

Florida Department of Environmental Protection



Wakulla Springs Basin Nitrogen Sourcing Inventory

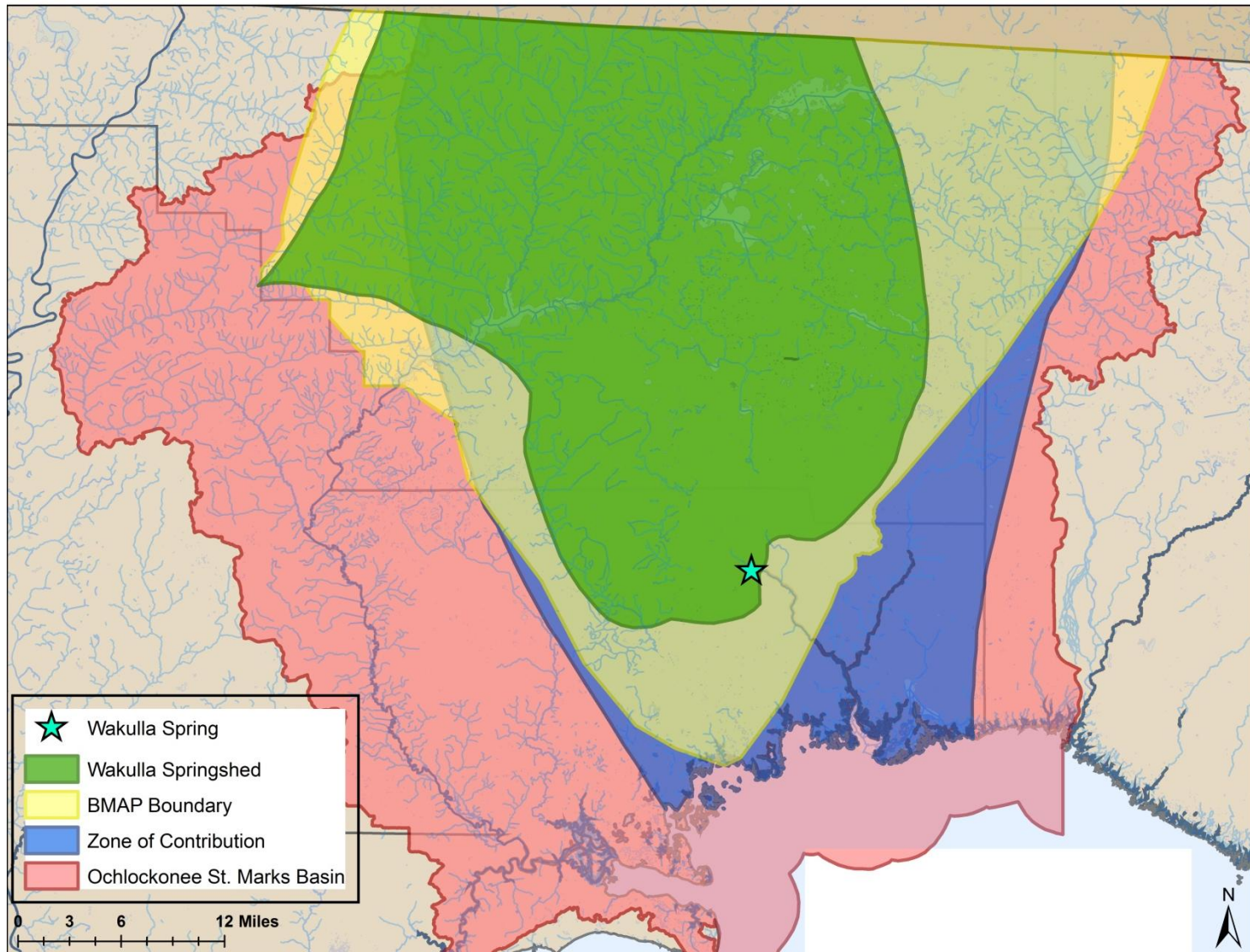
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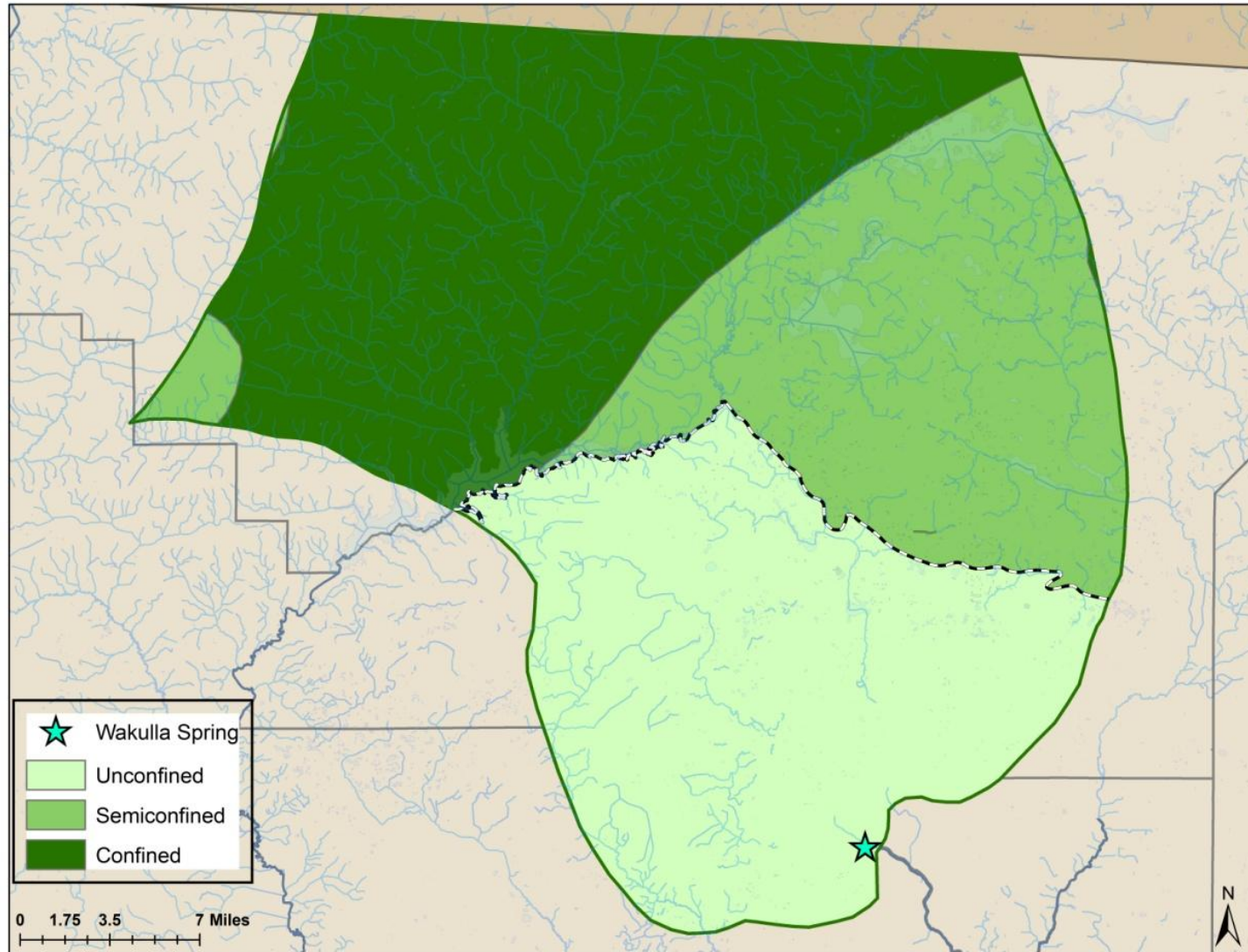
Study Areas





