Department of Health
Environmental Health
Bureau of Onsite Sewage Programs

Nitrogen Impacts from Onsite Systems in the Wekiva Study Area

Presentation for the

Florida Environmental Health Association

August 8, 2007

Purpose and Scope:

- Provide background on Onsite Sewage Systems
- Provide historical information on Wekiva and Onsite Sewage Systems
- 2006 Legislative Mandate
- Department of Health approach
- Conclusions and Recommendations

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Background Information

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What do onsite systems contribute?

- 1/3 of population in Florida served by onsite systems
- Septic is one of the largest artificial groundwater recharge sources in the state
- 93% of drinking water comes from groundwater

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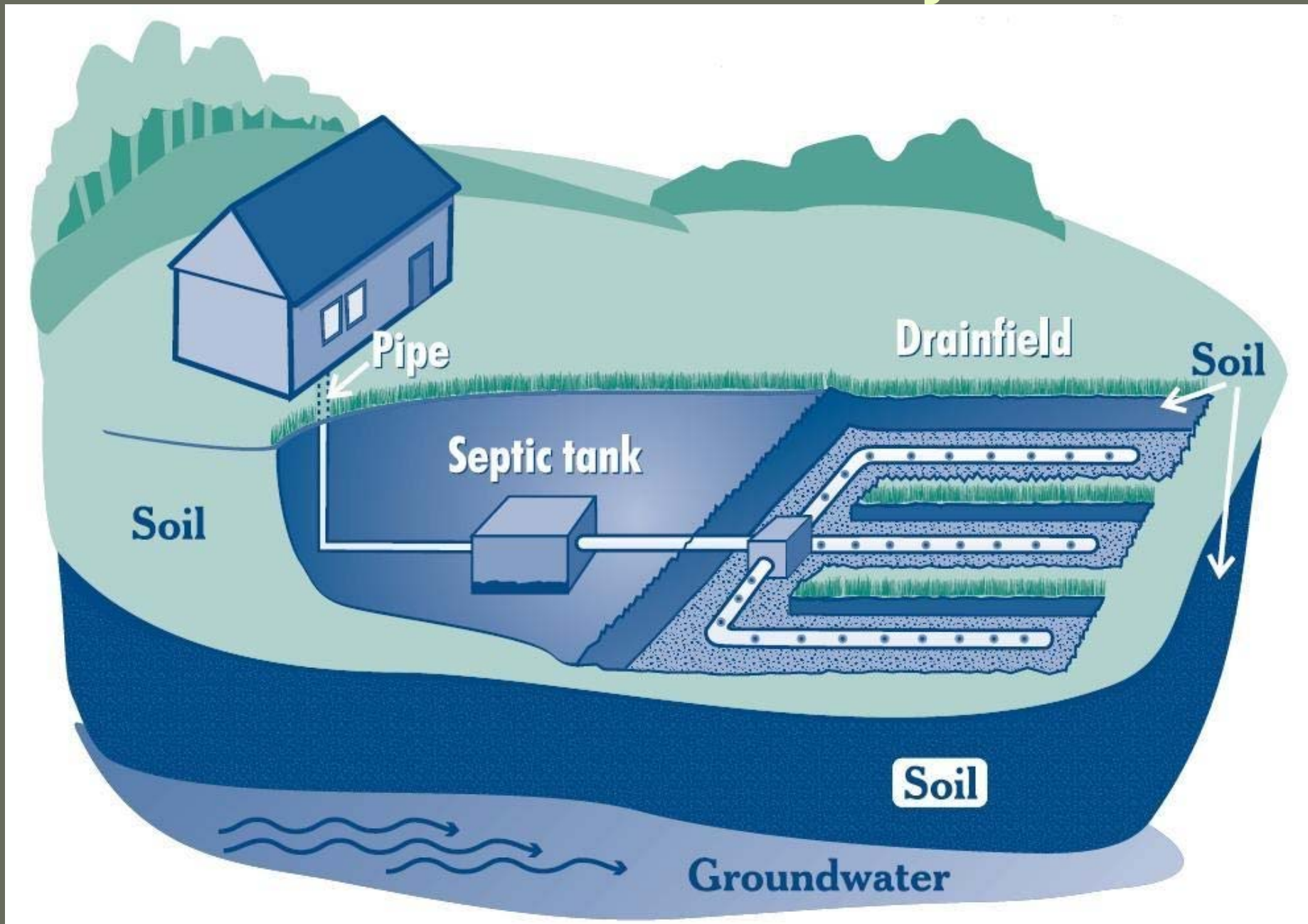
Standard Onsite System



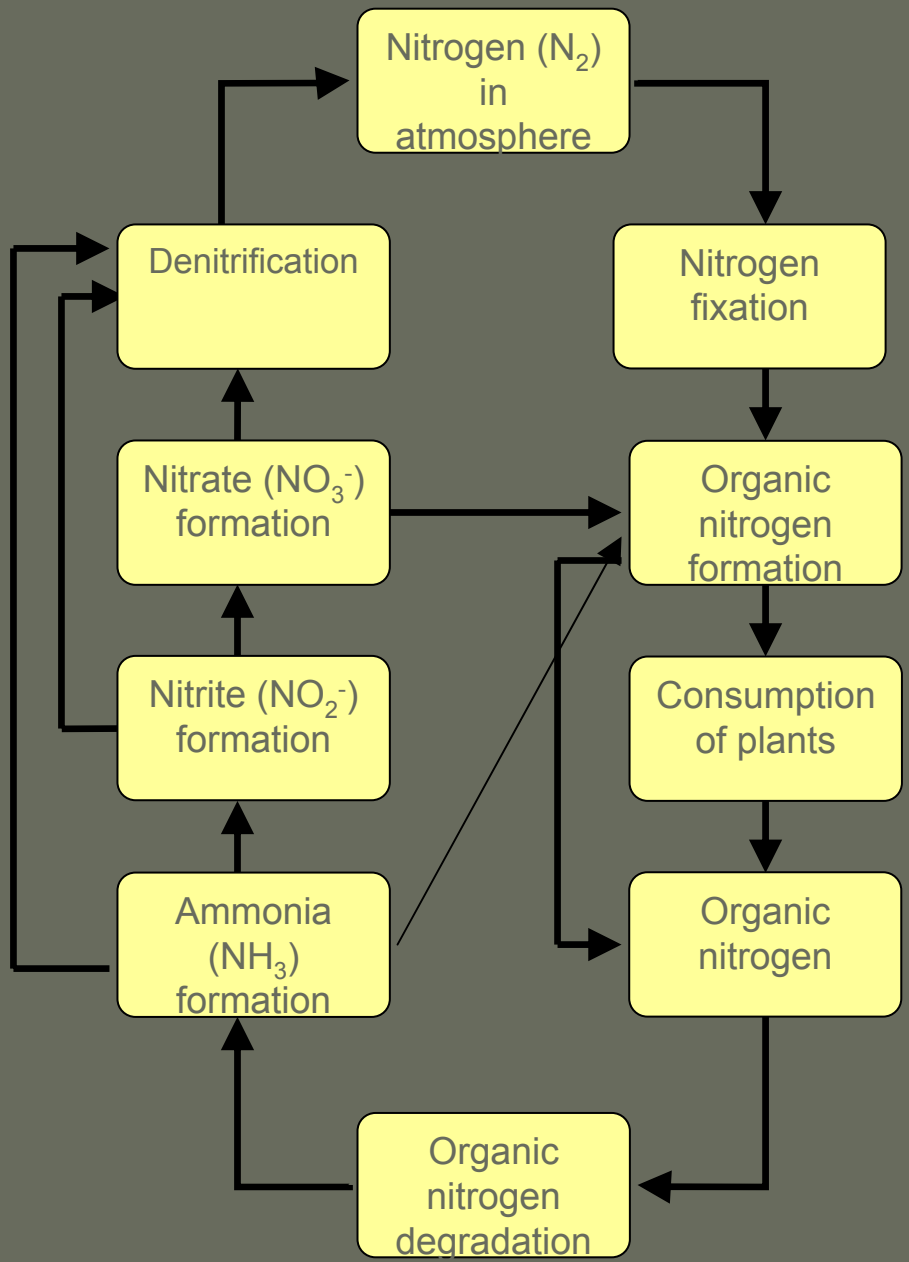
Why all the fuss about nitrogen?

