

# Making the Most of Reclaimed Water

We're using water wisely  
by irrigating with  
reclaimed water



Please don't drink the water



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## Water & Nutrients

**Erich Marzolf, Ph.D**

**St. Johns River Water Management District**

# *What is Reclaimed Water?*

“Water reuse involves taking domestic wastewater, giving it a high degree of treatment, and using the resulting high-quality reclaimed water for a new, beneficial purpose. Extensive treatment and disinfection ensure that public health and environmental quality are protected.”



**Source: FDEP website**



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# *The Case for Reuse of Reclaimed Water*

- There is an ongoing search for water sources other than aquifers (rivers, estuaries, oceans, reuse) to meet growing demand
- Reducing effluent disposal into water bodies helps reduce nutrient pollution
- Our wastewater has to go somewhere
- Since ~50% of domestic water goes for landscape irrigation, reclaimed water appears to be a good alternative to irrigating with potable water



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# *Reuse - Nutrient Recognition*

## 2010 Senate Select Committee on Florida's Inland Waters

- Finding #4  
"Preliminary studies have shown that using reclaimed water for irrigation may lead to increased nutrient loading to Florida's water bodies."
- Recommendation #9  
"Require the DEP to study the effects that reclaimed water have on nutrient loading in Florida's water bodies and report its findings to the Legislature. If it is determined that using reclaimed water has negative effects, then the DEP must provide recommendations in its report that eliminates such effects."



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# 2009 WateReuse Foundation Study



**A Reconnaissance-Level Quantitative  
Comparison of Reclaimed Water,  
Surface Water, and Groundwater**

**Has been  
summarized,  
“Reclaimed,  
surface and  
ground water  
more similar  
than dissimilar”**

**True for many  
compounds, but  
not nutrients**

TD  
429  
.H44  
2009

WateReuse  
Foundation



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# 2009 WaterReuse Foundation Study Sampling Areas

## Tampa Bay Metro Area Nutrient Impaired Examples

- Tampa Bay
- Lake Hancock
- Banana Lake
- Lake Lena
- Lake Parker
- Alligator Lake
- Lake Tarpon

## Orlando Metro Area Nutrient Impaired Examples

- St. Johns River
- Lake Monroe
- Lake Jesup
- Wekiva & Rock Springs
- Lake Apopka

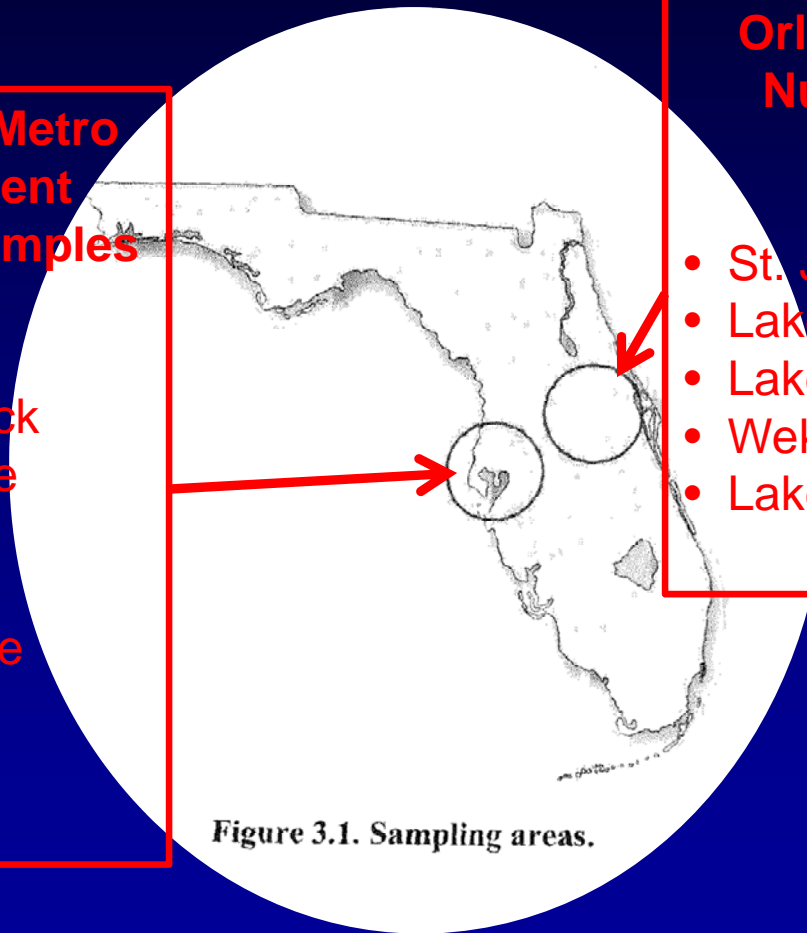


Figure 3.1. Sampling areas.

These areas include nutrient impaired waterbodies and thus begs the question, Are comparison is being made to already polluted waterbodies? Sampled waterbodies are not listed, so question can't be answered.

