Florida Department of Environmental Protection

Division of Environmental Assessment and Restoration

Wekiva River, Rock Springs Run, and Little Wekiva Canal Basin Management Action Plan (BMAP)

Moira R. Homann

August 15, 2017





Agenda

1. Welcome and Opening Remarks.
2. Recap Items.
   a. Progress Report.
   b. Teleconference - Coordinated OSTDS Education Campaign.
   c. Others.
3. New Items/Discussion.
   a. Grant Opportunity.
   b. Nitrogen Source Inventory Methodology and Draft Results.
   c. Draft Approaches to Achieve Reductions and Restoration.
4. Public Comments.
5. Adjourn.

Grant Opportunity

- The Fish & Wildlife Foundation of Florida (Foundation) accepting proposals for the FY 2017-18 Protect Florida Springs Tag grants program.
- Eligible applicants: Federal, state or local government agencies, public and private colleges and universities; and 501(c)(3) non-profit organizations, including all-volunteer organizations.
- Springs-focused projects in two areas:
  - Research projects.
  - Community education and other outreach activities.
- More information https://www.fishwildlifeflorida.org/protect-florida-springs-grants/.
- Deadline for submission of proposals is September 15, 2017.
- Contact Erin Smart, esmart@wildlifeflorida.org

Florida Department of Environmental Protection

Division of Environmental Assessment and Restoration

Estimated Nitrogen Loading to the Upper Floridan Aquifer:

Nitrogen Source Inventory and Loading Tool for Wekiwa and Rock Springs

Celeste Lyon
Groundwater Management Section

August 15, 2017

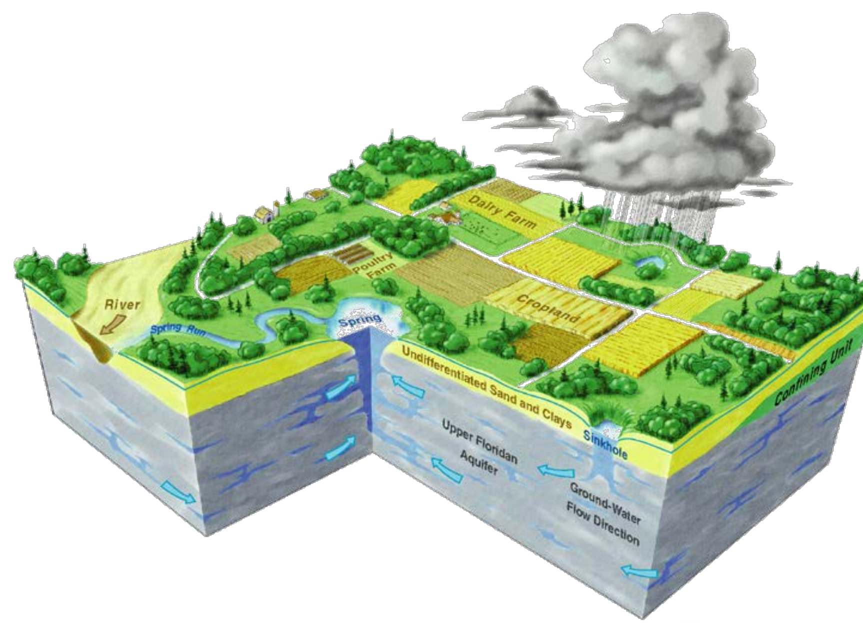
Celeste.Lyon@dep.state.fl.us

Nitrogen Inventories

- The Florida Springs and Aquifer Protection Act of 2016 requires DEP to develop nitrogen inventories for the contributing areas of all Outstanding Florida Springs that are impaired
- The information developed from the nitrogen inventory for the Wekiwa-Rock combined springshed will be used to provide nitrogen load estimates for sources in the springshed (by source category)

Nitrate-Impaired Spring Waters

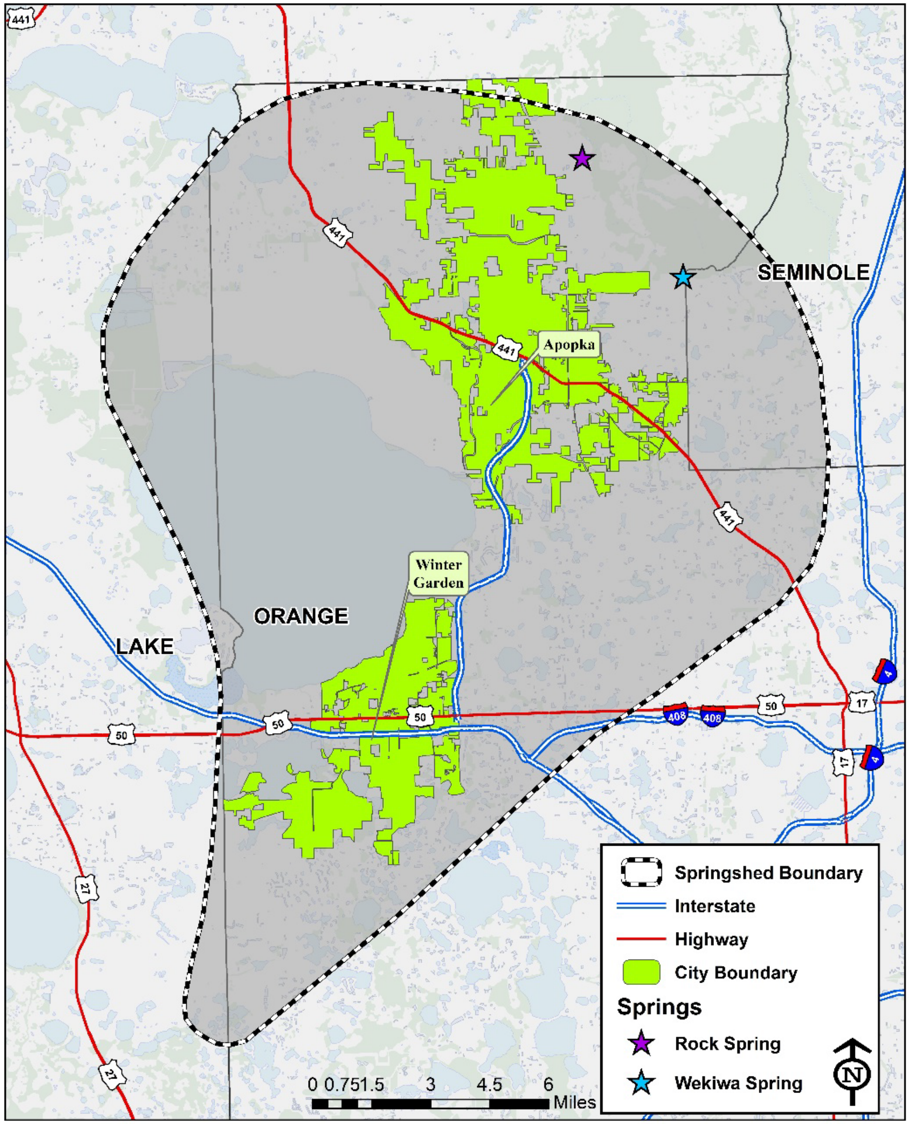
- The water quality in several Outstanding Florida Springs, including Wekiwa and Rock Springs, is impaired due to elevated nitrate concentrations
- Many sources contribute nitrogen in each springshed:
  - atmospheric deposition
  - urban turfgrass fertilizers
  - septic tanks
  - land application of wastewater
  - livestock manure
  - farm fertilizers



Nitrogen Source Inventory and Loading Tool

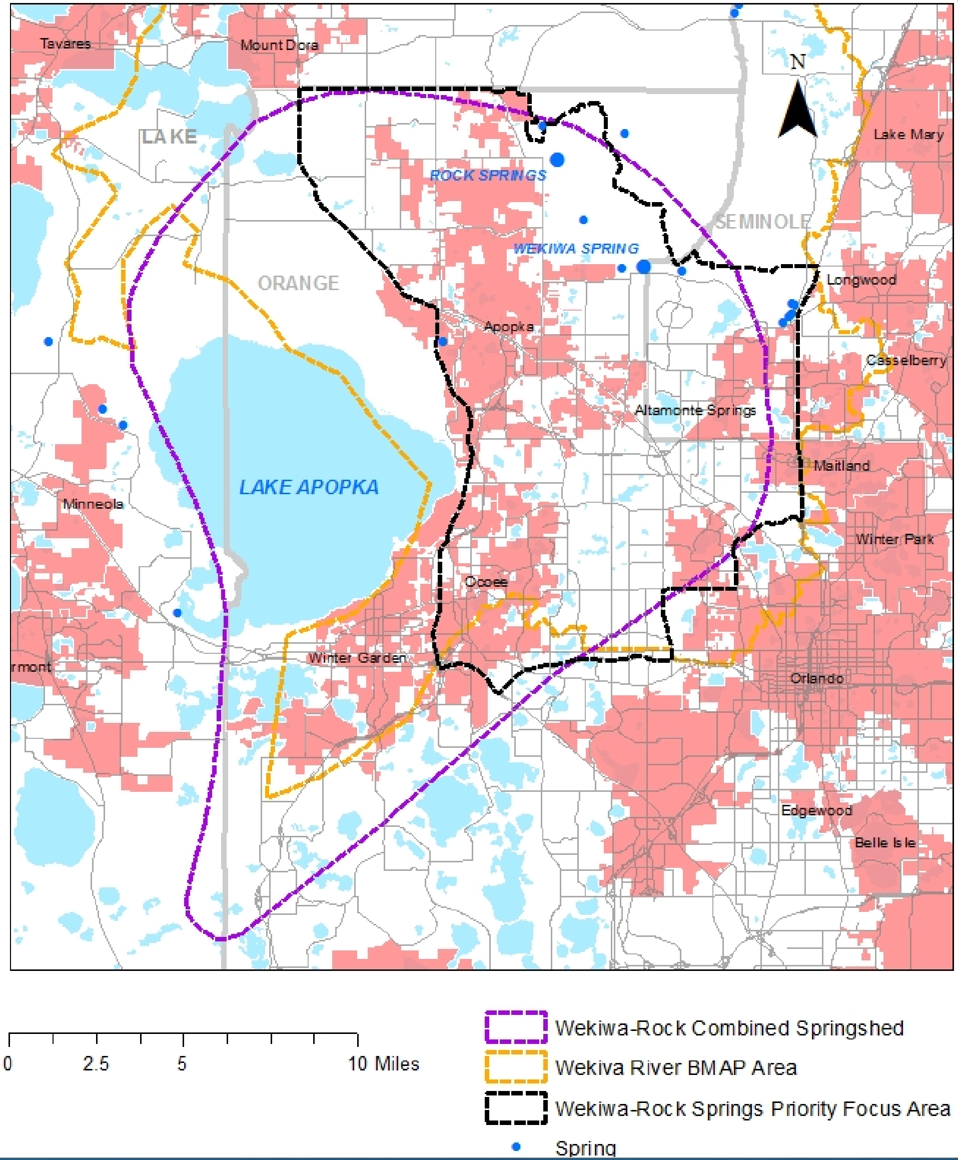
- Estimate N loading to groundwater with BMAP areas
- Identify sources for which reductions in N loading could achieve restoration of impaired waters
- We customize the inventory for each spring basin or BMAP area to account for hydrogeologic and land use differences
- Inventories have been completed for Wakulla, Jackson Blue, Volusia Blue, Silver, Rainbow, the Springs Coast Springs, and springs in the Suwannee Basin

Combined Wekiwa-Rock Springshed Area



This map was prepared on 05/03/17 by FDEP Groundwater Management Section. For display purposes only. For more information: C.Lyon (850) 245-8652

Wekiwa-Rock Area



Estimating Nitrogen Loads to Groundwater

Steps:

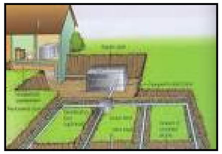
1. Estimate the <u>inputs</u> of nitrogen to the land surface from the source inventory information **(best available and most current).**

2. Apply attenuation factors based on the various environmental processes that could transform the various forms of nitrogen in the subsurface (such as denitrification, nitrification of ammonia, uptake by plants, mineralization of organic nitrogen).

3. Apply areal weighting factors that are based on the rate of recharge to groundwater to estimate <u>nitrogen loads</u> to groundwater.

