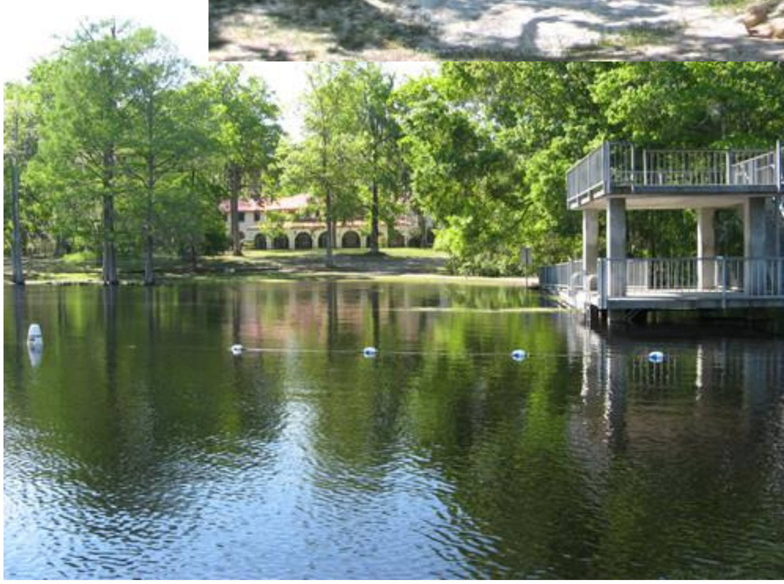
ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS – FINAL REPORT

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL



Submitted to:

Ms. Kim Dressel, Leon County
Senior Assistant to County Administrator
301 S. Monroe St.
Tallahassee, FL 32301

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

November 4, 2011

Table of Contents

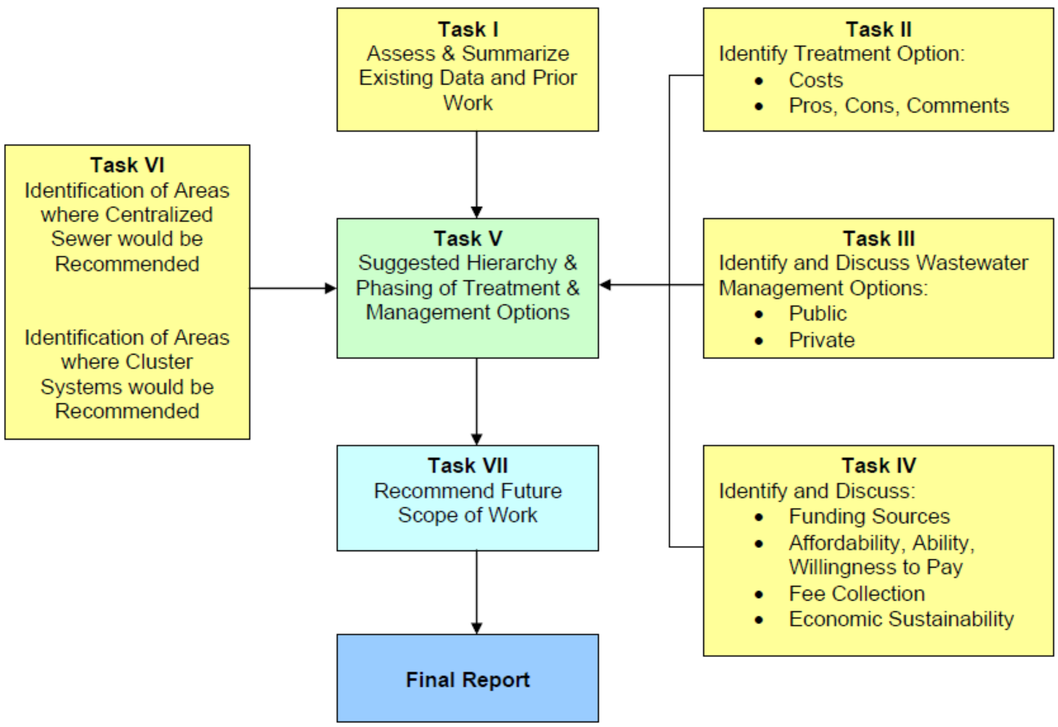
PROJECT OVERVIEW

Project

Lombardo Associates, Inc. (LAI) has been retained to perform an evaluation of Onsite Sewage Treatment and Disposal System (OSTDS) technology and management options for the Wakulla Springs watershed on behalf of Leon County, Wakulla County and City of Tallahassee. LAI's analysis includes consideration of the local economic, social, soil and environmental conditions, as well as political and government structures.

The project is organized into the following tasks, integrated as illustrated on Figure 1.

Figure 1 Scope of Work Integrated Flow



The project is being managed by Leon County with the Project Team of:

- Kim Dressel, Leon County, Senior Assistant to County Administrator & Project Manager
- Mike Stewart, Commissioner, Wakulla County
- Padraic Juarez, Wakulla County Health Department
- Alex Mahon, Leon County Health Department
- Catherine Bray, City of Tallahassee Water Resource Engineering
- Wayne Tedder, Tallahassee/Leon County Planning Department

This Final Report consists of the seven (7) Task Reports detailed in Figure 1 above. Each report has been reviewed by the Project Team and all received comments as of the date of this report have been responded to and incorporated into the appropriate sections of this Final Report.

TASK 1 FINAL REPORT

ASSESSMENT & SUMMARIZATION OF EXISTING DATA & PRIOR RESEARCH

ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL

November 4, 2011

Submitted to:

Ms. Kim Dressel, Leon County
Senior Assistant to County Administrator
301 S. Monroe St.
Tallahassee, FL 32301

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

Table of Contents

List of Tables

List of Figures

EXECUTIVE SUMMARY

This Task 1 Report summarizes and analyzes the existing data and prior research, utilizing the reports listed in Appendix A, and other readily available public information for the Study Areas of Leon County, Wakulla County and the City of Tallahassee.

Leon County and Wakulla County are underlain by the Floridan Aquifer. Soils and surficial geology divide this part of the aquifer into the following two areas:

- The unconfined aquifer – the portion of the aquifer that is overlain with shallow, sandy soils
- The semi-confined aquifer – the portion of the aquifer that is overlain with deep, clayey soils offering a measure of protection against nutrient and other water borne contaminants
- Confined aquifer

The Cody Scarp is the geologic feature that separates the semi-confined aquifer and the unconfined aquifer. Throughout this report, "north of the Cody Scarp" is synonymous with the semi-confined aquifer and "south of the Cody Scarp" is synonymous with the unconfined aquifer.

The July 2007 Leon County Aquifer Vulnerability Assessment (LAVA) and the September 2009 Wakulla County Aquifer Vulnerability Assessment (WCAVA) reports identified the more densely populated areas south of the Cody Scarp as being in the more vulnerable and most vulnerable areas relative to contamination from surface sources.

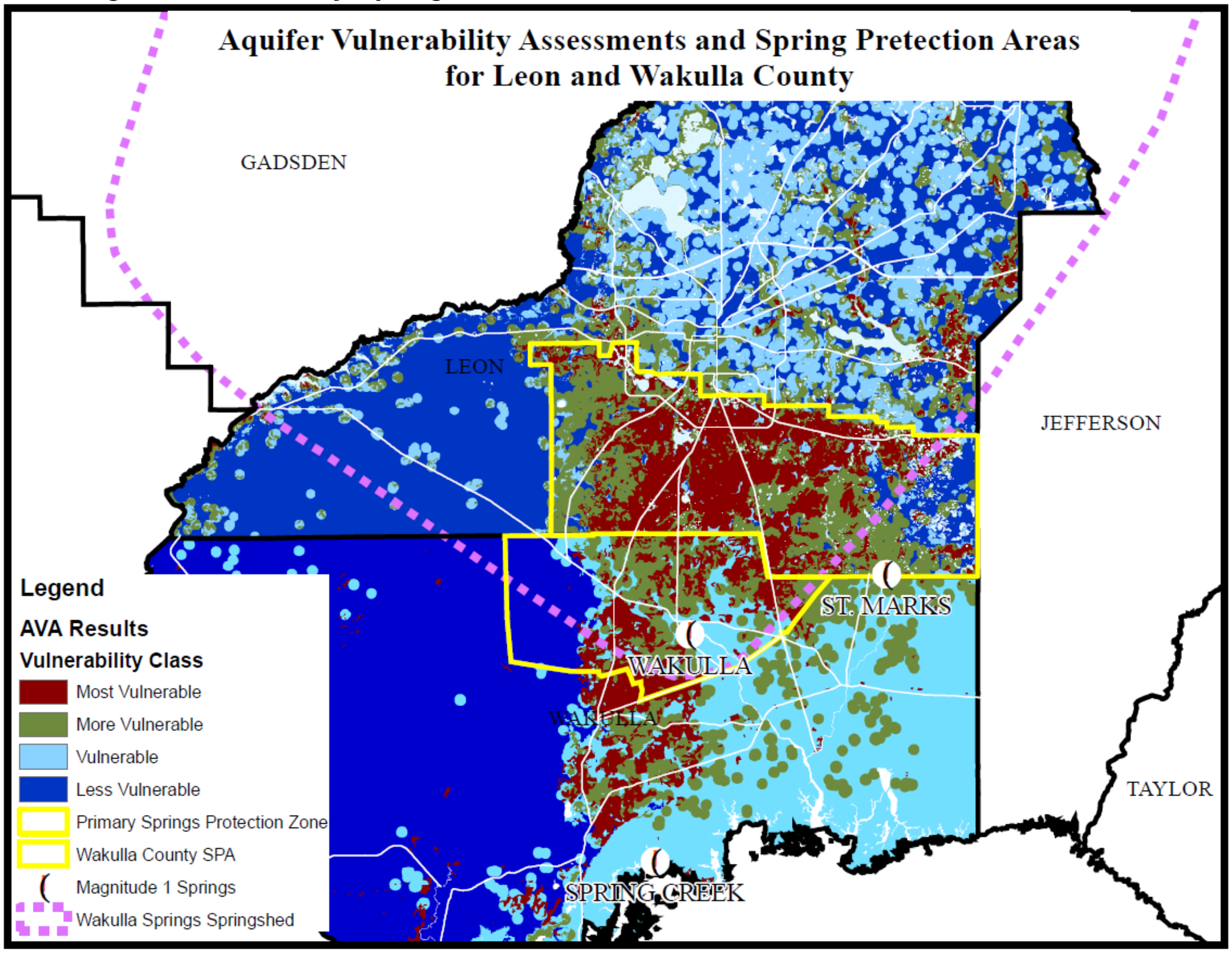
More simply stated, the developed areas of the Wakulla Springs watershed that lie within the unconfined aquifer are the primary areas of concern with respect to contamination from OSTDS, as shown on Figure ES-2.

Throughout the literature review, several similar areas were delineated with the intent of identifying the areas of concern. The areas of the unconfined aquifer contributory to Wakulla Springs, as defined by others, are summarized as follows:

- PSPZ – the Primary Springs Protection Zone, the portion of the unconfined aquifer located within Leon County
- SPA – the Special Planning Area, the portion of the unconfined aquifer located in Wakulla County
- USGS Study Area – the unconfined aquifer within Leon and Wakulla Counties South of the Cody Scarp extending down to the Gulf of Mexico

The PSPZ and the SPA are shown on Figure ES-2. The USGS Study Area is shown on Figures ES-3a and ES-3b for two different flow scenarios. The USGS Study Area can be further subdivided into contributory watersheds for Wakulla Springs, the Wakulla River, the St. Marks River and Spring Creek Springs.

Figure ES-2 Primary Springs Protection Zones In Leon and Wakulla Counties



Source: City of Tallahassee http://www.talgov.com/planning/compln/briefhistory.cfm

These areas change depending on which of two flow scenarios is occurring. The two potential flow scenarios are:

- Scenario 1 – where the Spring Creek Springs Group flows to Spring Creek Springs
- Scenario 2 – where the Spring Creek Springs Group flows to Wakulla Springs

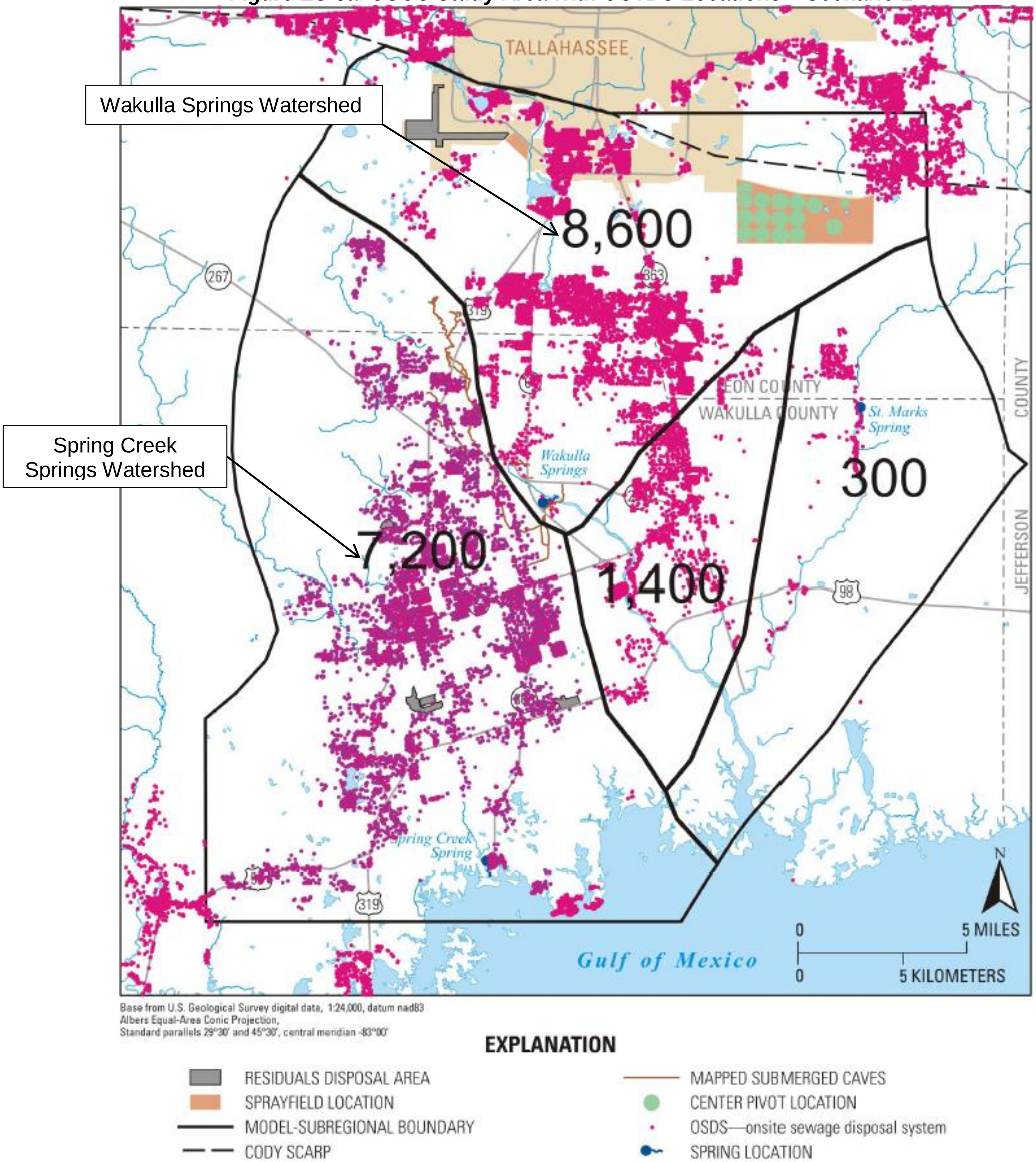
The Spring Creek Springs Group intermittently flows to either Wakulla Springs or to Spring Creek Springs (Kincaid and Werner). The relative water levels in the Wakulla River vs. the water level at the Spring Creek Spring vent dictates the flow condition. The contributory area to the Wakulla Springs and Spring Creek Springs watersheds changes depending on the direction of flow from the Spring Creek Springs Group.

Figure ES-3a shows the unconfined aquifer portion of the Wakulla Springs watershed when the Spring Creek Springs Group flows toward Spring Creek Springs (Scenario 1). Figure ES-3b shows the unconfined aquifer portion of the Wakulla Springs watershed when the Spring Creek Springs Group flows toward Wakulla Springs (Scenario 2). The number of and OSTDS locations within these areas are shown on both figures. As can be seen, during Scenario 2 conditions, there is a significant increase in the number of OSTDS that discharge within the Wakulla Springs watershed. However, this increase is offset by an even larger increase in flow. The resulting concentration observed in Wakulla Springs is significantly lower during Scenario 2.

Table ES-1 presents the number of OSTDS within the unconfined aquifer portion of the watersheds within the USGS Study Area for Scenarios 1 and 2 as provided by Hal Davis, (Sept. 2010). A review of the literature and data sources for OSTDS showed much variation. LAI has determined that the Hal Davis/USGS numbers are within the range of numbers presented from other sources due to the USGS data being available by sub-watershed and for each flow scenario as described herein, the USGS numbers for OSTDS will be used in this and subsequent Task Reports. Table ES-1 uses the quantities in each area as the best approximation possible on the number of systems in the following area, per the Scope of Work:

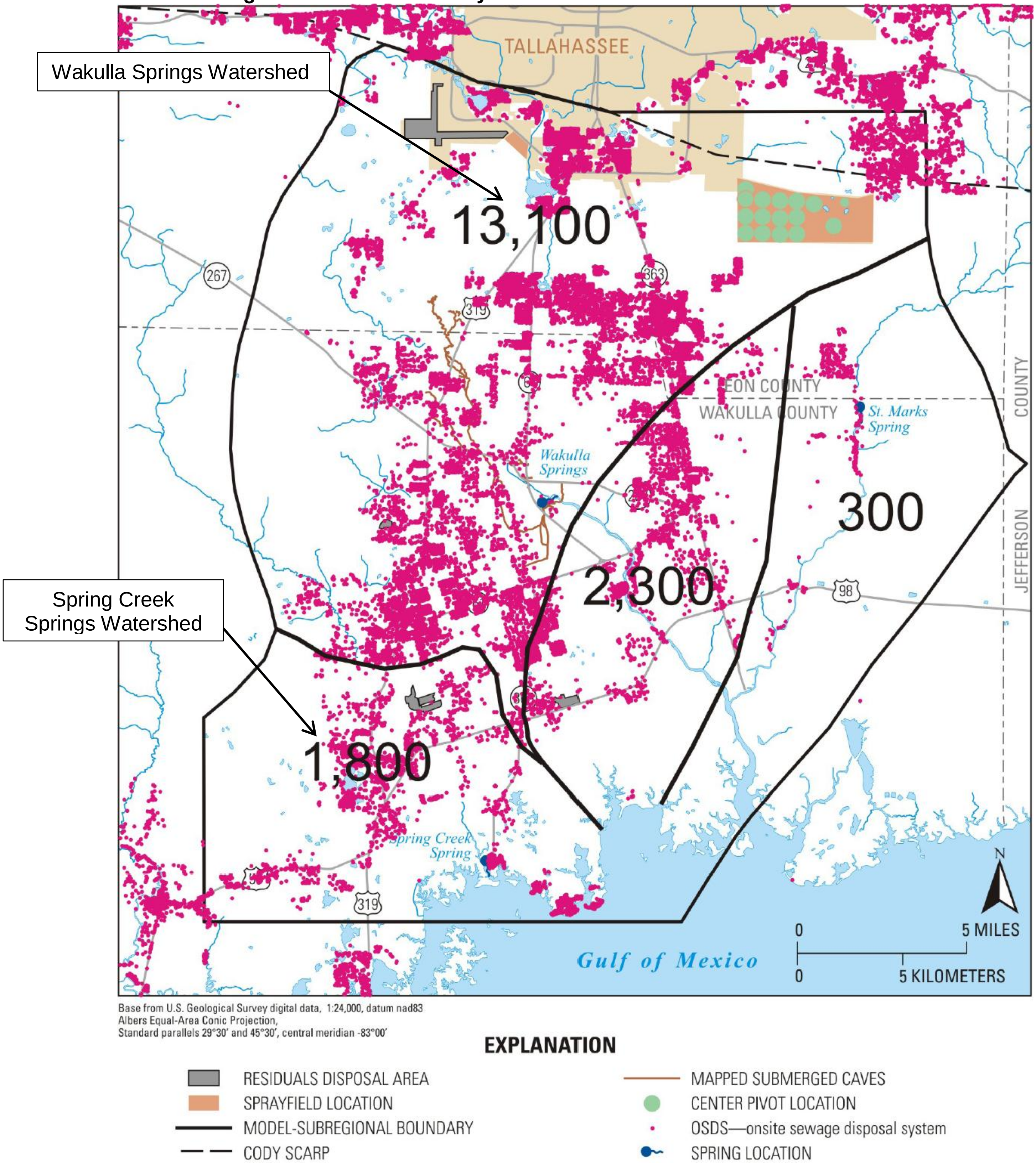
- Wakulla County
- Leon County with a subset of the City of Tallahassee
- Leon County Primary Springs Protection Zone with subset within the City of Tallahassee
- Leon and Wakulla Counties combined

Figure ES-3a. USGS Study Area with OSTDS Locations – Scenario 1



Source: Hal Davis, Personal Communication, 2010

Figure ES-3b. USGS Study Area with OSTDS Locations – Scenario 2



Source: Hal Davis, Personal Communication, 2010

Table ES-1. Scenarios 1 and 2 OSTDS

(Data provided by Hal Davis personal communications (Sept. 2010)

Sub-Watershed	Estimated Number of OSTDS Contributory to Wakulla Springs Watershed							
	Scenario 1			% Total	Scenario 2			% Total
	Leon	Wakulla	Subtotal		Leon	Wakulla	Subtotal	
Wakulla Springs - Unconfined Aquifer Area Only	7,500	1,100	8,600	21.7%	7,800	5,300	13,100	29.7%
Leon County - North of Cody Scarp	31,017	0	31,017	78.3%	31,017	0	31,017	70.3%
SubTotal:	**38,517**	**1,100**	**39,617**	**100.0%**	**38,817**	**5,300**	**44,117**	**100.0%**
Other Watersheds in USGS Study Area - Unconfined Aquifer								
Spring Creek Springs	200	7,000	7,200	18.2%	0	1,800	1,800	4.1%
Wakulla River	200	1,200	1,400	3.5%	100	2,200	2,300	5.2%
St. Marks	170	130	300	0.8%	170	130	300	0.7%
SubTotal:	**570**	**8,330**	**8,900**	**22%**	**270**	**4,130**	**4,400**	**6%**
Total Unconfined / Semi-Confined	**39,087**	**9,430**	**48,517**		**39,087**	**9,430**	**48,517**	
Other		**1,904**	**1,904**			**1,904**	**1,904**	
Grand Total	**39,087**	**11,334**	**50,421**		**39,087**	**11,334**	**50,421**	

Table ES-1a. OSTDS in Leon and Wakulla Counties, by Scope Defined Areas

Data Source	Wakulla	Leon								Leon - PSPZ Only			Total Leon and Wakulla Counties
		COT			Other				Total	COT	Other	Total	
		PSPZ	Semi conf.	Total	PSPZ	Other Unconf.	Semi conf.	Total					
OSTDS	11,334	118	1,100	1,218	7,682	270	29,917	37,869	39,087	118	7,952	8,070	50,421

The 2010 USGS Report used a transient modeling approach to determining the nitrate loads to Wakulla Springs over the period modeled. For planning purposes, the steady-state nitrate load is appropriate for determining the level of nitrate removal that will ensure compliance with the water quality standard of 0.35 mg/L under future conditions. USGS released a revised report on February 1, 2011. The 2010 USGS Report did an excellent job of expanding on previous efforts to quantify the mass of nitrate being applied to the Study Area ground surface. LAI used the USGS mass loads to the ground surface along with the anticipated attenuation between ground surface and the Upper Floridan Aquifer, as defined in the USGS Report, to calculate the mass of nitrate reaching Wakulla Springs. Table ES-2 summarizes the nitrate loads by source for 2007 and 2018. The values in Table ES-2 were calculated using the following information, obtained from the USGS Report, for each source of nitrate:

- Mass load to the ground surface from USGS Report data
- Attenuation between ground surface and the Upper Floridan Aquifer
- Where total Study Area mass loads were presented, the nitrate loads were apportioned to Scenarios 1 and 2 based on Scenario 1 being 30% of the Study Area and Scenario 2 being 50% of the Study Area.
- 2018 loads were calculated using growth projections provided by CoT and Leon County Planning Departments
- LAI was informed by CoT and Leon County personnel that the SESF appropriate mass load presented in the USGS Report for 2007 is 111,000 kg/yr.

Table ES-2. LAI's Estimated Attenuated Nitrate Mass Loads to Wakulla Springs

Description	Scenario	Nitrate Loads to Wakulla Springs Planned Growth Projection (kg/yr)						
		Inflow	OSTDS	*Ferti lizer*	*Creeks / Sinks*	*Live stock*	*Atmo spheric Depo sition*	*SE Farm Spray field*
2007 Mass Balance	**1**	**44,000**	**49,200**	**9,000**	**7,800**	**6,500**	**2,400**	**111,000**
	2	**52,000**	**74,900**	**15,000**	**31,000**	**10,800**	**4,000**	**111,000**
2018 Mass Balance	**1**	**47,800**	**51,200**	**9,400**	**7,800**	**6,800**	**2,400**	**30,100**
	2	**56,500**	**77,900**	**15,600**	**31,000**	**11,300**	**4,000**	**30,100**

For quality control purposes, LAI prepared Table ES-3 that compares the measured nitrate concentrations reported in the Draft Nutrient (Biology) TMDL for Wakulla River WBID 1006 (TMDL) and NWFWMD reports to nitrate concentrations calculated by LAI. NWFWMD reported a median flow from 1907 to 1999 of 340 ft^3/s and an average nitrate concentration of 0.89 mg/L for Wakulla Springs. As discussed in Section 3, the total attenuated nitrate load to Wakulla Springs was estimated at 270,900 kg/yr. For planning purposes, using the average flow and the total assumed loading, the calculated concentration is essentially the same as the measured concentration. This is not a coincidence since the attenuation factors presented in the NWFWMD Report were calculated by using the measured flows and concentrations.

The TMDL report presented measured nitrate data by year. The LAI mass balance total loads for 2007 Scenarios 1 and 2 were 229,900 kg/yr and 298,700 kg/yr respectively. As can be seen in Table ES-3, the measured average value from 1990 – 1999 (predominantly Scenario 1 conditions) and the maximum value measured in 2007 correlate with the LAI mass balance for Scenario 1. In addition, the measured average and minimum value for 2007 correlate well with the LAI mass balance for Scenario 2. In LAI's opinion, for this level of analysis and recognizing the complexities of the groundwater aquifer, the data appear consistent.

The applicable water quality standard for nitrate concentration in the Wakulla River, per the TMDL Report and EPA standards, is 0.35 mg/L.
Table ES-4 uses the flows associated with Scenarios 1 and 2 and the applicable water quality standard of 0.35 mg/L to calculate the maximum nitrate load that can be received by Wakulla Springs without violating the standard of 0.35 mg/L.

Table ES-3. Measured vs. Calculated Nitrate Concentrations in Wakulla Springs

Report	Scenario			Total Mass Load	Flow	Calc. NO_3	Measured NO_3 (mg/L)		
				kg/yr	ft^3/s	mg/l	Avg.	Min.	Max
NWFWMD	**1990 - 1999 Averages**			267,700	340	0.88	0.89		
TMDL	**2007**						0.58	0.47	0.80
LAI Mass Balance	**2007**	**1**	*Assumed Wakulla Springs **NOT** capturing Spring Creek Springs Group Flow*	229,900	350	0.73			
		2	*Assumed Wakulla Springs **CAPTURING** Spring Creek Springs Group Flow*	298,700	750	0.44			

Table ES-4. Maximum Nitrate Loads to Wakulla Springs to Achieve Water Quality Standard

Scenario	Flow		Water Quality Based Max. Nitrate Conc.	Max. Nitrate Mass Load	
	ft^3/s	MGD	mg/l	lb/day	kg/yr
Scenario 1	350	226	0.35	663	**110,000**
Scenario 2	750	485	0.35	1,416	**235,000**

Table ES-5 combines the total nitrate loads from Table ES-2 and maximum load from Table ES-4 to calculate the nitrate removal required to meet the water quality standard of 0.35 mg/L. Removal requirements as a percent of the total nitrate load and as a percent of the OSTDS nitrate load are also presented in Table ES-5.

Table ES-5. Water Quality Standard Based Nitrate Removal Requirements

Description	Scenario	Nitrate Loads to Wakulla Springs Planned Growth Projection (kg/yr)			
		Total	W.Q. Standard Max. Nitrate Load	Nitrate Removal Rqmt.	% Total Nitrate Removal Rqmt.
2007 Mass Balance	**1**	**229,900**	**110,000**	**119,900**	**52%**
	2	**298,700**	**235,000**	**63,700**	**21%**
2018 Mass Balance	**1**	**155,600**	**110,000**	**45,600**	**29%**
	2	**226,500**	**235,000**	**-8,500**	**-4%**

The implication of the data shown in Table ES-5 is that there are two separate removal requirements applicable for achieving the water quality threshold of 0.35 mg/L, based on the flow scenario that is occurring. It is important to note that the 2018 numbers reflect the full effect of the improvements planned to the SESF effluent. As can clearly be seen in Table ES-5, ***for Scenario 1 conditions, the improvements to the SESF effluent will not achieve the water quality standard without significant additional nitrate removal from other sources.***

For Scenario 2 conditions, the improvements at the SESF appear to meet and even exceed the nitrate removal requirement. ***Using the revised nitrate load projections presented in this report, it does not appear that additional nitrate removal is required in the Scenario 2 areas outside the Scenario 1 boundary.***

Also noted from Table ES-5 are the vastly different nitrate removal requirements under Scenarios 1 and 2. Scenario 1 requires 29% of the total nitrate load to be reduced for 2018 conditions while Scenario 2 does not require any removal beyond the planned improvements at the SESF. This conclusion will need to be examined in detail to determine the effect on the number and location of OSTDS that will need additional treatment as well as the level of treatment required. It is important to note that the OSTDS within the Scenario 2 boundary but not within the Scenario 1 boundary have no effect on the water quality for Scenario 1 conditions.

The literature reviewed reported attenuation of OSTDS effluent nitrate ranging from 25 – 40%. Table ES-6 shows the effect this has on the removal requirements shown in Table ES-5. This is a very important conclusion for the Scenario 2 area. ***The nitrate removal requirements, beyond the SESF improvements, increase from -4% (no removal required) to 11% for Scenario 2 when the assumed OSTDS effluent attenuation decreases from 50% to 25%.***

Table ES-6. Effect of Attenuation on OSTDS Removal Requirements

Description	Scenario	% Total Nitrate Removal Rqmt.		
		50% Atten.	40% Atten.	25% Atten.
2007 Mass Balance	1	52%	54%	57%
	2	21%	25%	30%
2018 Mass Balance	1	29%	34%	39%
	2	-4%	3%	11%

The options for achieving the water quality standard required nitrate removal for OSTDS are developed in the Task 2 report. Table ES-7 lists nitrate sources, sorted from largest to smallest loads, along with the associated issues for nitrate removal:

Table ES-7. Wakulla Springs Nitrate Sources within Leon and Wakulla Counties

Nitrate Source	2018 Nitrate Load *(kg/yr)*		Issues / Representative Options
	Scenario 1	Scenario 2	
OSTDS	51,200	77,900	Sewer connections, cluster systems, nitrate reducing OSTDS and/or groundwater treatment.
Inflow	47,800	56,500	Large recharge area requiring sewer connections, cluster systems or nitrate reducing OSDS. Low % of nitrates from OSDS in this area reaches Wakulla Springs, increasing the effective $/lb NO_3 removed.
SE Farm Sprayfield	30,100	30,100	2018 load includes a 75% reduction from 12 mg/L to 3 mg/L. Additional removal is not likely to be economically feasible
Fertilizer	9,400	15,600	BMPs include regulations on type and amount of fertilizers allowed.
Creeks / Sinks	7,800	31,000	Stormwater BMPs for areas draining to the creeks and sinkholes. Due to the quantity and intermittent nature of stormwater, only marginal removals are expected.
Livestock	6,800	11,300	Not feasible to control for grazing livestock. Caged livestock could capture and treat washdown water.
Atmospheric Deposition	2,400	4,000	Uniformly applied across the entire land surface. Not feasible to capture/treat.
Totals:	**155,500**	**226,400**	
N Removal Requirement	45,500	-8,600	
% of Total	**29%**	**-4%**	

Of the sources listed in Table ES-7, only the following are considered "controllable sources" that are technically and economically feasible for the nitrate reduction necessary to meet the water quality standard:

- Inflow
- OSTDS
- Fertilizer

Observations, Conclusions & Recommendations

The total nitrate removal requirements are 29% for Scenario 1 and -4% for Scenario 2, assuming 50% attenuation performance from conventional septic systems. The negative percent removal (-4%) indicates that during Scenario 2 conditions, the upgrades at the SESF will result in exceeding the nitrate removal requirements.

If the 45,600 kg/yr required reduction is allocated to the remaining sources excluding atmospheric deposition (i.e., OSTDS, Inflow, Fertilizer, Creeks/Sinks, and Livestock) then a minimum 37% reduction OSTDS would be required. The efficacy and reliability of achieving 37% reduction of Inflow, Fertilizer, Creeks/Sinks, and Livestock contributions are unknown. Extensive analysis will be required to determine what is required and the ability, if at all possible, to do so to achieve this requirement. It is noted that the nitrogen contributions from these sources and the % of the subtotal are:

2018 Scenario 1 N Mass Contributions		
Sourc e	kg/yr	% of Subtotal
Inflow	47,800	66.57%
Fertilizer	9,400	13.09%
Creeks/Sinks	7,800	10.86%
Livestock	6,800	9.47%
Subtotal	71,800	100%

with Inflow, which is heavily OSTDS contributions north of the Cody Scarp, being the predominant contributor at 67% of the subtotal. Alternately removing 56% of Inflow nitrogen and 37% of Scenario 1 OSTDS achieves the required 45,600 kg/yr nitrogen removal. Obviously other combinations are possible.

If the Scenario 1 29% total reduction (45,600 kg/yr) was addressed solely by reducing OSTDS loading (51,200 kg/yr) then an 89% reduction of OSTDS loading would be required in Scenario 1. Essentially that level of reduction would require AWT level treatment in 100% of the Scenario 1 area. For the executive level of review in this Report it is assumed that OSTDS contribution is the controllable source that would be addressed to achieve the desired load reductions.

The financial implications of the 37% approach is partially addressed in the Task 4 Report in which the costs for 37% OSTDS are estimated. However no estimates of costs have been made, in part due to the lack of technical feasibility and associated cost information/basis on which to make cost estimates, for removal of 37% of the Inflow, Fertilizer, Creeks/Sinks, and Livestock loads. The financial implications of achieving 89% N removal via OSTDS upgrades to AWT are presented in the Task 4 Report.

The costs for achieving the Scenario 1 nitrogen reduction requirement of 45,600 kg/yr will therefore be between the Task 4 Report budgets for 37% OSTDS AWT budget and 89% OSTDS AWT budget.

It is noted that no allocation is made for growth beyond 2018, to maintain the Scenario 1 requirements. Future growth would then need to comply with a no net contribution goal – which is used in other nitrogen stressed watersheds.

Through continuing project optimization efforts and adaptive management, cost minimization can be achieved.

- Adopt a modified USGS groundwater steady-state model that includes concentration data, along with a continuing groundwater and water quality monitoring program, as an on-going management tool for adaptive management planning purposes.
- Reduction of OSTDS nitrate contributions needs to occur to the maximum extent possible in the USGS Study areas contributing to Wakulla Springs, especially the Scenario 1 and Scenario 2 areas of the unconfined aquifer. See Task 2 Report for further details.

Please note these OSTDS are in the USGS Study Area, which includes and is larger than the combined PSPZ and SPA areas. OSTDS in the other areas, primarily north of Cody Scarp are predominately represented in the INFLOW category of Table ES-2 and have an estimated 79% natural attenuation between the application point and Wakulla Springs.

CAVEATS

1. Nitrate loadings should be validated. It is noted that OSTDS mass loadings are calculated based upon multiplying the number of OSTDS by the attenuation factor- assumed as 50% by the USGS. Although LAI is of the opinion that the 50% attenuation factor in the unconfined aquifer is on the high end of expectations / measurements, it is being used for planning purposes.
2. Natural attenuation for areas north of Cody Scarp was estimated at 79+% based on 100% of the “Inflow” load originating from OSTDS effluent. Since the N contributions include sources in addition to OSTDS, the OSTDS N attenuation in the confined area (i.e. north of Cody Scarp) is greater than 79%. Verification of this estimate should be performed in subsequent studies.
3. Most vulnerable areas north of the Cody Scarp likely have a lower attenuation, which would mean that OSTDS and other nitrate sources within these areas have the potential to be a significant, controllable percentage of the inflow nitrate load.
4. Scenarios 1 and 2 have significantly different flows and loads and they represent the two extremes of flow and loading conditions. An average flow and loading condition may be an acceptable approach and should be investigated further.
5. Two major reports discuss the most significant major man-made source of nitrate is treated wastewater applied at the SESF. Improvements are planned to upgrade this source to AWT standards. This represents a 75% reduction in nitrate load, which is sufficient to meet the 2018 Scenario 2 reduction requirement; however it is not sufficient to meet the 2018 Scenario 1 reduction requirement. Significant additional nitrate removal, beyond the improvements at the SESF, is required from the Scenario 1 area to meet the water quality standard.
6. OSTDS nitrate loading is the next largest controllable source of nitrates contributing to Wakulla Springs.

INFORMATION GAPS

Lombardo Associates, Inc. (LAI) identified the following gaps in information that would assist decision makers in identifying cost-effective means to reduce the nitrate load to Wakulla Springs from OSTDS:

- Actual attenuation of nitrates between the septic tank effluent pipe and the underlying groundwater.
- Updated numbers and locations of OSTDS in both counties. Number and location of OSTDS in the City of Tallahassee and the PSPZ within the City of Tallahassee
- Determination of the expected future flow conditions as well as more detail on total flows and nitrate concentrations associated with Scenario1 or Scenario 2.
- Better understanding of the fate of nitrate applied to the landscape north of the Cody Scarp, including the isolated unconfined or poorly confined areas that may not have the same attenuation as the rest of the semi-confined area.

1 INTRODUCTION

1.1 TASK 1 REPORT OBJECTIVES

The objectives of this Task 1 Report are as follows:

- Summarize and assess the existing data on:
  a. Wakulla Springs hydrogeology and nitrate contributions
  b. OSTDS contributions to Wakulla Springs, as well as totals in study area, and statistical information, such as age, type, demographic of owners, etc.
  c. TMDL requirements – existing or anticipated
  d. Projected OSTDS TMDL nitrate removal requirements

- Provide details relevant to each of the following geographic areas:
  a. Wakulla County only;
  b. Leon County – Countywide, with subset data for areas within the City of Tallahassee;
  c. Leon County – PSPZ only, with subset data for areas within the City of Tallahassee;
  d. Combined Leon and Wakulla approach.

- Identify gaps in information that would assist decision makers in identifying cost-effective means to reduce the nitrate load to Wakulla Springs from OSTDS and provide the missing data elements, as practical within budget constraints.

1.2 RELEVANT REPORTS SUMMARIZED

The following reports provide information relevant to hydrology, OSTDS and nitrate loading to Wakulla Springs and will be summarized in this report:

1. Nitrate-N Movement in Groundwater from the Land Application of Treated Municipal Wastewater and Other Sources in the Wakulla Springs Springshed, Leon & Wakulla Counties, Florida, 1966-2018 (USGS Report 2010-5099). (USGS, 2010)

2. Fate of Effluent-Borne Contaminants Beneath Septic Tank Drainfields Overlying a Karst Aquifer, Journal of Environmental Quality, Brian G. Katz, Dale W. Griffin, Peter B. McMahon (USGS); Harmon S. Harden (FSU); Edgar Wade, Richard Hicks (FL DEP); Jeffrey P. Chanton (FSU); March 18, 2010.

3. Draft Nutrient (Biology) TMDL for Wakulla River WBID 1006, Douglas Gilbert, FL DEP, May 14, 2010.

4. Conduit Flow Paths & Conduit/Matrix Interactions Defined by Quantitative Groundwater Tracing in the Floridian Aquifer, Kincaid & Werner 2008.

5. Leon County Aquifer Vulnerability Assessment, July 19, 2007 & Wakulla County Aquifer Vulnerability Assessment, September 14, 2009.

6. Nitrate Loading as an Indicator of Nonpoint Source Pollution in the Lower St. Marks-Wakulla Rivers Watershed (Chelette, Pratt & Katz), April 2002.

7. Wakulla County Wastewater Facilities Plan FY 2006, FL Dept. of Environmental Protection State Revolving Fund, Marc E. Neihaus, P.E., November 30, 2006.

8. City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010

1.3 REPORT STRUCTURE

The subsequent sections of the report are organized into the following sections:

- Section 2 – Community Profile, geology and soils for the Study Area. Elements of some of the reports and other data sources will be referenced in this section.
- Section 3 – Summary of specific reports that are relevant to hydrology, OSTDS and other nitrate loads to Wakulla Springs and the Study Area
- Section 4 – Summary of nitrate loads to Wakulla Springs
- Section 5 – Summary and sensitivity analysis of TMDL nitrate removal requirements
- Section 6 – Wastewater Facilities Plans for the Study Area
- Section 7 – Summary of other TMDLs affecting the Study Area
- Section 8 – Summary and conclusions

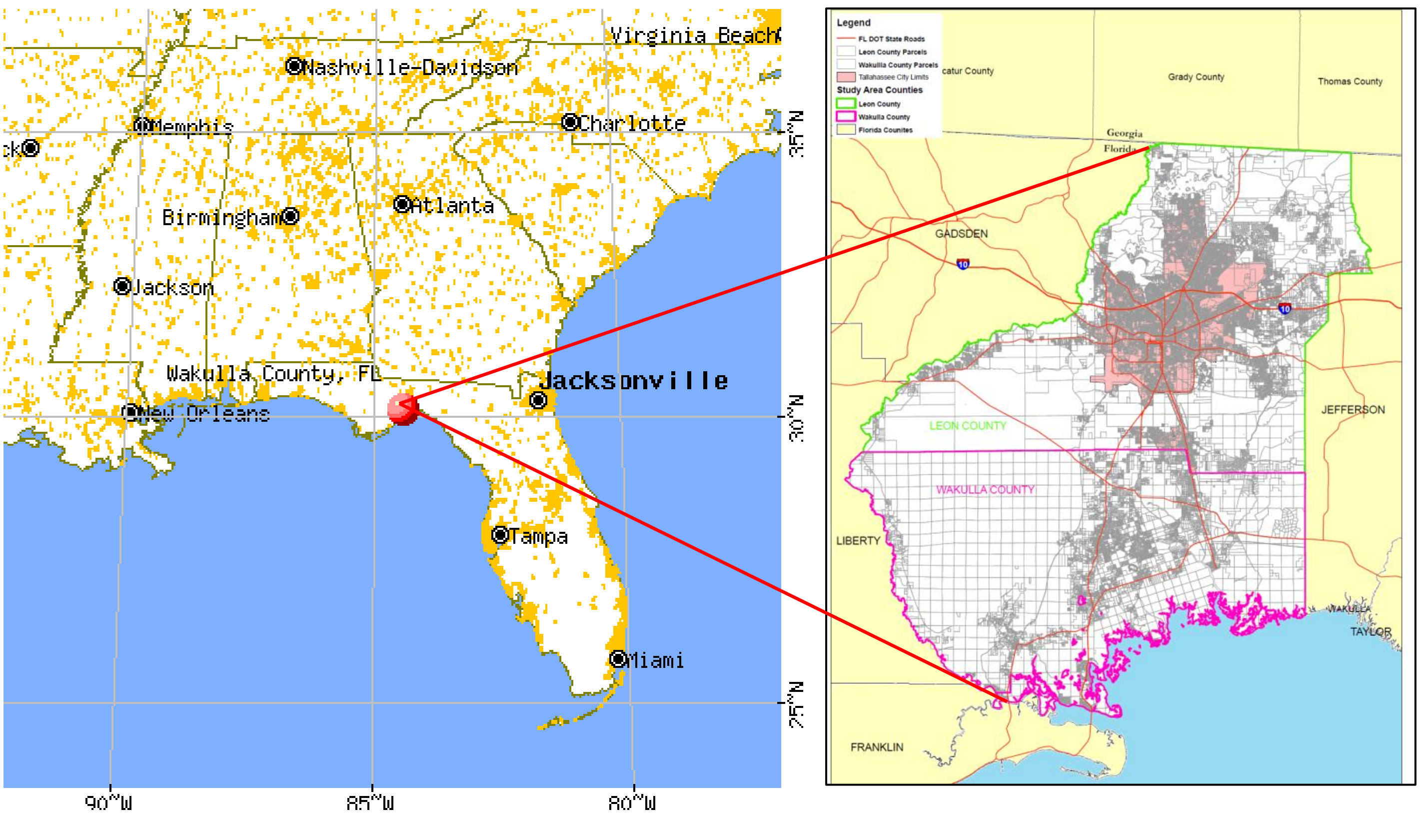
2 COMMUNITY PROFILE, GEOLOGY AND SOILS

The focus of the project is on addressing onsite treatment and disposal systems (OSTDS) management for the restoration of the water quality of Wakulla Springs. This Report provides the context for addressing this matter. The project's study areas consist of:

- Leon County
- Wakulla County
- that portion of the City of Tallahassee in the PSPZ

with a location map and an aerial photograph of the Study Area presented as Figure 2-1 and Figure 2-2, respectively.

Figure 2-1. Location Map



There is a high level of sinkhole activity to the south of the Cody Scarp in the Woodville Karst Plain, an unconfined portion of the Floridan aquifer, which attracts geologists from all over the world. The Woodville Karst Plain hosts the Wakulla Springs, one of the world's largest and deepest freshwater spring and a natural, national treasure.

Wakulla Springs is a first magnitude spring and is part of the longest and deepest known submerged freshwater cave system in the world. Located 14-miles south of downtown Tallahassee, 5-miles south of the Leon County line, and within Wakulla County, Florida, Wakulla Springs is an important part of the regional ecology and recreational economy.

U.S. Census data regarding Leon and Wakulla Counties and City of Tallahassee are provided on Table 2-1:

Figure 2-2. Aerial Photograph of Leon & Wakulla Counties

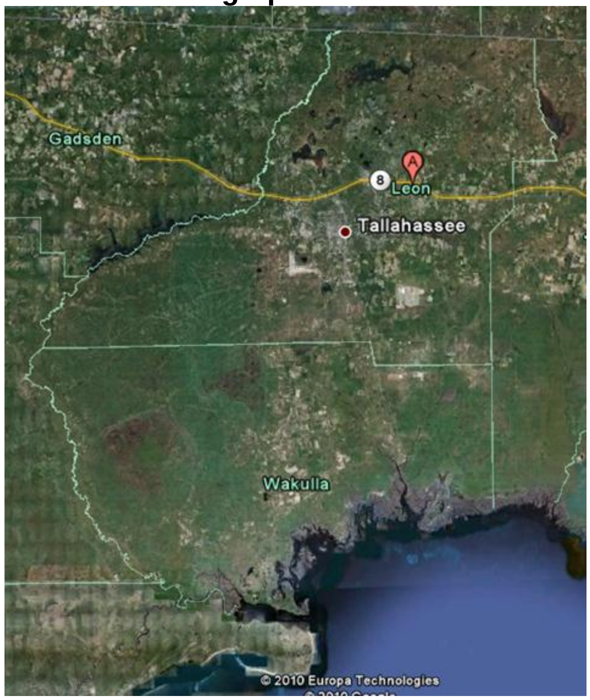


Table 2-1. Leon & Wakulla County Quick Facts

People QuickFacts	Wakulla County	Leon County		City of Tallahassee	Florida
		Total	Outside CoT[1]		
Population, 2009 estimate	32,815	265,714	93,140	172,574	18,537,969
Population, percentage change, April 1, 2000 to July 1, 2009	43.50%	11.00%		14.57%	16.00%
Population estimates base (April 1) 2000	22,866	239,454	88,830	150,624	15,982,839
Homeownership rate, 2000	84.20%	57.00%		43.80%	70.10%
Median value of owner-occupied housing units, 2000	96,200	110,900		102,500	105,500
Housholds, 2000	8,450	96,521	33,304	63,217	6,337,929
Persons per household, 2000[2]	2.57	2.34	2.66	2.17	2.46
Median household income, 2008 (1999 for City of Tallahassee)	$48,012	$47,318		$30,571	$47,802
Per capita money income, 1999	$17,678	$21,024		$18,981	$21,557
Persons below poverty level, percent, 2008	13.00%	18.60%		24.70%	13.30%

People QuickFacts	Wakulla County	Leon County		City of Tallahassee	Florida
		Total	Outside CoT*		
Land Area, 2000 (square miles)	607	667	572	95	53,927
Persons per square mile, 2000	37.7	359	155	1,574	296

[1] ***Areas of Leon County outside the City of Tallahasse calculated as the difference between Leon County Total and City of Tallahassee Total.***

[2] ***Number of persons per household calculated using persons per household and number of households data for Leon County and the City of Tallahassee.***

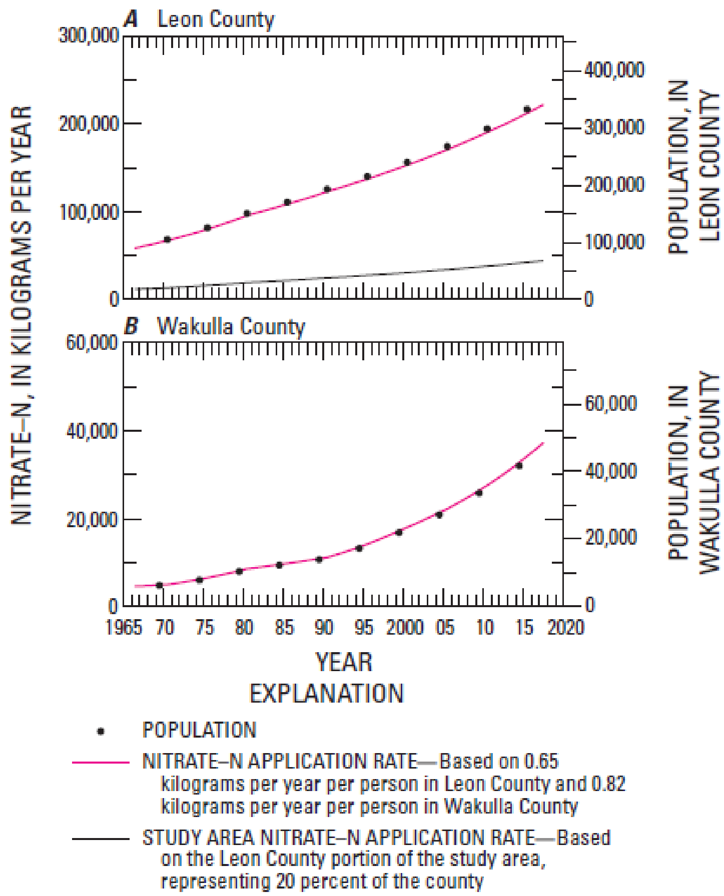
Source: US Census Bureau (http://quickfacts.census.gov/qfd/states/12/12073.html)

Poverty household income for a 2.5 person household is approximately $16,440.

2.1 POPULATION

Figure 2-3 presents historical population of Wakulla and Leon Counties.

Figure 2-3. Historical and Projected Population Trends



Source: USGS 2010 Report, Figure 18

Table 2-2A illustrates the City of Tallahassee, Leon County (and unincorporated Leon County) population projections through 2035.

Table 2-2A. City of Tallahassee & Leon County Population Projections

Year		City of Tallahassee	Unincorporated Leon County	Leon County
2000		150,624	88,828	239,452
2009	(E)	177,879	96,924	274,803
2015	(P)	185,300	99,600	284,900
2020	(P)	194,500	103,100	297,600
2025	(P)	203,500	106,400	309,900
2030	(P)	211,800	109,400	321,200
2035	(P)	219,200	112,200	331,400

(E) *Estimate*
(P) *Projection*

Sources:
- 1930-2000: U.S. Census Bureau
- 1991-1999, 2009, Leon County, City of Tallahassee, Unincorporated Leon County estimates: University of Florida, Bureau of Economic and Business Research (BEBR)
- 2010-2035 Leon County projections: BEBR
- 2010-2035 City of Tallahassee and Unincorporated Leon County projections: Tallahassee-Leon County Planning Department

August 2009
Tallahassee-Leon County Planning Department

Table 2-2B illustrates the Wakulla County population projections through 2030.

Table 2-2B. Wakulla County Population Projections

Year	Wakulla County
1990	14,202
2000	22,863
2009	31,791
2010	31,806
2015	34,997
2020	38,795
2025	42,600
2030	46,298

Source: Florida Housing Data Clearinghouse (http://flhousingdata.shimberg.ufl.edu/a/profiles?action=results&nid=6500)

2.2 LAND USE AND ZONING

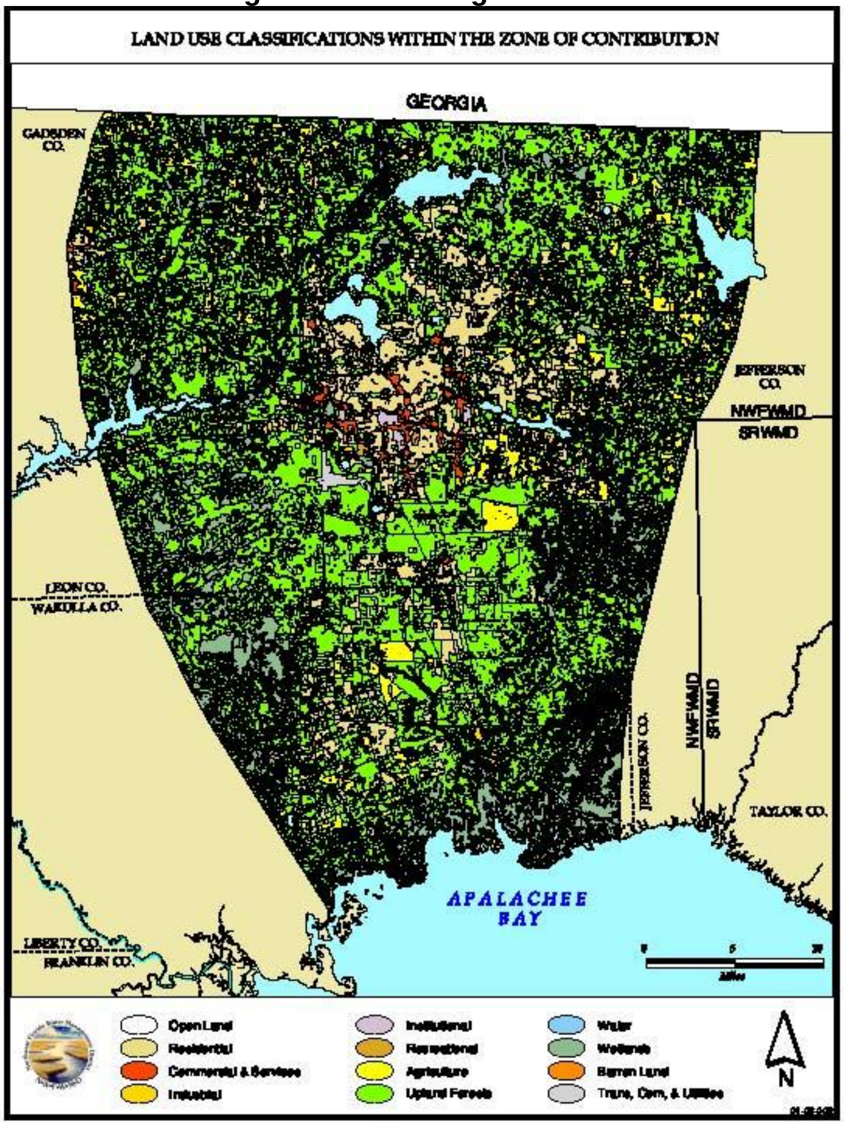
Existing land use (2002) in the Wakulla Springs drainage area is presented on Figure 2-4.