- Nitrogen is a common element that occurs in different forms
- Law of Conservation of Matter: Matter can neither be created nor destroyed
- We are increasing nitrogen into the biosphere through release of oxidized nitrogen as a result of burning fossil fuels and by applying fertilizers
- High nitrogen levels can cause excessive algae growth
- Too much algae can eventually kill fish and other aquatic life
- Drinking water standard is 10 mg/L, too much nitrogen in drinking water can lead to health hazards such as blue baby syndrome

How fast does nitrogen move through the soil and rock?

- Nitrogen is very soluble and can move at the rate of the groundwater
- USDA Soil Surveys document movement of between 1.2 to greater than 40 feet per day
- The karst study documented movement rates of 1 to 280 feet per day horizontally

Nitrogen Cycle



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Nitrogen Sources

- Fertilizer from both Agricultural and Residential land uses
- Atmospheric deposition
- Livestock, feedlots, manure
- Wastewater treatment plants
- Drainage wells
- Onsite systems
- Other (sinking streams, etc.)

How much nitrogen does an onsite system produce?

One septic system (~ 2 – 3 bedrooms) generates about 20 pounds of total nitrogen per year, equal to about four bags of 10-10-10 fertilizer

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Historical Information on Wekiva Issue

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Wekiva River

- Wekiva River is designated an Outstanding Florida Water, a State Canoe Trail, and has recently been added to the federal Wild and Scenic Rivers program
- Majority of flow to river comes from Wekiwa Springs and Rock Springs

- What are the nitrogen levels in the springs?
  - Wekiwa and Rock Springs contain 20 times the level of nitrogen of springs without development (1.5 mg/L Wekiwa, 1.6 mg/L Rock as compared to Juniper Springs which has 0.08 mg/L)
- What is the source of the nitrogen?
  - A mixture of fertilizer and animal waste (human included) contributions

SJRWMD Pollutant Load Reduction Goal (PLRG)

Proposed for Wekiva River and Rock Springs Run

	Nitrate	Total Phosphorus	Total Coliform Bacteria
Wekiwa Spring	82%	- - -	- - -
Upper Wekiva River (to Little Wekiva River)	69%	50%	49%
Lower Wekiva River (to Blackwater Creek)	36%	50%	30%
Rock Spring	85%	- - -	- - -
Rock Springs Run	52%	29%	50%

Table 1. SJRWMD recommended percent reductions in loading of nitrate, TP, and total coliform bacteria for the Wekiva River and Rock Springs Run from all sources.

Reproduced from the Executive Summary from the PLRG (Mattson, et. al. 2006) with permission from the author

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Wekiva Parkway and Protection Act

- Wekiva Protection Act – signed into law on June 29, 2004
- The law authorizes building the Wekiva Parkway and provides protection to the Wekiva River system
- Wekiva River Basin Commission
- Master Stormwater Plan
- Wastewater Facility Plan
- Comprehensive Plan Amendments
- Coordination of Land Use and Water Supply
- All nitrogen pollution sources are being addressed in the study area. Multi agency, coordinated approach (DOH, DEP, DACS, DCA, etc.)

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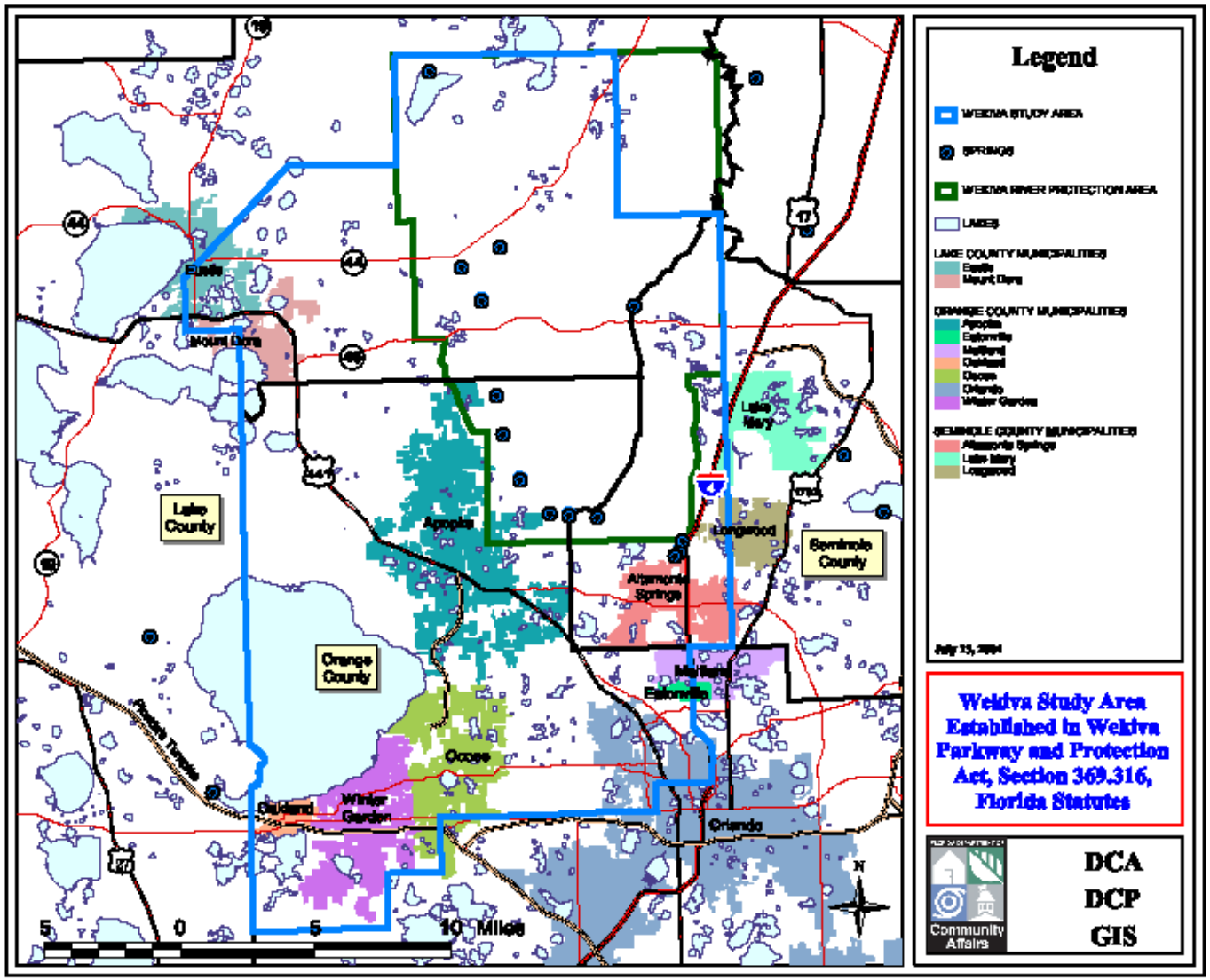
Wekiva Study Area Defined



Incorporates data from various contributing sources to the Wekiva River System

Contains parts of Lake, Seminole, and Orange Counties

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What does wastewater have to do with building the Wekiva Parkway?