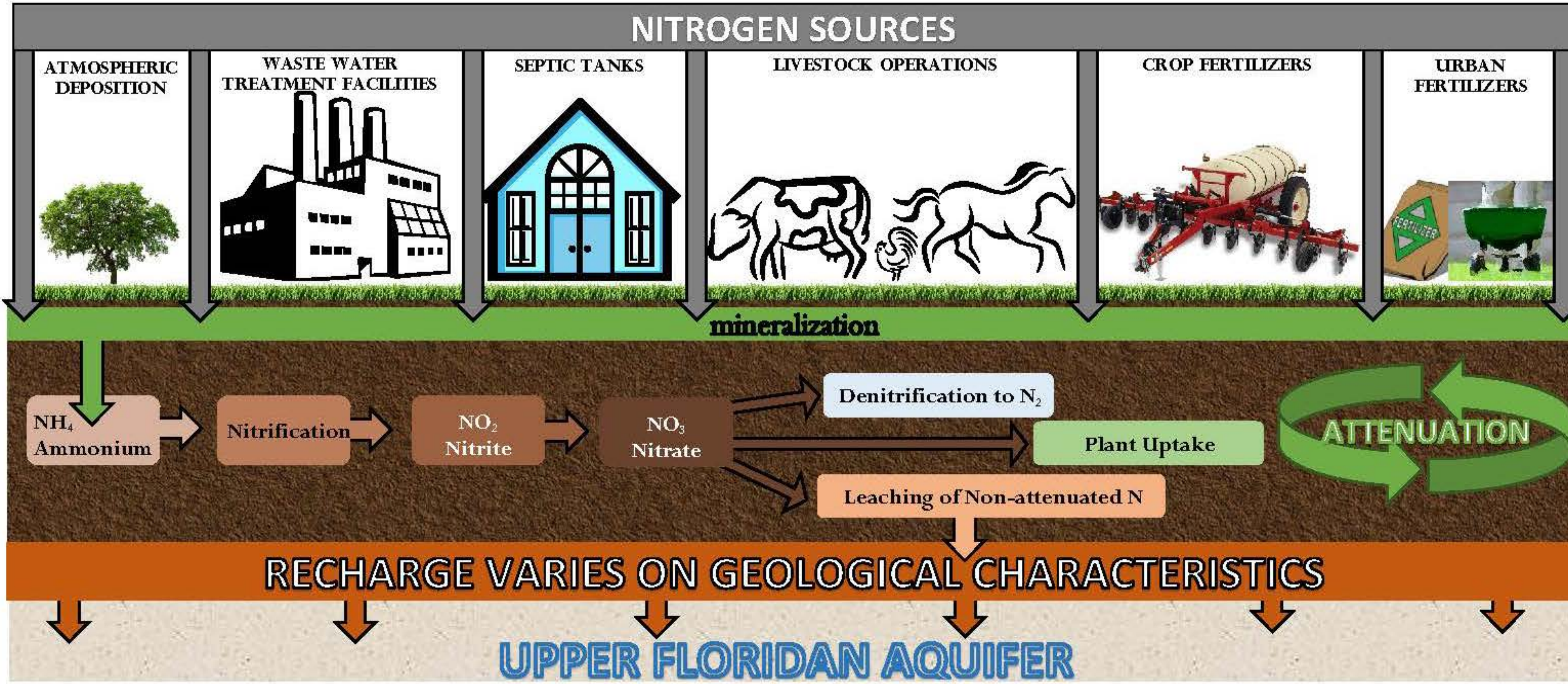
4. Fine-tune estimates after getting feedback from stakeholders.







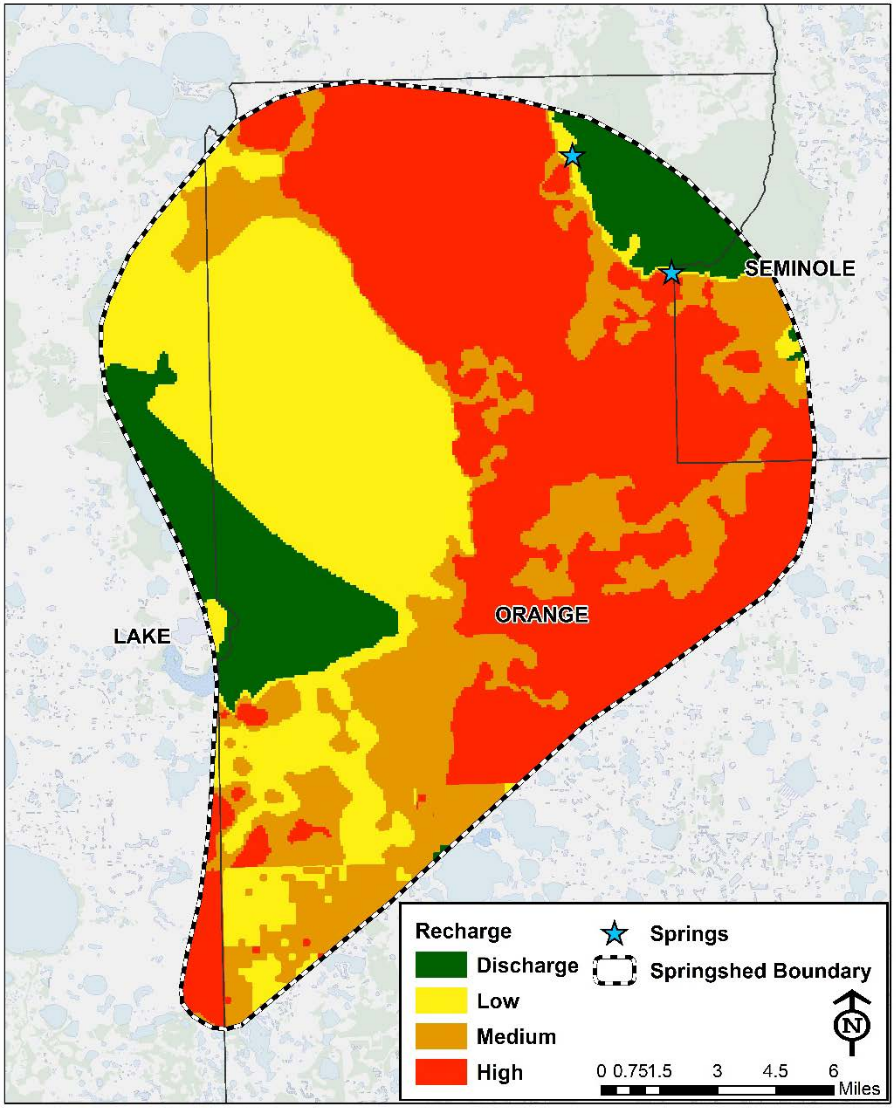

Nitrogen Cycle and Nitrogen Attenuation



Processes that control the transformation of N in soils and the subsurface.

The wide ranges reflect variable soil conditions, fertilizer material, livestock, crop types, etc., ALL AFFECT LEACHING OF N TO GROUNDWATER

Groundwater Recharge Areas

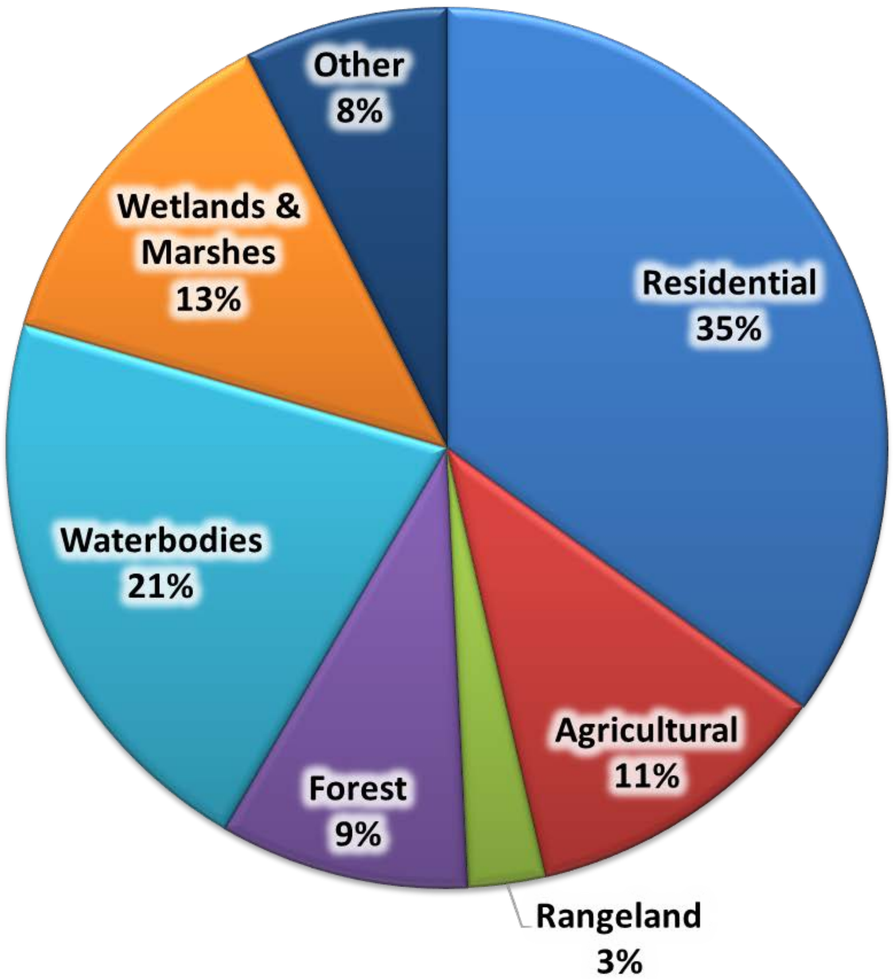


This map was prepared on 05/03/17 by FDEP Groundwater Management Section. For display purposes only. For more information: C.Lyon (850) 245-8652

- Inputs to land and loads to groundwater are calculated by recharge region within the springshed
- SJRWMD (2015) mapped areas of relative recharge to the UFA based on geological properties
  - High Recharge: >10 in/yr
  - Medium Recharge: 3-10 in/yr
  - Low Recharge: 0-3 in/yr
- A weighting factor is assigned to recharge category to account for additional attenuation:
  - High, 0.9
  - Medium, 0.5
  - Low, 0.1

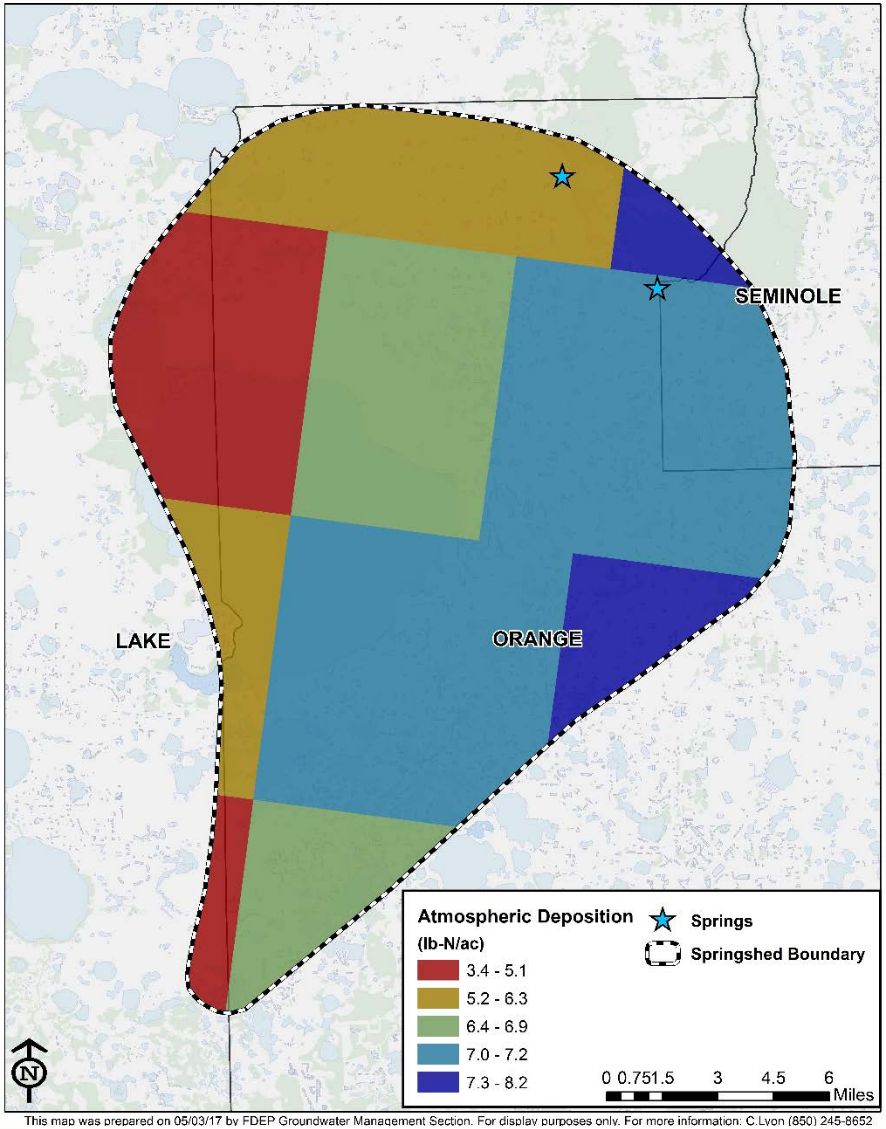
The amount of nitrate that is transported to the UFA in a given year is related to the rate of recharge to the aquifer