2.3 ADDITIONAL RELEVANT INFORMATION

2.3.1 Tourism Value to Economy

The annual economic impact of visitors to Wakulla Springs is about $22.2 million on the area's economy.

Figure 2-4. Existing Land Use



Source: Nitrate Loading as an Indicator of Nonpoint Source Pollution in the Lower St. Marks- Wakulla Rivers Watershed (Chelette, Pratt & Katz), April 2002.

2.3.2 Historical Resources

Wakulla Spring is one of the largest and deepest freshwater springs in the world. The spring is the centerpiece of Wakulla Springs State Park, considered to be a crown jewel of the Florida state parks. Wakulla Spring is also a national cultural treasure – the site of Indian artifacts, and the setting for classic movies – the original Tarzan series and the Creature from the Black Lagoon.

2.4 STUDY AREA PHYSICAL CHARACTERISTICS

Evaluating a proposed area in terms of its environmental conditions (climate, geology, slopes, soils, landscape, ground water and surface water aspects), physical features and wastewater characteristics provides important information needed to size, select and site the appropriate wastewater treatment systems. In the following sections the relevant characteristics of the Study Area relevant to the Project will be discussed.

2.4.1 Geology

Geographically, the Leon County and Wakulla County areas of Florida are unique. Leon County is divided by an east to west feature known as the Cody Scarp, which was formed thousands of years ago when sea levels were much higher, as shown on Figure 2-5. The Cody Scarp marks an area where elevations drop from heights of 230 feet to 50 feet in a relatively short distance and where red clay in the north changes abruptly to soft sand in the Woodville Karst Plains to the south. Figure 2-6 illustrates a hydrogeologic cross section through the Study Area.

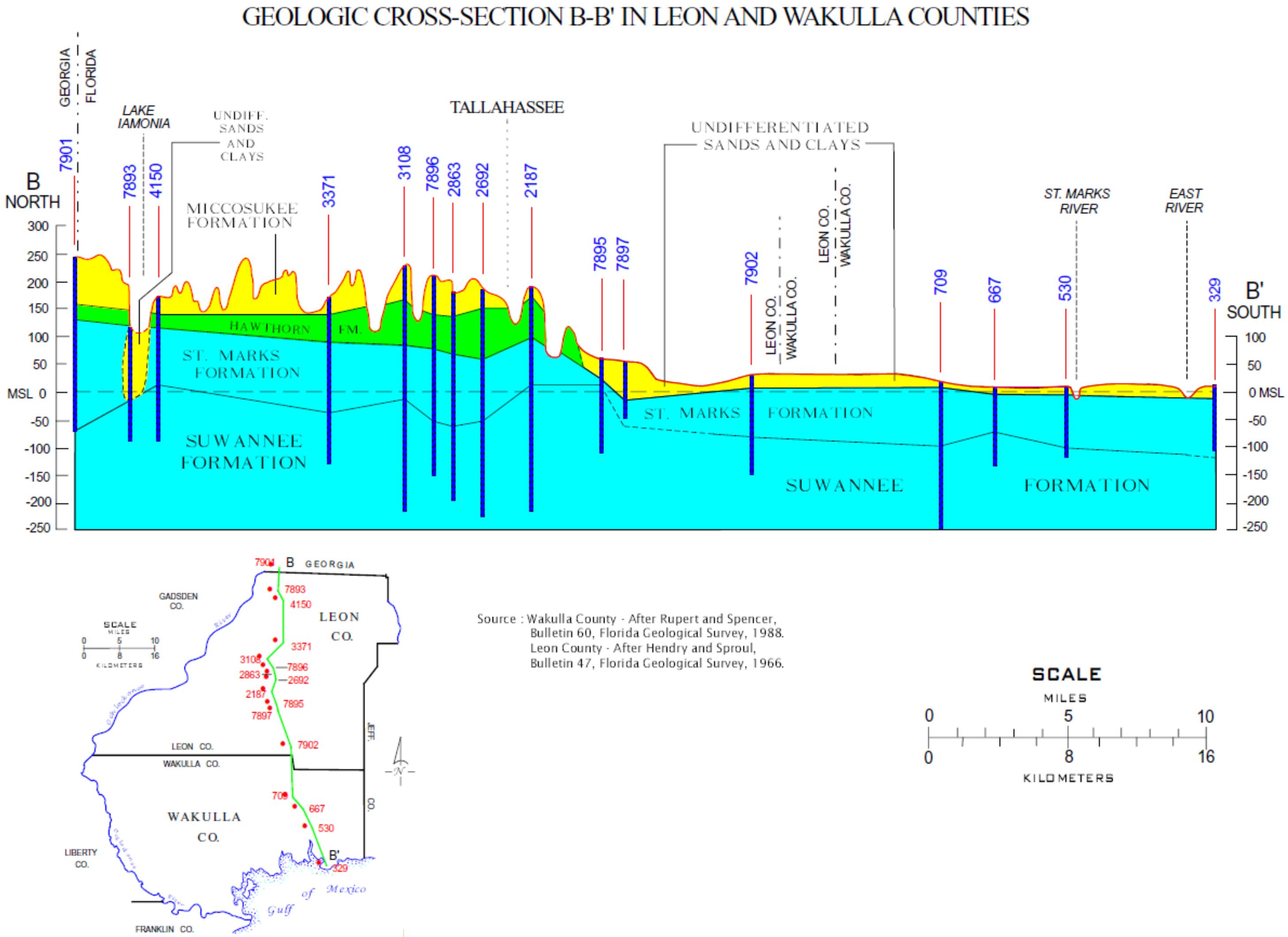
Figure 2-5. Cody Scarp & Confined versus Unconfined Areas

Source: Todd Kincaid, Wakulla Karst Plain Project, Presentation at Wakulla Spring Symposium May 2004

2.4.2 Wakulla County Geology

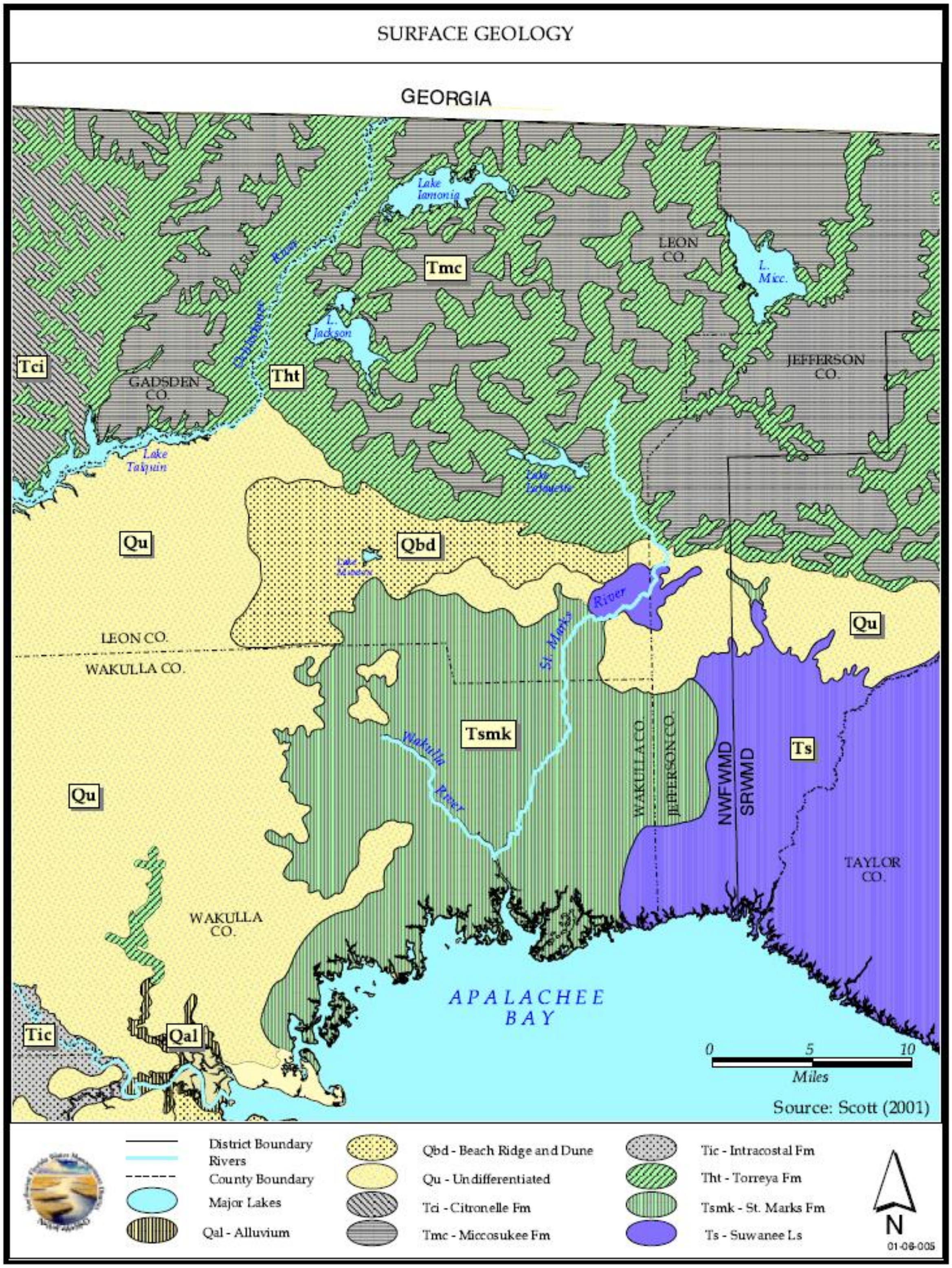
The surficial geology of the Study Area is illustrated on Figure 2-7.

Figure 2-6. Hydrogeologic Cross-Section through the Study Area



Source: USGS, 2010

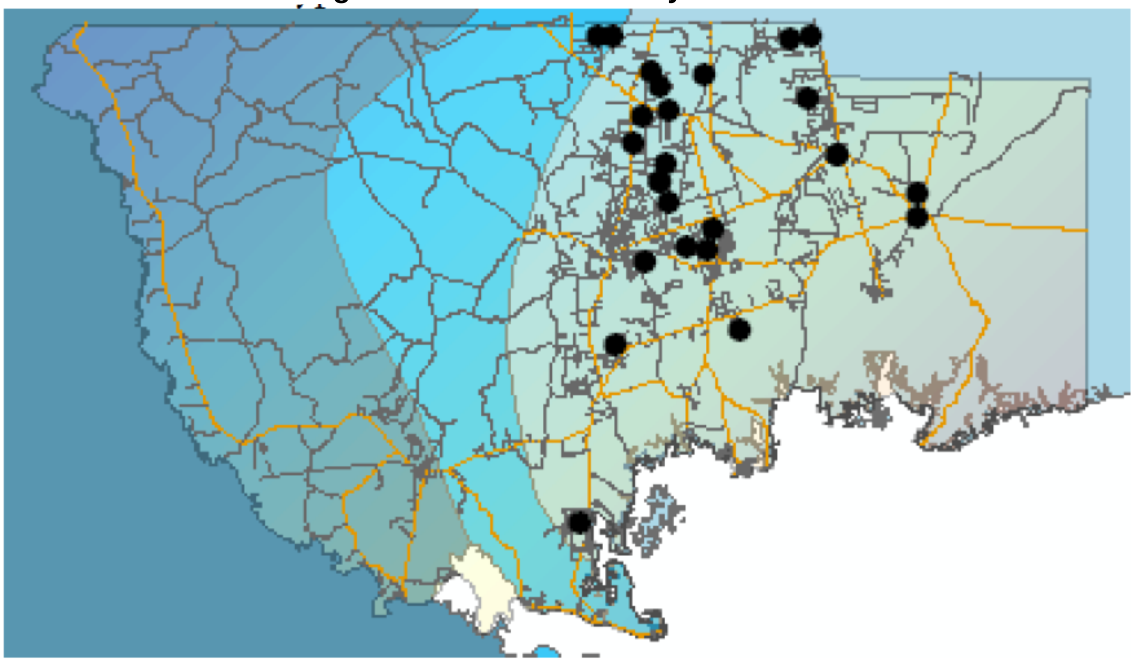
Figure 2-7. Surficial Geology



Source: Nitrate Loading as an Indicator of Nonpoint Source Pollution in the Lower St. Marks- Wakulla Rivers Watershed (Chelette, Pratt & Katz), April 2002.

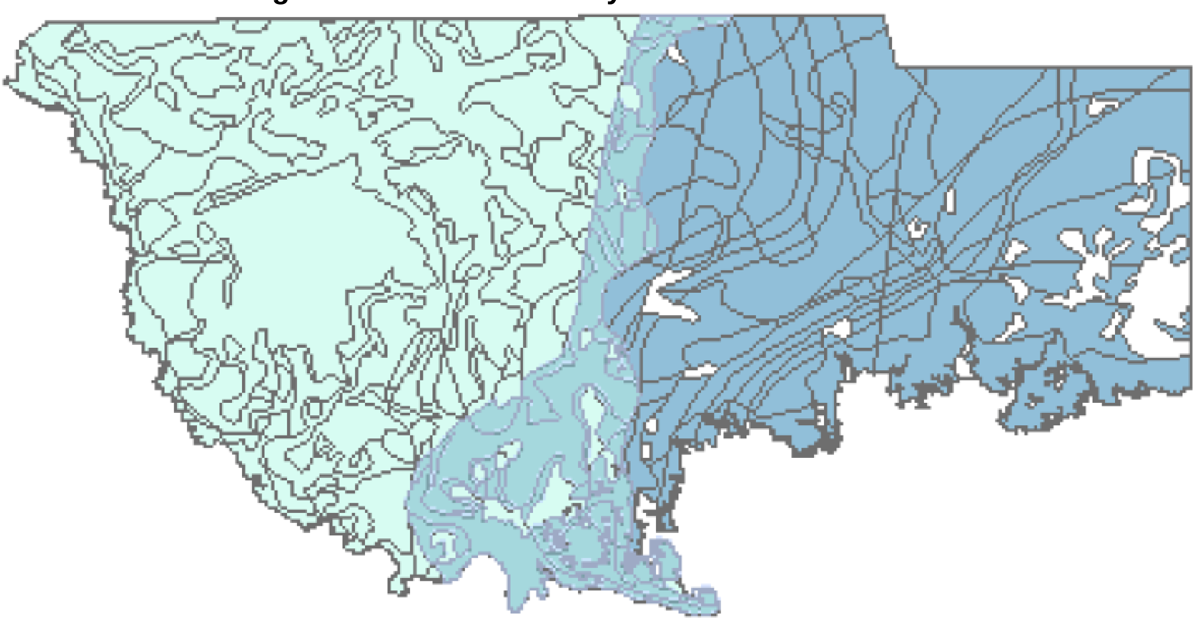
Figure 2-8 illustrates the sinkholes within Wakulla County and Figure 2-9 illustrates Karst Limestone areas, based upon Geology data from ftp://ftp1.fgdl.org/pub/.

Figure 2-8. Wakulla County Sinkholes



Source: OSTDS & Decentralized Systems Wastewater Treatment Program- Phase I Report, FSU, Revised January 2007

Figure 2-9. Wakulla County Karst Limestone Areas



Source: OSTDS & Decentralized Systems Wastewater Treatment Program- Phase I Report, FSU, Revised January 2007

2.5 SOILS

Wakulla and Leon County Soils

Based upon USDA Natural Resource Conservation Service Reports, the soils and their extent in Wakulla County and Leon County are briefly described in Tables 2-4 and 2-5, respectively.

Table 2-4. Wakulla County Soils

	Wakulla County Soil Type	Description	Acreage	% of County
1	Leon-Scranton-Rutlege	Nearly level,poorly drained and very poorly drained, sandy soils; some have an organic stained subsoil	97,360	25.3%
2	Ridgewood-Ortega-Rutlege	Nearly level to gently undulating, somewhat poorly drained, moderately well drained, and very poorly drained sandy soils;	59,010	15.3%
3	Croatan-Dorovan	Nearly level, very poorly drained, organic soils that are underlain by mineral material	58,025	15.1%
4	Tooles-Nutall-Chaires	Nearly level, very poorly drained, sandy soils; some have a loamy subsoil underlain by limestone, and some have a sandy and loamy subsoil	49,785	12.9%
5	Otela-Alpin-Shadeville	Nearly level to gently undulating; moderately well drained and excessively drained, sandy soils; some have a loamy subsoil, and some have a loamy subsoil underlain by limestone	31,930	8.3%
6	Bayvi-Isles-Estero	Nearly level, very poorly drained, sandy soils; some have an organic surface layer underlain by a dark, organic-stained subsoil; and some have an organic surface layer and a loamy subsoil underlain by limestone	25,300	6.6%
7	Lakeland-Ortega-Alpin	Nearly level to gently undulating; excessively drained and moderately well drained, sandy soils; some have thin bands of loamy material at a depth of 40 inches or more	18,365	4.8%
8	Otela-Ortega-Shadeville	Nearly level to sloping, moderately well drained, sandy soils; some have a loamy subsoil, and some have a loamy subsoil underlain by limestone	14,560	3.8%
9	Tooles-Nutall	Nearly level, very poorly drained, sandy soils that have a loamy subsoil underlain by limestone	11,020	2.9%
10	Moriah-Ridgewood-Ortega	Nearly level to gently undulating; somewhat poorly drained and moderately well drained, sandy soils; some have a loamy subsoil underlain by limestone	9,120	2.4%
11	Meggett-Croatan	Nearly level,poorly drained and very poorly drained soils; some have a loamy surface layer and a clayey subsoil; and some have organic layers underlain by mineral material	5,300	1.4%
12	Ridgewood-Otela-Lutterloh	Nearly level to sloping, somewhat poorly drained and moderately well drained, sandy soils; some have a loamy subsoil	4,800	1.2%
	Total		**384,575**	**100.0%**

Source: USDA Soil Survey of Wakulla County, Florida, March 1991.

Table 2-5. Leon County Soils

	Leon County Soil Type	Description	Acreage	% of County
1	Orangeburg-Lucy-Norfolk	Nearly level to strongly sloping, well drained soils; some are loamy throughout; some are sandy to a depth less than 20 inches and loamy below; some are sandy from 20 to 40 inches and loamy below	112,800	26%
2	Dorovan-Talquin-Chipley	Nearly level, somewhat poorly drained to very poorly drained soils; some are organic; some are sandy to a depth of 80 inches; some have a sandy subsoil	93,400	22%
3	Kershaw-Ortega-Alpin	Nearly level to sloping, excessively drained and moderately well drained; all are sandy to depth of 80 inches or more; some have thin loamy lamellae below 45 inches	85,568	20%
4	Faceville-Orangeburg-Dothan	Gently sloping to strongly sloping; well drained soils; all are sandy or loamy to a depth less than 20 inches; some are clayey below and some are loamy below	36,630	9%
5	Plummer-Pelham-Yonges	Nearly level, poorly drained soils; some are loamy throughout; some are sandy at a depth of 20 to 40 inches; some are sandy from 40 to 80 inches; all are loamy below	30,740	7%
6	Blanton-Lutterloh-Chaires	Nearly level to gently sloping; mderately well drained to poorly drained soils; some are sandy at a depth of 40 to 80 inches and loamy below; some have a sandy and loamy subsoil	20,500	5%
7	Dothan-Orangeburg-Fuquay	Nearly level to strongly sloping, well drained soils; some are loamy throughout; some are sandy to a depth less than 20 inches and loamy below; some are sandy from 20 to 40 inches and loamy below	16,240	4%
8	Blanton-Wagram-Troup	Nearly level to sloping, well drained and moderately well drained soils; most are sandy to depth of 80 inches and loamy below; some are sandy from 20 to 40 inches and loamy below	14,170	3%
9	Fuquay-Leefield-Bonifay	Nearly level to sloping, well drained and somewhat poorly drained soils; most are sandy at a depth of 20 to 40 inches and loamy below; some are sandy from 40 to 80 inches and loamy below	9,440	2%
10	Meggett	Nearly level; poorly drained soils, loamy to a depth less than 20 inches and clayey below	9,440	2%
	Total		**428,928**	**100%**

Source: USDA Soil Survey of Leon County, Florida, February 1981.

2.6 CLIMATE

The annual rainfall for the Wakulla River drainage basin is 63.21 inches, as presented on Table 2-6, with USGS reporting 66 inches per year. Potential evapotranspiration for the Tallahassee area is 46 inches/year (USGS, 2010). According to USGS (2010), the annual average rainfall-groundwater recharge is 18 inches.

Table 2-6. Annual Temperature and Rainfall

Analysis	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
30 Yr Mean-Max Temp	63.8	67.4	74.0	80.0	86.5	90.9	92.0	91.5	88.5	81.2	72.9	65.8	79.5
30 Yr Mean-Min Temp	39.7	42.1	48.2	52.8	62.3	69.8	72.7	72.7	69.2	56.9	47.9	41.6	56.3
30 Yr Mean-Ave Temp	51.8	54.8	61.1	66.4	74.4	80.4	82.4	82.1	78.9	69.1	60.4	53.7	68.0
30 Yr Mean-Precip	5.36	4.63	6.47	3.59	4.95	6.92	8.04	7.03	5.01	3.25	3.86	4.10	63.21

Source: Draft Nutrient (Biology) TMDL for Wakulla River WBID 1006, Douglas Gilbert, FL DEP, May 14, 2010.

3 SUMMARY OF RELEVANT REPORTS

Numerous studies and reports have been completed on the subjects of hydrology and nitrate loadings in the Study Area. This section will summarize key elements of each study and discuss issues related to their use for planning purposes.

3.1 LEON COUNTY AND WAKULLA COUNTY AQUIFER VULNERABILITY STUDIES

In 2007 and 2009, two reports were issued by Advanced GeoSpatial, Inc. that evaluated the Floridan Aquifer System in Leon and Wakulla Counties for relative vulnerability to contamination from activities at the land surface. Factors considered in this analysis were as follows:

- Thickness of protective material overlying the aquifer
- Presence of sinkholes or other karst features
- Hydraulic conductivity

Models were developed that predicted the vulnerability to potential contamination from land surface activities. As expected, the conclusions showed that areas with little or no protective cover overlaying dense karst features with high hydraulic conductivity in the surface soils were the most vulnerable. Factors such as density of development and wastewater treatment and disposal methods were not considered.

Figure 3-1 illustrates the relative aquifer vulnerability for Wakulla County and Leon County. The Wakulla Springs Springshed is also shown for reference, however as will be discussed later in this section, the delineation of this springshed can change significantly depending on flow conditions in contributing groundwater conduits. As can be seen in this Figure, the majority of the most vulnerable areas are located in the densely developed portions of the unconfined aquifer, such as the Woodville and Lake Munson areas.

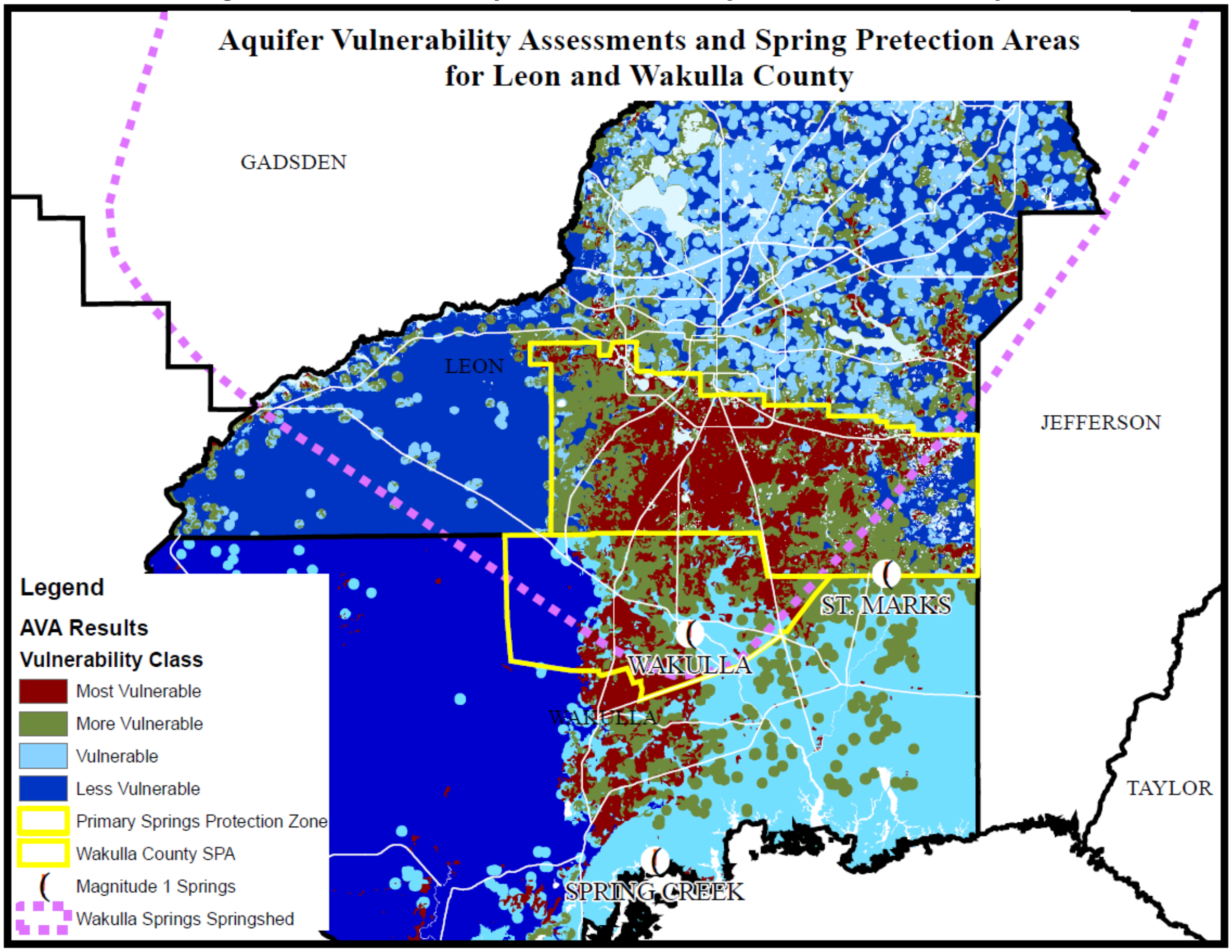
In March, 2009, Leon County adopted the Primary Springs Protection Zone (PSPZ), which was mapped to capture a single area of Leon County with the highest aquifer vulnerability. The PSPZ lies to the south of the Cody Scarp and includes approximately 10,763 parcels of land located both in the Tallahassee City limits and unincorporated areas of Leon County. Similarly, Wakulla County adopted a Special Planning Area (SPA) with the goal of restoring water quality in Wakulla Springs. This area covers 85 square miles, 46% of which is public land. Both the PSPZ and the SPA are shown on Figure 3-1. Although areas south of the PSPZ and SPA are also unconfined and vulnerable, they are largely outside the Wakulla Springs recharge area and are generally not densely developed.

3.2 CONDUIT FLOW PATHS IN THE WAKULLA KARST PLAIN

The efforts of numerous underwater cave explorers and scientists have identified a complex system of ground water conduits that interconnect many of the sinking streams in the springshed, as well as the City of Tallahassee Southeast Spray Field (SESF) to Wakulla Spring. These conduits range in size from 10-80 meters in diameter and up to 20 kilometers long with ground water velocities from 800-6,000 meters/day (TMDL, 2010).

In 2007, Kincaid and Werner conducted tracer studies in the karst areas recharging Wakulla Springs (Kincaid and Werner, 2008). The key conclusion of these studies was that groundwater flow south of the Cody Scarp is dominated by conduits. Groundwater velocities orders of magnitude higher than those predicted by soil hydraulic conductivity were observed. Simply stated, groundwater does not appear to flow through the soil, but rather through tunnels in the area.

Figure 3-1. Relative Aquifer Vulnerability for Wakulla County

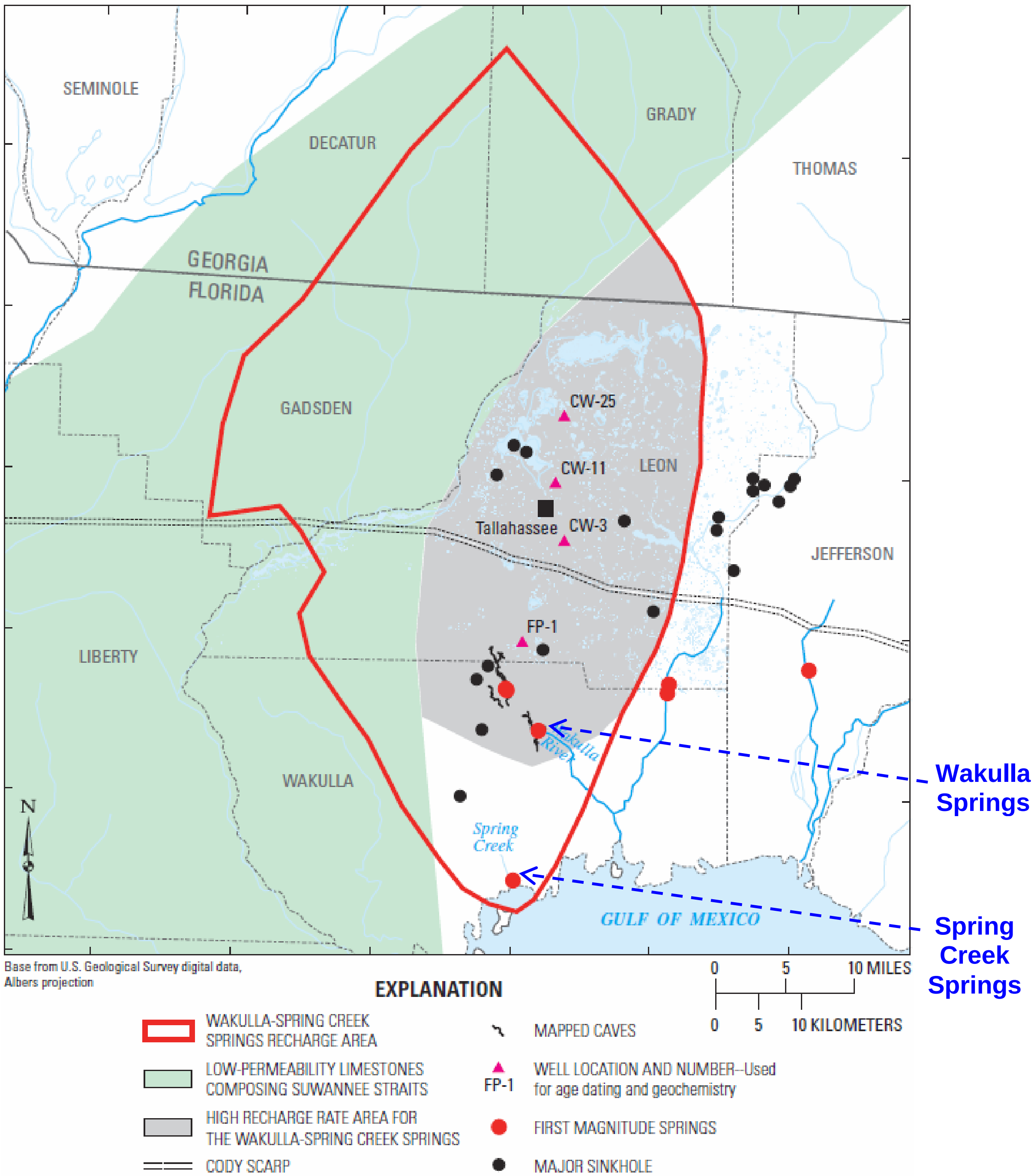


Source: City of Tallahassee http://www.talgov.com/planning/compln/briefhistory.cfm

Kincaid and Werner referenced previous observations concerning discharge at Wakulla Springs relative to unusually high and low tides. During hurricanes Ivan and Francis in 2004, abnormally high tides were associated with a nearly immediate and substantial increase in flow at Wakulla Springs. Abnormally low tides resulted in a similar decrease in flow. These observations along with other tracer tests led to the conclusion that flow from the Spring Creek Springs Group can travel either to Spring Creek Springs or to Wakulla Springs depending on the hydraulic conditions (relative water levels) at either site. Simply stated, when the effective water level at Spring Creek Springs is higher than the level at Wakulla Springs (as observed during an abnormally high tide), the Spring Creek Springs Group will flow to Wakulla Springs. When the reverse is true, (as observed during an abnormally low tide) Spring Creek Springs will receive the flow. During more neutral conditions, the flow will split between the two outlets. A variety of other factors, such as vegetation restricting flow in the Wakulla River and saltwater intrusion can create fluctuation in the relative water levels of the two springs, which in turn will affect the fraction of the Springs Creek Springs Group discharge that flows to Wakulla Springs. This conclusion has a direct impact on the delineation of the southernmost portion of the Wakulla Springs Springshed, as will be discussed later in this section.

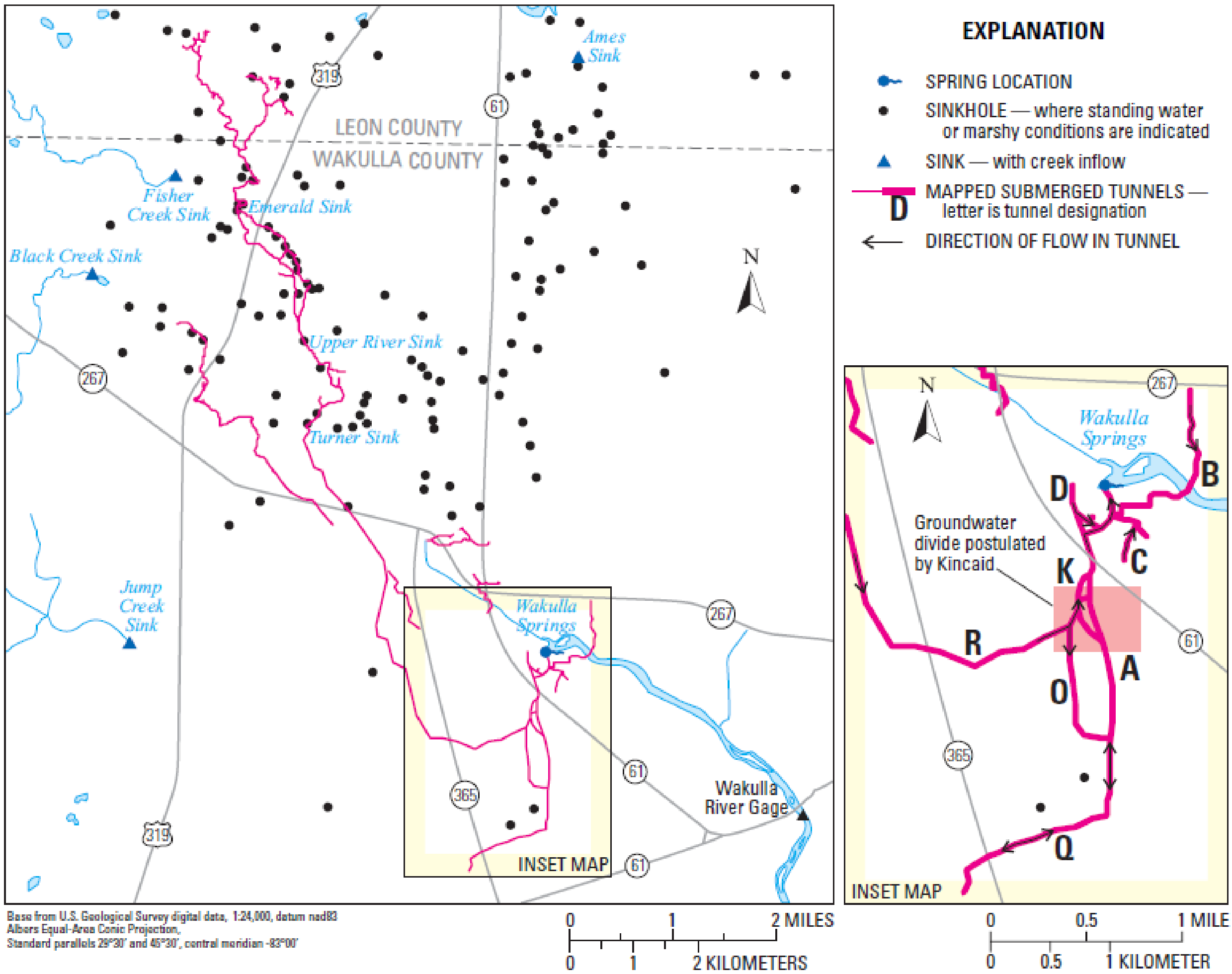
Figure 3-2 shows the delineation of the Wakulla Springs Springshed under the flow scenario where the Spring Creek Springs Group flows entirely to Wakulla Springs.

Figure 3-2. Wakulla Springs and Spring Creek Springs Recharge Area



Source: Hydrogeologic Investigation, Water Chemistry Analysis and Model Delineation of Contributing Areas for City of Tallahassee Public-Supply Wells, Tallahassee, FL, (USGS 2007-5070).

Figure 3-3. Mapped Caves and Proposed Flow Split



Source: USGS Report 2010-5099

Figure 3-3 above shows the mapped cave system surrounding Wakulla Springs. Kincaid postulated a flow divide that can move north or south based on the hydraulic conditions described previously. When the divide is located as shown by the shaded square on Figure 3-3, the flow in the R and the A-K-O tunnels goes both to Wakulla Springs and the Spring Creek Springs Group. When the divide is further south, below the A-K-O junction, the flow from the R tunnel will go entirely to Wakulla Springs. Dye injected in Lost Creek Sink, south of the area shown on Figure 3-3, showed up at both Wakulla Springs and Spring Creek Springs. This proves that the Q tunnel can flow in both directions.

These complex hydraulic conditions will have an effect on the delineation of areas that contribute nitrates to Wakulla Springs. The two extreme flow scenarios are as follows:

- Scenario 1 – where the Spring Creek Springs Group is flowing to Spring Creek Springs
- Scenario 2 – where the Spring Creek Springs Group is flowing to Wakulla Springs

While many combinations of flow scenarios are possible, these two bracket the range of expected conditions.

3.3 2002 NWFWMD NITRATE LOADING REPORT

The 2002 NWFWMD Report identified sources of total nitrogen (TN) in the unconfined and semi-confined aquifer areas within Leon and Wakulla Counties. For planning purposes, TN and nitrate from the sources identified in this study are either similar or equal. This area makes up the majority of the recharge area for Wakulla Springs. Included in the Study Area are areas south and east of the Wakulla Springs Springshed.

WWTF discharge from the City of Tallahassee's wastewater treatment facilities and associated sprayfield farm, located south of the Cody Scarp, was identified as the most significant human introduced source of TN discharged into the Wakulla Springs recharge area as shown on Figure 3-4. The impact of the sprayfield facility includes WWTF residuals and livestock grazing. Table 3-1 summarizes the nitrate loads generated within both the semi-confined and the unconfined aquifer in Leon and Wakulla Counties as of 1999. Table 3-2 summarizes the estimated portion of the average TN loads that reached Wakulla Springs over the period 1990-1999. The WWTF Residuals category no longer applies, as land application within the Study Area no longer occurs. In addition to the loads listed both Table 3-1 and 3-2, inflow across the Cody Scarp into the Wakulla Springs Springshed was approximated at 73,000 kg/yr.

Table 3-1. 1999 Raw Total Nitrogen Loads to Ground Surface in the NWFWMD Study Area

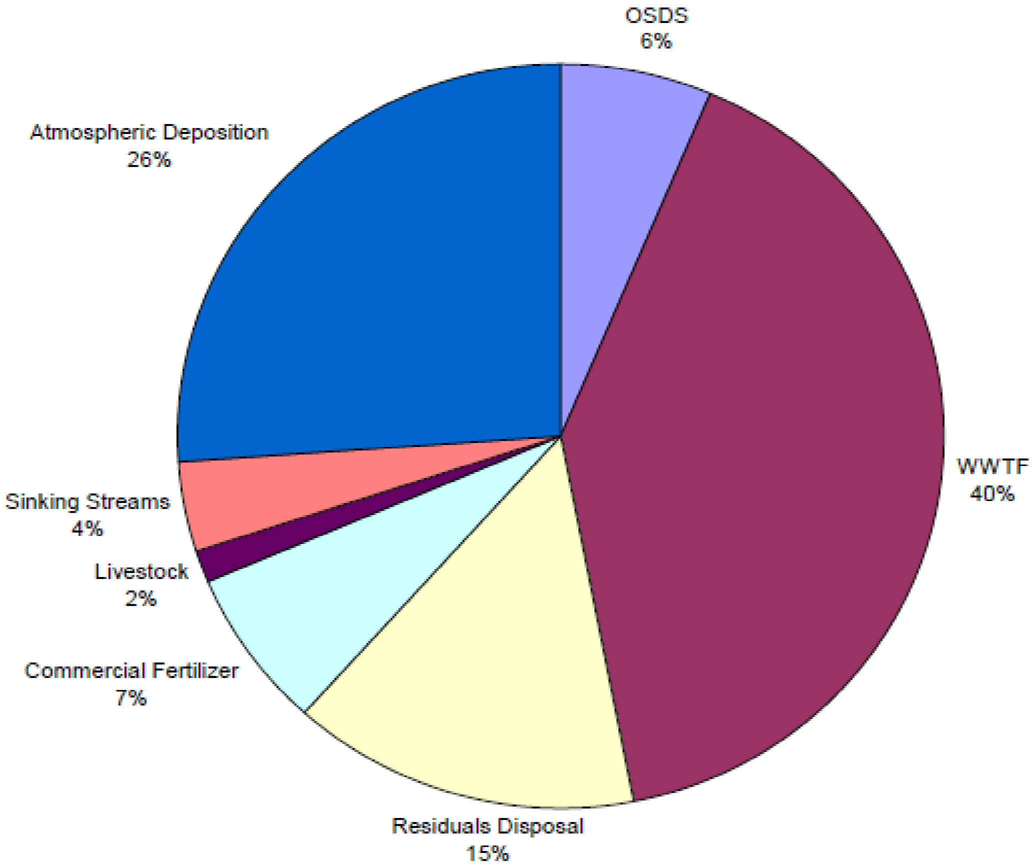
Source	Predominant form	Semi-confined (kg-N/yr)	Unconfined (kg-N/yr)	Total (kg-N/yr)
Atmospheric Deposition	IN	479,000	523,000	1,002,000
WWTF Effluent	IN	9,000	331,000	340,000
WWTF Residuals	indeterminate	0	177,000	177,000
OSDS	IN	172,000	111,000	283,000
Commercial Fertilizer	IN	150,000	62,000	212,000
Livestock	ON	124,000	33,000	157,000
Sinking Streams	ON	0	72,000	72,000
Total		934,000	1,309,000	2,243,000

Table 3-2. 1990-1999 Average Raw Total Nitrogen Loads to Ground Surface in the Wakulla Springs Contributory Area

Source	Average N Load (kg/yr)	Median N Load (kg/yr)	Percent of Total
WWTF Effluent	360,000	345,000	40
Atmospheric Deposition	232,000	229,000	26
WWTF Residuals	130,000	126,000	15
OSDS	56,000	56,000	6
Commercial Fertilizer	60,000	65,000	7
Sinking Streams	33,000	33,000	4
Livestock	14,000	14,000	2
Total	885,000	868,000	100

The above loads represent "raw" loads to the ground surface or in disposal system effluent. These loads are subject to attenuation prior to blending with groundwater. Individual attenuations were not assumed – rather a weighted average attenuation of 78% was deduced by comparing these surface loads to the measured loads in groundwater and discharging at

Figure 3-4. 1999 NWFWMD Total Nitrogen Loads Within Wakulla Springs Recharge Area



Wakulla Springs. Figures of 80% for atmospheric deposition and 50% for OSTDS effluent were cited as expected values for these two specific sources. Using the 78% attenuation on the 885,000 kg/yr total load, then adding the 73,000 kg/yr of inflow, the final attenuated nitrate load to Wakulla Springs was determined to be ***270,000 kg/yr***. Median flow of ***340 ft^3/s*** was reported for Wakulla Springs based on USGS data dating back to 1906 with a mean of 397 ft^3/s and a standard deviation of 266. This flow rate suggests that the predominant flow condition, at least when measurements were taken, was likely to be the USGS Scenario 1. ***0.89 mg/L*** was the median nitrate concentration over the period from 1989 – 2000, which NWFWMD determined was representative of concentrations at the time of their study released in 2002.

The number of OSTDS and associated TN load in the Study Area as of 1999 was estimated as shown in Table 3-3. The number of OSTDS estimated to be contributory to Wakulla Springs was 5,600. No information was given on how many were in the PSPZ and/or SPA.

Table 3-3. 1999 NWFWMD Estimated OSTDS and Associated TN Loads

Area	# OSDS	Household occupancy	Kg-N/cap/yr	Kg-N/Yr
Leon Semi-confined	17,498	2.34	4.2	172,000
Leon Unconfined	4,290	2.34	4.2	42,000
Wakulla Unconfined	6,429	2.57	4.2	69,000

Conclusions of a 2002 report prepared by the Northwest Florida Water Management District (NWFWMD), Nitrate Loading as an Indicator of Nonpoint Source Pollution in the Lower St. Marks-Wakulla Rivers Watershed ("2002 NWFWMD Report"), included the following significant observations:

1. Existing data indicate that nitrate concentrations in the Floridian Aquifer ground waters beneath the semi-confined portion of Leon County have been constant or slightly increasing over the past 20 years. This implies that the flux of nitrate-N from the semi-confined Floridian Aquifer into the unconfined Floridian Aquifer (along the Cody Scarp) has been relatively constant over this period. The estimated nitrate-N mass flux across this boundary under present conditions is 73,000 kg-N/yr.
2. The increase in nitrate-N output from Wakulla Springs over the past 25 years is largely attributable to TN inputs that have occurred south of the Cody Scarp.
3. Assuming that removal efficiencies remain at present levels, the TN load discharged through the spring will increase as the population of Leon and Wakulla counties increases.

In response to this and other report findings, the City of Tallahassee began making improvements at the City-owned WWTF and associated sprayfield farm. The City ceased land application of wastewater residuals, prohibited the use of additional fertilizers, and removed all livestock from the sprayfield farm in June, 2006. The City also agreed to a new permit for operation of the wastewater treatment facility that called for upgrading to Advanced Wastewater Treatment standards. The upgrade to the existing facility will cost approximately $220 million and will reduce TN concentrations in the treated effluent from approximately 12 mg/L to 3 mg/L.

3.4 USGS 2010 GROUNDWATER NITRATE STUDY

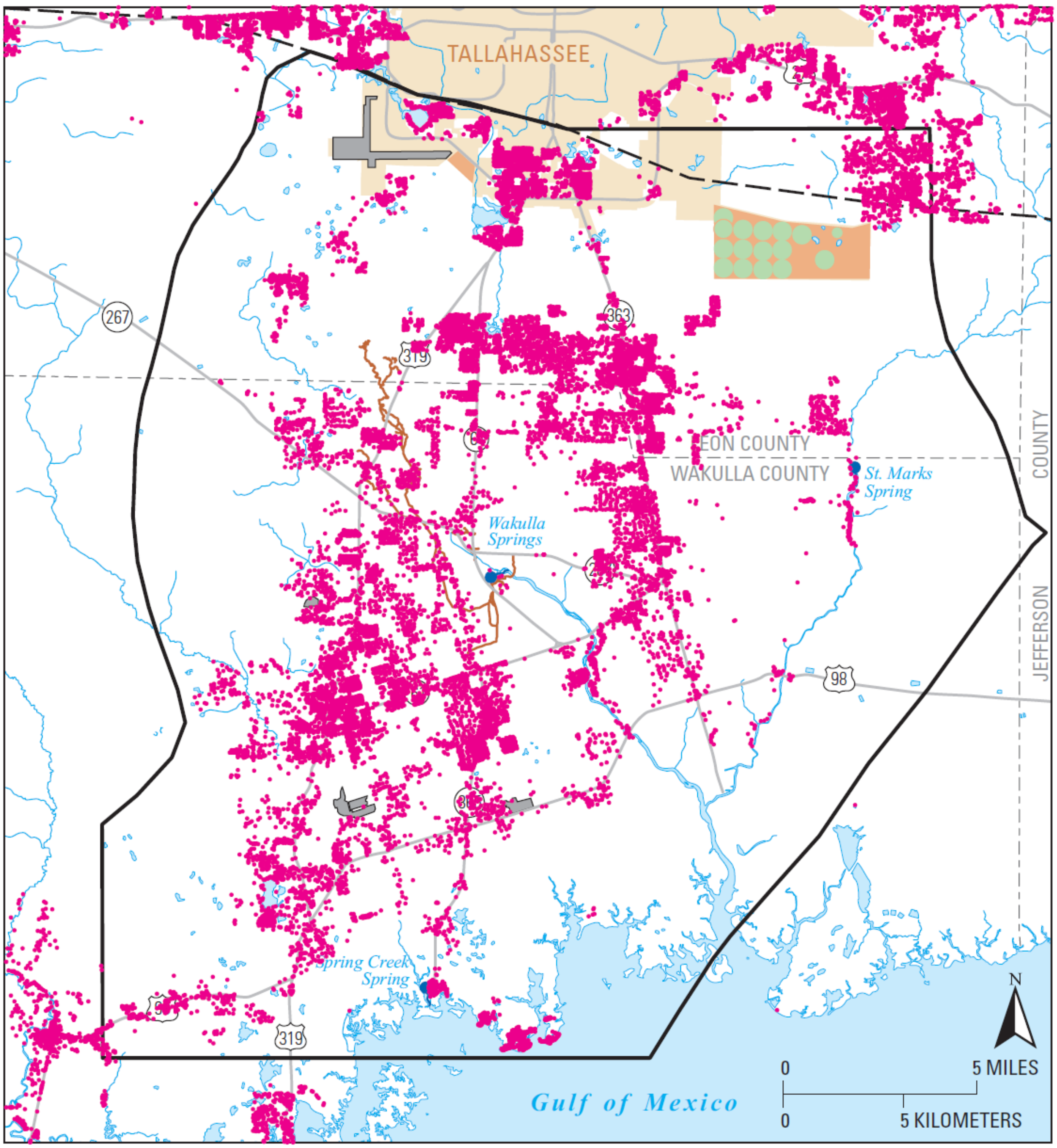
In 2010, USGS released a report titled "Nitrate-N Movement in Groundwater from the Land Application of Treated Municipal Wastewater and Other Sources in the Wakulla Springs Springshed, Leon and Wakulla Counties, Florida, 1966-2018". The Study Area for the USGS report (USGS Study Area) is shown on Figure 3-5.

A hydrogeologic model of the Wakulla Springs and Spring Creek watersheds was developed to simulate groundwater and nitrate levels for the unconfined aquifer in Leon and Wakulla Counties. This model is a transient model, defined as one that predicts the nitrate concentration over time in Wakulla Springs as a function of changing nitrate loadings to the USGS Study Area.

For planning purposes, the steady state nitrate concentration is the appropriate standard. When considering water quality goals, the steady-state nitrate concentration must be less than the applicable water quality standard under future loading conditions.

This section summarizes the data presented "as-is" from the 2010 USGS report. A discussion of the appropriate nitrate loadings will follow in Section 4.

Figure 3-5. USGS Study Area with OSTDS Locations



Base from U.S. Geological Survey digital data, 1:24,000, datum nad83
Albers Equal-Area Conic Projection,
Standard parallels 29°30′ and 45°30′, central meridian -83°00′

EXPLANATION

- RESIDUALS DISPOSAL AREA
- SPRAYFIELD LOCATION
- MODEL-SUBREGIONAL BOUNDARY
- CODY SCARP
- MAPPED SUBMERGED CAVES
- CENTER PIVOT LOCATION
- OSDS—onsite sewage disposal system
- SPRING LOCATION

Source: USGS Report 2010-5099

Table 3-4 summarizes the assumed nitrate loads to the land surface or to the unsaturated zone across the USGS Study Area, as presented in the 2010 Report. These loads are the inputs to the Model and represent the best available information on the various sources of nitrate in the Leon and Wakulla County parts of the Study Area.

Table 3-4. USGS Nitrate Mass Loadings to Ground Surface

Year	*Inflow (1)*	*OSTDS (2)*	*Fertilizer (3)*	*Creeks / Sinks (4)*	*Live stock (5)*	*Atmo spheric Depo sition (6)*	*SE Farm Spray field (7)*	*Total*
2007	74,900	240,000	60,000	70,000	43,000	400,000	275,000	1,162,900
2018	80,700	350,000	84,000	70,000	65,000	400,000	95,000	1,144,700

(1) Calculated using zone flows from Table 5 and concentrations from Figure 41, per text on page 52 of USGS Report. See Table 4-6 of this Report.
(2) Page 23 2006 value and extrapolation from Figure 13D, USGS Report
(3) Page 23 (2007 values interpolated between 2006 and 2018) and Figure 13G, USGS Report
(4) Page 23 (2007 values interpolated between 2006 and 2018) Figure 13F, USGS Report
(5) Page 24 (2007 values interpolated between 2006 and 2018) and Figure 13H, USGS Report
(6) Page 20 (2007 values interpolated between 2006 and 2018) and Figure 13C, USGS Report
(7) Extrapolation from Figure 13A of USGS Report

The USGS Study Area, shown on Figure 3-5, can be further subdivided into contributory watersheds for Wakulla Springs, the Wakulla River, the St. Marks River and Spring Creek Springs. These subwatershed areas change depending on which of two typical flow scenarios is occurring. The two potential flow scenarios that were modeled to bracket the expected conditions are as follows:

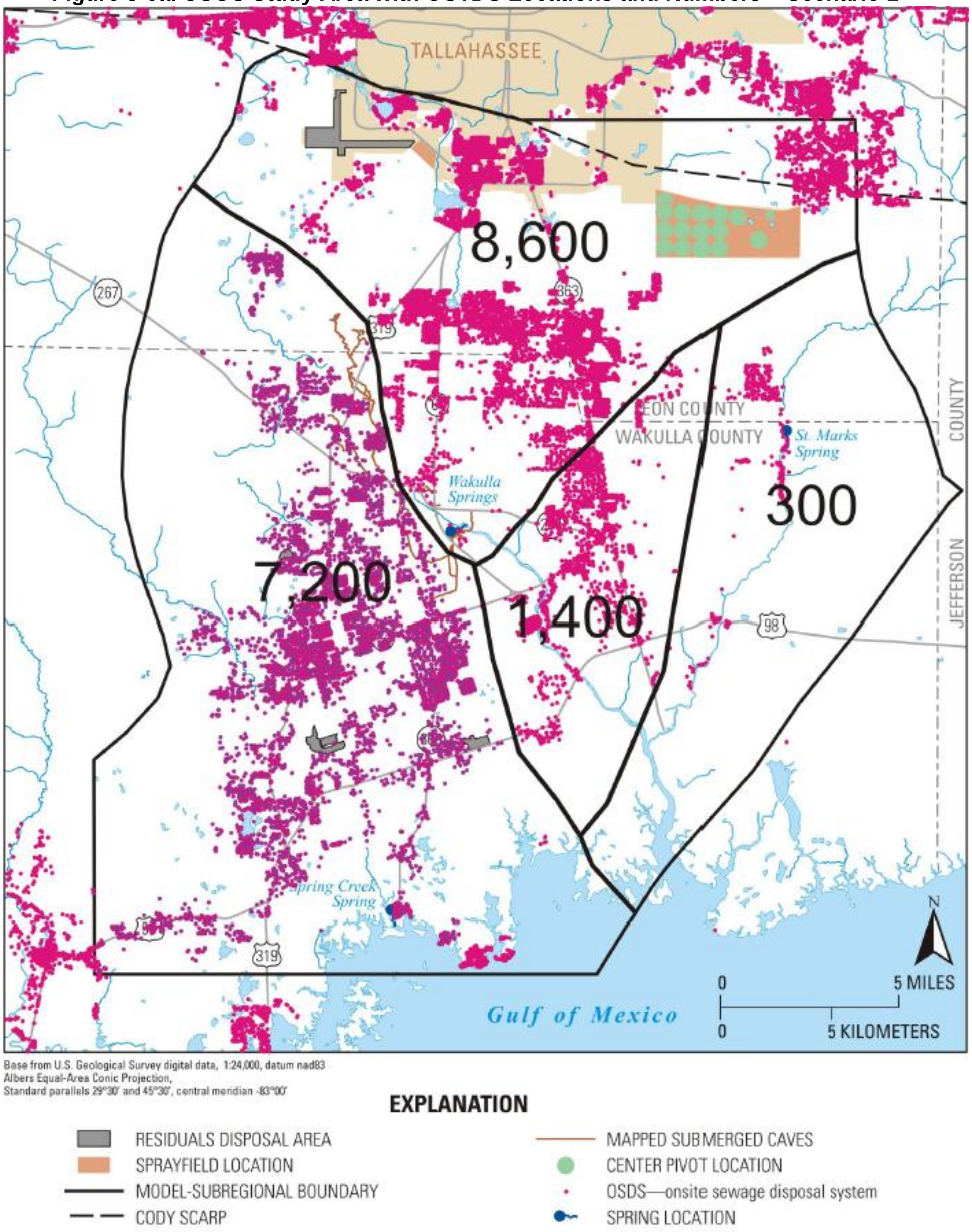
- Scenario 1 – where the Spring Creek Springs Group predominantly flows to Spring Creek Springs
- Scenario 2 – where the Spring Creek Springs Group flows to Wakulla Springs

The portion of the Spring Creek Springs Group that flows to Wakulla Springs varies under these two scenarios (Kincaid written communication referenced by Davis). Rising sea levels may cause Scenario 2 to occur more often in the future. The Wakulla Springs and Spring Creek Springs subwatersheds depend on the direction of flow from the Spring Creek Springs Group. When it flows toward Spring Creek Springs (Scenario 1), the unconfined contributory area to Wakulla Springs is as shown on Figure 3-6a. When the Spring Creek Springs Group flows to Wakulla Springs (Scenario 2), the unconfined contributory area is as shown on Figure 3-6b.