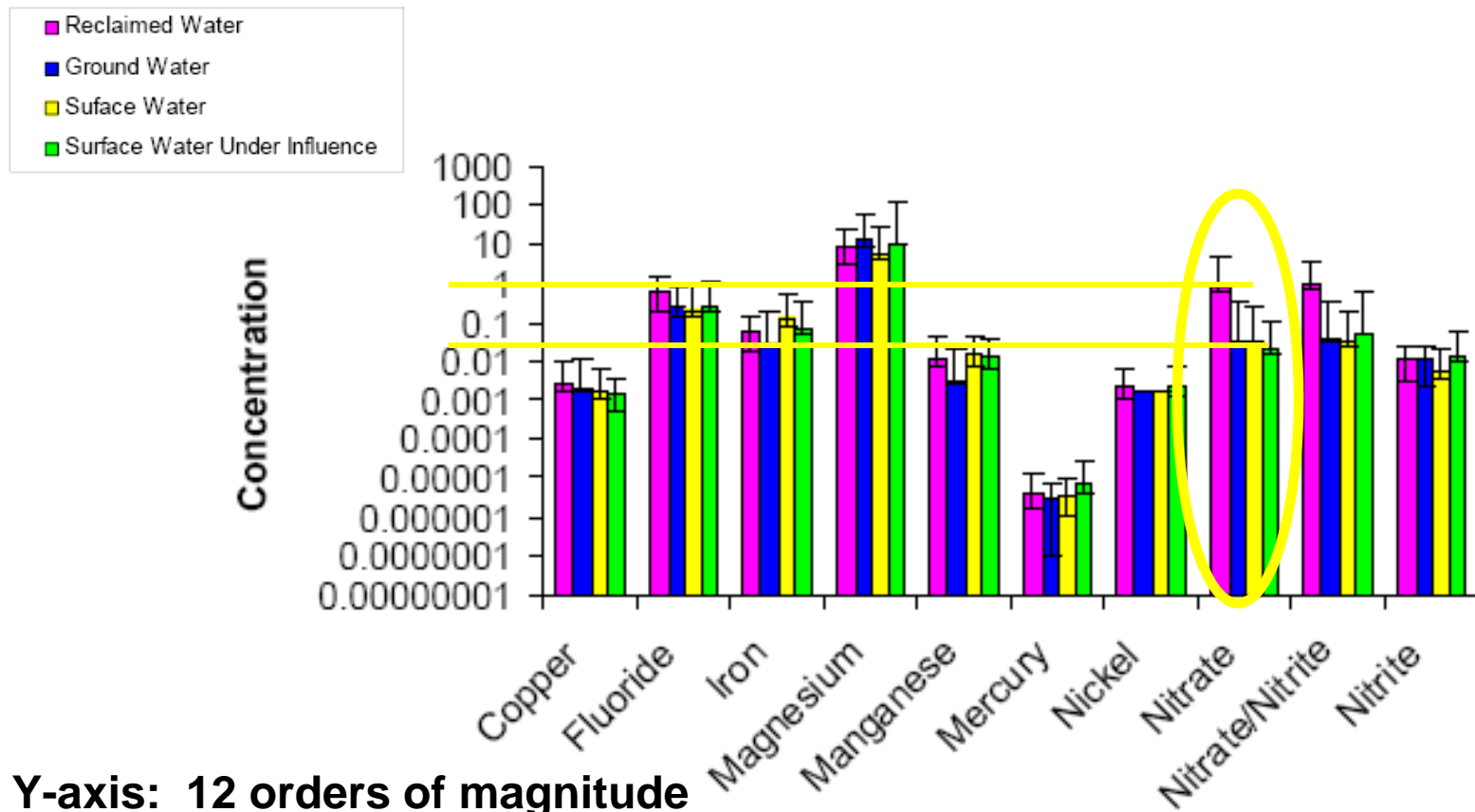


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# 2009 WaterReuse Foundation Study Water Quality Data

**FIGURE 4**

Concentrations of inorganic constituents (mg/L) (continued)



Y-axis: 12 orders of magnitude

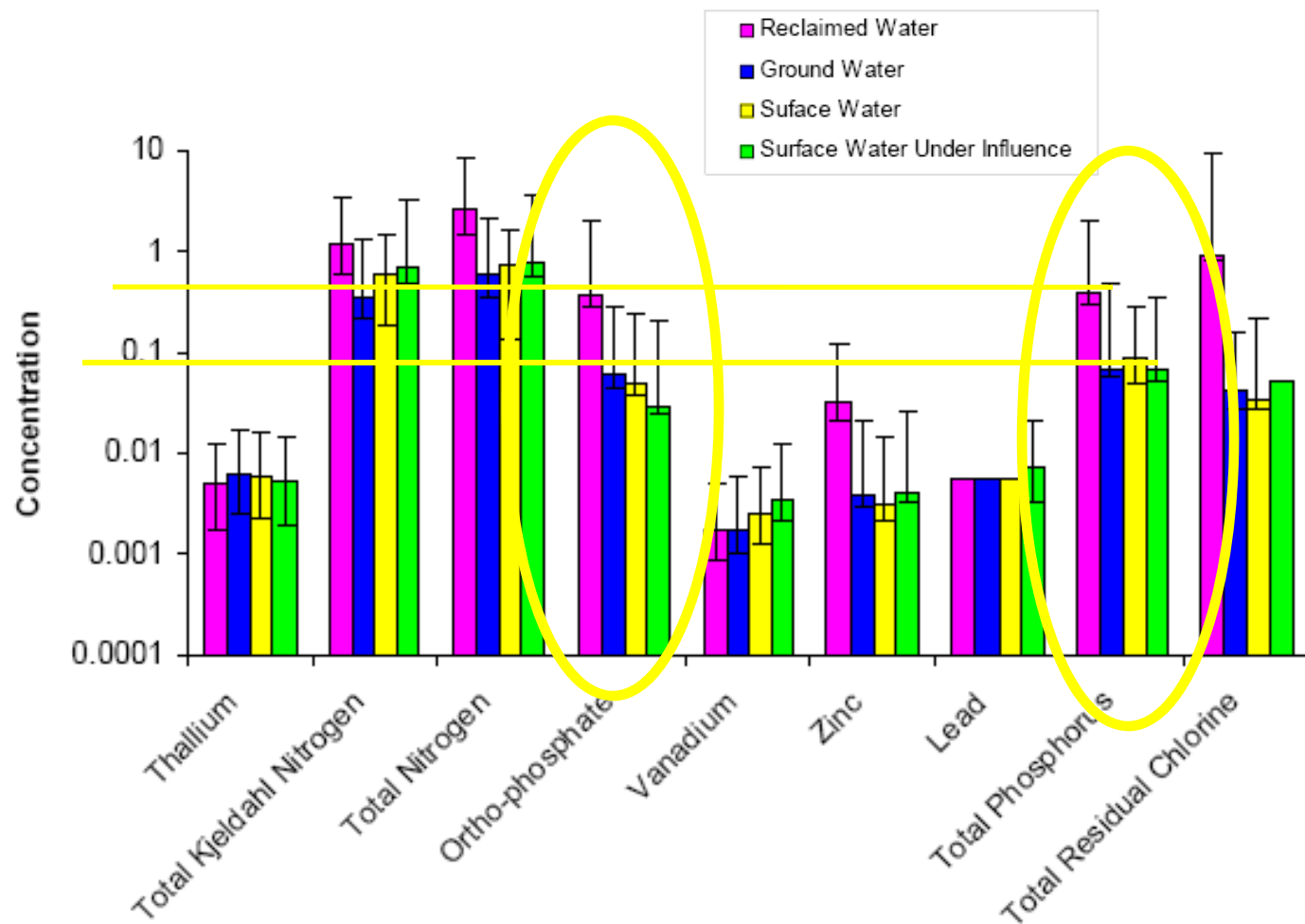


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# 2009 WaterReuse Foundation Study Water Quality Data

**FIGURE 15**

Concentrations of inorganic constituents (mg/L) (continued)