Study Area

Confinement of Upper Floridan Aquifer





Sources of Nitrogen

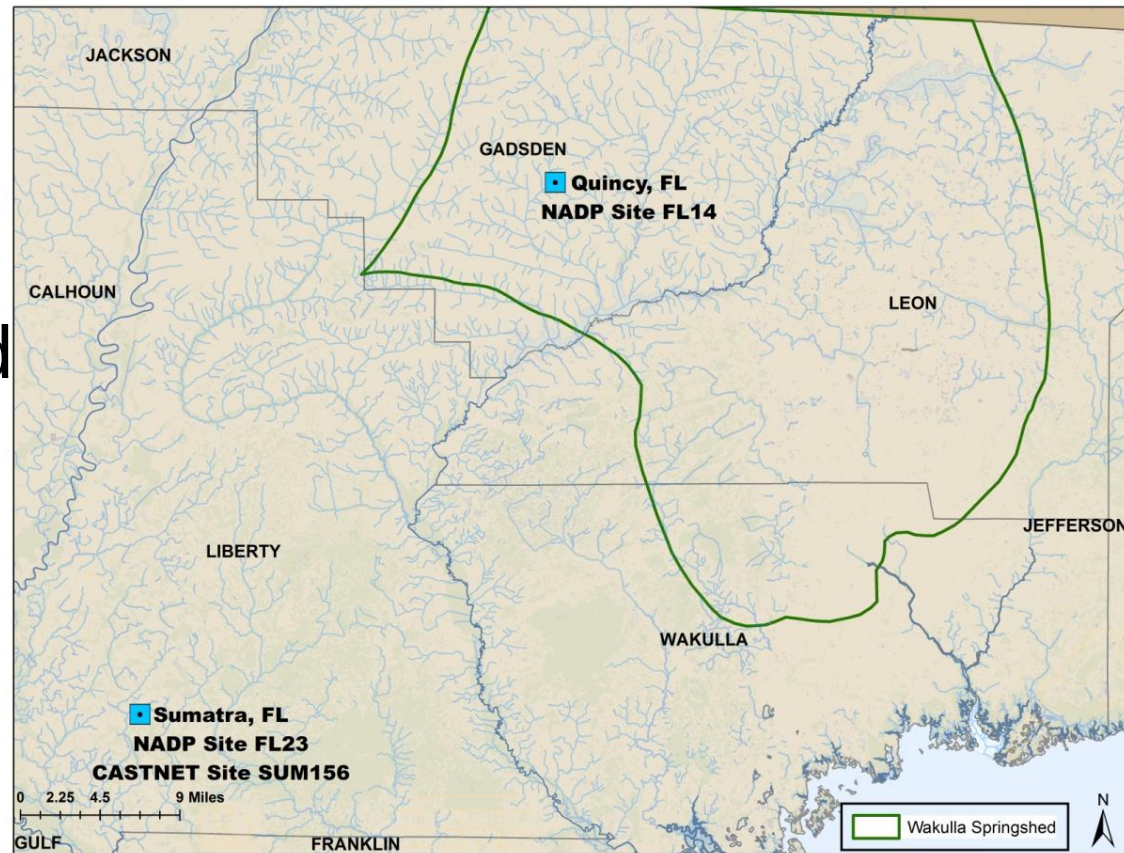
- ❖ Atmospheric Deposition
- ❖ Wastewater Treatment Facilities
- ❖ Septic Tanks
- ❖ Fertilizers (Farm and Residential)
- ❖ Livestock Waste
- ❖ Sinking Streams
- ❖ Data analyzed from 2002-2012





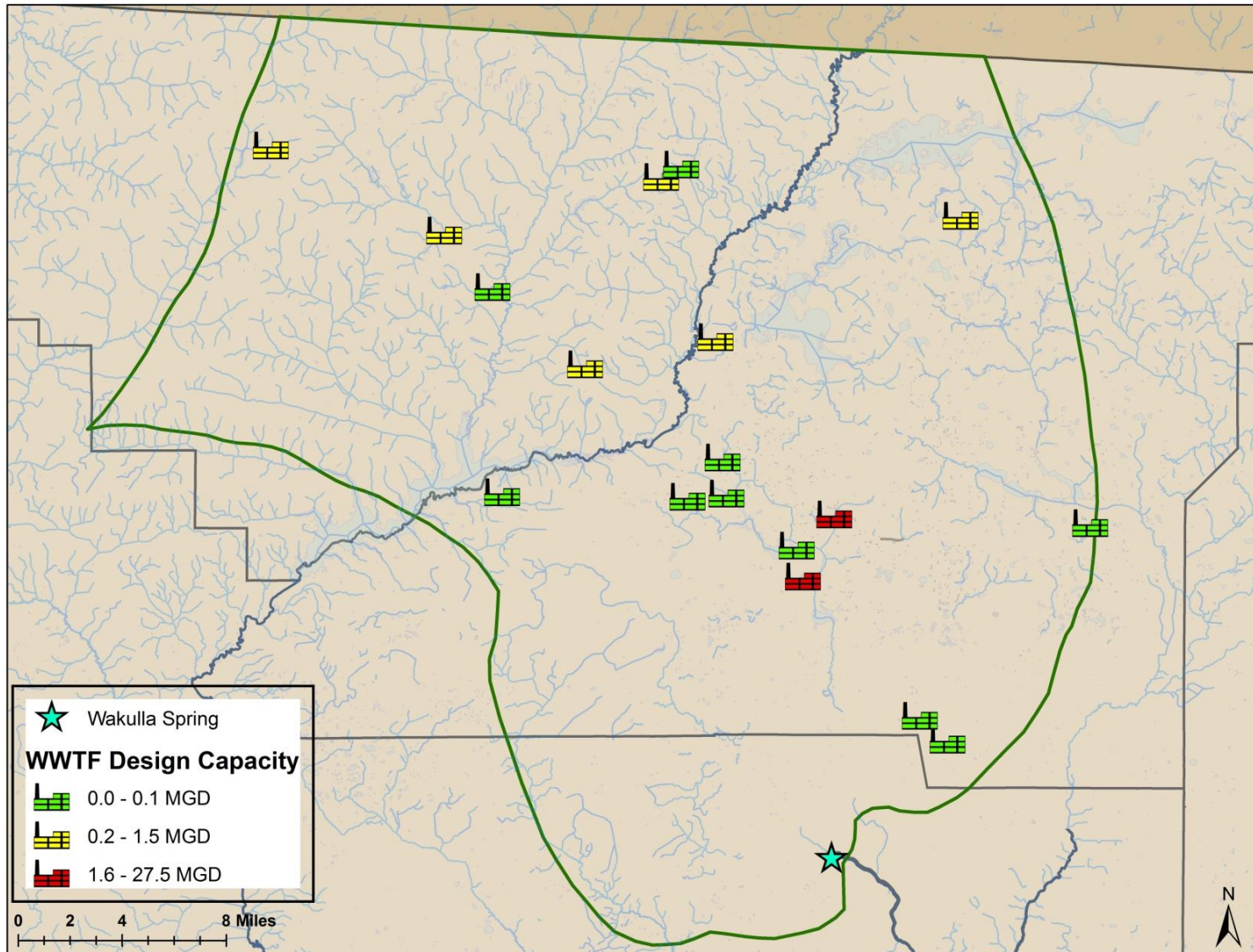
Atmospheric Deposition

- ❖ National Atmospheric Deposition Program (NADP)
 - ❖ Wet deposition
 - ❖ Sumatra, FL
 - ❖ Quincy, FL
- ❖ Clean Air Status and Trend Network (CASTNET)
 - ❖ Dry deposition
 - ❖ Sumatra, FL





