flow in Spring Creek because when Spring Creek is in reverse flow, without any fresh water input, the salt content of the water does not change (Figure 2.24).

MLI flow data from Spring Creek (10/03/13-06/30/20), modeled by the fraction of salinity method, with USGS and NWFWMD specific conductance data from the Wakulla River, modeled using salinities further upstream to better predict the negative flows (Figure 2.25).

This map, from Hal Davis, of Spring Creek, shows all 13 springs and the USGS gauge at Spring Creek and the drone photo by Andreas Hagberg shows vent 1, 4 and 9. The gauge misses springs 12 and 13 which are in Stewart Cove. The gauge is in a backwater area on the other side of the channel from the springs. The gauge is, in my opinion, too far out in the lagoon to accurately read the fresh water inflow at the north of the lagoon, which is considerably fresher than where the gauge is located, and causes the USGS gauge to be very accurate on high flows and not good on low flows. Also, in the part of the Bay where the gauge is located the salinity is stratified with the fresh water flowing on top and the salt water on the bottom, usually flowing in opposite directions. I think they need multiple gauges to correctly monitor the flow at Spring Creek which is becoming important for the health of Wakulla Springs (Figure 2.26).

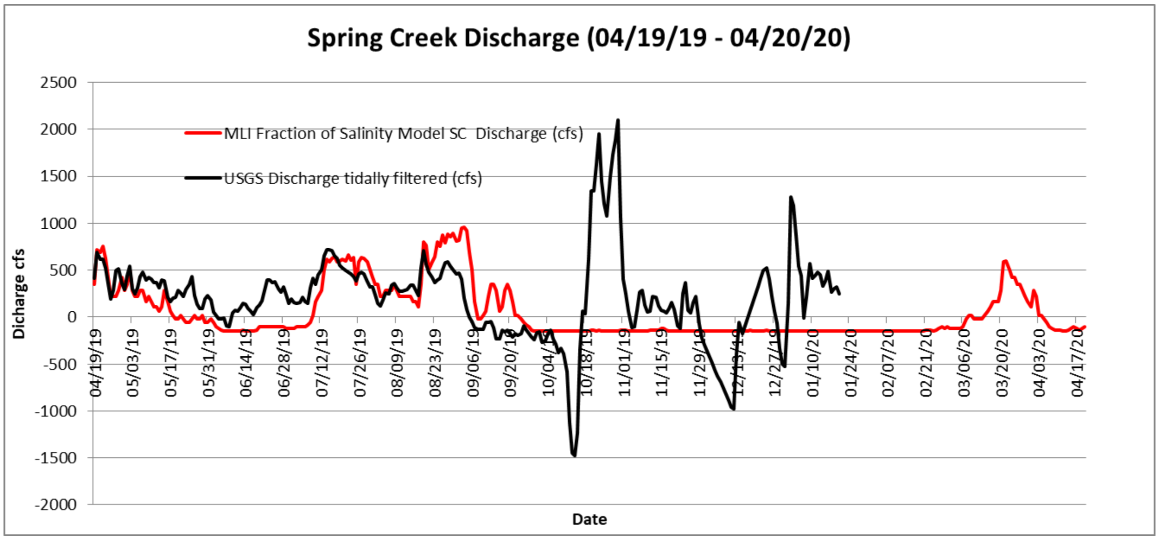

Figure 2.19: The past year of data from the USGS tidally corrected flow data and MLI Fraction of Salinity model flows. Data from USGS 02327031 Spring Creek near Spring Creek, FL and MLI.

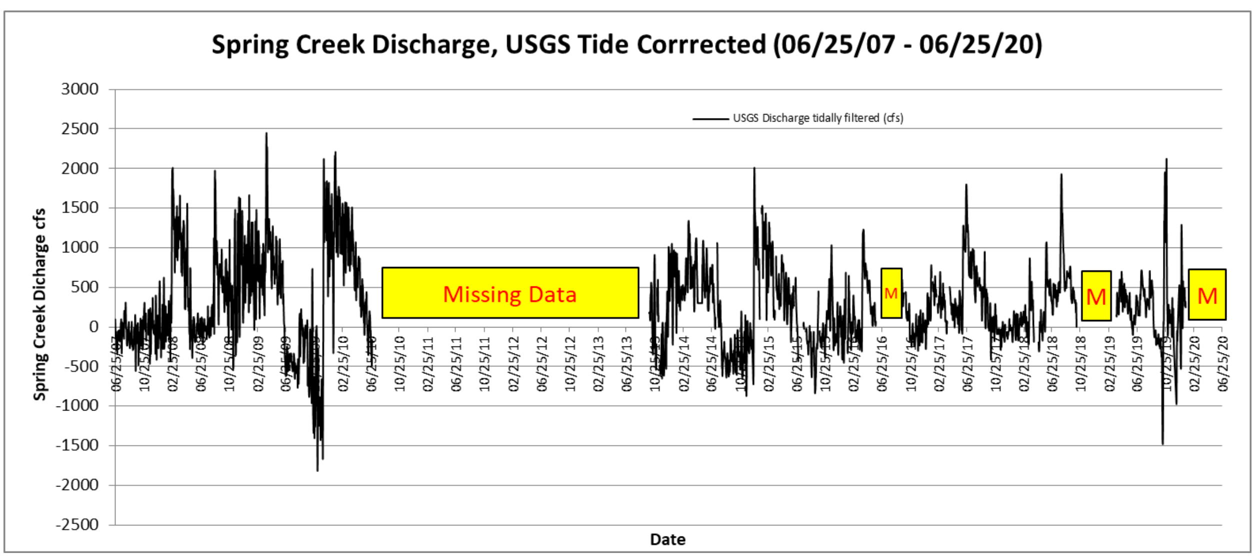

Figure 2.20: The USGS gauge at Spring Creek (07/25/07-06/30/20) which has been plagued by numerous malfunctions and has multiple periods of missing data. USGS 02327031 Spring Creek near Spring Creek, FL

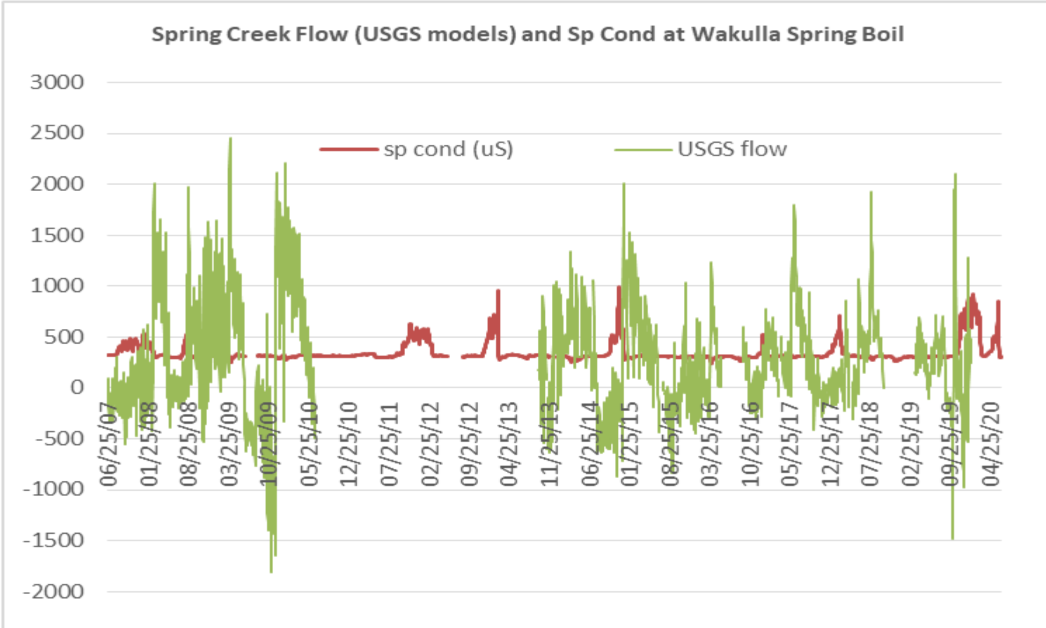

Figure 2.21: USGS flow data from Spring Creek (10/03/13-06/30/20) with USGS and NWFWMD specific conductance data from the Wakulla River. Flow data is from USGS 02327031 Spring Creek near Spring Creek, FL and specific conductance data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL.

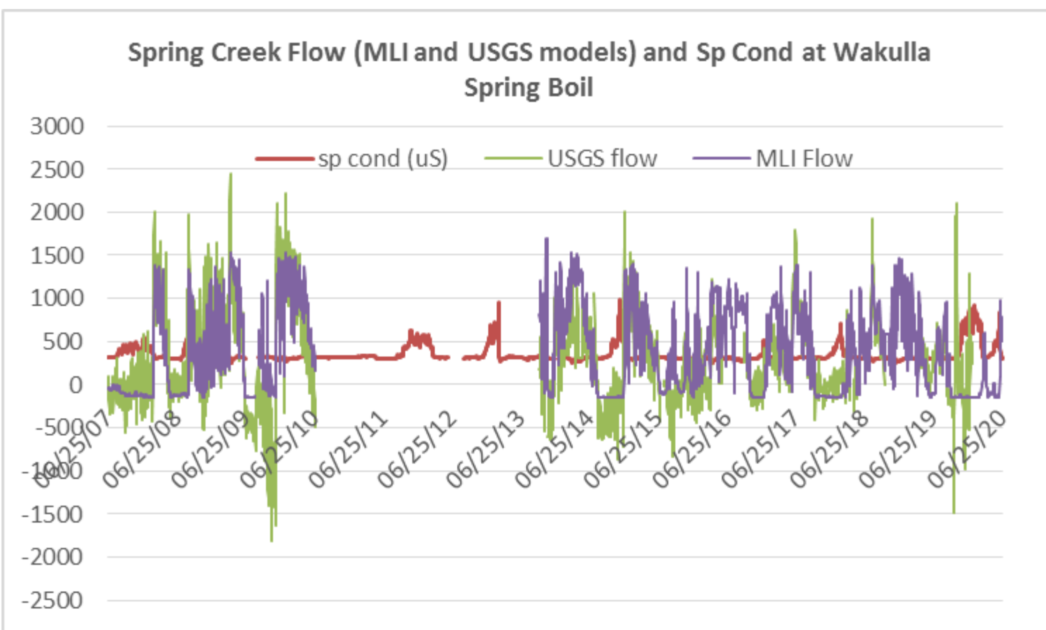

Figure 2.22: MLI and USGS flow data from Spring Creek (10/03/13-06/30/20) modeled by the fraction of salinity method, with USGS and NWFWMD specific conductance data from the Wakulla River. Flow data is from USGS 02327031 Spring Creek near Spring Creek, FL., MLI and specific conductance data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL.

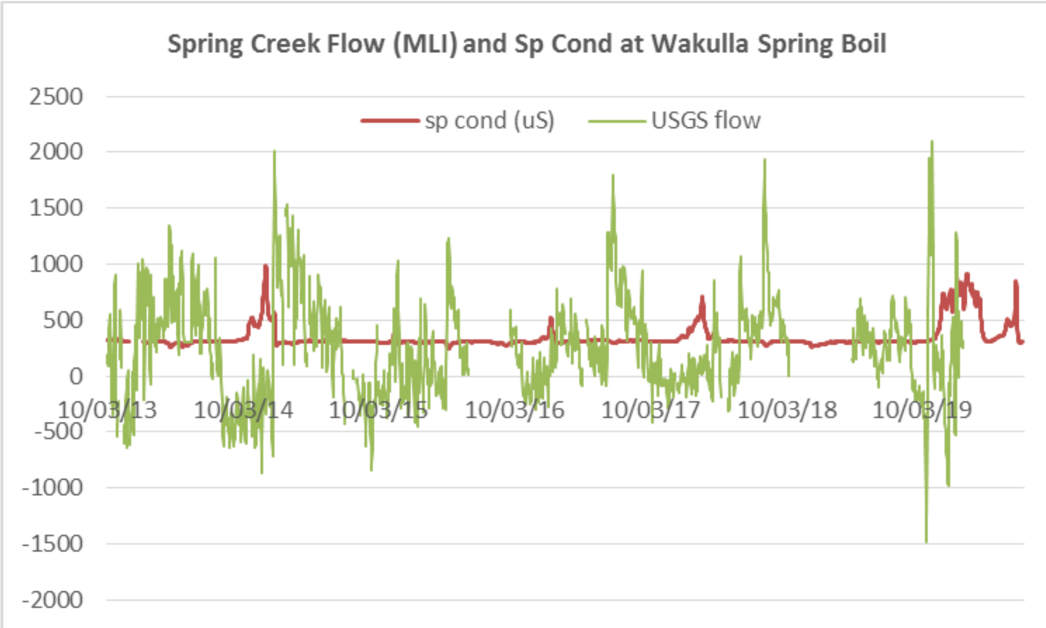

Figure 2.23: USGS flow data from Spring Creek (10/03/13-06/30/20) with USGS and NWFWMD specific conductance data from the Wakulla River. Flow data is from USGS 02327031 Spring Creek near Spring Creek, FL. and specific conductance data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL.

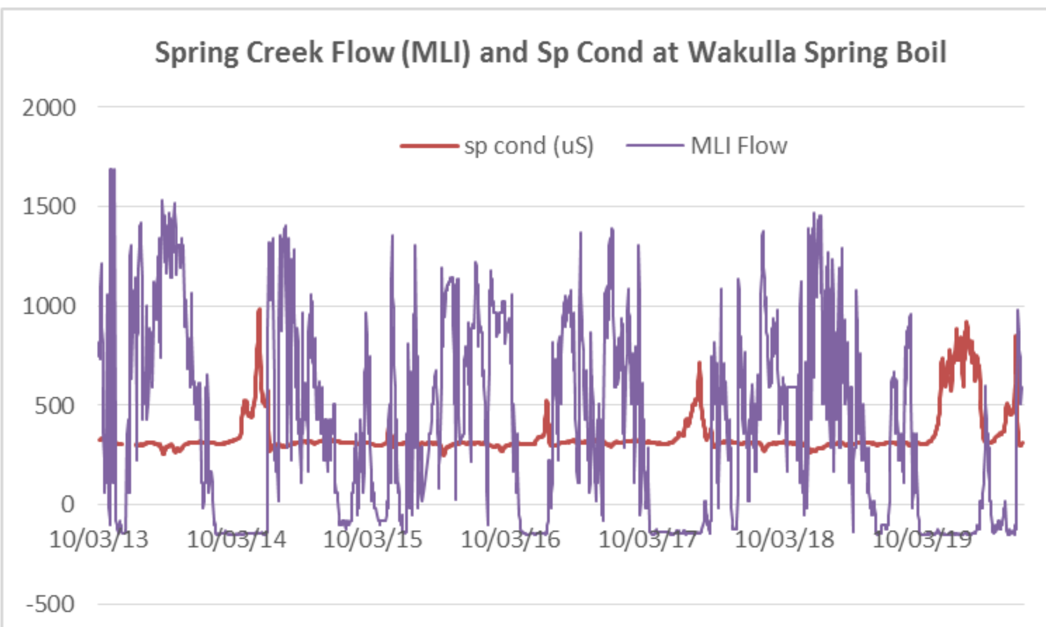

Figure 2.24: MLI flow data from Spring Creek (10/03/13-06/30/20), modeled by the fraction of salinity method, with USGS and NWFWMD specific conductance data from the Wakulla River. Flow data is from USGS 02327031 Spring Creek near Spring Creek, FL., MLI and specific conductance data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL.

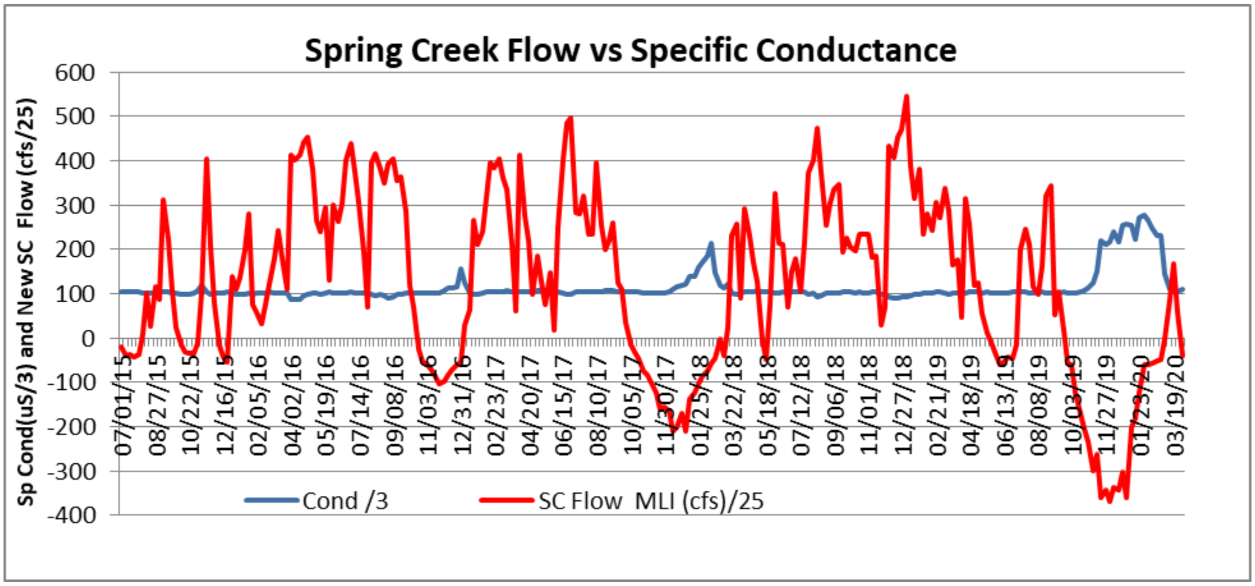

Figure 2.25: MLI flow data from Spring Creek (10/03/13-06/30/20), modeled by the fraction of salinity method, with USGS and NWFWMD specific conductance data from the Wakulla River, modeled using salinities further upstream to better predict the negative flows. Flow data is from MLI and specific conductance data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL.

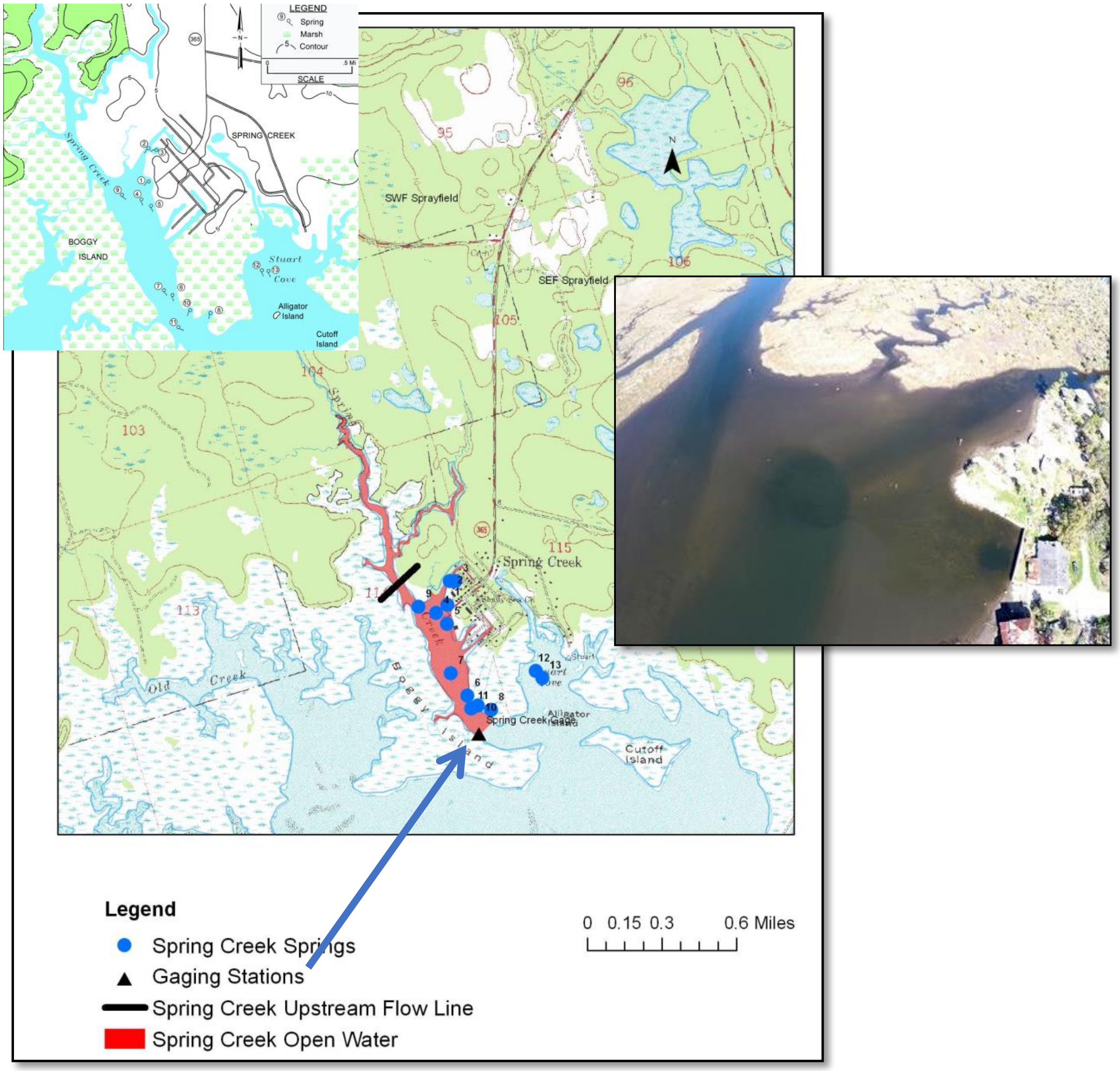

Figure 2.26: This map, from Hal Davis, of Spring Creek, shows all 13 springs and the USGS gauge at Spring Creek and the drone photo by Andreas Hagberg shows vent 1, 4 and 9.

Section 2H, Diver and videographer
All videos by the diver, Andreas Hagberg <andreas@scubasoft.net>

These videos and dives were not funded, but occurred simultaneously with funded grant activities. We could not have done these dye studies without Andreas Hagberg's assistance, he actually dove the tubing which carried the dye, down the vent of the sinkhole while filming the whole thing.

Spring Creek #4, dive exploration

https://youtu.be/daSmjohiulU
The footage came out worse than I expected this time. It seems I need to add more lighting on my left side to make lighting more even.

Spring Creek #1, dive

https://youtu.be/Sjc90C3Gsdc
A quick glimpse of some of the debris.
When we installed the big Falmouth meter in #1 (in 2009) one could descend straight down to about 90' depth from the ledge of the spring. But now I can't get deeper than about 60' straight down. In 2015 I also struggled to find my way down deeper than 70' depth, so I wonder if much of the debris might have filled in even before the last big hurricane.

Lake Jackson, dye trace video

https://youtu.be/JmNWs_I9-oU
Lake Jackson Dye Study Porter Hole Video.

Lafayette Sink, dye trace video

https://youtu.be/rCHC-M0L9mI

The GoPro camera is having a hard time with the difficult light levels, and quality suffers quite a bit. But you see a little bit of the rock wall structure now and then. I could see more than the camera shows, but not much. I did recognize the biggest overhead area from my previous dive, but did not have any luck in finding a going passage. The shallow layer of water was 64 degrees, but only 60 degrees on the bottom. Very strange, and I still don't understand how there can be such a layering of different temperatures and clarity when there is water actively flowing in and out of the sink hole.

Upper Lakes Lafayette and Zoes Sink, Drone Video

https://www.youtube.com/watch?v=fHt8zxEfnaU

Zoe's Sink, drone exploration

Last week I let my drone have a quick look at Zoe's sink and Upper Lake Lafayette. It's very full of brown water after all the rain. Here is the video if you are interested.
https://youtu.be/WuoVqedmicA

Zoe's Sink, dive exploration, 1st dive

https://www.youtube.com/watch?v=cDYW-DFlDEs
I did not bring enough lighting for good video, but on this first dive I did find a small cavern where water disappears deeper.

Zoe's Sink, dive exploration, 2nd dive

https://youtu.be/9vXxD1N_7t4
Today I was able to see the bottom clearly, but could only confirm that there is currently no opening into the cave system big enough for a person. I do wonder if the latest recent collapse plugged a previously bigger opening. We'll never know. But maybe after the lake floods again there might be enough water flow and pressure to clear an opening again. We will have to wait and see.

Lake Iamonia, dye trace video

https://youtu.be/TJyJriWu4nw
The flow of water around that sink hole was very strange. When the hose was firmly placed in that hole there was no dye leaking out. But as soon as I moved the hose out just a few inches (to get better video), it seemed like some other water flow moved the dye elsewhere, and was likely then carried upwards with my exhaled bubbles. But I wonder if there was also some leakage in the connection of the two hoses. It was a strange amount of dye "spillage" close to the surface. I hope the dye sank to the bottom again after we left.

Lake Iamonia, drone video

https://www.youtube.com/watch?v=j6xC15HySlE

Meeting House Sink (Ferrell Property), dive exploration

https://www.youtube.com/watch?v=9NyVZAPM1JI
A video I made from the Meeting House cave showing some of the conduits we discovered in the past few years – likely the most significant system of conduits directing huge amounts of water straight towards Wakulla Springs, just to the North-East.

Indian Spring, dive exploration

https://www.youtube.com/watch?v=l4vqm9_F6wI

Indian Spring, dive for retrieval of dye study equipment

https://www.youtube.com/watch?v=8wEUreA_c_w

Chapter 3
Water Quality in the Wakulla Springs

Water Quality at Wakulla Springs is currently improving.

Daily water quality samples for color, specific conductance and nitrate were sampled and analyzed for this project from 07/01/15 to 04/02/20. The Wakulla Springs Park Service performed the daily sampling of these water samples as an in-kind match for the grant valued at $33,000 per year. Methodology for sampling and analysis are detailed in *Wakulla Springs Dark Water: Causes and Sources Phase II, Final Report* (McGlynn, S.E. and R.E. Deyle. 2018). Analytical results were NELAC certified. The average color level in Wakulla Springs was 25.1 PtCo Units, which is considered clear by the NNC (Figure 3.1). The average nitrate in Wakulla Springs was 0.33 mg/L, which is slightly below the TMDL target of 0.35 mg/L (Figure 3.2). However, the specific conductance readings at the Wakulla Springs were very unusual, showing spikes of salinity in the spring that actually exceeded the Florida Statutes for potable water. Samples were taken and analyzed from 07/01/15-04/02/20. The average specific conductance was 344 uS (Figure 3.3).

Weekly chlorophylls and visibility were sampled at the spring boil and the L well from 07/01/15 to 04/02/20 by park volunteers and analyzed by McGlynn Labs Inc. Methodology for sampling and analysis are detailed in *Wakulla Springs Dark Water: Causes and Sources Phase II, Final Report* (McGlynn, S.E. and R.E. Deyle. 2018). The Wakulla Springs Park Service provided a tour boat and driver as in-kind matching funds for the grant valued at $26,000 per year. Analytical results were NELAC certified. The average total chlorophyll was 0.71 ug/L, this is considered healthy for Florida lakes. Chlorophylls do not normally occur in springs which by definition flow from underground (Figure 3.4).

Weekly visibility was also measured concurrently with the water quality sapling at Wakulla Springs. Visibility is defined as an average of photosynthetically active radiation, spectral radiometric and secchi visibility measurements (all in feet). The average visibility in Wakulla Springs was 19.5 feet. Florida Statutes for transparency state "The annual average value shall not be reduced by more than 10% as compared to the natural background value. Annual average values shall be based on a minimum of three samples, with each sample collected at least three months apart (62-302.530 Table: Surface Water Quality Criteria)." Every time the visibility goes below 18 feet this statute is violated at Wakulla Springs (Figure 3.5).

There is seasonality to the life cycle of the plankton in lentic aquatic systems. The blooms of algae and zooplankton are depicted in figure 3.5: Seasonality of algae blooms in surface waters, in Wakulla Springs, is a reflection of this seasonality in the sinking lakes of the Springshed with peaks in chlorophyll occurring in lake summer, coinciding with the blooms of blue and green algae in our lakes, and clearer episodes in the early springtime coinciding with minimal algae growth in the lakes (Figure 3.4).

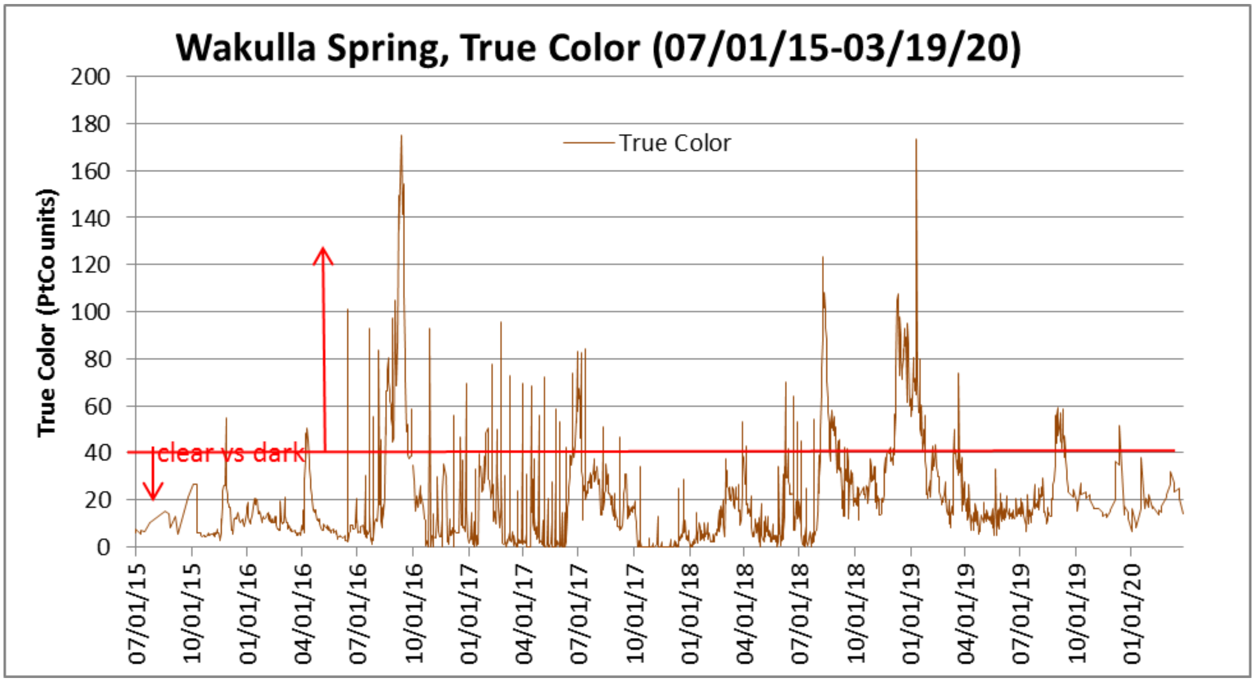

Figure 3.1. Daily true color in platinum cobalt units at the Wakulla Springs boil, 07/01/15-04/02/20. MLI data.

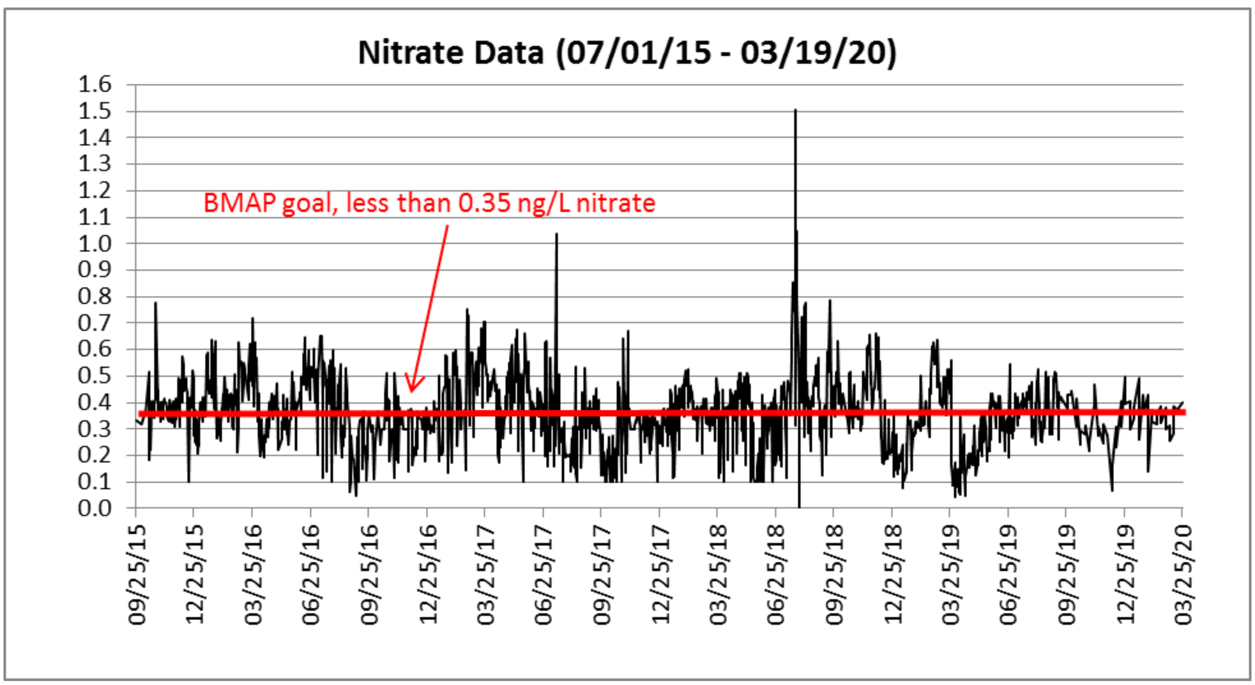

Figure 3.2. Daily nitrate in milligrams per liter at the Wakulla Springs boil 07/01/15-04/02/20. MLI data.