- Good roads encourage development
- More development means more septic tanks
- The proposed routes go through an area with a very sensitive *Karst* environment
- The river and groundwater in the area are interconnected and very sensitive to nitrogen pollution
- Conventional septic systems release nitrogen

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Department of Health and Wekiva Protection Issue

- Directed DOH to study the effectiveness of onsite wastewater systems and, if appropriate, develop rules that are protective of the public health and environment
- DOH added to the Wekiva River Basin Commission

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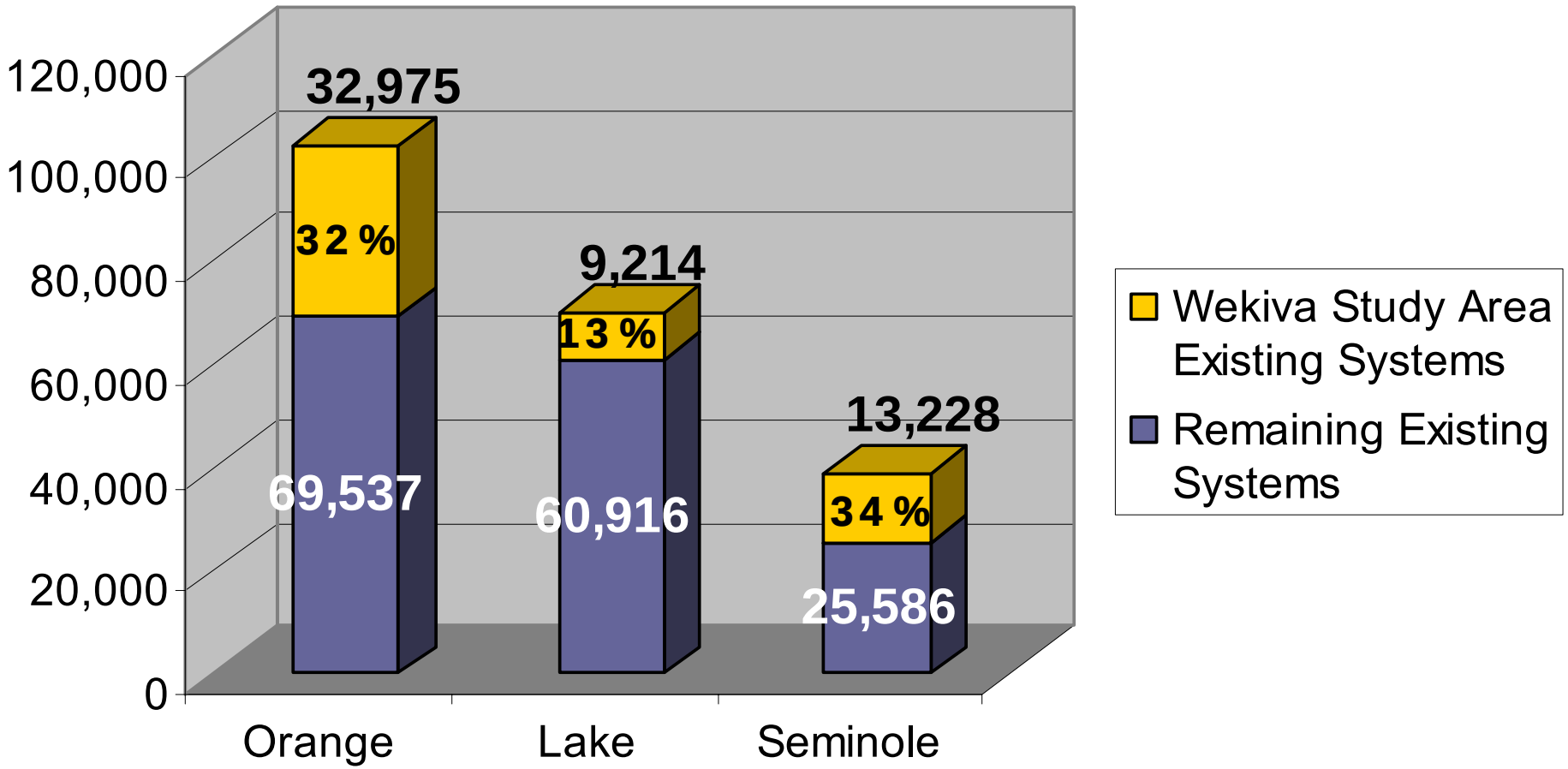
2004 Existing Onsite Systems in Wekiva Study Area



Total of 55,417 existing systems in the Wekiva Study Area

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DOH 2004 Recommendations

- Set a discharge limit of 10 milligrams per liter of total nitrogen in the more vulnerable areas
- Require the use of drip irrigation drainfields
- Prohibit the land-spreading of septage and grease trap waste
- Create regional wastewater management entities

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Public Input on Past Recommendations

- Four public meetings
- Answer questions and seek public input
- Approximately one-thousand attendees
- Concerns were:
  - Costs to homeowners
  - What portion of the contribution comes from onsite systems?
  - What is being done for other nitrogen inputs?
  - What local scientific data was used to form policy decisions?

2006 Legislative Mandate

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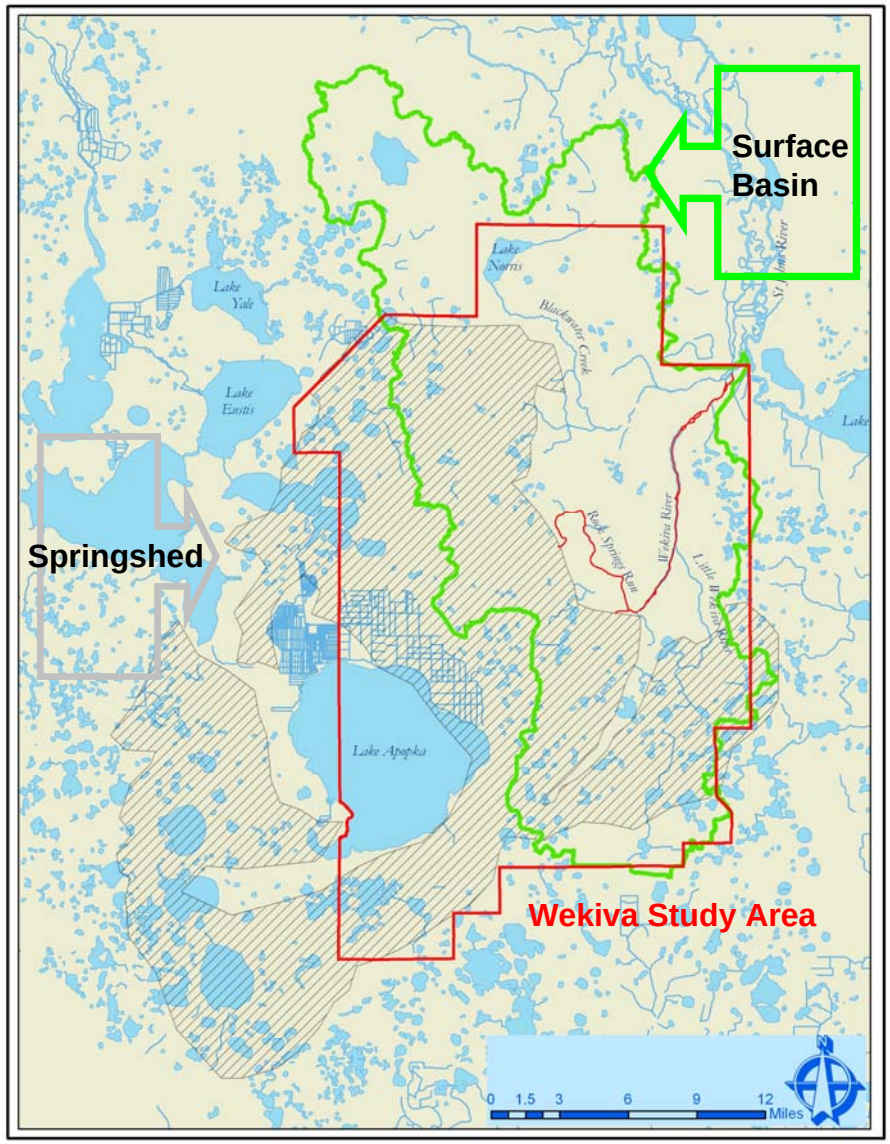
DEP Legislative Mandate



- DEP tasked to conduct a Wekiva River and Floridan Aquifer study to determine nitrate impacts to the system
- Contracted with SJRWMD who subcontracted with MACTEC
- Looked at various sources of nitrogen in the Wekiva basin (DOH tasked to look at Wekiva Study Area)

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DEP Nitrate sources considered

Total nitrogen (TN) data used when nitrate not available or reported (assumed to be a surrogate for nitrate)

- Industrial & Domestic wastewater (nitrate)
  - Use of reclaimed water for irrigation assumed to replace fertilizer use
- Septic tank drainfields (total nitrogen)
- Fertilizer (total nitrogen)
  - Agricultural (row crop, citrus, nurseries, pasture)
  - Residential
  - Golf course
  - 'Other' (ball fields, roadside, etc.)
- Livestock (total nitrogen)
- Atmospheric deposition (nitrate)

What is the difference between an input and a load?

