Research Review and Advisory Committee for the Bureau of Onsite Sewage Programs

Approved Minutes of the Meeting held at the Polk County Health Department, Bartow, FL
January 23, 2008
Approved by RRAC on May 29, 2008

In attendance:

- **Committee Membership and Alternates**: Sam Averett (alternate, Septic Tank Industry); David C. Carter (Chairman, member, Home Building Industry); Paul Davis (member, DOH-Environmental Health); Anthony Gaudio (member, Septic Tank Industry); John Glenn (member, Environmental Interest Group); Marc Hawes (alternate, Home Building Industry); Bill Melton (member, Consumer); Eanix Poole (alternate, Consumer); Patti Sanzone (alternate, Environmental Interest Group); Pam Tucker (member, Real Estate Profession); and Ellen Vause (alternate, Septic Tank Industry)
- **Not represented**: Professional Engineers, Restaurant Industry, State University System
- **Visitors**: Damann Anderson (Hazen & Sawyer); Rick Baird (Orange County Environmental Protection Division); John Byrd (Aide to Orange County Commissioner Brummer); Ron Davenport (Infiltrator Systems); Doug Everson (Plastic Tubing Inc.); Christopher Finkbeiner (Aide to Representative Bryan Nelson); Robert Harper (Harper Realty and Development); Ken Jones (Markham Woods Association); Steve Meints (Averett Septic); Cory Mong (Economy Septic); Len Moore (Eco-Pure, Inc.); Daniel Smith (AET); Ron Suchecki (Hoot Systems)
- **Department of Health (DOH), Bureau of Onsite Sewage Programs**: Paul Booher; Dr. Eberhard Roeder; and Elke Ursin

1. **Introductions:** Six out of nine groups were present, representing a quorum. Chairman David Carter calls the meeting to order at 9:35 am. Several new members and alternates have been added to the committee as of the last meeting: Eanix Poole (alternate for Consumer, replaced John Heber), Geoff Luebkemann (member for Restaurant Industry, replaced Adam Parmer), Susan McKinley (alternate for Restaurant Industry, replaced Richard Turner), and Anthony Gaudio (member for Septic Industry, replaced Scott Womble). David Carter pointed out that the agenda items on the budget and the prioritization for research directions were put off from the last meeting, and is something that could take half a day.
2. **Election of Chair and Vice-Chair**: This is something that should have been done last year, but with the Wekiva project it was delayed until now. David Carter is the current chair. Patti Sanzone was the vice-chair previously and it has been several years since there was a vote on this. The duties of the chair are to run the meeting and to review the agenda prior to the meeting. The vice-chair will take over the meeting if the chair is out. Both the chair and vice-chair need to be committed to attending the meetings. David Carter stated that he has been chair for several years and has been thinking of stepping down. He stated that he could stay on for the next two meetings. The floor was opened for nominations. Bill Melton read the list of current members and alternates. There was a discussion on whether the chair has to be a member, or whether they can be an alternate. Elke Ursin stated that Roberts Rules did not prohibit anyone from being the chair, but that the voting privileges remain with the members. Anthony Gaudio made a motion which was seconded by Bill Melton:

   David Carter to remain chair for the next two meetings and then this issue will be revisited.

   The members voted and all were in favor with none opposed, the motion passed.

3. **Discussion on Travel Reimbursement**: Elke Ursin briefly went over the travel reimbursement requirements for RRAC members/alternates.
4. **Review of Previous Meeting Minutes**: Motion by Bill Melton, seconded by Paul Davis:
   The minutes were approved as submitted.
   The members voted and all were in favor with none opposed, the motion passed.
5. **Wekiva Update:** There is no new information on rulemaking; options are still being discussed with the governor's office. Dr. Eberhard Roeder has revised the input and loading estimates and has written a draft report that is available on the FDOH website:

http://www.doh.state.fl.us/environment/ostds/research/01-23-08Materials/Revised_Nitrogen_Estimates.pdf

Any comments or questions can be sent directly to Eberhard_Roeder@doh.state.fl.us within the next two weeks from any interested party. The presentation does not address the load to surface water discharge as that was not part of the legislative mandate. The following describes what numbers were used for the inputs:

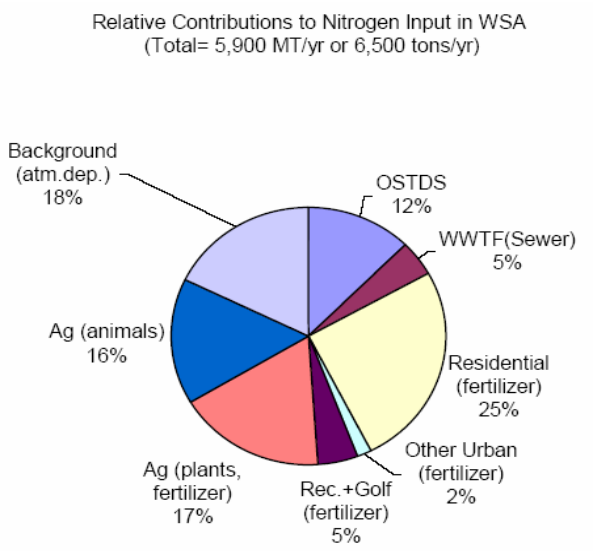
- OSTDS based on Wekiva Study
- Wastewater Treatment Plants based on available discharge records, prorated by capacity (MACTEC report)
- Fertilizer based on sales, attributed to land uses based on recommended application rates
- Livestock based on livestock density (MACTEC report)
- Atmospheric Deposition based on UCF records

The nitrogen inputs in the Wekiva Study Area were shown to be increasing. The fertilizer sales for farm fertilizer were shown to be relatively steady over time, with non-farm fertilizer sales increasing.

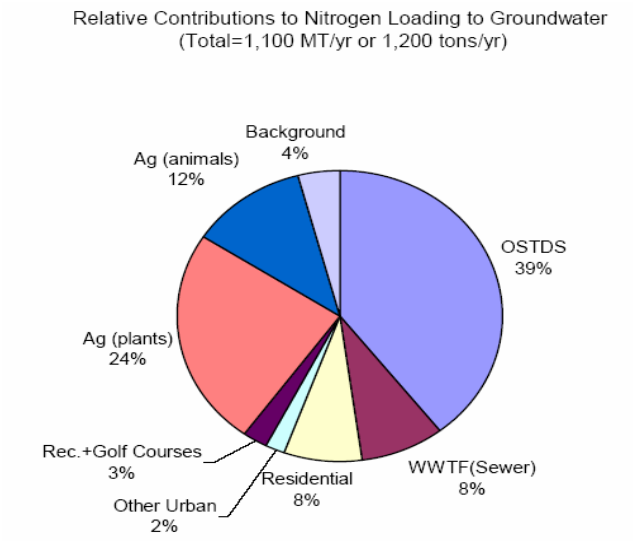
The revised loading estimates were also discussed. The following describes what numbers were used for the loadings:

- OSTDS based on Wekiva Study
- Centralized Wastewater reduction from inputs based on EPA guidance
- Land uses based on groundwater concentration times recharge
  - Residential and urban land use concentrations based on Wekiva Study
  - Agricultural tree crops concentration and recharge based on Best management Plan (BMP) study
  - Background based on TN=0.2 mg/L

The draft revised input and loading pie charts were presented and discussed:

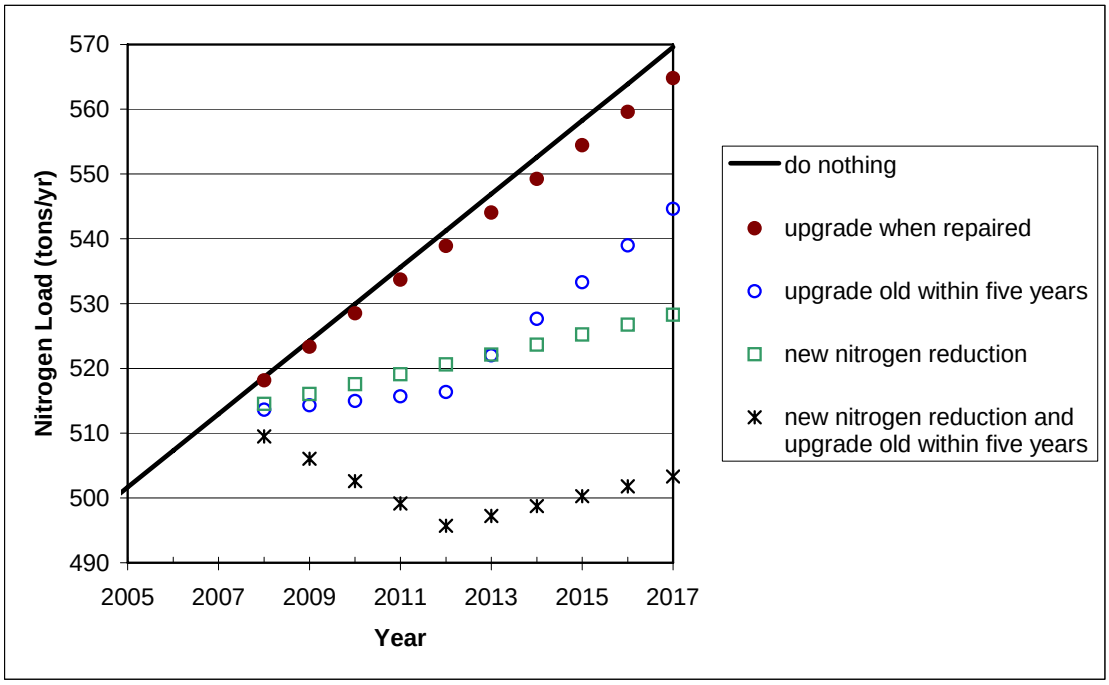


Input to the Environment



Loading to the Groundwater

The projections of onsite nitrogen-load based on various management options were discussed:



There was a discussion on why this revised estimate for input and loading was being brought up. Dr. Roeder explained that at the June 2007 meeting, RRAC provided two options with regard to further revisions of input and loading estimates: to wait for FDEP to revise their

numbers or staff to bring new information back to the RRAC as it became available. This is in response to reviewing and refining new information.

An update was presented on the FDEP Phase II study scope that was released in November 2007. There were questions why this study only focused on fertilizers and no additional work was to be done with onsite systems. Patti Sanzone stated that FDOH is dealing with the onsite systems and that FDEP does not have regulatory authority over onsite systems.

Pam Tucker made a motion which was seconded by John Glenn:

> **RRAC recommends a request to FDEP expand the design of the Phase II study to include groundwater testing of onsite systems in the wet and dry seasons to obtain accurate numbers for onsite systems in the Wekiva Study Area.**

There was a discussion on this motion. Sam Averett stated that RRAC should not tell FDEP to study onsite systems. Ellen Vause suggested withdrawing the motion, that FDEP's study will confirm or debate Dr. Roeder's revised calculations. She stated that significance can still not be determined for fertilizer inputs and loadings until FDEP completes their study and RRAC makes a decision. The RRAC members voted with four members against (Anthony Gaudio, Bill Melton, Paul Davis, and David Carter) and two members for (Pam Tucker and John Glenn). **The motion did not pass.**

Bill Melton made a motion which was seconded by Paul Davis:

> **To ask FDEP to get their information in a format that is as comparable as possible with the FDOH numbers and to provide Total Nitrogen numbers and to use the atmospheric deposition numbers used in the FDOH report.**

The members voted and all were in favor with none opposed, the motion passed.

New labeling and content regulations are required for lawn fertilizers. This is effective December 30, 2007. The Urban Turf rule reduces phosphorus content for maintenance, limits the how much nitrogen fertilizer can be applied to the lawn per application and also how much can be applied in total, and has expected reductions of 20-25% of TN and 50-70% of Phosphorus. The Consumer Fertilizer Task Force was described, and some costs and effects were discussed.

6. Brief updates on other projects

a. Ongoing projects

i. **Passive Nitrogen Removal Assessment** – The final literature review report and database has been received. The Quality Assurance Project Plan (QAPP) has been finalized. The media evaluation experiments are currently in progress. Dr. Smith, the contract provider, expressed that this study is very short. The contract is expected to complete before the end of this fiscal year (June 30, 2008).

ii. **Remote Sensing of Optical Brighteners Study** – Development of revised contract with FDEP is in progress. Several phone conferences were had between FDOH and FDEP to go over the content of the new contract.

iii. **Manatee Springs, Performance of Onsite Systems Phase II Karst Study** – Manuscript from Florida State University was accepted by Water Research. Due to contractual and timing issues, this contract has expired and must be re-contracted. Grant end date was extended by EPA.

iv. **Taylor County Source Tracking Study** – The draft final report was submitted for comment. Some of the conclusions from the study were discussed:
   - No significant differences in ammonia trends between sewer & OSTDS
   - Nitrate levels low for all sampling events
   - Caffeine and optical brighteners ineffective tracers due to dilution, low development density, etc.
   - Good correlation between Enterococcus and E. coli and the change from seasonal low water table (SLWT) and seasonal high water table (SHWT)
   - E. coli violations were nearly 4 times more frequent at sewered sites as compared to OSTDS sites, and the number of violations was higher in 2007 than in 2006 (thought that because sewer was only recently installed previous contamination may still be reflected) (any thoughts???)
   - High TN with high Enterococcus indicates greater contribution of nutrients from septic systems as opposed to runoff contributions
   - Nitrogen isotope analysis seems to implicate fertilizers at beach communities
   - Background sites had a low Enterococcus/E. coli ratio, and beach sites had high ratios showing human-derived sources of pollution
   - Sewered areas do not show improved water quality in comparison to areas that remain on OSTDS

   Elke Ursin requested comments be sent to her by January 27'th so that she can compile and send to the provider to develop the final report. Grant end date was extended by EPA. The final task is for FDOH to develop a tri-fold brochure on the results of the study, and to write a final report for EPA.

- **Monroe County Performance Based Treatment System Performance Assessment** – Dr. Eberhard Roeder stated that Monroe County appears to have remained below budget for the study so far and would like direction on what RRAC would like for them to study with the remainder of the allocated money. Ellen Vause stated that resampling the locations previously sampled would be a good option and there was general agreement on this.

b. Projects coming up

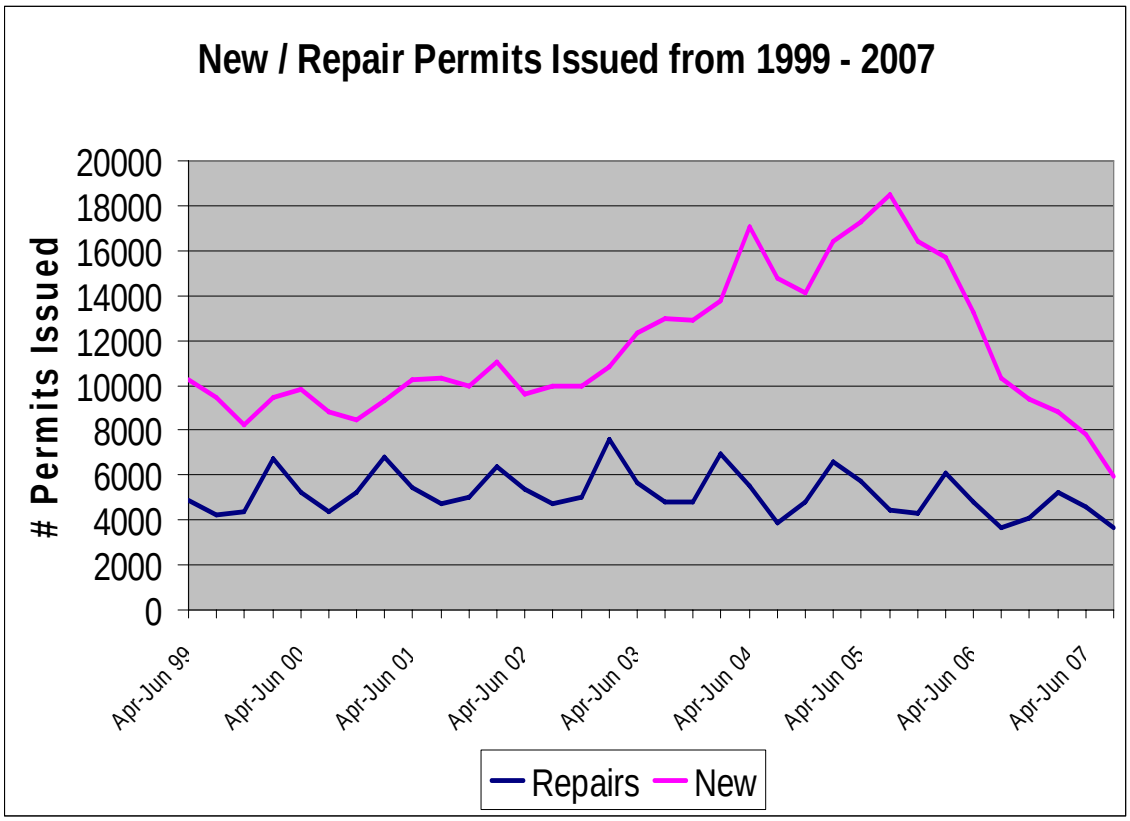
i. **319 Project on Performance and Management of Advanced Onsite Systems** – A TRAP teleconference was held on November 20, 2007 to discuss approval of this project. TRAP recommended approval of the initial process of the 319 monitoring study to secure the funding with the condition that the project be brought before RRAC for discussion on the protocol and sampling details and then be presented back to TRAP. This agreement is going through the routing process with FDEP and EPA. The first task is to develop a database of all advanced systems in the state and Elke Ursin asked the RRAC to start thinking about what fields to incorporate. She will send a reminder out later with a list of the potential data fields.

ii. **Coastal Management Program Grant Funding Opportunity** – FDOH submitted the grant proposal on November 14, 2007 to resample the Town of Suwannee. A final decision should be made prior to the next RRAC meeting.

iii. **University of Central Florida Research Facility** – UCF has a grant with FDEP to look at nutrient reducing onsite systems and to develop a research facility with test beds. UCF provided some slides that were provided to the RRAC members for review. FDOH and UCF have developed a memorandum

of understanding (MOU) to allow this facility to be built, and is subject to various conditions.

7. **Budget Discussion** – The total revenue from the $5 surcharge on new permits for 2006-2007 fiscal year (FY) was $181,747 and the expenditures were $342,895 leaving an ending cash balance of $882,955. A discussion was had on the limitations for spending the cash, and how it is subject to budget authority which is beyond the Bureau's control. A graph was presented showing the decline in permitting, which results in a reduced research budget. Damann Anderson stated that the research fee was set in 1985 and that it is time for this fee to be increased.



8. **Prioritization of Future Projects** – The RRAC had a discussion on priorities for future projects, and each member was given an opportunity to add additional projects to the prepared list. After all the projects were compiled, each member listed their top three research priorities. From that selection, five projects had more than 1 vote. Editorial note: Approximate costs below were staff estimates after the RRAC-meeting for purposes of TRAP-discussion.

    1. **Restoration of the University of South Florida (USF) Lysimeter Station**
        a) $20,000 - $50,000 approximate cost
        b) Dependant on updating the memorandum of understanding between USF and FDOH
        c) Several projects, that RRAC wanted to pursue, could potentially be conducted at the station if restored
    2. **Phase II of the Florida Passive Nitrogen Removal Project**
        a) $200,000 approximate cost

b) Build on the results of the Phase I study to go from a lab scale project to a prototype scale project

3. Wekiva Onsite Sewage Treatment and Disposal System (OSTDS) Seasonal Variability Assessment

a) $200,000 approximate cost
b) Investigate if there is a seasonal variability of nitrogen concentrations from OSTDS in the Wekiva Study Area of Central Florida

4. Alternative Drainfield Product Assessment

a) $300,000 approximate cost
b) TRAP approved this project 2-years ago
c) Contract in place and then canceled due to industry concerns
d) Compare the functioning of alternative drainfield materials to standard aggregate

5. Long-term deformation of tanks of different materials

a) $20,000 approximate cost
b) Project is in response to problems observed in the field

This list is to be presented to the TRAP for their approval at the TRAP meeting the following day (January 24, 2008).

9. Public Comment - The public was allowed to comment throughout the meeting.

10. Closing Comments, Next Meeting, and Adjournment

a. No date was set for the next meeting. Next meeting anticipated to be some time in April or May 2008 at a location to be determined. The meeting adjourned at 3:04 pm.

Florida Department of Health
Bureau of Onsite Sewage Programs
Research Review and Advisory Committee Meeting

DATE AND TIME: **January 23, 2008 at 9:30 am**

PLACE: **Polk County Health Department, Environmental Health Support Building**
Hearing Rooms A & B
2090 East Clover Street
Bartow, FL 33830-6741
(863) 519-8330

This meeting is open to the public

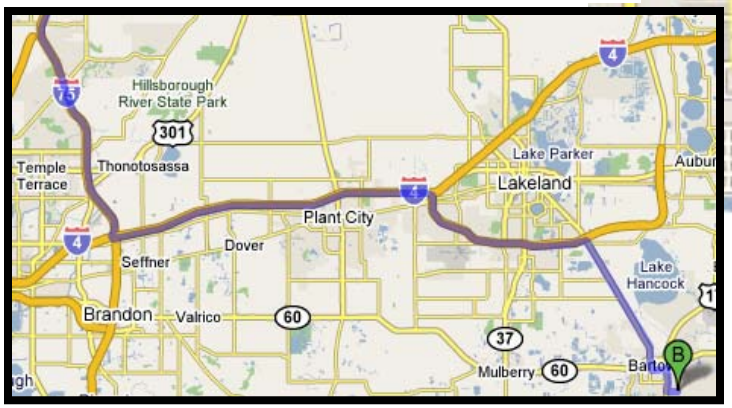
AGENDA: DRAFT 1/14/2008 Elke Ursin

1. Introductions
    a. New RRAC Members / Alternates
2. Election of Chairman and Vice-Chairman
3. Discussion on Travel Reimbursement
4. Review Minutes of Meeting 10/18/2007
5. Brief update on Wekiva
    a. Discussion on Revised Input / Load Estimates
    b. FDEP Wekiva Phase II Study
    c. Urban Turf Rule
6. Brief updates on Ongoing Projects
    a. Passive Nitrogen Removal Assessment
    b. Remote Sensing of Optical Brighteners Study: Mote Marine Report
    c. Manatee Springs, Performance of Onsite Systems Phase II Karst Study
    d. Taylor County Source Tracking Study
    e. Monroe County Performance Based Treatment System Performance Assessment
7. Brief updates on Future Projects
    a. 319 Project on Performance and Management of Advanced Onsite Systems
    b. Coastal Management Program Grant Funding Opportunity
    c. University of Central Florida Research Facility
8. Budget Discussion
9. Prioritization of Research Directions
10. Public Comment
11. Closing Comments, Next Meeting, and Adjournment

Directions to 2090 E. Clower St. Bartow FL 33830-6741
Phone: 863-519-8330 and hit "0" for the operator

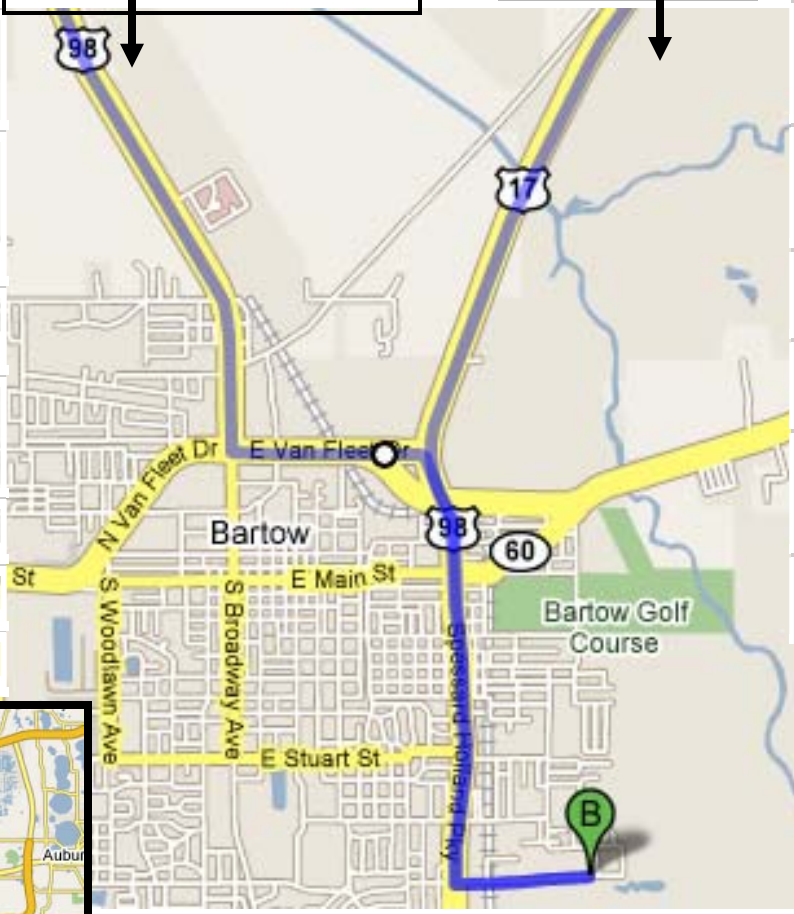
From Tallahassee/Tampa

Take **I-75 S** toward **Tampa**	
Take exit **261** to merge onto **I-4 E** toward **Orlando**	18.4 mi 16 mins
Take exit **27** to merge onto **Polk Pkwy/SR-570-TOLL E** toward **Winter Haven/Lakeland** Partial toll road	9.9 mi 10 mins
Take exit **10** for **US-98** toward **Bartow/Lakeland**	0.5 mi
Turn **right** at **Bartow Rd/US-98 S** Continue to follow US-98 S	7.5 mi 10 mins
Turn **left** at **E Van Fleet Dr**	0.8 mi
Turn **right** at **US-17 S/US-98 E**	1.8 mi
Turn **left** at **E Clower St**	0.5 mi



From Tallahassee/Tampa

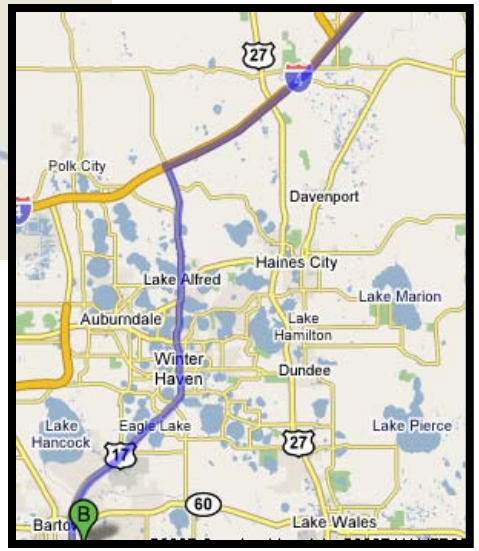
From Tallahassee/Tampa **From Orlando**



There is a large pallet-factory on the corner of Clower street and Hwy 17 south. It is a beige warehouse and yard. When traveling south, turn left directly after the warehouse and onto Clower. When on Clower, we are the first building on the left after crossing the RR tracks.

From Orlando

Take **I-4 W** toward **Tampa**	
Take exit **48** for **CR-557 S** toward **Winter Haven/Lake Alfred**	0.3 mi
Merge onto **CR-557/Old Grade Rd** Continue to follow CR-557	6.5 mi 8 mins
Continue on **S Buena Vista Dr**	1.1 mi 3 mins
Turn **right** at **US-17-92**	295 ft 1 min
Turn **left** at **US-17 S**	16.2 mi 27 mins
Turn **left** at **E Clower St**	0.5 mi 3 mins



From Orlando

Research Review and Advisory Committee for the Bureau of Onsite Sewage Programs

Draft Minutes of the Meeting held at Sylvan Lake Park, Sanford, FL
October 18, 2007
Draft by Elke Ursin 1/10/2008

In attendance:

- **Committee Membership and Alternates**: Sam Averett (alternate, Septic Tank Industry); David C. Carter (Chairman, member, Home Building Industry); Paul Davis (member, DOH-Environmental Health); John Glenn (member, Environmental Interest Group); Marc Hawes (alternate, Home Building Industry); Stan Keely (alternate, Professional Engineer); Bill Melton (member, Consumer); Jim Rashley (alternate, DOH-Environmental Health); Patti Sanzone (alternate, Environmental Interest Group); Clay Tappan (member, Professional Engineer); Pam Tucker (member, Real Estate Profession); and Ellen Vause (alternate, Septic Tank Industry)
- **Not represented**: Restaurant Industry, State University System
- **Visitors**: Phillip Alexander (Superior Septic); George Bartuska (BFA Environmental); Alice Berkley (Office of Representative Bryan Nelson); Dominic Buhot (Greens Environmental Services); John Byrd (Aide to Orange County Commissioner Brummer); David Childs (FWEA Utility Council); Ron Davenport (Infiltrator Systems); Kim Dove (Seminole County Environmental Health Department); Doug Everson (Plastic Tubing Inc.); Chris Ferraro (Florida Department of Environmental Protection); Roxanne Groover (Florida Onsite Wastewater Association); Roland Harris (Complete Ozone Inc.); Jerry Henkins (Seminole County Environmental Health Department); John Higgins (Markham Woods Association); Ken Jones (Markham Woods Association); Tony Matthews (Seminole County); Steve Meints (Averett Septic); Harley Pattee (Complete Ozone Inc.); Daniel Smith (Applied Environmental Technology); Britt Watson (Averett Septic Tank); Walter Wood (Lake County)
- **Department of Health (DOH), Bureau of Onsite Sewage Programs**: Paul Booher; Dr. Eberhard Roeder; and Elke Ursin

1. **Introductions:** Seven out of nine groups were present, representing a quorum. Chairman David Carter calls the meeting to order at 9:40 am.
2. **Review Minutes of Meeting June 12, 2007:**
    a. **Motion was made by Stan Keely and seconded by Sam Averett for the RRAC to approve the June 12, 2007 meeting minutes. One clarification change was requested on the June 12, 2007 meeting minutes. Under the Closing Comments section, the minutes are to change to: "Ellen Vause stated that Florida needs to stop dumping wastewater into streams and oceans. We need to allow it to filter down to the aquifer through the soil." The minutes were approved as amended. All were in favor with none opposed of approving the amended minutes, and the motion passed.**
3. **Wekiva Onsite Nitrogen Contribution Study:**

    Elke Ursin presented the progress of the study since the June 12th meeting. Linda Young revised the pie charts for Task 3 to eliminate the loading estimates from the other sources and the onsite sewage loading estimates were included. John Byrd asked for clarification

on this. Elke Ursin explained that Task 2 and Task 3 were required to report the estimates on loading from onsite systems. The final report does not include loading estimates for other sources and there is only one pie chart comparing the relative contributions of inputs. John Byrd read from the past meeting minutes that the RRAC made a motion to remove the loading numbers from the report. Pam Tucker stated that the report said that contrary to the RRAC's recommendation it was decided administratively that they were going to put the onsite sewage loadings into the report. The report was sent on June 30th and the deadline was met. There was a TRAP meeting on August 21st. There was a motion made, seconded, and passed to approve rule language prohibiting land application of septage and food establishment sludge within the Wekiva Study Area. There was a motion made, seconded, and passed to table all other proposed rule language specific to the Wekiva Study Area until completion of the DEP phase II study. The vote was 7 in favor, with 2 opposed. The two dissenting votes were Patti Sanzone representing the Florida Environmental Health Association and Russ Melling representing the County Health Departments. Both indicated they wanted the panel to discuss each specific proposal. There was debate over the first issue regarding requiring performance based treatment systems for new systems, but the second issue eliminating grandfathering for separation to wet season water table and surface water setbacks and the third issue requiring all systems to be pumped and evaluated every 5-years were both good recommendations that should not only apply to the Wekiva Study Area, but statewide. There was a discussion on the Wekiva River Basin Commission meeting that was held on October 16, 2007. During the commission meeting Gerald Briggs, Bureau Chief of the Department of Health Bureau of Onsite Sewage Programs, presented the proposed rule language and reported that at that time the department is discussing options with the governor's office but there were no specific plans with moving forward with rule making. Paul Booher reported that after the commission meeting, Mr. Briggs received a call from Dr. Conti, Environmental Health Division Director, advising him that the department would proceed with rule making.

There was a discussion on the process of rule making, filing, and public notification. Paul Booher called Dale Holcomb in the program office and reported that when the office is given the notice to proceed, language will be submitted to the Florida Administrative Weekly (FAW) where it takes 10-days to prepare for advertisement. Then it is advertised for 21-days for public hearings and comments. If there are significant changes, then it would need to be re-advertised. Assuming there are no changes or legal challenges, the rule is filed and becomes effective 20-days after the date filed.

Some of the public education that has been done since the last meeting is that a presentation on Wekiva was made at the Florida Environmental Health Association Annual Education Meeting in August, a poster was also presented at this meeting and received a certificate of excellence, a presentation was made to the Ichetucknee Springs Working Group in October, and an abstract was accepted for presentation at the National Onsite Wastewater Recycling Association 2008 Water Symposium.

Pam Tucker stated that there is no hurry for this rule to be implemented. The Wekiva Parkway can be up to 20-years away. She stated that there is no scientific proof that the nitrogen contribution is significant and the study is not complete on this issue. Bill Melton stated that Pam Tucker should be speaking about relative significance. The data is not

available to make the determination of the relative significance as it relates to other contributors. He does think that a determination can be made that there is a significant amount of nitrogen that is getting to the aquifer from onsite systems in the WSA.

The proposed rule was discussed, with the understanding that this is more in the purview of the Technical Review and Advisory Panel (TRAP), and that the RRAC has not come to a conclusion on relative significance of nitrogen impacts. Some of the discussion points:

- The rule proposal to prohibit land spread of sewage in the Wekiva Study Area (WSA) was approved by TRAP.
- Each of the three counties in the WSA has a comprehensive plan that should illustrate whether sewer is planned to be available to specific areas. It would be helpful to have a GIS map available to better view this information, but it is not clear whether this exists or not.
- The proposed rule does not have any specific requirements for testing. Dr. Roeder stated that the ability for DOH to gather fees that covered testing was taken out of the statute in 2001, but the design engineer can require it. The state code requires an inspection to make sure the system is functioning mechanically as it should. DOH does an inspection annually and the maintenance entity does an inspection a minimum of two times per year. If it does not meet the requirements specified by the engineer, the engineer will be required to redesign the system. Sam Averett stated that one of the biggest issues is who will pay for the sampling. He mentioned a previous TRAP issue regarding the manufacturer to sample a subset of all installed systems and if the subset passes then they are approved. This would require each manufacturer to assure the state that they are performing as stated. It is too expensive to require the homeowner to pay for the sampling. Ellen Vause stated that the homeowners also have a part in whether a system is working or not, because water-use habits determine the strength of the effluent. She stated that if the state feels that this has to be done in the WSA then some assurances need to be set to make sure systems do meet the discharge requirements. In order to verify the 70% nitrogen reduction standard an influent sample would be required which would double the cost. Paul Davis stated that pumping the tank helps bring the system back to normal. The county health departments will not have enough time to sample influent and effluent for each system. Sam Averett stated that it is crucial that DOH develops a maintenance protocol and a testing protocol for each manufacturer and make the manufacturer pay for it. He stated that the performance based language in the code is still vague and that the department could interpret the language to say that monitoring is required on every system at least once or twice a year. This interpretation could be clarified in a memo to allow the existing code to be used to monitor systems.
- The proposed rule does not specifically state **total** nitrogen.
- Requiring a minimum bottom of drainfield elevation of 18-inches below finished grade would wipe out any alternative drainfield product that is more than 12-inches in height. This requirement would also make it difficult to ensure the required fall in the drainlines. An installer commented that only 6-inches of soil cover over the top of the drainfield would make it easy to crush the drainfield when covering.
- There was some confusion over what forms are required, and whether this indicates that a non-certified individual would be allowed to perform a site evaluation. [NOTE: clarification on this issue was received, and a Certified

Environmental Health Professional (CEHP) is required to perform any site evaluation]. Some septic contractors voiced a concern over there being too many forms to fill out and whether there are any other options. They stated that this is time consuming and expensive. Kim Dove stated that if a site evaluation is required there is also an additional fee for the county health departments or other CEHP.

- The proposed rule language as written would prohibit tanks that are larger than within one tank size of current requirements.
- In the existing system language it states that the system would need to meet these requirements if it is in need of repair, modification, or re-approval. Re-approval would include those systems being inspected under part (c) when they are pumped and certified every five years.

Paul Booher stated that there were several good points that would need to be considered, and that staff will report these comments to Gerald Briggs.

David Carter summarized the discussion. At the last RRAC meeting the committee made a motion that no action be taken on Task 4 (to develop recommendations to reduce impact if significance was determined). The department is now prepared to move forward with new rule language. The department staff are taking notes and listening and this is a good group with a lot of expertise and experience. He thinks the department will take into consideration several of the comments made at this meeting. The RRAC is supposed to be a research committee looking at studies and recommending new studies. This is blurring into a TRAP area. Bill Melton agrees that this is not RRAC's purview and making comments is essentially all that can be done. Pam Tucker stated that adopting the rule without DEP's Phase II being completed is wrong. TRAP and RRAC tabled the issue to wait for the scientific data to be completed. She stated that it is important for RRAC to have these inputs and have an agreed upon position. Ellen Vause crafted a motion stating that RRAC stands behind their previous position and that the proposed rules are premature. Bill Melton stated that he is not sure the rules are premature, that onsite systems are contributing nitrogen, but that the data is not there to determine the relative significance. Sam Averett stated that he has no doubt that onsite systems in the Wekiva Area put nitrogen into the Wekiva Springs. Patti Sanzone stated that DOH could propose rules on this issue, even if there was no proposed Wekiva Parkway. Paul Davis stated that most of the discussion so far has been a TRAP committee discussion, not research.

Sam Averett made a motion which was seconded by John Glenn:

> **RRAC, after review of the Department of Health proposed rule language for Wekiva, still stands behind the previous statement that RRAC is unable to determine relative significance of onsite system impacts of nitrogen to the Wekiva Study Area.**

There was a discussion on the relative significance of nitrogen impacts from onsite systems. Several RRAC members were in agreement that onsite systems contribute to the quantity of nitrogen in the Wekiva Study Area, but the relative significance has not yet been agreed upon. After a lengthy discussion, Stan Keely called the motion into question. The members voted and four were in favor: Sam Averett, David Carter, Paul Davis, and

Stan Keely; and three were opposed: John Glenn, Bill Melton, and Pam Tucker and the motion passed. [NOTE: a clarification was made later in the meeting from Pam Tucker stating that she was actually in favor of this motion and would like the minutes to reflect this.]

Paul Davis made a motion which was seconded by Bill Melton:

> **If the proposed rule goes forward, if a pump is required, low pressure dosing should be used due to the increase in system longevity and relatively low additional cost.**

There was a discussion that for a minimal additional fee, the life of the system could be extended by years. The members voted and six were in favor with one opposed (Pam Tucker).

It was decided that RRAC would not go through the proposed rule item by item as that is TRAP's area.

After a short break, both the engineer member and alternate left, but there was still a quorum. [NOTE: Clay Tappan returned to the meeting during the updates on other projects].

David Carter stated that DEP has posted the MACTEC report and some additional information on their website www.dep.state.fl.us/water/waterprojectfunding, under Wekiva nitrate sourcing. Chris Ferraro with DEP made an announcement that DEP has been working on the Total Maximum Daily Flows (TMDL's) for the Wekiva Study Area. Tentatively, on November 29th, there will be a public meeting for the TMDL's for the Wekiva Study Area. Bill Melton asked whether DEP will get the MACTEC information refined to help RRAC make a final determination on relative significance. Elke Ursin stated that she had received an email from Bonnie Hall with DEP who stated that they are working on the scope of work right now and the scope is close to being complete. There were no specific dates set at that time, but as soon as there is any additional information she will forward it on.

4. **Brief updates on other projects**
   a. Ongoing projects
      i. **Passive Nitrogen Removal Assessment** – Elke Ursin provides a brief overview of the project. The draft literature review report and draft quality assurance project plan were provided in the mailed packets to the RRAC members for review. Dr. Daniel Smith presented on his progress to date. The literature review and database portion was completed with assistance from Dr. Dick Otis. The goal of the study is to evaluate passive treatment media for removal of total nitrogen from onsite wastewater. This project will focus on various filter materials, which are more stable and less subject to variation. The project has five tasks: a literature review and database, laboratory experiments, a feasibility analysis (how the results and recommendations deployed), an economic analysis, and a final report. The literature review task involved searching databases and search engines, looking into test centers,

and personal contacts. Paul Booher recommends that the report include suggestions on how to deal with the material that has been expended and needs to be disposed. Dr. Smith goes over zeolites and coir fiber as aerobic filters. Roxanne Groover stated that Quanics has performed NSF testing on the coir fiber and has information on total nitrogen. Dr. Smith stated that the coir may not need to be tested. He then went over anoxic filters. Next Dr. Smith went over the Quality Assurance Project Plan (QAPP). The Invitation to Negotiate defines passive treatment as **"***A type of onsite sewage treatment and disposal system that* ***excludes the use of aerator pumps*** *and includes* ***no more than one effluent dosing pump*** *in mechanical and moving parts and uses a* ***reactive media*** *to assist in nitrogen removal".* Dr. Smith stated that first the effluent needs to be nitrified and then denitrified, so he is proposing a two stage process. The first stage is an unsaturated media filter that provides ammonification and nitrification. The second stage is a saturated media filter containing an electron donor and is anoxic thus providing denitrification. The next decision is where to put the pump. Dr. Smith decided to place the pump in the front because nitrification will be the trickiest part of this process. This placement of the pump will allow pressure dosing at the first stage filter and will also allow for timed dosing. He has located some potential sites for the laboratory experiments. Septic tank effluent will be used for the experiments. He went over the media configuration, and how the columns will be configured. The experiment will be set up and then monitored to see how well they work. The stage one will be dosed once per hour for 2-3 minutes as needed, at a minimum loading rate of 2 gallons/sq.ft./day. Both stage one and stage two will be operated and monitored over 60 days and will test for temperature, pH, alkalinity, DO, and the entire nitrogen species. In response to a suggestion to change conditions in the experiment, Roxanne Groover asks how the determination will be made to adjust the loading. She stated that she would be more comfortable with a baseline that does not change. Dr. Smith stated that before altering the flow he will gather enough information prior to making a change. He stated that he is planning on running the column for about 3-weeks prior to taking any samples to allow for the microbial population to become established. He stated that the experiments should be run for a longer timeframe, but that the time and budget do not allow for this. The feasibility and economic assessment portions of the project will be based on the best available information in the timeframe allotted for this project. Dr. Eberhard Roeder suggests keeping the parameters the same for the first 6 samples and then an assessment can be done on what to adjust for a potential new project. Paul Davis asks whether the experimental design calls for part of the system to be above the ground, and if so is it possible to do an unsaturated tricking filter for aeration coming directly from the outlet of the septic tank then pumping to the saturated zone to keep the system in the ground. Dr. Smith stated that that the design calls for an unsaturated area and it is possible to configure the system as Mr. Davis suggests but that having the pump at the beginning will be more aggressive at converting to nitrates. Dominic Buhot asks whether lava rock was considered as a media, and Dr. Smith stated that it was not looked at but that it is similar to some of the expanded shale media. Dr. Smith asks if there is anywhere to find that material in a granular form, and Mr. Buhot stated that it can be found at landscaping suppliers. Elke Ursin stated that RRAC and

DOH have to provide comments on the Literature Review report and the Laboratory Experiments report within two weeks of the RRAC meeting. She will send an email to remind the RRAC members.

ii. **High Strength Waste Study** – Paper submitted to American Society of Agricultural and Biological Engineers. If there are any comments please forward them on.

iii. **Manatee Springs, Performance of Onsite Systems Phase II Karst Study** – Paper submitted to Water Research on 8/21/07 by Florida State University. Due to contractual and timing issues, this contract has expired and must be re-advertised and re-contract.

iv. **Monroe County Performance Based Treatment System Performance Assessment** – Dr. Eberhard Roeder presented on the preliminary results of the Monroe County project. Some of the preliminary observations are:

1. Only a few odd numbers
2. Diurnal variability appears lower for nutrients than for $CBOD_5$ and TSS
3. Nutrient grab samples appear very consistent with time-composite samples, less so for TSS
4. Wastewater strength ($CBOD_5$ and TSS) appears to be lower than in Keys Onsite Wastewater Nutrient Reduction Study (OWNRS)
5. Nutrient concentrations appear to be higher than in Keys OWNRS study
6. There will be repeat sampling done to assess variability for the same system over time with the added sample parameters of fecal coliform, alkalinity, and pH.

There was some discussion over the strength of the influent being higher than expected. The system may be working properly, but if the influent is too high the effluent may be higher than the 10 mg/L that is required. Sam Averett wanted clarification on whether any of the tested systems are on the list of state approved systems. Dr. Roeder stated that it was primarily one manufacturer with some others that were approved by the county health department. Sam Averett stated that it is difficult to take an influent sample, and the sample may be skewed by fecal matter. Dr. Roeder pointed out that the low number of Total Suspended Solids (TSS) supports that there was low solid fecal matter or other solids that may skew the results, and that the settling tank where the sample was taken from has effectively settled the solids.

v. **Remote Sensing of Optical Brighteners Study: Mote Marine Report** – Summary report from DEP has been submitted on results of tasks up to the airborne Light Detection and Ranging (LiDAR). The flow-through fluorescence method showed potentially interesting patterns (i.e. one location showed a higher signal corresponding to locations where failed septic systems were known to exist). Contract was amended on Oct. 15th to comply with Contract Administration requirements (end date changed to 12/31/07). New contract will need to be issued using IGA exemption to allow for completion of scope. Phone conference to be held on Oct. 25th to discuss next steps. The Mote Marine portion of this project looked into the optical properties of water and optical brighteners in great detail. They also took some wastewater from onsite systems and characterized it. They discovered two inputs that could be an indicator of wastewater. The results were very promising and now DEP will look into how to incorporate these results in what they have to do.

vi. **Taylor County Source Tracking Study** – RRAC made motion on May 8, 2007 meeting for staff to look into a follow-up sampling event to capture the May seasonal low water table event. FDEP was contacted to see if funds were available, and they were not available for a May sampling event, FDOH utilized research $ to fund the project (just under $14,000). Request for proposal was sent to various interested parties and FAU was selected to conduct the study. The sample site locations were determined to be the same as the original list with the exception of one site, which the previous study did not find a marked difference between another site in close proximity, which could be replaced with a new one. An interim progress report was submitted at the end of June 2007 outlining the May 2007 seasonal low water table sampling event, and is included in the packets sent to the RRAC. FDEP's 319 program has funded a September 2007 sampling event. Analysis is ongoing, and a final project report compiling all sampling events will be submitted in January 2008.

b. Projects coming up

i. **319 Project on Performance and Management of Advanced Onsite Systems** – $300,000 grant through the EPA 319 program administered by FDEP. FDOH will provide $200,000 in matching funds through the Monroe County project. Tasks:

1. Monroe County detailed study of variability of performance of advanced systems (Keys study)
2. Statewide database of advanced systems based on permit records
3. Survey of the perceived strengths and weaknesses of the current management of advanced onsite systems. County health department employees, septic contractors, homeowners will be polled and each set will have different questions.
4. Statewide assessment of operating condition and performance of advanced systems (random sample of 600 systems)
5. Quarterly influent and effluent sampling for a sample of systems (approximately 70 systems) to see seasonal variability
6. Booklet with case studies outlining both strengths and weaknesses of the current program and best practices in advanced onsite management

Elke Ursin stated that she needs RRAC to vote on whether this project scope is acceptable to move forward, so that she can present it to the TRAP. Sam Averett made a motion that was seconded by Paul Davis:

RRAC recommends moving forward with the 319 project.