Wastewater Treatment Facilities

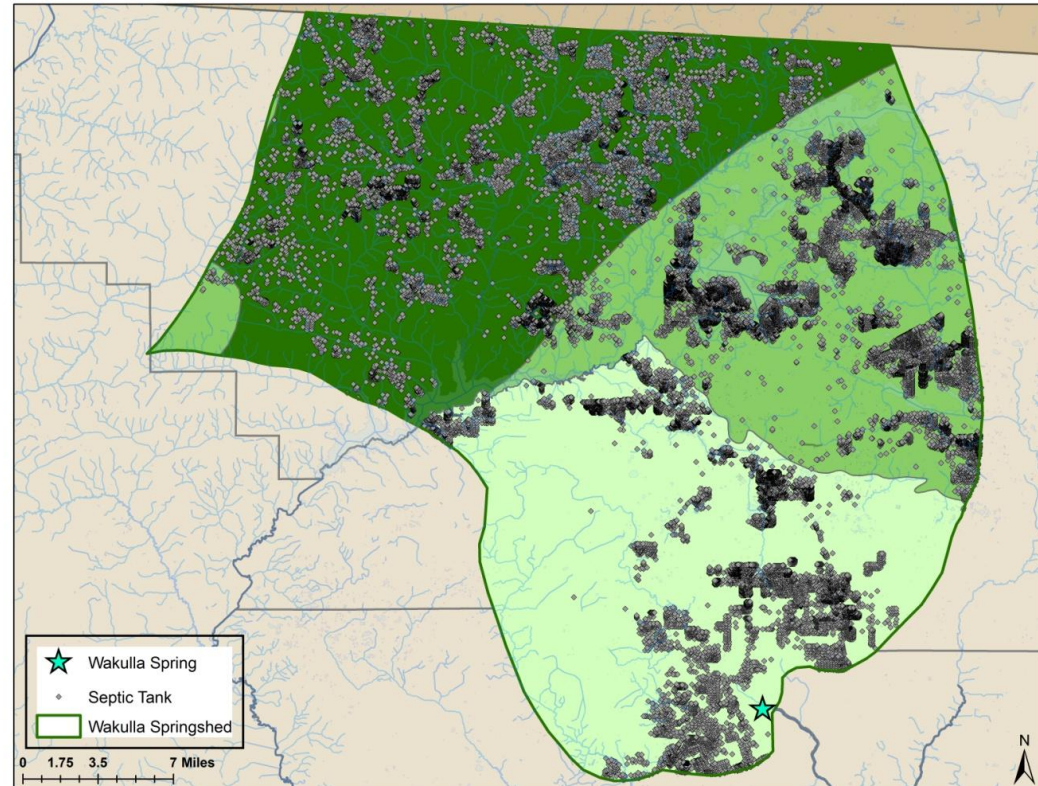


Septic Tanks

❖ DOH model relying on tax parcel data and sewer service areas

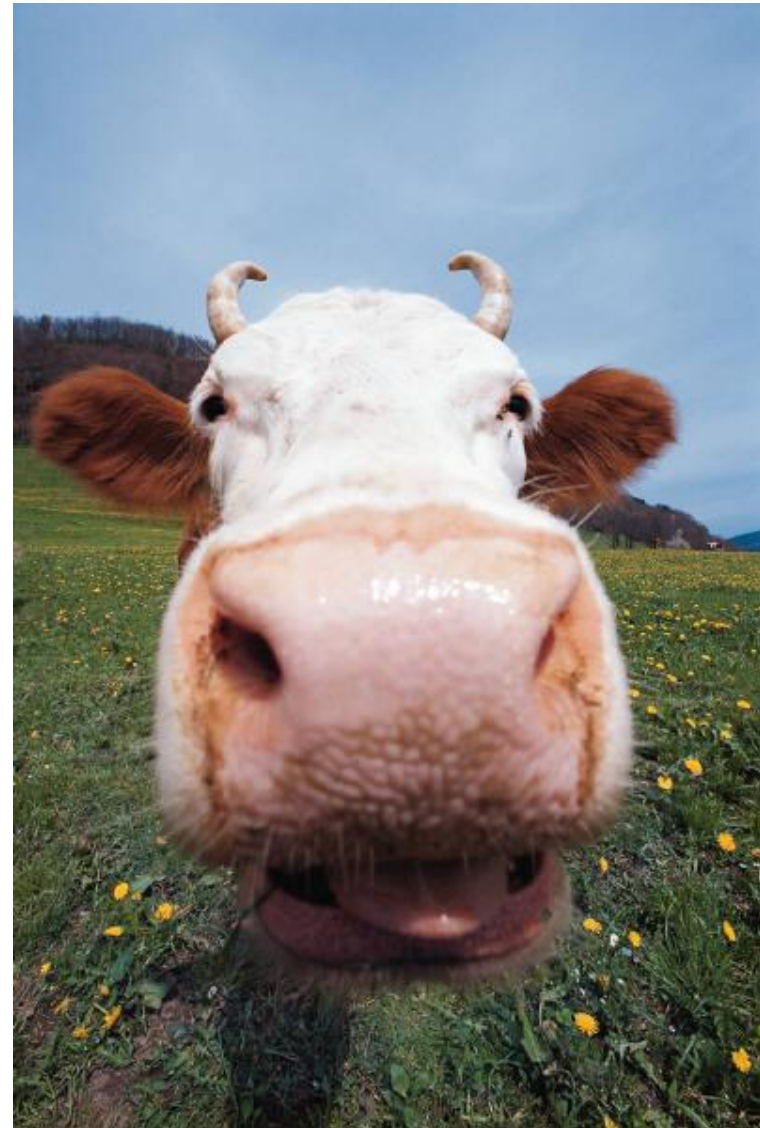
County	People per household (2010 Census)	Recharge Area	# of septic tanks
Leon	2.48	Unconfined	7,682
		Semi-Confined	17,883
		Confined	362
Wakulla	2.93	Unconfined	2,952
Gadsden	2.74	Semi-Confined	369
		Confined	10,932

❖ Average N input per person – 4.24 kg-N/yr



Livestock

- ❖ Census of Agriculture
 - ❖ Department of Agriculture
 - ❖ Every 5 years
 - ❖ # of livestock (categorized by animal)
 - ❖ Full county data only
- ❖ Aerial imagery analysis was preformed to confirm cow and horse populations
- ❖ Loading factors were applied to livestock estimates
 - ❖ Cows – 0.219 kg-N/day/animal
 - ❖ Horses – 0.124 kg-N/day/animal





Farm and Residential Fertilizer

- ❖ FL Department of Agriculture Fertilizer Sales Data
 - ❖ Total Fertilizer in tons
 - ❖ Total N in Fertilizer in tons
 - ❖ Total Fertilizer for Farm practices
 - ❖ Total Fertilizer for Non-farm practices





Farm and Residential Fertilizer

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 - ❖ Total Fertilizer in tons
 - ❖ Total N in Fertilizer in tons
 - ❖ ~~Total Fertilizer for Farm practices~~
 - ❖ Total Fertilizer for Non-farm practices
- Calculated % N in fertilizer





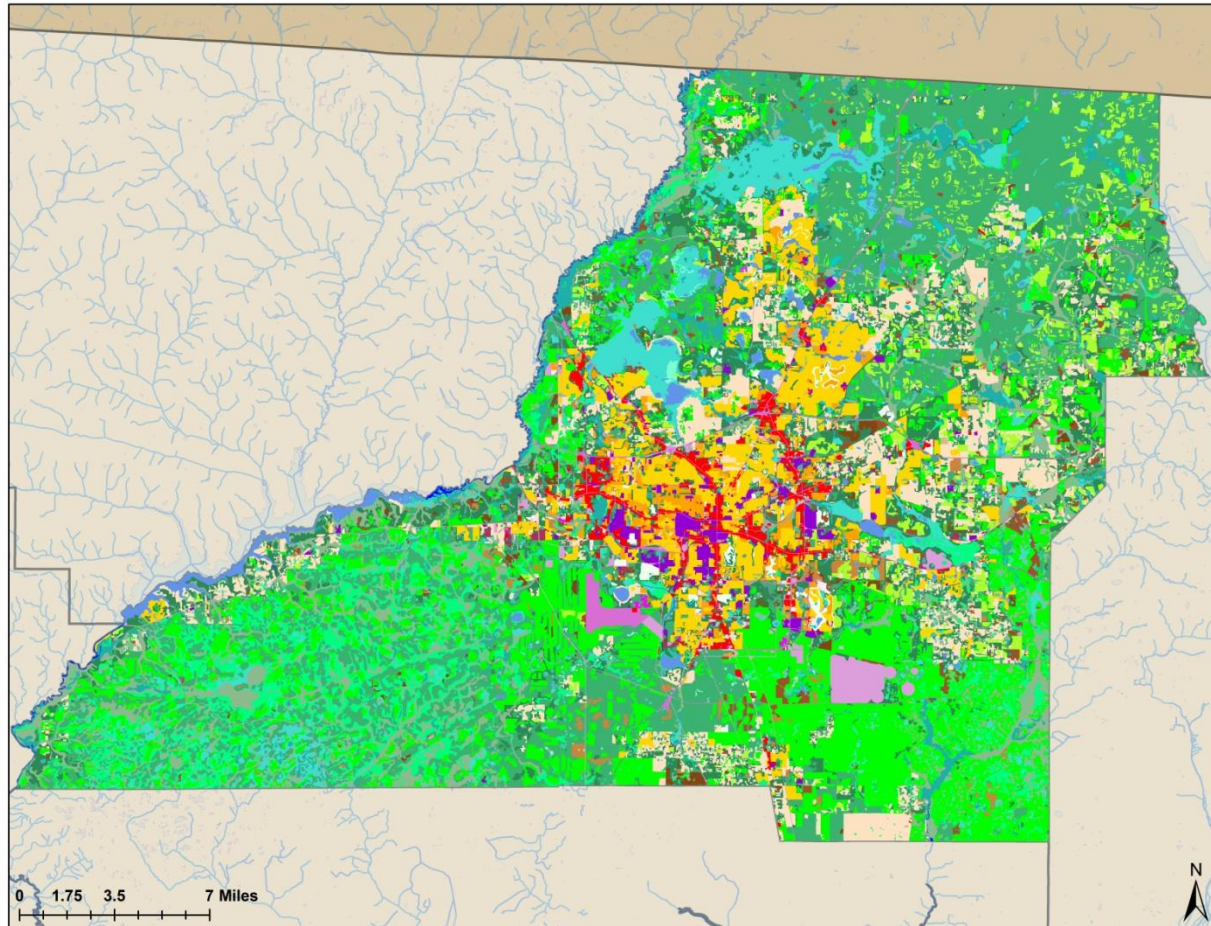
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- Calculated % N in fertilizer
- Total N in fertilizer