The delineation of the Wakulla Springs Watershed affects the number of OSTDS that are within this area and ultimately the number of systems that will be identified as contributing nitrate to Wakulla Springs. The same effect is expected for all other sources of nitrate. However, it was noted by Davis that during periods of higher discharge at Wakulla Springs (Scenario 2), the nitrate concentration was lower despite the substantially larger contributory area and the associated increase in OSTDS and other sources of nitrate. This suggests that the increase in flow outweighs the increase in nitrate inputs with the larger Scenario 2 contributory area.

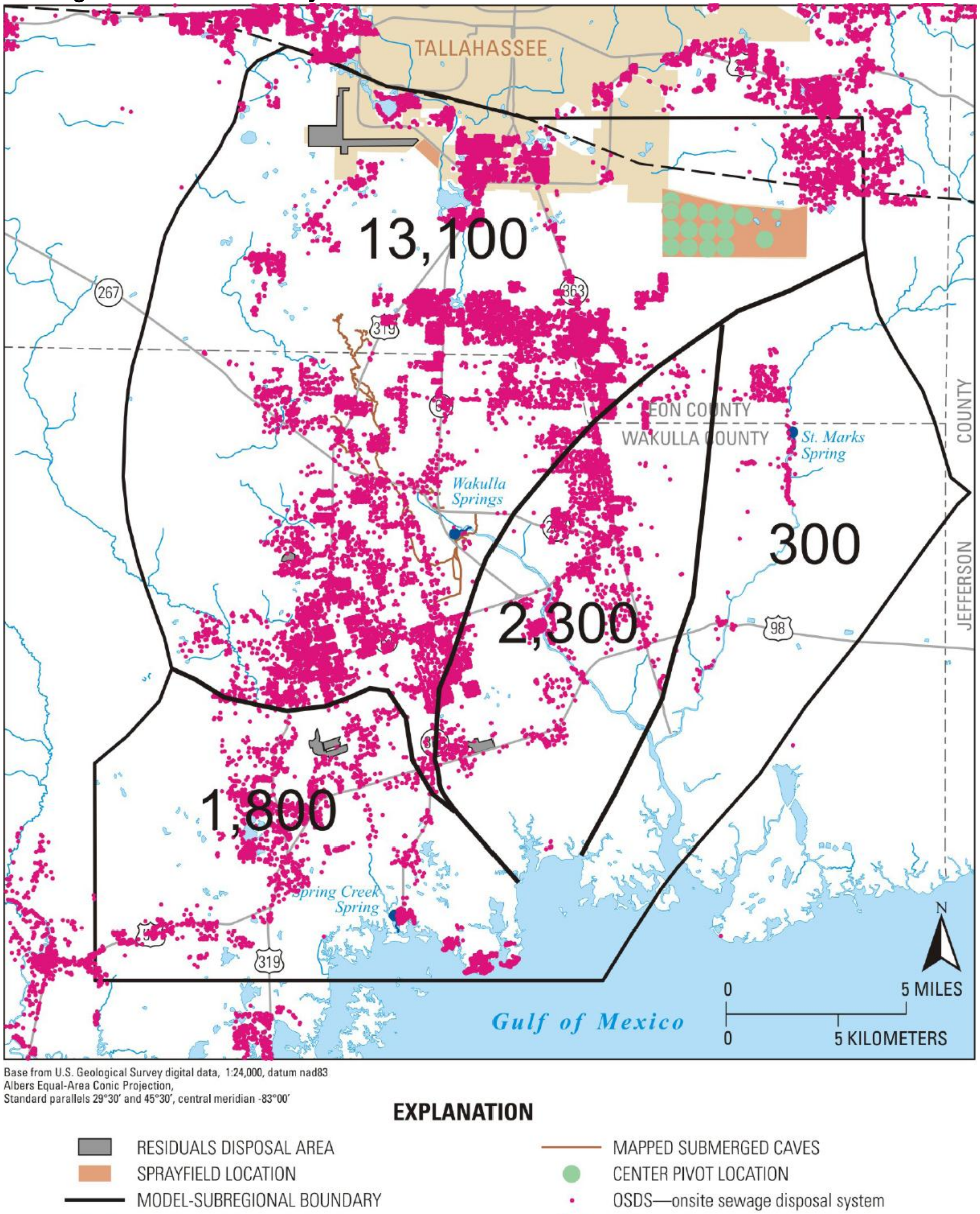
The mass loadings to the ground surface shown in Table 3-4 are subject to attenuation in the unsaturated zone prior to reaching the Upper Floridan Aquifer (UFA). Table 3-5 summarizes the attenuation factors assumed and the technical basis for each assumption.

Figure 3-6a. USGS Study Area with OSTDS Locations and Numbers – Scenario 1



Source: Hal Davis, Personal Communication, 2010

Figure 3-6b. USGS Study Area with OSTDS Locations and Numbers – Scenario 2



Source: Hal Davis, Personal Communication, 2010

Table 3-5. USGS Modeled Nitrate Attenuation and Basis

Source of nitrate-N	Simulated percentage of nitrate-N removed in the unsaturated zone	Justification for using simulated value	Problems
SEF Sprayfield	45	Numerous monitoring wells with long-term data were used to calibrate the fate and transport model.	High recharge rates at the sprayfield may make this value not applicable to other parts of the study area.
SWF Sprayfield	30	A limited number of monitoring wells with data was used to calibrate the fate and transport model.	High recharge rates at the sprayfield may make this value not applicable to other parts of the study area.
OSDSs	50	Preliminary data from one ongoing study. Consistent with literature review by Horsley and Witten (2000).	Insufficient field to independently verify with model.
Biosolids disposal	50	A limited number of monitoring wells with data was used to calibrate the fate and transport model.	Limited number of monitoring wells with data.
Fertilizer	50	Applied the value determined at biosolids airport disposal area.	Insufficient field data to independently verify with model.
Livestock	50	Applied the value determined for biosolids disposal.	Insufficient field data to independently verify with model.
Atmospheric deposition	98	Simulation matched the nitrate-N levels in Wakulla Springs in 1966 when other sources were minor. Monitoring well data in undeveloped areas showed little or no nitrate-N.	Only sporadic measurements. No long-term studies in the study area.

Source: USGS 2010 Report, Table 7

Table 3-6 presents the number of OSTDS within the unconfined aquifer portion of the watersheds within the USGS Study Area for Scenarios 1 and 2. The number of OSTDS within each subgroup was not published as part of the USGS Report. This data was obtained directly from personal communications with Hal Davis. The totals shown on Table 3-6 correspond to the numbers shown on Figures 3-6a and 3-6b.

Table 3-7 uses the quantities in each area as the best approximation possible on the number of systems in the following area, per the Scope of Work:

- Wakulla County
- Leon County with a subset of the City of Tallahassee
- Leon County Primary Springs Protection Zone with subset within the City of Tallahassee
- Leon and Wakulla Counties combined

Table 3-6. OSTDS Contributing to USGS Study Area by Watershed

Sub-Watershed	Estimated Number of OSTDS Contributory to Wakulla Springs Watershed							
	Scenario 1			% Total	Scenario 2			% Total
	Leon	Wakulla	Subtotal		Leon	Wakulla	Subtotal	
Wakulla Springs - Unconfined Aquifer Area Only	7,500	1,100	8,600	21.7%	7,800	5,300	13,100	29.7%
Leon County - North of Cody Scarp	31,017	0	31,017	78.3%	31,017	0	31,017	70.3%
SubTotal:	**38,517**	**1,100**	**39,617**	**100.0%**	**38,817**	**5,300**	**44,117**	**100.0%**
Other Watersheds in USGS Study Area - Unconfined Aquifer								
Spring Creek Springs	200	7,000	7,200	18.2%	0	1,800	1,800	4.1%
Wakulla River	200	1,200	1,400	3.5%	100	2,200	2,300	5.2%
St. Marks	170	130	300	0.8%	170	130	300	0.7%
SubTotal:	**570**	**8,330**	**8,900**	**22%**	**270**	**4,130**	**4,400**	**6%**
Total Unconfined / Semi-Confined	**39,087**	**9,430**	**48,517**		**39,087**	**9,430**	**48,517**	
Other		**1,904**	**1,904**			**1,904**	**1,904**	
Grand Total	**39,087**	**11,334**	**50,421**		**39,087**	**11,334**	**50,421**	

(*Source: Hal Davis, Personal Communication, 2010)*

Table 3-7. OSTDS in Leon and Wakulla Counties, by Scope Defined Areas

Data Source	Wakulla	Leon								Leon - PSPZ Only			Total Leon and Wakulla Counties
		COT			Other				Total				
		PSPZ	Semi conf.	Total	PSPZ	Other Unconf.	Semi conf.	Total		COT	Other	Total	
OSTDS	11,334	118	1,100	1,218	7,682	270	29,917	37,869	39,087	118	7,952	8,070	50,421

Figure 3-7 and Table 3-8 present the model grid (500 feet x 500 feet = 25,000 square feet) and boundary conditions for the Wakulla Springs Contributory Area, respectively. USGS model specified nitrate concentrations for the zones indicated on Figure 3-7 were:

- Zone 1 0.0 mg/l, constant over the period modeled
- Zone 2 0.33 mg/L in 2007, 0.40 mg/L in 2018 (Figure 41, USGS 2010 Report)
- Zone 3 0.55 mg/L in 2007, 0.66 mg/L in 2018 (Figure 41, USGS 2010 Report)
- Zone 4 0.1 mg/l, constant over the period modeled

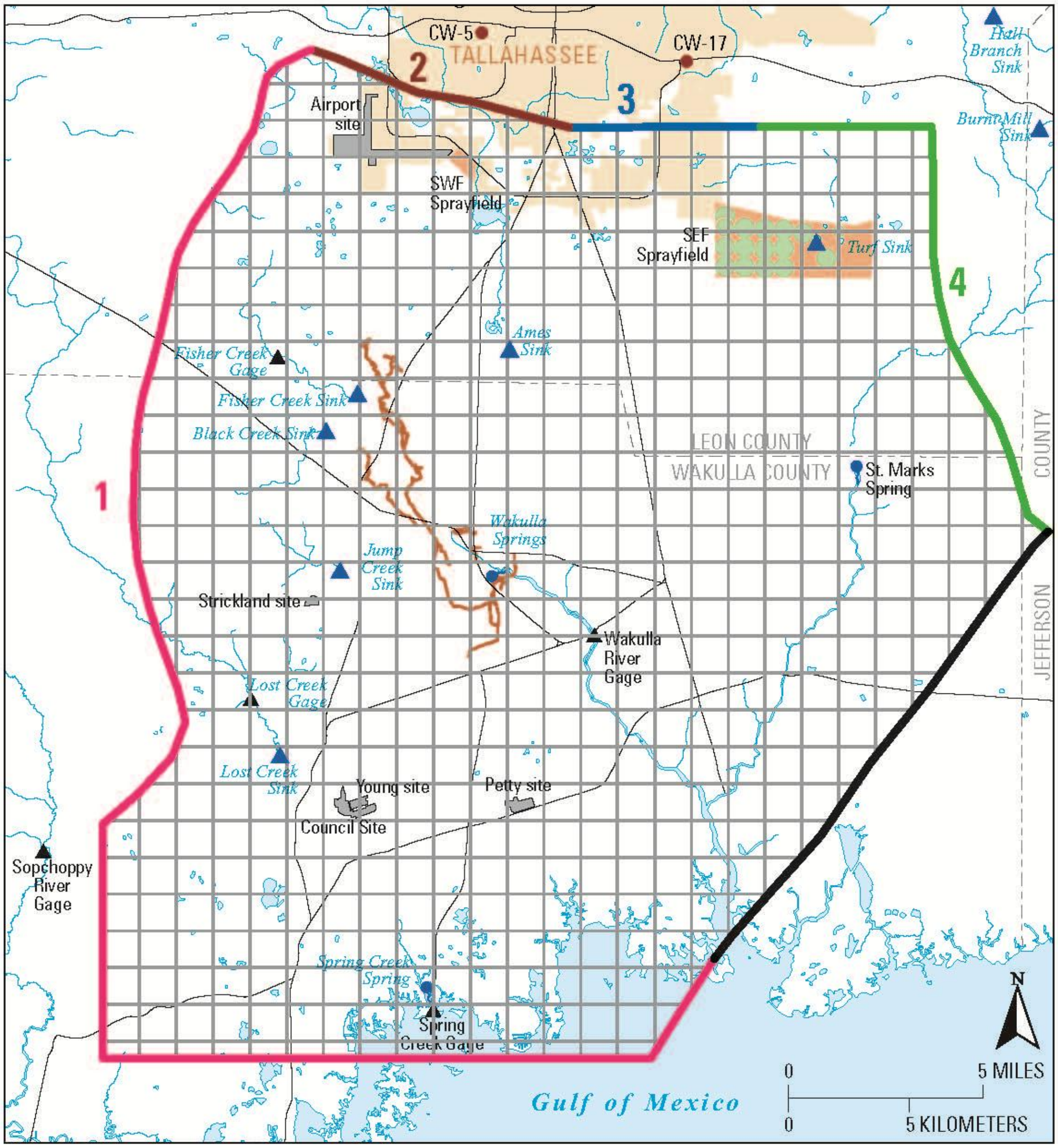
Table 3-8. USGS Groundwater Model Boundary Flows

Table 5. Simulated sources of recharge to the Upper Floridan aquifer.

[ft^3/s, cubic feet per second; OSDS, onsite sewage disposal system; SWF, Southwest Farm sprayfield; SEF, Southeast Farm sprayfield]

Groundwater input source	Groundwater flow rate, in ft^3/s	
Flow across model boundaries:		
Zone 1	98	
Zone 2	67	
Zone 3	40	
Zone 4	721	
Subtotal for boundaries	926	
Recharge from net precipitation	500	
Creek inflows: Ames Sink	30	
Black Creek Sink	3.0	
Fisher Creek Sink	10	
Lost Creek Sink	60	
Subtotal for creeks	103	
	Min	Max
OSDS flows –Leon County	0.0	2.3
OSDS flows –Wakulla County	0.4	3.7
SWF Sprayfield	1	11
SEF Sprayfield	11	30
Totals	1,531	1,576

Figure 3-7. Grid & Boundaries for USGS Modeled Study Area



EXPLANATION

- RESIDUALS DISPOSAL AREA
- SPRAYFIELD LOCATION--Southeast farm (SEF) and southwest farm (SWF)
- NO-FLOW MODEL BOUNDARY (REMAINDER OF MODEL PERIMETER IS SPECIFIED HEAD)
- MODEL BOUNDARY 1—Specified nitrate concentration is 0 milligram per liter
- MODEL BOUNDARY 2—Specified nitrate concentration is variable
- MODEL BOUNDARY 3—Specified nitrate concentration is variable
- MODEL BOUNDARY 4—Specified nitrate concentration is 0.1 milligram per liter
- MODEL GRID—Each line shows the location of every tenth line of model cells
- MAPPED SUBMERGED CAVES
- CENTER PIVOT LOCATION
- COT WELL—Used to established nitrate levels at model boundary
- SINK—With creek inflow
- SPRING LOCATION

Source: USGS Report 2010-5099

3.5 SUMMARY

The nitrate loadings to the surface as presented in the 2010 USGS Report are consistent with the NWFWMD loadings and, in LAI's opinion, are the best available numbers to use for planning purposes. This section will discuss the limitations of the NWFWMD and USGS Reports and the basis for the nitrate loads that LAI recommends be used as the basis for the remaining Tasks on this project.

3.5.1 Strengths and Limitations of NWFWMD Report

The following are the key strengths of the NWFWMD Report:

- Excellent inventory of TN sources with a clear and reasonable basis for estimating each source.
- The flow split that results in the two flow scenarios is acknowledged, however no information is presented on how this affects the TN loads and resulting concentrations in Wakulla Springs.

The following are the key issues, from a planning perspective, with using data from the NWFWMD Report:

- Attenuations were not presented for the various sources of TN. A single value was used based on the difference between TN input and output within the Wakulla Springs contributory area.
- Information on TN loads to Wakulla Springs was presented only as an average of 1990 – 1999.

3.5.2 Strengths and Limitations of USGS Report

The following are the key strengths of the USGS Report:

- Updated and refined estimates on nitrate loadings from the same sources as the NWFWMD Report to the ground surface in the USGS Study Area
- Separation of Scenario 1 and Scenario 2 loads to Wakulla Springs
- Attenuations for each nitrate source were clearly presented with reasonable basis. OSTDS attenuations based on actual measurements at 3 local OSTDS installations
- Best available information on the various sources of nitrate loading to the ground surface

The following are the key issues, from a planning perspective, with using data from the USGS Report:

- Transient model was not run to steady-state conditions, as best as we understand
- Revised report issued February 1, 2010

4 NITRATE LOADINGS

This section summarizes the Wakulla Springs Springshed nitrate loadings, by source, that LAI recommends using for planning purposes based on information from the data sources reviewed as well as simple mass balance calculations. The two principle sources of loadings are the 2002 NWFWMD report and the 2010 USGS report and information obtained directly from Hal Davis.

4.1 ONSITE SEWAGE TREATMENT DISPOSAL SYSTEMS (OSTDS)

The results of a recent Florida Statewide Inventory of OSTDS (Hall, 2009) are presented on Table 4-1. The inventory matched, as best as possible, parcel datasets with Assessors databases to estimate the number of OSTDS in the Study Area.

Table 4-1. OSTDS in Leon & Wakulla Counties

County	NULL *(Vacant No WW)*	EstSeptic	EstSewer	Not Estimated	Known Septic	Known Sewer	Known Vac Septic	Known Vac Sewer	Known Imp Septic	Known Imp Sewer
Leon	14,352	13,784	10,123	0	18,387	50,608	1,403	2,586	16,984	48,022
Wakulla	11,217	6,232	2,116	0	3,154	2,151	333	612	2,821	1,539
Total:	**25,569**	**20,016**	**12,239**	**0**	**21,541**	**52,759**	**1,736**	**3,198**	**19,805**	**49,561**
Florida	2,850,379	2,846,363	1,137,714	50,904	649,757	2,056,129	50,850	64,135	598,907	1,991,994

Source: Statewide Inventory of On-site Sewage Treatment & Disposal Systems in Florida, EarthSTEPS, LLC & GlobalMind, June 29, 2009.

Estimates from the Florida Department of Health's database are summarized in Table 4-2.

Table 4-2. On Site Treatment and Disposal System Installations and Repair Permits

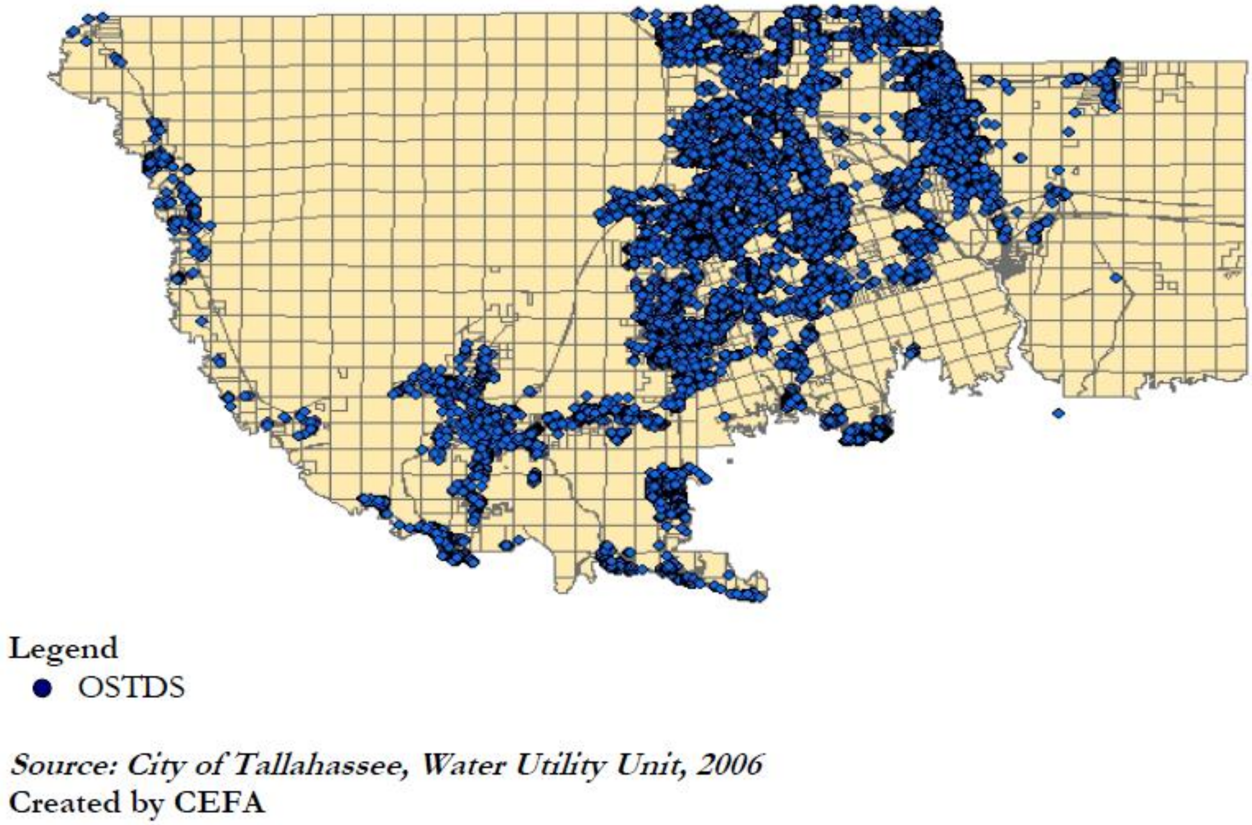
	Leon County	Wakulla County	Total (Leon & Wakulla)
1970 Census (in service)	9,921	2,151	12,072
Total Estimated In Service as of 2007-08 (1970 Census, Plus Total Installations, Minus 50% of Repairs (assumes 50% of repairs were replacements) (Cumulative Total)	35,663	9,905	45,568
Average Annual Number of Repair Permits During Last 5 Years (2003/04 through 2007/08)	385	110	495
Source: Florida Department of Health's Statistics			

FSU Center for Economic Forecasting and Analysis (CEFA) manually entered the new septic permit records obtained as hard copies from the Wakulla County Department of Health (from 1979 to 1997), for a total of 9,476 septic permit records. The City of Tallahassee also tallied the existing septic systems in Wakulla County (based on a series of assumptions) with a grand total of 11,436 septic systems. No data was available on how many are in the PSPZ or SPA.

In Leon County, there were approximately 1,000 OSTDS installations per year in the early 1980s through 1991/92, with a decline in installations since that time to an average of approximately 308 per year over the last five years (2003/04 through 2007/08).

In Wakulla County, there has been an average of 314 OSTDS installations a year over last five years. Of note, these figures do not account for systems taken out of service (data is not available on the numbers of systems that were taken out of service). The Wakulla County OSTDS locations, as determined by CEFA, are shown on Figure 4-1.

Figure 4-1. Wakulla County OSTDS Map



In Wakulla County, the majority of its growth is in areas where central sewer is not available. While in raw numbers the amount of growth in Leon County has exceeded that of Wakulla County, the number of OSTDS installations has been comparable to Wakulla County over the past few years.

Estimates for the number of OSTDS vary from report to report. The OSTDS numbers presented in the USGS model for 2005 are presented in Table 4-3, separated by county and USGS Study Area, along with estimates by others. The difference in numbers appears to be due to the varying delineation of the Wakulla Springs Watershed, i.e. Scenario 1 or 2. Hal Davis provided LAI with the delineation of the Scenario 1 and 2 areas. In addition, the number of OSTDS within each subwatershed in the Study Area was provided by Hal Davis (See Table 3-6). Based upon our review, LAI is of the opinion that the USGS representation of both number and locations of OSTDS in the Study Area is the most accurate, as it relies on parcel information from the City of Tallahassee and modeling of properties draining to Wakulla Springs. However, per the scope of this report, it does not disaggregate OSTDS numbers in Leon County into the City of Tallahassee with a further subset of the PSPZ within the City of Tallahassee.

Per personal communication forwarded from a City of Tallahassee water resource engineer, there are 1,153 OSTDS within the City of Tallahassee. Of these, approximately 42 are within the PSPZ. The caveat to this information was that the City numbers were probably close to reality, but the number within the PSPZ is not correct. This is the best information obtained to date with respect to the number of OSTDS in sub-groups of Leon County and the City of Tallahassee.

Table 4-3. USGS & Others Estimates of OSTDS within Leon and Wakulla Counties

County	Total OSTDS (2005)	OSTDS in USGS Study Area	OSTDS in WS Unconfined Recharge Area		Onsite Sewage Treatment & Disposal Systems (OSTDS) in High Vulnerability Areas of Leon & Wakulla County	
			Scenario 1	Scenario 2	2002 NWFWMD Report (1999)	Leon County Staff (2009)
Wakulla	11,334	9,714	1,100	5,300	6,429	2,400
Leon	39,043	8,026	7,500	7,800	4,290	6,640
Total:	**50,377**	**17,740**	**8,600**	**13,100**	**10,719**	**9,040**

Leon County Semi-Confined Area	**31,017**

As can be seen in Table 4-3, the USGS number of OSTDS in the Study Area is within the range of other estimates for Scenario 1, which most closely resembles the combined PSPZ and SPA areas. Scenario 2 includes systems that are south and west of the SPA. This is why those numbers are higher.

The number of OSTDS is one of several factors that determines the nitrate load to Wakulla Springs associated with OSTDS. The other factors are as follows:

1. Per capita flow and people per OSTDS
2. nitrate concentration in septic tank effluent
3. Attenuation of nitrate in the drainfield.

Table 4-4 summarizes the calculated mass of nitrate contributing to Wakulla Springs using the NWFWMD and USGS assumptions in their previous analyses. NWFWMD used a nitrate load per capita that, using a flow of 137.5 gpd/person, converts to approximately 53 mg/L for the septic tank effluent concentration. USGS used 60 mg/L in their nitrate loading calculations. It is LAI's opinion that 60 mg/L is the appropriate number to use for residential septic tank effluent when actual sampling data is not available. The per capita flow of 55 gpd, used by USGS, is also appropriate for the purpose of estimating flows from septic systems. As can be seen in the assumptions shown on Table 4-4, the estimated effluent nitrate load from each OSTDS is similar for the two studies.

The only factor that is expected to vary significantly is the attenuation of nitrate in the drainfield. Both USGS and NWFWMD were in agreement that 50% attenuation of nitrate was the appropriate number, citing a variety of studies. LAI has not seen any data that suggest this is unreasonable, however it is noted that 50% is on the high side of what is typically assumed for nitrate attenuation in sandy soils such as those in the unconfined aquifer as well as measured by USGS and others. After adjusting for dilution, attenuation measured at three sites in the Wakulla Karst Plain was reported as 25-40% (Katz et al, March 2010). No estimates were made in any of the reviewed reports for the attenuation attributed to OSTDS north of the Cody Scarp. The nitrate load from those OSTDS is accounted for in groundwater inflow into the Study Area.

Table 4-4. Nitrate Loading Calculations from USGS and NWFWMD Reports

Study	People / System	Flow / System (gpd)	Nitrate or TN Load / System (kg/yr)*	# of OSTDS in Unconfined Aquifer		OSTDS Nitrate or TN Load to Drainfield (kg/yr)		Attenuated OSTDS Nitrate or TN Load to Wakulla Springs (kg/yr)	
				Scenario 1 WS Only	Scenario 2 WS Only	Scenario 1 WS Only	Scenario 2 WS Only	Scenario 1 WS Only	Scenario 2 WS Only
USGS	2.5	138	11.4	8,600	13,100	98,400	149,800	49,200	74,900
NWFWMD	2.4	n/a	10.1	5,600		56,400		28,200	

Assumptions / Basis:

NWFWMD		*USGS*	
TN Atten. STE to WS	*50%*	*Nitrate Atten. STE to WS*	*50%*
TN per Capita (kg/yr)	*4.2*	*STE Nitrate (mg/L)*	*60*
		Per Capita Flow (gpd)	*55*

Note: STE = Septic Tank Effluent; WS = Wakulla Springs

The 49,200 kg/yr and 74,900 kg/yr Scenario 1 and Scenario 2 numbers represent the steady state mass load of nitrates flowing to Wakulla Springs from OSTDS in the unconfined aquifer. This is a simple mass balance that relies on the following assumptions:

1. Septic tank effluent nitrate concentration = 60 mg/L
2. Per capita flow = 55 gpd
3. nitrate Attenuation in drainfield = 50%
4. All nitrate that enters the groundwater from OSTDS is transported to Wakulla Springs – no nitrate is lost or otherwise attenuation within the unconfined aquifer.

The USGS number of OSTDS in the Scenario 1 and Scenario 2 Study Area, as shown on Figures 3-6a, 3-6b and Table 3-6 will be used in this and all subsequent task reports unless new data is provided.

4.1.1 Attenuation Sensitivity Analysis

Measured attenuations within the Wakulla Karst Plain ranged from 25 – 40%. USGS assumed 50% based on their review of the data. It is important to note that of the 50% reduction observed in the Woodville Karst Plain, 10-25% was attributed to dilution, and other removal mechanisms include ammonia adsorption to the soil (Katz, et. al. March 2010). Adsorption of ammonia is not a permanent process. Desorption as well as conversion by microbial activity may ultimately result in the release of ammonia over time. It is LAI's opinion that the appropriate attenuation value for planning purposes is 25%. The effect this has on nitrate removal requirements is discussed in Section 5.2. Table 4-4a shows the difference in attenuated nitrate loads from OSTDS reaching Wakulla Springs over the 25 – 50% range.

4.2 Southeast Sprayfields (SESF) and Other Wastewater Treatment Facilities

The major domestic and industrial wastewater facilities were mapped by NWFWMD in their 2002 report and are presented on Figure 4-2. NWFWMD estimated that the total nitrate load from WWTF discharges to the unconfined aquifer was 104% of the load applied at the sprayfield facility. In short, the SESF load accounts for nearly all of the WWTF nitrate load with all other

Table 4-4a. OSTDS Nitrate Load Using Different Attenuation Factors

Year / Scenario		Nitrate Load to W.S. - 50% Atten. (kg/yr)	Nitrate Load to W.S. - 40% Atten. (kg/yr)	Nitrate Load to W.S. - 25% Atten. (kg/yr)
2007	Scenario 1	49,200	59,040	73,800
	Scenario 2	74,900	89,880	112,350
2018	Scenario 1	51,200	61,400	76,700
	Scenario 2	77,900	93,500	116,800

sources combining to only add 4% to the total. However, the SESF load has decreased since the 2002 NWFWMD report was released. In addition, the total load from other WWTFs has likely changed since 2002. The USGS analysis does not appear to account for any nitrate loads from private WWTFs. LAI does not have any data on WWTF nitrate loads beyond the SESF. This is identified as a gap in the data that will need resolution as part of refining nitrate removal requirements.

The USGS 2010 Report estimated SESF mass loads to the ground surface as approximately 275,000 kg/yr and 95,000 kg/yr for years 2007 and 2018 respectively, as shown on Figure 13A in the 2010 Report. Attenuations were reported as 45%. The result was an attenuated load to Wakulla Springs of 152,000 kg/yr for 2007. Per the direction of CoT staff, the appropriate 2007 attenuated nitrate load to Wakulla Springs is 111,000 kg/yr. The 2018 SESF nitrate load was calculated by first applying the anticipated 8.57% growth rate provided by the CoT and Leon County Planning Departments. The growth rate adjusted load was then reduced by 75% to reflect the planned improvements to the effluent that is being dispersed. These improvements are expected to reduce the nitrate concentration from 12 mg/L to 3 mg/L. Table 4-5 shows the mass balance for the SESF nitrate load reaching Wakulla Springs.

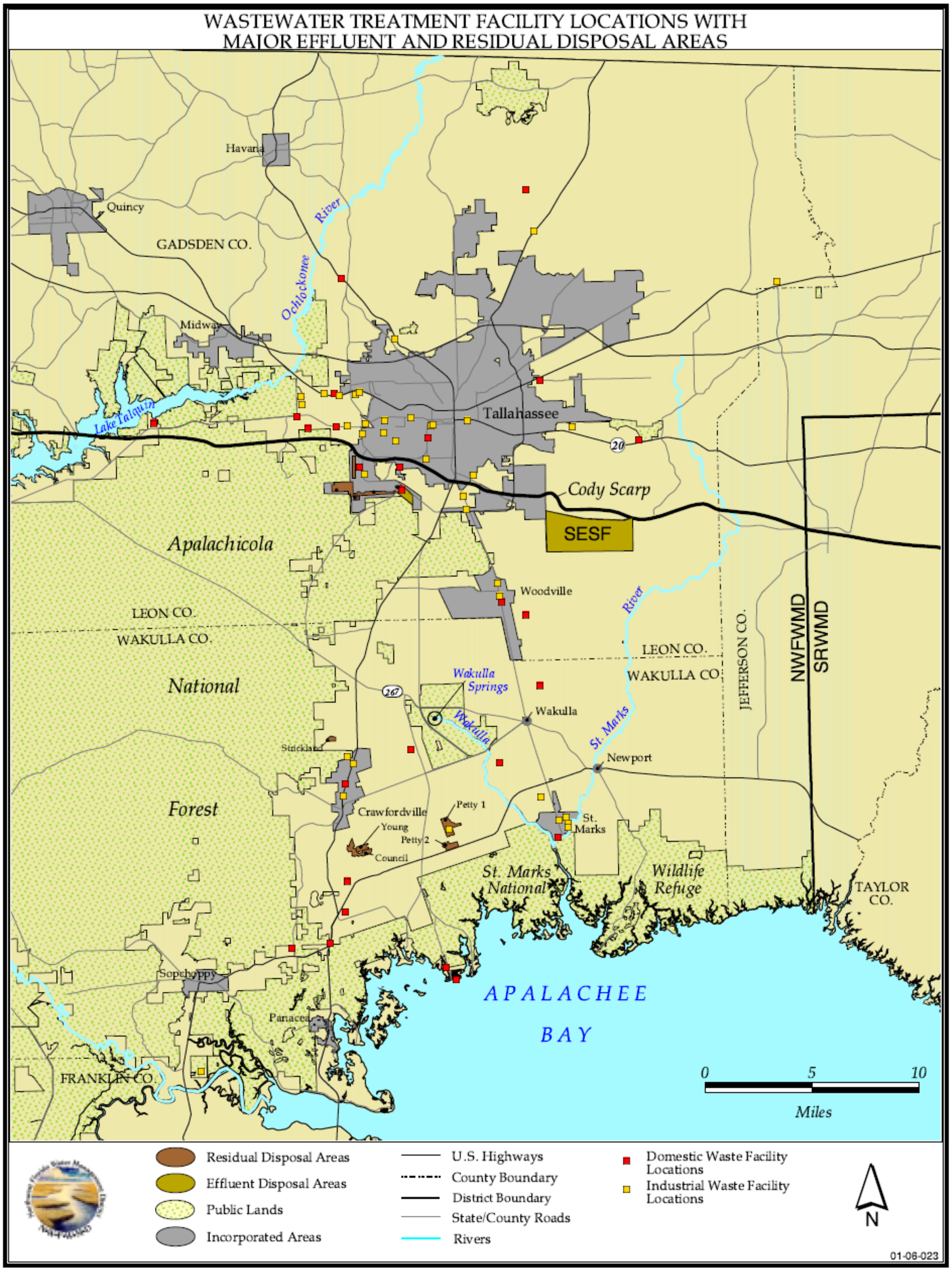
Table 4-5. Mass Balance for SESF Nitrate Load

Year / Scenario		Mass to Surface (kg/yr)	Atten. %	Nitrate Load to W.S. (kg/yr)
2007	Scenario 1	202,000	45%	**111,000**
	Scenario 2	202,000	45%	**111,000**
2018	Scenario 1	54,900	45%	**30,200**
	Scenario 2	54,900	45%	**30,200**

4.3 INFLOW

Inflow is the result of nitrate inputs to the Wakulla Springs springshed in areas other than the unconfined aquifer. Inputs in these other areas will blend with the groundwater and result in a nitrate concentration in the groundwater that flows across the boundary to the Study Area – predominantly delineated by the Cody Scarp.

Figure 4-2. Major Domestic & Industrial Wastewater Facilities



Source: Nitrate Loading as an Indicator of Nonpoint Source Pollution in the Lower St. Marks- Wakulla Rivers Watershed (Chelette, Pratt & Katz), April 2002.

The concentration and flow of this groundwater flowing into the Study Area is derived from years of data at multiple locations from the City of Tallahassee's drinking water supply wells. This concentration has been steady with no statistically significant increase or decrease over the period of record. The nitrate concentration has remained steady despite increases in surface loadings. This suggests that the soils in the semi-confined aquifer area have a high degree of attenuation, effectively muting any increases in surface loading.

NWFWMD estimated that 73,000 kg/yr was crossing the Cody Scarp. The report was not clear on how much of that load made it to Wakulla Springs. NWRWMD used work done by USGS in making their estimations.

Table 4-6 calculates the mass of nitrate crossing the model boundaries based on information presented in the USGS Report. Using the reported flows and nitrate concentrations across the USGS Study Area boundaries, the 2007 inflow nitrate load is 74,900. This is in excellent agreement with the NWFWMD number presented in the 2002 Report, with a slight increase that is expected. The 2018 inflow load is calculated to be 80,700.

Table 4-6. USGS Groundwater Model Boundary Nitrate Loadings Calculation

Model Boundary Zone		1	2	3	4	Total
Flow	CFS	98	67	40	721	**926**
	MGD	45	31	19	335	**430**
Nitrate Conc. (mg/L)	2007	0	0.33	0.55	0.1	**0.125**
	2018	0	0.4	0.66	0.1	**0.135**
Nitrate Load (kg/yr)	2007	0	14,300	14,200	46,400	**74,900**
	2018	0	17,300	17,000	46,400	**80,700**

The USGS report did not specify how much of the flow across the model boundaries reaches Wakulla Springs. Simulated nitrate loads to Wakulla Springs were reported, as well as a discussion on the minimal effect of dispersion on the model results. No attenuation was modeled for nitrates once they enter the Upper Floridan Aquifer. LAI has no basis for evaluating the modeled inflow nitrate load to Wakulla Springs. As such, the values shown in Table 4-6a for the mass of nitrate associated with inflow across the model boundaries will be used going forward. The 2018 load was scaled up based on the population projection increase of 8.57%, provided by the Leon County and CoT planning departments. It is assumed that the remaining nitrates (74,900 total minus 44,000 or 52,000 to Wakulla Springs) bypass Wakulla Springs.

Using the assumption that the inflow nitrate load across the model boundaries (Table 4-6) was entirely a result of the ~31,000 OSTDS north of the Cody Scarp, then a conservative estimate of attenuation in the soils north of the Cody Scarp can be made. Using 74,900 kg/yr as the inflow nitrate and 31,000 OSTDS contributing to that load, the calculated OSTDS nitrate load per system is 2.42 kg/yr. When compared to the expected 11.4 kg/yr calculated in Table 3-9 (using 60 mg/L and 55 gpd/capita), this results in an attenuation factor of 79% for OSTDS north of the Cody Scarp. If other sources of surface nitrate loads such as fertilizer, livestock, atmospheric deposition and private WWTF outfalls are considered, the estimated attenuation would be significantly higher.

Table 4-6a. Inflow Nitrate Loads to Wakulla Springs

Year / Scenario		Nitrate Load to W.S. - 50% Atten. (kg/yr)
2007	Scenario 1	44,000
	Scenario 2	52,000
2018	Scenario 1	47,800
	Scenario 2	56,500

4.4 Atmospheric Deposition

Atmospheric deposition was estimated by NWFWMD using rainfall totals and measured concentrations for wet deposition. Dry deposition was assumed to be 96% of wet deposition. Dry deposition was assumed to blend in with rainfall prior to transport to the aquifer. The combined concentration assigned to the rainfall was assumed to be .022 mg/L. USGS used this value in the model runs that simulated nitrate concentrations in Wakulla Springs in 1966, when only atmospheric deposition and sinking streams were expected to be significant sources. The model results were correlated well with measured nitrate concentrations from 1966. For this reason, the combined atmospheric deposition and sinking streams assumptions were assumed to be valid. An attenuation of 98% was assumed across the Study Area. This assumption was supported by well samples in undeveloped areas where little to no nitrates were found in groundwater wells.

Table 4-7 calculates the mass of nitrate reaching Wakulla Springs using a mass balance approach. The mass to the ground surface, the percentage of the Study Area that is in the Scenario 1 and 2 areas and the assumed attenuation were used in the mass balance. Scenario 1 represents approximately 30% of the total area associated with the Study Area. Scenario 2 represents approximately 50% of the total area associated with the Study Area.

Table 4-7. Mass Balance for Atmospheric Deposition Nitrate Load

Year / Scenario		Mass to Surface (kg/yr)	% of Study Area	Atten. %	Nitrate Load to W.S. (kg/yr)
2007	Scenario 1	400,000	30%	98%	**2,400**
	Scenario 2	400,000	50%	98%	**4,000**
2018	Scenario 1	400,000	30%	98%	**2,400**
	Scenario 2	400,000	50%	98%	**4,000**

4.5 SINKING STREAMS

Streams that sink into sinkholes directly enter the conduit pathways that flow toward Wakulla Springs and other springs in the Study Area. The following streams sink into sinkholes within the Study Area:

- Munson Slough
- Fisher Creek
- Black Creek
- Lost Creek

The concentrations and flows for these creeks is known and assumed to remain constant over time. The variability in loading between Scenarios 1 and 2 is attributed to different conduit flow paths. Under Scenario 2, a significantly higher percentage of the sinking stream flow is captured by Wakulla Springs. The nitrate load attributed to sinking streams was 7,800 kg/yr for Scenario 1 and 31,000 kg/yr for Scenario 2.

None of this load is assumed to be attenuated after sinking below grade. Validation for this assumption comes from the 1966 model runs where atmospheric deposition and sinking streams were expected to make up the majority of the nitrate load from the unconfined aquifer. The modeled data correlated well with measured data from 1966.

4.6 FERTILIZER

Fertilizer nitrate loads were estimated based on total commercial fertilizer sales in both counties. Attenuation of 50% was assumed for fertilizer applied to the land surface. The coverage areas were assigned evenly to all lands designated as “crop / pasture". Table 4-8 shows the calculation for the fertilizer nitrate mass balance.

Table 4-8. Mass Balance for Fertilizer Nitrate Load

Year / Scenario		Mass to Surface (kg/yr)	% of Study Area	Atten. %	Nitrate Load to W.S. (kg/yr)
2007	Scenario 1	60,000	30%	50%	**9,000**
	Scenario 2	60,000	50%	50%	**15,000**
2018	Scenario 1	62,352	30%	50%	**9,400**
	Scenario 2	62,352	50%	50%	**15,600**

4.7 LIVESTOCK

Livestock nitrate loads were estimated based on the number of various types of livestock documented for Leon and Wakulla counties. Attenuation of 50% was assumed for livestock waste applied to the land surface. The coverage areas were assigned evenly to all lands designated as “crop / pasture". Table 4-9 shows the calculation for the livestock nitrate mass balance.

Table 4-9. Mass Balance for Livestock Nitrate Load

Year / Scenario		Mass to Surface (kg/yr)	% of Study Area	Atten. %	Nitrate Load to W.S. (kg/yr)
2007	Scenario 1	43,000	30%	50%	**6,500**
	Scenario 2	43,000	50%	50%	**10,800**
2018	Scenario 1	44,686	30%	50%	**6,800**
	Scenario 2	44,686	50%	50%	**11,300**

4.8 SUMMARY

The mass balance approach was used to calculate the steady state nitrate loadings to Wakulla Springs based on the nitrate mass loads to the surface in the Study Area and the assumed attenuations. Table 4-10 summarizes the mass balance nitrate loads for Scenario 1 and 2.

Table 4-10. Summary of Nitrate Loads to Wakulla Springs

Description	Scenario	Nitrate Loads to Wakulla Springs Planned Growth Projection (kg/yr)						
		Inflow	OSTDS	*Fertilizer*	*Creeks / Sinks*	*Livestock*	*Atmospheric Deposition*	*SE Farm Sprayfield*
2007 Mass Balance	1	44,000	49,200	9,000	7,800	6,500	2,400	111,000
	2	52,000	74,900	15,000	31,000	10,800	4,000	111,000
2018 Mass Balance	1	47,800	51,200	9,400	7,800	6,800	2,400	30,100
	2	56,500	77,900	15,600	31,000	11,300	4,000	30,100

5 WATER QUALITY STANDARD BASED NITRATE REMOVAL REQUIREMENTS

5.1 WAKULLA SPRINGS NITRATE CONCENTRATIONS

The Wakulla River Draft TMDL Report *(FL DEP, 2010)* presents the Total Maximum Daily Load (TMDL) for nutrients for the Wakulla River watershed in the St. Marks/Wakulla River Basin. The Upper Wakulla River (WBID 1006) was verified as impaired for biology and was included on the Verified List of impaired waters for the St. Marks/Wakulla River Basin that was adopted by Secretarial Order in June, 2008. The TMDL establishes the allowable level of nutrient loadings to the Upper Wakulla River that would restore the waterbody so that it meets its applicable water quality impairment threshold for biology**. The applicable water quality standard for nitrate concentrations per the TMDL and EPA standards is 0.35 mg/L.**

According to the Florida Department of Environmental Protection (FL DEP) TMDL Report *(FL DEP, 2010)* Nitrate-N concentrations have increased from about 0.2 to as high as 1.1 mg/L (milligrams per liter) during the past 30 years in Wakulla Springs. Wakulla Springs' nitrate level has been steady in recent years at 0.5 mg/L, which remains above the 0.35 mg/L water quality standard. Elevated nitrate concentrations have led to rapid growth of invasive aquatic plants and nuisance algal mats that smother native plants and disrupt the ecosystem within the Wakulla River.

5.2 WATER QUALITY STANDARD REQUIREMENTS & NITRATE LOAD ANALYSIS

The TMDL reported a nitrate reduction requirement of 56.2% from levels that existed over the "verified period", which ranged from January 1, 2000 – June 30, 2007. The peak monthly nitrate concentration over the Verified Period was observed for February at 0.80 mg/L. Using this peak level and the required 0.35 mg/L water quality standard, the 56.2% reduction requirement was established (*Draft Nutrient "Biology" TMDL for Wakulla River WBID 1006, Douglas Gilbert, FL DEP, May 14, 2010*).

The TMDL Report analysis did not factor in the two flow scenarios. Scenario 1 appears to correlate well with the flows, loads and concentrations used in the TMDL report's analysis.

The USGS has created a groundwater model of the Wakulla Springs Study Area complete with quantified sources of nitrates that simulates nitrate loading in Wakulla Springs. A steady state version of this model would be a useful management tool to evaluate the TMDL compliance of alternate management scenarios. This is especially true in areas like this where groundwater flow patterns and geographic location play such an important role in where the nitrates from each OSTDS ultimately surface.

Using the flows associated with Scenario 1 and 2 along with the water quality standard of 0.35 mg/L, Table 5-1 calculates the maximum attenuated loads that can be discharged within the Wakulla Springs contributory area without violating the 0.35 mg/L water quality standard.

Table 5-1. Maximum Nitrate Loads to Wakulla Springs to Achieve Water Quality Standard

Scenario	Flow		Water Quality Based Max. Nitrate Conc.	Max. Nitrate Mass Load	
	ft^3/s	*MGD*	*mg/l*	*lb/day*	*kg/yr*
Scenario 1	350	226	0.35	663	**110,000**
Scenario 2	750	485	0.35	1,416	**235,000**

For quality control purposes, LAI prepared Table 5-2 that compares the measured nitrate concentrations reported in the TMDL and NWFWMD reports to calculated nitrate concentrations. NWFWMD reported a median of 340 ft^3/s and a median nitrate concentration of 0.89 mg/L for Wakulla Springs. As discussed in Section 3, the total attenuated nitrate load to Wakulla Springs was estimated at 270,000 kg/yr. Using the average flow and the total assumed loading, the calculated concentration is the same as the measured concentration. This is not a coincidence since the attenuation factors were derived by using the known flows and concentrations.

The TMDL report presented measured nitrate data by year. The LAI mass balance total loads for 2007 Scenarios 1 and 2 were 271,200 kg/yr and 339,800 kg/yr respectively. As can be seen in Table 5-2, the measured average value from 1990 – 1999 (predominantly Scenario 1 conditions) and the maximum value measure in 2007 correlate very well with the LAI mass balance for Scenario 1. In addition, the measured average and minimum value for 2007 correlate well with the LAI mass balance for Scenario 2. In LAI's opinion, for this level of analysis and recognizing the complexities of the groundwater aquifer, that data appears consistent.

Table 5-2. Measured vs. Calculated Nitrate Concentrations in Wakulla Springs

Report	Scenario			Total Mass Load	Flow	Calc. NO_3	Measured NO_3 (mg/L)		
				kg/yr	ft^3/s	*mg/l*	*Avg.*	Min.	Max
NWFWMD	**1990 - 1999 Averages**			267,700	340	0.88	0.89		
TMDL	**2007**						0.58	0.47	0.80
LAI Mass Balance	**2007**	**1**	*Assumed Wakulla Springs* ***NOT*** *capturing Spring Creek Springs Group Flow*	229,900	350	0.73			
		2	*Assumed Wakulla Springs* ***CAPTURING*** *Spring Creek Springs Group Flow*	298,700	750	0.44			

Table 5-3 combines information from Tables 4-10 and 5-1 to calculate the anticipated nitrate removal required to meet the water quality standard of 0.35 mg/L. Removal requirements as a percent of the total nitrate load and as a percent of the OSTDS nitrate load are also presented in Table 5-3.

Table 5-3. Water Quality Standard Based Nitrate Removal Requirements

Description	Scenario	Nitrate Loads to Wakulla Springs Planned Growth Projection (kg/yr)			
		Total	W.Q. Standard Max. Nitrate Load	Nitrate Removal Rqmt.	% Total Nitrate Removal Rqmt.
2007 Mass Balance	1	229,900	110,000	119,900	52%
	2	298,700	235,000	63,700	21%
2018 Mass Balance	1	155,600	110,000	45,600	29%
	2	226,500	235,000	-8,500	-4%

The implication of the data shown in Table 5-3 is that there are two separate removal requirements applicable for achieving the water quality threshold of 0.35 mg/L, based on the flow scenario that is occurring. It is important to note that the 2018 numbers reflect the full effect of the improvements planned to the SESF effluent. As can clearly be seen in Table 5-3, ***for Scenario 1 conditions, the improvements to the SESF effluent will not achieve the water quality standard without significant additional nitrate removal from other sources.***

For Scenario 2 conditions, the improvements at the SESF appear to meet and even exceed the nitrate removal requirement. ***Using the revised nitrate load projections presented in this report, it does not appear that additional nitrate removal is required in the Scenario 2 areas outside the Scenario 1 boundary.***

Also noted from Table 5-3 are the vastly different nitrate removal requirements under Scenarios 1 and 2. Scenario 1 requires 29% of the total nitrate load to be reduced for 2018 conditions while Scenario 2 does not require any removal beyond the planned improvements at the SESF. This conclusion will need to be examined in detail to determine the effect on the number and location of OSTDS that will need additional treatment as well as the level of treatment required. It is important to note that the OSTDS within the Scenario 2 boundary but not within the Scenario 1 boundary have no effect on the water quality for Scenario 1 conditions.

5.2.1 OSTDS Attenuation Sensitivity Analysis on Nitrate Removal Requirements

The literature reviewed reported attenuation of OSTDS effluent nitrate ranging from 25 – 40%. Table ES-6 shows the effect this has on the removal requirements shown in Table 5-4. This is a very important conclusion, particularly for the Scenario 2 area. ***The nitrate removal requirements, beyond the SESF improvements, increase from -4% (no removal required) to 11% for Scenario 2 when the assumed OSTDS effluent attenuation decreases from 50% to 25%.***

Table ES-6. Effect of Attenuation on OSTDS Removal Requirements

Description	Scenario	% Total Nitrate Removal Rqmt.		
		50% Atten.	40% Atten.	25% Atten.
2007 Mass Balance	1	52%	54%	57%
	2	21%	25%	30%
2018 Mass Balance	1	29%	34%	39%
	2	-4%	3%	11%

5.3 SENSITIVITY ANALYSIS ON GROWTH PROJECTIONS

USGS assumed a 33% increase in OSTDS nitrate load between 2007 and 2018 for Scenario 1 and a 43% increase over the same period for Scenario 2. The growth associated with Scenario 2 comes entirely from Wakulla County, where the growth rate was projected to be higher. These projected increases were derived from the 2007 and 2018 OSTDS nitrate loads presented in the USGS 2010 report. Projecting growth in uncertain economic times is an inexact science at best. Revised growth projections are significantly lower than those used in the USGS 2010 report. For this reason, LAI conducted a sensitivity analysis that covers the following three alternate growth projections:

- Zero growth – this would hold steady not only the OSTDS nitrate load, but all other nitrate loads including fertilizer, livestock and inflow. An adjustment to the 2018 SESF raw nitrogen load (independent of the AWT upgrades) must also be made.
- Planned growth – based on the following estimates of growth provided by the City of Tallahassee and Leon County Planning Commissions:
    - City of Tallahassee – 0.75% annually. This will be applied to the Inflow and SESF loads (prior to AWT treatment)
    - Unincorporated Leon County (assumed to be similar for Wakulla County) – 0.35% annually. This will be applied to the OSTDS, Fertilizer and Livestock loads.
- 15% total growth from 2007 to 2018 with all sources of nitrate being increased by this percentage.