Land Use in the Springshed



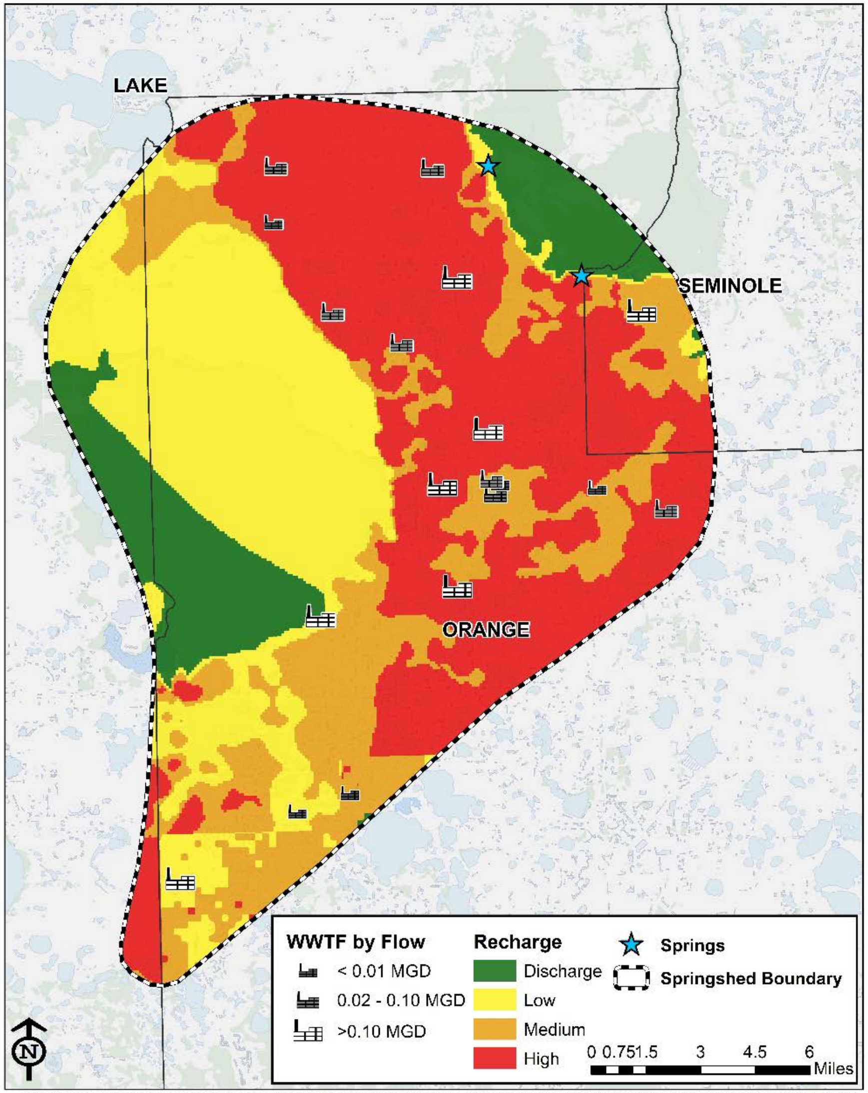
- Majority of N inputs occur within agricultural and urban land areas
- These categories represent 46% of the land use within the springshed

Nitrogen Input: Atmospheric Deposition



- TDEP model
  - U.S. EPA method to estimate spatially continuous atmospheric deposition
  - Nationwide total deposition model for N and S
  - Estimated deposition based on monitoring stations and modeled atmospheric concentrations
  - Model year is an average from 2011 to 2013
  - Average TN deposition
    - Range 5.4-7.8 lb-N/ac/yr

Nitrogen Input: Domestic Wastewater



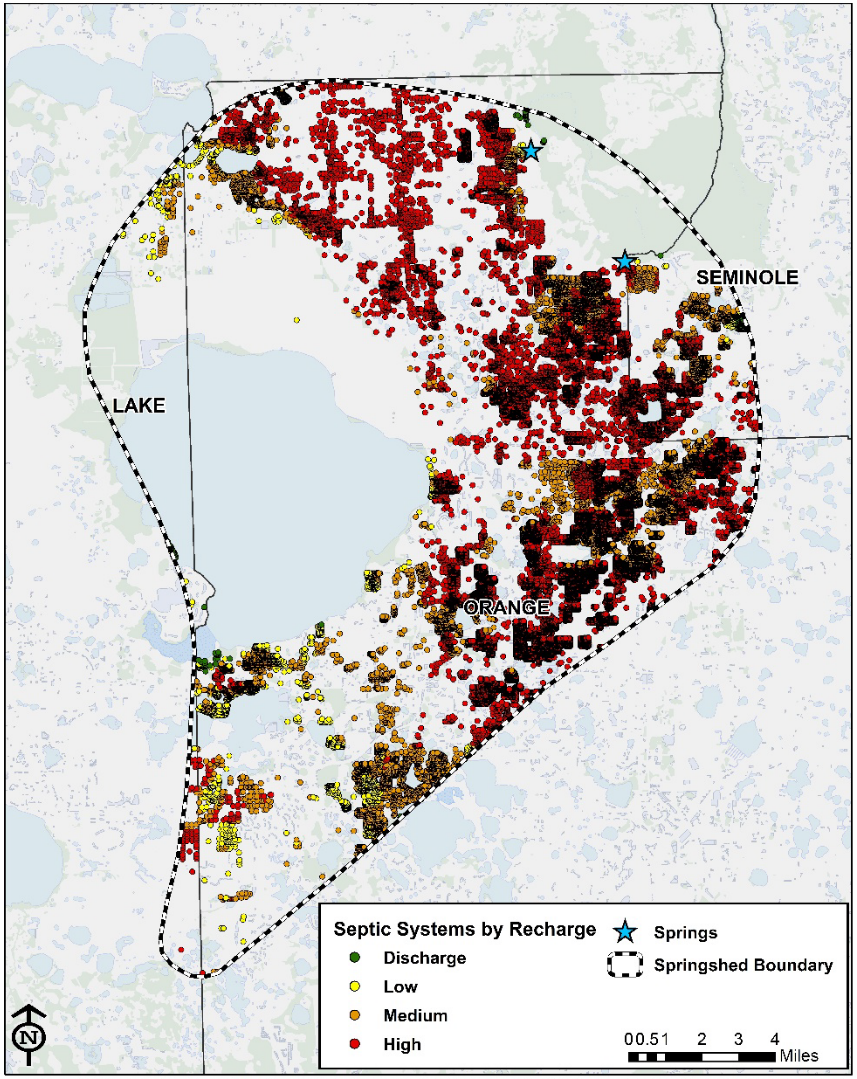
This map was prepared on 05/03/17 by FDEP Groundwater Management Section. For display purposes only. For more information: C.Lyon (850) 245-8652

- Inventory includes domestic WWTF application sites in the springshed
- TN effluent concentrations as reported to DEP
- NO_3 used to project TN data, if necessary
- Effluent data separated based on treatment type
  - RIBs, Absorption Fields
  - Sprayfields
  - Reclaimed Water Application
- 19 permitted facilities apply wastewater in the springshed
  - 7 with discharge ≥0.1 MGD

Nitrogen Input: Septic Systems (OSTDS)

- Septic count taken from DOH's Florida Water Management Inventory (FLWMI)
- Accuracy of this data was verified using an aerial analysis

- Calculate # of people relying on septic tanks
  - Lake County = 2.03 people per household
  - Seminole County =2.05 people per household
  - Orange County =2.15 people per household
  - Average annual input to septic tank = 9.012 lb-N/person (US EPA)



This map was prepared on 05/03/17 by FDEP Groundwater Management Section. For display purposes only. For more information: C.Lyon (850) 245-8652

Nitrogen Input: Livestock Waste

Literature review provided information on common livestock animals in Florida

- Animal waste factors

2012 Census of Agriculture (CoA)

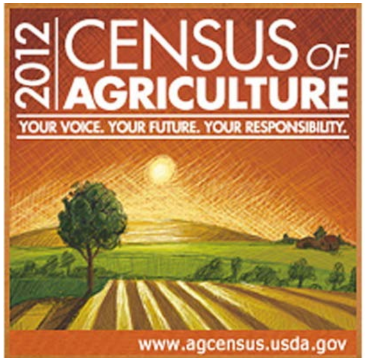
- # of livestock (categorized by animal)
- Full county data ONLY

2016 USDA Survey

- # of beef cattle

Use County-level land use information to estimate livestock population within the springshed

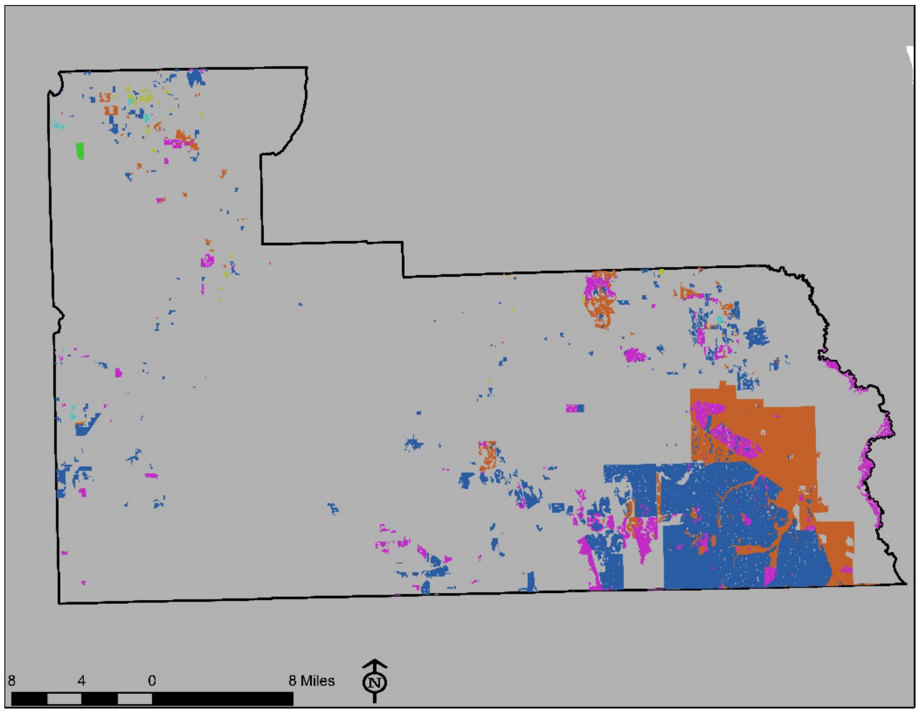
Land Use Description
Cattle Feeding Operations*
Feeding Operations*
Horse Farms
Improved Pastures*
Poultry Feeding Operations
Range Land, Herbaceous (Dry Prairie)*
Specialty Farms
Unimproved Pastures*

