Comprehensive Wastewater Treatment Facilities Plan

Task 8: Final Comprehensive Wastewater Treatment Facilities Plan

LEON
FLORIDA'S CAPITAL COUNTY

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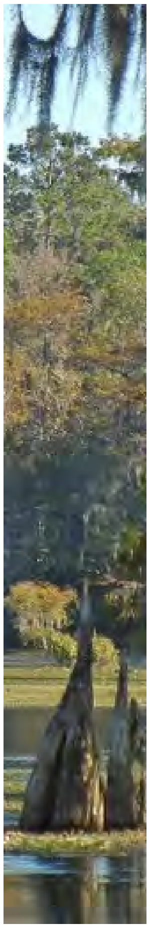

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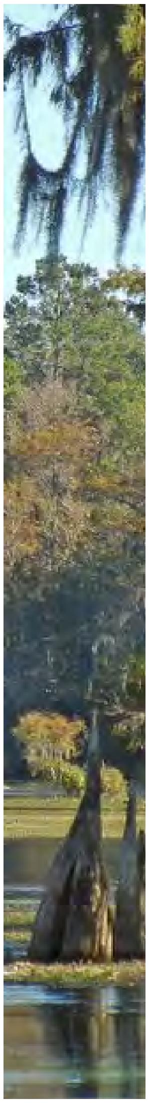

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Acronyms and Abbreviations

ATU	Aerobic Treatment Unit
AWTS	Alternative Wastewater Treatment Systems
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
FDOH	Florida Department of Health
GIS	Geographic Information System
INRB	In-Ground Nitrogen-Reducing Biofilter
JSA	Jim Stidham & Associates
lbs/yr	Pounds Per Year
NSILT	Nitrogen Source Inventory and Loading Tool
OSTDS	Onsite Sewage Treatment and Disposal System
PBTS	Performance Based Treatment System
PFA	Priority Focus Area
PSPZ	Primary Springs Protection Zone
TN	Total Nitrogen
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

The Florida Department of Environmental Protection found that nutrient loads from several sources—including onsite sewage treatment and disposal systems (OSTDSs) in Leon County—impaired Upper Wakulla River and Wakulla Spring. Leon County is developing a plan to reduce nitrogen loads from existing OSTDSs, as well as from future development, to groundwater and surface waters. OSTDSs are also known as septic tank and drainfield systems.

Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are to: (1) identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) identify future development that will require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County's plan is comprised of eight major tasks. This report describes the results of the eighth and final task: final comprehensive wastewater treatment facilities plan. This task involved a preparing a plan summarizing the findings from all previous project tasks, including responses to extensive comments from citizens and agencies.

1.0 Introduction

The Florida Department of Environmental Protection (DEP) found that nutrient loads from several sources have impaired Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive each day while still satisfying water quality standards. This maximum amount is called a total maximum daily load. DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore these important waterbodies by identifying actions that will reduce pollutant loads to the river and spring. DEP adopted the BMAP in June 2018.

As part of the BMAP, DEP developed a Nitrogen Source Inventory and Loading Tool (NSILT) to provide information on the major sources of nitrogen in the BMAP area including atmospheric deposition, wastewater treatment facilities (WWTFs), urban fertilizers, onsite sewage treatment and disposal systems (OSTDSs) (also known as septic systems), livestock wastes, and agricultural fertilizers. The NSILT found that the largest contribution of nitrogen loading to the Wakulla springshed is from OSTDSs. Therefore, the BMAP requires that stakeholders, including Leon County, prepare a plan to reduce nitrogen loads to the river and spring from OSTDSs. Leon County contracted with Jim Stidham & Associates (JSA) to develop an OSTDS remediation plan. JSA partnered with Advanced Geospatial, Applied Technology & Management, The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop this plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP plan with a grant to the county. About 40% of Leon County's land area is served by OSTDS, about 20% is served by five centralized WWTFs, and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (Figure 1).

The objective of Leon County's plan is to identify existing OSTDS to transition to alternative wastewater treatment systems (AWTSs), including connection to sewer, where the transition will most reduce nitrogen loads to the river and spring. This plan provides guidance for retrofit of existing development and technology selection for future development. The JSA team created the Leon County plan by performing the following tasks:

- Task 1. Develop a nitrogen reduction score to identify the likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTS; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas in the County (Appendix A);
- Task 2. Quantify cost-effectiveness of AWTS (Appendix B);
- Task 3. Identify other factors that influence selection of an AWTS (Appendix C);
- Task 4. Provide education to the community regarding information compiled in tasks 1, 2, and 3 and survey opinions of the citizens of Leon County, with respect to this plan (Appendix D);
- Task 5. Analyze implementation scenarios for AWTS (Appendix E);
- Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTS (Appendix F);
- Task 7. Provide additional education to the community regarding the information compiled in tasks 1 through 6 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan (Appendix G); and
- Task 8. Present the draft and final plan to the Leon County Board of County Commissioners.

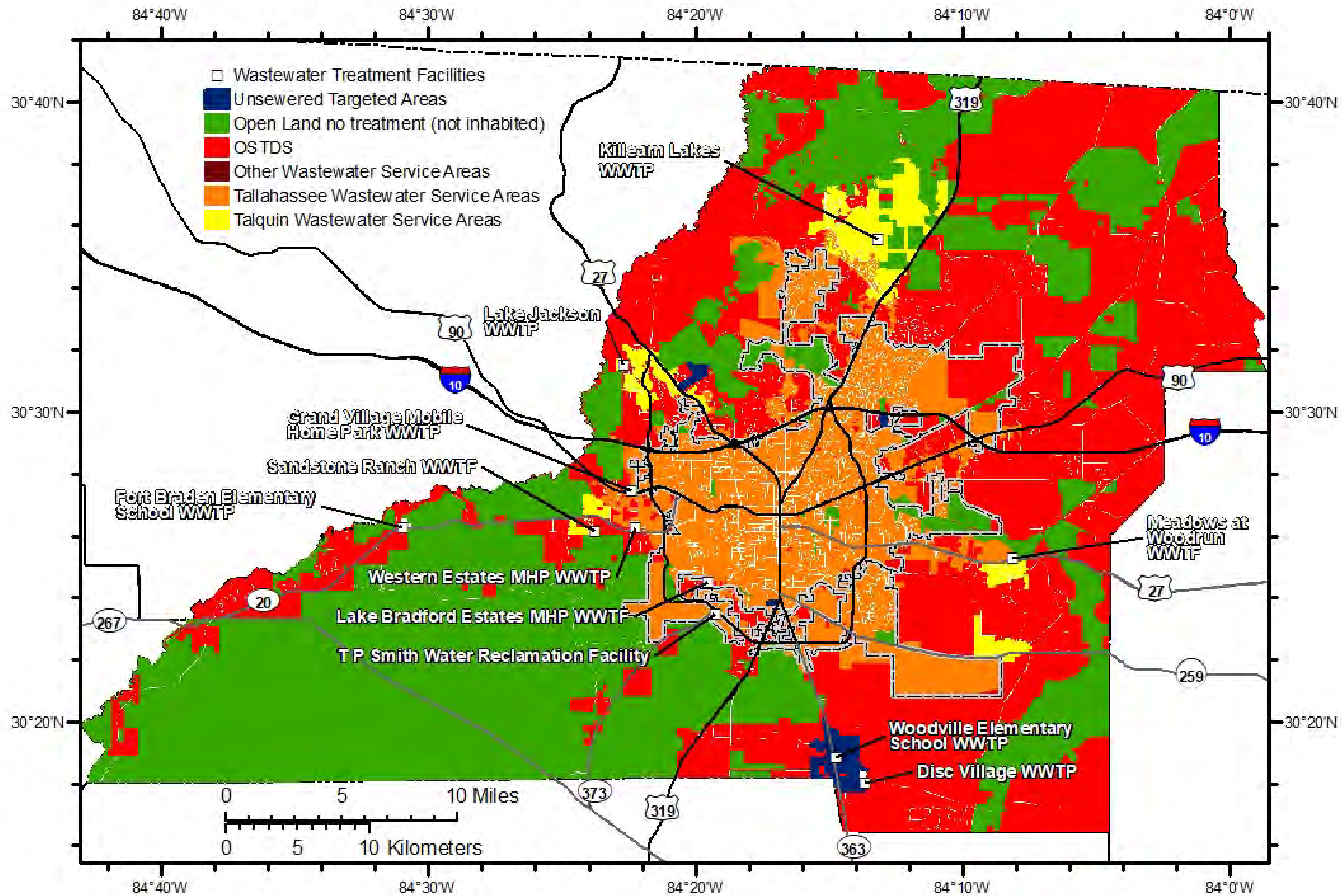

Figure 1. Parcels with an OSTDS, parcels in the Tallahassee wastewater service area, parcels in the Talquin service area, and WWTF locations.

This report is part of task 8 and presents both the final CWTFP and more focused BMAP area plan. Section 2.0 summarizes the evaluation approach taken in the previous tasks. Section 3.0 presents the countywide CWTFP. Section 4.0 presents the BMAP plan. Section 5.0 outlines the assumptions related to both the countywide and BMAP plans.

