February 9, 2023

Environmental Excellence Day

Florida's Springs and the Future of the Floridan Aquifer

Robert L. Knight, Ph.D.

John Crowe photo

Howard T. Odum
FLORIDA
SPRINGS
INSTITUTE

John Crowe

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MONITORING OUR SPRINGS
SAFEGUARDING OUR FUTURE

Florida Springs Welcome Center

High Springs

Springs exhibits| Research facilities| Classrooms and lecture hall | Headquarters of the Florida Springs Institute

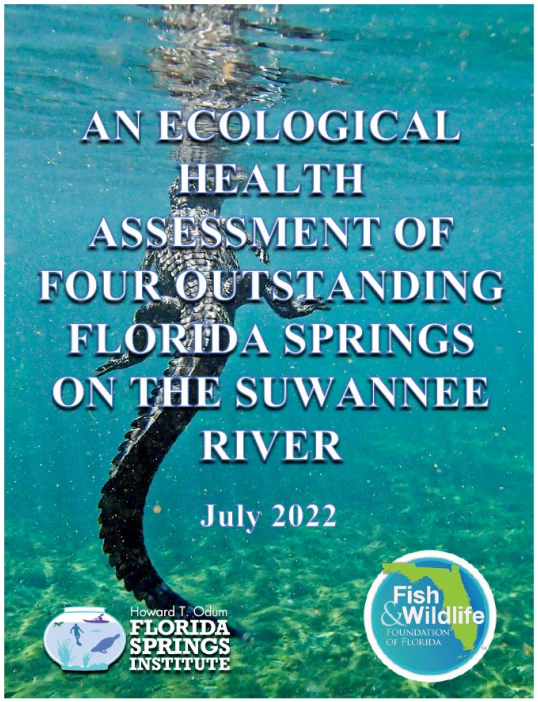
Springs Health Monitoring

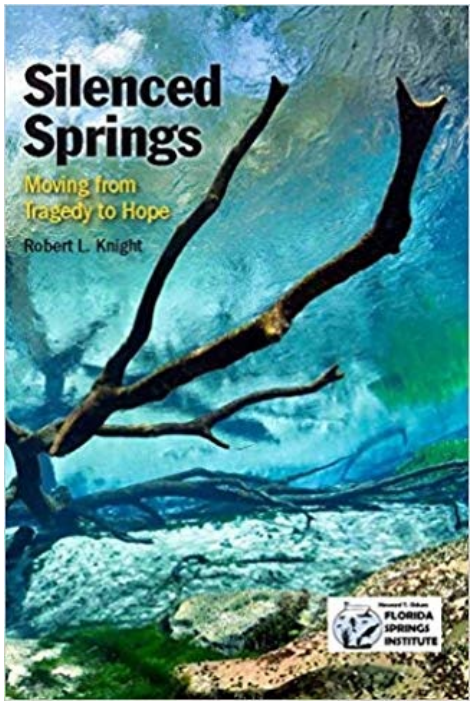
Springs Monitoring and Health Assessments | Blue Water Audit | SpringsWatch |

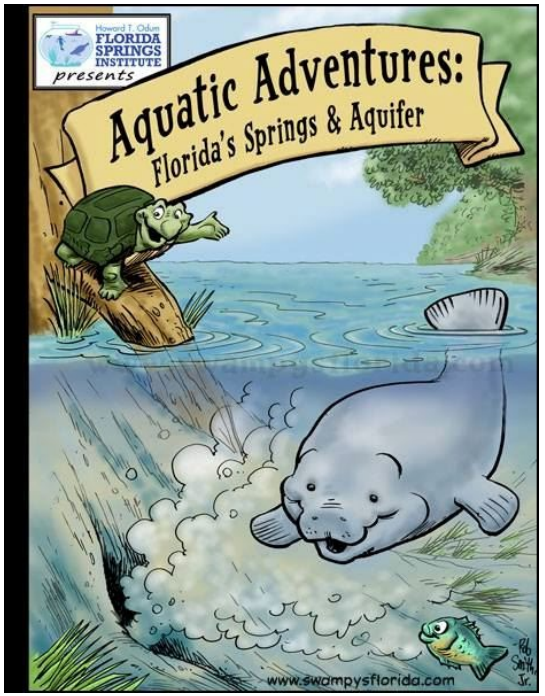
Photos by John Moran

Public Education

Educational Publications







Springs Health Assessments | Silenced Springs: Moving from Tragedy to Hope | Aquatic Adventures: Florida Springs & Aquifer

BLUE WATER AUDIT

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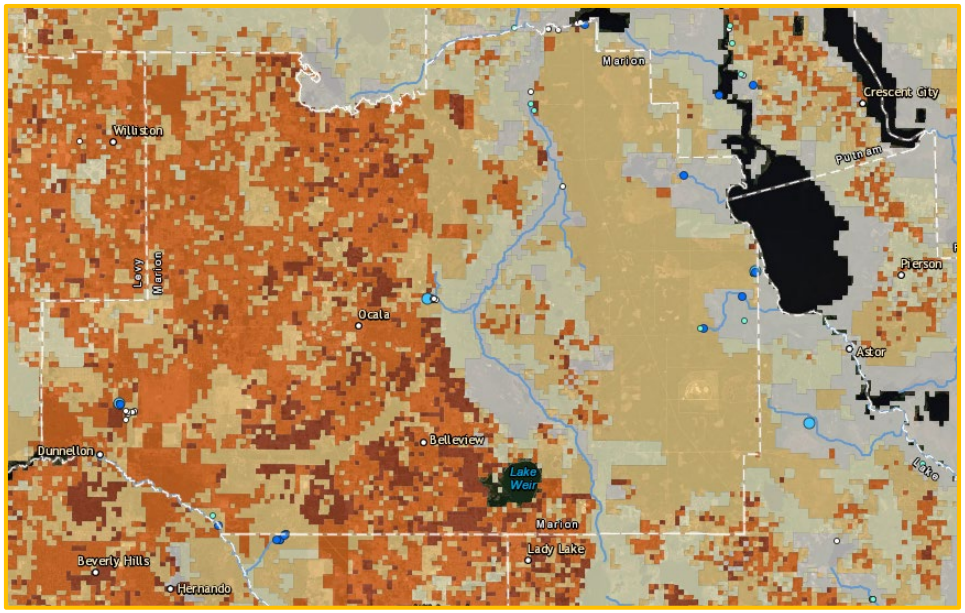
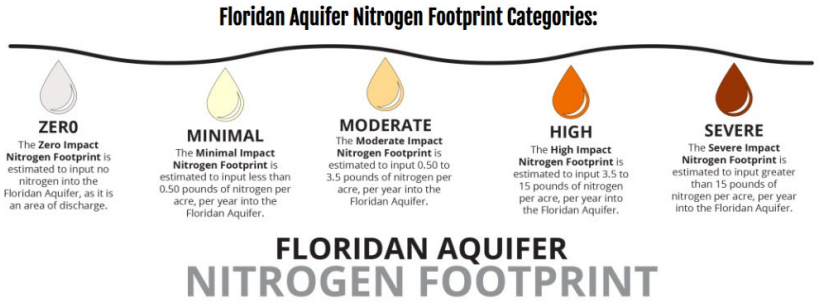
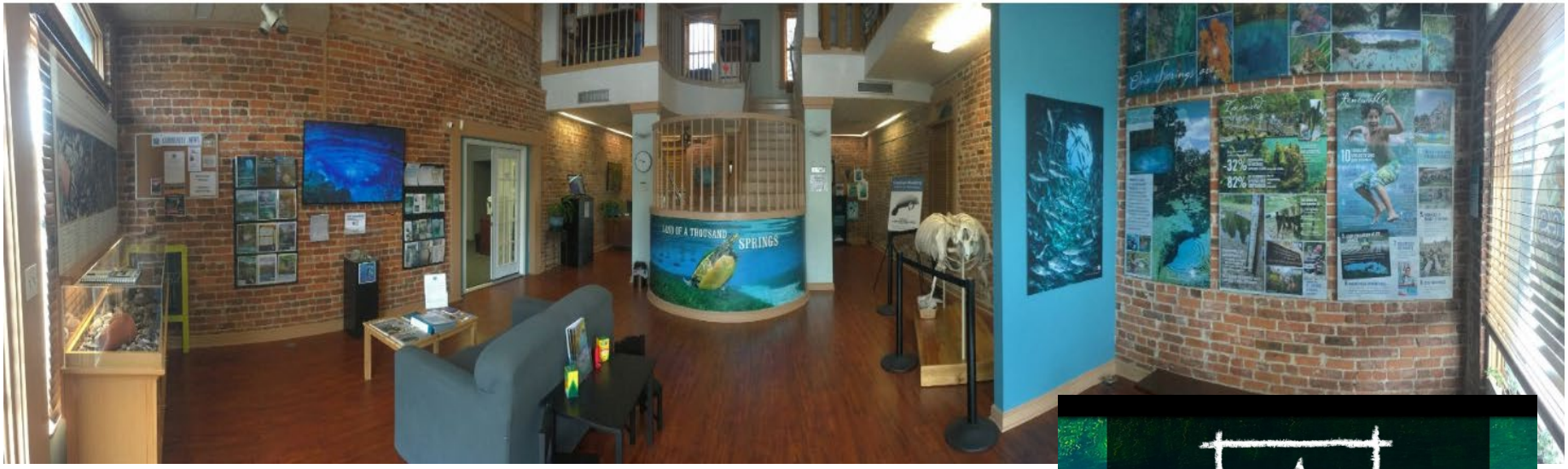
BLUE WATER AUDIT
Aquifer Footprint Calculator