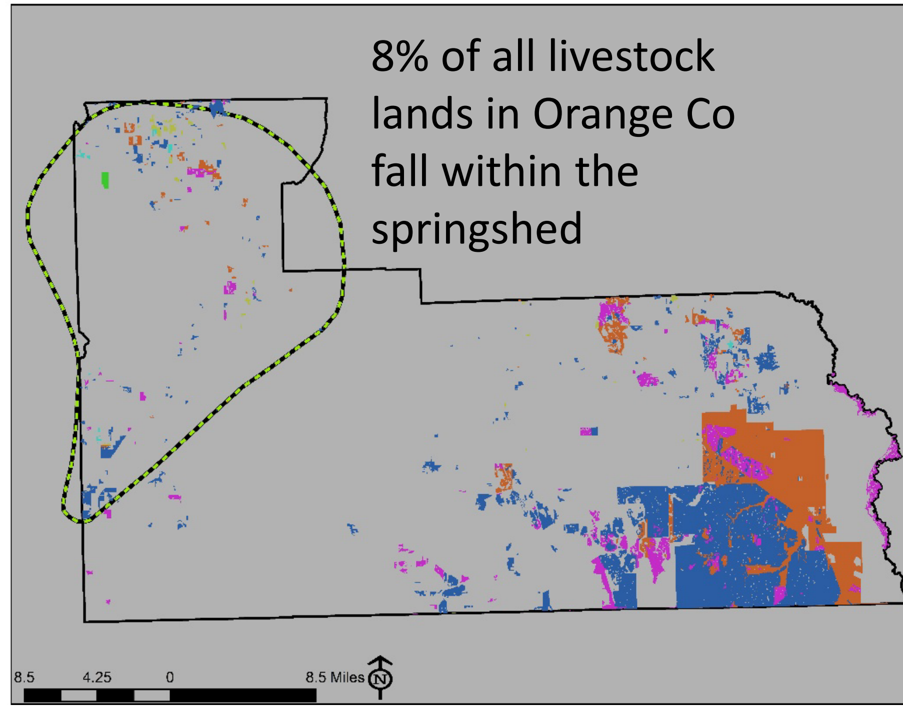


Livestock	Waste Factor (lb-N/day)
Beef Cows	0.337
Other Beef Cattle	0.31
Chicken, broilers	0.002
Chicken, layers	0.003
Calves	0.068
Equine	0.273
Goats	0.035
Hogs	0.19
Sheep	0.198
Turkeys	0.006

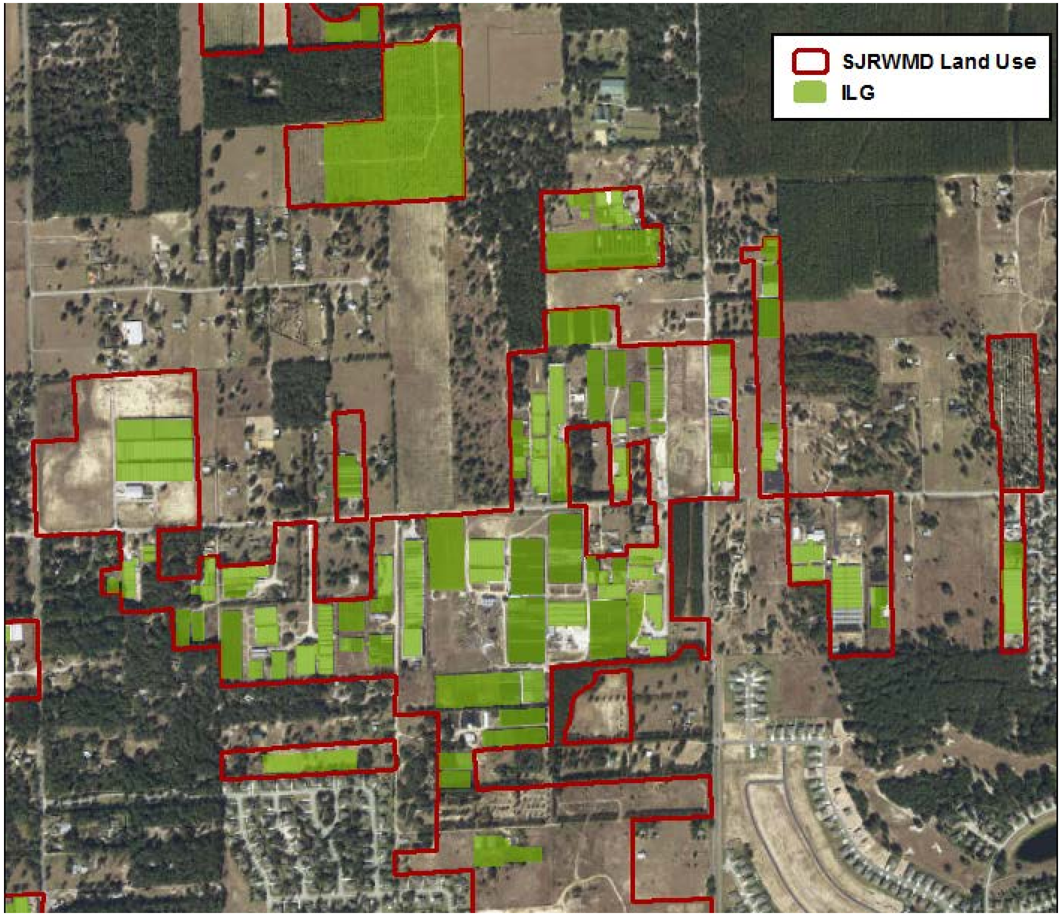
USDA

Land use Percentages: Livestock





Combination of Three Agricultural Land Use Tools to Estimate Crop Type and Acreage to Calculate Nitrogen Input



Irrigated lands and crop type based on FSAID irrigated lands geodatabase (ILG).

Outside of ILG, agriculture areas based on WMD land use and Property Appraiser Data.

Crop fertilizer application rates were applied to the acreages identified within springsheds based on crop type.

Application rates based on UF-IFAS recommended rates as well as producer feedback.

Worked with FDACS to verify coverage of nursery operations and citrus groves

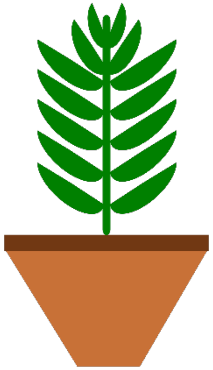
Worked with nursery industry to help understand nitrogen fertilizer use

Nurseries

- Overlaid Division of Plant Industry's coverage with the FSAID ILG coverage
  - Grouped nursery operations into 8 separate categories
  - Determined if each operation was indoors or outdoors
- Each operation type was assigned a fertilizer application rate based on IFAS recommended rates
  - Acreage for all operations was reduced by 20% to account for spacing between rows
- Assumed 30% of applied fertilizer does not stay with the plant (i.e. loss during application and leaching)

Nursery Operation Types
Tree Nurseries
Ornamentals
ContainerNursery
Ornamental - Container
GreenhouseNursery
Greenhouse
Field Container
Fern



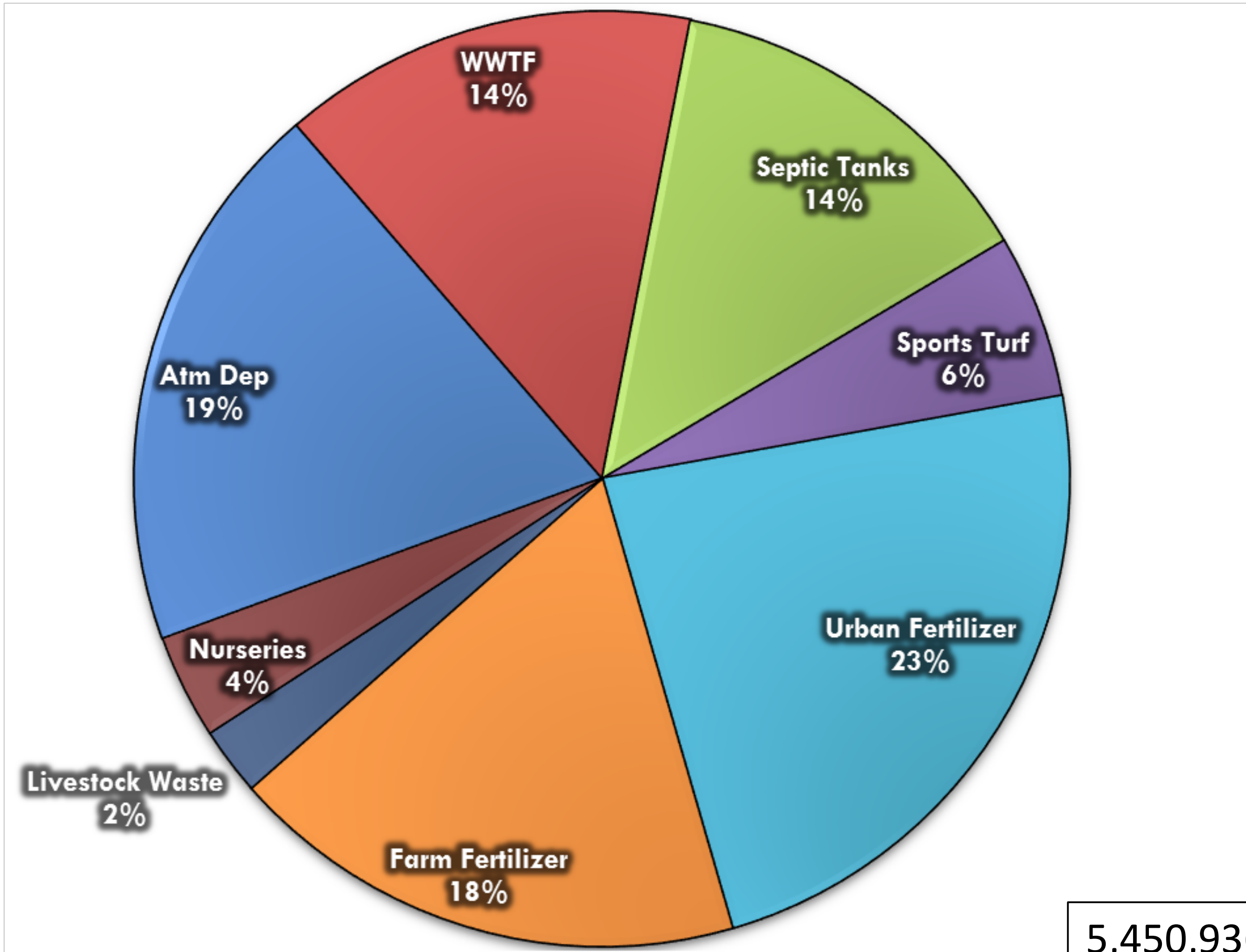
Nitrogen Input: Urban Turfgrass Fertilizers

- Acreage likely to receive fertilizer estimated from PA data and property values
  - Residential
  - Non-residential
- Maximum fertilizable acreage was capped at 1 acre
- Property values used to assess probability of fertilization
- Annual Application Rates based on 2009 study by UCF in the Wekiva area
  - 51% fertilized by owners
    - 2.88 times year
  - 33% fertilized by lawn service
    - 4.76 times a year
  - 16% non-fertilized