Input is the amount of nitrogen that is released into the environment

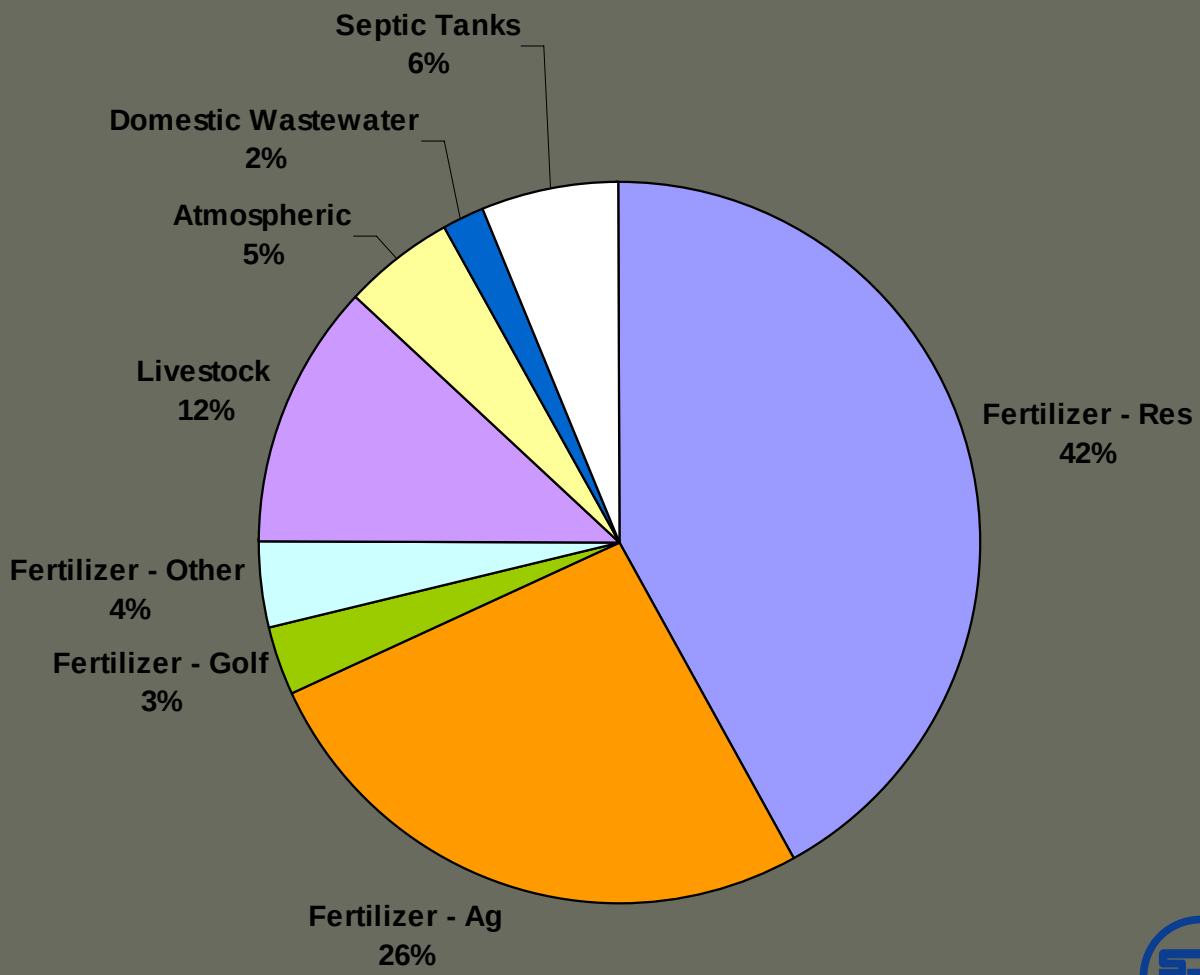
- Example: applying a bag of fertilizer to the ground surface

Load is the amount of nitrogen that reaches the groundwater

- Example: the remaining nitrogen from a bag of fertilizer that reaches the groundwater after the plants and the soil have utilized (denitrified) portions of the nitrogen that was originally considered an input

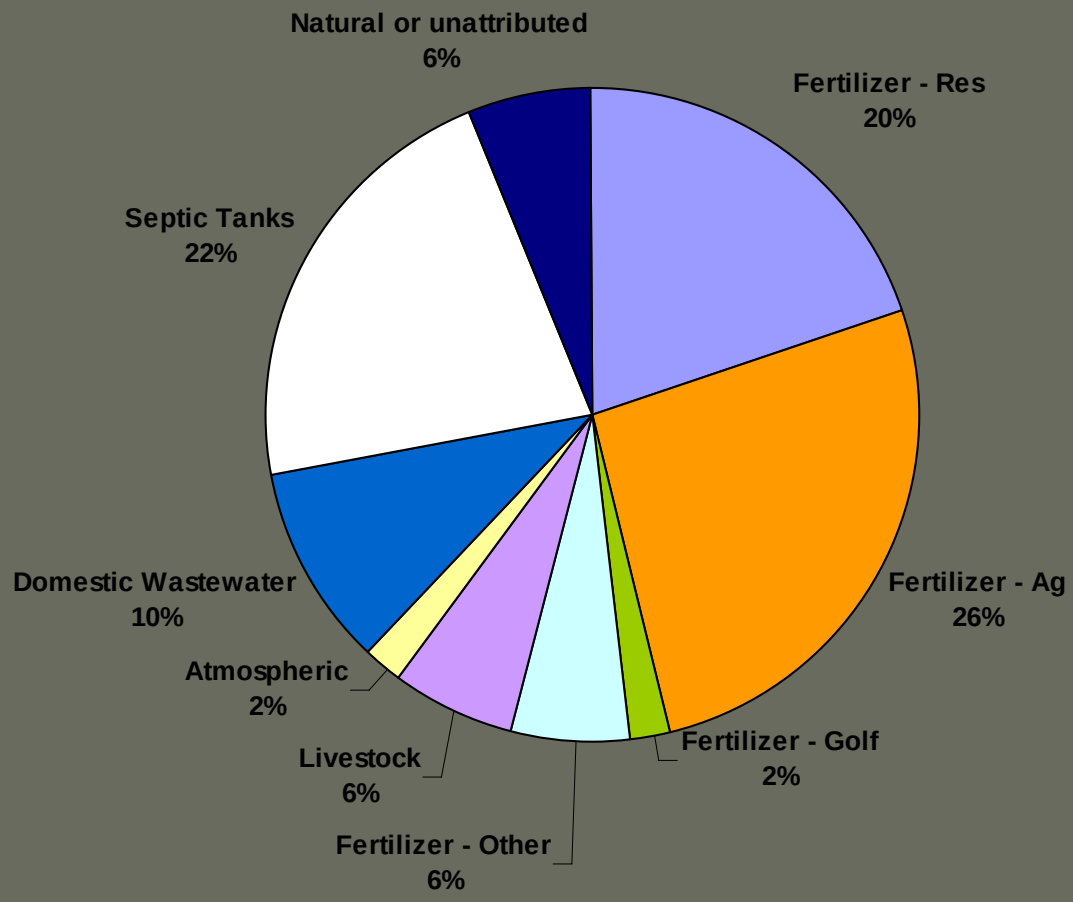
DEP Nitrogen / Nitrate **inputs** in the Wekiva Basin (by source)

21 Million Pounds/Year



DEP Nitrogen / Nitrate **loads** in the Wekiva Basin (by source)

4 Million Pounds/Year



DOH Approach

DOH tasked to:

- Quantify onsite nitrogen load contribution to groundwater
- Assess relative importance of onsite in comparison to other sources
- Recommend cost-effective solutions
- Project to be complete and report given to legislature June 30, 2007
- Total budget of $250,000

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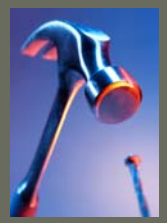
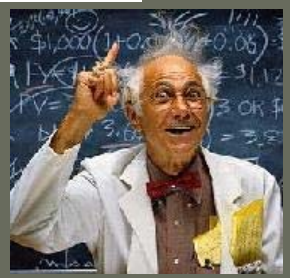







Research Review and Advisory Committee

- Given oversight of Wekiva Study
- Develop scope, select providers, and review reports
- Advise on directions for new research
- Next meeting will be in September of 2007 to discuss final report