- GIS-based analytical and educational tool to assess impacts on the Floridan Aquifer
- Includes parcel-specific estimates of groundwater consumption and aquifer nitrogen loading rates
- Allows prioritization of most cost-effective springs' restoration actions



Springs Academy



- Florida Springs Welcome Center in High Springs
- Monthly first Tuesday at 12 noon
- Six sessions twice each year
- Springs Hydrogeology/Chemistry/Biology/
- Impairments/Advocacy

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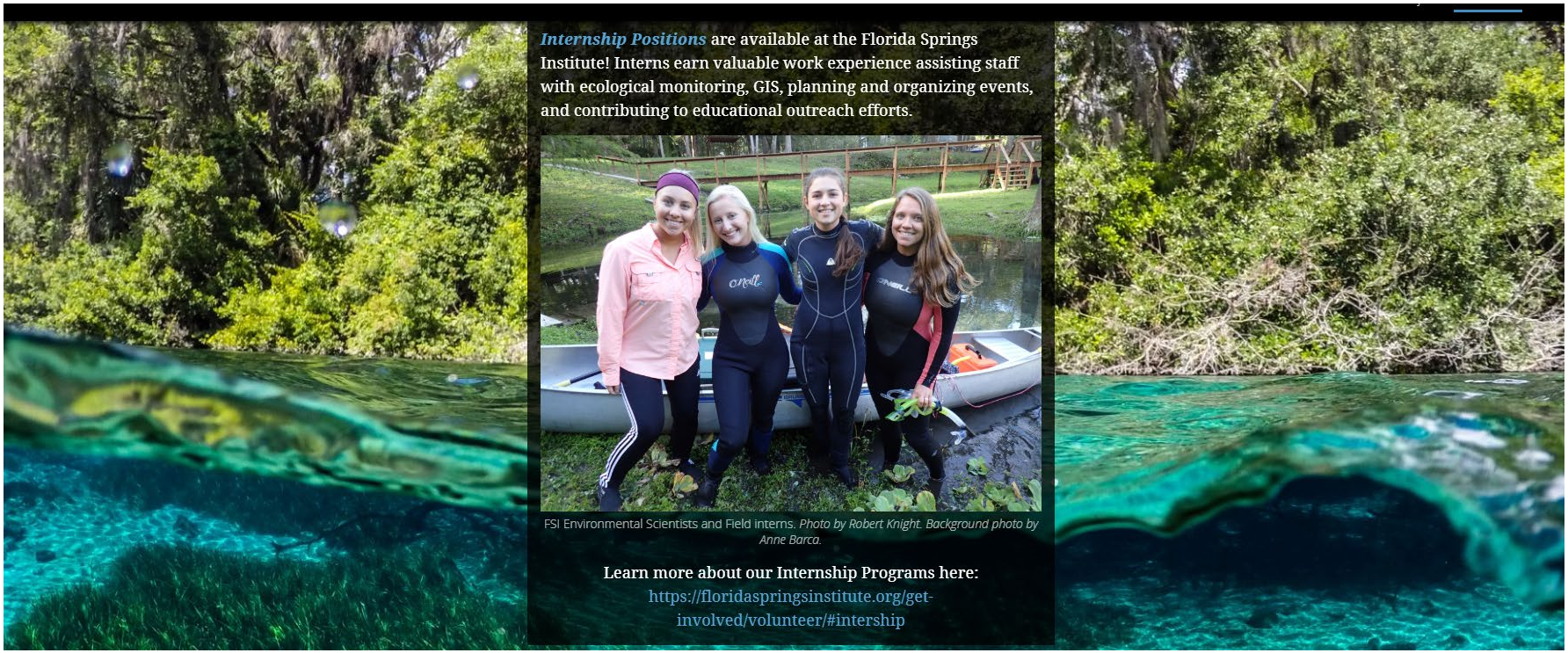
STUDENT INTERNSHIPS



- Four three-month sessions per year – total of 12 interns per year
- Trained in field data collection, data entry and analysis, and springs ecology
- Raises awareness of springs impairments

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SPRINGS RUN

- Collaboration with First Magnitude Brewing Company in Gainesville
- 7.2K run for beginners and top athletes
- Over 700 participants in 2020
- Raises awareness of springs impairments

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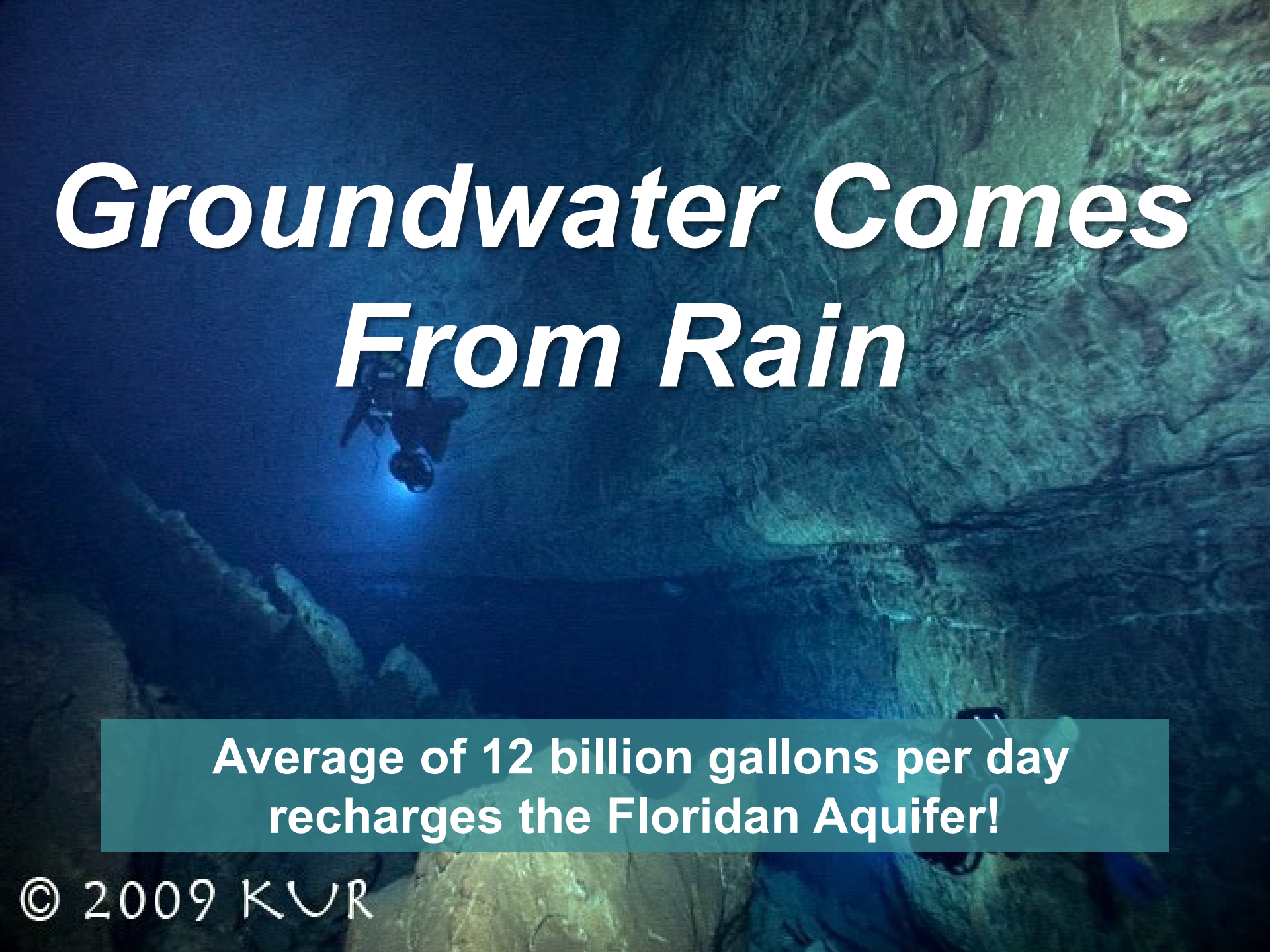
SPRINGSWATCH