Bill Melton stated that he thinks it is not a good idea to mix ATU's, PBTS, and interim systems with the sampling. Dr. Roeder stated that these are all in the category of advanced. Bill Melton thinks this category is too broad. Dr. Roeder stated that including all these classifications would allow for a distinction between the types of systems to see if there is a difference in treatment effectiveness between the different types. Patti Sanzone stated that she views this project as a program check. Sam Averett stated that it is critical to make sure the data is collected effectively. The specifics will be disused at future meetings. There was a discussion on making sure what is sampled will be statistically significant. The database will give an indication of the population of

systems, how many there are and of what type. Then a number can be determined on what systems to sample. If a system has too few units installed to be statistically significant, they may be removed from the sampling scheme and the extra numbers reallocated to other systems. The members voted and all were in favor with none opposed.

ii. **Coastal Management Program Grant Funding Opportunity** – FDEP has sent out a notification for a grant funding opportunity due November 15, 2007. One idea is to utilize this funding to sample in the Town of Suwannee, Cedar Key, and areas of Taylor County where areas have converted from onsite systems to sewer and where there is previous sample data from when the areas were still on onsite systems.

Sam Averett made a motion that was seconded by Clay Tappan:

RRAC recommends FDOH apply for the FDEP Coastal Management Program grant funding opportunity.

The members voted and all were in favor with none opposed.

5. **Budget Discussion** – This item is to be discussed at the next meeting
6. **Prioritization of Future Projects** – This item is to be discussed at the next meeting, RRAC members are encouraged to develop a list of potential future project ideas to assist in the discussion.
7. **Public Comment -** The public was allowed to comment throughout the meeting and their comments are included throughout the minutes.
8. **Closing Comments, Next Meeting, and Adjournment**
    a. David Carter requested that staff work on filling some of the vacant RRAC positions. The Real Estate Industry and State University System have vacancies for the alternate category, both member and alternate of the Restaurant Industry have been absent for many meetings, and the regular member of the Septic Industry has been absent for many meetings as well. David Carter requested that letters be sent to those four groups requesting that they find someone who will attend the meetings. The next meeting will also have an election for the chairperson and vice chairperson and it will be important to get someone in the position so that continuity is maintained.
    b. Pam Tucker asked for clarification on whether the passive nitrogen systems being studied in Dr. Smith's project would work with performance based treatment systems, and asked for clarification on what is passive about them. It was explained that passive systems just sit there and work with minimal outside influence. David Carter stated that we are always looking for ways to improve how systems are working, and this project is not necessarily tied into Wekiva. The results of the Passive Nitrogen Removal project could show, for example, that for $2,000 you can put this gizmo on a system and achieve an 80% reduction. Sam Averett stated that no private company wants to study this because you can't patent oyster shells, for example. Paul Davis stated that no one is going to study this except for entities like the State of Florida.
    c. No date was set for the next meeting. Next meeting anticipated to be some time in January 2008 at a location to be determined. Pam Tucker motioned to adjourn and Clay Tappan seconded. The meeting adjourned at 2:25 pm.

Revised Estimates of Nitrogen Input and Nitrogen Loading in the Wekiva Study Area

Draft 1.3
January 11, 2008

Prepared
by
Eberhard Roeder, Ph.D., P.E.
Bureau of Onsite Sewage Programs
Florida Department of Health

Table of Contents

List of Tables

List of Figures

Executive Summary

This report presents estimates of relative contributions of nitrogen to groundwater in the Wekiva Study Area. It is a follow-up to the report submitted by the Florida Department of Health in June of 2007 to the Governor. A goal of that study was to determine if OSTDS were a "significant source of nitrogen to the underlying groundwater relative to other sources".
The methodology and terminology of this report follows closely the previous Wekiva nitrogen assessments (MACTEC, 2007; Young, 2007). In particular, input is the amount of nitrogen that is released to or near the surface of the environment, while load is the amount of nitrogen that enters the ground or surface water. Figure 0-1 illustrates this distinction.

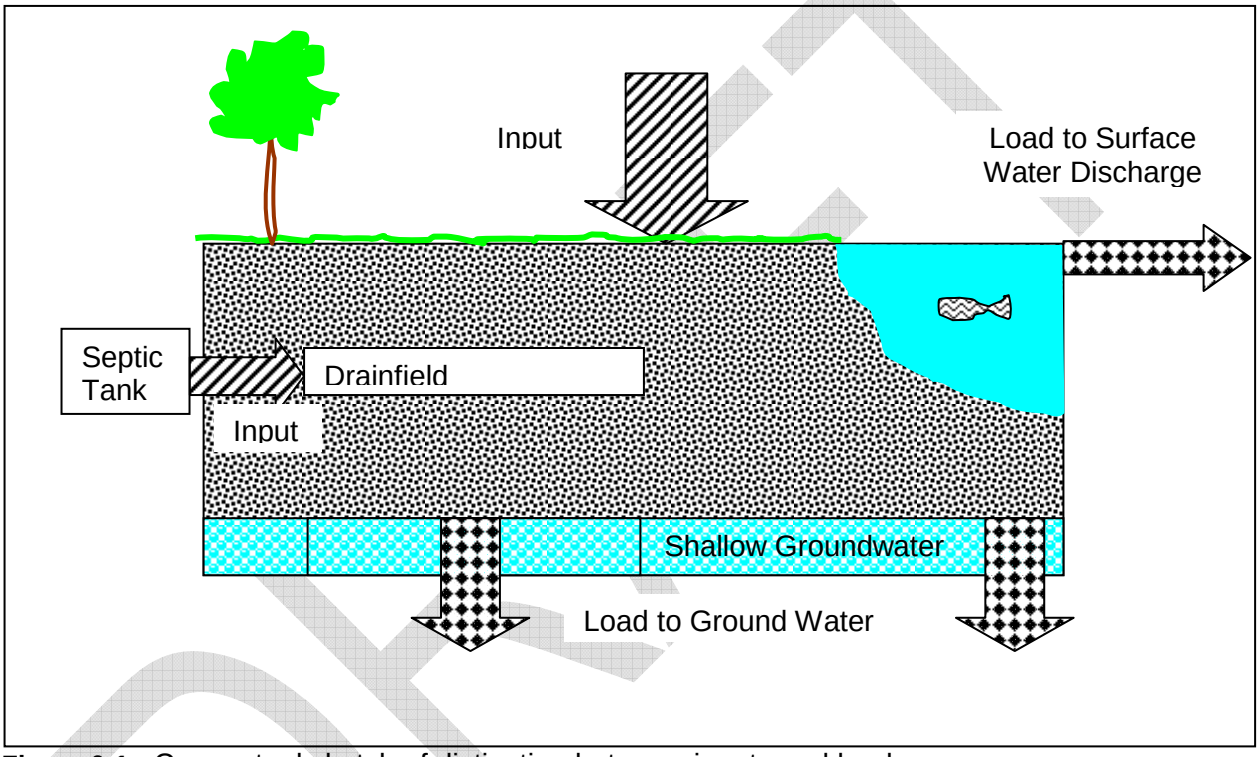


Figure 0-1. Conceptual sketch of distinction between inputs and loads.

Two issues raised in the 2007 report are addressed in this revised input estimate: First, the field work during the Department's study indicated a larger nitrogen contribution for an OSTDS than considered in the assessment (29 lbs/yr instead of 20 lbs/yr). Second, the estimated amount of fertilizer used in the Wekiva Study Area was twice the pro-rated total fertilizer sales registered by the Department of Agriculture and Consumer Services in Lake, Orange and Seminole Counties.

Inputs were determined by estimating atmospheric deposition, fertilizer use, livestock waste, and wastewater effluent discharged into the Wekiva Study Area. The revised relative contributions to nitrogen inputs to the Wekiva Study Area are shown in figure 0-2. The total input was estimated at 6,500 tons/yr or 5,900 metric tons (MT)/yr. Inputs are grouped together by land use category, except for wastewater and atmospheric deposition, which was uniform throughout the area. The figure illustrates that many sources, covered by a variety of jurisdictions contribute to the nitrogen problem. The contribution by wastewater treatment facilities (WWTF) accounts already for nitrogen reduction accomplished there. Without restrictive nitrogen treatment standards for these facilities, the inputs could be about 1,800 MT/yr higher.

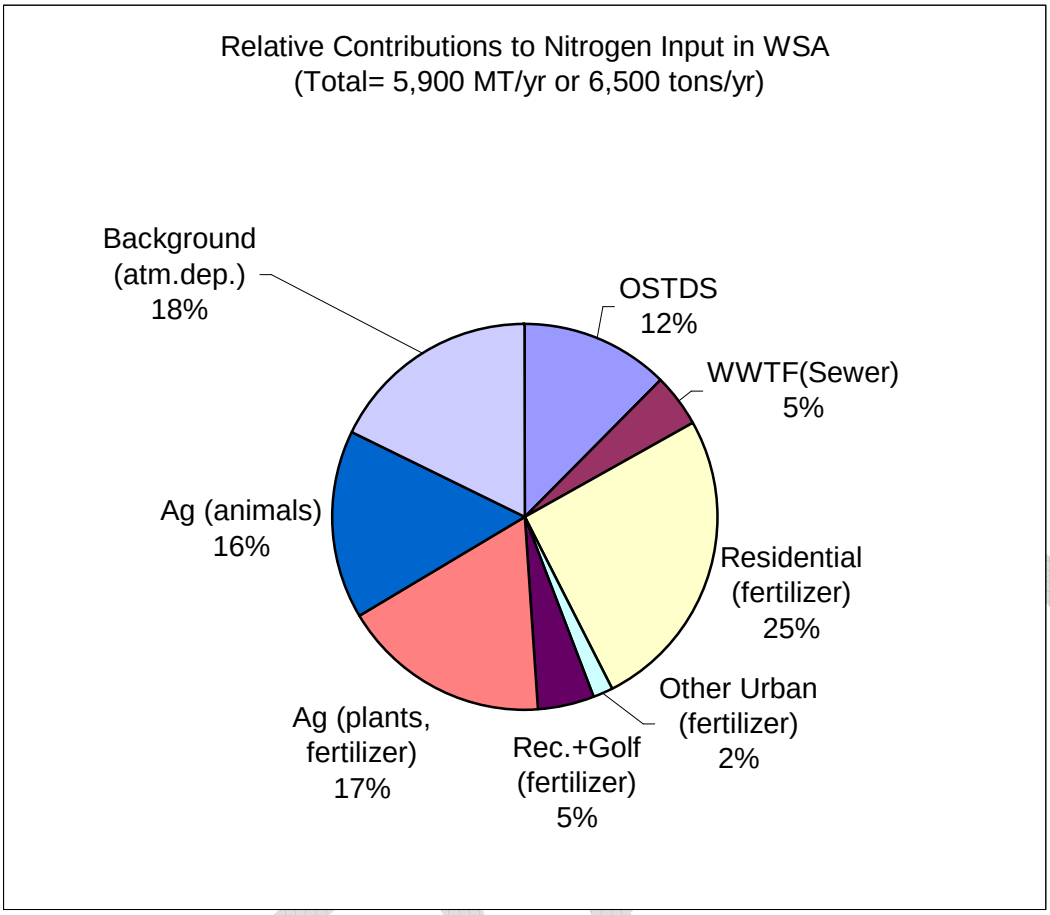


Figure 0-2. Relative contributions to nitrogen input by land use and special categories.

Loads were generally determined by multiplying concentrations with flow rates. For land uses classifications the concentrations were shallow groundwater concentrations and the flow was the groundwater recharge rate, which was with one exception obtained from the Groundwater flow model of the St. Johns River Water Management District. The exception was the agricultural tree crops land use classification, for which best management practices irrigation resulted in a much larger flow and therefore loading rate. Loads for each land use were adjusted for a hypothetical background load determined by multiplying a background concentration of 0.2 mg/L total nitrogen with the groundwater recharge rate.
Wastewater loads were determined by considering the concentration reduction observed under the discharge areas relative to concentrations and flows that determined the input. The concentration reduction (40%) for OSTDS was based on the results of the 2007 Wekiva Study field work.

Figure 0-3 presents the estimate for relative contributions to groundwater loading in the Wekiva Study Area. The shift in relative contributions is a result of the apparent treatment effectiveness of soil. Low nitrogen and water application rates, such as for atmospheric deposition, removed about 95% of the nitrogen, while high nitrogen and water application rates, such as for rapid infiltration basins, OSTDS and tree crops,

removed half or less of the nitrogen. This showed that the amount of irrigation is an important loading factor.

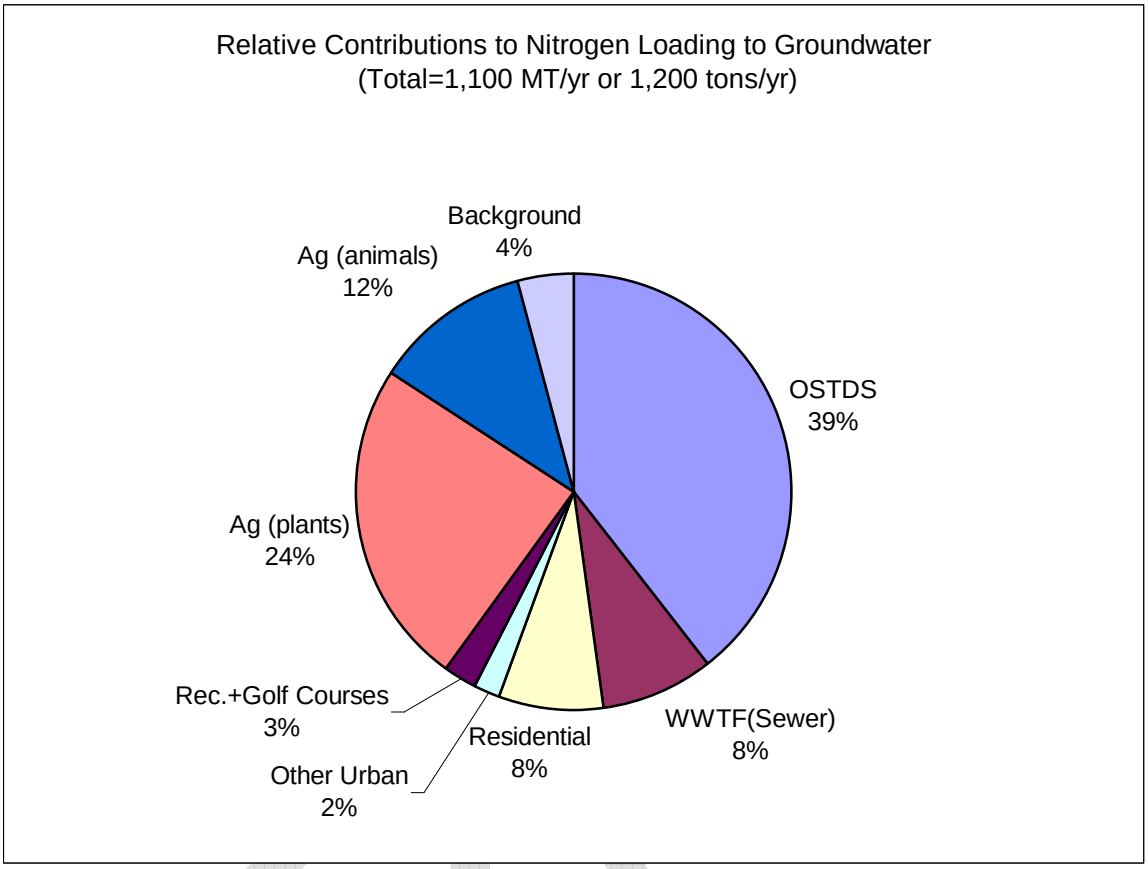


Figure 0-3. Relative contributions to nitrogen loading to groundwater.

In addition, an estimated 600 tons/yr or 550 MT/yr of nitrogen were discharged as surface water. Overall, these two estimates indicate that about 70% of the nitrogen input to the Wekiva Study Area is not transferred to water.

In order to reduce nitrogen loads to groundwater and surface water in the Wekiva Study Area, better management practices for sources are needed and future population growth must be addressed. This includes OSTDS, for which the Department has proposed nitrogen reduction strategies both for existing and new systems.

1 Introduction

The objective of this report is to present revised estimates of relative contributions of nitrogen to waters in the Wekiva Study Area. The 2007 Wekiva Study by the Florida Department of Health assessed nitrogen contributions by onsite sewage treatment and disposal systems (OSTDS) to the Wekiva Study Area. A goal of the study was to determine if OSTDS were a "significant source of nitrogen to the underlying groundwater relative to other sources". This included an assessment of the relative contribution of nitrogen inputs by onsite systems compared to other sources (Young, 2007). As the summary report (Briggs et al., 2007) pointed out, two pieces of information were not considered in that assessment: First, the field work during the Department's study indicated a larger nitrogen contribution for an OSTDS than considered in the assessment; Second, the estimated amount of fertilizer used in the Wekiva Study Area appeared unlikely high relative to the total fertilizer sales registered by the Department of Agriculture and Consumer Services in Lake, Orange and Seminole Counties.

The methodology and terminology of this report follows closely the previous Wekiva nitrogen assessments (MACTEC, 2007; Young, 2007). In particular, input is the amount of nitrogen that is released to or near the surface of the environment, while load is the amount of nitrogen that enters the ground or surface water. Either inputs or loads quantify the variety of sources of nitrogen to the underlying groundwater. For most sources, the difference between inputs and loads reflects largely treatment processes in the soil. In this way loads characterize better than inputs the impact on groundwater. Figure 1-1 illustrates this distinction.

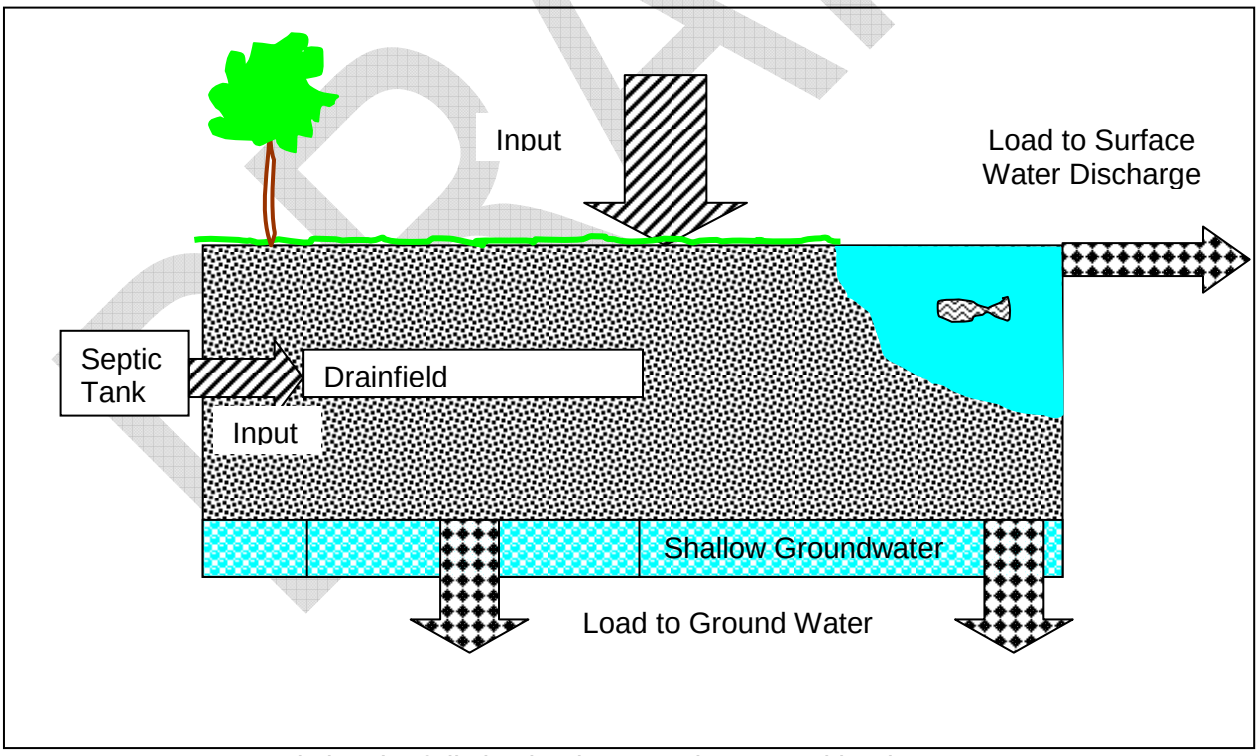


Figure 1-1. Conceptual sketch of distinction between inputs and loads.

The Wekiva Study Area encompasses 305,000 acres in Lake, Orange and Seminole Counties in central Florida. While boundaries are not hydrological they encompass most of the springsheds and surface watersheds that contribute water to the Wekiva River before it merges with the St. Johns River. Figure 1- 2 shows the location of the Wekiva Study Area in relation to surface drainage basins and springs recharge areas.

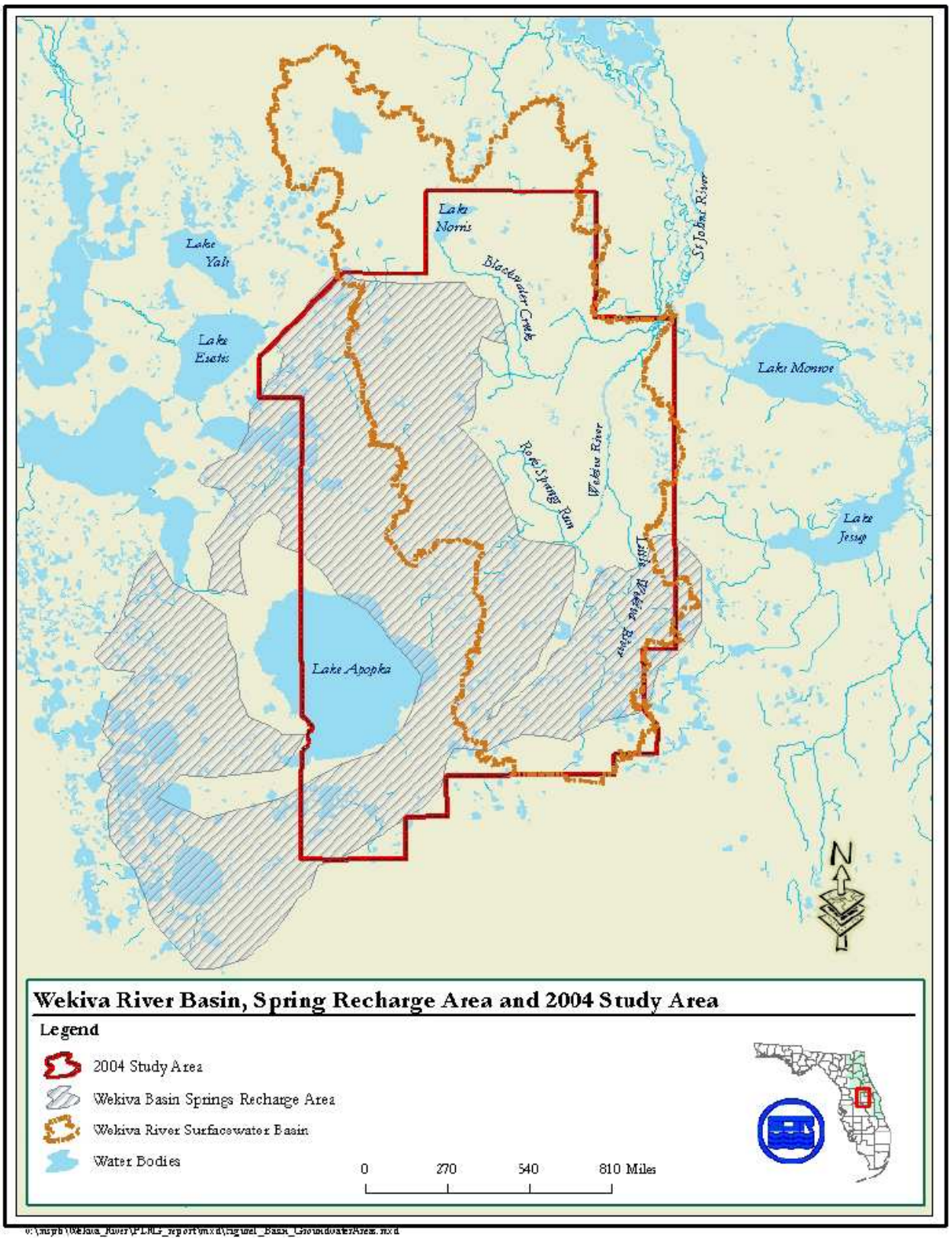


Figure 1-2. Location of Wekiva Study Area relative to springs recharge area and surface drainage basins (from Mattson et al., 2006).

2 Input Assumptions

2.1 Input by OSTDS

The input per system for a typical onsite sewage treatment and disposal system serving 2.6 people, the average household size, was taken as 29 lbs/year. This was based on the mid-range per-capita nitrogen release from the septic tanks observed in the DOH Wekiva Study field work. Such an input was consistent with other recent literature surveys of nitrogen discharged by septic systems. Data supporting this revision were discussed in the task 4 report of the Department's 2007 Wekiva Study (Roeder, 2007). For 55,417 OSDTS in the Wekiva Study Area at the end of 2005 this results in an estimated input of 730 MT/yr or 804 tons/year.

An estimate of how nitrogen inputs by OSTDS have developed over time was obtained by combining census data on house ages in the Wekiva Study Area with onsite permit information and is shown in figure 2- 1. The number of onsite systems estimated for 2005 were prorated by the age of the structures in the WSA given in census files, under the assumption that 91% of all systems were present by the end of 1998.

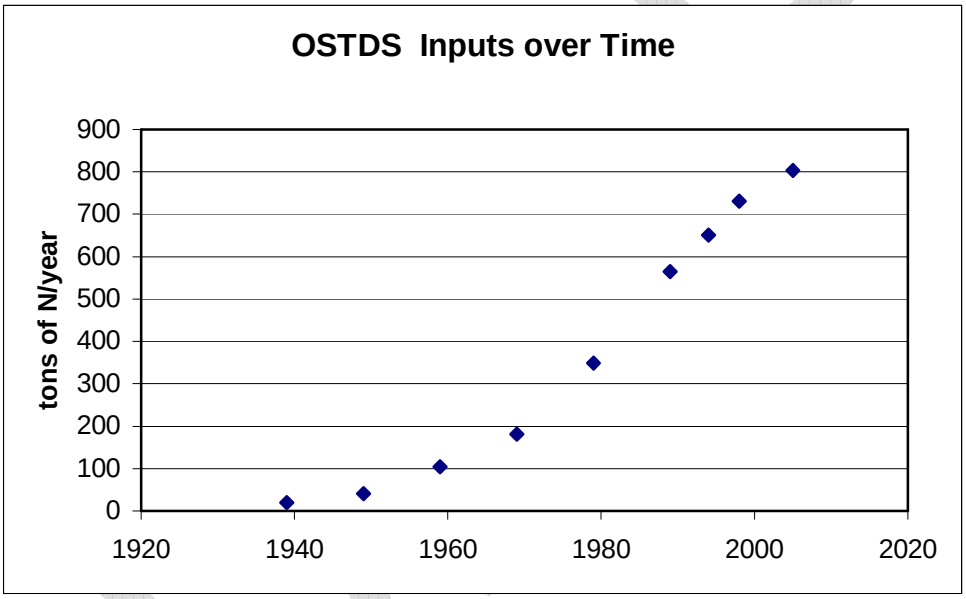


Figure 2-1. Estimated nitrogen inputs from OSTDS in the Wekiva Study Area.

2.2 Input by Sewer (Centralized Wastewater Treatment Facilities):

The estimates for inputs by centralized wastewater treatment facilities are: 28.8 MT/yr that are discharged to surface water; 72.6 MT/yr discharged to groundwater, and 164.7 MT/yr reused, for a total of 266 MT/yr or 293 tons/year. During the previous Wekiva Study Area assessment (Young, 2007), discharge flows and concentrations of wastewater treatment facilities in the Wekiva Study Area were reviewed. Information was available for approximately 80% of permitted capacity. The estimate prorated inputs based on permitted capacity for treatment systems with missing information. It also assumed that 10% of discharge by the Conserv II facility, a large regional facility for the distribution of treated sewage, occurs in the Wekiva Study Area.

A consistency check is achieved by comparison between this estimate and a coarse estimate of treated sewage generated. The number of households on not on onsite systems (157,000)

multiplied by an annual input of 29 lbs/household and an average treatment effectiveness of 87% would result in about the same input. The average total nitrogen discharge concentration for wastewater treatment facilities with data was 6.1 mg/L. The sewer input calculation did not consider losses due to exfiltration or import or export of nitrogen from or to areas outside of the WSA.

A similar estimate allowed an assessment of how large nitrogen inputs from wastewater would be if not for centralized wastewater treatment facilities. Without this treatment 2,100 MT/yr of nitrogen instead of 266 MT/yr would be discharged from sewers in addition to the nitrogen from onsite systems.

2.3 Input by Atmospheric Deposition:

The estimated nitrogen input to WSA from atmospheric deposition was 1,050 MT/year or 1,150 tons/yr. Compared to the MACTEC (2007) report, the estimate of nitrogen input from atmospheric deposition was changed in two ways: Data from a station in the Orlando area were used to estimate wet deposition of nitrate and ammonia rather than only nitrate. Nickerson and Madsen (2005) provided trend functions for wet ammonia and nitrate deposition recorded in Orlando from 1978 to 1997. Ammonia did not show a linear increase over time, with 1.02 meq/m^2 month or 1.7 kg/ha.yr as the constant value. Nitrate showed a positive trend for the monthly wet deposition: q= 1.33+0.044*(year-1978) meq/m^2month, which results in a yearly wet deposition of 4.2 kg/ha yr for the end of 2004. The estimated wet total nitrogen deposition is then 5.94 kg/ha year. Dry deposition was assumed to be 30% of the total deposition, the average of the 15% recorded by the CASTNET Indian River Lagoon monitor and the 44% reported by Poor, et al. (2001) for Tampa Bay, or 2.55 kg/ha year. This fraction is similar to 37% dry deposition cited by Dixon (1994) for the Gainesville area in a review of nitrogen deposition. Figure 2-2 shows the regressions of wet deposition with seasonal variability and the estimated total deposition over the period 1978-2004.

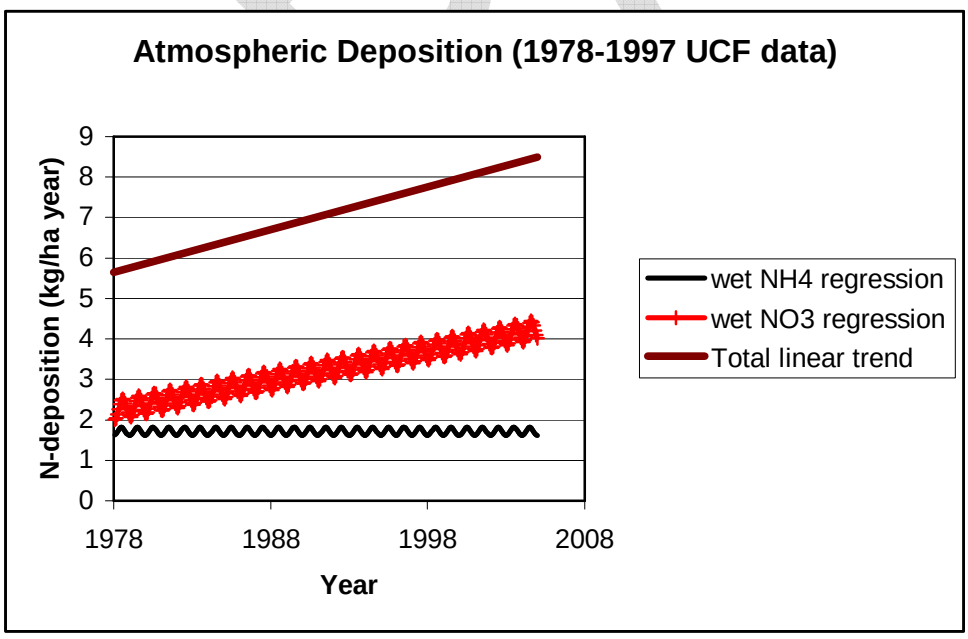


Figure 2-2. Estimated development of yearly wet and total nitrogen deposition based on 20-year observations at University of Central Florida. Regressions reported by Nickerson and Madsen (2005)

Thus, the total nitrogen from atmospheric deposition was estimated to be 8.5 kg/ha year. This value was higher but within the error bounds reported by Poor et al. (2001) for the Tampa Bay, and somewhat higher than the value of 7.6 kg/ha yr given as an estimate for urban bulk loading by Dixon (1994). It is somewhat lower than the 11.4 kg/ha yr obtained by Heyl (1992) for Sarasota Bay.

The input from atmospheric deposition was calculated by multiplying the deposition rate by the area for each land use/land cover classification. .

2.4 Inputs by Fertilizers

2.4.1 Fertilizer Sales

The nitrogen fertilizer sale estimates for the WSA are 1,470 tons/year (1,300 MT/yr) for farm use and 1,980 tons/year (1,800 MT/yr) for non-farm use, for a total of 3,450 tons/year (3,100 MT/yr). This estimate was developed from fertilizer sales data, published by the Department of Agriculture and Consumer Services (http://www.flaes.org/). These data include nitrogen sold and a split between farm and non-farm use of fertilizer for each of the three Wekiva counties for the time period 1998-2007. Total N-sale remained roughly constant at 12400 MT/yr over this period. Non-farm total N sales increased steadily over this period by about 520 tons/year. The average non-farm fraction over the ten-year period was 47%. This is illustrated in Figure 2-3.

In order to estimate how much fertilizer was used in the Wekiva Study Area the following approach was used:
Farm fertilizer nitrogen, estimated as the county farm-use fraction of fertilizer multiplied by county nitrogen sales, was prorated by the county's total area in the Wekiva Study Area. Non-farm fertilizer nitrogen, estimated as the county non-farm use fraction of fertilizer multiplied by county nitrogen sales, was prorated by the county's population in the Wekiva Study Area. Because population is relatively concentrated in the Wekiva Study Area, this approach leads to somewhat higher fertilizer use estimates than an approach that only considers total area as suggested by Anderson (2006). The consistency of the tons/person of non-farm fertilizer sales between the three counties supports the assumption that non-farm uses, such as residential fertilization, are more dependent on the number of people than on the area. Table 1 shows the resulting fertilizer sales for the Wekiva Study Area.

A further consistency check was possible by comparing the census estimate for the population increase in the three counties between 2000 and 2006 (U.S. Census Bureau, 2007) with the increase in non-farm fertilizer use. The population increased by about 44,800 person per year between 2000 and 2006. Multiplying the number of people by the estimate for per capita non-farm nitrogen use of 0.0117 tons/capita year resulted in an estimated increase of 520 tons/year in non-farm use, which matched the observed increase in non-farm nitrogen sales.

The resulting nitrogen fertilizer use estimates for the WSA were 1,470 tons/year (1,300 MT/yr) for farm use and 1,980 tons/year (1,800 MT/yr) for non-farm use, for a total of 3,450 tons/year (3,100 MT/yr). This was noticeably higher than prorating a gross average area sales rate to the Wekiva Study Area, (2,700 tons/year), or even an area-weighted average (3,000 tons/year) for the Wekiva Study Area. Still, a comparison with the estimates for fertilizer inputs based on application rates as given in the previous assessment suggests that the application rates based approach results in estimates higher by a factor of close to two (6,300 tons/ year for WSA). This discrepancy occurs similarly in the MACTEC study area where simple area-prorating of fertilizer sales lead to an estimated 3,700 tons/year sold and the application rate-based estimate resulted in an estimate of 8,400 tons/year nitrogen applied.

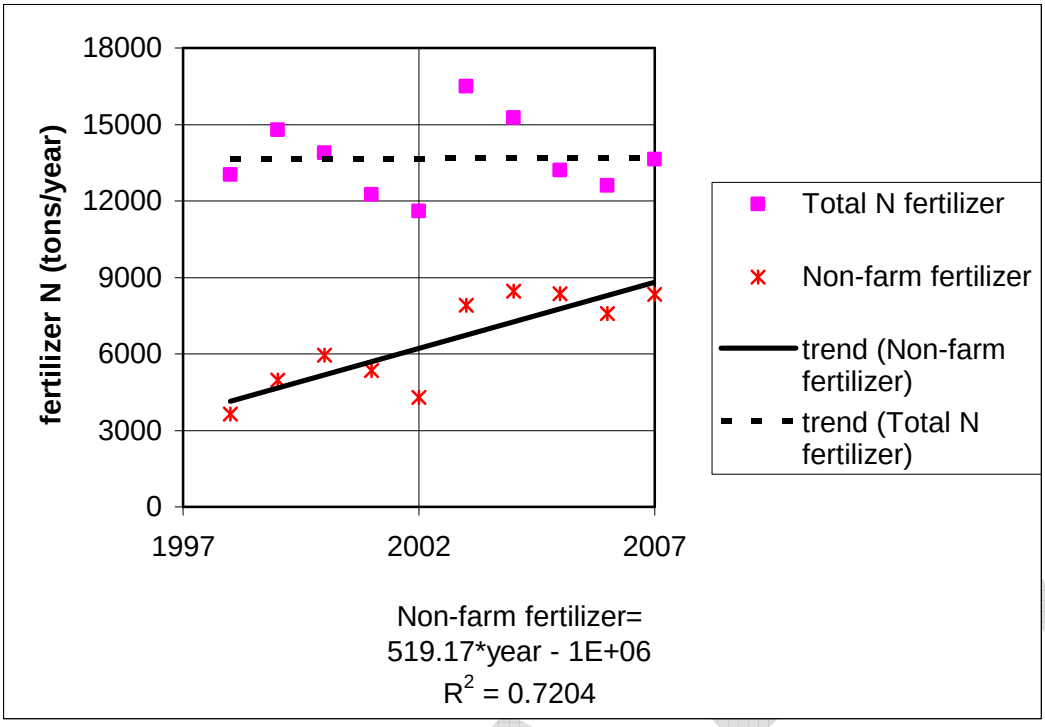


Figure 2-3. Farm and non-farm sales of total nitrogen fertilizer in the three counties, showing an increase by 520 tons/year for non-farm fertilizer between 1998 and 2007.

Table 1. Estimates of fertilizer use in the Wekiva Study Area, based on 1998-2007 average fertilizer sales, areas and 2000 populations.

Area	County Area from GIS (acres)	Area in WSA (acres)	Fraction of County in WSA	County Farm Fertilizer (tons/year)	WSA Farm Fertilizer (tons/year)	tons/ acre year
Lake	743040	101395	0.14	2262	309	0.0030
Orange	645120	163731	0.25	3712	942	0.0058
Seminole	221440	39655	0.18	1214	217	0.0055
Total	1609600	304780		7188	1468	0.0048
Population	County Population 2000 from census	Population in WSA 2000	Fraction of County in WSA	County Non-Farm Fertilizer (tons/year)	WSA Non-Farm Fertilizer (tons/year)	tons/ person year
Lake	210,528	98644	0.47	1204	564	0.0122
Orange	896,344	259774	0.29	3424	992	0.0132
Seminole	365,196	127054	0.35	1221	425	0.0096
Total	1472068	485472		5849	1981	0.0117

2.4.2 Effective Fertilizer Application Rates

In order to address these lower overall fertilizer numbers a modification in the approach was necessary. The previous model assumed that a fertilizer application rate derived from literature values applied to all area of a land use not classified as impervious (covered by hard surfaces). As no new literature was identified that would shed more light on application rates, the question was rephrased to assess if the fraction of a land use classification to which the application rate applies could be less than previously assumed.

The fraction of the area fertilized depended on two factors, how much area was impervious and how much of the pervious area was actually fertilized.

The first factor concerned perviousness as an indicator of usable area for plants that might need fertilizer. The stormwater model WMM, which was applied by CDM (2005) in the Wekiva area, utilizes directly connected impervious area (DCIA), the fraction of the land surface area that is directly connected to the storm water drainage system. The total impervious area can be larger by a factor of about 2 (Rouge River National Wet Weather Demonstration Project, 1998, p.18). Lee and Heaney (2002) reported both DCIA and total impervious areas from four sites in south Florida, which also showed larger impervious fractions than directly connected impervious area. Values for impervious fractions for residential land uses were based on Lee and Heaney's values. For other non-agricultural land uses the maximum of the DCIA-value given in the CDM (2005) stormwater report and the impervious fraction given in the MACTEC (2007) report were utilized. Agricultural areas were assumed to be pervious on 85% of the gross land use area, reflecting a stormwater runoff coefficient of 0.15 (DEP, undated).

The second factor indicated how much of the remaining pervious area was fertilized. The previous assessments (MACTEC, 2007; Young, 2007) assumed that all pervious areas in non-agricultural land uses would be fertilized at the rate for turf grass. An alternative scenario was that only a fraction of the remaining area was fertilized. For example, tree groups may be fertilized less and canopy cover in Broward county has been estimated between 11 and 45 % (Morrow et al. 2001). The fraction of fertilized pervious area was adjusted in 5% increments until the non-farm fertilizer use was within 5% of the sales estimate, which was reached at 70%. Pervious fraction multiplied by turf grass fertilization fraction yields an overall estimate of what fraction of an urban land use could be covered by turf grass.
Similarly, fertilized fraction of agricultural land uses was adjusted in 5% increments until the estimated fertilizer application mass was within 5% of the sales estimate. This resulted in an estimate of 85% and an overall fertilized fraction of 72% of agricultural land uses.

As a consistency check, the residential fertilizer estimate was compared to more direct estimates of the lawn area.
Hodges et al (1994, p.79) estimated 1.1 acre of lawn per single family household in Florida. If one applied this estimate to the 120,000 detached single unit structures present in the Wekiva Study Area in 2000 according to census data, 132,000 acres would be covered by lawn. This is about twice the total land use area for low and medium density residential land uses combined. Obviously, the average lawn must be smaller in the Wekiva Study Area. The MACTEC impervious assumption estimates result in an average lawn size of 0.4 acres per detached structure. The pervious area and fertilized fraction estimates in the revised estimate here lead to an average fertilized lawn area of about 0.2 acre. This is similar to a national average estimated by Vinlove and Torla (1995). Such an average would be comprised of smaller lawns in medium density residential land uses (2-5 units/acre) and larger lawns in low density residential land uses. A mix of 0.4 acre lots in medium density residential areas and 2 acre lots in low density residential areas would provide enough lots in these land use classifications to account for the number of detached structures (120,000) and yield an average lawn area of either 0.4 acre (MACTEC) or 0.2 acre (this revision). Phelps (2004) cites results of an evaluation of aerial photographs in Marion County by Jones et al (1996) that indicated that 34% of high density residential land use area was covered by turf, 66% of medium density, and 17% of low density. These ratios would result in about 40% higher turf area than estimated in this revision, about half way between this estimate and the MACTEC estimate. If the area is indeed larger, then the application rate would have to be smaller to remain within the fertilizer sales statistics.

2.4.3 Estimated Fertilizer Nitrogen Input

After the revisions discussed above, the total estimated fertilizer input was 3,200 MT/year or 3,500 tons/year. This was close to the 3,100 MT/yr or 3,450 tons/year estimated as the prorated county nitrogen sales data. The non-farm fertilizer fraction of 0.59 in this estimate was close to the 0.58 ratio between area-weighted farm fertilizer and population-weighted non-farm fertilizer sales for the Wekiva Study Area. Figure 2-4 shows the distribution of fertilizer by land use. For this graphic, low, medium and high density land uses were aggregated into a residential land use category.

The estimate suggested that around 2002 residential fertilizer use was the largest source of nitrogen fertilizer applied in the Wekiva Study Area, followed by agricultural fertilizer. The fertilizer sales over the ten-year period indicated a marked increase in the non-farm fraction while sales overall remained constant. This indicated that increasing urbanization is decreasing agricultural fertilizer inputs but does not decrease fertilizer inputs overall.

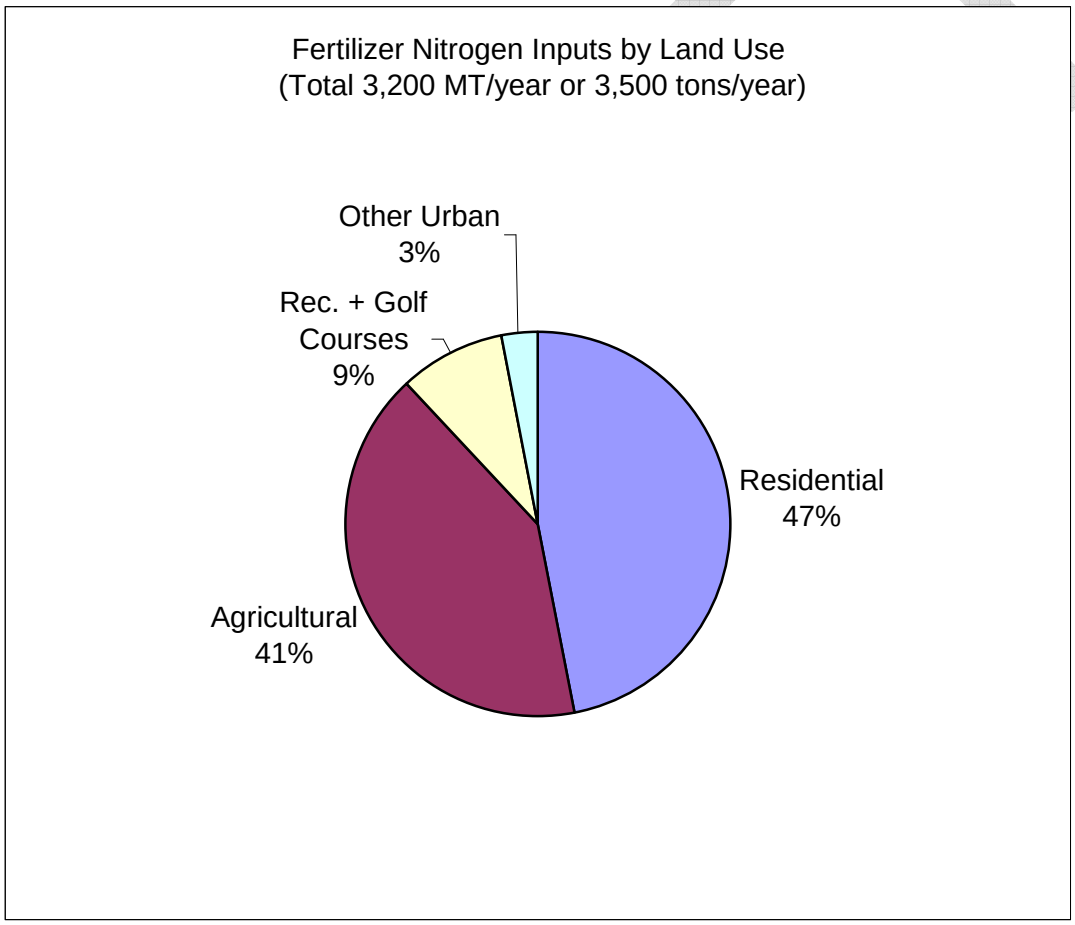


Figure 2-4. Distribution of estimated fertilizer nitrogen input between land uses.

2.5 Animal Waste:

The input assumptions of the previous assessments (MACTEC, 2007; Young, 2007) remained the same. The resulting estimate for the animal waste contribution to the Wekiva Study Area was 650 MT/yr or 720 tons/year nitrogen.

3 Relative Contributions to Inputs

3.1 Inputs without consideration of centralized wastewater treatment

A first approach to input assessment was an estimate of nitrogen that enters the land surface before consideration of the effectiveness of centralized wastewater treatment facilities. This includes fertilizer sales, all wastewater before treatment, atmospheric deposition, and live stock waste. The contributions of these inputs are shown in figure 3-1 and table 2. Fertilizer is the largest input, followed by human wastewater.

Table 2. Nitrogen inputs in the WSA without consideration of centralized wastewater treatment.

