

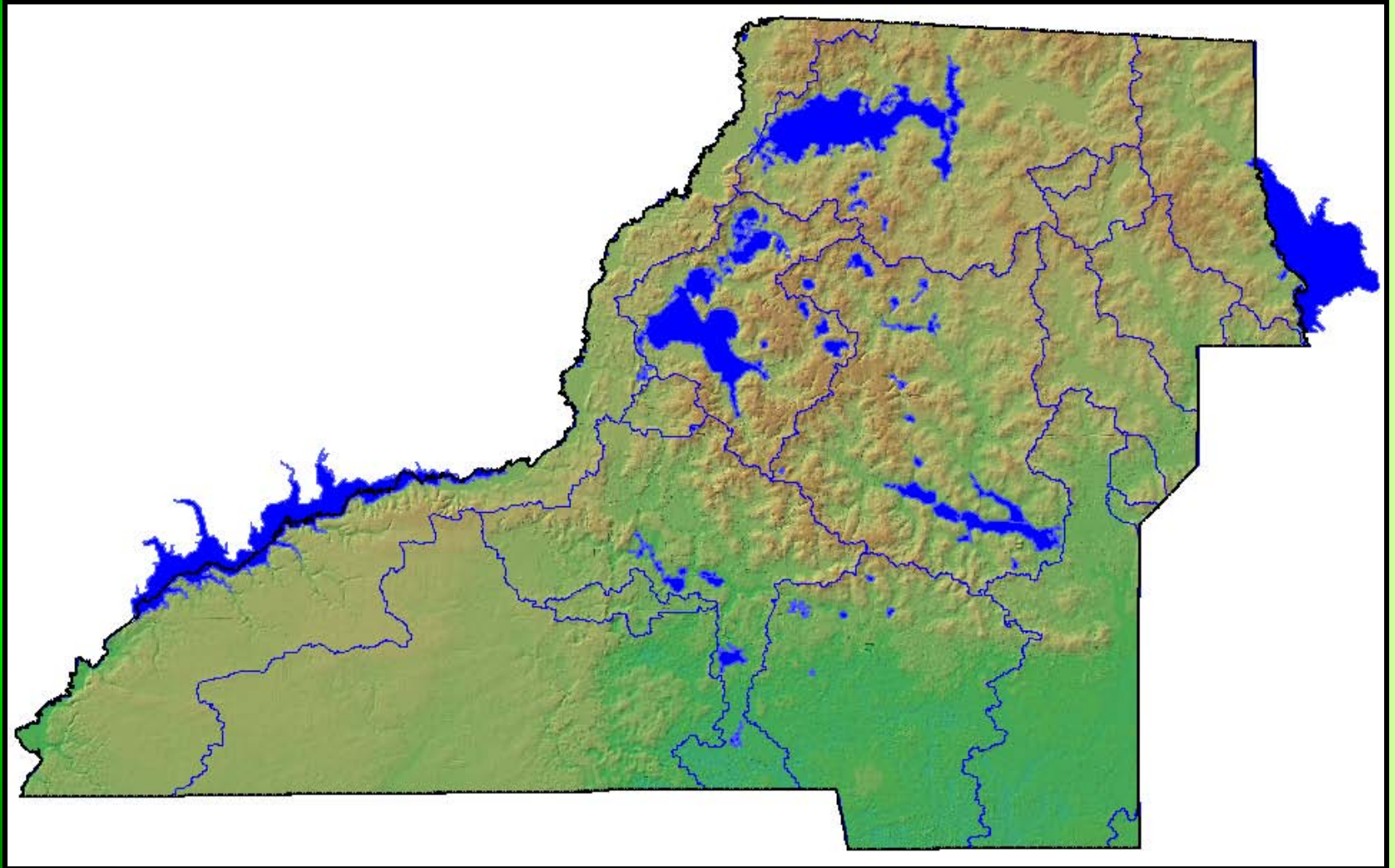
**The Woodville Recharge
Basin Aquifer Protection
Study**

**Water Quality
&
Karst Topography**

Sean E. McGlynn



Study Area



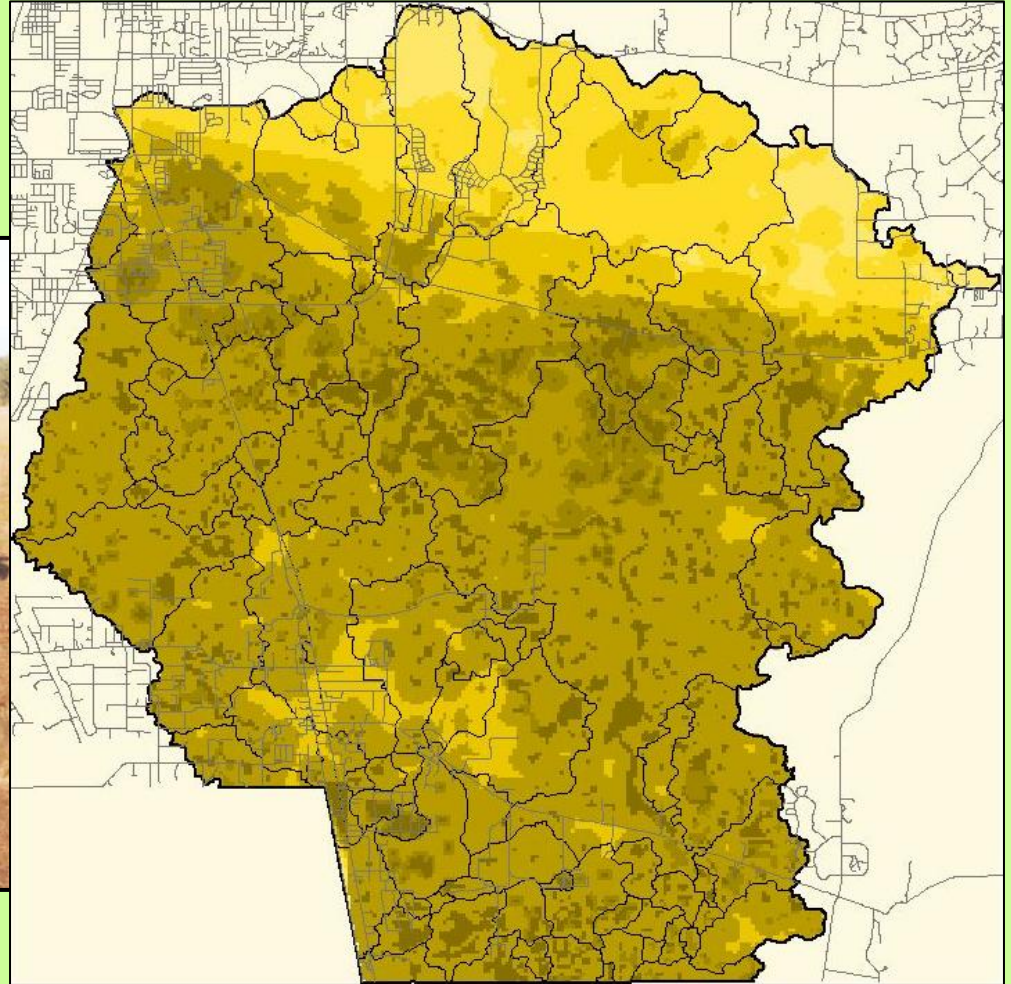


Program Goals

- Determine what conditions IMPAIR the **WATER QUALITY** of the AQUIFER in the WRB.
- Assess **RESTORATION ALTERNATIVES** in the WRB.
- Develop an **ACTION PLAN** to protect and restore the AQUIFER in the WRB.

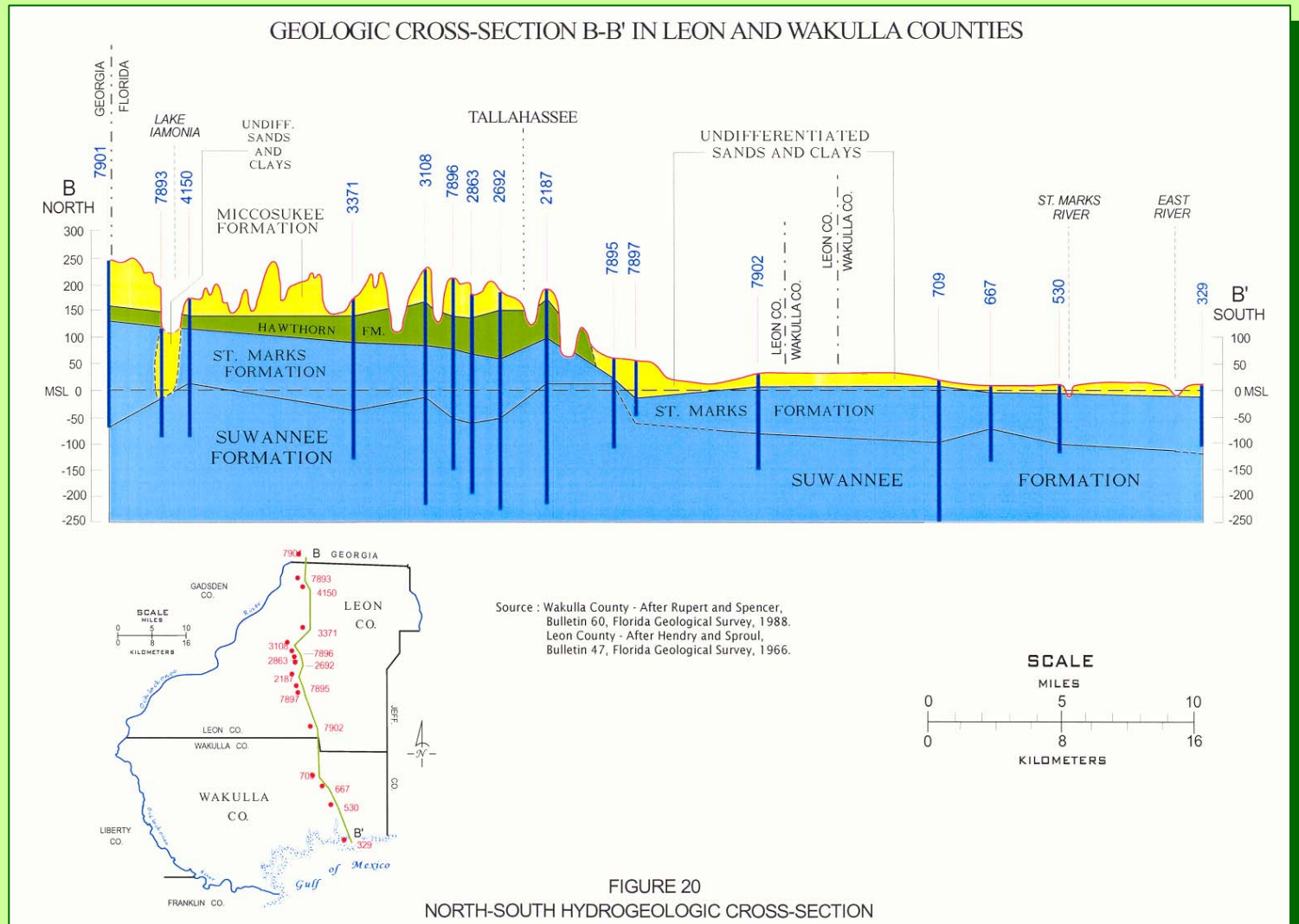


Aquifer Vulnerability





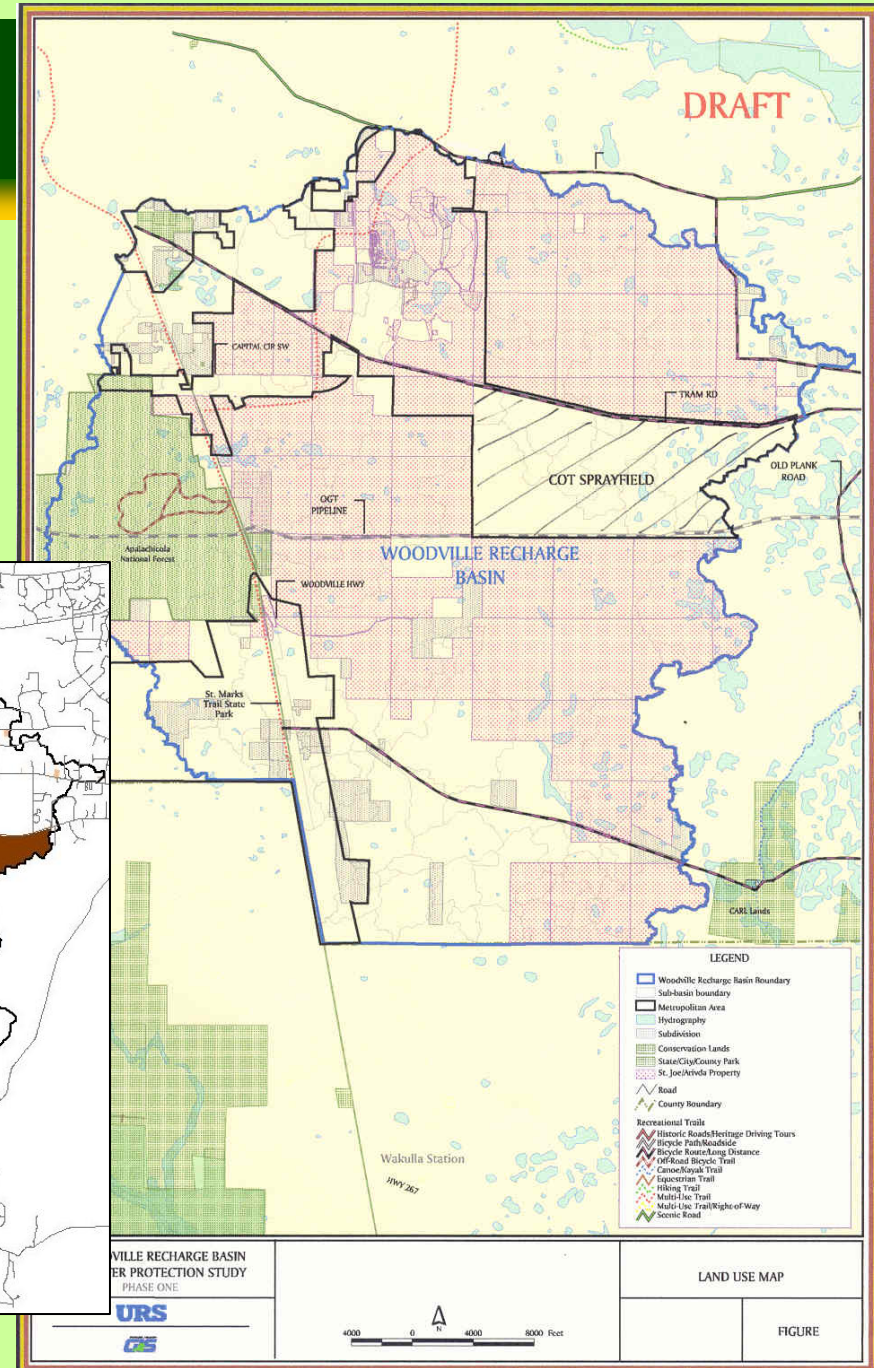
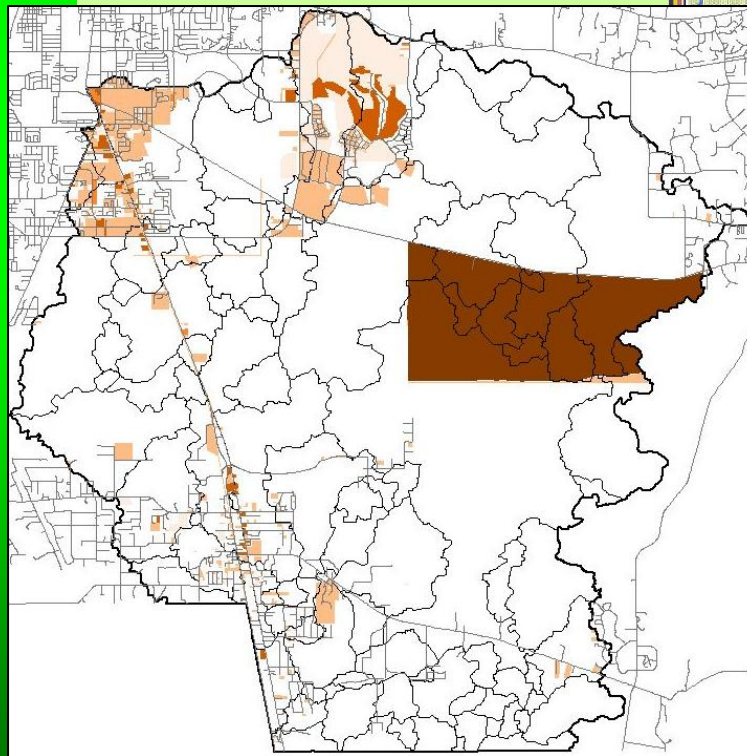
Geology