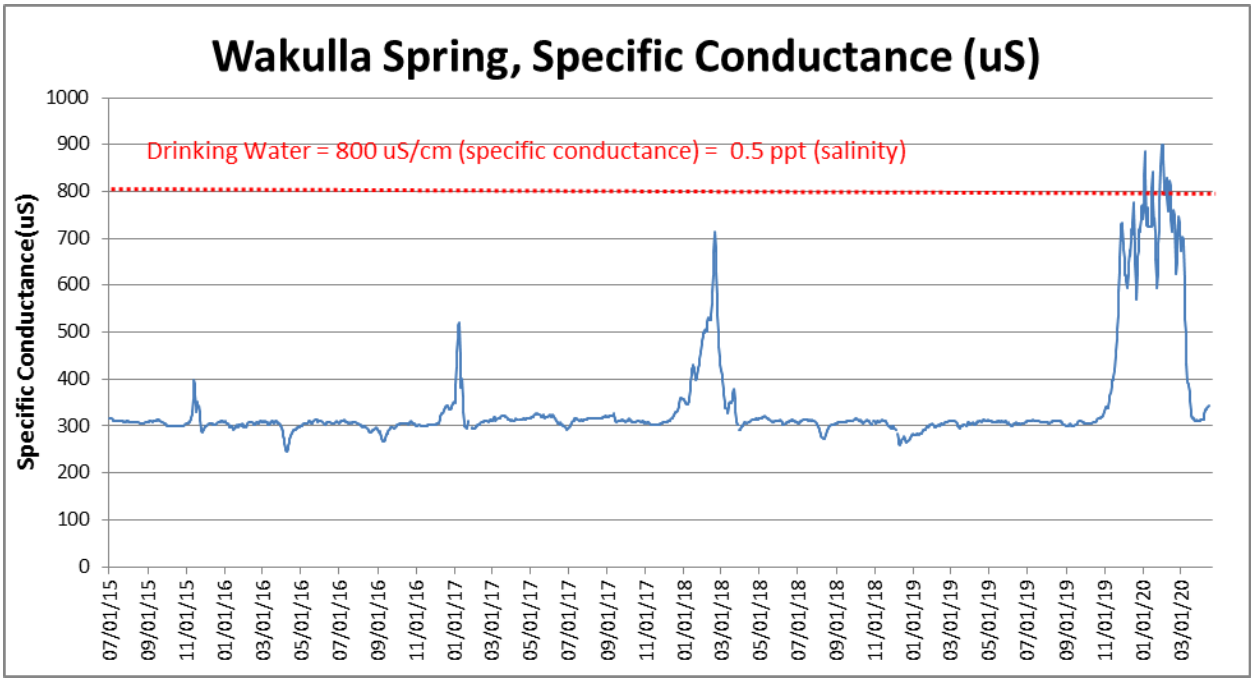

Figure 3.3. The daily specific conductance readings in microsiemens at the Wakulla Springs. MLI data.

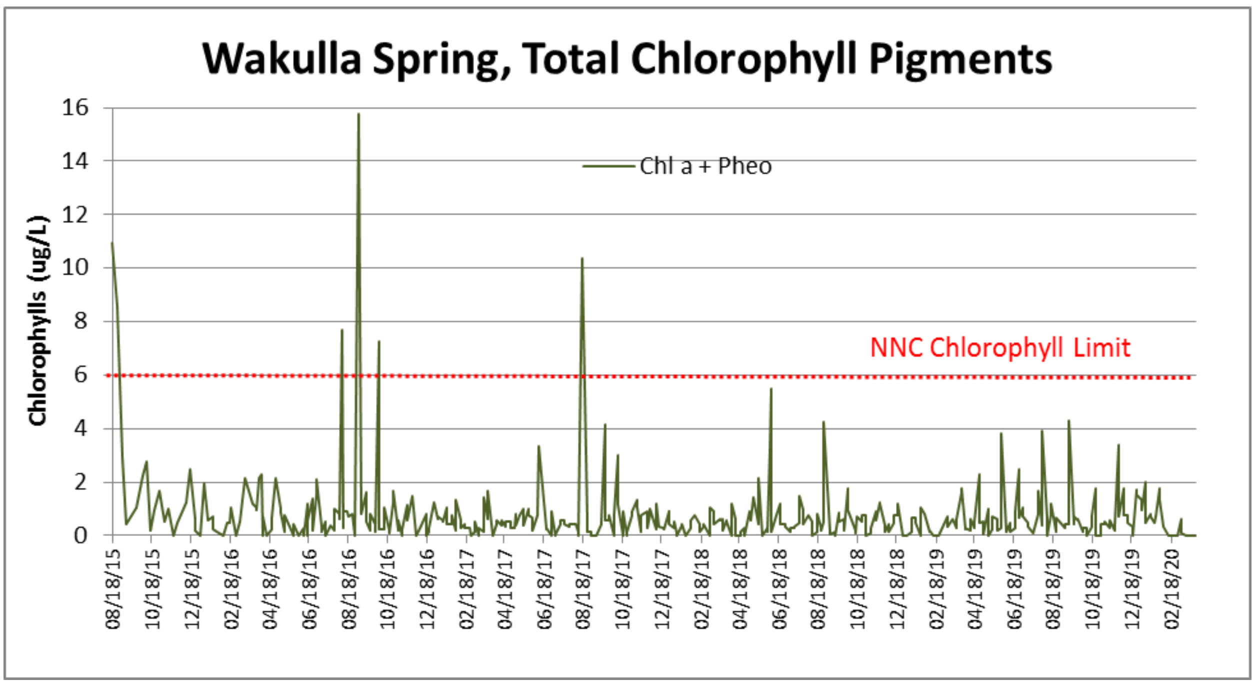

Figure 3.4. Weekly total chlorophyll (corrected chlorophyll a + phaeophytin) in micrograms per liter at the Wakulla Springs boil 07/01/15-04/02/20. MLI data.

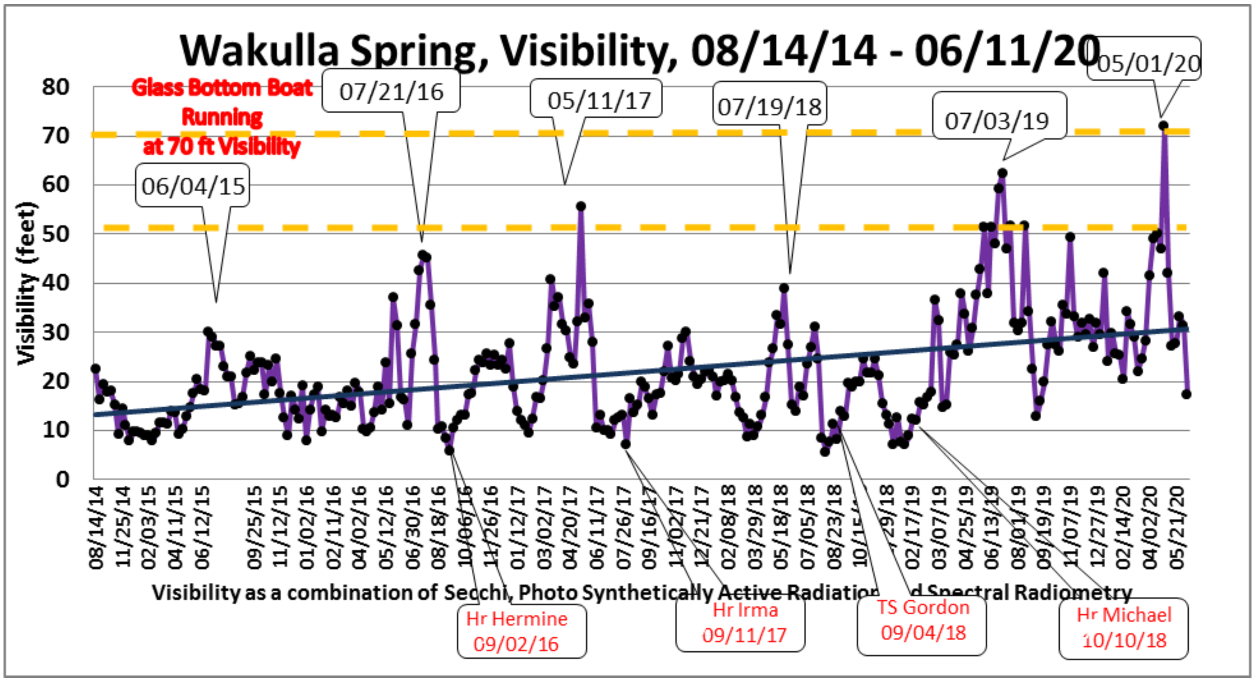

Figure 3.5: Weekly visibility at Wakulla Springs, and average of photosynthetically active radiation, spectral radiometric and secchi visibility measurements. MLI data.

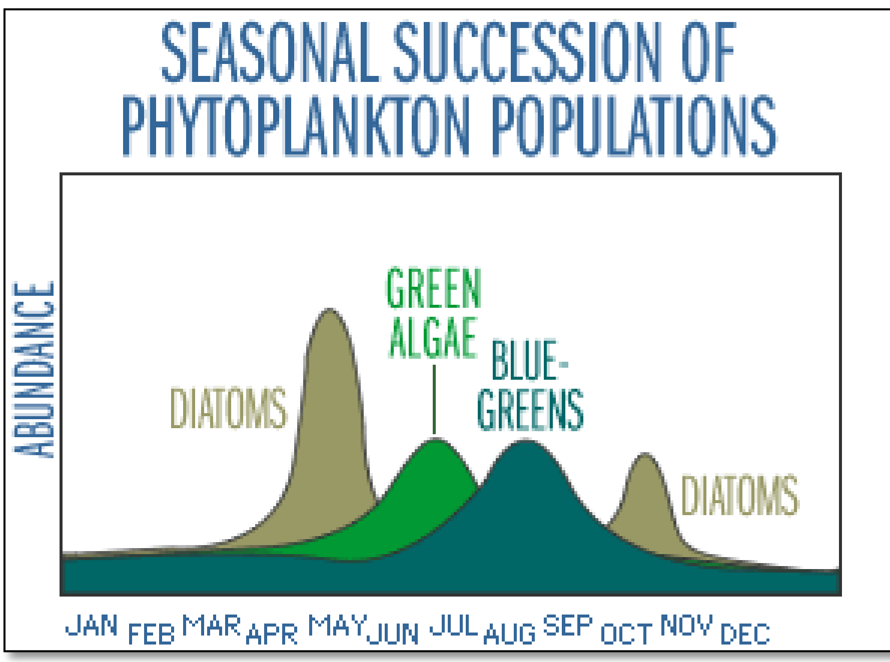

Figure 3.5: Seasonality of algae blooms in surface waters. Data from the Florida Lake Management Society.

Chapter 4
Factors Visibility Disruption Wakulla Springs (Weekly Data)

This chapter extends our analyses of the relationships between the Visibility at Wakulla Springs, the ever-changing depth limit of photosynthetically available radiation (PAR), tannic color, chlorophylls, salt, nitrates, turbidity and suspended solids. Figures 3.1 through 3.10 present the trend lines for those relationships for the duration of the Phase I through Phase III studies: 07/01/15 – 04/02/20.

In our Phase I study we found that while visibility was generally greatest when tannins were low, there was not a simple, direct, inverse relationship between visibility and true color. A simple linear regression model of the effect of color on PAR depth limit, while statistically significant at the 99% level, only explained 10% of the observed variance in PAR depth limit. That pattern continued through the Phase II study period which began in August 2016. A regression model for true color during the entirety of Phases I and II was more robust explaining 15% of the observed variance in PAR depth limit and statistically significant at the 99.9999% level.

Phase I and II revealed relationships between visibility and chlorophyll a, measured as corrected chlorophyll a, phaeophytin, and the sum of the two, total chlorophyll since both chlorophyll a and phaeophytin are green and are cumulative in their optical effect.

Simple linear regression models for each of these parameters true color; turbidity; nitrate, the chlorophyll factor (chlorophylls measured in situ at Wakulla Springs with a spectral radiometer); specific conductance; Wakulla Springs flow; Spring Creek flow; Sopchoppy flow; and rainfall at Wakulla Springs based on the Phase I, II and III data were not statistically significant, except of true color which proved to be only slightly significant, explaining only 32% of the variation in visibility. Individual simple regression models for each individual parameter do not explain the variation in visibility at Wakulla Springs and are statistically insignificant. A multiple regression analysis of the Phase I data evaluating the effects of true color, corrected chlorophyll a, and phaeophytin on PAR depth limit conducted on the Phase I data did yield a statistically significant model explained 39% of the observed variance in visibility.

Our Phase III flow data set was subjected to statistical analysis using multiple regressions. A multiple regression of the Wakulla Springs, Sopchoppy and Spring Creek flows was only slightly significant explaining 24 percent of the variability, it had a significant F[1]. All the P[2] values were significant except for that of the Sopchoppy River, the major source of color in the Wakulla Springshed. This indicates that the flow dynamics between the Wakulla Springs and Spring Creek flows have effects on the visibility. Perhaps flow data for the caves would complete the model.

We also performed multiple regression analysis on the Phase III water quality constituents. Analysis of the variations of specific conductance, true color, nitrate, the chlorophyll factor and turbidity produced a much more significant coefficient of correlation. These variables explained 47 percent of the variability in visibility. This analysis had a very significant ‘F’, but the ‘p values' for specific conductance and nitrate were not significant and the 'p value' for turbidity was barely significant. The reason for this is that both conductance and nitrate are colorless. Turbidity is a rather crude parameter. Measuring the light scattered by particles is susceptible to optical quenching by highly colored fluids as well as the color of the particle, because darker particles absorb light. The USGS and FDEP both decided to stop measuring turbidity, saying the reason was that most of the values were zero. I propose to measure total suspended solids to replace turbidity and hopefully improve the correlations.

With flows responsible for 24 percent of the variability in visibility and water quality being responsible for 47 percent that accounts for about 71% of the variability in visibility at Wakulla Springs. The visibility problem at Wakulla Springs is related to flow, true color, chlorophyll and turbidity. The turbidity at Wakulla Springs is really due to suspended particulates in the water column, we have observed extended periods of particulate filled spring water associated with flow reversal events in the aquifer. Hurricane Michael reversed the flow in the Wakulla River, for a whole day, and kicked up a lot of sediment in the spring. Hal Davis, PG. and Kathleen Coates (Chief, Bureau of Water Resource Evaluation, NWFWMD) attribute flow to the ever-increasing reversals and subsequent saline episodes at Wakulla Springs in the spring due to sea level rise and the lowering of head pressure at Wakulla Springs relative to Spring Creek. Others, like Robert Knight (Director of the Howard T. Odum, Florida Springs Institute), attributes this to the consumption of the base flow, or cavernous flow, the clear ground water that comes into the springshed from the north due to excessive ground water usage or over pumping.

1) High F-value graph shows a case where the variability of group means is large. In order to reject the null hypothesis that the group means are equal, we need a high F-value.
2) A low p-value (< 0.05) indicates that you can reject the null hypothesis. In other words, a predictor that has a low p-value is likely to be a meaningful addition to your analysis.

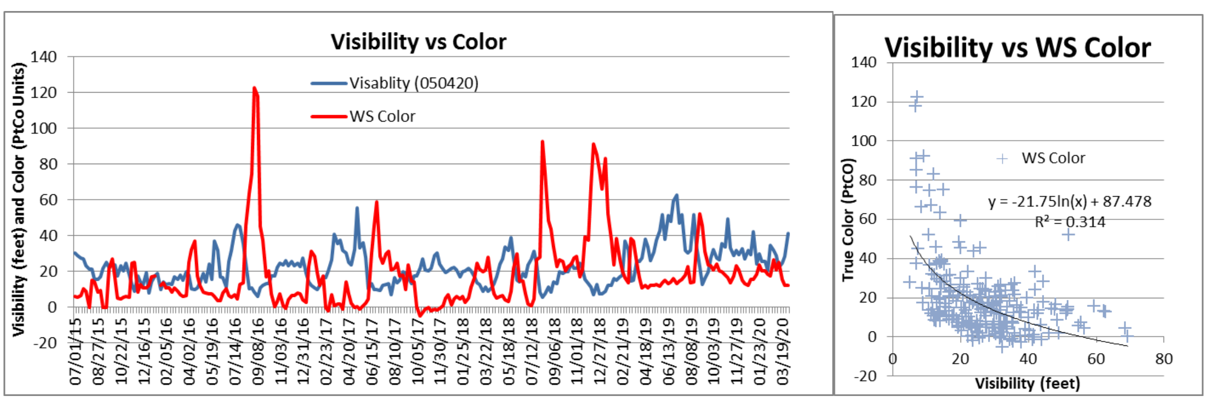

Figure 4.1: Weekly visibility and regression analysis at the spring boil and true color, 07/01/15 – 04/02/20. Visibility and color by MLI.

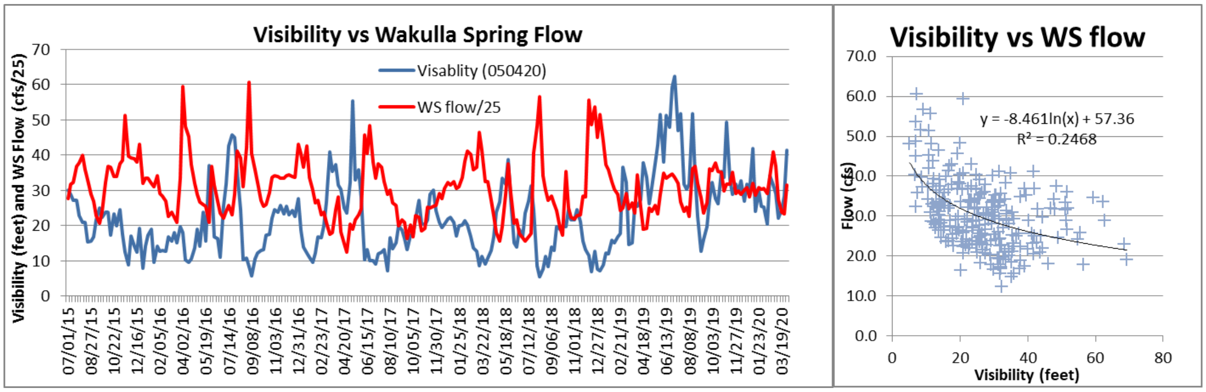

Figure 4.2: Weekly visibility and regression analysis at the spring boil and Wakulla Springss flow, 07/01/15 – 04/02/20. This flow data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL. Visibility by MLI.

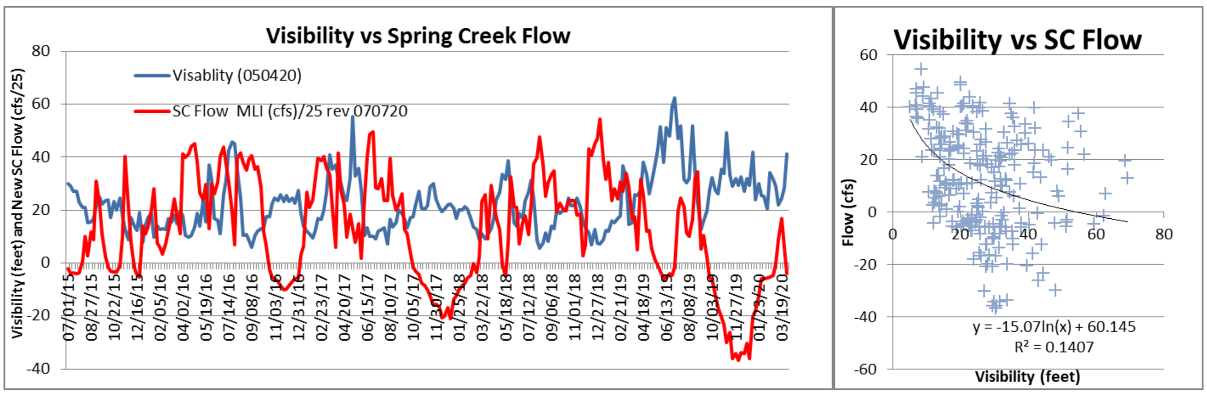

Figure 4.3: Weekly visibility and regression analysis at the spring boil and Spring Creek flow, 07/01/15 – 04/02/20. Visibility and Spring Creek flow by MLI.

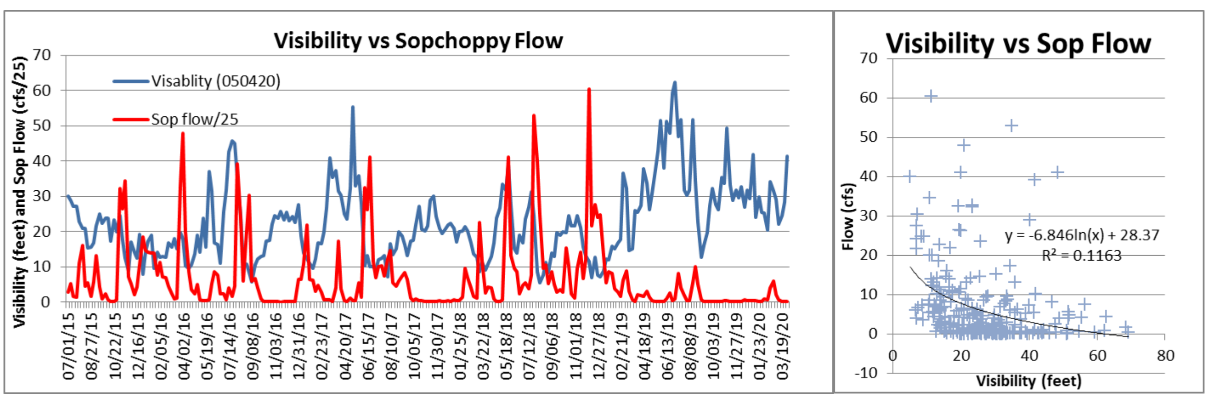

Figure 4.4: Weekly visibility and regression analysis at the spring boil and Sopchoppy flow, 07/01/15 – 04/02/20. The Sopchoppy flow data is from the USGS gauge 02327100, Sopchoppy River near Sopchoppy, FL. Visibility by MLI.

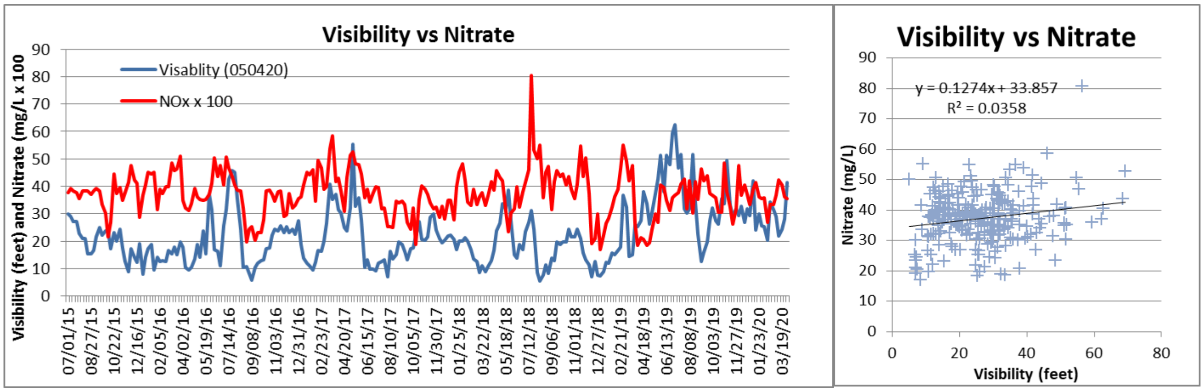

Figure 4.5: Weekly visibility and regression analysis at the spring boil and nitrate, 07/01/15 – 04/02/20. Visibility and nitrate by MLI.

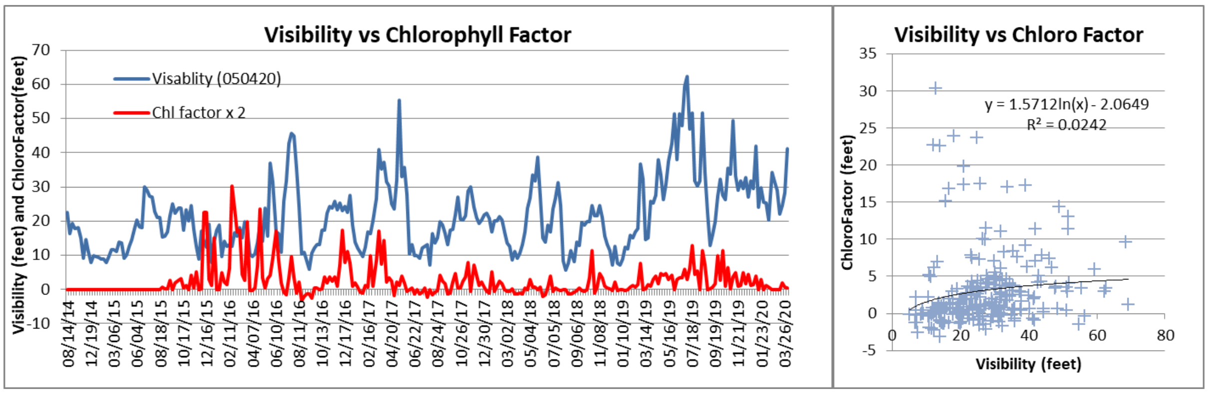

Figure 4.6: Weekly visibility and regression analysis at the spring boil and corrected chlorophyll factor, 07/01/15 – 04/02/20. Visibility and chlorophyll factor by MLI.

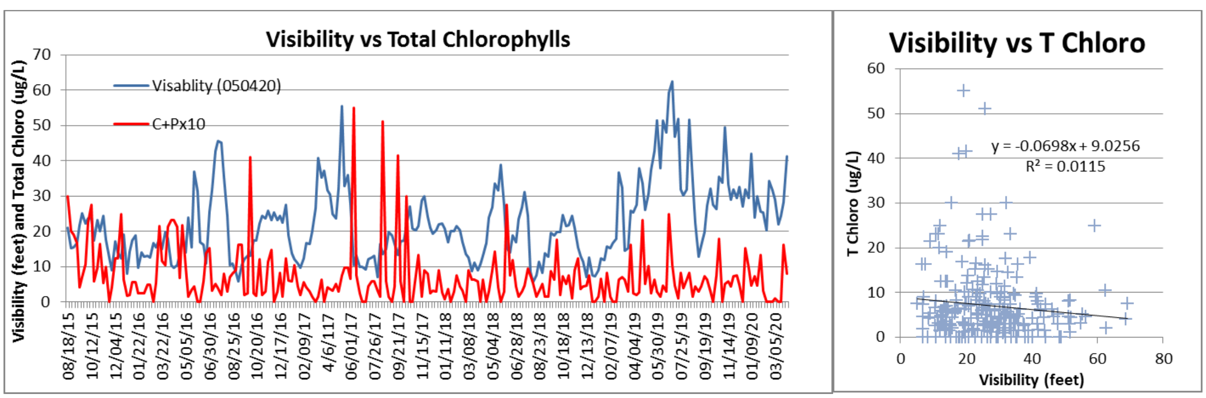

Figure 4.7: Weekly visibility and regression analysis at the spring boil and total chlorophylls, 07/01/15 – 04/02/20. Visibility and total chlorophylls by MLI.

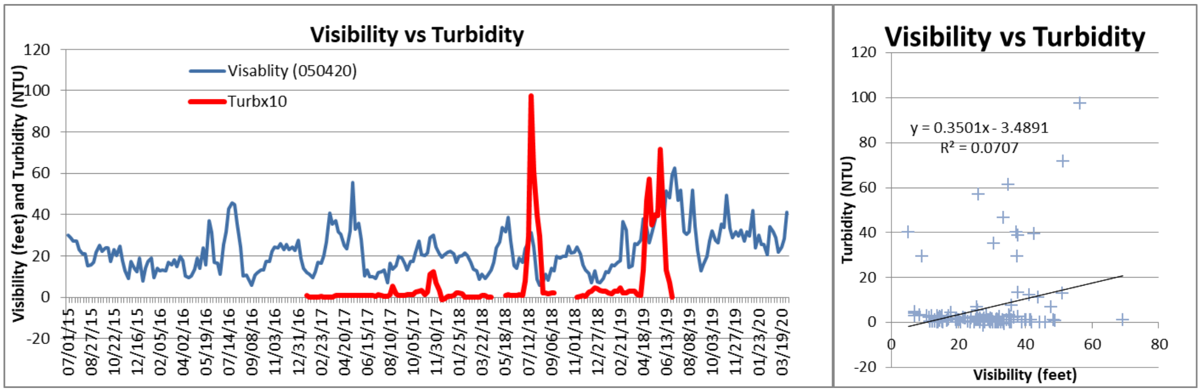

Figure 4.8: Weekly visibility and regression analysis at the spring boil and turbidity, 07/01/15 – 04/02/20. This turbidity data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL. Visibility by MLI.

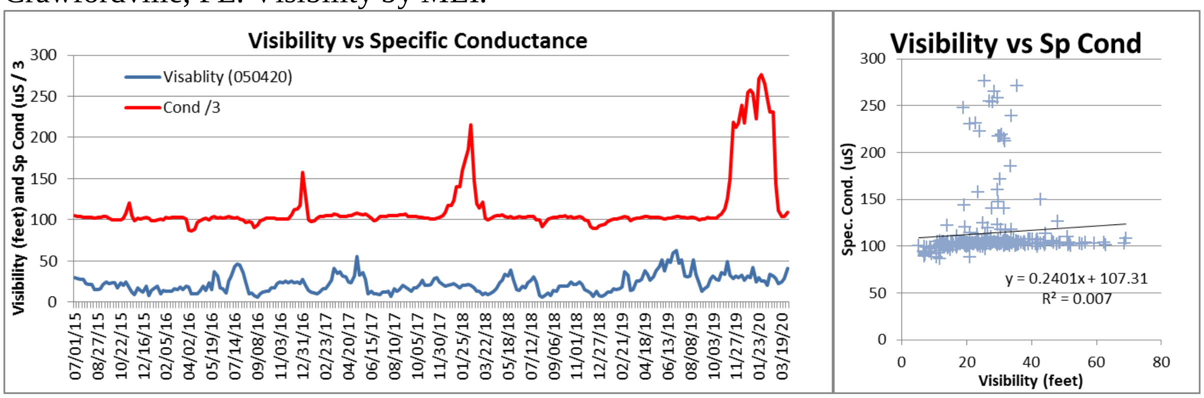

Figure 4.9: Weekly visibility and regression analysis at the spring boil and specific conductance, 07/01/15 – 04/02/20. Visibility and specific conductance by MLI.

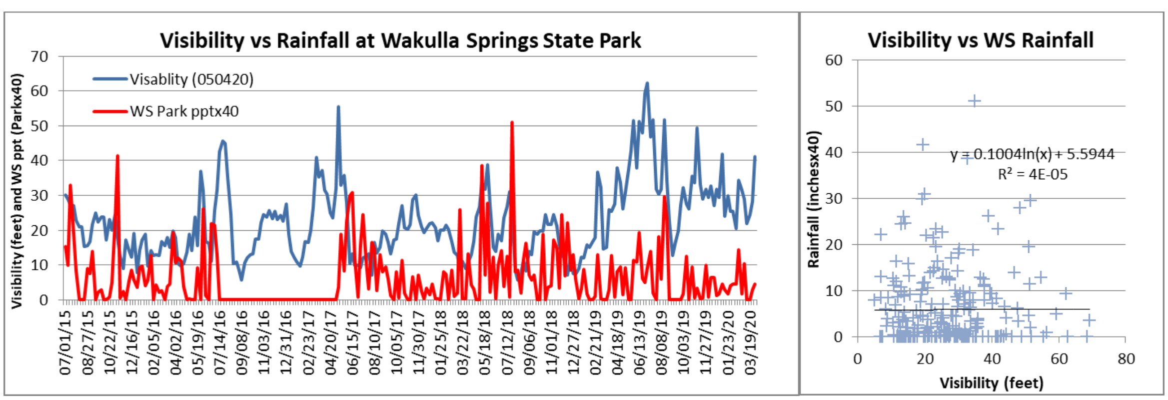

Figure 4.10: Weekly visibility and regression analysis at the spring boil and rainfall at Wakulla Springs State Park, 07/01/15 – 04/02/20. This rainfall data is from the USGS gauge 02327000 Wakulla Spring near Crawfordville, FL

Chapter 5
Tracking Chlorophyll Sources

The spectral radiometric analyses that we completed during Phase I demonstrated that prolonged dark water conditions at Wakulla Springs are due in part to chlorophyll a and its degradation product, phaeophytin. Water quality sampling of the spring boil and L well during Phase II showed that most, if not all, of the chlorophyll and phaeophytin observed in the spring boil is entering from the ground water flowing through the spring vent. Throughout this project water sampled in the L Well, a well installed into the top of the cathedral room (a large chamber, big enough to fit the Notre Dame Cathedral inside it), just before the boil and at the boil from a boat supplied by the Wakulla Springs State Park. From tables 4.1 and 4.2, it is evident that the chlorophyll levels are similar in both, thus the chlorophyll's in Wakulla Springs emanate from the cave. Lakes in the Wakulla Springshed were also sampled (Phases 1 and II). They are greatly enriched in chlorophylls when compared to Wakulla Springs (Tables 4.1 and 4.2). The algal biomass in the lakes varied from 5 to 500 times the concentrations in Wakulla Springs. These small concentrations of chlorophylls often imparted a greenish hue to the color of the water in Wakulla Springs and decreased visibility as evidenced in observed color and spectral radiometric measurements (see Chlorophyll Ratio discussion in Chapter 3).

Dye studies, both ours and others, have shown that the four largest karst lakes in Leon County, three of which (Lafayette, Munson and Jackson) receive about 33% of storm water from the City of Tallahassee (Tallahassee has minimal surface water discharge of stormwater, personal communication with Harvey Harper) and the fourth receives degraded river water from the Ochlocknee River mostly from Georgia (personal communication with FDEP TMDL staff). All of these lakes are hypereutrophic and three of them (Lafayette, Munson and Jackson, have impaired water quality and are in various stages of enforcement within the Florida TMDL program. Urban storm water and sewage spills (in which the City of Tallahassee is also fined under a consent order and South Georgia has a history of similar problems) cause these lakes to experience frequent and prolonged algae blooms, including potentially harmful bluegreen algae blooms. These lakes have been shown, by these dye traces, to be directly connected to the Wakulla Springs by subterranean cavern system: Lake Iamonia, Lake Jackson, Lake Munson, and Upper Lake Lafayette (ULL). Recent dye studies indicate that Lake Miccosukee is connected to the St. Marks Rise, though dye studies from Bird Sink indicate that the caves in this area can flow either to the Wakulla or St Marks Springshed, depending on hydrological conditions.