Sports Turfgrass Fertilizers

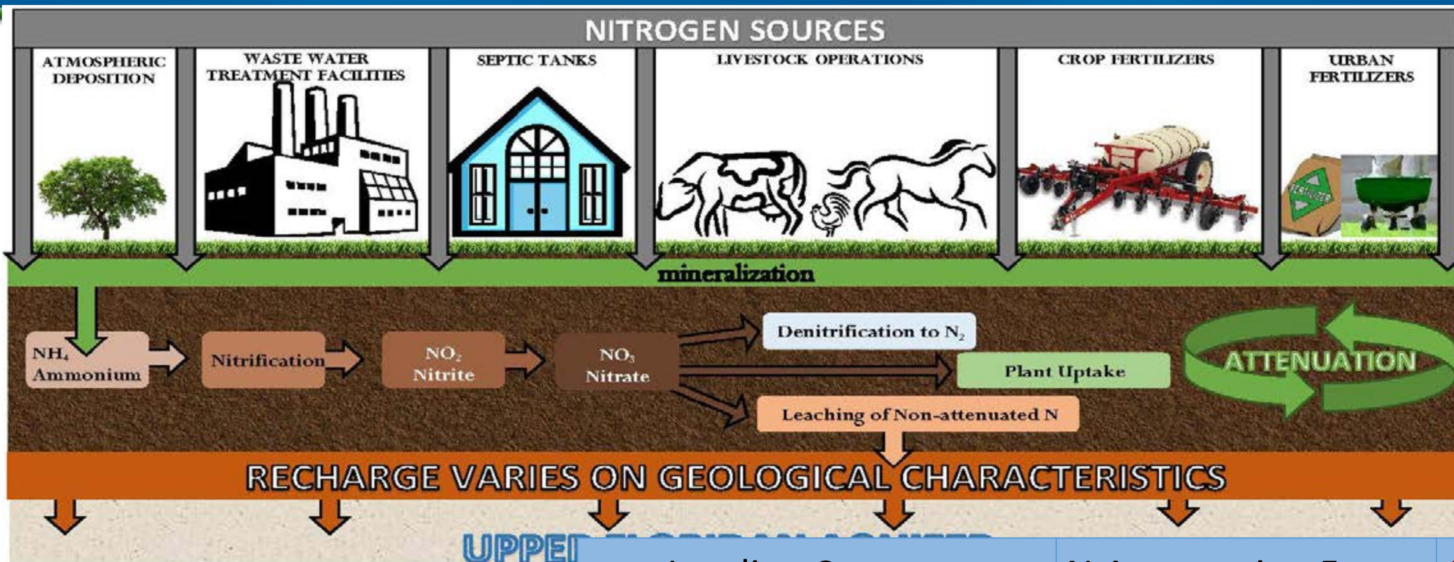
- Sports fields
  - Acreage estimates from aerial analysis of PA landuse data
  - Application rates based on commercial turf maintenance estimates
- Golf Courses
  - Acreage estimated through PA landuse data
  - Application rates based on data provided by golf courses
  - Annual application rate = 4.5 lb-N/1,000 sq ft

Nitrogen Input to Surface



5,450,936 lb-N

Biochemical Attenuation Factors



- Represent the percentage of N removed and therefore not available for leaching to groundwater
- Based on factors used in similar past studies and found in relevant literature

*Range of attenuation for septic based on model runs

Loading Category	N Attenuation Factor	N Leaching
Atmospheric Deposition	90%	10%
Septic Systems*	Range	Range
WWTF-RIB	25%	75%
WWTF-Sprayfield	60%	40%
WWTF-Reuse	75%	25%
Urban Turfgrass Fertilizers	70%	30%
Sports Turfgrass Fertilizers	70%	30%
Farm Fertilizers	80%	20%
Livestock	90%	10%
Nurseries- Indoor	95%	5%
Nurseries- Outside	40%	60%

STUMOD

STUMOD-- a tool for predicting the fate and transport of nitrogen from OSTDS in <u>**S**</u>oil <u>**T**</u>reatment <u>**U**</u>nits (developed at the Colorado School of Mines)

STUMOD-FL—modified to Florida soil conditions (contracted by FDOH) with Hazen Sawyer (2013)

The worksheet "HYDRUS" was provided by FDOH and contains model runs of the STUMOD-FL model for different combinations of soil type, water table depth, and drainfield configurations.

Run	Config	Soil	Effluent	Water Table	NH4 (mg-N/L)			NO3 (mg-N/L)			TN (mg-N/L)			%TN (mass) remaining			%TN (mass) Removed		
#		Texture	Type	Depth	1ft	2ft	6ft	1ft	2ft	6ft	1ft	2ft	6ft	1ft	2ft	6ft	1ft	2ft	6ft
1	Trench Equal	SCL	STE	1	38.4	---	---	14.5	---	---	53.0	---	---	0.7	---	---	34%	---	---
2	Trench Unequal	SCL	STE	1	51.2	---	---	6.8	---	---	58.0	---	---	0.8	---	---	21%	---	---
3	Bed Equal	SCL	STE	1	10.4	---	---	31.0	---	---	41.3	---	---	0.6	---	---	38%	---	---
4	Bed Unequal	SCL	STE	1	35.0	---	---	16.9	---	---	51.9	---	---	0.7	---	---	26%	---	---
5	Trench Equal	LPS	STE	1	11.5	---	---	40.8	---	---	52.3	---	---	0.7	---	---	28%	---	---
6	Trench Unequal	LPS	STE	1	36.2	---	---	20.8	---	---	57.0	---	---	0.8	---	---	19%	---	---
7	Bed Equal	LPS	STE	1	1.2	---	---	48.7	---	---	49.9	---	---	0.8	---	---	20%	---	---
8	Bed Unequal	LPS	STE	1	26.8	---	---	28.7	---	---	55.5	---	---	0.9	---	---	13%	---	---
9	Trench Equal	MPS	STE	1	4.1	---	---	47.8	---	---	52.0	---	---	0.8	---	---	22%	---	---
10	Trench Unequal	MPS	STE	1	30.4	---	---	26.4	---	---	56.8	---	---	0.8	---	---	20%	---	---
11	Bed Equal	MPS	STE	1	0.1	---	---	49.7	---	---	49.8	---	---	0.8	---	---	20%	---	---
12	Bed Unequal	MPS	STE	1	18.3	---	---	37.0	---	---	55.3	---	---	0.9	---	---	14%	---	---
13	Trench Equal	SCL	STE	2	1.5	0.0	---	48.6	34.9	---	50.0	34.9	---	0.7	0.4	---	32%	62%	---
14	Trench Unequal	SCL	STE	2	30.6	14.6	---	25.4	32.5	---	56.0	47.0	---	0.8	0.5	---	22%	48%	---
15	Bed Equal	SCL	STE	2	0.0	0.0	---	42.0	23.7	---	42.0	23.7	---	0.6	0.3	---	36%	68%	---
16	Bed Unequal	SCL	STE	2	4.3	0.1	---	47.3	40.7	---	51.6	40.8	---	0.8	0.5	---	24%	49%	---
17	Trench Equal	LPS	STE	2	0.0	0.0	---	53.9	43.5	---	53.9	43.5	---	0.8	0.5	---	20%	45%	---
18	Trench Unequal	LPS	STE	2	2.4	0.0	---	54.9	51.9	---	57.3	51.9	---	0.9	0.7	---	13%	33%	---
19	Bed Equal	LPS	STE	2	0.0	0.0	---	52.5	42.3	---	52.5	42.3	---	0.8	0.6	---	16%	36%	---
20	Bed Unequal	LPS	STE	2	0.0	0.0	---	56.2	50.8	---	56.2	50.8	---	0.9	0.7	---	10%	26%	---
21	Trench Equal	MPS	STE	2	0.0	0.0	---	55.3	45.4	---	55.3	45.4	---	0.8	0.6	---	16%	41%	---
22	Trench Unequal	MPS	STE	2	6.1	0.0	---	51.8	52.8	---	58.0	52.8	---	0.9	0.7	---	10%	30%	---
23	Bed Equal	MPS	STE	2	0.0	0.0	---	54.1	44.1	---	54.1	44.1	---	0.9	0.7	---	13%	32%	---
24	Bed Unequal	MPS	STE	2	0.3	0.0	---	56.7	51.7	---	57.0	51.7	---	0.9	0.8	---	8%	24%	---
25	Trench Equal	SCL	STE	6	0.0	0.0	0.0	50.3	41.2	0.0	50.3	41.2	0.0	0.7	0.5	0.0	26%	48%	100%
26	Trench Unequal	SCL	STE	6	0.0	0.0	0.0	55.2	49.8	5.9	55.3	49.8	5.9	0.8	0.6	0.0	16%	36%	97%
27	Bed Equal	SCL	STE	6	0.0	0.0	0.0	47.3	36.9	0.0	47.3	36.9	0.0	0.8	0.6	0.0	23%	45%	100%
28	Bed Unequal	SCL	STE	6	0.0	0.0	0.0	52.7	45.2	3.4	52.7	45.2	3.4	0.8	0.6	0.0	17%	36%	98%
29	Trench Equal	LPS	STE	6	4.5	0.0	0.0	53.8	56.2	24.0	58.3	56.2	24.0	1.0	0.9	0.2	3%	12%	76%
30	Trench Unequal	LPS	STE	6	21.9	0.0	0.0	37.3	57.7	36.5	59.2	57.8	36.5	1.0	0.9	0.4	-1%	8%	61%
31	Bed Equal	LPS	STE	6	0.5	0.0	0.0	57.6	56.2	33.1	58.1	56.2	33.1	1.0	0.9	0.4	3%	9%	58%
32	Bed Unequal	LPS	STE	6	11.7	0.0	0.0	47.2	57.5	42.3	58.9	57.5	42.3	1.0	0.9	0.5	0%	5%	47%
33	Trench Equal	MPS	STE	6	22.5	0.1	0.0	36.7	57.7	31.6	59.2	57.9	31.6	1.0	0.9	0.4	-1%	6%	62%
34	Trench Unequal	MPS	STE	6	35.7	9.6	0.0	23.9	49.2	42.4	59.6	58.8	42.4	1.0	1.0	0.5	-3%	4%	49%
35	Bed Equal	MPS	STE	6	13.4	0.0	0.0	45.6	57.8	39.1	58.9	57.8	39.1	1.0	0.9	0.5	1%	6%	47%
36	Bed Unequal	MPS	STE	6	28.9	4.9	0.0	30.5	53.8	46.6	59.4	58.6	46.6	1.0	1.0	0.6	-1%	2%	38%
37	Trench Equal	SCL	STE	FD	0.0	0.0	0.0	51.5	44.2	12.2	51.5	44.2	12.2	0.8	0.6	0.1	22%	41%	91%

STE = 60mg-TN/L

Futher details on the STUMOD-FL model are contained in multiple documents under Task D of the FOSNRS study.

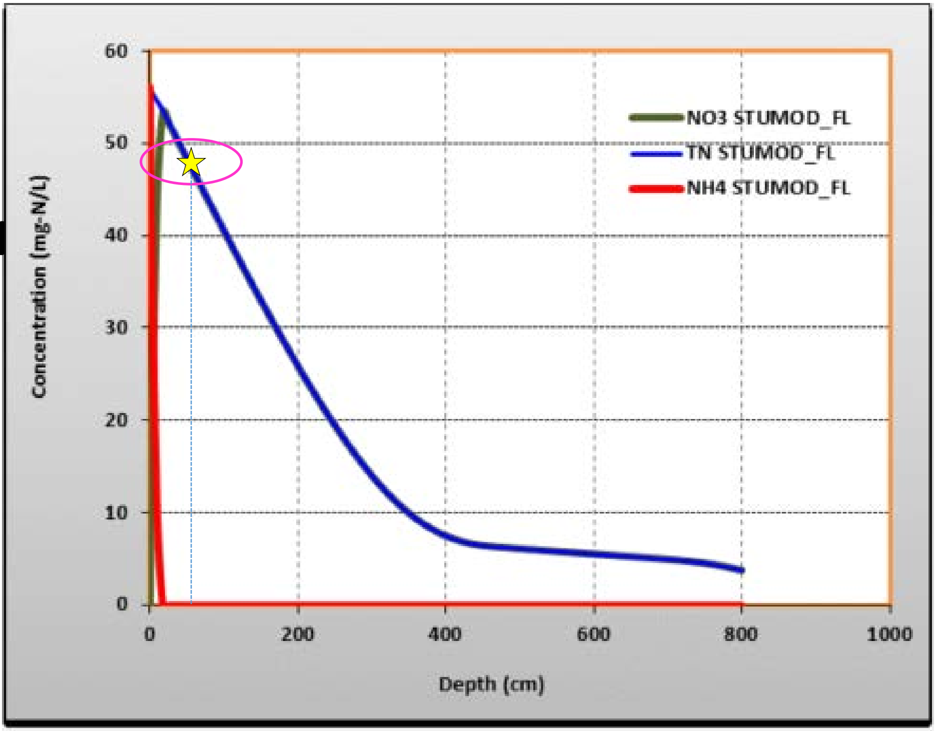
STUMOD– Wekiva Study Sites

Calibrate STUMOD based on results from FDEP's study

- Compare TN concentrations at 60cm in the soil
- No GW monitoring results to compare to TN concentrations at the water table reported by STUMOD