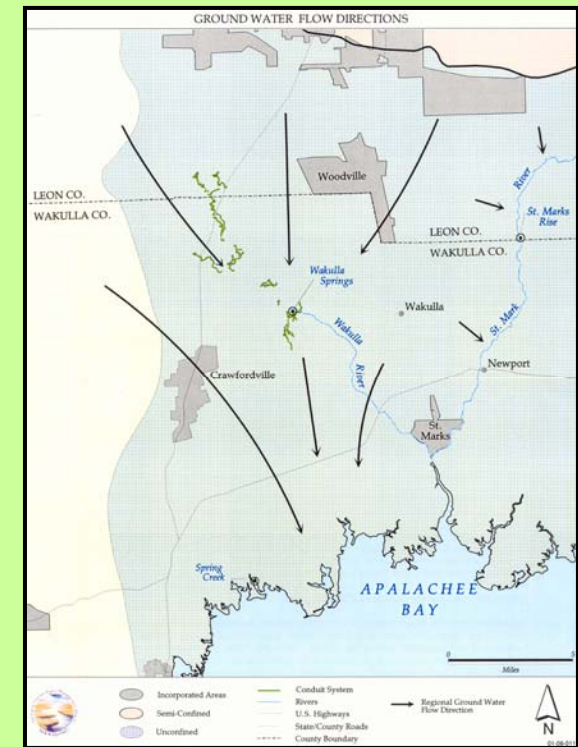
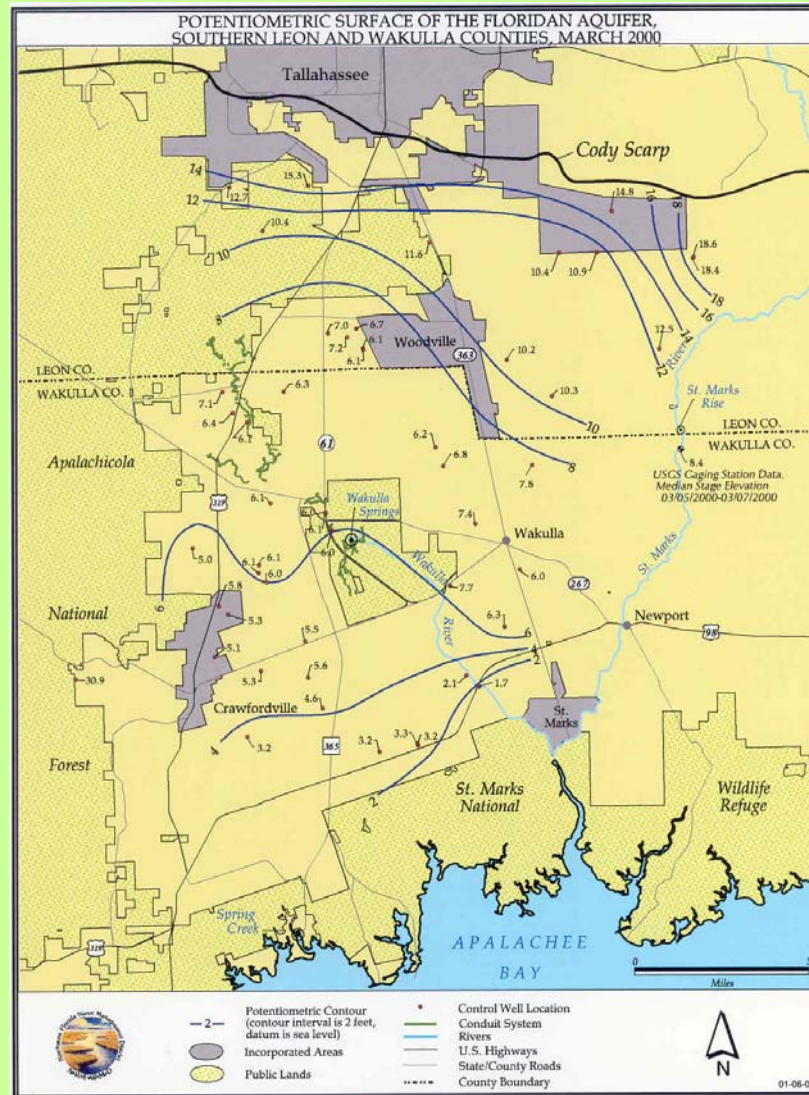
Land Use

- 52% St Joe/Arvida
- 28% Privately Owned
- 11% Sprayfield
- 9% Park





Groundwater Flows South





Project Approach

- Phase 1: Assessment of Previous Studies
- Phase 2: WRB Basin Assessment
 - ◆ Identify karst windows
 - ◆ Initial water quality monitoring
 - ◆ Determine well placement
- Phase 3: 1 Year of Study
 - ◆ Monitoring
 - ◆ Hydrogeology
 - ◆ Modeling
 - ◆ Preservation/Restoration Action Plan



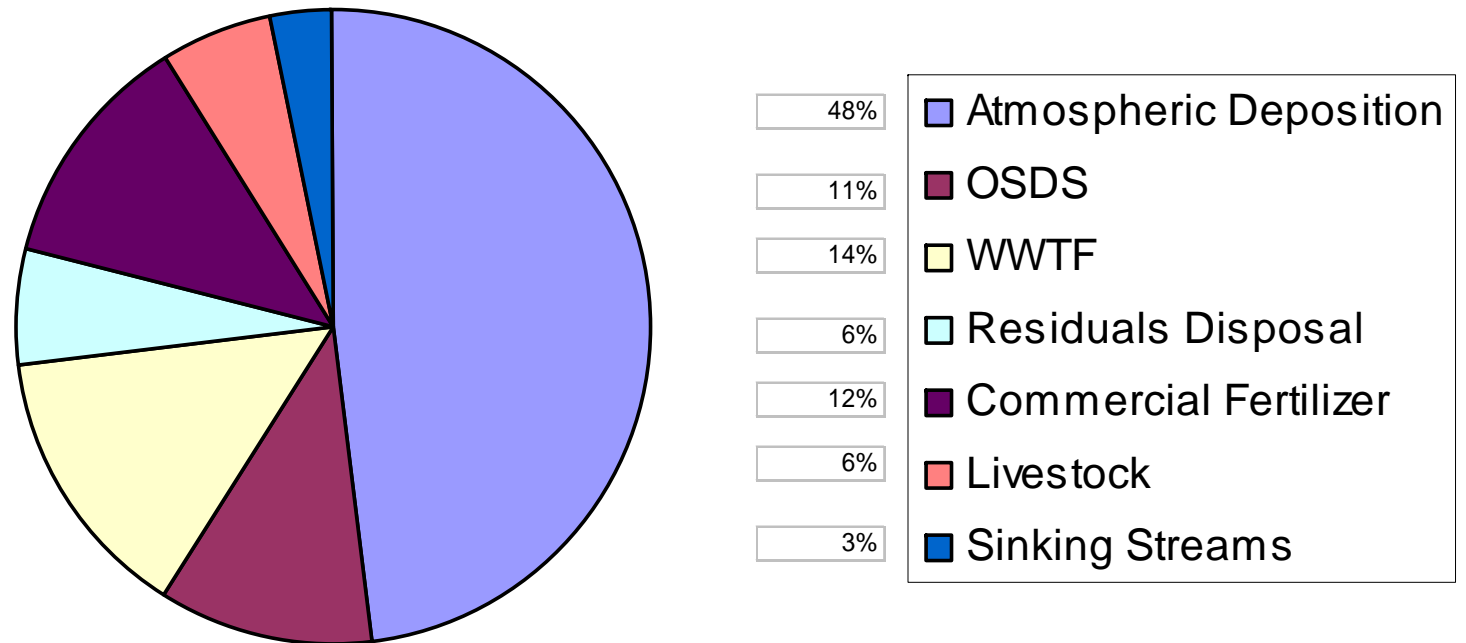
Phase 1: Assessment of Previous Studies

- City of Tallahassee
- Leon County
- US Geological Survey
- Florida Geological Survey
- Florida Department of Environmental Protection
- Hydrogeology Consortium
- Northwest Florida Water Management District



Nitrate Loading & Aquifer Quality,

N Sources to Leon and Wakulla Counties



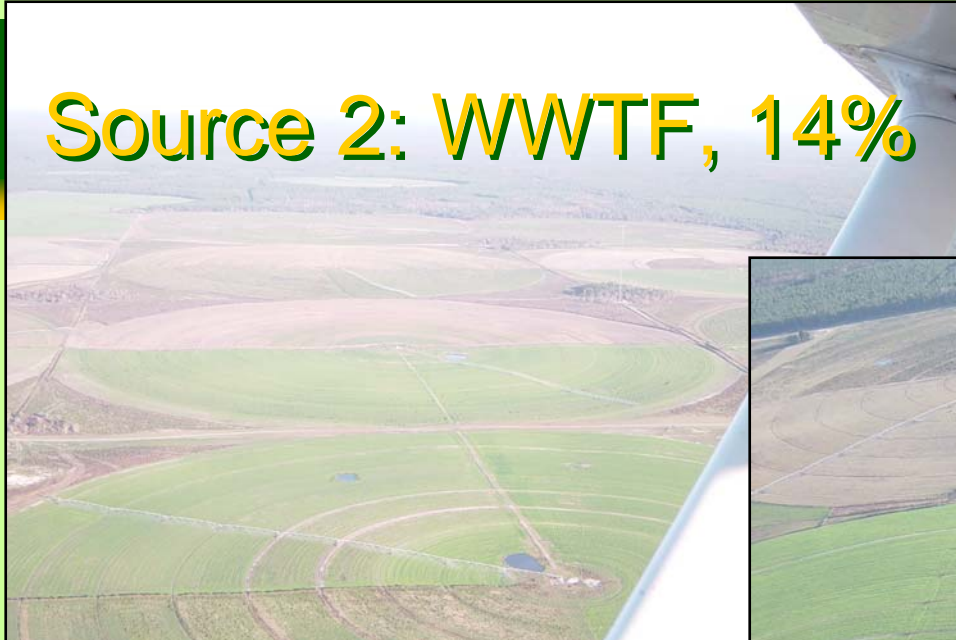


Source 1: Atmospheric Deposition, 48%





Source 2: WWTF, 14%



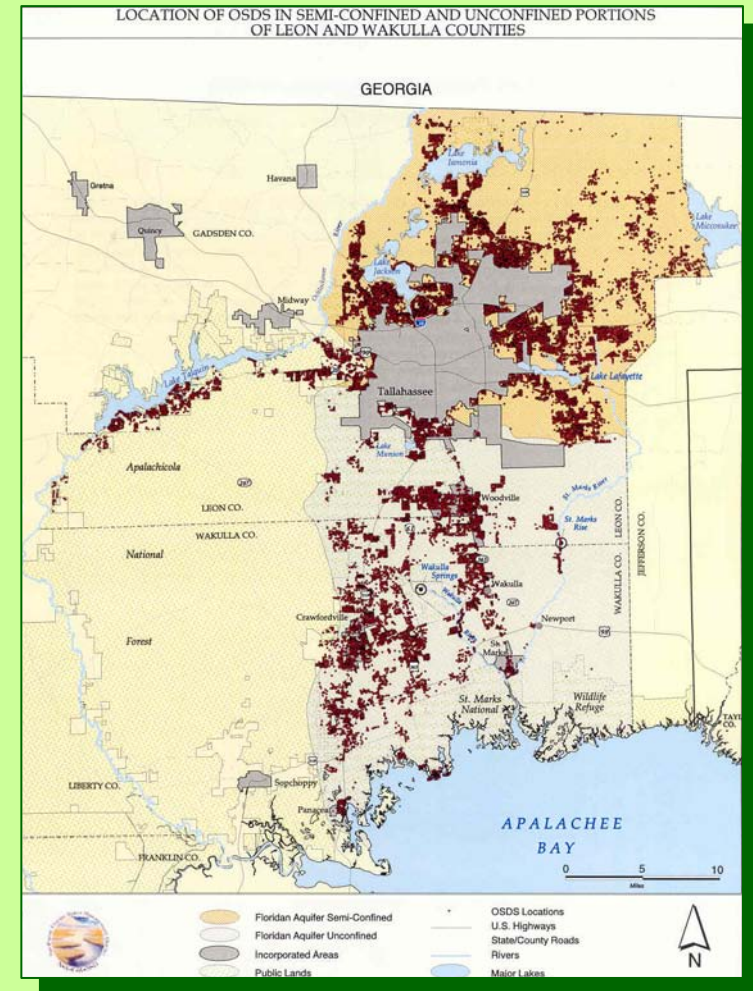
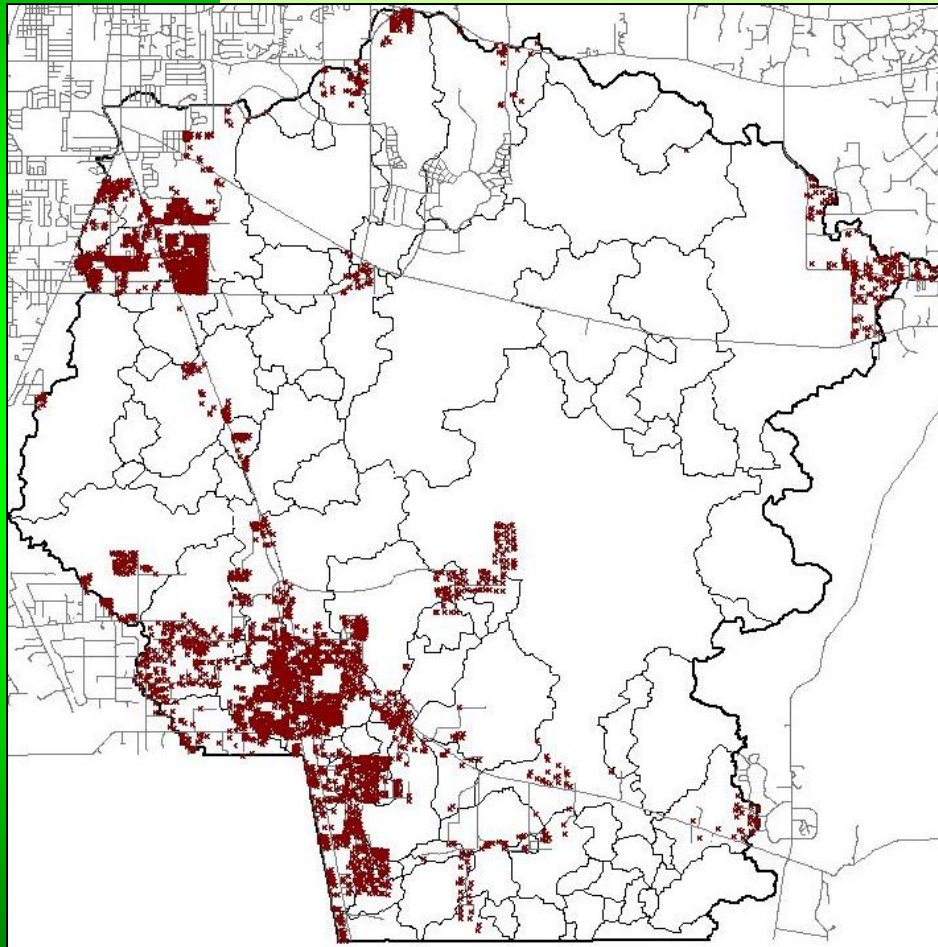


Source 3: Fertilizers, 12%





Source 4: OSDS, 11%





Source 5: Residuals, 6%



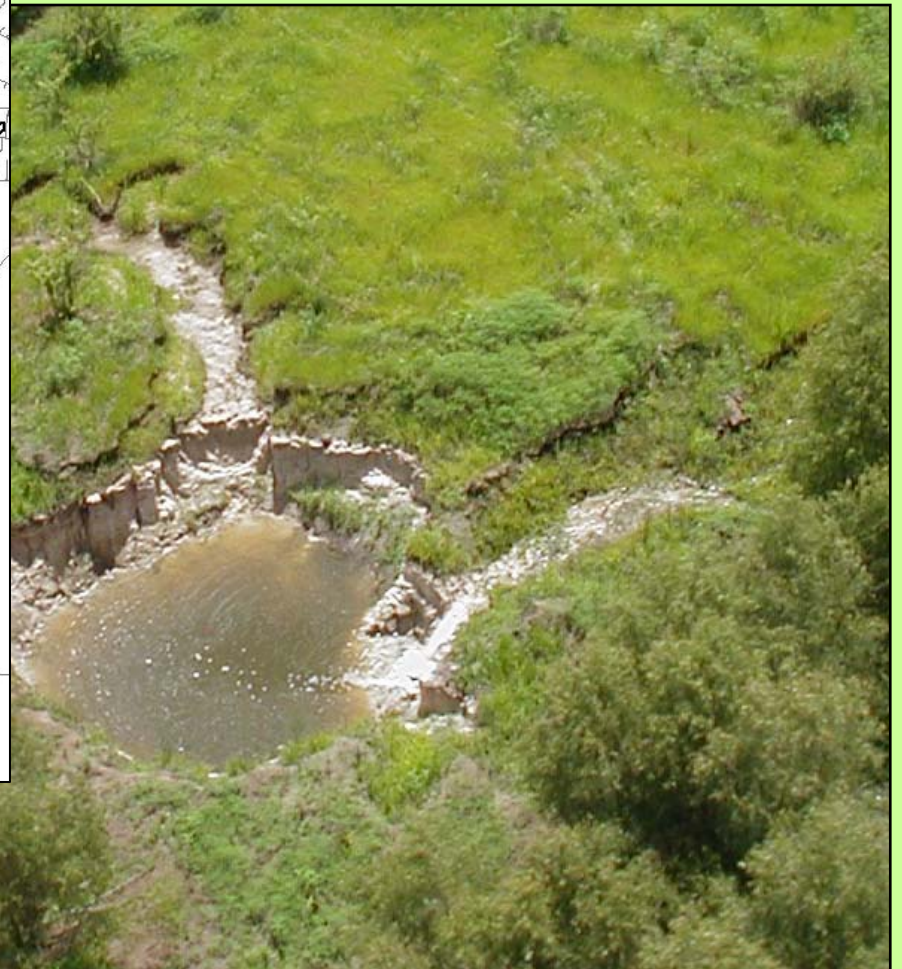
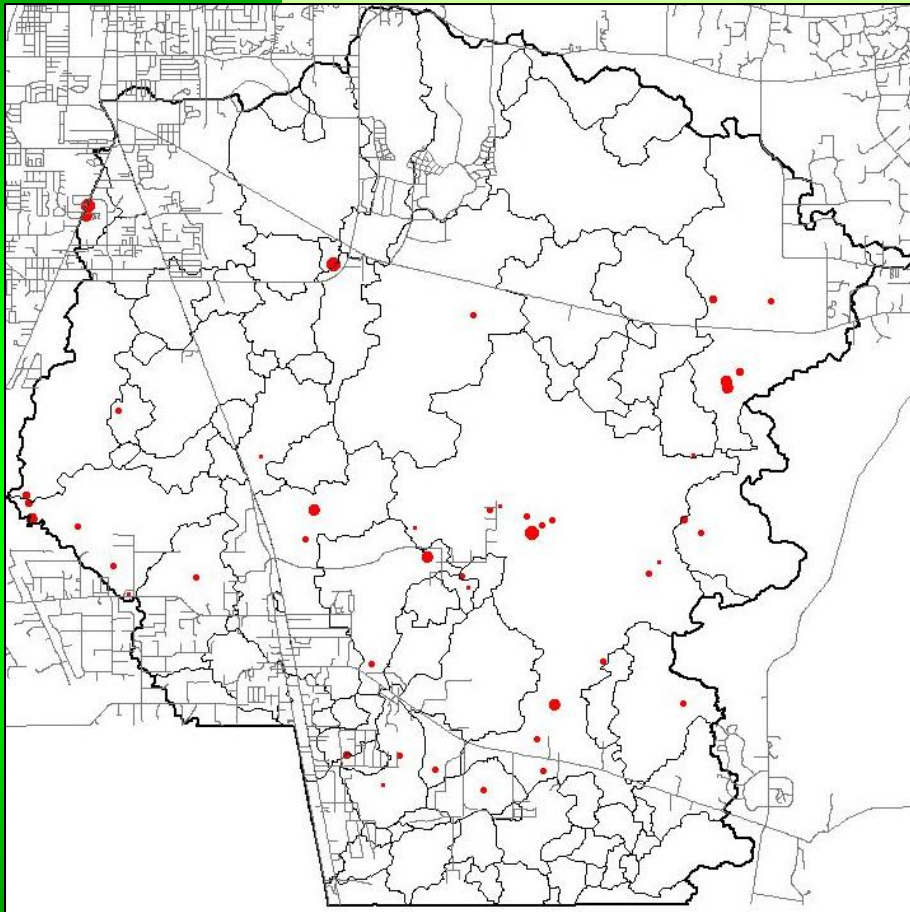