- Volunteer based citizen-science
- Monitor water quality and ecology
- Silver Springs, Ichetucknee Springs, Homosassa Springs, Rainbow Springs, Weeki Wachee Springs, Santa Fe River, Wakulla, Crystal River, and Wekiva River.

Extent of the Floridan Aquifer

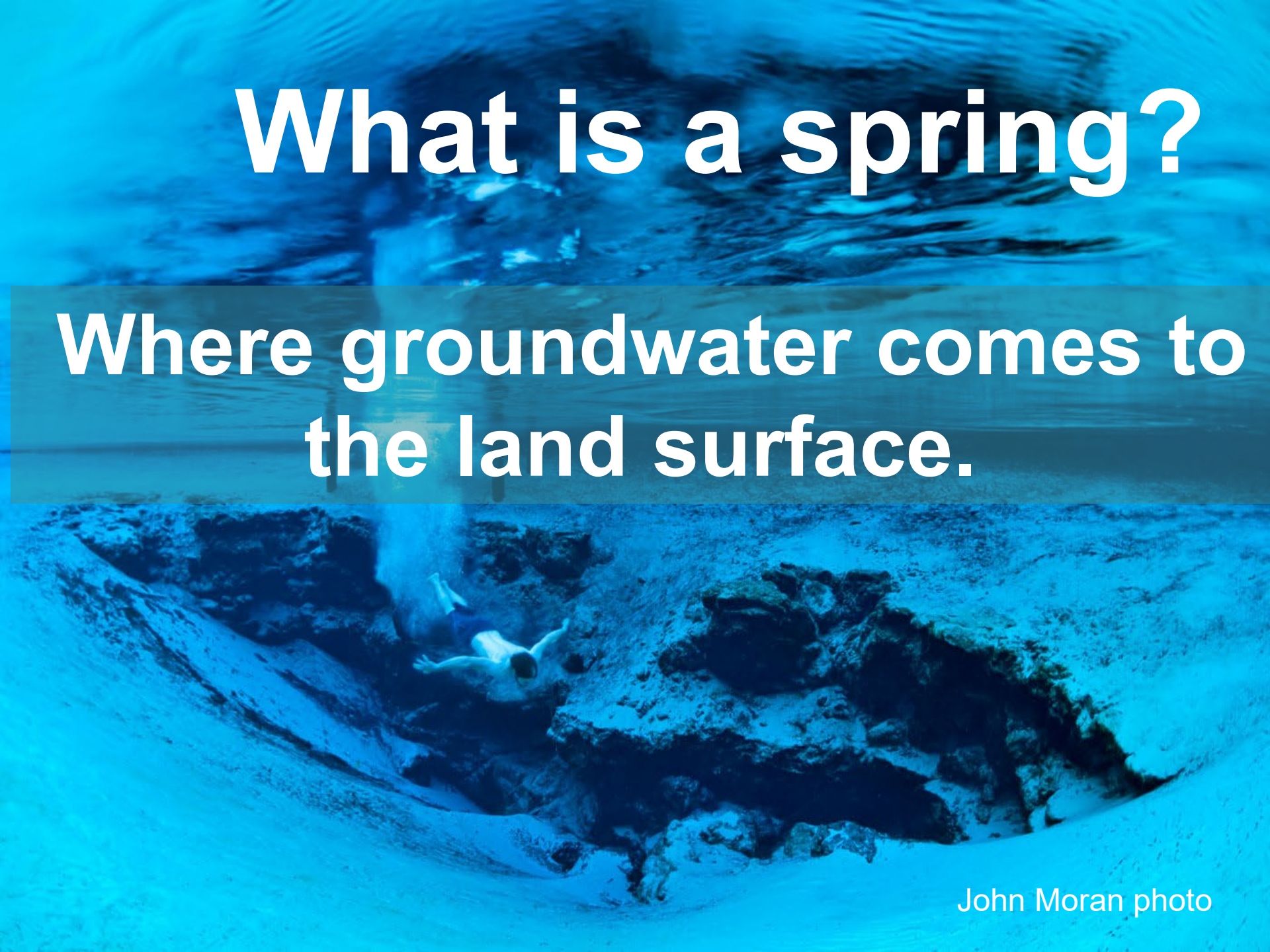
The Floridan aquifer underlies an area that includes all of Florida and parts of neighboring states, about 100,000 sq. mi.

http://fl.water.usgs.gov/FASWAM/


Groundwater Comes From Rain
Average of 12 billion gallons per day recharges the Floridan Aquifer!
© 2009 KUR

What is a spring?

Where groundwater comes to the land surface.



John Moran photo

Florida: *"Land of a Thousand Springs"*

The Floridan Aquifer System supplies fresh water to Florida's 1,000+ artesian springs – the largest springs concentration in the world!

Why Are Springs Important?

Springs are a Source of Life

Rainbow River John Moran photo

Springs Provide Wildlife Habitat

Ichetucknee River John Moran photo

Springs Support Fisheries

Silver Glen Springs
John Moran photo

Springs Protect Endangered Species

Three Sisters Springs
John Moran photo

Springs Allow Exploration

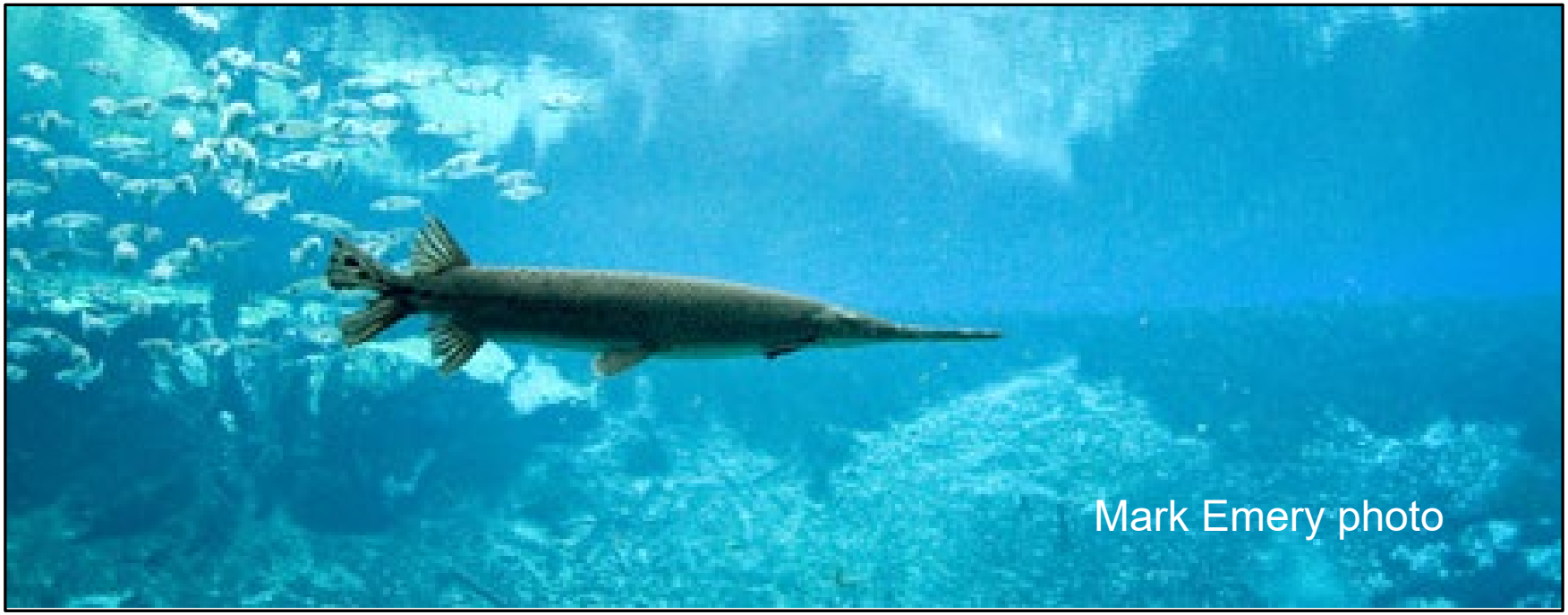
Ichetucknee Blue Hole
John Moran photo

Springs are an Economic Engine

More than a billion dollars per year!