In this chapter we present findings from algal taxonomy and environmental DNA analyses of samples of algae, aquatic photosynthetic organisms that contain chlorophyll, from the four sinkhole lakes or karst lakes in the Wakulla Springshed and the L well/spring boil at Wakulla Springs that we undertook in an effort to identify the possible sources of the chlorophyll entering the spring. Table 5.1 shows the algal biomass in the Wakulla Springshed samples. The maximum was Upper Lake Lafayette with 12.4 mg/L algal biomass, Wakulla Springs had 1000xless algal biomass, but still had some, and one would not expect to find algae in the groundwater, where it is perpetually dark and photosynthesis cannot take place. Most of the chlorophyll found in Wakulla Springs was degraded so to try to replicate the optical properties of the molecule we put the Corrected Chlorophyll and phaeophytin together as total chlorophyll (figures 4.6 and table 5.2) and used the spectral radiometric insitu measurement of chlorophyll (figure 4.7), chlorophyll factor). Degraded chlorophyll has the same optical properties as undegraded chlorophyll. Hence we have found that when discussing the optical properties of chlorophyll it is better not to separate degraded from undegraded and refer to this as Total Chlorophylls, while for an algae population standpoint, green phaeophytin is likely from dead or senescent algae cells and not indicative of healthy viable algae.

Furthermore, a photographic tour of the samples from Wakulla Springs demonstrates that the spring samples were not as green as the lake samples and other things in the water. The samples from the caves, while they contained some chlorophyll were dominated by algae species and by microscopic fecal pellets, occasional amphipods as well as a mucosa like slimy globules. We found obvious differences in the samples just by filtering them. Figure 5.1 depicts used filters from the water in the subterranean Wakulla Caves. They show mucus like substances possibly a fresh water sponge (picture 1). Picture 2 depicts troglodyte and fecal pellets. A stygobitic amphipod from Sally Ward cave, a similar specimen was identified as a juvenile Crangonyx grandimanus by Dr. Thomas Sawicki a species endemic to the Floridan aquifer (picture 3). Picture 4 shows filter pads from the AD tunnel, particulates in the water sample (1800 ml filtered). And picture 5 depicts the Upper Lake Lafayette Sink (50 ml filtered, mostly potentially harmful cyanobacteria, microcystis sp), these pictures were taken in November 2016 (Figure 5.1).

Table 5.1: Algal biomass differences between Wakulla Springs and the Sinking Lakes. MLI data.

Waterbody	Algal Biomass	Algal Biomass	% Algal Biomass	Number of
Units	(mg/L)	(ug/L)	(wet weight)	Samples
Lake Cascade	0.134	134	0.000013%	8
Lake Iamonia	0.259	259	0.000026%	8
Lake Jackson	0.420	420	0.000042%	10
Lake Miccosukee	0.259	259	0.000026%	7
Lake Munson	4.471	4471	0.000447%	8
Upper Lake Lafayette	12.372	12372	0.001237%	25
Wakulla Spring Boil	0.021	21	0.000002%	202
Wakulla Spring L well	0.017	17	0.000002%	201

Table 5.2: Chlorophyll differences between Wakulla Springs and the Sinking Lakes. MLI data.

Waterbody	chl a	chl b	chl c	Cor Chl a	Phaophytin	T Chloro	% Chlorophyll a	% Phaeophytin
Units	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)		
Lake Cascade	0.52	0.49	0.96	1.74	0.1	1.8	94%	6%
Lake Iamonia	4.21	1.90	0.88	2.99	2.0	5.0	60%	40%
Lake Jackson	6.26	0.91	1.01	4.78	3.3	8.1	59%	41%
Lake Miccosukee	3.86	1.19	0.53	2.96	0.5	3.5	86%	14%
Lake Munson	66.73	2.70	3.63	47.24	34.9	82.1	58%	42%
Upper Lake Lafayette	184.65	10.53	12.16	177.64	20.9	198.6	89%	11%
Wakulla Spring Boil	0.28	0.16	0.16	0.27	0.4	0.6	43%	57%
Wakulla Spring L well	0.23	0.16	0.17	0.32	0.4	0.7	48%	52%

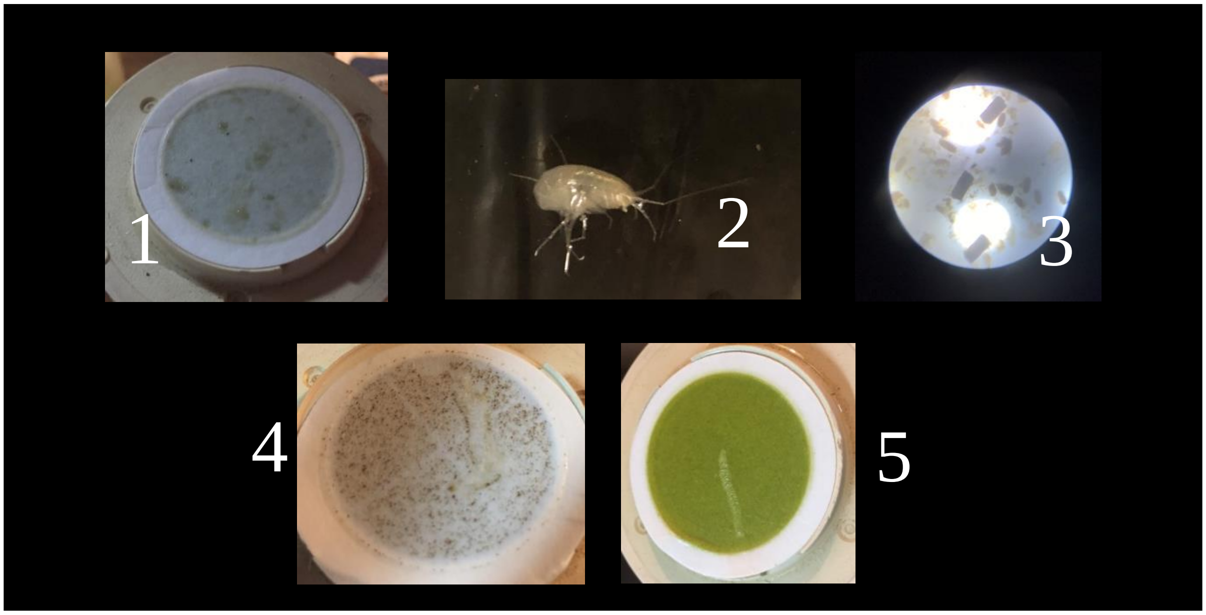

Figure 5.1: Filtration from the Wakulla Springs tunnels. These pictures were taken in November 2016. MLI data.

Section 5.1, Algal Taxonomic Analysis

Our two attempts to trace the algae from the lakes to the springs was with an algal taxonomist and they were failures. We engaged Dr. Akshinthala Prasad, an expert on diatoms with the Florida State University Department of Biology, who performed the algal taxonomic analysis of samples collected samples for him. I recommended against this because his detection levels, using traditional taxonomic techniques, was not sensitive enough for the Wakulla Springs water samples, but the project manager insisted we do this.

Dr. Akshinthala Prasad preferred technique, classical taxonomy, utilized whole water samples, fixed with lugols, and allowed to settle to concentrate the phytophankton. We describe his analytic approach and findings here in our previous report (please see Chapter 5, Tracking Chlorophyll Sources, McGlynn, S.E. and R.E. Deyle. 2018). We collected 1-liter surface water samples from the four lakes and Wakulla Springs: Ame's sinkhole (collected on 11-21-2018), Lake Jackson (11-11-2018), Upper Lake Lafayette sinkhole (11-10-2018) (Upper), and Lake Iamonia sinkhole (11/30/2018), and two sites at Wakulla Springss, the well, WSW-L (12/13/2018) and the spring boil, by boat, WS-Boil (12/13/2018).

Dr. Prasad obtained satisfactory samples at all the lakes, but the sample from the spring boil was lacking sufficient organisms for his taxonomic analysis but not from the samples from Wakulla Springs. He requested that we use a plankton net to tow behind the boat of the above the spring. The Park does not allow the use of nets in the spring, or any type of fishing, thus we decided to use the net at the L well on October 12, 2018. Doing so allowed us to pump 160 gallons of water through a 64-micron (µm) plankton net to concentrate the algae. We then rinsed the residue from the net into a container and fixed the sample with Lugol's. We also tried the freeze/thaw technique, used by the FAMU researchers, where they filter a liter of sample on a 0.2 micron filter pad and freeze it for viewing later by compound microscope.

None of these alternative techniques worked for Dr. Akshinthala Prasad. The prokaryotic potentially harmful blue green algae, which we were focusing on in these study are bacteria and are much smaller than traditional eukaryotic plankton. The lakes in the Wakulla Springshed suffer sever periodic blooms of these algae and their toxins have been detected. Dr. Akshinthala Prasad results did not reflect the diversity of prokaryote and eukaryote photosynthetic plankton we found in the Springshed. As I told the project manager, he really specializes in marine plankton, which is very different from fresh water plankton, and the techniques used by the microbiologists were much better for this study. The Analysis of the microbiological communities in these waters with DNA sequencing did not even necessitate having a whole organism; we actually analyzed consumed phytoplankton from the guts of carnivorous zooplankton. DNA from degraded or senescent cells and mutilated parts of organisms also sufficed. The size of the organisms definitely was an issue for the taxonomists, cyanobacteria range in size from 0.5 to 40 microns. These would pass through plankton nets, which go down to about 64 microns. The green algae are significantly larger ranging from 300 to 1000 microns and are definitely easier to find. Furthermore, Dr. Akshinthala Prasad uses a different taxonomic system from the microbiologists, who do seem to change the names in their own system every few months, and the species lists are too complex to compare. Therefore, Dr. Akshinthala

Prasad's findings are relatively unchanged from the findings presented in the previously cited report (McGlynn, S.E. and R.E. Deyle. 2018).

Section 5.2, Environmental DNA Analysis

Drs. Thomas Sawicki, Richard Long and soon to be one too, Graduate Student Kaylee Castle, of the Florida A&M University, Department of Biology conducted the environmental DNA sampling and data analyses. DNA sequencing was conducted by Molecular Research LP (MR DNA), from Shallowater, Texas. Again, the methods are detailed in Chapter 5, Tracking Chlorophyll (Sources, McGlynn, S.E. and R.E. Deyle. 2018).

As with Dr. Prasad's analysis there is a lot of interesting conclusions that can be gleaned from these two data sets. But for this study we are focusing on the eukaryotes (mainly the green algae) and prokaryotes, the cyanobacteria or bluegreen algae. These are aquatic photosynthetic organisms and the bluegreen algae are bacteria. Blue green algae blooms are fairly common in the lakes of the Wakulla Springshed. Upper Lake Lafayette and Lake Munson are the worst, though blue green algae blooms occur in the other waterbodies too. Bluegreen algae are symptoms of hyper eutrophication, or impaired water quality. Almost all the lakes of the Wakulla Springshed are impaired for water quality and violate Florida's Numeric Nutrient Criteria, particularly for phosphorus concentrations. These bacteria fix atmospheric nitrogen and thrive in a high phosphorus environment. Tallahassee, dominates the population of the Wakulla Springshed and most of the karst lakes in the Springshed receive drainage from developed areas in Tallahassee. Other areas in the Springshed do not contain significant populations and the lakes lack bluegreen algae blooms. So the presence of bluegreen algae, in appreciable concentrations is indicative of the urban lakes of the Wakulla Springshed of which we their flow to Wakulla Springs with dye tracers, tracked chlorophyll concentrations in both and sampled the following locations for this DNA analysis:

KWB K-well, conduit, (sampled 12/14/18);
BWB B-well, conduit (sampled 12/14/18);
DWB D-well, conduit (sampled 12/14/18);
CWB C-well, conduit (sampled 12/14/18);
LWB L-well, conduit at boil (sampled 12/13/18);
WSB Wakulla S. Boil, spring (sampled 12/13/18);
LJB Lake Jackson, sinkhole lake (sampled 11/11/18);
LMB Lake Munson, sinkhole lake (sampled 11/21/18);
FSB Upper Lake Lafayette, sinkhole lake (sampled 11/10/18);
And LIB Lake Iamonia, sinkhole lake (sampled 11/30/18).

Bluegreen algae do not originate in the subterranean caves. They spawn dense blooms and flourish in impaired still, shallow, stagnant surface waters like the hypereutrophic urban lakes in the Wakulla Springshed. Thee lakes often have open sinkholes, where the bluegreen algae enter the aquifer, with negligible treatment and flow through the subterranean conduits, many already mapped, to Wakulla Springs. All the lakes included in this study have open sinkholes, have had these sinks linked with dye studies to Wakulla Springs. The results of these dye studies indicate direct conduit flow by virtue of the high velocity of travel time associated with the dye study in conduit flow (Section 2D, Water Quality, Dye Studies, in this text).

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The DNA analysis of the algae in the Wakulla Springs samples is depicted as a dendrogram, the first dendrogram depicts the eukaryotes (including the green algae) and the second dendrogram shows the prokaryotes (bluegreen algae). Both dendrogram are in Figure 5.3. The eukaryotes dendrogram shows that the WSB (boil) is most closely related to the LWB (the L well, near the boil under the lodge) and then both these are most closely related to the CWB (the C tunnel). Next come the other wells and the group of lakes follow, but LMB (Lake Munson) and FMB (Lake Lafayette) are more closely related to the WSB/LWB (Wakulla Springs) than LIB (Lake Iamonia) and LJB (Lake Jackson). The two groups have a similarity of 56%. The prokaryotes have three groups more closely clustered and distinct with the lakes and the tunnels grouped and separated. There is a 50% similarity between groups. This statistical program splits the samples into three different classes based on the Agglomeration method (an unweighted pair-group average). The dotted line on the main dendrogram is the degree of similarity between the groups (figure 5.3).

The numbers in the color-coded cells of the Heatmaps are Operational Taxonomic Units (OTUs) for that sample based on predefined gene sequences. The abundance of similar or matching gene sequences, OTUs were assigned for each sample data library. OTUs are not the same as individual organisms, but are similar counts; but some organisms may contain multiple copies of the same OTU sequence. Eukaryote or green algae heatmaps are in tables 5.3 and 5.4. The prokaryote, bluegreen algae or cyanobacteria heatmaps are in table 5.5.

Several species of fresh water photosynthetic bluegreen algae occur in all the samples, at substantial numbers (as OTUs), in the springs, lakes and conduits. This indicates that these chlorophylls containing aquatic algae are in all four major sinkhole lakes and are also in Wakulla Springs and probably came from any of these lakes. These were:

1. Cyanobacterium spp.
2. Cyanothece spp.
3. Prochlorococcus spp.
4. Synechococcus spp.

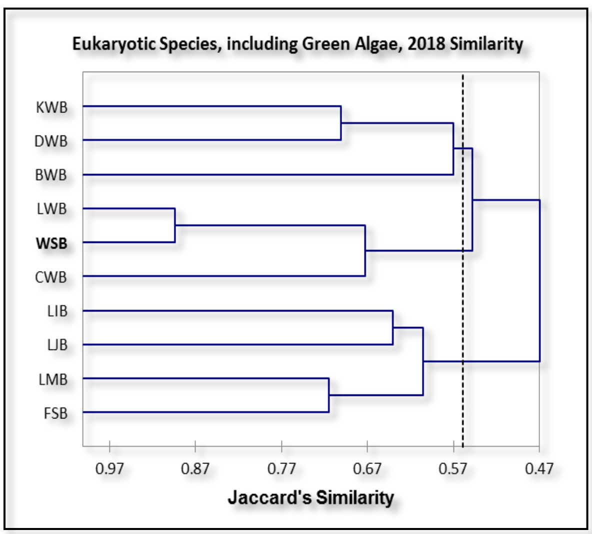
Several species of mixed fresh and marine photosynthetic green algae, at substantial numbers of OTUs, occurred in all the samples, springs, lakes and conduits (red type indicts a potentially toxic species). This indicates that these chlorophylls containing aquatic algae are in all four major sinkhole lakes and are also in Wakulla Springs and probably came from any of these lakes. These were:

1. Asterionella
2. Chrysosphaera
3. Dinophysis
4. Guillardia
5. Heterosigma
6. Nannochloropsis
7. Ochromonas
8. Rhodomonas
9. Stephanodiscus
10. Thalassiosira

The potentially toxic bluegreen nuisance algae, Microcystis spp. was also found in all samples, highest in Lake Munson, lower in the spring. Interestingly, the potentially toxic diatom, Nitzschia and unicellular flagellate algae Pelagomonas were both found at highest concentrations at the spring and associated L well. Both are marine species, indicating a connection with the sea, as as we saw in, Section 2F of this text, Water Quality, Salinity Episodes, the connection with the Gulf of Mexico is subterranean, coupled with low flows at Lost Creek and flow reversal at Spring Creek and exacerbated by sea level rise (Davis and Verdi, 2014).

The following species occurred only in one lakes and the boil (caverns excluded). This indicates that these chlorophylls containing aquatic algae found only in one of the lakes was traced directly to Wakulla Springs.

1. Cyanoptyche only occurred in Lake Jackson and the Boil
2. Nitzschia occurred only in Upper Lake Lafayette and the Boil
3. Pelagomonas occurred only in Lake Jackson and the Boil
4. Plagioselmis occurred only in Lake Munson and the Boil
5. Dinophysis norvegica occurred only in Upper Lake Lafayette and the Boil



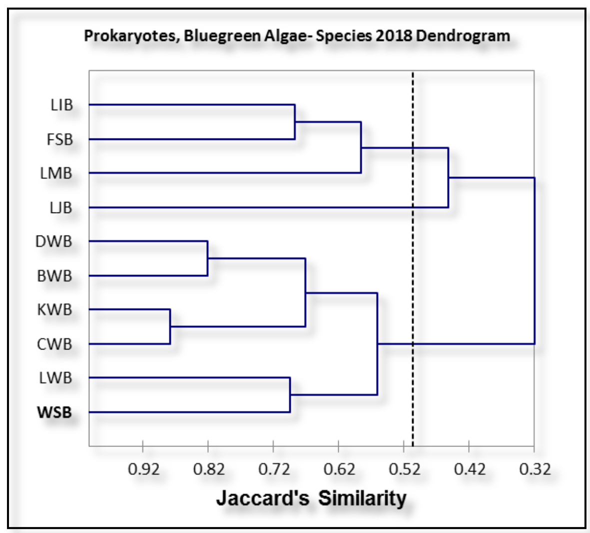


Figure 5.3: Jaccard's Similarity Analysis, the dotted line on the dendrogram represents is the level of similarity between 2 of the three groups, 56% for Eukaryotes and 50% for Prokaryotes. Sawicki et al data.

Table 5.3: Eukaryote Heatmaps: red lettering for potentially toxic species, Operational Taxonomic Units (OTUs). Sawicki et al data.

Species	FSB	LJB	LMB	LIB	WSB	LWB	BWB	CWB	DWB	KWB
Aglaothamnion halliae	0	0	0	0	0	0	16.2	0	443.7	19.6
Ankylochrysis lutea	0	2.8	0	28.3	3.5	0	28.7	0	0	0
Antithamnionella spirographidis	4.7	7.7	0.6	3.7	244.1	259.1	15.8	0	20.8	17.7
Asterionella ralfsii	286.3	144.4	54.9	2528.3	89.2	68.2	263.4	264.5	338	562.5
Chrysochromulina sp.	0.1	0.7	0.1	79.5	0	6.3	15.4	19.9	0	0
Chrysosphaera sp.	297.4	1389.7	406	507.9	102.4	114.5	332	384.7	190	219.5
Corethron pennatum	4.6	0.5	0	0.7	3.4	2.3	16	0	0	0
Coscinodiscus radiatus	16.1	119	27.3	41.4	77.9	105.1	39.9	22	64.4	40.2
Cryptoglena pigra	23.3	4.7	0.4	1.2	0	2	13.4	0	0	0
Cryptomonas pyrenoidifera	2861.4	3433.7	961.3	2187.5	200.2	183.3	1264.9	1087.6	1296.5	1328.6
Cyanoptyche gloeocystis	0	7.6	0	0.4	33.6	29.9	78.6	42.8	190.6	37.5
Cymatopleura solea	4.5	0.8	0.2	1.4	0	0	0	0	18.2	17.7
Cymbella subturgidula	0	0	0	0	0	0.8	349.9	64.2	288.2	53.6
Dinophysis norvegica	14.9	4	1.8	1.6	20.2	38.4	2720.8	1246.8	151.8	522.1
Dinophysis sp.	2168.6	32.5	318	80	42	42.3	499.5	442.8	494.3	546.9
Discoplastis euglena spathirhyncha	0	0	0	0	0	0	30.3	0	0	0
Euglena cantabrica	1.2	0	0	0	13.7	17.4	0	0	18.5	0
Euglena longa	2.8	3.4	0	1.1	817.3	688.3	14.3	42.2	43.7	18.5
Euglenaformis euglena proxima	0.5	0	0.6	1.4	150.3	81.4	402.5	43.7	0	230.5
Euptilota formosissima	0	0.5	0.1	1	2.7	2.5	76.2	0	63.6	0
Fucus vesiculosus	3.1	1.2	0.3	1.2	302.6	277.5	0	45.8	62	0
Georgiella confluens	0	0	0	12.4	0	0	0	0	0	0
Guillardia theta	813.6	311.2	210.6	909.2	106.1	103.3	254.3	298.6	190.5	381.3
Haslea ostrearia	0.9	0.2	3.1	1.5	0	1.4	0	0	20.5	17.7
Heterosigma akashiwo	600.6	767.9	6991.4	882.6	441.2	484.6	1911.2	2283.1	2953.1	2714.4
Melosira varians	15.6	8.4	0.3	14.6	46.9	39.6	0	0	0	20.4
Mesopedinella arctica	7.7	174.6	3.1	33.2	21	9.2	15.1	0	0	0
Monomorphina pyrum	3.8	1.5	1.3	0.6	0	0	15.3	0	0	0

Table 5.4: Eukaryote Heatmaps continued: red lettering for potentially toxic species, Operational Taxonomic Units (OTUs) Sawicki et al data.

Species	FSB	LJB	LMB	LIB	WSB	LWB	BWB	CWB	DWB	KWB
Nannochloropsis sp.	1205.1	859.7	18.9	660.3	203.9	217.4	385.2	384.8	686.6	450.8
Neosiphonia polysiphonia harveyi	0.2	5.6	0	0	3.6	0	0	0	727	526.6
Nitzschia sp.	14.5	5.1	3.4	7.8	633.3	585.2	31	21.8	60.4	16.7
Ochromonas distigma	96.6	1270.2	44.7	796.8	4337.9	4207.1	317.1	348.7	332	782.8
Odontella sinensis	2.3	0	0	0.6	0	1.7	15.8	0	42.4	0
Paralemanea annulata	6.4	114.7	0.5	19.3	3.3	0	16	0	0	16
Paulinella chromatophora	0.5	0	0	0.3	2.5	6.4	123.4	1960.2	62	19.7
Pavlova sp.	0.6	14.1	0.1	12.2	0	3.9	0	0	0	0
Paulinella chromatophora	9.2	54.9	1.1	3.9	1280.4	1454	78.5	127.1	0	18
Phacus euglena limnophila	0.1	0.6	1	0	0	0	0	20.7	0	0
Phacus similis	0.1	3.1	0	1.1	3.3	5.4	0	0	0	17.6
Phaeodactylum tricornutum	298.9	35.3	21.8	12.5	51.7	25.2	61.7	109	83	92.7
Phalacroma dinophysis mitra	0	5.4	0	6.1	0	7.1	14.5	0	0	20.7
Plagioselmis sp.	6.1	4.1	94.9	6.4	15.7	16.6	0	0	43.4	53.7
Porphyra purpurea	0.4	0.6	0	23.9	0	1.7	14.3	0	0	18.5
Ptilophora subcostata	0	0	0	0	0	0	0	0	0	107
Pylaiella pilayella littoralis	0.1	0.9	0.1	0.5	45.8	39.3	0	21.8	0	0
Rhodomonas salina	498.7	801.9	313.6	860.7	146.8	122.8	169.5	300.8	414.2	324.9
Sciurothamnion sp.	0.6	0.9	0.1	0	6.4	1.3	0	0	104	17.4
Stephanodiscus minutulus	75.6	290.6	84.5	130.8	297.8	334.3	78.7	112.2	207.8	182.9
Strombomonas acuminata	10.5	4.7	5.8	3.3	0	0	16.8	0	0	0
Teleaulax amphioxeia	15.2	2	129.7	12.8	3.6	8.6	30.1	42.6	41.2	34.6
Thalassiosira eccentrica marine	496.9	17.8	225.8	62.6	195.4	336.8	240.2	250.9	289	329.4
Thalassiosira pseudonana	16.7	0.6	67.3	27.6	10.1	27.7	26.8	0	58.6	34.1
Thalassiosira sp.	95.1	65.6	3	5.4	6.4	18.1	16.4	21.1	0	0

Table 5.5: Prokaryote Heatmaps: red lettering for potentially toxic species, Operational Taxonomic Units (OTUs). Sawicki et al data.

Cyanobacteria- Species	FSB	LJB	LMB	LIB	WSB	LWB	BWB	CWB	DWB	KWB
Chlorogloea microcystoides	2.7	1.6	4.9	1.6	48.8	89.6	3	0.2	0.9	1.8
Chroococcidiopsis spp.	298.2	66.4	38.8	34.5	0.6	3.1	1.5	1.3	9.6	8.4
Chroococcus spp.	0	0.8	0	0	0.4	1	2	0.8	54	10.5
Coelomoron pusillum	9.8	59.4	9	10.5	0.3	0.4	0	0	0	0.5
Cuspidothrix aphanizomenon issatschenkoi	91.8	1.4	23.4	20.5	0	0	0.5	0.3	0.2	0
Cyanobacterium spp.	6117.6	401.7	3443.8	7579.5	304.1	529.7	34.8	228.1	309.6	71.4
Cyanobium sp.	6.4	3.9	10.7	9.2	0	0	0	0	0.1	2.2
Cyanothece sp.	5.7	25.9	16.7	0	0	0	0.4	0.8	0	1.8
Cyanothece spp.	22.4	62.4	136	16.5	1339.6	1660.9	339.6	339.5	818.7	114.7
Dermocarpa sp.	0.1	0.4	0	0.1	0.3	0	12.9	9.6	35.6	1.1
Dolichospermum circinale	6.2	0	203	0.1	0	0	1	0	0.1	0.3
Dolichospermum planctonicum	14.9	1.2	275.8	0.6	0	0.8	0	0	0	0
Geitlerinema splendidum	0	0.6	30.2	0	0.4	0.2	0	0	0	0
Geobacter spp.	3.6	7.6	25.2	2.9	32.3	54.4	81.9	118.4	67.5	127.8
Gloeobacter spp.	12.1	32.7	85.9	6.6	971.4	1186.7	30.3	20.4	66.6	56.5
Leptolyngbya foveolarum	2.5	9.8	3.3	0.2	5	12	0.1	0.3	0.5	0.6
Leptolyngbya sp.	13.2	23.2	26.1	1	11.5	8.8	2.4	4.1	6.6	4
Leptolyngbya spp.	28.8	12.1	2	1	6.3	5.8	18.3	0.1	1.2	8.3
Limnothrix spp.	42.6	4.5	30.6	0.6	3.2	7	0.3	0.1	0	0
Merismopedia spp.	192.8	10.1	42	66	1.6	1.5	0.2	0	0.3	1.8
Microcystis spp.	503.5	47.3	1537.6	58.7	7.8	12.6	0.4	1.6	2.2	1
Oscillatoria sp.	2	1.9	16.6	0	0	0	0	0	0	0
Phormidium sp.	4.1	1.1	18.4	0.4	3.3	2.7	3.8	0.8	0	0.2
Planktothrix agardhii	0.5	0	1.2	0.2	0.7	0	51.6	1.8	29.1	1.2
Plectonema spp.	14.2	7.8	11.6	172.5	2.3	2.9	0	0.7	0.5	0
Plectonema spp.	14.2	7.8	11.6	172.5	2.3	2.9	0	0.7	0.5	0
Pleurocapsa spp.	37.8	0	16.9	1.5	0	0.7	0	0.2	0	0
Prochlorococcus sp.	1316.7	94.1	462.2	447.4	19	41.4	5.3	1.7	4.5	4.7
Prochlorococcus spp.	157.5	1055.7	738.4	48.4	699.5	732.3	1885	852.9	787.7	696
Pseudanabaena sp.	116.4	25.1	149.9	69.6	6	20.1	0.2	0.3	0	1.6
Synechococcus sp.	63.8	3.3	59.1	351.3	2.1	3.9	2.4	10.3	2.6	11.5
Synechococcus spp.	447.9	26.7	232.8	507.2	53.7	102.9	524.5	343.5	57.9	52.8

Chapter 6

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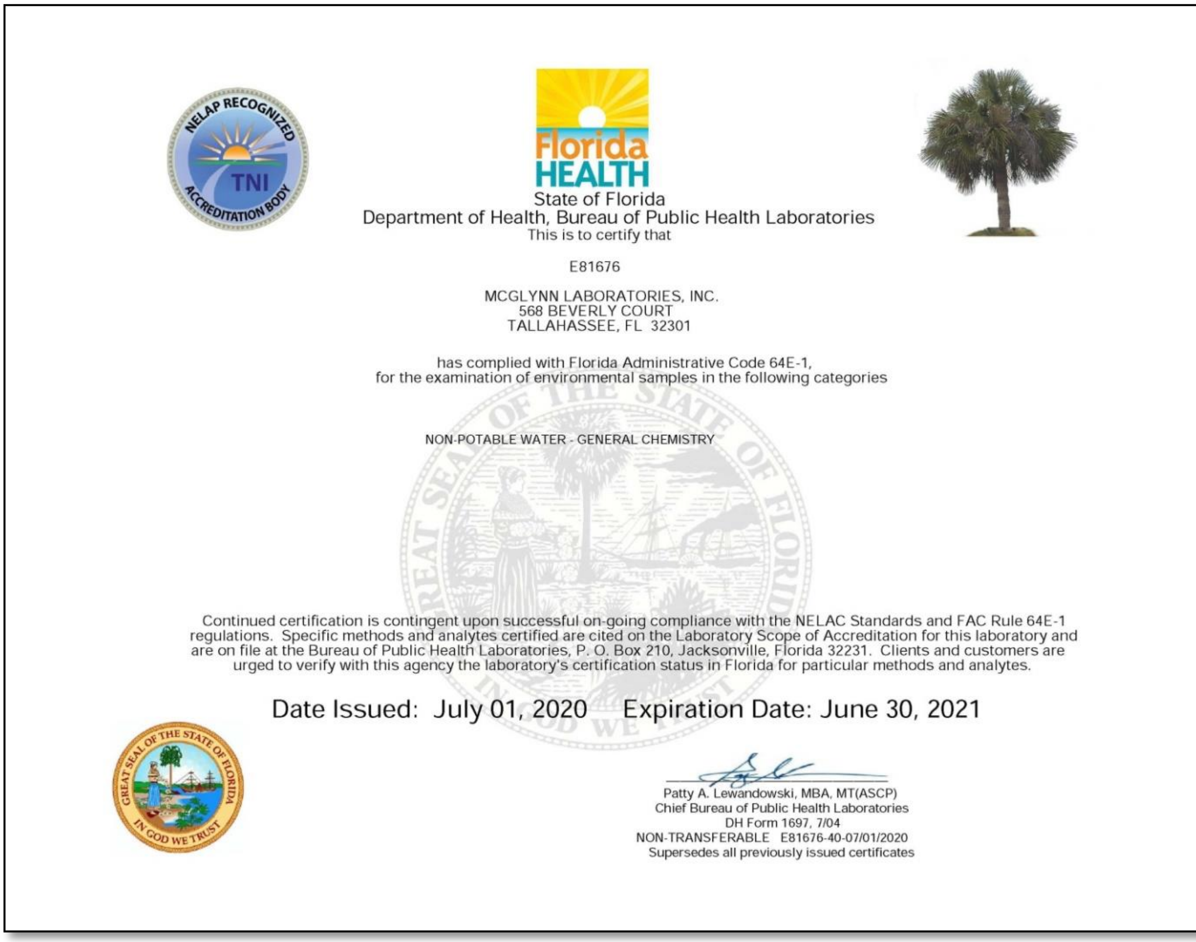
Appendix 1A
Wakulla Springs Dark Water: Causes and Sources Phases III: Support Data Generated for this Report

This project was completed for the Wakulla Springs Alliance by McGlynn Laboratories, Inc. with financial assistance provided by the Fish and Wildlife Foundation of Florida, Inc. through the Protect Florida Springs Tag Grant Program, project PFS #1617-08. The analytical results contained within this report meet all National Environmental Laboratory Accreditation Program (NELAP) requirements for parameters for which NELAP accreditation is required or available. Any deviations from NELAP requirements are noted in this report. Dr. Seán E. McGlynn (Laboratory Manager) and Kathleen A. McGlynn (Quality Assurance Officer) implemented the sampling program and laboratory analysis of the environmental parameters addressed in this report, concerning the authenticity, precision, limits of detection and accuracy of the data, except for the taxonomy and environmental DNA analysis which were run under the auspices of Dr. Akshinthala Prasad of Florida State University and Drs. Thomas Sawicki, Richard Long and Graduate Student Kaylee Castle, of the Florida A&M University, Department of Biology who are responsible for the authenticity, precision, limits of detection and accuracy of the data in Chapter 5.



State of Florida
Department of Health, Bureau of Public Health Laboratories
This is to certify that

E81676

MCGLYNN LABORATORIES, INC.
568 BEVERLY COURT
TALLAHASSEE, FL 32301

has complied with Florida Administrative Code 64E-1,
for the examination of environmental samples in the following categories

NON-POTABLE WATER - GENERAL CHEMISTRY

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: July 01, 2020 Expiration Date: June 30, 2021

Patty A. Lewandowski, MBA, MT(ASCP)
Chief Bureau of Public Health Laboratories
DH Form 1697, 7/04
NON-TRANSFERABLE E81676-40-07/01/2020
Supersedes all previously issued certificates

Figure A1: NELAP certification for McGlynn Laboratories Inc.