Source 6: Livestock, 6%





Source 7: Sinking Stream, 3%





The Woodville Recharge Basin





Nitrat





Surface Water Quality





Chicken Branch

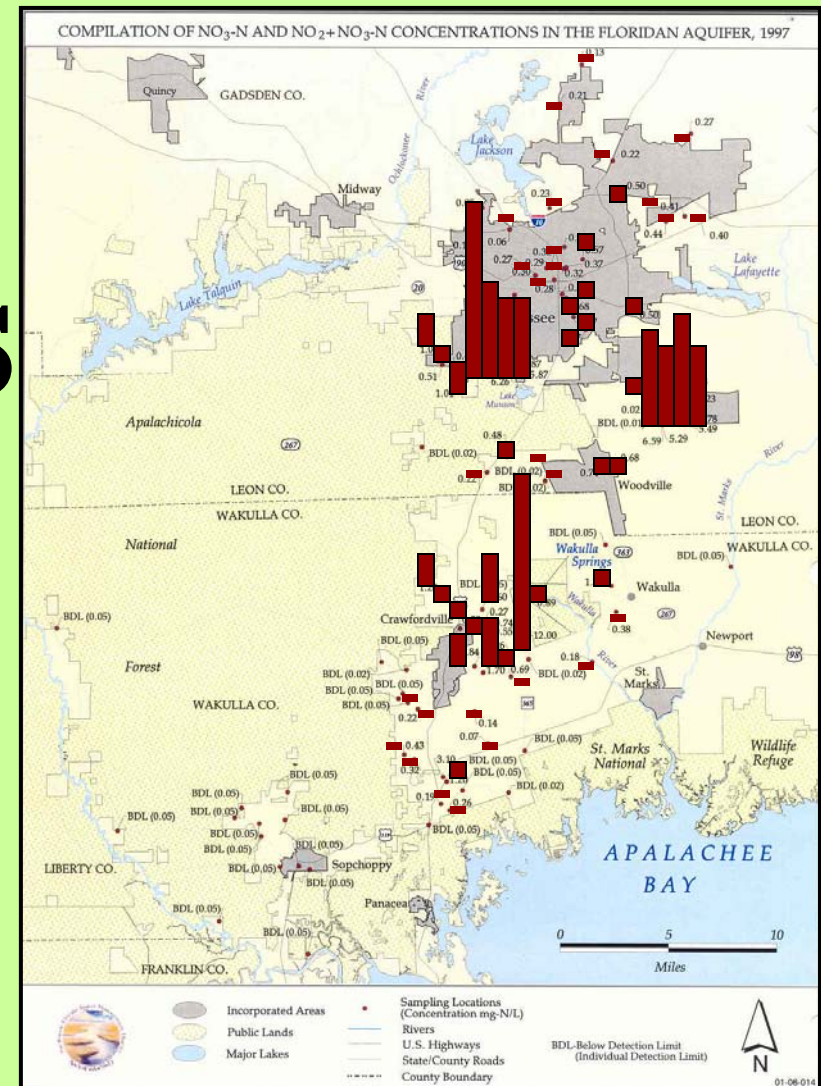




Ground Water Quality

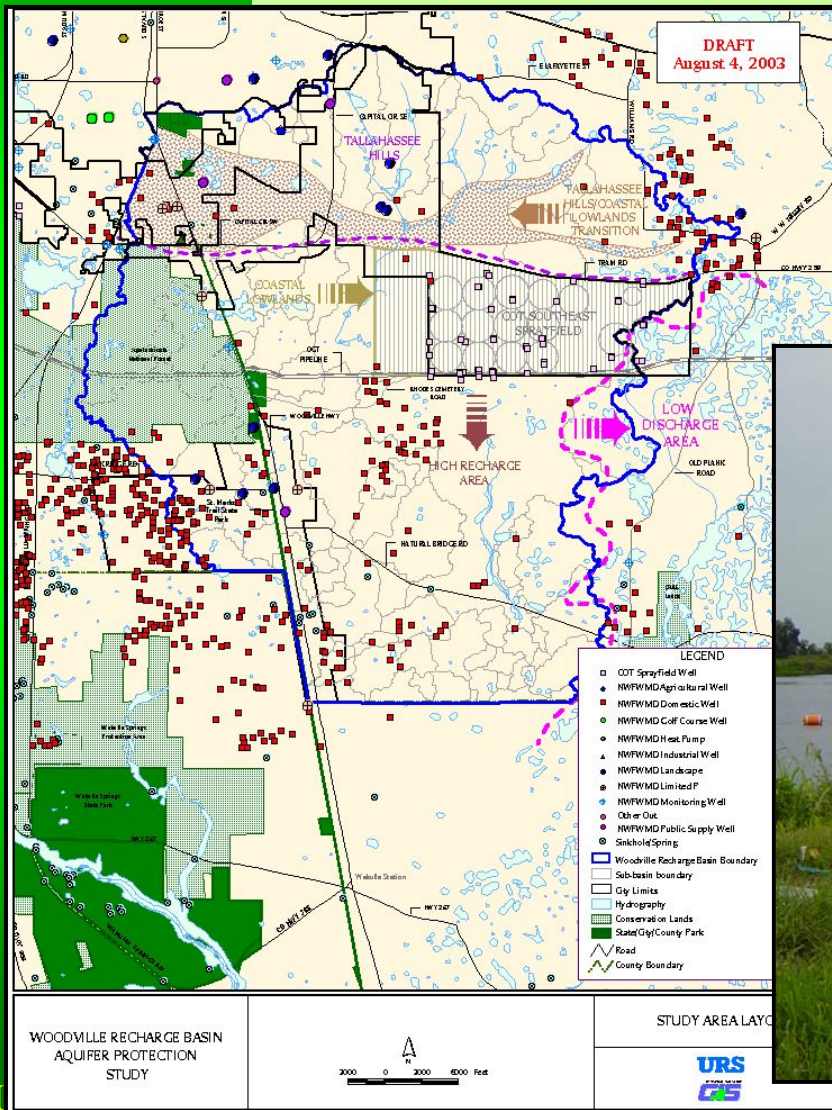
Nitrates

- **Airport**
(old landfill & residuals)
- **CoT Farm**
(Sprayfield)
- **South of Wakulla**
(residuals & munitions plant)





Ground Water Sampling

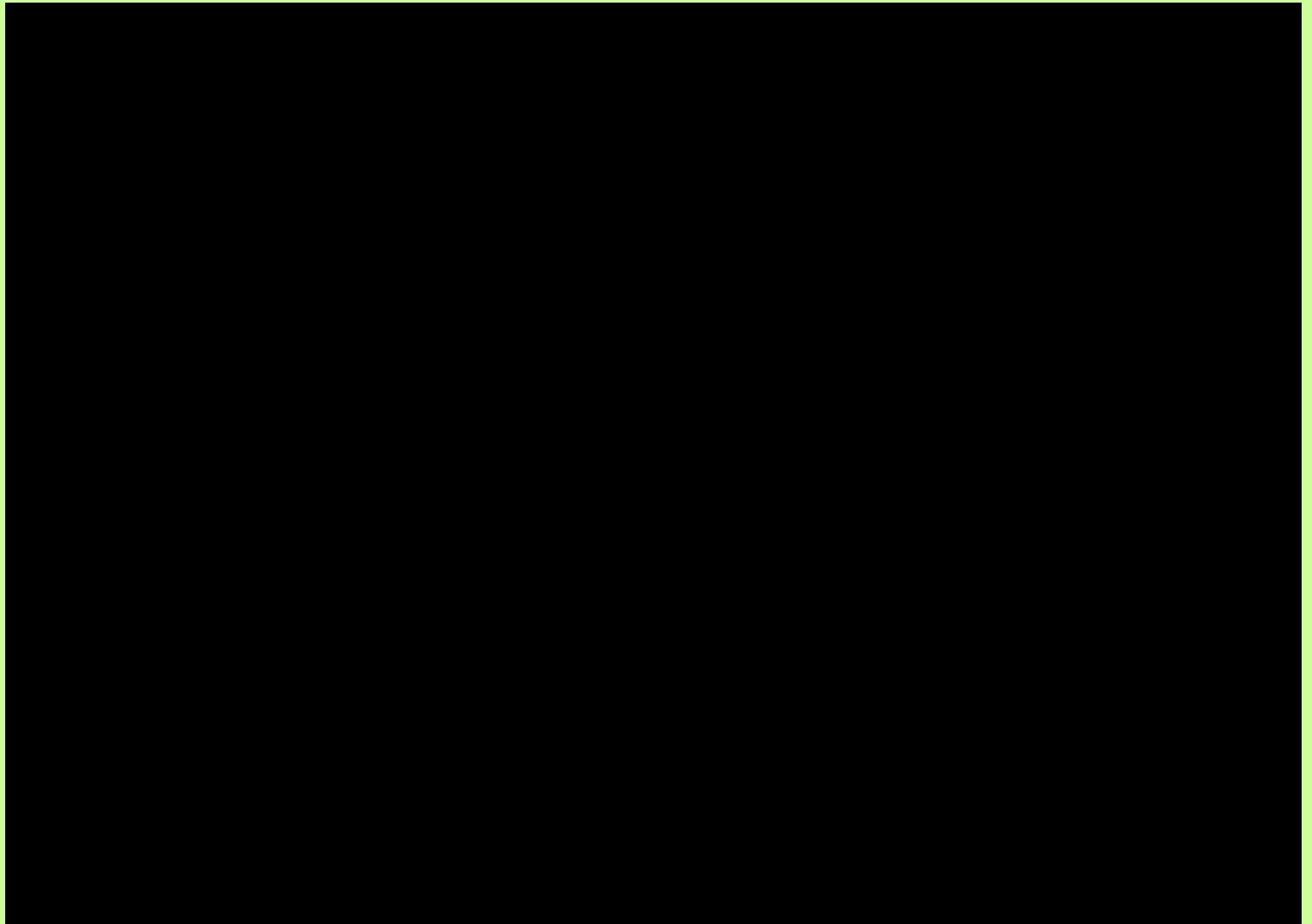


- Sample numerous wells in the study area for water quality and water level.





Conduit Flow





Regional Water Quality

Pollution plagues springs



Study indicates wastewater plants may be to blame

By Bruce Ritchie
Tallahassee Staff Writer

If you live in, work in or visit Tallahassee, you could be polluting Wakulla Springs State Park when you flush a toilet.

A recent study points to wastewater treatment plants as a possible source of nitrogen pollution at the springs, which receive 200,000 visitors a year. Biologists suspect nitrogen is fueling the growth of aquatic weeds that, until recently, were choking the springs.

About half the nitrogen going onto the land in Leon and Wakulla counties comes from wastewater plants, according to a Northwest Florida Water Management District study. The city's southeast spray field on Tram Road is by far the largest plant in that area.

Even though state environmental officials said they haven't read the study and can't comment on it, it seems likely that it will focus more public attention on the spray field and private farming operation there.

"I think what we need to do after we've all read it is to meet and decide what action we need to take," said Jim Stevenson, a biologist with the Florida Department of Environmental Protection. "If in fact action is needed, we'll get with the city of Tallahassee and talk to them."

A city Water Utilities Department official said the study represents "a good first step" but that more research is needed into whether septic tanks and farms closer to the springs might be causing the problem.

Nitrogen increase at springs

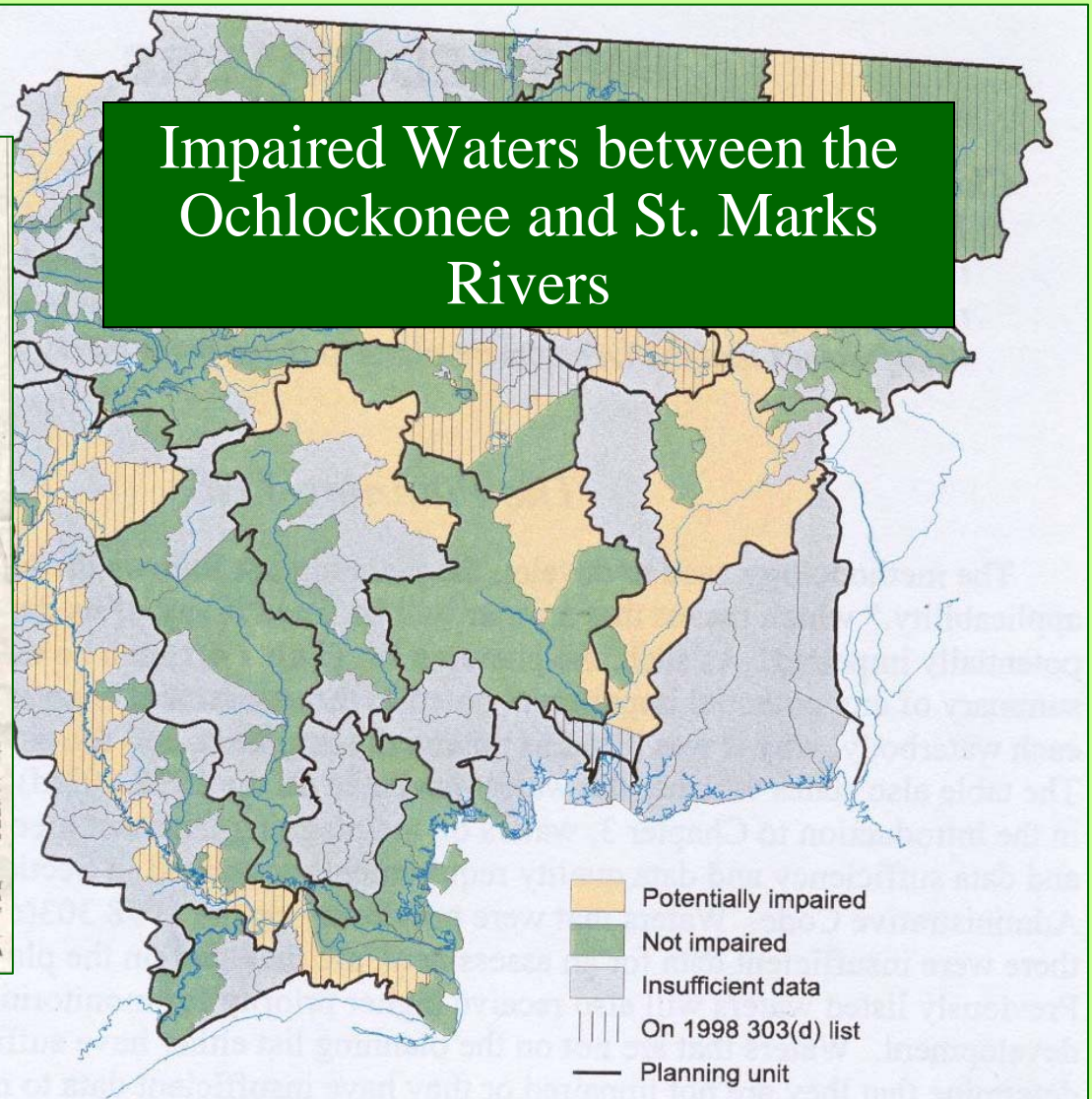
Nitrogen, in the form of nitrates, has tripled in Wakulla Springs from the 1970s to the

ALLISON LONG / Democrat

This photo, taken April 17, shows an aerial view of the spray field off Tram Road.