What is Killing Florida's Springs?

1. Groundwater in the Floridan Aquifer is over-utilized, and
2. Our groundwater has alarming concentrations of nitrate nitrogen.



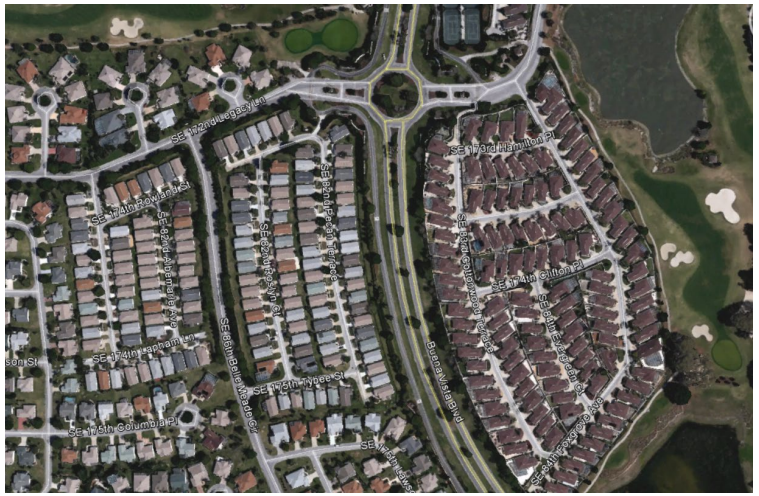
Springs Impairments – Lost Flow

Groundwater resources are stressed:

- Groundwater consumption is very high
- Groundwater levels have fallen
- Spring flows are lower