Tables 5-5 through 5-7 show the results of the three growth projections listed above. Under the Zero Growth projection, summarized in Table 5-5, the total nitrate removal requirements are 25% for Scenario 1 and -9% for Scenario 2. The -9% removal simply reflects that nitrate removal associated with the SESF upgrades is greater than that required to meet the water quality standard of 0.35 mg/L. With 15% growth applied to all nitrate sources, summarized in Table 5-6, the total nitrate removal requirements are 34% for Scenario 1 and 3% for Scenario 2.

Table 5-7 combines Table 4-10 and Table 5-3 for comparison of the CoT and Leon County planned growth projection loads and removal requirements.

This sensitivity analysis shows that growth rate has a significant effect on the total nitrate removal requirements.

Table 5-5. Zero Growth Projection Nitrate Loads and Removal Requirements

Description	Scenario	Nitrate Loads to Wakulla Springs - Zero Growth Projection (kg/yr)										
		Inflow	OSTDS	*Fertilizer*	*Creeks / Sinks*	*Livestock*	*Atmospheric Deposition*	*SE Farm Sprayfield*	Total	W.Q. Standard Max. Nitrate Load	Nitrate Removal Rqmt.	% Total Nitrate Removal Rqmt.
2007 Mass Balance	1	44,000	49,200	9,000	7,800	6,500	2,400	111,000	229,900	110,000	119,900	52%
	2	52,000	74,900	15,000	31,000	10,800	4,000	111,000	298,700	235,000	63,700	21%
2018 Mass Balance	1	44,000	49,200	9,000	7,800	6,500	2,400	27,800	146,700	110,000	36,700	25%
	2	52,000	74,900	15,000	31,000	10,800	4,000	27,800	215,500	235,000	-19,500	-9%

Growth Rate - OSTDS/Fertilizer/Livestock	0.00%	Initial SESF NO_3	12	mg/L
Growth Rate - Inflow / SESF	0.00%	Final SESF NO_3	3	mg/L
		SESF % Nitrate Reduction	75.0%	

Table 5-6. 15% Growth Projection Nitrate Loads and Removal Requirements

Description	Scenario	Nitrate Loads to Wakulla Springs 15% Growth Projection (kg/yr)										
		Inflow	OSTDS	*Fertilizer*	*Creeks / Sinks*	*Livestock*	*Atmospheric Deposition*	*SE Farm Sprayfield*	Total	W.Q. Standard Max. Nitrate Load	Nitrate Removal Rqmt.	% Total Nitrate Removal Rqmt.
2007 Mass Balance	1	44,000	49,200	9,000	7,800	6,500	2,400	111,000	229,900	110,000	119,900	52%
	2	52,000	74,900	15,000	31,000	10,800	4,000	111,000	298,700	235,000	63,700	21%
2018 Mass Balance	1	50,600	56,600	10,400	7,800	7,500	2,400	32,000	167,300	110,000	57,300	34%
	2	59,800	86,200	17,300	31,000	12,500	4,000	32,000	242,800	235,000	7,800	3%

Growth Rate - OSTDS/Fertilizer/Livestock	15.00%	Initial SESF NO_3	12	mg/L
Growth Rate - Inflow / SESF	15.00%	Final SESF NO_3	3	mg/L
		SESF % Nitrate Reduction	75.0%	

Table 5-7. Planned Growth Projection Nitrate Loads and Removal Requirements

Description	Scenario	Nitrate Loads to Wakulla Springs Planned Growth Projection (kg/yr)										
		Inflow	OSTDS	*Fertilizer*	*Creeks / Sinks*	*Livestock*	*Atmospheric Deposition*	*SE Farm Spray field*	Total	W.Q. Standard Max. Nitrate Load	Nitrate Removal Rqmt.	% Total Nitrate Removal Rqmt.
2007 Mass Balance	1	44,000	49,200	9,000	7,800	6,500	2,400	111,000	229,900	110,000	119,900	52%
	2	52,000	74,900	15,000	31,000	10,800	4,000	111,000	298,700	235,000	63,700	21%
2018 Mass Balance	1	47,800	51,200	9,400	7,800	6,800	2,400	30,200	155,600	110,000	45,600	29%
	2	56,500	77,900	15,600	31,000	11,300	4,000	30,200	226,500	235,000	-8,500	-4%

Growth Rate - OSTDS/Fertilizer/Livestock	3.92%	Initial SESF NO_3	12	mg/L
Growth Rate - Inflow / SESF	8.57%	Final SESF NO_3	3	mg/L
		SESF % Nitrate Reduction	75.0%	

The total nitrate removal requirements are 29% for Scenario 1 and -4% for Scenario 2, assuming 50% attenuation performance from conventional septic systems. The negative percent removal (-4%) indicates that during Scenario 2 conditions, the upgrades at the SESF will result in exceeding the nitrate removal requirements.

If the 45,600 kg/yr required reduction is allocated to the remaining sources excluding atmospheric deposition (i.e., OSTDS, Inflow, Fertilizer, Creeks/Sinks, and Livestock) then a minimum 37% reduction OSTDS would be required. The efficacy and reliability of achieving 37% reduction of Inflow, Fertilizer, Creeks/Sinks, and Livestock contributions are unknown. Extensive analysis will be required to determine what is required and the ability, if at all possible, to do so to achieve this requirement. It is noted that the nitrogen contributions from these sources and the % of the subtotal are:

2018 Scenario 1 N Mass Contributions		
Sourc e	kg/yr	**% of Subtotal**
Inflow	47,800	66.57%
Fertilizer	9,400	13.09%
Creeks/Sinks	7,800	10.86%
Livestock	6,800	9.47%
Subtotal	71,800	100%

with Inflow, which is heavily OSTDS contributions north of the Cody Scarp, being the predominant contributor at 67% of the subtotal. Alternately removing 56% of Inflow nitrogen and 37% of Scenario 1 OSTDS achieves the required 45,600 kg/yr nitrogen removal. Obviously other combinations are possible.

If the Scenario 1 29% total reduction (45,600 kg/yr) was addressed solely by reducing OSTDS loading (51,200 kg/yr) then an 89% reduction of OSTDS loading would be required in Scenario 1. Essentially that level of reduction would require AWT level treatment in 100% of the Scenario 1 area. For the executive level of review in this Report it is assumed that OSTDS contribution is the controllable source that would be addressed to achieve the desired load reductions.

The financial implications of the 37% approach is partially addressed in the Task 4 Report in which the costs for 37% OSTDS are estimated. However no estimates of costs have been made, in part due to the lack of technical feasibility and associated cost information/basis on which to make cost estimates, for removal of 37% of the Inflow, Fertilizer, Creeks/Sinks, and Livestock loads. The financial implications of achieving 89% N removal via OSTDS upgrades to AWT are presented in the Task 4 Report.

The costs for achieving the Scenario 1 nitrogen reduction requirement of 45,600 kg/yr will therefore be between the Task 4 Report budgets for 37% OSTDS AWT budget and 89% OSTDS AWT budget.

It is noted that no allocation is made for growth beyond 2018, to maintain the Scenario 1 requirements. Future growth would then need to comply with a no net contribution goal – which is used in other nitrogen stressed watersheds.

Through continuing project optimization efforts and adaptive management, cost minimization can be achieved.

6 MUNICIPAL WASTEWATER TREATMENT FACILITIES

6.1 EXISTING MUNICIPAL FACILITIES

6.1.1 Wakulla County Wastewater Facilities

Five sewer utilities serve Wakulla County as listed in Table 6-6. Figure 6-1 illustrates the location of sewer systems throughout Wakulla County. The Wakulla County utility has Panacea Area Water System (PAWS) handling their sewer billing. Talquin Electric handles a section of Spring Creek and the majority of Shell Point. The City of Tallahassee handles the sewer utility portion of St. Marks utility.

Figure 6-1. Wakulla County Sewer Locations

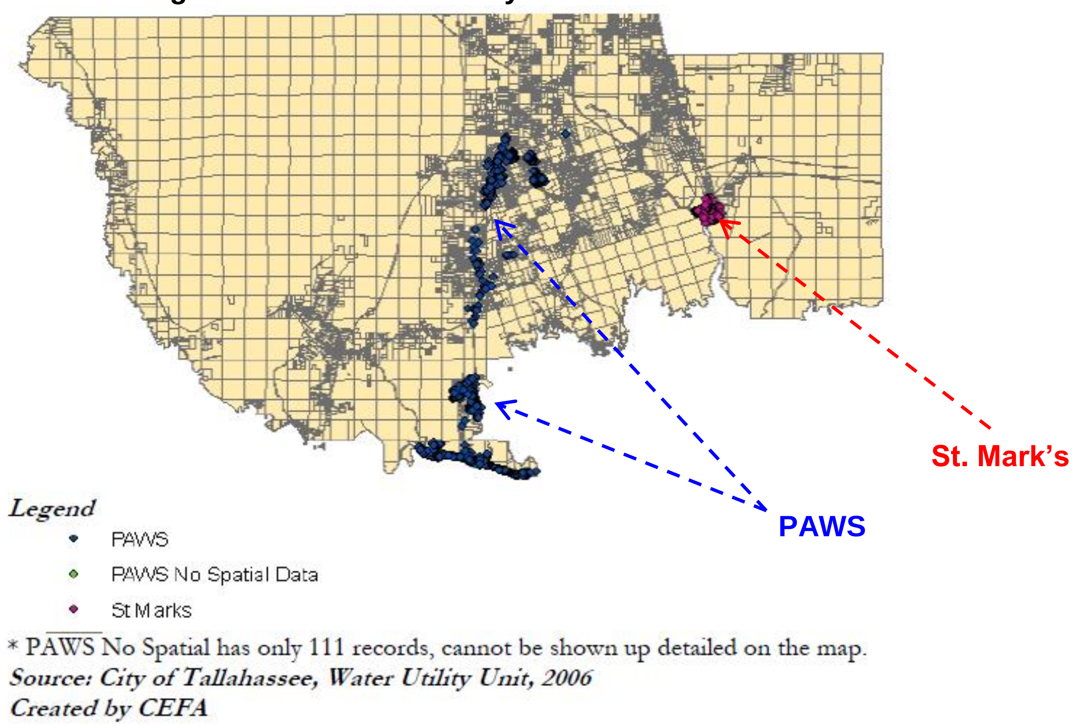


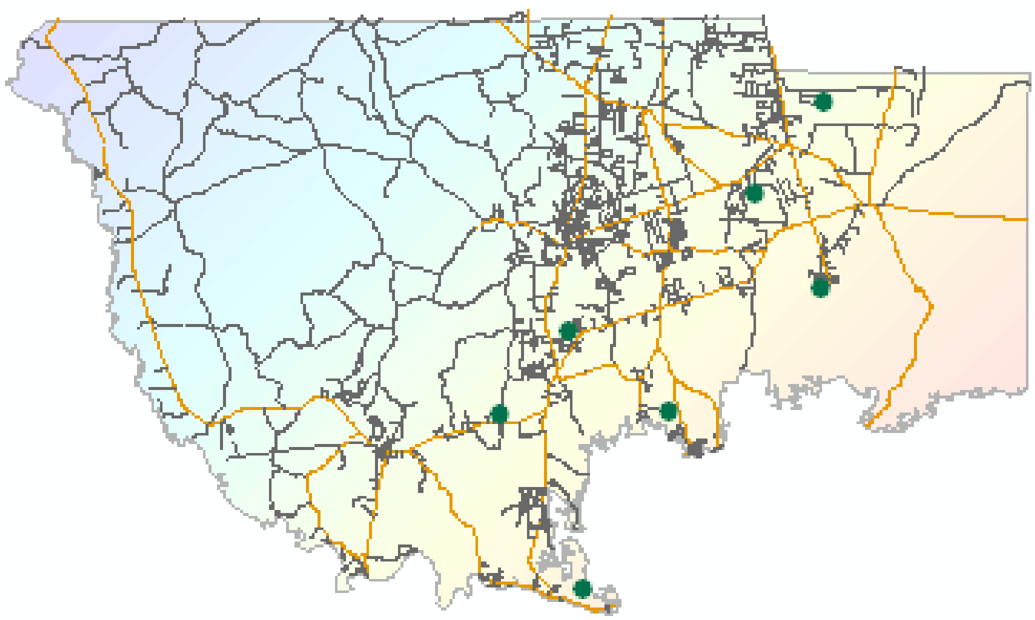
Table 6-1. Sewer and Water Utility Customer Base of Wakulla County ***(as of 10/18/2006)***

Customers	Wakulla County Utility	Talquin Electric	Panacea Area Water System (PAWS)	City of Tallahassee	Sopchoppy Water	St. Marks	Winco/ Southern Water Services***	River Plantation
Water Customers	110	2,387	1,000	608	3,168	229/38 **	1,500	N/A^
Sewer Customers	1,760	320	N/A*	N/A	0	229	1,500	47^

Source: OSTDS and Decentralized Systems Wastewater Treatment Program, Phase I Report, prepared by FSU Center for Economic Forecasting and Analysis, Revised January 2007
NOTES:
Utilities include both residential and commercial customers.
*Sewage billing for Wakulla County Utility and some 10 mile radius of Panacea is handled by PAWS
**229 inside city limits; 38 outside city limits, City of Tallahassee Water for St. Marks. City of St. Marks handles sewage at Purdom Plant upgraded to 0.150 mgd.
***Southern Water Services in Quincy is the utility that services Wakulla Correctional Institution sew and water, owned by Winco.
There is expansion capable for 3,000 customers including the commercial printing operation, CSG. Current capacity = 0.450 mgd, treating 0.200mgd
^67 capacity for sewer, 47 hooked up. There are 109 lots in River Plantation, NA^47 are hooked up to City of Tallahassee water.

Figure 6-2 shows the domestic wastewater treatment plants in Wakulla County, with data from ftp://ftp.dep.state.fl.us/pub/water/gisdata/).

Figure 6-2. Wakulla County Wastewater Treatment Plant Locations



Source: OSTDS & Decentralized Systems Wastewater Treatment Program- Phase I Report, FSU, Revised January 2007

The 2006 Wakulla County Wastewater Facilities Plan detailed plans to extend the existing sewer service area via a new force main and pump station along Lower Bridge Road. The

Wakulla Gardens development would be sewered and connected to the new pump station that would pump westward along Lower Bridge Road over to the Crawfordville service area. An April 28, 2009 Eutaw Utilities, Inc. memo detailed a revision to this plan in which the pump station would accept flows from a portion of Crawfordville, which appears to be in the Wakulla Springs recharge area, and pump down Spring Creek Highway to 98 and over to the Otter Creek WWTF. The Otter Creek WWTF is planned for an upgrade to AWT standards as well as a significant increase in flow from the existing 0.6 MGD to 1.6 MGD. The expanded service area and facility will collect a significant amount of wastewater from within the Wakulla Springs watershed and discharge via sprayfields that are located outside the watershed.

The existing sewer service area includes Panacea and Crawfordville. The sewer service area is largely confined to properties along the Crawfordville Highway, with limited service extensions along 3 intersecting streets. From Figure 3-1, it appears that there is a high density of onsite systems immediately outside the existing service area. Provided the capacity exists within the existing sewer system, there appears to be a large number of onsite systems that can likely be served by extensions along the existing system.

6.1.2 City of Tallahassee Wastewater Facilities

The City's wastewater treatment system is comprised of:

- Thomas P. Smith Water Reclamation Facility (TPSWRF) - design capacity of 26.5 million gallons per day (MGD).
- Lake Bradford Road Wastewater Treatment Facility (LBRWWTF), can treat 4.5 MGD
- Southeast Farm, and
- Tram Road Reuse Facility (TRRF) http://www.talgov.com/you/water/wastewater.cfm

The treated effluent from TPSWRF and LBRWWTF is currently transmitted to the Southeast Farm for agricultural reuse and the TRRF provides public access reuse water.

The City's sanitary sewer collection system is comprised of approximately 906 miles of gravity pipe and is connected to over 15,000 manholes. The gravity system is supported by over 100 pumping stations using approximately 100 miles of force main. These pipes that carry sewage are completely separate from the stormwater system.

The majority of the treated water is reused for spray irrigation on agricultural crops and pasture. City facilities used for effluent spray irrigation include the Southwest Sprayfield, located adjacent to the TPS plant, and the innovative Southeast Farm Wastewater Reuse Facility located eight miles east of the TPS Facility. Approximately two million gallons a day are reused at the TPS facility.

The new Tram Road Reuse Facility (TRRF) uses highly treated wastewater to irrigate the South Wood Country Club golf course, and an area high school. The TRRF is prepared to serve additional customers in the Southwood area and has a production capacity of 1.2 million gallons per day.

The biosolids from both facilities are processed at TPS, which utilizes thermal heat drying equipment. This drying system produces reusable "Class AA" biosolids, which can be sold as a beneficial fertilizer and soil conditioner to commercial nurseries, agricultural markets and other businesses. The drying unit became fully operational March of 2005 and the City ceased all land application of biosolids in December 2005.

The City of Tallahassee's Advanced Wastewater Treatment (AWT) Program consists of more than $220 million in capital improvements to the City's wastewater treatment facilities, which will be designed and constructed over a six year period and is expected to be fully operational by January 2014.

Tallahassee 2030 Master Sewer Plan Summary

The February 10, 2010 2030 Sewer Master Plan Phase II report (Master Plan) by Hatch Mott MacDonald (HMM) presented the projected flows and costs associated with providing sewer service to the entire Urban Service Area (USA). Nine (9) target unsewered areas were identified along with other large unsewered areas and existing franchise areas such as the Talquin Electric Cooperative owned sewer franchises. The total estimated flow for the USA in the year 2008 was 24.46 MGD. The projected flows for the USA in the year 2030 are 31.51 MGD.

A capacity analysis was performed on the 2030 wet weather flows, showing no overflowing manholes. Sixteen reaches of gravity sewers were flowing full, with none being identified as warranting additional analysis. Under the highest flow conditions modeled, none of the surcharging manholes were deemed to pose an overflow concern.

Costs were generated for the 9 Study areas and were presented on a cost per maximum potential connection basis. These costs are presented in Tables 6-3 and 6-4 which list the targeted unsewered areas, their population projections and sewer costs, including approximate house connection, treatment and disposal costs.

No information was presented on the costs per existing developed parcel. It appears that the costs cover only the sewer connections, and not the house connections or the incremental increase in treatment costs associated with this nitrate removal alternative, which have been added to Table 6-4 per discussions with CoT. LAI recommends that additional analysis be performed to quantify the $ / kg/yr cost of this method of nitrate removal factoring in the natural attenuation.

Figure 6-3 illustrates the existing sewered area and nine (9) unsewered target areas, which were identified as part of a 1988 Master Sewer Plan. Table 6-3 summarizes the population and flow projections for each unsewered target area through 2030.

It is noted that natural attenuation removes significant amounts of nitrate in the area north of the Cody Scarp. From a Wakulla Springs nitrate management cost effectiveness only perspective, servicing areas south of the Cody Scarp will be more cost-effective than sewering areas north of the Cody Scarp. This issue is fully addressed in the Task 2 Report.

Table 6-3. Targeted Unsewered Areas & Population Projections

YEAR	UNSEWERED AREA POPULATION									UNSEWERED AREA TOTAL POPULATION	TOTAL EST. FLOWS (gpd) *	INCREMENTAL FLOW INCREASE (gpd) *
	Killearn Acres (Area 1)	Buck Lake/ Lafayette Oaks/ Mahan (Area 2)	Lake Jackson (Area 3)	Huntington Estates (Area 4)	Lake Munson/ Four Points (Area 5)	Woodville (Area 6) †	Bobbin Mill/ Brooke (Area 7)	Centerville Trace (Area 8)	Rose Hill (Area 9)			
2008	5,066	5,094	4,205	2833	6,417	2,884	2,337	1,230	301	30,367	3,036,747	--
2010	5,082	5,211	4,275	3118	6,683	2,938	2,375	1,271	309	31,263	3,126,259	89,511
2015	5,119	5,503	4,448	3831	7,348	3,075	2,470	1,375	331	33,500	3,350,036	223,778
2020	5,171	5,700	4,578	4195	7,692	3,156	2,607	1,528	361	34,989	3,498,920	148,884
2025	5,223	5,897	4,708	4560	8,035	3,238	2,745	1,681	391	36,478	3,647,804	148,884
2030	5,274	6,094	4,838	4924	8,379	3,320	2,882	1,835	421	37,967	3,796,687	148,884

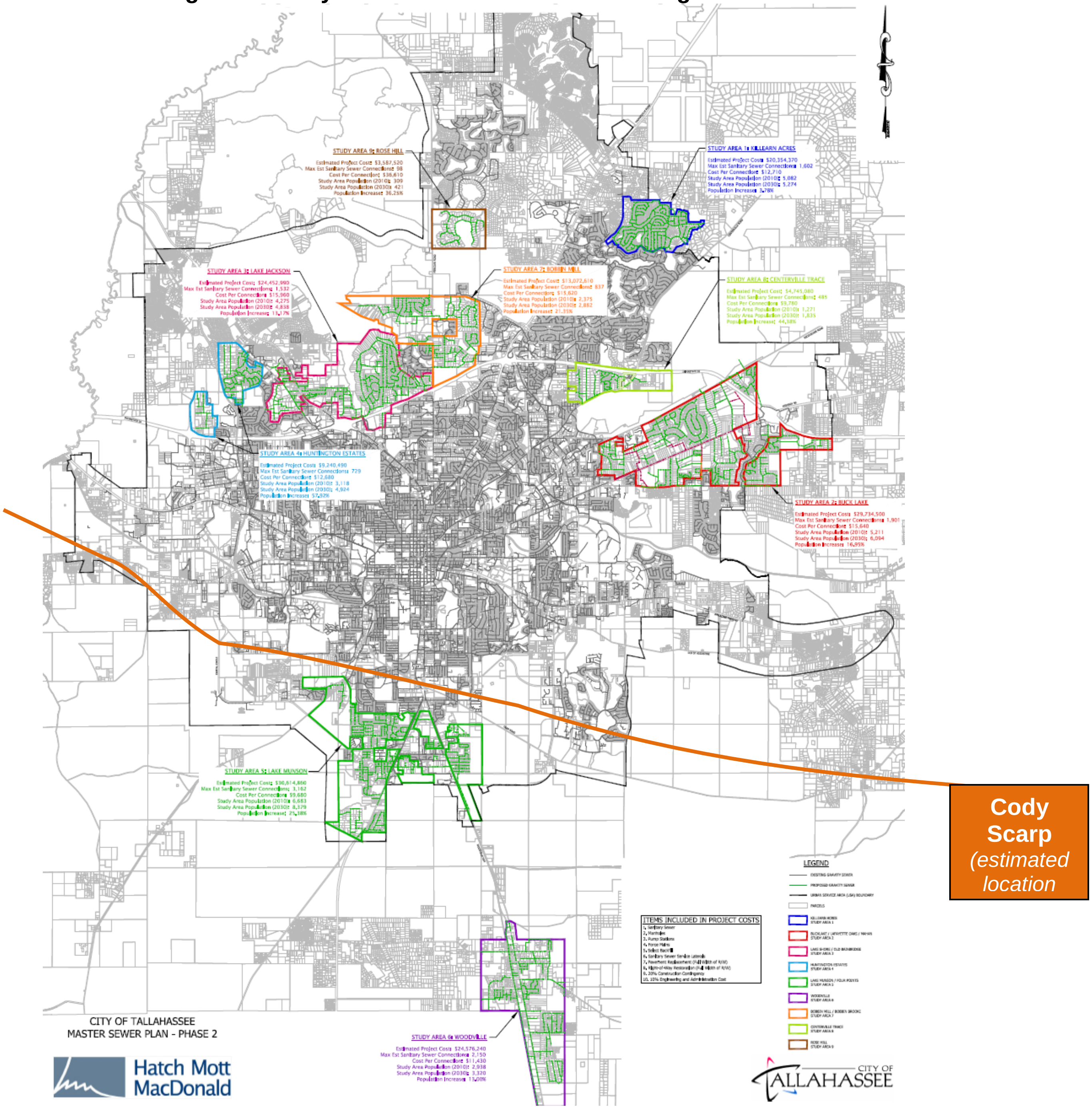
20-Year Population Growth (2010 to 2030): 21.4%

* At 100 gallons per capita-day (as per HMM scope of work)
† Currently outside the USA

Source: City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010.

The system cost based upon 2009 connections, including connection and system charge, inside the City of Tallahassee (CoT) is ~$21,810 and outside CoT is $23,010 (*shown above*) with an average usage fee of approximately $64/month. The two study areas within the SPZ have sewering costs of $18,249.

Figure 6-3. City of Tallahassee Unsewered Target Areas



Source: City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010.

Table 6-4. CoT Targeted Unsewered Areas

#	Unsewered Study Area Description	Population[1] 2010	Population[1] 2030	2010 as % of 2030 Pop.	Estimated Project Cost[1] (2009 $)	Estimated # of Connections[1] 2030	2010 Projected Flow[1] (gpd)
Outside Primary Spring Protection Zone (PSPZ)							
1	**Killearn Acres**	5,082	5,274	96.36%	$ 20,354,370	1,602	508,159
2	**Buck Lake**	5,211	6,094	85.51%	$ 29,374,500	1,901	521,094
3	**Lake Jackson**	4,275	4,838	88.36%	$ 24,452,990	1,532	427,459
4	**Huntington Estates**	3,118	4,924	63.32%	$ 9,240,490	729	311,803
5	**Bobbin Mill/Brooke**	2,375	2,882	82.41%	$ 13,072,610	837	237,525
6	**Centerville Trace**	1,271	1,835	69.26%	$ 4,745,080	485	127,116
7	**Rose Hill**	309	421	73.40%	$ 3,587,520	98	30,931
	Total:	**21,641**	**26,268**	**82.39%**	**$ 104,827,560**	**7,184**	**2,164,087**
Inside Primary Spring Protection Zone (PSPZ)							
1	**Woodville**	2,938	3,320	88.49%	$ 24,576,240	2,150	293,840
2	**Lake Munson**	6,683	8,379	79.76%	$ 30,614,860	3,162	668,332
	Total:	**9,621**	**11,699**	**82.24%**	**$ 55,191,100**	**5,312**	**962,172**

[1]*Source: City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010.*

An analysis should be done for the parcels outside of the Wakulla Springs recharge area that will be sewered and ultimately discharged within the Wakulla Springs discharge area.

It is unclear if the 2018 projections for the SESF include these properties. Given the high level of nitrate removal required in the study area, serious consideration should be given to any project proposing to increase nitrate loads in the Wakulla Springs recharge area.

7 OTHER TMDL ANALYSES

The known applicable TMDL Reports in Leon and Wakulla Counties are listed on Table 7-1, along with potential implications for OSTDS management. In LAI's opinion, the Wakulla Springs TMDL requirements will be the most important from executive level policy and management perspectives for Leon and Wakulla Counties.

Table 7-1 TMDL Reports in Leon & Wakulla Counties

Water Body	WBID	Impairment	TMDL Report Author/ Date	TMDL Target[1]		% Reduction	TMDL Requirements Implications on OSTDS Management
Munson Slough	**8070**	Fecal Coliform	FLDEP - 2008	200	*#/100 ml*		Fecal Coliform inspections of OSTDS & repair of those that have insufficient depth to groundwater
East Drainage Ditch	**916**	Fecal Coliform	EPA 2006	400	*#/100 ml*	83%	Fecal Coliform inspections of OSTDS & repair of those that have insufficient depth to groundwater
Lafayette Drain/ Northeast Drainage Ditch	**756**	Fecal Coliform	EPA 2006	400	*#/100 ml*	63%	Fecal Coliform inspections of OSTDS & repair of those that have insufficient depth to groundwater
St. Augustine Branch	**865**	Total Nitrogen	EPA 2006	0.72	*mg/l*	30%	Nitrogen removal systems may be needed in watersheds
		Fecal Coliform	EPA 2006	400	*#/100 ml*	75%	Fecal Coliform inspections of OSTDS & repair of those that have insufficient depth to groundwater
Central Drainage Ditch	**857**	Total Nitrogen	EPA 2006	0.72	*mg/l*	1%	Nitrogen removal systems may be needed in watersheds
		Fecal Coliform	EPA 2006	400	*#/100 ml*	56%	Fecal Coliform inspections of OSTDS & repair of those that have insufficient depth to groundwater
Godby Ditch/West Ditch	**820**	Total Phosphorus	EPA 2006	0.15	*mg/l*	6%	Phosphorus removal systems may be needed in watersheds
Black Creek	**628**	Fecal Coliform	FLDEP - 2008	400	*#/100 ml*	33%	Fecal Coliform inspections of OSTDS & repair of those that have insufficient depth to groundwater
Wakulla Springs - Upper Wakulla River	**1006**	Total Nitrogen	FLDEP - 2010	0.35	*mg/l*	56%	Nitrogen removal systems may be needed in watersheds

[1] *Fecal Coliform Bacteria - The most probable number (MPN) or membrane filter (MF) counts per 100 mL of fecal coliforms bacteria shall not exceed a monthly average of 200, nor exceed 400 in 10 precent of the samples, nor exceed 800 on any one day.*

Fecal coliform impairment may not be due to human wastewater. It has been recognized that fecal coliform is an inferior indicator organism. The U.S. EPA has recommended the use of enterococci and e. coli. in lieu of fecal coliform. Furthermore, use of specific human markers, sometimes referred to as DNA testing, using Bacteroidales and viruses are now accepted as more valid than fecal coliform.

8 SUMMARY & CONCLUSIONS

The Wakulla Springs hydrogeology, water quality and sources of nitrate have been studied and documented by numerous reports and entities. The USGS water quality model uses the best available nitrate loading data to estimate mass loadings to the ground surface within the Study Area. The applicable water quality standard is 0.35 mg/L nitrate to restore aquatic habitats to pre-development conditions.

LAI used a mass balance approach to calculate the attenuated nitrate loads reaching Wakulla Springs. This load was compared to the maximum load that would still achieve the water quality standard. The resulting nitrate removal requirement for Scenarios 1 2018 conditions is 29%. ***This removal requirement is in addition to the planned improvements to the effluent dispersed at the SESF.***

Scenario 2 conditions do not appear to require additional nitrate removal under the current loading and attenuation assumptions.

The options for achieving TMDL required removal for OSTDS are developed in the Task 2 report. Table 8-1 lists nitrate sources, sorted from largest to smallest loads, complete with the associated issues and potential BMPs:

Table 8-1. Wakulla Springs Nitrate Sources within Leon and Wakulla Counties

Nitrate Source	2018 Nitrate Load *(kg/yr)*		Issues / Representative Options
	Scenario 1	Scenario 2	
OSTDS	51,200	77,900	Sewer connections, cluster systems, nitrate reducing OSTDS and/or groundwater treatment.
Inflow	47,800	56,500	Large recharge area requiring sewer connections, cluster systems or nitrate reducing OSDS. Low % of nitrates from OSDS in this area reaches Wakulla Springs, increasing the effective $/lb NO_3 removed.
SE Farm Sprayfield	30,200	30,200	2018 load includes a 75% reduction from 12 mg/L to 3 mg/L. Additional removal is not likely to be economically feasible
Fertilizer	9,400	15,600	BMPs include regulations on type and amount of fertilizers allowed.
Creeks / Sinks	7,800	31,000	Stormwater BMPs for areas draining to the creeks and sinkholes. Due to the quantity and intermittent nature of stormwater, only marginal removals are expected.
Livestock	6,800	11,300	Not feasible to control for grazing livestock. Caged livestock could capture and treat washdown water.
Atmospheric Deposition	2,400	4,000	Uniformly applied across the entire land surface. Not feasible to capture/treat.
Totals:	**155,600**	**226,500**	
N Removal Requirement	45,600	-8,500	
% of Total	**29%**	**-4%**	

Of the sources listed in Table 8-1, only the following are considered “controllable sources” that are technically and economically feasible for the nitrate reduction necessary to meet the water quality standard:

- Inflow
- OSTDS
- Fertilizer

Observations, Conclusions & Recommendations

- Adopt a modified USGS groundwater steady-state model that includes concentration data, along with a continuing groundwater and water quality monitoring program, as an on-going management tool for adaptive management planning purposes.
- Reduction of nitrate contributions needs to occur to the maximum extent possible in the Scenario 1 area of the unconfined aquifer.

Please note these OSTDS are in the USGS Study Area, which includes and is larger than the combined PSPZ and SPA areas. OSTDS in the other areas, primarily north of Cody Scarp are predominately represented in the INFLOW category of Table 5-1 and have an estimated 79% natural attenuation between the application point and Wakulla Springs.

CAVEATS

1. Nitrate loadings should be validated. It is noted that OSTDS mass loadings are calculated based upon multiplying the number of OSTDS by the attenuation factor- assumed as 50% by the USGS. Although LAI is of the opinion that the 50% attenuation factor in the unconfined aquifer is on the high end of expectations / measurements, it is being used for planning purposes.
2. Natural attenuation for areas north of Cody Scarp was estimated at 79+% based on 100% of the “Inflow” load originating from OSTDS effluent. Since the N contributions include sources in addition to OSTDS, the OSTDS N attenuation in the confined area (i.e. north of Cody Scarp) is greater than 79%. Verification of this estimate should be performed in subsequent studies.
3. Most vulnerable areas north of the Cody Scarp likely have a lower attenuation, which would mean that OSTDS and other nitrate sources within these areas have the potential to be a significant, controllable percentage of the inflow nitrate load.
4. Scenarios 1 and 2 have significantly different flows and loads and they represent the two extremes of flow and loading conditions. An average flow and loading condition may be an acceptable approach and should be investigated further.
5. Two major reports discuss the most significant major man-made source of nitrate is treated wastewater applied at the SESF. Improvements are planned to upgrade this source to AWT standards. This represents a 75% reduction in nitrate load, which is sufficient to meet the 2018 Scenario 2 reduction requirement; however it is not sufficient to meet the 2018 Scenario 1 reduction requirement. Significant additional nitrate removal, beyond the improvements at the SESF, is required from the Scenario 1 area to meet the water quality standard.

6. OSTDS nitrate loading is the next largest controllable source of nitrates contributing to Wakulla Springs.

INFORMATION GAPS

Lombardo Associates, Inc. (LAI) identified the following gaps in information that would assist decision makers in identifying cost-effective means to reduce the nitrate load to Wakulla Springs from OSTDS:

- Actual attenuation of nitrates between the septic tank effluent pipe and the underlying groundwater.
- Updated numbers and locations of OSTDS in both counties. Number and location of OSTDS in the City of Tallahassee and the PSPZ within the City of Tallahassee
- Determination of the expected future flow conditions as well as more detail on total flows and nitrate concentrations associated with Scenario1 or Scenario 2.
- Better understanding of the fate of nitrate applied to the landscape north of the Cody Scarp, including the isolated unconfined or poorly confined areas that may not have the same attenuation as the rest of the semi-confined area.

APPENDIX A: BIBLIOGRAPHY – REFERENCE DOCUMENTS

The following documents were reviewed in preparation of the Lombardo Associates, Inc. (LAI) Onsite Sewage Treatment & Disposal and Management Options Report:

Groundwater:

1. Nitrate-N Movement in Groundwater from the Land Application of Treated Municipal Wastewater and Other Sources in the Wakulla Springs Springshed, Leon & Wakulla Counties, Florida, 1966-2018 (USGS Report 2010-5099). (USGS, 2010)

2. Fate of Effluent-Borne Contaminants Beneath Septic Tank Drainfields Overlying a Karst Aquifer, Journal of Environmental Quality, Brian G. Katz, Dale W. Griffin, Peter B. McMahon (USGS); Harmon S. Harden (FSU); Edgar Wade, Richard Hicks (FL DEP); Jeffrey P. Chanton (FSU); March 18, 2010.

3. Draft Nutrient (Biology) TMDL for Wakulla River WBID 1006, Douglas Gilbert, FL DEP, May 14, 2010.

4. Conduit Flow Paths & Conduit/Matrix Interactions Defined by Quantitative Groundwater Tracing in the Floridian Aquifer, Kincaid & Werner, 2008.

5. Leon County Aquifer Vulnerability Assessment, July 19, 2007 & Wakulla County Aquifer Vulnerability Assessment, September 14, 2009.

6. Nitrate Loading as an Indicator of Nonpoint Source Pollution in the Lower St. Marks-Wakulla Rivers Watershed (Chelette, Pratt & Katz), April 2002.

Water Supply:

7. Hydrogeologic Investigation, Water Chemistry Analysis and Model Delineation of Contributing Areas for City of Tallahassee Public-Supply Wells, Tallahassee, FL, (USGS 2007-5070).

On-site Technologies:

8. Statewide Inventory of On-site Sewage Treatment & Disposal Systems in Florida, EarthSTEPS, LLC & GlobalMind, June 29, 2009.

9. OSTDS & Decentralized Systems Wastewater Treatment Program- Phase I Report, FSU, Revised January 2007.

10. OSTDS & Decentralized Systems Wastewater Treatment Program- Phase II Report, FSU, Revised January 2007.

Wastewater Planning:

11. Wakulla County Wastewater Facilities Plan FY 2006, FL Dept. of Environmental Protection State Revolving Fund, Marc E. Neihaus, P.E., November 30, 2006.

12. City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010

Soils

13. Leon County Soils Survey, USDA, February 1981. *(http://soildatamart.nrcs.usda.gov/manuscripts/FL073/0/Leon.pdf)*

14. Wakulla County Soils Survey, USDA, March 1991. *(http://soildatamart.nrcs.usda.gov/Manuscripts/FL129/0/Wakulla.pdf)*

APPENDIX B: EMAIL FROM HAL DAVIS DESCRIBING ERRORS IN MODEL RUNS

Pio Lombardo

From:	Hal Davis <hdavis@usgs.gov>
Sent:	Friday, October 08, 2010 10:57 AM
To:	support@aquaveo.com
Cc:	Gary L Mahon; Eve L Kuniansky; Pio Lombardo
Subject:	[READ]GMS Technical Support

GMS Technical Support;
I am having a problem with GMS concerning the mass balance in an MT3D model run. I am using the latest edition of GMS 7.1.

This is the situation:
I have made, what should have been, two identical model runs. But I am getting different results when I sum the nitrate mass leaving the aquifer.

First I will describe the original model and then the "identical" model. Both models are in zip files on our FTP site.

ftp://ftpint.usgs.gov/pub/er/fl/tallahassee/

Then go to the Hal Davis directory.

ORIGINAL MODEL
The original model has 2 layers (288 rows and 258 columns) and simulates groundwater flow to three large springs (simulated as drain cells). Recharge is from rainfall and constant head cells along the northern perimeter of the model. Ninety-nine percent of the water leaving the model leaves through the springs. The only source of nitrate in the model is from septic tanks (which were simulated as injection wells). Naturally some model cells have several septic tanks simulated.

The MODFLOW water budget (from the out file) matches a hand calculation, so the correct amount of water from the septic tanks is going into the model.

The nitrate input concentration is a constant 30 mg/l. The input of nitrate is simulated for one year and then turned off. I then tracked the mass of nitrate as it comes out of the springs. Of the hand calculated 113,722 kg that went in only 74,619 kg came out. I calculated the out load by multiply the flow rate from the spring by the concentration at the spring and summed over the approximate 10-year period it took for all the nitrate to come out of the aquifer.

The model reported mass balances errors in MT3D were about 0.1 percent (or less for each stress period). The out file also showed that the nitrate concentration was 30 mg/l in the injection water as it should be.

The original model is in the zip file: New Modeling GMS7.1 -3 Springs Only.zip

"IDENTICAL MODEL"

For the "identical" model I copied the original model to a new folder. The only change was that I (in a spreadsheet) I summed the septic tanks flows for each of the model cells, so now the there was only one injection well in any one cell.

Again, the MODFLOW water budget (from the out file) matches a hand calculation, so the correct amount of water from the septic tanks is going into the model and it was the same as in the original model.

Of the hand calculated 113,722 kg that went in 108,742 kg came out.

Again, the model reported mass balances errors in MT3D were about 0.1 percent (or less for each stress period). The out file also showed that the nitrate concentration was 30 mg/l in the injection water as it should be.

The "identical" model is in the zip file: New Modeling GMS7.1 -3 Springs Only -A.zip

-Hal

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
J. Hal Davis
Hydrologist
Florida Water Science Center
U.S. Geological Survey
2639 North Monroe Street
Suite A-200
Tallahassee, Florida 32303
(850) 553-3673
(850) 553-3641 - FAX
http://fisc.er.usgs.gov/
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TASK 2 REPORT

IDENTIFICATION OF TREATMENT OPTIONS WHERE CENTRAL SEWER IS NOT AVAILABLE

ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL

November 4, 2011

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

Submitted to:

Leon County Purchasing Division
2284 Miccosukee Road
Tallahassee, FL 32308

Table of Contents

I

List of Tables

List of Figures

ACRONYM LIST

OSTDS	Onsite Treatment and Disposal System
PBTS	Performance Based Treatment System
ATU	Aerobic Treatment Unit
PRB	Permeable Reactive Barrier
FLDoH	Florida Department of Health
CoT	City of Tallahassee
AWT	Advanced Wastewater Treatment system
LAI	Lombardo Associates, Inc.
EPA	United States Environmental Protection Agency
O&M	Operations and Maintenance
RBC	Rotating Biological Contactor
SBR	Sequencing Batch Reactor
MBR	Membrane Bioreactor
RMF	Recirculating Media Filter
IFAS	Integrated Fixed Film and Activated Sludge System
RAS	Return Activated Sludge
WAS	Waste Activated Sludge
F/M	Food to Microorganism Ratio
MLSS	Mixed Liquor Suspended Solids
PBTS	Performance Based Treatment System
ATU	Aerobic Treatment Unit
TN	Total Nitrogen
DF	Drainfield
WS	Wakulla Springs
GW	Groundwater
STE	Septic Tank Effluent

EXECUTIVE SUMMARY

This document is the Task 2 Draft Report and examines the alternative nitrogen removal options available, herein referred to as decentralized treatment systems.

CAVEATS:

1. Changes in assumptions such as the attenuation of nitrate in the drainfield will affect the nitrate removal requirements and could affect the range of solutions available for achieving EPA's Numeric Nutrient Criteria for Florida's Springs.
2. Nitrogen loadings from OSTDS to the aquifer should be validated in all areas.
3. Natural attenuation for area north of Cody Scarp was calculated at 79% using the inflow load and the estimated total number of OSTDS north of the Cody Scarp. This calculation is conservative (estimates a low attenuation) since it assumes that 100% of the inflow nitrate load is a result of OSTDS contributions. If other sources of nitrate are included, the actual attenuation would be higher. The 79% attenuation does not account for other sources of nitrates such as fertilizer, stormwater and inputs from South Georgia.
4. OSTDS's located in the Most Vulnerable Areas north of the Cody Scarp may contribute significant levels of nitrate to the total inflow load. This issue needs to be investigated further to determine the appropriate attenuation to assume for OSTDS's in these areas.
5. For the Scenario 1 area that requires 89% removal of the total OSTDS nitrate load (assuming no other sources are treated) are assumed to require the maximum feasible level of nitrate removal, which is AWT. For clarity, areas that require AWT have a range of available solutions from connection to existing sewer systems served by an AWT treatment facility, to AWT cluster systems to AWT onsite systems. In addition, the option of connection to a facility that discharges outside the Study Area is, from a nutrient removal perspective, the best solution as it removes 100% of the existing OSTDS nitrate mass load. The appropriate solution is generally determined by costs and any concerns over unwanted growth.

Decentralized wastewater treatment systems consist of the following techniques:

1. Onsite, serving a single dwelling, typically a single family dwelling
2. Cluster System, serving two or more properties in localized areas of development
3. Groundwater treatment, removing nutrients in the groundwater in areas where this technique is technically feasible – limited in Leon and Wakulla Counties.

Potential wastewater treatment technologies fall within one of the following categories – see Table 2-1 for examples of each one:

PBTS Categories:

1. Fixed Film Systems
2. Suspended Growth – Activated Sludge (AS) Systems
3. Integrated Fixed Film and Suspended Growth Systems (IFAS)
4. Carbon Feed with Pretreatment

Other Promising Technologies:

1. Sulfur Denitrification System
2. Groundwater Treatment - Permeable Reactive Barrier (PRB)

Each of these technology categories has varying levels of nitrogen removal for on-site systems. It is our opinion that many OSTDS could be modified to achieve AWT standards, albeit at a cost. Cluster systems with the proper equipment/technology can achieve the AWT standard of 3 mg/l TN.

Disposal/Reuse system options consist of:

1. Drainfield with various options
2. Drip Irrigation
3. Reuse for non-potable purposes

Cluster systems, which require a house connection and a collection system, include the following collection system options:

1. Conventional gravity
2. Septic Tank effluent – gravity & pressure
3. Grinder Pump – low pressure
4. Vacuum system

Wastewater management solutions have been characterized in terms of the following criteria:

1. Treatment efficiency, measured as percent (%) nitrogen removal
2. Capital and annual O&M costs, Life Cycle costs and cost/kg of nitrogen removed from Wakulla Springs contributing watershed, and as compared to existing OSTDS
3. Non-monetary considerations

PBTS vary greatly in complexity and reliability. In addition, individual systems are subject to highly varying conditions with respect to flows and loads. Any contaminants that enter these systems do not get diluted with the flows from other homes and can be disruptive to the treatment processes.

Suspended Growth, Activated Sludge and IFAS systems rely on processes that are typically monitored on a daily or even hourly basis at larger treatment facilities. When compared to fixed film systems, the suspended growth process is more susceptible to upsets when not monitored and adjusted frequently. In short, suspended growth technologies are better suited for larger facilities where there is less variation in the flows and loads and more frequent monitoring with trained full time operators. Fixed film technologies do not rely on settling of suspended solids, and the biofilm that forms on the media (where treatment occurs) is stable and better suited to withstand varying flows and loads.

It is important to note that Test Center data is unreliable for projecting how a technology will perform in real-world applications (NEIWPCC, 2005). In test centers, the same flow and load is fed to the system each day, with the only variation being the typical morning and evening usage pattern associated with individual systems. Conditions such as shock loads and extended periods of low use are not adequately simulated. As such, it is important to establish the effectiveness of any individual systems that are going to be relied upon to achieve the necessary nitrate removal. Sampling programs need to be established for all systems until sufficient data is collected to establish the reliability of each system type in real world applications.

LAI is of the opinion that technology suppliers need to warranty the performance of their systems and technologies should be delisted, at least within the Study Area, that do not meet the required effluent quality. Some states require effluent quality attainment 70 - 90% of the time, otherwise they are delisted.

Table 1-1 presents results of the analysis of the nitrate removal performance for a variety of wastewater treatment system types, as compared to raw wastewater and OSTDS in the unconfined aquifer (generally South of the Cody Scarp) and the semi-confined aquifer (generally North of the Cody Scarp). This analysis shows the effective removal of nitrate from groundwater when a standard, functioning OSTDS is replaced with the various PBTS's.

Table 3-1 presents the life cycle costs for OSTDS based upon $/kg-yr removed from groundwater contributing to Wakulla Springs. Table 3-2 presents the results of this analysis for cluster systems. Useful life is difficult to assess as it varies greatly between system types, materials and methods of construction utilized and intensity of maintenance. In addition, different components such as sewers and treatment plants have different useful life expectancies. LAI used a weighted average life of 60 years for all systems. Actual repair rate data from the following FLDoH web site suggests that the useful life of the septic tank and disposal component is approximately 100 years in Leon and Wakulla Counties:

http://www.doh.state.fl.us/Environment/ostds/statistics/ostdsstatistics.htm

Data is not available on the useful life of the treatment system component, which comprises anywhere from 50% - 75% of the total cost of a PBTS. 40 years was assumed as the useful life expected for an RMF style PBTS.

Following is a summary of Task 1 findings that are relevant to Task 2:

- To achieve compliance with the water quality standard of 0.35 mg/L nitrate in Wakulla Springs, the 89% nitrogen removal needs to be required of OSTDS in the Scenario 1 portion of the Study Area. Scenario 2 does not require any further nitrogen removal.
- OSTDS in the Study Area discharge to groundwater in the unconfined aquifer at approximately 30 mg/l N. The industry/US EPA accepted limits of technology is 3 mg/l total N, which is achievable by on-site, cluster or centralized facilities.
- Due to what appears to be significant natural attenuation, there appears to be limited value in adding nitrate removal capability to OSTDS in areas north of the Cody Scarp that are not classified as Most Vulnerable. Nitrate removal efforts in those areas would have limited impact on nitrate concentrations in Wakulla Springs. The cost/kg N removed is approximately 1.5 - 2 times higher on average north of the Cody Scarp as compared to the USGS Study Area (see Table ES-2). This is using a very conservative (low) attenuation rate of 79% (see Task 1 Report) for septic systems north of the Cody Scarp. The relative costs increase quickly as this attenuation rises. If reduction of Inflow

nitrogen is pursued to achieve the removal requirement for Scenario 1, nitrate removal north of the Cody Scarp will be necessary.

The use of groundwater treatment is site specific, as technical feasibility needs to be assessed. At this point no watershed level PRB application candidate areas have been identified in Leon and Wakulla Counties. The use of individual scale PRB's may warrant further investigation.

Table 3-3 presents a comparison of the on-site – cluster – City of Tallahassee options, based upon achieving AWT, as compared to conventional septic systems in the unconfined areas south of the Cody Scarp. On a total life cycle cost basis, this level of analysis shows little difference between the options. Given the uncertainties in any executive level Life Cycle cost estimate, a more detailed evaluation of the cost impacts of specific management options is recommended as part of Phase II activities.

1. OVERVIEW OF DECENTRALIZED WASTEWATER TREATMENT

This Report examines the alternative decentralized wastewater management technology options available for addressing Wakulla Springs nitrogen management.

1.1 OVERVIEW

Decentralized wastewater treatment systems consist of the following techniques:

1. Onsite, serving a single dwelling, typically a single family dwelling
2. Cluster System, serving localized areas of development
3. Groundwater treatment, removing nutrients in the groundwater in areas where this technique is technically feasible – very limited in Leon and Wakulla Counties.

Figures 1-1 and 1-2 show the universe of potential collection, treatment and disposal options for OSTDS and cluster systems and are for reference purposes only. Sections 2 and 3 discuss in detail the options that are most applicable to the Study Area.

Chapter 64E-6 of the Florida Administrative Code defines performance-based treatment systems (PBTS) as follows:

"Performance-based treatment system - a specialized onsite sewage treatment and disposal system designed by a professional engineer with a background in wastewater engineering, licensed in the state of Florida, using appropriate application of sound engineering principles to achieve specified levels of $CBOD_5$ (carbonaceous biochemical oxygen demand), TSS (total suspended solids), TN (total nitrogen), TP (total phosphorus), and fecal coliform found in domestic sewage waste, to a specific and measurable established performance standard. This term also includes innovative systems."

The specified levels of treatment, with respect to nitrogen, include the following categories:

- Secondary Treatment Standard – no nitrogen limit, $CBOD_5$ and Fecal Coliform limits only
- Advanced Secondary Treatment Standard – TN < 20 mg/L, annual mean
- Advanced Wastewater Treatment Standard (AWT) – TN < 3 mg/L, annual mean

Potential wastewater treatment technologies fall within one of the following categories – see Table 2-1 for examples of each one:

<u>PBTS Categories</u>:

1. Fixed Film Systems
2. Suspended Growth – Activated Sludge (AS) Systems
3. Integrated Fixed Film and Suspended Growth Systems (IFAS)
4. Passive Carbon Feed with Pretreatment

Figure 1-1. Universe of OSTDS Treatment and Disposal Options

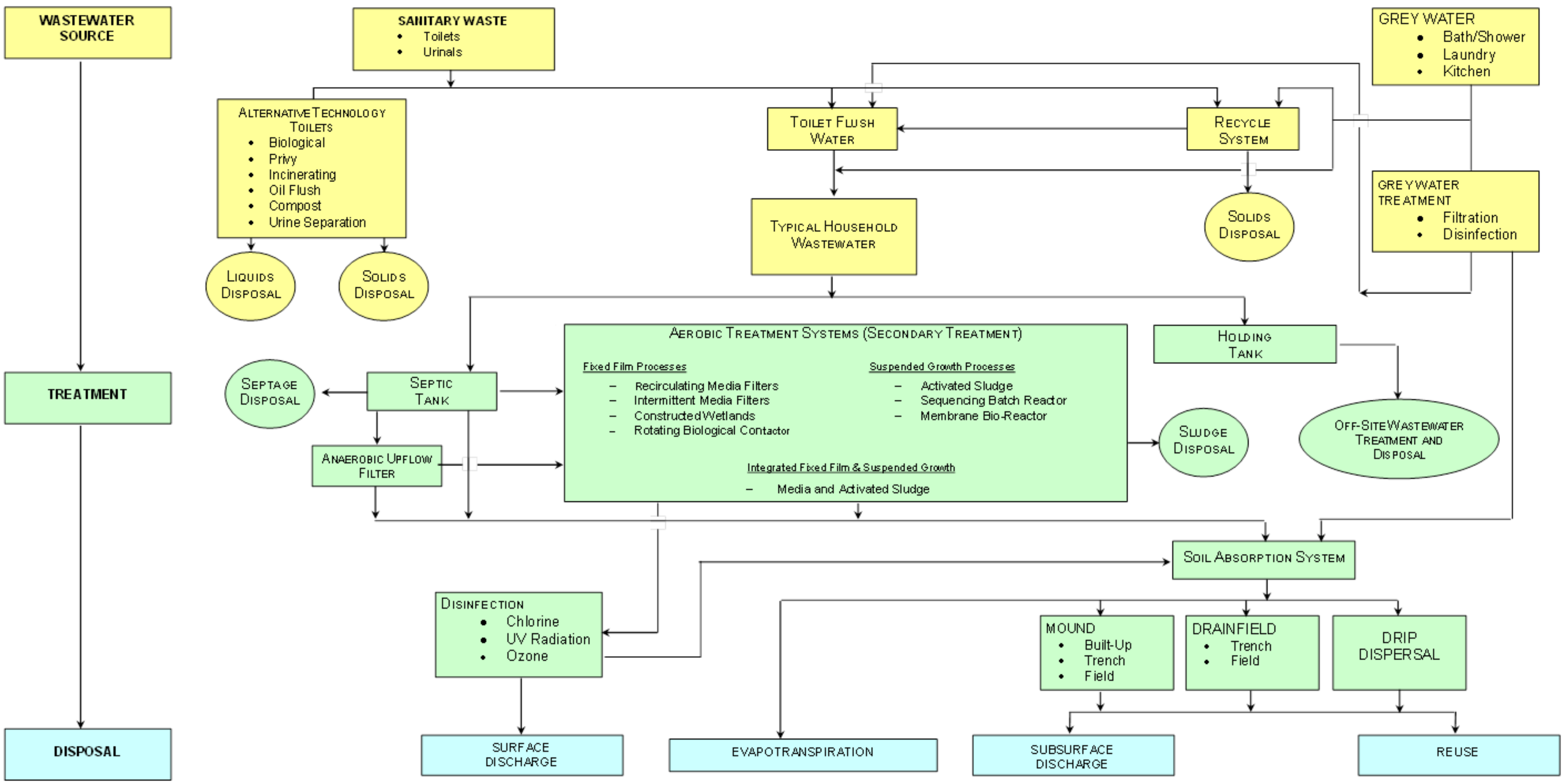
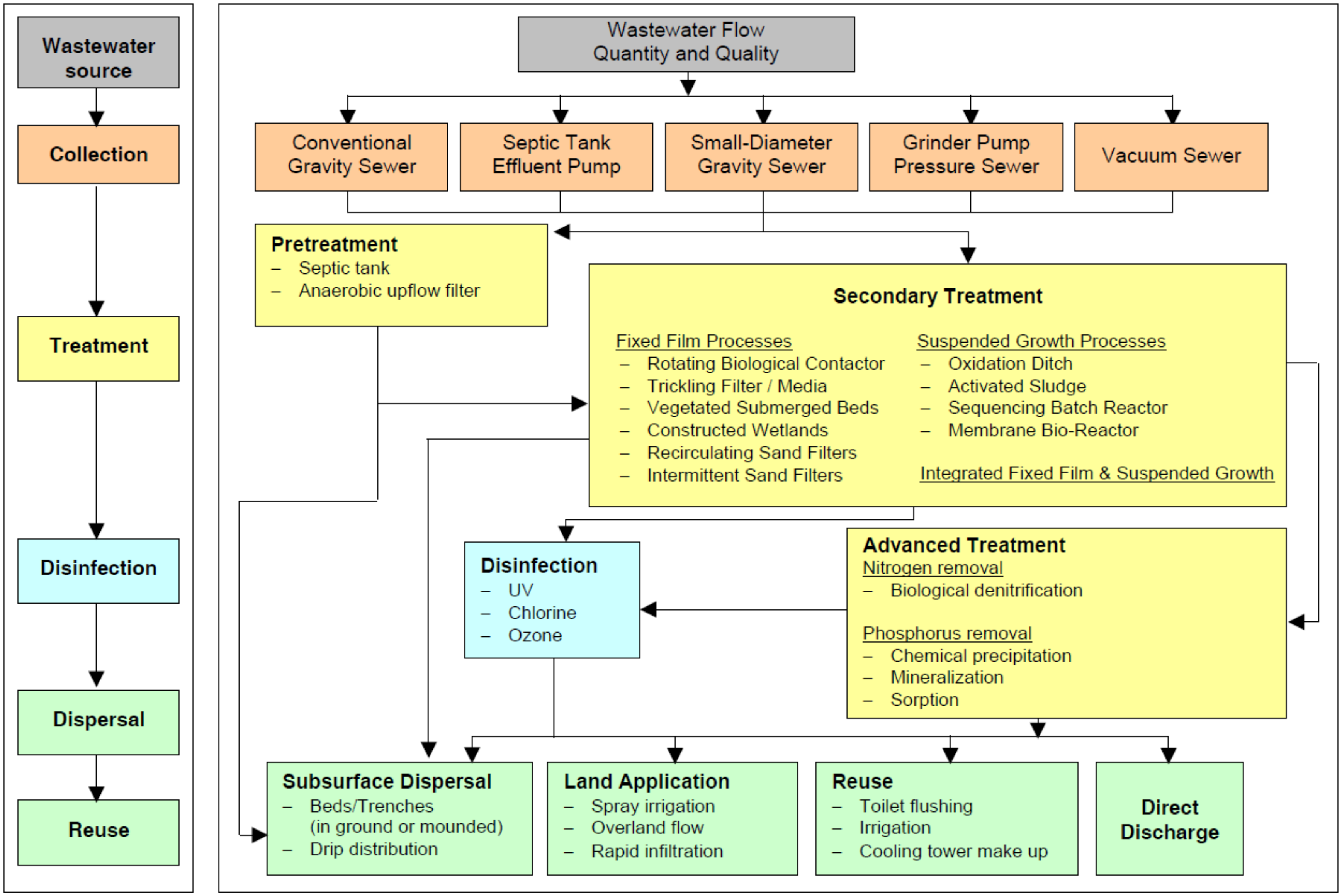


Figure 1-2. Universe of Cluster Collection, Treatment and Disposal Options



Other Promising Technologies:

1. Sulfur Denitrification System
2. Groundwater Treatment - Permeable Reactive Barrier (PRB)

Each of these technology categories has varying levels of nitrogen removal for on-site systems. It is our opinion that many OSTDS could be modified to achieve AWT standards, albeit at a cost. Cluster systems with the proper equipment/technology can achieve the AWT standard of 3 mg/l TN.