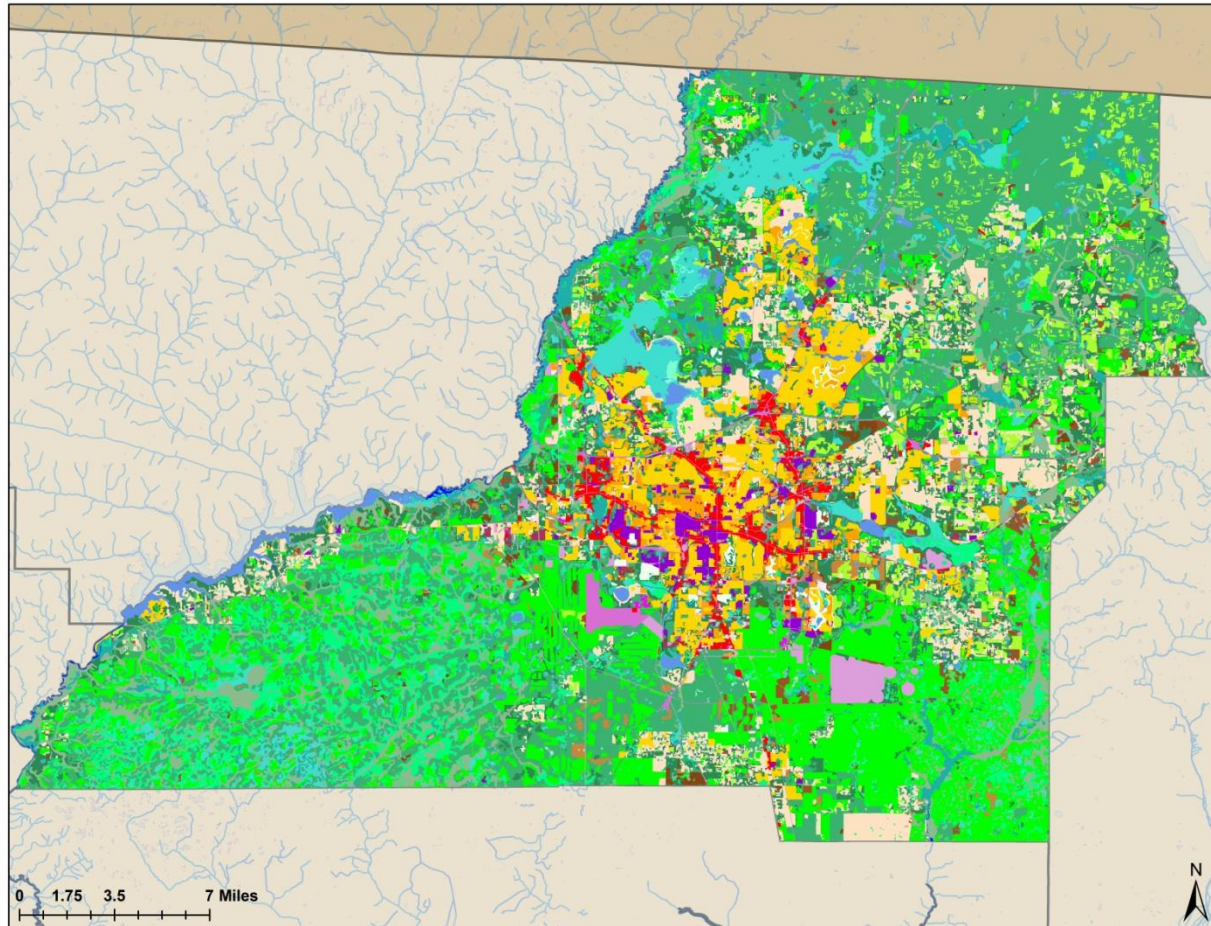
Landuse for Fertilizer



- ❖ Row Crops
- ❖ Field Crops
- ❖ Hay Fields
- ❖ Other Groves
- ❖ Nurseries and Vineyards
- ❖ Tree Nurseries
- ❖ Sod Farms
- ❖ Ornamentals



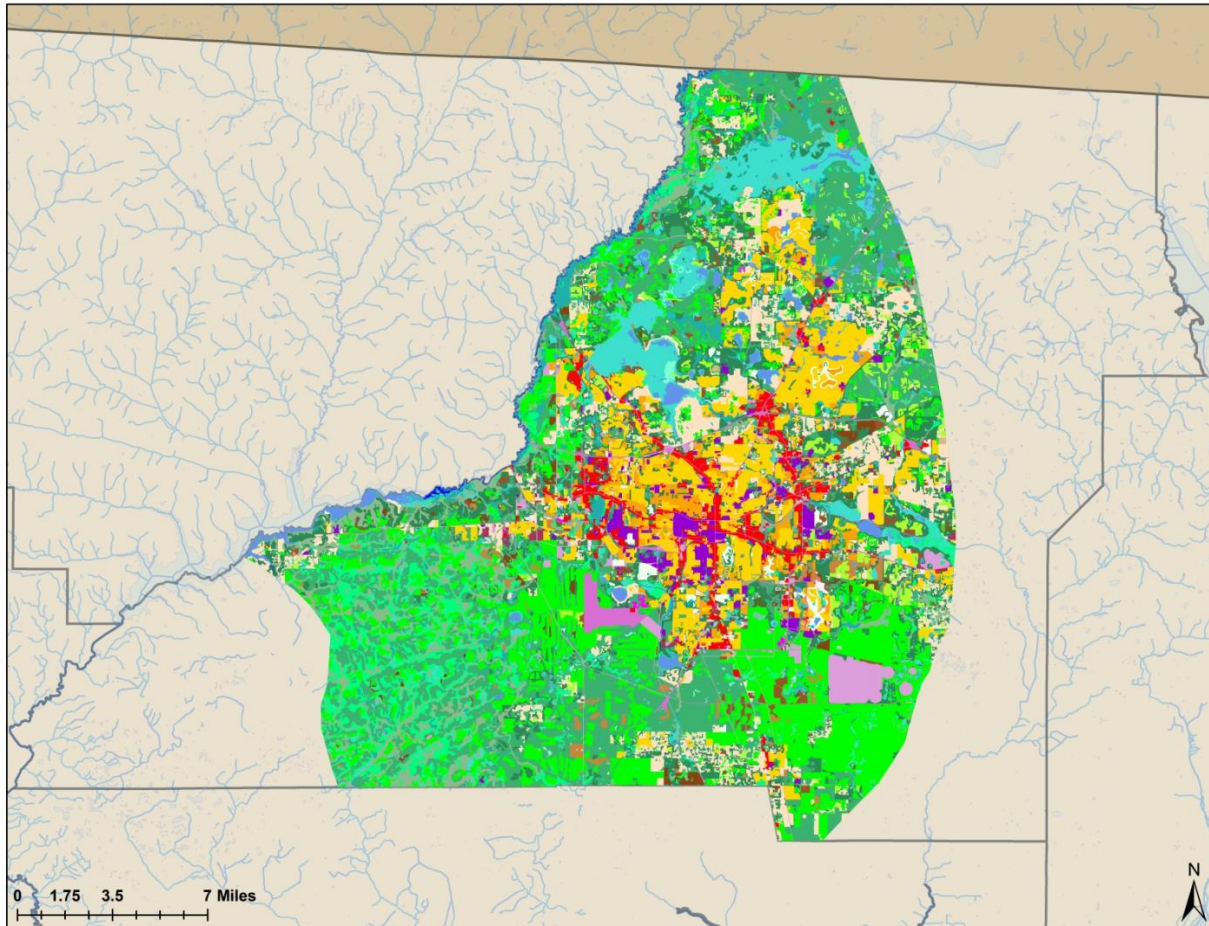
Landuse for Fertilizer



- ❖ Fertilizer lands in Leon County
 - ❖ Leon County – 3470 ha



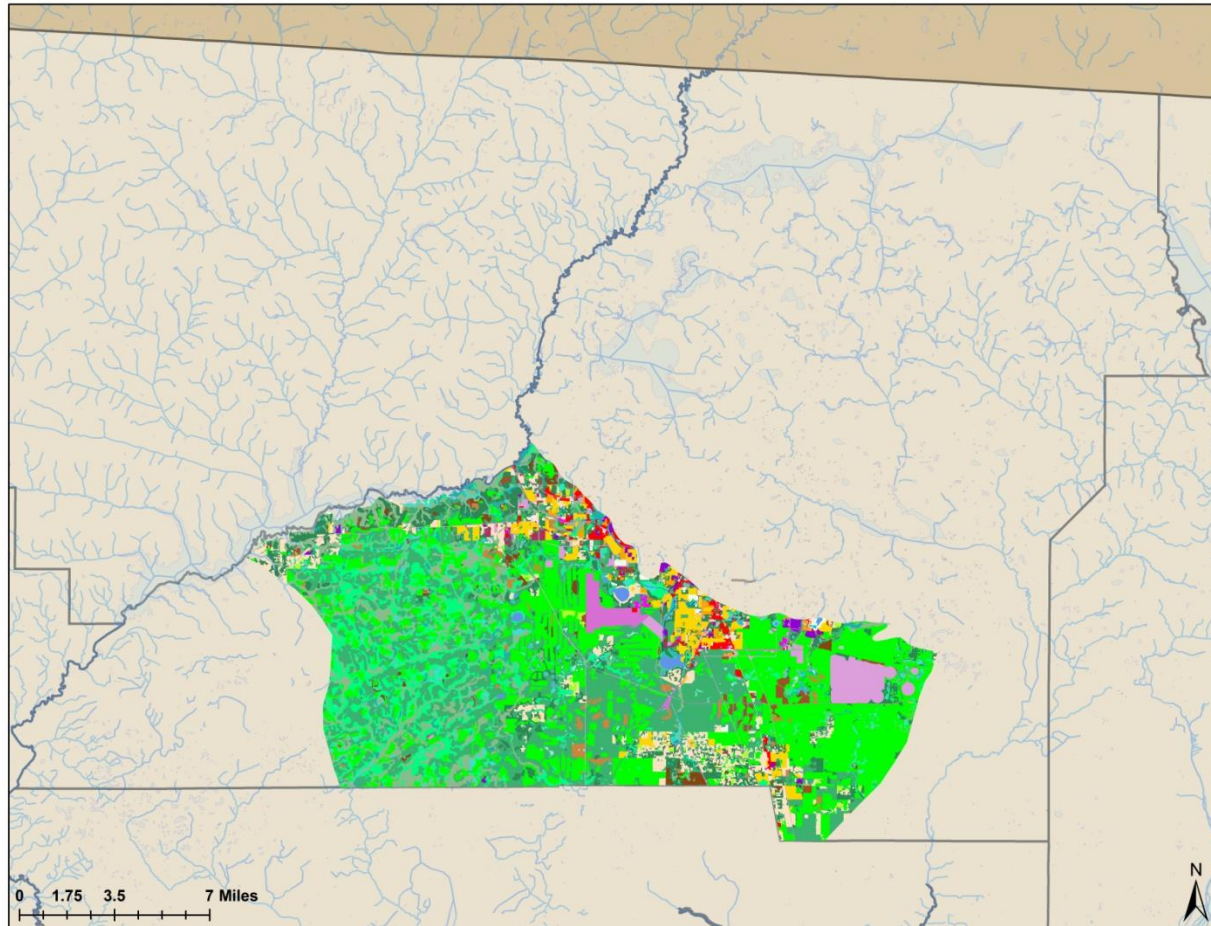
Landuse for Fertilizer



- ❖ Fertilizer lands in Leon County
 - ❖ Leon County – 3470 ha
 - ❖ Springshed – 981 ha, 28%