Site B

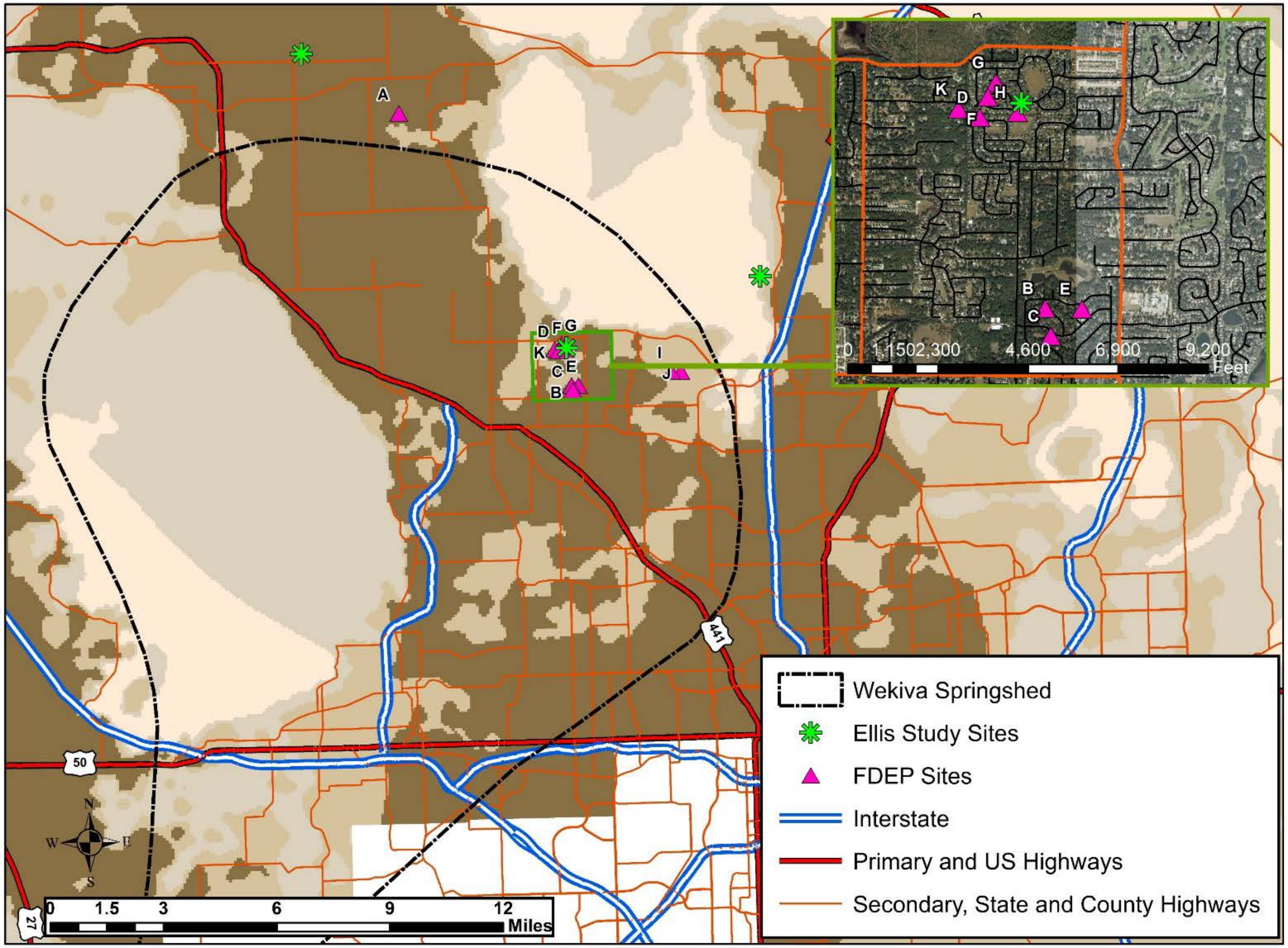
- Study Results
  - STE- 90 mg-TN/L
  - Lysimeter data @ 60cm reported a TN concentration of 46.41 mg/L
- STUMOD Run
  - TN concentration @ 60cm of ~48 mg/L



STUMOD– Wekiva Study Sites

2007 study conducted by Ellis & Associates for FDOH: *Nitrogen Loading Assessments from Onsite Waste Treatment and Disposal Systems within the Wekiva River Basin*

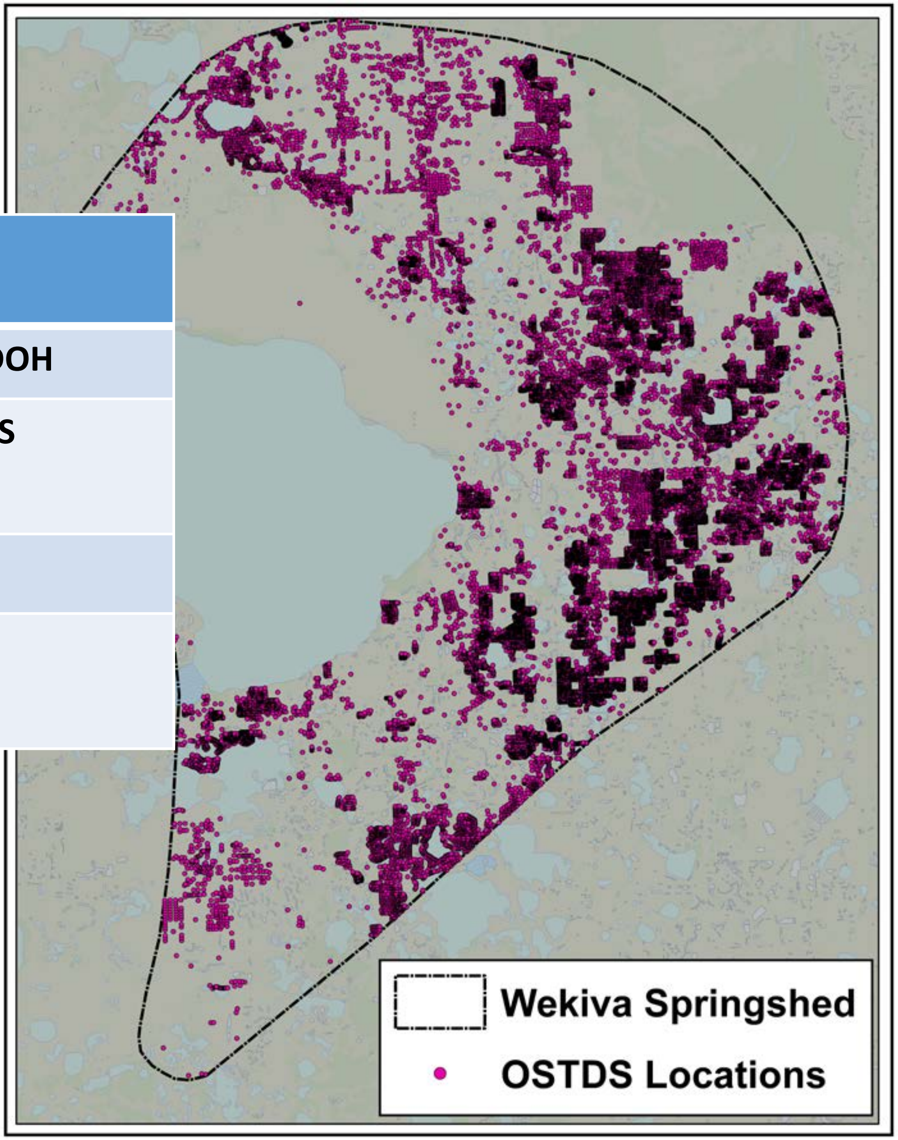
◊ Provided all of the data needed to calibrate STUMOD (STE concentration, GW concentration, DTW, soil type)



STUMOD- Application of run results

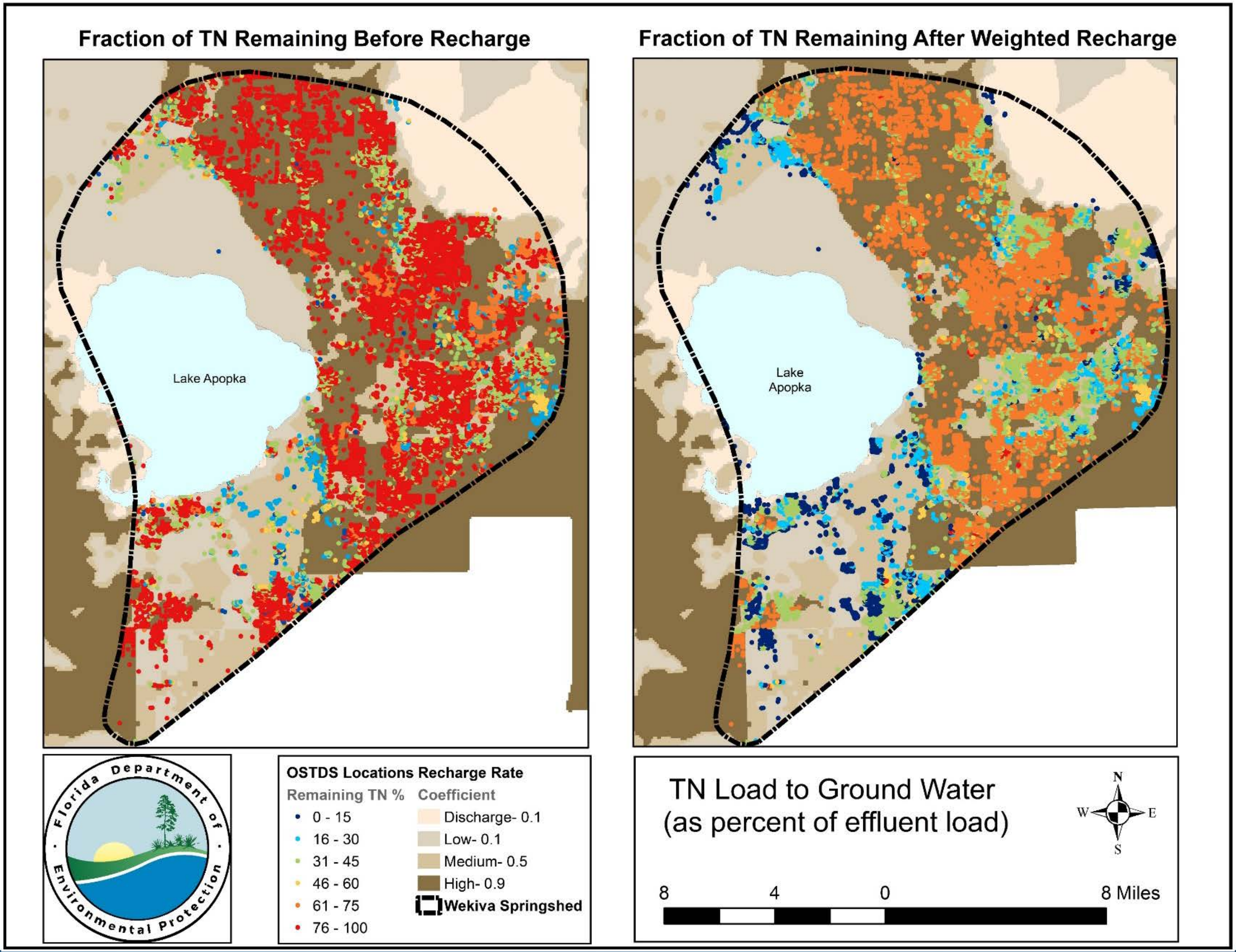
- Assign each OSTDS the appropriate site characteristics in order to compare to the lookup table

Dataset	Geometry	Source
OSTDS Locations	Point	FLWMI- FDOH
Soils- Florida SSURGO	Polygon	USDA NRCS
Depth to Water	Raster	SJRWMD
UFA Recharge Areas*	Raster	SJRWMD