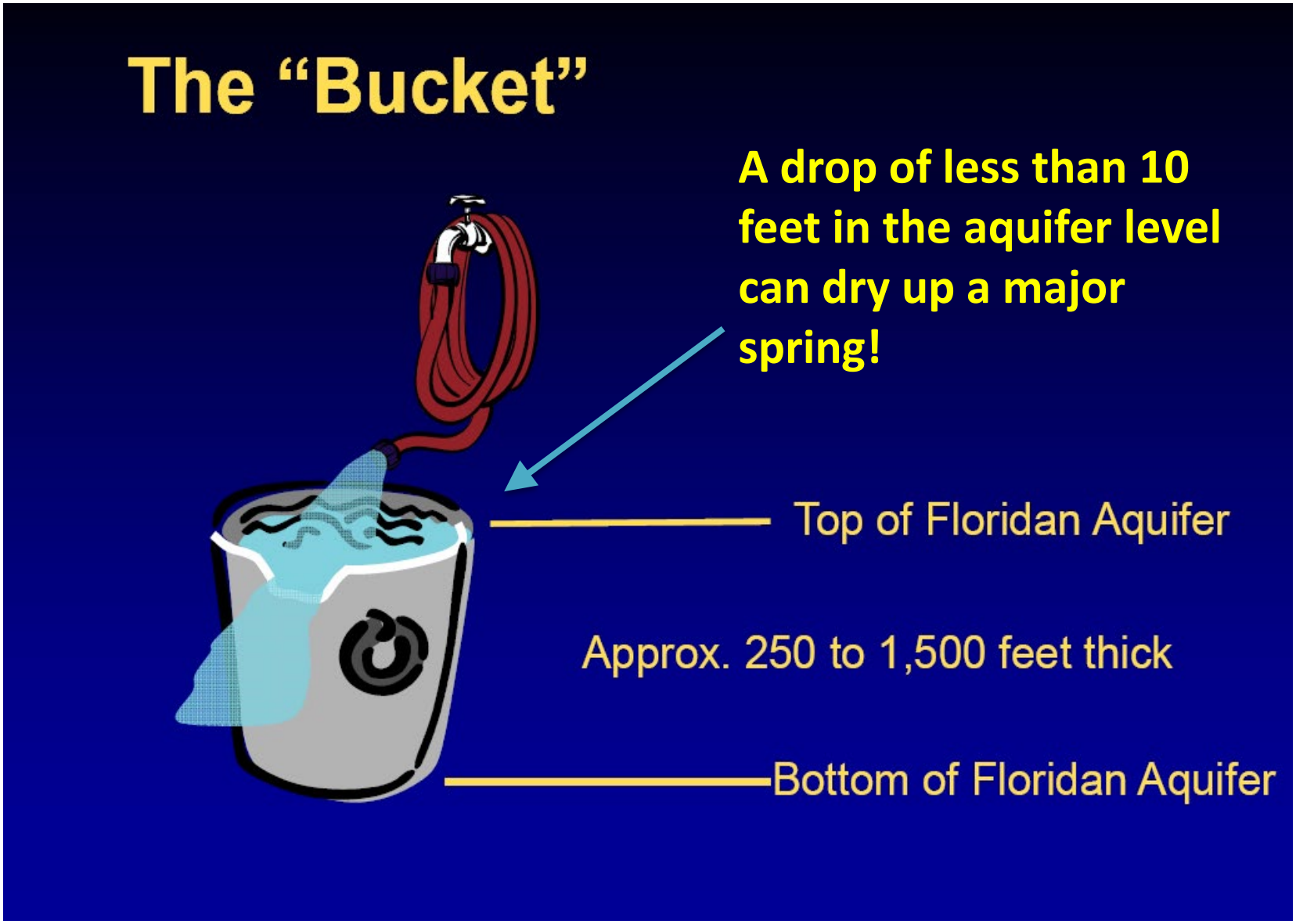
Commercial

Agriculture

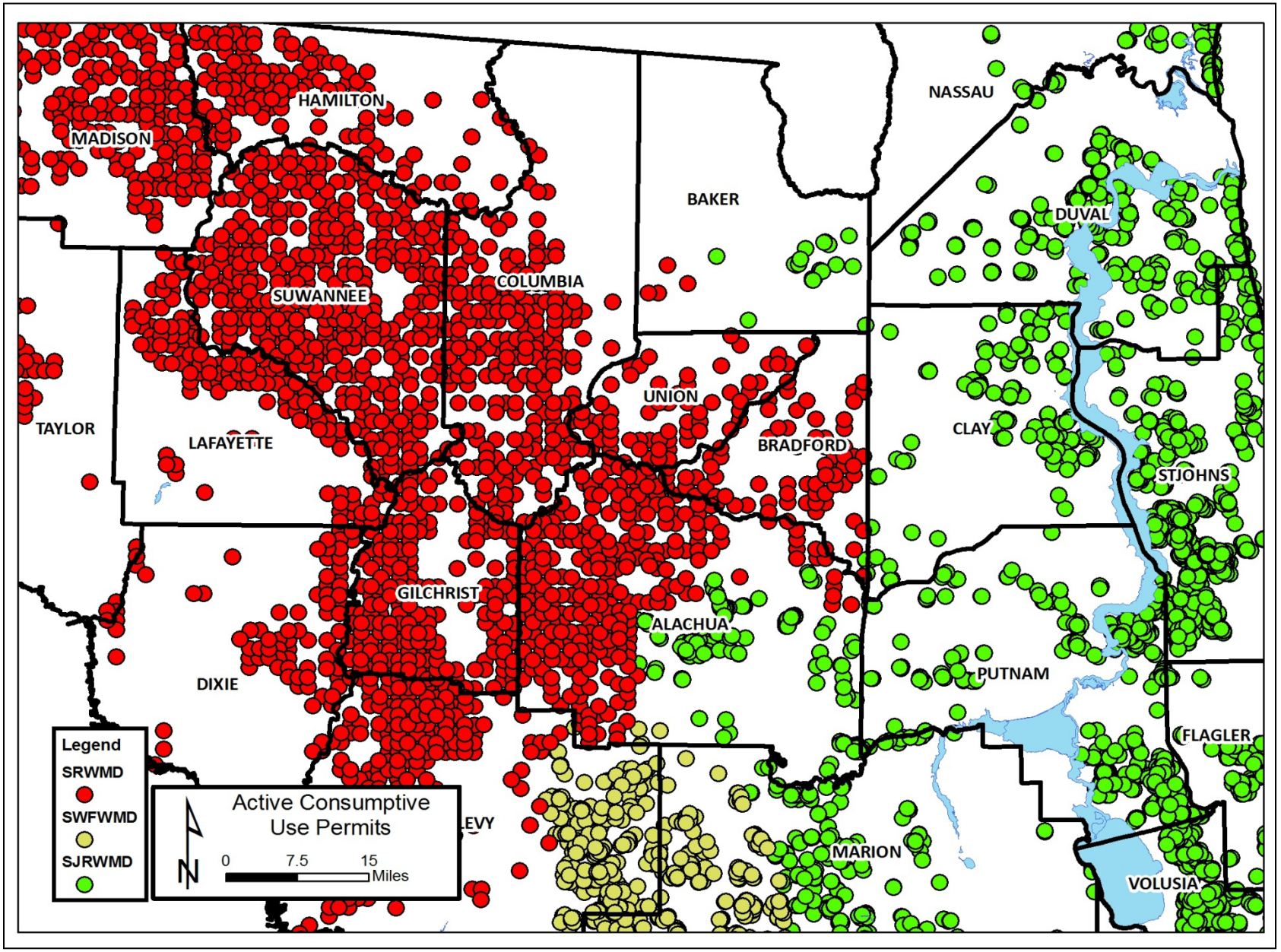


Urban

Springs Flow From the Top of the Aquifer



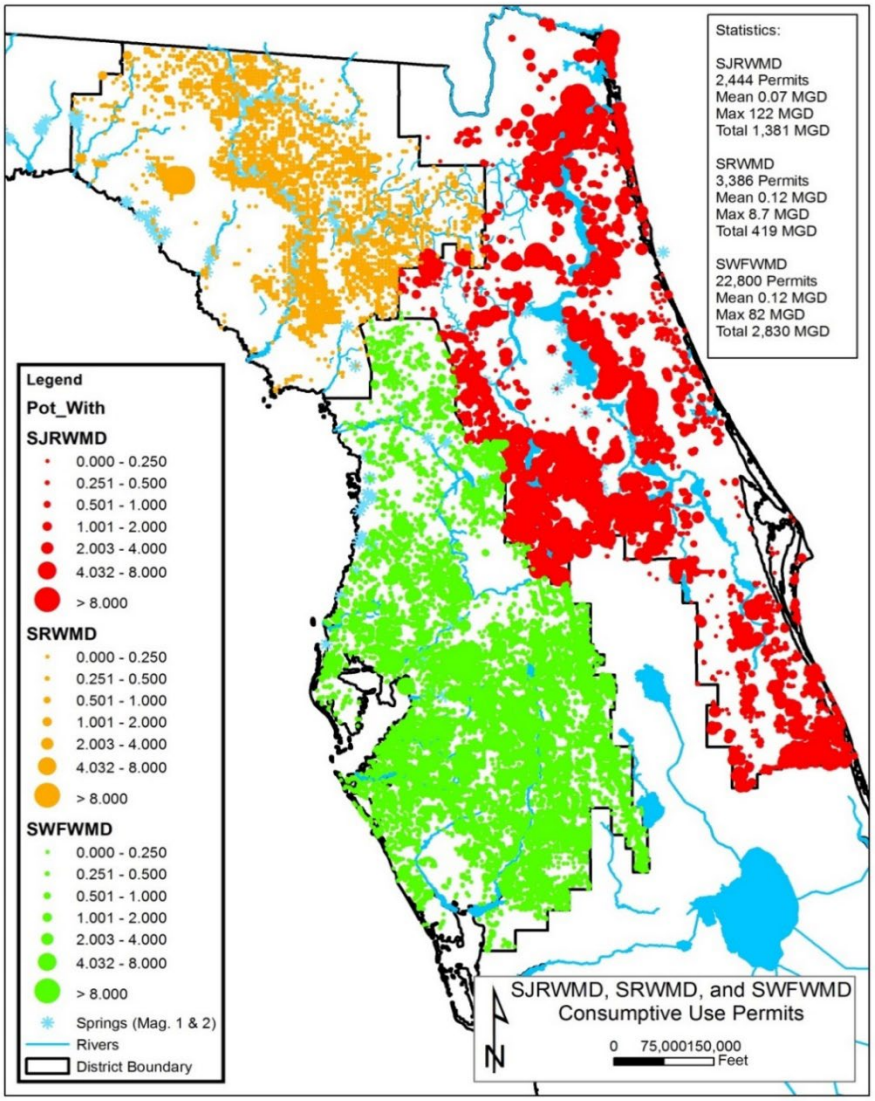
Only the Largest Wells Need a Permit



The Floridan Aquifer is Over-Permitted

Existing groundwater consumptive use permits:

- Estimated 2010 pumping – 2,622 MGD = 26% of recharge
- Total allocated groundwater use in Florida – 4,630 MGD = 46% of entire aquifer recharge
- Georgia pumping about 1,000 MGD



Water Management District data

North Florida has Issued 30,000 Large Water Use Permits Allocating More Than 4.6 billion gallons of groundwater pumping per day

40 center-pivot irrigation systems at Southern Cross Dairy (Google photo)

Spring Flow Declines by Water Management District (1930-2000)

WMD	# Springs	Est. Historic Flow (MGD)	Current Avg. Flow (MGD)	Change Flow (MGD)	% Change
NWF	318	2,397	2,013	-385	-16
SJR	151	1,277	1,000	-276	-22
SR	314	4,745	2,449	-2,296	-48
SWF	238	2,070	1,691	-379	-18
Total	1,021	10,489	7,153	-3,336	-32

Knight and Clarke 2016. Florida Springs—A Water-Budget Approach to Estimating Groundwater Availability. J. Earth Science & Engineering.