Ron DeSantis
Governor

Florida HEALTH

Laboratory Scope of Accreditation

Page 1 of 1

Attachment to Certificate #: E81676-40, expiration date June 30, 2021. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E81676 **EPA Lab Code: FL00153** **(850) 570-1476**

E81676
McGlynn Laboratories, Inc.
568 Beverly Court
Tallahassee, FL 32301

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Alkalinity as CaCO3	EPA 310.1	General Chemistry	NELAP	1/12/2015
Alkalinity as CaCO3	SM 2320 B	General Chemistry	NELAP	1/12/2015
Ammonia as N	EPA 350.3	General Chemistry	NELAP	2/17/2020
Ammonia as N	SM 4500-NH3 D (19th, 20th, 21st Ed.)ISE	General Chemistry	NELAP	2/17/2020
Biochemical oxygen demand	SM 5210 B	General Chemistry	NELAP	1/22/2015
Chloride	EPA 325.3	General Chemistry	NELAP	1/12/2015
Chloride	SM 4500-Cl$^-$ C	General Chemistry	NELAP	1/12/2015
Chlorophylls	SM 10200 H	General Chemistry	NELAP	9/11/2001
Color	SM 2120 C	General Chemistry	NELAP	5/24/2013
Kjeldahl nitrogen - total	EPA 351.4	General Chemistry	NELAP	4/8/2015
Kjeldahl nitrogen - total	SM 4500-NH3 D (19th, 20th, 21st Ed.)ISE	General Chemistry	NELAP	4/8/2015
Nitrate	SM 4500-NO3 E	General Chemistry	NELAP	5/24/2013
Nitrate as N	EPA 353.3	General Chemistry	NELAP	8/15/2003
Nitrite	SM 4500-NO2-B	General Chemistry	NELAP	2/20/2020
Nitrite as N	EPA 354.1	General Chemistry	NELAP	2/20/2020
Organic nitrogen	TKN minus AMMONIA	General Chemistry	NELAP	6/14/2004
Orthophosphate as P	EPA 365.2	General Chemistry	NELAP	12/4/2014
Orthophosphate as P	SM 4500-P E	General Chemistry	NELAP	12/4/2014
Phosphorus, total	EPA 365.2	General Chemistry	NELAP	12/4/2014
Phosphorus, total	SM 4500-P E	General Chemistry	NELAP	12/4/2014
Residue-filterable (TDS)	EPA 160.1	General Chemistry	NELAP	5/25/2004
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	5/24/2013
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	5/24/2013

Clients and Customers are urged to verify the laboratory's current certification status with the Environmental Laboratory Certification Program. **Issue Date: 7/1/2020** **Expiration Date: 6/30/2021**

Figure A2: NELAP scope of accreditation for McGlynn Laboratories Inc.

Table A1: Wakulla Spring Data, page 1, with Method Detection Limit (MDL) and Practical Quantitation Limit (PQL).

		Parameter	SpCond	Salinity	Color	Trichromatic Chlorophylls (SM10200H)				Monochromatic Chlorophylls		Nitrate
		Method	EPA	EPA	EPA	algal				*Corrected*	(SM10200H)	EPA
		Method	120	120.1	110.2	biomass	chl a	chl b	chl c	*Chl a*	*Phaophytin*	353.3
		MDL	3	0.05	*0.1*	*0.007*	*0.05*	*0.05*	*0.05*	*0.05*	*0.05*	*0.005*
		PQL	16	0.25	*0.5*	*0.035*	*0.25*	*0.25*	*0.25*	*0.25*	*0.25*	*0.025*
Station	**Date**	Units	uS	uS	PT/CU	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
			uS	**ppt**	**PtCo**	**mg/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**ug/L**	**mg/L**
WS P	01/01/18	9:00	356	0.11	0.9							0.375
WS P	01/02/18	9:00	361	0.11	0.2							0.313
WS P	01/03/18	9:00	349	0.11	<0.1							0.338
WS P	01/04/18	9:00	348	0.11	0.9							0.329
WS P	01/05/18	9:00	345	0.11	<0.1							0.290
WS P	01/06/18	9:00	340	0.10	2.3							0.325
WS B	01/07/18	13:00	653	0.29	3.0	<0.007	0.15	<0.05	0.14	0.27	<0.05	0.375
WS P	01/07/18	9:00	349	0.11	1.2							0.326
WSW L	01/07/18	15:15	561	0.23	2.0	<0.007	<0.05	<0.05	<0.05	0.53	<0.05	0.237
WS P	01/08/18	9:00	351	0.11	1.6							0.321
WS P	01/09/18	9:00	354	0.11	1.6							0.329
WS P	01/10/18	9:00	376	0.12	1.6							0.277
WS B	01/11/18	11:15	402	0.14	3.0	<0.007	<0.05	0.09	0.23	<0.05	0.09	0.300
WS P	01/11/18	9:00	391	0.13	9.4							0.448
WSW L	01/11/18	11:35	407	0.14	5.9	<0.007	0.13	<0.05	0.12	<0.05	<0.05	0.294
SC D	01/12/18	16:00	49715	32.00	9.4	0.200	2.98	<0.05	0.58	3.47	<0.05	
WS P	01/12/18	9:00	358	0.11	14.8							0.428
WS P	01/13/18	9:00	409	0.14	7.3							0.259
WS P	01/14/18	9:00	228	0.03	1.6							
WS P	01/15/18	9:00	426	0.15	5.5							0.115
WS P	01/16/18	9:00	413	0.15	9.4							0.394
WS P	01/17/18	9:00	429	0.16	10.1							0.123
SC D	01/18/18	14:08	49715	32.00	11.2	0.208	3.10	<0.05	0.56	3.20	<0.05	
WS B	01/18/18	13:13	413	0.15	5.9	<0.007	0.07	<0.05	<0.05	<0.05	0.36	0.415
WS P	01/18/18	9:00	417	0.15	2.7							0.462
WSW L	01/18/18	14:00	426	0.15	8.0	<0.007	0.07	<0.05	0.13	0.45	<0.05	
WS P	01/19/18	9:00	402	0.14	4.1							0.290
WS P	01/20/18	9:00	401	0.14	3.0							0.296
WS P	01/20/18	9:00	401	0.14	6.9							0.422
WS P	01/21/18	9:00	402	0.14	4.1							0.381
WS P	01/22/18	9:00	408	0.14	3.7							0.381
WS P	01/23/18	9:00	420	0.15	5.5							0.394
WS P	01/24/18	9:00	436	0.16	2.7							0.455
SC D	01/25/18	12:50	49715	32.00	8.4	0.062	0.93	<0.05	<0.05	0.80	0.32	
WS B	01/25/18	11:15	432	0.16	6.9	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.223
WS P	01/25/18	9:00	433	0.16	10.1							0.446
WSW L	01/25/18	12:00	457	0.17	9.4	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.354
WS P	01/26/18	9:00	425	0.15	4.1							0.435
WS P	01/27/18	9:00	457	0.17	5.9							0.437
WS P	01/28/18	9:00	460	0.17	5.5							0.381
WS P	01/29/18	9:00	474	0.18	5.2							0.455
WS P	01/30/18	9:00	485	0.19	10.5							0.469

Table A1: Wakulla Spring Data, page 2

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	01/31/18	9:00	489	0.19	3.4							0.442
WS B	02/01/18	11:08	515	0.21	5.2	<0.007	0.04	0.36	<0.05	0.30	<0.05	0.489
WS P	02/01/18	9:00	503	0.20	4.4							0.482
WSW L	02/01/18	11:40	554	0.23	7.3	<0.007	0.15	0.48	<0.05	0.59	<0.05	0.349
WS P	02/02/18	9:00	504	0.20	5.9							0.487
WS P	02/03/18	9:00	501	0.20	5.2							0.519
WS P	02/04/18	9:00	490	0.19	2.3							0.464
Horn Spring	02/05/18	12:30	326	0.09	6.6	0.112	1.67	0.71	<0.05	4.81	<0.05	0.184
WS P	02/05/18	9:00	517	0.21	2.3							0.491
SC D	02/06/18	11:00	45059	29.00	6.9	0.024	0.36	<0.05	<0.05	<0.05	0.75	
WS P	02/06/18	9:00	489	0.19	2.0							0.475
WS P	02/07/18	9:00	520	0.21	2.0							0.527
WS B	02/08/18	11:15	missing	missing	5.5	0.017	0.26	0.80	<0.05	0.74	<0.05	0.379
WS P	02/08/18	9:00	523	0.21	2.3							0.487
WSW L	02/08/18	11:40	602	0.26	3.0	0.021	0.31	0.08	<0.05	0.74	<0.05	0.428
WS P	02/09/18	9:00	506	0.20	2.0							0.417
WS P	02/10/18	9:00	519	0.21	2.3							0.405
WS P	02/11/18	9:00	528	0.21	4.4							0.462
WS P	02/12/18	9:00	524	0.21	5.9							0.453
WS P	02/13/18	9:00	537	0.22	5.9							0.435
WS P	02/14/18	9:00	552	0.23	4.8							0.437
WS B	02/15/18	11:11	588	0.25	7.6	0.018	0.26	<0.05	0.10	0.45	<0.05	0.369
WS P	02/15/18	9:00	579	0.25	5.9							0.405
WSW L	02/15/18	11:38	606	0.26	7.6	0.008	0.12	0.06	<0.05	0.15	<0.05	0.336
WS P	02/16/18	9:00	628	0.27	7.3							0.367
WS P	02/17/18	9:00	641	0.28	10.1							0.374
WS P	02/18/18	9:00	710	0.32	15.5							0.346
WS P	02/19/18	9:00	702	0.32	6.6							0.376
WS P	02/20/18	9:00	678	0.30	7.6							0.332
WS P	02/21/18	9:00	604	0.26	9.8							0.355
WS B	02/22/18	11:15	593	0.25	15.5	0.017	0.25	<0.05	0.06	<0.05	0.31	0.385
WS P	02/22/18	9:00	570	0.24	17.2							0.257
WSW L	02/22/18	12:00	580	0.25	14.4	0.034	0.50	0.09	0.00	0.45	<0.05	0.386
SC D	02/23/18	14:50	43507	28.00	22.2	0.276	4.12	<0.05	0.68	1.07	4.54	
WS P	02/23/18	9:00	537	0.22	12.3							0.367
WS P	02/25/18	9:00	475	0.18	20.1							0.360
WS P	02/26/18	9:00	426	0.15	9.4							0.376
WS P	02/28/18	9:00	421	0.15	4.1							0.388
WS P	03/01/18	9:00	416	0.15	30.8							0.308
SC D	03/02/18	12:00	38852	25.00	17.2	0.487	7.27	<0.05	1.90	6.34	1.13	
WS B	03/02/18	11:15	445	0.17	29.3	<0.007	0.02	0.23	<0.05	<0.05	<0.05	0.334
WS P	03/02/18	9:00	405	0.14	18.7							0.210
WS P	03/02/18	9:00	406	0.14	29.7							0.276
WSW L	03/02/18	11:42	474	0.18	37.5	0.026	0.39	<0.05	<0.05	1.04	<0.05	0.266
WS P	03/03/18	9:00	398	0.14	32.5							0.362
WS P	03/04/18	9:00	379	0.13	25.8							0.416
WS P	03/05/18	9:00	369	0.12	25.1							0.383
WS P	03/06/18	9:00	359	0.11	24.7							0.400

Table A1: Wakulla Spring Data, page 3

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	03/07/18	9:00	339	0.10	20.1							0.374
SC D	03/08/18	12:00	26438	17.00	46.4	0.826	12.33	0.20	1.10	9.79	4.23	
WS B	03/08/18	11:15	345	0.11	20.1	0.029	0.43	0.08	0.35	0.89	<0.05	0.369
WS P	03/08/18	9:00	338	0.10	22.9							0.367
WSW L	03/08/18	11:45	337	0.10	25.4	0.016	0.24	0.19	0.24	0.45	<0.05	0.325
WS P	03/09/18	9:00	333	0.10	19.4							0.416
WS P	03/10/18	9:00	335	0.10	21.2							0.329
WS P	03/11/18	9:00	325	0.09	19.7							0.316
WS P	03/13/18	9:00	349	0.11	25.4							0.344
WS P	03/14/18	9:00	350	0.11	24.4							0.295
WS P	03/15/18	9:00	348	0.11	18.0							0.360
WS P	03/16/18	9:00	351	0.11	16.5							0.334
WS P	03/16/18	9:00	350	0.11	17.6							0.381
WS P	03/17/18	9:00	353	0.11	19.7							0.353
SC D	03/18/18	11:45	41956	27.00	23.6	0.060	0.90	0.17	<0.05	0.53	1.15	
WS B	03/18/18	11:00	358	0.11	20.4	0.024	0.35	0.39	<0.05	<0.05	0.62	0.330
WS P	03/18/18	9:00	360	0.11	21.5							0.381
WSW L	03/18/18	11:03	362	0.12	25.4	<0.007	0.05	0.23	<0.05	<0.05	0.56	0.311
WS P	03/19/18	9:00	363	0.12	20.1							0.350
WS P	03/20/18	9:00	371	0.12	20.1							0.346
WS P	03/22/18	9:00	383	0.13	21.9							0.378
WS P	03/22/18	9:00	missing	missing	22.6							0.365
SC D	03/23/18	16:00	20230	13.00	78.4	0.031	0.46	<0.05	<0.05	0.27	0.85	
WS B	03/23/18	11:00	399	0.14	21.9	0.021	0.31	0.11	<0.05	0.15	0.47	0.365
WS P	03/23/18	9:00	362	0.12	15.1							0.423
WSW L	03/23/18	11:30	439	0.16	26.9	0.008	0.12	0.07	<0.05	0.15	0.06	0.253
WS P	03/24/18	9:00	327	0.09	14.8							0.439
WS P	03/24/18	9:00	494	0.19	15.8							0.344
WS P	03/25/18	9:00	318	0.09	9.4							0.491
WS P	03/26/18	9:00	306	0.08	11.2							0.444
WS P	03/28/18	9:00	299	0.08	22.6							0.441
SC D	03/29/18	12:00	14023	9.00	205.0	0.096	1.43	0.69	0.01	2.67	<0.05	
WS B	03/29/18	11:00	316	0.09	35.7	0.026	0.38	0.77	0.24	0.59	<0.05	0.182
WS P	03/29/18	9:00	450	0.17	28.6							0.297
WSW L	03/29/18	11:45	293	0.07	53.5	0.019	0.29	0.42	<0.05	<0.05	0.52	0.115
WS P	03/30/18	9:00	282	0.07	39.3							0.225
WS P	03/31/18	9:00	294	0.07	37.9							0.136
WS P	04/01/18	9:00	296	0.08	36.5							0.351
WS P	04/02/18	9:00	294	0.07	29.0							0.308
WS P	04/03/18	9:00	299	0.08	26.9							0.369
WS P	04/04/18	9:00	300	0.08	27.6							0.449
WS B	04/05/18	11:19	309	0.08	38.6	0.008	0.11	0.14	0.17	<0.05	<0.05	
WS P	04/05/18	9:00	304	0.08	18.0							0.383
WSW L	04/05/18	11:42	300	0.08	42.9	0.045	0.67	0.34	<0.05	1.19	<0.05	0.101
WS P	04/06/18	9:00	303	0.08	18.3							0.320
WS P	04/07/18	9:00	311	0.08	14.0							0.370
SC D	04/08/18	11:50	10920	7.00	88.0	0.081	1.21	0.50	0.83	1.87	<0.05	
WS P	04/08/18	9:00	307	0.08	14.4							0.380
WS P	04/09/18	9:00	311	0.08	16.5							0.359
WS P	04/10/18	9:00	306	0.08	14.0							0.381

Table A1: Wakulla Spring Data, page 4

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	04/11/18	9:00	306	0.08	13.0							0.327
SC D	04/12/18	12:40	9368	6.00	70.6	0.075	1.12	0.22	0.26	0.53	0.77	
WS B	04/12/18	11:22	314	0.09	14.4	0.012	0.18	0.11	0.16	0.15	0.47	0.211
WS P	04/12/18	9:00	312	0.09	13.0							0.385
WSW L	04/12/18	12:10	328	0.09	21.5	0.010	0.15	0.48	<0.05	<0.05	<0.05	0.181
WS P	04/13/18	9:00	309	0.08	8.4							0.359
WS P	04/14/18	9:00	308	0.08	4.1							0.392
WS P	04/15/18	9:00	312	0.09	5.2							0.364
WS P	04/16/18	9:00	311	0.08	6.6							0.450
WS P	04/17/18	9:00	315	0.09	5.5							0.402
WS P	04/18/18	9:00	310	0.08	4.4							0.432
WS P	04/19/18	9:00	314	0.09	9.8							0.424
WS B	04/20/18	10:40	321	0.09	8.7	<0.007	0.07	<0.05	0.13	<0.05	<0.05	0.208
WS P	04/20/18	9:00	313	0.09	10.8							0.418
WSW L	04/20/18	11:10	322	0.09	11.9	<0.007	0.06	0.07	0.08	0.15	<0.05	0.141
WS P	04/21/18	9:00	314	0.09	9.4							0.424
WS P	04/22/18	9:00	313	0.09	5.9							0.331
WS P	04/23/18	9:00	315	0.09	10.1							0.446
SC D	04/24/18	14:00	9200	5.42	80.6	0.067	1.00	0.27	0.28	0.53	<0.05	0.133
WS P	04/24/18	9:00	315	0.09	8.4							0.344
WS P	04/25/18	9:00	312	0.09	2.3							0.377
WS B	04/26/18	11:30	333	0.10	4.4	0.011	0.17	0.20	0.39	0.00	0.30	0.206
WSW L	04/26/18	12:10	320	0.09	12.6	<0.007	0.04	0.29	0.14	0.00	0.00	0.306
WS P	04/27/18	9:30	317	0.09	<0.1							0.483
WS P	04/28/18	9:30	313	0.09	8.4							0.427
SC D	04/29/18	11:30	6786	3.97	73.4	0.059	0.88	0.35	0.05	0.80	<0.05	0.120
WS P	04/29/18	9:30	323	0.09	18.3							0.509
WS P	04/30/18	9:30	318	0.09	4.8							0.417
WS P	05/01/18	9:30	317	0.09	3.4							0.512
WS P	05/02/18	9:30	314	0.09	3.4							0.422
WS P	05/03/18	9:30	312	0.09	2.3							0.460
WS B	05/04/18	13:15	313	0.09	10.8	0.023	0.34	<0.05	0.13	0.89	<0.05	0.292
WS P	05/04/18	9:30	317	0.09	2.0							0.472
Indian Spring	05/05/18	14:00	300	0.08	13.7	0.034	0.50	<0.05	0.09	1.34	<0.05	0.377
WSW L	05/05/18	15:30	309	0.08	13.0	0.019	<0.05	<0.05	0.44	0.59	<0.05	0.254
WS P	05/06/18	9:30	309	0.08	4.4							0.468
WS P	05/07/18	9:30	313	0.09	9.4							0.329
WS P	05/08/18	9:30	311	0.08	6.6							0.496
WS P	05/09/18	9:30	312	0.09	7.3							0.422
SC D	05/10/18	12:00	6171	3.60	45.0	0.612	9.13	<0.05	<0.05	2.23	10.75	
WS B	05/10/18	11:20	315	0.09	10.8	0.015	<0.05	<0.05	0.61	<0.05	1.44	0.265
WS P	05/10/18	9:00	308	0.08	4.8							0.405
WSW L	05/10/18	11:45	312	0.09	13.0	0.050	0.75	0.15	0.36	<0.05	1.44	0.164
WS P	05/11/18	9:00	311	0.08	6.9							0.394
WS P	05/12/18	9:00	309	0.08	4.1							0.512
WS P	05/13/18	9:00	307	0.08	6.9							0.498
WS P	05/14/18	9:00	306	0.08	5.5							0.448
WS P	05/15/18	9:00	302	0.08	2.3							0.466
WS P	05/16/18	9:00	306	0.08	4.4							0.387
WS P	05/17/18	9:00	306	0.08	2.3							0.383

Table A1: Wakulla Spring Data, page 5

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS B	05/18/18	14:45	308	0.08	9.4	<0.007	0.02	<0.05	<0.05	0.30	0.12	
WS P	05/18/18	9:00	305	0.08	3.7							0.354
WSW L	05/18/18	15:45	306	0.08	9.8	0.028	0.42	0.30	0.41	<0.05	2.15	0.136
WS P	05/19/18	9:00	306	0.08	3.4							0.400
WS P	05/20/18	9:00	311	0.08	3.0							0.238
WS P	05/21/18	9:00	307	0.08	4.8							0.322
WS P	05/22/18	9:00	302	0.08	4.8							0.115
Indian Spring	05/23/18	17:00	38852	25.00	33.6	0.491	7.33	0.78	2.07	7.21	<0.05	
WS P	05/23/18	9:00	301	0.08	2.3							
WS B	05/24/18	11:15	564	0.24	3.7	0.015	<0.05	<0.05	0.21	<0.05	<0.05	
WS P	05/24/18	9:00	304	0.08	2.0							
WSW L	05/24/18	11:40	758	0.35	3.7	0.011	0.16	<0.05	1.83	<0.05	<0.05	
WS P	05/25/18	9:00	319	0.09	4.8							
WS P	05/26/18	9:00	308	0.08	<0.1							
WS P	05/27/18	9:00	309	0.08	2.0							
WS P	05/28/18	9:00	308	0.08	34.3							0.157
WS P	05/29/18	9:00	304	0.08	5.5							0.207
WS P	05/30/18	9:00	305	0.08	9.8							0.134
WS B	05/31/18	11:15	312	0.09	0.5	0.008	<0.05	<0.05	0.24	0.30	<0.05	0.266
WS P	05/31/18	9:00	307	0.08	3.0							0.134
WS P	05/31/18	9:00	312	0.09	4.8							
WSW L	05/31/18	12:10	309	0.08	1.2	<0.007	0.04	0.32	<0.05	0.15	<0.05	
WS P	06/01/18	9:00	305	0.08	2.0							0.220
WS P	06/02/18	9:00	309	0.08	2.7							0.119
WS P	06/03/18	9:00	311	0.08	9.1							0.240
WS P	06/04/18	9:00	305	0.08	3.0							0.428
WSW L	06/04/18	11:50	295	0.08	30.8	0.009	0.13	<0.05	0.12	3.26	<0.05	
SC D	06/05/18	11:00	7816	5.00	280.1	0.017	0.25	<0.05	0.29	1.34	<0.05	
WS P	06/05/18	9:00	305	0.08	6.9							0.386
WS P	06/06/18	9:00	305	0.08	13.0							0.186
WS B	06/07/18	11:30	293	0.07	28.6	0.257	3.83	<0.05	<0.05	1.04	4.46	
WS P	06/07/18	9:00	303	0.08	20.1							0.144
WSW L	06/07/18	12:00	294	0.07	34.3	<0.007	0.01	<0.05	0.18	0.15	<0.05	
WS P	06/08/18	9:00	301	0.08	69.9							0.347
WS P	06/09/18	9:00	296	0.08	29.3							0.391
WS P	06/10/18	9:00	298	0.08	29.7							0.345
WS P	06/11/18	9:00	298	0.08	29.3							0.331
WS P	06/12/18	9:00	303	0.08	41.8							0.227
WS P	06/13/18	9:00	302	0.08	31.5							0.274
SC D	06/14/18	12:20	4183	2.41	129.6	0.059	0.88	0.33	0.30	1.34	<0.05	
WS B	06/14/18	10:20	311	0.08	32.2	0.012	0.18	0.11	0.16	0.74	<0.05	
WS P	06/14/18	9:00	302	0.08	27.6							0.352
WS P	06/15/18	9:00	302	0.08	26.1							0.380
WS P	06/16/18	9:00	304	0.08	22.2							0.311
WS P	06/17/18	9:00	305	0.08	22.6							0.373
WS P	06/18/18	9:00	305	0.08	22.2							0.398
SC D	06/21/18	12:15	7404	4.34	163.8	0.063	0.94	<0.05	<0.05	1.34	<0.05	
WS B	06/21/18	11:15	310	0.08	64.2	0.043	0.64	<0.05	<0.05	1.19	<0.05	
WSW L	06/21/18	11:35	304	0.08	22.6	0.010	0.14	<0.05	<0.05	0.45	<0.05	
WS P	06/22/18	9:00	305	0.08	6.9							0.421

Table A1: Wakulla Spring Data, page 6

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	06/23/18	9:00	307	0.08	13.0							0.401
WS P	06/24/18	9:00	304	0.08	6.9							0.447
WS P	06/25/18	9:00	306	0.08	19.4							0.162
WS P	06/26/18	9:00	301	0.08	16.9							0.183
WS P	06/27/18	9:00	303	0.08	13.0							0.393
WS B	06/28/18	11:00	309	0.08	17.2	<0.007	0.06	0.09	<0.05	0.45	<0.05	0.200
WS P	06/28/18	9:00	302	0.08	11.9							0.327
WSW L	06/28/18	11:43	297	0.08	53.2	0.011	0.16	0.35	0.08	0.30	0.01	
WS P	06/29/18	9:00	297	0.08	13.0							0.359
WS P	06/30/18	9:00	300	0.08	19.7							
WS P	07/01/18	9:00	307	0.08	16.9							0.324
WS P	07/02/18	9:00	303	0.08	11.9							0.386
WS P	07/03/18	9:00	303	0.08	9.1							0.182
WS P	07/04/18	9:00	306	0.08	7.3							0.465
SC D	07/05/18	12:43	8223	4.83	93.7	0.052	0.78	0.17	0.39	0.53	0.40	0.123
WS B	07/05/18	11:15	306	0.08	19.4	<0.007	<0.05	<0.05	<0.05	0.15	<0.05	0.158
WS P	07/05/18	9:00	308	0.08	4.8							0.436
WSW L	07/05/18	11:45	305	0.08	45.3	<0.007	0.01	0.10	0.09	0.30	<0.05	0.195
WS P	07/06/18	9:00	302	0.08	1.2							0.455
WS P	07/07/18	9:00	308	0.08	1.2							0.415
WS P	07/08/18	9:00	309	0.08	0.5							0.476
WS P	07/09/18	9:00	309	0.08	4.8							0.411
WS P	07/10/18	9:00	309	0.08	0.0							0.414
WS P	07/11/18	9:00	308	0.08	5.2							0.313
SC D	07/12/18	12:40	5522	3.21	185.5	0.205	3.06	0.35	<0.05	2.40	1.15	
WS B	07/12/18	11:00	358	0.11	25.1	0.013	0.20	<0.05	<0.05	0.30	<0.05	0.115
WS P	07/12/18	9:00	311	0.08	2.3							0.402
WSW L	07/12/18	11:50	304	0.08	9.1	<0.007	0.05	<0.05	<0.05	0.30	0.01	
WS P	07/13/18	9:00	300	0.08	2.3							0.411
WS P	07/14/18	9:00	303	0.08	0.5							0.481
SC D	07/17/18	13:00	17127	11.00	127.9	0.014	0.21	0.29	0.06	<0.05	0.56	
WS B	07/19/18	11:20	309	0.08	5.9	0.006	0.10	0.35	0.36	<0.05	0.46	0.351
WSW L	07/19/18	11:40	312	0.09	6.2	0.096	1.43	0.37	0.32	1.48	<0.05	0.433
WS P	07/20/18	9:00	300	0.14	0.2							0.576
WS P	07/21/18	9:00	303	0.15	2.0							0.659
WS P	07/22/18	9:00	306	0.15	5.9							0.852
WS P	07/23/18	9:00	304	0.15	1.6							0.836
WS P	07/24/18	9:00	304	0.15	3.7							0.746
WS P	07/25/18	9:00	308	0.15	2.3							0.815
WS B	07/26/18	10:30	336	0.17	54.6	0.029	0.43	<0.05	0.08	0.80	0.13	0.316
WS P	07/26/18	9:00	305	0.15	4.1							1.504
WSW L	07/26/18	11:34	301	0.14	5.5	0.027	0.40	<0.05	0.40	0.45	<0.05	0.722
WS P	07/27/18	9:00	301	0.14	5.2							0.905
WS P	07/28/18	9:00	301	0.14	6.2							1.047
WS P	07/29/18	9:00	301	0.14	7.3							0.788
WS P	07/31/18	9:00	299	0.14	14.0							0.619
WS P	08/01/18	9:00	299	0.14	14.4							0.427
SC D	08/02/18	15:00	7816	5.00	177.3	0.036	0.54	<0.05	0.96	0.30	0.33	0.038
Wakulla Beach	08/02/18	18:00	18679	12.00	73.1	0.350	5.22	<0.05	1.39	4.60	0.39	0.057
WS B	08/02/18	10:15	295	0.14	22.6	0.055	0.82	<0.05	1.84	<0.05	0.75	0.276

Table A1: Wakulla Spring Data, page 7

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	08/02/18	9:00	287	0.14	27.6							0.525
WSW L	08/02/18	10:35	214	0.09	38.9	0.063	0.94	<0.05	1.58	0.53	0.21	0.004
WS P	08/03/18	9:00	290	0.14	29.7							0.563
WS P	08/04/18	9:00	287	0.14	37.2							0.464
WS P	08/05/18	9:00	281	0.13	50.3							0.722
WS P	08/06/18	9:00	275	0.13	65.3							0.399
WS P	08/07/18	9:00	275	0.13	76.6							0.539
WS P	08/08/18	9:00	266	0.12	88.7							0.455
WS B	08/09/18	10:20	266	0.12	117.2	<0.007	0.02	0.86	<0.05	0.53	<0.05	0.269
WS P	08/09/18	9:00	263	0.12	100.5							0.480
WS P	08/10/18	9:00	263	0.12	105.8							0.762
WS P	08/11/18	9:00	265	0.12	101.9							0.775
WS P	08/12/18	9:00	266	0.12	107.9							0.444
WS P	08/13/18	9:00	267	0.12	100.8							0.385
WS P	08/14/18	9:00	270	0.13	93.0							0.478
SC D	08/15/18	13:00	7816	5.00	293.6	<0.007	<0.05	0.16	<0.05	0.45	<0.05	0.086
WS P	08/15/18	9:00	273	0.13	88.0							0.284
WS B	08/16/18	10:40	278	0.13	84.1	<0.007	0.06	<0.05	0.26	0.15	<0.05	0.343
WS P	08/16/18	9:00	276	0.13	69.9							0.419
WSW L	08/16/18	11:20	283	0.13	74.9	0.008	<0.05	<0.05	1.00	0.80	<0.05	0.346
WS P	08/17/18	9:00	283	0.13	62.8							0.332
WS P	08/18/18	9:00	285	0.13	57.1							0.396
SC D	08/19/18	15:00	2700	1.58	235.3	0.015	0.22	0.15	<0.05	0.27	<0.05	0.195
WS P	08/19/18	9:00	287	0.14	52.8							0.217
WS P	08/20/18	9:00	289	0.14	41.8							0.407
WS P	08/21/18	9:00	288	0.14	36.5							0.413
WS P	08/22/18	9:00	290	0.14	52.8							0.425
WS B	08/23/18	10:20	292	0.14	58.4	0.012	0.18	0.13	0.02	0.30	<0.05	0.425
WS P	08/23/18	9:00	291	0.14	50.3							0.463
WSW L	08/23/18	10:58	288	0.14	57.2	<0.007	0.07	<0.05	<0.05	0.15	0.06	0.385
WS P	08/24/18	9:00	295	0.14	57.6							0.465
WS P	08/25/18	9:00	294	0.14	49.5							0.491
Indian A West	08/26/18	11:00	289	0.14	17.6							0.531
Indian B Central	08/26/18	11:00	289	0.14	18.0							0.535
Indian C East	08/26/18	11:00	288	0.14	18.0							0.624
WS P	08/26/18	9:00	293	0.14	49.5							0.495
WS B	08/27/18	10:40	297	0.14	50.7	0.016	<0.05	0.03	<0.05	<0.05	0.50	0.541
WS P	08/27/18	9:00	294	0.14	47.1							0.463
WSW L	08/27/18	11:15	295	0.14	55.2	0.177	2.64	<0.05	<0.05	0.44	3.81	0.467
WS P	08/28/18	9:00	296	0.14	48.3							0.490
WS P	08/29/18	9:00	296	0.14	47.9							0.465
WS P	08/30/18	9:00	297	0.14	51.1							0.510
WS P	08/31/18	9:00	299	0.14	45.9							0.567
WS P	09/01/18	9:00	293	0.14	31.8							0.419
WS P	09/02/18	9:00	295	0.14	33.0							0.395
WS P	09/03/18	9:00	293	0.14	45.1							0.277
WS P	09/04/18	9:00	297	0.14	33.4							0.254
WS P	09/05/18	9:00	299	0.14	32.6							0.336
WS B	09/06/18	‼:00	300	0.14	45.9	0.012	<0.05	<0.05	<0.05	<0.05	0.15	0.268
WS P	09/06/18	9:00	300	0.14	33.8							0.360