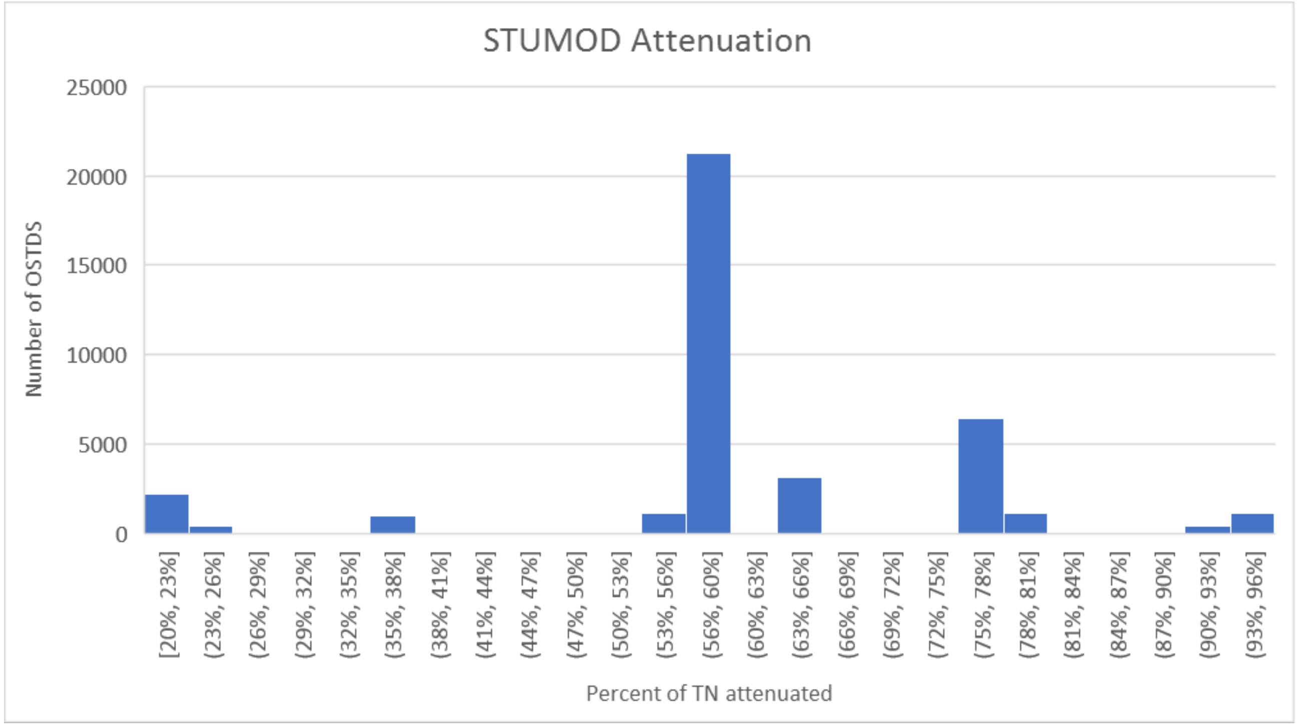


*The amount of nitrate that is transported to the UFA in a given year is related to the rate of recharge to the aquifer (soil properties, hydrogeology, rainfall)

STUMOD– Results

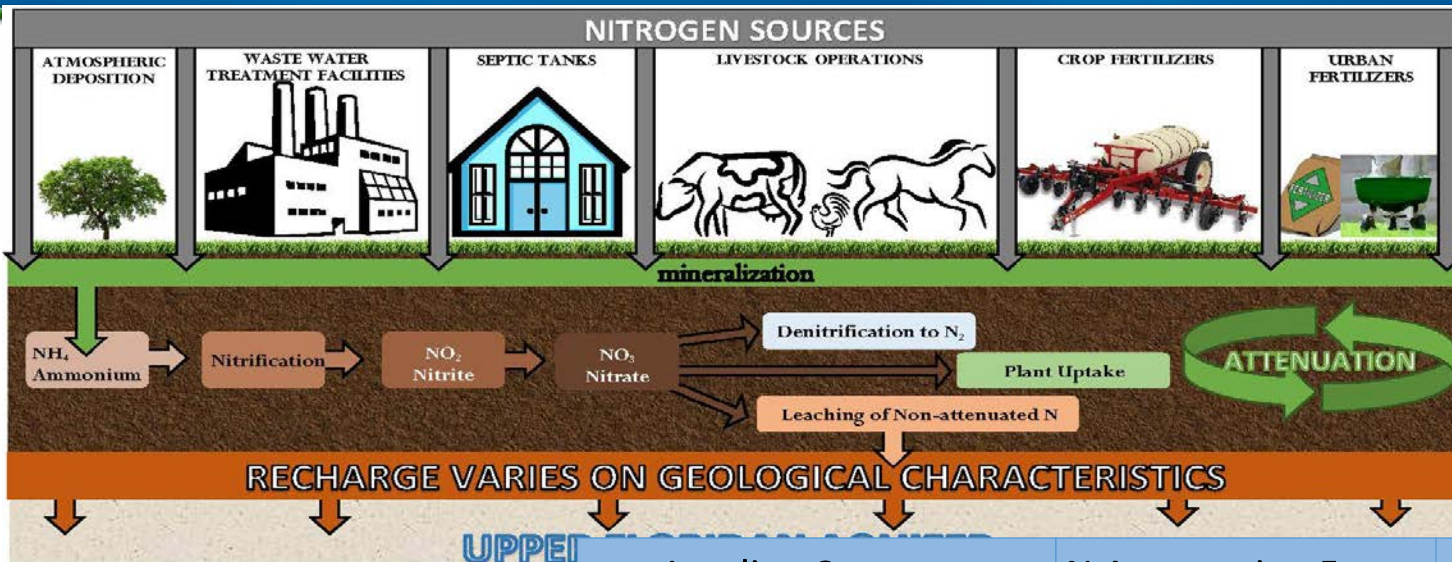


STUMOD– Attenuation



- Attenuation ranged from 22% to 96% due to different site properties (i.e. soil type, DTW, and recharge)
  - 55% of all OSTDS locations in the springshed were assigned an attenuation of **57%**
- FDEP generalized attenuation value used for OSTDS is 50%

Biochemical Attenuation Factors

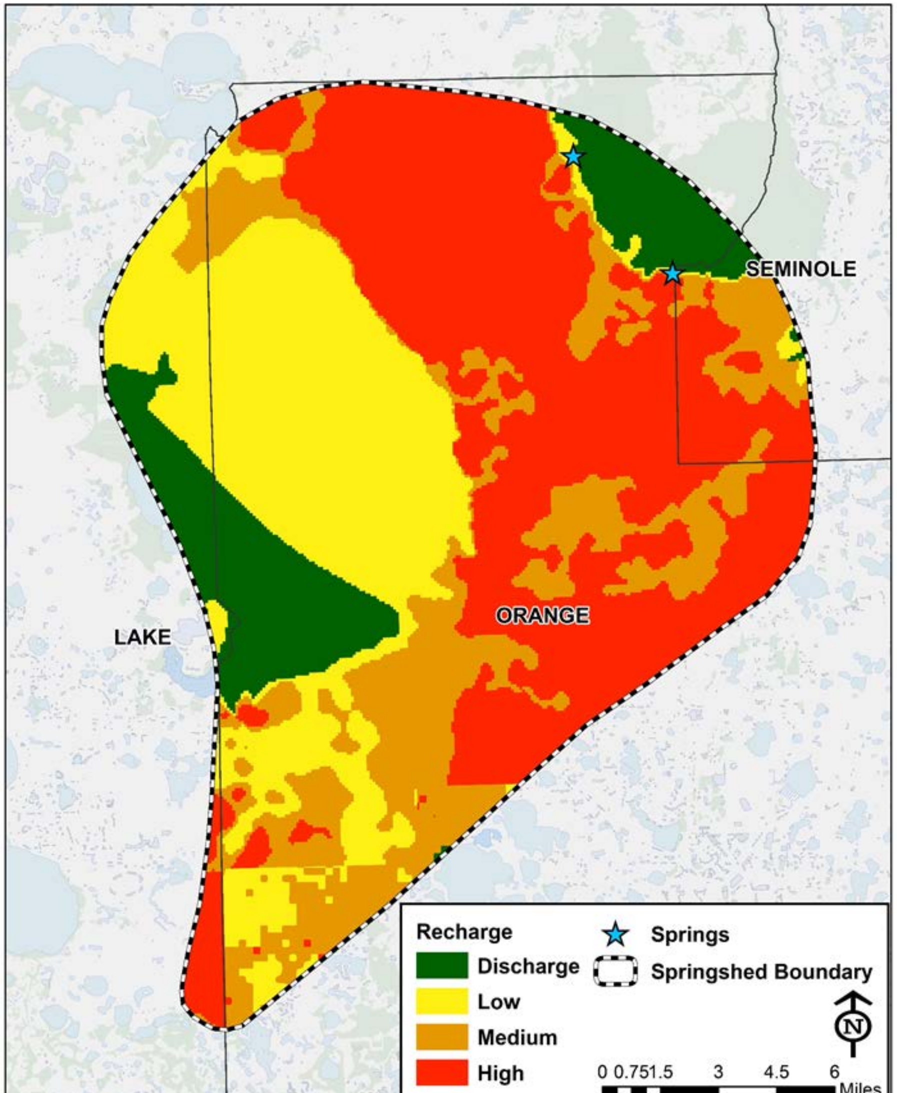


- Represent the percentage of N removed and therefore not available for leaching to groundwater
- Based on factors used in similar past studies and found in relevant literature

*Range of attenuation for septic based on model runs

Loading Category	N Attenuation Factor	N Leaching
Atmospheric Deposition	90%	10%
Septic Systems*	Range	Range
WWTF-RIB	25%	75%
WWTF-Sprayfield	60%	40%
WWTF-Reuse	75%	25%
Urban Turfgrass Fertilizers	70%	30%
Sports Turfgrass Fertilizers	70%	30%
Farm Fertilizers	80%	20%
Livestock	90%	10%
Nurseries- Indoor	95%	5%
Nurseries- Outside	40%	60%

Hydrogeological Attenuation Factors Based on Recharge to UFA



This map was prepared on 05/03/17 by FDEP Groundwater Management Section. For display purposes only. For more information: C.Lyon (850) 245-8652

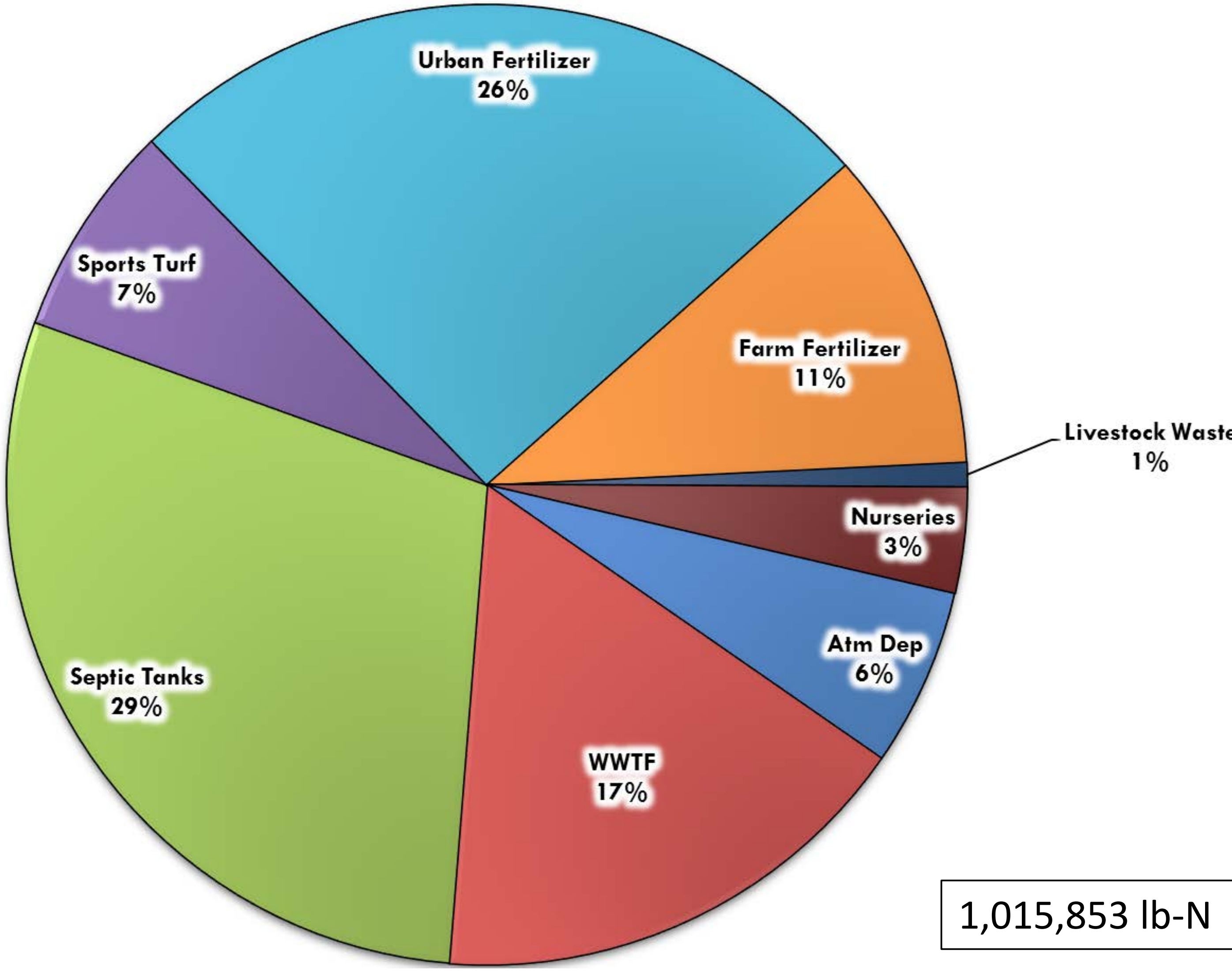
- Recharge factors are used to estimate the percentage of the non-attenuated nitrogen expected to reach the aquifer in a year

10%

50%

90%

Nitrogen Load to Groundwater



1,015,853 lb-N

QUESTIONS??