	Input (MT/yr)	Input (tons/yr)
Wastewater	2,797	3,080
Fertilizer	3,199	3,523
Livestock	657	724
Atmospheric Deposition	1,048	1,154
Sum	7,701	8,481

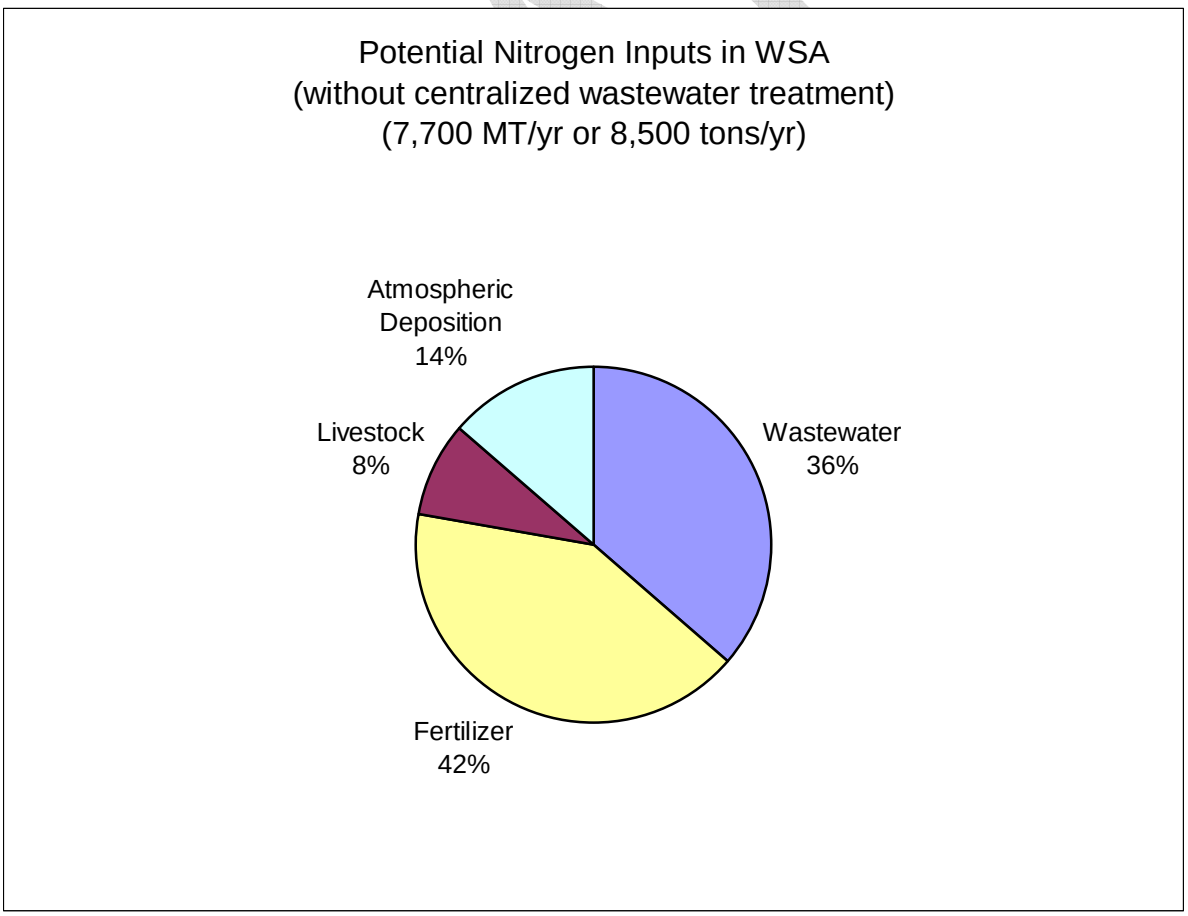


Figure 3-1. Relative contributions to overall nitrogen inputs in the Wekiva Study Area, without consideration of centralized wastewater treatment effectiveness.

3.2 Inputs including wastewater treatment facilities

Upon consideration that centralized wastewater treatment facilities control already part of the potentially available nitrogen, the picture shifted. The difference between figure 3-1 and 3-2 represents the effectiveness of centralized wastewater treatment, which effect a reduction of over 20% of nitrogen input between these estimates.

The estimated input of 5,900 MT/yr nitrogen was about 25% less than the 8,100 MT/yr estimated during task 3 of the DOH Wekiva Study (Young, 2007). The reduction was largely due to the consideration of fertilizer sales in estimating this input, which resulted in a 40% reduction of this input. OSTDS input increased by 45% with the inclusion of results from the 2007 DOH Wekiva Study. Of the inputs, OSTDS, atmospheric deposition, and non-farm fertilizer use had increasing tendencies. Fertilizer sales overall appeared to remain at a constant level. For livestock and sewer no historic data were researched.

Figures 3-2 and 3-3 and tables 3 and 4 present the estimated inputs released to the waters and soils of the Wekiva Study Area. The difference between the two presentations is in the role of land use. Looking ahead to the loading estimate, all inputs on a land use (except wastewater and a natural background) will result in a common loading to water. To make inputs and loads comparable and to provide somewhat more detail for management discussions it was considered helpful to aggregate by land use. The following categories are used: residential (low, medium, high), background (atmospheric deposition and inputs from extensively managed land uses, such as open range, upland forest), other urban (commercial, institutional, transport, utilities, extractive), recreational and golf, plant agriculture (all crops), animal agriculture (all pasture, horse farms, aquaculture, feeding operations).

Table 3. Nitrogen inputs in the Wekiva Study Area by source

Source	Input (MT/yr)	Input (tons/yr)
OSTDS	730	804
WWTF(sewer)	266	293
Fertilizer	3,199	3,523
Livestock	653	720
Atmospheric Deposition	1,048	1,154
Sum	5,896	6,493

Table 4. Nitrogen inputs in the Wekiva Study Area by land use, wastewater, and background

Land Use	Input (MT/yr)	Input (tons/yr)
OSTDS	730	804
WWTF(Sewer)	266	293
Residential (fertilizer)	1,505	1,658
Other Urban (fertilizer)	95	105
Rec.+Golf (fertilizer)	289	318
Ag (plants, fertilizer)	1,025	1,129
Ag (animals)	938	1,033
Background (atm.dep.)	1,048	1,154
Sum	5,896	6,493

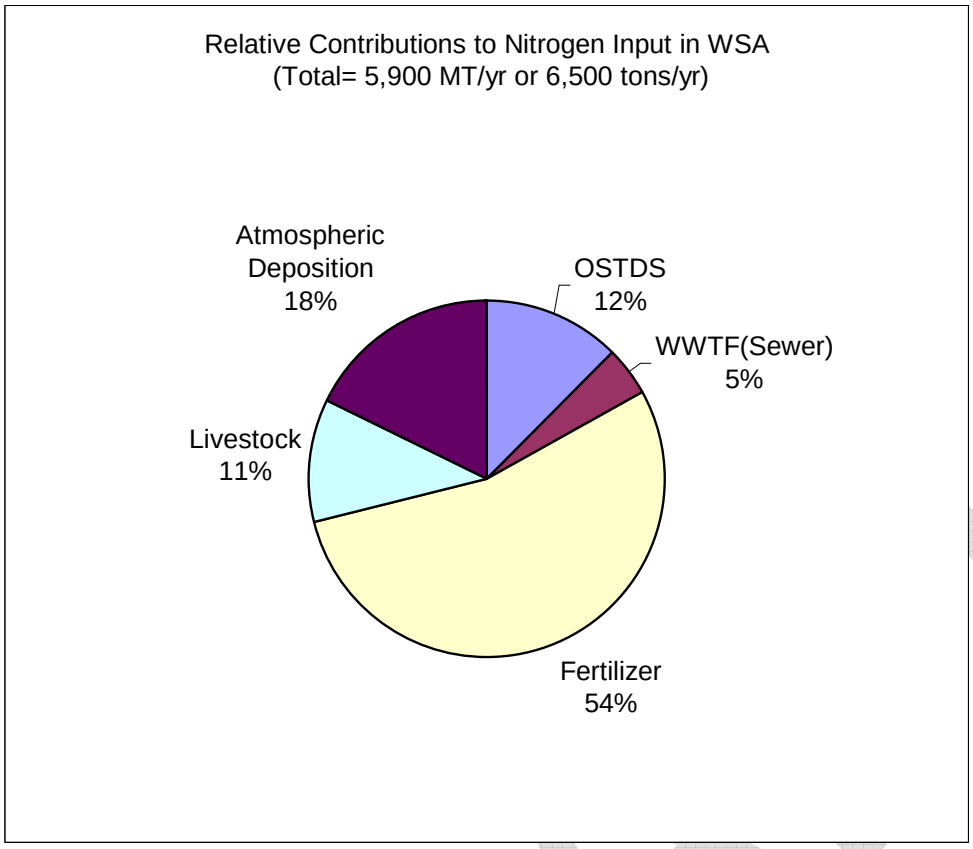


Figure 3-2. Estimated relative contributions to nitrogen input in the Wekiva Study Area.

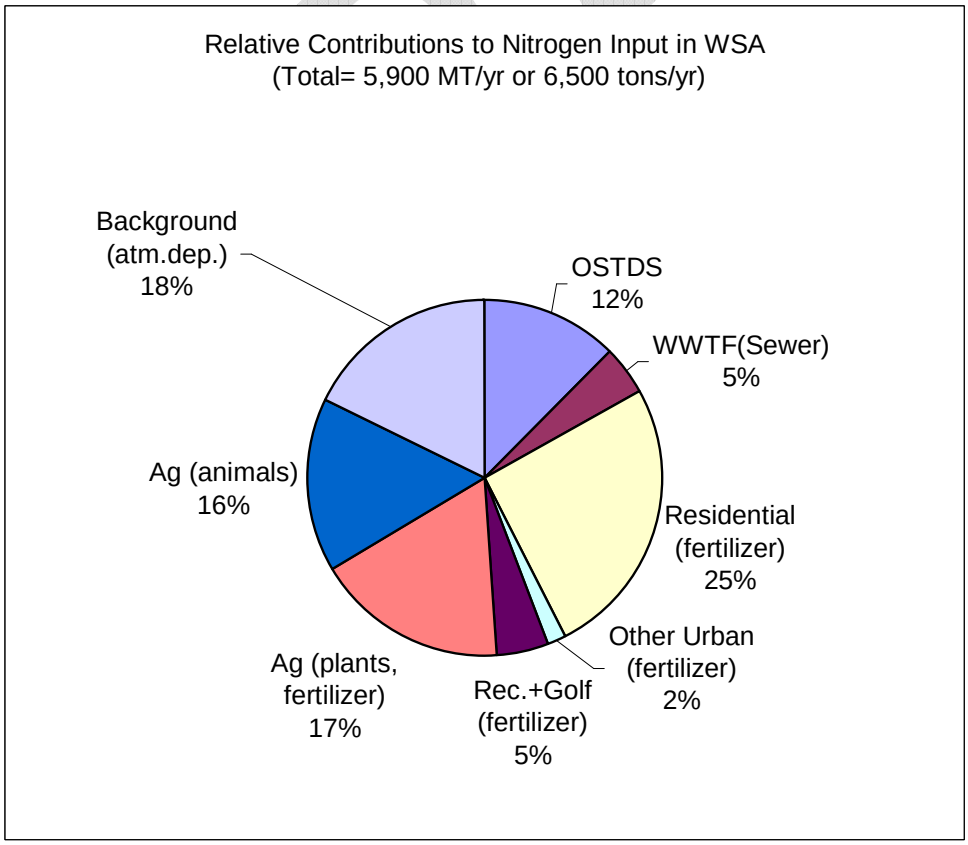


Figure 3-3. Relative contributions to nitrogen input by land use, wastewater and background.

4 Nitrogen Loading

As the MACTEC report (2007) outlined, three pathways are distinguished in this assessment of loadings. The loading mass rates are estimated as the product of flow and concentration. Stormwater runoff and recharge, or percolation of a part of rainfall to groundwater, are the two pathways that transport diffuse sources as a function of land use. For these diffuse loads, estimated concentrations, which vary by land use, and estimated flows, which vary by land use or location, were multiplied with each other. For more identifiable sources, in particular wastewater, the mass rate of loading was estimated as a fraction of the input, which was equivalent to calculating the discharge flow times a commonly observed reduction in concentration.

Anderson (2007), in commenting on the MACTEC-report suggested that "the relative contributions of each nitrogen source should be based on estimated inputs until such time that field data is available to more accurately calculate loadings from each source in a consistent fashion". The consistency concern related apparently chiefly to the estimation of flow rates as illustrated by his example in which local groundwater concentrations under a drainfield were multiplied by a diffuse recharge rate, thereby ignoring the available information on local wastewater flow out of a drainfield. A drawback of a loading contribution estimate based solely on input information is that it assumes that soil is equally effective in removing inputs from various sources and along various transport pathways. Such a simplifying assumption disregards much information regarding both concentration and flow.

The following presents a loading estimate based on current information. As additional information becomes available, such as results of additional inquiries in residential fertilizer fate and transport, this estimate can be updated. The loading estimate may also point towards areas where additional information can be most useful.

4.1 Water budget for the Wekiva Study Area

The first step in the loading assessment was an estimate of the water flows involved in transport of nitrogen. This was accomplished by an approximate water budget for the Wekiva Study Area. To allow comparisons between areas and account for the fact that the WSA has political and not hydrological boundaries, the amount of water was conveniently expressed as the annual depth of water on top of the area. CDM (2005) gave an average precipitation of approximately 50.3 in/yr. Average groundwater recharge values by land use were obtained by Dr. Young in the course of task 3 of the 2007 Wekiva Study from an overlay of land use and recharge values for the regional groundwater flow model of the St Johns River Water Management District. The area-weighted average recharge was 7.6 in/year. This value was consistent with results by Wanielista et al (2005), who estimated an average spring discharge of at least 7 in/yr in the 450 square miles of springshed.

Estimates for non-spring discharge by rainfall and stormwater runoff or possibly diffuse groundwater discharge were obtained by looking at the gaging station of the Wekiva River at SR 46, where the Wekiva River leaves the Wekiva Study Area, River Basin and MACTEC's area of analysis. Wanielista et al. (2005) estimated that at least 58% of the flow at this point stems from spring discharge. This left about 42% of the discharge that could be attributed to rainfall and stormwater runoff, which was 8.7 in/year. The value was very similar to 9.1 in/yr found by Wanielista et al. (2005) for part of the Little Wekiva River watershed within the Wekiva Study Area.

The Wekiva Study Area extends further west than the surface watershed of the Wekiva River, into an area where recharge is more important than runoff. Mattson et al. (2006) estimated the fraction of springs discharge in the Wekiva River flow higher. Both facts suggested that 8.7 in/year is an upper bound of surface water discharge that is not stemming from springs.

The remainder of the water, 50.3-7.6-8.7 = 34in/yr, was an estimate for the amount returned to the air as evapotranspiration. These values for spring discharge and evapotranspiration were similar to those obtained for water balances for springs on the west coast of Florida (Knochenmus and Yobbi, 2001). In that area no surface water discharge was present, and instead a similarly large diffuse groundwater flow provided outflow from the area.

Water supply was excluded from this gross water balance. For the purposes of this assessment the assumption was that human water use is supplied by water from the Wekiva Study Area and returned to the Wekiva Study area in a closed loop. Thus, this closed loop had on the scale of the Wekiva Study Area no net effect on the water balance and only the effect of flushing nitrogen into the groundwater.

For domestic use resulting in wastewater the amount of water could be quantified. The number of people living in the Wekiva Study Area (485,500 in 2000) multiplied by a daily per capita use of 68.6 gallons resulted in a yearly water use estimate of 12.2 billion gallons, or about 1.5in/year over the Wekiva Study Area.

Water use for agricultural irrigation was only estimated for tree crops (discussed below). The irrigation for this land use was estimated to recycle 0.7 in/year water over the entire Wekiva Study Area. If other land uses also experienced much irrigation the amount of water recycling through the Wekiva Study Area would become more important relative to the amount of water that flows simply from recharge areas to the springs and river. This effect was not assessed here in any more detail, but could be included in further studies.

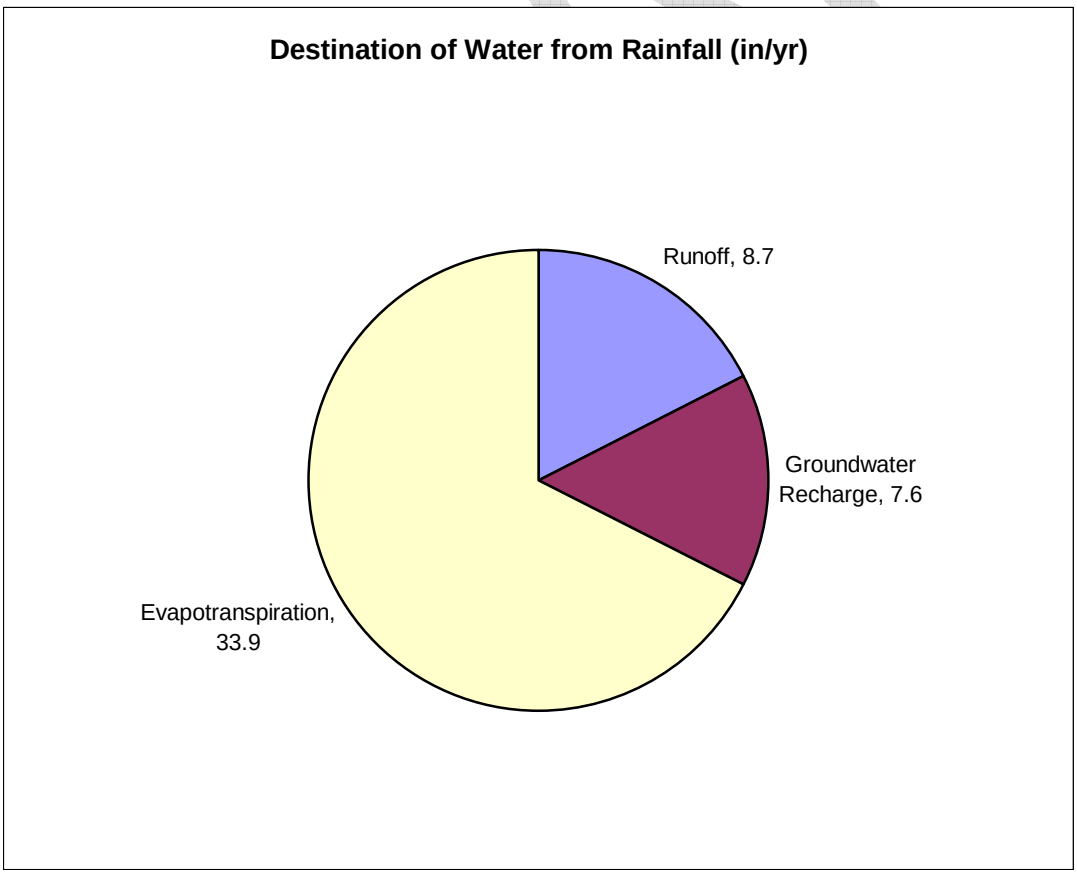


Figure 4-1. Water budget for the Wekiva Study Area based on the Wekiva River gaging station at SR46. For comparison, wastewater generation amounted to approximately 1.5 in/year and was assumed to not cause a net change in the water balance.

4.2 Load to Groundwater

4.2.1 Load from OSTDS

The average removal observed at the three sites of the field work was 40%, leading to a load estimate per system of 17.4 lbs N/year. The field work performed during the Department's Wekiva Study in 3007 included two systems in Tavares soil with low water table and passage through clay zones. For these the estimated removal was between 25% and 50%. This was higher than the 10% estimated by Otis (2007) in a separate task of the study, possibly due to the presence of clay. In the third site, in Myakka soil, the estimated removal was a third, this was lower than the 50% for discharge as TKN or >90% for discharge in nitrate form estimated by Otis (2007).

The average estimated removal fraction based on field work was noticeably higher than estimated in a draft report for task 3 of the Wekiva Study as the weighted average of soil denitrification potential. As Otis (2007) pointed out, nitrogen removal can be very site specific and depends on several factors. The 40% removal estimate is within the range of 10-50% given in Anderson and Otis (2000), but higher than the 30% removal estimated in the MACTEC (2007) report. In this report, 40% removal was assumed, which resulted in 438 MT/year or 482 tons/year.

Drainfields that don't maintain the modern requirements for separation from the water table are likely to experience less nitrogen removal. A coarse estimate based on soil types and system ages suggested that between 5 and 10% of systems may be in such a situation, which would increase the load from OSTDS by about 3%.

4.2.2 Load from wastewater treatment facilities

Loading from wastewater treatment facilities to groundwater varies by discharge mechanism. For groundwater discharge via rapid infiltration systems and similar technologies, 40% removal was assumed. This removal fraction was within the range given by EPA for rapid infiltration systems (EPA, 2003, 2006), and the same removal effectiveness as assumed for OSTDS (40%). It was only somewhat lower than the 50% suggested by FDEP's former reuse coordinator David York in his comments included in MACTEC report. For reuse applications, a similar removal fraction as given by EPA (2002) for slow rate land treatment was assumed (70%). This resulted in a groundwater load of 93 MT/yr or 102 tons/yr of nitrogen from wastewater treatment facilities. This load did not include exfiltration from wastewater transport networks.

4.2.3 Load from diffuse sources

The mass loading rate brought about by water recharging the ground water was determined by estimation of flow and concentration. Concentrations were adjusted for background concentrations to capture the increase in loading due to land uses.

The estimation method considered that the input is applied over large areas with little or no water, and subsequently only the percolating fraction of water facilitates transport. This is the case for transport of fertilizer input and livestock input and atmospheric deposition towards groundwater. To account for such more diffuse sources, MACTEC suggested the approach to utilize shallow groundwater concentrations, as an indicator of the nitrogen that as arrived in the water and multiply them with the recharge rate, which represent the flow of water that has this

apparent concentrations. The variation in the amount of water available to transport nitrogen to the groundwater means that the mass loading was spatially variable.

The shallow groundwater concentrations in the MACTEC report were applied here, with three exceptions:

First, background concentrations were assumed to be 0.2 mg/L total nitrogen, rather than 0.1 mg/L nitrate-nitrogen. This value was consistent with the concentrations observed in the unimpacted Alexander and Juniper Springs (Wetland Solutions, Inc, 2004; Mattson et al., 2006), and observations in wells in forests that appear unimpacted by fertilization and human disturbances (Phelps, 2004, Toth and Fortich, 2002). Generally, such samples have a high fraction of TKN and a low fraction of nitrate.

Second, for low density residential land uses field work during the 2007 Wekiva Study indicated that total nitrogen concentration under low density residential land uses are usually lower than 3 mg/L given by MACTEC (2007). That value was based on lysimeter studies. During the 2007 field work, background samples in shallow ground water unimpacted by drainfields averaged between 0.5 and 2 mg/L at the three sites. The mid-range of 1.3 mg/L or slightly less than half the previous estimate was the number used in the following for residential and urban land uses. This concentration was applied to all fertilized land uses that previously were assigned a 3 mg/L concentration in recharge water. This number is similar to nitrate-nitrogen well concentrations observed in shallow wells under residential land uses in the Silver Springs Basin by Phelps (2004). Nitrate-nitrogen dominated nitrogen species in that study.

Third, for tree crops among the agricultural land uses, data became available from a BMP verification study (Citrus Research and Education Center, 2007). The total nitrogen concentrations in shallow groundwater varied around 10 mg/L, somewhat lower than the 15 mg/L given by MACTEC (2007). The yearly fertilizer input for the years 2004-2006 for the 8 sites for which the yearly sums are given averaged around the 227 kg/ha yr given in the MACTEC report. The water balances for these 8 sites showed average yearly evapotranspiration of 43.8 in, rainfall of 47.2 in, irrigation of 41.8 in, and drainage to the water table of 45.8 in. Irrigation resulted in a recharge rate of 46 in/yr instead of 11 in/yr estimated from the groundwater recharge model. The resulting estimate for groundwater loading was 112 kg/ha yr, or half of the fertilizer input. These monitoring data pointed to the importance of irrigation for the mobilization of nutrient, which the MACTEC (2007) discussed in the context of turf grass. The estimated nitrogen transfer to groundwater was larger by a factor of two than what was observed in lysimeters during leaching events over the same time frame. These lysimeters measured an average load of 42 kg/ha yr, or only 20% of the input. For consistency, the product of recharge rate and shallow groundwater concentration was used in the following.

The question arose if the areas of land uses should be adjusted to account for impervious surfaces and non-fertilized areas. This adjustment appeared unnecessary for the following reason: the recharge rates are obtained by a regional groundwater model that does not distinguish between pervious and impervious surfaces for the recharge rate and therefore the average recharge rate accounts for variations in the local recharge between pervious and impervious surfaces. The non-fertilized areas accounted for the yearly nitrogen fertilizer application rates, while the shallow groundwater concentrations were not finely resolved enough to distinguish between fertilized and not-fertilized areas. Fertilized areas were only considered in the agricultural tree crops land use, for which the recharge rate was not determined from the groundwater flow model but from measurements within the citrus grove. Therefore the load from this land use was estimated by multiplying the groundwater concentration times the recharge due to irrigation times the effective fertilized area fraction of 0.72.

The results indicated that 580 MT/yr or 640 tons/year of nitrogen enters the groundwater as part of the diffuse recharge to ground water. Agriculture is the largest source, in turn dominated by tree crops. Tree crops, as a result of the consideration of irrigation, contributed about half of the agricultural nitrogen on a sixth of the agricultural area. The difference between the estimate using the assumptions of the MACTEC (2007) report and the BMP-based estimate was about 100 MT/yr for the agricultural tree crop land use. If other crops or urban turf are irrigated to a similar extent, the estimate of 580 MT/yr would need to be increased.

A comparison of inputs and loads provided an estimate of the apparent nitrogen losses occurring between the surface and the shallow groundwater. Background groundwater concentrations indicated about 95% removal relative to atmospheric deposition. Other land uses saw on average about a 90% apparent loss. The heavily irrigated tree crops show a 50% reduction of fertilizer input, similar to the estimated removals for onsite systems and rapid infiltration wastewater disposal facilities.

4.2.4 Total load to groundwater

The approximate overall nitrogen load to groundwater was estimated as 1,100 MT/yr or 1200 tons/yr nitrogen by adding onsite systems and land applications of wastewater to the diffuse loads discussed in the previous section. This groundwater load was effective on water that can eventually discharge from springs. Table 5 shows the contribution of groundwater loadings by sources.

The average concentration, determined by dividing the load of 1,100 MT/yr by 7.6 in/yr recharge over 305,000 acres of area was 4 mg/L. This was by a factor of about two higher than the total nitrogen concentrations estimated for Wekiva (2.1 mg/L) and Rock Springs (1.6 mg/L) from the sum of nitrate and organic nitrogen (Wetland Solutions, Inc., 2004 table 2-7). The loading assumptions appear unlikely be in error by this factor of two. A plausible explanation is that some nitrogen removal occurs during transport from shallow groundwater to the springs. The extent of this removal is likely to depend on aquifer vulnerability and travel time between shallow groundwater and springs. If these factors are correlated with land use, relative contributions could shift, for example, the more common occurrence of OSTDS in more vulnerable areas could increase their contributions to loads relative to background contributions from less vulnerable areas. Such shifts are expected to be very limited. A future more detailed study, such as a ground water quality model that incorporates conduit flow could quantify the impact of such attenuation factors.

Table 5. Estimated nitrogen loads to groundwater by source

Loading Ground Water	Load (MT/yr	Load (tons/yr)
OSTDS	438	482
WWTF(Sewer)	93	102
Residential	88	97
Other Urban	22	24
Rec.+Golf Courses	28	31
Ag (plants)	267	294
Ag (animals)	130	143
Background	47	52
Sum	1,113	1,226

4.2.5 Relative contributions to nitrogen loading to groundwater

Figure 4-2 presents the estimated relative contributions of nitrogen loading to groundwater. Among the sources of nitrogen considered, OSTDS is prominent with about 40%. Its share of wastewater loads has increased relative to inputs because of the higher nitrogen removal rate of slow rate applications and the diversion to surface discharge of some treated wastewater. OSTDS contribution relative to fertilizer has increased because fertilizer loads are more reduced relative to inputs, except in heavily irrigated situations. Still, fertilizer contributions to the load overall are similar to OSTDS. Background load contributions have much decreased relative to inputs, reflecting the low concentrations found in unimpacted springs.

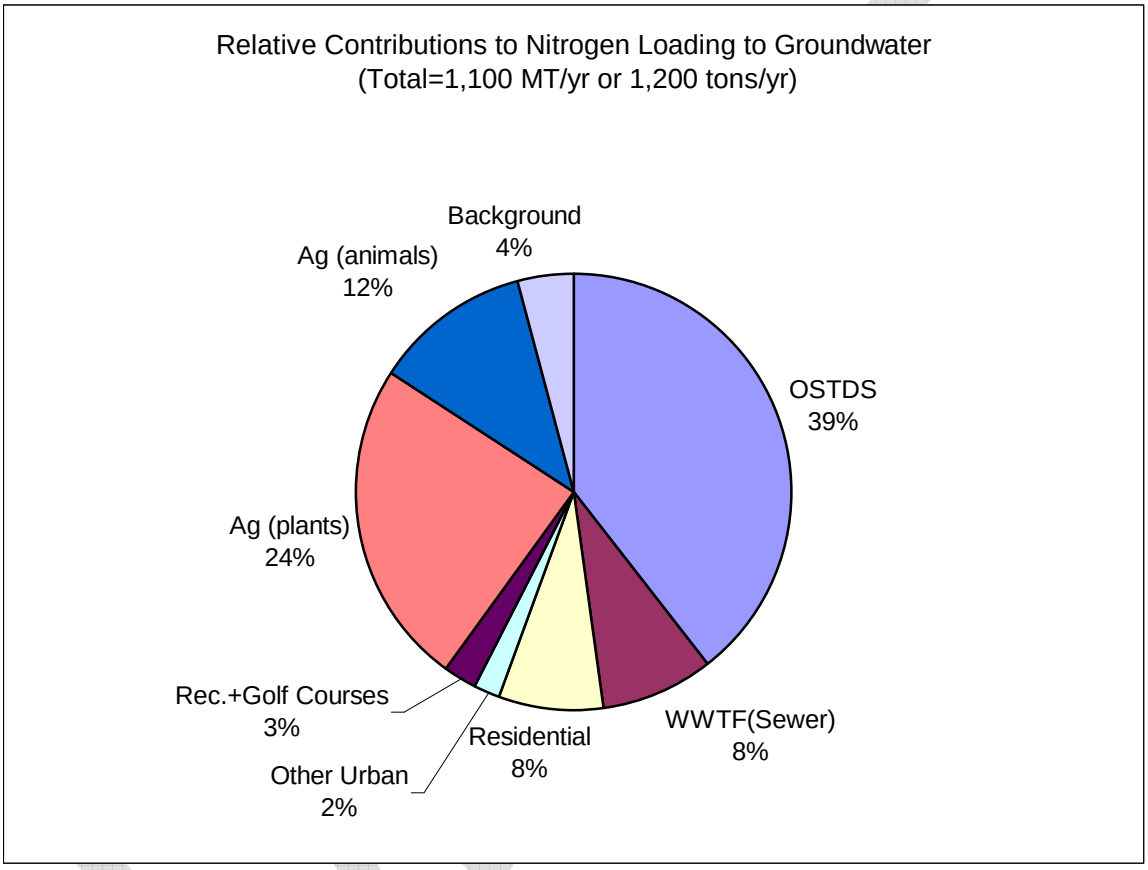


Figure 4-2. Relative contributions to nitrogen loading to groundwater.

4.3 Non-spring surface water discharge loading

The second transport mechanism of nitrogen from the land surface to water is storm water or runoff as surface water. The MACTEC report utilized event mean concentrations only for nitrate-nitrogen, not for total nitrogen, and did not provide loading rates for all land uses. Therefore, this estimate utilized values for event mean concentrations and directly connected impervious area fractions provided in the Wekiva Stormwater Model (CDM, 2005).

4.3.1 Rainfall-runoff coefficients

The coefficients suggested by CDM (2005) for predicting runoff assume that 20% of rainfall runs off as surface runoff even for pervious surfaces. This is higher than the conceptual model presented by Wanielista et al. (2005), and the assessment by Gao (2007) for the Wekiva River. Such an estimate would result in an average runoff of 19 in/year, which is more than twice than

what the water balance for the Wekiva River indicates as an upper limit for surface water discharge and what gaging stations in the area suggests for river flow as analyzed by Wanielista et al. (2005).

Various runoff coefficients could be chosen to meet the constraint that the overall runoff estimate can not exceed 9 in/yr in accordance with the water balance. A secondary constraint used here was that the pervious runoff coefficient should be at least five times smaller than the impervious runoff coefficient to agree with the relative importance assigned to the two by CDM (2005). Loading estimates overall were not very sensitive to changes in the parameters, given that the total runoff was fixed and event mean concentrations vary only within a factor of two except for agricultural feeding operations. A runoff coefficient of 0.06 for pervious surfaces results in a runoff of about 3.3 in/year. This value is close to those obtained for USGS gaging stations in high recharge areas in the Clermont area and thus appeared consistent for runoff from areas with much groundwater recharge and little impervious area (Wanielista et al., 2005). To meet the overall runoff limit, a 0.54 runoff coefficient for impervious surfaces was chosen.

4.3.2 Nitrogen concentrations

Event mean concentrations for total nitrogen by land use were also taken from the CDM (2005) report. Some information were available on treatment effectiveness with regard to downstream water bodies (CDM, 2005; Harper, 2007). Relatively little information was available on the treatment effectiveness with regard to groundwater recharge from retention facilities. On the scale of the Wekiva Study Area no explicit treatment effectiveness by stormwater management measures was considered in this report. Some effectiveness is implied by the lower runoff coefficient for impervious surfaces used here (0.54), which is about a third lower than proposed by CDM (2005).

Surface water contamination by onsite systems was not considered separately, but assumed to be addressed by the event mean concentrations for residential land uses. Stormwater loading models such as the one used here provide options to increase loads due to large numbers of systems that fail and discharge to the land surface instead of to ground water. Generally, this contribution is minor (Rouge River National Wet Weather Demonstration Project, 1998). Gao (2007) provides an estimate of 206 for the number of onsite system that are located within 200 m of river segments in the Wekiva River Basin. Yearly repair rates for the three counties having part of the Wekiva Study Area are on the order of 1.5% to 2% (Roeder, 2007). Both numbers suggest that a surface water contribution rate of 10% of onsite systems as suggested by Rouge River National Wet Weather Demonstration Project (1998) is much too high for consistent discharge to surface water in the whole Wekiva Study Area. Furthermore, the 10% estimate is based in part on the number of systems for which the drainfield is below the ground water table, which for the purposes of this report should be part of groundwater loading. There may be localized areas of higher failure rates or higher numbers of systems that don't meet modern construction standards where higher contribution rates could be justified in a more detailed assessment.

4.3.3 Rainfall-runoff or stormwater loading, including background load

Loads were estimated as the product of runoff, area and event mean concentration. Background contributions were estimated as those stemming from undeveloped land (DCIA fraction =0.005) with the event mean concentration for undeveloped land. The loading contribution from each land use was determined as the difference between background load and the load estimated for that land use with updated DCIA and event mean concentration. The fraction of load stemming from background concentrations varied between half for an impervious to pervious runoff coefficient ratio of four to somewhat more than a third for a ratio of 15. An intermediate estimate with a 0.06 runoff coefficient for pervious surfaces and a 0.54

runoff coefficient for impervious surfaces resulted in an estimate of 520 MT/yr or 570 tons/yr, of which background contributions were 42%.

4.3.4 Total surface water discharge load

To obtain the overall estimated surface water loading, surface water discharges by wastewater treatment facilities had to be added. These consisted of 29 MT/yr or 32 tons/yr. No additional in-stream reduction was considered. Although Gao (2007) and Wetland Solutions, Inc (2005) provided evidence that removal of nitrogen, in particular nitrate, occurs within the water body, the objective of this report was to provide a loading estimate to surface water rather than a river water quality model.

Table 7 provides the estimated nitrogen loading contributions from different land uses and wastewater. The overall load estimate was 550 MT/yr or 600 tons/yr. Division of this load by the 8.7 in/yr estimated runoff resulted in an average concentration of 2 mg/L. This appeared to be within a factor of two compared to the measured concentrations around 1 mg/L in the Wekiva River and Little Wekiva River (Wetland Solutions, Inc., 2004). Mattson et al., (2006) provide TN concentrations of 1.25 at the Wekiva River at SR 46 and 1.68 mg/L in the Rock Spring Run. They also discuss an apparent reduction in nitrogen concentrations with distance downstream from the springs. In addition to in-stream removal processes, such a reduction could be caused by dilution of more contaminated spring water with cleaner wetland and lake surface water discharge.

Figure 4-3 illustrates the nitrogen loading to surface water due to rainfall runoff or stormwater, and direct sewer discharge. Residential land uses represented a third of the stormwater nitrogen load, and a sixth of the stormwater nitrogen load came from the “other urban” category. Overall, about half of estimated surface water loading was associated with residential and urban land uses. Even without an increase in impervious surfaces and event mean concentrations due to urbanization, about 40% of the load would remain. More than half of this background load was provided by the flow out of wetlands and lakes. Agriculture, recreation and golf contributed only minor amounts to the estimated stormwater load, because very little runoff is attributed to them. About half of the estimated agricultural surface water load was from animal feeding operations.

Table 6. Estimated nitrogen loads to surface water other than springs discharge

Loading Surface Water Discharge	MT/yr	Tons/yr
OSTDS	0	0
WWTF(Sewer)	29	32
Residential	192	212
Other Urban	87	96
Rec.+Golf	4	5
Ag (plants)	5	6
Ag (animals)	14	15
Background	217	239
Sum	549	604

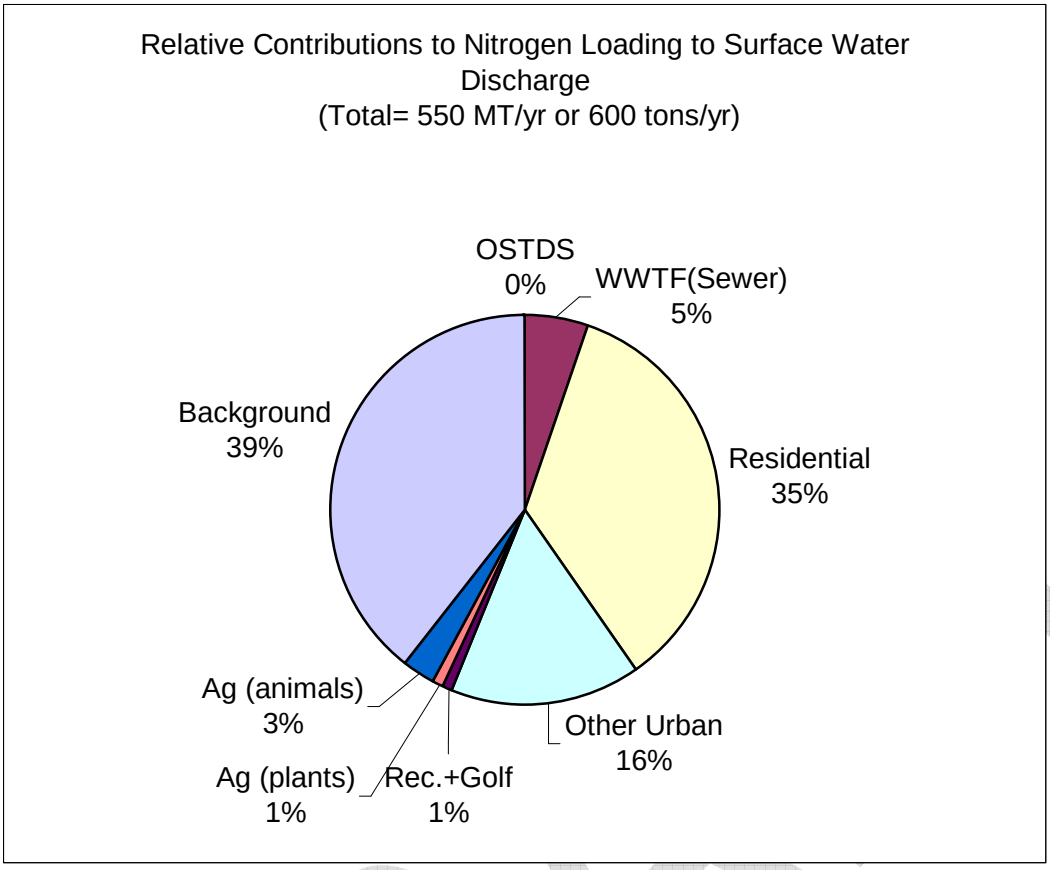


Figure 4-3. Distribution of total nitrogen loading to surface water discharge.

4.4 Total Load to Waters in the Wekiva Study Area

Addition of the loadings via different pathways and from different sources and land uses resulted in a loading estimate to waters of the Wekiva Study Area shown in table 9 and figure 4-4. This aggregation is most appropriate for nitrogen loads to the Wekiva River at SR46, where both surface and ground water contribute to the nitrogen load. By averaging surface water and groundwater loading contributions, which had very different patterns, the aggregated pie chart provides fewer insights into transport mechanisms and possible management approaches. Overall, these two estimates indicated that about 70% of the nitrogen input to the Wekiva Study Area is not transferred to water but removed before entering groundwater or a river.

OSTDS were a prominent contributor with 26% of the estimated load, all of which as load to ground water. OSTDS increased contribution to load relative to centralized wastewater treatment facilities was due to the higher removal effectiveness assumed for reuse slow-rate applications. OSTDS contributions are expected to increase with continued population growth unless this source is addressed.

Agricultural land uses together provided a contribution of 25% of the total nitrogen load, most of that as ground water load. This contribution is expected to decrease over time as agriculture is replaced by residential and urban land uses.

Table 7. Estimate nitrogen total load to waters of the Wekiva Study Area

Loading to Water	Load (MT/yr)	Load (tons/yr)
OSTDS	438	482
WWTF(Sewer)	122	134
Residential (fertilizer)	281	309
Other Urban (fertilizer)	109	120
Rec.+Golf Courses	32	35
Ag (plants)	272	305
Ag (animals)	144	159
Background	265	291
Sum	1,662	1,835

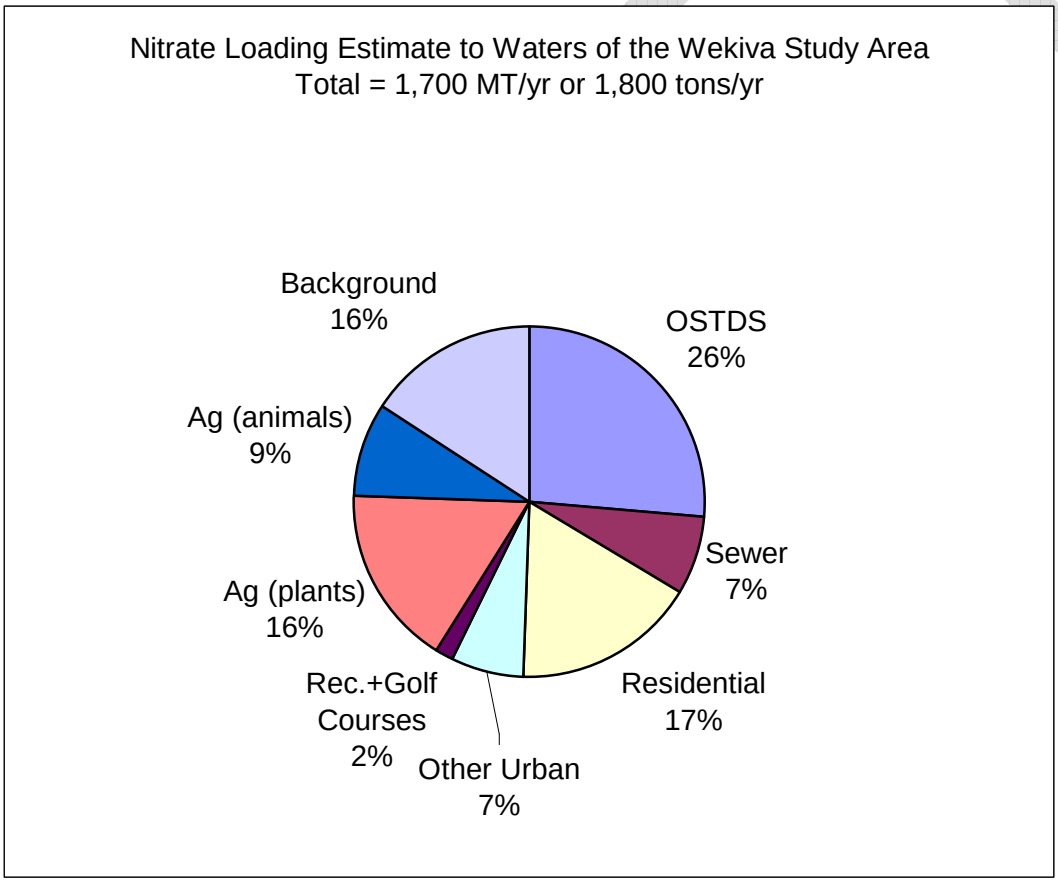


Figure 4-4. Estimated contributions to total nitrogen loading in the Wekiva Study Area

Residential and urban land uses together contributed a similar 24%. About three quarters of this contribution occurred in the form of stormwater. Non-farm fertilizer use was the largest input for these land uses. This contribution is expected to increase with new development and the increased fraction of non-farm fertilizer sold.

Background contributions were estimated at 16%. This contribution was determined by runoff from a hypothetically undeveloped Wekiva Study Area and recharge as if shallow groundwater

concentrations were unimpacted. This contribution is unlikely to change unless increased atmospheric deposition eventually affects it.

Sewer contributions were estimated at 7%. They are expected to decrease in the short term as the Wekiva-specific rules promulgated by FDEP come into effect. In the long run, increases in population may lead again to an increase.

4.5 Equitable and Cost-Effective Solutions

In order to achieve the nitrogen pollution reductions goals for the springs and river (35% to 85%), all controllable sources must be reduced to a large extent. One way to approximate an equitable distribution of reductions would be to ensure that the costs paid per pound of nitrogen removed or the fees paid per pound of nitrogen discharged are similar across sources. This was the motivation for the proposal of a nitrogen discharge fee in the Department's 2007 Wekiva Study report. Such a fee could fund cost effective nitrogen reduction measures in the Wekiva Study Area.

In the absence of such a fee, a comparison of past measures between sources provides suggestions of where additional contributions to nitrogen reduction could come from. Among the sources discussed, centralized wastewater treatment facilities have achieved the most quantifiable reductions in nitrogen inputs and loads. In response to concerns in the Wekiva Study Area, FDEP has adopted new rules that will require further upgrades in treatment. Data in FDEP's 2004 report suggest that the cost is at least $5 per pound of nitrogen removed for an upgrade of existing wastewater treatment facilities. Nitrogen reduction by providing sewer for additional people appears to be one to two orders of magnitudes more expensive.

The effectiveness of fertilizer best management practices is more difficult to assess without in-depth study. The decrease in farm uses of nitrogen is at least partly due to the replacement of farms by residences and other development, without a net reduction in fertilizer sales over the last ten years. A new residential turf rule that will be implemented in 2008 and 2009 aims to change lawn fertilizer compositions and application rates and is expected to result in reductions of primarily phosphorus but also nitrogen inputs by perhaps a quarter.

Onsite sewage treatment and disposal systems in the Wekiva Study Area have so far not contributed to nitrogen reduction practices. The costs of changing design and construction standards appear to be roughly similar to the costs for centralized wastewater treatment facilities. The Department has proposed modifications to onsite sewage rules in the Wekiva Study Area to reduce the nitrogen load of existing and system and decrease the growth in onsite nitrogen loading due to a growing population.

5 References

Anderson, D.L., 2006. A review of nitrogen loading and treatment performance recommendations for onsite wastewater treatment systems (OWTS) in the Wekiva Study Area. http://www.doh.state.fl.us/ENVIRONMENT/ostds/wekiva/damannandersonreview.pdf accessed 12/20/2007

Anderson D.,L., 2007. Review of Phase 1 Wekiva Basin Nitrate Sourcing Study. Memorandum May 23, 2007. http://www.doh.state.fl.us/environment/ostds/wekiva/AndersonMACTEC.pdf accessed 12/20/2007

Anderson, D.L. and Otis, R.J. 2000. Integrated Wastewater Management in Growing Urban Environments. In: American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Agronomy Monograph No. 39.