Please see WAKULLA, 2A

Impaired Waters between the Ochlockonee and St. Marks Rivers





T

M

D

L



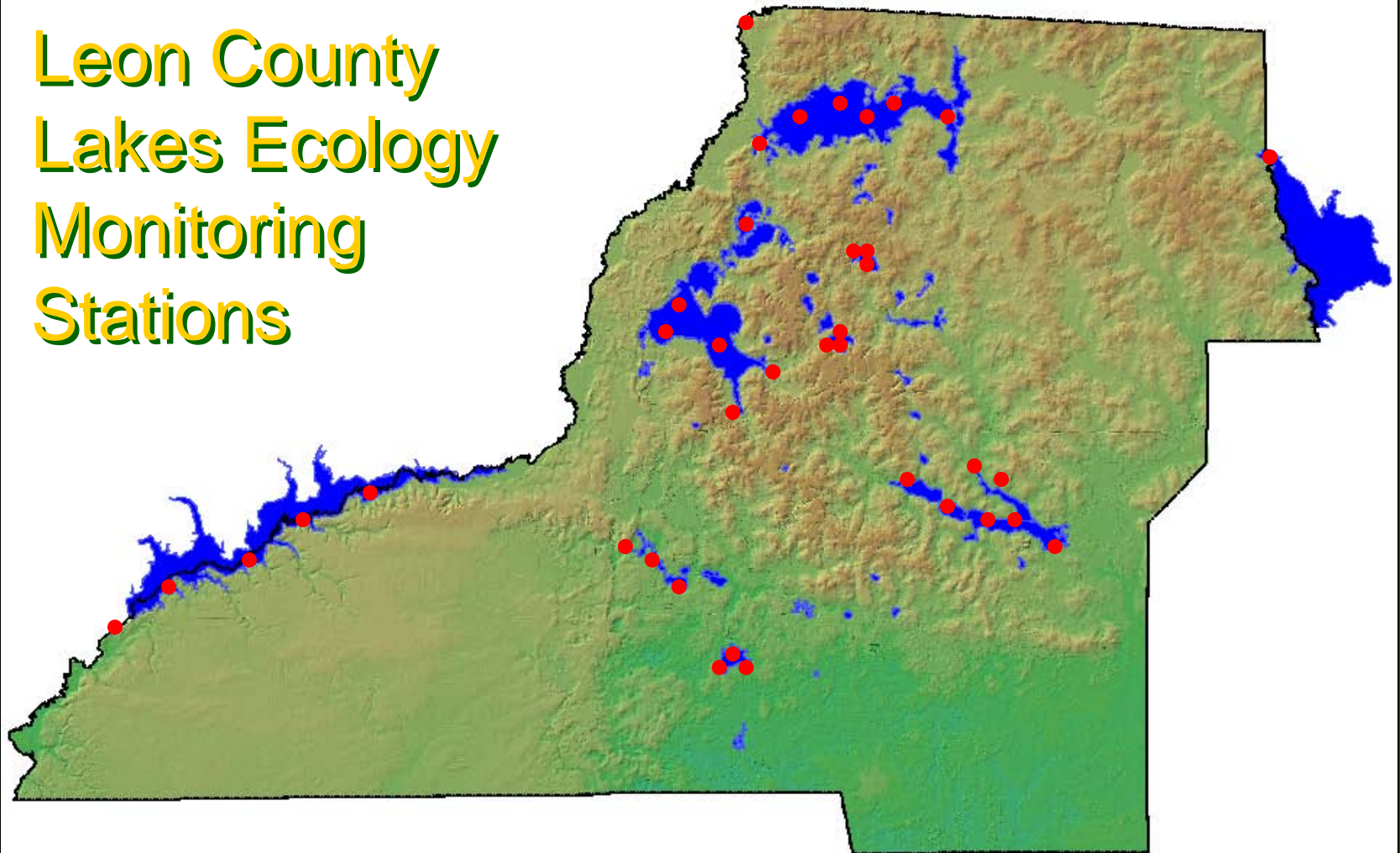
**Total
Maximum
Daily
Load**



Totally
Mysterious
Development
Limitations

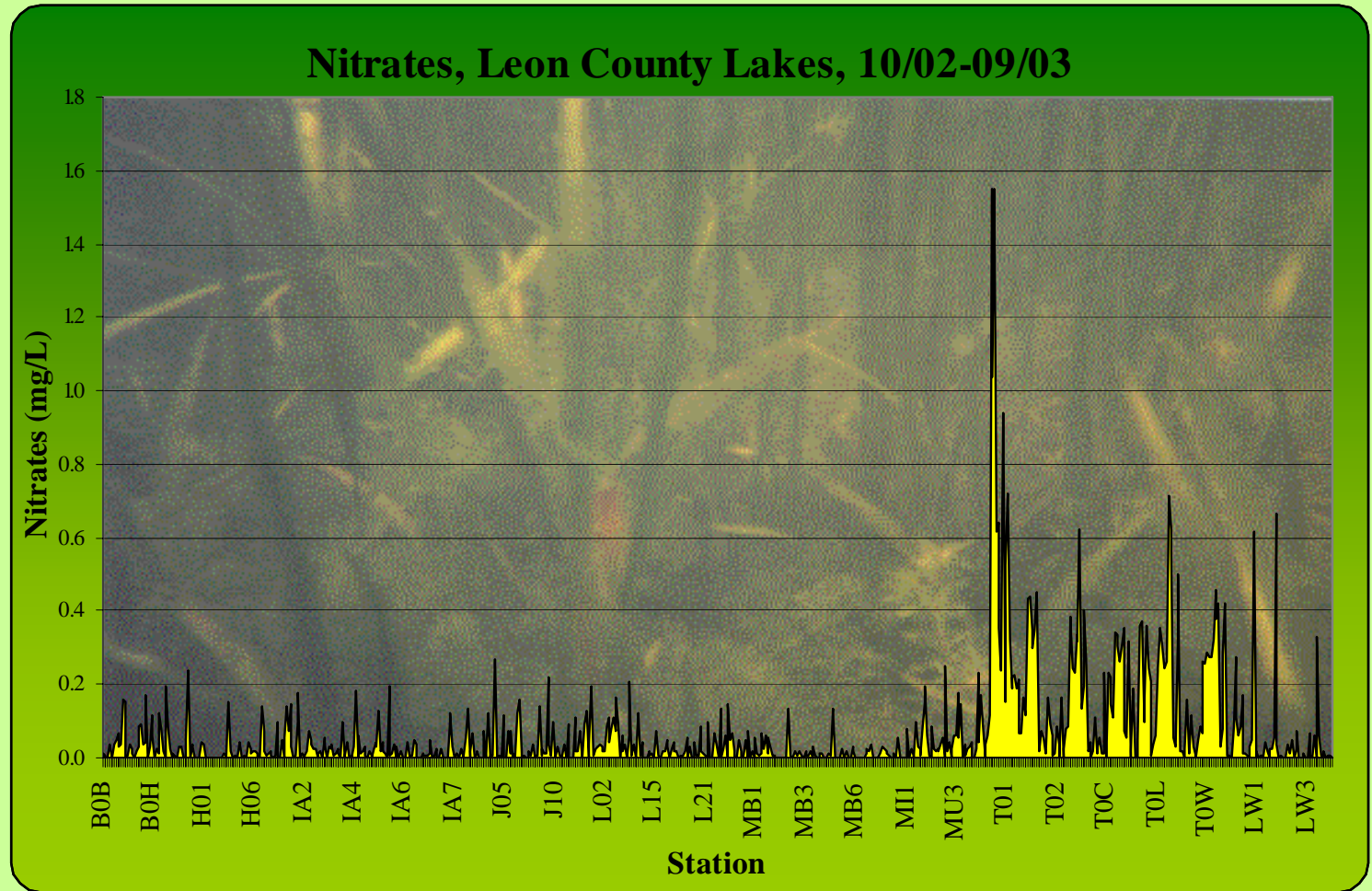


Leon County Lakes Ecology Monitoring Stations





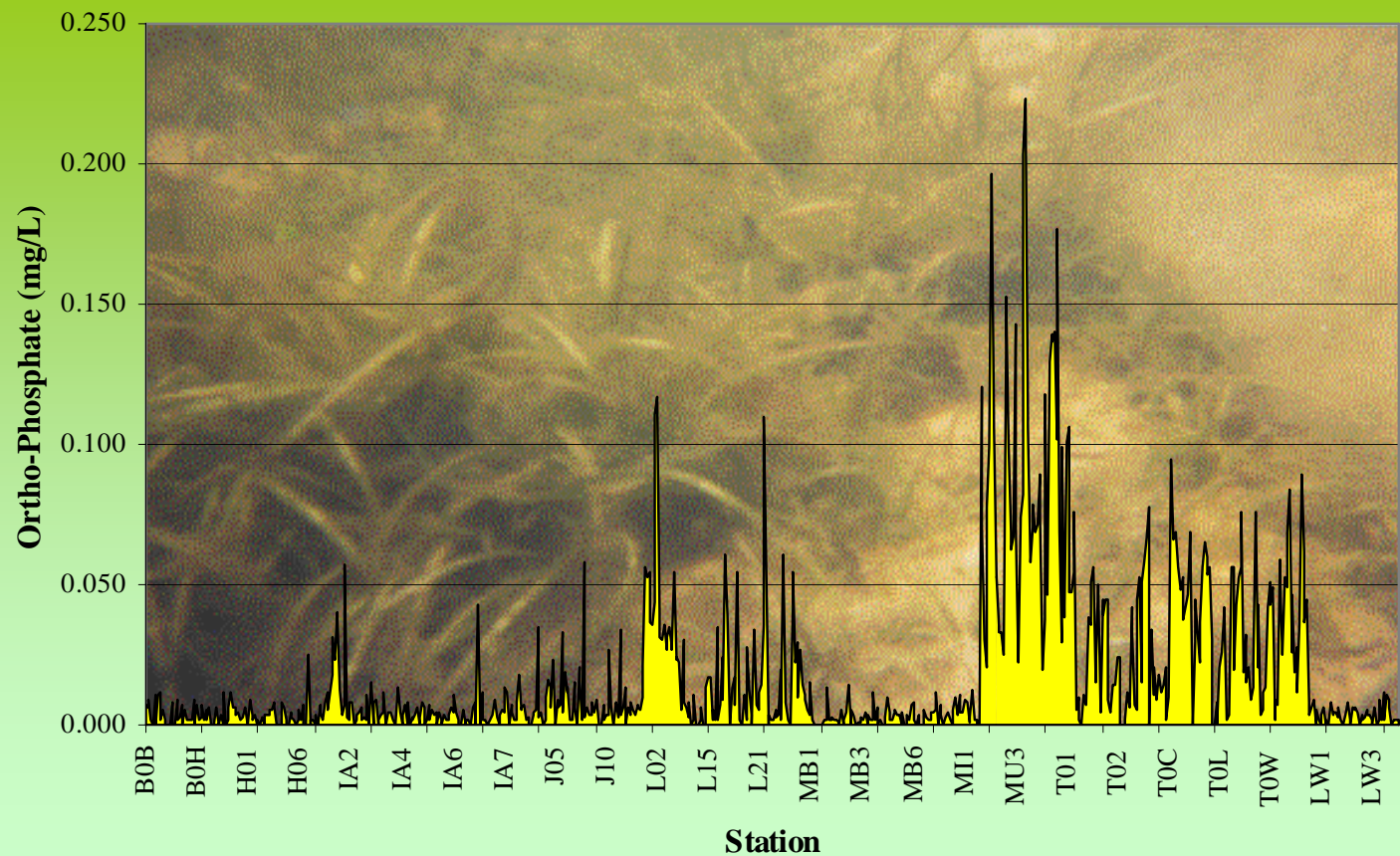
Nitrates in surface water





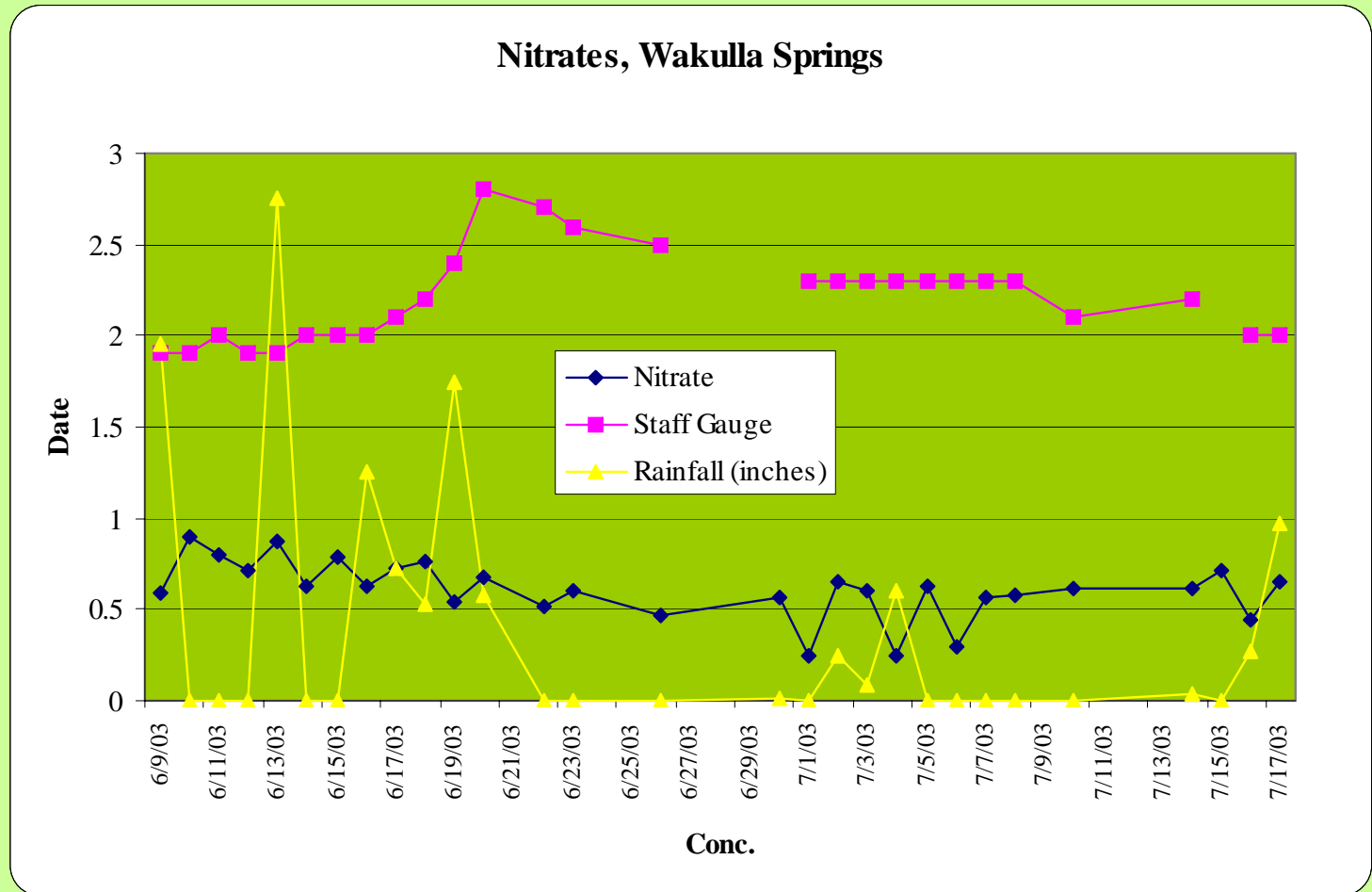
Phosphates in Surface water

Reactive Phosphorus, Leon County Lakes, 10/02-09/03