Division of Environmental Assessment and Restoration
Groundwater Management Section

Celeste.Lyon@dep.state.fl.us

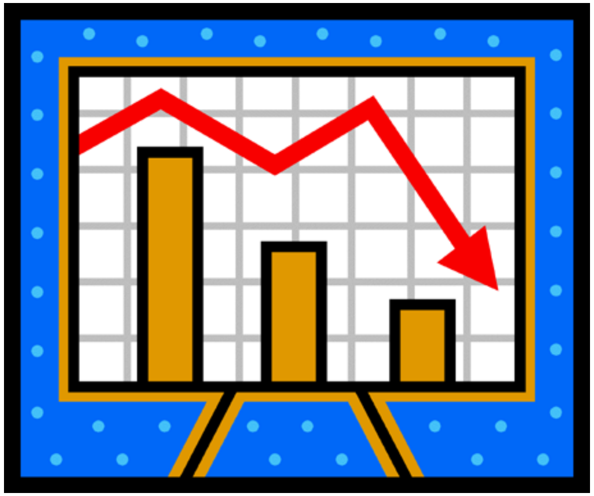
Draft Approach to Achieve Reductions and Restoration

TMDL/BMAP Plan

- Nitrate water quality targets for Wekiwa Springs and Rock Springs - 0.286 mg/L of nitrate (monthly average).
- To achieve TMDL, BMAP implementation will be a 20-year process.
- Plan will define nitrogen reduction milestones:
  - 30% reduction within 5 years.
  - 50% reduction within 10 years.
  - 20% reduction within 15 years.

Determining Reductions

- Total load reduction required to meet TMDL:
  - Difference between estimated total load at the spring vent (current concentration x current flow), and the TMDL load (target concentration x current flow).
- Reductions from projects:
  - Estimated reductions resulting from projects submitted by stakeholders.
    - Existing and planned efforts.
- Remaining reduction balance (Gap):
  - Estimated by subtracting the total reduction required from the estimated reductions from projects submitted.



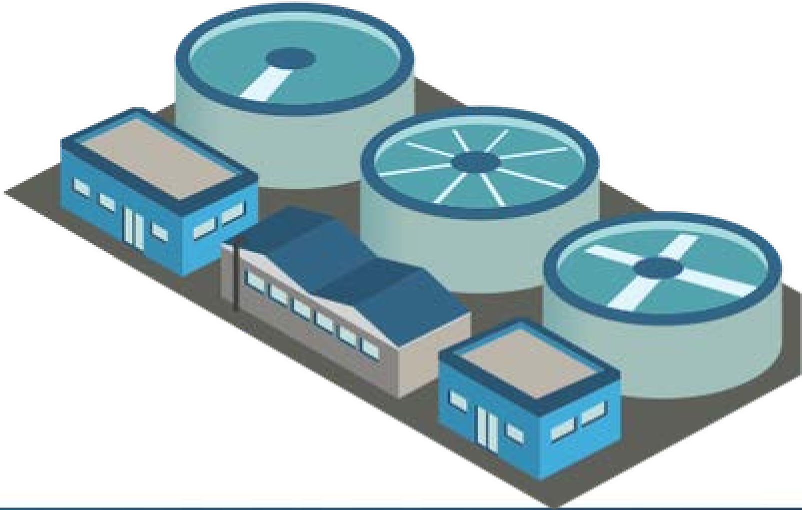
Example - Kings Bay

Gap Analysis		
Nitrogen Source	**Credits Based on Projects Submitted (lb-N/yr)**	**Description**
OSTDS	103,868	Credits identified for stakeholder OSTDS projects (including enhancement and sewer projects)
UTF (Urban Turfgrass)	4,050	DEP approved credits (up to 6%) for public education activities as well as credits identified for stakeholder stormwater projects
AD (Atmospheric Deposition)	–	No reduction
FF (Farm Fertilizer)	10,604	15% BMP credit on FF load to groundwater, assuming 100% owner-implemented BMPs on all fertilized lands
STF (Sports Turfgrass)	4,886	6% BMP credit for sports fields and 10% BMP credit for golf courses on STF load to groundwater, assuming 100% BMP implementation on golf courses and sports fields
Livestock	3,079	10% BMP credit on load to groundwater, assuming 100% owner-implemented BMPs at all livestock facilities
WWTF (Wastewater Treatment Facility)	9,322	Achieved by BMAP WWTF policy if BMAP-wide (achieving 3 or 6 mg/L)
Total Credits	135,810	
Required Reduction	274,000	
Load Remaining	**138,190**	

How address remaining 138,190 pounds?

Possible Approaches to Achieve Remaining Reduction

- *OSTDS* –
  - Evaluate the potential for nitrogen reductions based on OSTDS enhancement or replacement.
- *Wastewater Treatment Facilities* (*WWTFs*) −
  - Option: apply more stringent effluent standards to all WWTFs in the BMAP (inside and outside the PFA).



Possible Approaches to Achieve Remaining Reduction (con't)

- *Urban Turfgrass Fertilizer (UTF)* –
  - Sources have the option to collect and provide monitoring data to quantify reduction credits for additional measures.
- *Farm Fertilizer (FF)* –
  - Additional credits could be achieved through better documentation of reductions achieved through BMP implementation or implementation of advanced cost-share BMPs, such as precision irrigation, soil moisture probes, and cover crops.
- *Livestock Waste (LW)* –
  - Additional credits could be achieved through advanced cost-share BMPs if data are available.

Challenges – Food for thought

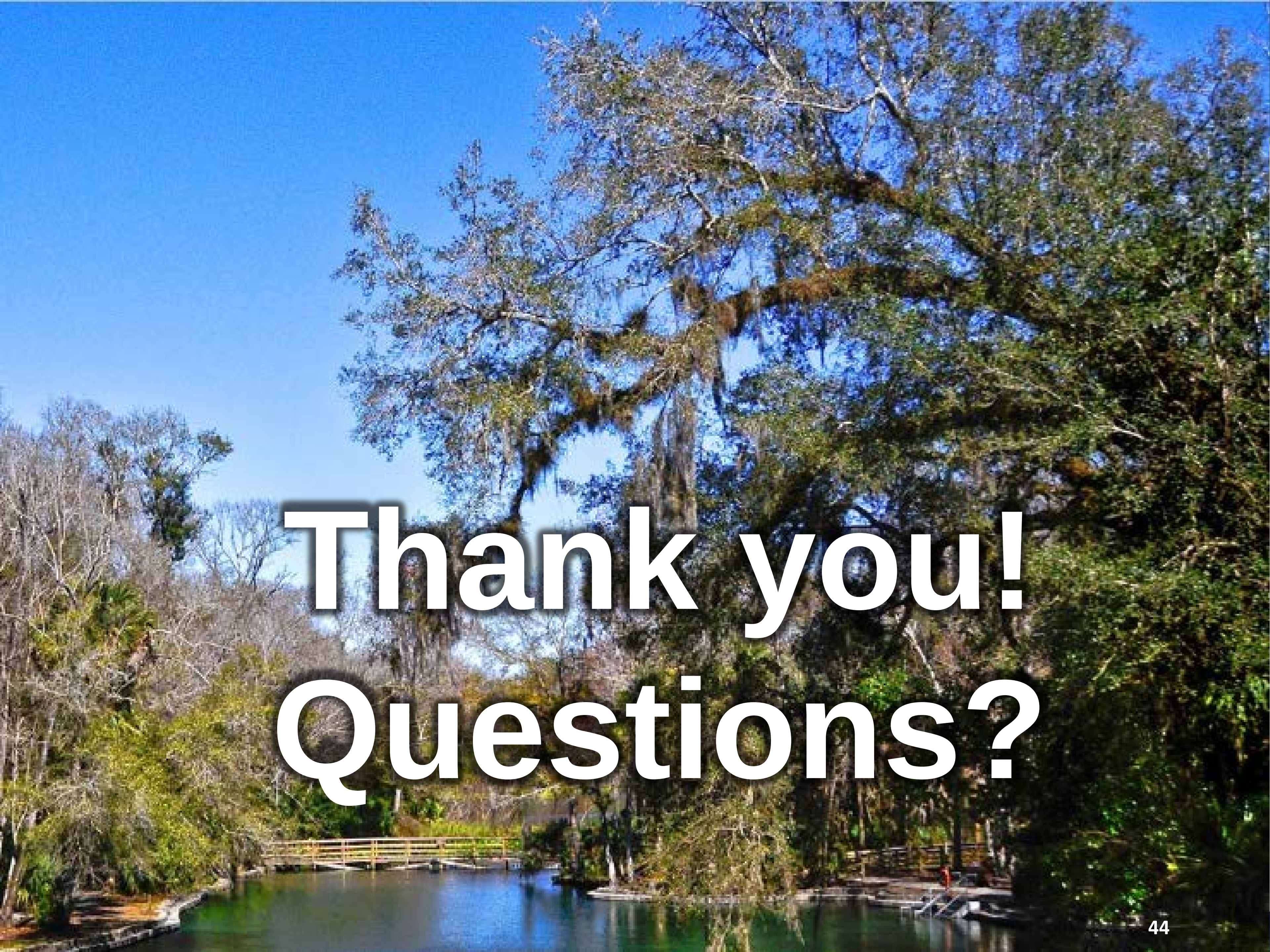
- *NSILT estimates are a current snapshot only.*
- *Unquantified project benefits.*
- *Legacy sources.*
- *OSTDS permitting.*
- *Improvements at the springs.*

Next Steps

- Calculate loads and reductions needed:
  - Total load reduction.
  - Project reductions.
  - Gap (remaining load).
- Determine milestone load reductions (5-, 10-, 15-year).
- Calculate septic tanks per recharge area and credits associated with remediation options – this will allow group to start talking about best policy options to address this source.

Wrap Up

- Action Items.
  - Next meeting, October/November time frame.
- Other comments/announcements.


Thank you!
Questions?

Contacts

- Tom Frick, Director, Division of Environmental Assessment and Restoration, Thomas.Frick@dep.state.fl.us
- Kevin Coyne, Administrator, Watershed Planning and Coordination Section, Kevin.Coyne@dep.state.fl.us
- Rick Hicks, Administrator, Ground Water Management Section, Richard.W.Hicks@dep.state.fl.us
- Moira Homann, Wekiva River, Rock Springs Run, and Little Wekiva Canal BMAP Coordinator, Moira.Homann@dep.state.fl.us
- Celeste Lyon, Environmental Specialist, Celeste.Lyon@dep.state.fl.us
- Tiffany Busby, Facilitator/Consultant, TLBusby@wildwoodconsulting.net
- Laura Savage, Consultant, LSavage@wildwoodconsulting.net