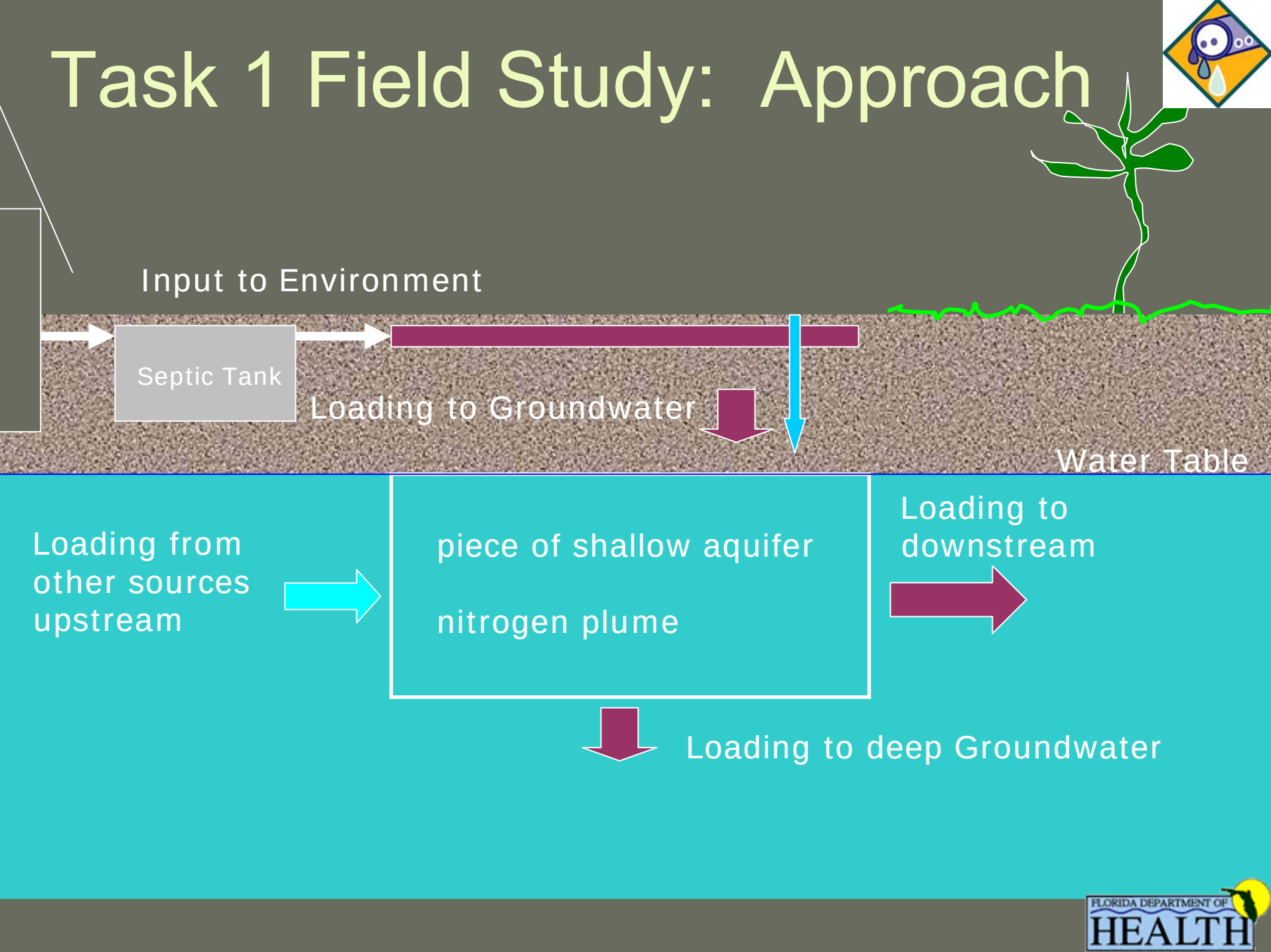
Tasks

- Field work
- How much nitrogen does one system contribute per category (drainage class, depth to water, soil organic content, etc.)
- How much total nitrogen do septic systems contribute as compared to other sources
- Provide a range of cost-effective strategies

Task 1: Field Study in Wekiva Study Area to sample actual onsite systems

- Ellis & Associates, Inc., $200,000
- What does one system contribute to the groundwater?
- Detailed field sampling of three systems in Wekiva Study Area to determine how much nitrogen comes out of the septic tank, and how much makes it to the groundwater
- Analyzed samples in the septic tank (input) and under the drainfield at the top of the water table (load)
- Also identified the effluent plume in the groundwater as it moves away from the source