Table A1: Wakulla Spring Data, page 8

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WSW L	09/06/18	11:10	298	0.14	44.3	0.008	0.11	0.13	0.31	<0.05	0.04	0.123
WS P	09/07/18	9:00	299	0.14	31.8							0.322
WS P	09/08/18	9:00	308	0.15	33.8							0.305
WS P	09/09/18	9:00	292	0.14	23.3							0.360
WS P	09/10/18	9:00	293	0.14	16.0							0.393
WS P	09/11/18	9:00	297	0.14	23.7							0.328
WS P	09/12/18	9:00	290	0.14	12.8							0.301
WS B	09/13/18	10:00	289	0.14	42.3	0.006	<0.05	0.23	0.20	0.15	<0.05	0.201
WS P	09/13/18	9:00	301	0.14	12.8							0.244
WSW L	09/13/18	11:00	284	0.13	34.2	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.322
WS P	09/14/18	9:00	353	0.18	32.2							0.594
SC D	09/15/18	16:00	5173	3.07	187.7	0.085	1.26	0.07	<0.05	2.37	<0.05	0.078
WS P	09/15/18	9:00	300	0.14	28.1							0.555
WS P	09/16/18	9:00	307	0.15	33.4							0.514
WS P	09/17/18	9:00	332	0.16	27.7							0.592
WS P	09/18/18	9:00	292	0.14	41.9							0.787
WS B	09/20/18	10:45	295	0.14	33.0	0.045	0.67	0.20	0.02	0.53	0.34	0.516
WS P	09/20/18	9:00	312	0.15	12.0							0.449
WS P	09/20/18	9:00	289	0.14	19.6							0.268
WSW L	09/20/18	11:05	293	0.14	35.8	0.047	0.70	<0.05	0.34	0.53	<0.05	0.416
WS P	09/21/18	9:00	311	0.15	14.0							0.379
WS P	09/22/18	9:00	303	0.15	28.5							0.369
WS P	09/23/18	9:00	312	0.15	27.7							0.399
WS P	09/24/18	9:00	303	0.15	32.6							0.383
WS P	09/25/18	9:00	281	0.13	26.5							0.461
WS P	09/26/18	9:00	307	0.15	30.1							0.346
SC D	09/27/18	11:38	9396	5.60	131.5	0.051	0.76	0.35	0.56	0.53	0.59	0.078
WS B	09/27/18	10:45	299	0.14	28.5	0.025	0.38	0.07	<0.05	0.15	0.47	0.363
WS P	09/27/18	9:00	308	0.15	31.8							0.367
WSW L	09/27/18	11:10	301	0.14	31.4	<0.007	0.04	<0.05	<0.05	0.15	0.06	0.350
WS P	09/28/18	9:00	287	0.14	17.2							0.516
WS P	09/29/18	9:00	309	0.15	20.9							0.459
WS P	09/30/18	9:00	285	0.13	20.4							0.516
Devils Eye	10/01/18	18:20	330	0.16	9.5	0.014	<0.05	<0.05	<0.05	<0.05	1.09	1.633
Ginnie Spring	10/01/18	17:20	305	0.15	8.3	<0.007	<0.05	<0.05	0.28	<0.05	<0.05	1.524
WS P	10/01/18	9:00	305	0.15	19.2							0.631
WS P	10/02/18	9:00	296	0.14	20.4							0.442
WS P	10/03/18	9:00	306	0.15	18.0							0.395
Hampton Spring	10/04/18	15:00	1159	0.66	31.8	0.124	1.85	<0.05	<0.05	0.80	1.07	<0.005
SC D	10/04/18	13:19	9829	5.86	96.8	0.154	2.29	<0.05	<0.05	0.53	2.83	0.360
Tobacco Sink	10/04/18	13:00	96	0.02	358.1	0.977	14.59	<0.05	0.82	13.62	0.03	<0.005
WS B	10/04/18	10:45	307	0.15	17.6	0.086	1.28	<0.05	0.33	0.30	1.47	0.430
WS P	10/04/18	9:00	319	0.15	22.1							0.473
WS P	10/04/18	9:00	315	0.15	25.7							0.420
WSW L	10/04/18	11:52	294	0.14	23.7	0.021	0.31	0.11	0.00	<0.05	0.96	0.463
WS P	10/05/18	9:00	309	0.15	25.3							0.430
WS P	10/06/18	9:00	312	0.15	24.9							0.367
WS P	10/07/18	9:00	323	0.16	11.2							0.385
WS P	10/08/18	9:00	310	0.15	21.3							0.432
SC D	10/15/18	14:44	5306	3.15	98.8	0.492	7.34	0.91	0.84	6.68	1.17	0.126

Table A1: Wakulla Spring Data, page 9

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS D	10/15/18	14:15	305	0.15	22.1	0.011	0.16	0.35	0.08	0.15	0.06	0.359
WSW L	10/15/18	14:22	300	0.14	25.7	<0.007	0.04	0.34	<0.05	<0.05	0.10	0.346
WS B	10/18/18	11:18	314	0.15	20.4	0.034	0.51	<0.05	0.02	0.15	0.58	0.513
WSW L	10/18/18	11:45	318	0.15	22.1	0.016	0.25	0.08	0.15	<0.05	0.73	0.285
WS P	10/19/18	9:00	313	0.15	26.1							0.471
WS P	10/20/18	9:00	314	0.15	24.5							0.519
SC D	10/21/18	17:50	5945	3.53	185.6	0.242	3.62	<0.05	<0.05	3.86	0.30	<0.005
WS P	10/21/18	9:00	324	0.16	25.3							0.467
WS P	10/22/18	9:00	310	0.15	18.4							0.344
WS B	10/25/18	10:45	311	0.15	28.9	<0.007	0.01	0.12	<0.05	<0.05	0.52	0.320
WSW L	10/25/18	11:10	305	0.15	30.5	0.008	0.12	0.06	<0.05	0.74	<0.05	0.303
WS P	10/26/18	9:00	304	0.15	34.2							0.468
WS P	10/27/18	9:00	304	0.15	37.4							0.361
WS P	10/28/18	9:00	302	0.14	34.2							0.345
WS P	10/29/18	9:00	309	0.15	27.7							0.388
WS P	10/30/18	9:00	313	0.15	30.5							0.366
WS P	10/31/18	9:00	310	0.15	28.1							0.376
WS B	11/01/18	10:45	317	0.15	28.9	0.009	0.13	<0.05	0.12	0.74	<0.05	0.403
WS P	11/01/18	9:00	306	0.15	30.1							0.340
WSW L	11/01/18	11:10	296	0.14	34.2	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.339
WS P	11/02/18	9:00	306	0.15	29.7							0.344
SC D	11/03/18	10:55	8261	4.92	100.8	0.038	0.57	0.48	0.26	0.71	0.53	0.010
WS P	11/03/18	9:00	306	0.15	34.2							0.337
WS P	11/04/18	9:00	316	0.15	18.8							0.378
WS P	11/05/18	9:00	307	0.15	26.9							0.342
WS P	11/06/18	9:00	314	0.15	16.4							0.296
WS P	11/07/18	9:00	308	0.15	21.7							0.356
SC D	11/08/18	12:00	10025	5.98	85.5	0.016	0.24	<0.05	<0.05	0.80	<0.05	0.036
WS B	11/08/18	10:45	308	0.15	20.4	0.006	<0.05	0.37	0.02	<0.05	0.10	0.354
WS P	11/09/18	9:00	296	0.14	20.4							0.471
ULL	11/10/18	10:30	249	0.11	54.0	3.040	45.38	2.87	3.28	43.98	<0.05	0.432
WS P	11/10/18	9:00	303	0.15	13.6							0.518
Lake Jackson	11/11/18	10:00	37	<0.05	26.9	0.234	3.49	1.43	1.47	3.12	2.18	<0.005
WS P	11/11/18	9:00	310	0.15	13.6							0.487
Munson (ORR)	11/12/18	15:00	278	0.13	76.6	0.846	12.63	<0.05	<0.05	6.48	8.73	0.048
WS P	11/13/18	9:00	303	0.15	14.0							0.457
WS P	11/14/18	9:00	301	0.14	17.2							0.446
WS B	11/15/18	10:55	318	0.15	20.9	0.038	0.57	0.11	<0.05	0.89	<0.05	0.449
WS P	11/15/18	9:00	310	0.15	18.8							0.493
WSW L	11/15/18	11:27	305	0.15	17.6	<0.007	<0.05	0.09	<0.05	<0.05	0.55	0.408
Munson (Ames)	11/16/18	14:30	91	0.02	97.6	1.864	27.83	<0.05	1.75	34.71	14.15	0.048
SC D	11/16/18	15:30	4338	2.57	162.2	0.115	1.72	0.73	<0.05	1.19	0.47	0.020
WS P	11/16/18	9:00	348	0.17	20.4							0.606
WS P	11/17/18	9:00	309	0.15	19.2							0.611
WS P	11/18/18	9:00	302	0.14	22.1							0.619
WS P	11/19/18	9:00	303	0.15	23.7							0.578
WS P	11/19/18	9:00	296	0.14	33.0							0.597
WS P	11/20/18	9:00	299	0.14	37.8							0.658
Munson (Ames)	11/21/18	14:00	96	0.02	104.5	1.054	15.73	<0.05	<0.05	14.24	1.34	0.147
WS B	11/21/18	10:40	308	0.15	31.8	0.064	0.96	<0.05	<0.05	0.59	0.65	0.518

Table A1: Wakulla Spring Data, page 10

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WSW L	11/21/18	11:25	307	0.15	34.2	<0.007	0.04	<0.05	<0.05	<0.05	1.17	0.468
WS P	11/23/18	9:00	293	0.14	39.8							0.369
WS P	11/24/18	9:00	293	0.14	40.2							0.376
SC D	11/25/18	8:45	31093	20.00	83.5	0.214	3.19	<0.05	<0.05	2.97	0.77	<0.005
WS P	11/25/18	9:00	297	0.14	40.6							0.413
WS P	11/26/18	9:00	290	0.14	39.8							0.445
WS P	11/27/18	9:00	288	0.14	41.5							0.460
SC D	11/29/18	11:45	4779	2.83	193.7	0.440	6.56	0.19	1.50	5.93	1.13	0.097
WS B	11/29/18	10:45	301	0.14	36.6	<0.007	0.04	0.29	0.14	<0.05	0.36	0.581
WS P	11/29/18	9:00	294	0.14	36.6							0.660
WSW L	11/29/18	11:30	322	0.16	42.3	0.007	<0.05	<0.05	0.19	0.15	<0.05	0.541
Lake Iamonia	11/30/18	15:00	90	0.02	37.4	0.052	0.77	<0.05	0.35	1.19	<0.05	0.074
WS P	12/01/18	9:00	288	0.14	37.8							0.571
WS P	12/03/18	9:00	294	0.14	34.6							0.645
WS P	12/04/18	9:00	285	0.13	41.9							0.450
WS P	12/05/18	9:00	288	0.14	39.0							0.507
WS B	12/06/18	10:50	285	0.13	56.4	<0.007	<0.05	<0.05	0.09	0.45	<0.05	0.556
WS P	12/06/18	9:00	283	0.13	46.7							0.536
WSW L	12/06/18	11:29	280	0.13	56.4	<0.007	<0.05	<0.05	<0.05	<0.05	0.15	0.418
WS P	12/07/18	9:00	278	0.13	56.0							0.266
WS P	12/09/18	9:00	297	0.14	104.9							0.174
WS P	12/11/18	9:00	256	0.12	107.7							0.174
WS P	12/12/18	9:00	260	0.12	99.6							0.169
SC D	12/13/18	11:50	4224	2.50	275.3	0.018	0.26	<0.05	<0.05	1.48	<0.05	0.055
WS B	12/13/18	10:50	268	0.12	93.2	0.005	0.07	<0.05	<0.05	<0.05	0.46	0.351
WS P	12/13/18	9:00	264	0.12	89.9							0.181
WSW L	12/13/18	11:30	288	0.14	73.0	<0.007	0.02	<0.05	0.08	0.74	<0.05	0.410
WS P	12/14/18	9:00	268	0.12	97.6							0.215
WS P	12/15/18	9:00	265	0.12	89.5							0.211
WS P	12/16/18	9:00	267	0.12	80.2							0.190
WS P	12/17/18	9:00	269	0.12	71.3							0.190
WS P	12/18/18	9:00	27	<0.05	75.8							0.190
WS B	12/19/18	11:15	268	0.12	84.3	0.009	0.13	<0.05	0.02	0.74	<0.05	0.339
WS P	12/19/18	9:00	263	0.12	82.7							0.208
WSW L	12/19/18	11:30	272	0.13	79.8	0.013	0.20	<0.05	0.11	1.19	<0.05	0.309
WS P	12/20/18	9:00	261	0.12	79.4							0.211
WS P	12/21/18	9:00	262	0.12	92.7							0.206
SC D	12/22/18	10:00	3612	2.13	276.1	<0.007	<0.05	<0.05	<0.05	0.59	<0.05	<0.005
WS P	12/22/18	9:00	263	0.12	85.5							0.222
WS P	12/23/18	9:00	263	0.12	89.9							0.211
WS P	12/24/18	9:00	265	0.12	89.1							0.213
WS P	12/25/18	9:00	261	0.12	85.1							0.291
SC D	12/27/18	11:45	4057	2.40	232.1	<0.007	<0.05	<0.05	0.44	1.19	<0.05	<0.005
WS B	12/27/18	10:00	271	0.13	69.3	0.020	<0.05	<0.05	0.35	<0.05	<0.05	0.121
WS P	12/27/18	9:00	269	0.12	75.4							0.365
WS P	12/27/18	9:00	270	0.13	95.2							0.257
WSW L	12/27/18	11:15	282	0.13	61.2	0.016	<0.05	<0.05	0.12	<0.05	<0.05	0.181
WS P	12/28/18	9:00	277	0.13	85.9							0.171
WS P	12/29/18	9:00	283	0.13	78.6							0.203
WS P	12/31/18	9:00	278	0.13	59.6							0.279

Table A1: Wakulla Spring Data, page 11

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	01/01/19	9:00	278	0.13	63.3							0.143
WS P	01/02/19	9:00	281	0.13	55.2							0.171
WS B	01/03/19	11:15	274	0.13	60.8	0.011	<0.05	<0.05	0.02	<0.05	<0.05	0.162
WS P	01/03/19	9:00	272	0.13	58.4							0.143
WSW L	01/03/19	11:40	271	0.13	64.9	0.016	<0.05	<0.05	0.30	<0.05	<0.05	0.130
WS P	01/04/19	9:00	274	0.13	63.3							0.156
WS P	01/05/19	9:00	285	0.13	80.6							0.200
WS P	01/06/19	9:00	281	0.13	70.1							0.177
WS P	01/07/19	9:00	282	0.13	71.7							0.198
WS P	01/08/19	9:00	278	0.13	66.5							0.213
WS P	01/09/19	9:00	273	0.13	70.1							0.211
WS B	01/10/19	10:05	278	0.13	64.5	<0.007	0.07	0.03	0.01	0.15	<0.05	0.243
WS P	01/10/19	9:00	281	0.13	66.5							0.075
WS P	01/11/19	9:00	305	0.15	173.5							0.160
WSW L	01/11/19	11:25	271	0.13	82.2	0.014	0.20	0.00	0.42	<0.05	0.67	0.236
SC D	01/12/19	10:00	5158	3.06	260.0	0.227	3.39	0.21	1.19	<0.05	3.74	0.000
WS P	01/12/19	9:00	297	0.14	70.1							0.118
WS P	01/13/19	9:00	277	0.13	70.1							0.107
WS P	01/15/19	9:00	284	0.13	57.2							0.124
WS P	01/16/19	9:00	290	0.14	57.6							0.141
WS B	01/17/19	11:13	295	0.14	62.5	<0.007	0.02	<0.05	<0.05	<0.05	0.65	0.220
WS P	01/17/19	9:00	312	0.15	49.9							0.196
WSW L	01/17/19	10:45	290	0.14	79.8	<0.007	0.05	0.22	<0.05	<0.05	0.46	0.245
WS P	01/18/19	9:00	301	0.14	47.5							0.355
SC D	01/19/19	11:30	4789	2.84	206.7	0.031	0.46	0.01	<0.05	<0.05	1.12	0.068
WS P	01/19/19	9:00	302	0.14	60.4							0.326
WS P	01/21/19	9:00	332	0.16	41.0							0.324
WS P	01/22/19	9:00	317	0.15	45.1							0.314
SC D	01/23/19	15:00	4035	2.38	147.7	0.034	<0.05	1.29	2.27	<0.05	<0.05	<0.005
WS P	01/23/19	9:00	316	0.15	49.9							0.334
WS B	01/24/19	10:45	313	0.15	38.6	0.036	<0.05	1.23	0.04	<0.05	<0.05	0.168
WS P	01/24/19	9:00	290	0.14	56.0							0.301
WSW L	01/24/19	11:08	286	0.14	43.1	0.011	<0.05	0.51	0.01	1.04	<0.05	0.147
WS P	01/25/19	9:00	309	0.15	36.6							0.211
WS P	01/26/19	9:00	314	0.15	32.6							0.268
WS P	01/27/19	9:00	337	0.17	22.5							0.284
WS P	01/28/19	9:00	310	0.15	22.5							0.282
WS P	01/29/19	9:00	306	0.15	20.4							0.275
WS P	01/30/19	9:00	310	0.15	22.5							0.330
SC D	01/31/19	11:38	2562	1.50	140.8	<0.007	0.04	<0.05	<0.05	<0.05	<0.05	<0.005
WS B	01/31/19	10:45	298	0.14	24.9	0.014	0.20	<0.05	0.56	<0.05	0.82	0.284
WS P	01/31/19	9:00	313	0.15	23.7							0.320
WSW L	01/31/19	11:30	294	0.14	25.7	0.010	<0.05	0.44	<0.05	<0.05	0.80	0.289
WS P	02/01/19	9:00	298	0.14	24.5							0.327
WS P	02/02/19	9:00	301	0.14	28.1							0.325
WS P	02/03/19	9:00	333	0.16	21.3							0.303
WS P	02/05/19	9:00	301	0.14	34.2							0.311
WS P	02/06/19	9:00	327	0.16	43.1							0.303
WS B	02/07/19	10:45	297	0.14	36.6	0.006	0.09	<0.05	<0.05	0.15	<0.05	0.303
WS P	02/07/19	9:00	307	0.15	38.6							0.296

Table A1: Wakulla Spring Data, page 12

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WSW L	02/07/19	11:15	308	0.15	32.6	0.011	0.16	0.38	<0.05	0.15	0.06	0.451
WS P	02/08/19	9:00	282	0.13	34.2							0.503
SC D	02/09/19	10:30	6235	3.70	131.9	0.043	0.64	<0.05	0.37	0.30	0.95	0.066
WS P	02/10/19	9:00	299	0.14	43.5							0.314
WS P	02/12/19	9:00	297	0.14	33.8							0.316
WS B	02/14/19	10:50	319	0.15	30.1	<0.007	0.01	0.13	<0.05	<0.05	<0.05	0.372
WSW L	02/14/19	11:20	297	0.14	31.4	0.012	<0.05	<0.05	<0.05	<0.05	<0.05	0.318
WS P	02/16/19	9:00	312	0.15	29.7							0.407
WS P	02/17/19	9:00	296	0.14	23.3							0.357
WS P	02/19/19	9:00	301	0.14	21.7							0.364
WS P	02/20/19	9:00	320	0.16	21.7							0.312
WS B	02/21/19	10:50	308	0.15	18.0	0.011	<0.05	<0.05	<0.05	<0.05	<0.05	0.287
WS P	02/21/19	9:00	294	0.14	18.0							0.307
WSW L	02/21/19	11:20	317	0.15	19.6	0.014	<0.05	<0.05	<0.05	<0.05	<0.05	0.270
WS P	02/22/19	9:00	305	0.15	18.8							0.453
WS P	02/23/19	9:00	285	0.13	18.8							0.436
WS P	02/24/19	9:00	300	0.14	20.4							0.513
WS P	02/25/19	9:00	307	0.15	22.1							0.600
WS P	02/26/19	9:00	305	0.15	22.1							0.614
WS P	02/27/19	9:00	306	0.15	27.7							0.557
WS P	02/28/19	9:00	314	0.15	22.1	<0.007	0.07	<0.05	0.71	<0.05	0.21	0.625
WSW L	02/28/19	11:45	308	0.15	19.2							0.569
WS P	03/01/19	9:00	3087	1.82	15.2							0.587
SC D	03/02/19	11:15	3874	2.29	87.1	0.036	0.54	<0.05	1.10	<0.05	1.75	0.109
WS P	03/02/19	9:00	309	0.15	15.2							0.578
WS P	03/03/19	9:00	311	0.15	13.6							0.544
WS B	03/05/19	10:45	314	0.15	20.0	<0.007	0.03	<0.05	0.03	<0.05	0.62	0.559
WS P	03/05/19	9:00	316	0.15	9.5							0.557
SC D	03/06/19	12:00	2396	1.40	75.8	<0.007	0.03	<0.05	0.58	<0.05	0.62	0.039
WS P	03/06/19	9:00	308	0.15	11.2							0.610
WS B	03/07/19	10:45	310	0.15	8.7	0.006	<0.05	<0.05	0.04	<0.05	0.71	0.480
WS P	03/07/19	9:00	306	0.15	7.9							0.637
WSW L	03/07/19	12:20	305	0.15	9.1	0.021	0.31	0.08	<0.05	0.30	0.01	0.457
WS P	03/08/19	9:00	320	0.16	14.4							0.466
WS P	03/09/19	9:00	305	0.15	13.6							0.475
WS P	03/10/19	9:00	305	0.15	17.6							0.473
WS P	03/11/19	9:00	301	0.14	15.2							0.398
WS P	03/12/19	9:00	338	0.17	13.6							0.392
WS P	03/13/19	9:00	292	0.14	37.8							0.415
WS B	03/14/19	11:45	294	0.14	41.0	0.015	0.23	0.27	0.48	0.15	0.47	0.400
WS P	03/14/19	9:00	293	0.14	39.8							0.383
WSW L	03/14/19	11:15	290	0.14	49.9							0.379
WS P	03/16/19	9:00	288	0.14	41.5							0.496
WS P	03/17/19	9:00	299	0.14	39.8							0.424
WS P	03/18/19	9:00	293	0.14	33.0							0.396
WS P	03/19/19	9:00	298	0.14	37.0							0.436
WS P	03/20/19	9:00	300	0.14	30.5							0.496
SC D	03/21/19	11:40	15310	10.32	97.6	0.247	3.68	<0.05	0.03	1.19	3.80	0.011
WS B	03/21/19	10:50	295	0.14	38.6	0.008	<0.05	0.01	<0.05	<0.05	0.30	0.383
WS P	03/21/19	9:00	310	0.15	73.8							0.354

Table A1: Wakulla Spring Data, page 13

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WSW L	03/21/19	11:00	296	0.14	35.0	0.011	0.16	0.12	0.02	<0.05	0.64	0.441
WS P	03/22/19	9:30	281	0.13	31.4							0.528
WS P	03/23/19	9:30	293	0.14	39.4							0.510
WS P	03/24/19	9:30	295	0.14	32.2							0.525
WS P	03/25/19	9:30	296	0.14	35.4							0.453
SC D	03/26/19	15:00	23051	13.79	94.4	0.201	3.01	<0.05	0.30	2.40	0.59	0.033
WS P	03/26/19	9:30	295	0.14	15.2							0.477
WS P	03/27/19	9:30	310	0.15	38.2							0.434
WS B	03/28/19	10:43	305	0.15	19.2	0.006	<0.05	0.23	0.20	<0.05	1.62	0.558
WS P	03/28/19	9:30	310	0.15	30.1							0.495
WST 1	03/28/19	12:17	304	0.15	17.2							0.440
WST 2	03/28/19	12:26	296	0.14	39.0							0.416
WST 3	03/28/19	11:17	298	0.14	18.4							0.546
WST 4	03/28/19	11:29	294	0.14	17.6							0.510
WST 5	03/28/19	11:37	296	0.14	18.4							0.320
WST 6	03/28/19	11:41	298	0.14	18.4							0.465
WST 7	03/28/19	12:03	305	0.15	14.0							0.483
WST 8	03/28/19	12:11	314	0.15	15.2							0.609
WSW L	03/28/19	12:44	300	0.14	19.6	<0.007	0.03	0.31	0.28	<0.05	1.77	0.492
WS P	03/29/19	9:00	356	0.18	18.0							0.165
WS P	03/30/19	9:00	310	0.15	21.7							0.104
WS P	03/31/19	9:00	304	0.15	27.7							0.085
WS P	04/01/19	9:00	307	0.15	20.4							0.134
WS P	04/02/19	9:00	303	0.15	16.0							0.124
SC D	04/03/19	16:00	40081	24.01	51.5	0.547	8.16	1.51	<0.05	9.35	<0.05	<0.005
Wakulla Beach	04/03/19	15:10	21502	12.86	84.7	0.186	2.77	0.98	0.39	2.94	<0.05	0.049
WS P	04/03/19	9:00	296	0.14	15.2							0.175
WS B	04/04/19	10:45	306	0.15	15.6	<0.007	<0.05	<0.05	<0.05	<0.05	0.25	0.073
WS P	04/04/19	9:00	299	0.14	16.8							0.112
WSW L	04/04/19	11:18	298	0.14	20.4	0.012	0.18	0.17	<0.05	0.30	<0.05	0.044
WS P	04/05/19	9:00	309	0.15	11.2							0.080
WS P	04/06/19	9:00	302	0.14	12.8							0.097
WS P	04/07/19	9:00	306	0.15	26.5							0.151
WS P	04/08/19	9:00	296	0.14	15.2							0.119
WS P	04/09/19	9:00	297	0.14	15.6							0.131
WS P	04/10/19	9:00	304	0.15	7.1							0.063
WS B	04/11/19	11:45	306	0.15	12.0	0.011	0.16	0.30	0.48	0.15	0.06	0.092
WS P	04/11/19	9:00	323	0.16	13.6							0.124
WSW L	04/11/19	11:20	296	0.14	12.8	0.013	0.20	<0.05	0.11	<0.05	0.62	0.051
WS P	04/12/19	9:00	305	0.15	11.2							0.345
SC D	04/13/19	15:00	5375	3.19	66.1	0.038	0.57	<0.05	1.07	0.80	<0.05	0.107
Wakulla Beach	04/13/19	11:00	xxx	23.00	30.1	0.495	7.39	<0.05	1.71	9.79	<0.05	0.165
WS P	04/13/19	9:00	306	0.15	11.6							0.134
WS P	04/14/19	9:00	308	0.15	9.9							0.208
WS P	04/15/19	9:00	307	0.15	7.1							0.189
WS P	04/16/19	9:00	307	0.15	14.8							0.191
WS P	04/17/19	9:00	300	0.14	10.8							0.281
WS B	04/18/19	10:45	311	0.15	12.0	0.019	0.28	0.01	0.62	0.27	<0.05	0.216
WS P	04/18/19	9:00	302	0.14	18.4							0.150
WSW L	04/18/19	11:20	310	0.15	11.2	0.023	0.35	<0.05	0.40	0.53	<0.05	0.175

Table A1: Wakulla Spring Data, page 14

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
SC D	04/19/19	17:30	1840	11.00	54.4	0.142	2.12	<0.05	<0.05	<0.05	4.36	0.164
Wakulla Beach	04/19/19	18:00	xxx	24.00	30.9							0.230
WS P	04/19/19	9:00	304	0.15	15.6							0.046
WS P	04/20/19	9:00	335	0.16	11.6							0.120
WS P	04/21/19	9:00	341	0.17	9.1							0.148
WS P	04/22/19	9:00	315	0.15	15.2							0.150
WS P	04/23/19	9:00	331	0.16	5.5							0.202
WS P	04/24/19	9:00	317	0.15	6.7							0.186
WS B	04/25/19	11:00	321	0.16	6.7	<0.007	<0.05	<0.05	0.13	<0.05	2.31	0.172
WS P	04/25/19	9:00	324	0.16	7.9							0.208
WST 1	04/25/19	12:09	303	0.15	12.0							0.361
WST 2	04/25/19	12:16	304	0.15	10.4							0.210
WST 3	04/25/19	12:24	303	0.15	14.0							0.153
WST 4	04/25/19	12:30	303	0.15	16.4							0.131
WST 5	04/25/19	12:36	304	0.15	12.0							0.172
WST 6	04/25/19	12:53	317	0.15	5.9							
WST 8	04/25/19	13:04	311	0.15	6.3							0.295
WSW L	04/25/19	13:40	316	0.15	7.1	0.006	<0.05	0.37	0.02	<0.05	0.46	0.172
WS P	04/26/19	9:00	310	0.15	9.1							0.154
SC D	04/27/19	16:00	7711	4.59	54.4	0.059	0.88	0.95	<0.05	<0.05	3.07	<0.005
Wakulla Beach	04/27/19	17:00	37300	22.34	48.7							<0.005
WS P	04/27/19	9:00	320	0.16	13.6							0.184
WS P	04/28/19	9:00	316	0.15	13.2							0.206
WS P	04/29/19	9:00	304	0.15	12.0							0.169
WS P	04/30/19	9:00	308	0.15	12.0							0.186
WS P	05/01/19	9:00	334	0.16	10.4							0.163
WS B	05/02/19	10:45	305	0.15	19.2	0.005	0.08	<0.05	0.89	<0.05	0.50	0.218
WS P	05/02/19	9:00	298	0.14	10.4							0.165
WSW L	05/02/19	11:17	303	0.15	15.6	0.011	0.17	0.17	0.66	<0.05	0.04	0.235
WS P	05/03/19	9:00	312	0.15	14.0							0.313
WS P	05/04/19	9:00	306	0.15	13.2							0.291
WS P	05/05/19	9:00	298	0.14	11.6							0.154
WS P	05/06/19	9:00	379	0.19	10.8							0.126
WS P	05/07/19	9:00	322	0.16	15.6							0.154
WS P	05/08/19	9:00	299	0.14	14.0							0.152
WS B	05/09/19	10:45	301	0.14	12.0	<0.007	0.04	1.20	<0.05	<0.05	1.01	0.180
WS P	05/09/19	9:00	299	0.14	12.0							0.165
WSW L	05/09/19	11:15	299	0.14	12.8	0.011	0.17	0.23	0.12	<0.05	<0.05	0.206
SC D	05/10/19	17:00	14203	8.49	46.7	0.207	3.09	0.77	1.33	2.37	0.12	0.015
Wakulla Beach	05/10/19	15:30	40404	24.21	56.4							<0.005
WS P	05/10/19	9:00	309	0.15	12.8							0.220
WS P	05/11/19	9:00	304	0.15	11.6							0.216
WS P	05/12/19	9:00	307	0.15	12.8							0.287
WS P	05/13/19	9:00	329	0.16	11.2							0.323
WS P	05/14/19	9:00	302	0.14	9.5							0.336
SC D	05/15/19	12:00	9368	5.58	30.5	0.099	1.47	<0.05	0.70	1.60	0.45	0.103
WS P	05/15/19	9:00	301	0.14	13.2							0.351
WS B	05/16/19	10:45	305	0.15	12.8	0.011	<0.05	<0.05	0.02	<0.05	0.25	0.325
WS P	05/16/19	9:00	346	0.17	8.3							0.199
WS P	05/16/19	9:00	302	0.14	14.4							0.360

Table A1: Wakulla Spring Data, page 15

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WSW L	05/16/19	11:46	302	0.14	16.0	0.006	<0.05	0.34	0.29	<0.05	0.71	0.308
Lost Creek	05/18/19	16:16	85	<0.05	137.6							0.084
SC D	05/18/19	17:00	27989	16.76	19.2	0.502	7.50	0.17	1.55	8.81	<0.05	0.056
Wakulla Beach	05/18/19	18:00	41956	25.14	18.8							0.021
WS P	05/18/19	9:00	313	0.15	4.7							0.253
WS P	05/19/19	9:00	300	0.14	8.7							0.272
WS P	05/20/19	9:00	310	0.15	21.7							0.362
WS P	05/21/19	9:00	237	0.11	33.0							0.302
WS P	05/22/19	9:00	298	0.14	5.1							0.313
WS B	05/23/19	11:13	312	0.15	7.5	0.035	0.52	<0.05	0.16	0.15	0.47	0.178
WSW L	05/23/19	11:15	396	0.20	9.1	0.007	0.10	0.25	0.26	0.15	0.06	0.195
WS P	05/24/19	9:00	314	0.15	15.6							0.222
WS P	05/25/19	9:00	305	0.15	9.9							0.222
WS P	05/26/19	9:00	473	0.25	9.5							0.228
WS P	05/27/19	9:00	307	0.15	7.5							0.216
WS P	05/28/19	9:00	303	0.15	15.6							0.383
WS P	05/29/19	9:00	304	0.15	17.2							0.419
WS B	05/30/19	11:11	310	0.15	15.6	<0.007	<0.05	0.03	<0.05	0.30	<0.05	0.399
WS P	05/30/19	9:00	304	0.15	14.0							0.435
WSW L	05/30/19	11:52	305	0.15	22.9	0.192	2.87	0.66	0.00	1.48	2.36	0.258
WS P	05/31/19	9:00	302	0.14	10.8							0.401
WS P	06/01/19	9:00	304	0.15	18.8							0.432
WS P	06/02/19	9:00	304	0.15	12.0							0.385
WS P	06/03/19	9:00	302	0.14	13.6							0.407
Lost Creek	06/04/19	9:00	97	<0.05	163.4							<0.005
SC D	06/04/19	9:45	35708	21.39	66.5	0.302	4.51	<0.05	0.53	6.14	<0.05	<0.005
Wakulla Beach	06/04/19	10:30	46611	27.93	39.4							0.000
WS P	06/04/19	9:00	303	0.15	16.0							0.398
WS P	06/05/19	9:00	301	0.14	11.2							0.383
WS B	06/06/19	10:40	326	0.16	15.6	0.008	<0.05	0.03	<0.05	0.15	<0.05	0.363
WS P	06/06/19	9:00	301	0.14	12.4							0.383
WSW L	06/06/19	11:25	319	0.15	15.6	0.009	<0.05	0.09	<0.05	0.15	<0.05	0.305
WS P	06/07/19	9:00	300	0.14	13.2							0.390
WS P	06/08/19	9:00	303	0.15	21.7							0.374
WS P	06/09/19	9:00	303	0.15	15.6							0.396
WS P	06/10/19	9:00	299	0.14	14.0							0.404
WS P	06/11/19	9:00	302	0.14	14.0							0.425
WS P	06/12/19	9:00	302	0.14	12.8							0.394
WS B	06/13/19	11:00	312	0.15	13.2	<0.007	0.02	0.00	0.00	0.00	0.46	0.406
WS P	06/13/19	9:00	302	0.14	12.0							0.425
WSW L	06/13/19	11:55	305	0.15	16.0	0.008	0.12	0.06	0.00	0.15	0.00	0.251
WS P	06/14/19	9:00	306	0.15	12.8							0.339
WS P	06/15/19	9:00	302	0.14	13.2							0.339
WS P	06/16/19	9:00	307	0.15	14.0							0.365
WS P	06/17/19	9:00	304	0.15	14.8							0.292
WS P	06/18/19	9:00	302	0.14	12.0							0.326
SC D	06/19/19	16:00	40404	24.21	41.0	0.749	11.19	<0.05	3.40	<0.05	22.76	<0.005
WS P	06/19/19	9:00	303	0.15	13.2							0.356
WS B	06/20/19	10:50	303	0.15	13.6	0.020	<0.05	<0.05	<0.05	<0.05	0.30	0.253
WS P	06/20/19	9:00	303	0.15	12.4							0.326