2.0 Evaluation Approach

2.1 AWTS Options

The JSA team evaluated five options for OSTDS upgrades to AWTS: aerobic treatment units (ATUs), performance based treatment systems (PBTSs), in-ground nitrogen-reducing biofilters (INRBs), cluster systems, and centralized wastewater collection systems.

ATUs introduce air into the treatment of wastewater to help reduce organic pollutants and suspended particles. ATUs generally include a blower or pump to achieve this. Aeration converts ammonia in the wastewater to nitrate, which helps remove nitrogen from the wastewater. These systems must be certified to meet the National Sanitation Foundation International/American National Standards Institute standard 245, which requires testing showing that, on average, at least 50% nitrogen reduction is achieved before partially treated wastewater is discharged to the drainfield. All new construction of OSTDS with ATU needs to have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. If an existing system is being repaired and the 24-inch separation cannot be achieved, the nitrogen reducing ATUs must be capable of reducing nitrogen by at least 65% before discharge to the drainfield to meet BMAP requirements. ATUs with treatment capacity less than 1,500 gallons per day, which includes most homes, do not need to be designed by an engineer; however, they do need an operating permit from the county health department and at least semi-annual inspections from a maintenance entity certified by the product manufacturer.

PBTSs use specialized technologies and rely on engineering principles to achieve a specific and measurable established performance standard for several pollutants including carbonaceous biochemical oxygen demand; concentrations of total suspended solids, total nitrogen (TN), and total phosphorus; and fecal coliform removal. PBTSs designed for springs protection must be approved by the Florida Department of Health (FDOH) and DEP and certified by the design engineer to be capable of providing, on average, at least 50% nitrogen reduction before partially treated wastewater is discharged to the drainfield. As with ATUs, all new construction of OSTDSs with PBTSs needs to have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. They must be capable of reducing nitrogen by at least 65% before discharge to the drainfield for system repairs where the 24-inch separation cannot be met.

INRBs include a reactive media layer consisting of wood mulch, sawdust, or other organic material mixed with sand under a drainfield so that effluent in the drainfield percolates through the reactive media. An INRB drainfield is a two-stage, passive biofilter based on ammonification and nitrification in the first stage and denitrification in the second stage. INRBs are passive upgrades to conventional OSTDS that do not require electrical components for nitrogen treatment. Like a conventional system, however, a pump may still be needed if the drainfield is located higher than the septic tank. The drainfield for an INRB can be implemented using various approaches: lined, non-lined, gravity-feed, low-pressure dosed, and others. The FDEP-approved system with a gravity-fed, non-lined drainfield was used for this study. INRBs require certain soil conditions and are not suitable for all areas. The presence of an INRB must be recorded in the public record as notification to any future property owners. However, they do not require an engineered design, maintenance contract, or operating permit from the county health department under current FDOH regulations.

Cluster systems are wastewater treatment systems designed to serve two or more dwellings or facilities with multiple owners. These systems require adequate land and a system manager, such as a homeowner's association. For this study, cluster systems may include INRBs, ATUs, or PBTSs and would be permitted as an OSTDS, not a WWTF.

Centralized wastewater collection systems, which collect wastewater from multiple parcels and convey it to a WWTF for treatment, work through either gravity or pressure flow. A gravity system transmits wastewater to WWTFs by gravity flow alone and does not include pumps. A pressure system includes lift stations and force mains to deliver wastewater to WWTFs.

2.2 Identification of Nitrogen Reduction Areas

The JSA team calculated a nitrogen reduction score for each parcel within unincorporated Leon County using the following geologic criteria that influence nitrogen reduction and loading to groundwater:

1. Whether the parcel is within the Priority Focus Area (PFA) or Primary Springs Protection Zone (PSPZ). The PFA is an area of concern identified by DEP in the BMAP, while the PSPZ was delineated by Leon County ordinance.
2. Current and future development units per acre based on a combination of the following:
    a. Development units per acre on the 2018 land use assigned to the parcel.
    b. Development units per acre at the built-out condition assigned to the parcel.
3. Whether the parcel is underlain by a confined, semi-confined, or unconfined part of the Upper Floridan aquifer.
4. Distance from the parcel to the nearest wetlands or surface waters.
5. Distance from the parcel to the nearest karst feature, such as a known sinkhole.
6. The saturated hydraulic conductivity of the soil on the parcel, which typically contributes more nitrogen when it is higher.

Figure 2 shows the nitrogen reduction for each parcel. Parcels in the southeastern part of Leon County exhibit greater nitrogen reduction scores than other parts of the county and are therefore more vulnerable to nitrogen loading to groundwater. This southeastern portion of Leon County is part of the PFA delineated by DEP in the BMAP and the PSPZ delineated by Leon County and City of Tallahassee. This area has little to no confining layer, more karst features, a higher groundwater table, greater density of surface waters and wetlands, and greater hydraulic conductivity than other parts of the county.

Nitrogen reduction scores in the northeastern part of the county are less than the average score because the Upper Floridan aquifer is confined, less karst exists, and soil hydraulic conductivity is less than other parts of the county. In other areas, there are parcels inside the urban service area and outside the corporate limits of the City of Tallahassee that have greater nitrogen reduction scores than other parcels in the county.

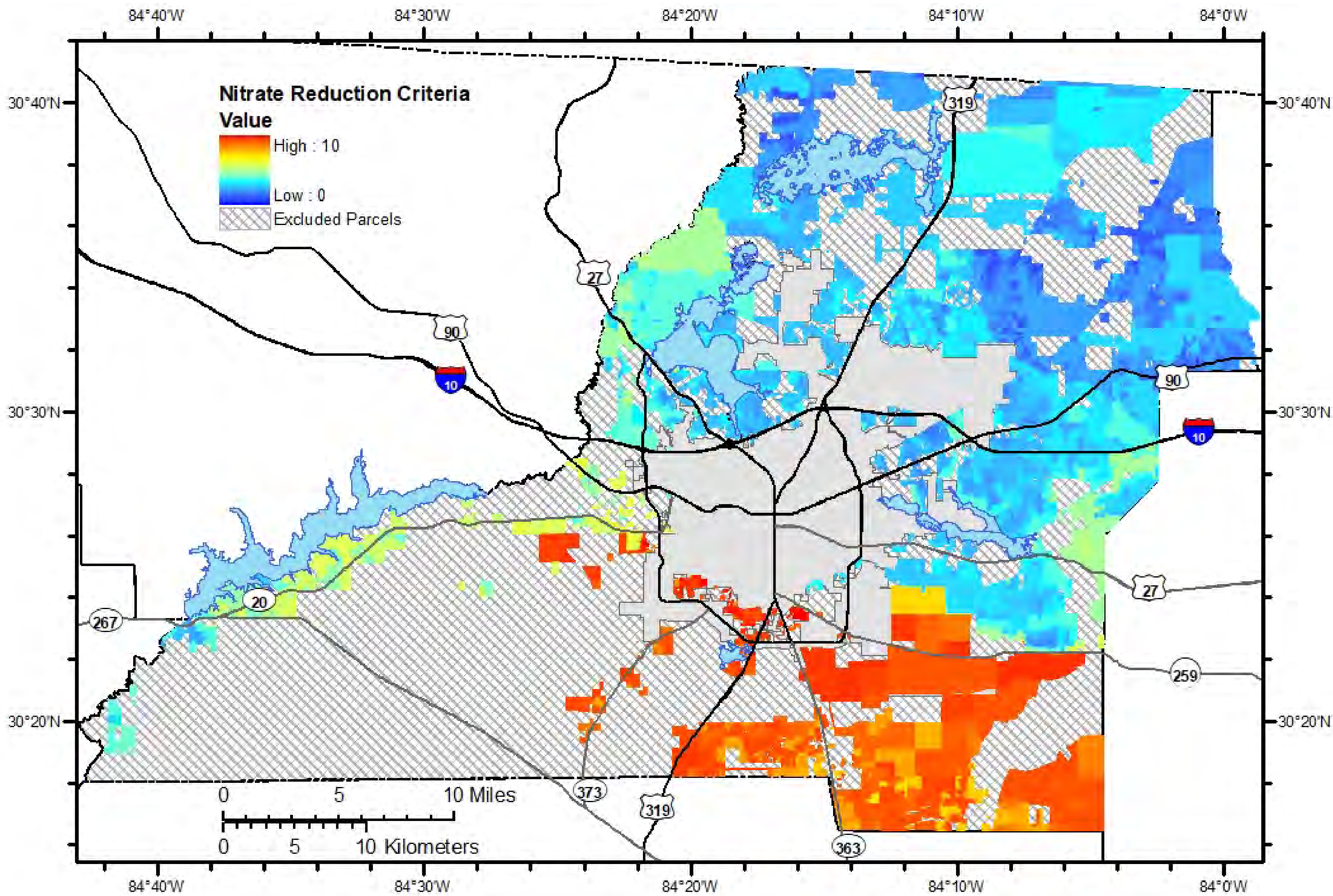

Figure 2. Nitrogen reduction score in unincorporated Leon County.