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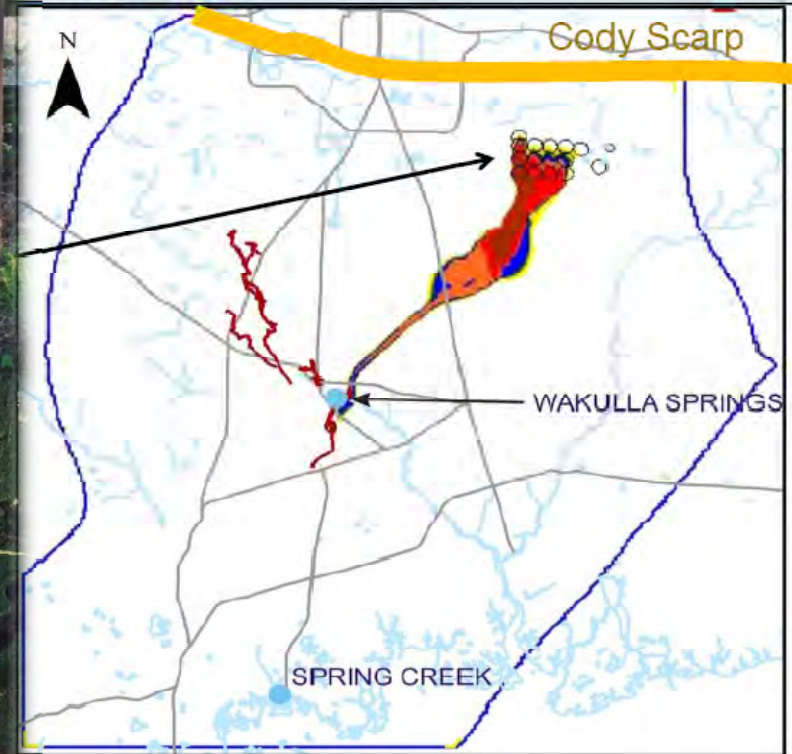
# Wakulla Springs

*Southeast Farm*

An Award-Winning Water Reuse Facility

City of Tallahassee  
Your Own Utilities

Southeast Farm Sprayfield and Related Nitrate Concentrations.



**Simulated Nitrate Concentrations:**

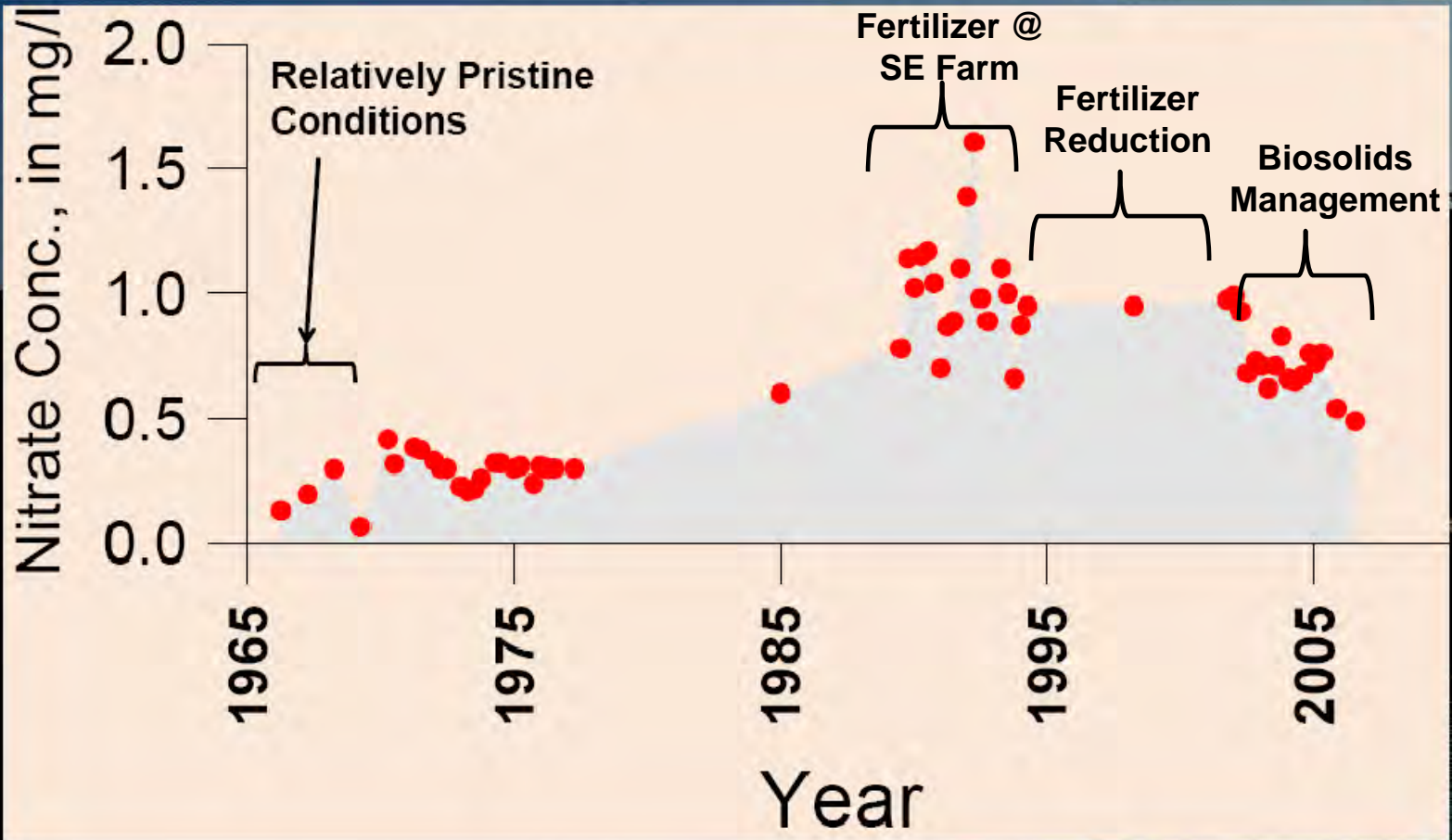
- Greater Than 0.1 mg/l
- Greater Than 0.2 mg/l
- Greater Than 0.3 mg/l
- Greater Than 0.4 mg/l
- Greater Than 0.5 mg/l
- Greater Than 0.6 mg/l
- Greater Than 0.7 mg/l



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# Wakulla Springs Nitrate Concentrations