Disposal/Reuse system options consist of:

1. Drainfield with various options
2. Drip Irrigation
3. Reuse

Cluster systems, which require a house connection and a collection system, include the following collection system options:

1. Conventional gravity
2. Septic Tank effluent – gravity & pressure
3. Grinder Pump – low pressure
4. Vacuum system

Wastewater management solutions have been characterized in terms of the following criteria:

1. Treatment efficiency, measured as percent (%) nitrogen removal
2. Capital and annual O&M costs, Life Cycle costs and cost/kg of nitrogen removed from Wakulla Springs contributing watershed, and as compared to existing OSTDS
3. Non-monetary considerations

PBTS vary greatly in complexity and reliability. Due to the small number of people using these systems, individual systems are frequently subjected to highly varying conditions with respect to flows and loads. In addition, any contaminants that enter these systems as a result of careless homeowner practices do not get diluted with the flows from other homes and can be disruptive to the treatment processes. The stability and reliability of any treatment process that is being relied upon to achieve nitrate removal under these conditions is a critical component for planning purposes.

1.2 Projecting Field Performance Based on Test Center Data

It is important to note that Test Center data does not replicate stressful field conditions that are relatively common for individual systems in real-world applications. In Test Center facilities the same flow and load is fed to the system each day, with the only variation being the typical morning and evening usage pattern. Conditions such as extended periods of low use followed by high flows and loads are not adequately simulated. As such, it is important to establish the effectiveness of any individual systems that are going to be relied upon to achieve nitrate removal. Proper sampling programs need to be established for all systems until sufficient data is collected to establish the reliability of each system type within the Study Area.

LAI is of the opinion that technology suppliers need to warranty the performance of their systems and technologies should be delisted, at least within the Study Area, that do not meet the required effluent quality. Some states require effluent quality attainment 70 - 90% of the time, otherwise they are delisted.

A summary of OSTDS and cluster system technology nitrate removal capabilities is presented on Table 1-1.

The following assumptions were made in Table 1-1, relating to OSTDS applications only:

- Fixed Film processes, on average, will have superior nitrogen removal than suspended growth and IFAS systems. 19 mg/L is used for fixed film and 25 mg/L is used for suspended growth and IFAS.
- Drainfield attenuation of "clean" effluent from ATUs will be significantly less compared to the 50% reported for septic tank effluent. 25% was used for the secondary treatment options and 5% was assumed for AWT options.

Of note in Table 1-1 is the removal efficiencies when treated effluent is compared to septic tank effluent after the drainfield. As can be seen, the suspended growth and IFAS systems remove approximately 58% of the wastewater nitrogen. However, when the nitrate load to groundwater is compared with and without this level of treatment on the septic tank effluent, only 38% more nitrogen is removed. This is due to the lower attenuation rate associated with treated effluent. More data is needed to determine the expected drainfield attenuation for treated effluent**.**

Wastewater treatment technologies are grouped according to the following performance categories with respect to total nitrogen in the effluent (nitrate concentrations are always less than or equal to TN concentrations):

Category	*Expected Effluent TN*
1. Secondary Treatment	< 30 mg/l
2. Advanced Secondary Treatment	< 20 mg/l
3. Tertiary Treatment	
a. Basic	8-10 mg/l
b. Enhanced	3-5 mg/l

Some states require OSTDS classified similarly to PBTS to achieve compliance with their effluent quality limits 70 – 90% of the time. This is typically seen where PBTS are used as part of a regulatory requirement to remove pollutants from stressed watersheds. LAI recommends that an adequate sampling program be required for all PBTS within the Study Area and that non-performing systems be removed from the list of acceptable systems for this area.

Figures 1-1 and 1-2 illustrate the range of technical options for on-site and cluster decentralized management, respectively, with a technical description of the options in Section 2.

Section 3 presents a cost-effectiveness analysis of the various OSTDS and cluster options.

Table 1-1. OSTDS & Cluster Options Effluent Quality and Groundwater Discharges

		Nitrogen Loadings and Removals																
		Effluent Quality					Removal Efficiency Comparisons					N-Load Discharged to			N Removals			
System Type	Onsite System Category	Flow	Eff. TN Conc. Prior to DF	% Drain field Atten	Effluent TN Conc. After DF *(to WS GW)*	Effluent TN Conc. After DF *(to WS GW)*	Prior to DF as Comp. STE prior to DF	After DF (to WS GW) as Compared to STE prior to DF		After DF (to WS GW) as Compared to STE after DF		Drain field	Groundwater		As Compared to STE N Load		In Addition to Load Currently Removed by Standard OSTDS	
					Unconf. Aq. using DF Removal %	Conf. Aq. using DF Removal %		Unconf. Aquifer using DF Removal %	Conf. Aq. using DF Removal %	Unconf. Aquifer using DF Removal %	Conf. Aquifer using DF Removal %		Unconf. Aquifer using DF Removal %	Conf. Aquifer using DF Removal %	Unconf. Aquifer using DF Removal %	Conf. Aquifer using DF Removal %	Unconf. Aquifer using DF Removal %	Conf. Aquifer using DF Removal %
		(gpd)	*(mg/L)*	*(%)*	*(mg/L)*	*79%*	*(%)*	*(%)*		*(%)*	*(%)*	*(kg/yr)*	*(kg/yr)*	*(kg/yr)*	*(kg/yr)*	*(kg/yr)*	*(kg/yr)*	*(kg/yr)*
	Septic Tank Effluent (STE)	137.2	**60**	n/a	**n/a**	**n/a**	n/a	n/a	n/a	n/a	n/a	11.39	11.39		n/a	n/a	n/a	n/a
	Drainfield Effluent to Groundwater - unconfined aquifer	137.2	**60**	50%	**30**	**n/a**	n/a	50%	n/a	n/a	n/a	n/a	5.70	n/a	5.70	n/a	n/a	n/a
	Drainfield Effluent to WS Groundwater - confined aquifer	137.2	**60**	79%	**n/a**	**12.6**	n/a	79%	n/a	n/a	n/a	n/a	n/a	2.39	n/a	9.00	n/a	n/a
	Advanced Secondary Treatment Nitrogen Removal Standard																	
1	**Suspended Growth**	137.2	**25**	25%	**18.75**	**5.25**	58%	69%	91%	38%	58%	4.75	3.56	1.00	6.64	10.39	2.14	1.40
2	**IFAS**	137.2	**25**	25%	**18.75**	**5.25**	58%	69%	91%	38%	58%	4.75	3.56	1.00	6.64	10.39	2.14	1.40
3	**Fixed Film**	137.2	**19**	25%	**14.25**	**3.99**	68%	76%	93%	53%	68%	3.61	2.71	0.76	7.78	10.63	2.99	1.63
	AWT Standard - Nitrogen Removal																	
4	**Carbon Feed & PreTreat**	137.2	**3**	5%	**2.85**	**0.63**	95%	95%	99%	91%	95%	0.57	0.54	0.12	10.82	11.27	5.15	2.27
5	**Cluster Systems**	137.2	**3**	5%	**2.85**	**0.63**	95%	95%	99%	91%	95%	0.57	0.54	0.12	10.82	11.27	5.15	2.27

Acronyms:
TN – Total Nitrogen
DF – Drainfield
WS – Wakulla Springs
GW - Groundwater
STE – Septic Tank Effluent

2. TREATMENT SYSTEM OPTIONS

Florida Department of Health (FL DoH) approved OSTDS, along with assumed nitrogen removal levels are presented on Table 2-1. It is important to note that literature values for the various OSTDS technologies nitrogen removal capabilities is limited and has extreme variability. There is limited consensus on the exact values to assign. This analysis makes assumptions on nitrogen removal efficiencies for analytical purposes. Actual nitrogen removal performance needs to be established through a comprehensive monitoring program. This is especially important for the Study Area, where OSTDS may be relied upon for nitrate removal required to meet water quality standards. OSTDS effluent quality are assumed based upon data contained in the publications listed in the Appendix, many of which are independent 3rd party studies and peer reviewed, or as noted.

It is LAI's opinion that numerous on-site systems that do not achieve AWT standards of TN 3 mg/L can do so with the proper additional equipment, albeit at a cost. The small numbers of OSTDS in FL that achieve TN of 3 +/- mg/L is, in LAI's opinion, because they are not required through regulation and their costs are significantly higher than standard installed systems that achieve less nitrogen removal.

2.1 FIXED FILM SYSTEMS

Fixed film processes technologies include:

- Single Pass Media Filters
- Recirculating Media Filters (RMF)

The media contained within each fixed film system is typically either sand, gravel, foam, peat, textile, plaster media or rotating biological contactors (RBC).

Single pass media filters represent the simplest type of treatment. However, they are very limited when it comes to nitrogen removal.

Recirculating Media Filters (RMF) utilize media with a high surface area to volume ratio as a substrate for a biofilm to grow on. Wastewater and air are mixed, using fans and/or spray heads, and contacted with the biofilm that grows on the media. The media effluent is split between recirculating and discharging to the next stage of the treatment process. Recirculation flows are directed to the recirculation tank where some denitrification (typically 50%) and dilution of the septic tank effluent flow occurs. RBCs use an engineered surface that is rotated half-submerged through the wastewater stream. A biofilm grows on the surface and aerates when the film is not submerged.

Recirculating media filters have the advantage of not producing large quantities of sludge and not needing energy intensive aeration and mixing, as compared to suspended growth systems. In addition, secondary clarifiers and return sludge pumps are not necessary, simplifying the treatment process. Fixed film processes are also more resistant to varying flows and loads than suspended growth systems. This is due to the stability of the biofilm during periods of varying loading. These systems are more reliable and require less operator involvement than processes that utilize the suspended growth technology. Sludge production is also much lower for these systems, when compared to systems that utilize suspended growth technology. The result is simplicity and lower O&M costs, along with consistency of treatment results.

Table 2-1. Representative and Estimated Effluent Quality FL DoH Approved and Emerging Treatment System Options

System Type		Effluent TN *mg/l*
Septic Tank Effluent (STE)		
STE		60
Representative FL DoH Approved Fixed Film Systems		
Single Pass Media Filter	Intermittent Sand Filter (ISF)	50
	Peat System	50
Recirculating Media Filters (RMF)	Advantex™	19
Representative FL DoH Approved Suspended Growth Systems		
Conventional & Modified Activated Sludge Processes		25
Sequencing Batch Reactor (SBR)[5]		16
Membrane Bioreactor (MBR)[5]		3
HOOT		25
Representative FL DoH Approved IFAS Systems		
FAST		25
Representative Passive Carbon Feed Systems		
Nitrex™,[3]		3
HOOT		10
Black & Gold[1,4]		?
Sulfur Denitrification Systems[4]		
FLDoH Project		3
Groundwater Treatment[2,4]		
Permeable Reactive Barrier (PRB)		**n/a**

[1]According to FLDoH analysis effluent quality TN is 12 - 15 mg/l

[2]Effluent is not treated - groundwater is. This option treats all sources of nitrates.

[3]Permitted for <10mg/L, field data supports <3mg/L - see Chesapeake Bay US EPA Study referenced in Appendix A

[4]Emerging treatment technologies, not currently approved by FL DoH

[5]Not tupically used for individual systems

Separating the sludge prior to treatment results in a carbon-limited system. While these systems excel in nitrification (conversion of ammonia to nitrate) provided that sufficient alkalinity exists, denitrification (conversion of nitrate to nitrogen gas) is limited by the availability of carbon. The primary process control on these systems is the recirculation ratio. Water is pumped in frequent short cycles, with total pump run times typically being less than an hour per day.

Pros of individual fixed film systems include:

- Consistent nitrification
- Simple, stable and reliable process
- Energy efficient
- Low sludge production

Cons associated with individual fixed film systems include:

- Larger footprint
- Higher installation costs
- Carbon-limited system for complete denitrification
- Alkalinity addition may be needed – not expected in Leon & Wakulla Counties

2.2 Suspended Growth – Activated Sludge (AS) Systems

The generic options for suspended growth technologies applicable to on-site and cluster systems include the following:

- Conventional and Modified Activated Sludge Processes
- Sequencing Batch Reactors (SBR)
- Membrane Bioreactors (MBR)

Suspended growth processes treat wastewater using similar bacteria as the fixed film processes. The difference is that in this process, bacteria and solids are maintained in suspension within an aeration tank. These bacteria grow as they absorb nutrients. A secondary clarifier is needed following the aeration tank to settle the biosolids into what is then called activated sludge. Suspended growth systems rely on processes that are typically monitored on a daily or even hourly basis at larger treatment facilities. In larger facilities, sludge is separated into Return Activated Sludge (RAS) and Waste Activated Sludge (WAS). In individual systems, this is not typically done. All of the sludge is maintained in the system until it is pumped. By maintaining the sludge within the treatment process, there is sufficient carbon to achieve high levels of denitrification, if properly configured and operated. Factors that are monitored / adjusted at larger treatment facilities include:

- WAS / RAS ratio
- Mixed Liquor Suspended Solids (MLSS)
- Food to Microorganism Ratio (F/M)
- Oxygen / redox levels
- Aeration cycles
- Recirculation ratio
- Sludge Age

All of the above factors affect nitrification (conversion of ammonia to nitrate) primarily and also denitrification (conversion of nitrate to nitrogen gas). When these factors are adjusted and monitored properly to match influent flows and loads, suspended growth systems are capable of reliably meeting AWT standards for nitrate removal. This process and its many variations are the standard for large-scale wastewater treatment worldwide. However, when these factors are not monitored and / or not even adjustable, as is the case with all individual and many small-scale systems, the reliability of the suspended growth process decreases dramatically.

SBRs are unique in that they utilize a batch process to combine treatment stages in a single tank. These units have great treatment potential, however, they are highly reliant on the close supervision of skilled operators. For this reason, they are not recommended for lower flows where full time specialized operations is not practicable.

MBRs utilize the same suspended growth technology, replacing the secondary clarifiers with membranes. These processes have a range of treatment options, depending on the type of membranes used. Specialized operations and high life-cycle costs limit the feasibility of MBRs to areas with space constraints and/or a higher required treatment levels. These systems operate at a high bacteria concentration, referred to as Mixed Liquor Suspended Solids (MLSS), and a long sludge age, thereby reducing the amount of sludge production and adding stability to the process during varying flows and loads. The major concern with activated sludge processes is washout of the solids in the clarifier. By substituting membranes for the clarifier, MBRs eliminate this mode of failure. Nitrification performance is still dependent on the same factors as conventional suspended growth systems.

Typical individual suspended growths systems do not have most of the functionality of larger systems and are packaged in a single tank. This results in poor performance compared to the larger systems, however it does result in low installation costs. The energy use and sludge production is higher than the fixed film systems. The economies of scale must reach a point where the higher O&M costs are offset by the lower construction costs. Typically, flows should exceed 50,000 – 100,000 gpd (depending on the type of suspended growth system) before systems that are properly designed and operated start to become competitive on a total life cycle cost basis. The reliability of these systems is highly dependent on the operations staff. With full-time skilled operations, adjustments can be made as potential upsets occur.

Pros of individual suspended growth systems include:

- Smaller footprint due to single tank configuration
- Lower installation costs
- Generally not carbon-limited

Cons associated with individual suspended growth systems include:

- Many factors affecting performance are not monitored or adjustable
- Relative stability of biological process when faced with varying flows and loads is low
- Reliance on settling of suspended solids introduces possibility of solids carryover to the drainfield
- Inconsistent nitrification
- Energy intensive process – property owners are able to disconnect
- Higher sludge production
- High dependence on operator attention and skill

2.3 Integrated Fixed Film and Suspended Growth – Activated Sludge (IFAS) Systems

Integrated fixed film and suspended growth (IFAS) processes combine the fixed film and suspended growth technologies in one treatment process. These processes tend to require less space and are often more applicable to lower flows than the traditional suspended growth processes. In addition, by combining both processes, resistance to process upsets is increased over the suspended growth process alone. The addition of a fixed film media to the aeration tank in these processes increases the treatment capacity and reduces the footprint of the aeration tank. Despite the incorporation of the fixed film process, this technology has the same dependencies on operator attention and skill when higher levels of nitrogen removal are required.

Pros of individual IFAS systems include:

- Small footprint
- Lower installation costs
- Not carbon-limited
- More stable than traditional suspended growth systems

Cons associated with individual IFAS systems include:

- Many factors affecting performance are not monitored or adjustable
- Less stable and reliable than traditional fixed film processes
- Reliance on settling of suspended solids introduces possibility of solids carryover to the drainfield
- Inconsistent nitrification
- Energy intensive process
- Higher sludge production

2.4 Active and Passive Carbon Feed (Two-Stage Heterotrophic) Systems

The primary limitation on nitrogen removal in both fixed film and the simplified suspended growth systems is available carbon for the denitrifying bacteria. If the nitrification system fully nitrifies, meaning that ammonia is less than 1 mg/L in the nitrification system, then an anaerobic environment and a carbon source (electron donor) are all that is needed to convert the nitrates to nitrogen gas. Active carbon feed systems use a chemical feed system that stores and doses methanol or some other liquid carbon source into an anaerobic tank following the nitrification system. Passive carbon feed systems use media to supply carbon for denitrification. These systems are classified as two-stage, autotrophic denitrification systems (FLDoH and Hazen and Sawyer, 2009)

Small footprint and lower construction costs are two key advantages to chemical feed systems for denitrification. However, chemical feed systems require increased operator attention and have the potential to overfeed or underfeed chemicals. In addition, hazardous chemical storage, ongoing consumable chemical costs and sludge production are the drawbacks of chemical feed systems.

The leaching of carbon from media used in passive carbon feed systems is biologically mediated. Provided the systems are appropriately sized, there is neither a concern with overfeeding nor underfeeding. Passive systems have the advantage of reliability and simplicity, no sludge production and no increase in operator attention beyond that required for the nitrification system. The disadvantages of passive systems are larger footprints and higher construction costs than active feed systems as passive systems have a 40 +/- year useful life.

Although FLDoH http://www.myfloridaeh.com/ostds/pdfiles/forms/Sewer_vs_Onsite.pdf states that OSTDS technology is currently limited to advanced secondary treatment, based upon installations in other States, the FLDoH approved PBTS that can achieve advanced wastewater treatment standards of TN 3 mg/l is the Nitrex™ system. No Nitrex™ systems exist at this time in Florida, however one is being permitted in Wakulla County.

UCF has developed the Black and Gold system that utilizes a variety of media, which includes a media identical to the Nitrex™ system and incorporates it into a lined drainfield. This system has shown promise for nitrogen removal; however, it is not a FLDoH approved system at this time, as well as only very limited (1-2) full scale systems have been installed. FLDoH review of the Black and Gold Evaluation Report raises numerous issues on the technology.

Pros of individual carbon feed with pretreatment systems include:

- Simple, stable process
- Capable of AWT standards for nitrogen removal
- Little/no energy use for passive systems
- No sludge production for passive systems

Cons associated with individual carbon feed with pretreatment systems include:

- Larger footprint
- Higher installation costs

2.5 SULFUR DENITRIFICATION (TWO-STAGE AUTOTROPHIC) SYSTEM

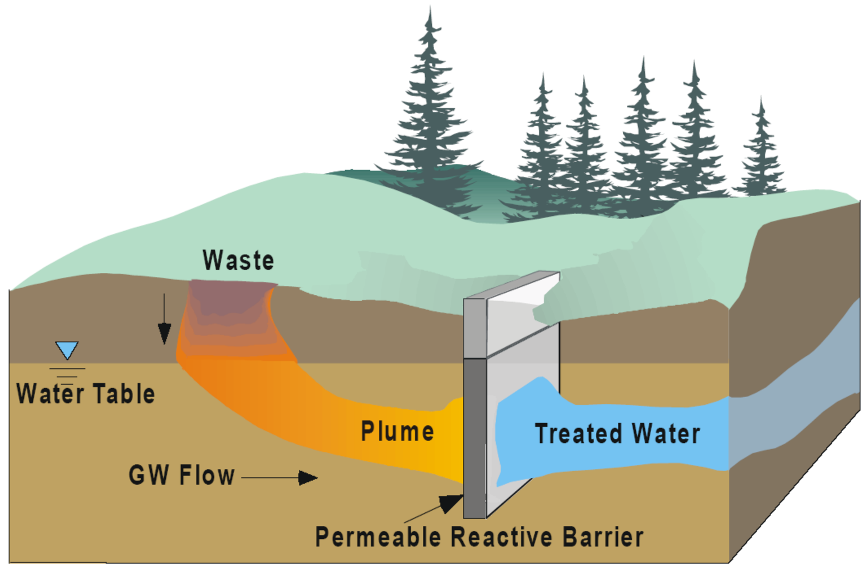
Sulfur denitrification systems rely upon autotrophic denitrification with the conversion of solid sulfur to soluble sulfate to convert nitrate to nitrogen gas. Although no systems are yet approved by FLDoH, the FLDoH passive nitrogen removal project, describe below, is investigating and pilot testing the technology. Serious concerns about the environmental impact of sulfate additions due to potential mercury release to groundwater exist.

2.6 PERMEABLE REACTIVE BARRIER (PRB) – WATERSHED SCALE

The Permeable Reactive Barrier (PRB) consists of installing the denitrification media in groundwater in strategic locations to remove nitrates from groundwater (USEPA, 2010). Figure 2-1 presents a schematic drawing of a PRB. Determining the feasibility and costs of the PRB is challenged by the uncertainty on groundwater flow patterns and nitrogen concentrations. There may be areas near point sources, such as the sprayfields, where this method has application. The PRB removes virtually all nitrates from groundwater passing through it.

No collection system, pumps or any other equipment is needed with the PRB. The only ongoing O&M cost is sampling to ensure performance. As such, for areas where the PRB may be applicable, the PRB approach offers the lowest lifecycle costs of all the methods of nitrogen removal. While there is a great deal of uncertainty as to the exact locations and size of the barriers, given the overwhelming cost savings associated with the PRB approach, this option may merit further investigation, if candidate sites are identified. Candidate locations would include any area where septic plumes can be intercepted prior to entering one of the many flow conduits that contributes to Wakulla Springs.

Figure 2-1. EPA Schematic of Groundwater Barrier



2.7 PRB – Individual Scale

Although it has not been used for this purpose, the PRB has applicability on an individual scale in areas with shallow groundwater, say <10+/- feet. It is LAI's opinion that the technique holds great promise for application in the Study Area and could produce cost savings of 50+/- %, as compared to existing techniques. Whether the PRB requires permitting is an issue that needs to be addressed. For reference purposes, the State of MA does not require permitting of PRBs, however, does require nitrogen removal performance validation for it to be used as part of nitrogen reduction compliance plans.

2.8 Recommendations

More data is needed on the effluent quality of each of the approved system types in the Study Area and other similar areas. In addition to effluent quality, attenuation factors need to be better understood for the various levels of treated effluent through the drainfield. All PBTS are dependent on proper design, installation and operations. However, due to their stability and reliability, fixed film technologies are the recommended alternative for individual PBTS where nitrogen removal performance is critical.

Innovative emerging technologies, such as the PRB on an individual scale, sulfur denitrification and the Black and Gold system should be further investigated, particularly where high levels of nitrate reduction are required and centralized sewer is not available. The potential cost savings associated with achieving AWT levels of nitrate removal on an individual system basis warrants further investigation and data collection.

FLDoH commissioned a study with the goal of ranking nitrogen removal technologies. Two-stage autotrophic and heterotrophic denitrification systems scored significantly higher than all other technology types (FLDoH and Hazen and Sawyer, 2009)

3. COST-EFFECTIVENESS ANALYSIS

Table 3-1 presents the cost-effectiveness analysis of the various OSTDS and their cost/kg of nitrogen removed as compared to raw wastewater and as compared to nitrogen reaching Wakulla Springs – which reflects the influence of existing natural attenuation in both the Study Area and the areas north of Cody Scarp (except Most Vulnerable areas), for the assumptions of natural nitrogen removal attenuations of 50% and 79+% respectively. Appendix B contains the cost basis.

Useful life is difficult to assess as it varies greatly between system types, materials and methods of construction utilized and intensity of maintenance. In addition, different components such as sewers and treatment plants have different useful life expectancies. Actual repair rate data for septic systems in Leon and Wakulla County can be found on the following FLDoH web site:

http://www.doh.state.fl.us/Environment/ostds/statistics/ostdsstatistics.htm

According to FLDoH data, the annual failure rate is approximately 1% based on the number of repair permits issued annually. This translates to a useful life of approximately 100 years. RMF style PBTS are simply a treatment component added to a standard septic system. Very limited data is available on the useful life of PBTS. LAI has assumed a 40 year useful life for RMF style treatment systems. Given that the treatment system can represent between 50% and 75% of the total cost of a complete PBTS, the weighted average useful life for the type of OSTDS that would be recommended for the Study Area is 60 years. A similar analysis using 40 years for the treatment works and 75 years for the sewers yields a similar useful life for the complete sewering option. Due to the high level of variations between systems within the same category, simplifying assumptions have been made for planning purposes. The useful life of all systems is assumed to be 60 years. By setting the planning period equal to the useful life, there is no salvage value to account for, further simplifying this executive level analysis.

Table 3-1. On-site Treatment Options Summary

Life Cycle Cost Analysis		
Rate	Term	PW Factor -
5.00%	60	17.159

System Type	Onsite System Category	Nitrogen Loadings and Removals – Effluent Quality: Eff. TN Conc. Prior to DF	% Drain field Atten	Effluent TN Conc. After DF (to WS GW): Unconf. Aq. using DF Removal %	Effluent TN Conc. After DF (to WS GW): Conf. Aq. using DF Removal %	Capital Cost ($)		Annual O&M Cost ($)		Use ful Life time	Present Worth of O&M		Life Cycle Cost[1] ($)		Life Cycle Costs - N Removal Compared to ($/kg/yr N Removed): As Compared to STE N Load		In Addition to Load Currently Removed: Unconfined Aquifer using DF 50% Removal		In Addition to Load Currently Removed: Confined Aquifer using DF 79% Removal	
		(mg/L)	*(%)*	*(mg/L)*	*79%*	*Low*	*High*	*Low*	*High*	*(yr)*	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*	*Low*	*High*
	Septic Tank Effluent (STE)	**60**	n/a	**n/a**	**n/a**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Drainfield Effluent to Groundwater - unconfined aquifer	**60**	50%	**30**	**n/a**	$2,500	$3,500	$35	$40	60	$601	$686	$3,101	$4,186	n/a	n/a	n/a	n/a	n/a	n/a
	Drainfield Effluent to WS Groundwater - confined aquifer	**60**	79%	**n/a**	**12.6**	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Advanced Secondary Treatment Nitrogen Removal Standard																			
1	**Suspended Growth**	**25**	25%	**18.75**	**5.25**	$6,800	$8,600	$668	$822	60	$11,468	$14,099	$18,268	$22,699	$2,749	$3,416	$8,554	$10,628	$13,092	$16,268
2	**IFAS**	**25**	25%	**18.75**	**5.25**	$7,000	$8,800	$668	$822	60	$11,468	$14,099	$18,468	$22,899	$2,779	$3,446	$8,647	$10,722	$13,236	$16,411
3	**Fixed Film**	**19**	25%	**14.25**	**3.99**	$8,000	$12,000	$486	$596	60	$8,339	$10,227	$16,339	$22,227	$2,099	$2,856	$5,465	$7,434	$9,996	$13,598
	AWT Standard - Nitrogen Removal																			
4	**Carbon Feed & PreTreat**	**3**	5%	**2.85**	**0.63**	$17,800	$21,000	$486	$596	60	$8,339	$10,227	$26,139	$31,227	$2,416	$2,886	$5,071	$6,059	$11,503	$13,742
5	**Cluster Systems**	**3**	5%	**2.85**	**0.63**	See Table ES-3 for Cluster System Costs						**Max**	$26,139	$31,227	$2,779	$3,446	$8,647	$10,722	$13,236	$16,411
												Min	$16,339	$22,227	$2,099	$2,856	$5,071	$6,059	$9,996	$13,598

[1] *Salvage Value is $0 for all systems*

Table 3-2 presents LAI's opinion of probable costs associated with cluster collection and AWT treatment system options in candidate areas within the Study Area. See Appendix B for detailed cost estimates. Unit pricing is based on a cluster system analysis LAI conducted on nearby Wakulla Gardens, from which LAI consulted with a local contractor. This analysis is for planning purposes only, as there are many factors that can affect the cost. The density of potential cluster system areas will have a significant effect on the cost per connection. As can be seen in Table 3-2, the total life cycle costs are similar for AWT cluster alternatives under this analysis. Phase II activities should include case study areas where more detailed, updated cost estimates for various alternatives are evaluated.

Table 3-2. AWT Cluster System Treatment Options Summary

Interest Rate	Term *(years)*
5.00%	60

System Type	Cluster System Category		Effluent TN STE *(mg/L)*	Effluent TN To DF *(mg/L)*	N-Load Removed *(kg/yr)*	Capital Cost *($)*	Annual O&M *($)*	Life Cycle *($)*
	System Type		**Performance**			**Cost**		
1	Septic Tank Effluent	*Suspended Growth*	60	3	10.65	$21,301	$548	$31,670
		IFAS	60	3	10.65	$21,301	$548	$31,670
		Fixed Film w/ Carbon Feed	60	3	10.65	$22,712	$489	$31,965
2	Conventional Gravity	*Suspended Growth*	60	3	10.65	$21,943	$548	$32,312
		IFAS	60	3	10.65	$21,943	$548	$32,312
		Fixed Film w/ Carbon Feed	60	3	10.65	$23,354	$489	$32,607
3	Grinder Pump / Pressure Sewer	*Suspended Growth*	60	3	10.65	$23,633	$548	$34,002
		IFAS	60	3	10.65	$23,633	$548	$34,002
		Fixed Film w/ Carbon Feed	60	3	10.65	$25,044	$489	$34,297

Table 3-3 presents a comparison of the on-site – cluster – City of Tallahassee options. As can be seen in this table, the total life cycle costs per kg/yr of additional (on top of what was already being removed by standard OSTDS's in the Study Area) nitrate removed is similar between the AWT solution alternatives, with the O&M costs having the highest level of variation. A more detailed analysis of case study areas would likely produce significantly different results for different areas. Phase II activities should include case studies of candidate areas to determine the optimal solution.

Table 3-3. Treatment Options Summary

WW Mgmt. Option	Capital Cost		O&M Cost		Life Cycle Cost		Life Cycle Cost Per kg/yr of Wastewater N Removed: Life Cycle Cost[2]		Life Cycle Cost[3]		Life Cycle Cost[4]	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
AWT Onsite[1]	$17,800	$21,000	$486	$596	$26,139	$31,227	$2,416	$2,886	$5,071	$6,059	$11,503	$13,742
AWT Cluster	$22,712	$25,044	$489	$548	$31,670	$34,297	$2,973	$3,219	$6,276	$6,796	$13,937	$15,093
Connection to AWT CoT System	$18,890	$20,974	$768	$768	$33,428	$35,512	$3,138	$3,333	$6,486	$6,890	$14,710	$15,627

[1] *Carbon Feed and Pretreatment system used for this analysis*

[2] *Per kg/yr as compared to raw wastewater*

[3] *Per kg/yr above what conventional septic system achieves in unconfined aquifer*

[4] *Per kg/yr above what conventional septic system achieves North of Cody Scarp*

4. ANALYSIS AND CONCLUSIONS

4.1 Analysis

Based upon the Task 1 Report and the cost-effectiveness analysis contained herein, the pros and cons and considerations associated with each option is presented on Table 4-1

Table 4-1. Wastewater Treatment Options Pros & Cons

Technique	Pro	Con
On-site	Able to achieve TN 3 mg/l	Few technologies exist with limited installations
	Allows targeted on-site upgrades	Sampling requirements can become excessive if every system is tested on a regular basis.
	Lowest capital cost alternative - no collection system needed. Can be phased in with property ownership changes.	Numerous facilities to manage
Cluster	Allows targeted sewering and minimizes undesired growth stimulation of sewers	Multiple facilities to manage
	Able to achieve AWT levels of treatment with the same reliability as centralized treatment facilities.	Cost-effectiveness declines with density - low density areas can become expensive to cluster compared to onsite options
	Eliminates long runs of sewer to connect pockets of development	Subject to availability of suitable treatment and disposal locations
	Regular O&M and sampling is cost-effective.	Cost / logistics of aquiring treatment and dispersal sites must be considered
Connection to CoT System	Existing management infrastructure exists	Lack of familiarity with OSTDS and cluster systems
	Excess capacity can be used	Cost-effectiveness declines with density - low density areas can become expensive to sewer compared to onsite options
	Economies of scale apply to treatment and dispersal costs	Cost of connecting remote areas can become large.
	Familiarity with existing system and process - no new staff / training required	Secondary growth impacts are difficult to avoid for areas "along the way" of the sewer connection routes.

Density and proximity affect both cluster and CoT per user connection costs. In nearly all cases, onsite options are less expensive to install than cluster systems, due to the elimination of the collection system. Sampling and other O&M costs associated with managing many systems instead of one cluster system can tilt the life cycle costs in favor of cluster systems. Connection to existing treatment facilities has the advantage of reducing or eliminating the capital costs associated with treatment. Phase II activities should include case studies on the total life cycle costs of the available, feasible alternatives to achieve the required nitrate removal.

4.2 Conclusions

The following conclusions have been drawn:

- To achieve compliance with the water quality objective of 0.35 mg/L nitrate, the maximum practicable nitrogen removal needs to be required of all OSTDS in the Scenario 1 portion of the Study Area.
- Within the Study Area, septic systems discharge 30 mg/L nitrate to the underlying groundwater and ultimately to Wakulla Springs.
- The industry/US EPA accepted limits of technology is 3 mg/l total N, which is achievable by innovative AWT on-site systems or AWT cluster / centralized facilities.
- Due to what appears to be significant natural attenuation, there appears to be limited value in adding nitrogen removal capability to OSTDS in areas north of the Cody Scarp, not classified as Most Vulnerable. Efforts in those areas would have limited nitrogen removal impact on a per dwelling basis on Wakulla Springs. . If reduction of Inflow nitrogen is pursued to achieve the removal requirement for Scenario 1, nitrate removal north of the Cody Scarp will be necessary.
- Growth / buildout assumptions significantly affect the projected required removal.
- A better understanding of the drainfield nitrate attenuation of treated effluent is required, as this unknown variable has a significant effect on the relationship between OSTDS removal % and the resulting % of nitrate removed from the Wakulla Springs contributory area.
- For individual and small flow systems, where highly variable flows and loads are coupled with little operational oversight, fixed film technologies are a more robust, stable and reliable technology for nitrogen removal applications.
- The Permeable Reactive Barrier may have application in areas where typical non-conduit groundwater flow patterns exist. The extent to which septic plumes can be intercepted prior to entering one of the many flow conduits contributing to Wakulla Springs warrants further investigation.
- Areas in Wakulla County outside the Study Area are in the confined aquifer region. No nitrates are expected to reach Wakulla Springs from these areas. Nitrate removal from these properties will have no effect on the nitrate concentrations in Wakulla Springs.

APPENDIX A: BIBLIOGRAPHY – REFERENCE DOCUMENTS

The following documents were reviewed in preparation of the Lombardo Associates, Inc. (LAI) Onsite Sewage Treatment & Disposal and Management Options Report:

1. Bill No. SB 550: Committee on Environmental Preservation and Conservation

On-site Technologies:

2. Variability and Reliability of Test Center and Field Data: Definition of Proven Technology From a Regulatory Viewpoint, New England Interstate Water Pollution Control Commission, September 2005

3. Florida Onsite Sewage Nitrogen Reduction Strategies Study, FLDoH report prepared by Hazen and Sawyer, September 2009

4. Statewide Inventory of On-site Sewage Treatment & Disposal Systems in Florida, EarthSTEPS, LLC & GlobalMind, June 29, 2009.

5. OSTDS & Decentralized Systems Wastewater Treatment Program- Phase I Report, FSU, Revised January 2007.

6. OSTDS & Decentralized Systems Wastewater Treatment Program- Phase II Report, FSU, Revised January 2007.

7. Wakulla County Septic Tank Study: Interim Report on Performance Based Treatment Systems (FLDOH Agreement No. WM926), FSU Dept. of Oceanography, January 2010.

8. Onsite Sewage Treatment & Disposal Systems Evaluation for Nutrient Removal, UCF

9. Florida Passive Nitrogen Removal Study, Prepared for FL DoH, Daniel P. Smith, PhD., PE, DEE, Applied Environmental Technology, May 26, 2008.

FL DoH Onsite Sewage Nitrogen Reduction Strategies Study

10. Classification, Ranking & Prioritization of Technologies – Draft Report, May 2009

11. Passive Nitrogen Removal Study II Quality Assurance Project Plan

12. Task C: Literature Review

13. Task D: Selection of Existing Data Sets for Calibration

Wekiva Springs

14. Wekiva Springs, Middle St. John's River Basin TMDL, USEPA, December 2005

15. Final Report – Wekiva River Basin Nitrate Sourcing Study, MACTEC, March 2010.

16. Wekiva Study Area, Technical Review & Advisory Panel, August 21, 2007

17. FL DoH Nitrogen Impact of OSTDS in the Wekiva Study Area

18. Estimates of N-Loadings to GW from OSTDS in the Wekiva Study Area, Prepared for FL DoH, Richard J. Otis, PhD., PE, DEE, Otis Environmental Consultants, June 2007.

19. Revised Estimates of Nitrogen Inputs & Nitrogen Loads in the Wekiva Study Area, Eberhard Roeder, PhD, P.E. FL DoH, May 19, 2008.

Miscellaneous

20. State of the Science: Review of Quantitative Tools to Determine Wastewater Soil Treatment Unit Performance, WERF, 2009.

21. Estimating Nitrogen Loading to Groundwater & Assessing Vulnerability to Nitrate Contamination in a Large Karstic Springs Basin, Florida, JAWRA, Katz, Sepulveda & Verdi, 2009.

22. UCF Interim Report Draft Comments, Eberhard Roeder, March 25, 2010.

23. Evaluation of Onsite Sewage Treatment & Disposal Systems in Shallow Karst Terrain, Harden, Roeder, Hooks & Chanton, 2008.

List of Independent Evaluations of OSTDS Technologies

- La Pine (OR)
  http://www.deschutes.org/deq/
- Chesapeake Bay US EPA Study
  http://www.epa.gov/nps/chesbay502/onsite.html
- Barnstable County
  http://www.buzzardsbay.org/etistuff/bched-alternative-septic-sytems-2007.pdf
- Pinelands Commission (NJ)
  http://www.state.nj.us/pinelands/landuse/waste/assp/index.html
- Florida Department of Health (FL DoH) Onsite Sewage Nitrogen Reduction Strategies Studies
  http://www.myfloridaeh.com/ostds/research/Nitrogen.html

- Maryland Department of the Environment http://www.mde.state.md.us/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/Water/cbwrf/osds/brf_bat.aspx

Comparable Locations Where Nitrogen Removal is Required

Comparable locations where these issues have been addressed are:

- State of Maryland – Chesapeake Bay, http://www.epa.gov/nps/chesbay502/onsite.html,
- Rhode Island
- Cape Cod

Maryland Chesapeake Bay Program

As part of its Chesapeake Bay Restoration Program the State of Maryland collects an annual fee from all households – currently at $30/year (sometimes referred to as toilet tax) – and uses these funds to provide partial, or full, project grants for:

- Wastewater treatment upgrades
- OSTDS Nitrogen Removal Systems
- Agricultural Projects

OSTDS nitrogen systems were paid for in full by the program during its early years. Currently, grants are a percent of cost determined by household income, with preference for systems in the Critical Areas – areas as defined as within 1,000 feet of a water body. All new development and repairs in the Critical Areas that use OSTDS must use a nitrogen removal OSTDS. Although the program defines eligible technologies as "Best Available" there is no differentiation between secondary treatment and AWT systems.

Calvert County, MD, in its initial administration of the OSTDS nitrogen removal grant program, selected technologies based upon the lowest cost/kg removed, with cost being capital cost and 5 years of annual O&M.

The Maryland Department of the Environment has upgraded over 2,000 septic systems to nitrogen removing Best Available Technology (BAT) through the Bay Restoration Fund (BRF) Onsite Sewer Disposal System (OSDS) grant program.

Rhode Island

Rhode Island requires use of nitrogen removal systems guaranteed to achieve TN <10 mg/l in prescribed nitrogen sensitive areas in their coastal area – see http://www.dem.ri.gov/programs/benviron/water/permits/wtf/index.htm

Cape Cod

Septic nitrogen has been identified as the major cause of coastal water quality degradation. Although many of Cape Cod communities are considering septic nitrogen management, the

State of Massachusetts has indicated that an integrated, multi-faceted approach is acceptable for TMDL compliance. A nitrogen mitigation bank is maintained by the Cape Cod Commission for developments with nitrogen contributions that exceed Commission guidelines. Funds can be used for nitrogen removal projects.

APPENDIX B: COST BASIS

Appendix B presents an opinion of probable costs, based on local pricing, where available and industry standards otherwise. Detailed cost estimates are not part of this executive level analysis and are recommended for inclusion in Phase II activities

Onsite Systems Capital and O&M Costs

Cost Category	Suspended Growth		IFAS		Fixed Film		Carbon Feed & PreTreat	
	Low	High	Low	High	Low	High	Low	High
Materials	$4,500	$6,000	$4,500	$6,000	$6,000	$8,200	$14,000	$15,000
Installation	$1,800	$2,000	$2,000	$2,200	$1,500	$3,200	$3,000	$5,000
Subtotal	*$6,300*	*$8,000*	*$6,500*	*$8,200*	*$7,500*	*$11,400*	*$17,000*	*$20,000*
Engineering	$500	$600	$500	$600	$500	$600	$800	$1,000
Land Acquisition	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Total Capital Cost	***$6,800***	***$8,600***	***$7,000***	***$8,800***	***$8,000***	***$12,000***	***$17,800***	***$21,000***
Septic / Sludge Pumping	$58	$67	$58	$67	$35	$40	$35	$40
Pump Frequency (yr)	*3*	*3*	*3*	*3*	*5*	*5*	*5*	*5*
$ / Pumpout	*$175*	*$200*	*$175*	*$200*	*$175*	*$200*	*$175*	*$200*
Inspections - each cost	$100	$125	$100	$125	$100	$125	$100	$125
Number per year	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*
Sampling	$200	$250	$200	$250	$100	$125	$100	$125
Electricity	$80	$100	$80	$100	$20	$25	$20	$25
kw/yr	*800*	*1000*	*800*	*1,000*	*200*	*250*	*200*	*250*
$/kw	*$0.10*	*$0.10*	*$0.10*	*$0.10*	*$0.10*	*$0.10*	*$0.10*	*$0.10*
Miscellaneous	$50	$75	$50	$75	$50	$75	$50	$75
Total Annual O&M Cost	***$668***	***$822***	***$668***	***$822***	***$486***	***$596***	***$486***	***$596***

AWT Cluster System Capital, O&M and Life Cycle Costs

Unit Pricing and Global Variables

Suspended Growth System Costs ($/gpd)		IFAS System Costs ($/gpd)		Fixed Film w/ Carbon Feed ($/gpd)		Drainfield Costs	Land		STE House Lateral	STE Street Sewer	ST Inst.	STE Pump Station			Gravity House Lateral	Gravity Street Sewer	Grinder Pump Inst.	Gravity Pump Station	Grinder Force Main ($/LF)	
Mat.	Install	Mat.	Install	Mat.	Install	($/gpd)	(ft^2/gpd)	($/Acre)	($/LF)	($/LF)	($)	%	In Tank	Area	($/LF)	($/LF)	($)	($)	House	Street
$18	$10	$18	$10	$22	$11	$4	0.80	$25,000	$15	$30	$2,000	15%	$3,000	$100,000	$20	$35	$5,000	$125,000	$8	$20

Collection System Type	Treatment System Type	WW Flow Per Parcel (gpd)		Nitrogen Concentration (mg/L)		Nitrogen Load Removed From STE[1] (kg/yr)	Nitrogen Load Removed Compared to Conventional OSDS[1] (kg/yr)	Collection System per Connecton Costs - Materials & Install: Septic Tanks	Pumps	Pump Stations	House Laterals (Length @ $10/ft)		Street Sewer (Length @ $25/ft)		Total Collection System Construction	
		Average	Design	STE	To DF			Includes Abandonment of Old Tank	15% Req. STEP or Grinder Pump to Connect	Area P.S	50	100	50	100	Low	High
Septic Tank Effluent	*Suspended Growth*	*135*	*180*	*60*	*3*	10.65	5.05	$2,000	$450	$1,318	$750	$1,500	$1,500	$3,000	$5,568	$7,818
	IFAS	*135*	*180*	*60*	*3*	10.65	5.05	$2,000	$450	$1,318	$750	$1,500	$1,500	$3,000	$5,568	$7,818
	Fixed Film w/ Carbon Feed	*135*	*180*	*60*	*3*	10.65	5.05	$2,000	$450	$1,318	$750	$1,500	$1,500	$3,000	$5,568	$7,818
Conventional Gravity	*Suspended Growth*	*135*	*180*	*60*	*3*	10.65	5.05	$1,500	$750	$1,960	$1,000	$2,000	$1,750	$3,500	$6,210	$8,960
	IFAS	*135*	*180*	*60*	*3*	10.65	5.05	$1,500	$750	$1,960	$1,000	$2,000	$1,750	$3,500	$6,210	$8,960
	Fixed Film w/ Carbon Feed	*135*	*180*	*60*	*3*	10.65	5.05	$1,500	$750	$1,960	$1,000	$2,000	$1,750	$3,500	$6,210	$8,960
Grinder Pump / Pressure Sewer	*Suspended Growth*	*135*	*180*	*60*	*3*	10.65	5.05	$1,500	$0	$5,000	$400	$800	$1,000	$2,000	$7,900	$9,300
	IFAS	*135*	*180*	*60*	*3*	10.65	5.05	$1,500	$0	$5,000	$400	$800	$1,000	$2,000	$7,900	$9,300
	Fixed Film w/ Carbon Feed	*135*	*180*	*60*	*3*	10.65	5.05	$1,500	$0	$5,000	$400	$800	$1,000	$2,000	$7,900	$9,300

Collection System Type	Treatment System Type	WWTF Construction Costs[2]: Materials	Install	Total WWTF Const. Costs	Drain field Cost[2]	Total Const. Costs	Development Costs: Engin. 25%	Land Acq. 0.80	Cont. 20%	Total Development Costs	Total Capital Cost	Annual O&M Cost ($)	Useful Life time	Life Cycle Cost Analysis (Interest Rate 5.00%; Term 60; PW Factor 18.929): Present Worth O&M	Life Cycle Cost ($)	Life Cycle Costs - NO_3 Rmv. Above STE only ($/kg/yr NO_3)	Life Cycle Costs - NO_3 Rmv. Above OSTDS ($/kg/yr NO_3)	Attenuation: Confined Aquifer using DF 79% Removal
Septic Tank Effluent	*Suspended Growth*	$5,081	$2,823	$7,904	$1,129	$14,601	$3,650	$130	$2,920	$6,700	$21,301	$548	60	$10,369	$31,670	$2,973	$6,276	$13,937
	IFAS	$5,081	$2,823	$7,904	$1,129	$14,601	$3,650	$130	$2,920	$6,700	$21,301	$548	60	$10,369	$31,670	$2,973	$6,276	$13,937
	Fixed Film w/ Carbon Feed	$6,210	$3,105	$9,315	$1,129	$16,012	$3,650	$130	$2,920	$6,700	$22,712	$489	60	$9,253	$31,965	$3,000	$6,334	$14,067
Conventional Gravity	*Suspended Growth*	$5,081	$2,823	$7,904	$1,129	$15,243	$3,650	$130	$2,920	$6,700	$21,943	$548	60	$10,369	$32,312	$3,033	$6,403	$14,219
	IFAS	$5,081	$2,823	$7,904	$1,129	$15,243	$3,650	$130	$2,920	$6,700	$21,943	$548	60	$10,369	$32,312	$3,033	$6,403	$14,219
	Fixed Film w/ Carbon Feed	$6,210	$3,105	$9,315	$1,129	$16,654	$3,650	$130	$2,920	$6,700	$23,354	$489	60	$9,253	$32,607	$3,061	$6,461	$14,349
Grinder Pump / Pressure Sewer	*Suspended Growth*	$5,081	$2,823	$7,904	$1,129	$16,933	$3,650	$130	$2,920	$6,700	$23,633	$548	60	$10,369	$34,002	$3,192	$6,738	$14,963
	IFAS	$5,081	$2,823	$7,904	$1,129	$16,933	$3,650	$130	$2,920	$6,700	$23,633	$548	60	$10,369	$34,002	$3,192	$6,738	$14,963
	Fixed Film w/ Carbon Feed	$6,210	$3,105	$9,315	$1,129	$18,344	$3,650	$130	$2,920	$6,700	$25,044	$489	60	$9,253	$34,297	$3,219	$6,796	$15,093
										Max	**$25,044**	**$548**	**Max**	**$10,369**	**$34,297**	**$3,219**	**$6,796**	**$15,093**
										Min	**$21,301**	**$489**	**Min**	**$9,253**	**$31,670**	**$2,973**	**$6,276**	**$13,937**

[1] *Nitrogen Loads calculated using the average flow.*

[2] *Treatment and dispersal system costs calculated using Design WW Flow per Parcel and Global $/gpd cost factors.*

City of Tallahassee Connection Life Cycle Costs / Life Cycle Costs - N Removal Compared to ($/kg/yr N Removed)

Capital Costs	Annual O&M	Useful Life	PW O&M	Life Cycle Cost	Septic Tank Effluent	Unconf. Aquifer - 50% Removal	Conf. Aquifer - 79% Removal
$18,890	$768	60	$14,538	$33,428	$3,138	$6,486	$14,710
$20,974	$768	60	$14,538	$35,512	$3,333	$6,890	$15,627

Capital Recovery Factor *1.0%*

Executive Summary - Cluster

Interest Rate	Term *(years)*
5.00%	60

System Type		Cluster System Category	Performance: Effluent TN STE	To DF	N-Load Removed from STE	Cost: Capital Cost	Annual O&M Cost	Life Cycle Cost
			(mg/L)	*(mg/L)*	*(kg/yr)*	*($)*	*($)*	*($)*
1	Septic Tank Effluent	*Suspended Growth*	60	3	10.65	$21,301	$548	$31,670
		IFAS	60	3	10.65	$21,301	$548	$31,670
		Fixed Film w/ Carbon Feed	60	3	10.65	$22,712	$489	$31,965
2	Conv. Gravity	*Suspended Growth*	60	3	10.65	$21,943	$548	$32,312
		IFAS	60	3	10.65	$21,943	$548	$32,312
		Fixed Film w/ Carbon Feed	60	3	10.65	$23,354	$489	$32,607
3	Grinder Pump / Pressure Sewer	*Suspended Growth*	60	3	10.65	$23,633	$548	$34,002
		IFAS	60	3	10.65	$23,633	$548	$34,002
		Fixed Film w/ Carbon Feed	60	3	10.65	$25,044	$489	$34,297

Cost Category	Susp. Growth	IFAS	FF & Carbon Feed
Septic / Sludge Pumping	$12,320	$12,320	$6,160
Pump Frequency (yr)	*5*	*5*	$5
$ / Pumpout	*$350*	*$350*	$175
Inspections	$7,200	$7,200	$7,200
Sampling	$12,480	$12,480	$12,480
Electricity	$11,400	$11,400	$5,700
kw/yr	*103,636*	*103,636*	$51,818
$/kw	*$0.11*	*$0.11*	$0
Chemical Feed	$1,000	$1,000	$0
Miscellaneous	$12,000	$12,000	$12,000
Collection System	$3,000	$3,000	$3,000
Administration	$12,000	$12,000	$12,000
Capital Recovery	$37,490	$37,490	$39,974
Total Annual O&M Cost	***$96,410***	***$96,410***	$86,034
Annual O&M per Parcel	**$548**	**$548**	$489

Task 3 Final Report

Identification & Discussion of Options for Managing The Permitting, Operations & Maintenance of Privately-Owned and Publicly-Owned Treatment Options

Onsite Sewage Treatment And Disposal And Management Options

for

Wakulla Springs, Leon County, Wakulla County & City of Tallahassee, FL

November 4, 2011

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

Submitted to:

Leon County Purchasing Division
2284 Miccosukee Road
Tallahassee, FL 32308

Table of Contents

List of Tables

1 OVERVIEW

1.1 SUMMARY OF RELEVANT INFORMATION FROM PREVIOUS REPORTS

The following are relevant conclusion from previous Task Reports:

- The Scenario 1 area requires the maximum feasible OSTDS nitrogen removal as part of a program to achieve the 0.35 mg/L water quality criteria for nitrate.
- Providing AWT levels of nitrogen removal in the Scenario 1 area may eliminate the need for nitrogen removal in the Scenario 2 areas outside Scenario 1.
- OSTDS outside the Scenario 1 and 2 areas, with the possible exception of OSTDS located in Most Vulnerable areas north of the Cody Scarp, either do not contribute to Wakulla Springs or appear to have 79% or higher natural nitrogen attenuation.
- There are 50,421 OSTDS in Leon and Wakulla counties, of which approximately 8,600 are within the Scenario 1 area.