2.3 Estimated AWTS Costs

The JSA team evaluated the cost-effectiveness of the different technologies by looking at the (1) overall cost per pound of TN removed, (2) cost per pound of TN removed relative to performance by a traditional OSTDS, and (3) benefit-cost ratio of the treatment alternatives. The JSA team made the following assumptions in the cost-effectiveness and benefit-cost evaluations:

- The period of economic analysis is 20 years
- Where applicable, the inflation rate is 3% and the discount rate is 7%
- The volume of wastewater generated is 300 gallons per household or connection per day
- The typical TN concentration in OSTDS effluent is 23.97 milligrams per liter, based on 2.43 persons per household and 300 gallons per day discharge
- TN reduction for a centralized wastewater collection system is 95% for connection to the City of Tallahassee's T.P. Smith WWTF

Table 1 summarizes the additional treatment provided by each AWTS option beyond a traditional OSTDS as well as the total treatment through the tank, drainfield, and underlying soil. In discussions with DEP about this plan, DEP staff confirmed that the TN reduction calculations should be applied in a manner consistent with the approach currently presented in the BMAP, with the understanding that this methodology may change in the future as the BMAP is updated or revised. It should be noted that the BMAP (2018) used a 65% reduction compared to conventional OSTDSs ("Base Case" in Table 1) for all AWTSs, while the efficiencies in Table 1 for ATUs, PBTS, and INRBs are based on information from FDOH (2020).

Table 1. *TN load reduction by option, percent relative to OSTDS.*

	Percent TN Reduction		
Treatment Option	**Base***	**Additional Treatment Relative to Base**	**Total Treatment**
OSTDS (Base Case)	50.0%	0.0%	50.0%
ATU		+80.0%	90.0%
PBTS		+95.0%	97.5%
INRB		+65.0%	82.5%
Central Sewer		+95.0%	97.5%

* Base treatment efficiency includes reductions from the tank, drainfield, and underlying soil consistent with Lyon and Katz (2018).

Based on the lifecycle costs, cost-effectiveness was calculated as the total cost per unit over the 20-year planning horizon divided by the expected pounds of TN reduced. Table 2 estimates the TN reduced per unit, by AWTS option, over the 20-year economic planning horizon and calculates the cost per pound reduction based on the total direct costs, which include operations and maintenance and system replacement typically expected to be required during the 20-year planning period. The results show that central sewer is by far the most expensive per pound of TN removed, while some economies of scale may be realized for cluster systems.

Table 2. Direct cost per pound of nitrogen reduced, by AWTS option.

Treatment Option	TN Reduction (pounds per unit per year)	Total 20-Year TN Reduction (pounds)	Expected Lifecycle Cost per Unit	Direct Costs (Dollars per Pound of TN)
OSTDS	10.95	219.00	$14,294	$65
ATU	19.71	394.20	$29,750	$75
PBTS	21.35	427.05	$31,100	$73
INRB	18.07	361.35	$19,256	$53
Cluster Active (ATU)*	19.71	394.20	N/A	N/A
Cluster Active (PBTS)*	21.35	427.05	$19,595	$57
Cluster Passive (INRB)*	18.07	361.35	$17,280	$58
Central Sewer (Gravity)	21.35	427.05	$57,987	$136
Central Sewer (Pressure)	21.35	427.05	$59,067	$138

* The expected costs for cluster systems assume service for 8 units, as a midpoint in system size. For purposes of this analysis, costs for a cluster ATU are assumed to be similar to costs for a cluster PBTS.

2.4 Potential AWTS Retrofit Options by Parcel

The JSA team used the geographic information system (GIS) database that was developed as part of this study to identify conditions throughout Leon County that were best suited to each AWTS technology. The nitrogen reduction score (see Section 2.2) was used to focus retrofits in the most vulnerable areas of the county. A series of GIS queries were used to identify potential AWTS options for each parcel in these areas.

The first step in the process was to identify whether parcels are within the urban service area. A parcel's location relative to the urban service area determines, in part, whether connection to a centralized wastewater collection system is feasible. In addition, some areas outside the urban service area were already identified for sewer as part of the City of Tallahassee Master Sewer Plan (Hatch Mott MacDonald, 2016). These areas were also considered in this evaluation to determine target areas that could be connected to central sewer.

The next step was to identify whether parcels are within the PFA and PSPZ. The location of a parcel within the PFA and PSPZ is one of the most important factors in targeting the parcel for conversion to an AWTS or connection to the central sewer system. DEP prepared the Upper Wakulla River and Wakulla Spring BMAP to comply with the requirements of the Florida Springs and Aquifer Protection Act. The Act prohibits conventional OSTDS on parcels less than one-acre within the PFA, unless the OSTDS includes enhanced nitrogen treatment, or a connection to the central sewer system will be available within five years. When an existing traditional OSTDS must be repaired or replaced, the OSTDS must include nitrogen-reducing enhancements, unless connection to the central sewer system will be available within five years. In addition, the Leon County Comprehensive Plan requirements (Policy 1.2.6 [SS] and Policy 4.2.5 [C]) for the PSPZ include connection to sewer with advanced WWTFs where feasible, and PBTSs where connection is not feasible. Therefore, parcels on traditional OSTDSs within the PFA and PSPZ should be upgraded to AWTSs or connected to the central sewer system.

For each parcel, the depth to groundwater was evaluated to determine which technologies were applicable. Some technologies, such as INRBs, require greater separation from groundwater than other technologies to achieve optimal nitrogen removal. An evaluation was also made to determine which parcels had wetlands and/or easements and, therefore, may not have sufficient space to install an AWTS.

Based on the GIS data evaluations, the potential AWTS technologies were assigned to each parcel. The potential technologies were further evaluated to determine the recommended alternative on a parcel-by-parcel basis. The costs to implement each technology were determined using the lifecycle costs shown in Table 2. In evaluating the costs to implement feasible technologies on each parcel, the primary type of AWTS recommended for each parcel was determined (Figure 3).

Using the data from Figure 3, the JSA team then identified contiguous areas of parcels that had the same or similar best AWTS options. The JSA team grouped these areas by technology and identified them as "target areas" for the initial focus on retrofits. Figure 4 provides an overview of all the target areas. Target areas were assigned identification numbers, which are for reporting purposes only and do not indicate priority. The identification numbers appear on the maps below.