Nitrate Concentrations in Wakulla Springs from 1965 to 2006



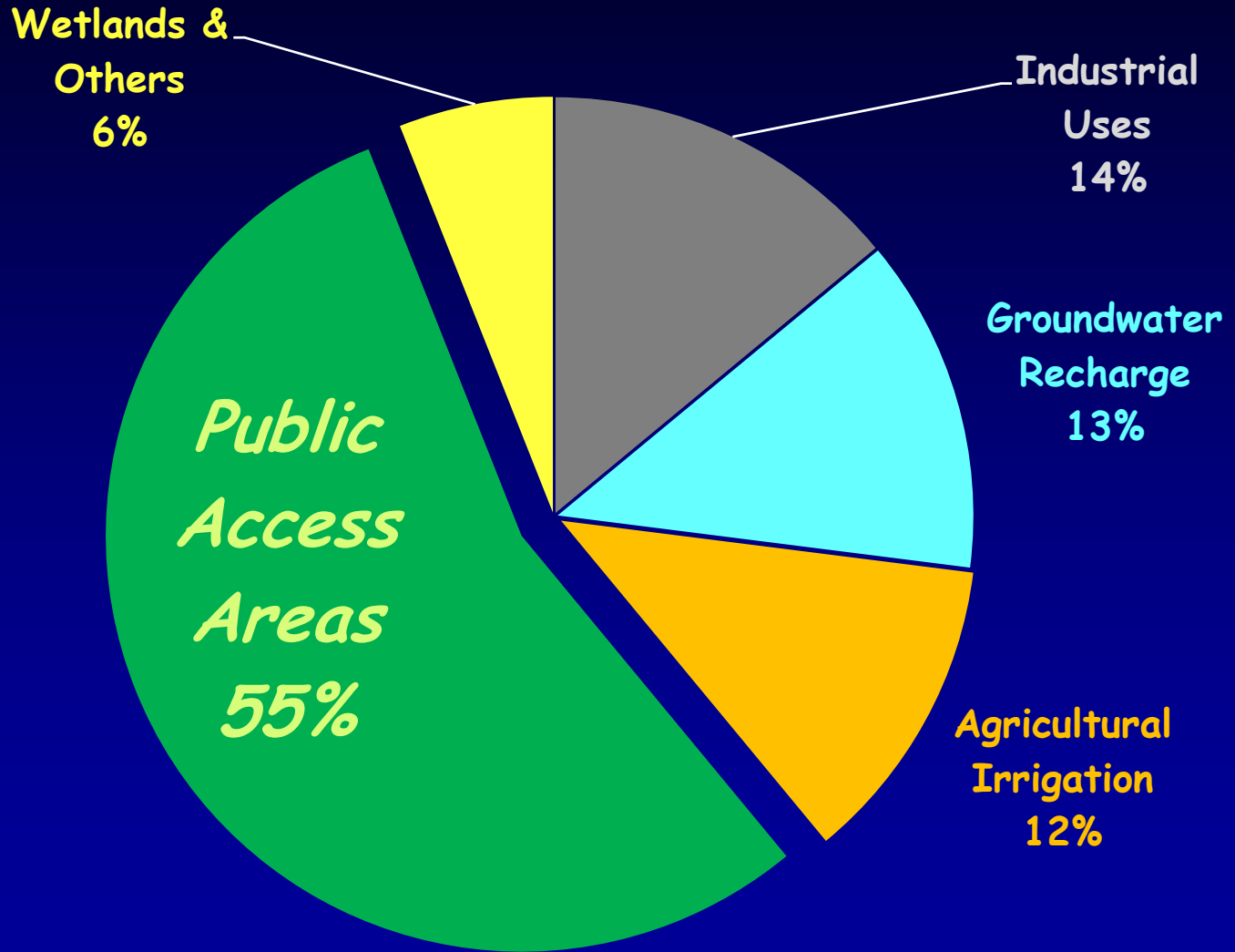
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Hal Davis, USGS, Feb 25, 2009.

# Reclaimed Water Use

## Reclaimed Water Use by Flow (2009)



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Shanin Speas-Frost – FDEP Reuse Coordinator

# Nutrient Needs of Plants

## What Reclaimed Water Concentration Meets Turf's Nutrient Demands?

*Where in Florida?  
What kind of plants?*

$$\frac{\text{MASS}}{\text{VOLUME}} = \text{“FERTILIZER” EQUIVALENT CONCENTRATION}$$

FDACS (2008) rule lbs/year

Water Use up to 3"/week

*Where in Florida?  
Local irrigation rules*

For St. Augustine grass in central FL, irrigated at the SJRWMD's revised potable water irrigation rate, the critical P concentration is ~0.65 mg P/L. For nitrogen the concentrations are a range, 6 to 9 mg N/L.



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# *What If Reclaimed Water Meets Turf's Nutrient Demands?*

**REUSE  
CONCENTRATION** **IF** **>** **"FERTILIZER"  
EQUIVALENT  
CONCENTRATION**



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# Potential Winners!



Environment (less pollution)



Homeowners (buy less fertilizer)



Taxpayers (buy less fertilizer)



Taxpayers (less pollution cleanup)



Utilities (TMDL credit for offset??)



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# Nutrient Distribution

**Grow More Plants;  
Fertilize**



**Reduce Nutrient  
Pollution**



- Our nutrient impairment problems are in part, distribution problems
- Reuse is one way that nutrient distribution can create a better balance between need and supply, thus reducing pollution



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# *Fertilizer Needs by Reclaimed Customers*

- Most reclaimed water will supply customers' lawns with enough Phosphorus and can use Phosphorus-free fertilizer.
- The need for additional Nitrogen fertilizer is more variable.
- Utilities have information necessary to inform their reuse customers of the mass of nutrients delivered.



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# Reuse BMP Development

**Objective:** Evaluate the nutrients delivered via reuse from a fertilization perspective and develop BMPs for reuse irrigation of turf and to develop EMCs for areas with reuse to improve nutrient loading models

**Contractor:** UF/IFAS

**Participants:** FDEP, SJRWMD, others?? eg. WaterReuse Foundation, utilities, local governments

**Experimentally evaluate** role of irrigation rates, nutrient species, seasonality, soils and latitude

**Tentative Assumption**

- Irrigation with any reclaimed water source will supply the phosphorus needs of turf without the addition of P-containing fertilizer

**New BMP:** All reuse customers should use P-free fertilizer



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# Residential Fertilization Practices in the Wekiva Springshed

*Table 8: Frequency of fertilizer application (Last 12 Months) with outliers removed*

Population Segment	Average Annual Fertilizer Application Rate	(n)
All (Overall average)	3.53	(525)
Internal fertilizers (homeowner applied)	2.88	(341)
External fertilizers (lawn care company applied)	4.76	(183)
Homes using reclaimed water	4.56	(50)



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**Wekiva Residential Fertilizer Practices. 2009.**  
[http://www.dep.state.fl.us/water/wekiva/docs/wekiva-survey\\_fr0310.pdf](http://www.dep.state.fl.us/water/wekiva/docs/wekiva-survey_fr0310.pdf)

# Lake Tibet Watershed (Butler Chain of Lakes)



Mean Concentrations of NO<sub>x</sub> in Groundwater Samples Collected from Lake Tibet Sub-basins 1 and 2 from August 2008-February 2009

-Groundwater NOx standard = 10,000 ppb  
-Values below golf course areas exceed this value