Abundant Groundwater = Healthy Springs

White Sulfur Springs on the Suwannee River in the 1920s

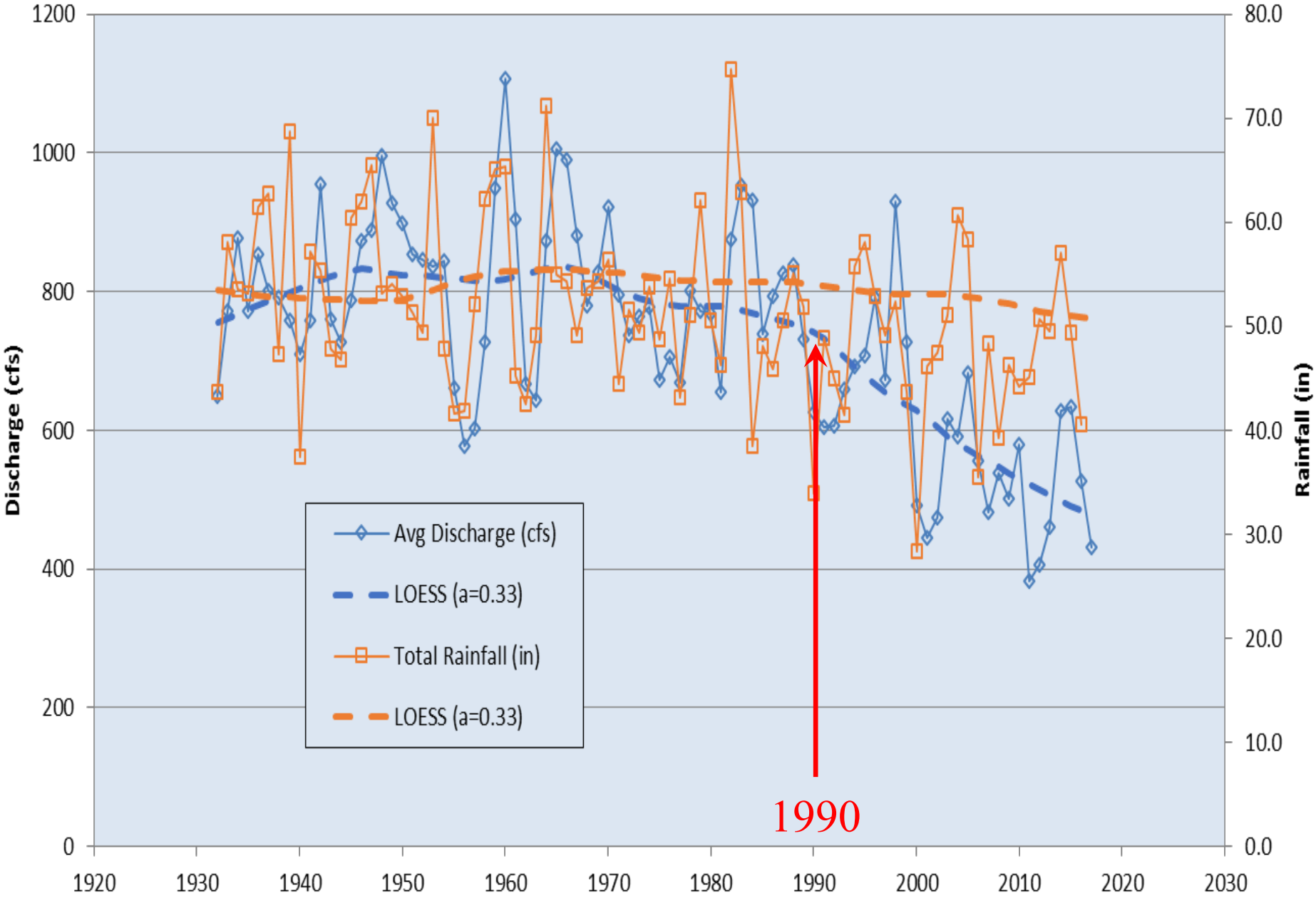
46 MGD

Excessive Pumping Lowers Aquifer Levels and Dries Up Springs

White Springs declining flows since 1960s

(John Moran photo)

Silver Springs Annual Rainfall and Annual Discharge



Springs Impairments – Nutrients

GW nitrate nitrogen levels are increasing:

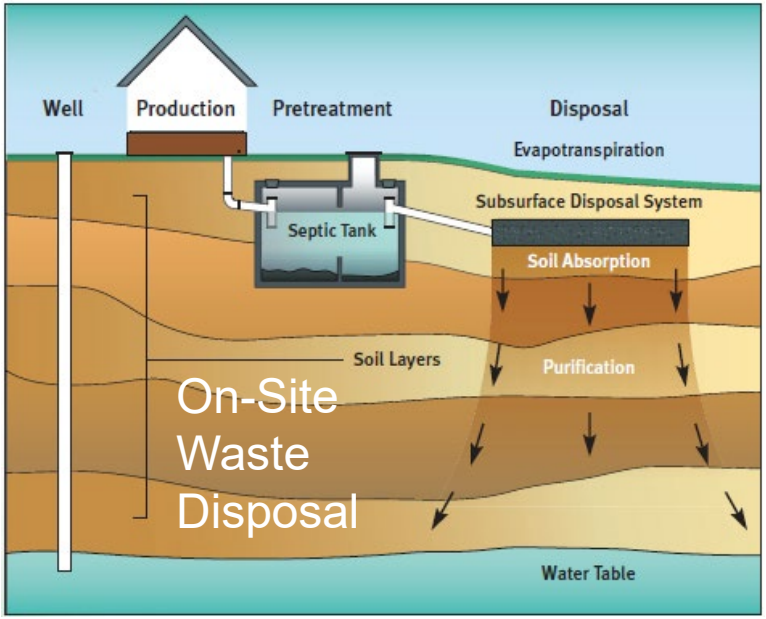
- Nitrate contamination is wide-spread in the Floridan Aquifer
- Springs are sensitive to elevated nitrate

John Moran photos

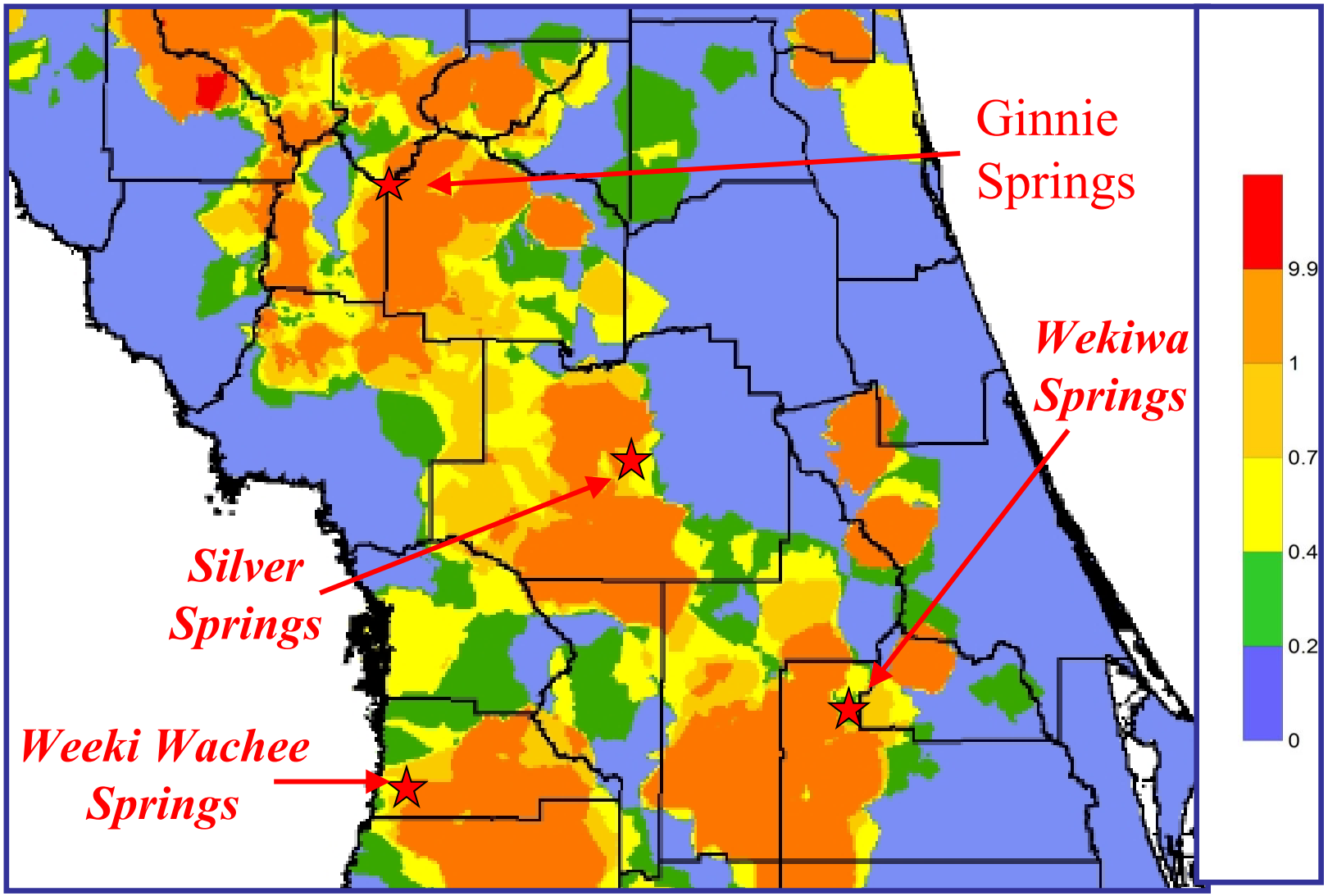
Everything we pour on the ground up here
ends up in our drinking water down there...
John Moran photo