Briggs, G.R., Roeder, E., Ursin, E. 2007. Nitrogen Impact of Onsite Sewage Treatment and Disposal Systems in the Wekiva Study Area. June 30, 2007. Tallahassee, FL: Florida Department of Health. http://www.doh.state.fl.us/environment/ostds/wekiva/TaskFinal/2006WekivaFinal.pdf accessed 12/21/2007

CDM, 2005. Appendix E of Wekiva Parkway and Protection Act Master Stormwater Plan Support, Final Report, completed by CDM, 2005. found in MACTEC, 2007 at http://www.dep.state.fl.us/water/wekiva/docs/phase-i-final-report.pdf accessed 12/20/07

Citrus Research and Education Center, 2007. Ridge Citrus Nitrate BMP Verification. http://128.227.177.113/bmp/ accessed 12/10/07

Dixon, L.K., 1994: Literature compilation and data synthesis for atmospheric deposition to the Tampa Bay water shed. Tampa Bay National Estuary Program. Mote Marine Laboratory Technical Report No. 370 46 pp. +app.

Ellis&Associates, 2007. Multiple nitrogen loading assessments from onsite wastewater treatment and disposal systems within the Wekiva River Basin; Wekiva Study Area, Florida. May 2007. http://www.doh.state.fl.us/environment/ostds/wekiva/TaskFinal/AppendixA.zip. Accessed 12/21/2007

EPA, 2002. Wastewater technology fact sheet: Slow rate land treatment www.epa.gov/owm/mtb/sloratre.pdf

EPA, 2003. Wastewater technology fact sheet: Rapid infiltration land treatment www.epa.gov/owm/mtb/final_rapidinfiltration.pdf)

EPA, 2006. Process Design Manual: Land Treatment of Municipal Wastewater Effluents http://www.epa.gov/nrmrl/pubs/625r06016/625r06016whole.pdf accessed 12/20/2007

FDEP (Florida Department of Environmental Protection), 2004. A strategy for water quality protection: Wastewater treatment in the Wekiva Study Area. December 2004. http://www.dep.state.fl.us/central/Home/Admin/WekivaReportDecember2004.pdf accessed 12/21/2007

FDEP, undated. Florida erosion and sediment control inspector's manual: Chapter 3: estimating stormwater runoff. www.dep.state.fl.us/water/nonpoint/docs/erosion/chapter3.pdf accessed 12/06/07

Gao, Xueqing. 2007. TMDL Report: Nutrient TMDLs for the Wekiva River (WBIDs 2956, 2956A, and 2956C) and Rock Springs Run (WBID 2967). November 15, 2007. Tallahassee, FL: FDEP.

Heyl, Michael G., 1992. Point- and nonpoint-source pollutant-loading assessment of Sarasota Bay. In: Sarasota Bay National Estuary Program: Framework for Action. Sarasota, FL: Sarasota Bay National Estuary Program p. 12.1-12.19 www.sarasotabay.org/pdf/SBNEP_Framework_for_Action.pdf. Accessed 12/06/07

Hodges, A.W. , Haydu, J.J., van Blokland, P.J. and Bell, A.P., 1994. Contribution of the turfgrass industry to Florida's economy, 1991-92: A value-added approach. Institute of Food and Agricultural Sciences, Food & Resource Economics Department, Economics Report 94-1, December 1994 http://www.economicimpact.ifas.ufl.edu/publications/Er94-1.pdf

Jones, G.W., Upchurch, S.B., and Champion, K.M., 1996. Origin of nitrate in ground water discharged from Rainbow Springs, Marion County, FL. Southwest Florida Water Management District publication, 155p. cited by Phelps (2004)

Knochenmus, Lari A. and Dann K. Yobbi 2001 Hydrology of the Coastal Springs Ground-Water Basin and Adjacent Parts of Pasco, Hernando, and Citrus Counties, Florida. Water-Resources Investigations Report 01-4230 Tallahassee, FL: USGS http://fl.water.usgs.gov/PDF_files/wri01_4230_knochenmus.pdf

Lee, Joong. G., and Heaney, James P. 2002. Directly connected impervious areas as major sources of urban stormwater quality problems-evidence from South Florida. In: Proceedings of the seventh biennial stormwater research&watershed management conference. 45-54 stormwaterauthority.org/assets/182MDCIA.pdf

MACTEC, 2007. Phase I Report Wekiva River Basin Nitrate Sourcing Study. March 2007 Newberry, FL: MACTEC http://www.dep.state.fl.us/water/wekiva/docs/phase-i-final-report.pdf

Mattson, R.A., Lowe, Edgar F., Lippincott, Carol L. , Di, Jian, and Battoe, Larry. 2006. Wekiva River and Rock Springs Run Pollutant Load Reduction Goals. Palatka, FL: St. Johns River Water Management District

McGurk, Brian and Paula Fischl Presley (2002) Simulation of the Effect of Groundwater Withdrawals on the Floridan Aquifer System in East-Central Florida: a Model Expansion and Revision. Technical Publication SJ2002-03. Palatka, Florida: St. John's River Water Management District

Morrow, Victoria, Young, Jill and Roberts, Charles. July 2001. Mapping Tree Canopy in Broward County, Florida http://gis.esri.com/library/userconf/proc01/professional/papers/pap273/p273.htm accessed 12/08/07

Nickerson, David M., and Madsen, Brooks C. 2005. Nonlinear regression and ARIMA models for precipitation chemistry in East Central Florida from 1978 to 1997. Environmental Pollution 135: 371–379

Otis, R.J.. 2007. Estimates of nitrogen loadings to groundwater from onsite wastewater systems in the Wekiva Study Area: Task 2 Report, June 2007. Prepared for Florida Department of Health. Tallahassee, FL: Florida Department of Health. http://www.doh.state.fl.us/environment/ostds/wekiva/TaskFinal/AppendixB.pdf

Phelps, G.G., 2004. Chemistry of Ground Water in the Silver Springs Basin, Florida, with an emphasis on Nitrate. USGS Scientific Investigation Report 2004-5144, 54 pp.

Roeder, E., 2007. A Range of Cost-Effective Strategies for Reducing Nitrogen Contributions from Onsite Sewage Treatment and Disposal Systems; Task 4 of the 2006/2007 Wekiva Study by the Florida Department of Health. June 27, 2007. http://www.doh.state.fl.us/environment/ostds/wekiva/TaskFinal/AppendixD.pdf

Rouge River National Wet Weather Demonstration Project (1998). User's Manual: Watershed Management Model Version 4.1. Technical Memorandum RPO-NPS-TM27.02 November 1998. Wayne County, MI. http://www.rougeriver.com/proddata/wmmmanul.pdf accessed 12/21/2007

Toth, D.G. and Fortich, C., 2002. Nitrate concentrations in the Wekiva Ground Water Basin with emphasis on Wekiva Springs. Technical Publication SJ2002-2. Palatka, FL: SJRWMD, 84 pp.

U.S. Census Bureau (2007). State & County QuickFacts.

http://quickfacts.census.gov/qfd/states/12000.html accessed 12/13/07

Vinlove, F.K. and Torla, R.F., 1995. Comparative estimations of U.S. home lawn area. Journal of Turfgrass Management 1(1), 83-97. cited in http://www.backyardnature.com/cgi-bin/gt/tpl.h,content=381 accessed 12/11/07

Wanielista, Martin, Ewoud Hulstein, Yuan Li, Gour-Tsyh Yeh. "Wekiva Area Water Budget." University of Central Florida in association with Florida Department of Transportation, Contract # BD521/RPWO #1. June, 2005 http://www.stormwater.ucf.edu/FILES/Rev-FINALWekivaAreaHydrologicBalance05_20.pdf accessed 12/10/07

Wetland Solutions, Inc., 2004. Work Plan: Pollutant Load Reduction Goal (PLRG) Analysis for the Wekiva River and Rock Springs Run, Florida. Prepared for St. Johns River Water Management District, September 2004. Appendix B in Mattson et al. 2006.

Wetland Solutions, Inc. 2005. Final Report: Pollutant Load Reduction Goal (PLRG) Analysis for the Wekiva River and Rock Springs Run, Florida.. Prepared for St. Johns River Water Management District, October 2005. Appendix C in Mattson et al., 2006.

Young, L.J. 2007. Final Report: Task 3: Assess Contributions of Onsite Wastewater Treatment Systems Relative to Other Sources; Wekiva Onsite Nitrogen Contribution Study June 4, 2007. http://www.doh.state.fl.us/environment/ostds/wekiva/TaskFinal/AppendixC.pdf

6 Appendix 1

Summary of Inputs by Land Use/Land Cover

Land Use/Land Cover		Area		Input atm dep.	impervious fraction			net fertil.d fraction	Fertilizer rate	Input fertilizer	Animal waste rate	Input animal waste	Input w/o atm. dep.	Input Total
LU code	Decription	(acre)	(ha)	(kg/yr)	MACTEC, (2007) (-)	DCIA CDM, (2005) (-)	this report (-)	(-)	(kg/ha year)	(kg/yr)	(kg/ha year)	(kg/yr)	(kg/yr)	(kg/yr)
1100	Low density Residential	22,645	9,168	77,928	0.147	0.3	0.4	0.42	148	569,884	0	0	569,884	647,812
1200	Medium density Residential	44,361	17,960	152,660	0.278	0.37	0.55	0.315	148	837,294	0	0	837,294	989,954
1300	High density Residential	7,792	3,155	26,815	0.67	0.71	0.7	0.21	148	98,050	0	0	98,050	124,865
1400+ 1480	Commercial and airports	8,470	3,429	29,149	0.9425	0.85	0.94	0.042	200	28,806		0	28,806	57,954
1500	Industrial	2,714	1,099	9,340		0.85	0.85	0.105	0	0	0	0	0	9,340
1600	Extractive	634	257	2,183		0.85	0.85	0.105	0	0	0	0	0	2,183
1700	Institutional	3,311	1,341	11,396	0.91	0.65	0.91	0.063	200	16,892		0	16,892	28,288
8100	Transportation	3,492	1,414	12,017	0.85	0.01	0.85	0.105	200	29,688	0	0	29,688	41,705
8300	Utilities	2,327	942	8,007	0.85	0.85	0.85	0.105	200	19,783	0	0	19,783	27,790
1800	Recreational, Marinas and fish camps, swimming beaches	1,839	744	6,327	0.015	0.005	0.02	0.686	200	102,123		0	102,123	108,450
1820	Golf Courses	3,174	1,285	10,923	0	0.17	0.17	0.83	175	186,652	0	0	186,652	197,574
2100	Agriculture-Field Crops	59	24	204	0	0.01	0.15	0.7225	150	2,602	0	0	2,602	2,806
2140	Agriculture-Row Crops	693	280	2,384	0	0.01	0.15	0.7225	630	127,641	0	0	127,641	130,024
2150	Agriculture-Field Crops	2,569	1,040	8,839	0	0.01	0.15	0.7225	150	112,703		0	112,703	121,543
2200	Agriculture-Tree Crops	6,016	2,436	20,703	0	0.01	0.15	0.7225	227	399,470	0	0	399,470	420,174
2400	Agriculture-Nurseries	129	52	443	0	0.01	0.15	0.7225	227	8,554		0	8,554	8,998

2410	Agriculture-Tree Nurseries	83	34	285	0	0.01	0.15	0.7225	227	5,505		0	5,505	5,790
2420	Agriculture-Soc Farms	120	49	414	0	0.01	0.15	0.7225	200	7,039	0	0	7,039	7,453
2430	Agriculture-Ornamentals	5,353	2,167	18,422	0	0.01	0.15	0.7225	227	355,449	0	0	355,449	373,871
2450	Agriculture-Floriculture	21	9	72	0	0.01	0.15	0.7225	200	1,231	0	0	1,231	1,304
2500	Agriculture-Specialty Farms	87	35	298		0.01	0.15	0.7225	200	5,066		0	5,066	5,364
2110	Agriculture-Improved Pasture	13,268	5,372	45,658	0	0.01	0.15	0.7225	63	244,499	41	220,233	464,732	510,390
2120	Agriculture-Unimproved Pasture	4,226	1,711	14,541		0.01	0.15	0.7225	0	0	41	70,141	70,141	84,682
2130	Agriculture-Woodland pasture	3,280	1,328	11,287	0	0.01	0.15	0.7225	0	0	41	54,441	54,441	65,728
2300	Agriculture-Feeding Operations	162	66	558		0.01	0.15	0.7225	0	0	4,150	272,287	272,287	272,845
2510	Agriculture-Horse Farms	2,151	871	7,403	0	0.01	0.15	0.7225	63	39,641	41	35,707	75,347	82,750
2540	Agriculture-Aquaculture	15	6	52		0.01	0.15	0.7225	0	0	0	0	0	52
1900	open land	2,841	1,150	9,778		0.005	0.15	0.7225	0	0	0	0	0	9,778
2600	Other open lands rural	266	108	914		0.005	0	1	0	0	0	0	0	914
3000	Upland nonforested	17,096	6,921	58,831		0.005	0	1	0	0	0	0	0	58,831
4000	Upland forest	45,169	18,287	155,441		0.005	0	1	0	0	0	0	0	155,441
5000	Water Body	38,688	15,663	133,136		0.275	0.28	0.72	0	0	0	0	0	133,136
6000	Wetlands	52,103	21,094	179,303		0.275	0.28	0.72	0	0	0	0	0	179,303
7000	Barren Land	9,428	3,817	32,443		0.005	0	1	0	0		0	0	32,443
	Totals	304,582	123,313	1,048,157						3,198,574		652,809	3,851,383	4,899,540
	Totals (MT/yr)			1,048						3,199		653	3,851	4,900
	Totals (tons/yr)			1,154						3,523		719	4,242	5,396

7 Appendix 2

Summary of Groundwater Loads by Land Use/Land Cover

Land Use/Land Cover		Area	Input	Input	GW concentration		GW recharge		GW load		Apparent removal	
			atm. dep.	w/o atm. dep.	Background TN	Impacted TN	recharge	recharge	Background	Additional	Background	additional
LU Code	Descriptive	(ha)	(kg/yr)	(kg/yr)	(mg/L)	(mg/L)	(mm/yr)	(in/yr)	(kg/yr)	(kg/yr)	(-)	(-)
1100	Low Density Residential	9,168	77,928	569,884	0.2	1.3	287	11.3	5,254	28,896	0.93	0.95
1200	Medium Density Residential	17,960	152,660	837,294	0.2	1.3	254	10.0	9,126	50,196	0.94	0.94
1300	High Density Residential	3,155	26,815	98,050	0.2	1.3	267	10.5	1,684	9,263	0.94	0.91
1400+ 1480	Commercial and airports	3,429	29,149	28,806	0.2	1.3	285	11.2	1,952	10,735	0.93	0.63
1500	Industrial	1,099	9,340	0	0.2	0.2	316	12.4	694	0	0.93	n/a
1600	Extractive	257	2,183	0	0.2	0.2	404	15.9	208	0	0.90	n/a
1700	Institutional	1,341	11,396	16,892	0.2	1.3	297	11.7	797	4,383	0.93	0.74
8100	Transportation	1,414	12,017	29,688	0.2	1.3	259	10.2	731	4,021	0.94	0.86
8300	Utilities	942	8,007	19,783	0.2	1.3	259	10.2	487	2,679	0.94	0.86
1800	Recreational, Marinas and fish camps, swimming beaches	744	6,327	102,123	0.2	1.3	228	9.0	339	1,863	0.95	0.98
1820	Golf Courses	1,285	10,923	186,652	0.2	8	259	10.2	666	25,986	0.94	0.86
2100	Agriculture-Field Crops	24	204	2,602	0.2	6	274	10.8	13	382	0.94	0.85
2140	Agriculture-Row Crops	280	2,384	127,641	0.2	23	135	5.3	75	8,605	0.97	0.93
2150	Agriculture-Field Crops	1,040	8,839	112,703	0.2	4	271	10.7	563	10,693	0.94	0.91
2200	Agriculture-Tree Crops	2,436	20,703	399,470	0.2	10	287	**46***	1,006	200,803	0.95	0.50
2400	Agriculture-Nurseries	52	443	8,554	0.2	6	392	15.5	41	1,187	0.91	0.86
2410	Agriculture-Tree Nurseries	34	285	5,505	0.2	6	355	14.0	24	691	0.92	0.87
2420	Agriculture-Sod Farms	49	414	7,039	0.2	4	80	3.2	8	148	0.98	0.98
2430	Agriculture-Ornamentals	2,167	18,422	355,449	0.2	6	347	13.6	1,502	43,566	0.92	0.88
2450	Agriculture-Floriculture	9	72	1,231	0.2	6	221	8.7	4	109	0.95	0.91
2500	Agriculture-Specialty Farms	35	298	5,066	0.2	6	469	18.5	33	954	0.89	0.81
2300	Agriculture-Feeding Operations	66	45,658	464,732	0.2	18	257	10.1	34	3,003	0.94	0.99
2110	Agriculture-Improved Pasture	5,372	14,541	70,141	0.2	5.5	271	10.7	2,916	77,278	0.94	0.83
2120	Agriculture-Unimproved Pasture	1,711	11,287	54,441	0.2	5.5	197	7.8	675	17,890	0.95	0.74
2130	Agriculture-woodland pasture	1,328	558	272,287	0.2	5.5	284	11.2	755	20,006	0.93	0.63
2510	Agriculture-Horse Farms	871	7,403	75,347	0.2	5.5	257	10.1	447	11,857	0.94	0.84
2540	Agriculture-Aquaculture	6	52	0	0.2	6	469	18.5	6	168	0.89	n/a
1900	open land	1,150	9,778	0	0.2	0.2	206	8.1	475	0	0.95	n/a
2600	Other open lands rural	108	914	0	0.2	0.2	216	8.5	46	0	0.95	n/a
3000	Upland nonforested	6,921	58,831	0	0.2	0.2	192	7.6	2,655	0	0.95	n/a
4000	Upland forest	18,287	155,441	0	0.2	0.2	206	8.1	7,522	0	0.95	n/a
5000	Water Body	15,663	133,136	0	0.2	0.2	121	4.8	3,781	0	0.97	n/a
6000	Wetlands	21,094	179,303	0	0.2	0.2	54	2.1	2,278	0	0.99	n/a
7000	Barren Land	3,817	32,443	0	0.2	0.2	72	2.8	551	0	0.98	n/a
	Totals	123,313	1,048,157	3,851,383	0.2		194	7.6	47,348	535,361	0.95	0.86

* based on irrigation

8 Appendix 3

Summary of Stormwater and Total Loads by Land Use/Land Cover

Land Use/Land Cover			Stormwater runoff					Background				
		Area	DCIA	EMC	Run-off	Load rate	Storm load	Run-off	Storm load	excess storm load	Total Background	Total Excess Load
LU Code	Descriptive	(ha)	(-)	(mg/L)	(in/yr)	(kg/ha yr)	(kg/yr)	(in/yr)	(kg/yr)	(kg/yr)	(kg/yr)	(kg/yr)
1100	Low Density Residential	9168	0.3	2.29	10.3	6.0	54,742	3.1	9,140	45,602	14,394	74,498
1200	Medium Density Residential	17960	0.37	2.36	12.0	7.2	128,720	3.1	17,905	110,814	27,032	161,010
1300	High Density Residential	3155	0.71	2.42	20.2	12.4	39,110	3.1	3,145	35,965	4,829	45,228
1400+ 1480	Commercial and airports	3429	0.85	2.01	23.5	12.0	41,231	3.1	3,419	37,812	5,371	48,547
1500	Industrial	1099	0.85	1.79	23.5	10.7	11,766	3.1	1,096	10,670	1,790	10,670
1600	Extractive	257	0.85	1.79	23.5	10.7	2,750	3.1	256	2,494	464	2,494
1700	Institutional	1341	0.65	2.29	18.7	10.9	14,598	3.1	1,337	13,261	2,134	17,644
8100	Transportation	1414	0.85	1.79	23.5	10.7	15,137	3.1	1,409	13,728	2,141	17,749
8300	Utilities	942	0.85	1.79	23.5	10.7	10,087	3.1	939	9,148	1,426	11,827
1800	Recreational, Marinas and fish camps, swimming beaches	744	0.005	1.25	3.1	1.0	742	3.1	742	0	1,081	1,863
1820	Golf Courses	1285	0.17	2.32	7.1	4.2	5,396	3.1	1,281	4,115	1,947	30,101
2100	Agriculture-Field Crops	24	0.01	2.48	3.3	2.1	49	3.1	24	25	37	407
2140	Agriculture-Row Crops	280	0.01	2.68	3.3	2.2	622	3.1	280	343	355	8,948
2150	Agriculture-Field Crops	1040	0.01	2.52	3.3	2.1	2,171	3.1	1,037	1,134	1,600	11,827
2200	Agriculture-Tree Crops	2436	0.01	2.05	3.3	1.7	4,136	3.1	2,428	1,707	3,434	202,511
2400	Agriculture-Nurseries	52	0.01	2.3	3.3	1.9	99	3.1	52	47	93	1,235
2410	Agriculture-Tree Nurseries	34	0.01	2.3	3.3	1.9	64	3.1	33	30	57	721
2420	Agriculture-Sod Farms	49	0.01	2.3	3.3	1.9	93	3.1	49	44	56	192
2430	Agriculture-Ornamentals	2167	0.01	2.3	3.3	1.9	4,129	3.1	2,161	1,968	3,663	45,533
2450	Agriculture-Floriculture	9	0.01	2.3	3.3	1.9	16	3.1	8	8	12	117
2500	Agriculture-Specialty Farms	35	0.01	2.34	3.3	1.9	68	3.1	35	33	68	987
2300	Agriculture-Feeding Operations	66	0.01	78.23	3.3	64.8	4,251	3.1	65	4,186	99	7,189
2110	Agriculture-Improved Pasture	5372	0.01	2.48	3.3	2.1	11,033	3.1	5,355	5,678	8,271	82,956
2120	Agriculture-Unimproved Pasture	1711	0.01	2.48	3.3	2.1	3,514	3.1	1,706	1,808	2,381	19,698
2130	Agriculture-woodland pasture	1328	0.01	2.48	3.3	2.1	2,727	3.1	1,324	1,404	2,079	21,410
2510	Agriculture-Horse Farms	871	0.01	2.34	3.3	1.9	1,688	3.1	868	820	1,316	12,676
2540	Agriculture-Aquaculture	6	0.01	2.34	3.3	1.9	12	3.1	6	6	12	174
1900	open land	1150	0.005	1.25	3.1	1.0	1,147	3.1	1,147	0	1,621	0
2600	Other open lands rural	108	0.005	1.25	3.1	1.0	107	3.1	107	0	154	0
3000	Upland nonforested	6921	0.005	1.25	3.1	1.0	6,900	3.1	6,900	0	9,555	0
4000	Upland forest	18287	0.005	1.25	3.1	1.0	18,232	3.1	18,232	0	25,753	0
5000	Water Body	15663	0.275	1.25	9.7	3.1	48,047	9.7	48,047	0	51,828	0
6000	Wetlands	21094	0.275	1.6	9.7	3.9	82,827	9.7	82,827	0	85,105	0
7000	Barren Land	3817	0.005	1.25	3.1	1.0	3,805	3.1	3,805	0	4,356	0
	Totals	123313					520,016		217,165	302,850	264,514	838,212

9 Appendix 4

Wastewater Inputs and Loads

Category	Units	#	Input/ unit (lbs/yr)	Input (MT/ year)	Input (tons/ year)	Assumed removal (-)	Load (tons/ year	Load (MT/ year)
OSTDS	Systems	55,417	29	730	804	0.4	482	438
WWTF (sewer)	GW discharge			72.6	80	0.4	48	44
	Surface Water discharge			28.8	32	0	32	29
	Reuse discharge			164.7	181	0.7	54	49
	Sum WWTF (sewer)			266	293		134	122

Wekiva River Basin Nitrate Sourcing Study, Phase II

Florida Department of Environmental Protection

November 2007

Scope

Phase II of DEP's 2006 Wekiva River Basin Nitrate Sourcing Study will re-visit MACTEC's loading estimates for fertilizer from residential land uses by developing better estimates of nitrate concentrations in shallow ground water from fertilizer application and documentation of lawn management activities. The study will also evaluate BMP effectiveness in reducing nitrate losses to ground water from lawn and turf fertilization in the Wekiva Study Area.

This project is limited to an evaluation of shallow ground water impacts from fertilization practices on residential lawn and turf areas. Other potential nitrate sources (nurseries/greenhouses, septic tanks, and areas irrigated with reclaimed water) are not in the scope of this study. However, if this study results in a different estimate of nitrate loading from residential fertilizer than the Phase I estimate, then estimates of source contributions identified in Phase I will likely shift (septic tanks, domestic wastewater, agricultural fertilizer, etc.).

It is envisioned that most work will be performed by a contractor for the SJRWMD, with a Project Manager certified in the State of Florida as a P.G. (Professional Geologist), with technical input provided by a soils scientist and by DEP.

Site Selection

In order to provide meaningful data that satisfies the greatest number of needs, the following criteria are established for site selection:

- within the high recharge areas of the Wekiwa springshed and within the WSA;
- areas that are most prone to contamination of the shallow ground water table due to high-density residential land use;
- where depth to ground water will be less than 30 feet to facilitate ground water sampling using less intrusive direct-push techniques;
- where soils are well drained and have a high potential for leaching of fertilizers;
- where residential lawn and turf areas have been established and consistently maintained for at least 5 years (to assure that sufficient time has elapsed to allow ground water quality to represent overlying land use);
- sites where previous land use did not include citrus groves (to rule out legacy loads of nitrate in the aquifer beneath study sites);
- residential areas where homes follow similarly uniform lawn management practices;
- where all homes are on central sewer and have been for at least 10 years and where reclaimed water is not used for irrigation.

Methods

At each site, direct-push sampling techniques will be used to collect geologic core samples to allow soil profile description and determine depth to ground water. It will then be used to install a small-diameter "micro-well" for ground water sampling. These wells can either be pulled out after the sample is collected, or they can be installed permanently and covered with a small irrigation valve cover. Up to six soil cores will be taken at each sampling event to evaluate nutrient content and nitrogen transformation in pore water. GPS will be used to establish each location, which will make it easy to return to the site for re-sampling.

The wells will be sampled at least twice (one in the wet season and one in the dry season), and if budget permits four times (three in the wet season and one in the dry season), and soil cores will be taken during the first sampling event in Groups 1 and 2, and at each sampling event for Group 3 sites. Permission to install and sample the wells for the duration of the project will have to be obtained from the public and private entities responsible for the land at each well location, and will be the responsibility of the SJRWMD and their contractor. If permanent wells are installed, provisions for their removal and abandonment will also be made in the agreement, or they will be turned over to another entity for continued sampling/monitoring.

A homeowner survey will be conducted to determine current fertilization and irrigation practices in the study area and whether homeowners will allow sampling on their property. Homeowners will be placed into one of the three sampling groups (see below) based on survey responses and initial sampling results. Of those sites with high initial nutrient levels, Best Management Practices (BMPs) will be prescribed and changes in soil and groundwater chemistry will be documented.

Three study groups will be compared: Group 1 will measure background ground water quality of non-fertilized residential turf, Group 2 will measure ground water quality of residential areas using fertilizers , Groups 3a & b will measure ground water quality of residential areas with initially elevated nutrient levels both before and after employing various prescribed BMPs. Group 3a will require the use of DACS approved fertilizers only, while Group 3b will require BMPs for fertilizer application and irrigation rates using the DACS approved fertilizer.

Group 1. Background Sampling Sites. Three sites will be established in residential areas that do not apply fertilizers to evaluate background nitrate concentrations in the soil and Surficial Aquifer If large neighborhoods that do not fertilize are unavailable for sampling, then three sites in undisturbed natural areas will be used for reference, but not to separate fertilizer contributions entirely. These will be selected to have similar soils, recharge, and drainage characteristics to the other study sites. The two main areas

which appear to have merit are upland areas in Rock Springs Run State Reserve or Seminole State Forest.

Group 2. Residential Sampling Sites. Approximately 15-20 monitoring sites will be established in residential areas that meet the selection criteria defined above. The sites will be selected to represent a range of residential properties that include residential yards maintained by homeowners, and golf course communities treated and maintained by commercial lawn maintenance companies. The locations at these sites will be selected to measure shallow ground water quality that is associated with ongoing lawn fertilization practices representative of the majority of surrounding homes. Well locations may be a yard, a public right of way, or a common area.

Group 3a and b. Residential Sampling Sites with BMPs. The number of study sites for this group is to be determined and will depend on additional funding, if available. Group 3 sites will compare baseline nutrient loading prior to BMP implementation. Of those sites with high initial nutrient levels, one of two BMP scenarios will be prescribed for subsequent monitoring. Group 3a will continue their usual fertilizer and irrigation practices but use the newly adopted DACS rule-approved fertilizers for residential turf. Group 3b will use the same DACS approved fertilizer products as Group 3a, but they will also be educated on and employ BMPs for fertilization and irrigation.

Group 3 study sites will include individual homes or properties (such as a neighborhood or complex under a common management program) with uniformly prescribed fertilizer and irrigation practices. At a minimum, each site will have three soil core samples (to show more immediate changes in nitrate concentrations) and one well per yard or property. They will be located (as best as practicable), in areas with similar soils, geology, etc. to the Group 1 and 2 study sites.

Differences between nutrient levels in Group 1 and 2 will characterize the current nitrate load coming from fertilized lawns versus unfertilized ones and allow an estimate of the load due to fertilizer alone. The difference between Group 2 and 3a will show any changes to nutrient loading from simply changing fertilizer products, but not practices. Groups 3a and 3b will demonstrate the achievable nutrient load reductions possible from using DACS approved fertilizer products with BMPs. Comparing loading rates from Groups 3a and 3b will show what reductions in nutrient loading can be expected when BMPs are employed in the study area.

All water samples collected will be analyzed for the following fertilizer components or tracers:

- Ammonia N
- Nitrate/Nitrite N
- TKN
- Total P

- Soluble Reactive P
- Total Organic Carbon
- Potassium
- Chloride
- Calcium
- Magnesium
- Sodium
- Sulfate
- Alkalinity
- Conductivity
- pH
- delta N^{15} isotope analyses to discern between inorganic and organic sources of the nitrogen
- atrazine (Used in a high % of homeowner fertilizer events and very susceptible to leaching)

If budget permits, an inventory of available Floridan Aquifer monitoring wells upgradient, within, adjacent to and downgradient of the study areas will be conducted. Water samples will be collected from Floridan wells located as near to each study site as possible to reflect the vertical gradient from the Surficial to the Floridan aquifer. Attempts will be made to coordinate with any concurrent sampling of those wells.

Final Report

The results of this project will be summarized in a final report. This report shall include a re-analysis of the Phase I model using the data collected in this project and any new data from residential and other land uses in the Wekiva basin, including the 2006 DOH Wekiva Onsite Nitrogen Contribution study. The report will include an updated estimate of nitrate source load contributions to the Wekiva River.

COLLEGE OF ENGINEERING & COMPUTER SCIENCE
Department of Civil Engineering
777 Glades Road, ENG 213
Boca Raton, FL 33431
tel: 561.297.0466, fax: 561.297.0493
www.civil.fau.edu

Florida Atlantic University

Department of Civil Engineering

"Taylor County Beaches Pathogen and Nutrient Sources Assessment Study: Seasonal Water Quality Impacts"

-FINAL REPORT-

D.E. Meeroff, Ph.D. and F. Bloetscher, Ph.D., P.E.
Florida Atlantic University, Department of Civil Engineering
777 Glades Road 36/222, Boca Raton, FL 33431-0091
(561) 297-3099 ▪ (561) 297-0493 (FAX)

Laboratories for Engineered Environmental Solutions

December 22, 2007

Taylor County Beaches Pathogen and Nutrient Sources Assessment Study: Seasonal Water Quality Impacts

December, 2007

Prepared for:
Eberhard Roeder, Ph.D., DOH contract and QA manager
Florida Department of Health, Bureau of Onsite Sewage Programs
Bin A08, 4052 Bald Cypress Way, Tallahassee, Florida 32399-1317

Prepared by:
Thais Bocca, Graduate Student, Daniel E. Meeroff, Ph.D., and
Frederick Bloetscher, Ph.D., P.E., Asst. Professors
Florida Atlantic University, Civil Engineering Department
777 Glades Road, Building 36/222, Boca Raton, FL 33431

Approving Signatures and Dates:

Daniel Meeroff, Ph.D., FAU, Principal Investigator	Date
Frederick Bloetscher, Ph.D., P.E., FAU, Co-Principal Investigator, QA Officer	Date

EXECUTIVE SUMMARY

Prior to 2004, beach water quality sampling conducted by the Suwannee River Management District and the Taylor County Health Department has shown that counts of the pathogen indicators fecal coliform and enterococci frequently exceed the water quality standards for recreationally used surface waters at coastal communities in Taylor County, FL. This resulted in frequent beach advisories, significant because these waters are commonly used for recreational fishing (including scallops). In fact, the ongoing weekly beach monitoring program posts advisories approximately 46% of the time due to high concentrations of indicator bacteria (>400 CFU/100ml for fecal coliforms, >100 CFU/100ml for *Enterococcus*), and between the years of 2004 and 2006, the SRWMD and TCHD monitoring programs found that 94 of 181 samples (52%) failed for enterococci. Nutrients, while not a part of the regular beach water quality monitoring program, were also of concern. Initially, it was suspected that onsite sewage treatment and disposal systems (OSTDS), in particular pre-1983 and other systems operating without a permit may be a source of the pathogen indicators in these waters.

Of concern are the rapid development and the change from seasonal to full-time residents in the coastal communities of Taylor County, FL, both of which have been identified as potential threats to water quality. Most of the coastal communities historically rely on OSTDS. Various studies (Meeroff et al. 2005; Morin et al. 2005; Ahmed et al. 2004; Lipp et al. 2001) have investigated the contribution of failing septic tanks on the degradation of water quality, particularly during the seasonal high water table (SHWT) elevation, when septic tanks are expected to operate inefficiently.

There is a need to obtain information on bacteriological and nutrient sources and to evaluate the contribution of OSTDS to the observed water quality problems. The information gathered will be used by state and local officials to address the contamination of coastal waters, to develop plans to improve sewage treatment and disposal in the coastal communities, and provide data that may be applicable to the management of shellfish in this and other areas. The United States Environmental Protection Agency (USEPA), through the Gulf of Mexico Program, has provided funding for this

investigation to the Florida Department of Health, Bureau of Onsite Sewage Programs, which contracted Florida Atlantic University (FAU) to assist in the scientific study to assess possible sources of pathogen indicators and the contribution of OSTDS to coastal surface water quality in Taylor County, FL, by using multiple tracers. Additional support was provided by the Florida Department of Health and the Florida Department of Environmental Protection.

The objective of this study is to test the hypothesis that OSTDS significantly contribute to the observed water quality degradation and that the problem is aggravated during the SHWT. This hypothesis will be evaluated using pair-wise comparison, intervention analysis, and multiple tracers. The results will be used to assess source tracking hypotheses for nutrients and pathogen indicators so that water quality managers will be able to develop plans for improving water quality in these coastal communities. The results will be used to evaluate source tracking hypotheses for nutrients and pathogen indicators so that water quality managers will be able to develop plans for improving water quality in coastal communities.

The results of the first year of sampling prompted additional questions that could only be addressed by returning for another round of sampling with additional recommended analyses and sampling site density. By using multiple tracers, including nitrogen isotopic ratios and shallow sediment re-growth experiments, seasonal variability issues were addressed for distinguishing between human and non-human sources and also between functioning OSTDS and surface runoff contributions to pathogen indicators and nutrient concentrations for identification of significant sources of contamination.

A summary of the results of the five sampling events conducted between 2006 and 2007 indicate the following:

- As expected, the percentage of violations for dissolved oxygen, *Enterococcus*, and *E. coli* are all higher in the SHWT season.

- DO decreased during the SHWT events, in contract to expectations. It is hypothesized that since microbial activity generally increased during this period, it could have accounted for the observed consumption of dissolved oxygen, even after temperature effects are taken into account.
- The bacteriological results also reveal that *Enterococcus* counts are generally higher in OSTDS areas as compared to sewered areas, by a factor of about 1.5, independent of season.
- For both *Enterococcus* and *E. coli*, the microbial densities were generally higher for the SHWT, especially for the OSTDS areas. Between 5-10% of all *Enterococcus* samples violated the trigger levels in SLWT, but 30-35% violated in SHWT.
- A general increasing trend from upstream to downstream is apparent. *Enterococcus* counts were higher in the SHWT period when compared to the SLWT, by a factor of 2 – 3. However, *E. coli* was found to be consistently higher in the sewered areas, which was not expected. When taken in context with the *Enterococcus* results, these higher levels of *E. coli* may not be necessarily of human origin.
- Unexpectedly, *E. coli* violations are nearly four times more frequent at sewered sites compared to those served by OSTDS, a trend that increased in 2007. Since the sewer system was only just recently installed, water quality conditions monitored may still reflect previous contamination from older OSTDS, or more likely that microbial regrowth in warm, shallow, stagnant waters may be causing this signal.
- No noticeable differences in ammonia trends are observed between sites with sewer and sites with OSTDS.
- Ammonia was generally higher during the May SLWT sampling events for all sites.
- TOC and higher ammonia in the 2006 SLWT (May and December) data may indicate anthropogenic background sources from lawn fertilizers or an industrial source, but this requires further research. On average, nitrate levels were below the concentrations considered high for coastal marine environments

- From the speciation of nitrogen containing parameters (ammonia, nitrate, nitrite, and total nitrogen), it was determined that most of the nitrogen detected was in the form of organic nitrogen. The nitrogen isotope analysis seems to implicate fertilizers at the beach communities, but a possible industrial source signal could not be discounted upstream at the background site locations in May 2007.
- High total nitrogen (which was indicative of organic-N) in conjunction with higher *Enterococcus* concentrations would tend to indicate a greater contribution of nutrients to coastal waters from septic systems as opposed to runoff contributions.
- Keaton Beach had 2-3 isolated cases of extreme microbial contamination recorded during the 2006 SLWT. The elevated microbial counts were repeated in May 2007 SLWT, which may indicate a persistent local source, such as sediment reservoirs of pathogen indicators.
- During the SLWT, only 1 of 6 Ec/Ent ratio values was above the human-derived input cut-off (ratio > 4). However, during the SHWT sampling events, more than 50 percent of the ratios were indicative of human contributions.
- All of the beach sites showed *E. coli/Enterococcus* ratios that were well above 4.0, indicative of human-derived sources of pollution, within the documented limits of this parameter.
- The background sites, with the exception of the Creek at Dekle Beach, consistently produced *E. coli/Enterococcus* ratios below approximately 1.0, a possible indication of a contribution from non-human sources of pollution.
- Sewered areas (Keaton Beach and Cedar Island) have not shown improved water quality in comparison to areas that remain on OSTDS. Thus, in sewered areas, the possibility that remnant OSTDS inputs have not been fully flushed from the surficial soils cannot be discounted. This finding is also supported by the absence of a change in slope in the bacteriological densities over time at the sewered sites.
- After tidally influenced transport, the ground water and runoff contributions for a given area do not return to exactly the same water quality level from which they originated. This daily periodicity can be termed as a “slosh” effect, which may play an important role here in cycling nutrients and pathogen indicators. A second

possibility is that during the SHWT, the soils and canals in the sewered areas may be flushed less effectively, and therefore do not show the same concentrations of bacteria as the septic areas that would tend to leach even more bacteria into the soil

- Overall, the molecular data indicated that the analyzed water samples were not grossly contaminated with fecal contamination or human-derived fecal contamination. These results are supported by the low IDEXX MPN results for *Enterococcus* and the lack of confluent growth from the samples incubated on the bacterial media.
- Caffeine was not shown to be an effective tracer.
- Optical brighteners were also ineffective.

Interesting differences in multiple water quality tracers between sewered and non-sewered areas were observed. In terms of microbial pathogen indicators, unexpectedly high *E. coli* counts were found at sewered sites, along with potential re-growth in shallow sediments, which point to legacy OSTDS sources, sediment reservoirs harboring pathogen indicators, or steady upstream contributions. Some evidence of human-derived input from sewage or OSTDS is found, and from molecular techniques, an important dog or bird contribution cannot be discounted. Elevated TOC and higher ammonia levels at the beach communities may indicate recent anthropogenic input from lawn fertilizers or an upstream industrial source, but this certainly requires further research. The nitrogen isotope analysis from May 2007 supports this supposition, in particular for the beach communities. Elevated levels of total nitrogen (which was indicative of organic-N) combined with high enterococci tend to implicate a greater contribution of nutrients to coastal waters from OSTDS, but this combination was not seen consistently. OSTDS are expected to perform better during the SLWT event, with the likelihood of failure increasing in the SHWT event. This field study demonstrates that the magnitude of water quality degradation in the area may have a contribution from OSTDS, but outlines other potentially more important inputs. The analysis indicates that the source of the differences may be due to human-derived inputs.

CONCLUSIONS

In general, the measured physical parameters fell within the expected ranges (see Table 37). A summary of the water quality trigger levels with the range of results collected for each parameter is found in Table 37 and Table 38.

Table 37 – Summary of field results for 2006 and 2007 sampling events.

Parameter	Analytical Method/SOP	Trigger Level	Expected Level	Encountered Range
pH	FDEP FT1100	N/A	6.0 – 8.5	7.0 – 8.6
Conductivity	FDEP FT1200	N/A	5 – 55 mS/cm	0.1 – 51 mS/cm
Salinity	FDEP FT1300	N/A	9,000 – 40,000 mg/L	100 – 41,000 mg/L
Temperature	FDEP FT1400	N/A	15 – 25°C	11 – 30°C
Dissolved oxygen	FDEP FT1500	< 4.0 mg/L	< 9.0 mg/L	0.5 – 10.5 mg/L
Turbidity	FDEP FT1600	>29 NTU	< 10 NTU	0.1 – 21.1 NTU
Optical Brighteners	FAU LT9200	N/A	Absent	Absent – Inconclusive

Table 38 – Summary of laboratory results for 2006 and 2007 sampling events.

Parameter	Analytical Method/SOP	Trigger Level	Expected Level	Encountered Range
E. coli **(& Total coliforms)**	Standard Methods SM9223B FAU LT6100	> 400 CFU/100 mL	BDL – 800 CFU/100 mL	BDL – 24000 CFU/100 mL
Enterococcus	Standard Methods SM9223C FAU LT6200	> 104 CFU/100 mL	BDL – 2,000 CFU/100 mL	BDL – 610 CFU/100 mL
Caffeine	FLEnviro SOP	> 0.10 µg/L	BDL	BDL – 0.32 µg/L
Nitrate	EPA 353.2 (FLEnviro SOP)	None*	< 5.0 mg/L	BDL – 1.0 mg/L
Ammonia-nitrogen	EPA 350.1 (FLEnviro SOP)	9.15 mg/L** @pH 7.9, T = 25°C	< 5.0 mg/L	BDL – 3.2 mg/L
TOC	EPA 415.1 FAU LT5200	None	1 – 200 mg C/L	BDL – 170 mg/L
TN	EPA 415.1 FAU LT5200	None	< 10.0 mg/L	BDL – 7.0 mg/L

*0.07 mg/L as N (nitrate and ammonia) has been suggested as a human-impacted threshold level by NOAA-AOML
**From National Ambient Water Quality Criteria for Saltwater (www.epa.gov/waterscience/criteria/wqcriteria.html), EPA 440/5-88-004

The trigger levels for only three of the parameters were violated in this study. These were dissolved oxygen, *Enterococcus*, and *E. coli*. These were investigated for seasonal effects in Table 39, which lists the percentage of violations by season for sewered and non-

sewered sites. As expected, the percentage of violations for dissolved oxygen, *Enterococcus*, and *E. coli* are all higher in the SHWT season. For non-sewered areas, 8% of the *Enterococcus* samples violated the trigger levels in SLWT, but 35% violated in SHWT. Similarly *E. coli* violations increased from SLWT (14%) to the SHWT (19%). Keaton Beach had 2-3 isolated cases of extreme microbial contamination recorded during the May 2006 SLWT, which skewed the average results but did not mask the general trend because this was repeated in May 2007 SLWT. Unexpectedly, *E. coli* violations are nearly four times more frequent at sewered sites compared to those served by OSTDS. Even more alarming is that the number of *E. coli* violations for the sewered sites was much higher in 2007 compared to 2006. Since the sewer system was only just recently installed, water quality conditions monitored may still reflect previous contamination from older OSTDS, but since the frequency of violations increased in 2007, it is more likely that microbial regrowth in warm, shallow, stagnant waters may be causing this signal.

Table 39 – Summary of trigger level violations from sampling events in 2006 and 2007.

	Dissolved oxygen*				Enterococci**				*E. coli***			
	SLWT		SHWT		SLWT		SHWT		SLWT		SHWT	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
OSTDS	10/75	13%	26/51	51%	6/74	8%	18/51	35%	10/74	14%	13/69	19%
Sewer	0/69	0%	25/48	52%	3/69	4%	14/48	29%	24/51	47%	40/48	83%

*Dissolved oxygen: Class III waters, marine > 4.0 mg/L; freshwater > 5.0 mg/L
***Enterococcus*: > 104 MPN/100 mL
****E. coli*: > 400 MPN/100 mL (fecal coliforms)

Results for nutrients such as ammonia and nitrate were all below regulatory trigger levels as seen in Table 38; however, many individual results were considered high for marine environments. Nitrate can be an indicator of a runoff contribution, but in this study, the average nitrate readings were measured at below elevated levels at the paired sites for both seasons. On the other hand, ammonia is a better indicator of more recent nutrient inputs, and in this study, many individual ammonia results were considered high for coastal marine environments. The Fenholloway River set of samples showed elevated nutrient levels that were 1-2 orders of magnitude higher than those measured at the paired sites. Further investigation into the significance of the nitrogen species levels is warranted to determine if a water quality impact is in fact occurring and if the source is related to the industrial discharge from the Fenholloway River.

Compared to the SLWT, water quality (as evidenced by violations in DO and microbial pathogen indicators) decreased during the SHWT as expected. In addition, more pressure was put on the assimilation capacity of the environment during the SHWT because the end of summer coincides with the peak of the scalloping season, when the tourist population at the sampling sites tends to increase and more wastewater is generated. Water temperatures are also higher in September, which increases bacterial growth rates and reduces DO. Although the DO exhibited large decreases during SHWT, microbial activity generally increased simultaneously. This may have accounted for the observed dissolved oxygen depletion and frequency of trigger level violations.

Higher TOC and ammonia in the SLWT indicate that runoff may be considered an important input in the region. The nitrogen isotope analysis from May 2007 supports this supposition for the beach communities. Differences in water quality parameters measured between sewered and non-sewered areas were also observed in terms of microbial pathogen indicators. Elevated levels of total nitrogen (which was indicative of organic-N) and enterococci tend to implicate a greater contribution of nutrients to coastal waters from septic systems, but this combination was not seen consistently. OSTDS are expected to perform better during the SLWT event, with the likelihood of failure increasing in the SHWT event. This field study demonstrates that the magnitude of water quality degradation in the area may have a contribution from OSTDS, but outlines other potentially more important inputs. The analysis indicates that the source of the differences may be due to human-derived inputs. It is suggested that further monitoring of these rural coastal developments continue, so that the results can be compared to other parts of the United States to determine if the methods employed here are universally applicable.

In summary, the results of the five sampling events indicate the following:

- Although the DO exhibited large decreases during September 2006 SHWT, microbial activity generally increased during this period, which could have accounted for the observed consumption of dissolved oxygen, even after temperature effects are taken

into account. The opposite occurred during the December 2006 SLWT event (i.e. DO increased dramatically and microbial activity was lower than observed in the other two sampling events of 2006).