Source: Dr. Harvey Harper, PE  
Environmental Research & Design



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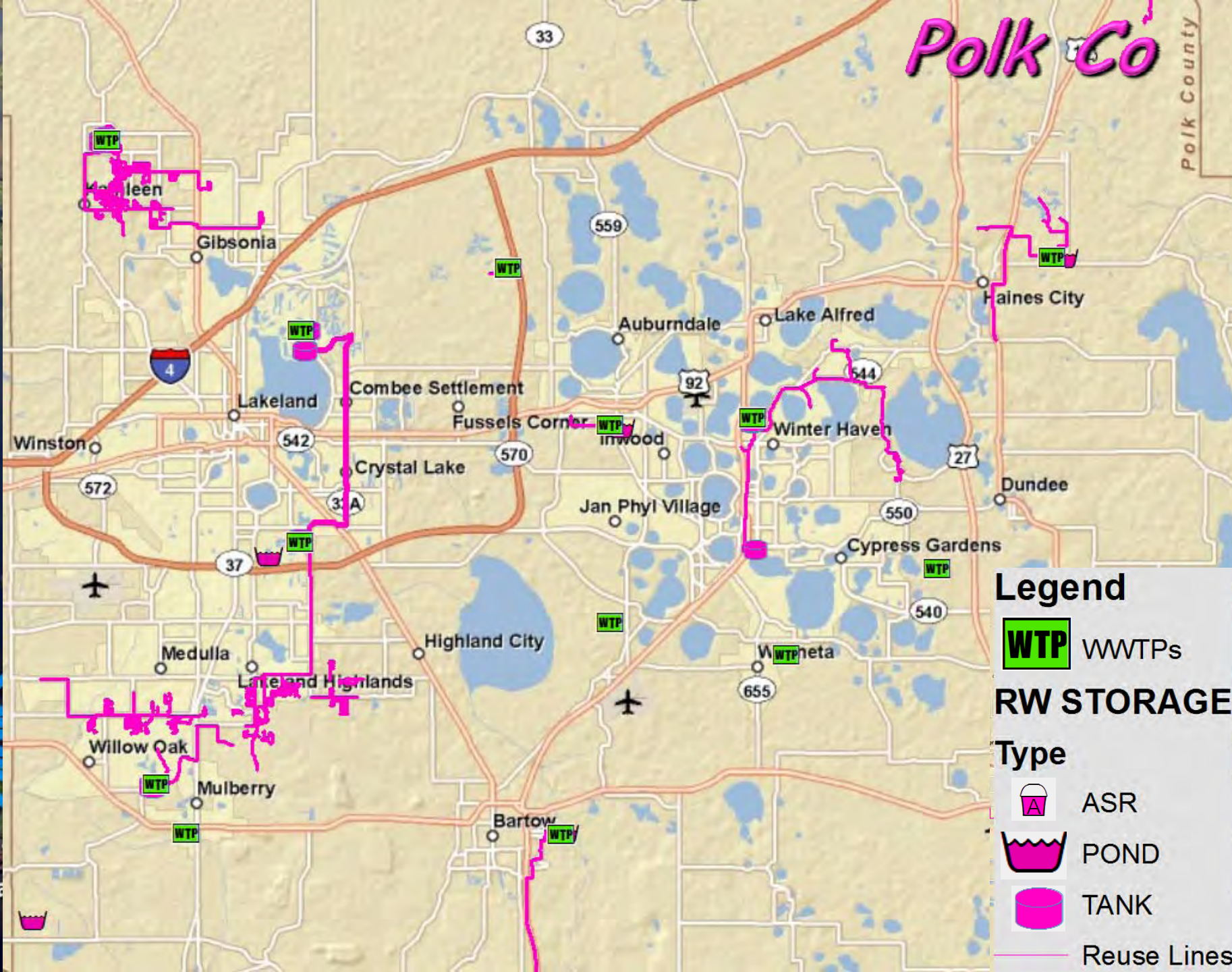
# *Where Do The Nutrients in Reclaimed Water Go?*

- Is there a potential for nutrients in reclaimed water to make it back to water bodies? **Yes!**
- Just like we can't ignore other activities which distribute nutrients on the ground (fertilizer, manure, septic systems, biosolids), reuse can't be ignored. We shouldn't assume that all nutrients distributed by reuse will be bound up by plants and soils.




# Polk Co

Polk County





## Legend

 WWTPs

## RW STORAGE

### Type

 ASR

 POND

 TANK

 Reuse Lines

# Reuse Irrigation Management



1. Expensive Point Source
2. Overspray greatly exacerbates nutrient runoff
3. No “fertilizer” buffer to protect pond is missing

Grand Haven (Flagler Co.)