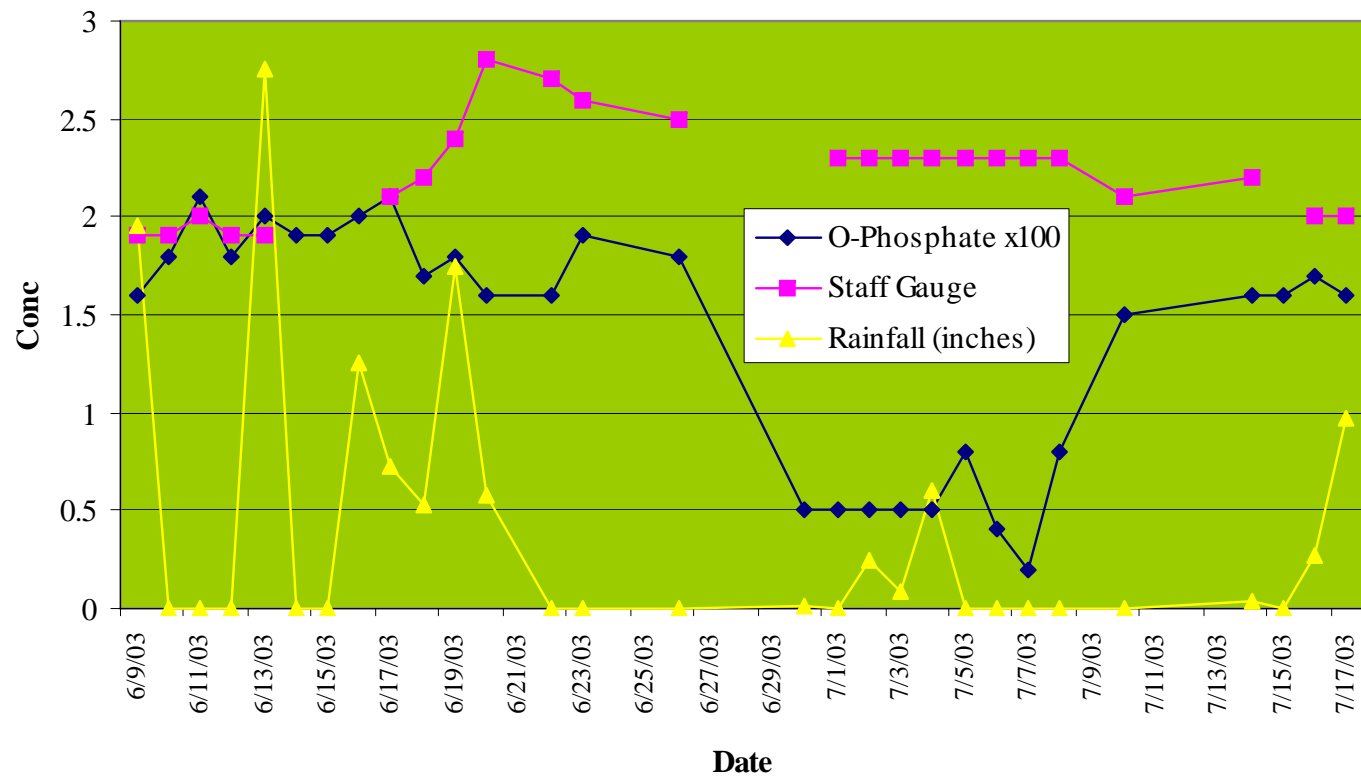
Limiting Nutrients





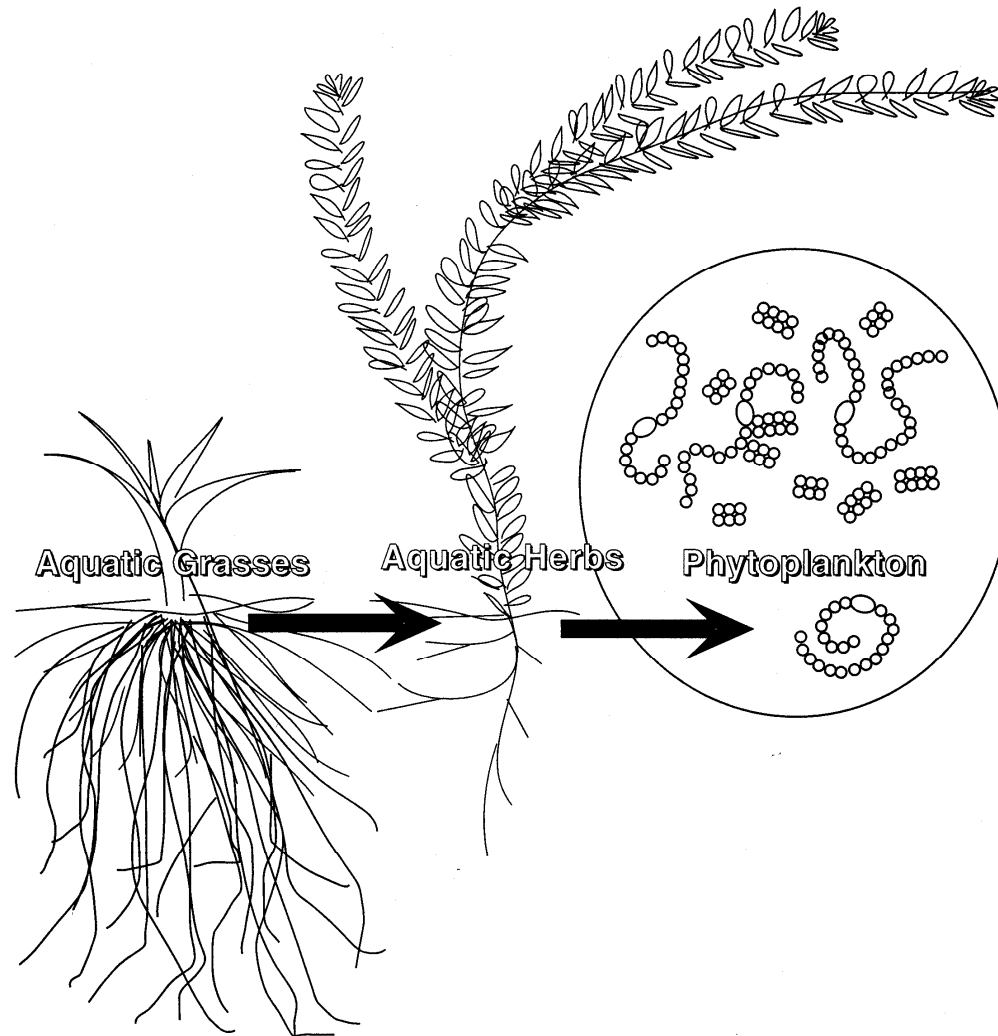
Limiting Nutrients

Reactive Phosphate, Wakulla Springs





Aquatic Plant Succession

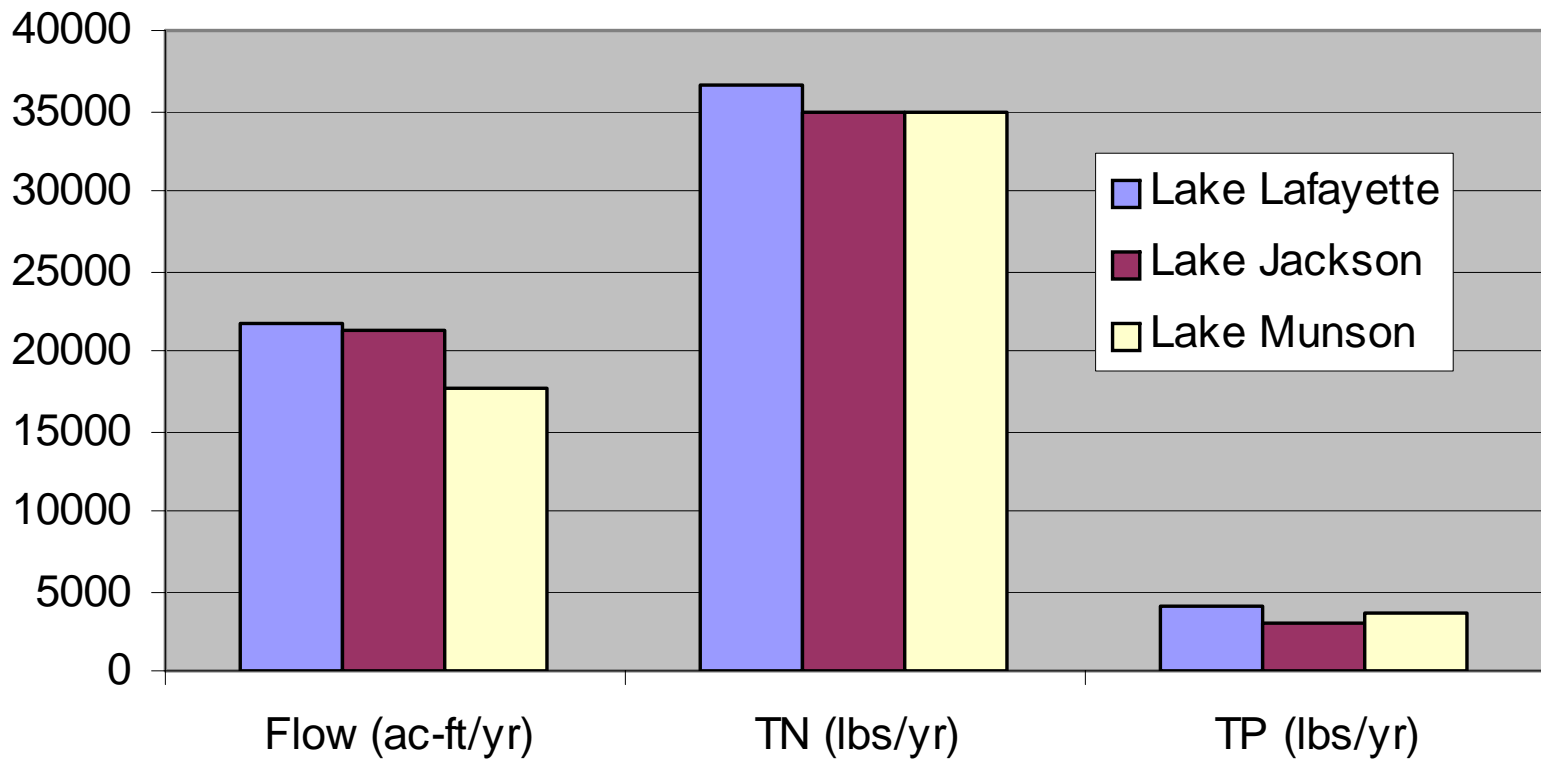


Rosette → **Vittate** → **Non-Rooted**
Low Nutrients → **High Nutrients**
Oligotrophic → **Mesotrophic** → **Eutrophic** → **Distrophic**



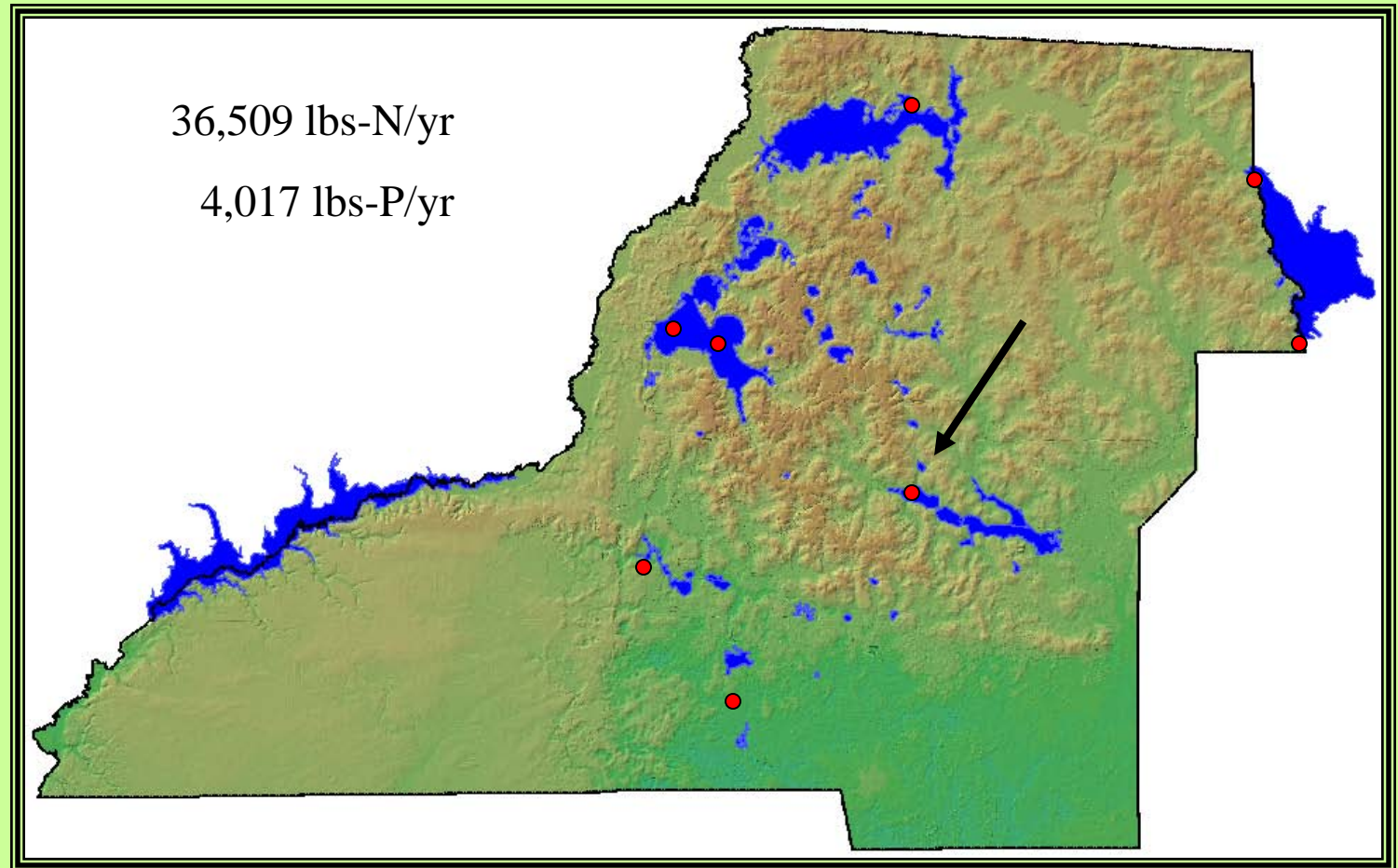
Phosphorus and Nitrogen Stormwater Loading