- During the September 2006 SHWT event, ammonia levels were substantially lower in comparison to the May 2006 SLWT, but nearly one-quarter of the samples were considered high for coastal marine environments (>0.07 mg/L as N). The December 2006 SLWT event showed very low ammonia levels.
- The lowest ammonia levels were encountered in Steinhatchee during the SHWT, but during the SLWT, Steinhatchee had some of the highest ammonia readings measured. Ammonia is an indicator of recent nutrient inputs. However, no noticeable differences in ammonia trends are observed between sites with sewer and sites with OSTDS.
- On average, nitrate levels were below the concentrations considered high for coastal marine environments for the OSTDS and sewered paired sites for all sampling events in both years.
- *Enterococcus* and *E. coli* correlated with the change from SLWT to SHWT. However, the actual microbial densities appear to be misleading due to several very high *E. coli* results from sewered areas that occurred during both seasons, at Cedar Island Beach, Cortez Road Pump Station and Dekle Beach Canal. The high *E. coli* densities were replicated during both SHWT and SLWT (May) in 2006 at the Cortez Road site (Site E). Further investigation of this phenomenon is suggested to determine if a sewer leak is responsible.
- For both *Enterococcus* and *E. coli*, the microbial densities were generally higher for the SHWT, especially for the OSTDS areas, but this was also largely true of the newer sewered areas as well. Keaton Beach had 2-3 isolated cases of extreme microbial contamination recorded during the 2006 SLWT (possible pump station leak), which skewed the average results but did not mask the general trend. The elevated microbial counts were repeated in May 2007 SLWT, which may indicate a persistent local source, such as sediment reservoirs of pathogen indicators.
- Although sewer sites presented higher *E. coli* concentrations, it is worth reminding that the sewer system was just recently installed and conditions monitored may still reflect previous contamination, particularly at Cedar Island, where the findings

suggest microbial regrowth in warm, shallow, stagnant waters as a possible source rather than an external input.

- Between 5-10% of all *Enterococcus* samples violated the trigger levels in SLWT, but 30-35% violated in SHWT. A similar pattern was observed for *E. coli*.
- High total nitrogen (which was indicative of organic-N) in conjunction with higher *Enterococcus* concentrations would tend to indicate a greater contribution of nutrients to coastal waters from septic systems as opposed to runoff contributions.
- TOC and higher ammonia in the 2006 SLWT (May and December) data may indicate anthropogenic background sources from lawn fertilizers or an industrial source, but this requires further research. The nitrogen isotope analysis seems to implicate fertilizers at the beach communities, but a possible industrial source signal could not be discounted upstream at the background site locations in May 2007.
- The background sites, with the exception of the Creek at Dekle Beach, consistently produced *E. coli/Enterococcus* ratios below approximately 1.0, a possible indication of a contribution from non-human sources of pollution. Conversely, nearly all of the beach sites showed *E. coli/Enterococcus* ratios that were well above 4.0, indicative of human-derived sources of pollution, within the documented limits of this parameter.
- Sewered areas (Keaton Beach and Cedar Island) have not shown improved water quality in comparison to areas that remain on OSTDS. Thus, in sewered areas, the possibility that remnant OSTDS inputs have not been fully flushed from the surficial soils cannot be discounted. This finding is also supported by the absence of a change in slope in the bacteriological densities over time at the sewered sites.
- Caffeine was not shown to be an effective tracer for Taylor County, since very little material was detectable. High dilution and low development intensity are suspected as reasons for this result.
- Similarly, optical brighteners were also ineffective for the same reasons as caffeine. The qualitative method is not refined enough to be as sensitive as required to be considered an effective tracer.

Over the course of the investigation, a great deal of information has been collected and analyzed. The findings indicate that to resolve the different sources of pollution to the coastal Taylor County communities, the following additional work is necessary:

1. Monitor sewered areas with respect to OSTDS areas for a longer time period to see if the system stabilizes to a point in which water quality improvements are observable. Indications from the December 2006 SLWT sampling are that this may be happening, but the conditions were found to degrade again in 2007. To better accomplish this, it is recommended to add more representative background sites, particularly for Dekle Beach, and to go further upstream for Blue Creek.
2. Monitor during the secondary SHWT. Taylor County has four seasonal events (i.e. two SHWT and two SLWT events) with a bimodal distribution over the course of the year. In this study, only the primary SHWT, which occurs in September was monitored (twice), while both the primary (December) and secondary (May) SLWT events were monitored. Some differences were noted between the primary and secondary SLWT events, and it would add to the completeness of the study, to evaluate if differences can be observed between the primary and secondary SHWT.
3. More station density is required at the beach communities to help resolve upstream – downstream influences.
4. Sewer leaks in the newly installed areas must be cataloged to remove this possibility as a confounding factor.
5. Studies of shallow sediments are recommended to determine regrowth patterns of microbial indicators. The results from this study were largely inconclusive because of the relatively small sample size. The potential for regrowth was recorded in May 2007 but the results were not reproducible in sediments collected in September 2007.
6. Monitor the Fenholloway River input with respect to proposed new industrial treatment upgrades and pipelines coming on line (intervention analysis).
7. Investigate the water quality from the coastal estuary downstream of Blue Creek. Keaton Beach and Cedar Island are located on opposite sites of the estuary into which Blue Creek discharges. The estuary consistently contained high *Enterococcus* counts. As a result, further analysis of Blue Creek inputs should be undertaken to determine

the contributions to the estuary caused by anthropogenic activities upstream of the estuary. Hydraulic studies could be utilized to determine how current move nutrients in the estuary to help identify other sources of contamination and limitations caused by stagnant waters due to marine structures.

8. It is recommended that nitrogen isotopic ratios be monitored to separate fertilizer inputs from OSTDS inputs. In May 2007, runoff was implicated at the beach sites, but the upstream background sites showed a possible contribution from an industrial source. More data is needed to make a stronger conclusion.
9. Molecular techniques require much larger sample sizes than first anticipated. It is recommended to attempt additional tests with greater sensitivity to help resolve the human vs. animal input issue.
10. The first several sample sets for molecular techniques conducted in this study focused on enterococci esp., HF8, and most recently added in May 2007, HuBac and DogBac from direct DNA filter extracts. One way to potentially improve sensitivity would be to move the assays from a PCR/electrophoresis detection system (which were used for all samples in this study) to a fluorescent real-time qPCR detection system. The drawback is that reagents for qPCR are more expensive than for regular PCR and gel electrophoresis. It may be possible in the future to add independent qPCR assays based on commercially available primers for another human enterococci marker, a dog enterococci marker, a human *Bacteroides* marker, a cow *Bacteroides* marker, and a dog *Bacteroides* marker. These additional tests may be costly due to the proprietary nature of these newly available markers.
11. Direct DNA filters used in molecular techniques allow for the testing of a wide range of targets from the same filters, but it also limits detection sensitivity, especially if targets are in low abundance in relation to a large background microbial assemblage. Sensitivity can potentially be increased with culture pre-enrichment before extraction (this is basically the approach with the MFC and mEI media filters). Basically, in addtion to direct DNA filters, MFC filters and mEI filters, two more filters could be collected. One from an azide dextrose broth culture incubated overnight to enrich for enterococci (while limiting enzyme inhibition due to media dyes as can happen with

mEI), and the other from a filter that is incubated under anaerobic conditions on BBE plates to enrich for *Bacteroides*.

12. Another recommendation to improve the sensitivity of molecular techniques would be to consider using media enrichment filters in addition to direct DNA extraction filters. For instance, a *Bacteroides* specific media filter could be added, although this would require anaerobic incubation. This can be accomplished inexpensively in the field using small disposable GasPak EZ pouches.
13. Expanding the microbial screening to include other known human pathogens such as *Giardia*, *Cryptosporidium*, and viruses could potentially be added to the investigation, but these tests are progressively more expensive and labor intensive. The *Giardia* and *Cryptosporidium* testing requires filtering on site with a pump filter rig for water volumes ranging from 60 to 100 liters, then the filters are analyzed for IMS/IMF capture and enumeration. Tissue culture *Cryptospordium* viability/infectivity analysis is required after enumeration to determine how many of the oocysts are actually alive. Screening for viruses also involves filtering a large volume of water sample; however, qPCR enumeration of viruses does not take into account infectivity. Enumeration for noroviruses, enteroviruses, human adenovirus, and Hepatitis A can be done simultaneously. However, the expense and labor for these tests is partly why protozoans and viruses are not routinely measured in environmental water quality monitoring programs.

FLORIDA KEYS
ONSITE WASTEWATER
NUTRIENT REDUCING
PERFORMANCE ASSESSMENT

SAMPLING PROTOCOL

Revised August 20, 2007 by William Brookman

Edited for Clarity January 14, 2008 by Eberhard Roeder

TABLE OF CONTENTS

Wastewater Sampling Protocol

Florida Keys Onsite Wastewater Nutrient Reducing Systems (OWNRS)
Performance Assessment

1 INTRODUCTION AND SCOPE

This sampling protocol has been developed from the Florida Department of Environmental Protection's Standard Operating Procedure for Wastewater Sampling (DEP-SOP-001/01), manufacturer's owner's manuals, and various other publications listed in the reference section. The Monroe County Health Department developed these procedures in collaboration with the Florida Department of Health, Bureau of Onsite Sewage Programs.

This protocol will be used during sampling and field evaluations of 15 Onsite Wastewater Nutrient Reduction (OWNR) systems and 5 interim systems. To be included in the study, systems had to fulfill the following criteria: residential system, current maintenance contract, permanent residency in the Keys (homestead exemption). OWNR systems included were those that were volunteered by OWNRS owners that responded to mailings by MCHD sent to all OWNR systems on record that fulfilled the three criteria (192 out of 326 systems). Interim systems were randomly selected from the total population of interim systems in the Florida Keys using the same inclusion criteria. Each system will be sampled during a "peak" season (November through May) and an "off "season (June through October). The protocols are designed to ensure representative wastewater samples are collected.

This protocol was amended after completion of approximately half of the sampling (August 2007) to include additional sampling parameters.

2 ORGANIZATIONAL OVERVIEW

All **persons** conducting field investigations shall be knowledgeable of the protocols contained in this document, and shall receive field training prior to the commencement of the sampling and evaluation regime.

An upper keys sample team and a lower keys sample team shall be assembled. The upper keys shall sample 8 units (5 OWNRS and 3 Interim). The lower keys team shall sample 12 units (10 OWNRS and 2 Interim).

Each team is responsible for chain of custody requirements, laboratory submissions, data collection, and data entry. Analysis of the data will be performed by the Bureau of Onsite Sewage Programs at the conclusion of the assessment project.

Three **auto samplers** manufactured by Global Water Instrumentation Inc. shall be employed. These are suction-lift samplers using a peristaltic pump to collect wastewater. The maximum rated lift is 22 feet in the neoprene ¼ inch inside diameter hose. This meets FDEP requirements.

Two of the auto-samplers are model WS300 samplers. These units will be used for influent and effluent time-composite samples. A 150 ml sample will be collected each hour for 24 hours to form a 3600 ml composite. One unit, model WS700, will be used to collect discrete 500 ml grab samples at designated times.

The auto-samplers shall be calibrated, maintained and cleaned according to the manufacturer's specifications. (See user manuals in Appendix)

While composite samples are being gathered, the collected sample shall be maintained at 4°C. To accomplish this, bags of ice shall be used in the cooler compartment, around the sample container.

Each **treatment unit** shall be evaluated for the unique design parameters that will affect sample points. Sample points shall be identified prior to commencement of the sampling regime. Influent samples from the settling tank prior to treatment shall be preferred. Influent sampling locations in the treatment tank can be used according to the specific manufacturer's recommendation. Influent sampling ports will be installed if there is no other viable alternative. Take precautions when taking samples from inside a treatment unit so as not to disturb equipment or the treatment process.

Chain of custody forms (see sample in Appendix) will be used by all samplers. At the end of each system's 24 hour sampling cycle, the completed forms will be faxed to a central location. (Tavernier Environmental Health). Data can then be reviewed and entered into a central database.

3 SAMPLING PROTOCOL

3.1 LABORATORY METHODS

Samples from selected onsite systems will be analyzed for the following parameters from the treatment process point as noted:

INFLUENT sample from settling chamber (24 hr. composite of 3.6 liters)
EFFLUENT sample from sample port (24 hr. comp. of 3.6 liters and grab samples)

Parameter	Method	Detection Limit
$CBOD_5$	SM 5210B	2.00 mg/l
TSS	EPA 160.2	2.00 mg/l
Nitrate Nitrogen	SM 4500NO3F	.05 mg/l N
Nitrite Nitrogen	SM 4500NO3F	.03 mg/l N
Total Kjeldahl Nitrogen	EPA 351.2	.070 mg/l N
Ammonia Nitrogen	EPA 350.1	0.04 mg/L N
TN	Calculated	.120 mg/l N
TP	EPA 365.4	.080 mg/l P

During Phase 2, the following parameter was added

Total alkalinity	EPA 310.1	5 mg/L

and, for the last sample during an event: fecal coliform: pH and fecal coliform

3.2. Sample Plan

An effluent and influent composite sample will be collected from each OWNRS twice per season on different days of the week. June through October is recommended as the "off-season" months and November through May is recommended as the "peak-season" months. In addition, grab samples will be taken of effluent. Field blanks and duplicates as quality control will be randomly taken. During phase 2, duplicates will generally be taken of the effluent composite samples.

Composite Samples will be accumulated using a time composite method. 3.6 liters (3,600 ml) of wastewater (approximately 1 Gallon) will be collected in a 24 hour period. 24 samples of 150 ml will be automatically extracted from the sample point. The samples will correspond to the 24 hour delineations. These measurements correspond to calibrated measurements on the Global Water samplers and will be easily standardized.

The selected onsite wastewater systems will be sampled according to the following plan. The first set of samples will begin Sunday at 8am; Monday will begin at 10am, Tuesday at 12pm, and Wednesday at 2pm. This will allow time for the breakdown and set up of the equipment and shipping.

PEAK-SEASON (NOVEMBER - MAY)

	SUNDAY	**MONDAY**	**TUESDAY**	**WEDNESDAY**
WEEK 1 (UK)	OWNRS 7	INTERIM 4	OWNRS 6	OWNRS 4
WEEK 2 (UK)	OWNRS 5	INTERIM 5	INTERIM 3	OWNRS 14
WEEK 3 (LK)	OWNRS 1	OWNRS 2	OWNRS 3	OWNRS 8
WEEK 4 (LK)	OWNRS 9	OWNRS 10	OWNRS 11	OWNRS 12
WEEK 5 (LK)	OWNRS 13	INTERIM 1	INTERIM 2	OWNRS 15
WEEK 6 (UK)	INTERIM 4	OWNRS 6	OWNRS 4	OWNRS 5
WEEK 7 (UK)	INTERIM 5	INTERIM 3	OWNRS 14	OWNRS 7
WEEK 8 (LK)	OWNRS 1	OWNRS 2	OWNRS 3	OWNRS 8
WEEK 9 (LK)	OWNRS 9	OWNRS 10	OWNRS 11	OWNRS 12
WEEK 10 (LK)	OWNRS 13	INTERIM 1	OWNRS 15	INTERIM 2

This sample scheme will produce approximately 8 composite samples per week, 80 composite samples in a 10 week period.

OFF-SEASON (JUNE - OCTOBER)

	SUNDAY	**MONDAY**	**TUESDAY**	**WEDNESDAY**
WEEK 1 (UK)	INTERIM 4	OWNRS 6	OWNRS 4	OWNRS 5
WEEK 2 (UK)	INTERIM 5	INTERIM 3	OWNRS 14	OWNRS 7
WEEK 3 (LK)	OWNRS 1	OWNRS 2	OWNRS 3	OWNRS 8
WEEK 4 (LK)	OWNRS 9	OWNRS 10	OWNRS 11	OWNRS 12
WEEK 5 (LK)	OWNRS 13	INTERIM 1	INTERIM 2	OWNRS 15
WEEK 6 (UK)	OWNRS 6	OWNRS 4	OWNRS 5	INTERIM 5
WEEK 7 (UK)	INTERIM 3	OWNRS 14	OWNRS 7	INTERIM 4
WEEK 8 (LK)	OWNRS 1	OWNRS 2	OWNRS 3	OWNRS 8
WEEK 9 (LK)	OWNRS 9	OWNRS 10	OWNRS 11	OWNRS 12
WEEK 10 (LK)	OWNRS 13	INTERIM 1	OWNRS 15	INTERIM 2

This sample scheme will produce 8 composite samples per week, 80 composite samples in a 10 week period. Up to 4 grab samples can be taken during each 24 hour sampling period.

3.3. PREPARATIONS PRIOR TO COMMENCEMENT OF SAMPLING

COORDINATE THE SAMPLING EVENT WITH THE ASSIGNED MAINTENANCE PROVIDER. At least 2 weeks prior to the first sampling event, contact the maintenance entity assigned to the system. Inform them of the date and time of sampling. Inform them to prepare the site by pumping out the tank if necessary, and vacuuming out the effluent sample port with a wet-dry vac and cleaning it of all residue. If an influent sample port must be installed, this too must be accomplished by the maintenance provider prior to the sampling event.

DETERMINATION OF SAMPLE POINTS

Influent and effluent sample points will be determined individually for each of the wastewater systems to be sampled. Existing site conditions, manufacturer's recommendations and other pertinent information will be considered when establishing sample points. A schematic of each of the wastewater systems with the influent and effluent sample points clearly delineated is provided. (see Appendix)

3.4. PREPARATIONS PRIOR TO FIELD VISITS

3.4.1. NOTIFICATION

Two days prior to the field sampling, CALL THE HOMEOWNER and let them know when the health department staff will be on their property. Answer any questions they may have about the sampling process.

COORDINATE THE SAMPLING EVENT WITH THE ASSIGNED MAINTENANCE PROVIDER. They may assist you to set up the property and may have valuable insight into the workings of the onsite system.

3.4.2. EQUIPMENT

Insure that auto-samplers are clean and hoses are free of obstructions. BE SURE THE BATTERY FOR THE AUTO-SAMPLER IS FULLY CHARGED. Collect all necessary sample containers. Insure that personal protective equipment (latex gloves, hand-sanitizer, eye-protection) is available. Insure the vehicle has sufficient fuel. Take along Taylor testing kit (phase 2)

3.4.3. FILES

Collect the system schematics, maintenance reports, permit files and other paperwork that will assist in the field evaluation. Be sure to have a supply of "Chain of Custody" forms. Be sure to have directions to the property and have a site plan available.

3.4.4. SUPPLIES

Pack the laboratory provided sample cooler-kit, fill coolers with ice.

3.5. GATHERING SAMPLES

3.5.1. PREPARING THE SITE

Once at the site, knock on the door to let the homeowner know you are there. Assess the situation to insure there are no dangers, such as dogs, that may affect your work. Locate the water meter and take a "water meter begin" reading. Attach flow meters to hose bibs, if practicable. Be sure to replace hoses just as you found them.

Take the auto samplers out of the vehicle. Find the influent sample point which should already be designated on the system schematic. Place a WS300 near the influent sample point. Find the effluent sample point, also designated on the system schematic. Place a WS300 and the WS700 near this point.

Expose the sample points. This means getting weeds, or other obstructions, away from the sampling points, making them easily and cleanly accessible.

Have the laboratory provided sample cooler-kit on the site prior to the collection of samples.

3.5.2. PROCEDURES FOR COLLECTING SAMPLES WITH AUTO-SAMPLERS

3.5.2.1. The sampler should be placed upright. It will not work if it is placed on its side or back. Open the sampler and remove the battery charger from the unit. Store the charger for later use.

3.5.2.2. To secure the sample bottle, screw the bottle cap/float switch onto the sample bottle. Place the bottle in the sample enclosure. Insert the end of the peristaltic pump hose into the hole in the bottle cap. Plug the float switch lead into the control panel.

3.5.2.3. If possible, secure the auto-sampler to a fixed point, such as a tree or fence post to prevent theft. The unit is water resistant, not water proof. Avoid submerging the unit.

3.5.2.4. The pickup hose should be installed in the sample port or sample chamber. The pickup strainer should be submerged under water and should be situated so as to avoid contact with the sample port bottom, or chamber bottom.

3.5.2.5 The Global Water WS300 wastewater sampler will function only if the battery plug is securely fastened into the battery socket on the control panel and the float sensor plug is inserted into its socket.

3.5.2.6 Set the composite sample interval. For composite samples it will be 1h, or 1 hour.

3.5.2.7. Set the composite sample size. For composite samples it will be the mark between 100 ml and 200 ml. This mark corresponds to 150 ml. (With these settings, the sampler will draw a 150 ml sample every hour for 24 hours. The total composite sample volume should approximate 3.6 liters, or about 1 gallon.)

3.5.2.8. Turn the sampling unit ON. (Switch is on the control panel) and verify the sampler is operating. The unit should go through a sample cycle.

NOTE: If the unit does not start the sample cycle press the pump test button to initiate a sample. If the pickup strainer is under water the bottle will fill to the desired level then the pump will back flush the pickup hose to clear it.

3.5.2.9. For grab samples, using the Global Water WS700, set up the unit as described above. Set the size to 500 ml. Push the pump test button. The WS700 collects a 500 ml sample. Repeat as necessary to obtain sufficient sample volume. Be sure to note the time of the grab sample on the chain of custody form.

3.5.2.10. Cover the opening of the jug and shake the large sample jug from the auto-sampler 5 times.

3.5.2.11. Pour the effluent into a smaller container if you wish.

3.5.2.12. Pour the sample effluent into the CBOD5 lab bottle.

3.5.2.13. Pour sample effluent from the large container into the TSS lab bottle

3.5.2.14. Pour sample effluent from the large container into the second TSS lab bottle

3.5.2.15. Pour sample effluent from the large container into the TP lab bottle.

3.5.2.16. Pour sample effluent from the large container into the nitrate lab bottle.

3.5.4 CHAIN OF CUSTODY

The Monroe County Health Department's Chain of Custody Form (See Appendix 1) shall be used for all sample collections. This form corresponds to sampling events for a 24 hour period for one wastewater system. Samplers shall sign when the cooler is relinquished to a shipper. The laboratory attendant shall sign when received by the shipping agent. This insures accountability for sample integrity. Copies of the chain of custody forms shall be retained during the period of sampling and analysis.

3.5.5 SAMPLE LABELING

Sample containers from the laboratory are marked: influent composite CBOD5, influent composite TSS, Effluent Grab CBOD5, etc. etc***. Be sure that your sample corresponds to the label provided by the laboratory***. The name of the sample will be:

Householder's last name + System I.D. number from this protocol. To insure accuracy of the sample, label bottles prior to field use. This will minimize the possibility of mislabeling the samples.

For example: **COVERT OWNRS 7**

COOPER INTERIM 4

NEGRON OWNRS 8

3.5.6 DUPLICATES AND FIELD BLANKS

3.5.6.1 DUPLICATES

During Phase 2, two duplicates will be created for each 24 hour system-sampling cycle. An effluent composite duplicate will be created. Also, an effluent grab sample duplicate will be created on the first grab sample according to when the sampling scheme commences. For example, if the field sampler begins sampling the wastewater system at 10:00 AM, then the 10:00 AM effluent grab sample will have a duplicate. This is to take advantage of the fact that the first grab sample will be taken from a full sample port.

3.5.6.1.1. Collect enough effluent to fill 2-series of sample bottles. (8 bottles total)This should be approximately 3 L.
3.5.6.1.2. Fill the sample bottles.
3.5.6.1.3. Label the bottles with the time of the sample and mark "DUPLICATE"

3.5.6.2 FIELD BLANKS

For each cooler of samples taken from the 24-hour wastewater sampling regime, a representational field blank will be included. Be sure your field blank is added to the appropriate QC lab bottles. Mark on the MCHD Internal chain of custody whether it is "tap water" or "distilled water".

3.6 SAMPLE ANALYSIS

3.6.1 LABORATORY SUBMISSIONS

The effluent composite sample shall be analyzed for CBOD5, TSS, TN and TP using the provided chain of custody and laboratory containers from Advanced Environmental Laboratories. The effluent composite sample shall be analyzed for fecal coliform and pH using the chain of custody provided by Synagro Laboratories.

3.6.1.1 ADVANCED ENVIRONMENTAL LABORATORIES

Batched samples for $CBOD_5$, TSS, TN and TP shall be submitted to the qualified laboratory daily. The sample batch of 9 – 12 sample aliquots shall be packed in ice, securely sealed to

prevent water loss from the cooler, and marked "WATER SAMPLES". All necessary shipping information, including the method of payment shall be included on the shipping label. Call the shipping company to insure proper pick-up as valid sample analysis is dependent on maintaining proper holding times. Make a copy of the chain of custody form and retain in the MCHD records.

3.6.1.2. SYNAGRO LABORATORY (Phase 2 only)

Samples for fecal coliform and pH will be submitted to the Synagro laboratory in Marathon on a daily basis. Samples will be collected in 100 mL whirlpacks. Keep samples at 4 degrees C. Observe the 6-hour holding time.

3.6.2. HACH KIT ANALYSIS PROTOCOL

Samples for field analysis will be drawn from the effluent composite sample. Sample shall be maintained at 4 degrees C. Field analysis will be conducted by Monroe County Health Department staff. Field analysis will be conducted for the following analytes: PO4-P, NH3-N, NO3-N, visual, olfactory, alkalinity, pH. The following is largely excerpted from the manufacturer's instructions.

3.6.2.1 PHOSPHORUS (Reactive vs Total) AS PO4-P

NOTE: Total Phosphorus cannot be easily measured with the Hach kit. Reactive Phosphorus (Equivalent to EPA Method 365.2) can be used as a proxy measure of total Phosphorus. This study will undertake a comparison of laboratory analysis data for Total Phosphorus with Hach kit measurement data for Reactive Phosphorus to determine if there is an association.

3.6.2.1.1. {Calibrate test equipment using a standard solution}
3.6.2.1.2 Enter the stored program number for reactive phosphorus (PO_4), Test'N'Tube. Press: **PRGM**, the display will show **PRGM ?.**

3.6.2.1.3. Press: **82 ENTER** The display will show mg/L, PO_4 and the ZERO icon.

3.6.2.1.4. Insert the COD/TNT adapter into the cell holder by rotating the adapter until it drops into place. Then push down to fully insert it.

3.6.2.1.5. Use a TenSette Pipet to add 5.0 mL of sample to a Reactive Phosphorus Test'N'Tube dilution Vial. Cap and mix.

3.6.2.1.6 Clean the outside of the vial with a towel

3.6.2.1.7. Place the sample vial into the adapter. Push straight down on the vial until it seats solidly into the adapter.

3.6.2.1.8. Tightly cover the sample vial with the instrument cap.

3.6.2.1.9. Press: ZERO The cursor will move to the right, then the display will show: 0.00 mg/L PO4

3.6.2.1.10. Using a funnel, add the contents of one PhosVer 3 Phosphate Powder Pillow to the vial.

3.6.2.1.11. Cap the vial tightly and shake for 10-15 seconds.

3.6.2.1.12. Press: TIMER ENTER A 2-minute reaction time will begin

3.6.2.1.13. Immediately after the timer beeps, place the sample vial in the adapter.

3.6.2.1.14. Push straight down on the top of the vial until it seats solidly in the adapter.

3.6.2.1.15. Tightly cover the vial with the instrument cap.

3.6.2.1.16. Press: READ the cursor will move to the right, then the result in mg/L phosphate (PO_4) will display.

3.6.2.1.17. Empty used sample contents into a holding container. This container will be neutralized and placed in the solid waste after sampling is complete.

3.6.2.2 NITRATE (high range, Test'n'Tube, Chromotrophic Acid Method) AS NO3-N

3.6.2.2.1. {Calibrate test equipment using a standard solution}

3.6.2.2.2. Press the "PRGM 7" key. The display will show "PRGM ?"

3.6.2.2.3. Press "TIME 5" then "PRGM 7" (57) and then press "ENTER" The display will show mg/L, NO3-N and the ZERO icon.

3.6.2.2.4. Insert the COD/TNT adapter into the cell holder by rotating the adapter until it drops into place. Then push down to fully insert it.

3.6.2.2.5. Remove the cap from a Nitrate Pretreatment Solution Vial and add 1 mL of sample. (the blank)

3.6.2.2.6. Cap the tube and invert 10 times to mix

3.6.2.2.7. Clean the outside of the vial with a towel

3.6.2.2.8. Place the blank in the vial adapter with the Hach logo facing the front of the instrument. Press straight down on the top of the vial until it seats solidly into the adapter.

3.6.2.2.9. Cover the vial tightly with the instrument cap.

3.6.2.2.10. Press "ZERO" The cursor will move to the right, then the display will show 0.0 mg/L NO3-N

3.6.2.2.11. Remove the vial from the instrument. Remove the cap from the vial.

3.6.2.2.12. Using a funnel, add the contents of one NitraVer X Reagent B Powder Pillow to the vial. Cap. Invert 10 times to mix. (this will be the prepared sample)

3.6.2.2.13. Press "TIMER CE" and "ENTER". A five minute reaction period will begin. Do not invert the vial again.

3.6.2.2.14. After the timer beeps, clean the outside of the vial with a damp towel and follow with a dry one to remove fingerprints and other marks.

3.6.2.2.15. Place the prepared sample in the adapter with the Hach logo facing the front of the instrument.

3.6.2.2.16. Cover the vial tightly with the instrument cap.

3.6.2.2.17. Press "READ" The cursor will move to the right, then the result in mg/L nitrate nitrogen (NO_3 – N) will be displayed.

3.6.2.2.18. Record the results on the MCHD Internal chain of custody form.

3.6.2.2.19. Empty used sample contents into a holding container. This container will be neutralized and placed in the solid waste after sampling is complete.

3.6.2.3. NITROGEN (Ammonia, High Range, Test'n'Tube. Salicylate method) AS NH3-N

3.6.2.3.1. {Calibrate test equipment using a standard solution}

3.6.2.3.2. Press the "PRGM 7" key. The display will show "PRGM ?"

3.6.2.3.3. Press "CONC 6" and "PRGM 7" (67) ,then press "ENTER". The display will show mg/L NH3-N and the ZERO icon.

3.6.2.3.4. Insert the COD/TNT adapter into the cell holder by rotating the adapter until it drops into place.Then push down to fully insert it.

3.6.2.3.5. Remove the caps from 2 AmVer Diluent Reagent high range vials. Add 0.1 mL of sample to one vial (the sample) Add 0.1 mL of deionized water to the other vial. (the blank)

3.6.2.3.6. Add the contents of 1 Ammonia Salicylate Reagent Powder Pillow for 5 mL sample to each vial.

3.6.2.3.7. Add the contents of 1 Ammonia Cyanurate Reagent Powder Pillow for 5 mL Sample to each vial.

3.6.2.3.8. Cap the vials tightly and shake thoroughly to dissolve the powder.

3.6.2.3.9. Press: "TIMER CE" then "ENTER". A 20 minute reaction period will begin.

3.6.2.3.10. Clean the outside of the vial with a towel. After the timer beeps, place the blank into the vial adapter. Tightly cover the vial with the instrument cap.

3.6.2.3.11. Press: "ZERO 0" The cursor will move to the right, then the display will show: 0.00 mg/L NH3-N

3.6.2.3.12. Place the prepared sample in the adapter. Push straight down on the top of the vial until it seats solidly into the adapter.

3.6.2.3.13. Tightly cover the vial with the instrument cap.

3.6.2.3.14. Press: "READ" the cursor will move to the right, then the result in mg/L NH_3 – N will be displayed.

3.6.2.3.15. Record the result on the chain of custody form.

3.6.2.3.16. Empty used sample contents into a holding container. This container will be neutralized and placed in the solid waste after sampling is complete.

3.6.3. VISUAL / OLFACTORY PROTOCOLS

According to the Franklin County Board of Health (Franklin, Ohio) there was no significant difference between visual and olfactory assessment methods for BOD_5 and TSS, and effluent laboratory tests of aerobic treatment units. Based on these results the MCHD will make similar comparisons in this study using the following protocols:

3.6.3.1. Two assessors will be used. One assessor will take effluent samples, the other will do the effluent V/O assessment

3.6.3.2. Exclusion criteria for the V/O vs Laboratory assessment will be : obvious wastewater surge causing bypass of treatment, waste strength not typical of household waste, and/or electrical hazards exist.

3.6.3.3.. Access the effluent sample point according to the system schematic. Transfer at least 300 ml of effluent into the V/O analysis container. (provided in the laboratory cooler-kit)

3.6.3.4. Determine effluent discharge color using the following rating scale:

Colorless
Grey
Black

3.6.3.5. Determine the effluent discharge odor using the following rating scale;

No odor or musty
Septic odor

3.6.3.6. Record V/O observations on the MCHD Internal chain of custody form.

3.6.4. ALKALINITY (USE TAYLOR TEST KIT)

3.6.4.1. After inverting the composite sample 5 times, pour sufficient amount of sample into a graduated cylinder.

3.6.4.2. Pour sufficient volume of liquid analyte into the Taylor Test Kit analysis large compartment tube to 25 ml mark with water to be tested.

3.6.4.3. Add 2 drops R-0007, swirl to mix.

3.6.4.4. Add 5 drops R-0008, swirl to mix

3.6.4.5. Add R-0009 drop-wise. After each drop count and swirl to mix until color changes from green to red.

3.6.4.6. Multiply drops in Step 4.0.4.5 by 10. Record as ppm total alkalinity as Calcium carbonate on MCHD Internal chain of custody

3.6.5. pH ANALYSIS (USE TAYLOR TEST KIT)

3.6.5.1. After inverting the composite sample 5 times, pour a sufficient amount of sample into a graduated cylinder

3.6.5.2. Pour sufficient volume of liquid sample into the Taylor Test Kit analysis large compartment tube to 44 ml mark with water to be tested

3.6.5.3. Add 5 drops R-0004, cap and invert to mix

3.6.5.4. Match color with color standard. Record as pH units on MCHD Internal chain of custody.

Appendix 1

DIVISION OF Environmental Health

MONROE COUNTY HEALTH DEPARTMENT

50 High Point Road Suite 104

Tavernier, Florida 33070

HEALTHY PEOPLE HEALTHY COMMUNITY

SYSTEM I.D. _____

2007 OWNRS / ATU SAMPLING LOG (Phase II - OFF-SEASON)

PHONE: (305) 853-1900 FAX: (305) 853-1909

Signature of Sampler: ----------

Print Name:

MCHD INTERNAL CHAIN OF CUSTODY
ONSITE WASTEWATER NUTRIENT SYSTEM
PERFORMANCE ASSESMENT

SAMPLE IDENTIFICATION							HACH FIELD DATA			TAYLOR KIT		Observer	SYNAGRO
SAMPLE NUMBER	SAMPLE TYPE	DATE	TIME	AEL LAB I.D.	WATER METER***	Number of containers	NO3-N	NH3-N	PO4-P	pH	Alkalinity	V/O ****	Fecal Coliform
001	IN COMP												
002	EF COMP												
003	EF COMP DUP												
004	GRAB												
005	GRAB DUP**												
006	GRAB												
007	GRAB												
008	GRAB												
009	FIELD BLANK*												

Relinquished by / Affiliation	DATE	TIME	Accepted by / Affiliation	DATE	TIME

NOTES FOR SAMPLERS:

* Specify distilled or tap water for blank.

** Closely follow protocol for grab duplicates

*** Record actual meter readings

**** See protocol for V/O coding

CANAL

REFERENCES

1. ***Wastewater Sampling for Process and Quality Control***; Task Force on Wastewater sampling for Process and quality Control; under the direction of the Operations and Maintenance subcommittee of the Technical Practice Committee. Copyright 1996 by the Water environment Federation, ISBN 1-57278-037-1

2. ***Onsite Wastewater Treatment Systems***, Burks, Bennette D., and Minnis Mary Margaret, 1994, Published by Hogarth House Ltd. ISBN 0-9641049-0-3

3. ***Hach DR/890 Colorimeter Procedures Manual***, Hach Company 1997-2000

4. ***Multi-Flo Wastewater Treatment Systems Manual for Operations, Maintenance and Troubleshooting***. Consolodated Treatment Systems Inc., retrieved from the worldwide web on December 8, 2006: www.consolidatedtreatment.com/manuals/Multi-Flo_Maintenance_Manual.PDF

5. ***Whitewater Treatment Systems UC O&M Manual,*** Delta Environmental Products. Retrieved from the worldwide web on December 8, 2006. www.deltaenvironmental.com/literature

6. ***Bio-Microbics Inc. Service Manual***, 2003 Revised august 2003,Bio-microbics, retrieved from the worldwide web on December 8, 2006, www.biomicrobics.com/downloads/FAST_Service_Manual.pdf

7. ***FS 2400 Wastewater Sampling DEP-SOP-001/01*** Florida Department of Environmental Protection, Standard Operating Procedures for Wastewater Sampling., Retrieved from the worldwide web on December 8, 2006:
8. ftp://ftp.dep.state.fl.us/pub/labs/assessment/sopdoc/2004sops/fs2400.doc

9. ***Global Water Instrumentation, Inc. WS700 Sampler Owners Manual***, retrieved from the worldwide web on December 8, 2006; http://www.globalw.com/downloads/WS/WS700.pdf

10. ***Global Water Instrumentation, Inc. WS300 Sampler Owners Manual***, retrieved from the worldwide web on December 8, 2006; http://www.globalw.com/downloads/WS300/WS300manual.pdf

11. ***La Pine National Demonstration Project, Onsite Wastewater System Sampling Plan***, Retrieved from the worldwide web on December 8, 2006: http://marx.deschutes.org/deq/WWSampPlan.htm

12. ***A Visual/Olfactory Assessment Tool that Accurately Predicts the Operational Status of Aerobic Treatment Units When Compared to biochemical Oxygen demand and suspended solids Effluent Sample Results,*** Rosile, Paul, MPH, RS, Assistant Health Commissioner for Environmental Health, Franklin County Board of Health, Columbus, Ohio. Presentation At-06-24, In: 2006 NOWRA Technical Education Conference Proceedings (CD), held August 28-31, 2006 in Denver. Edgewater, MD: NOWRA

FY 2005 SECTION 319 GRANT PROPOSAL APPLICATION

PROJECT: Assessment of water quality protection by advanced onsite sewage treatment and disposal systems: performance, management, monitoring

PROJECT FUNDING: $300,000.00 **FY05 319** $200,000.00 **Match**

LEAD ORGANIZATION: FL Department of Health, Bureau of Onsite Sewage Programs

COOPERATING ORGANIZATIONS: Monroe County Health Department

PROJECT ABSTRACT: This project will assess water quality protection by advanced onsite sewage treatment and disposal systems. Three aspects will be considered: Performance of treatment systems in terms of operational status and treatment effectiveness of nitrogen, biological oxygen demand and suspended solids, and to a lesser extent phosphorus and fecal coliform; Management of such systems by surveying owners/users, maintenance entities and regulators; Monitoring of systems by developing and validating a qualitative monitoring protocol. Detailed data from Monroe County, where large numbers of such systems are installed, will be complemented with samples from the rest of the state.

PROJECT LOCATION AND WATERSHED CHARACTERISTICS: Statewide; Monroe County (match project)

Watershed Name: Florida Bay-Florida Keys (match project)
Latitude: 26.00
Longitude: 81.00
Hydrologic Unit Code(HUC): 03090203

POLLUTION REDUCTION STRATEGY: Increased pretreatment and in particular nitrogen removal in onsite systems to reduce nitrogen concentrations before the effluent reaches the groundwater. This strategy addresses Goals 3 and 4 of the DEP's Action Plan for Onsite Wastewater NPS Management Program.

PROJECT OBJECTIVE(S): Quantify the reduced loading of contaminants from advanced onsite sewage treatment and disposal systems (OSTDS) to the environment; assess the operational status of systems under the current management framework; survey perceptions of user groups regarding the management of such systems; validate elements of a monitoring protocol for consistent assessment of systems; document good management practices.

PROJECT DESCRIPTION:

Problem: Onsite sewage treatment and disposal systems (OSTDS) are one of the nutrient sources in nutrient impaired watersheds. Estimates of the extent of their contribution to nitrogen loadings for different watersheds in Florida have ranged between less than five and 20%. Conventional OSTDS (septic tank-drainfields) have limited capacity to reduce nitrogen concentrations in water discharged to the drainfields. Because of this, residential density limitations have been used as one approach to meet the nitrate drinking water standard of 10 mg/L, which is not necessarily protective of ecological health. The phosphorus loading from OSTDS has been of most concern in the Florida Keys, where small lots and poor soils and building practices increased the risks of impacts on surface water.

To achieve higher reductions of nutrient concentrations, additional treatment steps in OSTDS are necessary. Advanced OSTDS can utilize various approaches to improve treatment before discharge to a drainfield, or the drainfield itself can be modified. On occasion, engineers have included the drainfield as part of the treatment process, usually as means to achieve fecal coliform removal. In such cases, the engineer is required to include shallow groundwater monitoring wells in the monitoring plan.

The emphasis of this study will be on assessing the effectiveness of pretreatment before discharge to the drainfield. There are two large permitting categories in Florida onsite regulations that qualify as advanced

treatment: Aerobic Treatment Units (ATUs) (Florida Administrative Code 64E-6.012), which are generally permitted based on certification by the National Sanitation Foundation; and performance-based treatment systems (PBTS) (Florida Administrative Code 64E-6, part IV), which are permitted based on design by an engineer experienced in wastewater. A third permitting category, rarely used, consists of engineer-designed alternative systems, such as sand filters.
Advanced systems have been required by local regulations, at least in part, with the objective to reduce nitrogen loading to sensitive areas (Florida Keys, St. George Island, Aucilla and Suwannee River floodplains, Volusia County). In addition, Florida Administrative Code (FAC) 64E-6 requires advanced treatment, sometimes including nitrogen and fecal coliform removal, for lots where the usually required setback or authorized lot flow restrictions cannot be met.

Advanced systems differ in three aspects from conventional treatment systems consisting of a septic tank with drainfield. The design of advanced systems is more variable than the prescriptive approach for conventional systems. They need more frequent checkups and maintenance, which has been the reason for requiring operating permits for them. The performance expectations are more specific than absence of sewage on the ground surface, while failure definitions for advanced systems are more vague. The first two issues have been challenges for the permitting process. Site specific performance specifications are not captured completely in the three databases that are used statewide for tracking permits, two that were developed for conventional system permitting for the state, and one that was developed for inspection tracking by Carmody, Inc. The third issue has made it hard to determine how well this aspect of Florida's onsite program is working. Until early 2001, operating permit fees allowed County Health Departments to perform limited sampling. In 2001, the legislature decided to limit operating permit fees. Since then, there has been no systematic statewide assessment of the management and performance of these systems. The proposed project aims to perform such a statewide assessment and develop improvements in the management of advanced systems where indicated.

Proposed Project: The project to be performed statewide, and in particular in Monroe County, will evaluate the performance, management and monitoring of advanced systems in Florida.

TASKS:

Task 1:

Monroe County detailed study of diurnal and seasonal variability of performance of advanced systems [Monroe County Project]

The Department of Health, Bureau of Onsite Sewage Programs (Bureau), has allocated $200,000 of research funds to contribute to the assessment in Monroe County. After two failed attempts to find an outside contractor for this study, both Bureau and County Health Department (CHD) staff have decided to implement this study using CHD personnel.

The Monroe County Health Department (MCHD) staff will select a sample of up to nine nutrient-reducing systems and up to four ATUs. Criteria for inclusion are currency of operating permit, year-round use, and willingness of the system user to participate. As part of this task, Bureau and MCHD staff will develop assessment procedures for the performance of advanced systems, including the sampling and monitoring methodology. Repeated sampling will be performed to characterize the variability of the performance of such systems in detail.

Deliverables: Validated sampling procedures; Sampling results from Monroe County; Report containing analyses for diurnal and seasonal variability using Keys data

Task 2:

Development of a statewide database of advanced systems based on permit records [Database]

The primary function of this statewide database will be to store and provide information for this project. A second function will be to serve as an assessment tool of the completeness of the source databases.

Systems to be included will be:
-PBTS (of which nutrient reducing and innovative systems are a subset)
-ATUs (including engineer-designed ATU with drip irrigation)
-Engineer-designed sand filters and other alternative systems
The proposed methodology for the development of this database is as follows: The database will contain information about permit records, system types, property location and contact information, components used, maintenance, monitoring, inspection and sampling results, performance specifications, and system location. Data fields will be based largely on the existing databases: the statewide permitting databases CENTRAX and CENTRAX-Rehost, and the Carmody Program maintenance database, which is capable of receiving data from CENTRAX. The project database will be compatible with these databases in so far as it will be capable of receiving suitably formatted data dumps from them.

Information will be extracted from these database sources by querying for the system types of interest. The result of merging these records and supplementing the information with any additional records provided by county health department staffs will be a database of all advanced systems identified at the time of completion of the database. All addresses shall be geocoded to the best extent possible in order to allow for mapping and trip planning. Comparison of the results from different databases with each other and with the project database will allow an assessment of relative completeness of records and data fields.

The project database will be used for the tracking of systems during the project and for other tasks, such as for survey mailing addresses and selection of systems to be sampled. The project database will also be available to update the source databases. This update is outside of the scope of this project, because the permitting databases are currently not capable of uploading additional records and the extent of needed data entry is difficult to predict.

This task will be implemented by a temporary staff position and/or intern with assistance from Bureau staff in conjunction with County Health Departments. For the purposes of budgeting, two months of contract staff at the base salary of an Environmental Specialist III are assumed.

Deliverables: Description of advanced systems database, including fields and structure; summary statistics of the results of the data aggregation, such as number of each type system, number of advanced systems by county, etc.

Task 3:

Elucidation of the perceived strengths and areas for further improvement of the current management of advanced onsite systems [Surveys]

Surveys of system owners/users, installers, engineers, manufacturers, maintenance entities and regulators will be used to evaluate the perceptions and experiences with operation, maintenance, performance and other issues relating to advanced onsite systems.

Onsite regulators may be surveyed initially to help in developing the database of advanced systems. Surveying tools may differ by stakeholder group, such as electronic surveys for regulators, phone surveys for maintenance entities, a combination of mail, phone and electronic tools for onsite system users. If feasible, information about county health department, manufacturer or maintenance entity will be linked to responses to assess if strengths or areas for further improvement are statewide or specific to an organization. Differences between county health department, manufacturer or maintenance entities can provide leads to best practices for follow-up during Task 6.

A third party will undertake the implementation of surveys. Questions and the detailed methodological approach will be developed by the vendor in coordination with Bureau staff with some common questions complemented by user group specific questions. The exact number of surveys and the format for distribution will be determined after Task 2. Initial contact has been made with state university system survey labs for purposes of verifying costs and timelines. For budgeting purposes the upper limit of a purchase order was used.

Deliverables: Survey forms, raw survey results, analysis of results

Task 4:

Statewide assessment of operating conditions and performance of advanced onsite systems [Assessment of Operational Status and Performance]

A random selection of advanced systems will be inspected and sampled in coordination with annual county health department inspections. The systems will be selected based on the Task 2 project database. If manufacturer information and system type are available initially for at least half of the systems, the sampling will be stratified to assure proportional representation of manufacturers and system types. The final subgroup categories and sizes will be determined with input from RRAC and consideration of results of Task 1. A very general approach could consist of an assessment if differences between two subgroups in exceeding the common concentration median are significant at some level of significance (e.g. 0.05). The group size determines then how large a difference can be detected at that significance level. To give an example in which two subgroup sizes are equal: for fifty (50) systems a difference between 60% exceedance of the median in one group and 40% exceedance in the other group is significant, while for 10 systems only a difference between 75% and 25% is significant.

A Quality Assurance Project Plan (QAPP) will be developed, with input from the Research Review and Advisory Committee, based on the results of Tasks 1 and 3. The standardized protocol developed in Task 1 will be modified as needed and used in the sampling and qualitative assessment. Available inspection and sampling records will be added to the project system database. During each inspection, the configuration of the unit will be compared to permit records as available and characterized. Evaluation criteria may include: operating permit status; maintenance inspection status; presence of sewage outside of treatment receptacles; operational status of the unit; and qualitative assessment of effluent. Sampling results of effluent (BOD, TSS, and TN) will be determined for all systems. Fecal coliforms and TP will be sampled where lab facilities are close enough to meet holding times. These analyses will allow an assessment of how frequently secondary and advanced secondary effluent concentration standards for fecal coliforms and TP are met. For budgeting purposes, it is assumed that half of all systems sampled will be analyzed for fecal coliform and TP.

The emphasis of the sampling will be on effluent quality. While the final number of samples will depend on budget and time constraints and preferences of the Research Review and Advisory Committee, the initial target will be approximately 600 samples. About 600 samples will allow for 95% confidence that the median is between the 46^{th} and 54^{th} percentile of measured effluent concentrations. To reduce this confidence interval by two percentage points would require nearly doubling the number of samples. About 600 samples will also allow estimation of the 10^{th} and 90^{th} percentile within 2.5%.