Based on the above conclusions, the following assumptions have been made:

- OSTDS within the Scenario 1 area will require nitrogen removal.
- Scenario 2 areas outside the Scenario 1 area can remain with conventional OSTDS, provided they are properly inspected and managed to ensure that systems operate properly and do not cause bacterial contamination from drainfield failures.
- All other areas, with the possible exception of OSTDS located within Most Vulnerable areas north of the Cody Scarp which may require nitrogen removal, can remain with properly inspected and managed conventional OSTDS

More simply stated, from a nitrogen removal perspective, all OSTDS in Leon and Wakulla counties will be divided into the following two categories:

- Scenario 1 Area where AWT or a lower nitrogen removal should nitrogen removal be achievable from alternate sources is the recommended practice
- All other areas, with the possible exception of OSTDS in the Most Vulnerable areas north of the Cody Scarp where nitrogen removal may be needed, where conventional OSTDS with proper inspection and maintenance oversight is the recommended practice

1.2 SCOPE OF MANAGEMENT

Management services would be performed by one or more Responsible Management Entities (RME) that would service all of Leon and Wakulla Counties for sanitary purposes only and/or to include nitrogen removal. Prior to discussing management options, a definition of what is to be managed is needed.

The following 2 management categories for OSTDS are proposed:

- *Conventional OSTDS*

  Management for the 41,821 OSTDS located outside the Scenario 1 area. These properties would require only periodic inspections along with maintenance and repairs / replacements as needed. 10% of existing systems plus 1% per year are assumed to be failing and in need of replacement.

- *OSTDS Upgrades to AWT*

  Management of the onsite and/or cluster AWT solution(s), or lower level if alternate sources of nitrogen removal are achieved, for the 8,600 OSTDS in the Scenario 1 area. Properties connected to an existing sewer would be managed by the sewer system owner, not the OSTDS management entity, i.e. RME.

- Sanitary purposes

  The typical purpose of septic systems is for public health protection through the removal of bacterial and pathogenic organisms.

The estimated total number of properties in each of the two management categories described above is shown in Table 1-1. These categories and the number of OSTDS within each one may change based on subsequent studies related to nitrogen removal requirements.

The focus of this Report is on the management of the operations and maintenance (O&M) repair and replacement of privately and publicly owned wastewater treatment systems, from the perspective of achieving sufficient nitrogen removal to achieve the 0.35 mg/L water quality standard for nitrate in Wakulla Springs as well as to ensure the long term viability of relying on OSTDS. Management of the needed capital improvements could be addressed as a separate activity or as part of the RME.

Table 1-1. Estimated Number of Properties in Wakulla and Leon Counties

Area	*Conventional OSTDS (Outside Scenario 1)*	*AWT Required (Scenario 1)*	Total
Leon County	31,587	7,500	39,087
Wakulla County	10,234	1,100	11,334
CoT*	1,100	118	1,218
Total:	**41,821**	**8,600**	**50,421**

Included in Leon County Total

1.3 Management Alternatives

Achievement of the necessary nitrogen removal from OSTDS can be accomplished one of the following two management alternatives:

1. Compelling Scenario 1 area OSTDS (and other areas that may be identified in future studies) to upgrade to AWT standards, individually, or in some type of cluster or centralized sewer system with no County funding. In this case, user costs would be dictated by property location and associated AWT upgrade requirements. This could be performed by Ordinance or through a RME.
2. "Providing" funding of OSTDS upgrades (regardless of solution type) by amortizing the costs of N-removal systems over all members of a RME that would govern properties currently, and in the future, with OSTDS or cluster systems. The benefit of this approach is to lower the user costs for the Scenario 1 OSTDS properties and provide "sewer equivalency" service to all members of the RME, where, similar to sewer systems,

maintenance and repairs are not the responsibility of the property owners. The financial aspects of these options are addressed in the Task 4 Report. Initial capital costs could be paid for in part or whole by:

- Property type tax
- Fee on a uniform basis – such as equivalent dwelling unit

Where connection to either the CoT or Wakulla County sewer system is the recommended option, the wastewater service for those properties would be managed by the sewer system owner.

Key management issues are:

- Ownership
- Administration
- Operations & Maintenance, including repair & replacement
- Use Fees

In alternative 1, described above, ownership can be public or private (i.e property owner), with private being the typical approach. In alternative 2, described above, ownership is usually public, but can be privatized.

The public ownership options include:

- A joint Leon County entity established pursuant to Florida Statute Section 163.01
- Separate entities in each County

The private options are:

- Maintain ownership with property owner
- Privatization whereby a private entity could own and operate OSTDS. Although this has not been done previously, LAI is of the opinion that private firms are interested and capable. Many details will need to be addressed.

Permitting is by statute performed by the Florida Department of Health (FL DoH) for domestic wastewater systems with flows of 10,000 gpd or less, and for commercial systems with flows less than 5,000 gpd. All other wastewater systems are permitted by FL DEP. At the present time, Leon County has designated the Leon County Health Department as providing management for OSTDS performance-based treatment systems (PBTS). Wakulla County has not officially designated the Wakulla County Health Department in this capacity, however they are presently performing this function.

2 RESPONSIBILITIES & SERVICE LEVELS

2.1 OWNERSHIP & MANAGEMENT OPTIONS AND RESPONSIBILITIES

The ownership and management options for decentralized wastewater systems consist of:

1. Public
2. Private
   - 2.1. Non-Property Owner
     - 2.1.1. Private for-profit
     - 2.1.2. Private non-profit
   - 2.2. Property Owner

Management responsibilities for wastewater system ownership include:

- Administration
  - o Program management for implementation of capital improvements
  - o Use regulation
  - o Regulatory compliance reporting
  - o Customer service, billing, and collections
  - o User-charge system
  - o Financial

- Operations
  - o Monitoring
  - o Maintenance and routine repair
  - o Major repair/replacement

2.1.1 Ownership

Ownership describes the entity that has legal responsibility, liability, and authority regarding all aspects of a wastewater system. Ownership is sometimes referred to as the institutional structure of a wastewater system, and generally falls into the categories of public, property/homeowner, or outsourced to private for-profit, or private non-profit entity.

The ownership options in FL are defined by existing enabling legislation that defines the responsibilities, authorities, composition, and functioning of the ownership entity. Additionally, the state legislature can be petitioned to establish a wastewater management entity with unique, locally desired features. Naturally, these desired features must be constitutional and endorsed by the will of the community. Public options can be within each jurisdiction or a joint entity.

Traditionally, centralized wastewater systems have been owned and managed publicly, while onsite and cluster systems have been owned and managed privately with public oversight.

These are not the only options, as decentralized wastewater systems have successfully been implemented using other innovative ownership structures. Table 2-1 describes the range of potential ownership structures.

Table 2-1. Matrix of Decentralized Wastewater Systems Ownership Options

Ownership Institution	Infrastructure	Examples
Public	Added to existing unit	CoT, DoH, DPW
	Independent public entity	Single or Multiple Jurisdictions Wastewater District
Private	Property Owner	Property Owner
	Special purpose entity	HOA
	For-profit corporation	Aqua Utilities Florida
	Non-profit corporation	Cooperative

The ownership of a wastewater system may constrain the available financial and institutional management system options available. For example, privately owned systems are unable to obtain public funding in the form of grants whereas publicly owned systems are eligible. Low interest septic system rehabilitation loan programs under the EPA/State Revolving Fund Program (SRF) can be used for private and public systems.

The administration and monitoring, maintenance, and repair (MMR) options are discussed in the following sections. An owner can either perform some or all of these activities internally or have them performed by others, i.e. outsourced.

2.1.2 Administration

Administrative functions include:

- Ownership Management
- Program Management for Capital Improvements
- Use Regulation
- Regulatory Compliance Reporting
- Customer Service, Billing, and Collections
- User-Charge System
- Financial

Ownership Management

The ownership management function can consist simply of oversight of the activities of others to whom all activities have been outsourced, the performance of all activities by the owner's manager directly or within a Responsible Management Entity (RME), or a combination. At a minimum, ownership management maintains records on the wastetwater systems and submits required compliance performance reports to regulatory agencies, and educates system users.

Ownership administration management costs include:

- General administration
- Professional services for engineering, legal, and accounting
- Insurance
- Office space and other overhead
- Customer service, billing, and collection

Program Management for Capital Improvements

For capital improvement projects, there is a significant need for management of the proposed system's capital facilities planning and implementation. These activities are usually outsourced to an experienced engineering or program management-type firm, with the public entity defining what is performed internally.

Use Regulation

Onsite Sewage Treatment and Disposal Systems that produce 10,000 gallons or less of domestic strength sewage flow or 5,000 gallons or less of commercial strength sewage per day are regulated by the Florida Department of Health under Chapter 64E-6 of the Florida Administrative Code. Permits must be obtained from the local health department to install or make repairs to these systems.

These systems are usually Septic Tanks, Aerobic Treatment Systems, or special Performance Based Treatment Systems that are used for homes and small residential units, or small commercial or industrial sites which only produce domestic or commercial type wastes.

Commercial systems producing more than 5,000 gpd and residential systems producing >10,000 gpd are regulated by the Florida Department of Environmental Protection.

Regulatory Compliance Reporting

As decentralized wastewater systems increase in size and proximity to environmentally sensitive areas, their regulatory reporting requirements generally increase. Owners must provide for gathering and transmission of the required regulatory compliance reporting information.

Customer Service, Billing, and Collections

Cluster wastewater systems are mini-sewer systems, so customer service is a required activity. Customer service issues range from responding to odor complaints to change of use, including service termination and the addition of new service connections. Billing and collections are vital functions of any RME. Many private and public utilities provide this service for other utilities.

A key issue is the ability of the RME to take enforcement action for non-payment of fees.

Typical enforcement options include:

- Property liens
- Water shut-off, when central water is available, which may be unlikely in most OSTDS use areas of Leon and Wakulla County
- Civil actions (small claims court)

Owners must ensure that all stakeholders understand the legal mechanisms and proper notification procedures as well as the impact of non-payments of fees on the financial viability of the RME. Owners can contract with private organizations that guarantee user-charge payments. These organizations provide the revenue cash flow and will place liens (or use other legal instruments) on the property of non-paying users, naturally for a fee.

User-Charge System

In Florida, private ownership user rates for large flow systems are regulated by the FL Public Service Commission (PSC); however, Leon and Wakulla Counties are not in PSC jurisdictional areas. The PSC has extensive approval requirements for setting and raising rates to end users.

The primary cost categories for user-charges associated with decentralized wastewater systems are:

- Capital Costs amortization
- Administration Costs
- Operation and Maintenance Costs
- Repair Funds
- Replacement-Depreciation Funds

Capital costs are the total installed costs of the wastewater system, including engineering (design and construction management), land, financing, administration, etc. and construction costs. Capital costs for decentralized systems have been paid for in one or more of the following ways:

- Federal or state grants and loans
- User-charges, in which a portion or all of the capital costs are amortized over a fixed term (such as 20-30 years)
- Connection charges, in which users pay a fee when the decentralized system is constructed or when users connect
- Property taxes in which all property owners in an entire community, regardless of whether the property owners are served by the decentralized system or a special tax district, finance some or all of the wastewater system's capital cost. Municipal Service Taxing Units (MSTU) which is a service unit for which an ad valorem tax levy is imposed to cover the cost of providing a service or improvement, based upon taxable value can be used.
- Unique taxing mechanisms, such as dedicated sales tax, in which revenues are restricted for payment of capital costs
- Private entity building the decentralized system, as in a new parcel development
- Private entity providing design, build, own, operate and finance services.
- Municipal Service Benefit Unit (MSBU) which is a service unit which receives a specific benefit for which a special assessment is imposed to cover the cost providing the service or improvement. MSBUs can be used.

A key determinant of which financing options are available is the ownership of the system, as many public funding sources are restricted from being used for private property.

O&M costs include the annual cost of operating and maintaining the system arising from:

- Electricity use
- Labor
- Chemicals
- Equipment servicing
- Residuals removal and ultimate disposal
- Routine repair/parts replacement - for equipment with useful life < 10 years

- Equipment and major component replacement

A repair and replacement (R&R) fund should be established for equipment with a useful life of less than 10 years. This fund is used to pay for small equipment repair/replacement when it fails or on a scheduled basis (to avoid damaging impacts). Establishing an annual repair fund contribution ensures that funds are available when needed. A repair fund also levels impacts on necessary user-charge rates.
A major challenge with decentralized wastewater systems is the funding for future replacements of major capital equipment. This funding is sometimes referred to as a depreciation fund.

Therefore, user-charge systems need to be established to cover:

- Amortization of capital costs, if any
- Annual actual O&M costs
- Repairs, when needed (R&R account)
- Replacement, when needed (Depreciation account)

Typically, funding of future major equipment replacement has been a challenge for RMEs. Inclusion of replacement-depreciation fund contributions in user-charge systems is essential so that funds are available when major repairs are required. An affordability challenge exists when the user-charge includes capital amortization.

Some states require that privately owned cluster systems maintain the replacement-depreciation fund (sometimes referred to as the reserve fund) with the regulatory authority having access to those funds, should the private entity not repair/replace the system when necessary to maintain permit compliance. In addition to actual fund contributions, numerous financial instruments (such as bonds or letters of credit) provide equivalent financial assurances. Florida does not have such requirements, however depreciation funding is recommended to be included in the RME structure to ensure that funds exist to replace major equipment at the end of its useful life.

GASB 34 (Government Accounting Standards Board 2000) requires replacement-depreciation funding of municipal systems, for proper asset management.

Financial

The financial issues associated with decentralized systems are:

- Budgeting, cash flow management, accounts payable, and accounts receivable, as with any business operations
- Capital resources procurement

The owner will need to establish a budget for any decentralized system, in particular for user-charge determination. Projected revenues will need to provide excess amounts (usually 115-125%) of expenses, for unforeseen conditions and to maintain a good credit rating. Cash flow difficulties arise when the timing of expenses outpaces revenue receipts. In part for this reason, capitalizing the first year or two of operating expenses is typically performed.

The procurement of capital resources for decentralized systems is a significant issue, with the options discussed in the Task 4 Report.

2.1.3 Operations

The maintenance, monitoring, and repair (MMR) activities required for decentralized wastewater systems are heavily influenced by system capacity and effluent requirements. Maintenance and repair activities are dictated by the equipment, while monitoring requirements are dictated by permits and environmental setting.
Table 2-2 presents typical MMR responsibilities for the medium and large cluster systems compared to onsite systems.

A monitoring program, specific to the proposed OSTDS improvements in the SPZ will need to be developed and will need to demonstrate compliance with public health and water quality requirements. Such a monitoring program should be integrated into the planning process to ensure that implemented improvement are resulting in the expected nitrate reduction in Wakulla Springs.

Table 2-2. Typical MMR Responsibilities for the Range of Decentralized Systems in Leon & Wakulla Counties

MMR Activity	Conventional OSTDS	Medium AWT Cluster	Large AWT Cluster
Maintenance	Residuals removal every 5-7 years	Treatment, collection, dispersal system maintenance activities	Ongoing treatment, collection, dispersal system maintenance activities
Monitoring	Inspections every 3-5 years	Monthly inspections / Operation Activities	Daily Inspections / Operation Activities
		Monthly sampling	Daily sampling
	Remote monitoring systems available	On-call personnel	Full-time personnel
		SCADA system	SCADA system
Repair	Component repair, as needed	Preventative repair and replacement program	Preventative repair and replacement program
			Full-time personnel
		On-call personnel	Redundant systems
Administration	Varies by degree of oversight (Education, Permit Applications, Inspections, etc.)	Discharge permit	Discharge permit
		Compliance reporting	Compliance reporting
	System use regulation through FL DoH	Moderate customer service	Full customer service
		System use regulation	System use regulation

3 LOCAL WASTEWATER MANAGEMENT OPTIONS

3.1 EPA OPTIONS

The United States Environmental Protection Agency (U.S. EPA) recommends five model management programs for decentralized systems:

1. System inventory (awareness of maintenance needs)
2. Management through maintenance contracts
3. Management through operating permits
4. Responsible Management Entity (RME) operation and maintenance
5. RME ownership and management

Each of these model management programs is summarized in Table 3-1, with full reports at: www.epa.gov/owm/mtb/decent/index.htm.

A mixture of ownership and management options is not uncommon. Many publicly owned systems are managed in varying degrees by private entities, commonly referred to as public-private partnerships. An owner can outsource any or all of the management activities for a cluster system. Ownership can be held by a public utility, a private for-profit or non-profit entity.

3.2 MANAGEMENT OPTIONS IDENTIFIED TO DATE IN LEON & WAKULLA COUNTIES AND CITY OF TALLAHASSEE

3.2.1 Current State of Florida Statute & Procedures

Chapter 381 and Part III, Chapter 489 Florida Statutes, and Chapter 64E-6, Florida Administrative Code, define state-standards for onsite sewage treatment and disposal systems, including an operational management program for aerobic treatment units (ATU) and performance-based treatment systems (PBTS) throughout the state.

Florida law requires owners of ATU and PBTS to have a contract with an approved maintenance entity. For each residential system under maintenance contract, the approved maintenance entity is required to obtain the applicable permit from the local county health department for a fee of $100.00. The state operational management program is limited in the fact that it does not require mandatory pumping for these types of systems. Florida law requires owners of ATU and PBTS to have a contract with an approved maintenance entity. For each residential system under maintenance contract, the approved maintenance entity is required to obtain the applicable permit from the local county health department for a fee of $100.00. The state operational management program is limited in the fact that it does not require mandatory pumping for these types of systems.

The State of Florida's current procedures require the county health department to inspect the systems with operating permits, including performance-based treatment systems, on an annual basis for residences and two times per year for commercial business. In addition, the approved maintenance entity must inspect the system two times per year for residences and four times per year for commercial businesses, as shown on Table 3-2.

Table 3-1. Overview of U.S. EPA Management Model Objectives

Management Model	Objectives	Basic Features
Management Model 1 ***Inventories and Maintenance Reminders***	• Owner awareness of permitting program, installation, and O&M needs • Compliance with codes, regulations	• Only conventional onsite systems • Prescriptive design/site requirements • Owner education to improve O&M • Inspections only during construction and complaint evaluations • Create and maintain system inventory
	• Maintain prescriptive program for sites that meet code criteria (MP 1)	• Allowances for specified alternatives where code is not met
Management Model 2 ***Maintenance Contracts (Cont.)***	• Permit only approved alternative systems on sites not quite meeting criteria	• O&M contracts and reporting required for alternative systems • Inspections and owner education as in MP 1 • Create and maintain inventory
Management Model 3 ***Operating Permits***	• Onsite system designs based on site conditions and performance requirements • System performance assumed by O&M task completion and verified through permit renewal inspections	• Wider variety of designs allowed • Performance of required O/M tasks governs operating permit renewal • Onsite Wastewater Treatment System (OWTS) monitoring/inspections required • Property sale and change-of-use compliance-assurance inspections • Create and maintain inventory
Management Model 4 ***Responsible Management Entity Operation and Maintenance***	Responsible public or private entity assumes O&M and inspection/monitoring responsibilities for all systems in management area	• Performance governs acceptability • Operating permits ensure compliance • All systems are inspected regularly • Monthly/yearly fees support program • Owner responsible for all costs • Create and maintain inventory
Management Model 5 ***Responsible Management Entity Ownership***	• Public or private RME owns and operates all systems in management area • Similar to centralized sewer system service approach	• Performance governs acceptability • All systems are inspected regularly • Monthly/yearly fees support program • Users relieved of all O&M responsibilities • RME funds installation and repairs • Create and maintain inventory

Source: Cluster Wastewater Systems Planning Handbook, 2004

Table 3-2. State of Florida Operating Permit Inspection Requirements

# Required Annual Inspections		
Entity	**Property Type**	
	Residential	**Commercial**
County Health Department	1	2
Approved Maintenance Entity	2	4

In addition, commercial wastewater systems, such as those serving restaurants, and systems located in industrial/manufacturing zones or the equivalent require operating permits from the Department of Health for a fee of $150 and are inspected annually.

Florida's inspection and monitoring requirements for aerobic treatment units (ATU's) and performance-based treatment systems are summarized in Table 3-3, including inspection/maintenance frequencies by County Health Departments (CHD) and Maintenance Entities (ME).

Table 3-3. Inspection and Monitoring for ATU's and PBTS, 64E-6 FAC Summary

Table 5 - Inspection and Monitoring for ATU's and PBTS, 64E-6 FAC Summary

Performance Standards	Conventional Septic System	Aerobic Treatment Unit	>1500 gpd Aerobic Treatment Unit	Secondard Treatment Standards	Advanced Treatment Standards	Advanced Wastewater Treatment Standards	Florida Keys Treatment Standards	Other[6]
INSPECTION MAINTEN-ANCE FREQUENCY	Recommended every 3 to 5 years	1 x per year – CHD 2 x per year – ME	1 x per year – CHD 2 x per year – ME (Class D Operator)	1 x per year – CHD 2 x per year – ME	1 x per year – CHD 2 x per year – ME	1 x per year – CHD 2 x per year – ME	1 x per year – CHD 2 x per year – ME[5]	1 x per year – CHD 2 x per year – ME[5]
MONITORING / SAMPLING (This is for all systems designed to meet the specified treatment standards)	N/A	N/A	CBOD5 and TSS or Ponding Depth [1] and Fecal Coliforms Semi-annually	Specifi-cations to be Set by Design Engineer [4]	Specifi-cations to be Set by Design Engineer [4]	CBOD5 and TSS or Ponding Depth [1] Frequency Varies [2]	Specifi-cations to be Set by Design Engineer [4]	Specifi-cations to be Set by Design Engineer [4]
For Drainfield Reductions	N/A	N/A	N/A	Ponding Depth [1] Quarterly [3]	Ponding Depth [1] Quarterly [3]	Ponding Depth [1] Quarterly [3]	Ponding Depth [1] Quarterly [3]	Ponding Depth [1] Quarterly [3]
For Reduced Setbacks and/or Increase Authorized Flows	N/A	N/A	N/A	Fecal Coliforms Semi-annually	TN, P and Fecal Coliforms Semi-annually	TN, P and Fecal Coliforms Frequency Vaires [2]	N/A	N/A

NOTES:
1. Ponding depth cannot be measured in a drip irrigation system. You can either sample for CBOD5 and TSS or perform a visual inspection of the ground surface above the emitter lines for soil saturation.
2. Twice monthly for the first 6 months, if results are in compliance with applicable standards, then the frequency is reduced to quarterly, if 8 consecutive quarterly results are below the applicable standards, the frequency is reduced to twice per year. See Chapter 64E-6.029(1), FAC for more specific details.
3. If drainfield size reduction is the only benefit being utilized, then the only monitoring required is ponding depth on a quarterly basis.
4. Engineer cannot specify "Per Chapter 64E-6 FAC" as monitoring requirements.
5. If injection well is utilized, maintenance shall be performed every 4 months.
6. These are other performance-based treatment systems mandated by local county ordinances that do not meet any of the PBTS standards set forth in this rule.

Source: RFP BC-01-20-10-16, Identify On-site Sewage Treatment, Disposal & Management Options for Leon County, Wakulla County & City of Tallahassee

3.2.2 Existing Management Recommendations by Others

3.2.2.1 Peer Review Committee – Wakulla Springshed of North Florida

A December 2005 report, Degradation of Water Quality at Wakulla Springs, Florida: Assessment and Recommendations, prepared by the Peer Review Committee on the Workshop Solving Water Pollution Problems in the Wakulla Springshed of North Florida, made the following recommendation relative to septic systems: "…establish a wastewater utility and charge it with maintaining all on-site disposal systems and facilitating the necessary environmental education of septic-tank owners." It recommended the utilities' activities should be in accordance with the goal of minimizing the input of nitrate and other pollutants to groundwater and encompass those areas of Leon and Wakulla Counties not currently served by a wastewater treatment facility and should be funded by an appropriate fee. It identified the following benefits of a utility: (1) Failing systems would get prompt attention; (2) Advanced systems would be employed where necessary to protect the aquifer; and (3) The cost of maintenance and improvement would be distributed, rather than falling on the individual homeowner.

On February 26, 2009, a Memorandum of Understanding was signed between the City of Tallahassee, Leon County and Wakulla County stating the following:

- To work cooperatively to investigate and consider methods to limit nutrient pollution inputs to surface and ground waters within the Wakulla Springshed;
- To work cooperatively to investigate and consider methods to lessen pollution inputs from both existing and new wastewater disposal systems;
- To work cooperatively to investigate and consider methods to explore the development of either a common regional entity or coordinated and consistently structured local entities to address management of the numerous septic systems in our area;
- To work cooperatively to identify and deploy the stormwater collections, management systems, and best management practices that reduce the generation of pollutants that enter stormwater.
- To allocate staff to jointly review and consider the recommendations derived from the February 25-26, 2009 Wakulla Springs Restoration Workshop and return with recommendations on appropriate follow-up actions by each respective government; and,
- To build upon the recommendations derived from the February 25-26, 2009 Wakulla Springs Restoration Workshop and jointly pursue regional, state and federal funding opportunities to further these recommendations

Both the 2005 and 2009 workshops recommended and ultimately committed to investigating the establishment of a single or multiple, coordinated RME's to manage OSTDS within Leon and Wakulla Counties.

3.2.2.2 Florida State University's Center for Economic Forecasting and Analysis (CEFA)

A report prepared by the Florida State University's Center for Economic Forecasting and Analysis (CEFA) in January, 2007 provided a high-level assessment of Wakulla County's situation. The CEFA study noted "…the costs of managing onsite wastewater treatment systems are mostly determined by the local soil conditions and the corresponding types of wastewater treatment technologies used" and identified five options for OSTDS management.

1. **Status Quo** – The Wakulla County Health Department provides oversight as provided for by Department of Health regulations. Consistent with Wakulla County's ordinance, new development would install performance-based systems, and failing systems and those in need of repair would replace their traditional system with a performance-based one. Individual property owners will remain responsible for contracting with certified OSTDS operators to meet inspection and maintenance requirements for the performance-based systems.
2. **Wakulla County Health Department Oversight** (greater than currently required by the State) – This option would involve additional financial support for expanding the Wakulla County Department of Health staff.
3. **Wakulla County or City Management Utility for OSTDS** – The City or Wakulla County may levy property taxes, set fees, rates, charges and penalties; condemn land, impose special assessments; issue general obligation and revenue bonds; and establish rules and regulations. There is an established governing body.
4. **Wakulla County Management Utility** for all Wastewater (sewer and OSTDS) and/or a Wakulla County Management Utility for all Water and Wastewater – Similar to point 3, however, now including water and sewer in addition to OSTDS functions.
5. **"Special District" Utility** for OSTDS or Special District Utility for all wastewater (OSTDS and sewer). A special district can involve a county OR a region OR a defined geographical area. Two types of special districts are a Private Entity (operated for profit or as a non-profit, established under general law), and a Government Utility Authority created by interlocal agreement.

3.2.2.3 Friends of Wakulla Springs State Park

Recommendations made by the Friends of Wakulla Springs State Park, during its presentation at the February 25-26, 2009 Wakulla Springshed Restoration Workshop, included the recommendation for centralized management of septic systems by the Wakulla County Health Department with the Wakulla County Health Department responsible for annual assessments for all septic systems in the county; maintaining a database of all systems in the county; annual inspections of all systems; contracting with local contractors for pump outs and for maintenance contracts for performance-based systems; permitting of repair and new systems; recommending policy changes to the Board of County Commissioners; and recommending annual fees.

3.2.2.4 STATEWIDE SEPTIC TANK EVALUATION PROGRAM

On June 4, 2010, Governor Charlie Crist approved Senate Bill 550 which directs the Department of Health to create and administer a statewide 5-year cycle septic tank evaluation program. However, at the time of this report writing, this bill has be put on hold and may be repealed.

The evaluation program was created to ensure all onsite sewage treatment systems (septic tanks) in the State are assessed to determine whether they are working properly and to identify any failures.

1. The evaluation program was to be phased in beginning in January 1, 2011.
2. Evaluation procedures must be documented and include tank and drainfield evaluation and an assessment of system condition.
3. Evaluations may be performed by registered septic tank contractors, professional engineers, or certified environmental health professionals.
4. The department must provide 60 days notice to system owners that the evaluation is required.
5. The implementation schedule - who gets noticed when - is under development.
6. Owners are responsible for the costs of the evaluation (including pump-out) and any repairs or replacements. The cost of the pump-out will vary according to the size and number of tanks to be pumped-out on a given property.
7. Any system installed or serviced in the previous 5 years, where capacity and condition of the tank is documented as satisfactory, may omit the pump-out requirement from the evaluation.
8. The evaluator is responsible for submitting the report to the local CHD.

While comprehensive OSTDS inspections are a critical component of OSTDS management to ensure that systems operate properly and do not cause bacterial contamination from drainfield failures, programs such as those required by SB550 will not address the levels of nitrogen removal required to meet the water quality threshold of 0.35 mg/L nitrate, as additional nitrogen removal can only occur by advanced/performance based treatment OSTDS.

3.2.2.5 Leon County Septic Tank Advisory Committees Recommendations & Wakulla County Comprehensive Plan

On January 23, 2007, Leon County's Septic Tank Advisory Committee recommended that the Board of County Commissioners require a U.S. Environmental Protection Agency (EPA) Model 3 or higher management program for new OSTDS installed within the PSPZ. With the approval of The Board of County Commissioners voted to accept the report and table further discussions.

In 2010, Septic System Loan and Inspection Programs Planning Committee submitted its final report, which detailed recommendations for a RME that would service all of Leon County. An inspection program could be adopted that would require county-wide inspections on a periodic basis or at the point of sale (a model followed by Escambia County, Florida) or limit inspections to environmentally sensitive areas of the county, such as the PSPZ (a model followed by Charlotte and Santa Rosa counties in Florida). The Florida models staff identified provide for centralized tracking of inspections by the County Health Departments, with inspections performed by the County Health Departments and/or private inspectors, with the costs paid by the property owner.

Wakulla County's November 2009 Comprehensive Plan provides the following requirements:

Objective 1.3: To implement mandatory requirements for inspections, operations and maintenance of on-site wastewater treatment systems.

Policy 1.3.1: Use of on-site wastewater treatment systems shall be limited to the following conditions:

(a) Existing septic tank and package treatment plants may remain in service until such time as centralized service is made available, or the systems fail to properly perform;

(b) The County shall maintain in its land development regulations a provision that existing septic systems shall be replaced with performance-based septic systems when the existing system fails or otherwise requires replacement, or modification as determined by the Department of Health. As part of such land development regulations, the County will provide an exception from the requirement of replacing or modifying a system with a performance-based septic system if the system's owner has demonstrated a financial hardship to the satisfaction of the County, and that the user cannot afford to upgrade the system without public funding. The County shall define the financial hardship test by resolution. If such a demonstration is made, the system's owner must replace the system but a performance-based septic system shall not be required until sources of funding are available to assist those owners who cannot afford to pay for the upgrade;

(b) The County shall diligently seek sources of funding through the SHIP program and other sources, to assist those who cannot afford to upgrade failed systems as required.

(c) Septic systems for new development shall be limited to performance-based septic systems as certified by the Department of Health;

(d) All existing and new septic systems shall be inspected every three years by a licensed septic system contractor for maintenance or upgrade, and

(e) Use of package treatment plants shall be limited to those with business and management plans approved by the County.

Policy 1.3.2: The Public Works Department shall develop and implement inspection, operation and maintenance guidelines for package treatment plants, utilizing private sector sources for implementation whenever possible. The Public Works Department may perform such functions through contractual agreement with facility owners.

Policy 1.3.3: Issuance of all development orders or permits will be conditioned upon demonstration of compliance with applicable federal, state and local permit requirements for on-site wastewater treatment systems.

Policy 1.3.4: The County will coordinate with appropriate federal and state agencies and amend local ordinances to require that issuance of permits for replacement or expansion of existing on-site wastewater treatment systems is conditioned upon compliance with current regulatory requirements and water quality standards.

Policy 1.3.5: The County will coordinate with Leon County and the City of Tallahassee to explore the establishment of a regional management entity for decentralized wastewater systems.

Policy 1.3.6: All new development shall connect to central wastewater treatment facilities within one year from the date that such facilities are available or become available as provided by law. The standards for treatment are:

a. Advanced Wastewater Treatment (AWT) levels (3mg/L for nitrogen, 5 mg/L CBOD, 1 mg/L total phosphate, 5 mg/L suspended solids, & a high level of disinfectant) for all Type I (design capacity of 500,000 gallons per day to 12.5 million gallons per day) and Type II

(100,000 to 500,000 gallons per day) central wastewater treatment facilities using Rapid infiltration Basins.

b. A treatment standard above secondary treatment of 10 mg/L for nitrogen for Type III (less than 100,000 gallons per day) facilities.

3.2.2.6 Leon County's Comprehensive Plan

Leon County's Comprehensive Plan provides the following requirement within the Primary Springs Protection Zone, "To ensure that all existing traditional OSTDS and new Performance Based OSTDS function effectively, local government shall designate or institute a Responsible Management Entity and supporting fee structure" and defines a Responsible Management Entity as follows: "A legal entity that has the technical, managerial, and financial capacity to ensure viable long-term, cost-effective, centralized management, operation, and maintenance of decentralized wastewater systems in accordance with appropriate regulations and generally accepted accounting principles. Viability is defined as the capacity of a responsible management entity to provide adequate technical, managerial, and financial resources to protect the public health and the environment consistently, in perpetuity, and at a minimal cost to taxpayers."

Leon County has appointed the Leon County Health Department as its management entity for performance-based treatment systems. This appointment does not preclude the appointment of additional entities for more complex systems, or for oversight, management or coordination beyond that required by Florida law, or revision of the current appointment, etc.

Relative to land use, Leon County's Comprehensive Plan includes the following guidance for the Primary Springs Protection Zone:

1. The preferred method of wastewater treatment in the PSPZ within the Woodville Rural Community and the Urban Service Area shall be connection to sewer facilities designed to achieve Advanced Wastewater Treatment standards.

2. New development and redevelopment in the PSPZ shall use a Low Impact Development approach, in addition to conventional water quality treatment infrastructure required outside the PSPZ, to minimize adverse impacts of development on water quality and Wakulla Springs. Land development regulations shall specify the mechanism for implementing the Low Impact Development planning and design approach.

3. Establish a transfer of development units system within the PSPZ to foster growth in Woodville Rural Community, increase the feasibility of providing centralized sewer service, and protect Wakulla Springs. The transfer of development units system shall be based on the policies below:

    - The Rural and Urban Fringe Future Land Use Map categories inside the PSPZ shall be designated as the sending areas to transfer dwelling units out of. Expansion of the Urban Fringe Future Land Use Map category shall not be allowed in the PSPZ.
    - Areas inside the Woodville Rural Community Future Land Use Map category, where connection to sewer facilities designed to achieve Wastewater Treatment

standards is available and required, shall be designated to receive dwelling units.

- No net increase in dwelling units, as allowed by the Future Land Use Map on the effective date of this policy, shall be allowed in the PSPZ. Areas inside the USA are exempt from this policy and may increase in allowed density when consistent with applicable Comprehensive Plan policies. Approval of a Future Land Use Map amendment outside the USA that would allow an increased number of dwelling units shall require appropriate documentation that rights to the number of increased dwelling units have been, or are committed by a legally binding agreement to be, acquired from the designated sending areas.

The Urban Fringe clustering provision provided in Policy 2.2.2: [L] shall not be allowed within the PSPZ. Urban Fringe areas in the PSPZ may develop at one dwelling unit per three acres or as a Conservation Subdivision.

3.2.2.7 CoT – Leon County Sewer Service Agreement

Under the May 10, 2005 Water and Sewer Agreement, entered into by Leon County and the City of Tallahassee, the City was granted the water and sewer franchise for all of Leon County, except where there were existing water or sewer franchises previously granted or where there were active applications for water or sewer franchises prior to the date that the Water and Sewer Agreement was executed. The Water and Sewer Agreement provides criteria for the service of new development within Leon County based on the distance of the new development from existing City utility systems. If the development is beyond these distances, the City is not required to serve the property. When a proposed development is outside of the areas which the City is obligated to serve, Section 8 of the Water and Sewer Agreement, the County may revoke the franchise for the geographic area in question and grant water and/or sewer franchises to other providers.

4 MANAGEMENT MODEL COST ANALYSIS

For decentralized wastewater systems the capital costs are usually apportioned into the following components:

- Connect fee
- Assessment fee (in some areas referred to as a betterment fee)
- Amortized (usually 20 years) capital portion with annual payment added to O&M
- Other and non-user sources
    - Property assessment
    - Special/innovative taxes
    - Grants/loans

Typical cluster system costs per connection are shown in Table 4-1, taken from the Task 2 Report.

Table 4-1. Typical Cluster System Costs per Connection

Capital Cost		O&M Cost		Life Cycle Cost	
Low	High	Low	High	Low	High
$21,043	$23,544	$489	$548	$31,412	$32,797

City of Tallahassee wastewater system costs, including connection, abandonment and system charges are summarized on Table 4-2. Inside the CoT, the cost per connection is $21,592 - $24,235 and outside CoT is $23,092 – 25,735, with the low and high ends representing the costs spread over the buildout and existing number of connections respectively. The average usage fee was estimated at $64/month.

Of the nine unsewered study areas examined by the City of Tallahassee, only the Lake Munson and Woodville Study Areas are within the SPZ. Projected capital costs by CoT for those areas only are $20,974 for the current number of developed properties to $18,890 at buildout.

Table 4-3 presents the projected capital costs for addressing the recommended capital improvements. The following assumptions have been made:

- OSTDS upgrades to AWT have an average capital cost of $22,000 per property
- 10% of OSTDS outside the Scenario 1 area will require repair at $4,000 each (legacy issues)
- An additional 1% per year of new failures will occur. 5 years of these new failures are capitalized as part of the Capital Improvement Program (CIP)

In addition to the costs of the CIP, a management allowance of 15% is many times used for CIP financing, land acquisition, legal and administration. As an initial executive level placeholder amount, LAI is of the opinion that a 15% CIP Management allowance is prudent. Table 4-3 costs include the 15% CIP management allowance.

Table 4-2. CoT Targeted Unsewered Areas Sewer Connection, House Connection, Treatment & Disposal/Reuse Costs

Unsewered Study Area	Population		2010 Pop. as % of 2030 Pop.	Estimated Project Cost	Estimated Number of Sewer Connections		Average Cost per Connection (2009 $)		2010 Projected Flow *
	2010	2030		(2009 $)	2010	2030	2010	2030	(gpd)
Outside Scenario 1 Area									
Killearn Acres	5,082	5,274	96.4%	$ 20,354,370	1,544	1,602	$ 13,186	$12,710	508,159
Buck Lake	5,211	6,094	85.5%	$ 29,374,500	1,626	1,901	$ 18,070	$15,640	521,094
Lake Jackson	4,275	4,838	88.4%	$ 24,452,990	1,354	1,532	$ 18,064	$15,960	427,459
Huntington Estates	3,118	4,924	63.3%	$ 9,240,490	462	729	$ 20,017	$12,680	311,803
Bobbin Mill/Brooke	2,375	2,882	82.4%	$ 13,072,610	690	837	$ 18,953	$15,620	237,525
Centerville Trace	1,271	1,835	69.3%	$ 4,745,080	336	485	$ 14,125	$ 9,780	127,116
Rose Hill	309	421	73.4%	$ 3,587,520	72	98	$ 49,876	$36,610	30,931
Total:	**21,641**	**26,268**	**82.4%**	**$ 104,827,560**	**6,082**	**7,184**	**$ 17,235**	**$14,592**	**2,164,087**
Inside Scenario 1 Area									
Woodville	2,938	3,320	88.5%	$ 24,576,240	1,903	2,150	$ 12,917	$11,430	293,840
Lake Munson	6,683	8,379	79.8%	$ 30,614,860	2,522	3,162	$ 12,139	$ 9,680	668,332
Total:	**9,621**	**11,699**	**82.2%**	**$ 55,191,100**	**4,425**	**5,312**	**$ 12,474**	**$10,390**	**962,172**

Notes:

1. House connection costs assume 15% will require grinder pump systems

2. All costs are in 2009 dollars

3. Cost per connection decreases in 2030 due to future increases in the # of connections

	Charge	Outside CoT	Inside CoT	Scenario 1 Area
System Buildout Cost	Average Cost per Connection (2030)	$14,592	$14,592	$ 10,390
	Average Cost per Existing Connection (2010)	$17,235	$17,235	$ 12,474
Homeowner Cost	System Charge	$ 4,500	$ 3,000	$ 4,500
	Abandon Septic	$ 1,500	$ 1,500	$ 1,500
	House Connection[1]	$ 2,500	$ 2,500	$ 2,500
	Total (2030)[2,3]	**$23,092**	**$21,592**	**$ 18,890**
	Total (2010)[3]	**$25,735**	**$24,235**	**$ 20,974**

Monthly Usage Fee	**$ 64**
Annual Usage Fee	**$ 768**

Source: City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010.

Table 4-3. Projected Capital Costs for Upgrades & Repairs – assuming 100 % of Required Nitrogen Removal is Achieved via OSTDS upgrades

Area	*Conventional OSTDS (Outside Scenario 1)*	*AWT Required (Scenario 1)*	5% Capitalization of First 5 Years of Failure Repairs	Subtotal Capital Costs	15% CIP Management *(Financing, Land Acquisition, Legal, Administrative)*	Total
Leon County	$ 12,635,000	$165,000,000	$ 6,317,000	$183,952,000	$ 27,593,000	$ 211,545,000
Wakulla County	$ 4,094,000	$ 24,200,000	$ 2,046,000	$ 30,340,000	$ 4,551,000	$ 34,891,000
CoT*	$ 440,000	$ 2,596,000	$ 220,000	$ 3,256,000	$ 488,000	$ 3,744,000
Total (Leon + Wakulla):	**$16,729,000**	**$189,200,000**	**$ 8,363,000**	**$214,292,000**	**$ 32,144,000**	**$ 246,436,000**

Included in Leon County Total

Notes / Assumptions:

1. ***10% of existing conventional OSTDS will require replacement at $4,000 per property***
2. ***Average AWT solution cost is $22,000 per property***
3. ***Costs are in 2009 dollars***

Table 4-4. Projected Capital Costs for Upgrades & Repairs – assuming 37 % of Required Nitrogen Removal is Achieved via OSTDS upgrades

Area	*Conventional OSTDS (Outside Scenario 1)*	*AWT Required (Scenario 1)*	5% Capitalization of First 5 Years of Failure Repairs	Subtotal Capital Costs	15% CIP Management *(Financing, Land Acquisition, Legal, Administrative)*	Total
Leon County	$ 12,635,000	$ 61,050,000	$ 6,317,000	$ 80,002,000	$ 12,000,000	$ 92,002,000
Wakulla County	$ 4,094,000	$ 8,954,000	$ 2,046,000	$ 15,094,000	$ 2,264,000	$ 17,358,000
CoT*	$ 440,000	$ 960,520	$ 220,000	$ 1,620,520	$ 243,000	$ 1,863,520
Total (Leon + Wakulla):	**$16,729,000**	**$ 70,004,000**	**$ 8,363,000**	**$ 95,096,000**	**$ 14,264,000**	**$ 109,360,000**

Included in Leon County Total

Table 4-5. Projected Capital Costs for Upgrades & Repairs – assuming 0 % of Required Nitrogen Removal is Achieved via OSTDS upgrades

Area	*Conventional OSTDS (Outside Scenario 1)*	*AWT Required (Scenario 1)*	5% Capitalization of First 5 Years of Failure Repairs	Subtotal Capital Costs	15% CIP Management *(Financing, Land Acquisition, Legal, Administrative)*	Total
Leon County	$ 12,635,000	$ -	$ 6,317,000	$ 18,952,000	$ 2,843,000	$ 21,795,000
Wakulla County	$ 4,094,000	$ -	$ 2,046,000	$ 6,140,000	$ 921,000	$ 7,061,000
CoT*	$ 440,000	$ -	$ 220,000	$ 660,000	$ 99,000	$ 759,000
Total (Leon + Wakulla):	**$16,729,000**	**$ -**	**$ 8,363,000**	**$ 25,092,000**	**$ 3,764,000**	**$ 28,856,000**

Included in Leon County Total

5 EVALUATION OF MANAGEMENT OPTIONS

An evaluation of management options needs to be preceded by a definition of what is being managed. The following preliminary plan is proposed:

- *Existing OSTDS Management*

  Management for the 41,821 OSTDS systems located outside the Scenario 1 area, providing EPA Level 4 or 5 functions

- *OSTDS Upgrades to AWT*

  Management of solution(s) for upgrading OSTDS to AWT within the Scenario 1 area, whether the solution is on-site, cluster or centralized, using the US EPA Level 4 or 5 functions.

Therefore, this section will be revisited, if necessary, once the Task 5 hierarchy is completed. The management options for addressing the nitrogen removal requirements of OSTDS in the Scenario 1 area include:

1. Connection to the CoT Sewer System
2. Connection to the sewer system in Wakulla County
3. Connection to a new AWT Cluster System
4. OSTDS upgrades to onsite systems capable of AWT

Leon County has appointed the Leon County Health Department as its management entity for performance-based treatment systems. Leon County has not passed an Ordinance for PBTS yet.

The existing management structure is presented on Table 5-1. The LAI recommended management structure is presented in Table 5-2. .

Table 5-1. Existing Management Structure

Management of Decentralized Wastewater Systems Status as of 2011				
Component	Wakulla County		Leon County	
	On-Site	Cluster	On-Site	Cluster
Ownership	Property Owner	Private	Property Owner	Private
Management	Property Owner	Property Owner or Private Utility	Property Owner	Property Owner or Private Utility
Operations & Maintenance	Property Owner	Private	Property Owner	Private
Permitting	Wakulla County Health Dept.	Fl DEP	Leon County Health Dept.	
"Designated PBTS Management Agency"			Leon County Health Dept.	

Table 5-2. Lombardo Associates, Inc. Recommended Management Structure

Recommended Management Structure for Decentralized Wastewater Systems				
Component	**Wakulla County**		**Leon County**	
	On-Site	**Cluster**	**On-Site**	**Cluster**
Ownership	RME or Private	RME or Private	RME or Private	RME or Private
Management	RME	RME	RME	RME
Operations & Maintenance	RME	RME	RME	RME
Permitting	Wakulla County Health Dept.	Fl DEP	Leon County Health Dept.	Fl DEP
"Designated PBTS Management Agency"	Wakulla County Health Dept.	Wakulla County Health Dept.	Leon County Health Dept.	Leon County Health Dept.

APPENDIX A: BIBLIOGRAPHY – REFERENCE DOCUMENTS

The following documents were reviewed in preparation of the Lombardo Associates, Inc. (LAI) Onsite Sewage Treatment & Disposal and Management Options Task 3 Report:

1. Cluster Wastewater Systems Planning Handbook. Project No. WU-HT-01-45. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Lombardo Associates, Inc., Newton, MA, 2004
2. OSTDS & Decentralized Systems Wastewater Treatment Program- Phase II Report, FSU, Revised January 2007.
3. RFP BC-01-20-10-16, Identify On-site Sewage Treatment, Disposal & Management Options for Leon County, Wakulla County & City of Tallahassee
4. City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010
5. Wakulla County Comprehensive Plan, November 2009

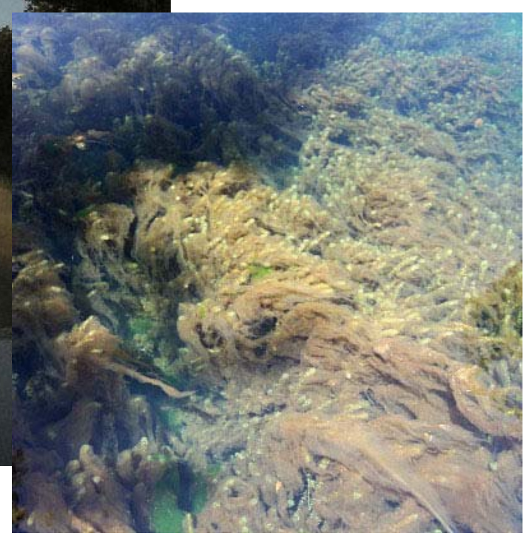
TASK 4 FINAL REPORT

PROGRAM FINANCING

ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL



November 4, 2011

Submitted to:

Kim Dressel, Leon County
Senior Assistant to the County Administrator
301 S. Monroe St.
Tallahassee, FL 32301

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

Table of Contents

List of Tables

1. PROGRAM FINANCING

1.1 GOVERNMENT FINANCING OPTIONS

Grants and loans for the capital (construction plus development costs such as engineering and financing), not Operations & Maintenance (O&M), costs of wastewater projects are available under several Florida state and Federal programs. Major programs that are available include:

- Federal Sources
  - USDA Rural Utilities Service (RUS)
  - US EPA Nonpoint Source Section 319 Grant Program
  - HUD Community Development Block Grants
  - Department of Commerce Economic Development Administration
  - US EPA Hardship Grants Program for Rural Communities

- Federal/State Combined Sources
  - State Revolving Funds (SRF) Program

with the SRF and RUS programs being the largest.

With recent Federal program budget cuts, funding from these sources will become even more challenging and competitive, however given the leadership of the project communities (City of Tallahassee, Leon and Wakulla Counties) and significance of the issues to the State of Florida, communication with funding sources should be initiated as they may be interested in being partners with the project communities and/or be interested in limited funding of demonstration projects.

However at this time, in Lombardo Associates, Inc.'s opinion the majority of project funding is best achieved through conventional municipal financing, either individually and/or collectively by the City and Counties, and that while State and Federal grants and loans should be further investigated, they should not be relied upon, again at this time. The 319 grant program (requires a 40% local match which can be a SRF loan) is, in LAI's opinion, the best available existing grant program, however its funds are limited and therefore should only be viewed for initial and demonstration projects. Efforts should always be maintained to stay in contact with the funding sources identified in this report and pursue funding sources as funding availability/appropriations and priorities change, at least yearly. Given the importance of the issues to the State of Florida as well as the CoT, Leon and Wakulla Counties, contact with State and Federal legislature representatives for potential funding for demonstration projects at a minimum should be maintained.

The major federal programs, along with the state revolving funds, are briefly described below.

1.1.1 State Revolving Fund (SRF) Loans

Capital for state SRF programs is provided 20 percent by the state and 80 percent by US EPA. States have broad discretion to establish program priorities and project eligibility criteria. The SRF programs for which communities may be eligible:

- Clean Water State Revolving Fund (CWSRF), which distributes approximately $200-$300 million to public entities in Florida. The repayment period for loans is 20 years. Interest rates are calculated for each system using the Thomson Publishing Corporation's "Bond Buyer" 20-Bond GO Index and an affordability index developed specifically for the Bureau. Once the affordability index for a service area is determined (the affordability index calculator is available on the web at http://www.dep.state.fl.us/water/wff/wwmanual.htm), it is divided by 200 and the resulting number is multiplied by the 20-Bond GO Index. The maximum interest rate is limited to eighty percent of the market rate.

The SRF program requires projects applying for and being placed on the Intended Use Plan. Applications are due June 1. Hearings on applications are normally held in January, April, July and October on the second Wednesday of that month.

Following is a recent email from FLDEP on this matter.

From: Banks, Timothy [mailto:Timothy.Banks@dep.state.fl.us]
Sent: Tuesday, June 21, 2011 3:45 PM
To: Pio Lombardo; Jones, Kristine P.
Cc: Holmden, Robert
Subject: RE: SRF Funding for Leon and Wakulla Counties

The loan financing rate for a project that involves the management of on-site systems would be 50% of the market rate, which is currently 2.55%. You may want to visit our website at http://www.dep.state.fl.us/water/wff/cwsrf/index.htm for more information. Within DEP, the best chance for a grant would be the 319 program. Kristine Jones is the administrator of the non-point source management section and should be able to help you with the availability of those grants.

If you need additional information, please let me know.

Tim

State Revolving Fund (SRF) funding is difficult to obtain due the high demand and is a loan not a grant. Leon County's current (June 2011) bond rating is AA and loan rates are 4.5% for a 20-year term and 4.75% for a 30-year term.

Local contact:

Mr. Bob Holmden
Chief, Bureau of Water Facilities Funding
Florida Department of Environmental Protection
2600 Blair Stone Road Mail Station 3505
Tallahassee, FL 32399-2400
(850) 245-8394
robert.holmden@dep.state.fl.us

Timothy Banks
Timothy.Banks@dep.state.fl.us

1.1.2 USDA Rural Utility Service (RUS)

Communities may be able to fund projects through RUS, formerly Farmers Home Administration (FmHA). RUS offers low interest loans depending on the criteria set by RUS for award. The RUS grant/loan program is a grant in conjunction with a low-interest loan. The population and the median income are two important factors used to determine pre-qualifiers for the RUS grant and low interest loan. The final eligibility for RUS funding depends upon the available funding in the program, the number of projects submitted, and the rankings for each project. The projects can be phased to spread the cost over a number of years to maximize funding.

To receive funding a community must show that it:

- Cannot obtain funding from commercial lenders at reasonable rates
- Has the capacity to borrow and repay loans and pledge security
- Can operate and maintain the affected facilities

The maximum grant funding level is 75 percent of a project's total cost.

Interest rates for Rural Utilities Service (RDUS) water and wastewater loans—issued quarterly at three different levels: the poverty line rate, the intermediate rate, and the market rate— have been announced. The rate applied to a particular project depends on community income and the type of project being funded.

To qualify for the *poverty line rate*, two criteria must be met. First, the loan must primarily be used for facilities required to meet health and sanitary standards. Second, the median household income of the area being served must be below 80 percent of the state's non-metropolitan median income or fall below the federal poverty level. As of May 31, 2010, the federal poverty level was $22,050 for a family of four.

To qualify for the *intermediate rate*, the service area's median household income cannot exceed 100 percent of the state's non-metropolitan median income.

The *market rate* is applied to projects that don't qualify for either the poverty or intermediate rates. The market rate is based on the average of the Bond Buyer index.

Subareas of Leon and Wakulla Counties may qualify for the small community wastewater facilities grant program.

Rates approved *after* May 23, 2011, are:

poverty line: 4.25 percent;

intermediate: 4.375 percent; and

market: 4.50 percent.

Local contact:

Mr. Michael Langston
Program Director

Florida/Virgin Island Rural Development
Water and Environmental Programs Staff
4440 N.W. 25th Place
P.O. Box 147010
Gainesville, FL 32606
(352) 338-3440 telephone
michael.langston@fl.usda.gov

1.1.3 Small Community Wastewater Facilities Grants Program

This is a grant program to assist small communities in the planning, designing, and constructing of wastewater management facilities. An eligible small community must be an incorporated municipality, have a total population and a service area population of 7,500 or less, and have a per capita income (PCI) less than the State of Florida average PCI of $21,557.

Subareas of Leon and Wakulla Counties may qualify for the small community wastewater facilities grant program.

1.1.4 Clean Water Act Section 319 Non-Point Source Management Program

This program provides grants through state governments. The goal of the program is to support projects nationwide that work to restore water adversely affected by non-point source pollution and to protect waters endangered by such pollution. Most states allow the use of Section 319 funds for decentralized wastewater system projects. The program has provided money to small communities and state agencies to construct decentralized wastewater systems in areas where these systems are more cost effective than centralized systems. Funds have also been used for the repair of existing decentralized wastewater systems and for decentralized system technology demonstration projects. Projects must meet a minimum set of project planning, implementation, monitoring, and evaluation requirements designed to lead to successful documentation of project effectiveness with respect to water quality protection or improvement.

Funding is limited and there is significant competition for grant funds, which require a local 40% local match.