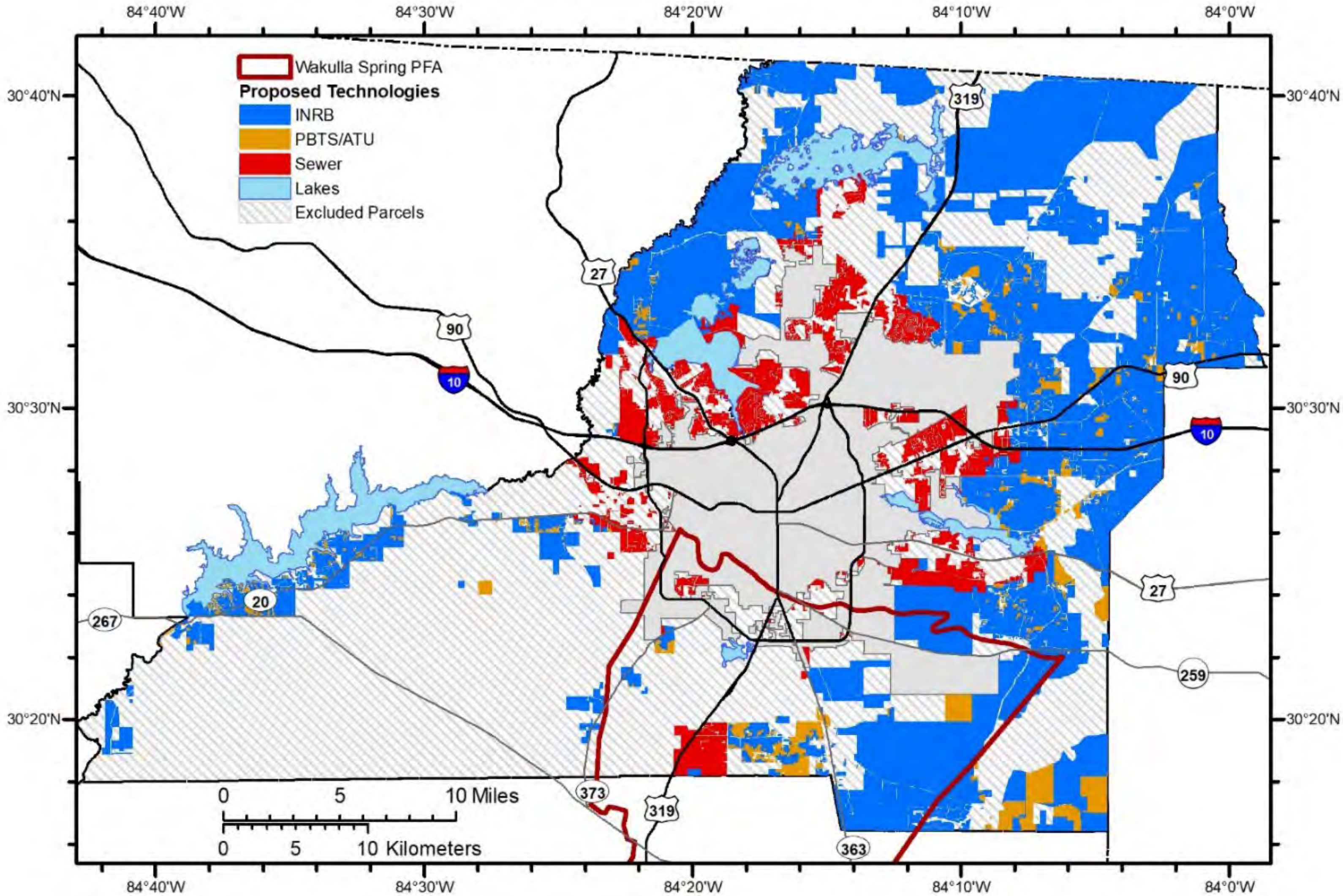

Figure 3. *Proposed primary AWTS technology by parcel.*

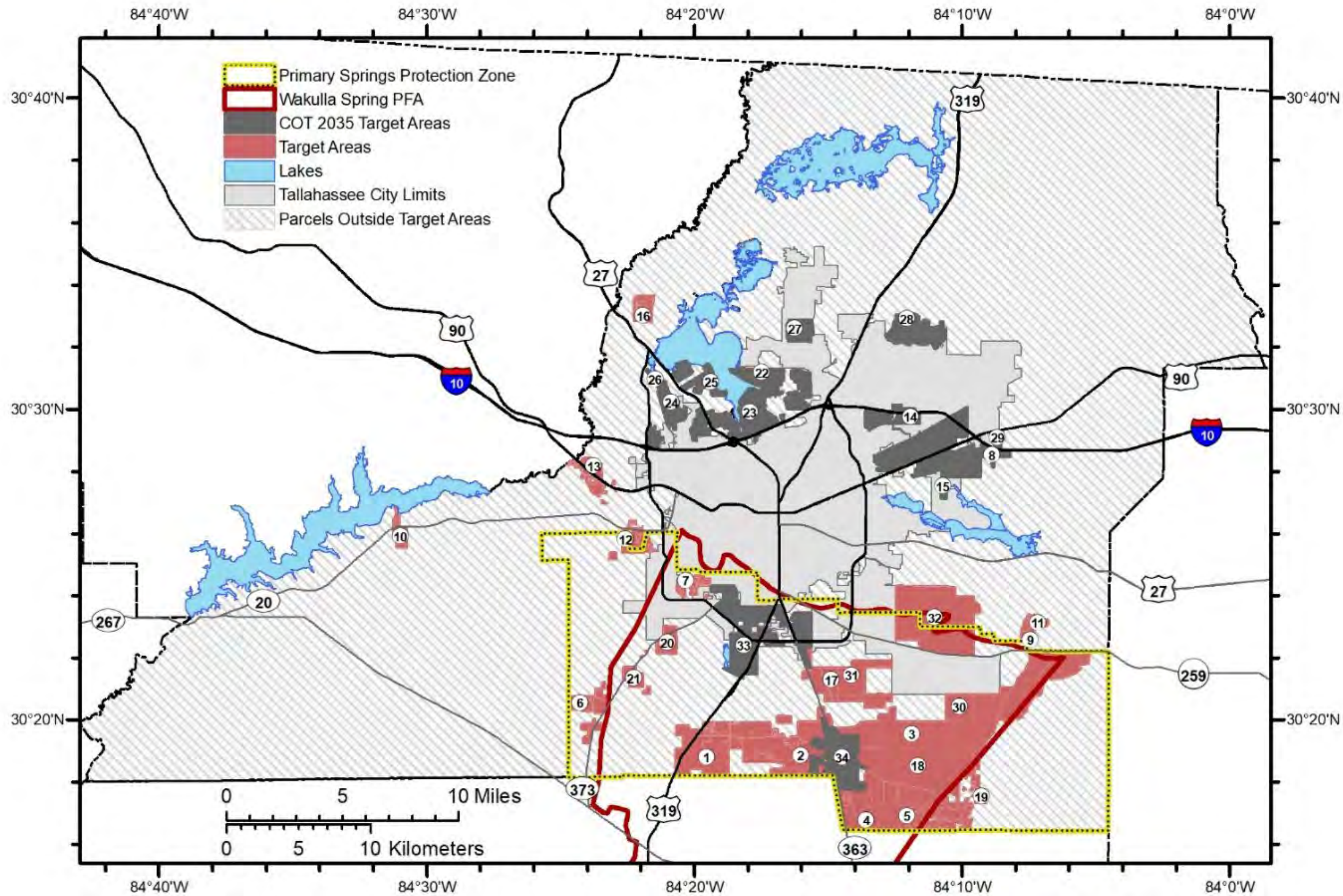

Figure 4. Overview of proposed target areas for AWTS.

3.0 Countywide CWTFP

Detailed maps showing the target areas and recommended AWTS technologies for Leon County are shown in Figure 5 through Figure 8.

Throughout Leon County, all areas within 2,000 feet of existing central sewer are included in a target area for future connection to sewer. Many of these sewer target areas are included in the City of Tallahassee 2035 Master Sewer Plan Update (Hatch Mott MacDonald, 2016). Where sewer is the primary recommended technology to retrofit a target area, all parcels are recommended for connection to the central sewer system to make that option as cost-effective as possible, since the cost per household is lower with more connections to the same sewer line. In other target areas, the recommended technology may vary from parcel-to-parcel based on the conditions in that area, including soil type, depth to groundwater, presence of wetlands, and other factors.

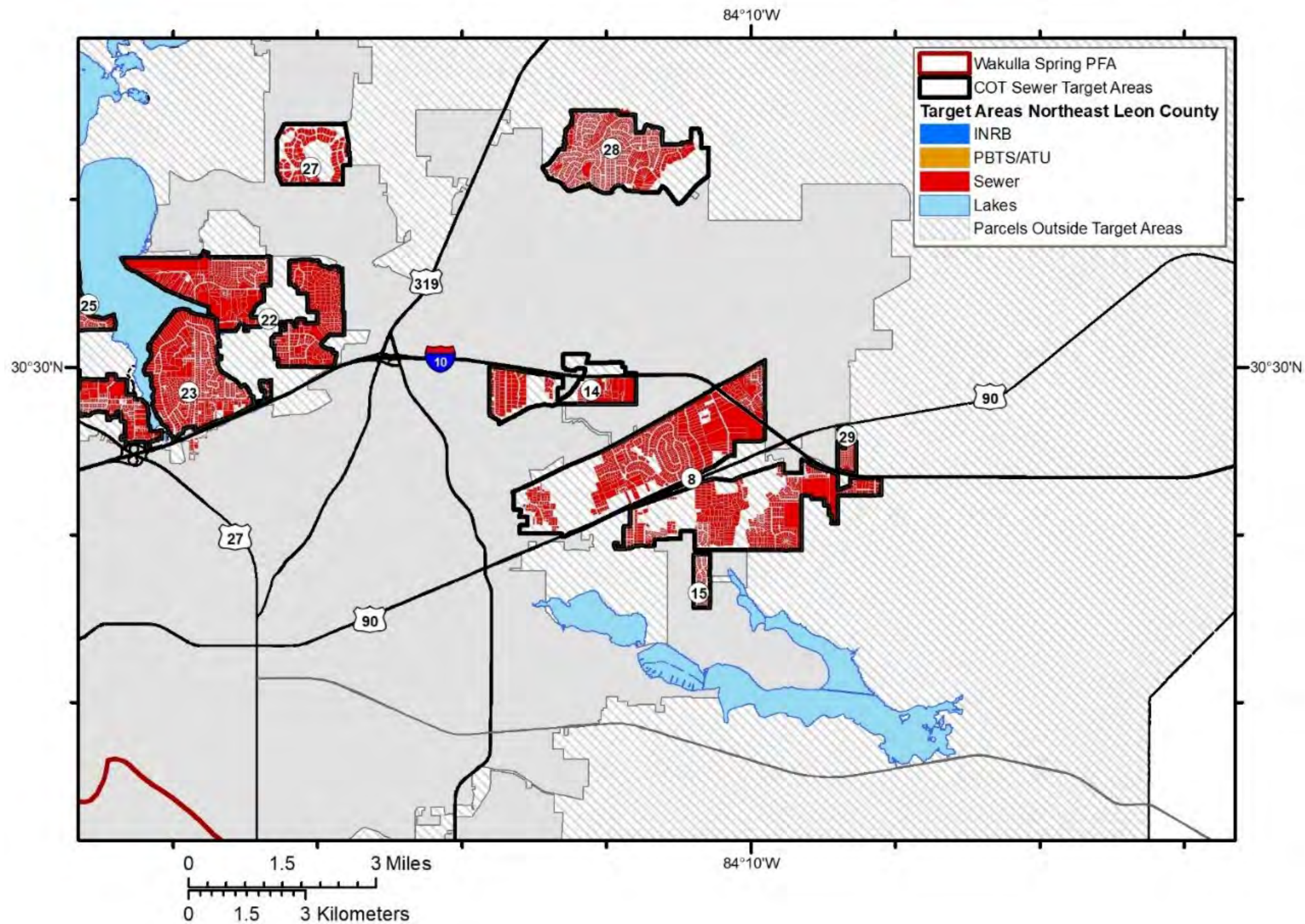

Figure 5. Proposed target areas for AWTS in northeast Leon County.