$PO_4 \sim 4.5 \text{ mg/L}$

$DIN \sim 8.9 \text{ mg/L}$

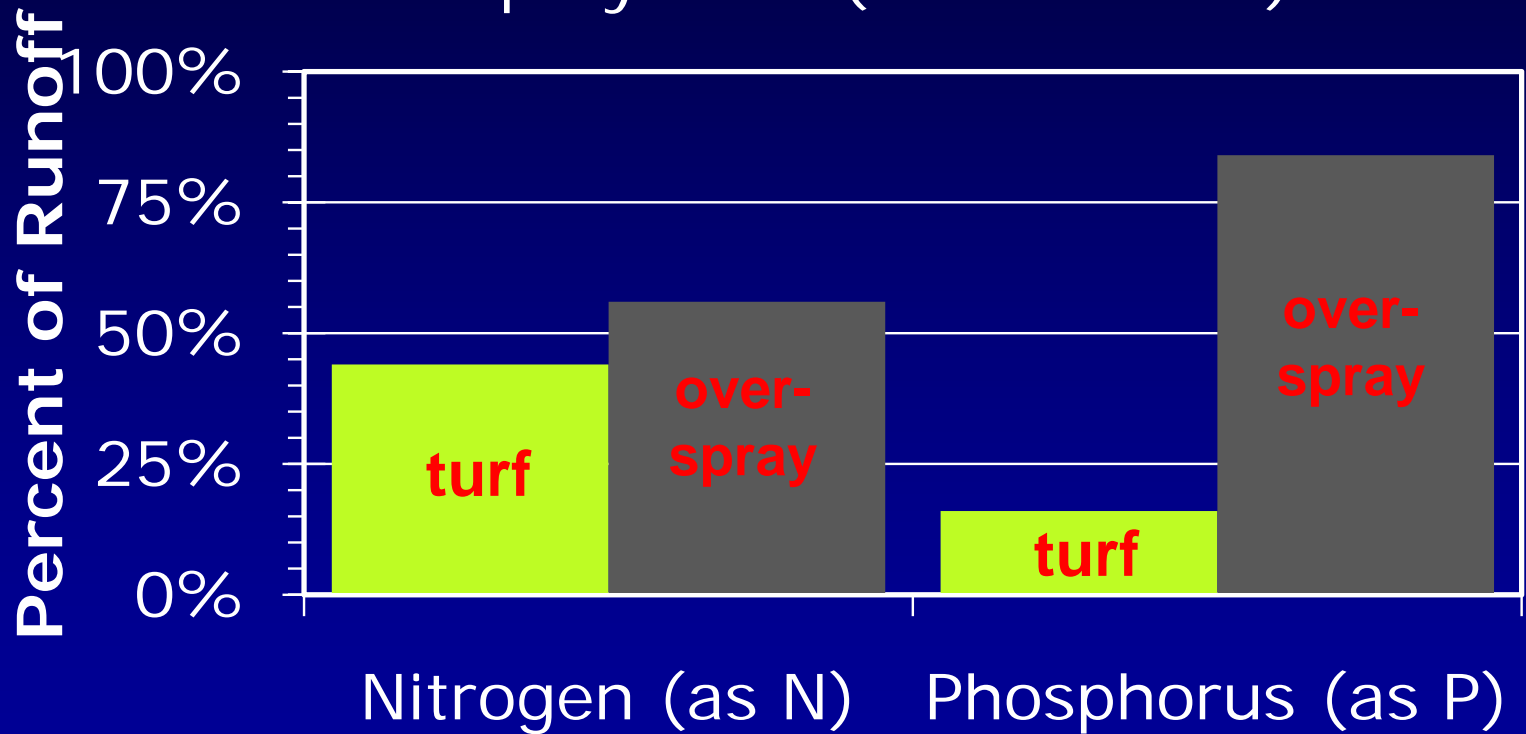


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# Estimated Overspray Loadings

## Percent of Nutrient Runoff

- Lawn Load (95% of water)
- Overspray Load (5% of water)



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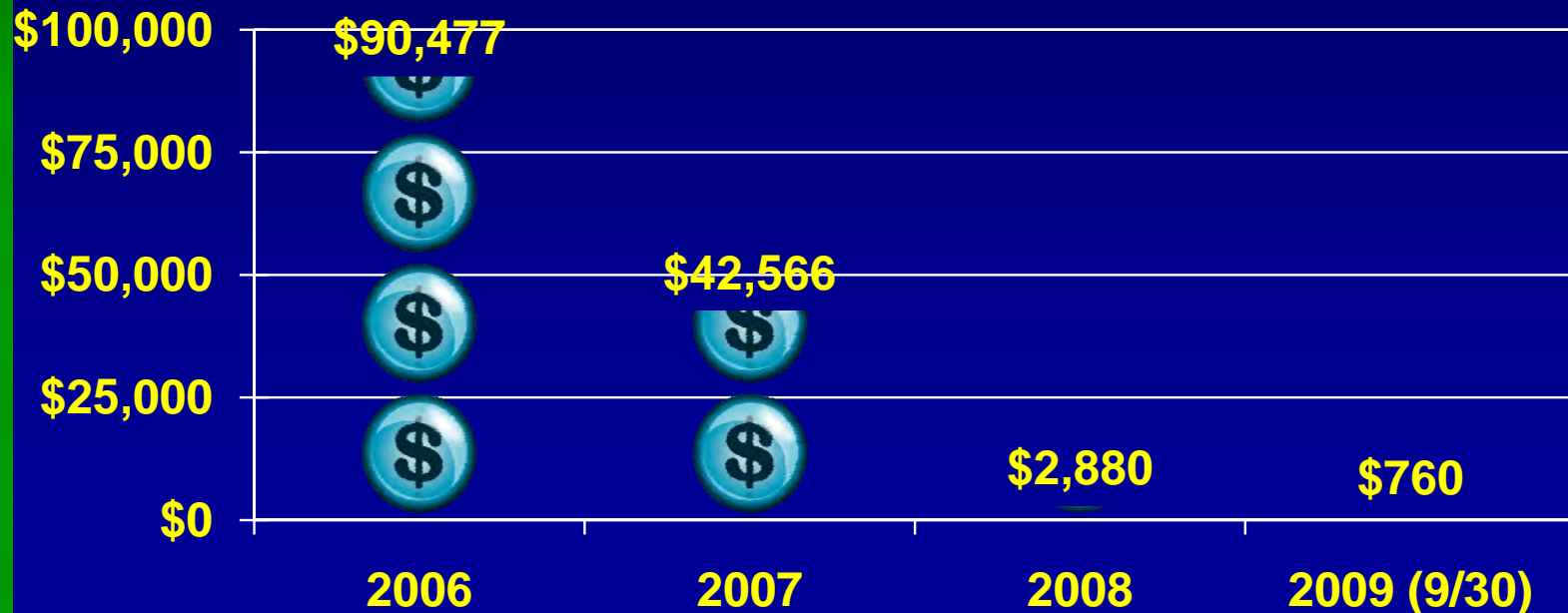
Good aim is important

# Reuse Management = Savings

Palmer Ranch Master Property Owners Association altered turf management on ~200 acres of common area turf to account for nutrients in reclaimed water

- Less unnecessary summer growth ~ \$16,000/yr savings on mowing
- Improved turf appearance & health which saved ~\$90,000/yr

## Annual Turf Refurbishment Expenses



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# *Pollution Prevention Vs. Pollution Clean Up*

- General Rule:  
Prevention is cheaper  
than Clean Up
- When evaluating  
techniques to meet  
nutrient load reductions  
(TMDLs) costs should  
matter to everyone
- Look for the easy, cheap  
low hanging fruit



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# *Point Source* *Non-Point (Reuse)*

- **Removing wastewater point sources is essential**
- **Reuse converts point source to a non-point source**
  - **We shouldn't assume the nutrients discharged via reuse can't return to water bodies**
  - **We need to educate reuse customers to use less fertilizer, because reclaimed water supplies nutrients as well as water**
- **Reuse is a means to:**
  - **Reduce point-source pollution**
  - **Offset potable water demand**
  - **Offset fertilizer needs**