Table A1: Wakulla Spring Data, page 16

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WSW L	06/20/19	10:10	301	0.14	15.6	0.018	0.27	<0.05	0.28	0.89	<0.05	0.217
WS P	06/21/19	9:00	304	0.15	12.0							0.278
WS P	06/22/19	9:00	305	0.15	12.0							0.294
Lost Creek	06/23/19	14:44	64	<0.05	351.7							<0.005
SC D	06/23/19	14:00	18671	11.17	389.6	0.874	13.04	3.78	<0.05	10.24	2.54	<0.005
WS P	06/23/19	9:00	305	0.15	14.0							0.321
WS P	06/24/19	9:00	308	0.15	20.4							0.345
WS P	06/25/19	9:00	305	0.15	13.2							0.288
WS P	06/26/19	9:00	307	0.15	13.6							0.339
WS B	06/27/19	10:45	304	0.15	16.4	0.116	1.72	0.81	<0.05	0.30	2.20	0.350
WS P	06/27/19	9:00	305	0.15	14.4							0.365
WST 1	06/27/19	11:50	301	0.14	14.0							0.333
WST 2	06/27/19	12:01	301	0.14	14.4							0.356
WST 3	06/27/19	12:08	297	0.14	13.2							0.331
WST 4	06/27/19	12:15	300	0.14	17.2							0.340
WST 5	06/27/19	12:21	300	0.14	19.2							0.296
WST 6	06/27/19	12:32	305	0.15	29.7							0.422
WST 7	06/27/19	11:46	302	0.14	16.8							0.322
WST 8	06/27/19	12:38	316	0.15	18.4							0.594
WSW L	06/27/19	13:10	319	0.15	14.0	0.015	0.22	0.51	<0.05	<0.05	0.65	0.193
WS P	06/28/19	9:00	304	0.15	14.4							0.543
WS P	06/29/19	9:00	303	0.15	14.0							0.289
WS P	06/30/19	9:00	306	0.15	16.8							0.286
WS P	07/01/19	9:00	304	0.15	14.8							0.311
WS P	07/02/19	9:00	309	0.15	20.4							0.316
WS B	07/03/19	10:35	307	0.15	16.8	0.037	0.56	0.15	0.16	0.15	0.89	0.340
WSW L	07/03/19	11:30	301	0.14	13.2	0.028	0.42	0.20	0.31	<0.05	0.73	0.266
WS P	07/04/19	9:00	304	0.15	14.0							0.294
WS P	07/05/19	9:00	309	0.15	19.2							0.312
WS P	07/06/19	9:00	328	0.16	14.4							0.392
WS P	07/07/19	9:00	311	0.15	13.6							0.436
WS P	07/10/19	9:00	307	0.15	9.1							0.348
Lost Creek	07/11/19	13:00	46	<0.05	357.3							<0.005
SC D	07/11/19	12:00	18679	11.17	55.2	0.032	0.48	0.46	<0.05	<0.05	0.83	<0.005
WS B	07/11/19	11:00	305	0.15	9.5	0.014	0.21	<0.05	<0.05	<0.05	0.46	0.420
WS P	07/11/19	9:00	306	0.15	6.3							0.364
WSW L	07/11/19	11:30	301	0.14	9.1	0.007	0.10	<0.05	<0.05	0.15	0.16	0.315
WS P	07/12/19	9:00	305	0.15	19.2							0.344
WS P	07/13/19	9:00	305	0.15	22.1							0.354
WS P	07/14/19	9:00	306	0.15	9.9							0.397
WS P	07/15/19	9:00	307	0.15	15.6							0.389
WS P	07/16/19	9:00	306	0.15	13.2							0.394
WS P	07/17/19	9:00	305	0.15	15.6							0.407
WS B	07/18/19	10:50	306	0.15	11.6	0.014	0.21	<0.05	0.60	0.15	<0.05	0.369
WS P	07/18/19	9:00	304	0.15	12.8							0.435
WSW L	07/18/19	11:37	302	0.14	10.4	0.045	0.66	<0.05	0.63	0.15	0.79	0.389
WS P	07/19/19	9:00	309	0.15	14.8							0.362
WS P	07/20/19	9:00	304	0.15	14.0							0.415
WS P	07/21/19	9:00	304	0.15	13.6							0.415
WS P	07/22/19	9:00	305	0.15	15.6							0.385

Table A1: Wakulla Spring Data, page 17

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	07/23/19	9:00	305	0.15	17.6							0.407
WS P	07/24/19	9:00	294	0.14	18.8							0.427
WS 1	07/25/19	11:41	298	0.14	26.1							0.418
WS 2	07/25/19	11:50	295	0.14	19.6							0.391
WS 3	07/25/19	12:00	296	0.14	22.5							0.430
WS 4	07/25/19	12:07	297	0.14	21.7							0.380
WS 5	07/25/19	12:11	297	0.14	23.7							0.368
WS 6	07/25/19	12:25	302	0.14	18.4							0.508
WS 7	07/25/19	12:35	297	0.14	23.3							0.447
WS 8	07/25/19	12:30	315	0.15	9.9							0.635
WS B	07/25/19	11:30	307	0.15	25.3	0.029	0.44	0.04	1.25	<0.05	0.83	0.365
WS P	07/25/19	9:00	298	0.14	21.7							0.441
WSW L	07/25/19	12:55	339	0.17	26.5	0.039	0.58	1.25	0.27	<0.05	1.68	0.406
WS P	07/26/19	9:00	288	0.14	16.0							0.412
Lost Creek	07/27/19	14:00	223	0.10	428.0							<0.005
SC D	07/27/19	14:55	xxx	7.00	117.0	0.041	0.62	0.83	0.42	<0.05	2.67	<0.005
Wakulla Beach	07/27/19	15:10	xxx	23.00	41.5	0.692	10.33	0.31	2.24	8.01	4.14	<0.005
WS P	07/27/19	9:00	299	0.14	18.4							0.414
WS P	07/28/19	9:00	297	0.14	17.2							0.461
WS P	07/29/19	9:00	296	0.14	16.8							0.433
SC D	07/30/19	16:30	xxx	9.00	105.3	0.175	2.62	0.14	<0.05	0.53	2.83	<0.005
WS P	07/30/19	9:00	298	0.14	19.6							0.408
WS P	07/31/19	9:00	298	0.14	16.0							0.423
WS B	08/01/19	10:55	319	0.15	15.6	0.007	0.11	0.32	<0.05	<0.05	0.40	0.477
WS P	08/01/19	9:00	301	0.14	16.0							0.464
WSW L	08/01/19	11:30	295	0.14	24.9	0.170	2.53	<0.05	<0.05	0.27	3.66	0.312
WS P	08/02/19	9:00	301	0.14	22.1							0.272
Lost Creek	08/03/19	19:00	208	0.09	367.4							0.035
SC D	08/03/19	16:00	xxx	14.00	81.8							<0.005
WS P	08/03/19	9:00	299	0.14	22.1							0.334
WS P	08/04/19	9:00	298	0.14	21.3							0.286
WS P	08/05/19	9:00	301	0.14	25.7							0.339
WS P	08/06/19	9:00	300	0.14	21.7							0.291
WS P	08/07/19	9:00	301	0.14	29.3							0.242
SC D	08/08/19	13:00	xxxx	7.00	93.6	0.114	1.70	0.21	<0.05	0.53	0.96	xxx
WS B	08/08/19	11:20	297	0.14	20.4	0.057	0.86	<0.05	<0.05	0.59	0.03	0.392
WS P	08/08/19	9:00	297	0.14	14.4							0.265
WSW L	08/08/19	10:45	299	0.14	18.4	<0.007	0.01	<0.05	<0.05	<0.05	<0.05	0.398
WS P	08/09/19	9:00	299	0.14	14.8							0.484
WS P	08/10/19	9:00	301	0.14	15.6							0.478
WS P	08/11/19	9:00	304	0.15	14.0							0.527
WS P	08/12/19	9:00	315	0.15	13.6							0.472
WS P	08/13/19	9:00	311	0.15	12.0							0.385
WS P	08/14/19	9:00	316	0.15	9.9							0.330
WS B	08/15/19	10:55	387	0.20	12.4	0.042	0.63	0.02	0.05	0.74	0.09	0.328
WS P	08/15/19	9:00	302	0.14	16.8							0.271
WSW L	08/15/19	11:25	302	0.14	11.2	0.055	0.82	<0.05	<0.05	1.19	<0.05	0.258
WS P	08/16/19	9:00	303	0.15	12.8							0.302
WS P	08/17/19	9:00	302	0.14	14.4							0.248
WS P	08/18/19	9:00	301	0.14	13.6							0.269

Table A1: Wakulla Spring Data, page 18

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	08/19/19	9:00	303	0.15	13.2							0.308
WS P	08/20/19	9:00	299	0.14	12.8							0.369
WS P	08/21/19	9:00	320	0.16	13.2							0.355
WS B	08/22/19	10;45	302	0.14	15.6	<0.007	<0.05	0.18	0.49	0.16	<0.05	0.312
WS P	08/22/19	9:00	302	0.14	15.2							0.312
WSW #1	08/22/19	11:21	303	0.15	15.6							0.315
WSW #2	08/22/19	11:29	299	0.14	16.8							0.340
WSW #3	08/22/19	11:37	300	0.14	33.0							0.306
WSW #4	08/22/19	11:44	300	0.14	17.2							0.312
WSW #5	08/22/19	11:49	304	0.15	16.4							0.325
WSW #6	08/22/19	12:03	309	0.15	14.4							0.489
WSW #7	08/22/19	12;14	303	0.15	17.2							0.446
WSW #8	08/22/19	12:09	319	0.15	13.2							0.703
WSW L	08/22/19	12:55	309	0.15	20.9	0.009	0.14	0.03	0.24	0.67	<0.05	0.304
WS P	08/23/19	9:00	304	0.15	20.0							0.518
Lost Creek	08/24/19	14:30	30	<0.05	581.5							<0.005
SC D	08/24/19	15:30	9368	6.00	295.5	0.029	0.43	0.39	<0.05	0.27	0.48	<0.005
Wakulla Beach	08/24/19	17:00	27989	18.00	108.9							<0.005
WS P	08/24/19	9:00	303	0.15	26.5							0.405
WS P	08/25/19	9:00	308	0.15	28.1							0.381
WS P	08/26/19	9:00	298	0.14	28.5							0.360
WS P	08/27/19	9:00	310	0.15	34.6							0.496
WS P	08/28/19	9:00	310	0.15	38.6							0.414
WS P	08/29/19	9:00	303	0.15	56.0							0.340
WS P	08/30/19	9:00	299	0.14	44.3							0.280
WS P	08/31/19	9:00	292	0.14	56.0							0.347
WS P	09/01/19	9:00	296	0.14	59.2							0.334
WS P	09/02/19	9:00	304	0.15	47.1							0.282
Lost Creek	09/03/19	9:30	46	<0.05	549.2							<0.005
SC D	09/03/19	11:00	5062	3.00	308.8	0.025	0.38	0.91	0.70	0.53	<0.05	0.023
WS P	09/03/19	9:00	294	0.14	50.7							0.301
WS P	09/04/19	9:00	290	0.14	51.1							0.429
WS B	09/05/19	10:55	298	0.14	51.1	<0.007	<0.05	0.12	<0.05	0.30	<0.05	0.450
WS P	09/05/19	9:00	299	0.14	55.6							0.494
WSW L	09/05/19	11:30	296	0.14	56.8	0.014	0.21	0.51	0.39	0.45	<0.05	0.472
WS P	09/06/19	9:00	297	0.14	45.1							0.514
WS P	09/07/19	9:00	299	0.14	44.3							0.516
WS P	09/08/19	9:00	311	0.15	41.9							0.504
WS P	09/09/19	9:00	298	0.14	58.8							0.490
WS P	09/10/19	9:00	296	0.14	47.5							0.407
Lost Creek	09/11/19	15:41	52	<0.05	414.3							0.007
SC D	09/11/19	16:00	23334	15.00	132.7	0.063	0.94	1.01	0.96	0.27	1.42	0.038
Wakulla Beach	09/11/19	18:00	38852	25.00	45.9							<0.005
WS P	09/11/19	9:00	299	0.14	43.9							0.379
WS B	09/12/19	10:45	310	0.15	40.6	0.015	0.23	0.29	0.34	0.45	<0.05	0.327
WS P	09/12/19	9:00	302	0.14	37.8							0.437
WSW L	09/12/19	11:15	329	0.16	47.1	0.274	4.09	0.23	0.96	4.30	<0.05	0.262
Lost Creek	09/13/19	15:06	66	<0.05	397.7							<0.005
SC D	09/13/19	16:00	10920	7.00	143.6							0.070
WS P	09/13/19	16:00	302	0.14	40.6							0.432

Table A1: Wakulla Spring Data, page 19

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
ULL	09/14/19	15:30	128	0.04	63.7							0.013
WS P	09/14/19	15:30	303	0.15	37.0							0.411
WS P	09/15/19	9:00	302	0.14	32.2							0.419
WS P	09/16/19	9:00	302	0.14	28.5							0.421
WS P	09/17/19	9:00	302	0.17	28.5							0.419
WS P	09/18/19	9:00	304	0.17	31.4							0.386
WS B	09/19/19	11:00	314	0.18	23.3	0.047	0.70	<0.05	<0.05	0.45	0.28	0.409
WS P	09/19/19	9:00	306	0.17	20.9							0.451
WSW L	09/19/19	11:32	308	0.17	24.9	0.006	0.09	0.55	<0.05	0.45	<0.05	0.403
WS P	09/20/19	9:00	311	0.18	22.1							0.503
WS P	09/21/19	9:00	310	0.17	16.0							0.394
WS P	09/22/19	9:00	305	0.17	26.5							0.575
WS P	09/23/19	9:00	304	0.17	20.4							0.433
WS P	09/24/19	9:00	319	0.18	32.6							0.369
WS 1	09/26/19	10:25	306	0.17	21.3							0.354
WS 2	09/26/19	11:03	312	0.18	23.3							0.344
WS 3	09/26/19	11:18	304	0.17	22.1							0.324
WS 4	09/26/19	11:25	305	0.17	26.5							0.326
WS 5	09/26/19	11:32	304	0.17	26.1							0.358
WS 6	09/26/19	11:42	309	0.17	17.6							0.412
WS 7	09/26/19	10:48	303	0.17	24.9							0.316
WS 8	09/26/19	11:48	320	0.18	12.8							0.582
WS B	09/26/19	10:30	300	0.17	24.5	0.036	0.54	<0.05	<0.05	0.59	0.03	0.427
WS P	09/26/19	9:00	306	0.17	20.9							0.392
WSW L	09/26/19	12:30	301	0.17	21.3	0.031	0.46	<0.05	0.34	0.59	<0.05	0.378
WS P	09/27/19	9:00	314	0.18	24.1							0.344
WS P	09/28/19	9:00	308	0.17	25.3							0.356
Lost Creek	09/29/19	12:00	92	<0.05	183.2							0.024
SC D	09/29/19	11:30	38585	24.00	54.8							<0.005
WS P	09/29/19	9:00	305	0.17	23.3							0.367
WS P	09/30/19	9:00	304	0.17	24.1							0.337
WS P	10/01/19	9:00	306	0.17	22.1							0.369
WS P	10/02/19	9:00	304	0.17	20.9							0.403
WS B	10/03/19	11:00	311	0.18	15.2	0.007	0.11	0.29	<0.05	0.30	<0.05	0.446
WS P	10/03/19	9:00	299	0.17	22.9							0.431
WSW-L	10/03/19	11:26	297	0.17	18.4	<0.007	<0.05	<0.05	0.38	0.15	<0.05	0.429
Lost Creek	10/04/19	16:00	98	<0.05	132.3							<0.005
SC D	10/04/19	16:30	48237	30.00	49.5							<0.005
WS P	10/04/19	9:00	298	0.17	16.4							0.382
WS P	10/05/19	9:00	296	0.17	17.6							0.380
WS P	10/06/19	9:00	298	0.17	24.5							0.386
WS P	10/07/19	9:00	300	0.17	16.8							0.351
WS P	10/08/19	9:00	299	0.17	24.1							0.349
WS P	10/09/19	9:00	300	0.17	20.4							0.349
WS B	10/10/19	11:00	301	0.17	22.1	0.008	0.11	0.14	0.17	<0.05	<0.05	0.417
WS P	10/10/19	9:00	300	0.17	26.5							0.395
WSW L	10/10/19	11:30	299	0.17	26.9	<0.007	0.06	0.07	0.08	0.30	<0.05	0.310
WS P	10/11/19	9:00	301	0.17	20.9							0.425
WS P	10/12/19	9:00	309	0.17	26.9							0.360
WS P	10/13/19	9:00	302	0.17	20.4							0.341
WS P	10/14/19	9:00	303	0.17	23.3							0.362
WS P	10/15/19	9:00	303	0.17	20.9							0.345

Table A1: Wakulla Spring Data, page 20

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	10/16/19	9:00	312	0.18	20.0							0.364
WS B	10/17/19	11:15	305	0.17	20.9	0.011	0.16	0.29	0.62	<0.05	0.76	0.294
WS P	10/17/19	9:00	326	0.18	35.4							0.319
WSW L	10/17/19	11:50	303	0.17	23.3	<0.007	<0.05	0.73	0.24	0.15	0.16	0.242
WS P	10/18/19	9:00	306	0.17	25.7							0.259
WS P	10/20/19	9:00	305	0.17	21.7							0.243
WS P	10/21/19	9:00	309	0.17	20.9							0.294
WS P	10/22/19	9:00	310	0.17	16.4							0.302
WS P	10/23/19	9:00	311	0.18	15.2							0.297
WS B	10/24/19	11:00	312	0.18	20.0	<0.007	<0.05	0.02	<0.05	<0.05	<0.05	0.314
WS P	10/24/19	11:00	312	0.18	17.6							0.337
WSW L	10/24/19	11:33	310	0.17	22.1	0.030	0.45	1.69	<0.05	1.78	<0.05	0.281
WS P	10/25/19	9:00	310	0.17	22.9							0.343
WS P	10/26/19	9:00	312	0.18	20.0							0.299
WS P	10/27/19	9:00	314	0.18	18.0							0.300
WS P	10/28/19	9:00	313	0.18	18.0							0.338
WS P	10/29/19	9:00	316	0.18	17.6							0.308
WS P	10/30/19	9:00	317	0.18	16.4							0.230
SC D	10/31/19	12:30	46628	29.00	72.6	7.401	110.47	0.63	14.01	48.06	97.72	0.047
WS B	10/31/19	10:52	321	0.18	16.0	0.016	0.25	0.11	<0.05	0.15	0.27	0.252
WS P	10/31/19	9:00	335	0.19	24.5							0.319
WS T#1	10/31/19	11:36	324	0.18	20.0							0.327
WS T#2	10/31/19	11:40	323	0.18	16.8							0.330
WS T#3	10/31/19	11:48	322	0.18	14.4							0.219
WS T#4	10/31/19	11:54	324	0.18	16.8							0.246
WS T#5	10/31/19	11:58	324	0.18	43.1							0.270
WS T#6	10/31/19	12:09	324	0.18	15.2							0.313
WS T#7	10/31/19	11:19	323	0.18	18.0							0.338
WS T#8	10/31/19	12:15	320	0.18	12.0							0.568
WSW L	10/31/19	12:34	326	0.18	16.8	<0.007	<0.05	0.45	<0.05	<0.05	<0.05	0.216
WS P	11/01/19	9:00	335	0.19	16.0							0.561
WS P	11/02/19	9:00	333	0.19	14.8							0.506
WS P	11/03/19	9:00	330	0.19	18.0							0.552
Lost Creek	11/04/19	15:00	107	<0.05	150.5							<0.005
SC D	11/04/19	12:30	45020	28.00	44.7	0.424	6.33	<0.05	1.70	5.04	1.81	<0.005
WS P	11/04/19	9:00	330	0.19	21.7							0.517
WS P	11/05/19	9:00	330	0.19	16.8							0.429
WS P	11/06/19	9:00	330	0.19	18.0							0.483
WS B	11/07/19	10:50	386	0.22	16.0	0.035	0.53	<0.05	0.20	0.45	0.07	0.469
WS P	11/07/19	9:00	348	0.20	19.2							0.358
WSW L	11/07/19	11:25	358	0.20	16.4	0.025	0.37	0.17	<0.05	0.30	0.12	0.394
WS P	11/08/19	9:00	346	0.20	15.6							0.396
WS P	11/09/19	9:00	358	0.20	19.2							0.429
WS P	11/10/19	9:00	364	0.21	13.6							0.327
WS P	11/11/19	9:00	366	0.21	18.0							0.356
WS P	11/12/19	9:00	376	0.21	23.3							0.352
WS P	11/13/19	9:00	393	0.22	12.8							0.390
WS B	11/14/19	10:45	434	0.25	12.8	0.037	0.56	0.12	0.43	0.59	<0.05	0.306
WS P	11/14/19	9:00	391	0.22	12.4							0.408
WSW L	11/14/19	11:05	452	0.26	14.4	0.022	0.33	<0.05	0.23	0.30	<0.05	0.277

Table A1: Wakulla Spring Data, page 21

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	11/15/19	9:00	407	0.23	14.4							0.333
WS P	11/16/19	9:00	411	0.24	12.8							0.277
WS P	11/17/19	9:00	416	0.24	12.8							0.298
WS P	11/18/19	9:00	444	0.25	13.2							0.329
WS P	11/19/19	9:00	454	0.26	14.4							0.331
WS P	11/20/19	9:00	475	0.27	13.2							0.392
WS B	11/21/19	10:45	510	0.29	12.4	0.017	0.26	0.01	<0.05	0.45	<0.05	0.316
WS P	11/21/19	9:00	491	0.28	14.8							0.303
WSW L	11/21/19	11:30	545	0.32	14.0	0.008	0.12	0.06	<0.05	<0.05	0.21	0.247
WS P	11/22/19	9:00	535	0.31	27.3							0.300
WS P	11/23/19	9:00	539	0.31	13.2							0.282
WS P	11/24/19	9:00	608	0.35	14.4							0.272
WS P	11/25/19	9:00	641	0.37	16.4							0.280
WS P	11/26/19	9:00	695	0.41	13.6							0.278
WS B	11/27/19	10:45	737	0.43	15.6	0.038	0.57	<0.05	0.24	0.59	0.13	0.280
WS P	11/27/19	9:00	720	0.42	13.6							0.260
WS T #1	11/27/19	11:48	722	0.42	15.2							0.249
WS T #2	11/27/19	11:52	719	0.42	16.4							0.247
WS T #3	11/27/19	12:00	719	0.42	14.8							0.251
WS T #4	11/27/19	12:06	695	0.41	16.8							0.260
WS T #5	11/27/19	12:09	656	0.38	14.8							0.287
WS T #6	11/27/19	12:20	562	0.33	14.0							0.350
WS T #7	11/27/19	11:23	717	0.42	15.2							0.224
WS T #8	11/27/19	12:25	325	0.18	9.1							0.592
WSW L	11/27/19	12:52	631	0.37	15.2	0.089	1.33	2.61	<0.05	3.41	<0.05	0.272
WS P	11/28/19	9:00	720	0.42	22.9							0.171
Lost Creek	11/29/19	10:45	103	<0.05	166.7							0.018
SC D	11/29/19	10:00	48237	30.00	31.4	0.213	3.18	1.58	<0.05	4.45	<0.05	<0.005
WS P	11/29/19	9:00	716	0.42	24.5							0.220
WS P	11/30/19	9:00	671	0.39	20.9							0.234
WS P	12/01/19	9:00	664	0.39	20.0							0.217
WS P	12/02/19	9:00	653	0.38	30.1							0.090
WS P	12/03/19	9:00	607	0.35	18.0							0.377
WS P	12/04/19	9:00	612	0.36	26.5							0.377
WS B	12/05/19	11:00	627	0.36	36.2	0.023	0.34	<0.05	0.27	0.74	<0.05	0.163
WS P	12/05/19	9:00	594	0.34	15.6							0.344
WSW L	12/05/19	11:40	645	0.38	20.0	0.055	0.82	0.08	<0.05	1.78	<0.05	0.068
WS P	12/05/19	9:00	594	0.34	15.6							0.344
WSW L	12/05/19	11:40	645	0.38	20.0	0.055	0.82	0.08	<0.05	1.78	<0.05	0.068
WS P	12/06/19	9:00	582	0.34	30.5							0.311
WS P	12/07/19	9:00	578	0.34	19.2							0.684
WS P	12/08/19	9:00	638	0.37	23.3							0.407
WS P	12/09/19	9:00	626	0.36	19.6							0.736
WS P	12/10/19	9:00	649	0.38	23.3							0.369
WS P	12/11/19	9:00	666	0.39	17.6							0.399
WS B	12/12/19	11:00	671	0.39	51.5	0.009	0.14	<0.05	0.35	0.49	<0.05	0.232
WS P	12/12/19	9:00	648	0.38	25.7							0.427
WSW L	12/12/19	11:25	575	0.33	34.6	<0.007	<0.05	<0.05	<0.05	0.74	<0.05	0.306
WS P	12/13/19	9:00	651	0.38	16.0							0.309

Table A1: Wakulla Spring Data, page 22

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	12/14/19	9:00	701	0.41	15.2							0.306
WS P	12/15/19	9:00	718	0.42	17.2							0.392
WS P	12/16/19	9:00	761	0.45	18.0							0.387
WS P	12/17/19	9:00	809	0.47	16.8							0.392
WS P	12/18/19	9:00	716	0.42	14.0							0.290
WS B	12/19/19	10:45	688	0.40	17.6	<0.007	<0.05	0.16	0.60	0.00	<0.05	0.306
WSW L	12/19/19	12:30	588	0.34	13.6	0.020	0.30	0.16	0.24	<0.05	0.31	0.403
WS P	12/21/19	9:00	638	0.37	12.0							0.399
WS P	12/22/19	9:00	562	0.33	13.2							0.394
Lost Creek	12/23/19	11:00	76	<0.05	262.4							<0.005
SC	12/23/19	14:00	46628	29.00	19.6							<0.005
WS P	12/24/19	9:00	662	0.39	13.6							0.421
WS P	12/25/19	9:00	679	0.40	14.4							0.392
WS #1	12/26/19	11:42	716	0.42	13.2							0.379
WS #2	12/26/19	11:48	710	0.41	14.0							0.425
WS #3	12/26/19	11:55	711	0.42	13.2							0.394
WS #4	12/26/19	12:01	697	0.41	14.0							0.423
WS #5	12/26/19	12:11	646	0.38	12.0							0.493
WS #6	12/26/19	12:17	553	0.32	12.8							0.451
WS #7	12/26/19	11:22	710	0.41	12.8							0.388
WS #8	12/26/19	12:22	328	0.19	13.2							0.753
WS B	12/26/19	11:00	727	0.42	12.0	0.008	0.12	0.03	0.21	<0.05	1.51	0.397
WS P	12/26/19	9:00	764	0.45	12.0							0.394
WSW L	12/26/19	12:42	621	0.36	14.4	<0.007	<0.05	0.99	0.16	<0.05	1.72	0.495
SC	12/27/19	11:30	46628	29.00	18.4							<0.005
WS P	12/27/19	9:00	698	0.41	12.4							0.432
WS P	12/28/19	9:00	730	0.43	8.7							0.469
WS P	12/29/19	9:00	735	0.43	9.5							0.462
WS P	12/30/19	9:00	786	0.46	14.8							0.464
WS P	12/31/19	9:00	761	0.45	11.2							0.267
WS P	01/01/20	9:00	732	0.43	12.8							0.275
WS P	01/02/20	9:00	783	0.46	14.8							0.354
WS P	01/03/20	9:00	840	0.49	14.0							0.306
WS P	01/04/20	9:00	905	0.53	12.4							0.289
WS P	01/05/20	9:00	874	0.51	33.0							0.372
WS P	01/06/20	9:00	743	0.43	12.0							0.354
WS P	01/07/20	9:00	818	0.48	12.0							0.245
WS P	01/08/20	9:00	787	0.46	13.6							0.361
WS B	01/09/20	10:50	714	0.42	8.3	0.013	0.19	0.01	0.07	<0.05	0.46	0.385
WS P	01/09/20	9:00	712	0.42	7.5							0.381
WSW L	01/09/20	11:30	644	0.37	9.9	<0.007	<0.05	<0.05	<0.05	<0.05	2.02	0.343
WS P	01/10/20	9:00	753	0.44	19.2							0.333
Lost Creek	01/11/20	12:00	64	<0.05	249.5							<0.005
SC D	01/11/20	10:40	48237	30.00	18.8							<0.005
WS P	01/11/20	9:00	833	0.49	18.8							0.352
WS P	01/12/20	9:00	912	0.54	13.6							0.367
WS P	01/13/20	9:00	919	0.54	14.0							0.352
WS P	01/14/20	9:00	944	0.55	13.2							0.357
WS P	01/15/20	9:00	929	0.55	20.4							0.446
WS B	01/16/20	12:15	824	0.48	38.2	0.008	0.12	0.04	0.08	<0.05	0.73	0.262

Table A1: Wakulla Spring Data, page 23

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	01/16/20	9:00	865	0.51	12.0							0.415
WSW L	01/16/20	11:11	690	0.40	16.4	<0.007	0.00	0.23	0.20	<0.05	0.82	0.494
WS P	01/17/20	9:00	848	0.50	15.2							0.427
WS P	01/19/20	9:00	757	0.42	18.4							0.415
WS P	01/20/20	9:00	741	0.41	24.9							0.453
WS P	01/21/20	9:00	659	0.36	14.4							0.435
WS P	01/22/20	9:00	633	0.34	16.8							0.451
WS B	01/23/20	11:00	533	0.28	16.0	<0.007	<0.05	<0.05	0.84	<0.05	0.46	0.428
WS P	01/23/20	9:00	601	0.32	16.0							0.437
WS P	01/24/20	9:00	627	0.34	20.0							0.316
Lost Creek	01/25/20	12:00	72	<0.05	255.9							<0.005
SC D	01/25/20	10:26	49715	29.79	25.7							<0.005
WS P	01/25/20	9:00	685	0.37	26.9							0.318
WSW L	01/25/20	11:15	632	0.34	20.9	<0.007	<0.05	<0.05	0.38	<0.05	0.71	0.366
WS P	01/26/20	9:00	711	0.39	22.9							0.338
WS P	01/27/20	9:00	765	0.42	20.4							0.484
WS P	01/28/20	9:00	875	0.49	17.6							0.318
WSW AD	01/28/20	10:45	804	0.45	18.0							<0.005
WSW AK	01/28/20	11:30	772	0.43	21.3							<0.005
WSW B	01/28/20	10:15	309	0.15	11.2							0.122
WSW C	01/28/20	10:32	382	0.19	8.7							0.160
WSW D	01/28/20	10:52	323	0.16	9.5							<0.005
WSW K	01/28/20	11:22	803	0.45	19.2							0.005
WSW SW	01/28/20	11:07	324	0.16	14.4							0.702
WS P	01/29/20	9:00	852	0.47	21.7							0.324
WS #1	01/30/20	11:46	946	0.53	14.8							0.330
WS #2	01/30/20	11:53	903	0.51	15.2							0.337
WS #3	01/30/20	12:04	898	0.50	14.0							0.249
WS #4	01/30/20	12:11	868	0.48	12.8							0.273
WS #5	01/30/20	12:16	844	0.47	12.8							0.309
WS #6	01/30/20	12:31	leaked	leaked	27.3							0.433
WS #7	01/30/20	11:15	912	0.51	12.0							0.318
WS #8	01/30/20	12:35	526	0.28	10.8							0.527
WS B	01/30/20	11:00	899	0.50	22.5	0.047	0.71	0.47	1.55	1.34	<0.05	0.140
WS P	01/30/20	9:00	893	0.50	36.6							0.343
WSW L	01/30/20	11:50	732	0.40	16.8	<0.007	0.05	<0.05	1.89	1.78	<0.05	0.428
WS P	02/01/20	9:00	913	0.51	18.8							0.266
WS P	02/02/20	9:00	902	0.50	21.3							0.364
Lost Creek	02/03/20	14:06	185	0.07	167.5							<0.005
SC	02/03/20	13:20	49715	29.79	37.8							<0.005
WS P	02/03/20	9:00	933	0.52	20.0							0.339
WS P	02/04/20	9:00	795	0.44	20.4							0.345
WS B	02/05/20	10:45	796	0.44	17.2	<0.007	0.03	0.39	0.23	0.30	0.01	0.330
WS P	02/05/20	9:00	794	0.44	14.0							0.303
WSW L	02/05/20	11:22	686	0.38	16.4	<0.007	<0.05	0.83	0.33	0.15	0.16	0.373
WS P	02/06/20	9:00	800	0.44	22.5							0.404
Lost Creek	02/07/20	11:45	72	<0.05	239.4							<0.005
WS P	02/07/20	9:00	844	0.47	23.7							0.461
SC 10 cold hole	02/08/20	13:00	46611	27.93	32.6							<0.005
SC 7	02/08/20	13:00	46611	27.93	33.8							<0.005

Table A1: Wakulla Spring Data, page 24

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
SC 8	02/08/20	13:00	46611	27.93	35.0							<0.005
SC dock	02/08/20	10:15	46611	27.93								<0.005
WS P	02/08/20	9:00	752	0.41	19.2							0.289
WS P	02/09/20	9:00	794	0.44	20.0							0.342
WS P	02/10/20	9:00	753	0.42	21.3							0.361
WS P	02/11/20	9:00	801	0.44	29.7							0.393
WS P	02/12/20	9:00	793	0.44	15.2							0.364
WS P	02/13/20	9:00	823	0.46	14.0							0.421
WS B	02/14/20	10:50	796	0.44	15.6	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.355
WS P	02/14/20	9:00	780	0.43	21.3							0.330
WSW L	02/14/20	11:28	688	0.38	13.6	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.317
WS P	02/15/20	9:00	772	0.43	16.8							0.359
WS P	02/16/20	9:00	719	0.39	20.9							0.239
WS P	02/17/20	9:00	726	0.40	15.2							0.259
Lost Creek	02/18/20	17:30	51	<0.05	262.4							<0.005
SC D	02/18/20	17:10	43507	26.07	46.3							<0.005
WS P	02/18/20	9:00	778	0.43	19.2							0.139
WSW AD	02/18/20	15:10	770	0.43	15.2							<0.005
WSW AK	02/18/20	14:00	809	0.45	13.2							0.032
WSW B	02/18/20	12:30	314	0.15	19.2							0.125
WSW C	02/18/20	12:38	403	0.21	11.2							0.187
WSW D	02/18/20	15:00	331	0.16	9.1							0.119
WSW Indian Spring	02/18/20	16:30	288	0.14	39.4							1.434
WSW K	02/18/20	13:55	889	0.50	13.2							0.031
WSW SW	02/18/20	13:30	323	0.16	8.3							0.442
WS P	02/19/20	9:00	766	0.42	22.5							0.261
WS B	02/20/20	11:00	750	0.41	17.6	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.321
WS P	02/20/20	9:00	763	0.42	18.4							0.301
WSW L	02/20/20	11:40	671	0.37	14.4	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.385
WS P	02/21/20	9:00	740	0.41	14.0							0.315
SC D	02/22/20	10:00	45059	27.00	33.4							<0.005
WS P	02/22/20	9:00	652	0.35	13.2							0.301
WS P	02/23/20	9:00	620	0.34	15.6							0.325
WS P	02/24/20	9:00	623	0.34	14.4							0.309
WS P	02/25/20	9:00	689	0.38	18.0							0.299
WS P	02/26/20	9:00	721	0.40	15.6							0.325
WS #1	02/27/20	11:23	731	0.40	18.4							0.313
WS #2	02/27/20	11:38	739	0.41	17.6							0.303
WS #3	02/27/20	11:45	737	0.41	18.8							0.395
WS #4	02/27/20	11:53	730	0.40	20.4							0.379
WS #5	02/27/20	11:57	678	0.37	18.0							0.421
WS #6	02/27/20	12:06	575	0.31	18.4							0.558
WS #7	02/27/20	11:08	728	0.40	18.0							0.281
WS #8	02/27/20	12:12	333	0.16	14.0							0.652
WS B	02/27/20	11:00	740	0.41	22.5	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.297
WS P	02/27/20	9:00	742	0.41	20.0							1.729
WSW L	02/27/20	12:30	653	0.36	21.3	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.379
WS P	02/28/20	9:00	780	0.43	24.8							0.386
WS P	02/29/20	9:00	718	0.39	27.6							0.386
WS P	03/01/20	9:00	667	0.36	17.5							0.341