CoT / ERD Stormwater Model Data





#1, Lake Lafayette: 35.7% of stormwater

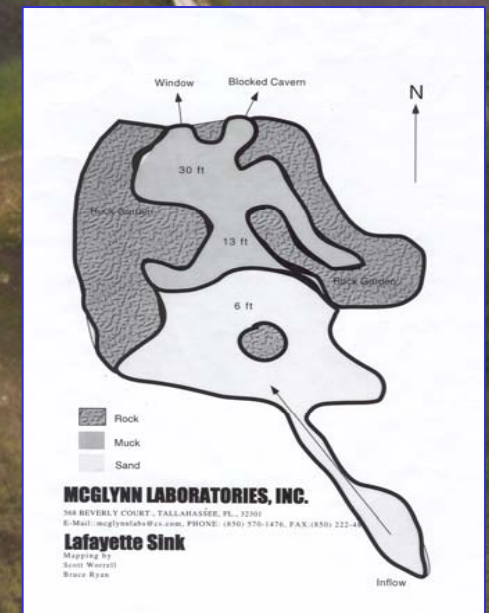


- 18 million gallons of reported sewage spills in Lafayette



Lafayette Sink 30-50 cfs

Stormwater
flows into the
Aquifer at a
rate of 30-50
cfs





Stormwater in Lafayette Sink

The water in Weems Pond is often contaminated with fecal coliform bacteria

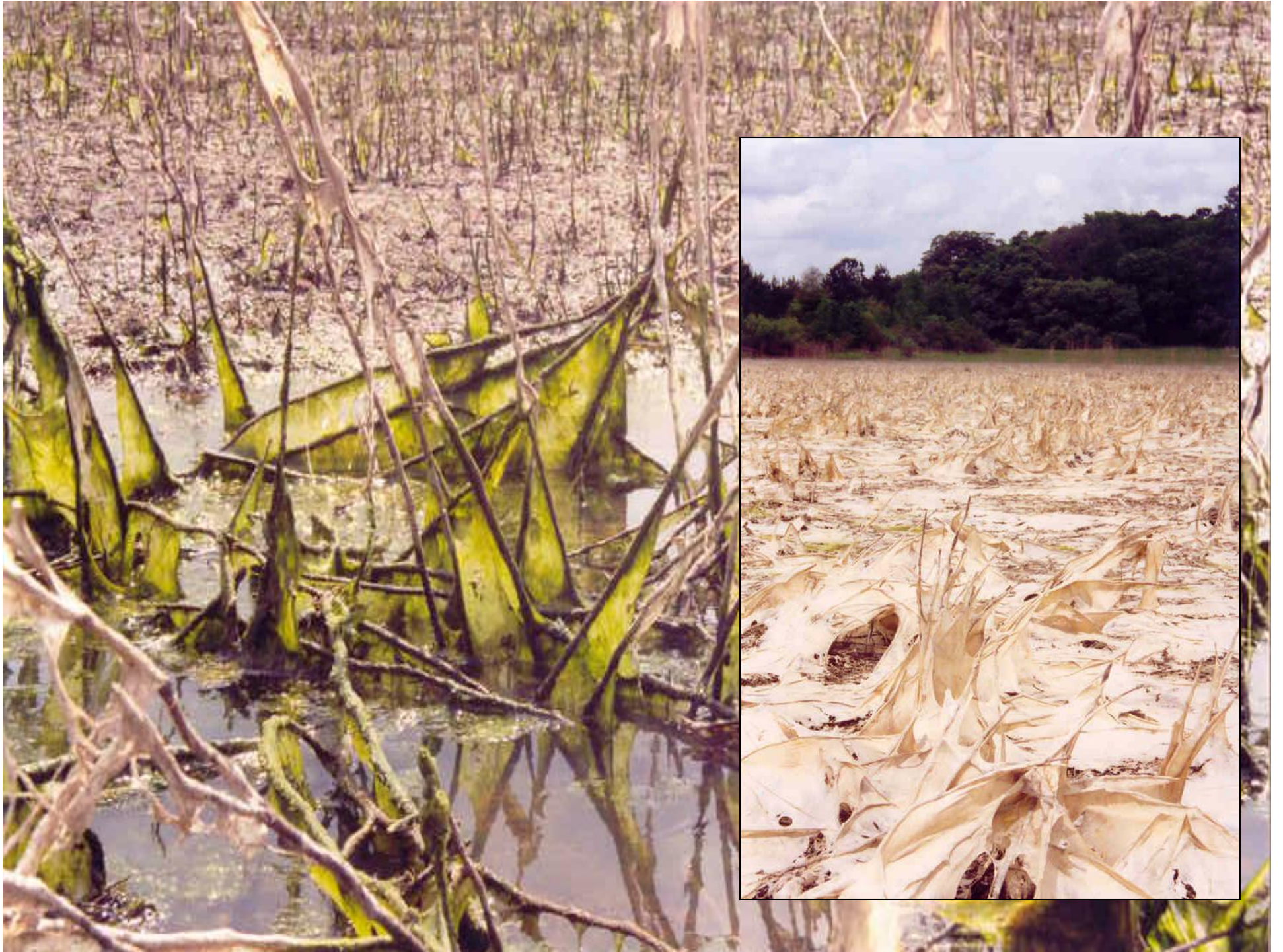


In June 2001, 500,000 gallons of sewage flowed to the Sink



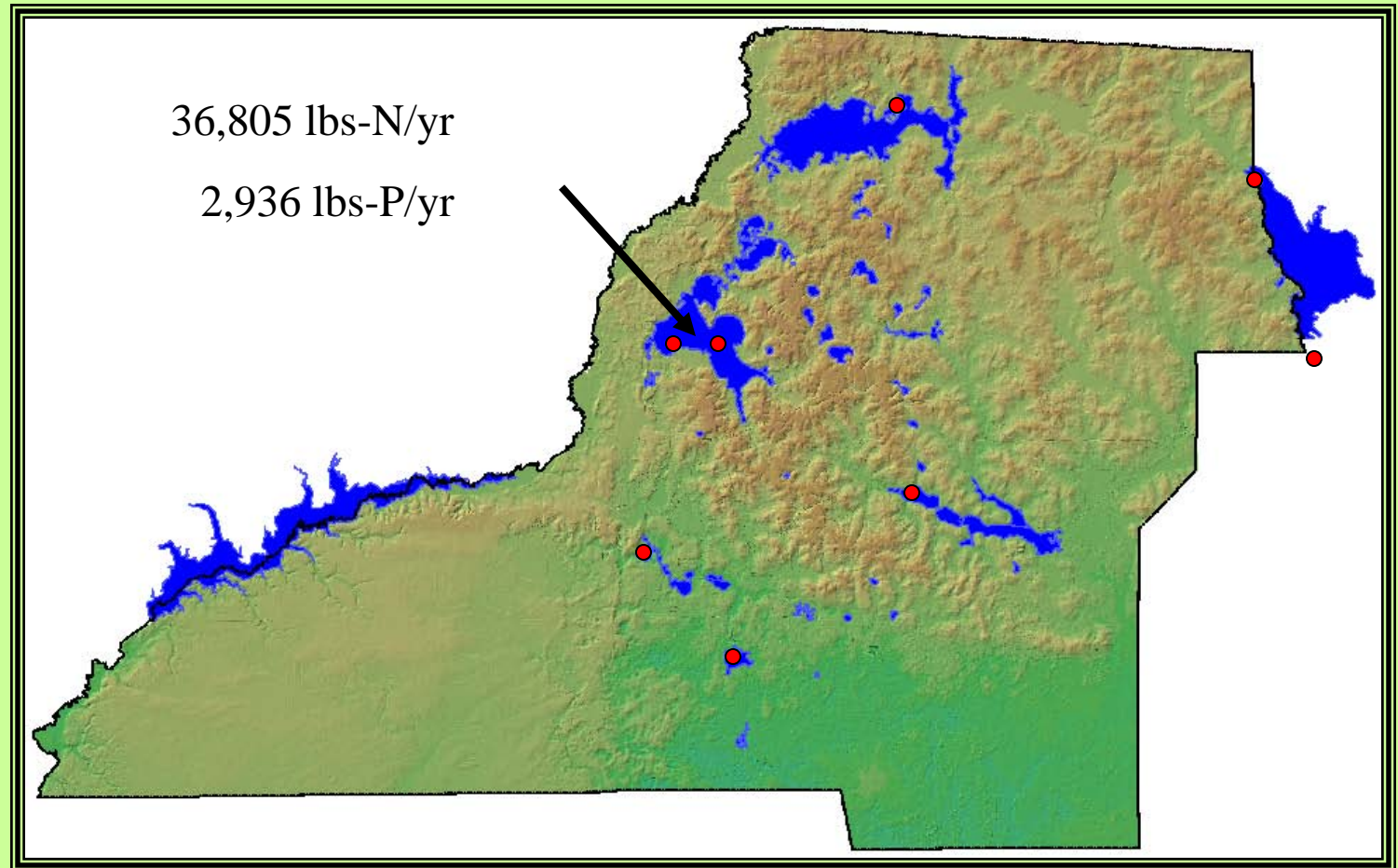
Algal Bloom in Lafayette Sink







#2, Lake Jackson: 35.1% of stormwater





Once there was water...





The Once and Future Lakes



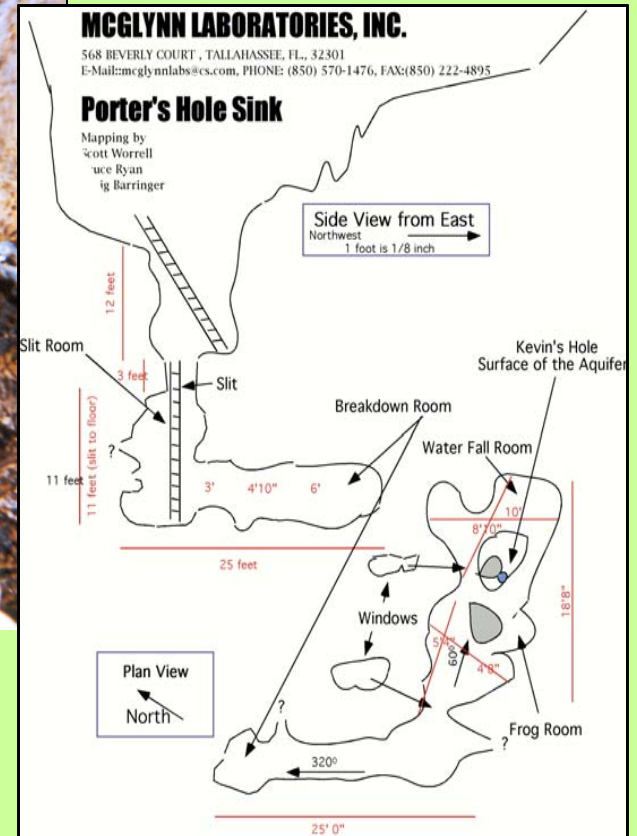
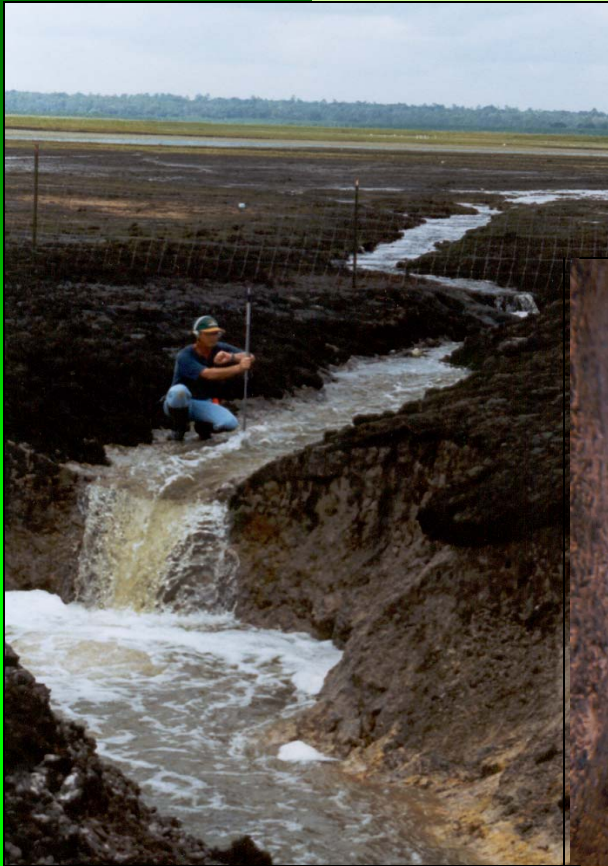


There were many fish...