In order to determine reduction of contaminants, some measure of influent strength will be necessary. The ability to measure influent strength depends on the presence and accessibility of a settling tank that feeds the treatment unit, which may well only be determined during the site visit. Therefore, influent sampling at this stage will be a convenience sample. These systems will also be noted for inclusion in Task 5. With 100 influent samples, the budget assumption, we can be 95% confident that the true median influent concentration is between the 40^{th} and 60^{th} percentile of the measured influent concentrations. The number of influent samples is smaller than the number of effluent samples because no treatment-type specific differences in influent strength are expected and effluent concentrations are more important in terms of environmental effect.

Several issues may arise, which could result in a modification of this proposed approach and reallocation of proposed budget, which would be undertaken in coordination with FDEP. The time required to coordinate inspections with County Health Departments and reach the sites may be so long that less than the anticipated four systems per day can be accomplished. This will depend in part on the balance between counties with few systems and many systems and on access to laboratories. Access to sampling ports may be sparse, resulting in a relatively large number of field visits with a smaller number of samples, or in a much larger fraction of effluent samples than influent samples. If a qualitative method is available and validated that can indicate lack of functioning without sampling, the number of samples for cBOD5 and TSS could be reduced. Effective analytical costs could be higher or lower than the assumptions in the budget. Optimization of travel may result in samples not being randomly distributed over the state and sampling period.

This task will be implemented by trained contract staff in coordination with county health department inspectors and Bureau staff. The coordination with county health department inspections will provide contract staff with an opportunity to train county health department staff on effective inspection procedures.

For the purposes of budgeting, 12 months of contract staff at the base salary of an Environmental Specialist III are assumed. The contract staff shall hold a current OSTDS certification. The budget is based on estimated costs for 700 samples from 600 systems and an additional 10% QA/QC samples. NELAP-certified laboratory services will be provided by DOH-labs, or procured in a set of purchase orders with local labs, or by contract with regional labs.

Deliverables: QAPP for Tasks 4 and 5; inspection results for approximately 600 systems, system descriptions, and rates of exceedance of evaluation criteria in final project report

Task 5:

Quarterly influent and effluent sampling for a sample of advanced systems [Assessment of Annual Variability of Performance]

Annual variability of effluent and influent quality will be assessed for a selection of volunteer systems. These systems will be from counties where regular sampling is feasible based on staffing qualifications and numbers of systems. Initial candidates are Lee, Monroe, Charlotte, Brevard, Franklin, and Wakulla counties. Recruitment will begin with the survey of Task 3. Depending on the level of recruitment, volunteers will also be solicited among systems for which influent samples were taken during the first few months of executing Task 4. All systems will be sampled for BOD, TSS, and TN in effluent and influent, and for fecal coliform and TP for approximately half of the total number of systems sampled with a preference for advanced secondary systems. One of the sampling events at each site can be coordinated with the yearly CHD inspection.

This task will be implemented by trained contract staff in coordination with county health department inspectors and Bureau staff. For the purposes of budgeting, three (3) months of contract staff time at the base salary of an Environmental Specialist III are assumed. The contract staff shall hold a current OSTDS certification. The budget is based on estimated costs for influent and effluent samples for 70 sites. This task will have three separate sampling events for each site with the first sampling event preferably completed in Task 4. If none or few of the volunteer sites were part of the random sample of Task 4, the number of sampled systems may have to be reduced within the overall budgeted cost or an amendment to increase funding may be necessary. NELAP-certified laboratory services will be provided by DOH-labs, or procured in a set of purchase orders with local labs or by contract with regional labs.

Deliverables: Sampling; tabulation of sampling results; and, evaluation of seasonal variability of sampled systems

Task 6:

Documentation of good maintenance management programs by CHD and maintenance entities [Management Practices]

During Task 2 several county health departments and maintenance entities will be selected to quantify and characterize steps in the management of advanced systems. The counties and maintenance entities will be among those with many systems and/or for which survey results indicated a relatively high satisfaction by user groups. Each selected entity will participate in a characterization of the status of management of advanced onsite systems. The characterization will include detailed information on the number and types of advanced systems; compliance and enforcement rates; systems used for tracking compliance; the presence, and responsiveness of maintenance entities and county health departments; the role of education of stake holders, and management costs. The collected experiences and viewpoints from the county health departments and maintenance entities will outline strengths as well as areas for further improvement in the management of advanced onsite systems. The experience of these entities will be documented and illustrated in a case studies booklet that will be published on the Department's web site and distributed in limited amounts in hard copy format. If additional publication needs are warranted beyond this project's budget, a separate project with other funding will be used to accomplish the printing.

This task will be implemented by a contract staff position and/or interns with assistance from Bureau staff. For the purposes of budgeting, three (3) months of contract staff at the base salary of an Environmental Specialist III are assumed.

Deliverables: Characterization outcomes in report format; booklet with case studies outlining both strengths and areas for further improvement of the current program and best management practices in advanced onsite systems management uploaded on the DOH web site and distributed in limited amounts in hard copy format

Task 7:

Project administration

Administrative responsibilities will include project oversight, financial accounting, invoicing, and grant reporting to the Florida Department of Environmental Protection. The final project report will include: a description of the project; a summary of the survey results; problems encountered during the project; and a detailed financial accounting of the project costs, including grant and match funding. Copies of scientific or technical publications resulting from this project will be included in quarterly reports. Other work products that are to be submitted to FDEP with the final report or as separate items include sampling results associated with this grant project, copies of related press releases, and meeting agendas, fact sheets or other materials distributed to the public as a direct result of this project.

Deliverables: Quarterly progress reports and invoices submitted to FDEP; preliminary (draft) report; and final project report (five paper copies in addition to an electronic version in either Adobe or Word format); copies of scientific or technical publications resulting from this project (to be included with quarterly progress reports); all other work products associated with this project

PROJECT MILESTONES:

Task	Activity	Start	Complete
1	Detailed sampling QAPP development, staff training	Month 1	Month 3
1	Detailed sampling	Month 3	Month 9
1	Analysis of detailed sampling	Month 9	Month 12
2	Database development	Month 1	Month 6
3	Survey (contracting for services)	Month 2	Month 4
3	Survey (CHDs)	Month 4	Month 6
3	Survey (other stakeholders)	Month 6	Month 12
4	Assessment of Operational Status and Performance	Month 6	Month 23
5	Assessment of Annual Variability of Performance	Month 9	Month 21
6	Case studies of best management practices	Month 13	Month 23
7	Project administration	Month 1	Month 30

PROJECT BUDGET:

Project Funding Activity	319 (h) Amount	Matching Contribution	Match Source**
Staff	$94,259	$0	
Travel	$44,198	$0	
Equipment	$0	$0	
Supplies	$3,618	$0	
Contractual			
Survey (up to)	$25,000	$0	DOH Headquarters contract
Monitoring	$127,925	$0	with Monroe County Health
Task 1 Match Project	$0	$200,000	Department
Public Education	$5,000	$0	
Other:	$0	$0	
Total:	$300,000	$200,000	

**Department of Health Septic Tank Research Fund ($200,000) - Not quantified in-kind contributions will include: QAPP-development, technical assistance, and project administration by DOH research staff. For Task 1, the method of procurement for laboratory analytical services was an ITB, resulting in a contract between Monroe County Health Department and a NELAC-certified lab for analyzing samples from the Florida Keys.

BUDGET BY TASK:

Project Funding Activity	319 (h) Amount	Matching Contribution	Match Source**
Task 1: Monroe County Project		$200,000	DOH Headquarters contract with Monroe County Health Department
Task 2: Database	$9,425.90	$0	
Task 3: Surveys	$25,000	$0	
Task 4: Assessment of Operational Status and Performance	$183,128.40	$0	
Task 5: Assessment of Annual Variability of Performance	$63,306.85	$0	
Task 6: Management Practices	$19,138.85	$0	
Task 7: Project Administration	$0	$0	
Total:	$300,000.00	$200,000.00	

**Department of Health Septic Tank Research Fund ($200,000) - Not quantified in-kind contributions will include: QAPP-development, technical assistance, and project administration by DOH research staff. For Task 1, the method of procurement for laboratory analytical services was an ITB, resulting in a contract between Monroe County Health Department and a NELAC-certified lab for analyzing samples from the Florida Keys.

Evaluating the Environmental Impacts of Onsite Sewage Systems on Surface Waters by Assessing the Effect of Sewering Areas that were Previously Served by Onsite Sewage Systems in the Town of Suwannee, Florida

Florida Department of Health
Bureau of Onsite Sewage Programs

Official Contact and Project Manager:
Elke Ursin
Environmental Health Program Consultant
Telephone: 850-245-4070 x 2708
Fax: 850-922-6969
E-mail: Elke_Ursin@doh.state.fl.us
Postal Address: 4052 Bald Cypress Way, Bin #A08
Tallahassee, Florida 32399-1713

This project does not propose any construction activities, exotic species removal, habitat restoration, or land acquisition.

Grant application for FY 2008-2009 Florida Coastal Management Program

Signed by: _____ Date: _____

Elke Ursin
Environmental Health Program Consultant

Work Plan

1. **Project abstract:** This project is to evaluate the effectiveness of sewering the Town of Suwannee that was previously served by onsite sewage systems. The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs obtained historical sampling data from 1996 and 1997 on pre-construction and immediately post-construction of the sewer infrastructure. By sampling the same locations again, this project will help to evaluate the long-term effect of sewering on water quality.

2. **Project location:** The location of the sample sites are in the Town of Suwannee and the surrounding areas in Dixie County, Florida. The Town of Suwannee lies at the mouth of the Suwannee River as it discharges into the Gulf of Mexico. This is an economically important area for shellfish harvesting as well as recreational activities such as fishing, hiking, and kayaking. In addition to the economic importance of the area, there is also an important environmental impact as well. The mixture of freshwater and marine habitats in this area provide for a unique assortment of wildlife.

   This project is located in or near several designated waterbodies. The town is surrounded by the Lower Suwannee River National Wildlife Refuge which is one of the largest river-delta estuarine systems that is undeveloped in the United States. This refuge is also classified as a Florida Gulf Ecological Management (GEM) Site. This area is also located within the Big Bend Seagrasses Aquatic Preserve. The Suwannee River is listed as an Outstanding Florida Water “Special Waters”. The Suwannee River is also designated Surface Water Improvement & Management (SWIM) project of the Suwannee River Water Management District. The proposed study will help to monitor the quality of water around the most developed portion of this ecologically significant area. This water quality monitoring will help to evaluate the current environmental impact from the Town of Suwannee on the surrounding waterbodies.

   This project is requesting to be considered under the specific initiative category for remarkable coastal places. The unique characteristics that can be found in this remarkable location are becoming increasingly difficult to find as development increases in the State of Florida. Protection of this area can be supported by the research performed in this project, and the results can be applied to other locations throughout the state.

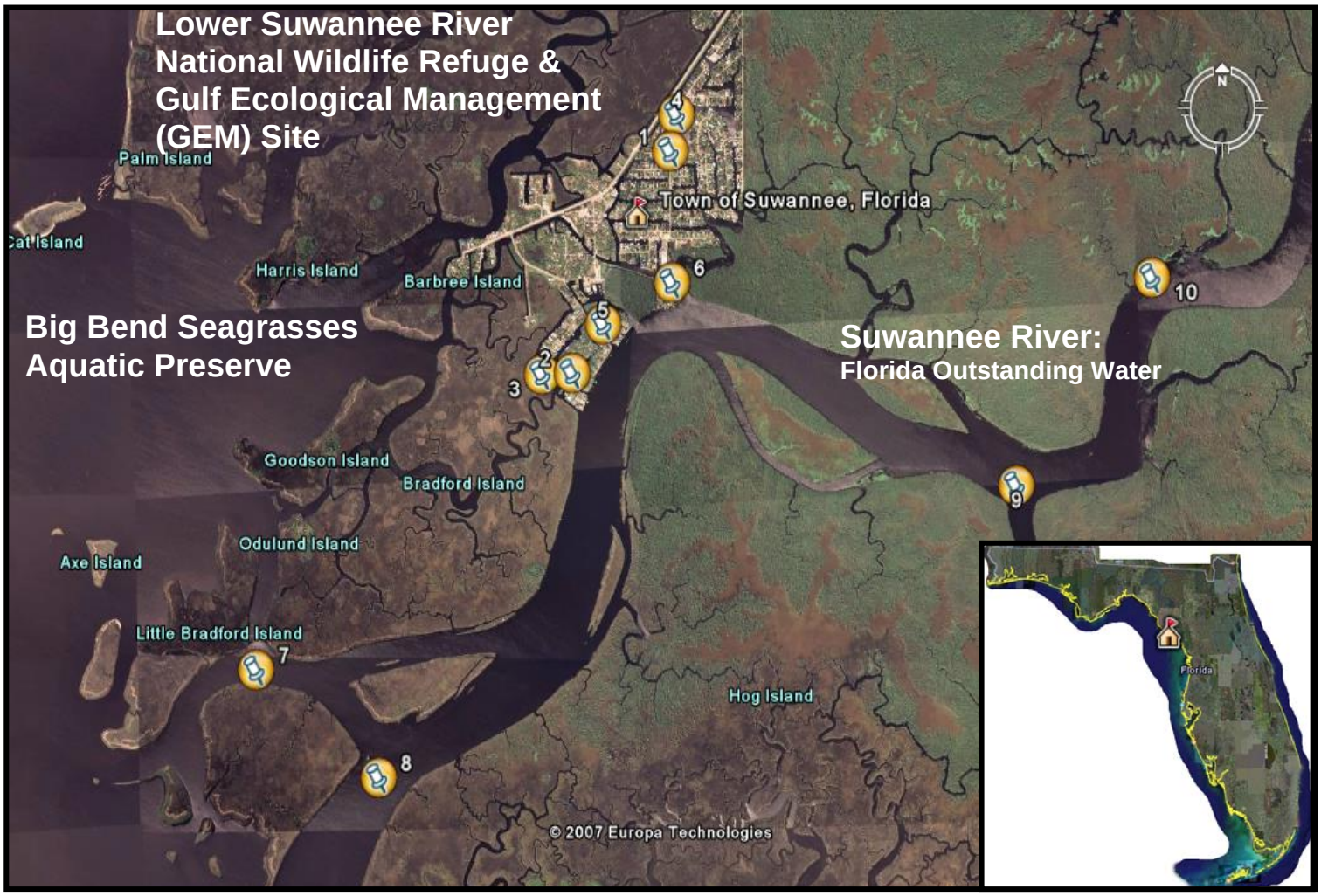


Figure 1. Sample site locations of the 1996/1997 study, Town of Suwannee, Dixie County, Florida

Project Description – Central sewer and wastewater treatment plants (WWTP) are frequently proposed and installed as a solution to water quality problems that are linked to insufficient onsite sewage treatment and disposal systems. Low water quality is usually well documented before the installation of a WWTP. Fewer studies are available that compare the actual improvement of water quality to the expected one. The proposed study will perform such a follow-up for a wastewater infrastructure project in the Town of Suwannee in Dixie County, Florida. The hypothesis is that as central sewer replaces onsite systems, the change in water quality can be measured. This change can then serve as a measure of the previously present impact of onsite systems.

The Town of Suwannee replaced septic systems with a central sewer and WWTP during the period of October 1997 through March 1998. The Florida Department of Health, with funding from United States Environmental Protection Agency's Gulf of Mexico Program, contracted for an evaluation study on the effects of this conversion in 1996. Background and canal locations were sampled weekly for two months in November and December before (1996) and at the end of sewer installation (1997). Water quality parameters monitored were fecal and total coliform, *Salmonella,* total

nitrate + nitrite, total Kjeldahl nitrogen, and other parameters as outlined in Table 1. The study was inconclusive.

From the Executive Summary of the study (Environmental Consulting and Technology, 1998):

> *"This study indicates that the primary source of* Salmonella *is not the Town of Suwannee but rather the Suwannee River upstream of the town." "The fecal coliform concentrations in the canals were very high. There did appear to be improvement in these values during the weekly sampling until the extensive rains began and masked the results. Although an improvement resulting from the WWTP could not be documented during this study, an extensive baseline database has been established that can be readily used for comparison in subsequent years"*

In the proposed project a third set of eight weekly samples will be taken by a contractor during November and December of 2008 at locations as close as possible to the original sampling locations shown in Figure 1. Use of largely the same sites and methods will allow an evaluation of water quality changes in sewered areas (five stations) compared to the Suwannee River upstream and downstream of the town (four stations) and a monitoring well. The parameters that will be sampled are outlined in Table 1. Ten percent of the laboratory samples will have quality assurance / quality control samples taken to verify the accuracy of the results.

Parameter	**Laboratory / Field Sample**	**Pre-construction 1996**	**Post-construction 1997**	**Post-construction 2008**
Total Coliform	Laboratory Sample	x	x	x
Fecal Coliform	Laboratory Sample	x	x	x
Enterococci	Laboratory Sample			x
Salmonella	Laboratory Sample	x	x	x
Total Nitrate + Nitrite	Laboratory Sample	x	x	x
Total Kjeldahl Nitrogen	Laboratory Sample	x	x	x
Total Phosphorus	Laboratory Sample			x
Water Temperature	Field Sample	x	x	x
Conductivity	Field Sample	x	x	x
pH	Field Sample	x	x	x
Dissolved Oxygen	Field Sample	x	x	x

Table 1. Sampling parameters

The results of this project will help to determine whether the installation of the WWTP was an enhancement to this coastal community. This project may help to guide other communities facing similar water quality concerns in making the decision to convert from onsite sewage systems to a more centralized solution.

The proposed project will quantify the water quality impacts of wastewater infrastructure, and evaluate the improvement they caused. By establishing the environmental effects of sewering this area, this project will also contribute to potential

cost benefits of protecting water quality. The methodology and results of this project can be readily transferred to other locations in which historical monitoring data exist. This transfer will be facilitated by publicizing the results of the study to the onsite and wastewater community at conferences, by circulating the report among Florida resource agencies, making the report web-accessible, and by submitting a journal manuscript to a technical journal. Comparison of water quality before and after a wastewater infrastructure measure is the key to determine meaningful environmental benefits. The proposed project will provide a case study of such a determination which can be used as a model for other local governments facing similar issues.

This project will help address two water quality research priorities identified by the Florida Ocean and Coastal Resources Council's FY 2007-2008 Annual Science Research Plan. One is to "assess the effect that human waste management, and septic tank use in particular, has on nutrient loading and water quality in nearshore habitats". Another is to "compare the water quality of coastal waters that are adjacent to land areas that use septic systems versus centralized sewage systems, particularly on islands". Both of these are not included in the top 20 priorities for which the Council has requested funding from the legislature, so there is little potential for duplication of effort.

The Dixie County Local Mitigation Strategy looks at actions "to permanently reduce or eliminate long-term risk to people and their property from the effects of hazards" (June 2004 Draft Dixie County LMS). Adequate wastewater infrastructure and properly functioning wastewater disposal methods (both onsite and offsite) are critical to protecting public health and the environment. This study aims to evaluate the effectiveness of centralized sewer in the Town of Suwannee. Attempts were made to determine who the Local Mitigation Strategy working group chairperson is in Dixie County to obtain a letter of support for this project, and unfortunately this was not resolved in time for this application.

This project directly relates to specific goals in the Dixie County Comprehensive Plan adopted on November 16, 2006. Goal IV-2 is to "ensure the provision of public sanitary sewer facilities in a timely, orderly, efficient and environmentally sound manner at an acceptable level of service for the county's population." Goal V is to "conserve, through appropriate use and protection, the resources of the county to maintain the integrity of natural functions." Both of these critical goals can be supported by this project. Through the evaluation of the effectiveness of the sanitary sewer infrastructure, some of the conclusions can demonstrate how the sewer facilities are operating in an environmentally sound manner, are not detrimentally affecting public health, and are protecting the natural resources of this area.

This project can be completed effectively and efficiently in the one-year time requirement for this Coastal Management Program grant. Project management overall will be performed by contract management staff in DOH's Division of Environmental Health. The Bureau of Onsite Sewage Programs has a nationally recognized research program, and has managed and conducted numerous research projects related to public health and onsite sewage systems since the mid 1980's. The department also has a Research Review and Advisory Committee (RRAC) which consists of nine members from various backgrounds. The represented groups range from an environmental interest group, the home building industry, the real estate profession, a consumer representative, the State University System, the septic tank industry, a professional engineer, the restaurant industry, and the Department of

Health. This committee will be available to review and comment on the design of the project, the selection of the contracted entity who will perform the sampling, data analysis, and the final project report. The proposed study builds upon previous projects, which will facilitate the implementation of this project in cooperation with a contracted entity for data analysis and report writing.

This project proposes no construction activities, exotic species removal, habitat restoration, or land acquisition.

3. Objective –

In order to accomplish the goal of this project, as described above, the following tasks will be performed. See Figure 2 for a diagram of the project timeline.

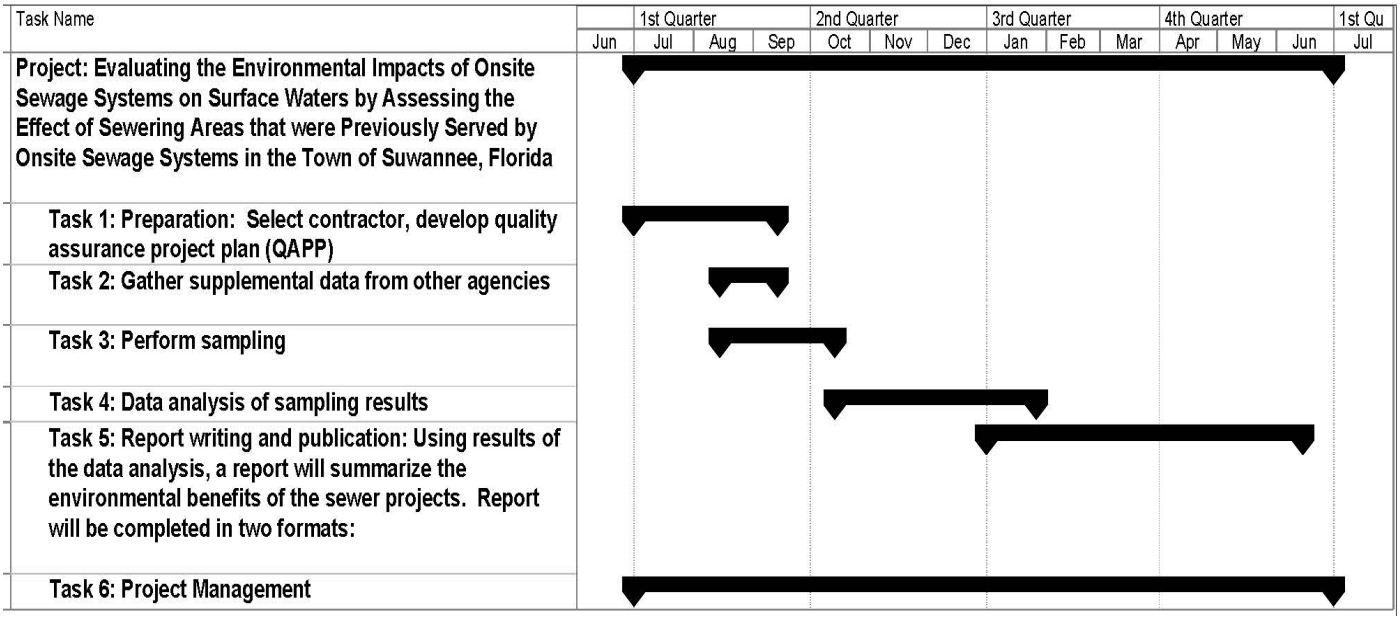


Figure 2. Project timeline, 2008 - 2009

Task 1: *Preparation: Select contractor, develop quality assurance project plan (QAPP)*

DOH will prepare the procurement documents during the first two weeks after the grant award and funds have been made available. DOH will then advertise for and contract with an entity to perform the sampling and analysis. The advertising and contracting process will take approximately one-month. DOH and the contract provider will develop a Quality Assurance Project Plan (QAPP) over one month with input from the Research Review and Advisory Committee (RRAC). This will require at least one site visit during the development of this document. This task will take a total of 2.5 months to complete.

Deliverable: Copy of the procurement document and selection results, copy of the executed QAPP

Task 2: *Gather supplemental data from other agencies*

Gather additional monitoring data and construction data by other agencies, such as the Florida Department of Environmental Protection, the Florida Department of Agricultural and Consumer Services, and the Suwannee River Water Management District. This task will take a total of 1 month to complete.

Deliverable: Copy of complied additional data

Task 3: *Perform Sampling*

Eight weekly samples will be taken during November and December 2008. The following analytes will be sampled: total and fecal coliform, Salmonella, total nitrate + nitrite, and total Kjeldahl nitrogen. Department of Health staff shall attend at least one sampling event. This task will take a total of 2 months to complete.

Deliverable: Copy of sample data in tabular format

Task 4: *Data analysis of sampling results*

Data analysis will address the following question: How much has water quality been affected relative to pre-construction and background stations? This will, at the same time, evaluate what the contribution was from septic systems to the water quality. This task will take a total of 3.5 months to complete.

Deliverable: Copy of data analysis and sample results in draft report format

Task 5: *Report writing and publication*

Using results of the data analysis, the report will summarize the environmental effects of the sewer projects. The report will be produced in two formats. One format will be a report containing project description, data sets, procedures, and summary of the results. This report will be reviewed by the RRAC and DOH. The second format will be a journal manuscript targeted to a municipal engineering audience. This task will take a total of 5.5 months to complete.

Deliverable: Copy of final report and journal manuscript in electronic and hard copy format

Task 6: *Project management*

Administrative responsibilities will include project oversight, financial accounting, invoicing, and grant reporting to the Florida Department of Environmental Protection. DOH will provide copies of all reports to the Florida Department of Environmental Protection and will share results with the general public by posting reports on its web-site and conducting public meetings of the RRAC. DOH and the report authors will work toward presenting the results of the study to the applicable audiences, such as Florida and national onsite and environmental health conferences. This task will be ongoing and will take a total of 12 months to complete.

Deliverable: Quarterly reports to FDEP

4. **Budget –** The Florida Department of Health is requesting $64,860.00 to perform this study. The requested budget for this evaluation is cost effective and reasonable. The proposed project costs about half of what evaluation projects would usually cost because the historical data, before installation of wastewater treatment plants, have already been collected. Not quantified in-kind contributions from the Florida Department of Health will include: QAPP-development, technical assistance, and project administration by DOH staff. No additional funds will be used from other sources to complete the proposed project.

PROJECT BUDGET:

Budget by Funding Activity	**Requested Amount from Coastal Management Program**
Contractual	$64,860.00

Budget by Task	**Requested Amount from Coastal Management Program**
Task 1: Select contractor, development of quality assurance project plan (QAPP)	**$7,000.00**
Task 2: Gather supplemental data from other agencies	**$3,000.00**
Task 3: Perform sampling	**$42,360.00 (see below for breakdown of costs for this task)**

# of Sites	**Price per occurrence**	**Parameter**	**Total Cost**
10	60	TKN, NO2+NO3	600
10	20	total phosphorous	200
10	50	Salmonella	500
10	40	fecal coli and enterococci	400
1	170	10% Quality Assurance / Quality Control Samples	170
10	75	Sampling	750
10	150	additional parameters (field samples/utilization of equipment: temperature, conductivity, pH, DO)	1500
10	45	Transportation	450
10	70	courier service	700
		Total / weekly event	5270
		weekly events *	8
		total analytical budget	42,160
10	20	Installation of site identifying markers	200
		Total Task 3	42,360

Task 4: Data analysis of sampling results	**$7,000.00**
Task 5: Report writing and publication	**$5,500.00**
Task 6: Project management	**$0.00 (in kind match)**
Total Project Cost	**$64,860.00**

References:

Dixie County Comprehensive Plan 2016. Evaluation and Appraisal Report Based Amendments. Adopted November 16, 2006.

Dixie County Local Mitigation Strategy Draft June 2004. http://www.dixieemergency.com/content/56/File/LMS_Draft_June2004_FULL.pdf

Environmental Consulting &Technology, Inc. June 1998. Evaluation of the potential for restoring commercially viable oyster harvesting in Suwannee Sound. Prepared for Florida Department of Health.

Florida Oceans & Coastal Resources Council. FY 2007-2008. Investing in Florida's Coastal & Oceans Future: Annual Science Research Plan.

MEMORANDUM of UNDERSTANDING
BETWEEN
THE FLORIDA DEPARTMENT OF HEALTH
AND
THE UNIVERSITY OF CENTRAL FLORIDA

SUBJECT: Memorandum of Understanding (MOU) for the University of Central Florida (UCF) On-site Wastewater Treatment System Research Project

Purpose. The purpose of this MOU is to allow for the installation and operation of a wastewater treatment system research facility on the UCF campus, which includes disposal of effluent onsite. By signing below, both parties agree to the terms and conditions outlined in this document or any subsequent agreed upon revisions.

Description. The proposed location of the above referenced facility is on a property on which central sewer is currently available. The proposed research includes two types of experimental arrangements: one that captures the effluent and discharges it to the sewer line and one that releases the effluent into the soil to filter to the groundwater table. The Florida Department of Environmental Protection has issued a memo stating that they have no objection to the installation of the research facility and disposal of sewage onsite. The Florida Department of Health (FDOH) has found that parts of the proposed research involves unproven technology that does not satisfy the requirements of Rule 64E-6.026(1)(b), F.A.C., for providing compelling evidence pursuant to requesting an innovative system permit. UCF has stated that research rather than innovative system testing is the purpose of the research facility. FDOH has authority to supervise research on the performance of onsite systems.

In various proposals, UCF has indicated that it intends to research the functioning of three different types of pretreatment processes (recirculating sand filter, subsurface wetland, lined subsoil media filter) and up to three drainfield installations.

Location. The proposed research facility is located at 4000 Central Florida Blvd. in Orlando Florida. The source of the sewage that will enter the research facility is a fifteen person dormitory.

The University of Central Florida agrees:

1. Wastewater that has passed through the research facility will either be pumped back into the sewer line, or discharged into a drainfield; surface discharge will be not permitted and is considered a sanitary nuisance. The location where the effluent is released shall meet rule and statute requirements. Specifically, a minimum seventy-five foot separation from the boundaries of any surface water body, a minimum of two-hundred feet from a public drinking water well, a minimum twenty-four inch separation from the estimated wet season high water table, avoidance of exposure of the effluent to the public either directly or via vectors, and not to exceed 2,500 gallons per day per acre.
2. To submit for review and approval to the FDOH Bureau of Onsite Sewage Programs, prior to implementation of the research facility, the following information:
    a. A quality assurance project plan (QAPP) At a minimum, the QAPP shall address flow, influent quality, and effluent quality for each pretreatment and disposal element.

b. Design details and calculations for proposed experiments with sufficient detail on construction materials and sizes to allow understanding of sizing criteria and re-creation of such pretreatment units and drainfield installations by third parties.

3. Any materials for which the expected reactions with wastewater effluent are a part of the treatment shall be evaluated by UCF and the FDOH according to Rule 64E-6.0151, F.A.C. Materials for which the FDOH has not yet issued a non-objection letter may only be used in parts of the research facility from which effluent is returned to the sewer.
4. To provide the FDOH with progress reports from UCF, to include any draft and final project reports, sampling results, or any other documentation required by the Florida Department of Environmental Protection to fulfill the terms of the grant agreement.
5. To establish and submit to FDOH, prior to beginning work on the project, a contingency plan outlining procedures for shutting down any failing component and bypassing into the sewer system.
6. To properly abandon the systems that discharge to the groundwater before this memorandum or a successor document expires and reconnect the sewage source to the existing central sewerage system.

The Florida Department of Health agrees:

1. To accept jurisdiction of this research facility for the purposes of research.
2. To review submitted documents within 15 days.

Expiration. This memorandum of understanding shall expire April 1, 2010 unless an extension is agreed to by all parties. Conditions of this memorandum can be changed by joint agreement in writing.

To determine compliance with this MOU, the FDOH shall receive progress reports from the University of Central Florida, to include any draft and final project reports, sampling results, or any other documentation required by the Florida Department of Environmental Protection to fulfill the terms of the grant agreement. If the terms of the MOU are not being fulfilled this MOU may be terminated by the department for non-performance upon no less than *twenty-four (24) hours* notice in writing to the other party. A waiver by FDOH of the breach of any provisions of this MOU shall not be deemed to be a waiver of any other breach and shall not be construed to be a modification of the terms of this MOU. The provisions herein do not limit the Florida Department of Health's right to remedies at law or in equity.

Effective date. January 1, 2008.

Lisa Conti, D.V.M., M.P.H., Dipl. ACVPM, CEHP
Director, Division of Environmental Health

12/22/07
(Date)

SIGNATURE BLOCK
Marty Wanielista
Ni-Bin Chang

Dec. 15, 2007
(Date)

University of Central Florida

Stormwater Management Academy
407-823-4143
www.stormwater.ucf.edu

September 11, 2007

Eberhard Roeder
Bureau of Onsite Sewage Programs
Florida Department of Health
4052 Bald Cypress Way
Tallahassee, FL 32399 -1701

Reference: Onsite Wastewater Treatment System (OWTS) Test Beds

Dear Eb:

Submitted this day is a request for approval to construct experimental OWTS test beds on the campus of the University of Central Florida. The experimental systems will provide research beds for evaluating product lines, as well as a training and education facility for the professionals. It is also in a highly visible location on campus and will help promote the OWTS efforts in the State.

Four different OWTS treatment train test beds are planned. The systems are each designed for an average daily flow rate of 300 gallons. The wastewater source is a 15 person dormitory complete with kitchen and living quarters. The effluent from the dormitory is currently directed to a central treatment facility via a sanitary sewer system. This sewer line will be intercepted to provide dosing of the experimental treatment trains. The OWTS experimental systems will be plumbed with the provision for capture of the effluent and discharge to the central sanitary sewer system in case of failure or the need to disconnect due to research funding limitations. The tap in the sewer line will be such that the existing operational central sewer line function can be re-established.

University of Central Florida

Stormwater Management Academy
407-823-4143
www.stormwater.ucf.edu

The OWTS are sized and configured in general accordance with the requirements of the State Code Chapter 64E-6. The systems and purpose of the test beds are described in the attached documents. This application is not for approval of innovative systems or new product approval but for permission to install experimental on-site sewage disposal and treatment systems for research.

We submit for your review and approval to construct the OWTS test beds. Please contact either of us with questions or comments.

Respectfully Submitted

Marty Wanielista, PhD, P.E.
Professor of Engineering
University of Central Florida
407.823.4144
wanielis@mail.ucf.edu

Donald S. Law, P.E., MBA
President, Law and Associates, Inc
Florida Registration No 45286
321.235.9105
donlaw@law-associates.com

Enclosures: Background Information
Permit Application Forms,
Timir Shah Thesis, Spring 2007

Copy without enclosures: Gerald Briggs, Chief

Background Permit Application Information for

On-site Wastewater Treatment System Test Beds

Purpose: Four test beds for on-site wastewater treatment will be constructed to support research projects focused on the evaluating and testing different types of treatment systems for nutrient removal and the subsequent impact on soil and groundwater quality.

Background: This project aims at developing and comparing four performance-based on-site wastewater treatment system (OWTS), including 1) a septic tank followed by a recirculating sand filter (RSF) with effluent discharged to an unlined drip irrigation field, 2) a septic tank followed by a recirculating sand filter (RSF) with effluent discharged to a low pressure mount drain field, 3) a septic tank followed by a subsurface flow (SSF) wetland system, and 4) a septic tank with effluent discharged to a lined drip irrigation field with soil substitution, to potentially enhance the effective removal of nutrient flux from septic tanks. Monitoring and modeling of the fate and transport of nutrient flux in vadose zone and aquifer system is expected. Different sorption media will be configured to fit in different types of filtration processes involved in these four treatment trains.

The first two processes sharing a common septic tank system with 600 GPD are standard type processes for the purpose of comparison. The third and fourth ones sharing a common septic tank system with 600 GPD are innovative which are devised to test how the sorption media could perform or outweigh the existing ones in terms of nutrient removal. Figure 1 shows the schematic for the systems. The wastewater comes from a 15 person scholars dormitory that is configured with kitchen, sleeping and bathrooms.

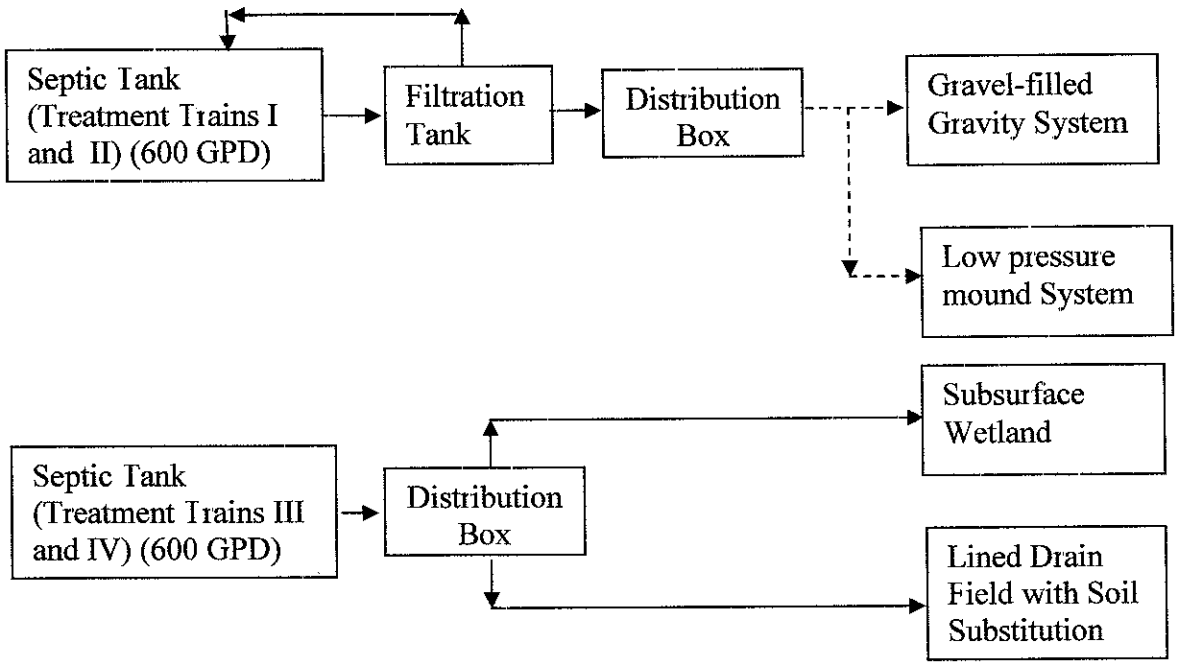


Figure 1: The layout of the test bed and its integrative conditions

Treatment Train I: This is a septic tank, an effluent filter, a pump, a distribution system including header pipe, various cleanouts, and a drip irrigation drain field system. The sand filter will be composed of additional sorption media to perform the pollutants removal. It will be designed as a re-circulating sand filter (RSF) system. A sand filter system is a biological and physical wastewater treatment component consisting of an under drained bed of sand to which pre-treated effluent is periodically applied. Effluent filter (treatment filter), filled with different sorption media, will require risers with 6" of sorption media. It will be followed by a drain field. The conventional drain field will be designed with standard practices. Particular to drip irrigation systems is the use of small diameter piping with underground drip emitters placed about 6" depth under the surface. Effluent is applied at a controlled rate in the plant root zone, which tends to minimize percolation and enhance evapotranspiration (the evaporation of water from soils, plants and surface waters).

Treatment Train II: The second treatment train constructed includes a septic tank followed by a sand filter connected with a mounding system for effluent dispersal. In this case, filtered effluent is dispersed by the use of an elevated soil absorption bed called a mound. The mound includes slowly permeable soils, over a limiting layer (clay or rock), or permeable soils with high water tables. Mounds require more care than conventional systems in site selection, design, and construction. This is partly because the soil and site characteristics are marginal, and special sand is required. Proper location and soil preparation are essential for a properly functioning mound.

Treatment Train III: The third treatment train was designed to include a septic tank followed by a wetland-based treatment unit and a subsequent drain filed if needed. Constructed wetlands may offer an affordable solution to wastewater for some communities with the following unique characteristics: warm climate, failed conventional absorption field, narrow or oddly-shaped lot, high water table, low soil percolation, high organic matter/suspended solids in wastewater, and enough un-shaded area.

Constructed wetlands may be used to assimilate nutrients directly, using flow beds to support water-loving plants in this study. Within the constructed wetland, it is believed that the roots of these plants help provide an aerobic environment to aggressively break down contaminants while the anaerobic environment in deep soil may still function for supporting the denitrification process. Overall, the system includes header pipe, distribution pipe within the cell, collection pipe, water level control structure, various cleanouts and a drainage field.

Treatment Train IV: The fourth treatment train is designed to encourage an anaerobic zone to form in the drain field so as to remove nitrogen species. Sorption media will be provided in the anaerobic zone to further enhance the removal of nitrogen and phosphorus. The sorption media planned to be used are a mixture of tire crumb, sand and an additional carbon source, most likely sawdust.

Sampling: For each treatment train, four groundwater monitoring wells will be installed to check the water quality conditions around each treatment train, at its edges and up stream from the treatment train. In addition, sampling locations will include but are not limited to the inlet of septic tank, outlet of septic tank, outlet of effluent filter, outlet of constructed wetland, outlet of drain field, and up-gradient and down-gradient of the aquifer. Bimonthly sampling campaigns will be organized in the second project year to track down the removal efficiencies through the chemical analyses. All samples will be collected and delivered according to the required Quality Assurance/Quality Control (QA/QC) procedure. Certified laboratories will be used to process all samples. The Certified lab of Engineering Research and Design Inc. (ERD) will be used to process all the nutrient samples. The UCF laboratory will provide additional analyses.