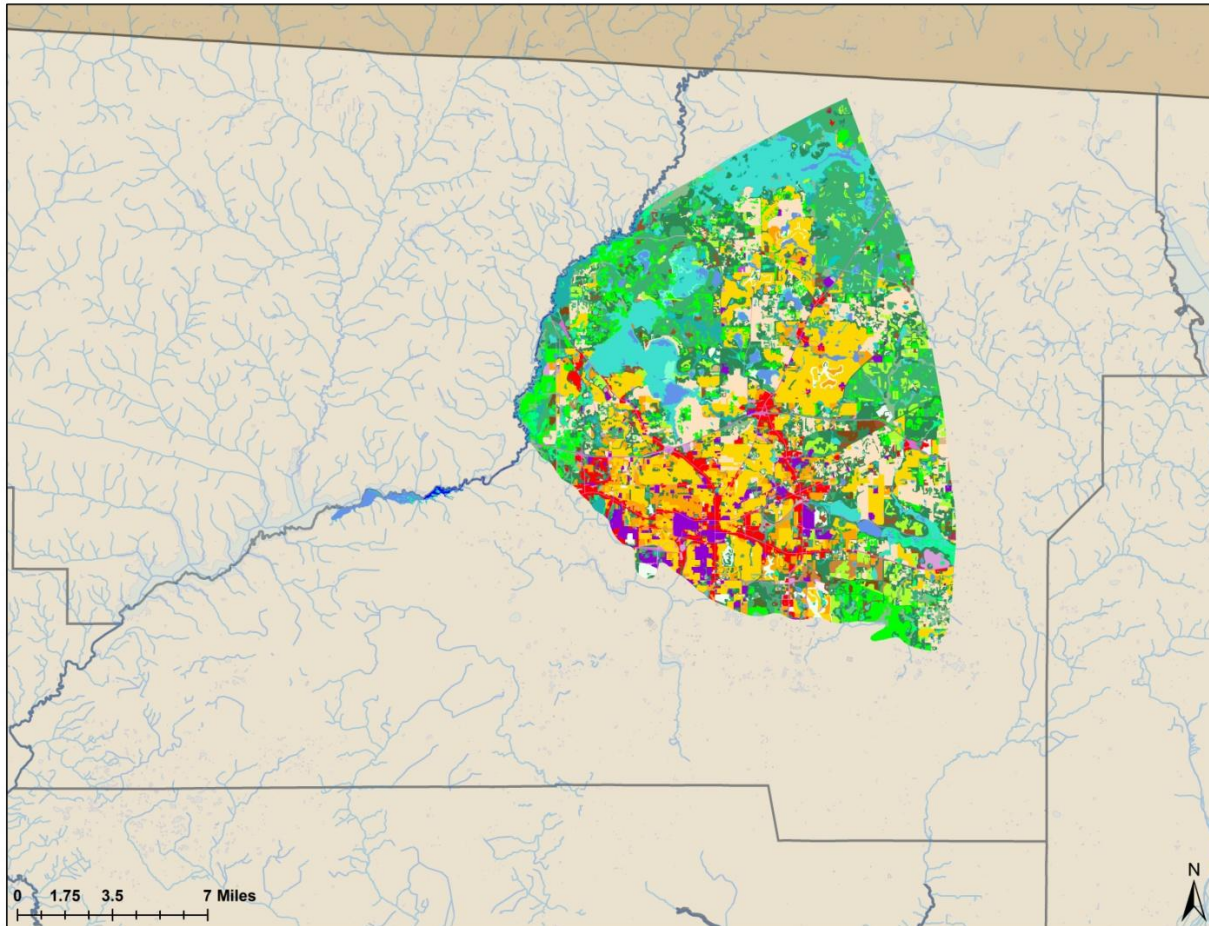
Landuse for Fertilizer



- ❖ Fertilizer lands in Leon County
 - ❖ Leon County – 3470 ha
 - ❖ Springshed – 981 ha, 28%
 - ❖ Unconfined – 74 ha, 2%



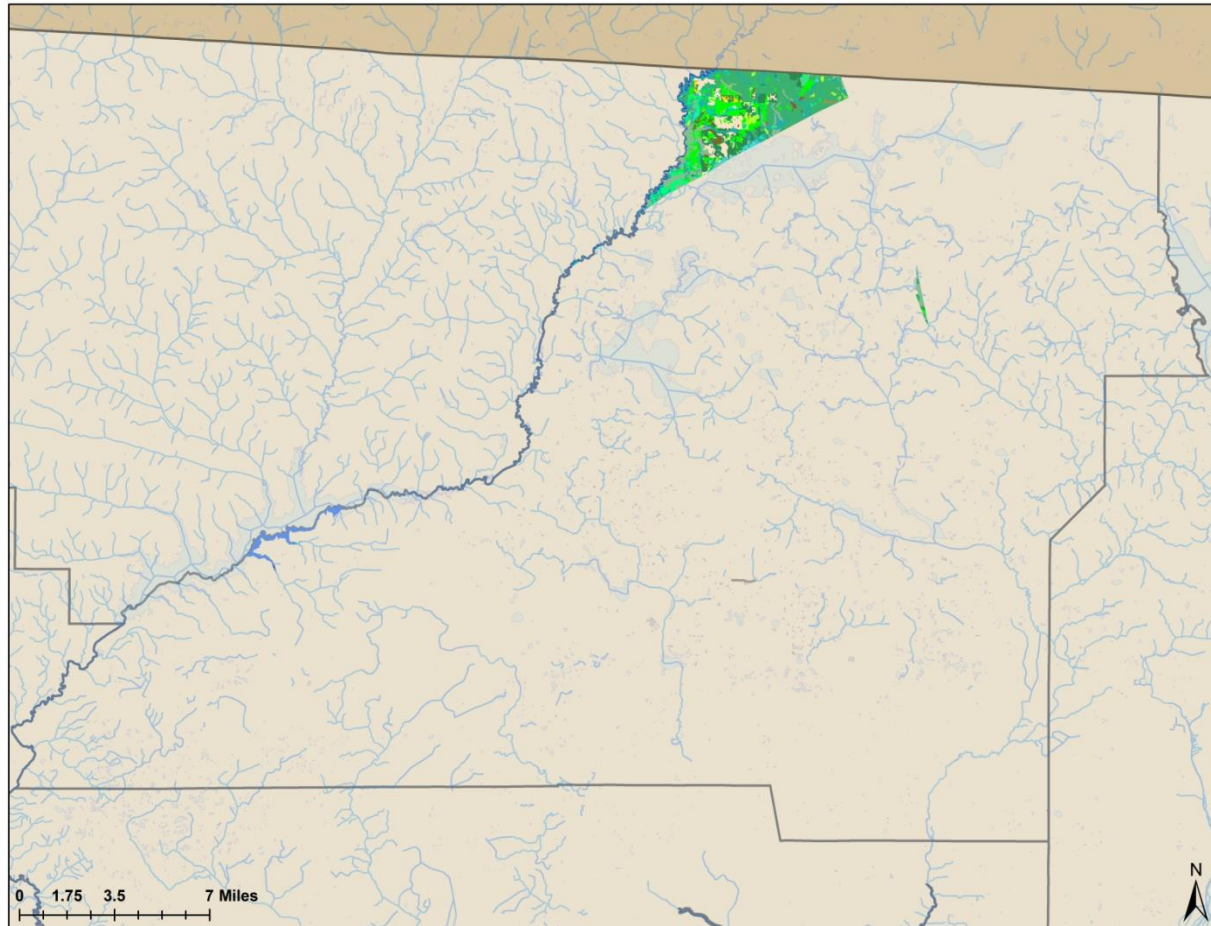
Landuse for Fertilizer



- ❖ Fertilizer lands in Leon County
 - ❖ Leon County – 3470 ha
 - ❖ Springshed – 981 ha, 28%
 - ❖ Unconfined – 74 ha, 2%
 - ❖ Semi-confined – 814 ha, 23%