Porter Hole Sink 14 cfs



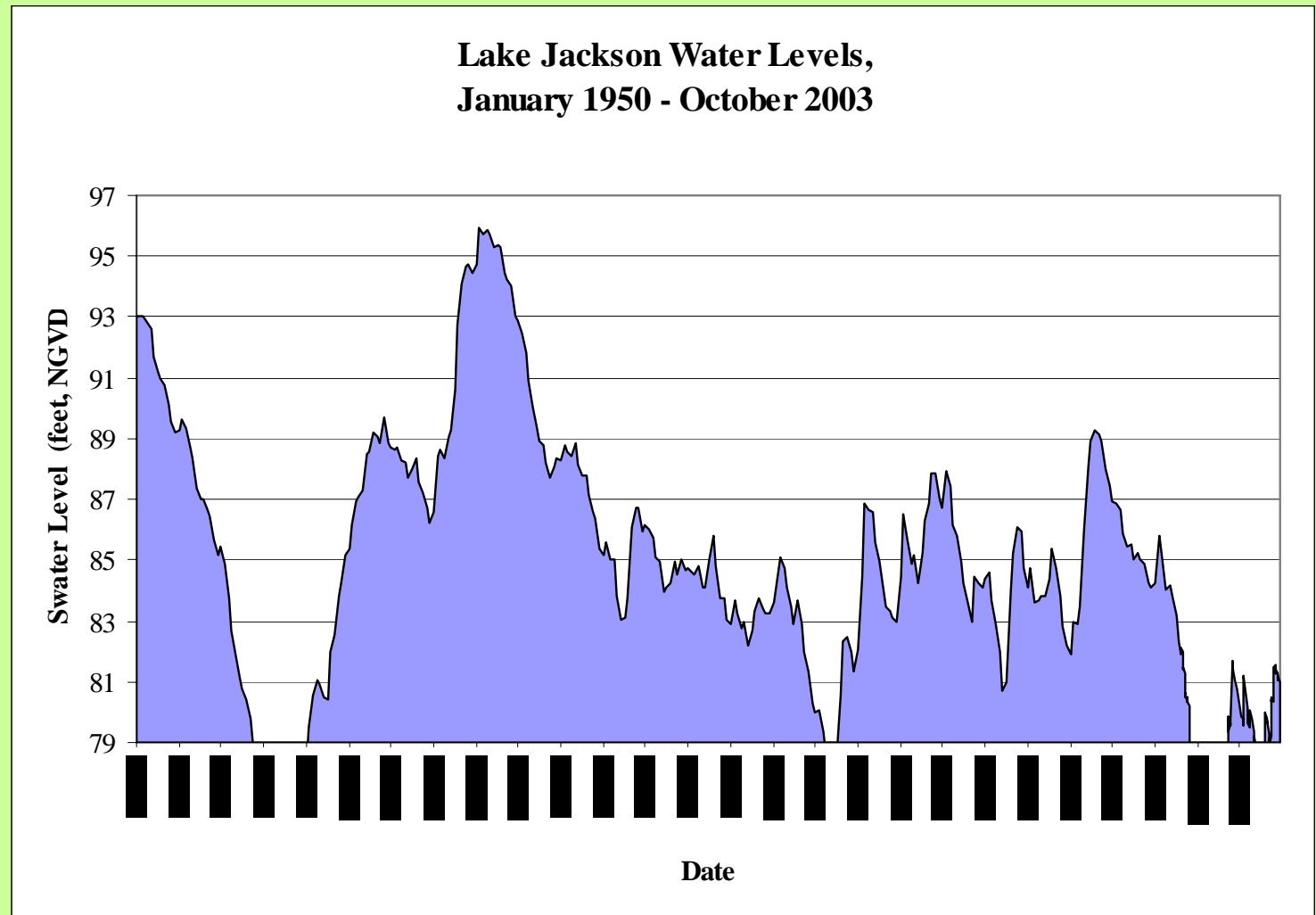


Lake Jackson a Karst Lake



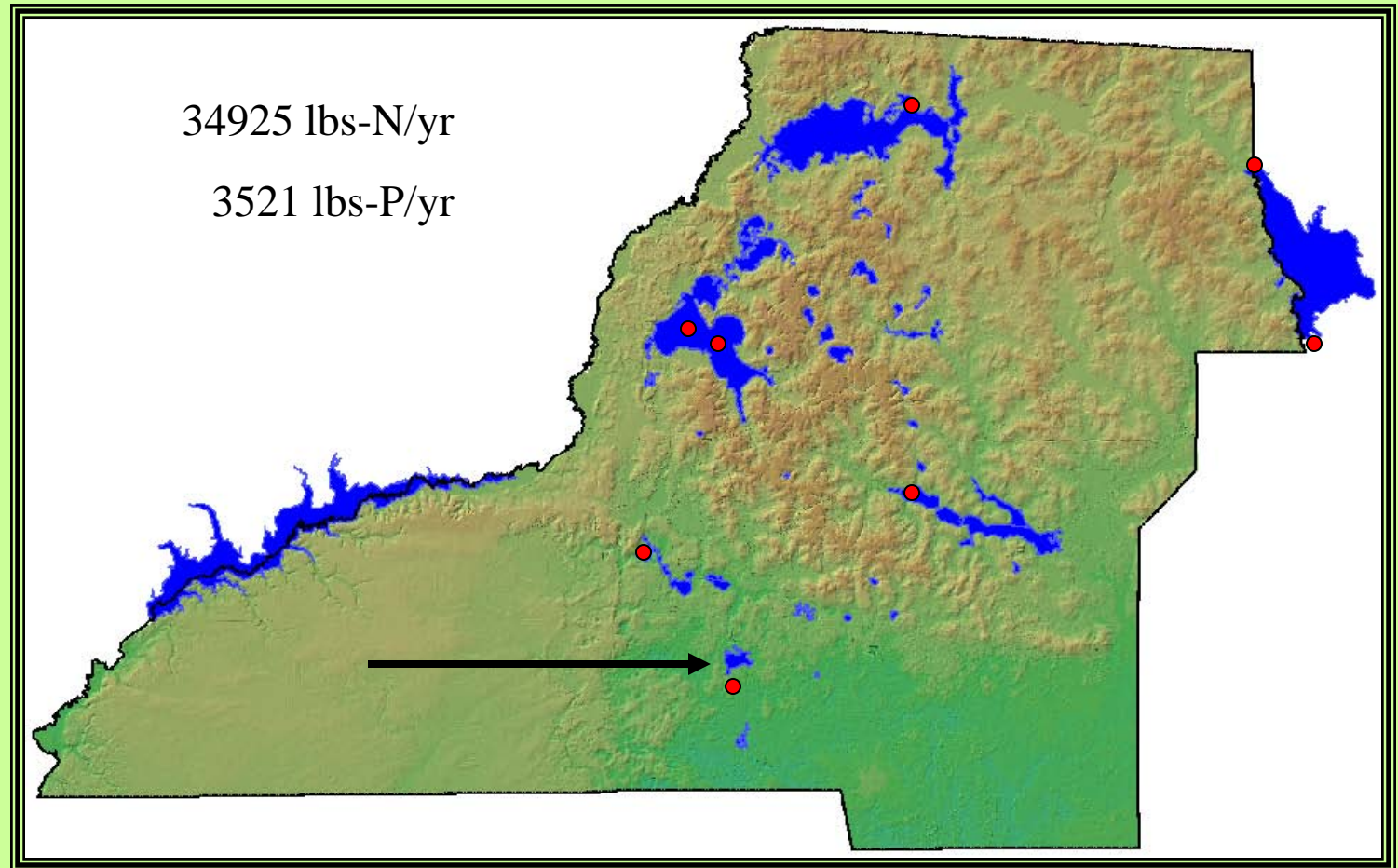


Lake Jackson Water Levels





#3, Lake Munson: 29.1% of stormwater





Lake Munson





Aimes Sink





The Sinkhole in Henrietta Holding Pond

Close-up of the Sinkhole





The Sinkholes in Elberta Crate Holding Pond

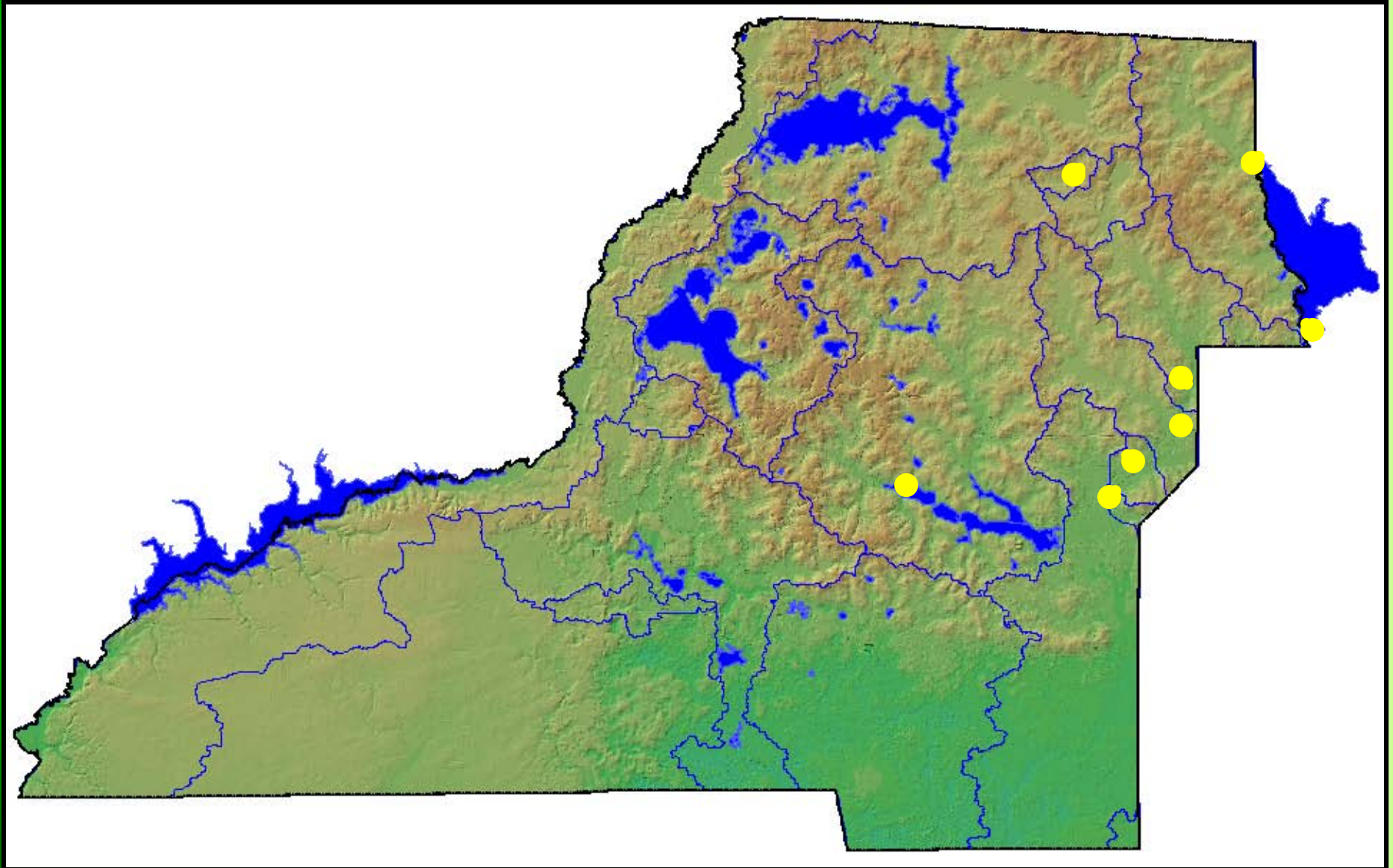


Iamonia Sink





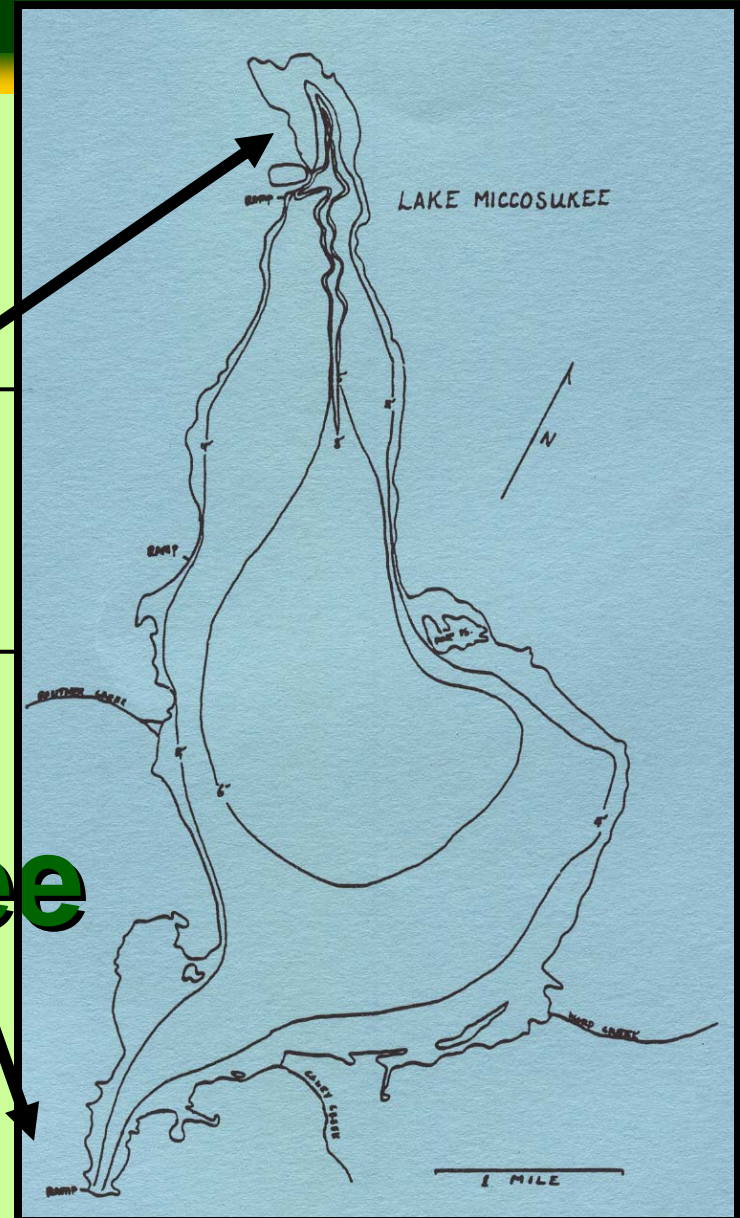
The Eastern Sinks





- Miccosukee Sink
- Lake Drain Sink

Lake Miccosukee

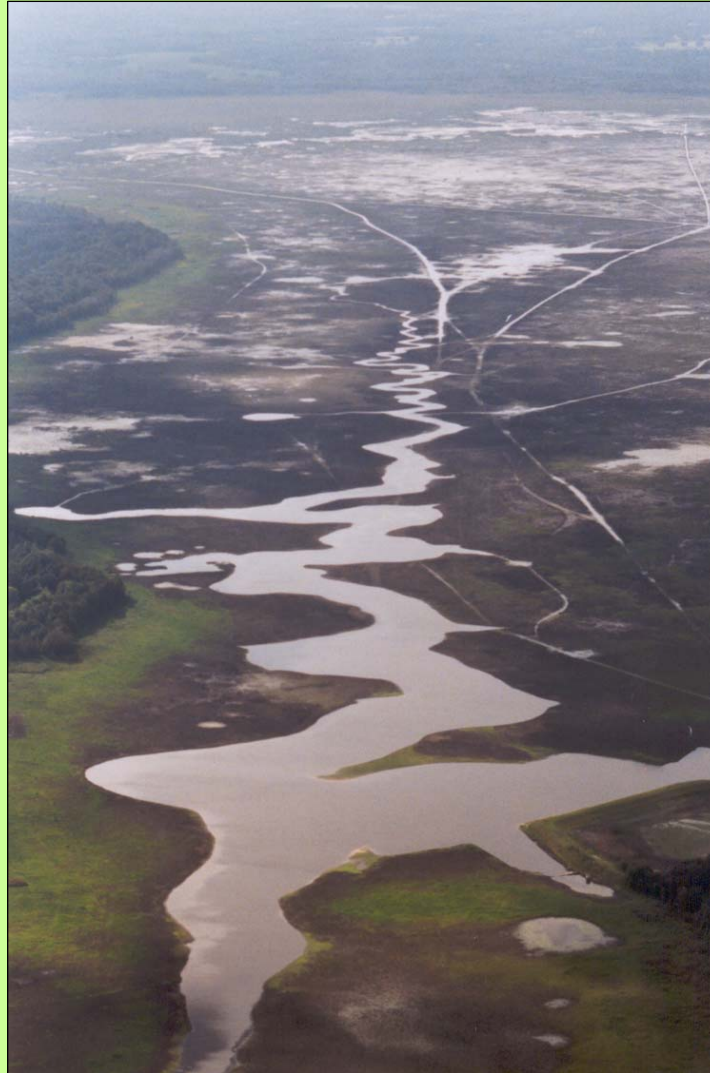


**The water went down the
sink...**





Karst valley and Sinkhole

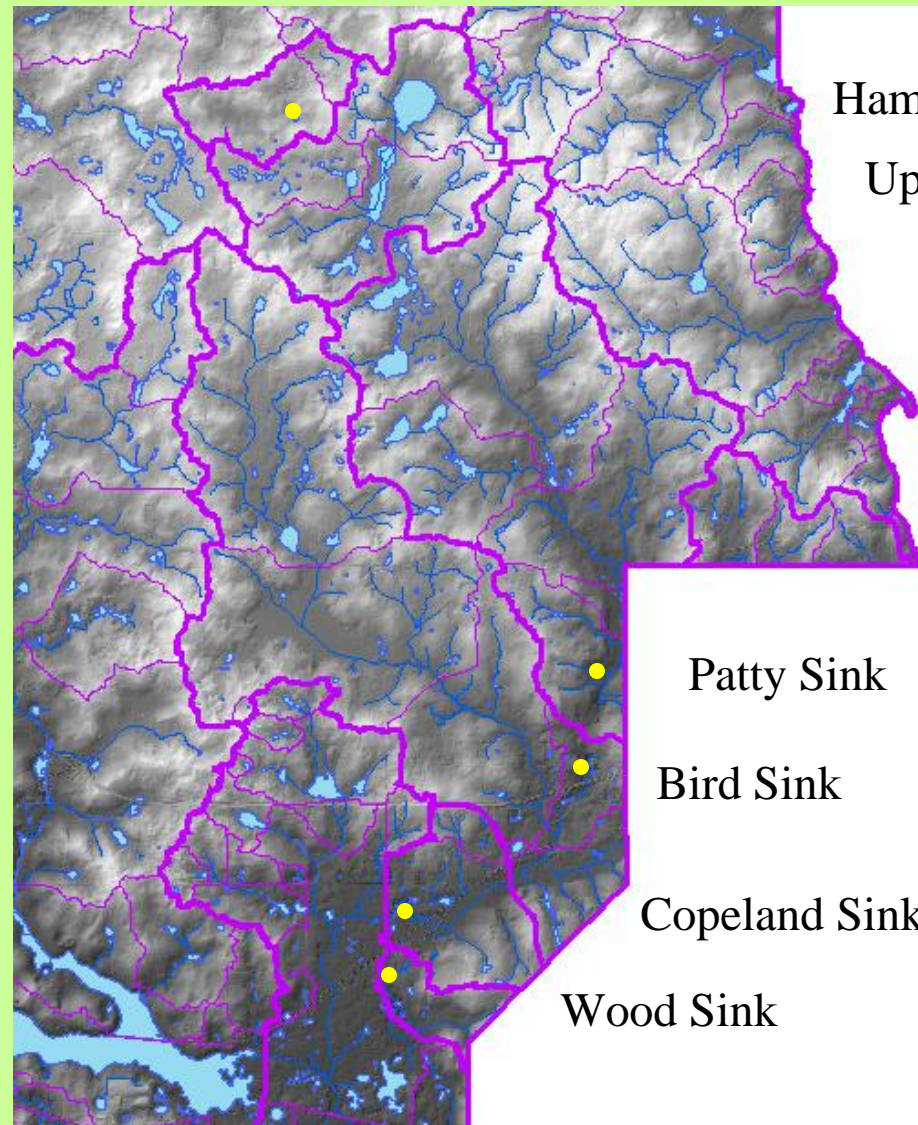


Big Sinkholes





Waterbodies, Eastern Sinks



Hammock Sink

Upper Moccasin Gap

Patty Sink

Bird Sink

Copeland Sink

Wood Sink



Bird Sink

- Flows into the aquifer
- Caverns over 30 feet across
- Caverns flow underground to the east





Bird Sink



- The basin periodically fills with 30 feet of water
- The vortex over the sink ‘whistles like a bird’

Copeland Sink...
...has been logged





Copeland Sink...

...several creeks vanish

- ***Where a drainage basin flows into the Aquifer...***



Wood Sink

- Several creeks flow into Wood Sink and never leave
- The ruins of Verdura Plantation and an old colonial cemetery are nearby