Research Budget Projection FY 07/08 and 08/09

Research income from $5 surcharge on new onsite system permits

	FY 07/08	FY 08/09
Expected Research Budget Balance		
Balance Forward	$882,955	$828,205
Expected Income (Research $5 Surcharge) *	$127,250	$127,250
Total Balance	**$1,010,205**	**$955,455**
Expected Expenditures		
Operating Budget (Salaries, Collocated, OPS, Expenses, OCO, Other)	$90,000	$90,000
Projects		
Keys Performance-Based Treatment Evaluation Study (will be a two-year project starting in FY 06/07)	0	
Phase II of Manatee Springs Karst Study	5,000	31,000
Taylor County follow-up project (May Sampling Event)	11,000	
Florida Passive Nitrogen Removal Study	41,000	
Columbia CHD river front survey	5,000	
Suwannee Sampling Event (possibly grant funded, waiting to hear whether awarded)	0	64,860
Other	30,000	30,000
Total Expected Expenditures	**$182,000**	**$215,860**
Total Remaining Balance Forward **	**$828,205**	**$739,595**

* Projection based on first quarter FY 07/08 acutal reciepts received

** Operating budget authority is less than the balance forward, approximately equal to the the total expected expenditures

Grant funding is used to either completely fund a project, or to supplement funding from the research budget

Grant funded projects:	FY 07/08	FY 08/09	FY 09/10
Remote sensing of optical brighteners to identify sources of sewage (completely grant funded)	43,840	25,000	
319 Performance of PBTS/ATU's (completely grant funded, Keys project is match)	55,000	195,000	50,000
Taylor County Coastal Community Coliform and Nutrient Reduction Study (Trifold Brochure) (partially grant funded)	5,500		
Phase II of Manatee Springs Karst Study (partially grant funded)	24,000		
Total Grant Funding	**$128,340**	**$220,000**	**$50,000**

1/11/2008

Research Priorities 2007 - 2008

RRAC Member/Alternate Name:

Number	Issue (Scope; B-9 funding)	Weight: Choose top five projects (highest priority = 5, lowest priority = 1)
1	Evaluate effectiveness of nitrogen reducing systems in a county with a mandated maintenance program (sample systems in Wakulla county; budget to be determined)	
2	UCF study on differing sorption media to monitor and model the fate and transport of nutrient flux in the vadose zone and aquifer system (determine how to be involved in the project; budget to be determined)	
3	USF Lysimeter Station restoration [dependant on updating the memorandum of understanding between USF and DOH] (perform maintenance to restore the lysimeter station (update/replace the computer system, replace the vacuum pump, install a valve to allow sewage to go to the station, replace the force main that brings the sewage to the station, evaluate the structural soundness of the facility; and replace the well pump for the artificial water table), once restored potential future projects could include: examining the treatment effectiveness of OSTDS for pharmaceuticals and new viruses, the benefits of drip irrigation looking at various parameters and various vegetation types, and dosing versus gravity distribution; budget to be determined)	
4	Determine the effectiveness of sewering an area previously on onsite systems with historical sampling results (re-sampling of Town of Suwannee, Cedar Key, etc.; $15,000, possible Coastal Management Program grant funding opportunity)	
5	Inventory of onsite systems in the Wekiva Study Area (create an updated inventory of location, type of system, and other parameters for systems in the Wekiva Study Area; budget to be determined)	
6	Study to determine effects water saving fixtures have on influent / effluent concentrations and flow amounts for residential and various commercial establishments (sampling of systems that do not have water saving fixtures, then install the fixtures and resample; budget to be determined)	
7	Study the benefits of keeping high organic content in existing soil to increase denitrification and determine sufficient loading rates for such situations (utilizing septic tank effluent with artificially constructed trenches with various levels of soil organic content and varying flows; budget to be determined)	
8	Evaluate if seasonal high water table indicators rise under drainfields due to the increased water load (combine modeling, comparisons of construction and repair site evaluations, and field work; budget to be determined)	

9	Evaluate effect of pretreatment on effluent disposal in drainfields (budget to be determined)	
10	Evaluation of nutrient and virus treatment effectiveness and clogging failures by disposal method alternatives (Previous Alternative Drainfield Contract that was cancelled, this is a previous RRAC priority and has been approved by TRAP)	
11	Monitor 10 systems in Wekiva Study Area with already approved nitrogen remvoing technology ($200,000 approximately, this is a previous RRAC priority and has been approved by TRAP)	
12	GIS study of correlations between water quality in wells, health effects, and types of septic tanks (FAMU intern working on this in 2004)	
13	Relationship between soils and failure rates and treatment effectiveness	
14	Compile existing drinking water and monitoring well data into GIS and evaluate as a function of land use/septic system use	
15		
16		
17		
18		
19		
20		
21		
22		

Florida Onsite Research Business Plan Summary

Short Term Objectives (by 2009)	**Objective Reached?**
Continue to meet with the RRAC at least twice a year to review ongoing and new research projects	
Continue research studies in progress such as Phase II Research of the Manatee Springs Karst Study, the Taylor County Coastal Water Quality Study, and Remote Sensing of Wastewater Impacts, Review of Nutrient Reducing Systems in the Keys, and the Passive Nitrogen Removal Study	
Develop and implement further studies in support of the program on performance and impacts of onsite systems, such as the assessment of water quality protection by advanced OSTDS study and studying the effectiveness of sewering areas previously on OSTDS in the Town of Suwannee	
Maintain a comprehensive list of research priorities recommended by the RRAC	
Continue to provide updates on the research program throughout the State and the Nation by giving presentations, presenting posters, and writing papers	
Continue to maintain the Bureau research program website to ensure current information is available on the research program	
Long Term Objectives (by 2010)	
Develop and implement further research studies in coordination with priorities developed by the RRAC	
Market the results of research studies by presenting the results throughout the State and the Nation	
Provide more training at a national level	
Continue to seek outside funding through grants to supplement the state research funds used to conduct research projects	
Long Term Objectives (by 2011)	
Develop a manuscript for a research study that is suitable for publication in a peer-reviewed journal	

Florida Onsite Research Business Plan Summary

Strategy	Benchmark	Target Date	Benchmark Met?
Assessment of water quality protection by advanced OSTDS (EPA 319 Program Grant)	Create framework for a statewide database of advanced systems to include data fields for sampling results	1/1/2009	
Follow-up Phase II to Manattee Springs State Park Karst Study to determine impact of nutrient reducing technologies (EPA Gulf of Mexico Grant)	Design, permit, and install nutrient-removing systems. Coordinate with State Park in operation of systems. Contract for field sampling	9/1/2008	
Impact of older coastal development on coastal water quality in Taylor County (EPA Gulf of Mexico Grant)	Complete data analysis, complete final report combining all sampling events, and create tri-fold brochure	10/1/2008	
Remote Sensing of optical brighteners to detect plumes of wastewater (EPA Gulf of Mexico Grant)	Initiate a new contract with FDEP for the remaining work, complete final project report	12/31/2008	
Assess environmental impact of sewering communities previously served by OSTDS	Obtain budget authority. Select vendor to do selected sampling in the Town of Suwannee	10/1/2008	
Review Nutrient Reducing Systems in the Keys	Conduct a study to evaluate performance of PBTS relative to design and program goals, based on an average basis of equal to or less than; BOD5 10 mg/L, TSS 10 mg/L, N 10 mg/L, and P 1 mg/L. Complete report with sampling results.	12/31/2008	
Assessment of water quality protection by advanced onsite sewage treatment and disposal systems: performance, management, monitoring (EPA 319 Program Grant)	Finalize work plan with FDEP and EPA, create database of statewide advanced systems, contract for survey task, develop QAPP for assessment of operational status and performance and annual variability	1/1/2009	
Evaluate possible passive treatment media for nitrogen removal and evaluated their use in onsite applications	Amend the contract end date by 6-months, complete the laboratory experiments, complete the cost assessment report, complete the recommendations report, and complete the final project report.	9/20/2008	
Support research on OSTDS done by other agencies / universities	Provide guidance to UCF on their research on nitrogen reduction once Memorandum of Understanding has been signed	12/30/2008	
Evaluation of management of conventional onsite systems	Decide on priority for this project	12/30/2008	
Meetings with RRAC	The RRAC sould meet at least twice a year to review the ongoing and proposed research projects	ongoing	
Ensure a DOH certified contract manager is on staff	Obtain recertification within two years of issuance of DOH Contract Manager certificate	8/11/2008	
Publications and presentations of research results	Upon completion of a research project any final report shall be distributed to the RRAC, posted on the DOH website. A minimum of three presentations shall be made prior to the end of the calendar year.	12/31/2008	

Historical Florida Onsite Research Priorities

Date of RRAC Meeting	Research Topic	Estimated Project Cost	Evaluation Points	TRAP Approved?	Status
2006	Evaluation of nutrient and virus treatment effectiveness and clogging failures by disposal method alternatives	No Information	Not Ranked	Yes	(2008) Alternative DF Products study canceled
2006	Use of crushed glass as a substitute for fill sand	No Information	Not Ranked	Yes	(2008) Project completed
2006	Passive treatment investigation	No Information	Not Ranked	Yes	(2008) Passive Nitrogen Remvoal study
2006	Monitor 10 systems in Wekiva Study Area with already approved nitrogen remvoing technology	200000	Not Ranked	Yes	(2008) performed Wekiva Study on conventional systems
2004	Design parameters for loading rates (interpret and reanalyze UF study, review some additional information)	5000	22	Unknown	(2008) Paper written
2004	Performance-based-treatment system evaluation (Keys, nutrient removal in general; apply for additional outside funding)	200000	21	Unknown	(2008) Keys study and 319 project underway
2004	Repair/early failure analysis (DOH evaluate/data mine existing data within the program, report back to RRAC)	No Information	16	Unknown	(2008) completed by intern
2004	Fate and transport of nutrients and pathogens after drainfield (Keys material effectiveness study, lysimeter, budget to be determined)	To be determined	14	Unknown	(2008) Wekiva Study, Karst Study
2004	Phase II of the Karst study (combines nutrient removal and fate of nutrient and pathogens, $15K)	15000	10	Unknown	(2008) Karst study Phase I and II
2004	OSTDS as source of nutrients and pathogens (optical brightener study, Taylor County Study)	100000	7	Unknown	(2008) Remote sensing study, Taylor County study
2004	Reconsideration of seasonally inundated areas	No Information	0	Unknown	(2008) No action
2004	Hydrology (mounding/ditching issues)	No Information	0	Unknown	(2008) No action
2004	GIS study of correlations between water quality in wells, health effects, and types of septic tanks	No Information	Not Ranked	Unknown	(2004) FAMU intern working on project

2004	Evaluate repair records to identify strength and weaknesses in installation practice	No Information	Not Ranked	Unknown	(2004) Bart Harris (DOH) working on a form
2004	Relationship between soils and failure rates and treatment effectiveness	No Information	Not Ranked	Unknown	(2008) No action
2001	Coastal Coliform Reduction	No Information	Not Ranked	Unknown	(2001) EPA Funded, (2008) Underway
2001	Karst Nutrient Reduction	No Information	Not Ranked	Unknown	(2001) EPA Funded, (2008) Underway
2001	Demonstration Project	No Information	Not Ranked	Unknown	(2001) EPA Funding Requested
1998	Food Study Phase III	No Information	49	Unknown	(2001) Underway (2008) Completed
1998	Training Center development	No Information	35	Unknown	(2001) Ongoing
1998	Additional virus modeling	No Information	24	Unknown	(2001) No Action
1998	Karst systems - setbacks to sinkholes	No Information	23	Unknown	(2001) Underway, EPA Funded (2008) Underway
1998	Tank design to minimuze virus loading	No Information	23	Unknown	(2001) No Action
1998	Seasonal use of systems	No Information	22	Unknown	(2001) No Action
1998	"Picalo Pipe" study	No Information	22	Unknown	(2001) No Action
1998	Risk assessment on virus transport	No Information	21	Unknown	(2001) Seasonal Inundated Areas Study Component
1998	Dismantle Lysimeter station	No Information	15	Unknown	(2001) No Action, site available
1998	Aerobic vs anaerobic affect on virus inactiviation	No Information	12	Unknown	(2001) No Action
1998	Improvments under $500 without permits	No Information	10	Unknown	(2001) No Action
1998	Evaluation of disinfection systems	No Information	9	Unknown	(2001) No Action
1998	5-ft shoulder on mounds-use of moderately limited soil	No Information	8	Unknown	(2001) No Action
1998	Further study of styrofoam, plastics, etc.	No Information	5	Unknown	(2001) No Action
1998	Horizontal transport of virus in saturated zone	No Information	0	Unknown	(2001) No Action
1998	Jetting systems - $150 job becomes $700	No Information	0	Unknown	(2001) No Action

Department of Health
Bureau of Onsite Sewage Programs
Research Review and Advisory Committee

Wednesday January 23, 2008
9:30 am – 3 pm

Polk County Health Department,
Environmental Health Support Building
Hearing Rooms A & B
2090 East Clover Street
Bartow, FL 33830-6741

Agenda:

- Introductions: New RRAC members/alternates
- Election of Chairman and Vice-Chairman
- Discussion on travel reimbursement
- Review of minutes from 10/18/07
- Brief update on Wekiva
- Updates on other projects
- Budget discussion
- Prioritization of research direction
- Public comment
- Closing comments, next meeting, and adjournment

Introductions
&
Housekeeping

New RRAC members/alternates:

- Consumer Alternate: Eanix Poole
- Restaurant Industry Member: Geoff Luebkemann
- Restaurant Industry Alternate: Susan McKinley
- Septic Tank Industry Member: Anthony Gaudio

Election of Chairman and Vice-Chairman

- Recommendation of nominees
- Vote

Travel Reimbursement

RRAC members/alternates are entitled to reimbursement of travel expenses:

- Submit completed State Travel Reimbursement form with original receipts
- Mileage can be claimed at $0.445 per mile
- Tolls can be reimbursed
- If traveling more than 50-miles (one-way) from your residence can claim per diem or lodging reimbursement if you stay overnight the night before the meeting (maximum hotel cost = $150). Submit time you return to your office or home.
- If staying overnight, meals can be reimbursed
  - Breakfast - $6 (travel begins before 6 am)
  - Lunch - $11 (travel begins before 12 noon)
  - Dinner - $19 (travel begins before 6 pm)

Review Minutes of Meeting 10/18/2007

- See draft minutes

Wekiva Update

Since last meeting:

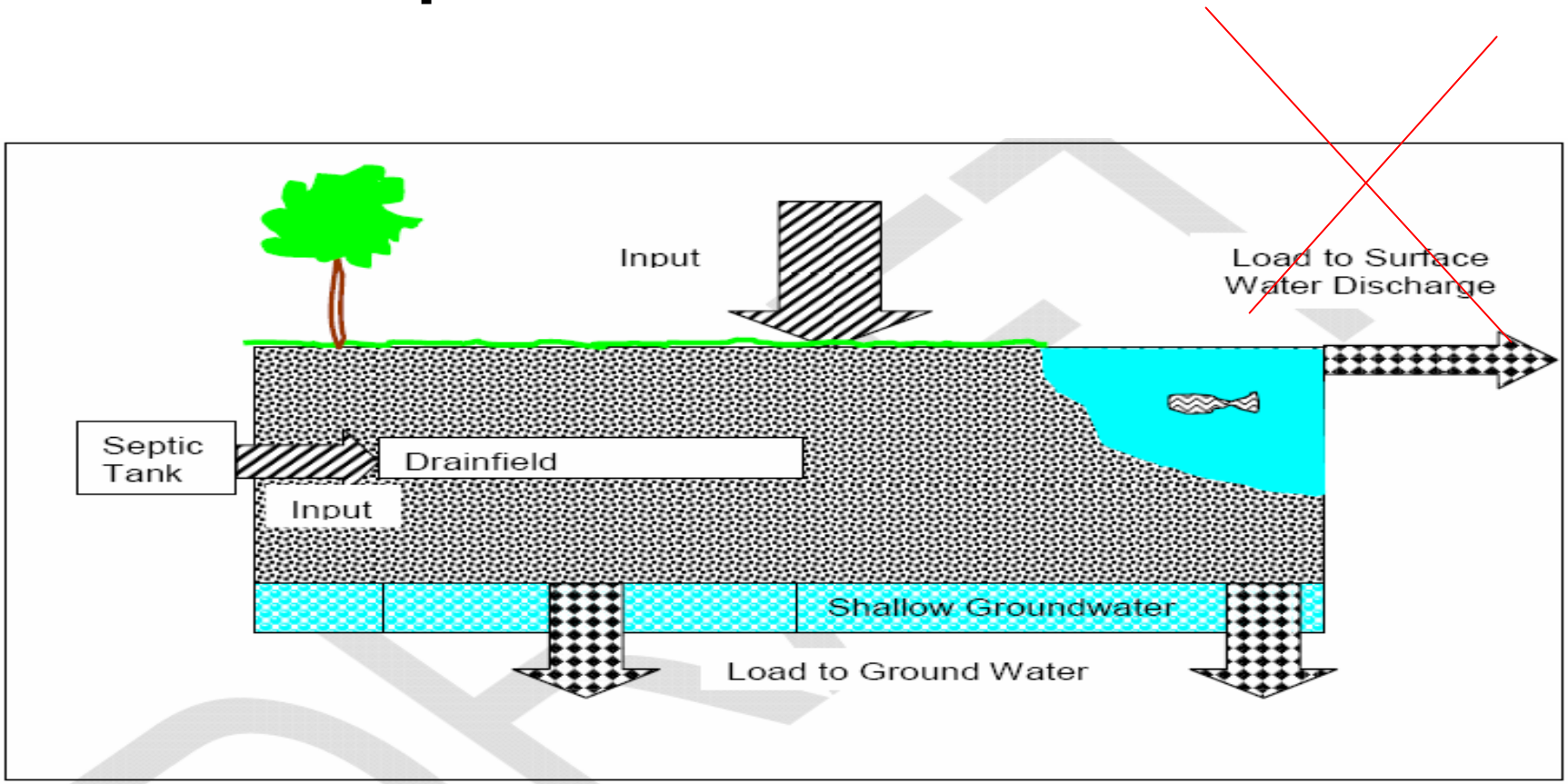
1. Still discussing options with the governors office. No new information available
2. DOH revised loading projections and revised estimates
3. DEP Phase II proposal developed
4. Urban Turf Rule went into effect

Wekiva Update (cont.)

- Discussion on revised input / load estimates
- FDEP Wekiva Phase II study
- Urban Turf Rule / Consumer Fertilizer Task Force

Revised Estimates of Nitrogen Inputs and Loadings

Inputs and Loads



Inputs

- OSTDS based on Wekiva Study
- Wastewater Treatment Plants based on available discharge records, prorated by capacity (MACTEC)
- Fertilizer based on sales, attributed to land uses based on recommended application rates
- Livestock based on livestock density (MACTEC)
- Atmospheric Deposition based on UCF records

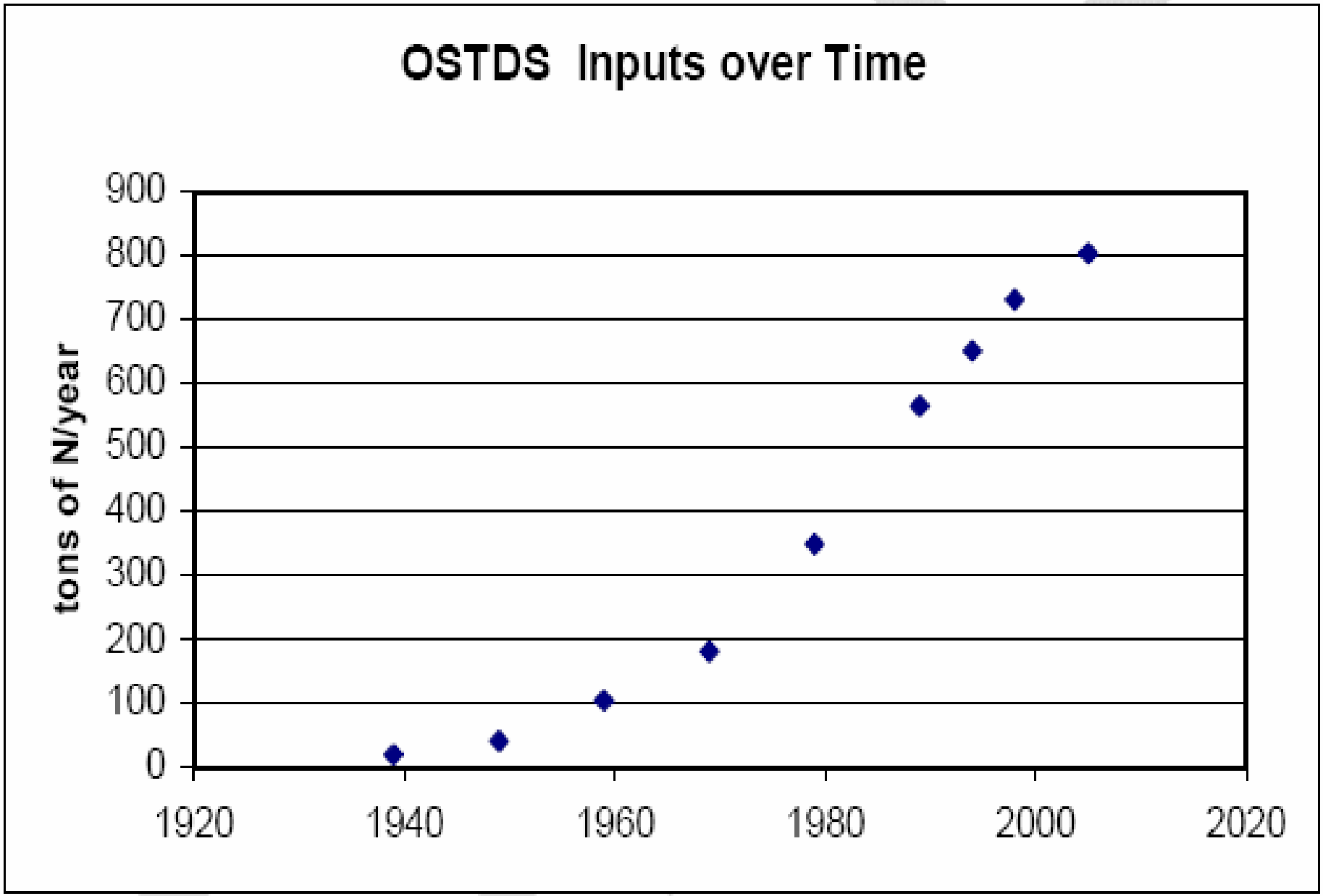
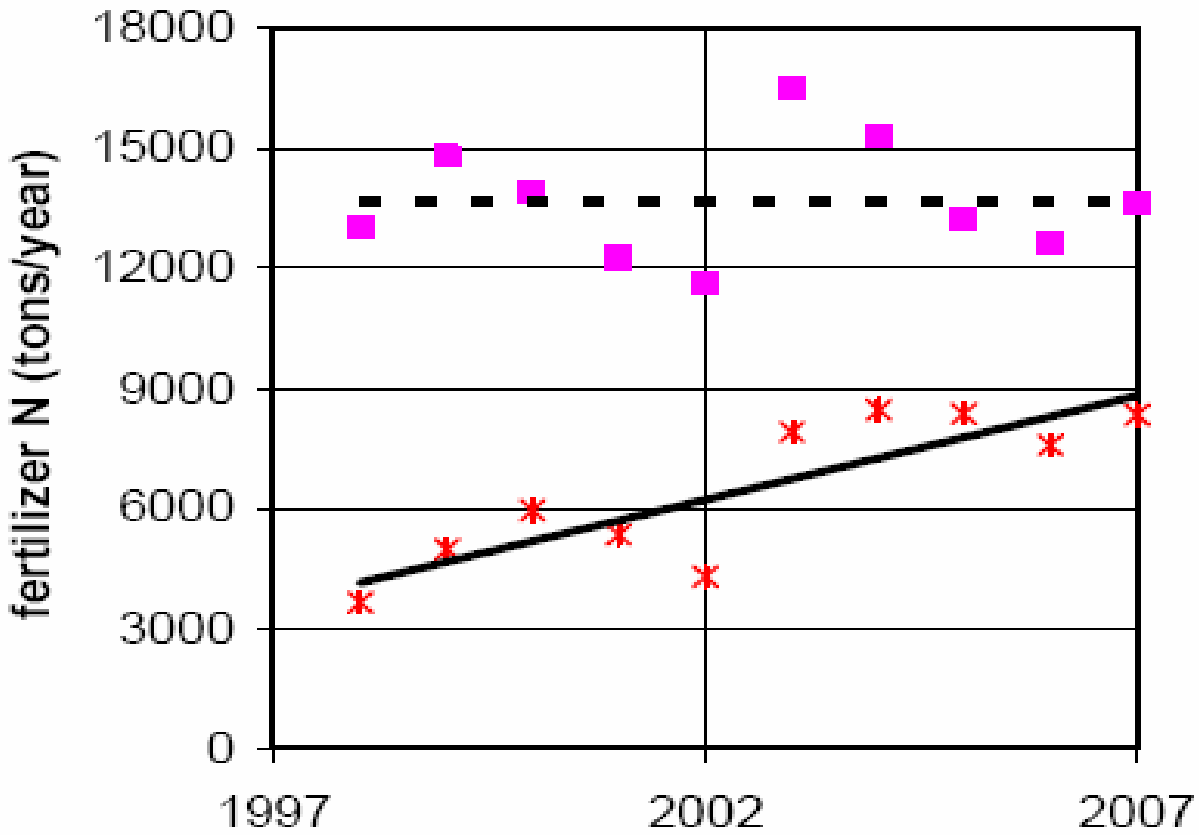


Figure 2-1. Estimated nitrogen inputs from OSTDS in the Wekiva Study Area

Fertilizer Sales in Lake, Orange, Seminole Counties



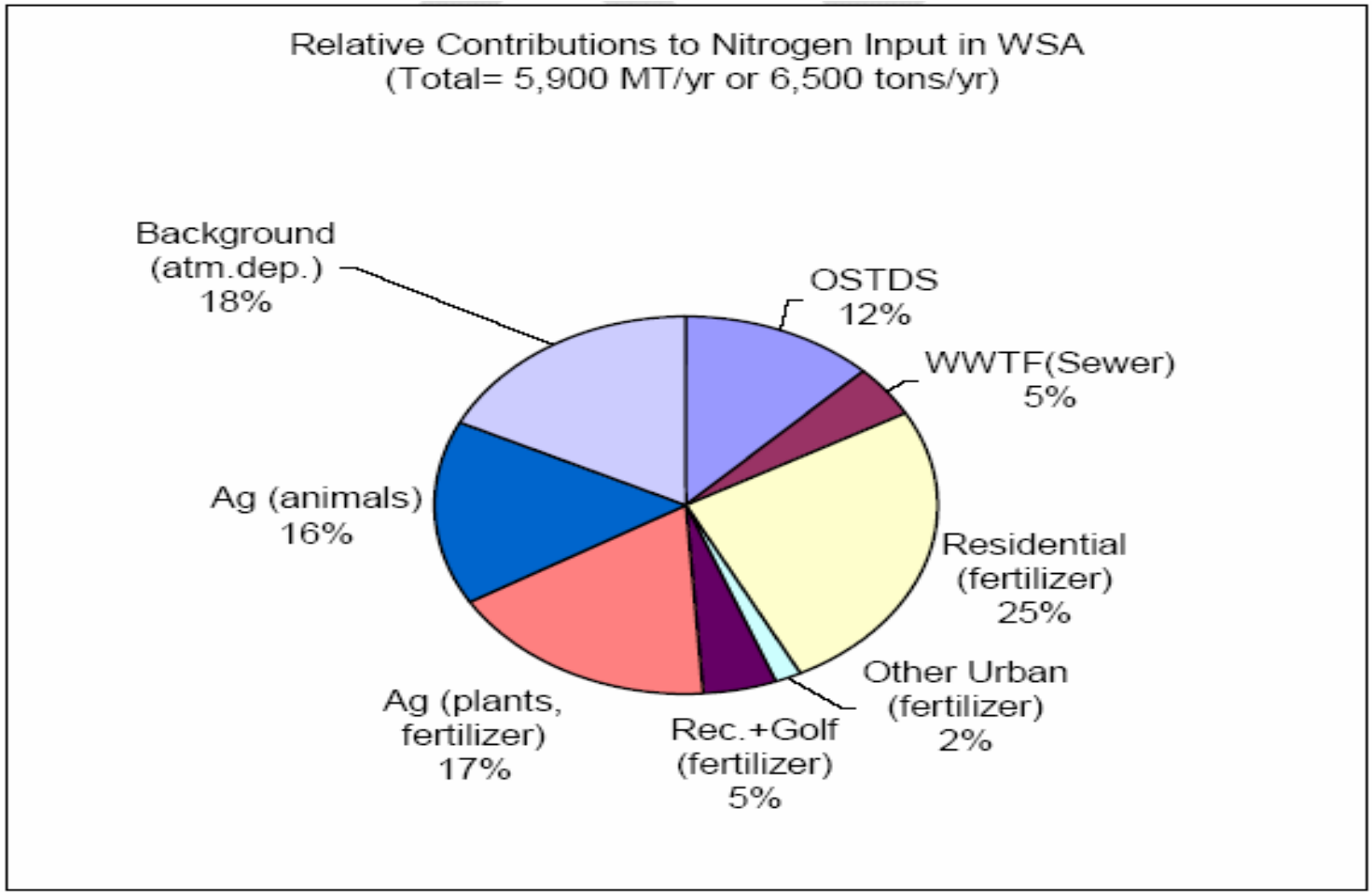
Non-farm fertilizer=
519.17*year - 1E+06
R^2 = 0.7204

Table 1. Estimates of fertilizer use in the Wekiva Study Area, based on 1998-2007 average fertilizer sales, areas and 2000 populations.

Area	County Area from GIS (acres)	Area in WSA (acres)	Fraction of County in WSA	County Farm Fertilizer (tons/year)	WSA Farm Fertilizer (tons/year)	tons/ acre year
Lake	743040	101395	0.14	2262	309	0.0030
Orange	645120	163731	0.25	3712	942	0.0058
Seminole	221440	39655	0.18	1214	217	0.0055
Total	1609600	304780		7188	1468	0.0048
Population	County Population 2000 from census	Population in WSA 2000	Fraction of County in WSA	County Non-Farm Fertilizer (tons/year)	WSA Non-Farm Fertilizer (tons/year)	tons/ person year
Lake	210,528	98644	0.47	1204	564	0.0122
Orange	896,344	259774	0.29	3424	992	0.0132
Seminole	365,196	127054	0.35	1221	425	0.0096
Total	1472068	485472		5849	1981	0.0117

Area to which recommended application rate applied was adjusted until total farm and non-far fertilizer use approximated values in table:
72% of agricultural land uses;
70% of pervious fraction of residential and other fertilized land uses

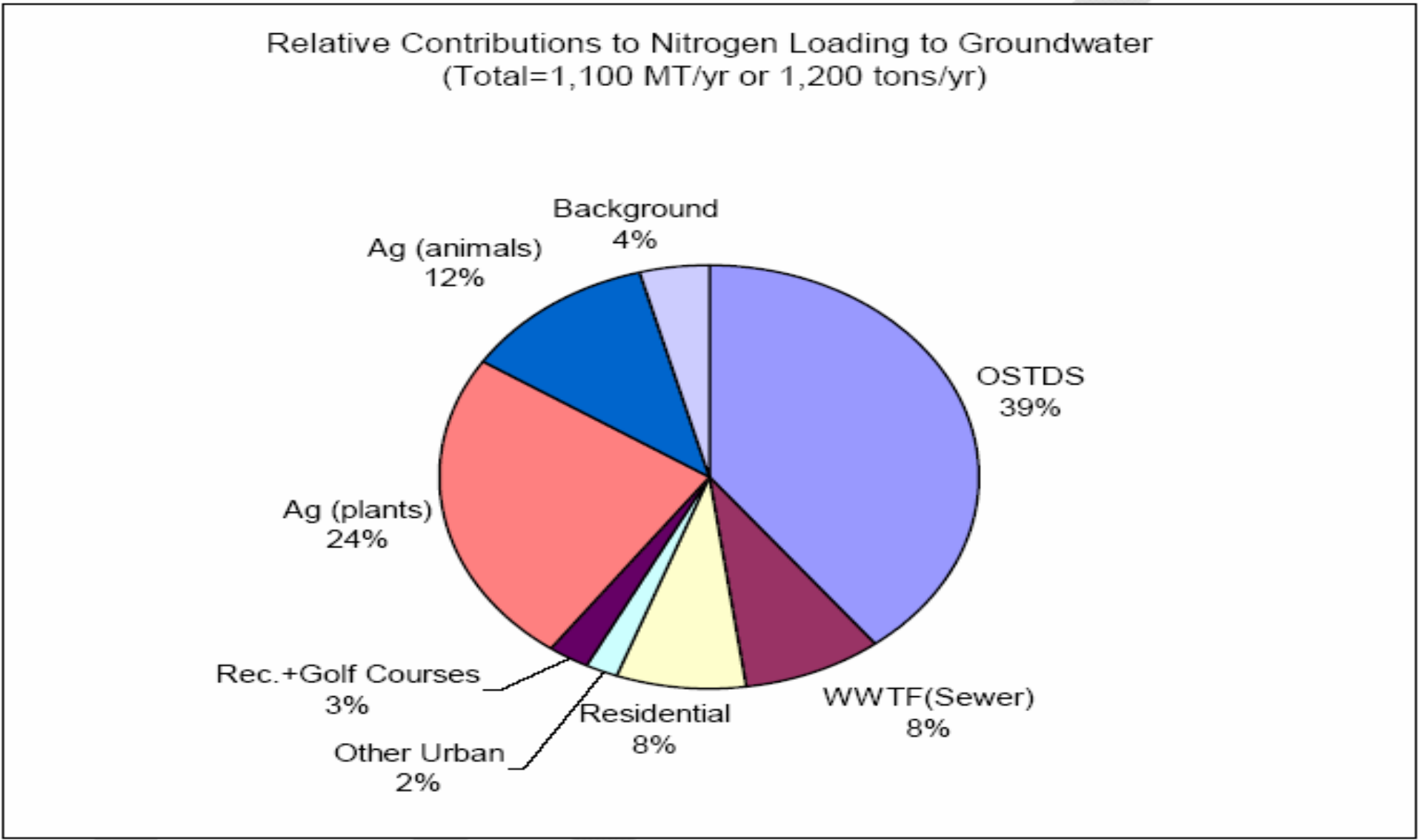
Relative Contributions to INPUT



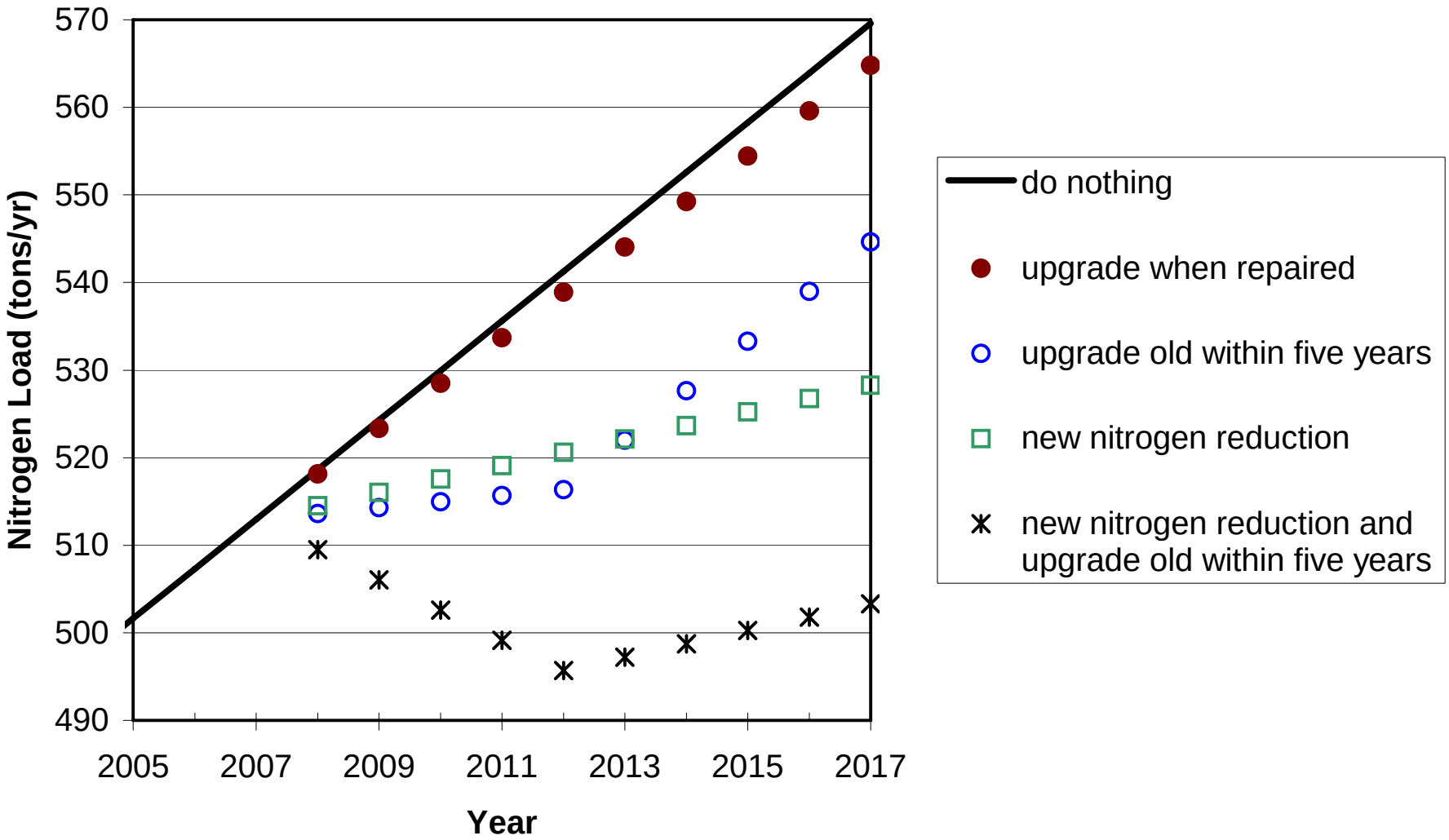
Loadings

- OSTDS based on Wekiva Study
- Centralized Wastewater reduction from inputs based on EPA guidance
- Land uses based on groundwater concentration times recharge
  - Residential and urban land use concentrations based on Wekiva Study
  - Agricultural tree crops concentration and recharge based on BMP-study
  - Background based on TN=0.2 mg/L

Relative Contributions to Groundwater Loading



Projections of Onsite N-load based on Management Options



DEP Phase II

- Focus on residential fertilizer use to determine better estimates of nitrate concentrations in shallow groundwater
- Soil will be characterized, and groundwater depth measured
- Micro-well installed to collect samples in wet and dry season
- Homeowner survey to determine current fertilization and irrigation practices
- DEP had meeting on Jan 22 to nail down the homeowners survey portion of the scope of work
- Survey will help to select study groups
  - Group 1: three background sites (residential /no fertilizer)
  - Group 2: 15-20 residential sites with fertilizer use
  - Group 3: residential sites with BMP's (# to be determined)

Urban Turf Rule

- New labeling and content regulations for lawn fertilizer (effective 12/20/2007)
- Reduces phosphorus content for maintenance
- Limits per application and total amounts of nitrogen fertilizer in lawns (readily available N to 0.7lbs/1000 sqft per application; total N to 1lbs/1000 sqft per application)
- Expected reductions:
  - 20-25% TN,
  - 50-70% Phosphorus
    (based on discussions of consumer fertilizer task force)

Consumer Fertilizer Task Force

- Tasked by legislature to develop recommendations for fertilizer use by consumers
  - Report issued 1/15/2008 (consensus.fsu.edu)
  - Recommendations
    - Support urban turf rule
    - Educate commercial applicators of fertilizer
    - Model ordinance language, local entities can be more stringent in case of local water quality issues (TMDL, verified harm, local improvement goal)
    - Public education on best management practices
    - More research on environmental effects of urban turf
    - Funding source for education and training up to $1.-/ton of nitrogen and phosphorus fertilizer

Costs and Effects

- Estimate on costs (Simon 11/2/2007)
  - ~$5 Mio for labeling changes
  - ~$50/ton for increased controlled-release N
- Estimate on Florida contribution (Martinez 10/11/2007)
  - ~80,000 tons/year DIY lawn fertilizer
  - ~500,000 tons/year non-farm fertilizer
- Further assumptions
  - N-content of non-farm fertilizer 12%
  - Expected input reduction 25%
  - Assign increased cost to reduction
  - Amortize labeling costs over 5 years over reduced amount
  - Load is 10% of input (could be by factor of 4 lower or higher)

A rough estimate of cost-effectiveness of lawn fertilizer reformulation and -labeling

	DIY lawn fertilizer	non-farm fertilizer
pre-use (tons/yr)	80,000	500,000
post-use (tons/yr)	60,000	375,000
cost increase formulation ($/yr)	3,000,000	18,750,000
cost increase labeling ($/yr)	1,200,000	1,200,000
decrease in tons (tons/yr)	20,000	125,000
decrease in N (lbs N/yr)	4,800,000	30,000,000
Input cost-effectiveness ($/lb N removed)	0.9	0.7
Load cost-effectiveness ($/lb removed)	9	7

Under the given assumptions, fertilizer sales will include about $0.25/lb N (~$60/ton) surcharge to cover costs.

Ongoing projects

Passive Nitrogen Removal Project

- Received final literature review report and database
- Received final Quality Assurance Project Plan (QAPP)
- Laboratory experiments are currently in progress

Passive Nitrogen Removal Study

Applied Environmental Technology

- Goal: Evaluate passive treatment media for on-site wastewater treatment
- Status: Media evaluation experiments underway (Task 2)
- Operation started 12 20 2007
- Initiate monitoring in late January

Passive Nitrogen Removal Study

Applied Environmental Technology

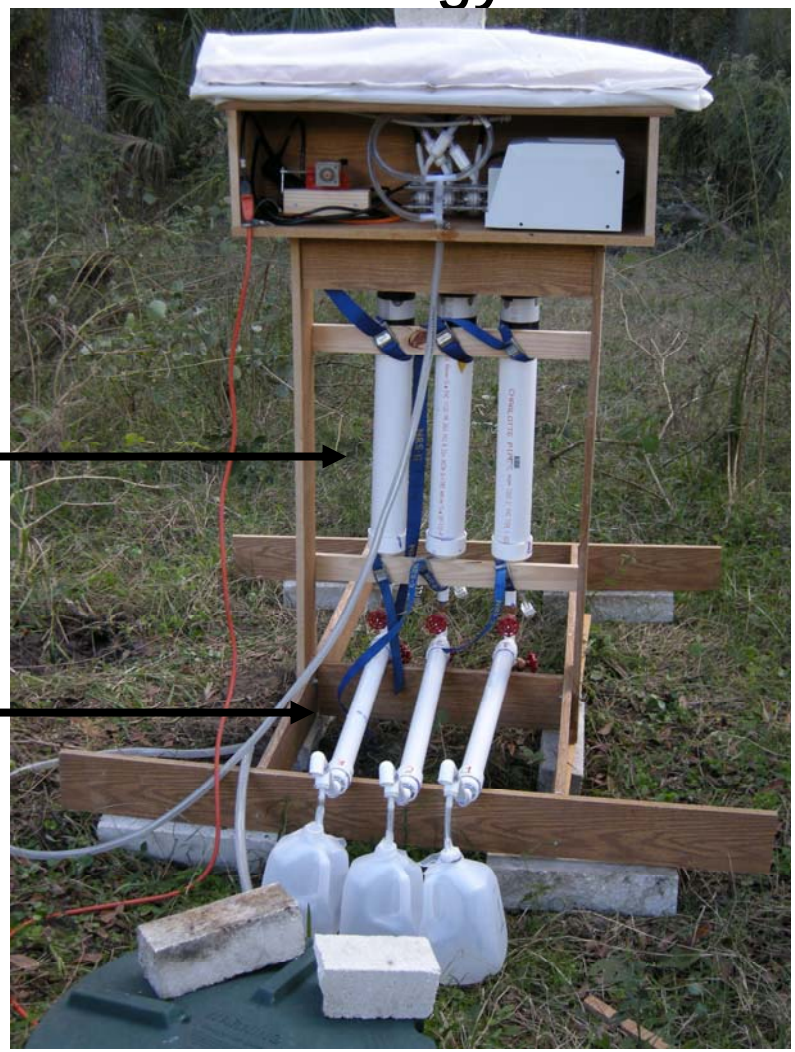
- Flatwoods Park, Hillsborough County
- Influent: septic tank effluent
- Three 2 stage columns
- Stage 1 unsaturated media (nitrification)
- Stage 2 saturated denitrification columns

Passive Nitrogen Removal Study

Applied Environmental Technology

Stage 1 (unsaturated)

Stage 2 (saturated)



Filter Configuration

Applied Environmental Technology

Stage	Filter	Column ID, inch.	Media depth, inch	Media placement	Media
Stage 1 (unsaturated aerobic)	1A	3.0	24.0	Stratified	8 in. clinoptilolite (2.3-4.8 mm) 8 in. clinoptilolite (0.8-2.3 mm) 8 in. clinoptilolite (0.5-1.1 mm)
	1B				8 in. expanded clay (3-5 mm) 8 in. expanded clay (0.8-2.3 mm) 8 in. expanded clay (0.5-1.1 mm)
	1C				8 in. tire crumb (3-5 mm) 8 in. tire crumb (1-3 mm) 8 in. tire crumb (0.4-1 mm)
Stage 2 (saturated anoxic)	2A	1.5	24.0	Nonstratified	75% elemental sulfur 25% oyster shell
	2B				60% elemental sulfur 20% oyster shell 20% expanded shale
	2C				45 % elemental sulfur 15% oyster shell 40% expanded shale

Stage 1 Media (nitrification)

Applied Environmental Technology

Zeo-Pure clinoptilolite

Tire crumb

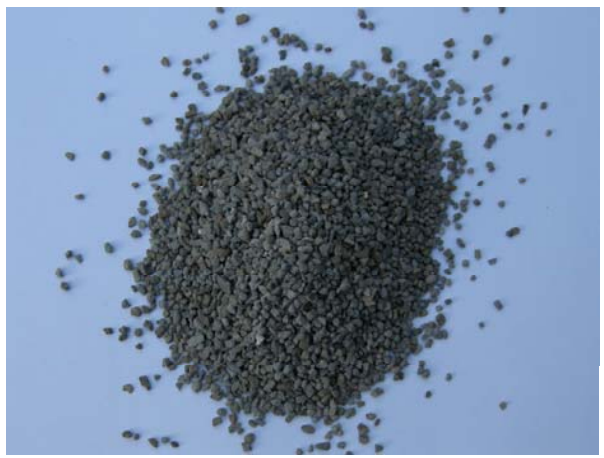
Expanded clay

Stage 2 Media (denitrification)

Applied Environmental Technology

Elemental sulfur

Expanded shale



Oyster shell

Remote Sensing of Optical Brighteners Study

- DOH and DEP had a phone conference on October 25, 2007 and November 21, 2007 to discuss next steps. DEP to have a conference with experts to develop the framework and move forward with the project.
- DEP had discussion with Mote Marine Lab and they are developing a draft scope which will be available soon.
- Total sample size to be approximately 90 samples to include field collected samples and laboratory generated samples (spikes and dilution series). This sample size is optimal for the maximizing the statistical strength of the Parallel Factor (PARAFAC) analysis.
- The total remaining project budget is $66,680 with $60,000 (possibly) going to Mote Marine Lab for EEM generation and lab analyses. Since DEP is conducting all of the sampling, the remaining $6,680 will be used in house for field supplies as well as laboratory costs associated with water chemistry analyses not being done by Mote.

Manatee Springs, Performance of Onsite Systems Phase II Karst Study

- Need to complete upgrades of systems
- Need new contract to perform sampling
- Grant extension awarded to 6/30/2009
- Manuscript accepted from FSU to Water Research

Taylor County Source Tracking

- Draft final report submitted from FAU (in packets) combining all sample events
- **Submit any comments to Elke Ursin by January 27'th so they can be compiled and sent to FAU to develop the final report**
- Grant extension was awarded to extend to 6/30/2008
- Once final report has been received, DOH will develop a tri-fold brochure to present the results of the study

Updated Conclusions

- No significant differences in ammonia trends between sewer & OSTDS
- Nitrate levels low for all sampling events
- Caffeine and optical brighteners ineffective tracers due to dilution, low development density, etc.
- Good correlation between Enterococcus and E. coli and the change from seasonal low water table (SLWT) and seasonal high water table (SHWT)
- E. coli violations were nearly 4 times more frequent at sewered sites as compared to OSTDS sites, and the number of violations was higher in 2007 than in 2006 (thought that because sewer was only recently installed previous contamination may still be reflected) (any thoughts???)
- High TN with high Enterococcus indicates greater contribution of nutrients from septic systems as opposed to runoff contributions
- Nitrogen isotope analysis seems to implicate fertilizers at beach communities
- Background sites had a low Enterococcus/E. coli ratio, and beach sites had high ratios showing human-derived sources of pollution
- Sewered areas do not show improved water quality in comparison to areas that remain on OSTDS

Monroe County Performance Based Treatment System Performance Assessment

- Discussion on sampling protocol and whether any changes need to be made for the statewide assessment quality assurance project plan

Projects coming up

319 Project on Performance and Management of Advanced Onsite Systems

- Grant amount: $300,000
- Matching: $200,000 (Keys Study)
- Assess water quality protection by advanced onsite sewage treatment and disposal systems

319 Project on Performance and Management of Advanced Onsite Systems

- TRAP recommended approval of the initial process of the 319 monitoring study to secure the funding with the condition that the project be brought before RRAC for discussion on the protocol and sampling details and then be presented back to TRAP.