*Questions? Comments? Discussion?*

Reuse &  
Restoration



OR

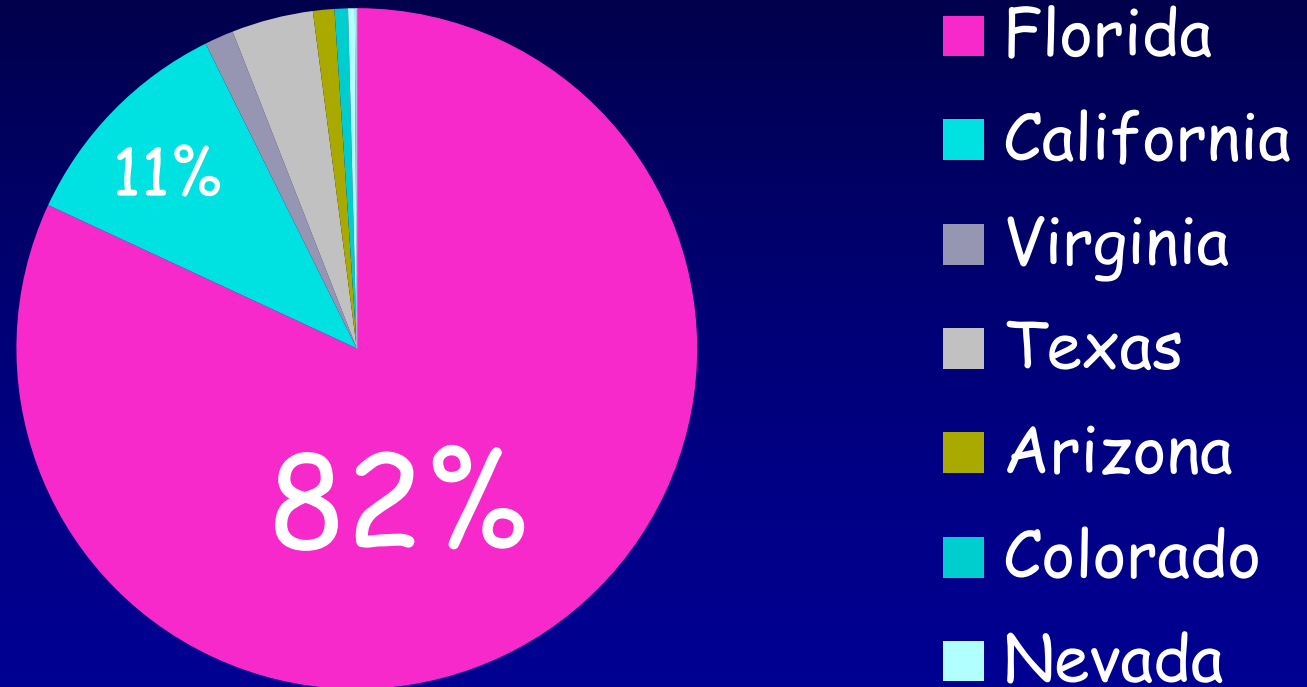
Reuse  Restoration



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# Reclaimed Water In the US

## Reported Reuse (mgd)



\*From the Water Reuse Foundation National Database of Water Reuse Facilities Summary Report, 2006

\*\*The state of Washington reported reuse systems and reuse pipe, but no reuse flow as of 2006.



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<http://www.dep.state.fl.us/water/reuse/inventory.htm>

# TMDLs & BMAPs

## Florida Efforts

- TMDLs & BMAPs for springsheds  
Analyses in Wakulla & Wekiva springsheds have documented the need to address reuse loads
- SJRWMD has just begun hydrogeologic investigations looking for most nitrogen sources most rapidly reaching Silver Springs
- Lake Jesup BMAP adopted but ongoing efforts to address sprayfields & reuse loads

## EPA Efforts

- Multiple proposed TMDLs
- Proposed Numeric Nutrient Criteria
- As proposed, each would require additional nutrient load reductions, thus all sources under additional evaluation



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# Reclaimed Water Tracer Study

**Objective:** To distinguish reuse inputs from other sources through development of reuse-specific markers that can then be used in Florida and other parts of the country.

**Contractor:** MWH

**Participants:** WaterReuse Foundation, FDEP, SJRWMD, SWFWMD, SFWMD, Orlando, Palm Beach, North Port, Pompano Beach, JEA, Miami-Dade Water & Sewer, Hillsborough Co, Orange Co Utilities

**Potential Tracers under evaluation include:**

- Isotopes of Boron, Strontium, Uranium, Nitrogen, Oxygen
- Sucralose (Splenda)
- Iohexal
- Gadolinium
- Galaxolide
- Carbamazepine
- Coprostanol

## Study Phases

- Literature Review
- Laboratory Evaluation of Markers
  - Reuse Plant Survey
  - Bench-Scale Experiments with soils
- Field Assessment
- Final Report - Sept 2011



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# County Code Example

## MARION COUNTY LAND DEVELOPMENT CODE SPRINGS PROTECTION OVERLAY ZONE (Silver & Rainbow Springs)

- (4) Any WWTF that provides Public Access Reuse shall institute a program to educate the end user about the value and benefits of Reuse. The program shall be designed to enable the user to easily calculate the amount of nitrogen was applied to the disposal area and, therefore, promote reduced use of purchased sources of nitrogen. The owners of the WWTF shall coordinate such program efforts with the Marion County Conservation Coordinator.



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## *It's the Water*

*"It is the water, folks,  
it is the water.....  
If we teach them how to  
manage irrigation,  
then they will be able to  
manage fertilizer."*



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Source: George Hochmuth, UF/IFAS



# Nitrogen Loads (as Fertilizer Equivalents) to Southeast Farm

(lbs/1,000 ft<sup>2</sup>/yr)

Irrigation (inches/week) (mgd)	WWTP Nitrogen Concentration (mg/L)		
	9.3	3	1.1
3 (23.3)	7.57 (379%)	2.43 (122%)	0.86 (43%)
2 (15.5)	4.87 (244%)	1.62 (81%)	0.57 (29%)
1.6 (12.1)	3.95 (198%)	1.27 (64%)	0.45 (23%)
0.91 (7.0)	2.3 (115%)	0.74 (37%)	0.26 (13%)

**1980**

Assumes a need for 2 lb N/1,000 ft<sup>2</sup>/year (St. Augustine in N FL) = 87 lb/acre



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# *Future of Reuse*



- Continued Reuse Expansion
  - Water Supply
  - Point Source Removal
- Reuse - Nutrient Issue Recognition
- Recent & Ongoing Studies
- Development of Reuse BMPs



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# Recent Progress

- FDEP is requiring Wastewater Treatment Plants to monitor and submit nutrient data as part of permit renewals

- Fertilizer companies are creating and marketing P-free fertilizers

- Studies to quantify reuse nutrient loadings and improve management

- The recent Report by the Florida Senate Select Committee on Florida's Inlands Waters included the following, "Require the DEP to study the effects that reclaimed water have on nutrient loading in Florida's water bodies and report its findings to the Legislature. If it is determined that using reclaimed water has negative effects, then the DEP must provide recommendations in its report that eliminate such effects."