Landuse for Fertilizer



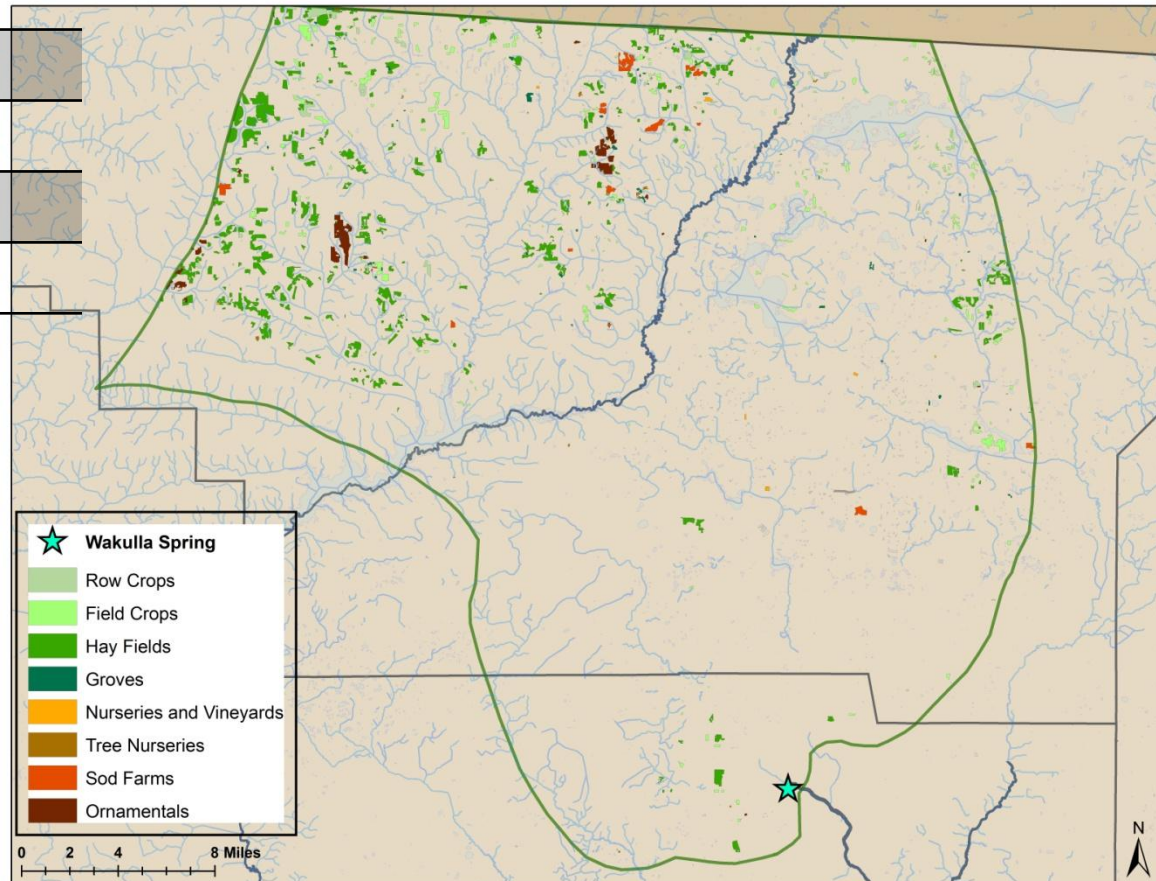
- ❖ Fertilizer lands in Leon County
 - ❖ Leon County – 3470 ha
 - ❖ Springshed – 981 ha, 28%
 - ❖ Unconfined – 74 ha, 2%
 - ❖ Semi-confined – 814 ha, 23%
 - ❖ Confined – 62 ha, 2%



Landuse for Farm Fertilizer

LEON COUNTY DATA

Land Delineation	Land %	N contribution (kg-N/yr)
County	100%	59,347
Springshed	28%	15,662
Unconfined	2%	1,180
Semi-confined	23%	12,989
Confined	2%	982

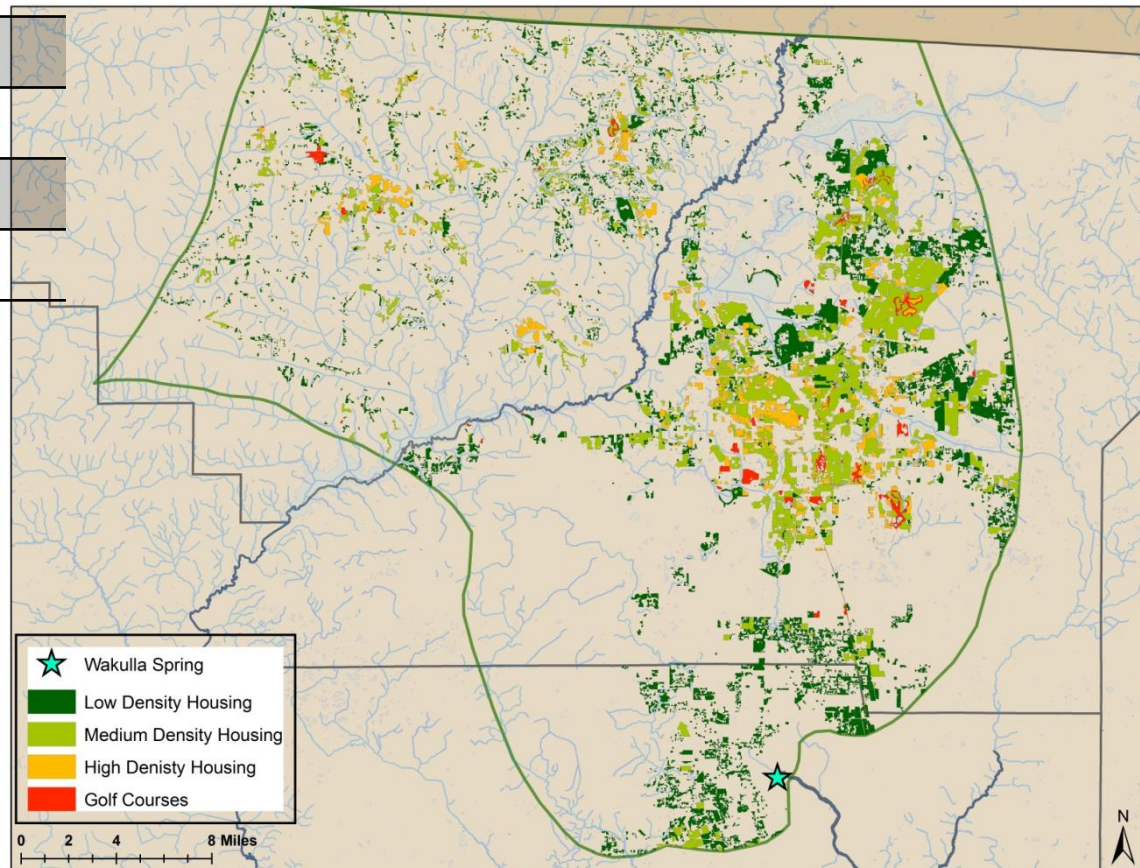




Landuse for Residential Fertilizer

LEON COUNTY DATA

Land Delineation	Land %	N contribution (kg-N/yr)
County	100%	220,904
Springshed	82%	180,258
Unconfined	16%	36,007
Semi-confined	64%	141,820
Confined	1%	2,430