FL DEP has awarded between $4 million and $5 million each year in the past years in Section 319 funds to local governments and others in Florida to implement projects designed to reduce the impacts of NPS pollution. The majority of funding is used to support the construction of stormwater treatment facilities; however, funding has also been used for demonstration projects (for agricultural and urban best management practices (BMPs)), training opportunities, and education programs. Grant applications for 2012 funding were due May 27, 2011 and each year special rules may apply as 2012 Section 319 funds are to be used only for implementation or construction activities, and may not be used for planning, engineering, design, or land acquisition.

– see http://www.dep.state.fl.us/water/nonpoint/319h.htm

Contact:
Ms. Kristine Papin Jones

Nonpoint Source Management Section
Florida Department of Environmental Protection
Phone: (850) 245-8682
Cisco phone: 5-8682
Fax: (850) 245-8434
Email: Kristine.P.Jones@dep.state.fl.us

1.1.5 HUD Community Development Block Grant (CDBG) Program

HUD provides block grants to participating states, which allocate funds to local governments that perform development activities, principally for people with low to moderate incomes. HUD requires that 70 percent of grant funds be used to benefit low- and moderate-income people. Detailed eligibility requirements vary by state. Funded activities include wastewater, drinking water, and economic development projects. As of 1999, 48 states and Puerto Rico participate in the HUD CDBG program. CDBGs are available directly from HUD for communities in these states.

State of Florida Contact
Ms. Jackie Dupree, CDBG Program Manager
2555 Shumard Oak Blvd
Tallahassee, FL 32399-2100
Phone: (850) 487-3644
Fax: (850) 922-5609

1.1.6 Department of Commerce Economic Development Administration (EDA) Funding

EDA grants are intended to help distressed communities attract new industry, encourage business expansion, diversify local economies, and generate long-term jobs. Water and wastewater facilities designed primarily to serve industry and commerce are among the many projects that can be funded under this program.

Florida Contact
Philip T. Trader
401 West Peachtree Street, NW, Suite 1820
Atlanta, GA 30308-3510
T: (404) 730-3017
E: ptrader@eda.doc.gov

1.2 LOCAL FINANCING OPTIONS

Local financing options include community-wide charges and those based on the service area:

- Community-Wide
  - Taxes - property or through local assessment districts such as a Municipal Service Taxing Units (MSTU) or
  - Special Assessments – such as a Municipal Service Benefit Unit (MSBU)
  - Sales tax
  - Bonding

- Service-Area-Wide
  - o User-charges
  - o Connection fees

1.2.1 Community-Wide

Local community-wide financing options include all financing options that are derived from the community at large through public means with fees paid by ad valorem taxes or special assessment.

Special assessments and associated bonding are possible through ordinance or resolution of the County Commissioners.

Municipal Service Benefit Unit (MSBU) is a service unit which receives a specific benefit for which a special assessment is imposed to cover the cost providing the service or improvement. MSBUs.

Municipal Service Taxing Units (MSTU) is a service unit for which an ad valorem tax levy is imposed to cover the cost of providing a service or improvement, based upon taxable value.

See http://www.osceola.org/specialassessments/132-6989-0/msbu_mstu_questions.cfm for how Osceola County uses MSTU and MSBUs.

Special legislation is always an option to create a community tailored financing system.

Alternative structures are also possible, such as establishing special tax rate districts. The property tax can be used to finance all or a portion of a wastewater system.

Various techniques have been used throughout the US to provide temporary or permanent relief of partial or all capital cost assessments to special needs groups such as low – income and elderly. Bond counsel and financing specialists will need to be relied upon should the project communities wish to utilize these techniques.

As described in EPA's comments on **Rate Options to Address Affordability Concerns for Consideration by District of Columbia Water and Sewer Authority,** http://water.epa.gov/infrastructure/sustain/upload/2009_05_26_waterinfrastructure_pricings_AffordOptions.pdf in developing an affordability program for wastewater rates, a utility will need to consider a number of aspects of the program:

(1) identification of groups are the intended beneficiary of subsidies,
(2) establishment of criteria and methods for assessing eligibility for participation in the program,
(3) the objectives of the assistance program,
(4) the particular nature and extent of subsidies, and
(5) the source of funds to pay for the subsidies.

Target groups for subsidies can be

- Elderly (specified age, typically 65 and over);

- Disabled (usually require a doctor's certification);
- Low income (criteria vary widely);
- Unemployed;
- Households facing temporary financial emergencies (criteria vary widely);
- Combination (e.g., low income AND elderly, low income AND disabled); and
- Owners/tenants – Programs are commonly limited to owner-occupants of single family residences or tenants of single family residences;

Naturally a financing-user charge impact analysis needs to be perform to determine the impact of subsidies on other users of the system.

1.2.2 Service-Area-Wide

Local service-area financing options include revenues that are derived only from the property owners served by the wastewater system. These financing options can be implemented through public or private entities. They can take the following forms:

- **User-charges** are periodic (monthly, quarterly, or semiannual) fees paid by all property owners in the wastewater system. User charges can be structured as a fixed fee per connection, a fee based on actual wastewater flows (flat rate or a usage based multi-step rate structure with a minimum monthly fee), or a fee based on allocated capacity (regardless of actual usage). User-charges can be implemented to raise revenues for capital, O&M, or both.
- **Connection fees** are typically a one-time payment or assessment made at the time the wastewater system is built or when the property connects to the system. The fee is the proportionate share of the capital costs. Connection fees are assessed based on the principal that the property is being improved by the wastewater system. Connection fees can be assessed based on lot size, street frontage, water demand/wastewater generation capacity, or as a fixed amount per equivalent dwelling unit (EDU), with non-residential properties assessed based upon similar capacity criteria.

A combination of property taxes, user fees, and connection fees is frequently used to finance public projects. The Municipal Service Benefit Unit (MSBU) is based upon the cost providing the service or improvement. The Municipal Service Taxing Units (MSTU) is based upon an ad valorem tax levy imposed to cover the cost of providing a service or improvement, based upon taxable value.

1.3 FINANCIAL CHARACTERISTICS OF STUDY AREA

Communities fund wastewater projects through municipal (or county or other public entity) bonds. Municipal bond interest rates will depend on the community's bond rating. Current municipal bond ratings for Leon and Wakulla Counties are:

- Leon County AA
- Wakulla County N/A as County has not bonded projects for years

As of June 2010, municipal bond rates are approximately:

- 20 year 4.50 %
- 30 year 4.75 %

2. AFFORDABILITY ANALYSIS

The affordability, ability not willingness, of the customer base to pay in accordance with the necessary fee structure is assessed using US EPA guidelines, as discussed herein.

2.1 FEDERAL GUIDELINES

US EPA (1997) developed guidelines to assess the affordability of wastewater fees using a two-phased approach, (See Environmental Protection Agency, Office of Water, Office of Wastewater Management, “Combined Sewer Overflows— Guidance for Financial Capability Assessment and Schedule Development,” EPA 832-B-97-004, February 1997).

Phase 1 determines the Residential Indicator using the projected fees as a percent of the local median household income (MHI). EPA’s guidance on the affordability of investment in wastewater systems uses an average household rate of 2 percent of MHI. The indicator characterizes whether the costs impose a low, mid-range or high financial impact on residential users.

EPA’s criteria compare the revenues collected by a water/wastewater system to the median household income (MHI) in a service area, <u>not to individual household income</u>, see Congressional Budget Office Study 2002 at
http://www.cbo.gov/doc.cfm?index=3983&type=0&sequence=7

EPA’s affordability assessment guidelines are the annual cost as a percentage of median household income with the following Table 2-1 benchmarks for comparison:

Table 2-1. Residential Affordability Indicators

Financial Impact	Residential Indicator (cost as % MHI)
Low	< 1.0 %
Mid-Range	1.0 - 2.0
High	> 2.0 %

The 2nd Phase develops the Financial Capability Indicators using six (6) indicators to evaluate:

- Debt;
- Socio-Economic conditions
- Financial conditions

which are used to serve as the basis for a 2nd phase analysis to characterize the municipalities financial capability as weak, mid-range or strong.

2.2 FEDERAL GUIDELINES – APPLICATION TO LEON AND WAKULLA COUNTIES

2.2.1 <u>*Phase One – Residential Indicator*</u>

The 2009 median household income (MHI) for Leon and Wakulla Counties were $40,725 and $48,022, respectively per quickfacts.census.gov. EPA (1997) states that the average

Consumer Price Index (CPI) for the past five (5) years should be used for projecting costs as the CPI is used as a simple and reliable method of indexing projected wastewater treatment costs and household income. The CPI index ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt for the past 5 and 10 years are presented on Table 2-2.

Table 2-2. CPI Indices

Year	CPI Index
2001	2.8
2002	1.6
2003	2.3
2004	2.7
2005	3.4
2006	3.2
2007	2.8
2008	3.8
2009	-0.4
2010	1.6
Average 2006 - 2010	2.20
Average 2000 - 2010	2.38

Consequently the estimated MHI 2011 for Leon and Wakulla Counties are estimated as presented in Table 2-3.

Estimated affordability rates <u>solely</u> using this criteria, are presented on Table 2-3. Affordability of lower income households, especially those below the poverty level of $22,400 for a family of four, and the unemployed will be an issue, especially due the recession and poor economic and housing conditions of the past few years. Techniques are available to address this matter, as described in Section 1.2.1.

Table 2-3. MHI & Calculated Average Affordability User Rates

Indicators	Leon County	Wakulla County
Median Household Income (MHI) *(2009)*	$40,725	$48,022
Est. Median Household Income (MHI) *(2011)*	$ 42,537	$ 50,158
User Charges as % MHI		
1.0%	$425	$502
2.0%	$851	$1,003

2.2.2 Phase Two – Financial Capability Indicators

The six Financial Capability Indicators are:

1) Bond rating
2) Overall net debt as a percentage of full market value of taxable property
3) Unemployment rate
4) Median household income – as a percentage of state median income
5) Property tax revenue collection rate
6) Property tax revenues as a percentage of full market value of taxable property

and, along with supplemental/supporting indicators, are presented on Table 2-4.

Table 2-4. Secondary Financial Health Indicators

Indicator	No.	Description	Leon County	Wakulla County
Debt	1	**Bond rating**	AA	
		Overall net debt *($ million)*	$ 76,000,000	$ 7,943,000.00
		Full market value of taxable property	$ 14,073,788,898	$ 1,200,150,296
	2	**Overall net debt** *(as % of full market value of taxable property)*	0.54%	0.66%
SocioEconomic	3	**Unemployment Rate** [1]	8.4%	8.5%
		National Rate	9.2%	9.2%
		Florida State Rate	10.6%	10.6%
		Tallahassee Metro Area (US BLS)	7.4%	7.4%
	4	**Median Household Income** *(2009)*	$40,725	$48,022
		National MHI (2009)	$50,221	$50,221
		Median household income *(2009)* **– as a percentage of national MHI**	81.1%	95.6%
		Per Capita Income (2009)	$ 27,308	$ 36,148
		Persons below poverty level, percent *(2008)*	18.6%	13.0%
Financial Management	5	**Property tax collection rate**	95.5%	
		Property tax revenues	$118,089,804	$9,976,249
		Median Taxable Property Value *(2000)*	$110,900	$96,200
		Per Property Taxes	$871	$794
		Millage Rate *($1 per thousand)*	7.85	8.25
	6	**Property tax revenues** *(as % of full market value of taxable property)*	0.84%	0.83%
		Sales Tax Rate	7.5%	7.0%

http://www.eflorida.com/profiles/CountyReport.asp?CountyID=21&Display=all

For each of the indicators, a score is assigned based upon the Benchmarks described below and the following

Benchmark	Score
Weak	1
Mid-Range	2
Strong	3

Then an overall average Financial Capability determined

Although the analysis should reflect existing conditions, pending changes should be considered in the development of the second phase indicators (EPA, 1997).
Comments on each indicator follows.

Debt

Financial data that illustrates existing and projected debt burden and remaining debt issuing capacity are also important indicators.

Bond Rating

When a Bond Rating is not available, this indicator is excluded from the analysis. The rating agencies categories and associated ratings are listed below.

Moody's Investor Services Category	Rating
Weak	Ba, B, Caa, Ca, C
Mid-Range	Baa
Strong	Aaa, AA, A
Standard & Poor's Investor Services Category	**Rating**
Weak	BB, B, CCC, CC, C, D
Mid-Range	BBB
Strong	AAA, AA, A

Overall Net Debt as % of Full Market Property Value

Overall net debt is debt repaid by property taxes and excludes debt which is repaid by special user fees, with benchmarks listed below.

Overall net debt (as % of full market value of taxable property) Benchmarks	
Weak	> 5.0 %
Mid-Range	2.0 - 5.0
Strong	< 2.0 %

SocioEconomic

Unemployment Rate

The unemployment rate and its comparison to national average is used as a socioeconomic indicator to assess the general economic well-being of residential users in the service area. Benchmarks are presented below:

Unemployment as compared to National Average	
Weak	> 1.0 %
Mid-Range	+/-1. %
Strong	< 1.0 %

Median Household Income as % of National Average

Benchmarks for MHI as compared to National averages are:

Mean Household Income as % of National Average	
Weak	> 25 % below
Mid-Range	+/-25 %
Strong	< 25 above %

Property Tax Revenues as % of Full Market Property Value

This indicator is referred to as the Property Tax Burden since it indicates the funding capacity available to support debt based upon the wealth of a community. It also reflects the effectiveness of management in providing community services (EPA, 1997).

Property Tax Revenues as % of Full Market Property Value	
Weak	> 4.0 %
Mid-Range	2.0 - 4.0

Property Tax Revenue Collection Rate

The Property Tax Revenue Collection Rate benchmarks are:

Property Tax Revenue Collection Rate	
Weak	<94 %
Mid-Range	94 -98%
Strong	> 98%

2.2.3 *Financial Capability Matrix*

The results of the Residential Indicator and Financial Capability Indicators Analysis are combined in the Financial Capability Matrix as illustrated on Table 2-5.

Table 2-5. Financial Capability Matrix

Financial Capability Indicators Average Score	Residential Indicator		
	Low (<1.%)	**Mid-Range (1.0 - 2.%)**	**High (above 2.%)**
Weak (Below 1.5)	Medium Burden	High Burden	High Burden
Mid-Range (1.5 and 2.5)	Low Burden	Medium Burden	High Burden
Strong (above 2.5)	Low Burden	Low Burden	Medium Burden

2.2.4 Scheduling Considerations

For reference purposes, the EPA (1997) developed scheduling considerations for Combined Sewer Overflows (CSO) controls implementation are presented on Table 2-6.

Table 2-6. Financial Capability Scheduling Considerations

Financial Capbility Matrix	Implementation Period
Low Burden	Normal Engineering / Construction
Medium Burden	Up to 10 years
High Burden	Up to 15 years

2.3 Affordability Analysis Application to Leon and Wakulla Counties

Based upon the above EPA guidance and data for Leon and Wakulla Counties, Table 2-7 presents the Financial Capability Score. With comparison of the score to for Leon County and Wakulla County to the Capability Matrix of Table 2-5, the affordability analysis indicates that there would be medium to high burden for all areas depending on the user charge system selected – see Section 4.

Table 2-7. Financial Capability Score

Financial Capability Indicators Score		
Category	Wakulla County	Leon County
Bond Rating (Moody's)	N/A	3
Overall net debt (as % of full market value of taxable property)	3	3
Unemployment as compared to National Average	2	2
Mean Household Income as % of National Average	2	2
Property Tax Revenues as % of Full Market Property Value	3	3
Property Tax Revenue Collection	2	2
Average	2.40	2.50
Wakulla County Bond rating not existing as County has not issued bonds since 1980s.		
Property Tax Revenue Collection Rate for Wakulla County not available. A mid-range rating assumed.		

3. FEE COLLECTION MECHANISMS

Alternative fee collection mechanisms include property taxes, betterments and user fees.

Annual O&M costs are typically assessed on property as a user fee. It is recommended that all or a significant portion of the replacement fund contribution be associated with the annual user fee. Deferring replacement fund contributions for a number of years (i.e. 5 years) and having "co-pays" for OSTDS replacements are options.

Fee collection through betterment are achieved through the use of MSBU fees.

Fee collection via property tax assessment is achieved through MSTU fees.

Table 3-1 illustrates property tax information for Leon and Wakulla Counties.

Table 3-1. Property Tax Information – Leon & Wakulla Counties

Indicators	Leon County	Wakulla County
Total Property Taxes - Residential, Commercial & Other *(2007)*	$118,089,804	$14,406,965
Median Taxable Property Value *(2011)*	$86,950	$96,200
Per Property Taxes	$683	$794

Source: Leon County Budget (http://www.leoncountyfl.gov/omb/budget.asp) & Wakulla County Tax Collector (http://www.wakullacountytaxcollector.com)

Grants are typically available for connection and assessment fees for low-income families and the elderly.

Examples in Florida counties include:

Broward http://www.broward.org/Housing/Pages/HomeownerWatersewer.aspx
Lee http://madisonfloridavoice.net/?cat=206

and have been funded by CBDG and State Housing Initiatives Partnership (SHIP) programs.

Developing fee deferral programs for the elderly and low-income households in which the fees accumulate and are paid when the property is sold may also be advantageous. Cash-flow financing, usually through fees on other users, will need to be provided to the ownership agency.

4. PRO FORMA & SUSTAINABLITY ANALYSIS

The financial sustainability of the wastewater management plan is addressed by consideration of the initial capital costs and ongoing operating and maintenance and replacement costs. To address this issue, a preliminary financial pro forma, presented as Table 4-1, illustrates the economic sustainability of a RME responsible for all OSTDS and AWT upgrades and connection to the CoT wastewater system, based upon the assumptions stated on the spreadsheet, with the yellowed cells indicating input variables.

Capital Improvement Programs for varying assumptions of nitrogen removal form Scenario 1 OSTDS are

Scenario 1 OSTDS achieving AWT Nitrogen Removal	Estimated Capital Costs
100 %	**$ 217.6**
37 %	**$ 80.5**
0 %, i.e. RME solely for OSTDS maintenance and repair	**$ 28.9**

Sustainable user charges are estimated for the following user charge scenarios assuming 100% of Scenario 1 OSTDS achieving AWT Nitrogen Removal along with inclusion of maintenance and repair of non-Scenario 1 OSTDS:

Table 4-2	Capital Improvement Program debt service is same for all properties with annual O&M varying dependent on solution type
Tabe 4-3	Capital Improvement Program debt service and annual O&M varies based upon solution type
Table 4-4	Capital Improvement Program debt service and annual O&M is same for all

The user charges for the 37% Scenario 1 would be identical for the purposes of this analysis with the only variable being the number of properties within the AWT or conventional OSTDS categories. The impact on economies of scale are, in LAI's opinion, inconsequential at this level of executive analysis.

Table 4-2. Estimated Annual User Costs – Capital Improvement Program debt service is same for all properties with annual O&M varying dependent upon solution type

CIP charge same for all			Financial Impact Analysis	
O&M Varies by Solution Type				
Conventional OSTDS Solution				
Annual O&M	$292		% of MHI	
OSTDS Replacement Fund	$40		Leon County	Wakulla County
CIP Debt Service[(1)]	$309		1.51%	1.28%
Total Annual Cost	$	641	User Charge Burden	
Total Monthly Cost	$	53	Medium	Medium
AWT Solution				
Annual O&M	$620		% of MHI	
Replacement Fund	$330		Leon County	Wakulla County
CIP Debt Service[(1)]	$309		2.96%	2.51%
Total Annual Cost		$1,259	User Charge Burden	
Total Monthly Cost		$105	High	High

Table 4-3. Estimated Annual User Costs – Capital Improvement Program debt service and annual O&M varies based upon solution type

CIP & O&M varies by Solution Technique			Financial Impact Analysis	
All OSTDS outside of Scenario 1 assuming all pay same				
Annual O&M	$292		% of MHI	
Replacement Fund	$40		Leon County	Wakulla County
CIP Debt Service[(1)]	$253		1.37%	1.17%
Total Annual Cost	$	585	User Charge Burden	
Total Monthly Cost	$	49	Medium	Medium
Scenario 1 Properties				
Annual O&M	$620		% of MHI	
Replacement Fund	$330		Leon County	Wakulla County
CIP Debt Service[(1)]	$1,391		5.50%	4.67%
Total Annual Cost		$2,341	User Charge Burden	
Total Monthly Cost		$195	High	High
[(1)] Financing Term (yrs)		30		
Financing Rate	4.75%			

Table 4-4. Estimated Annual User Costs – Capital Improvement Program debt service and annual O&M is same for all properties

All Same O&M & CIP charge		Financial Impact Analysis	
Annual O&M	$386		
OSTDS Replacement Fund	$89	% of MHI	
CIP Debt Service[1]	$309	Leon County	Wakulla County
Total Annual Cost	$ 784	1.84%	1.56%
Total Monthly Cost	$ 65	User Charge Burden	
[1] Financing Term (yrs)	30	Medium	Medium
Financing Rate	4.75%		

There are many variables that need to be reviewed and discussed to refine these estimates prior to public discussion as there are numerous options available. The above analysis assumes a MSBU approach with a variety of separate categories. It is not unusual to have all participants in a Plan pay the same fee using the rational that all benefit from a restored water body and avoids the disputes that will arise from different user classes.

Table 4-1. Preliminary Financial Pro Forma

Base Scenario — All cells in yellow are input variables

Capital Cost / Sceanrio 1 Parcel	$22,000	Annual ATU-Cluster-Sewer Failure Rate	1.5%	Capital Cost - All Scenario 1 Parcels	$ 189,200,000	Cost / existing parcel	$ 4,888	Interest Rate	4.75%
Capital Cost / Non Scenario 1 Parcel	$4,000	Annual OSTDS Failure Rate	1.0%	Capital Cost - All Non Scenario 1 Parcels	$16,728,000	Cost / buildout parcels		Term (years)	30
City of Tallahassee Connection	$21,000	% in Initial Failure in Non-SPZ	10%	Capital Cost of Years of OSTDS Failure in CIP	$8,364,000	Annual debt payment	$ 309	Capital Amortization Factor	0.0632
	Annual Payment	Years of OSTDS Failure in CIP	5	CIP Management 15%	32,144,000	Monthly debt payment	$ 25.75		
Annual Debt Service / Sceanrio 1 Parcel	$1,391			Total CIP	$246,436,000				
Annual Debt Service / Non Scenario 1 Par	$253								
CoT Connection Debt Service	$1,327								

Initial CIP

CIP Program	$ 246,500,000		$ 40,000,000	$ 40,000,000	$ 40,000,000	$ 40,000,000	$ 40,000,000	$ 46,500,000
Bond Series			2012	2013	2014	2015	2016	2017
Interest Rate			4.75%	4.75%	4.75%	4.75%	4.75%	4.75%
Term (years)			30	30	30	30	30	30
Capital Amortization Factor			0.0632	0.0632	0.0632	0.0632	0.0632	0.0632
CIP Term (Years)	6		1	2	3	4	5	6

#	%	Item	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
		Annual Growth Rate																					
		PSPZ, Wakulla		0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
		PSPZ, Leon		0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
		North of Cody Scarp		0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
		Non PSPZ, Spring Creek Sps, Wakulla River & St. Marks		0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%	0.35%
		Compounded Growth Rate		0.35%	0.70%	1.05%	1.41%	1.76%	2.12%	2.48%	2.83%	3.19%	3.56%	3.92%	4.28%	4.65%	5.01%	5.38%	5.75%	6.12%	6.49%	6.86%	7.24%
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		Number of OSTDS/Parcels																					
1		Wakulla Scenario 1	1,100	1,104	1,108	1,112	1,115	1,119	1,123	1,127	1,131	1,135	1,139	1,143	1,147	1,151	1,155	1,159	1,163	1,167	1,171	1,176	1,180
2		Leon Scenario 1, icludes CoT	7,500	7,526	7,553	7,579	7,606	7,632	7,659	7,686	7,713	7,740	7,767	7,794	7,821	7,849	7,876	7,904	7,931	7,959	7,987	8,015	8,043
3		Wakulla non Scenario 1	10,234	10,270	10,306	10,342	10,378	10,414	10,451	10,487	10,524	10,561	10,598	10,635	10,672	10,710	10,747	10,785	10,822	10,860	10,898	10,936	10,975
4		Leon non Scenario 1 - includes CoT	31,587	31,698	31,808	31,920	32,032	32,144	32,256	32,369	32,482	32,596	32,710	32,825	32,939	33,055	33,170	33,287	33,403	33,520	33,637	33,755	33,873
		Total Scenario 1	8,600	8,630	8,660	8,691	8,721	8,752	8,782	8,813	8,844	8,875	8,906	8,937	8,968	9,000	9,031	9,063	9,094	9,126	9,158	9,190	9,222
		Total non Scenario 1	41,821	41,967	42,114	42,262	42,410	42,558	42,707	42,856	43,006	43,157	43,308	43,460	43,612	43,764	43,918	44,071	44,225	44,380	44,536	44,691	44,848
		Total # OSTDS	**50,421**	**50,597**	**50,775**	**50,952**	**51,131**	**51,310**	**51,489**	**51,669**	**51,850**	**52,032**	**52,214**	**52,397**	**52,580**	**52,764**	**52,949**	**53,134**	**53,320**	**53,507**	**53,694**	**53,882**	**54,070**
		EXPENSES																					
		CIP Debt Service																					
		2011 Series	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		2012 Series	$ 40,000,000		$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378
		2013 Series	$ 40,000,000			$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378
		2014 Series	$ 40,000,000				$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378
		2015 Series	$ 40,000,000					$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378
		2016 Series	$ 40,000,000						$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378	$ 2,528,378
		2017 Series	$ 46,500,000							$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240	$ 2,939,240
		2018 Series	$ -								$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Annual CIP Debt Service Total	246,500,000	$ -	$ 2,528,378	$ 5,056,756	$ 7,585,134	$ 10,113,513	$ 12,641,891	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130	$ 15,581,130
		Annual CIP Debt Service w Coverage	115%	$ -	$ 2,907,635	$ 5,815,270	$ 8,722,905	$ 11,630,540	$ 14,538,174	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300
		Inflation on OSTDS Replacement		2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
		OSTDS Replacement Fund	$ 40	$ -	$ -	$ -	$ -	$ -	$ 462,964	$ 464,585	$ 466,211	$ 467,842	$ 469,480	$ 471,123	$ 472,772	$ 474,427	$ 476,087	$ 477,753	$ 479,426	$ 481,104	$ 482,787	$ 484,477	$ 486,173
		Sceanrio 1 System Replacement	$330	$ -	$ -	$ -	$ -	$ 2,888,014	$ 2,898,122	$ 2,908,265	$ 2,918,444	$ 2,928,659	$ 2,938,909	$ 2,949,195	$ 2,959,518	$ 2,969,876	$ 2,980,270	$ 2,990,701	$ 3,001,169	$ 3,011,673	$ 3,022,214	$ 3,032,791	$ 3,043,406
		(starts in year)	5																				
		Annual O&M Inflation Rate		3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%	3.00%
		OSTDS - Number Non Scenario 1		41,967	42,114	42,262	42,410	42,558	42,707	42,856	43,006	43,157	43,308	43,460	43,612	43,764	43,918	44,071	44,225	44,380	44,536	44,691	44,848
			Per Parcel	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
1	43%	Contract Operations	$125	$5,403,299	$5,584,877	$5,772,557	$5,966,544	$6,167,049	$6,374,293	$6,588,501	$6,809,908	$7,038,755	$7,275,292	$7,519,778	$7,772,481	$8,033,675	$8,303,646	$8,582,690	$8,871,112	$9,169,225	$9,477,357	$9,795,844	$10,125,033
2	12%	**Septic Pumping**	$35	$1,512,924	$1,563,766	$1,616,316	$1,670,632	$1,726,774	$1,784,802	$1,844,780	$1,906,774	$1,970,851	$2,037,082	$2,105,538	$2,176,295	$2,249,429	$2,325,021	$2,403,153	$2,483,911	$2,567,383	$2,653,660	$2,742,836	$2,835,009
		Annual Septage Generation (gal)	200																				
		Remove-Disposal Cost ($/gal)	$0.18																				
		Pumping Freq (years)	5																				
3		**Electricity**	$34	$1,458,891	$1,507,917	$1,558,590	$1,610,967	$1,665,103	$1,721,059	$1,778,895	$1,838,675	$1,900,464	$1,964,329	$2,030,340	$2,098,570	$2,169,092	$2,241,985	$2,317,326	$2,395,200	$2,475,691	$2,558,886	$2,644,878	$2,733,759
4	11%	**Equipment Repair**	$32	$1,383,245	$1,429,729	$1,477,775	$1,527,435	$1,578,765	$1,631,819	$1,686,656	$1,743,336	$1,801,921	$1,862,475	$1,925,063	$1,989,755	$2,056,621	$2,125,733	$2,197,169	$2,271,005	$2,347,322	$2,426,203	$2,507,736	$2,592,009
		% of Materials Costs	1.00%																				
5	10%	**Sampling**	$30	$1,296,792	$1,340,371	$1,385,414	$1,431,971	$1,480,092	$1,529,830	$1,581,240	$1,634,378	$1,689,301	$1,746,070	$1,804,747	$1,865,395	$1,928,082	$1,992,875	$2,059,846	$2,129,067	$2,200,614	$2,274,566	$2,351,003	$2,430,008
		# of samples per location	3																				
		# of locations to be sampled	1																				
		# of sampling trips per year	0.50																				
		Sample Cost ($/sample)	$20																				
6	7%	**Administration**	$20	$864,528	$893,580	$923,609	$954,647	$986,728	$1,019,887	$1,054,160	$1,089,585	$1,126,201	$1,164,047	$1,203,165	$1,243,597	$1,285,388	$1,328,583	$1,373,230	$1,419,378	$1,467,076	$1,516,377	$1,567,335	$1,620,005
7	5%	**Annual Misc. O&M Costs**	$16	$691,622	$714,864	$738,887	$763,718	$789,382	$815,910	$843,328	$871,668	$900,961	$931,237	$962,532	$994,878	$1,028,310	$1,062,867	$1,098,584	$1,135,502	$1,173,661	$1,213,102	$1,253,868	$1,296,004
		% of Materials Costs	0.50%																				
	88%	**TOTAL ONSITE O&M COST**	$292	$12,611,301	$13,035,103	$13,473,148	$13,925,913	$14,393,894	$14,877,600	$15,377,562	$15,894,325	$16,428,454	$16,980,532	$17,551,163	$18,140,970	$18,750,597	$19,380,711	$20,032,000	$20,705,175	$21,400,972	$22,120,152	$22,863,500	$23,631,828

Table 4-1. Preliminary Financial Pro Forma *(cont'd)*

			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	Annual O&M Inflation Rate		0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
	Scenario 1 AWT Properties		8,630	8,660	8,691	8,721	8,752	8,782	8,813	8,844	8,875	8,906	8,937	8,968	9,000	9,031	9,063	9,094	9,126	9,158	9,190	9,222
		Per Parcel	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Contract Operations	$89	$768,079	$793,890	$796,669	$799,457	$802,255	$805,063	$807,881	$810,708	$813,546	$816,393	$819,251	$822,118	$824,996	$827,883	$830,781	$833,688	$836,606	$839,534	$842,473	$845,421
2	**Septic Pumping**	$35	$302,054	$312,204	$313,297	$314,393	$315,494	$316,598	$317,706	$318,818	$319,934	$321,054	$322,177	$323,305	$324,436	$325,572	$326,711	$327,855	$329,002	$330,154	$331,309	$332,469
	Annual Septage Generation (gal)	200																				
	Disposal Unit Cost ($/gal)	$0.18																				
	Pumping Freq (years)	5																				
3	**Electricity**	$28	$241,643	$249,763	$250,637	$251,515	$252,395	$253,278	$254,165	$255,054	$255,947	$256,843	$257,742	$258,644	$259,549	$260,458	$261,369	$262,284	$263,202	$264,123	$265,048	$265,975
4	**Equipment Maintenance**	$220	$1,898,622	$1,962,425	$1,969,294	$1,976,186	$1,983,103	$1,990,044	$1,997,009	$2,003,998	$2,011,012	$2,018,051	$2,025,114	$2,032,202	$2,039,315	$2,046,452	$2,053,615	$2,060,803	$2,068,015	$2,075,253	$2,082,517	$2,089,806
	% of Materials Costs	1.00%																				
5	**Sampling**	$100	$863,010	$892,011	$895,133	$898,266	$901,410	$904,565	$907,731	$910,908	$914,097	$917,296	$920,506	$923,728	$926,961	$930,206	$933,461	$936,728	$940,007	$943,297	$946,599	$949,912
	# of samples per location	5																				
	# of locations to be sampled	1																				
	# of sampling trips per year	1.00																				
	Sample Cost ($/sample)	$20																				
6	**Administration**	$60	$517,806	$535,207	$537,080	$538,960	$540,846	$542,739	$544,639	$546,545	$548,458	$550,378	$552,304	$554,237	$556,177	$558,123	$560,077	$562,037	$564,004	$565,978	$567,959	$569,947
7	**Annual Misc. O&M Costs**	$88	$759,449	$784,970	$787,717	$790,474	$793,241	$796,017	$798,804	$801,599	$804,405	$807,220	$810,046	$812,881	$815,726	$818,581	$821,446	$824,321	$827,206	$830,101	$833,007	$835,922
	% of Materials Costs	0.50%																				
	TOTAL AWTproperties O&M COST	$620	$5,350,662	$5,530,471	$5,549,828	$5,569,252	$5,588,744	$5,608,305	$5,627,934	$5,647,632	$5,667,399	$5,687,234	$5,707,140	$5,727,115	$5,747,160	$5,767,275	$5,787,460	$5,807,716	$5,828,043	$5,848,441	$5,868,911	$5,889,452
	SPZ Replacement Fund																					
	Annual O&M Inflation Rate		3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
	AWT - Properties		8,630	8,660	8,691	8,721	8,752	8,782	8,813	8,844	8,875	8,906	8,937	8,968	9,000	9,031	9,063	9,094	9,126	9,158	9,190	9,222
	CoT Sewer Cost	$768	$6,826,754	$6,850,648	$6,874,625	$6,898,686	$6,922,832	$6,947,062	$6,971,376	$6,995,776	$7,020,261	$7,044,832	$7,069,489	$7,094,233	$7,119,062	$7,143,979	$7,168,983	$7,194,074	$7,219,254	$7,244,521	$7,269,877	$7,295,321
	Monthly	$64																				
	SUMMARY																					
		Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Annual CIP Debt Service w Coverage		$ -	$ 2,907,635	$ 5,815,270	$ 8,722,905	$ 11,630,540	$ 14,538,174	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300	$ 17,918,300
	OSTDS Replacement Fund		$ -	$ -	$ -	$ -	$ -	$ 462,964	$ 464,585	$ 466,211	$ 467,842	$ 469,480	$ 471,123	$ 472,772	$ 474,427	$ 476,087	$ 477,753	$ 479,426	$ 481,104	$ 482,787	$ 484,477	$ 486,173
	Sceanrio 1 System Replacement																					
	Subtotal Capital Payments		$ -	$ 2,907,635	$ 5,815,270	$ 8,722,905	$ 11,630,540	$ 15,001,139	$ 18,382,885	$ 18,384,511	$ 18,386,142	$ 18,387,780	$ 18,389,423	$ 18,391,072	$ 18,392,727	$ 18,394,387	$ 18,396,053	$ 18,397,726	$ 18,399,404	$ 18,401,087	$ 18,402,777	$ 18,404,473
	Excess Debt Service Payments per year		$ -	$ 379,257	$ 758,513	$ 1,137,770	$ 1,517,027	$ 1,896,284	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170	$ 2,337,170
	Excess Debt Service Payments - Cumulative		$ -	$ 379,257	$ 1,137,770	$ 2,275,540	$ 3,792,567	$ 5,688,851	$ 8,026,020	$ 10,363,190	$ 12,700,360	$ 15,037,529	$ 17,374,699	$ 19,711,868	$ 22,049,038	$ 24,386,207	$ 26,723,377	$ 29,060,546	$ 31,397,716	$ 33,734,886	$ 36,072,055	$ 38,409,225
	Annual O&M - OSTDS Non SPZ		$ 12,611,301	$ 13,035,103	$ 13,473,148	$ 13,925,913	$ 14,393,894	$ 14,877,600	$ 15,377,562	$ 15,894,325	$ 16,428,454	$ 16,980,532	$ 17,551,163	$ 18,140,970	$ 18,750,597	$ 19,380,711	$ 20,032,000	$ 20,705,175	$ 21,400,972	$ 22,120,152	$ 22,863,500	$ 23,631,828
	Annual O&M - OSTDS - Cluster-Sewer SPZ		$ 6,826,754	$ 6,850,648	$ 6,874,625	$ 6,898,686	$ 6,922,832	$ 6,947,062	$ 6,971,376	$ 6,995,776	$ 7,020,261	$ 7,044,832	$ 7,069,489	$ 7,094,233	$ 7,119,062	$ 7,143,979	$ 7,168,983	$ 7,194,074	$ 7,219,254	$ 7,244,521	$ 7,269,877	$ 7,295,321
	Total O&M		$ 19,438,055	$ 19,885,751	$ 20,347,773	$ 20,824,600	$ 21,316,725	$ 21,824,662	$ 22,348,938	$ 22,890,101	$ 23,448,715	$ 24,025,364	$ 24,620,652	$ 25,235,202	$ 25,869,659	$ 26,524,690	$ 27,200,982	$ 27,899,249	$ 28,620,226	$ 29,364,673	$ 30,133,377	$ 30,927,149
	Total Capital & Annual O&M		$ 19,438,055	$ 22,793,386	$ 26,163,043	$ 29,547,504	$ 32,947,265	$ 36,825,801	$ 40,731,823	$ 41,274,612	$ 41,834,858	$ 42,413,144	$ 43,010,075	$ 43,626,274	$ 44,262,386	$ 44,919,077	$ 45,597,036	$ 46,296,975	$ 47,019,629	$ 47,765,760	$ 48,536,154	$ 49,331,622
	Total Parcels		50,597	50,775	50,952	51,131	51,310	51,489	51,669	51,850	52,032	52,214	52,397	52,580	52,764	52,949	53,134	53,320	53,507	53,694	53,882	54,070
	Total Per Parcel / year		$ 384	$ 449	$ 513	$ 578	$ 642	$ 715	$ 788	$ 796	$ 804	$ 812	$ 821	$ 830	$ 839	$ 848	$ 858	$ 868	$ 879	$ 890	$ 901	$ 912
	Total Per Parcel / month		$ 32.01	$ 37.41	$ 42.79	$ 48.16	$ 53.51	$ 59.60	$ 65.69	$ 66.34	$ 67.00	$ 67.69	$ 68.40	$ 69.14	$ 69.91	$ 70.70	$ 71.51	$ 72.36	$ 73.23	$ 74.13	$ 75.07	$ 76.03

5. START – UP – INITIAL CAPITALIZATION OPTION

There will be numerous additional technical, legal and financial efforts in addition to those associated with this project prior to the establishment of an On-Site Wastewater Management RME for Leon County, Wakulla County and/or City of Tallahassee. Normal practice is the preparation of a detailed Engineering Plan that is then used as the basis for legal establishment of the RME, its boundaries, bonding, grant/loan applications, user charges, etc.

As the Engineering Plan and associated activities will require funding and as there is no current funding mechanism, it is recommended that one or more OSTDS **Municipal Service Benefit Unit(s) (MSBU)** be established by the Boards of County Commissioners and City of Tallahassee through an adopted ordinance or resolution that outlines the boundaries of the district and the services or improvements to be provided.

With an initial $20./year fee per OSTDS, annual revenues per political jurisdiction and totals would be approximately:

Number of OSTDS by Political Subdivision					
Sub-Area	Leon			Wakulla	Total
	CoT	Other	Total		
Scenario 1 - Wakulla Springs	118	7,382	7,500	1,100	**8,600**
Scenario 2 Outside Scenario 1 - Wakulla Springs	0	300	300	4,200	**4,500**
North of Cody Scarp	1,100	29,917	31,017	0	**31,017**
Other Watersheds	0	270	270	4,130	**4,400**
Confined Aquifer	0	0	0	1,904	**1,904**
Total	**1,218**	**37,869**	**39,087**	**11,334**	**50,421**
Annual Revenue Estimates					
Annual Fee	$ 20.00	$ 20.00	$ 20.00	$ 20.00	$ 20.00
Annual Revenue	$ 24,360	$ 757,380	$ 781,740	$ 226,680	$ 1,008,420

Should this option be pursued, having higher rates for commercial and institutional OSTDS is recommended.

It is LAI's opinion that with the establishment of OSTDS MSBU(s), the likelihood of grants and/or loans will be significantly improved.

APPENDIX A: BIBLIOGRAPHY – REFERENCE DOCUMENTS

The following documents were reviewed in preparation of the Lombardo Associates, Inc. (LAI) Onsite Sewage Treatment & Disposal and Management Options Draft Task 4 Report:

1. Cluster Wastewater Systems Planning Handbook. Project No. WU-HT-01-45. Prepared for the National Decentralized Water Resources Capacity Development Project, Washington University, St. Louis, MO, by Lombardo Associates, Inc., Newton, MA, 2004

2. Environmental Protection Agency, Office of Water, Office of Wastewater Management, "Combined Sewer Overflows— Guidance for Financial Capability Assessment and Schedule Development," EPA 832-B-97-004, February 1997

3. Future Investment in Drinking Water and Wastewater Infrastructure , November 2002, Congressional Budget Office http://www.cbo.gov/doc.cfm?index=3983&type=0&sequence=7

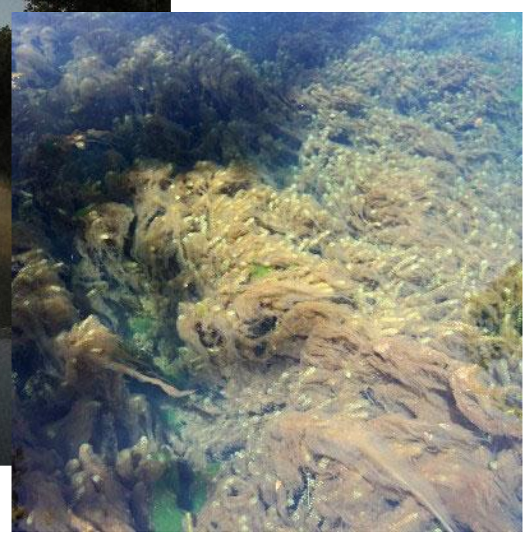
TASK 5 FINAL REPORT

SUGGESTED HIERARCHY & PHASE-IN FOR ON-SITE SEWAGE TREATMENT & DISPOSAL SYSTEMS MANAGEMENT OPTIONS

ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL



November 4, 2011

Submitted by:

Environmental Engineers/ Consultants

LOMBARDO ASSOCIATES, INC.

188 Church Street

Newton, Massachusetts 02458

www.LombardoAssociates.com

Submitted to:

Leon County Purchasing Division
2284 Miccosukee Road
Tallahassee, FL 32308

Table of Contents

1. OVERVIEW

The Task 1 Report identified the existing and future nitrate loads to Wakulla Springs as well as the nitrate removal required to achieve the water quality standard of 0.35 mg/L. Key conclusions from the Task 1 Report include:

1. The Scenario 1 area requires the 89% nitrogen removal from OSTDS if nitrogen reduction is only achieved from OSTDS and a minimum of 37% nitrogen removal if nitrogen if prorated from all other contributing sources that are potentially manageable.
2. Attenuation of OSTDS nitrate north of the Cody Scarp, with the exception of identified Most Vulnerable Areas, was very conservatively estimated at a minimum of 79% and is likely higher, making nitrate removal in these areas very expensive on a $/lb/day nitrate removed basis.
3. The identified Most Vulnerable Areas north of the Cody Scarp may have significantly lower nitrate attenuation and may be economically feasible for reducing the "Inflow" nitrate load.
4. The Scenario 2 area does not need nitrogen reduction

This Task 5 Report identifies and discusses:

- Suggested hierarchy by which on-site sewage treatment and disposal systems and management options may be reasonably phased in.

- The hierarchy criteria of life cycle cost minimization, ease of implementation and long term sustainability of wastewater treatment and management alternatives.

It is noted that any growth in the Wakulla Springs watershed beyond that assumed within these reports will require nitrogen removal offsets to maintain/achieve Wakulla Springs water quality objectives. In other words, additional growth will need to achieve No Net Nitrogen Contribution.

2. HIERARCHY FOR TREATMENT AND MANAGEMENT OPTIONS

The hierarchy for treatment options is as follows:

1. AWT treatment for Scenario 1 Areas
2. Nitrate removal systems for Most Vulnerable Areas North of the Cody Scarp, if applicable
3. Conventional OSTDS for remaining areas of Leon and Wakulla Counties

The hierarchy for management options is as follows:

1. RME for Scenario 1 area only
2. RME for all of Leon and Wakulla Counties
3. Individual CoT, Leon and Wakulla County management agencies for respective portions of Scenario 1 Area
4. Individual CoT, Leon and Wakulla County management agencies for all OSTDS within each jurisdictional boundary

In order to determine the appropriate solutions for the required treatment and management, the following detailed plans will be required:

1. Wastewater Facilities Plan (WWFP) – essentially the detailed engineering Plan for the needed wastewater system improvements
2. Wastewater Management Plan (WWMP) - essentially the Financial Plan for the RME that would support the WWFP and management of all OSTDS.

Extensive public participation is a major component of the Planning process for both Plans to determine the optimal technical, economic and politically acceptable solution(s), along with continuing efforts at water quality monitoring and modeling to enable adaptive management

Both Plans will require detailed analysis of both the economic and non-economic factors affecting the feasibility of the respective treatment and management alternatives for achieving the nitrate removal necessary to meet the water quality standard.

3. WASTEWATER FACILTIES PLAN

3.1 SCENARIO 1 AREA

AWT nitrate removal levels have been determined to be necessary for the Scenario 1 area. As such, the alternatives analysis will include an evaluation of the economic and non-economic factors for the following AWT alternatives:

1. Connection to the CoT system, where applicable
2. AWT Cluster Systems in areas that appear to have favorable density and potential treatment and dispersal sites
3. Individual OSTDS capable of meeting AWT treatment levels

3.2 WWFP ALTERNATIVES ANALYSIS – MOST VULNERABLE AREAS NORTH OF THE CODY SCARP

The alternatives analysis for Most Vulnerable Areas north of the Cody Scarp will depend on whether these areas are determined to have relatively low natural attenuation of nitrates and are therefore economically feasible for implementing nitrate removal alternatives. If these areas are determined to be feasible for nitrate reduction, the alternatives will depend on the level of nitrate reduction required. Should AWT levels be required, the same alternatives as those listed above will apply. If lower levels of removal are required, additional onsite and cluster alternatives will be evaluated. These determinations would be made through additional water quality data collection and modeling efforts.

4 WASTEWATER MANAGEMET PLAN

The WWMP will evaluate the alternatives for managing the selected treatment solutions and all OSTDS in the selected jurisdictional areas and selects a preferred option for adoption and implementation. The Plan would provide the basis for any bonding/financing efforts made in this regard.

5 PHASING

4.1 PHASING FOR FACILITIES PLAN

The following describes the estimated time frame for completing, adopting and implementing the Facilities Plan, per the previously stated hierarchy:

1. Develop WWFP – 18 months
2. Adopt WWFP – 6 months
3. Implement Solutions Recommended in WWFP – 6+ years

4.2 PHASING FOR MANAGEMENT PLAN

The following describes the estimated time frame for completing, adopting and implementing the Management Plan:

1. Develop WWMP – 9 months
2. Adopt WWMP – 6 months
3. Implement Management Structure for Adopted WWMP – Ongoing immediately following adoption of WWMP.

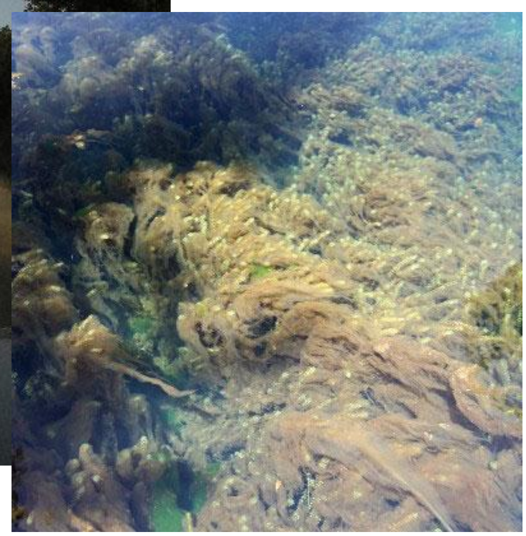
TASK 6 FINAL REPORT

IDENTIFICATION OF GENERALIZED AREAS WHERE CENTRAL & CLUSTER SEWER WOULD BE THE RECOMMENDED OPTION

ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL



November 4, 2011

Submitted to:

Leon County Purchasing Division
2284 Miccosukee Road
Tallahassee, FL 32308

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

Table of Contents

List of Tables

List of Figures

1 OVERVIEW

The purpose of this Task VI report is to detail generalized areas where central and cluster systems would be the recommended option. OSTDS in areas north of County Scarp, with the exception of identified Most Vulnerable Areas (see Figure 1-2), appears to benefit from natural nitrogen attenuation of 79% or higher, making the cost of additional nitrogen removal on a $/lb of nitrate removed excessive. Scenario 1 conditions occur when flow from the Spring Creek Springs Group flows south to Spring Creek Springs. Scenario 2 conditions occur when the Spring Creek Springs Group flows north to Wakulla Springs. Figure 1-1 delineates the contributory areas that result from these two flow conditions.

Areas requiring AWT levels of nitrogen removal may include all of the Scenario 1 area. Most Vulnerable areas north of the Cody Scarp may be candidates for connection to the City of Tallahassee (CoT) sewer system should future studies determine that the nitrogen contributions from OSTDS in these areas contributes a significant portion of the nitrate load flowing across the Cody Scarp, i.e. they are not achieving 79+% attenuation. Any nitrate that is removed from the inflow load will reduce the overall nitrate removal requirements for OSTDS sources.

AWT options include the following:

1. Connection to a centralized sewer system – the existing CoT and Otter Creek WWTFs are candidates.
2. Construction of new cluster wastewater treatment systems to serve localized areas of development
3. Installation of advanced onsite wastewater systems that are capable of meeting AWT standards

This report focuses on areas where options 1 and 2 above may be the recommended option.

1.1 SUMMARY OF RELEVANT CONCLUSIONS FROM PREVIOUS REPORTS

The following conclusions from the Task 1 and 2 reports are relevant to this report:

- Onsite AWT systems are relatively new and are listed as “Innovative” PBTS. The issues of performance certification and sampling frequency will need to be addressed if they are to be relied upon for AWT levels of nitrogen removal.

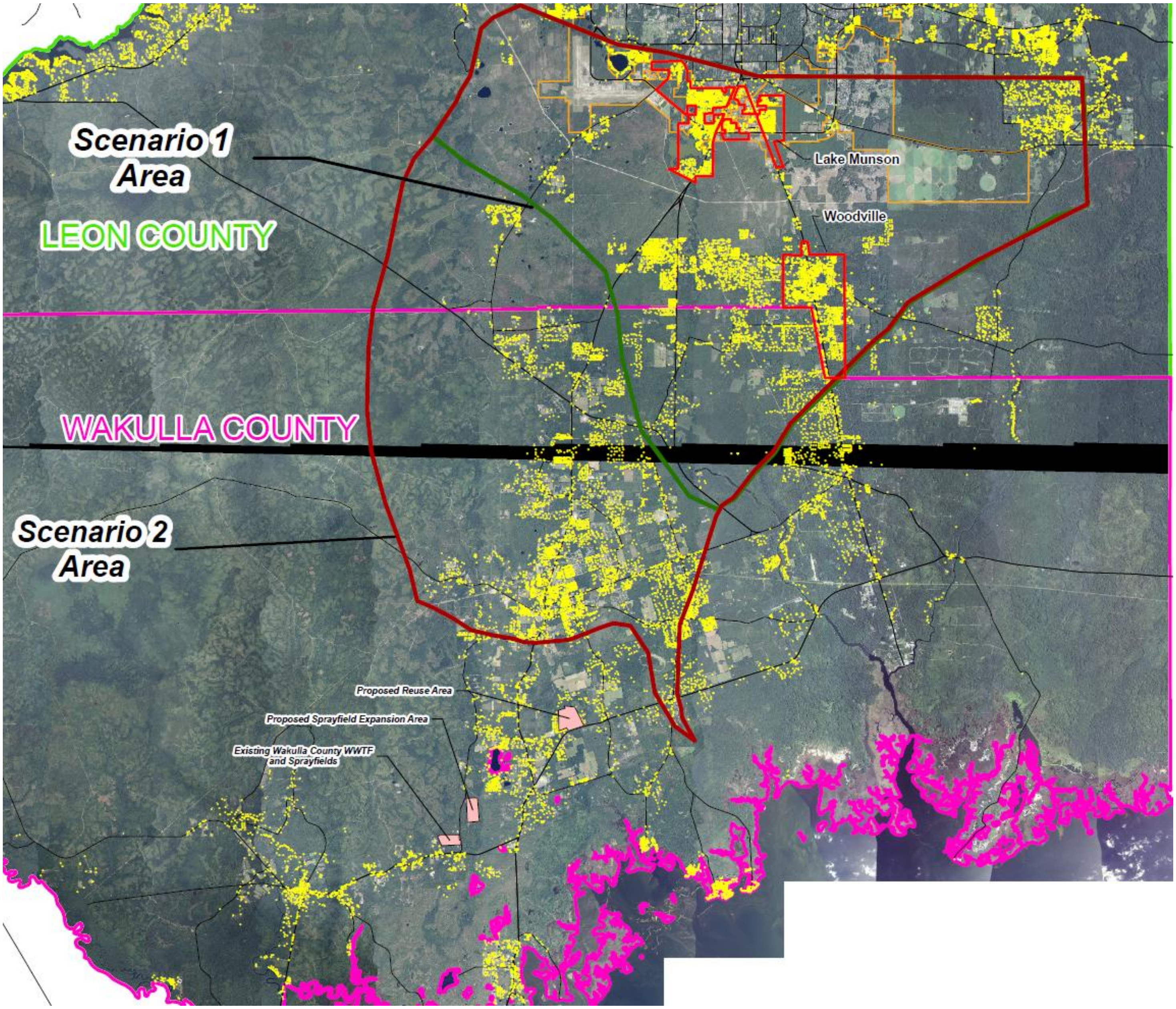
- The City of Tallahassee Master Plan identified the Lake Munson and Woodville areas as candidates for sewer extensions. These areas proved to be comparable to cluster AWT OSTDS on a life cycle $/kg/yr nitrogen removal basis.

- The Wakulla County Facilities Plan assumes expansion within Crawfordville, however the extent of that expansion is not clear.

- Costs for connection to the CoT system and for AWT cluster systems are based on areas like Lake Munson and Woodville, where density is favorable.

- Case studies are needed to determine which wastewater management approach is the most cost effective for less dense areas, such as north of Crawfordville center and west of Woodville center.