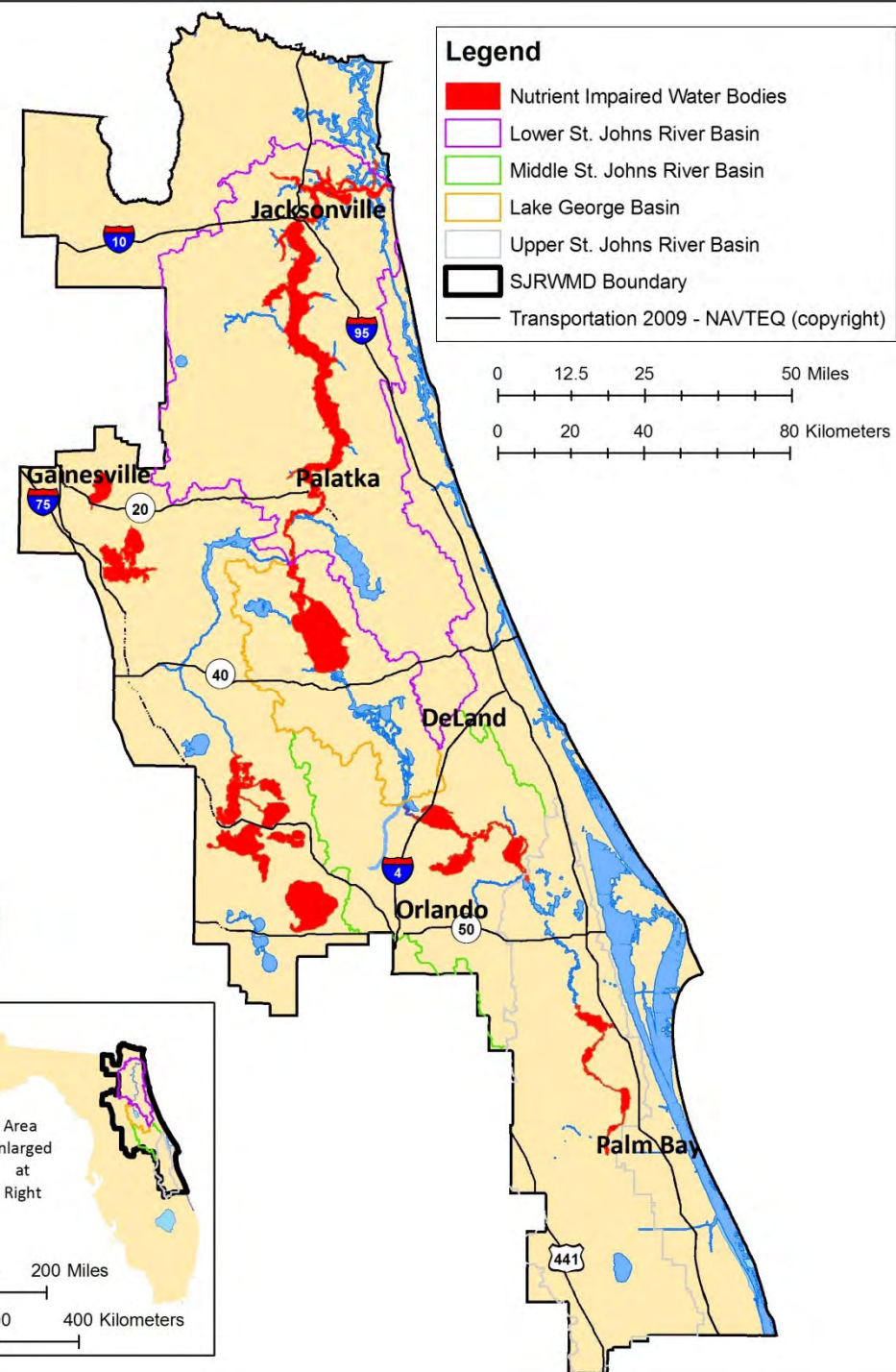
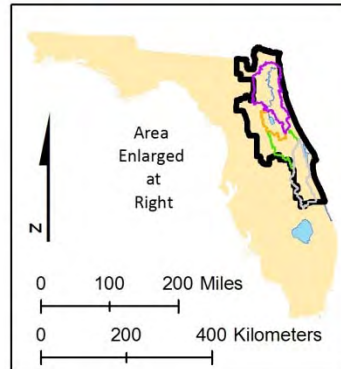


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# Nutrient Pollution in the SJRWMD



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# *Reuse Irrigation BMP Development*

Need to develop BMPs for reuse irrigation to address

- Overspray onto impervious surfaces & waterbodies
- Buffers around sensitive areas
- Ability to handle reclaimed water after pond storage (higher solids content) or stormwater/reclaimed mixtures
- Improved water use efficiency



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# Tallahassee Southeast Farm



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# Recent Progress

- DACS created rule in 2008 to address nutrients in fertilizer. DACS expects a 20 to 25 percent reduction in nitrogen and a 15 percent reduction in phosphorus in every bag of fertilizer sold to the public. The new rule requires that all fertilizer products labeled for use on urban turf, sports turf and lawns be limited to the amount of nitrogen and phosphorus needed to support healthy turf maintenance
- Orange and Seminole Counties have fertilizer ordinances.
- FDEP is requiring Wastewater Treatment Plants to monitor and submit nutrient data as part of permit renewals
- UF/IFAS is developing a Scope of Work to develop Best Management Practices (BMPs) for reuse, including a fertilizer offset for reclaimed water.
- The recent Report by the Florida Senate Select Committee on Florida's Inlands Waters included the following, "Require the DEP to study the effects that reclaimed water have on nutrient loading in Florida's water bodies and report its findings to the Legislature. If it is determined that using reclaimed water has negative effects, then the DEP must provide recommendations in its report that eliminate such effects."



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# Future of Reuse



- Continued expansion to help address water supply & removal of point source discharges
- Reuse - Nutrient Issue Recognition
  - Wakulla Springs demonstration
  - 2009 Conference "Emerging Issues with Reclaimed Water"
  - 2010 Select Committee on Florida's Inland Waters
- Development of BMPs for reuse
  - Evolution toward irrigation rates similar to potable water (water supply & nutrient loading)
  - Recognition of nutrients delivered and fertilizer offset promoted
    - Reuse customers use P-free fertilizers
    - Reuse customers use less N fertilizer
  - Turf evaluated as a functional land cover, less by green intensity
  - Irrigation design & maintenance
    - Reduce overspray (water supply & nutrients)
    - "Nutrient-free" buffers similar to fertilizer
- General improvement in nutrient treatment at WWTP (2<sup>nd</sup> to 3<sup>rd</sup>)
- Continued increases in reclaimed costs (free, fixed fee, metered)



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# Future of Reuse



- Continued reuse expansion to help address
  - water supply
  - removal of point source discharges
- Reuse - Nutrient Issue Recognition
  - 2010 Senate Select Committee on Florida's Inland Waters
  - Wakulla Springs demonstration
  - 2009 Conference "Emerging Issues with Reclaimed Water"
- Recent Studies
  - Reclaimed Water Tracer Study
  - Comparative Study
  - Loxahatchee Study
- Development of BMPs for reuse
  - Recognition of nutrients delivered and fertilizer offset promoted
    - Reuse customers use P-free fertilizers
    - Reuse customers use less N fertilizer
  - Irrigation design & maintenance
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