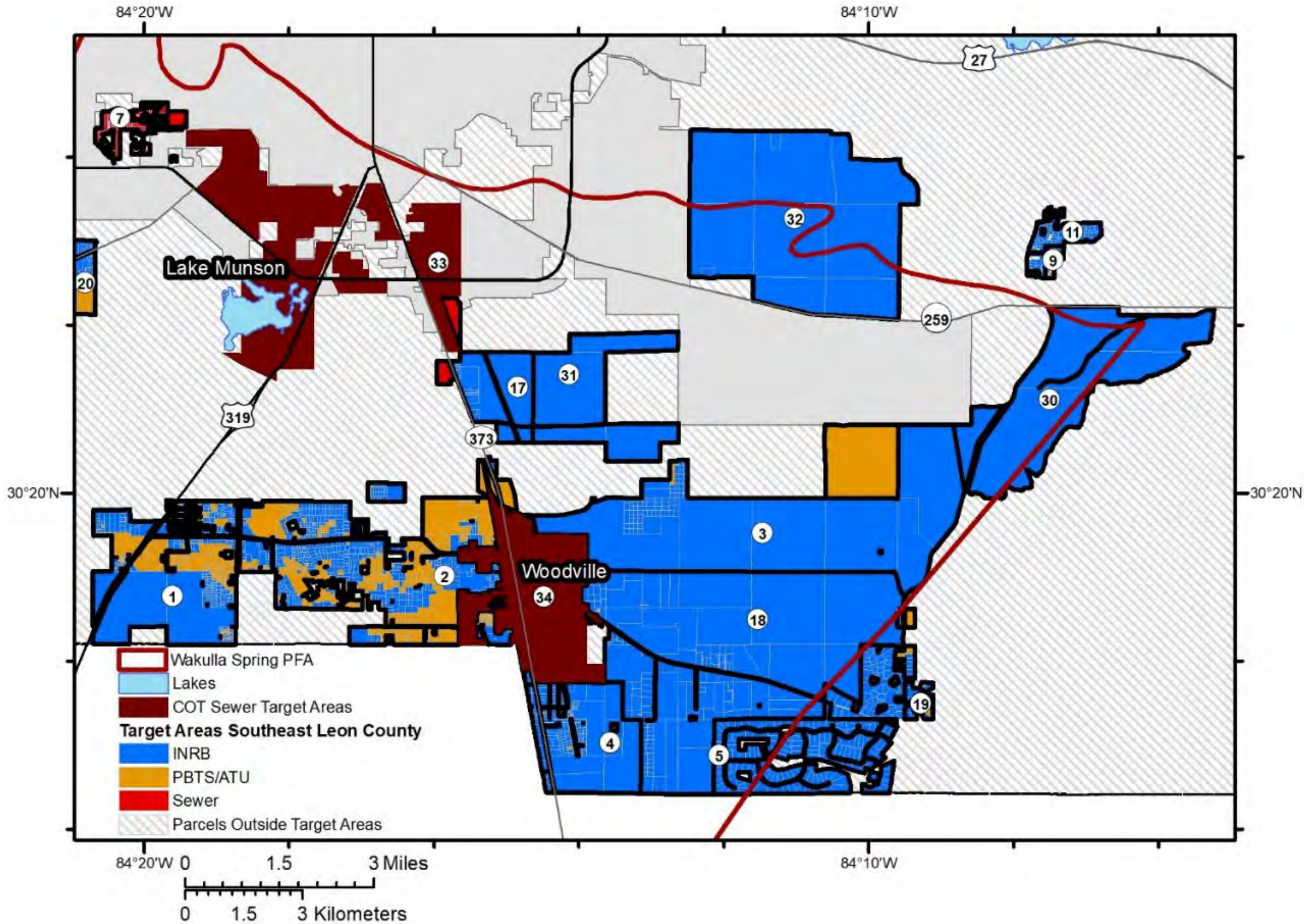

Figure 6. *Proposed target areas for AWTS in southeast Leon County.*

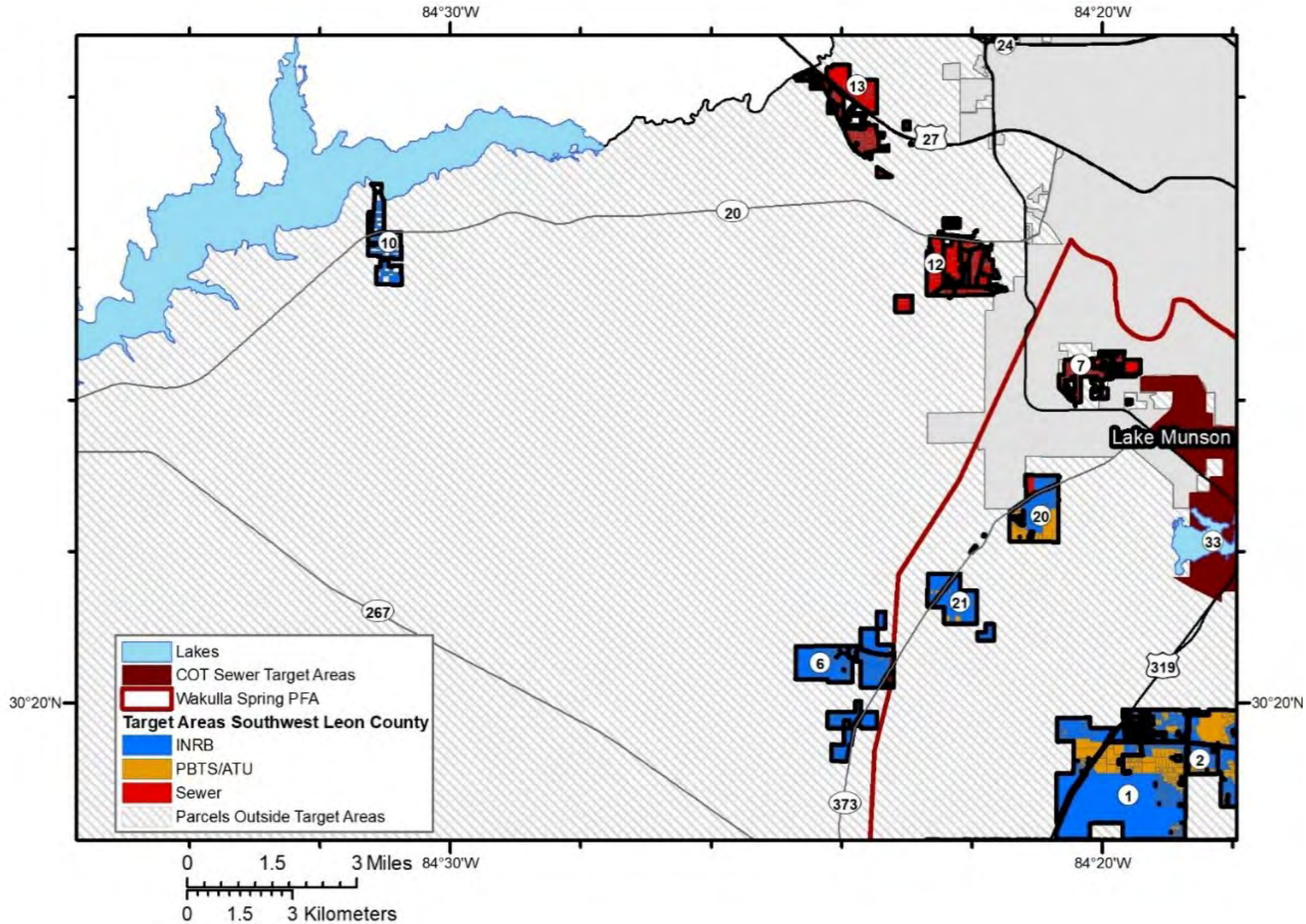

Figure 7. *Proposed target areas for AWTS in southwest Leon County.*

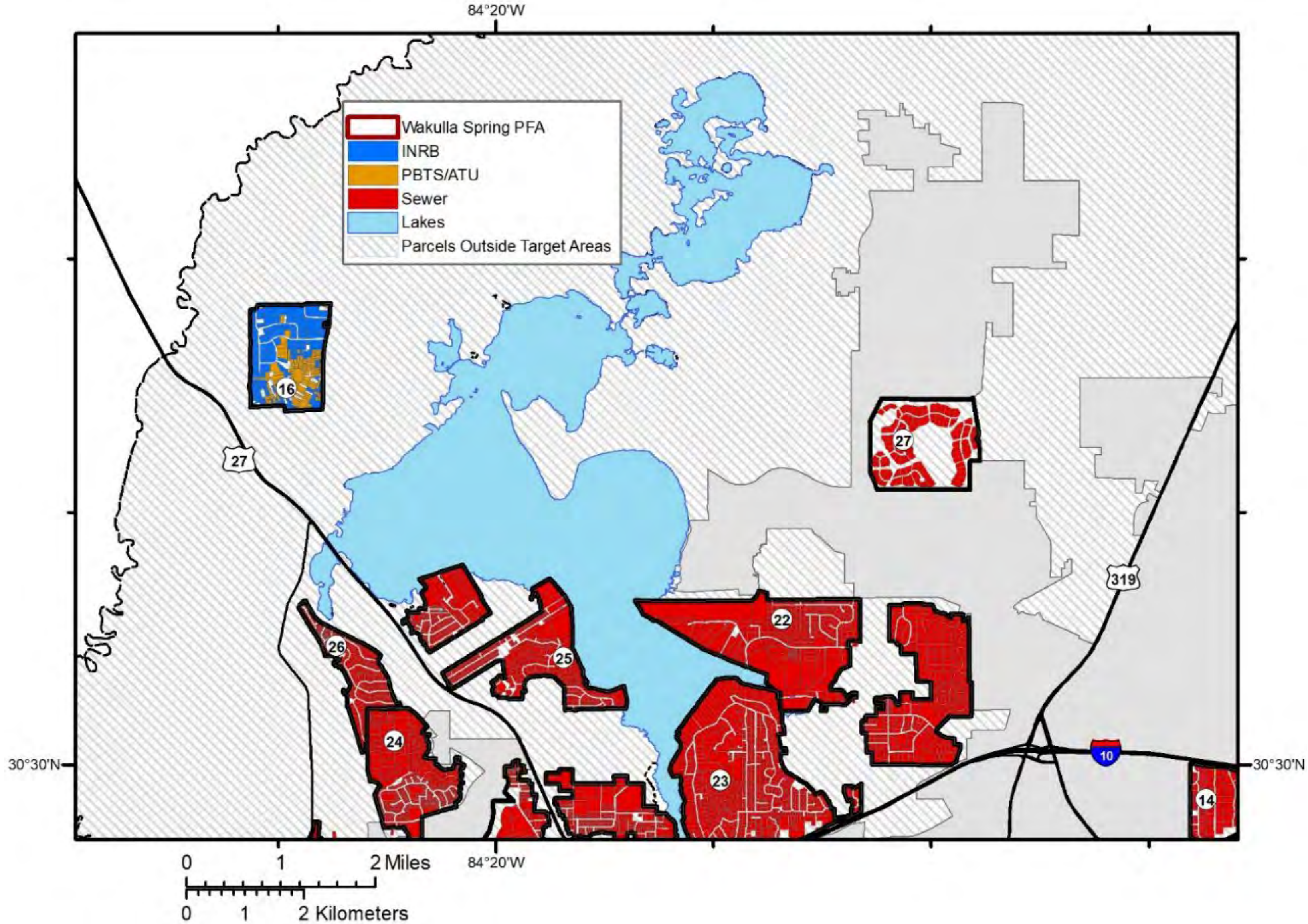

Figure 8. Proposed target areas for AWTS in northwest Leon County.

For each target area, the JSA team calculated TN loads from existing OSTDSs following DEP's methodology used in the Upper Wakulla River and Wakulla Spring BMAP NSILT (Lyon and Katz, 2018). The percent nitrogen reduction for each AWTS technology shown in Table 1 was then applied.

The countywide plan included parcels outside the PFA. There are 7,630 existing OSTDS parcels within the target areas outside the PFA, which could achieve an estimated reduction of 33,353 pounds per year (lbs/yr) of TN by implementing the AWTS recommendations. The estimated TN reductions for each target area are shown in Figure 9 and summarized in Table 3. The estimated costs to retrofit existing OSTDS to the recommended AWTS technology for each target area are also summarized in Table 3. The number of OSTDS retrofits in each target area represent the number of developed parcels currently on septic systems. The total number of developed parcels outside the PFA is 7,630 with a total nitrogen load of 35,894 lbs/yr of TN. Based on the recommendations within this report, total nitrogen could be reduced by 33,353 lbs/yr of TN with an estimated cost of $229,502,000 ($30,079 average cost per parcel). The cost of these conversions is not the responsibility of Leon County but of the property owner, much like the maintenance of the septic system is the responsibility of the property owner.

For target areas outside the PFA that are not part of the BMAP requirements, the plan recommendations can be implemented as opportunities arise and funding becomes available. The phasing for the target areas recommended for sewer connection should follow the timing in the City of Tallahassee 2035 Master Sewer Plan Update (Hatch Mott MacDonald, 2016).