Task 1 Field Study: Approach

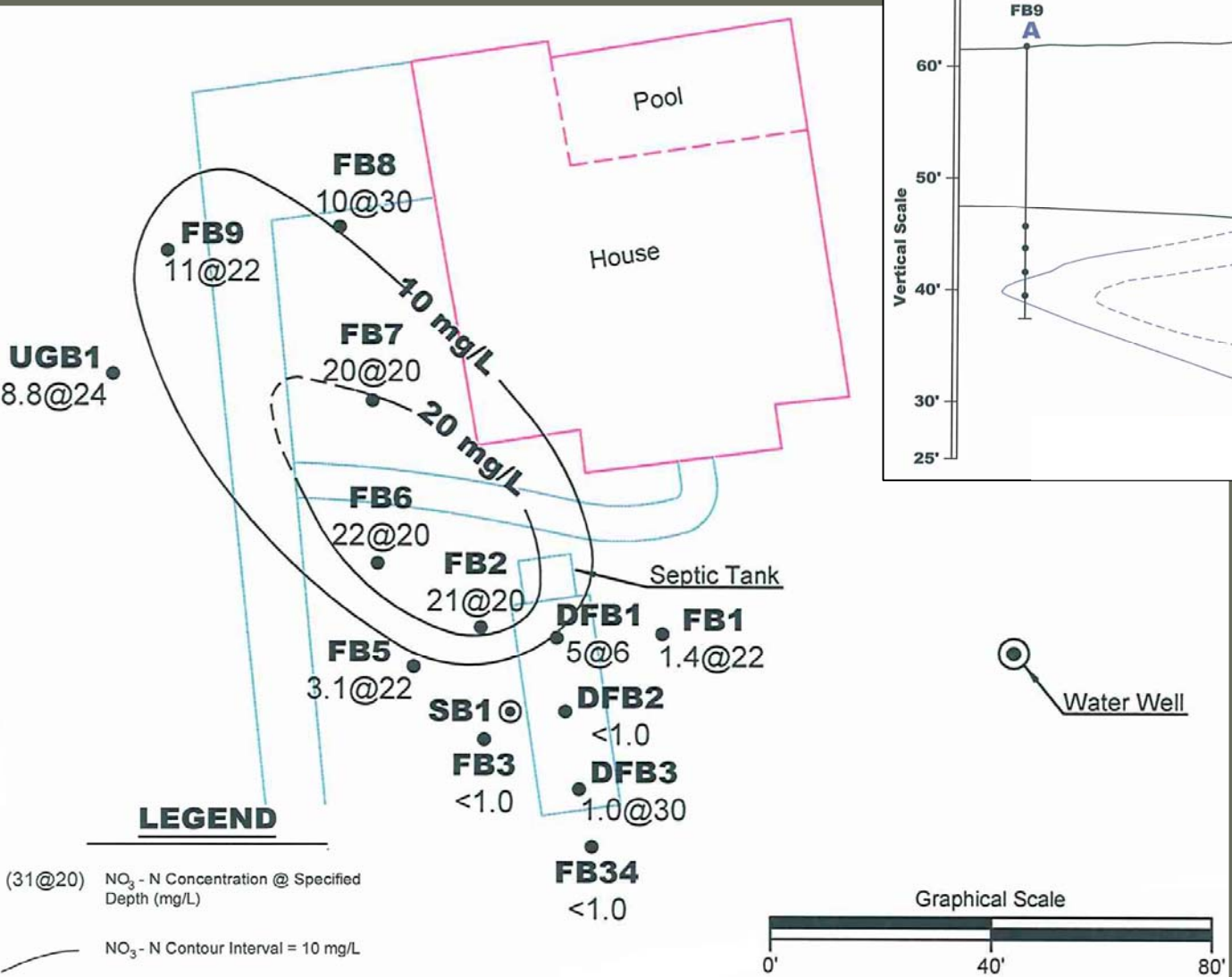


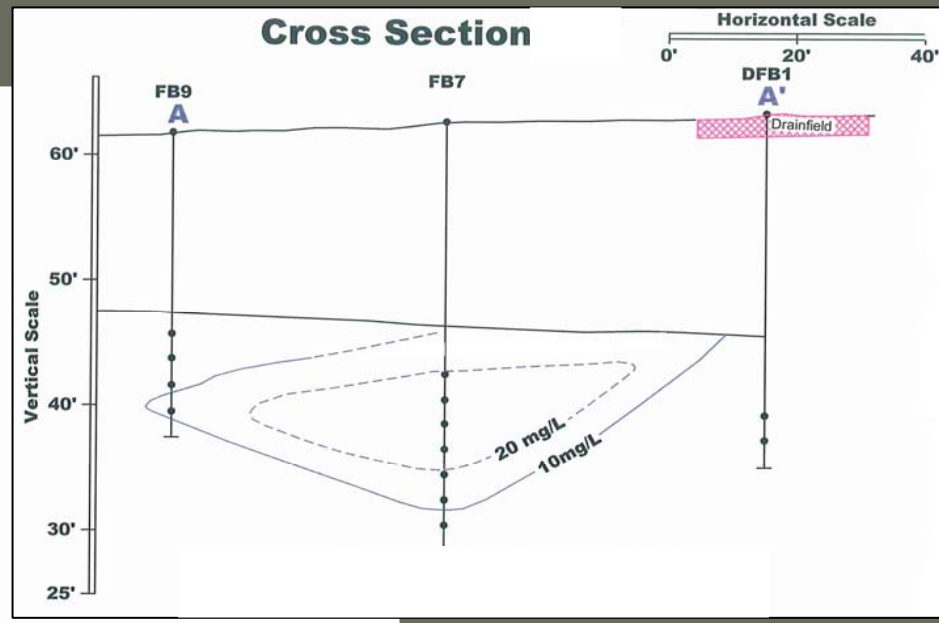
Task 1: Results

Soil types

- Seminole County site:
  - → Myakka fine sands
- Lake County site:
  - → Tavares Series fine sands near the surface, followed by alternating, non-continuous intervals of clay, clayey sands, and fine sands
- Orange County site:
  - → Tavares Series fine sands near the surface, followed by interfingering layers of clay loam, loamy sands, and fine sands

The nitrate plume encountered at the Lake County Site





Task 1: Results

Summary of apparent mass loading estimates

	TN Input from Septic Tank to Drainfield (lbs/person/year)	Percent Apparent Loss	Mass Loading TN to shallow aquifer (lbs/person/year)
DEP Study	7.7	10-50%	3.8-6.9
Seminole Co. Site	14.19	32%	9.65
Lake Co. Site	14.74	52%	7.07
Orange Co. Site	7.33	23-46%	3.95-5.64

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Task 1: Conclusions

- Mass loading input of nitrogen to the drainfield was higher in two out of three sites
- Definite nitrogen plumes were identified, conductivity was a good tracer
- About ½ to ¾ of the nitrogen input was loaded to shallow groundwater

Task 2: What categories are important to look at to determine loading from onsite wastewater systems to the groundwater?

- Otis Environmental Consultants, LLC, $25,000
- Two performance boundaries:
  - Tank (Input)
  - Water table (Load)
- Categories:
  - Drainage class
  - Depth to water
  - Organic content in soil

Task 2: Conclusions

- Important to release nitrate form into environment to aid denitrification
  - two foot separation is maintained from the bottom of the drainfield to the water table
- Cannot totally rely on soils to nitrify/denitrify
- Ideal conditions for denitrification:
  - water table no deeper than 3.5-feet below grade
  - Good chance of finding organic content in the soil
- Estimated nitrogen removal potential in soils found in the Wekiva Study Area ranged between 0-100% with an average of 33%

Task 3: Are onsite systems a significant source of nitrogen to groundwater relative to other sources?

- Dr. Linda Young, University of Florida, $25,000
- Work in coordination with Task 2 provider and Department of Environmental Protection and St. Johns River Water Management District provider to create pie chart of contributions from all sources
- Two performance boundaries: **Inputs** and **Loads**

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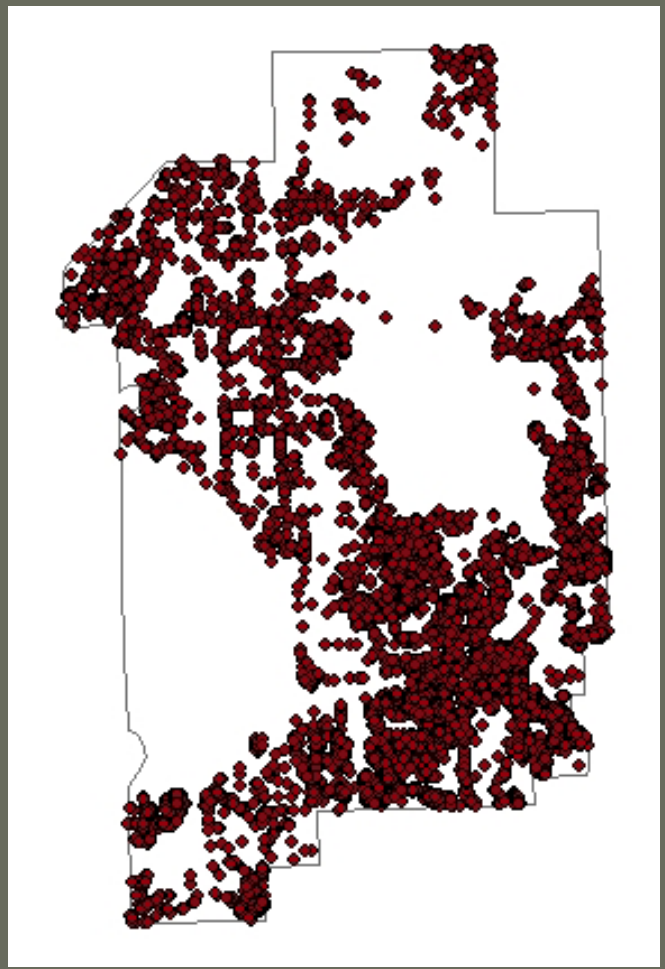
Task 3: Approach

- Utilizing much of the same methodology as MACTEC the inputs and the loads were scaled down from the Wekiva Basin to the Wekiva Study Area
- Total nitrogen values were used for all sources
- The data from Task 2 was used to obtain a more refined estimate for nitrogen input and loading from onsite systems

Location of Onsite Systems in Wekiva Study Area



- Over 55,000 onsite systems in the Wekiva Study Area
- Utilizing GIS, the number of septic systems located in each soil map unit was counted
- The estimated nitrogen removal potential from Task 2 was applied to each point to determine a total nitrogen loading estimate for the Wekiva Study Area

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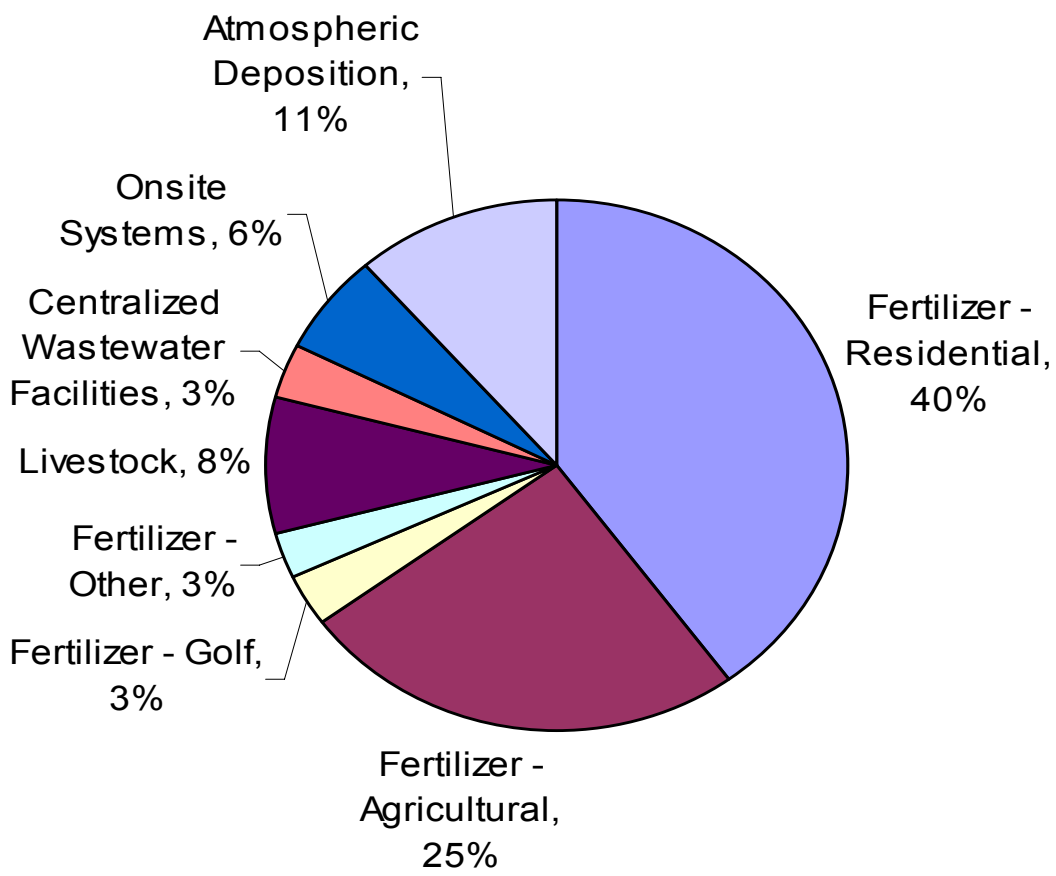
Inputs to the Wekiva Study Area