Table A1: Wakulla Spring Data, page 25

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	03/02/20	9:00	672	0.37	23.9							0.386
WS P	03/03/20	9:00	683	0.37	25.8							0.286
Lost Creek	03/04/20	14:00	72	<0.05	298.8							<0.005
SC D	03/04/20	13:30	38852	23.27	23.8							<0.005
WS P	03/04/20	9:00	713	0.39	23.1							0.281
WS B	03/05/20	11:00	690	0.38	32.2	<0.007	0.07	<0.05	0.04	0.10	<0.05	0.256
WS P	03/05/20	9:00	691	0.38	31.0							0.272
WSW L	03/05/20	11"35	643	0.35	26.7	<0.007	0.06	0.05	0.18	0.62	<0.05	0.314
WS P	03/06/20	9:00	708	0.39	35.5							0.392
WS P	03/07/20	9:00	627	0.34	27.6							0.298
Indian Springs	03/08/20	12:00	280	0.13	20.5							<0.005
SC D	03/08/20	9:30	37300	22.34	35.3							<0.005
WS P	03/08/20	9:00	543	0.29	19.0							0.400
WS P	03/10/20	9:00	393	0.20	22.3							0.360
WS P	03/11/20	9:00	393	0.20	20.1							0.352
WS B	03/12/20	10:42	392	0.20	23.5	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.386
WSW L	03/12/20	11:05	405	0.21	27.4	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.282
WS P	03/13/20	9:00	389	0.20	22.0							0.354
WS P	03/14/20	9:00	376	0.19	23.3							0.371
WS P	03/15/20	9:00	371	0.19	24.7							0.420
WS P	03/16/20	9:00	354	0.18	40.6							0.470
WS P	03/17/20	9:00	325	0.16	26.7							0.465
WS P	03/18/20	9:00	316	0.15	22.8							0.472
WS B	03/19/20	10:45	313	0.15	20.4	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.380
WS P	03/19/20	9:00	307	0.15	19.6							0.420
WSW L	03/19/20	11:10	307	0.15	24.8	<0.007	<0.05	<0.05	<0.05	<0.05	<0.05	0.366
Lost Creek	03/20/20	15:30	137	<0.05	293.6							<0.005
SC	03/20/20	16:30	18679	11.17	132.2							<0.005
WS P	03/20/20	9:00	310	0.15	21.7							0.366
WS P	03/21/20	9:00	309	0.15	19.1							0.353
Lost Creek	03/22/20	19:15	68	<0.05	305.6							<0.005
SC	03/22/20	17:10	6364	3.78	164.4							<0.005
WS P	03/22/20	9:00	309	0.15	13.9							0.409
WS P	03/23/20	9:00	304	0.15	15.9							0.431
WS P	03/24/20	9:00	304	0.15	13.1							0.418
WS P	03/25/20	9:00	305	0.15	13.2							0.424
WS B	03/26/20	10:45	306	0.15	13.2							0.443
WSW L	03/26/20	11:09	311	0.15	13.9							0.402
Fisher Creek	03/27/20	13:00	67	<0.05	270.1							<0.005
Lost Creek	03/27/20	12:45	112	<0.05	288.0							<0.005
Sally Ward	03/27/20	11:30	320	0.16	3.2							0.647
SC D	03/27/20	12:20	19765	11.82	106.5							<0.005
WSW AD	03/27/20	11:10	308	0.15	15.8							0.220
WSW AK	03/27/20	11:40	300	0.14	15.4							0.213
WSW B	03/27/20	10:45	330	0.16	4.1							0.488
WSW C	03/27/20	10:48	325	0.16	4.2							0.506
WSW D	03/27/20	11:15	324	0.16	2.1							0.442
WSW K	03/27/20	11:45	291	0.14	18.1							0.126
Wakulla Beach	03/28/20	18:00	36214	21.69	100.8							<0.005
WS P	03/26/20	9:00	324	0.16	25.1							0.426

Table A1: Wakulla Spring Data, page 26

Station	Date	Time	SpCond	Salinity	Color	Algal biomass	chl a	chl b	chl c	Cor Chloro	Phao	Nitrate
			uS	ppt	PtCo	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L
WS P	03/27/20	9:00	301	0.14	16.8							0.387
WS P	03/28/20	9:00	301	0.14	11.5							0.335
WS P	03/30/20	9:00	301	0.14	10.2							0.321
WS P	03/31/20	9:00	302	0.14	15.8							0.278
WS P	04/01/20	9:00	307	0.15	17.2							0.337
WS P	04/02/20	9:00	315	0.15	12.0							0.392
WS B	04/02/20	10:15	305	0.15	9.1	0.017	0.26	0.03	<0.05	<0.05	0.80	0.329
WSW L	04/02/20	10:50	303	0.15	9.4	<0.007	0.02	<0.05	<0.05	<0.05	1.80	0.371
SC D	04/07/20	17:00	443	0.23	27.3							<0.005
WS P	04/03/20	9:00	303	0.15	8.5							0.410
WS P	04/06/20	9:00	307	0.15	11.9							0.374
WS P	04/07/20	9:00	429	0.22	17.9							0.388
WS P	04/08/20	9:00	447	0.23	11.1							0.355
WS P	04/09/20	9:00	332	0.16	9.9							0.385
WS P	04/10/20	9:00	312	0.15	11.2							0.231

New Innovative Technology: Chlorophyll Factor. During this project MLI has developed a new analytical test for chlorophyll. This is a non-destructive insitu field measurement taken with the spectralradiometer. We use the water column scan we make for measuring the light intensity spectralradiometrically from 340nm-1024nm, three readings per nm. The water column is scanned at half meter intervals. From the wavelength scans we integrate over the visibly green chlorophyll absorbance in the water column. We calculate the extinction coefficient at 664nm to 691nm (pre-peak) and another extinction coefficient at 692nm to 719nm (post-peak). Then we subtract the post-peak extinction from the pre-peak extinction and we initially used a negative value to detect the presence of chlorophyll. The raw numbers we obtain, which we are calling a chlorophyll factor, prove to be slightly more significant, statistically, than our traditional chlorophyll measurements. We are currently working on calculating a chlorophyll concentration and method development with the Florida Department of Health Bureau of Laboratories, patent pending.

Table A2: Wakulla Spring Visibility Data, page 1

Date	LICOR	OO	Secchi	Chl factor	Visablity
	feet	feet	feet	unitless	feet
12/30/17	15.6	15.0	35.0	0.35	21.9
01/07/18	13.1	16.6	37.0	-0.27	22.2
01/11/18	16.1	15.3	31.0	-0.58	20.8
01/18/18	10.7	23.2		2.52	17.0
01/25/18	14.2	15.7	30.0	-0.22	20.0
02/01/18	14.0	16.4	30.0	0.43	20.1
02/08/18	15.1	18.2	31.0	1.16	21.4
02/15/18	15.3	16.3	29.0	0.90	20.2
02/22/18	14.5	15.5	20.5	-0.09	16.8
03/02/18	13.5	13.7	13.5	-0.25	13.6
03/08/18	10.6	11.6	15.8	-0.34	12.7
03/18/18	8.0	9.4		0.08	8.7
03/22/18	9.2	9.4	15.0	-0.66	11.2
03/29/18	9.4	7.2	10.5	-0.63	9.0
04/05/18	8.1	9.3	14.7	-0.50	10.7
04/12/18	10.4	10.6	18.0	-0.65	13.0
04/20/18	10.0	15.7	24.5	0.18	16.7
04/26/18	16.1	15.4	40.0	0.02	23.8
05/04/18	16.3	19.2	44.5	1.42	26.7
05/10/18	17.0	15.6	68.0	0.34	33.5
05/18/18	18.6	20.5	56.0	0.29	31.7
05/24/18	20.5	25.8	70.0		38.8
05/31/18	18.1	17.4	46.5	0.33	27.3
06/07/18	14.0	14.0	17.5	-1.08	15.2
06/14/18	13.2	14.3	14.4	-0.75	14.0
06/21/18	13.6	16.0	27.0	0.30	18.9
06/28/18	14.5	15.7	20.5	1.94	16.9
07/05/18	16.5	18.9	35.0	-0.34	23.5
07/12/18	19.6	17.3	43.7	0.26	26.9
07/19/18	26.7	26.7	40.0		31.1
07/26/18	18.7	15.9	38.9	-0.11	24.5
08/02/18	8.5				8.5
08/09/18	5.9	6.1	4.8	-0.04	5.6
08/16/18	8.9	8.1	5.7	-0.69	7.6
08/23/18	11.3	9.7	12.9	-0.64	11.3
08/27/18	14.1	10.7		-0.45	8.3
09/06/18	12.2	11.1	18.2	-0.11	13.8
09/13/18	9.1	14.1	15.6	0.24	12.9
09/20/18	15.3	16.5	27.0	-0.14	19.6
09/27/18	15.5	15.7	25.4	-0.26	18.9
10/04/18	15.4	16.7	27.4	-0.03	19.8
10/15/18	12.2	17.0	30.0	1.70	19.7
10/18/18	23.2	16.5	33.9	5.70	24.5

Table A2: Wakulla Spring Visibility Data, page 2

10/18/18	23.2	16.5	33.9	5.70	24.5
Date	LICOR	OO	Secchi	Chl factor	Visablity
	feet	feet	feet	unitless	feet
11/01/18	22.7	21.8	20.5	0.30	21.7
11/08/18	20.6	17.7	35.1	2.29	24.5
11/15/18	14.3	17.0	32.0	1.70	21.1
11/21/18	15.4	14.7	16.6	0.50	15.6
11/29/18	11.9	13.3	14.3	0.23	13.2
12/06/18	11.0	11.9	11.3	0.05	11.4
12/13/18	8.3	5.5	7.3	-0.16	7.0
12/19/18		12.7		1.10	12.7
12/27/18	6.9	8.3	7.5	-0.16	7.6
01/03/19	7.1	6.3	8.3	-0.08	7.2
01/10/19	10.4	6.5	9.8	0.02	8.9
02/17/19	12.5	13.9	10.6	-0.17	12.3
01/24/19	9.4	11.7	14.8	-0.02	12.0
01/31/19	14.3	13.0	20.0	0.36	15.8
02/07/19	14.6	16.8	14.0	0.61	15.1
02/14/19	14.4	12.8	23.0	0.31	16.7
02/21/19	15.0	16.6	22.0	0.70	17.9
02/28/19	44.1	29.5	36.4	3.82	36.7
03/07/19	19.6		45.0		32.3
03/14/19	10.9	18.0	14.8	0.09	14.5
03/21/19	13.3	15.8	16.4	0.72	15.2
03/28/19	27.6	23.1	27.0	0.44	25.9
04/04/19	25.4	18.1	32.7	1.46	25.4
04/11/19	19.4	21.0	42.0	1.96	27.5
04/18/19	29.8	26.8	57.0	0.78	37.9
04/25/19	21.3	28.9	50.5	2.32	33.6
05/02/19	18.8	24.7	35.0	2.05	26.2
05/09/19	21.5	23.2	47.5	2.27	30.7
05/16/19	20.0	24.4	68.0	1.46	37.5
05/23/19	39.2	34.1	55.0	2.10	42.8
05/30/19	43.2		59.6		51.4
06/06/19	33.3	29.8	50.7	1.43	37.9
06/13/19	55.5	32.4	66.0	1.74	51.3
06/20/19	40.8	49.2	53.8	1.68	47.9
06/27/19	52.6	58.7	66.6	2.98	59.3
07/03/19	54.1	64.9	68.1	1.48	62.4
07/11/19	47.9	35.5	57.1	3.09	46.8
07/18/19	60.3	38.4	56.6	6.49	51.8
07/25/19	31.2	36.2	27.8	2.22	31.7
08/01/19	32.3	31.4	27.1	2.72	30.3
08/08/19	33.0		30.6		31.8
08/15/19	32.8	69.6	52.6	5.66	51.7
08/22/19	36.0	21.8	45.1	3.54	34.3

Table A2: Wakulla Spring Visibility Data, page 3

Date	LICOR	OO	Secchi	Chl factor	Visablity
	feet	feet	feet	unitless	feet
08/29/19	20.0		25.0		22.5
09/05/19	15.0	12.9	10.4	0.15	12.8
09/12/19	17.5	13.6	16.9	0.39	16.0
09/19/19	19.7	16.0	23.7	0.90	19.8
09/26/19	30.6	21.4	30.0	4.94	27.3
10/03/19	32.7	30.7	33.1	1.31	32.2
10/10/19	31.2	19.0	32.4	5.74	27.5
10/17/19	31.4	17.3	29.9	0.50	26.2
10/24/19	39.4	27.4	39.5	3.15	35.4
10/31/19	23.1	33.7	44.4	0.07	33.7
11/07/19	47.1	51.9	49.0	1.79	49.3
11/14/19	36.0	22.8	40.8	2.51	33.2
11/21/19	34.5	17.4	35.0	0.46	29.0
11/27/19	28.5	32.0	35.0	0.54	31.8
12/05/29	28.0	29.4	31.1	2.41	29.5
12/12/19	36.7	26.1	35.1	0.85	32.6
12/19/19	33.2	17.4	30.3	2.24	27.0
12/27/19	28.5	32.0	35.0	0.54	31.8
01/02/20	33.2	26.1	29.0	0.74	29.4
01/09/20	31.3	26.0	26.6	1.98	41.9
01/16/20	23.1		24.9		24.0
01/23/20	35.6	18.3	35.6	1.52	29.8
01/30/20	33.9	25.3	17.3	0.01	25.5
02/05/20	35.0	15.9	25.0	0.64	25.3
02/14/20	21.5		19.3	0.34	20.4
02/20/20	35.3		33.2		34.3
02/27/20	33.0		30.0		31.5
03/05/20	33.0		25.0		29.0
03/12/20	30.6	14.7	20.7		22.0
03/19/20	31.3	14.8	27.4	0.96	24.5
03/26/20	33.6	13.2	38.0	0.29	28.3
04/02/20	37.7	32.8	53.6	0.18	41.4
04/10/20	virus	virus	49.0	virus	49.0

Appendix 1B
Wakulla Springs Dark Water: Causes and Sources Phases III: Weather and WaterLevelData Generated for this Report

***Please use the daily weather data in table A3 coupled with the major storms listed in figure A3 to determine antecedent weather conditions for any sample listed in this report**

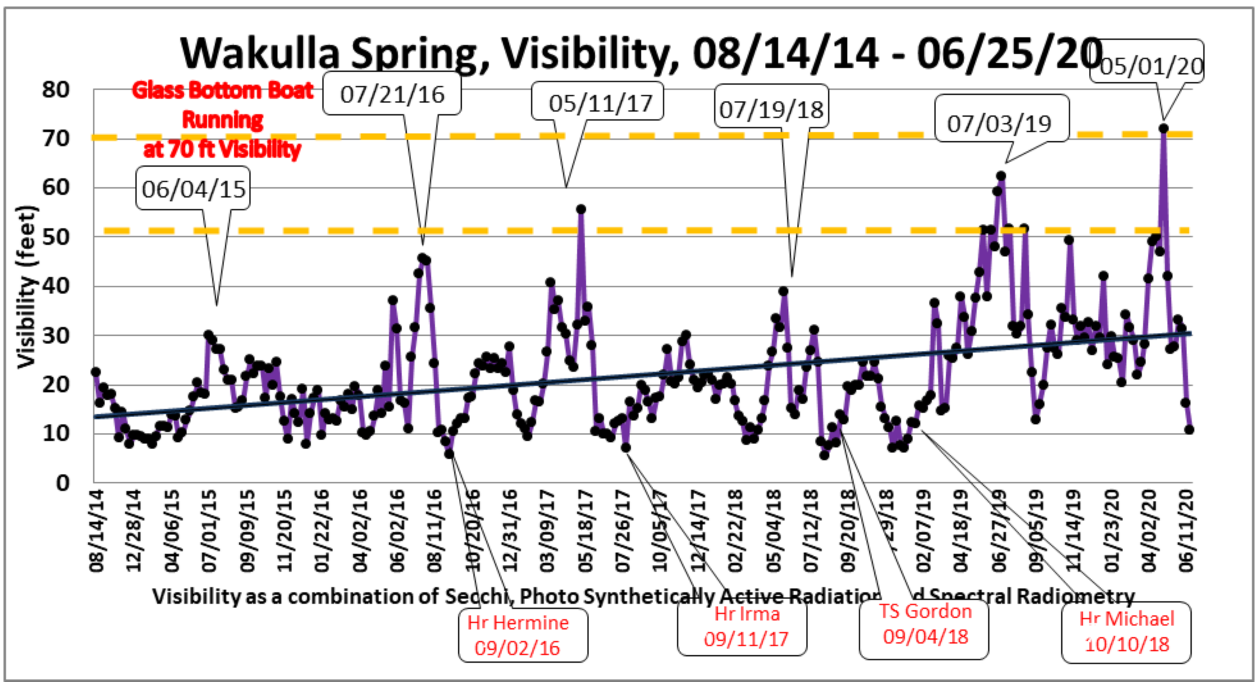


Figure A3: This graph shows the prominent weather systemsencountered during this study, it is Figure 2.1 from this text, depicting visibility at Wakulla Springs.

Table A3: Associated Weather, page 1

Date	Rainfall WS Park (inches)
01/01/18	0
01/02/18	0
01/03/18	0.04
01/04/18	0
01/05/18	0
01/06/18	0
01/07/18	0
01/08/18	0
01/09/18	0.02
01/10/18	0
01/11/18	0
01/12/18	0.76
01/13/18	0.01
01/14/18	0
01/15/18	0
01/16/18	0
01/17/18	0.03
01/18/18	0
01/19/18	0
01/20/18	0
01/21/18	0
01/22/18	0.06
01/23/18	0
01/24/18	0
01/25/18	0
01/26/18	0
01/27/18	0
01/28/18	0.5
01/29/18	0.01
01/30/18	0
01/31/18	0
02/01/18	0
02/02/18	0
02/03/18	0
02/04/18	0.9
02/05/18	0
02/06/18	0
02/07/18	0.63
02/08/18	0
02/09/18	0
02/10/18	0
02/11/18	1.04

Date	Rainfall WS Park (inches)
02/12/18	0.24
02/13/18	0
02/14/18	0
02/15/18	0
02/16/18	0
02/17/18	0
02/18/18	0
02/19/18	0
02/20/18	0.01
02/21/18	0
02/22/18	0
02/23/18	0
02/24/18	0
02/25/18	0.9
02/26/18	0.6
02/27/18	0
02/28/18	0
03/01/18	0
03/02/18	0
03/03/18	0
03/04/18	0
03/05/18	0
03/06/18	0.17
03/07/18	0
03/08/18	0
03/09/18	0
03/10/18	0
03/11/18	0.32
03/12/18	0.01
03/13/18	0
03/14/18	0
03/15/18	0
03/16/18	0
03/17/18	0
03/18/18	0.89
03/19/18	3.64
03/20/18	0.01
03/21/18	0
03/22/18	0
03/23/18	0
03/24/18	0
03/25/18	0
03/26/18	0

Date	Rainfall WS Park (inches)
03/27/18	0
03/28/18	0
03/29/18	0
03/30/18	0.06
03/31/18	0
04/01/18	0
04/02/18	0
04/03/18	0
04/04/18	0.06
04/05/18	0.01
04/06/18	0
04/07/18	1.9
04/08/18	0
04/09/18	0
04/10/18	0.41
04/11/18	0
04/12/18	0
04/13/18	0
04/14/18	0
04/15/18	0.76
04/16/18	0
04/17/18	0
04/18/18	0
04/19/18	0
04/20/18	0
04/21/18	0
04/22/18	0.52
04/23/18	0.03
04/24/18	0
04/25/18	0
04/26/18	0
04/27/18	0
04/28/18	0
04/29/18	0
04/30/18	0
05/01/18	0
05/02/18	0
05/03/18	0
05/04/18	0
05/05/18	0
05/06/18	0
05/07/18	0
05/08/18	0

Date	Rainfall WS Park (inches)
05/09/18	0
05/10/18	0
05/11/18	0
05/12/18	0
05/13/18	0
05/14/18	0.59
05/15/18	2.9
05/16/18	0.81
05/17/18	1.65
05/18/18	0.8
05/19/18	0
05/20/18	0.31
05/21/18	0.1
05/22/18	0.47
05/23/18	0.36
05/24/18	0
05/25/18	0
05/26/18	0.02
05/27/18	1.89
05/28/18	1.43
05/29/18	1.35
05/30/18	0
05/31/18	0
06/01/18	0
06/02/18	0.21
06/03/18	0
06/04/18	0
06/05/18	0
06/06/18	0
06/07/18	0
06/08/18	0.24
06/09/18	0.13
06/10/18	0.11
06/11/18	0.1
06/12/18	0.03
06/13/18	0.3
06/14/18	0.87
06/15/18	0.73
06/16/18	0.01
06/17/18	0
06/18/18	0
06/19/18	0
06/20/18	0.04

Table A3: Associated Weather, page 2

Date	Rainfall WS Park (inches)
06/21/18	0
06/22/18	0.03
06/23/18	0
06/24/18	0
06/25/18	0
06/26/18	0.01
06/27/18	0.08
06/28/18	0.34
06/29/18	0
06/30/18	1.32
07/01/18	0.15
07/02/18	0.04
07/03/18	1.23
07/04/18	0.01
07/05/18	0.31
07/06/18	0.03
07/07/18	0.72
07/08/18	0.03
07/09/18	0.16
07/10/18	0
07/11/18	0
07/12/18	0
07/13/18	0
07/14/18	0.48
07/15/18	0
07/16/18	0
07/17/18	0.37
07/18/18	0.03
07/19/18	0.08
07/20/18	1.21
07/21/18	0.49
07/22/18	0
07/23/18	0
07/24/18	0.08
07/25/18	0.01
07/26/18	0.06
07/27/18	0
07/28/18	0
07/29/18	0
07/30/18	0.19
07/31/18	0.94
08/01/18	3.77
08/02/18	2.53
08/03/18	1.5
08/04/18	0
08/05/18	0
08/06/18	0.6
08/07/18	0.01
08/08/18	0
08/09/18	0.01
08/10/18	0.84
08/11/18	0.01
08/12/18	0
08/13/18	0
08/14/18	0.19
08/15/18	0
08/16/18	0.03
08/17/18	0.08
08/18/18	0
08/19/18	0.05
08/20/18	0
08/21/18	0.68
08/22/18	0
08/23/18	0
08/24/18	0.67
08/25/18	0.01
08/26/18	0.68
08/27/18	0
08/28/18	1.3
08/29/18	0.05
08/30/18	0.64
08/31/18	0.01
09/01/18	0
09/02/18	0.86
09/03/18	0.72
09/04/18	0.08
09/05/18	0.08
09/06/18	0
09/07/18	0.35
09/08/18	0
09/09/18	0
09/10/18	0.84
09/11/18	0
09/12/18	0.16
09/13/18	0
09/14/18	0
09/15/18	0
09/16/18	0
09/17/18	0.25
09/18/18	0.11
09/19/18	0.84
09/20/18	0
09/21/18	0.03
09/22/18	0
09/23/18	0
09/24/18	0
09/25/18	0
09/26/18	0
09/27/18	0
09/28/18	0
09/29/18	0
09/30/18	0
10/01/18	0
10/02/18	0
10/03/18	0
10/04/18	0
10/05/18	0
10/06/18	0
10/07/18	0
10/08/18	0
10/09/18	0
10/10/18	3.31
10/11/18	0
10/12/18	0
10/13/18	0
10/14/18	0
10/15/18	0
10/16/18	0
10/17/18	0
10/18/18	0
10/19/18	0
10/20/18	0
10/21/18	0
10/22/18	0
10/23/18	0.05
10/24/18	0
10/25/18	0.23
10/26/18	0.35
10/27/18	0
10/28/18	0
10/29/18	0
10/30/18	0
10/31/18	0
11/01/18	0.18
11/02/18	0.35
11/03/18	0
11/04/18	0.18
11/05/18	0
11/06/18	2.57
11/07/18	0.03
11/08/18	0.18
11/09/18	0.21
11/10/18	0
11/11/18	0
11/12/18	0
11/13/18	1.62
11/14/18	0.75
11/15/18	0.24
11/16/18	0
11/17/18	0
11/18/18	0
11/19/18	0
11/20/18	0
11/21/18	0
11/22/18	0
11/23/18	0
11/24/18	0.11
11/25/18	0.1
11/26/18	0.37
11/27/18	0
11/28/18	0
11/29/18	0
11/30/18	0.03
12/01/18	1.82
12/02/18	1.86
12/03/18	0.57
12/04/18	0
12/05/18	0
12/06/18	0
12/07/18	0
12/08/18	0

Table A3: Associated Weather, page 3

Date	Rainfall WS Park (inches)
12/09/18	1.2
12/10/18	0
12/11/18	0
12/12/18	0
12/13/18	0.28
12/14/18	3.56
12/15/18	0.03
12/16/18	0
12/17/18	0
12/18/18	0
12/19/18	0
12/20/18	1.22
12/21/18	0.25
12/22/18	0
12/23/18	0
12/24/18	0
12/25/18	0
12/26/18	0
12/27/18	0.06
12/28/18	1.88
12/29/18	0.33
12/30/18	0.02
12/31/18	0
01/01/19	0
01/02/19	0
01/03/19	0.1
01/04/19	0.95
01/05/19	0
01/06/19	0
01/07/19	0
01/08/19	0
01/09/19	0
01/10/19	0
01/11/19	0
01/12/19	0
01/13/19	0.07
01/14/19	0
01/15/19	0
01/16/19	0
01/17/19	0
01/18/19	0
01/19/19	0.53

Date	Rainfall WS Park (inches)
01/20/19	0
01/21/19	0
01/22/19	0
01/23/19	0.94
01/24/19	0.61
01/25/19	0
01/26/19	0
01/27/19	0
01/28/19	0
01/29/19	0.26
01/30/19	0
01/31/19	0
02/01/19	0.01
02/02/19	0
02/03/19	0.03
02/04/19	0
02/05/19	0
02/06/19	0
02/07/19	0
02/08/19	0
02/09/19	0
02/10/19	0.01
02/11/19	0
02/12/19	0
02/13/19	0
02/14/19	0
02/15/19	0
02/16/19	0
02/17/19	0
02/18/19	0.01
02/19/19	0
02/20/19	0
02/21/19	0
02/22/19	0
02/23/19	0
02/24/19	0.17
02/25/19	0
02/26/19	0
02/27/19	0.31
02/28/19	0.03
03/01/19	0.75
03/02/19	0.22
03/03/19	0.68

Date	Rainfall WS Park (inches)
03/04/19	0.01
03/05/19	0.25
03/06/19	0
03/07/19	0
03/08/19	0
03/09/19	0
03/10/19	0
03/11/19	0.04
03/12/19	0
03/13/19	0
03/14/19	0
03/15/19	0.01
03/16/19	0
03/17/19	0
03/18/19	0
03/19/19	0
03/20/19	0
03/21/19	0
03/22/19	0
03/23/19	0
03/24/19	0
03/25/19	0
03/26/19	0
03/27/19	0.16
03/28/19	0
03/29/19	0
03/30/19	0
03/31/19	0.01
04/01/19	0.17
04/02/19	0.15
04/03/19	0
04/04/19	0.56
04/05/19	1.34
04/06/19	0.01
04/07/19	0
04/08/19	0.31
04/09/19	0
04/10/19	0
04/11/19	0
04/12/19	0
04/13/19	0
04/14/19	0.14
04/15/19	0

Date	Rainfall WS Park (inches)
04/16/19	0
04/17/19	0
04/18/19	0
04/19/19	1.39
04/20/19	0
04/21/19	0
04/22/19	0
04/23/19	0
04/24/19	0
04/25/19	1.63
04/26/19	0.04
04/27/19	0
04/28/19	0
04/29/19	0
04/30/19	0
05/01/19	0
05/02/19	0
05/03/19	0
05/04/19	0.25
05/05/19	0.01
05/06/19	0
05/07/19	0
05/08/19	0
05/09/19	0
05/10/19	0
05/11/19	0
05/12/19	1.57
05/13/19	0.06
05/14/19	0
05/15/19	0
05/16/19	0
05/17/19	0
05/18/19	0
05/19/19	0
05/20/19	0
05/21/19	0
05/22/19	0
05/23/19	0
05/24/19	0
05/25/19	0
05/26/19	0
05/27/19	0
05/28/19	0

Table A3: Associated Weather, page 4

Date	Rainfall WS Park (inches)	Date	Rainfall WS Park (inches)	Date	Rainfall WS Park (inches)	Date	Rainfall WS Park (inches)
05/29/19	0	07/11/19	0.38	08/23/19	0	10/05/19	0
05/30/19	0	07/12/19	1.96	08/24/19	2.96	10/06/19	0
05/31/19	1.99	07/13/19	0.08	08/25/19	0.01	10/07/19	0.28
06/01/19	0.01	07/14/19	0	08/26/19	0.78	10/08/19	0
06/02/19	0	07/15/19	0	08/27/19	0.32	10/09/19	0
06/03/19	0	07/16/19	0	08/28/19	0	10/10/19	0
06/04/19	0	07/17/19	0	08/29/19	0	10/11/19	0
06/05/19	0	07/18/19	0	08/30/19	0	10/12/19	0
06/06/19	0.45	07/19/19	0	08/31/19	0	10/13/19	0
06/07/19	0.41	07/20/19	0	09/01/19	0.02	10/14/19	0
06/08/19	0.26	07/21/19	0	09/02/19	0	10/15/19	2.2
06/09/19	0.16	07/22/19	0.07	09/03/19	0	10/16/19	0
06/10/19	0.63	07/23/19	0.21	09/04/19	0	10/17/19	0
06/11/19	0	07/24/19	0.06	09/05/19	0	10/18/19	0
06/12/19	0.01	07/25/19	0.01	09/06/19	0	10/19/19	0.01
06/13/19	0	07/26/19	0	09/07/19	0	10/20/19	0
06/14/19	0	07/27/19	0	09/08/19	0	10/21/19	0
06/15/19	0	07/28/19	0	09/09/19	0	10/22/19	0
06/16/19	0	07/29/19	0	09/10/19	0	10/23/19	0
06/17/19	0.95	07/30/19	0	09/11/19	0	10/24/19	0
06/18/19	1.97	07/31/19	0	09/12/19	0	10/25/19	0.02
06/19/19	0.48	08/01/19	0.19	09/13/19	0	10/26/19	0.04
06/20/19	0.24	08/02/19	2.31	09/14/19	0	10/27/19	0.07
06/21/19	0.27	08/03/19	0.25	09/15/19	0	10/28/19	0
06/22/19	0.44	08/04/19	0	09/16/19	0	10/29/19	0.53
06/23/19	0	08/05/19	0.06	09/17/19	0	10/30/19	0.92
06/24/19	0	08/06/19	0.06	09/18/19	0.01	10/31/19	0.06
06/25/19	0.12	08/07/19	0.31	09/19/19	0	11/01/19	0
06/26/19	0	08/08/19	0.99	09/20/19	0	11/02/19	0
06/27/19	0.26	08/09/19	0.05	09/21/19	0	11/03/19	0
06/28/19	0.53	08/10/19	0	09/22/19	0	11/04/19	0
06/29/19	0.04	08/11/19	0	09/23/19	0	11/05/19	0.1
06/30/19	0.04	08/12/19	0.01	09/24/19	0	11/06/19	0.01
07/01/19	0	08/13/19	0	09/25/19	0	11/07/19	0
07/02/19	0.01	08/14/19	0	09/26/19	0	11/08/19	0.07
07/03/19	0	08/15/19	1.16	09/27/19	0	11/09/19	0
07/04/19	0	08/16/19	0	09/28/19	0	11/10/19	0
07/05/19	0.07	08/17/19	0.89	09/29/19	0	11/11/19	0
07/06/19	0.88	08/18/19	1.77	09/30/19	0	11/12/19	0.04
07/07/19	0.09	08/19/19	1.35	10/01/19	0	11/13/19	0
07/08/19	0.54	08/20/19	0	10/02/19	0	11/14/19	0.48
07/09/19	0	08/21/19	0	10/03/19	0	11/15/19	0.03
07/10/19	0.05	08/22/19	0	10/04/19	0	11/16/19	0