Sinking Streams

Baseflow and Stormwater Runoff to Sinkholes and Swallets

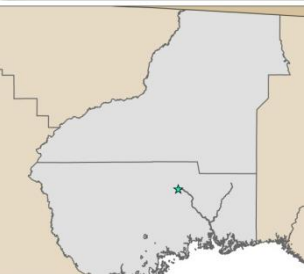


Black Creek, courtesy of Z. Kulakowski

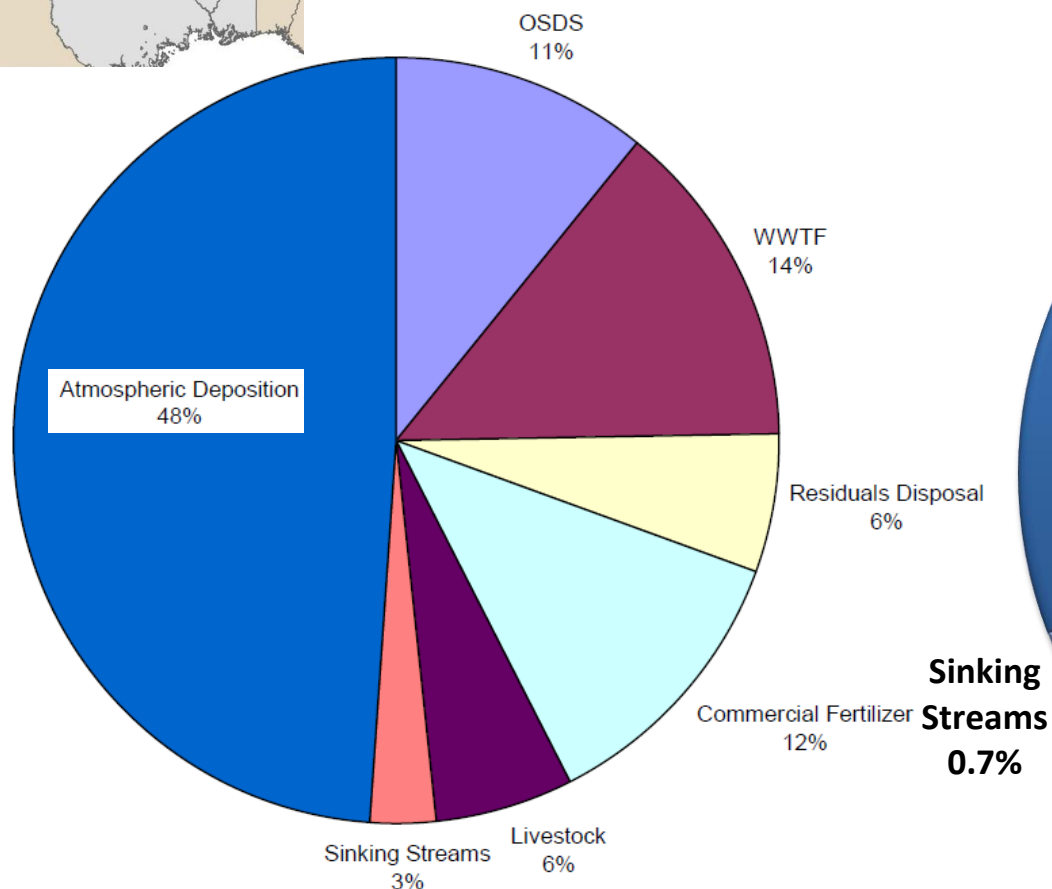
- ❖ Fisher Creek
- ❖ Black Creek
- ❖ Munson Slough
- ❖ Discharge was obtained from USGS gauging stations
- ❖ Nutrient data was taken from the most southern station data available in IWR



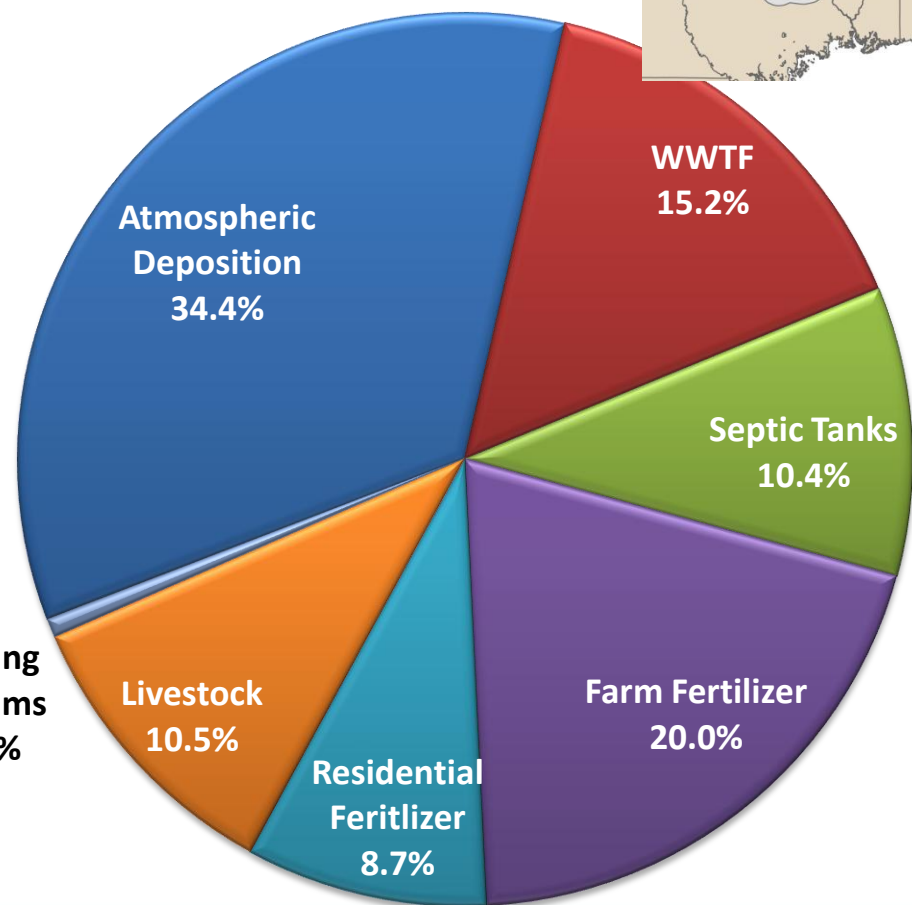
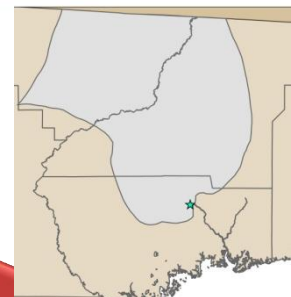
Nitrogen Inputs to Land Surface



1990-2000
Chelette et al 2002



2002-2012





Attenuation of Nitrogen

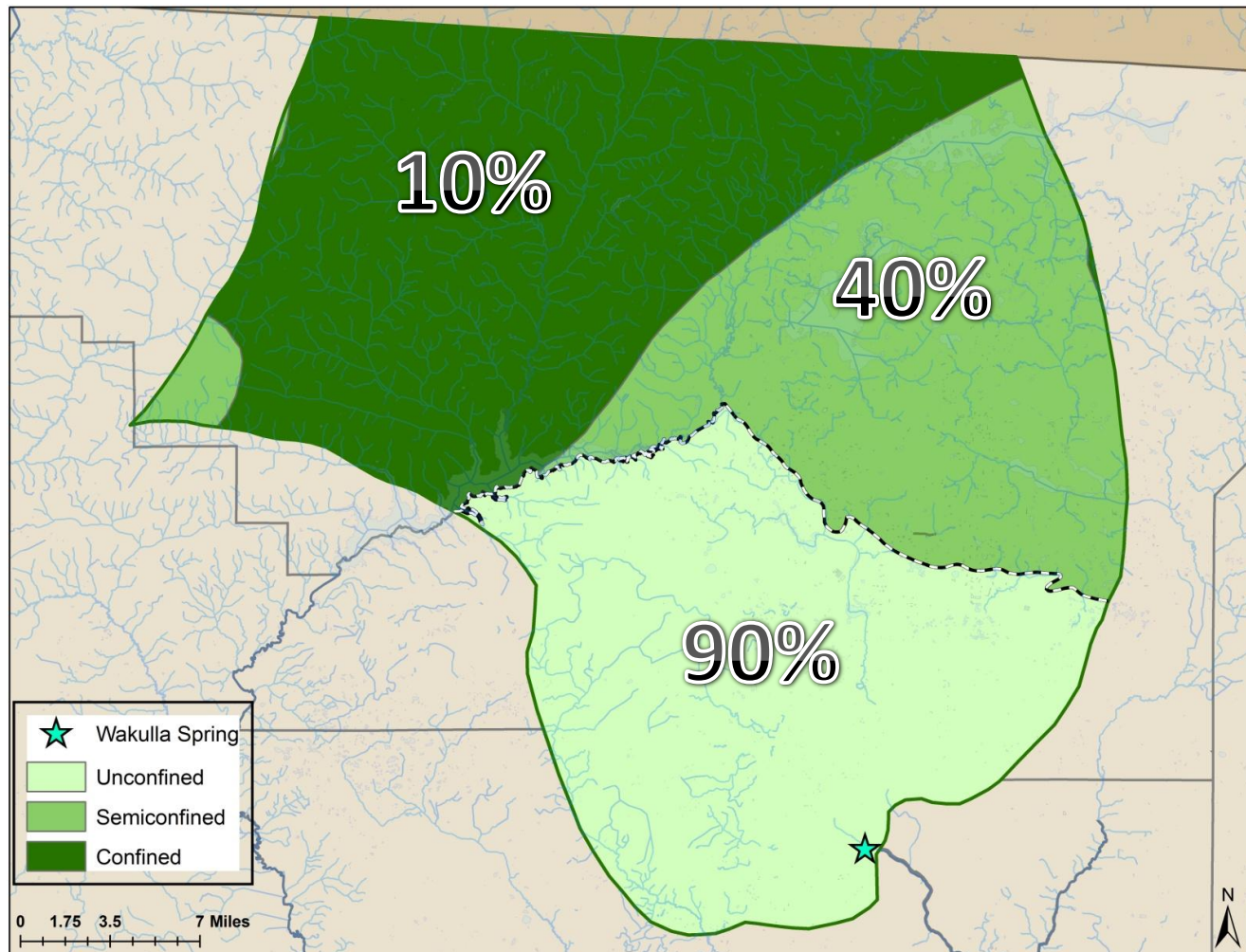
- ❖ Factors represent the percentage of uptake from the environment
- ❖ Based on factors used in similar past studies and found in relevant literature

Loading Category	Attenuation Factor
Atmospheric Deposition	90%
Waste Water	60%
Septic Tanks	30%
Farm Fertilizer	70%
Residential Fertilizer	80%
Livestock	75%
Sinking Streams	20%