Sources of Nitrate-Nitrogen

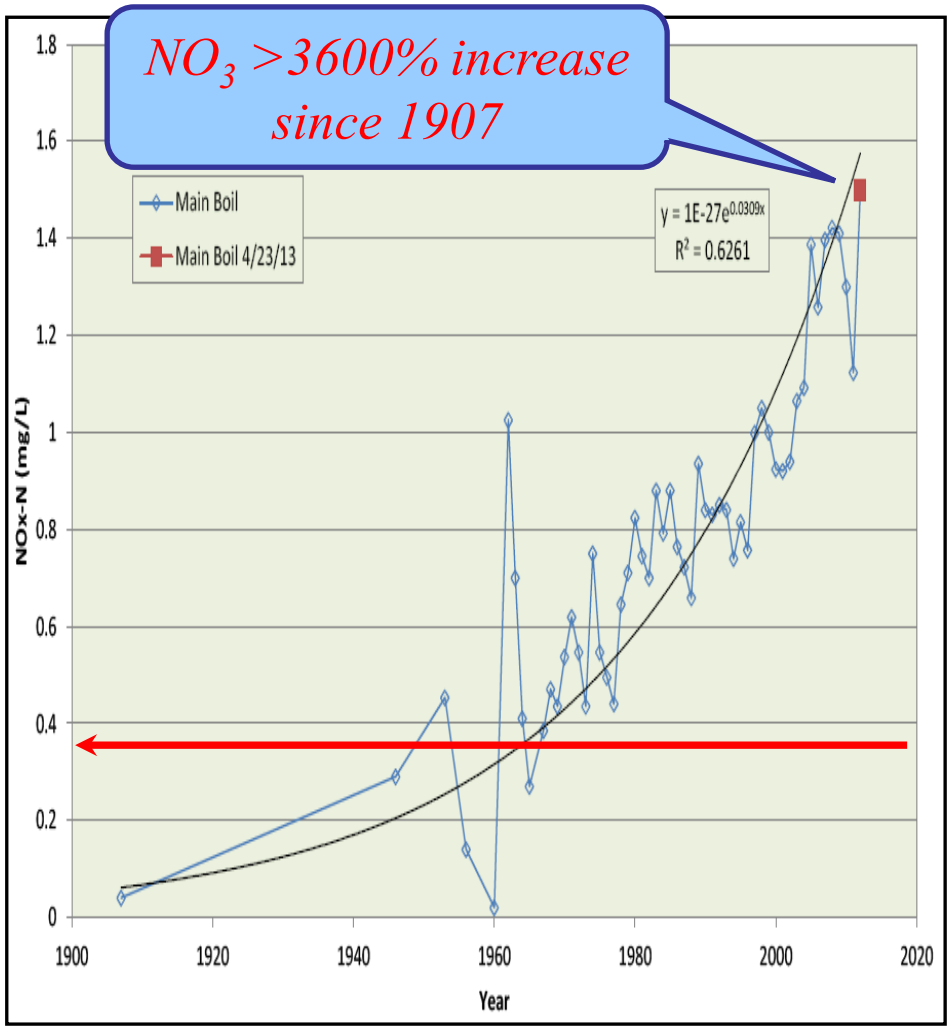
- Wastewater spray fields
- Animal waste
- Septic tanks
- Fertilizers



Groundwater Nitrate Concentrations are Very High (mg N/L)



Silver Springs Nitrate Concentration Needs to be Reduced by 79%



Greatly exceeds 0.35 mg/L spring standard!

Year	Nitrate-N Load (tons/yr)
1957	47
1979	407
1995	478
2005	529
2055 (projected)	880

Wakulla Spring – 1960s

Wakulla Spring - 2013

Fanning Springs, 1989
THEN&NOW
Fanning Springs, 2012

Levy Blue Springs, 1992

THEN & NOW

Levy Blue Springs, 2011

Nitrate in Spring Water = Nitrate in Drinking Water

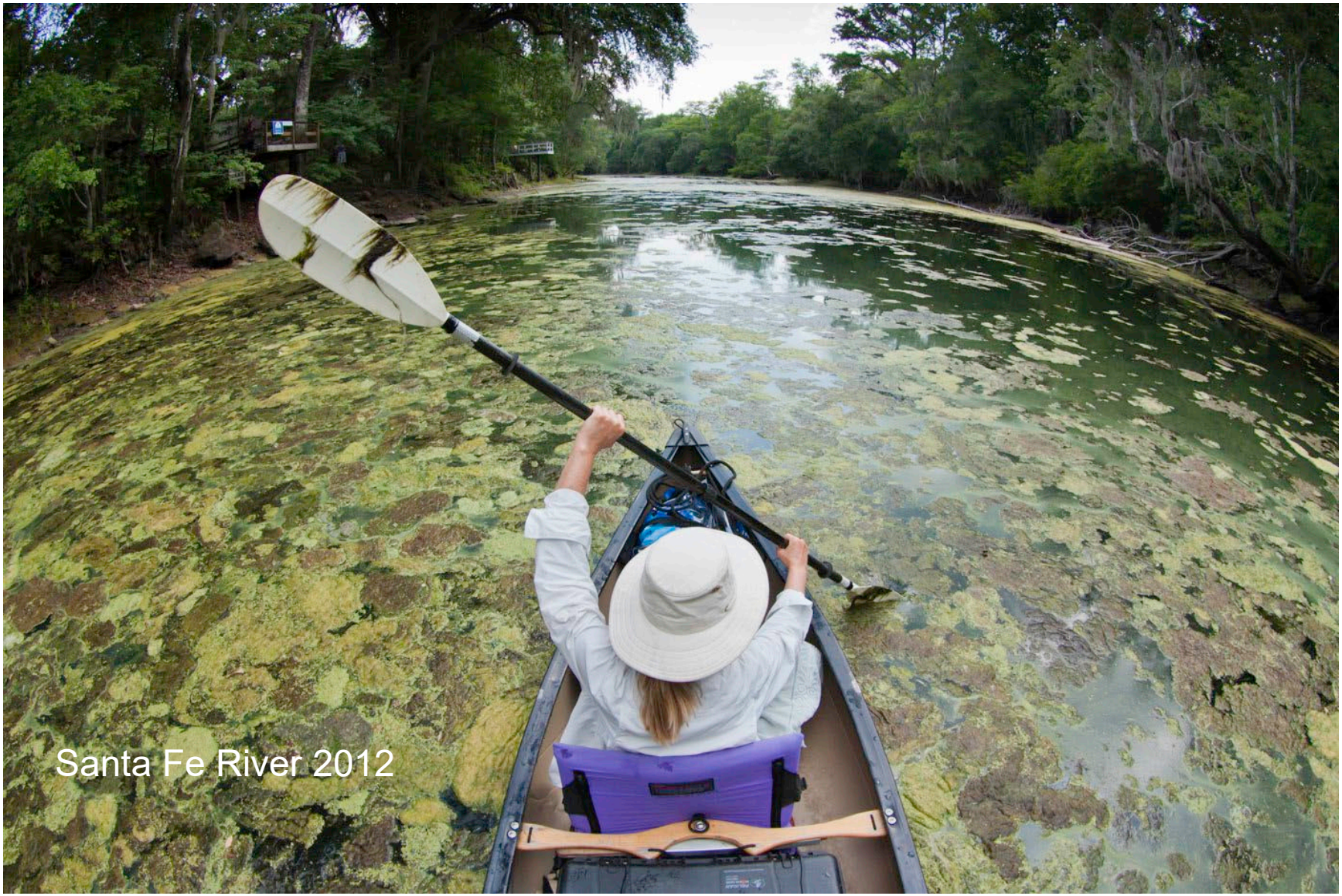
*Elevated nitrate in drinking water can result in **blue-baby syndrome**, a condition that can result in infant suffocation, and possibly **cancer** in adults.*