319 Project on Performance and Management of Advanced Onsite Systems

Tasks:

1. Monroe County detailed study of variability of performance of advanced systems (Keys study)
2. Statewide database of advanced systems based on permit records
3. Survey of the perceived strengths and weaknesses of the current management of advanced onsite systems
4. Statewide assessment of operating condition and performance of advanced systems (random sample of 600 systems)
5. Quarterly influent and effluent sampling for a sample of systems (approximately 70 systems)
6. Booklet with case studies outlining both strengths and weaknesses of the current program and best practices in advanced onsite management

319 Project on Performance and Management of Advanced Onsite Systems

Database Task discussion:

- What type of information do we want to capture? What fields?
  - Ex: permit records, system types, property location and contact information, components used, maintenance, monitoring, inspection and sampling results, performance specifications, and system location, sample location, configuration of the system (trashtank(where, how big), pump tank)

Coastal Management Program Grant Funding Opportunity

- Grant proposal submitted to DEP by the application deadline of November 14, 2007 to resample the Town of Suwannee to see what effects sewering has had on water quality
- Requested $64,860.00 with no match other than in-kind services for project management
- Spoke with DEP for update on status:
  - Ranking committee meets February 1, 2008
  - Final decision made beginning of March once they find out how much funding is available and which projects they can afford to support
  - They generally try to fund all applicants
  - They file an application to NOAA in April and NOAA determines whether they will fund the specific project
- If awarded: funds available July, 2008
- TRAP approved the project concept with some minor changes to the text in the proposal

University of Central Florida Research Facility

- Slides provided by UCF

PERFORMANCE-BASED ON-SITE WASTEWATER TREATMENT SYSTEMS ST UNIVERSITY OF CENTRAL FLORIDA

FUNDED BY FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

Dr. MARTIN WANIELISTA,UCF
Dr. NI-BIN CHANG, UCF

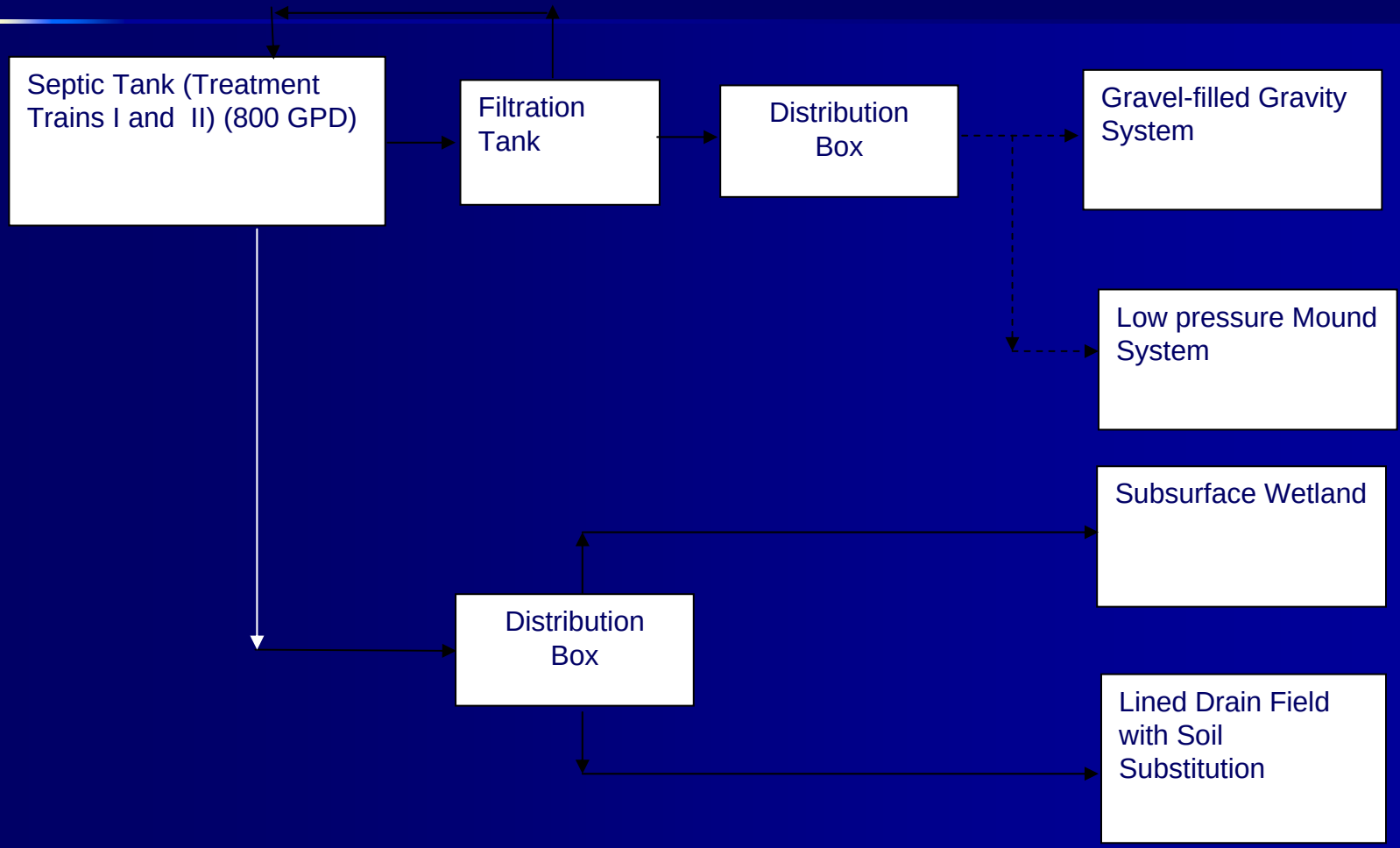
BACKGROUND

- UCF research project on alternative drainfield media for reducing nutrients generated by septic systems
- Waste Water source – BPW Scholarship House, UC

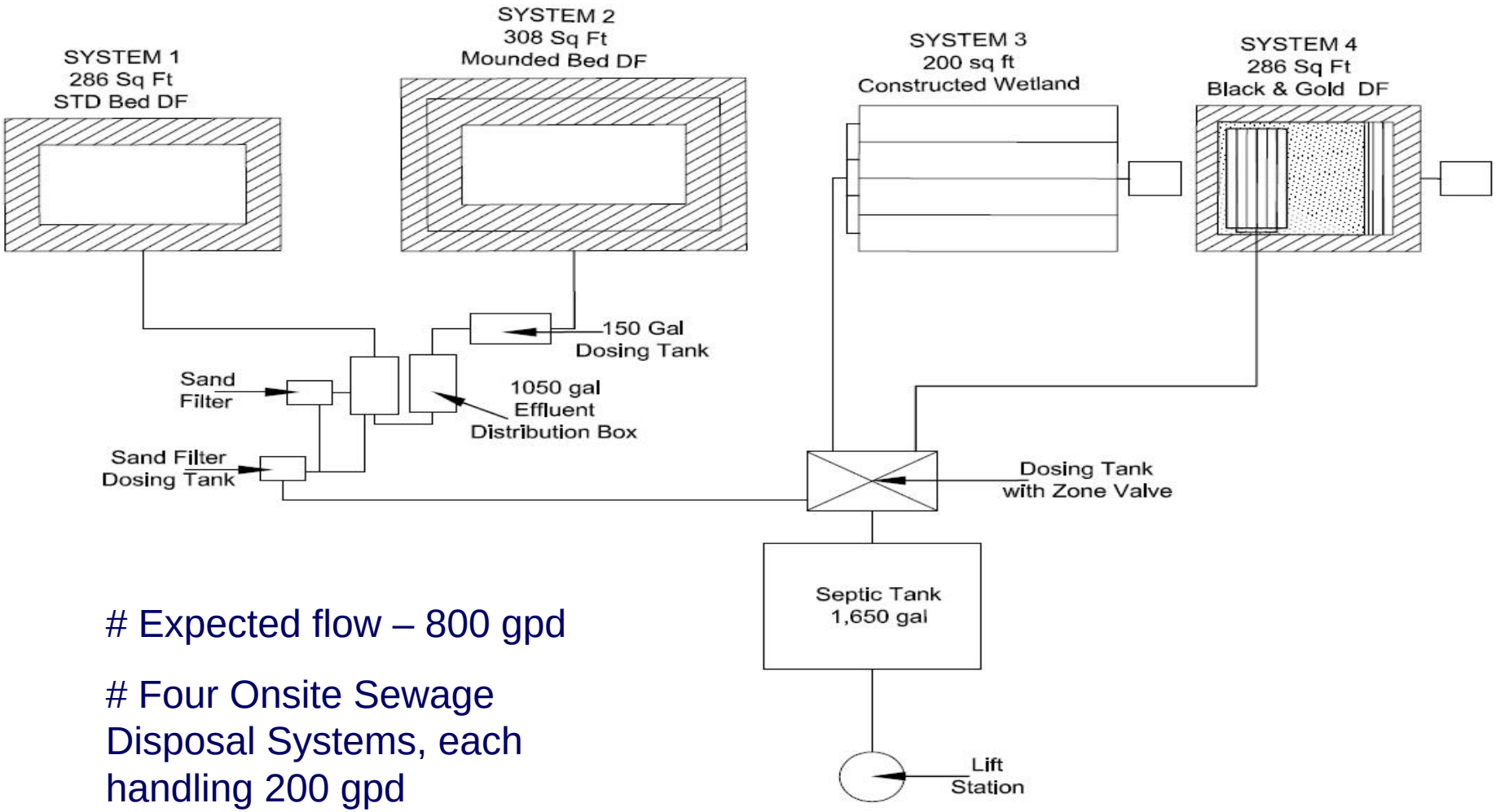
BACKGROUND

- This project include four treatment trains:
  - a septic tank followed by a recirculating sand filter (RSF) with effluent discharged to an unlined gravel-filled gravity field,
  - a septic tank followed by a recirculating sand filter (RSF) with effluent discharged to a low pressure mound drain field,
  - a septic tank followed by a subsurface flow (SSF) wetland system, and
  - a septic tank with effluent discharged to a lined underground drainfield with soil substitution, to ensure the effective removal of nutrient flux from septic tanks.

TREATMENT TRAINS



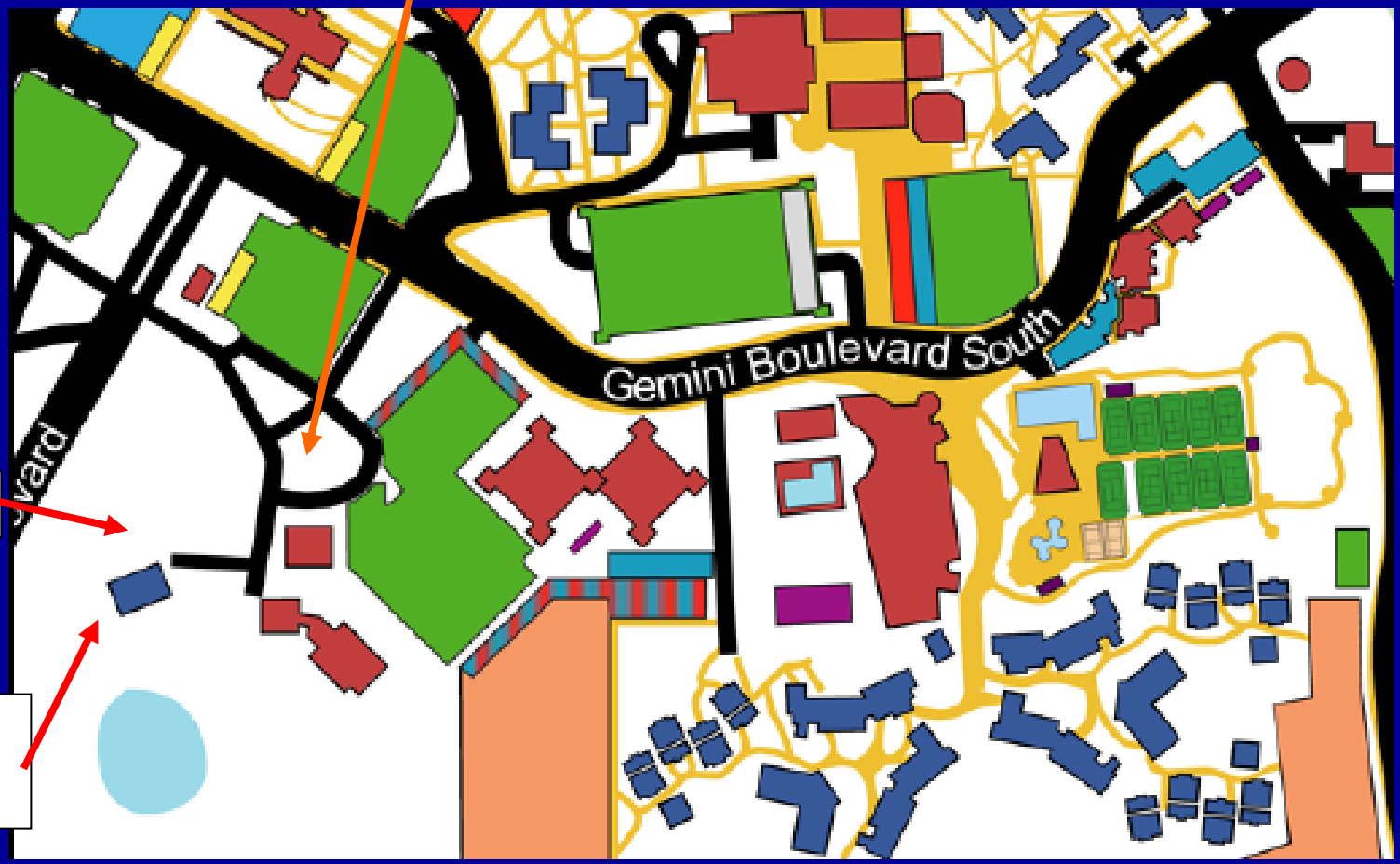
DESIGN LAYOUT



Expected flow – 800 gpd

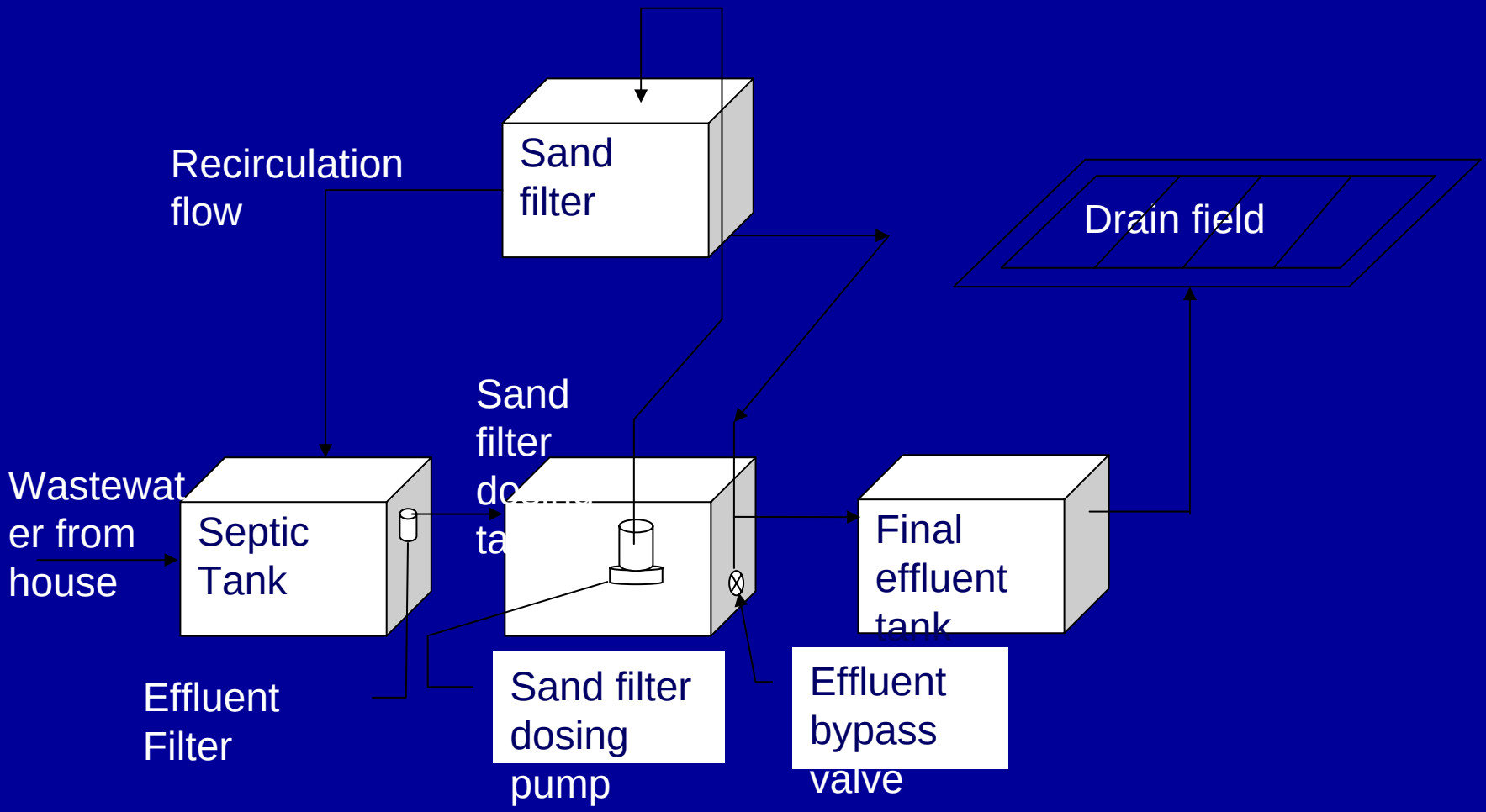
Four Onsite Sewage Disposal Systems, each handling 200 gpd

LOCATION


Barbara Ying
Gemini Boulevard South
Candidate site
BPW
Scholarship
House

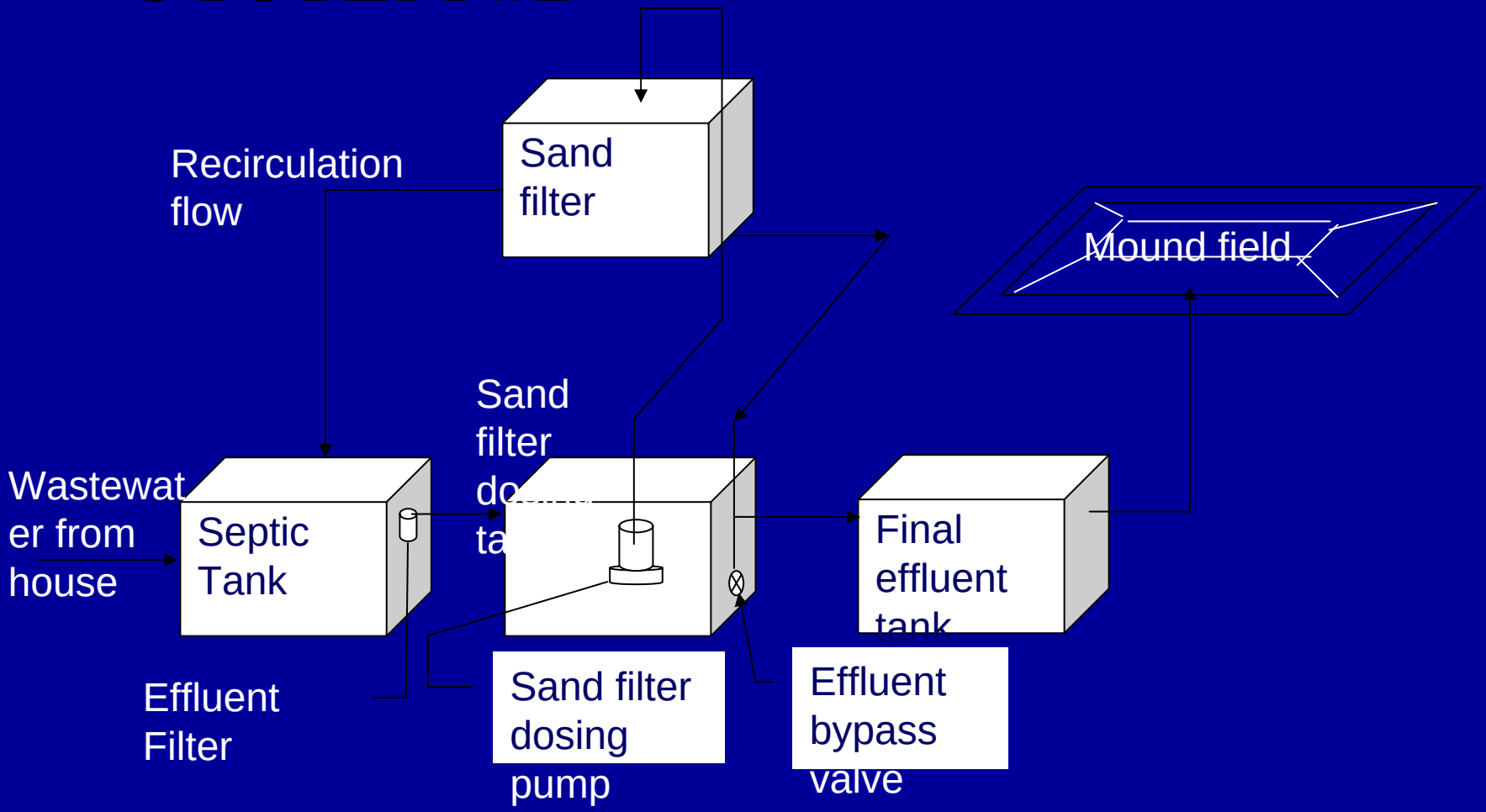
SITE VIEW

SYSTEM #1



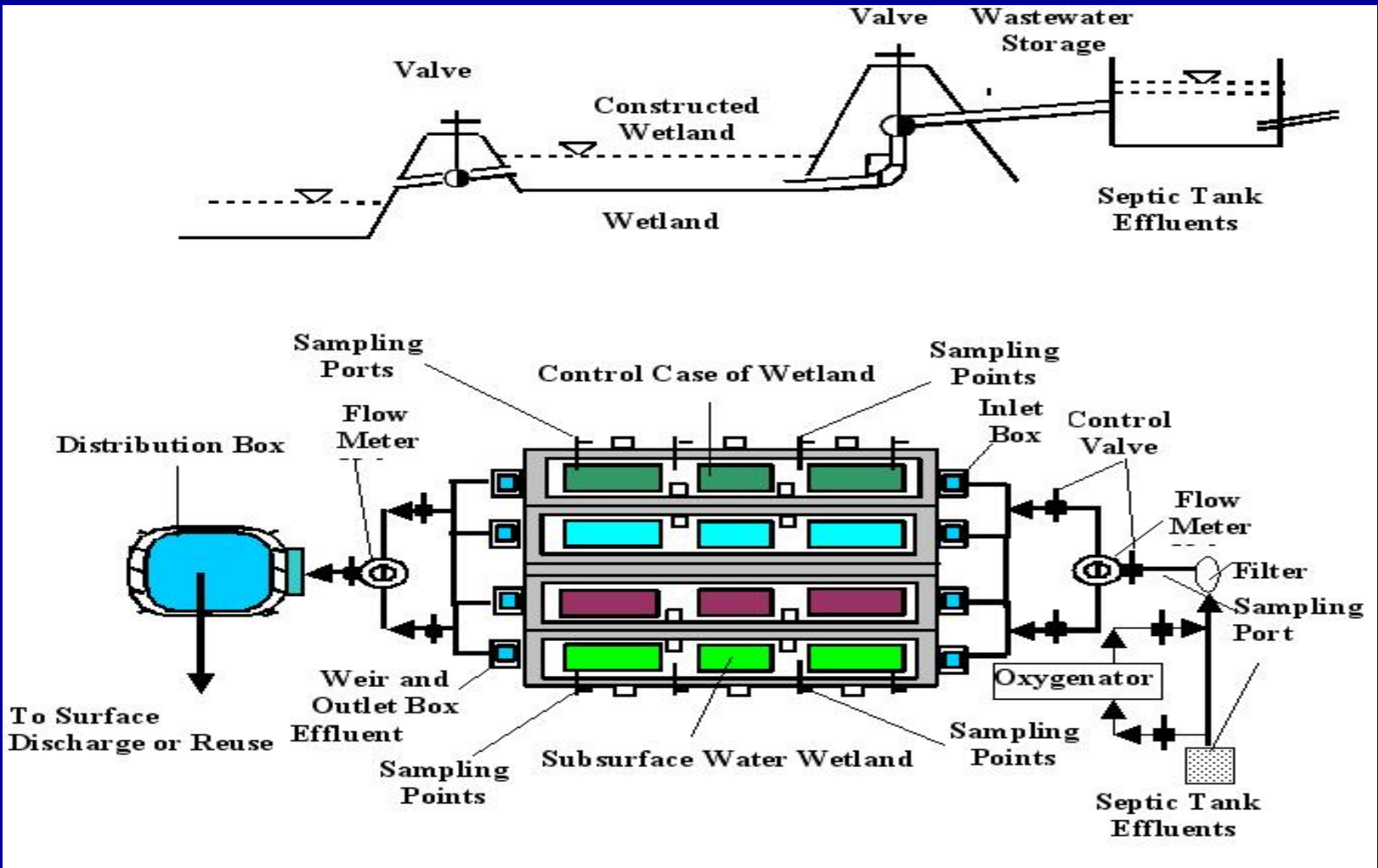
a septic tank followed by a recirculating sand filter (RSF) with effluent discharged to an unlined gravel-filled gravity field,

SYSTEM #2

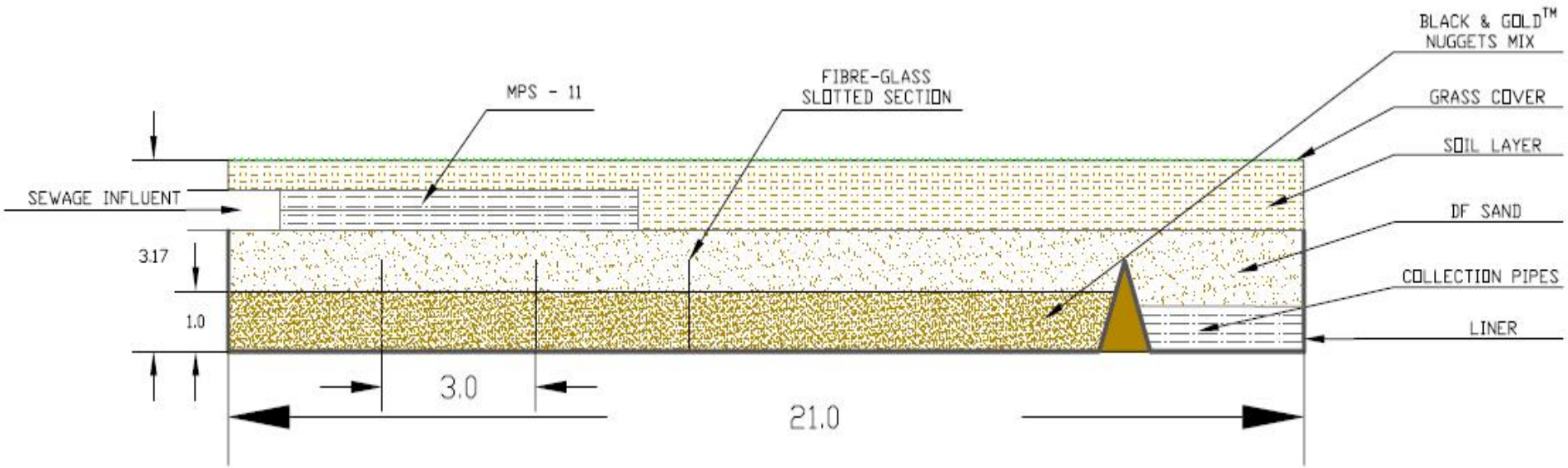


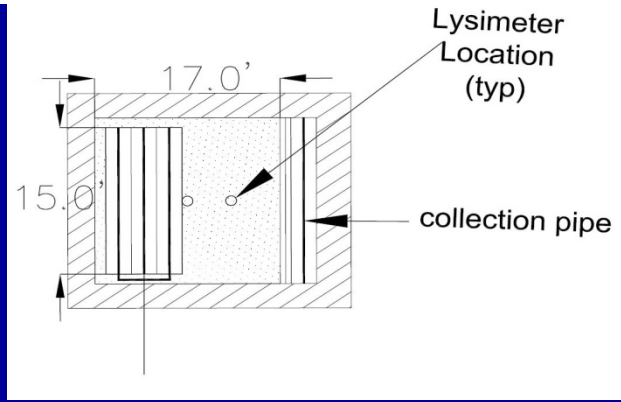
a septic tank followed by a recirculating sand filter (RSF) with effluent discharged to a low pressure mound drain field

SYSTEM #3
CONSTRUCTED WETLAND

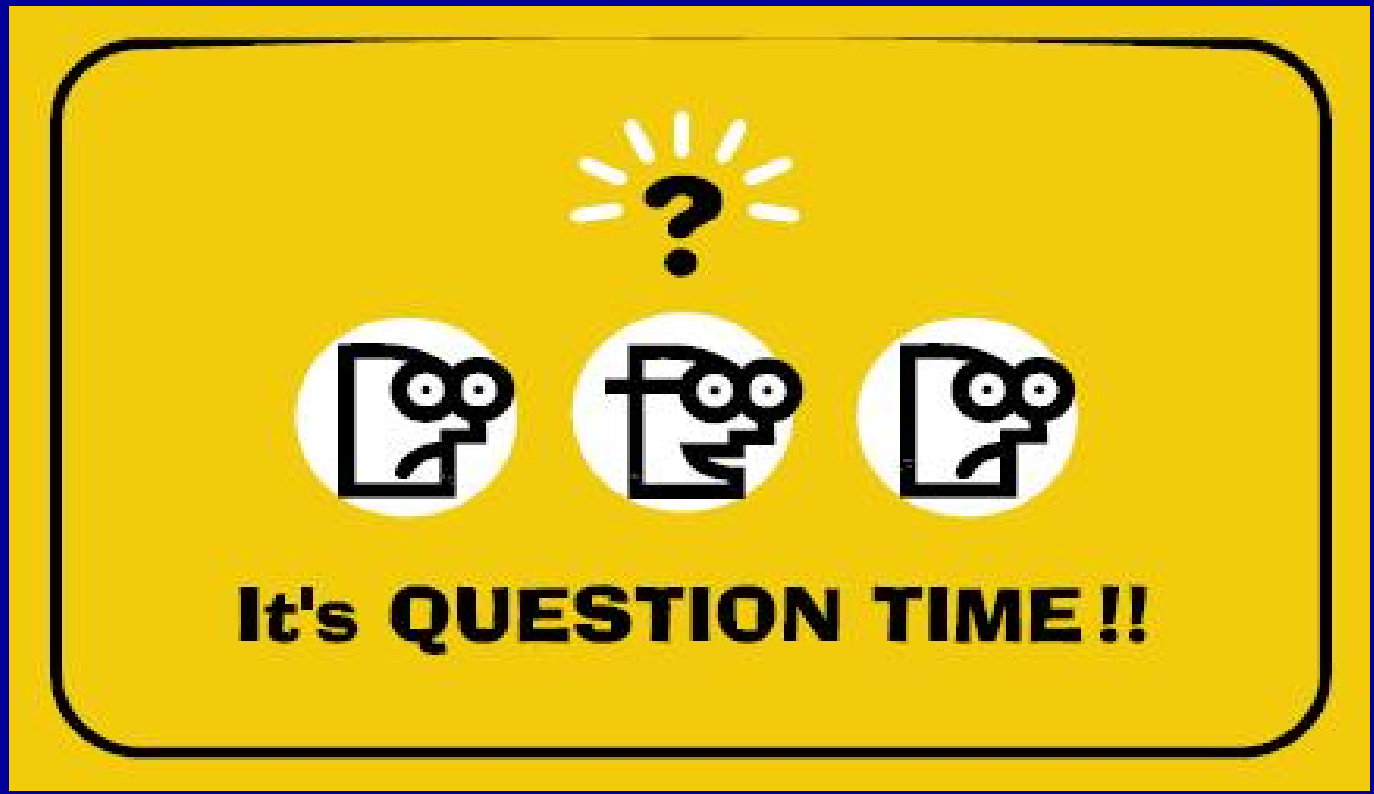


SYSTEM #4
BLACK & GOLD™ DRAINFILED





Questions ?



Thank you for your time!

Research Budget

For fiscal year 2006 – 2007:

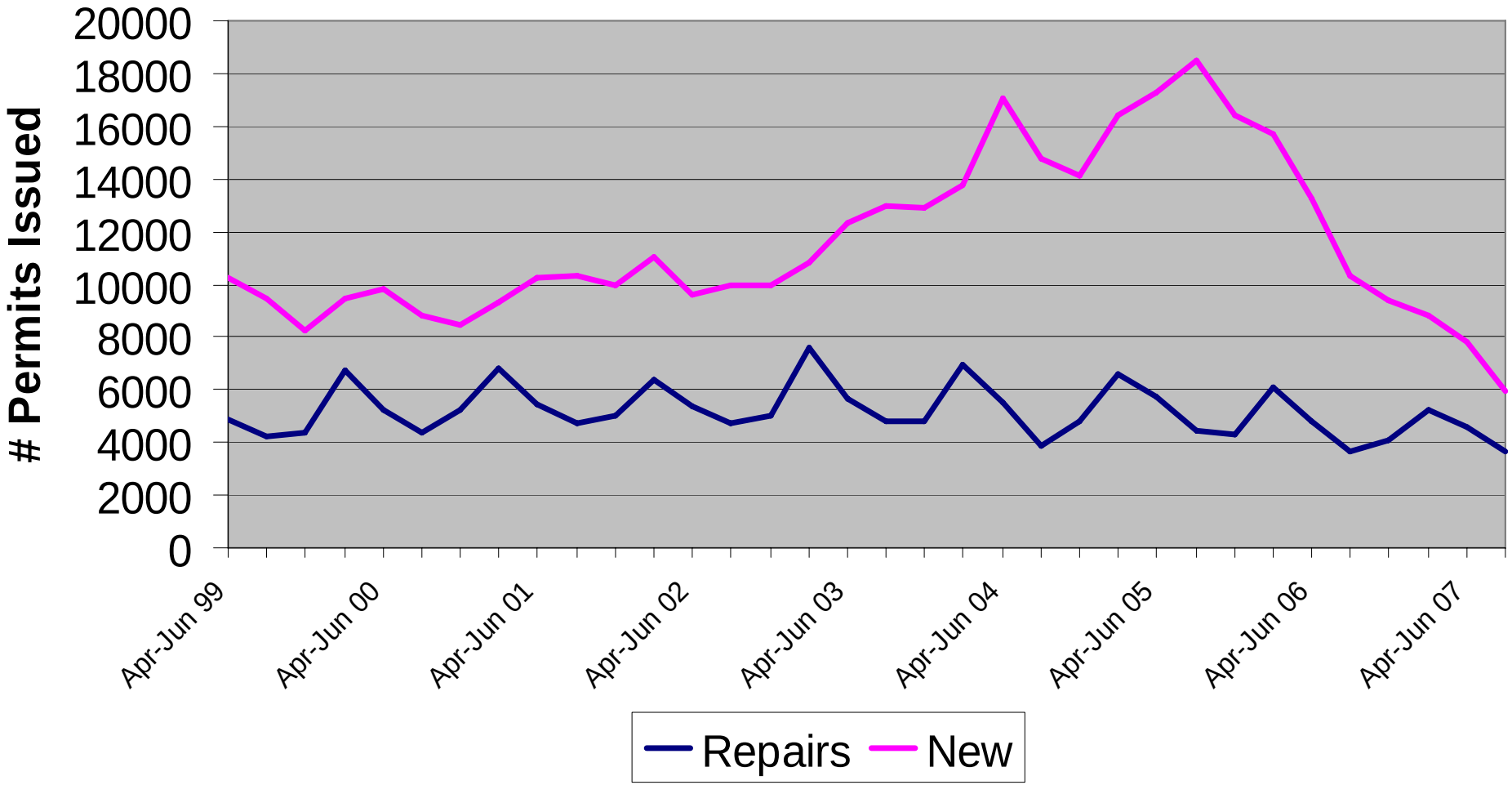
- Total Revenue $181,747
- Total Expenditures* $342,895
- Ending Cash (06/30/2007) $882,955

*Wekiva funding is not included in this amount as the funding source was not from research

For fiscal year 2007 – 2008:

- Projected Expenditures $182,000
- Expected grant funding $128,340

New / Repair Permits Issued from 1999 - 2007



As of July-September 2007, New = 5937 permits and Repair = 3671 permits

Research Budget

- Legislature has held 4% of the budget authority in DOH trust funds, including the research account, this may be permanent
- No issues with federally funded contracts

Prioritization of Future Projects

Ideas for potential projects:

- See priority list handout

What does RRAC want to study?

Studies related to:

- Human health
- Performance of systems
- Environmental impacts from onsite systems

Additional projects

- 15. Epidemiological study of failure rates in different soils and different materials
- 16. Evaluate effect of increasing drainfield sizes
- 17. Take passive nitrogen study to larger sizes (phase II)
- 18. Comparative effectiveness of drip, pressure dosing, gravity after ATU treatment (and/or after septic tank)
- 19. Seasonality of nitrogen concentrations underneath drainfields in the Wekiva Study Area
- 20. Long-term deformation (creeping) of tanks of different materials
- 21. Changing pathogen indicator standards (fecal, E. coli, enterococci) (check what DEP is doing)
- 22. Integrate treatment and disposal into a single drainfield

5 Highest ranked items

- Lysimeter refurbishments (USF, develop approach)
- Scope ITN for the following three
  - Passive nitrogen phase II:122121 (1)
  - alternative drainfield project:213233 (3)
  - Seasonality in Wekiva :331312 (2)
- Long term deformation (Creeping) of tanks (start with failure evaluation) (approach development)

Rank Projects

Public Comment

Closing Comments, Next Meeting, and Adjournment

Important dates:

TRAP meeting: **January 24, 2008**
Time: 9:00 am
Place: Orlando Airport Marriott

Wekiva Commission Meeting:

February 27, 2008
Time: 1:30 pm
Place: ECFRPC Office

Passive Nitrogen Removal Presentation:

Scheduled for mid-April 2008

Possible next RRAC meeting: **Tuesday April 15th ???**

Thursday April 17th ???

Florida Department of Health (FDOH)

Research Review and Advisory Committee (RRAC) Meeting Summary

Meeting on January 23, 2008, Polk County Health Department, Bartow, FL

- **RRAC Members/Alternates Present**: Sam Averett, David Carter, Paul Davis, Anthony Gaudio, John Glenn, Marc Hawes, Bill Melton, Eanix Poole, Patti Sanzone, Pam Tucker, and Ellen Vause. Six out of nine groups were present, representing a quorum.

- **Election of Chair and Vice-Chair**: Anthony Gaudio made a motion which was seconded by Bill Melton:

  David Carter to remain chair for the next two meetings and then this issue will be revisited.

  The members voted and all were in favor with none opposed, the motion passed.

- **Review of Previous Meeting Minutes**: The minutes were approved as submitted.

- **Wekiva Onsite Nitrogen Contribution Study**: There is no new information on rulemaking; options are still being discussed with the governor's office. Dr. Eberhard Roeder has revised the input and loading estimates and has written a draft report that is available on the FDOH website:

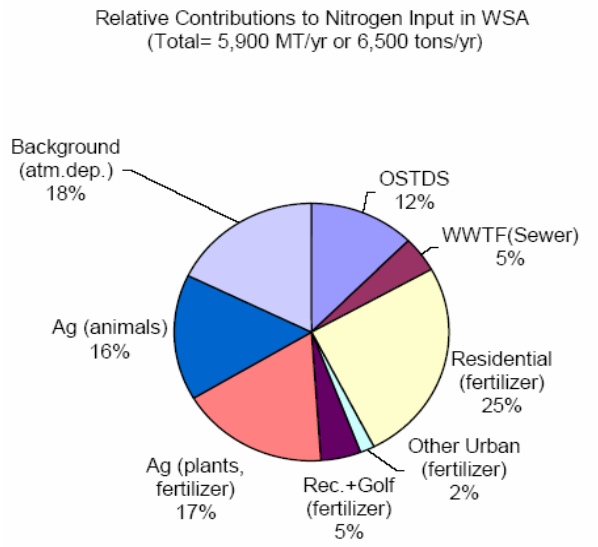
http://www.doh.state.fl.us/environment/ostds/research/01-23-08Materials/Revised_Nitrogen_Estimates.pdf

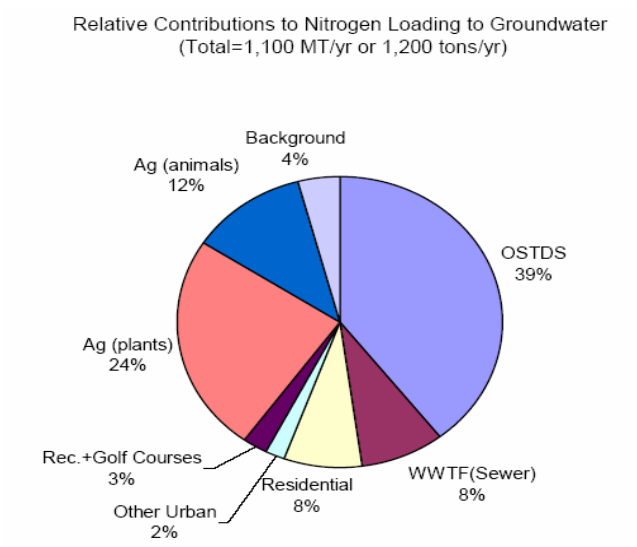
  Any comments or questions can be sent directly to Eberhard_Roeder@doh.state.fl.us within the next two weeks from any interested party. The presentation does not address the load to surface water discharge as that was not part of the legislative mandate. The following describes what numbers were used for the inputs:
  - OSTDS based on Wekiva Study
  - Wastewater Treatment Plants based on available discharge records, prorated by capacity (MACTEC report)
  - Fertilizer based on sales, attributed to land uses based on recommended application rates
  - Livestock based on livestock density (MACTEC report)
  - Atmospheric Deposition based on UCF records

  The nitrogen inputs in the Wekiva Study Area were shown to be increasing. The fertilizer sales for farm fertilizer were shown to be relatively steady over time, with non-farm fertilizer sales increasing.

  The revised loading estimates were also discussed. The following describes what numbers were used for the loadings:
  - OSTDS based on Wekiva Study
  - Centralized Wastewater reduction from inputs based on EPA guidance
  - Land uses based on groundwater concentration times recharge
    - Residential and urban land use concentrations based on Wekiva Study
    - Agricultural tree crops concentration and recharge based on Best management Plan (BMP) study
    - Background based on TN=0.2 mg/L

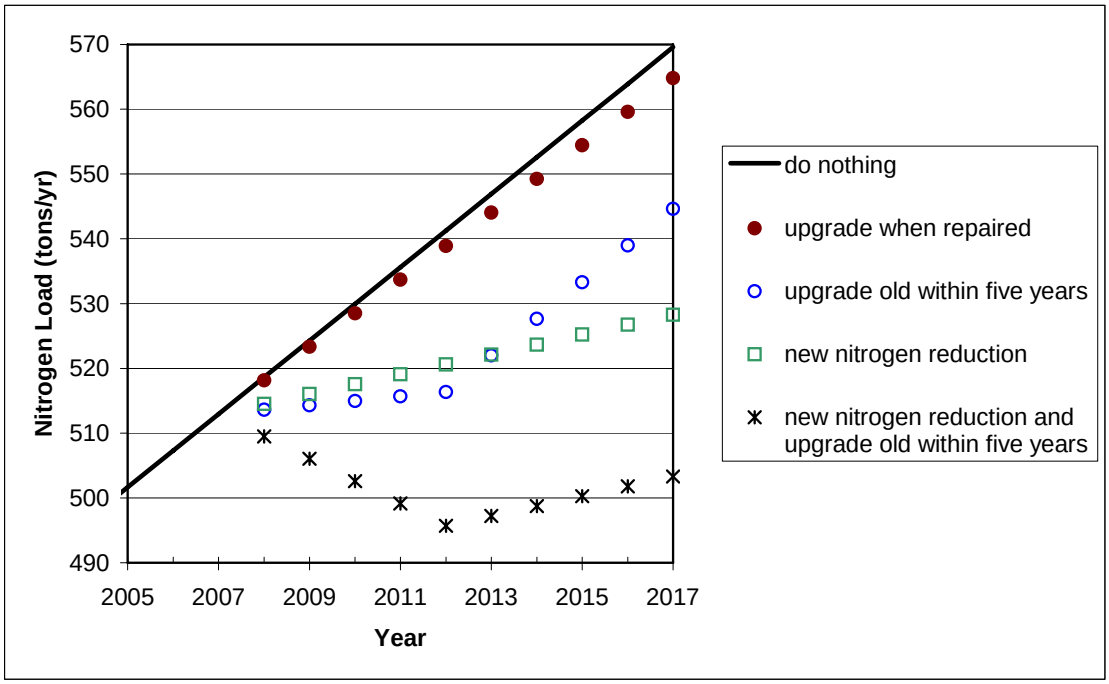
The draft revised input and loading pie charts were presented and discussed:





Input to the Environment **Loading to the Groundwater**

The projections of onsite nitrogen-load based on various management options were discussed:



There was a discussion on why this revised estimate for input and loading was being brought up. Dr. Roeder explained that at the June 2007 meeting, RRAC provided two options with regard to further revisions of input and loading estimates: to wait for FDEP to revise their numbers or staff to bring new information back to the RRAC as it became available. This is in response to reviewing and refining new information.

An update was presented on the FDEP Phase II study scope that was released in November 2007. There were questions why this study only focused on fertilizers and no additional work was to be done with onsite systems. Patti Sanzone stated that FDOH is dealing with the onsite systems and that FDEP does not have regulatory authority over onsite systems.

Pam Tucker made a motion which was seconded by John Glenn:

> **RRAC recommends a request to FDEP expand the design of the Phase II study to include groundwater testing of onsite systems in the wet and dry seasons to obtain accurate numbers for onsite systems in the Wekiva Study Area.**

There was a discussion on this motion. Sam Averett stated that RRAC should not tell FDEP to study onsite systems. Ellen Vause suggested withdrawing the motion, that FDEP's study will confirm or debate Dr. Roeder's revised calculations. She stated that significance can still not be determined for fertilizer inputs and loadings until FDEP completes their study and RRAC makes a decision. The RRAC members voted with four members against (Anthony Gaudio, Bill Melton, Paul Davis, and David Carter) and two members for (Pam Tucker and John Glenn). **The motion did not pass.**

Bill Melton made a motion which was seconded by Paul Davis:

> **To ask FDEP to get their information in a format that is as comparable as possible with the FDOH numbers and to provide Total Nitrogen numbers and to use the atmospheric deposition numbers used in the FDOH report.**

The members voted and all were in favor with none opposed, the motion passed.

New labeling and content regulations are required for lawn fertilizers. This is effective December 30, 2007. The Urban Turf rule reduces phosphorus content for maintenance, limits the how much nitrogen fertilizer can be applied to the lawn per application and also how much can be applied in total, and has expected reductions of 20-25% of TN and 50-70% of Phosphorus. The Consumer Fertilizer Task Force was described, and some costs and effects were discussed.

- **Brief updates on other projects**
  - Ongoing projects
    - **Passive Nitrogen Removal Assessment** – The final literature review report and database has been received. The Quality Assurance Project Plan (QAPP) has been finalized. The media evaluation experiments are currently in progress.
    - **Remote Sensing of Optical Brighteners Study: Mote Marine Report** – Development of revised contract with FDEP is in progress.
    - **Manatee Springs, Performance of Onsite Systems Phase II Karst Study** – Manuscript from Florida State University was accepted by Water Research. Due to contractual and timing issues, this contract has expired and must be re-contracted. Grant end date was extended by EPA.
    - **Taylor County Source Tracking Study** – The draft final report was submitted for comment. Some of the conclusions from the study were discussed. Elke Ursin requested comments be sent to her by January 27'th so that she can compile and send to the provider to develop the final report. Grant end date was extended by EPA. The final task is for FDOH

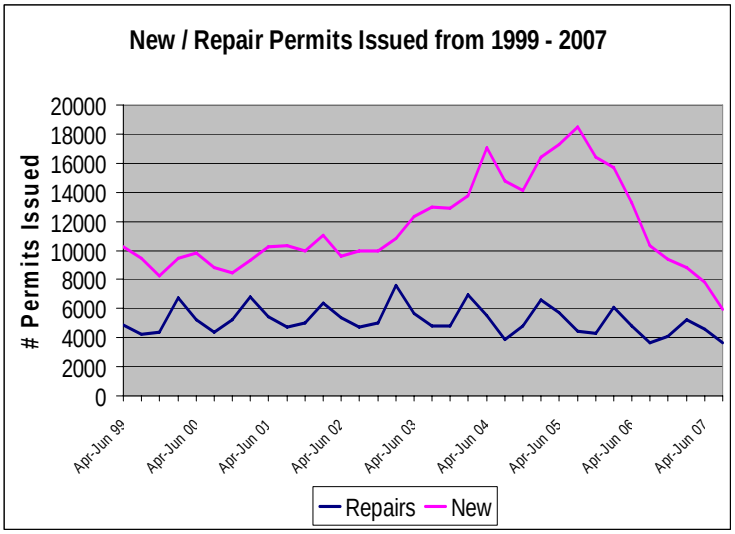
to develop a tri-fold brochure on the results of the study, and to write a final report for EPA.

- **Monroe County Performance Based Treatment System Performance Assessment** – Dr. Eberhard Roeder stated that Monroe County appears to have remained below budget for the study so far and would like direction on what RRAC would like for them to study with the remainder of the allocated money. Ellen Vause stated that resampling the locations previously sampled would be a good option and there was general agreement on this.

- Projects coming up

  - **319 Project on Performance and Management of Advanced Onsite Systems** – A TRAP teleconference was held on November 20, 2007 to discuss approval of this project. TRAP recommended approval of the initial process of the 319 monitoring study to secure the funding with the condition that the project be brought before RRAC for discussion on the protocol and sampling details and then be presented back to TRAP. This agreement is going through the routing process with FDEP and EPA. The first task is to develop a database of all advanced systems in the state and Elke Ursin asked the RRAC to start thinking about what fields to incorporate. She will send a reminder out later with a list of the potential data fields.
    Coastal Management Program Grant Funding Opportunity – FDOH submitted the grant proposal on November 14, 2007 to resample the Town of Suwannee. A final decision should be made prior to the next RRAC meeting.
  - **University of Central Florida Research Facility** – UCF has a grant with FDEP to look at nutrient reducing onsite systems and to develop a research facility with test beds. UCF provided some slides that were provided to the RRAC members for review. FDOH and UCF have developed a memorandum of understanding (MOU) to allow this facility to be built, and is subject to various conditions.

- **Budget Discussion** – The total revenue from the $5 surcharge on new permits for 2006-2007 fiscal year (FY) was $181,747 and the expenditures were $342,895 leaving an ending cash balance of $882,955. A discussion was had on the limitations for spending the cash, and how it is subject to budget authority which is beyond the Bureau's control. A graph was presented showing the decline in permitting, which results in a reduced research budget. Damann Anderson stated that the research fee was set in 1985 and that it is time for this fee to be increased.



- **Prioritization of Future Projects** – The RRAC had a discussion on priorities for future projects, and each member was given an opportunity to add additional projects to the prepared list. After all the projects were compiled, each member listed their top three research priorities. From that selection, five projects had more than 1 vote. Editorial note: Approximate costs below were staff estimates after the RRAC-meeting for purposes of TRAP-discussion.

    1. **Restoration of the University of South Florida (USF) Lysimeter Station**
        a) $20,000 - $50,000 approximate cost
        b) Dependant on updating the memorandum of understanding between USF and FDOH
        c) Several projects, that RRAC wanted to pursue, could potentially be conducted at the station if restored
    2. **Phase II of the Florida Passive Nitrogen Removal Project**
        a) $200,000 approximate cost
        b) Build on the results of the Phase I study to go from a lab scale project to a prototype scale project
    3. **Wekiva Onsite Sewage Treatment and Disposal System (OSTDS) Seasonal Variability Assessment**
        a) $200,000 approximate cost
        b) Investigate if there is a seasonal variability of nitrogen concentrations from OSTDS in the Wekiva Study Area of Central Florida
    4. **Alternative Drainfield Product Assessment**
        a) $300,000 approximate cost
        b) TRAP approved this project 2-years ago
        c) Contract in place and then canceled due to industry concerns
        d) Compare the functioning of alternative drainfield materials to standard aggregate
    5. **Long-term deformation of tanks of different materials**
        a) $20,000 approximate cost
        b) Project is in response to problems observed in the field

    This list is to be presented to the TRAP for their approval at the TRAP meeting the following day.

- **Public Comment** – The public was allowed to comment throughout the meeting.

Next Meeting: No date was set for the next meeting. Next meeting anticipated to be some time in April or May 2008 at a location to be determined.