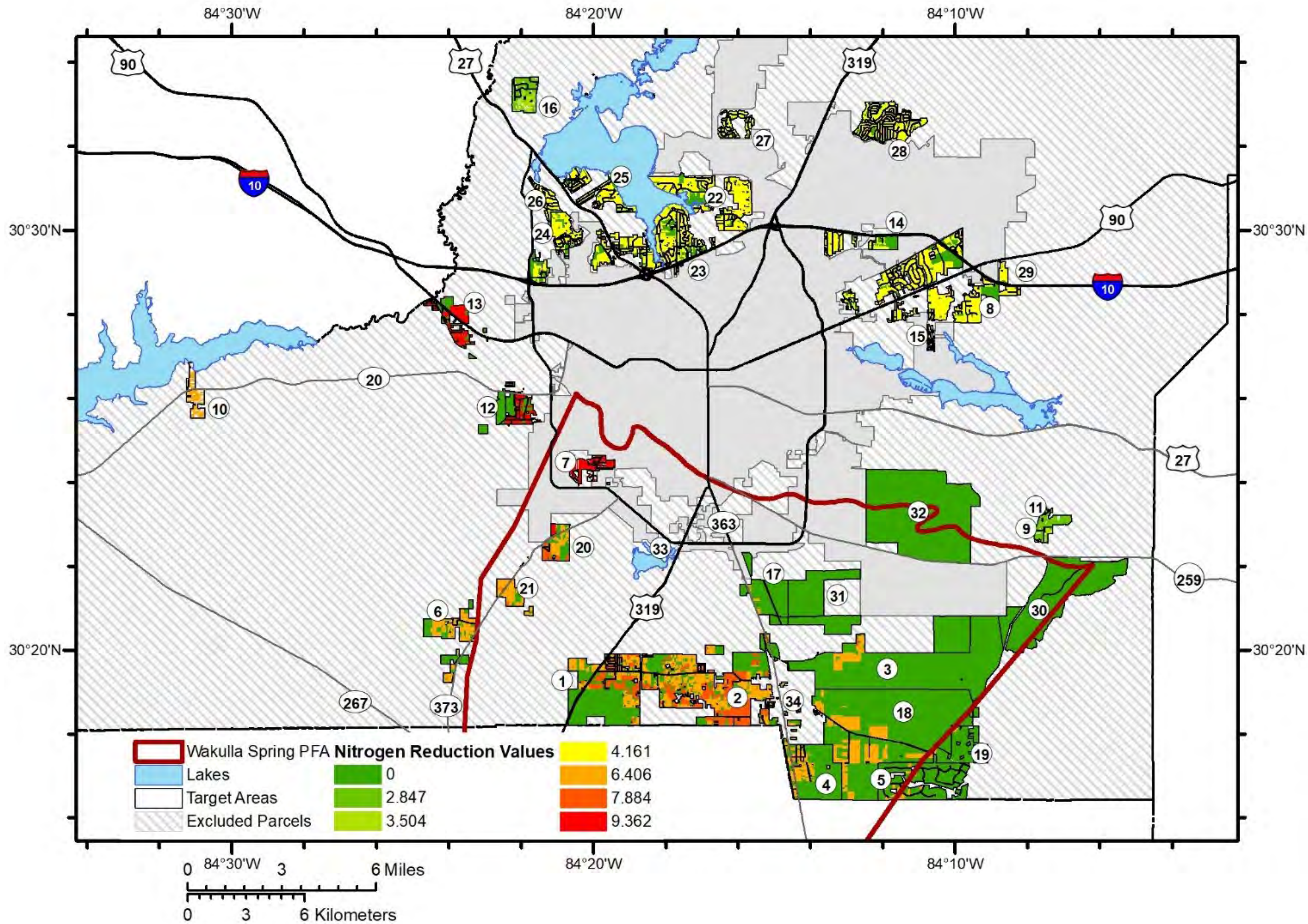

Figure 9. *Estimated TN reductions by target area.*

***Table 3.** Estimated TN reductions and retrofit costs for OSTDS outside the PFA by target area.*

Target Area Number	Target Area Name	Number of OSTDS Parcels	Existing TN Load (lbs/yr)	Future TN Load by Treatment Type (lbs/yr)			TN Reduction (lbs/yr)	Total Target Area Cost	Average Cost Per OSTDS Retrofit
				INRB	PBTS/ATU	Sewer			
8	Buck Lake Woods	1,395	6,110	0	0	306	5,805	$42,806,000	$30,685
9	Kelly Court/Louvenia Woods	75	328	35	46	0	248	$2,061,000	$27,480
10	Nottingham Castle Estates/Tully Estates	90	887	310	0	0	577	$1,734,000	$19,267
11	Kellywood Farms/Powder Horn Woods	106	464	162	0	0	302	$2,042,000	$19,264
12	Pineridge Estates	168	1,656	0	0	83	1,573	$5,190,000	$30,890
13	Geddie Road/Barineau Road	194	1,912	0	0	96	1,816	$6,001,000	$30,933
14	Benjamin's Run	124	543	0	0	27	516	$3,869,000	$31,202
15	Farmview Estates/Box Wood Estates/ North Lake Meadows	140	613	0	0	31	583	$4,341,000	$31,007
16	Rhodes Subdivision	284	1,244	210	129	0	905	$7,210,000	$25,387
22	Lake Breeze	597	2,615	0	0	131	2,484	$18,035,000	$30,159
23	Duck Lake Point	1,177	5,155	0	0	258	4,897	$36,175,000	$30,709
24	Rosehill	537	2,352	0	0	118	2,234	$16,540,000	$30,801
25	Killearn Acres	731	3,202	0	0	160	3,042	$22,099,000	$30,231
26	Plantation Forest Drive/Hill North Dale Drive North	325	1,424	0	0	71	1,352	$10,272,000	$31,606
27	Plank Road/Tram Road	84	368	0	0	18	350	$2,775,000	$33,036
28	Lutterloh Pond	1,455	6,373	0	0	319	6,054	$43,696,000	$29,949
29	Verdura Plantation	148	648	0	0	32	616	$4,656,000	$31,459
Total	-	***7,630***	***35,894***	***718***	***174***	***1,649***	***33,353***	***$229,502,000***	***$30,079***

Note: Total target area costs are rounded to the nearest $1,000.