Figure 1-1. Existing OSTDS Within Scenarios 1 and 2 Areas



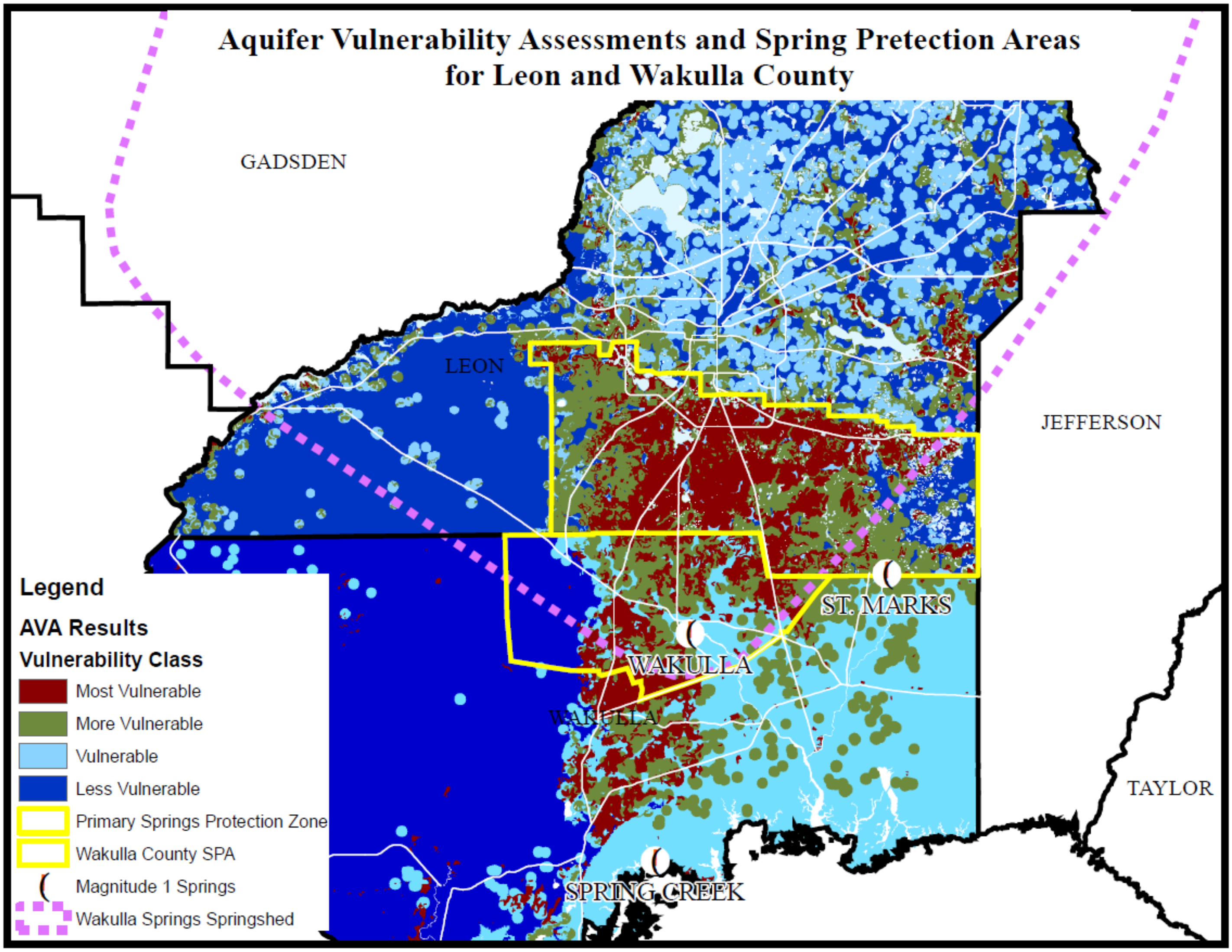
Source: Hal Davis, Personal Communication, 2010. Figure 1-1 is LAI's visual adaptation of the Scenario 1 and 2 boundaries from figures furnished by Hal Davis.

1.2 DESCRIPTION OF CANDIDATE AREAS

Figure 1-1 shows the approximate boundaries of the Scenario 1 and Scenario 2 areas, with the locations of septic systems shown in yellow. Also shown in Figure 1-1 are the Lake Munson and Woodville proposed CoT expansion areas and the existing and proposed Wakulla County WWTF, sprayfields and potential reuse site.

Figure 1-2 shows the results of the Leon County Aquifer Vulnerability Assessment, for reference purposes. Some of the red and green areas north of the Cody Scarp may, following future planning studies, prove to be cost-effective areas to implement AWT solutions. There are approximately 13,100 OSTDS in the Scenario 2 area, of which approximately 8,600 OSTDS are within the Scenario 1 area.

Figure 1-2. Relative Aquifer Vulnerability for Leon and Wakulla Counties



Source: City of Tallahassee http://www.talgov.com/planning/compln/briefhistory.cfm

This report discusses the factors that determine if an OSTDS within the Scenario 1 and 2 areas is recommended to be served by a central sewer system (via extension of an existing facility) or cluster treatment systems capable of meeting AWT standards. Cluster treatment facilities are comparable to centralized treatment facilities when it comes to performance and reliability. As such, the determining factor in deciding between cluster treatment and centralized sewering is typically cost-effectiveness. Non-economic factors such as unwanted growth may also impact the decision between cluster and centralized sewering. Factors affecting the cost effectiveness of clusters vs. centralized sewering include the following:

1. Density of development
2. Distance from the nearest centralized treatment facility
3. Capital and O&M costs associated with treating the collected wastewater

Both centralized and cluster systems can utilize the same type of collections systems, therefore collection system selection issues are not discussed as a part of this report.

1.3 CLUSTER VS. CONNECTION TO EXISTING CENTRALIZED SYSTEM

The advantages of extending existing sewers and utilizing an existing centralized treatment facility are as follows:

1. Use of existing plant capacity eliminates costs associated with constructing new treatment facilities.
2. Expansion of existing facilities is typically the most cost effective AWT option, on a $/kg/yr nitrate removed basis, particularly where unused capacity exists.
3. Potential to remove OSTDS nitrogen loads from watershed, resulting in 100% removal of wastewater nitrogen (as is the case with the Otter Creek WWTF existing and proposed discharge / reuse sites being outside the Scenario 1 and 2 areas).

Disadvantages of sewer extensions are as follows:

1. For conventional gravity sewers, large pump stations and force mains are required to convey wastewater over potentially long distances to connect to existing sewer systems. Alternative low pressure and septic tank effluent sewers have cost and non-economic advantages.
2. Energy use associated with pumping water over long distances.
3. Potential for unwanted growth for properties “along the way” between the new and existing service areas.
4. Moving water across watershed boundaries may not be desirable.

Figure 1-1 illustrates the density of development in the Scenario 1 and 2 areas. High density favors both cluster and centralized sewering options. The primary factors impacting the cost effectiveness of a centralized sewer system are as follows:

1. Density of development, summarized as length of street sewer per connection
2. House connection length
3. Distance and elevation change from the proposed extension area to the treatment facility
4. Cost of treating the additional flows

The distance between the extension area and the existing centralized facility typically requires a large pump station and a significant length of pipe to convey the extension area wastewater flows to the treatment facility or collection system feeding the treatment facility. The local lengths of house to street connection piping will be the same for either cluster or centralized options.

Cluster systems have the advantage of being localized, eliminating unnecessary piping and pump stations. In areas where sewer extensions are not cost-effective, multiple, small clusters serving all but the most isolated lots may prove to be a cost effective option. This flexibility eliminates collection system pipes that traverse sparsely or unpopulated areas within the service area. By using multiple, small clusters, high density streets within otherwise low density areas may be cost-effectively served. The disadvantage to this approach is having multiple facilities to manage and monitor. Cluster system alternatives require that suitable treatment and dispersal sites exist. Cluster systems can be sited underground and in paved areas. This flexibility increases the number of candidate treatment and dispersal sites for these smaller systems.

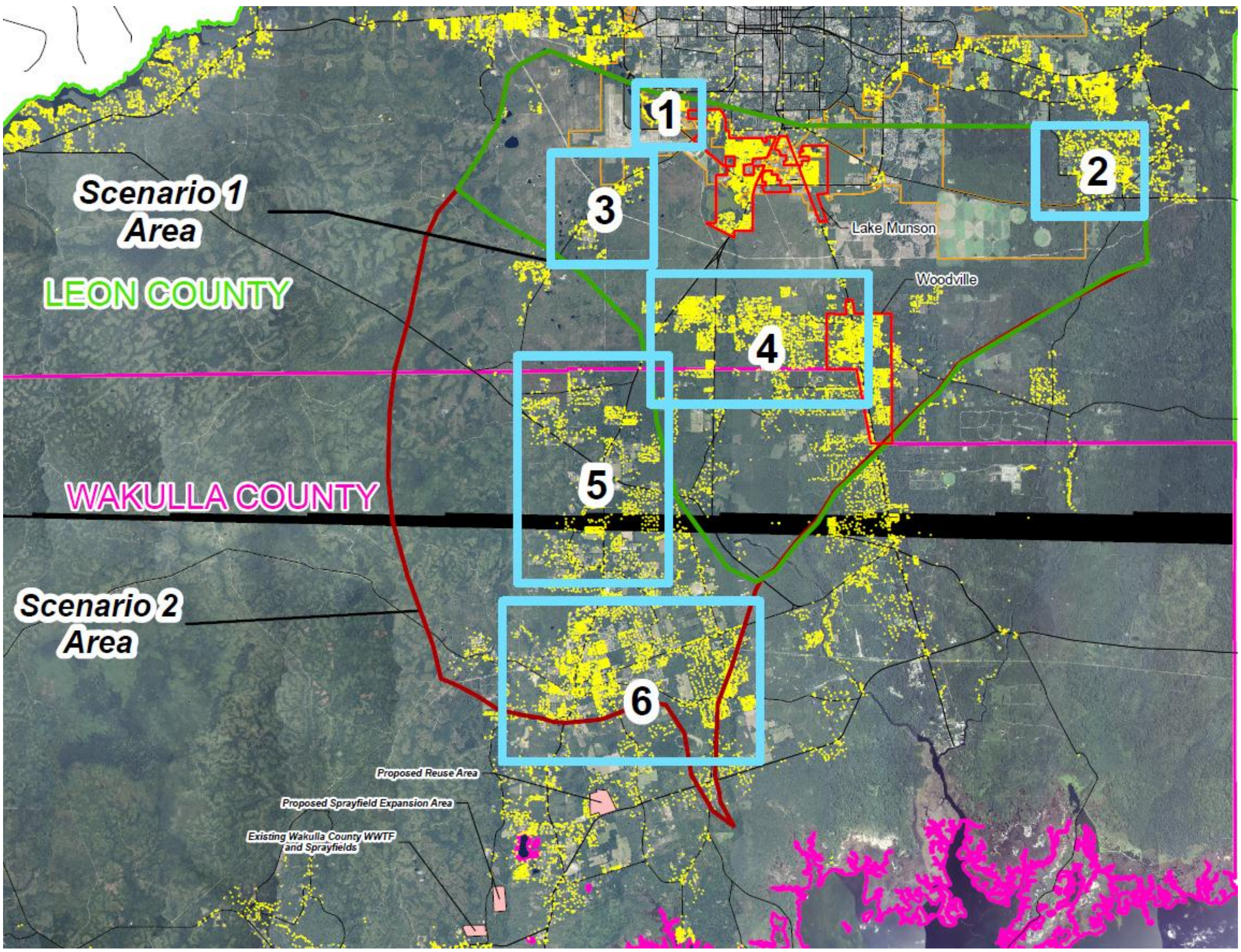
This report is an overview of general areas where cluster and/or connection to an existing centralized system is recommended for further evaluation.

2 IDENTIFICATION OF GENERALIZED AREAS WHERE CENTRAL SEWER SYSTEMS ARE THE RECOMMENDED OPTION

Figure 1-1 appears to show that the majority of development in the Scenario 1 and 2 areas is dense with few isolated lots. However, zooming in to the parcel level shows that the density of developed lots varies from what appears to be favorable to what is likely not favorable for sewer extensions. Six sub-areas were visually examined for determination of the likely optimal recommended solution. Figure 2-1 is a key that shows the location of six sub-areas to be discussed. Each area will be evaluated using the following assumptions:

- The Scenario 1 area will likely require AWT levels of nitrogen removal, making cluster systems and/or connection to existing systems the preferred treatment option where economically feasible
- The CoT and Otter Creek WWTFs either have or can feasibly add sufficient capacity to treat and disperse additional wastewater flows from areas that are feasible to connect

Figure 2-1. Cluster and Sewer Extension Candidate Sub-Areas



2.1 PREVIOUSLY IDENTIFIED SEWER EXTENSION AREAS

The City of Tallahassee (CoT) Master Plan provided detailed costs estimates for connecting two areas within the AWT areas. These areas are as follows:

1. Woodville
2. Lake Munson

Table 2-1 summarizes the capital costs associated with connection to the CoT centralized system.

Table 2-1. Centralize Sewering Costs for Two AWT Areas

Criteria	Lake Munson	Woodville
Buildout # of Connections	3,162	2,150
Buildout Population	8,379	3,320
People/Connection @ Buildout	2.65	1.54
Existing Population	6,683	2,938
Existing Potential Connections	2,522	1,903
Existing People/Potential Connection	2.65	1.54
Total Sewer Cost	$30,614,860	$24,576,240
Cost/Potential Connection - Existing	$12,139	$12,917
Cost/Potential Connection - Buildout	$9,682	$11,431
System Cost - Outside CoT	$4,500	$4,500
Abandon Septic	$1,500	$1,500
House Connection	$2,500	$2,500
Total Cost / Potential Connection - Buildout	***$16,680***	***$18,430***
Total Cost / Potential Connection - Existing	***$19,140***	***$19,920***

The City of Tallahassee Master Plan only identified the above two areas as part of its expansion plans within the Scenario 1 and 2 areas. The Lake Munson and Woodville areas appear to be favorable for sewer extensions to the CoT system – see Task 2 Report for a summary of total life cycle costs. Subsequent sections will discuss other areas that may warrant consideration for connection to the CoT system.

The 2006 Wakulla County Wastewater Facilities Plan detailed plans to extend the existing sewer service are via a new force main and pump station along Lower Bridge Road. The Wakulla Gardens development would be sewered and connected to the new pump station that would pump westward along Lower Bridge Road over to the Crawfordville service area. An April 28, 2009 Eutaw Utilities, Inc. memo detailed a revision to this plan in which the pump station would accept flows from a portion of Crawfordville and pump down Spring Creek Highway to 98 and over to the Otter Creek WWTF. The Otter Creek WWTF is planned for an upgrade to AWT standards as well as a significant increase in flow from the existing 0.6 MGD to 1.6 MGD. The expanded service area and facility will collect a significant amount of wastewater from within the Scenario 2 watershed and discharge via sprayfields that are located outside the watershed.

The existing sewer service area includes Panacea and Crawfordville. The sewer service area is largely confined to properties along the Crawfordville Highway, with limited service extensions along 3 intersecting streets. From Figure 1-1, it appears that there is a high density of onsite systems immediately outside the existing service area. Provided the capacity exists within the existing sewer system, there appears to be a large number of onsite systems that can likely be served by extensions along the existing system. Costs were provide for connecting all of Wakulla Gardens to the Otter Creek WWTF. These costs are summarized in Table 2-2, based on the approximate number of existing and buildout connections. A reasonable assumption for the future buildout condition is difficult to assess given the uncertainty of economic conditions and the overall condition of the housing market. In addition, it is unclear if the total collection system costs include fittings for every undeveloped lot. It is unlikely that the full buildout of 2,500 lots will occur in the foreseeable future, therefore the most relevant capital cost, for comparison purposes, is the cost per existing connection.

Table 2-2. Centralize Sewering Costs for Wakulla Gardens

Wakulla Gardens Community Collection System
Cost Summary

	Existing	*Buildout*
# Connections:	**800**	**2,500**

Component	Cost	Cost per Connection	
		Existing	Buildout
Collection System	$ 12,204,399	$ 15,255	$ 4,882
Master Lift Station & FM	$ 2,753,836	$ 3,442	$ 1,102
Wastewater Treatment	$ 3,957,673	$ 4,947	$ 1,583
Effluent Disposal	$ 653,110	$ 816	$ 261
Total Project Cost	**$ 19,569,018**	**$ 24,461.27**	**$ 7,827.61**
House-to-Street Connection		**$ 4,000**	**$ 4,000**
Total Project Cost		**$ 28,461**	**$ 11,828**

2.2 TYPICAL CLUSTER SYSTEM COSTS – WAKULLA GARDENS CASE STUDY

Cluster system cost effectiveness is determined by the same factors as centralized sewering, with the exception of proximity to an existing WWTF or collection system. When density is high, the length of street sewer per connection is low, resulting in a lower cost per connection. Cluster systems do not require a large pump station and force mains to transmit flow to a remote treatment facility. This cost savings is offset by the need to site, build and operate a local treatment and dispersal facility. LAI generated conceptual costs for a cluster system that would serve a section of the Wakulla Gardens development. While this area is outside the

Scenario 1 and 2 areas, it is representative of the costs associated with relatively high density cluster systems. Table 2-3 summarizes these costs.

Table 2-3. Local AWT Cluster System Cost – Relatively High Density

# of Conections	Existing	Buildout
	176	**280**

Component	Total Capital Cost		Cost per Connection	
	Existing	Buildout	Existing	Buildout
On Property	$891,000	$1,412,000	$5,100	$5,100
Street Sewer	$718,000	$718,000	$4,100	$2,600
Treatment	$1,657,000	$2,527,000	$9,500	$9,100
Dispersal	$196,000	$285,000	$1,200	$1,100
Total	**$3,462,000**	**$4,942,000**	**$19,900**	**$17,900**

These costs are marginally higher than the sewering costs developed for Woodville and Lake Munson, however they are less than the costs Eutaw estimated for connecting all of Wakulla Gardens to the Wakulla WWTF, based on existing development. This is an example of how proximity to existing sewers can influence the cost effectiveness of sewer extensions. It would appear from this analysis that cluster systems are more cost effective for Wakulla Gardens than the cost of extending the existing sewer service area to include Wakulla Gardens. Cluster treatment systems tend to be more modular, and therefore more easily phased in as flows increase. This facilitates delaying construction of excess treatment capacity that may not get used for many years, if at all. Deferring capital expenditures until closer to the date when revenue will be generated from those expenditures reduces financial risks.

2.3 AREA 1 – LAKE BRADFORD AREA

This area is located in the northwest portion of the Scenario 1 and 2 areas to the east of Lake Bradford, as shown in Figure 2-2 with OSTDS locations shown in yellow. Of note is the proximity of this area to the proposed CoT Lake Munson expansion area. The density is relatively high and appears to be comparable to Lake Munson area. Given the relatively high density, the proximity to a proposed sewer expansion area and its location within the Scenario 1 area, this area is recommended for further evaluation as a CoT sewer extension area. The relatively high density is favorable for clustering as well. There are a small number of isolated lots that may not be cost effective to include in a cluster or sewer extension. These lots could be served by AWT onsite systems as part of a plan to provide AWT to all OSTDS within the Scenario 1 area. By not extending collection lines out to the isolated lots, the cost per connection for sewer extensions or cluster systems can be minimized.

2.4 AREA 2 – NORTHEAST OF COT SPRAYFIELDS

Area 2 is located in the northeast corner of the Scenario 1 and 2 areas, northeast of the CoT sprayfields, and is characterized by moderately low density with pockets of relatively high density. Figure 2-3 is an aerial view of Area 2 with the OSTDS locations shown in yellow. This area is not close to either the CoT or Wakulla County systems and is unlikely to be a candidate for connection to either system. It is not known where the optimal connection point to the CoT system would be, however it appears that the minimum distance to connect this area via a pump station and force main would be approximately 5 miles.

The lower density will increase the cost per connection for a single cluster system. However, as shown in green on Figure 2-3, there are pockets of high density that would be favorable for smaller AWT cluster systems. Area 2 is located within the Scenario 1 area. With AWT levels of nitrogen removal likely to be necessary and the existence of pockets of high density development, Area 2 is recommended for further evaluation as a mixed cluster / onsite AWT area. Determining the optimal mix of clusters and onsite AWT systems would require a more detailed analysis.

Figure 2-2. Area 1 - Lake Bradford

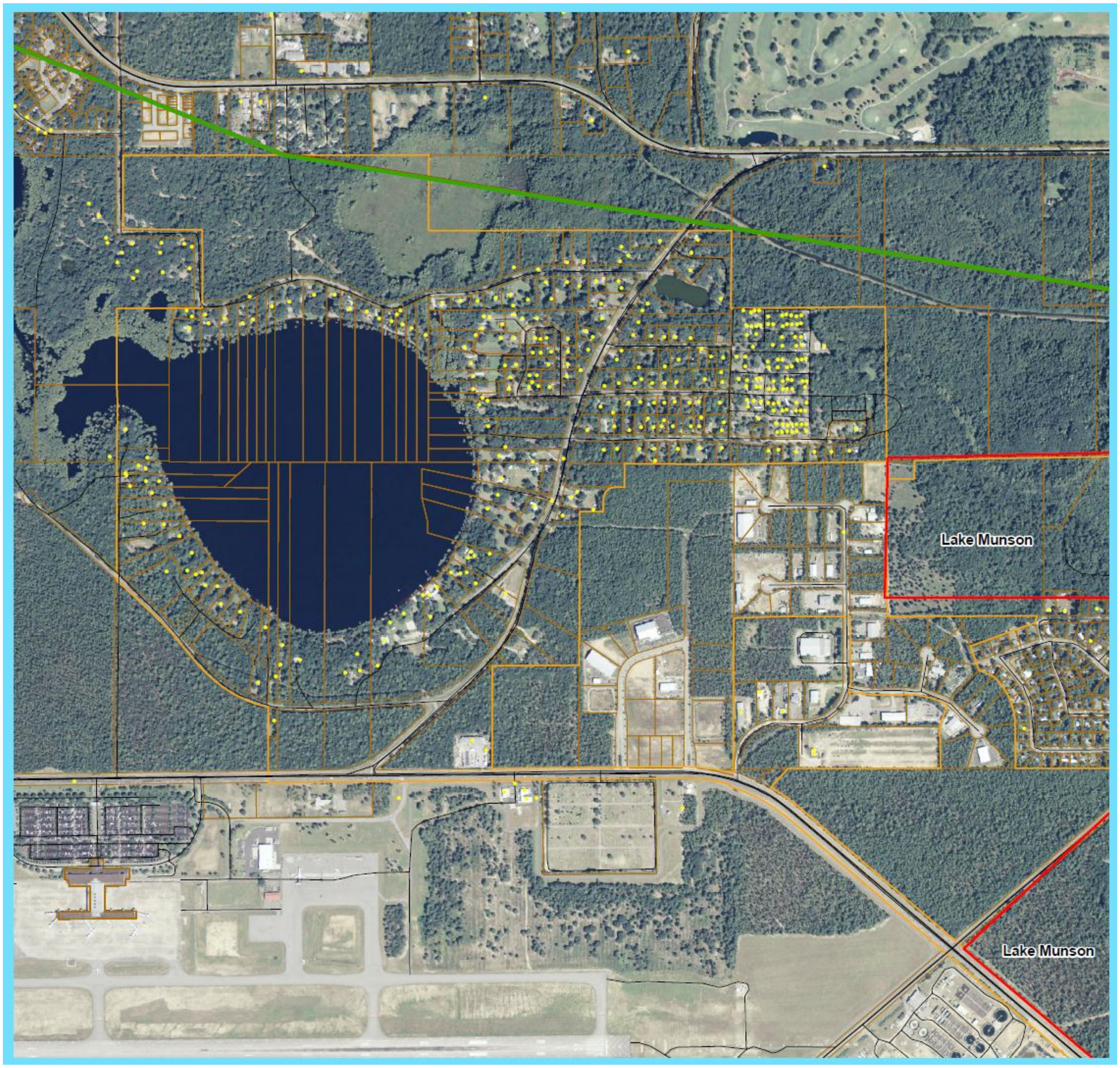
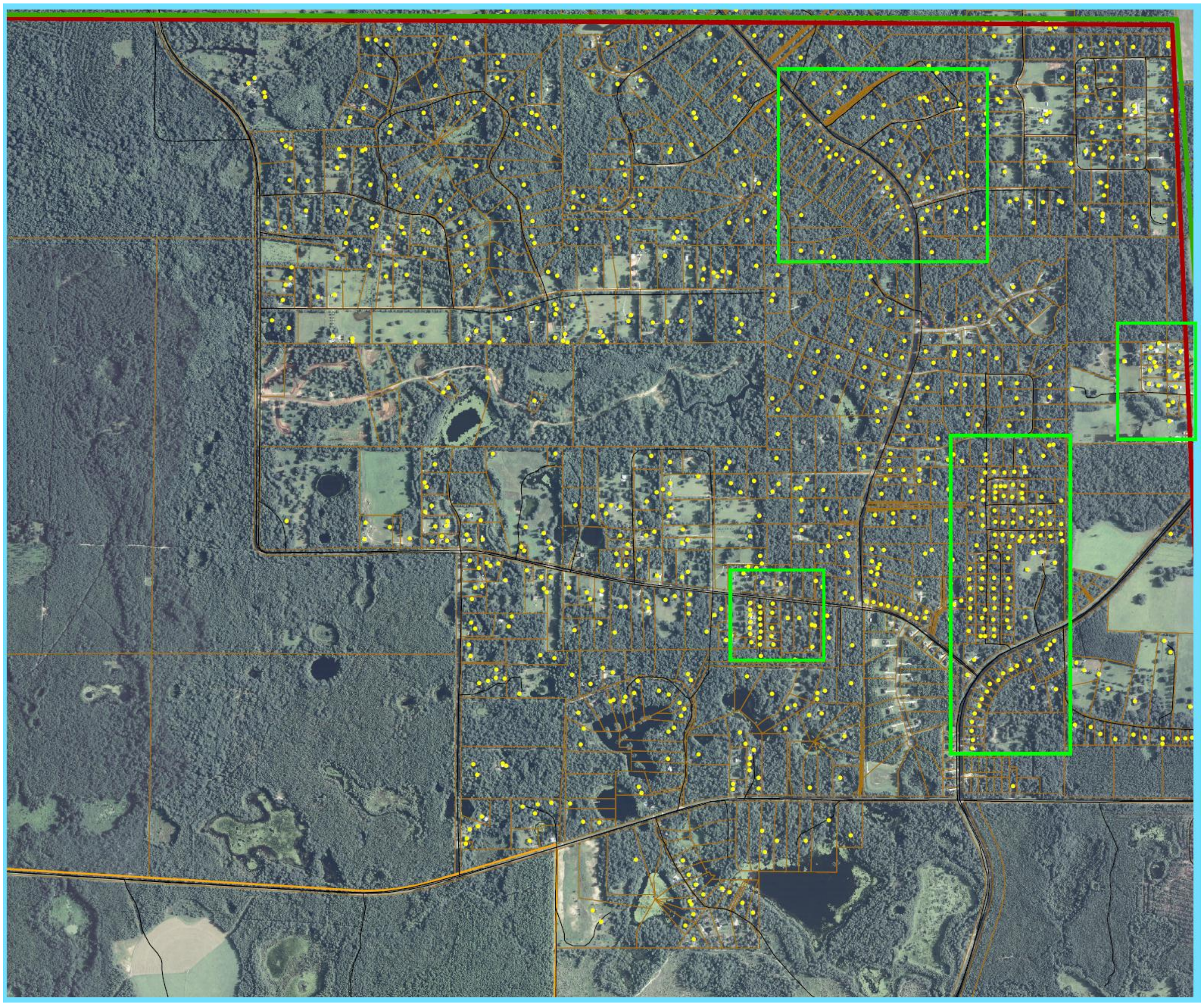


Figure 2-3. Area 2 – Northeast of CoT Sprayfields

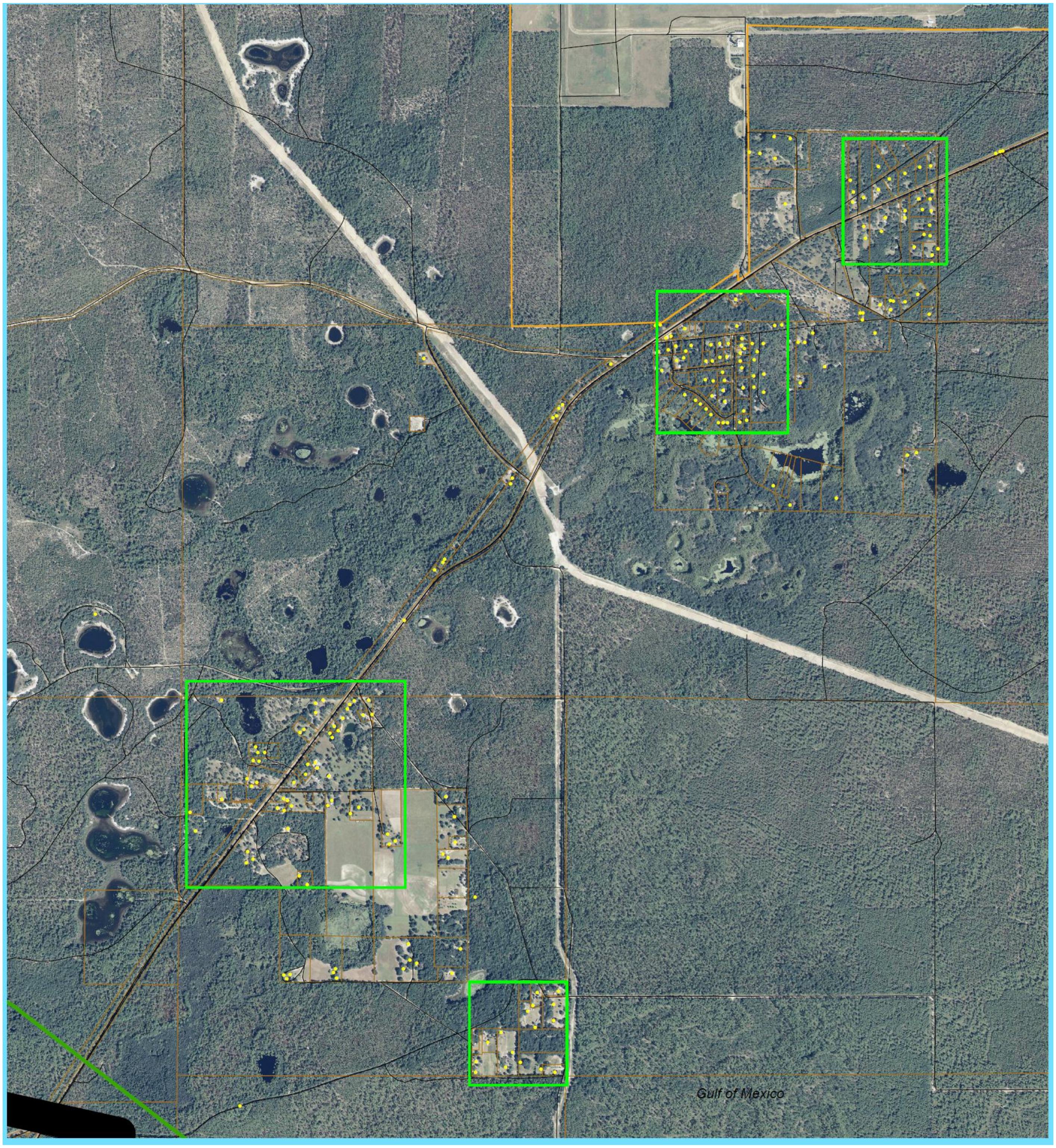


2.5 AREA 3 – SPRINGHILL ROAD SOUTH OF AIRPORT

Area 3 is located along Springhill Road, South of the Airport and within the Scenario 1 area. Similar to Area 2, this is a relatively low density area with pockets of higher density development, as shown on Figure 2-4. The approximate length of force main required to add this area to the proposed CoT Lake Munson expansion area is 3 miles from the northern most portion of Area 3. The southern pockets of development are approximately another 2 miles further. This area is not likely to be economically feasible for connection to the CoT system.

There are four areas of localized higher density that appear favorable for cluster systems, shown in green on Figure 2-4. Area 3 is recommended for further evaluation as a mixed cluster / AWT onsite system area.

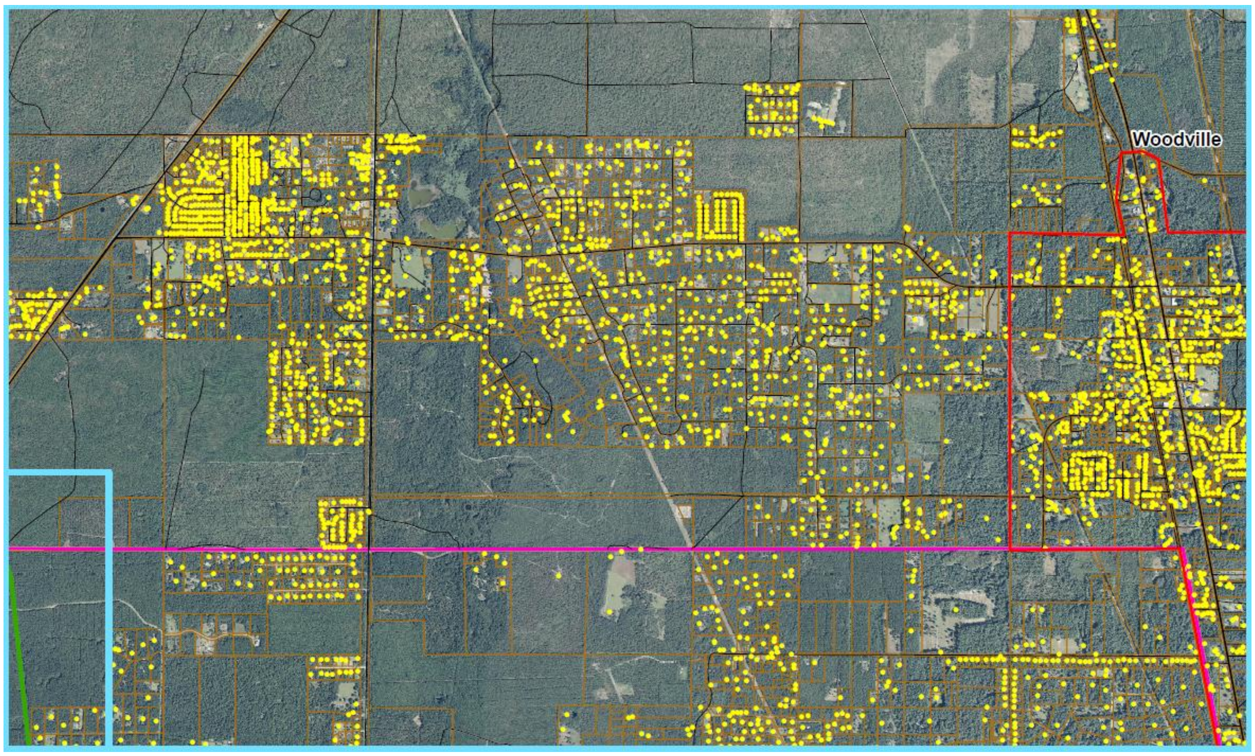
Figure 2-4. Area 3 – Springhill Road



2.6 AREA 4 – WEST OF PROPOSED COT WOODVILLE EXPANSION AREA

Area 4 is located in Leon County, west of the proposed CoT Woodville expansion area. This area is characterized by moderately high density development with pockets of high density and a few isolated lots. This area is located within the Scenario 1 area. The proximity of this area to the proposed CoT Woodville expansion area combined with the moderate to high density of development make this area a candidate for connection to the CoT system. The density of development is also favorable for one or more cluster systems. Area 4 is recommended for further evaluation as a CoT expansion area and/or a cluster treatment area.

Figure 2-5. Area 4 – West of CoT Woodville Expansion Area

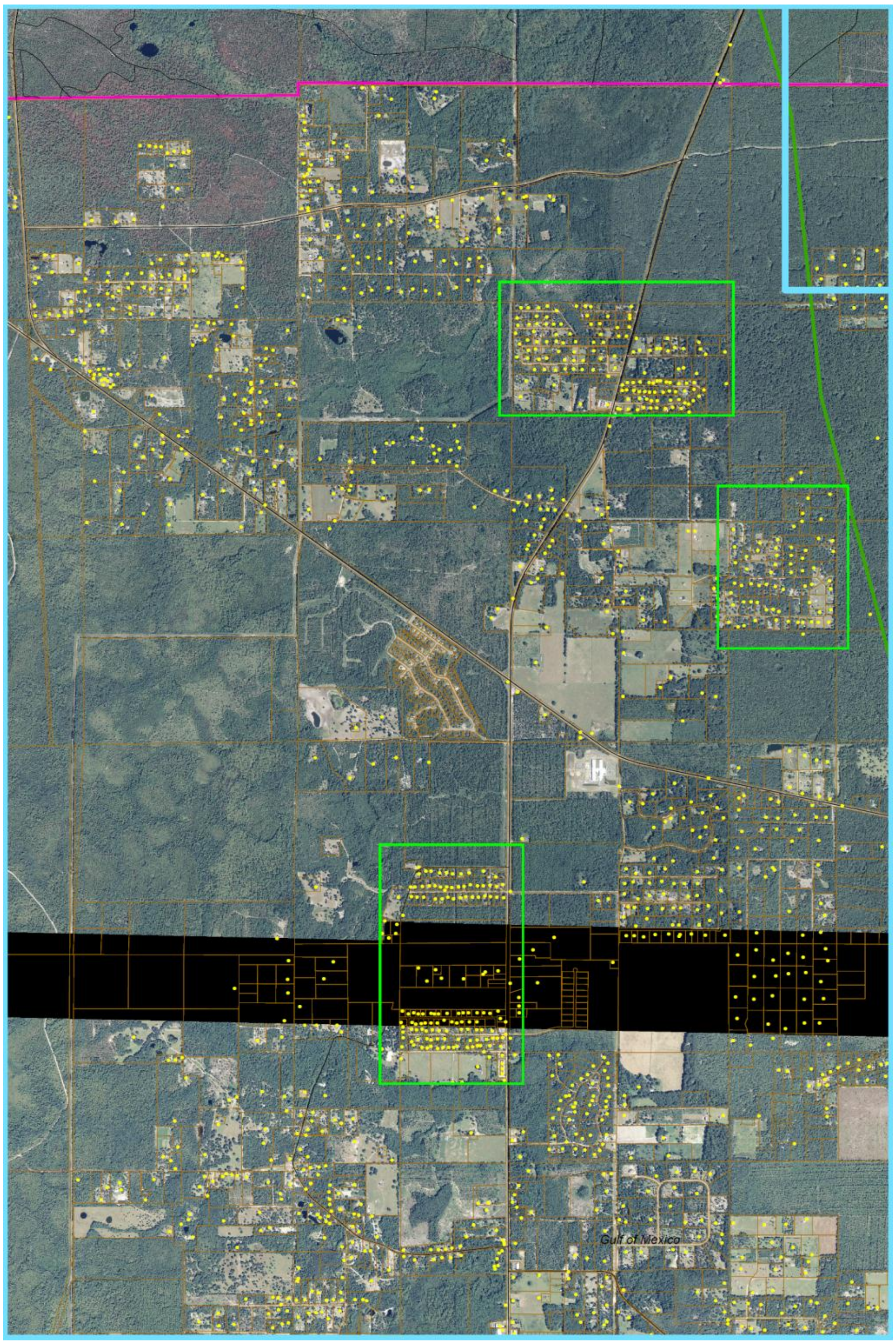


2.7 AREA 5 – NORTHERN CRAWFORDVILLE

Area 5 is located in the northern end of the Crawfordville area, extending up to the Wakulla / Leon County line. This area is characterized by overall low density with pockets of high density development, as shown on Figure 2-6. Area 5 is located in the Scenario 2 area, outside the Scenario 1 area. This area does not required AWT levels of nitrogen removal and may not require any additional nitrogen removal once the Scenario 1 area is upgraded to AWT treatment. The proposed expansion of the Wakulla County sewer service area includes portions of Crawfordville. Further expansion into this area may be an economically feasible option, however the overall density of development does not appear favorable for a sewer extension.

In the event nitrogen removal is required beyond what will be proposed in the Scenario 1 area, three higher density areas were identified as candidates for small cluster systems. These areas are shown in green on Figure 2-6.

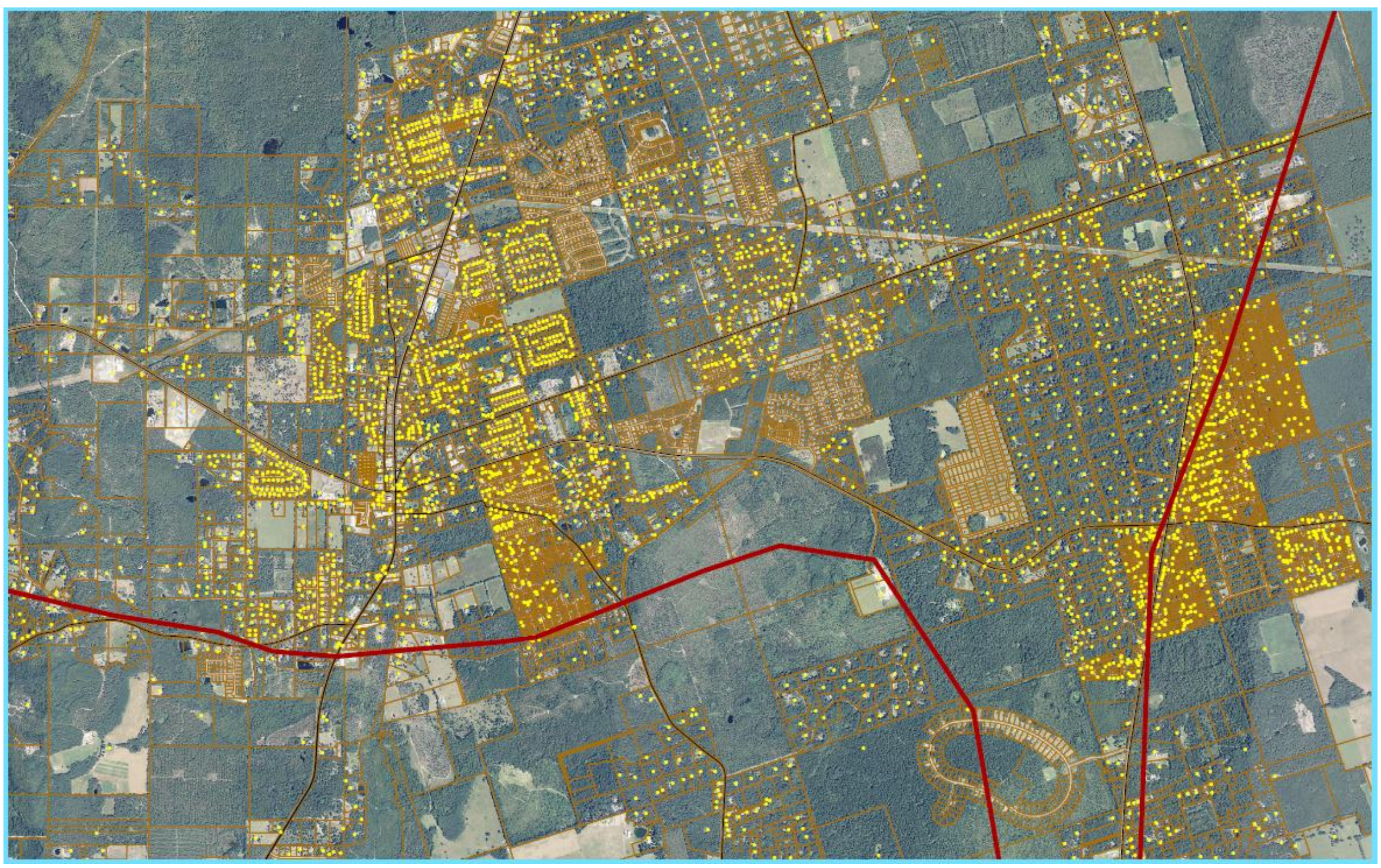
Figure 2-6. Area 5 – Northern Crawfordville



2.8 AREA 6 – CRAWFORDVILLE CENTER

Area 6 is located in the center of Crawfordville and is characterized by high density development. Portions of this area are included in the Wakulla County Facilities Plan as part of the planned expansion of the treatment and dispersal systems. The density of this area appears favorable for connection to the Wakulla County system. As with the other areas, there are areas with relatively low density of development that will negatively affect the economic feasibility of connecting the entire area. Similar to Area 5, this area is also outside of the Scenario 1 area and may not require nitrogen removal beyond what is recommended in the Scenario 1 area. It is recommended that this area be evaluated for additional connections, beyond what is already planned, to the Wakulla County System. This option has the added benefit of 100% removal, as the existing and proposed dispersal and reuse areas are outside both the Scenario 1 and 2 areas. Cluster systems are not likely to be competitive in the highest density areas adjacent to existing sewers. For other areas such as the western edge of Wakulla Gardens, where the length of force main and pump station costs are relatively high for connection to the Wakulla County system, cluster systems are likely to be more cost effective. This area is recommended for further evaluation as both a Wakulla County expansion area and a cluster treatment area.

Figure 2-7. Area 6 – Crawfordville Center



3 SUMMARY & CONCLUSIONS

The Scenario 1 area is assumed to require AWT levels of nitrogen removal for all OSTDS, making cluster and centralized treatment the preferred option for higher density areas. Areas 1-4 are located in the Scenario 1 area and are characterized by a mix of relatively low density areas with pockets of high density development. Only Area 1 appears to be feasible as a CoT expansion area. The remaining areas have pockets of higher density development that are candidates for cluster treatment systems.

The Scenario 2 area outside the Scenario 1 boundary is predominantly the higher density Crawfordville area, which is already partially sewered. As such, the high density areas adjacent to existing sewers should be investigated for inclusion in the planned expansion of the Wakulla County system. However, nitrogen removal in this area is not be necessary.

Other conclusions include the following:

- Connection to the CoT system appears to be the most cost effective means for servicing the Woodville and Lake Munson areas, and similarly Central Crawfordville appears to be cost effective to connect to the Wakulla County system.
- Higher density areas in the northern Crawfordville area and the areas around the western edge of Wakulla Gardens are candidates for AWT cluster systems.
- The Lake Bradford area is recommended for evaluation as an addition to the CoT Lake Munson expansion area.
- Areas 2-4 are within the Scenario 1 area and appear to be candidates for a mix of AWT cluster and AWT onsite systems.
- The remaining areas (not in Areas 1-6) are lower density areas that are likely to be best served by either AWT onsite systems in the Scenario 1 area or PBTS/conventional systems in the Scenario 2 areas that are located outside Scenario 1. A more detailed analysis may show portions of these areas that are candidates for AWT cluster systems.

APPENDIX A: BIBLIOGRAPHY – REFERENCE DOCUMENTS

The following documents were reviewed in preparation of the Lombardo Associates, Inc. (LAI) Onsite Sewage Treatment & Disposal and Management Options Task 6 Draft Report:

Wastewater Planning:

1. Wakulla County Wastewater Facilities Plan FY 2006, FL Dept. of Environmental Protection State Revolving Fund, Marc E. Neihaus, P.E., November 30, 2006.

2. City of Tallahassee (CoT) 2030 Master Sewer Plan – Phase II, CoT Water Resources Engineering Dept., February 10, 2010

TASK 7 REPORT

SCOPE OF WORK FOR FURTHER ANALYSIS, INCLUDING RECOMMENDED SUBSET OF TREATMENT & MANAGEMENT OPTIONS

ONSITE SEWAGE TREATMENT AND DISPOSAL AND MANAGEMENT OPTIONS

FOR

WAKULLA SPRINGS, LEON COUNTY, WAKULLA COUNTY & CITY OF TALLAHASSEE, FL

November 4, 2011

Submitted by:

Environmental Engineers/ Consultants
LOMBARDO ASSOCIATES, INC.
188 Church Street
Newton, Massachusetts 02458
www.LombardoAssociates.com

Submitted to:

Leon County Purchasing Division
2284 Miccosukee Road
Tallahassee, FL 32308

Table of Contents

List of Tables

1. OVERVIEW

This Draft Task 7 Report outlines and discusses the following:

- Recommendations on the scope of work of Phase II activities
- Potential funding sources for a Phase II activities

The objective of Phase II activities to reduce important uncertainties regarding nitrogen removal requirements and selection and further refinement of preferred nitrogen removal technique(s) and establishment of OSTDS management entity(ies).

The Phase II activities will be initial efforts that would be incorporated into the Wastewater Management Plan (WWMP) and Wastewater Facilities Plan (WWFP), discussed in the Task 5 Report.

2. RECOMMENDED PHASE II SCOPE OF WORK

The following areas of uncertainty were discussed as having an effect on nitrate removal requirements and the associated treatment and management alternatives in the Task 1 Report:

- Attenuation of nitrates in the following areas of concern:
    - Scenario 1 and 2 areas
    - Most Vulnerable (and possibly More Vulnerable) Areas north of the Cody Scarp
    - Vulnerable and Less Vulnerable areas north of the Cody Scarp
- Effect of CoT potential sewer expansions on Inflow and SESF nitrate loads to Wakulla Springs
- Growth projections for Wakulla County and unincorporated Leon County
- Future flow condition of Wakulla Springs – Scenario 1 vs. Scenario 2
- Techniques for reducing nitrogen contributions from Inflow, Fertilizer, Creeks/Sinks, and Livestock

The recommended future scope of work to address these issues is detailed in this report.

2.1 ATTENUATION OF NITRATES IN SOILS

As discussed in the Task 1 Report, the assumed attenuation affects the nitrate removal requirements under both Scenario 1 and Scenario 2 conditions. However, it is important to note that the nitrate removal requirements for Scenario 1 dominate. The consequences of this are as twofold:

1. AWT level of nitrate removal from OSTDS plus removal from additional sources within the Scenario 1 area is required under any reasonable assumption for attenuation.

2. Providing AWT levels of nitrate removal in the Scenario 1 area exceeds the nitrate removal requirements for the Scenario 2 area under any reasonable attenuation assumption.

The conclusion is that an AWT level of nitrate removal is required in the Scenario 1 area, the Scenario 2 areas outside of Scenario 1 do not require any additional nitrate removal, and other sources of nitrate must be reduced to meet the water quality standard for Scenario 1. The total additional nitrate removal required depends on the attenuation assumed, as outlined in Table 1 below.

Table 1 also presents the number of OSTDS that would require AWT north of the Cody Scarp assuming that Most Vulnerable (and possibly More Vulnerable) areas have attenuations of 50% instead of the 79+% that appears to apply to other OSTDS in less vulnerable areas. As can be seen, the attenuation assumed makes a significant difference in the additional mass of nitrate that needs to be removed to meet the water quality standard.

However this all assumes that the mass loadings and associated assumptions are accurate. Future efforts should be complimented with additional water quality monitoring and modeling to refine the understandings of the watersheds.

Table 1. Effect of Attenuation on Additional Nitrate Removal Requirement

Scenario 1 Conditions	% Attenuation Assumed South of the Cody Scarp		
	25%	40%	50%
NO_3 Removed by AWT on OSTDS (kg/yr)	69,030	55,260	46,080
Add'l NO_3 Removal Required (kg/yr)	2,070	540	0
% of Inflow NO_3 Load	4.3%	1.1%	0.0%
# of OSTDS Requiring AWT North of the Cody Scarp*	402	105	0

****Assumes that OSTDS in Most Vulnerable areas North of the Cody Scarp have 50% attenuation***

2.2 EFFECT OF POTENTIAL COT SEWER EXTENSIONS

The CoT Master Plan includes potential sewer extension projects that would reduce the nitrate load to the ground surface North of the Cody Scarp. Since the CoT treated wastewater is discharged at the SESF that lies within the Scenario 1 area, this reduction would be partially offset by the discharge of additional AWT treated wastewater within the Scenario 1 area. In order to determine the net change in the nitrate load expected as a result of these planned improvements, the attenuation in the proposed extension areas is needed. In addition to high natural attenuation, a percentage of the nitrate crossing the Cody Scarp bypasses Wakulla Springs, as noted in the Task 1 Report. The combined effect of high natural attenuation and the percent of nitrates that bypass Wakulla Springs must be better understood to determine the net reduction that would result from potential sewer extensions.

2.3 TECHNIQUES FOR REDUCING NITROGEN CONTRIBUTIONS FROM INFLOW, FERTILIZER, CREEKS/SINKS, AND LIVESTOCK

Techniques for reducing nitrogen contributions from Inflow, Fertilizer, Creeks/Sinks, and Livestock should be investigated to assist in developing the optimal least cost plan. With Inflow being the largest contributor of these sources, OSTDS in the most and more vulnerable areas north of the Cody Scarp should be targeted. Non-structural techniques for nitrogen reduction from fertilizer can be effective and have been adopted in other FL communities.

2.4 PROPOSED PHASE II SCOPE OF WORK

The following Scope of Work is proposed to determine the attenuations required to finalize nitrate removal requirements and associated treatment alternatives:

1. Review GIS and LAVA / WCAVA mapping to determine the total number of OSTDS that are in Most Vulnerable, More Vulnerable, and CoT potential sewer extension areas North of the Cody Scarp and within the Wakulla Springs recharge areas.
2. Conduct additional field studies to determine the appropriate attenuations for OSTDS contributing to the Inflow nitrate load.
3. Conduct additional field studies to determine the appropriate attenuation for OSTDS in the Scenario 1 area.
4. Combine information from 1-3 above to finalize the nitrate removal requirements for Scenario 1 conditions

5. Analyze the effect of sewering the potential CoT extension areas on Scenario 1 nitrate removal requirements
6. Divide the Scenario 1 area into subareas based on the most feasible of the following AWT treatment alternatives:
    a. Connection to CoT system
    b. New large AWT cluster system
    c. New small AWT cluster system
    d. AWT onsite systems
7. Develop capital and O&M costs for each sub-area and for the Scenario 1 area as a whole
8. Investigate techniques for reducing nitrogen contributions from Inflow, Fertilizer, Creeks/Sinks, and Livestock; estimate their costs and compare cost-effectiveness vs OSTDS nitrogen removal
9. Perform demonstration projects to quantify the ability of cost-effective techniques for reducing nitrogen contributions from Inflow, Fertilizer, Creeks/Sinks, and Livestock

3. RECOMMENDED SCOPE OF WORK FOR MANAGEMENT ALTERNATIVES

While there is still work to be done to finalize nitrate removal requirements and associated treatment alternatives, the common factor is the need for an AWT level of treatment for OSTDS in the Scenario 1 area. This is a significant undertaking that will require participation from Leon and Wakulla Counties, as well as the City of Tallahassee. The existing number of OSTDS in the Scenario 1 area that lie within these three jurisdictional areas is as follows, per the Task 1 Report:

- Leon County – 7,500
    - of which 118 are in the CoT portion of the PSPZ and therefore in the Scenario 1 area
- Wakulla County – 1,100

The primary decision that needs to be made is determining the number and scope of management entities that will be required for OSTDS in Leon and Wakulla Counties as well as the CoT. Management alternatives were discussed in detail in the Task 3 Report.

As stated in the Task 5 Report, a WWMP is needed to develop each management alternative sufficiently for stakeholders to review and comment on and for decision makers to evaluate. Extensive public participation is a key component to developing a management structure that is feasible to implement.

The following Scope of Work is proposed for the WWMP:

1. Finalize a short list of management alternatives in consultation with CoT, Leon and Wakulla County officials
2. Develop management alternatives sufficiently to estimate the required user charge structure
3. Present management alternatives to decision makers for review and comment and to facilitate a Preferred Management Plan
4. Conduct a series of public participation meetings to educate and obtain feedback from the public on the Preferred Plan
5. Incorporate the results of the finalized nitrate removal requirements into the number and type of systems to be managed

The Scope of Work for the WWFP should include:

1. Community Profile – update
2. Needs Analysis – update integrating results of Section 2.3 Scope of Work
3. Alternative Options - update integrating results of Section 2.3 Scope of Work
4. Alternatives Analysis - update integrating results of Section 2.3 Scope of Work
5. Selection of Preferred Option (s)
6. Management, Institutional and Financial Plan for Preferred Option
7. Implementation Plan of Preferred Option
8. Public Participation throughout entire WWFP process

4. POTENTIAL FUNDING SOURCES FOR PHASE II ACTIVITIES

Potential funding sources for the Phase II activities detailed in Sections 2 and 3 are as follows:

1. Establish one or more RME's that includes all OSTDS within Leon and Wakulla Counties and charge a nominal annual fee. With approximately 50,000 OSTDS, a $20 annual fee would generate revenue of approximately $1,000,000 annually

2. Pursuit grants and loans, especially the 319 grant program and SRF loan. These programs have annual appropriations and changing priorities, so it would be wise to initiate contact with funding sources and get applications prepared and submitted as soon as possible. The OSTDS nitrogen removal and management issues are high priorities throughout Florida so receptivity for grants/low interest loans may be high.