- Fertilizer use
  - Recommended application rates on pervious land area
- Livestock waste
  - Literature values for feedlots and pasture land
- Atmospheric deposition
  - Urban literature values for Orlando area for wet deposition, and 30% of total for dry deposition
- Centralized wastewater facility effluents
  - Review of FDEP system permit records in Wekiva Study Area, including nitrogen in reuse water, using the actual discharge by the concentration
- Onsite system effluents
  - Number of systems (55,000) x average number of persons in household (2.6) x average input of nitrogen per person per day (7.7 lbs)

Nitrogen inputs to the Wekiva Study Area by source

18 Million Pounds/Year



Variation on loads for onsite systems

- DEP estimate (average of literature values) =

  14 pounds per year per system

- Task 1 field work estimate (average of three sampled sites) =

  18 pounds per year per system

- Task 2 and Task 3 estimate (average based on soils and system construction) =

  15 pounds per year per system

Task 3: Conclusions

- Estimate 71% of inputs are fertilizer
- Estimate 6% of inputs are onsite systems
- Load estimates for all sources may be refined by DEP in a phase 2 study

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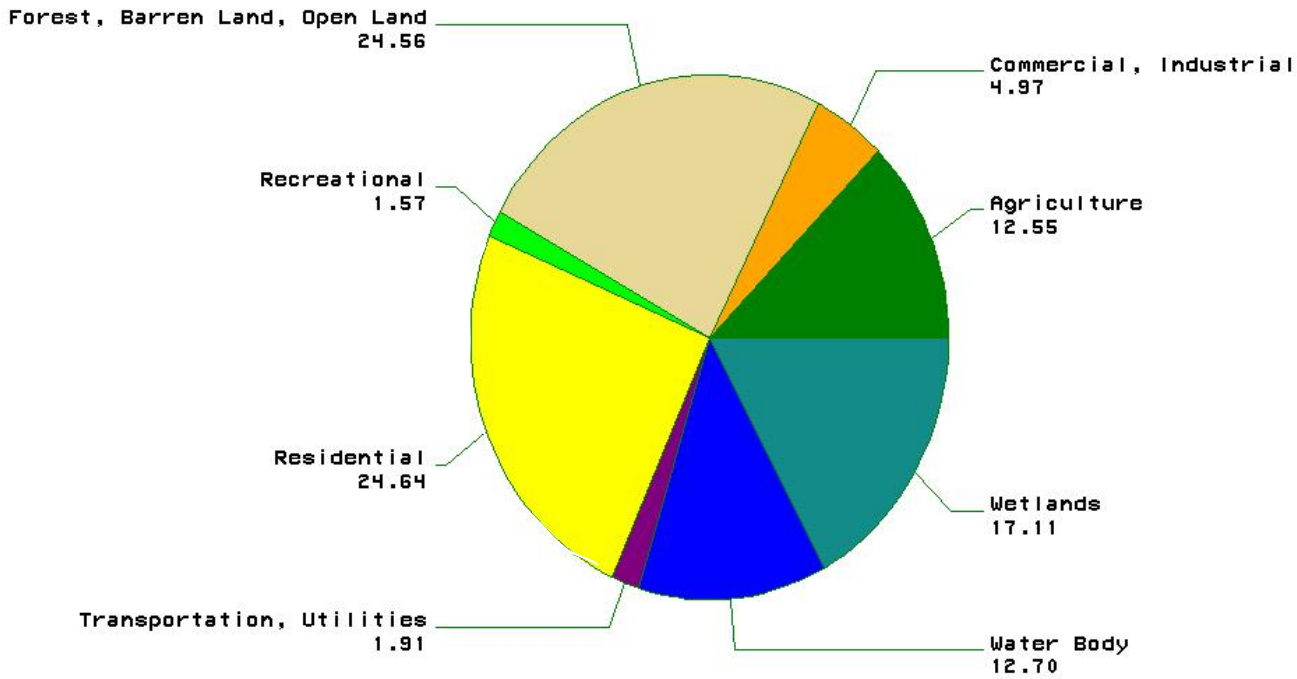
Determination of Significance

- No criteria provided to determine significance, two main ways to look at it:
  - Is the contribution significant as compared to other sources?
  - Is the contribution significant to reach springs protection levels?
- RRAC postponed decision on significance as compared to other sources until DEP phase 2 study complete

Determination of Significance

- By setting TMDL's EPA has set goals of up to 95% reduction in nitrogen output for springs contributing to the Wekiva River
- By setting PLRG's SJRWMD has set goals of up to 85% reduction in nitrogen output for springs contributing to the Wekiva River
- Nitrogen impacts overall are significant
- All contributing sources will need to do something to meet these goals

Land Uses in Wekiva Study Area



Largest human influenced land use is **residential**

Task 4: Recommend a range of possible cost-effective OWTS nitrogen reduction strategies if significant

- RRAC recommended DOH Staff work on this task simultaneously with the first three tasks

Task 4: Approach

- Cost information was gathered from each county
- Building on EPA's voluntary onsite management guidelines
- Various strategies were researched:
  - Provide funding mechanisms for cost-effective projects
  - Keep loadings the same or lower
  - Evaluate watershed impacts
  - Routine maintenance and inspection programs
  - Keep an inventory of location and condition of all systems