- A series of sinks



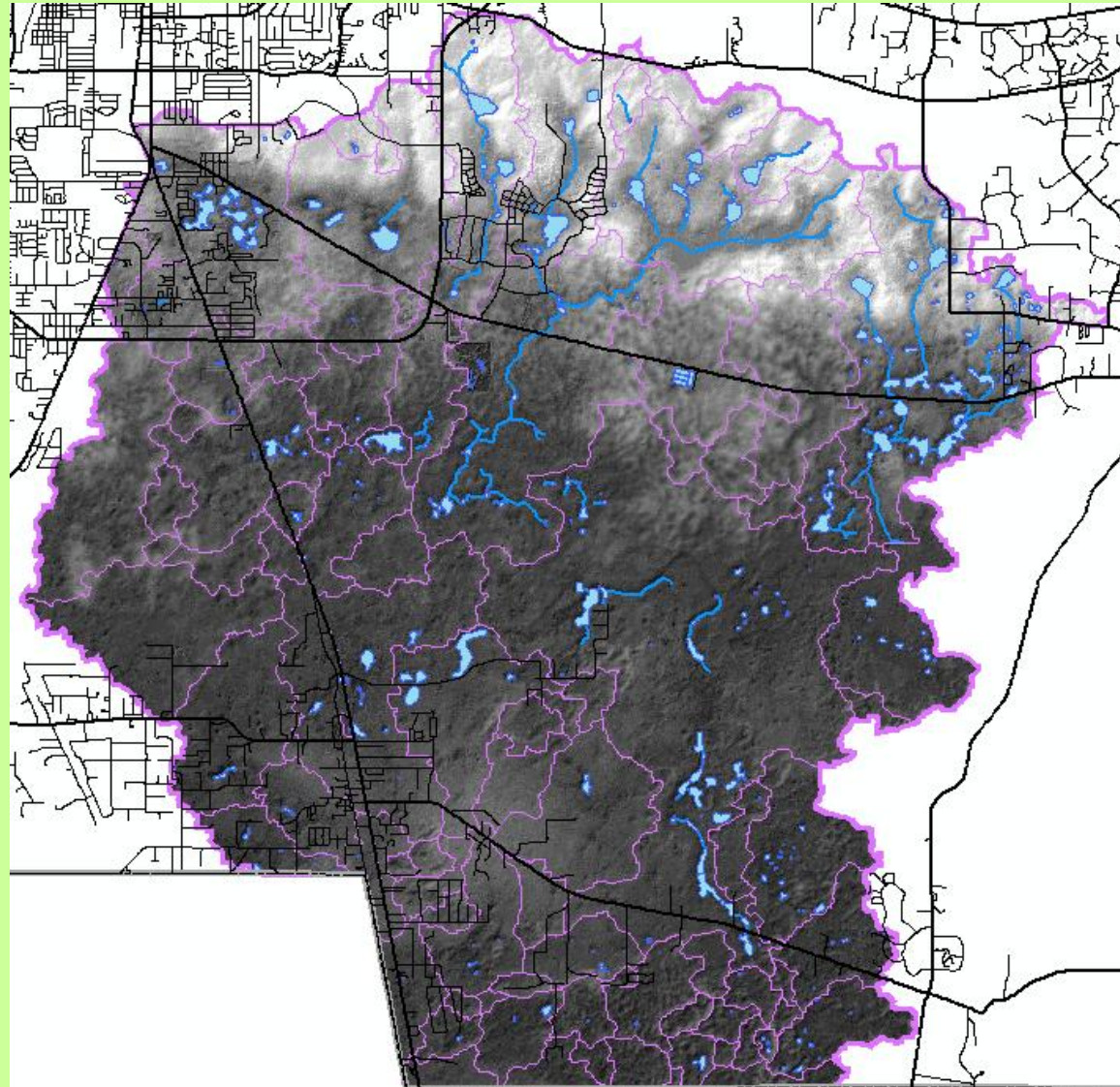
Wood Sink



McGlynn L

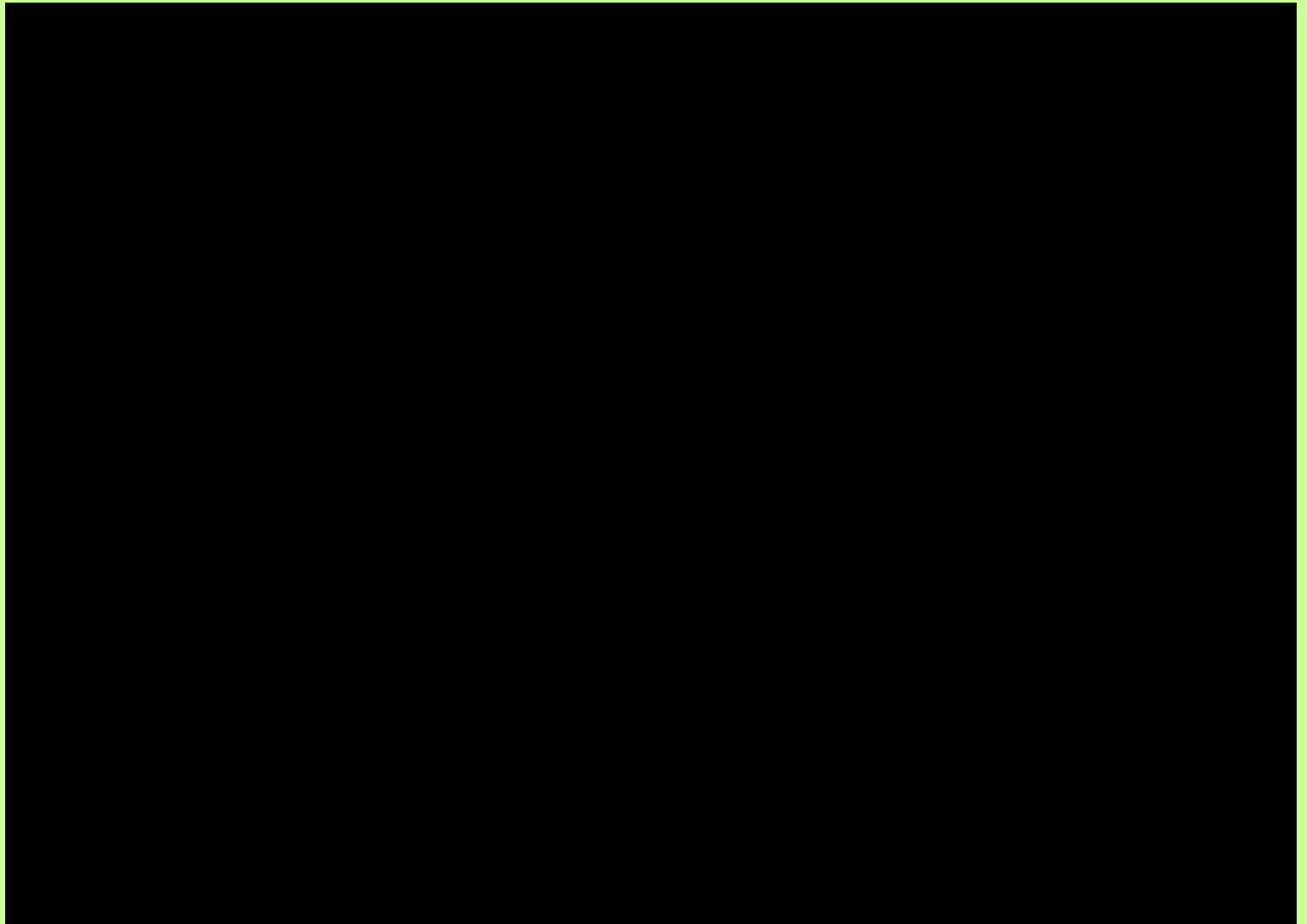


Waterbodies of Woodville Recharge Drainage Basin





Woodville Karst

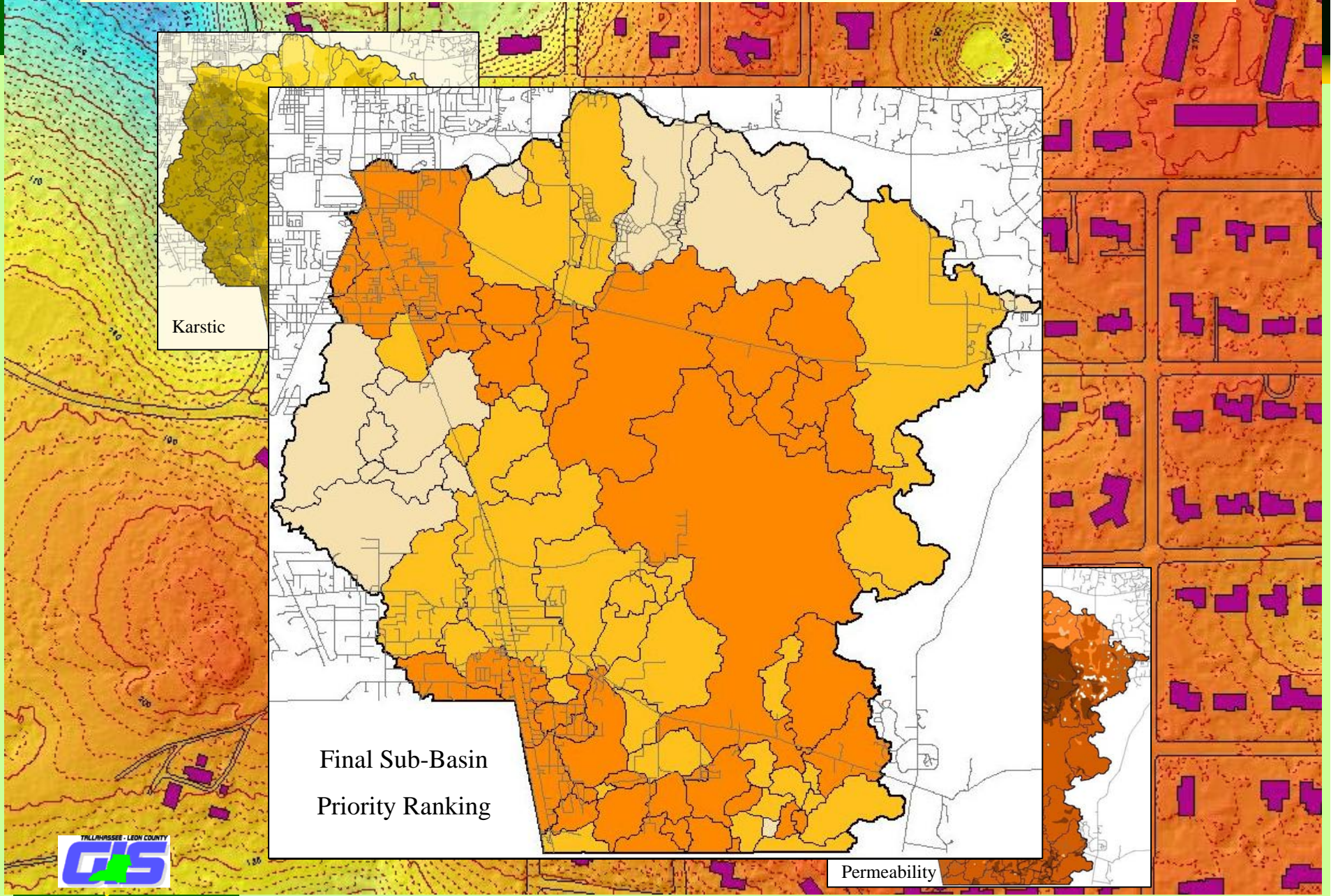




Prioritization Model

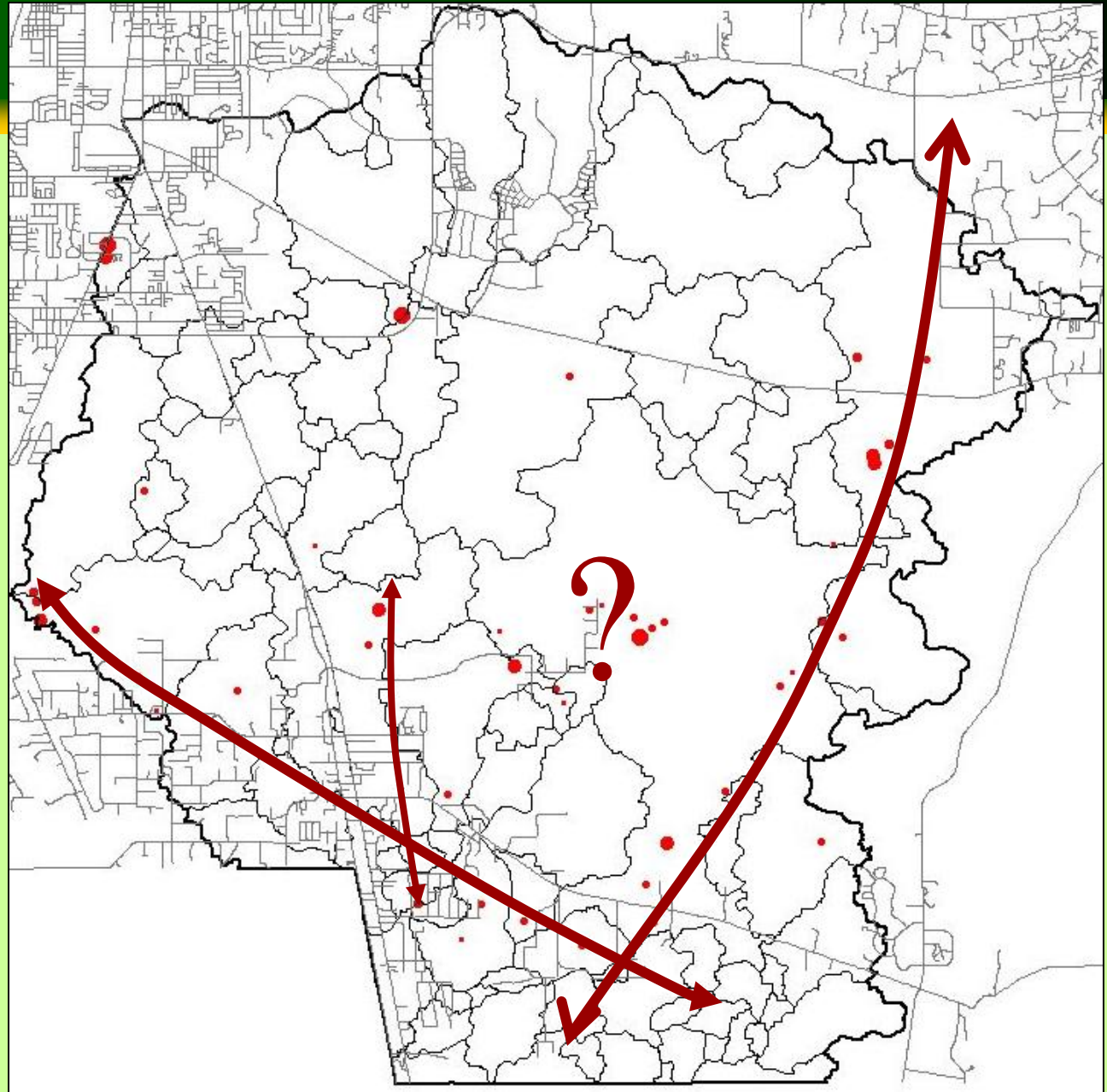
$$\begin{aligned} \blacksquare \text{ rank} &= (\text{karstic} * 3) \\ &+ (\text{septic} * 4) \\ &+ (\text{septic density} * 2) \\ &+ (\text{window} * 10) \\ &+ (\text{landuse} * 2) \\ &+ (\text{future landuse} * 2) \\ &+ (\text{soil permeability} * 7) \end{aligned}$$

Woodville Recharge Basin Water Quality Study: Basin Priority Assessment





Potential Cavern Systems





Cascade Sink



- This sink no longer exists but was so beautiful that it was cited in the decision to locate the state capitol here.



Church Sink





Church Sink





Natural Wells





Unnamed Sinks





Osgood Sink





Moonshine & Fairy Sink





Frog Sink



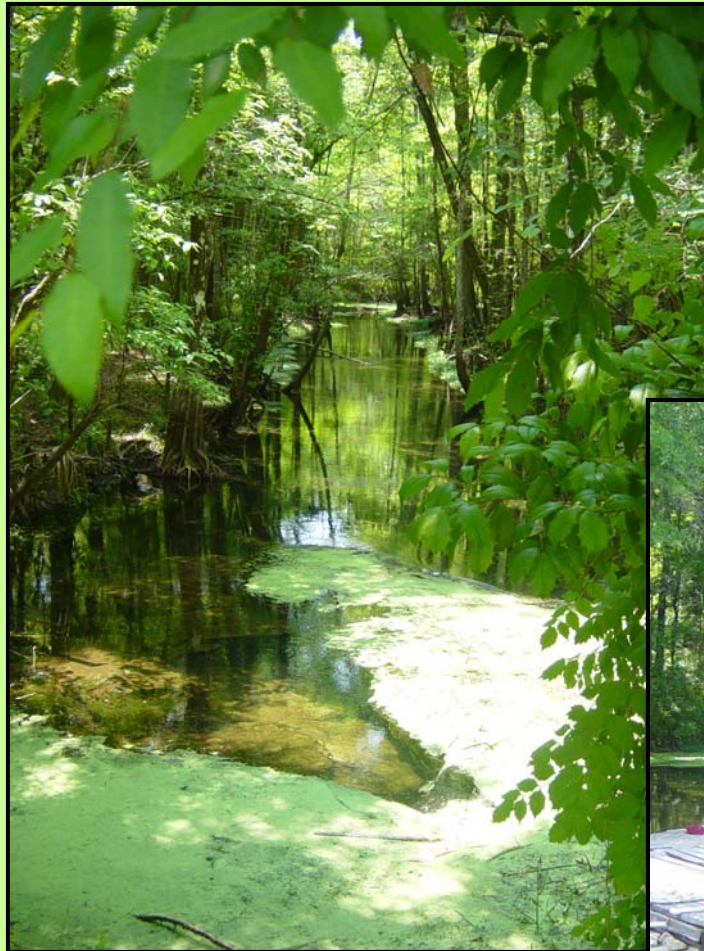


Frog Sink





Rhodes Siphon and Horn Springs





Hideaway Sink





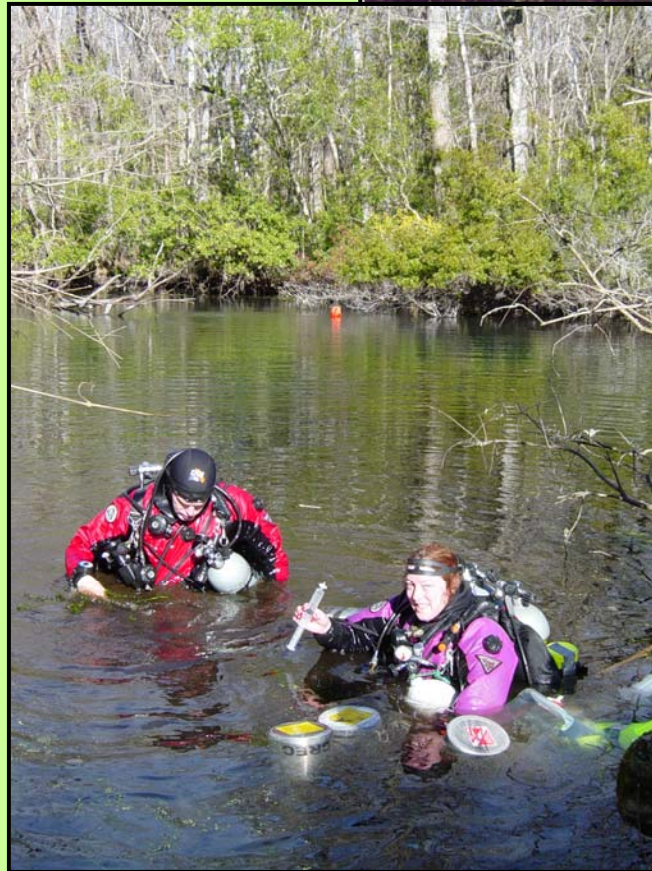
Porter Hole Sink, Lake Jackson





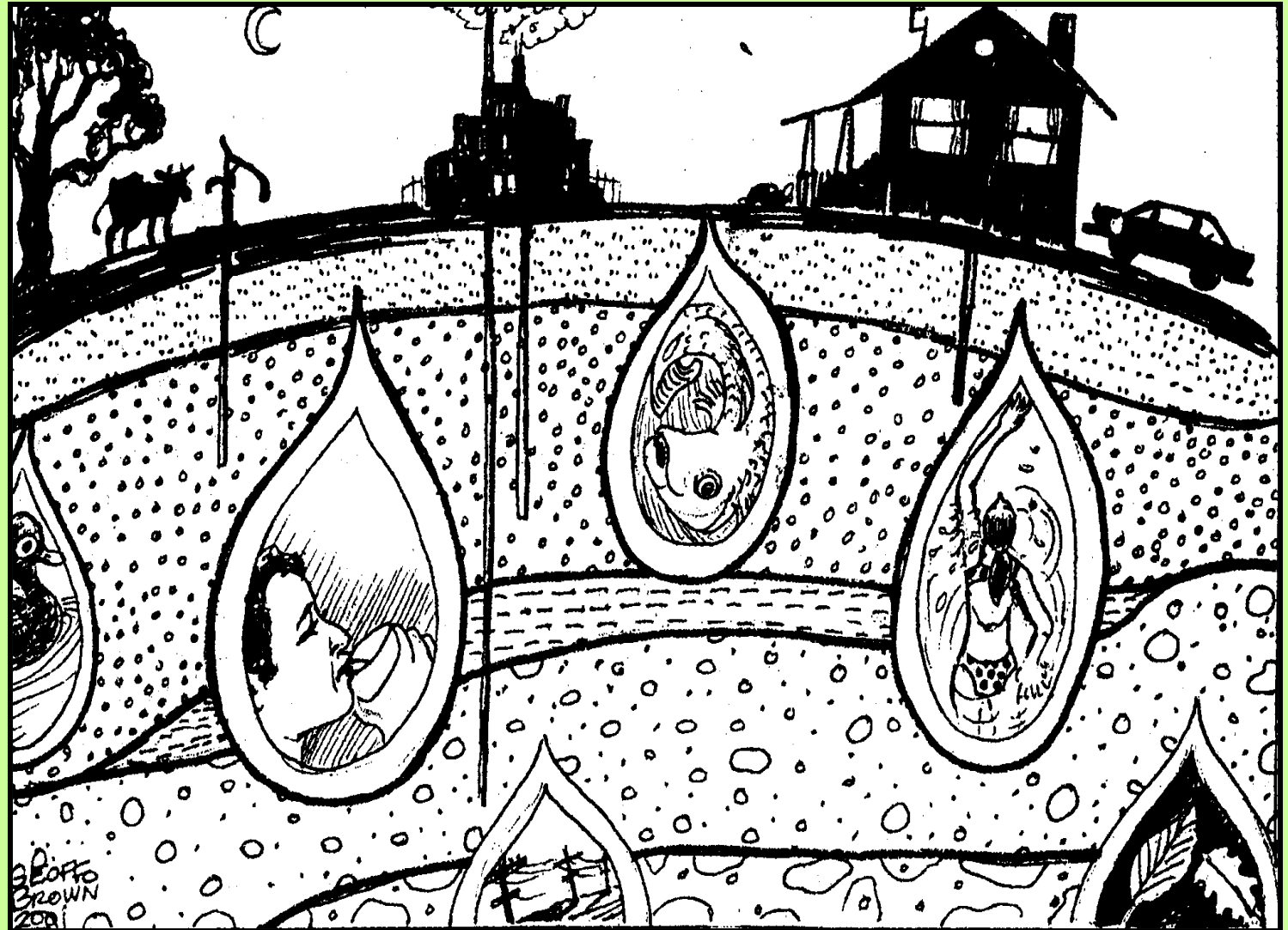
Wakulla Springs

- What goes down, eventually comes up...





Aquifer Protection



SCHUBB 2002
UFS



"GOOD GOD...IT'S SPONGE BOB SQUARE PANTS..!"