4.0 BMAP Plan

Due to BMAP requirements, all existing OSTDS parcels within the PFA are included in a target area with proposed AWTS options. To meet Leon County Comprehensive Plan requirements for the PSPZ, AWTS recommendations are also provided for the parcels within the PSPZ. Figure 10 shows the proposed AWTS for the currently developed OSTDS parcels within the PFA and PSPZ.

The Upper Wakulla River and Wakulla Spring BMAP includes an OSTDS Remediation Plan to address the nitrogen contributions from OSTDSs to the river and spring. DEP estimated that for the 11,917 OSTDSs in the two PFAs identified in the BMAP, including Wakulla County, the potential TN reductions that could be achieved range from 77,277 lbs/yr, if all OSTDSs were upgraded to AWTS, to 112,943 lbs/yr, if all OSTDSs were connected to the central sewer system (DEP, 2018). These estimated reductions are not an allocation and were not assigned to specific stakeholders and should be achieved by meeting statutory requirements for upgrade to an AWTS or connection to central sewer.

There are 2,438 OSTDSs within Leon County's portion of PFA1, which is about 20% of the OSTDSs estimated by DEP in the two PFAs. Therefore, for this study, the JSA team targeted reductions equal to 20% of the DEP BMAP estimates, which would be 15,455 to 22,589 lbs/yr of TN, for the Leon County OSTDSs within PFA1. The reductions for the existing OSTDS parcels in the PFA are shown in Figure 11 and summarized in Table 4. The estimated costs to retrofit existing OSTDS to the recommended AWTS technology for each target area within the PFA are also summarized in Table 4. The number of OSTDS retrofits in each target area represent the number of developed parcels currently on septic systems. The total number of developed parcels outside the PFA is 2,438 with a total nitrogen load of 23,939 lbs/yr of TN. Based on the recommendations within this report, total nitrogen could be reduced by 17,512 lbs/yr of TN with an estimated cost of $61,263,500 ($25,129 average cost per parcel). The cost of these conversions is not the responsibility of Leon County but of the property owner, much like the maintenance of the septic system is the responsibility of the property owner.

This reduction falls within the BMAP target range.

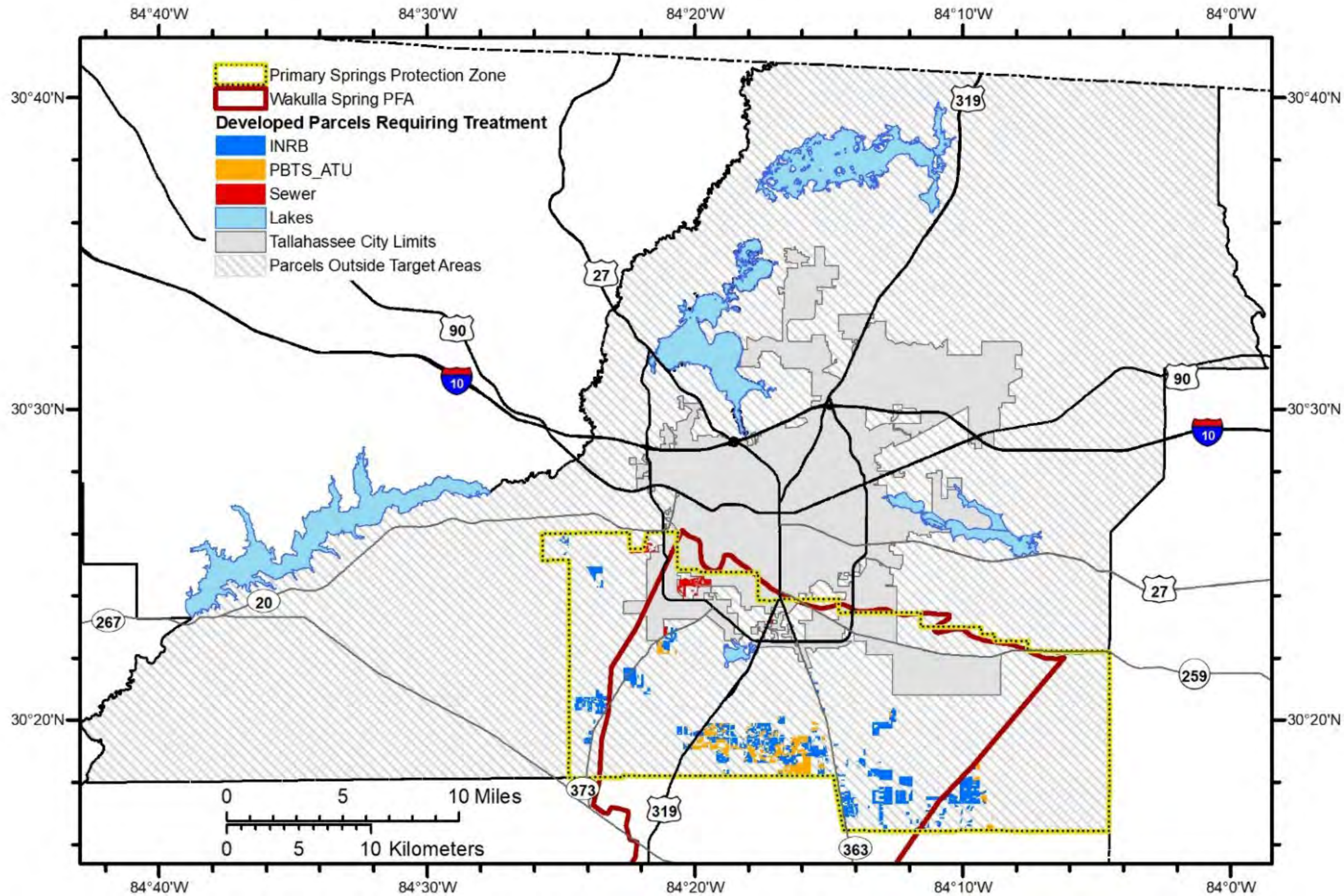

Figure 10. Recommended treatment type for currently developed parcels within the PFA and PSPZ.