Recharge Areas

- ❖ Factors describe the percentage of recharge expected



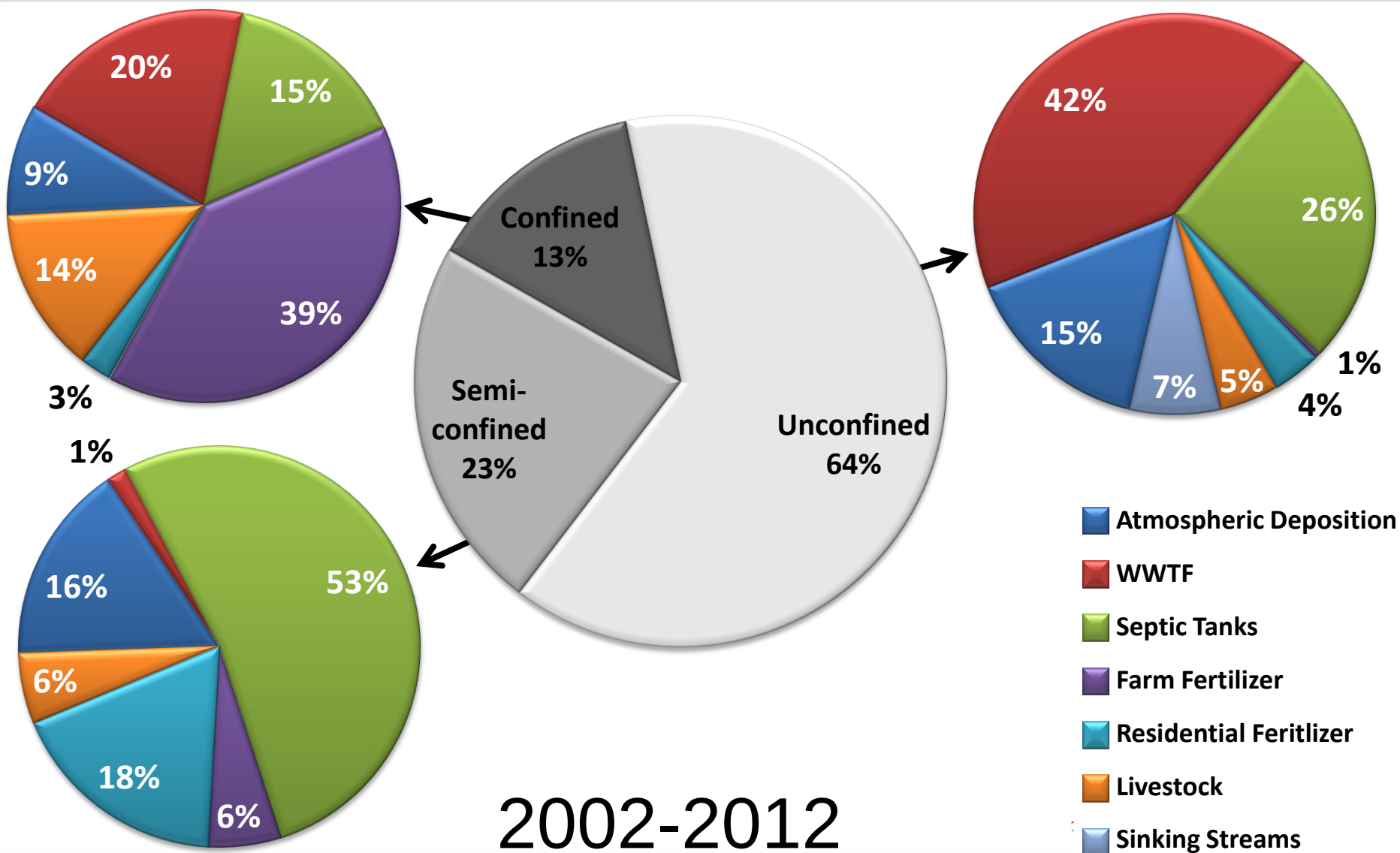


TN reaching to Floridan Aquifer (2002-2012)

	Area (ha)	Atm Dep	WWTF	Septic Tanks	Fertilizer		Livestock	Sinking Streams
					Farm	Res.		
Sorted by County								
Leon	112,500	25,100	69,300	59,200	1,900	16,200	4,400	11,800
Wakulla	25,300	8,200	---	13,200	500	400	6,100	
Gadsden	91,300	4,200	6,800	5,800	15,300	1,000	5,200	---
Sorted by Recharge Area								
Unconfined	76,900	25,000	68,400	42,200	800	6,300	7,700	11,800
Semi-confined	65,000	9,400	1,000	30,700	3,400	10,400	3,300	---
Confined	87,200	3,200	6,800	5,200	13,500	900	4,700	---
TOTAL	229,100	37,600	76,100	78,200	17,700	17,600	15,700	11,800
PERCENTAGE		14.8%	29.9%	30.7%	6.9%	6.9%	6.2%	4.6%
TOTAL LOADING	238,900		All values are rounded to the nearest 100				Units – kg-N/yr	



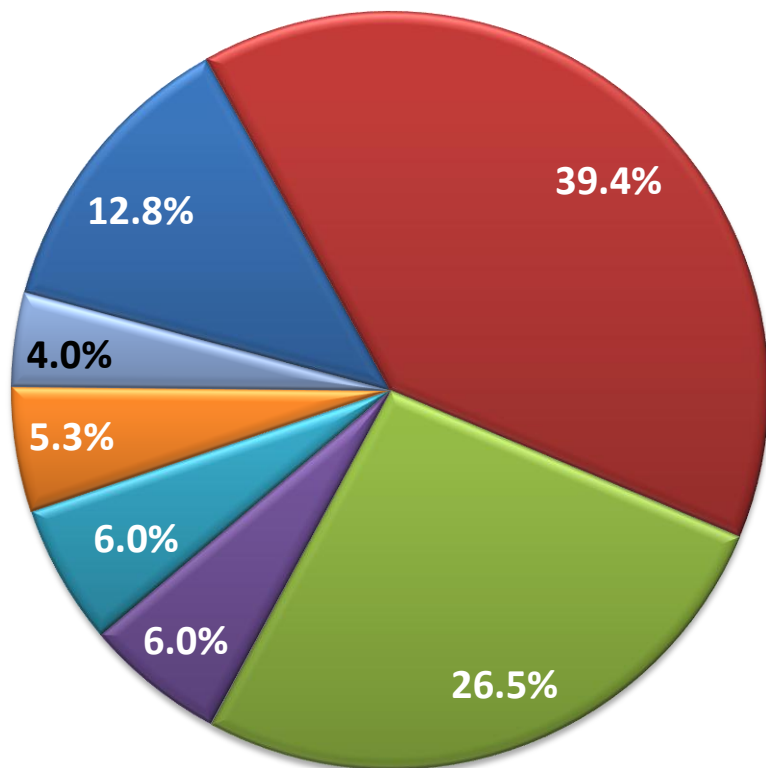
Average Annual Loading to Floridan



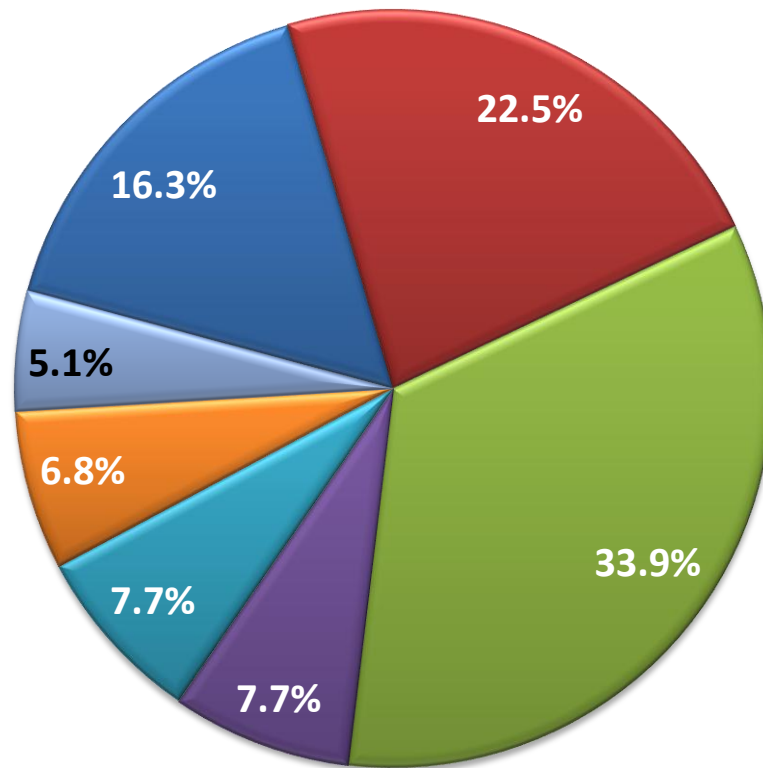


Impact of Decreasing Loads

Pre-AWT TN concentration: 12 mg/L



Post-AWT TN concentration: 2.6 mg/L



■ Atmospheric Deposition
■ Farm Fertilizer
■ Sinking Streams

■ WWTF
■ Residential Fertilizer

■ Septic Tanks
■ Livestock

Questions?