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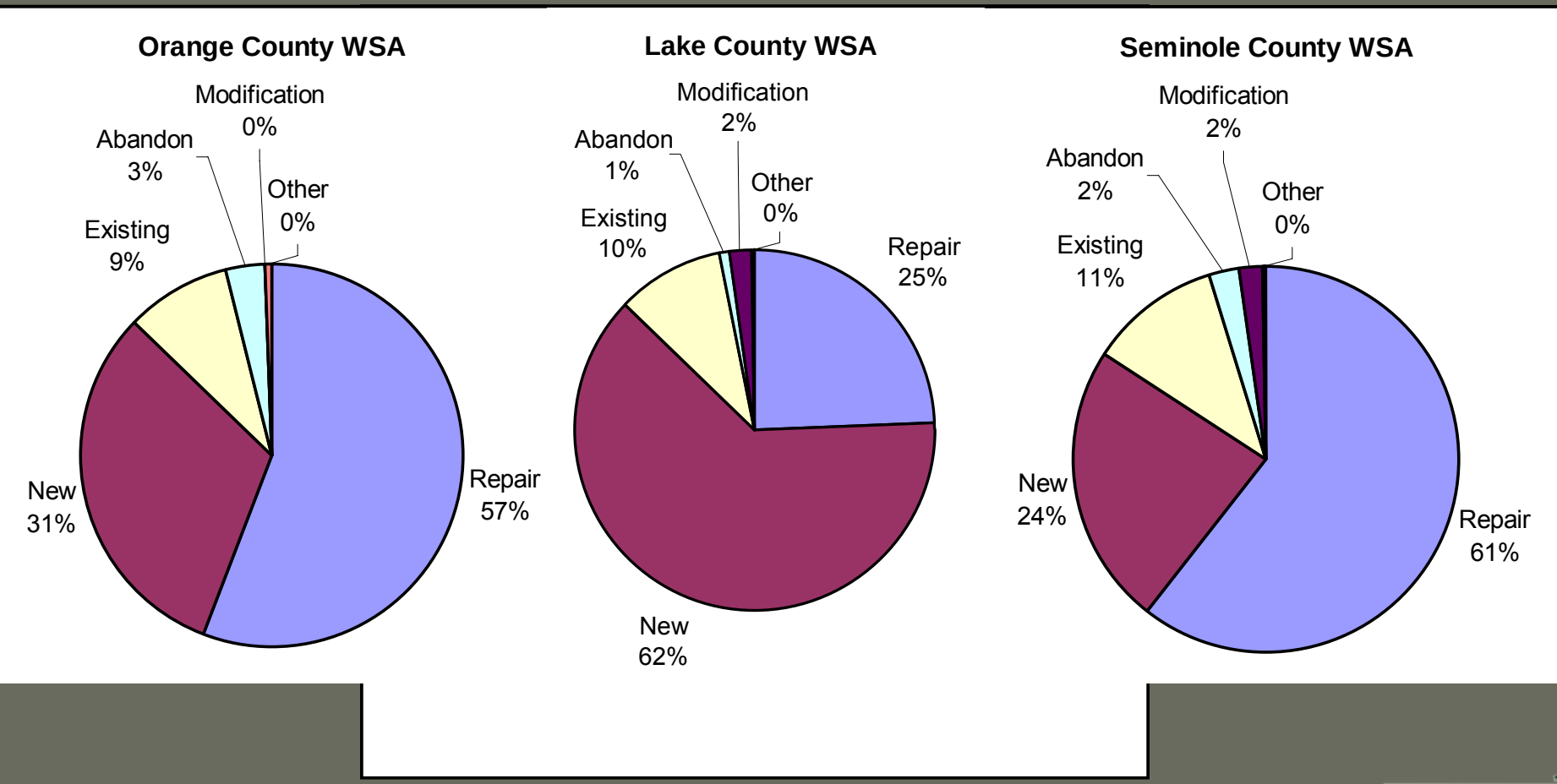
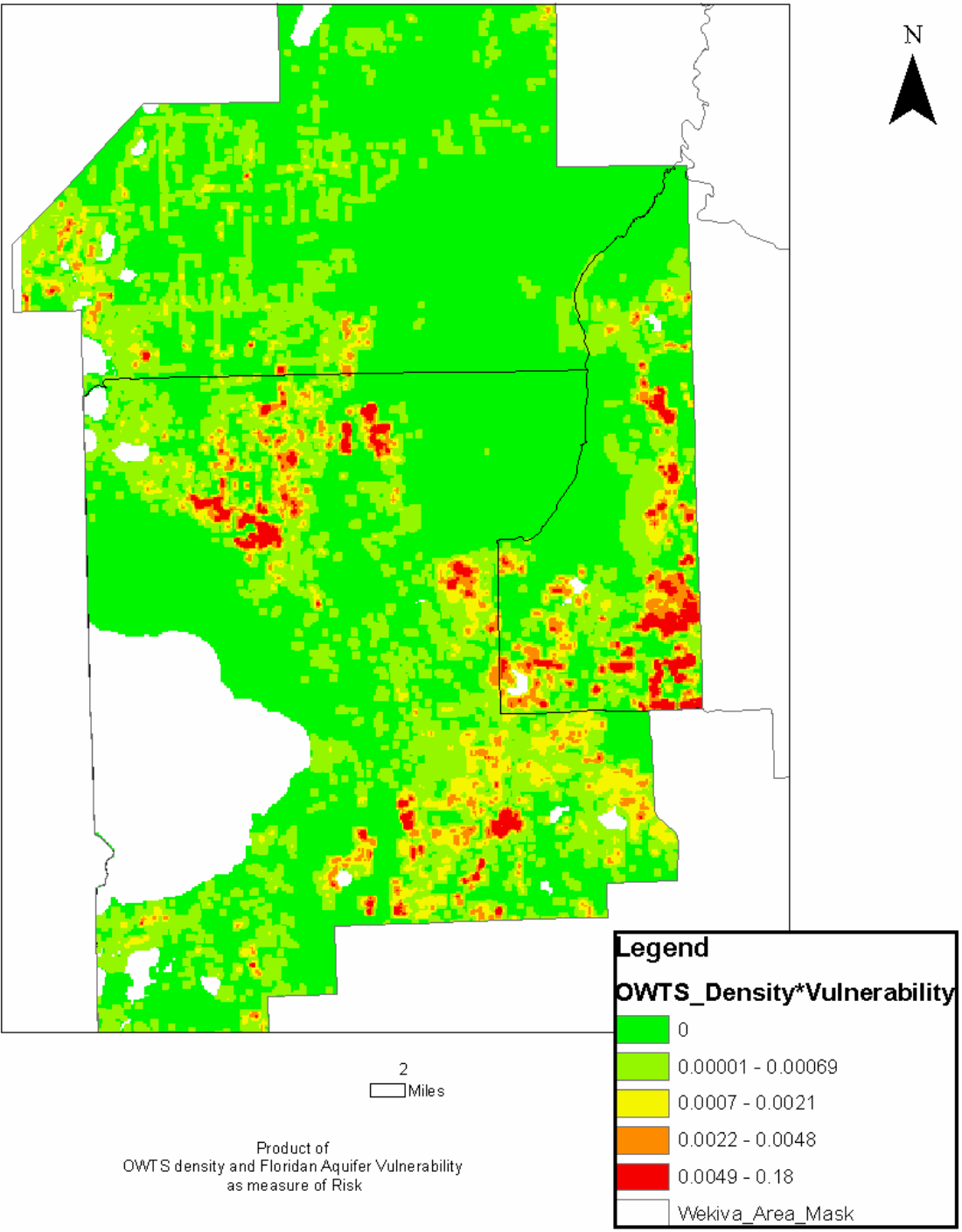
Distribution of Permit Types





Vulnerable Areas with High Density of Onsite Systems

- Potentially target red areas first for greater impact

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Task 4: Conclusions

Two funding mechanisms proposed:

- Grant program to solicit cost-effective nitrogen reduction projects from any source funded by all source contributors
- Wastewater management entities funded by onsite system owners to reduce nitrogen load
  - Providing grants or loans to upgrade systems
  - Can be existing utilities, new management entities, or county health departments

Overall Project Conclusions and Recommendations

Overall Conclusions

- All nitrogen contributors must work together to reduce inputs
- Onsite systems are not the major source of nitrogen input, but is similar to livestock and centralized wastewater
- No consensus on how much nitrogen is **loaded** from all sources to the groundwater

Overall Conclusions

- In the end RRAC recommended no action be taken on Task 4 until further refinement of the loading estimates from sources other than onsite systems
- DOH realizes, based on the nitrogen reduction goals, that onsite systems do have an impact on the nitrogen input and load to groundwater and recommends several strategies

Recommendations

- Nitrogen discharge fee for all sources to fund cost-effective projects
- Establish a maintenance program. Either:
  - US EPA Model 4: utility collects fee to provide maintenance, repairs, upgrades, sewer connection
  - All systems have an operating permit, and be inspected and pumped every 5-years. Portion of fee to fund grant program for low-income home-owners.
- Eliminate grandfathering provisions for minimum lot sizes and surface water setbacks
- All existing systems requiring repair or modification be upgraded to new system requirements for separation to water table and surface water setbacks

Recommendations, continued

- New systems add nitrogen. Nitrogen removing systems will help reduce this. All new systems should be performance based with nitrogen reduction to a level of 10 mg/L.
- Inventory **all** onsite systems to help locate areas with older systems closer to the water table and assess the overall impact
- Prohibit land spreading of septage
- Consider the economic feasibility of sewering high density areas

Next Steps

- TRAP meeting August 21, 2007, 9 am, Orlando Airport Marriott to discuss final report
- RRAC meeting to be in September
- DOH will proceed with rule-making now that the study has been completed

Information/Contacts

- **DOH -** http://www.doh.state.fl.us/environment/ostds/

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  Patti Sanzone 850-245-7511 Non Point Source Funding

- **EPA** - http://cfpub.epa.gov/owm/septic/

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Thank you!

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Questions?

OSTDS Research:

You have questions, we look for answers!