Water Quality and Quantity Bind North and South Florida

South Florida Water Woes

Photos by John Moran

North Florida Water Woes



John Moran photo

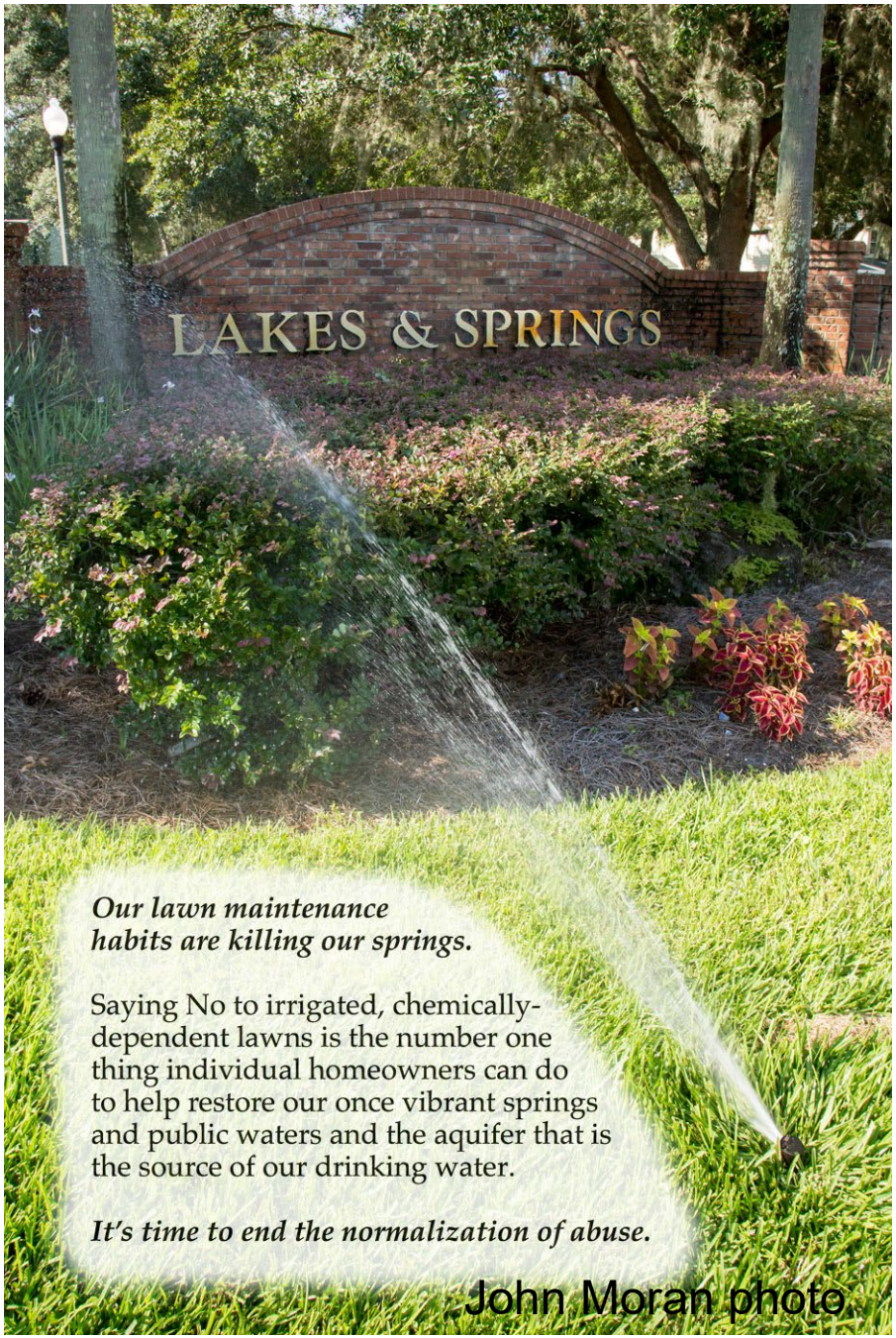
Key Springs Restoration Issues

1. Reduced spring flows due to competing groundwater uses
2. Elevated groundwater nitrate due to high fertilizer loads, and inadequate wastewater management
3. Man-made structures, including dams and seawalls

Affordable Solutions are Available:

- Place a cap and fee on all groundwater withdrawals;
- Place a cap and fee on all anthropogenic nitrogen sources; and
- Utilize the revenue from these “Aquifer Protection Fees” to protect vulnerable lands in the springshed.

Ichetucknee River
Jenny Adler photo



John Moran photo

Springs Friendly Yards

Replace all landscape Irrigation with Rainwater

Eliminate fertilizer use

Plant native species

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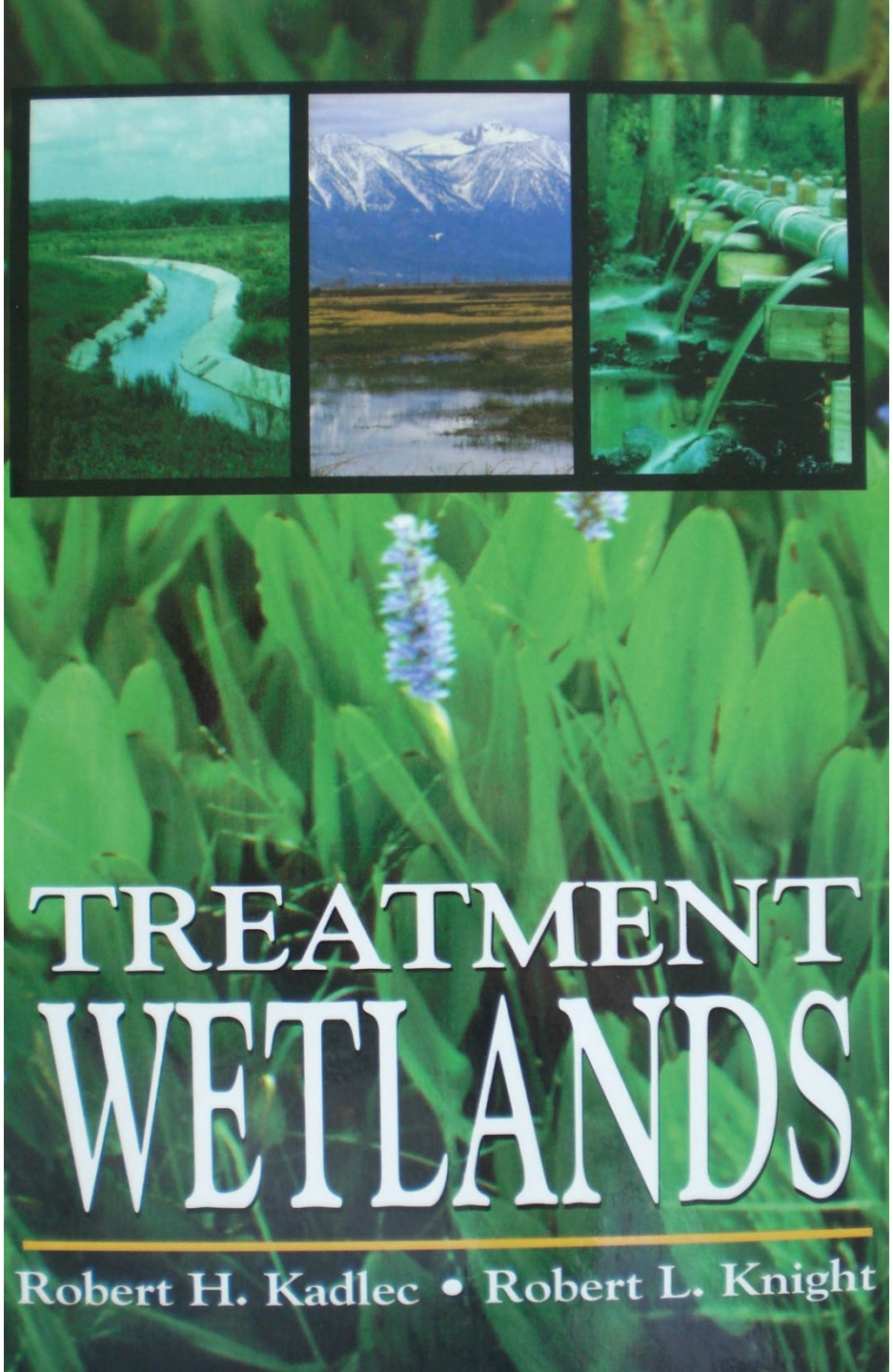
In Karst Areas, Convert Intensive Ag to Long Leaf Pine Forests

John Moran photos

A Practical Solution for Wastewater/Stormwater Treatment and Reuse:

Constructed Treatment Wetlands

- *Cost efficient nitrogen removal*
- *Beneficial reuse for aquifer and stream recharge*
- *Create wildlife habitat*



Clean And Abundant Water Will Likely Be The Most Important Environmental Issue Affecting Our Future!

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