Table A3: Associated Weather, page 5

Date	Rainfall WS Park (inches)
11/17/19	0.01
11/18/19	
11/19/19	0
11/20/19	0
11/21/19	0
11/22/19	0
11/23/19	0.08
11/24/19	0.01
11/25/19	0
11/26/19	0
11/27/19	0
11/28/19	0
11/29/19	0
11/30/19	0
12/01/19	0.1
12/02/19	0
12/03/19	0
12/04/19	0
12/05/19	0
12/06/19	1.63
12/07/19	0
12/08/19	0
12/09/19	0
12/10/19	0
12/11/19	0.04
12/12/19	0.04
12/13/19	0.07
12/14/19	0.24
12/15/19	0
12/16/19	0
12/17/19	0.86
12/18/19	0
12/19/19	0
12/20/19	0
12/21/19	0.04
12/22/19	1.02
12/23/19	0.06
12/24/19	0.01
12/25/19	0
12/26/19	0
12/27/19	0
12/28/19	0.11
12/29/19	0.07
12/30/19	0.02
12/31/19	0
01/01/20	0
01/02/20	0
01/03/20	0
01/04/20	0.3
01/05/20	0
01/06/20	0
01/07/20	0
01/08/20	0
01/09/20	0
01/10/20	0
01/11/20	0.72
01/12/20	0.06
01/13/20	0.01
01/14/20	0
01/15/20	0.01
01/16/20	0
01/17/20	0
01/18/20	0
01/19/20	0
01/20/20	0
01/21/20	0
01/22/20	0
01/23/20	0
01/24/20	0.5
01/25/20	0
01/26/20	0.1
01/27/20	0
01/28/20	0
01/29/20	0.1
01/30/20	0
01/31/20	0.1
02/01/20	0
02/02/20	0
02/03/20	0
02/04/20	0
02/05/20	0
02/06/20	0.7
02/07/20	0
02/08/20	0
02/09/20	0
02/10/20	0
02/11/20	0
02/12/20	0
02/13/20	0.5
02/14/20	0.3
02/15/20	0
02/16/20	0.4
02/17/20	0
02/18/20	0.1
02/19/20	0
02/20/20	0.3
02/21/20	0
02/22/20	0
02/23/20	0
02/24/20	0.3
02/25/20	1.5
02/26/20	0.7
02/27/20	0
02/28/20	0
02/29/20	0
03/01/20	0
03/02/20	0
03/03/20	0
03/04/20	0
03/05/20	0.3
03/06/20	0
03/07/20	0
03/08/20	0
03/09/20	1.8
03/10/20	0
03/11/20	0
03/12/20	0
03/13/20	0
03/14/20	0
03/15/20	0
03/16/20	0
03/17/20	0
03/18/20	0
03/19/20	0
03/20/20	0
03/21/20	0
03/22/20	0
03/23/20	0
03/24/20	0
03/25/20	0
03/26/20	0
03/27/20	0
03/28/20	0
03/29/20	0
03/30/20	0
03/31/20	0.5
04/01/20	0
04/02/20	0
04/03/20	0
04/04/20	0
04/05/20	0.1
04/06/20	0
04/07/20	0.1
04/08/20	0.5
04/09/20	0
04/10/20	0

Table A4: Upper Lake Lafayette water level elevations, page 1

Date	ULL Elevation (ft)	Date	ULL Elevation (ft)	Date	ULL Elevation (ft)	Date	ULL Elevation (ft)
01/01/18	22	03/02/18	22	05/01/18		06/30/18	
01/02/18		03/03/18		05/02/18		07/01/18	
01/03/18	21	03/04/18		05/03/18		07/02/18	
01/04/18		03/05/18		05/04/18	21	07/03/18	
01/05/18		03/06/18		05/05/18	22	07/04/18	24
01/06/18	22	03/07/18	22	05/06/18		07/05/18	
01/07/18		03/08/18		05/07/18		07/06/18	
01/08/18	23	03/09/18		05/08/18		07/07/18	
01/09/18	23	03/10/18		05/09/18	21	07/08/18	23
01/10/18		03/11/18	21	05/10/18		07/09/18	
01/11/18		03/12/18		05/11/18		07/10/18	
01/12/18		03/13/18		05/12/18		07/11/18	
01/13/18		03/14/18		05/13/18	28	07/12/18	
01/14/18	23	03/15/18	21	05/14/18		07/13/18	23
01/15/18		03/16/18		05/15/18	32	07/14/18	
01/16/18		03/17/18		05/16/18		07/15/18	
01/17/18		03/18/18		05/17/18		07/16/18	
01/18/18		03/19/18		05/18/18		07/17/18	22
01/19/18	23	03/20/18		05/19/18	32	07/18/18	
01/20/18		03/21/18	29	05/20/18		07/19/18	
01/21/18		03/22/18		05/21/18		07/20/18	
01/22/18		03/23/18	30	05/22/18	31	07/21/18	
01/23/18	20	03/24/18		05/23/18		07/22/18	22
01/24/18	21	03/25/18		05/24/18		07/23/18	
01/25/18		03/26/18		05/25/18		07/24/18	
01/26/18		03/27/18	29	05/26/18	30	07/25/18	
01/27/18		03/28/18		05/27/18		07/26/18	21
01/28/18		03/29/18		05/28/18		07/27/18	
01/29/18	21	03/30/18	27	05/29/18		07/28/18	
01/30/18		03/31/18		05/30/18		07/29/18	
01/31/18		04/01/18		05/31/18	29	07/30/18	21
02/01/18		04/02/18	25	06/01/18		07/31/18	
02/02/18	21	04/03/18		06/02/18		08/01/18	
02/03/18		04/04/18		06/03/18		08/02/18	
02/04/18		04/05/18		06/04/18		08/03/18	32
02/05/18		04/06/18	24	06/05/18		08/04/18	
02/06/18		04/07/18		06/06/18	28	08/05/18	
02/07/18		04/08/18	24	06/07/18		08/06/18	
02/08/18	20	04/09/18	23	06/08/18		08/07/18	29
02/09/18		04/10/18	21	06/09/18		08/08/18	
02/10/18		04/11/18	22	06/10/18		08/09/18	
02/11/18		04/12/18		06/11/18	27	08/10/18	29
02/12/18	22	04/13/18	20	06/12/18		08/11/18	
02/13/18		04/14/18	21	06/13/18		08/12/18	
02/14/18		04/15/18	25	06/14/18		08/13/18	25
02/15/18	24	04/16/18	26	06/15/18		08/14/18	
02/16/18		04/17/18	26	06/16/18	26	08/15/18	
02/17/18		04/18/18	27	06/17/18		08/16/18	
02/18/18		04/19/18	24	06/18/18		08/17/18	22
02/19/18		04/20/18		06/19/18		08/18/18	
02/20/18	23	04/21/18		06/20/18		08/19/18	
02/21/18		04/22/18	23	06/21/18	26	08/20/18	
02/22/18		04/23/18		06/22/18		08/21/18	
02/23/18		04/24/18		06/23/18		08/22/18	22
02/24/18		04/25/18		06/24/18		08/23/18	
02/25/18	21	04/26/18	22	06/25/18	25	08/24/18	
02/26/18		04/27/18		06/26/18		08/25/18	
02/27/18		04/28/18		06/27/18		08/26/18	21
02/28/18		04/29/18		06/28/18	24	08/27/18	
03/01/18		04/30/18	22	06/29/18		08/28/18	
03/02/18	22						

Table A4: Upper Lake Lafayette water level elevations, page 2

Date	ULL Elevation (ft)
08/29/18	
08/30/18	
08/31/18	20
09/01/18	
09/02/18	
09/03/18	
09/04/18	
09/05/18	20
09/06/18	
09/07/18	
09/08/18	
09/09/18	20
09/10/18	
09/11/18	
09/12/18	
09/13/18	
09/14/18	20
09/15/18	
09/16/18	
09/17/18	
09/18/18	21
09/19/18	
09/20/18	
09/21/18	
09/22/18	
09/23/18	21
09/24/18	
09/25/18	
09/26/18	
09/27/18	
09/28/18	20
09/29/18	
09/30/18	
10/01/18	
10/02/18	20
10/03/18	
10/04/18	
10/05/18	
10/06/18	20
10/07/18	
10/08/18	
10/09/18	
10/10/18	
10/11/18	20
10/12/18	
10/13/18	
10/14/18	
10/15/18	
10/16/18	20
10/17/18	
10/18/18	
10/19/18	
10/20/18	
10/21/18	20
10/22/18	
10/23/18	
10/24/18	
10/25/18	20
10/26/18	
10/27/18	

Date	ULL Elevation (ft)
10/28/18	20
10/29/18	
10/30/18	
10/31/18	
11/01/18	
11/02/18	20
11/03/18	
11/04/18	
11/05/18	
11/06/18	21
11/07/18	
11/08/18	
11/09/18	
11/10/18	20
11/11/18	
11/12/18	
11/13/18	
11/14/18	20
11/15/18	
11/16/18	
11/17/18	
11/18/18	
11/19/18	
11/20/18	
11/21/18	20
11/22/18	
11/23/18	
11/24/18	
11/25/18	
11/26/18	20
11/27/18	
11/28/18	
11/29/18	
11/30/18	
12/01/18	30
12/02/18	
12/03/18	
12/04/18	
12/05/18	
12/06/18	32
12/07/18	
12/08/18	
12/09/18	
12/10/18	
12/11/18	
12/12/18	32
12/13/18	
12/14/18	
12/15/18	
12/16/18	
12/17/18	33
12/18/18	
12/19/18	
12/20/18	
12/21/18	
12/22/18	32
12/23/18	
12/24/18	
12/25/18	
12/26/18	

Date	ULL Elevation (ft)
12/27/18	32
12/28/18	
12/29/18	
12/30/18	
12/31/18	31
01/01/19	
01/02/19	
01/03/19	
01/04/19	
01/05/19	31
01/06/19	
01/07/19	
01/08/19	
01/09/19	
01/10/19	30
01/11/19	
01/12/19	
01/13/19	
01/14/19	
01/15/19	30
01/16/19	
01/17/19	
01/18/19	
01/19/19	
01/20/19	30
01/21/19	
01/22/19	
01/23/19	
01/24/19	
01/25/19	30
01/26/19	
01/27/19	
01/28/19	
01/29/19	
01/30/19	30
01/31/19	
02/01/19	
02/02/19	
02/03/19	
02/04/19	31
02/05/19	
02/06/19	
02/07/19	
02/08/19	
02/09/19	32
02/10/19	
02/11/19	
02/12/19	
02/13/19	31
02/14/19	
02/15/19	
02/16/19	
02/17/19	
02/18/19	30
02/19/19	
02/20/19	
02/21/19	
02/22/19	
02/23/19	
02/24/19	31

Date	ULL Elevation (ft)
02/25/19	
02/26/19	
02/27/19	
02/28/19	
03/01/19	
03/02/19	30
03/03/19	
03/04/19	
03/05/19	
03/06/19	
03/07/19	30
03/08/19	
03/09/19	
03/10/19	
03/11/19	
03/12/19	
03/13/19	29
03/14/19	
03/15/19	
03/16/19	
03/17/19	
03/18/19	
03/19/19	28
03/20/19	
03/21/19	
03/22/19	
03/23/19	
03/24/19	28
03/25/19	
03/26/19	
03/27/19	
03/28/19	
03/29/19	27
03/30/19	
03/31/19	
04/01/19	
04/02/19	26
04/03/19	
04/04/19	
04/05/19	
04/06/19	
04/07/19	24
04/08/19	
04/09/19	
04/10/19	
04/11/19	
04/12/19	22
04/13/19	
04/14/19	
04/15/19	
04/16/19	
04/17/19	22
04/18/19	
04/19/19	
04/20/19	
04/21/19	
04/22/19	23
04/23/19	
04/24/19	
04/25/19	
04/26/19	22
04/27/19	
04/28/19	
04/29/19	
04/30/19	

Table A4: Upper Lake Lafayette water level elevations, page 3

Date	ULL Elevation (ft)
05/01/19	
05/02/19	22
05/03/19	
05/04/19	
05/05/19	
05/06/19	
05/07/19	
05/08/19	22
05/09/19	
05/10/19	
05/11/19	
05/12/19	31
05/13/19	
05/14/19	
05/15/19	
05/16/19	
05/17/19	25
05/18/19	
05/19/19	
05/20/19	
05/21/19	25
05/22/19	
05/23/19	
05/24/19	
05/25/19	25
05/26/19	24
05/27/19	25
05/28/19	
05/29/19	
05/30/19	
05/31/19	
06/01/19	
06/02/19	24
06/03/19	
06/04/19	
06/05/19	
06/06/19	
06/07/19	24
06/08/19	
06/09/19	
06/10/19	
06/11/19	
06/12/19	
06/13/19	23
06/14/19	
06/15/19	
06/16/19	
06/17/19	22
06/18/19	
06/19/19	
06/20/19	
06/21/19	22
06/22/19	
06/23/19	30
06/24/19	
06/25/19	30
06/26/19	
06/27/19	
06/28/19	
06/29/19	

Date	ULL Elevation (ft)
06/30/19	29
07/01/19	
07/02/19	
07/03/19	
07/04/19	
07/05/19	
07/06/19	27
07/07/19	
07/08/19	
07/09/19	
07/10/19	
07/11/19	
07/12/19	
07/13/19	26
07/14/19	
07/15/19	
07/16/19	
07/17/19	
07/18/19	
07/19/19	
07/20/19	
07/21/19	26
07/22/19	
07/23/19	
07/24/19	
07/25/19	
07/26/19	
07/27/19	25
07/28/19	
07/29/19	
07/30/19	
07/31/19	
08/01/19	
08/02/19	
08/03/19	
08/04/19	25
08/05/19	
08/06/19	
08/07/19	
08/08/19	
08/09/19	
08/10/19	
08/11/19	25
08/12/19	
08/13/19	
08/14/19	
08/15/19	
08/16/19	
08/17/19	
08/18/19	25

Date	ULL Elevation (ft)
08/19/19	
08/20/19	
08/21/19	
08/22/19	
08/23/19	
08/24/19	
08/25/19	
08/26/19	25
08/27/19	
08/28/19	
08/29/19	
08/30/19	
08/31/19	24
09/01/19	
09/02/19	
09/03/19	
09/04/19	
09/05/19	
09/06/19	25
09/07/19	
09/08/19	
09/09/19	
09/10/19	24
09/11/19	
09/12/19	
09/13/19	
09/14/19	
09/15/19	
09/16/19	24
09/17/19	
09/18/19	
09/19/19	
09/20/19	
09/21/19	
09/22/19	
09/23/19	23
09/24/19	
09/25/19	
09/26/19	
09/27/19	
09/28/19	
09/29/19	
09/30/19	
10/01/19	
10/02/19	23
10/03/19	
10/04/19	
10/05/19	
10/06/19	
10/07/19	
10/08/19	
10/09/19	
10/10/19	
10/11/19	32
10/12/19	
10/13/19	
10/14/19	
10/15/19	
10/16/19	
10/17/19	

Date	ULL Elevation (ft)
10/18/19	
10/19/19	28
10/20/19	
10/21/19	
10/22/19	
10/23/19	
10/24/19	
10/25/19	
10/26/19	
10/27/19	
10/28/19	27
10/29/19	
10/30/19	
10/31/19	
11/01/19	
11/02/19	
11/03/19	26
11/04/19	
11/05/19	
11/06/19	
11/07/19	
11/08/19	
11/09/19	
11/10/19	25
11/11/19	
11/12/19	
11/13/19	
11/14/19	
11/15/19	
11/16/19	23
11/17/19	
11/18/19	
11/19/19	
11/20/19	
11/21/19	
11/22/19	23
11/23/19	
11/24/19	
11/25/19	
11/26/19	
11/27/19	
11/28/19	22
11/29/19	
11/30/19	
12/01/19	
12/02/19	
12/03/19	22
12/04/19	
12/05/19	
12/06/19	
12/07/19	
12/08/19	
12/09/19	
12/10/19	
12/11/19	22
12/12/19	
12/13/19	
12/14/19	
12/15/19	
12/16/19	21
12/17/19	
12/18/19	
12/19/19	
12/20/19	
12/21/19	21
12/22/19	
12/23/19	

Table A4: Upper Lake Lafayette water level elevations, page 4

Date	ULL Elevation (ft)
12/24/19	
12/25/19	
12/26/19	22
12/27/19	
12/28/19	
12/29/19	
12/30/19	
12/31/19	22
01/01/20	
01/02/20	
01/03/20	
01/04/20	
01/05/20	22
01/06/20	
01/07/20	
01/08/20	
01/09/20	
01/10/20	22
01/11/20	
01/12/20	
01/13/20	
01/14/20	
01/15/20	22
01/16/20	
01/17/20	
01/18/20	
01/19/20	
01/20/20	22
01/21/20	
01/22/20	
01/23/20	
01/24/20	
01/25/20	
01/26/20	22
01/27/20	
01/28/20	
01/29/20	
01/30/20	
01/31/20	
02/01/20	
02/02/20	23
02/03/20	
02/04/20	
02/05/20	
02/06/20	
02/07/20	
02/08/20	23
02/09/20	
02/10/20	
02/11/20	
02/12/20	
02/13/20	
02/14/20	
02/15/20	24
02/16/20	
02/17/20	
02/18/20	
02/19/20	
02/20/20	
02/21/20	
02/22/20	24
02/23/20	
02/24/20	
02/25/20	
02/26/20	
02/27/20	
02/28/20	
02/29/20	25
03/01/20	
03/02/20	
03/03/20	
03/04/20	
03/05/20	26
03/06/20	
03/07/20	
03/08/20	
03/09/20	
03/10/20	26
03/11/20	
03/12/20	
03/13/20	
03/14/20	
03/15/20	25
03/16/20	
03/17/20	
03/18/20	
03/19/20	
03/20/20	
03/21/20	
03/22/20	25
03/23/20	
03/24/20	
03/25/20	
03/26/20	
03/27/20	
03/28/20	
03/29/20	23
03/30/20	
03/31/20	
04/01/20	
04/02/20	
04/03/20	
04/04/20	23
04/05/20	
04/06/20	
04/07/20	
04/08/20	
04/09/20	
04/10/20	22

Appendix 1C
Wakulla Springs Dark Water: Causes and Sources Phases III: Karst Feature Sampling Stations utilized for this Report

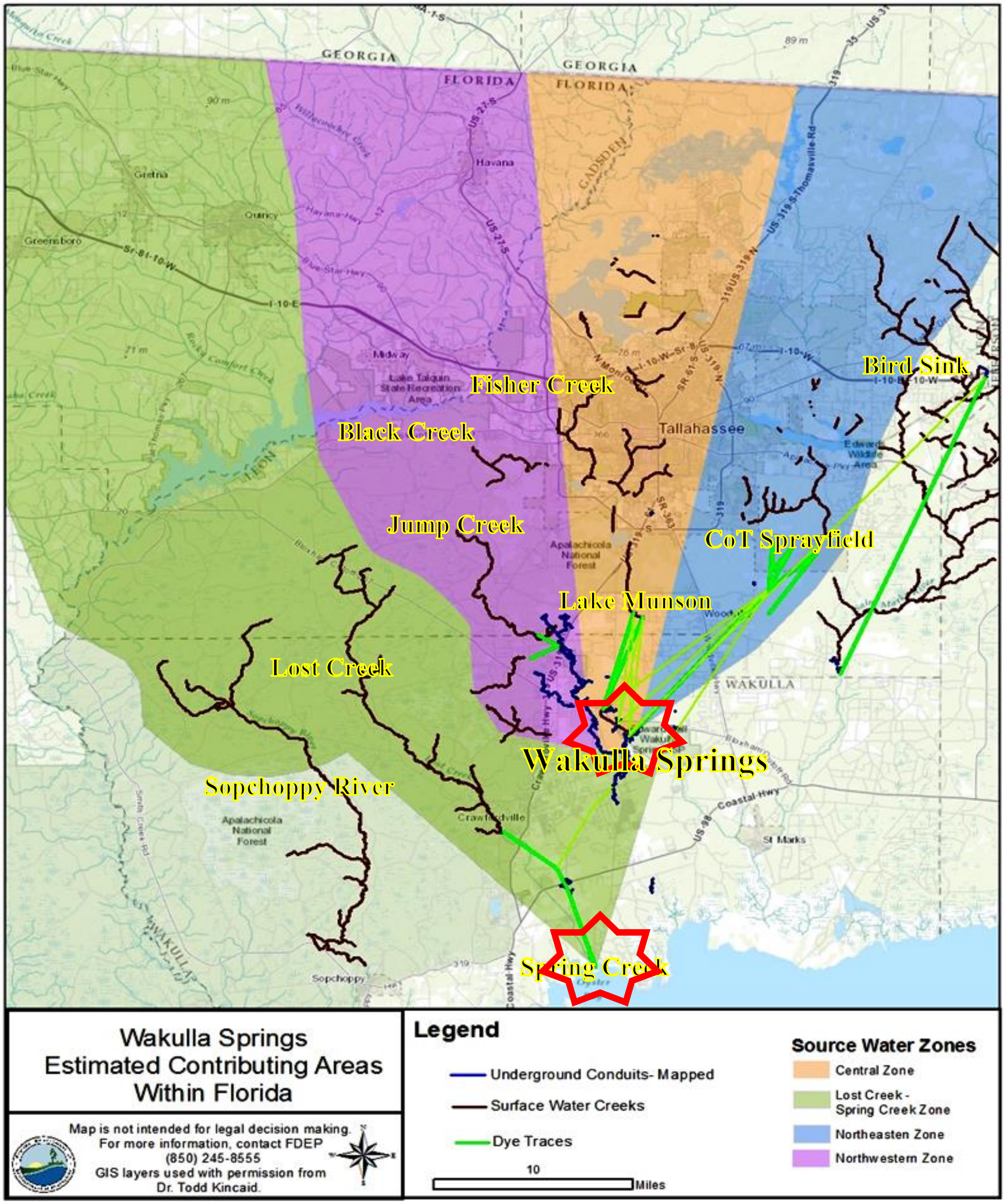


Figure A4: Karst 'Sinking' Streams and springs in the Wakulla Springshed.

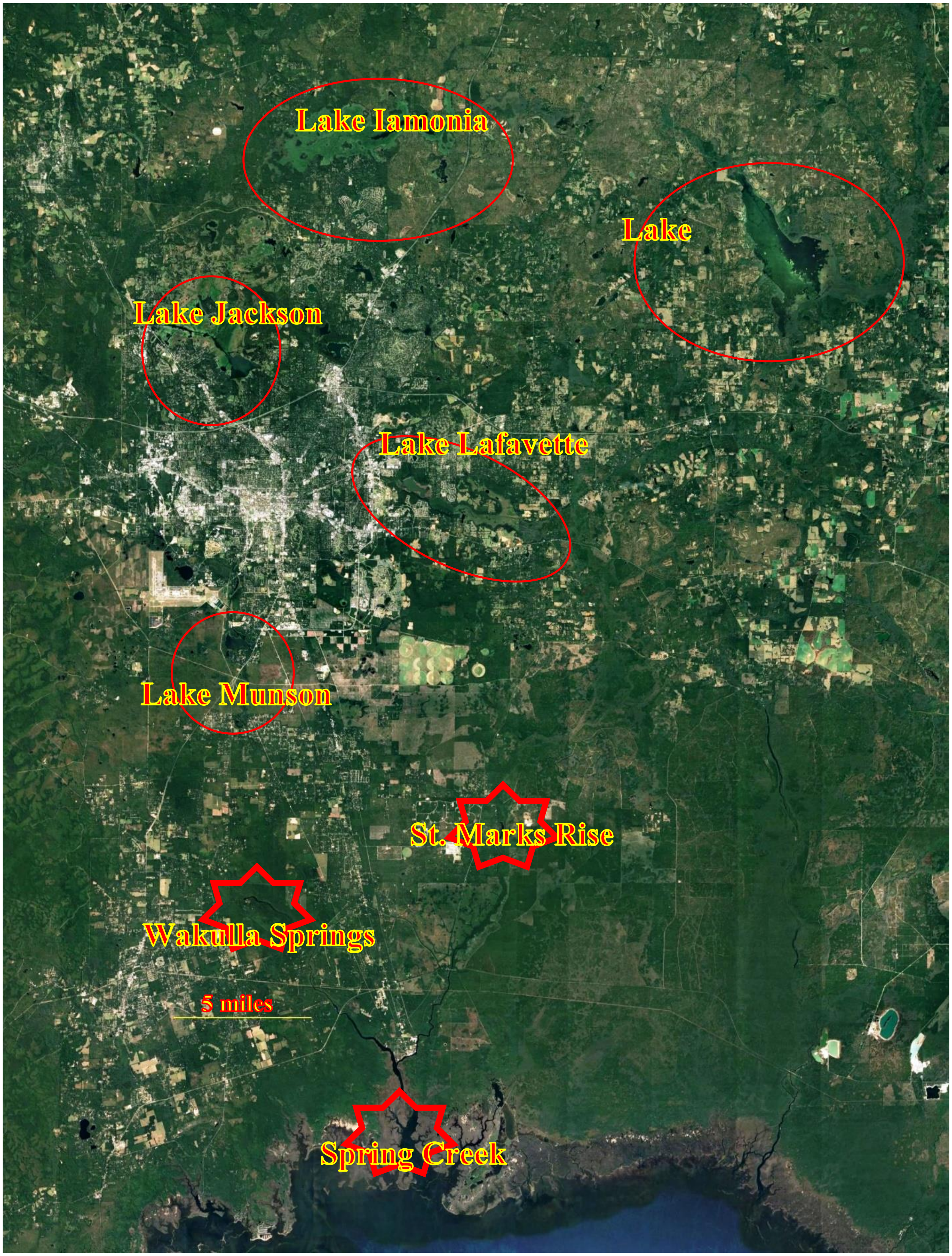


Figure A5: Karst 'Sinking' Lakes and springs sampled in the Wakulla Springshed.

Figure A6: Sampling wells in the Wakulla Springshed where we sampled the caves.

Table A4: Key to samples names in DNA and Water Quality Studies

Subterranean Water filled Caves K well: KWB; WSW-K conduit;

B-well: BWB; WSW B, conduit;
D-well: DWB; WSW D, conduit;
C-well: CWB; WSW C, conduit;

Wakulla Spring Samples

L-well: LWB, WSW L, conduit at boil;
Wakulla Spring. Boil: WS B, spring;

Karst Lakes

Lake Jackson: LJB, sinkhole lake;
Lake Munson: LMB, sinkhole lake;
Upper Lake Lafayette: FSB, sinkhole lake;
Lake Iamonia: LIB, sinkhole lake.

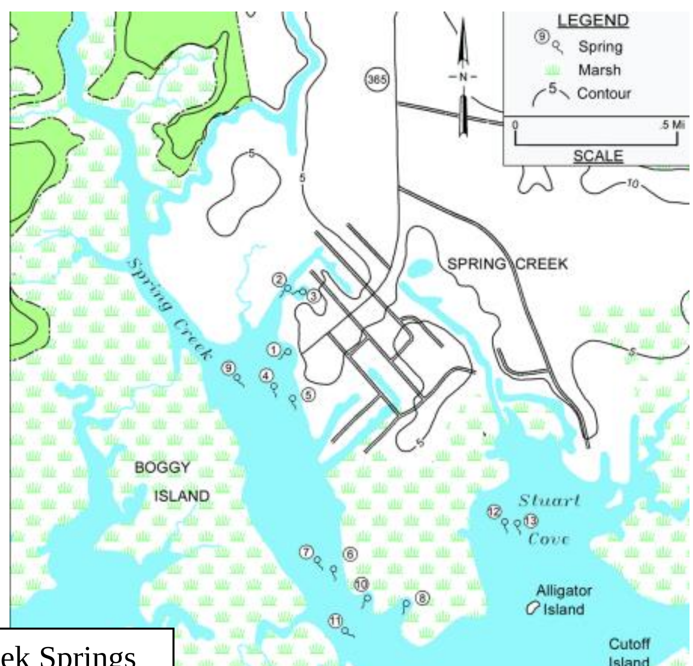


Figure A7: Spring Creek Springs

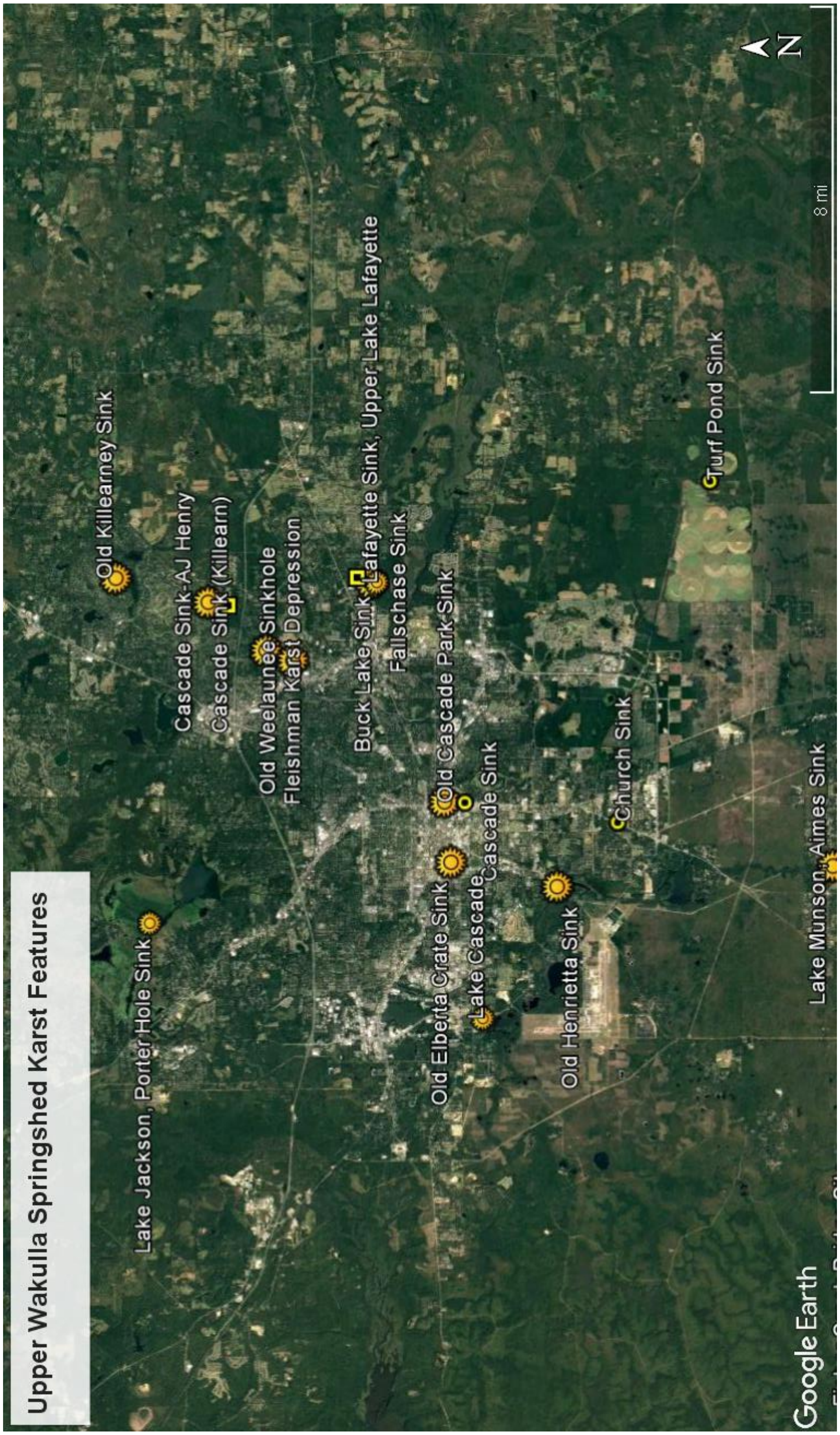


Figure A9: Karst Features in the Upper Wakulla Springshed

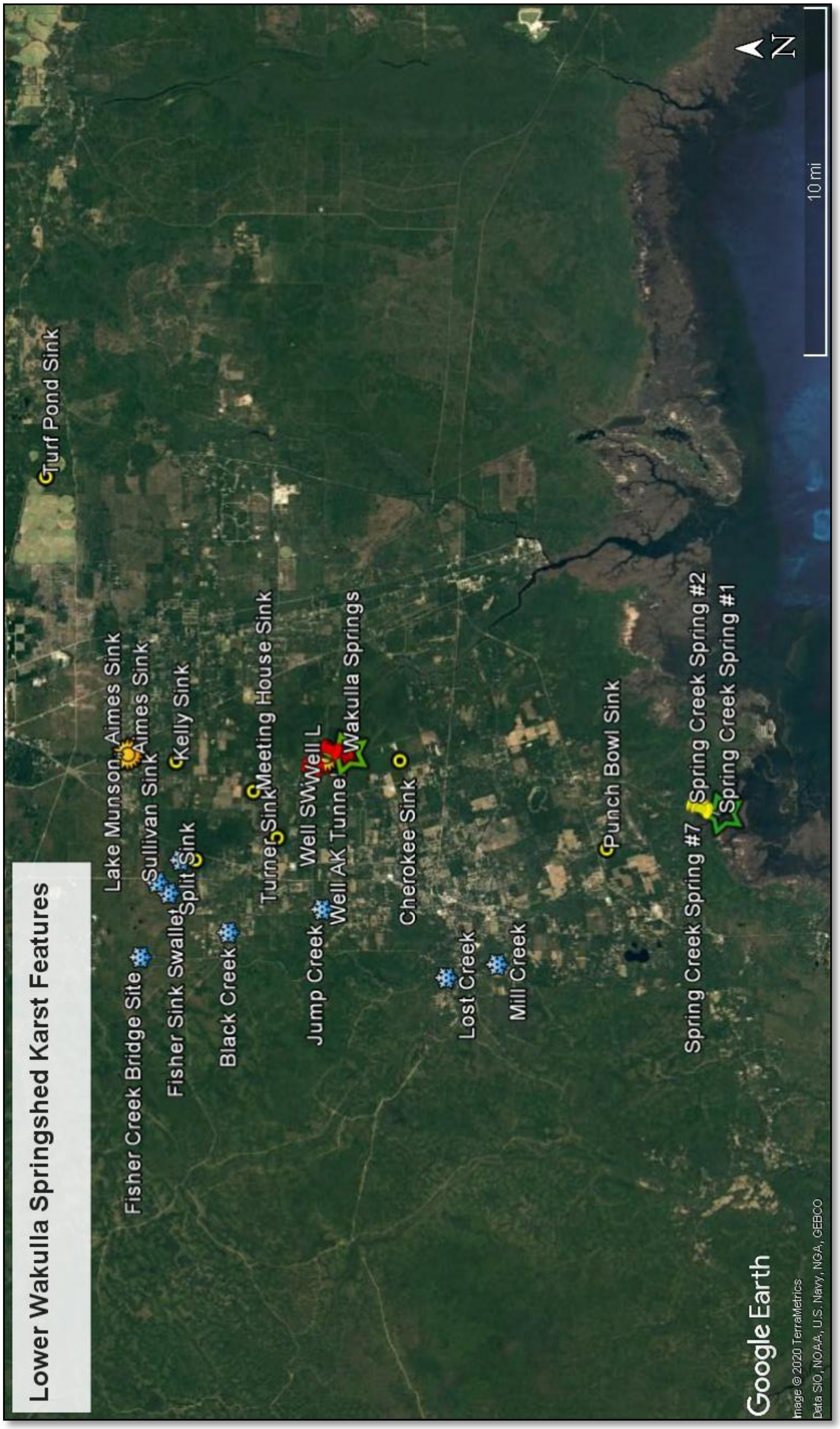


Figure A10: Karst Features in the Lower Wakulla Springshed