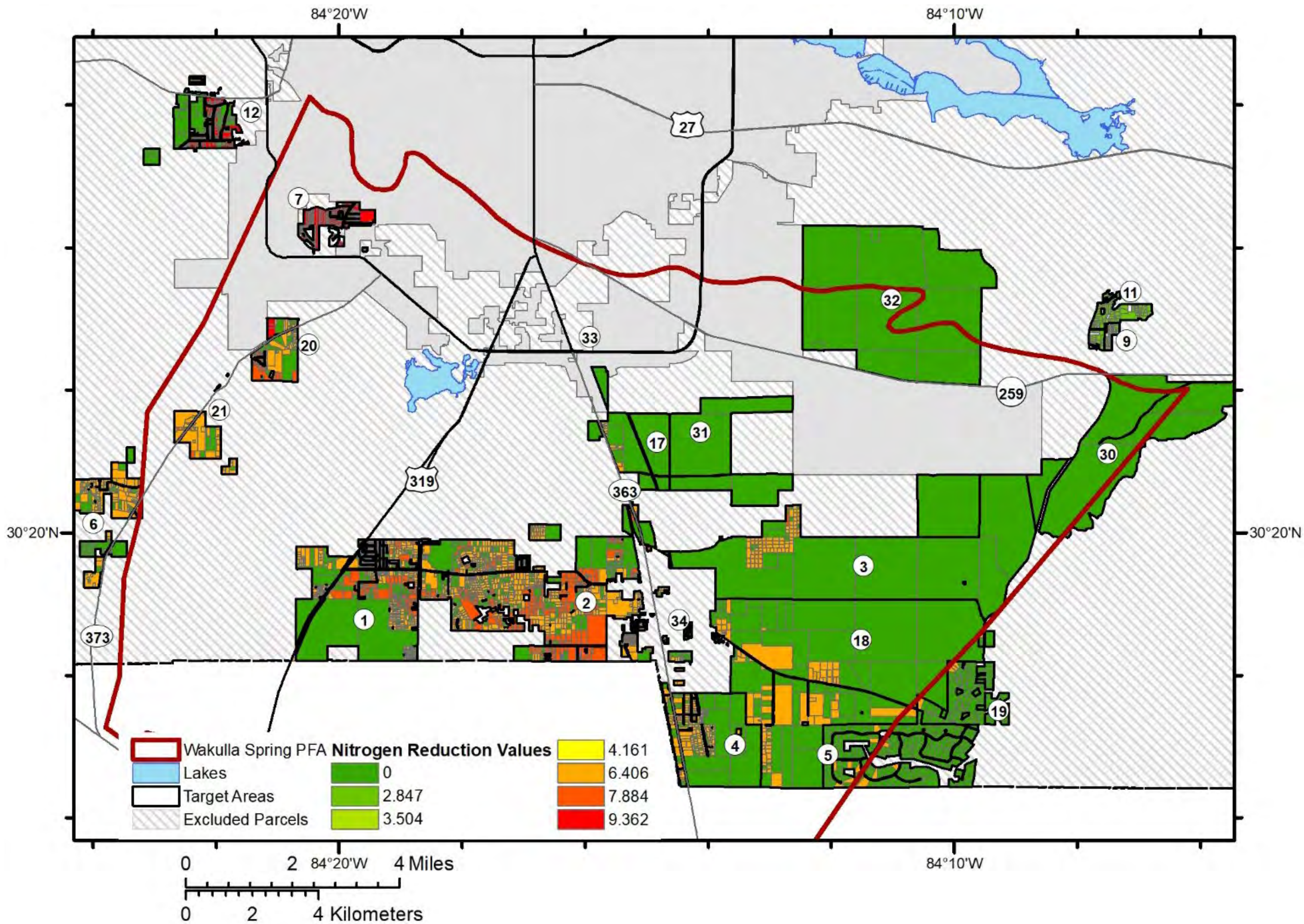

Figure 11. Estimated TN reductions for the target areas within the PFA.

Table 4. *Estimated TN reductions and retrofit costs for OSTDS within the PFA by target area.*

Target Area Number	Target Area Name	Number of OSTDS Parcels	Existing TN Load (lbs/yr)	Future TN Load by Treatment Type (lbs/yr)			TN Reduction (lbs/yr)	Total Target Area Cost	Average Cost Per OSTDS Retrofit
				INRB	PBTS/ATU	Sewer			
1	Oak Ridge Road West	643	6,337	917	743	0	4,676	$16,847,000	$26,201
2	Oak Ridge Road East	854	8,416	1,624	755	0	6,037	$20,981,000	$24,568
3	Rhodes Cemetery Road	75	739	245	8	0	486	$1,492,000	$19,893
4	Pine Acres	190	1,872	593	35	0	1,244	$3,872,000	$20,379
5	Tallahassee Ranch Club	16	158	55	0	0	102	$1,811,000	$19,266
6	Spring Hill Trace/Cox Road	114	1,123	386	4	0	733	$2,219,000	$19,465
7	Lake Bradford	156	1,537	0	0	77	1,460	$4,907,000	$31,455
12	Pineridge Estates	60	591	0	0	30	562	$1,854,000	$30,890
17	Natural Bridge Road	25	246	59	16	0	172	$577,000	$23,080
18	Lonnie Gray Road	105	1,035	321	24	0	690	$2,165,000	$20,619
19	Robert Golden Road	1	10	3	0	0	6	$23,500	$23,484
20	Lakeshore	80	788	148	67	1	572	$2,001,000	$25,013
21	Huntington Estates	45	443	128	16	0	300	$962,000	$21,378
-	Not Applicable	74	642	153	11	8	471	$1,552,000	$20,973
Total	*-*	***2,438***	***23,939***	***4,633***	***1,678***	***116***	***17,512***	***$61,263,500***	***$25,129***

Note: Total target area costs are rounded to the nearest $1,000.

The AWTS upgrades in the PFA target areas can be evenly distributed between now and the end of 2040, which is the required timeline for upgrades, to help spread out the costs for meeting the BMAP requirements. This would result in an average of 132 OSTDS retrofits per year over the next 18.5 years. The retrofits should start in target areas 2 and 1, which combined are 62% of the existing OSTDS parcels within the PFA. The next target areas would be 4, 7, 6, and 18, which make up an additional 23% of the existing OSTDS parcels within the PFA. The remaining parcels in target areas 20, 3, 12, 21, 17, 5, and 19, plus several parcels outside a target area but within the PFA, should then be retrofitted. If additional reductions are needed to meet BMAP requirements, transition to AWTSs within the target areas closest to the PFA will likely become a requirement, and these areas should be prioritized for retrofit after the PFA target area retrofits are completed. The cost of these conversions is not the responsibility of Leon County but of the property owner, much like the maintenance of the septic system is the responsibility of the property owner.

To prevent nutrient loading issues from new development, any new development within the PFA and PSPZ cannot be on traditional OSTDS. As new development occurs in Leon County, the following recommendations are provided for the PFA and PSPZ:

- Parcels within and adjacent to the target areas should use the same AWTS technology as the target area or nearby target area.
- Parcels within 2,000 feet of an existing central sewer main should be connected to central sewer where possible to meet Leon County code requirements.
- Areas of higher development density with available land area should be considered for cluster systems.

The recommended alternatives for currently undeveloped parcels within the PFA and PSPZ that could be developed in the future are shown in Figure 12.

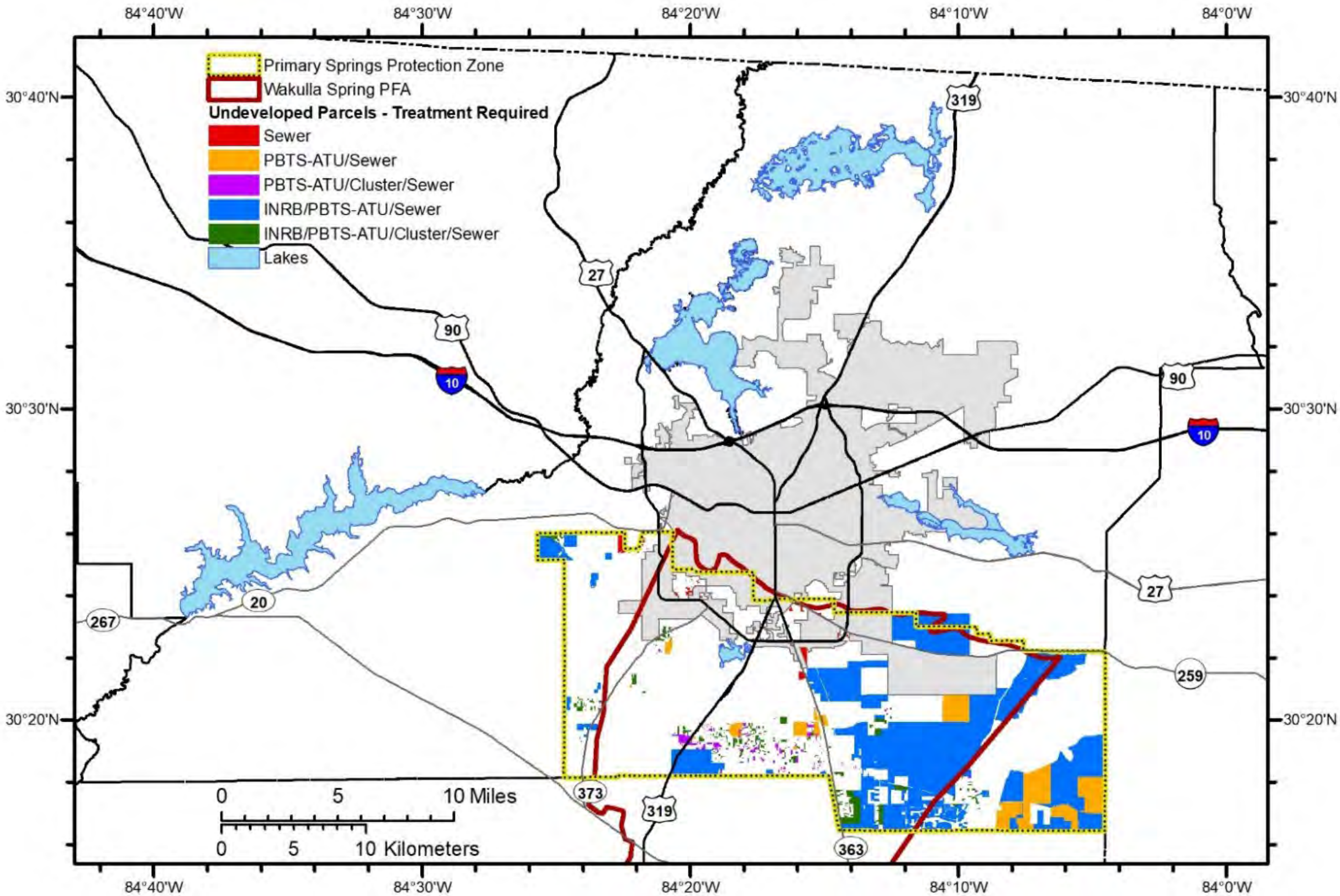

Figure 12. Recommended AWTS options for future development.

5.0 Assumptions

The following assumptions apply to the results of the countywide CWTFP and BMAP-specific plan:

- The calculated TN reductions and existing loads are based on the methods and procedures defined by FDEP and utilized as part of the NSILT reports. All methods and procedures were confirmed with FDEP personnel in the development of these calculations and reports.
- Traditional OSTDS that are properly sited, designed, constructed, maintained, and operated are considered a safe means of disposing domestic wastewater and reducing pathogens. However, these systems are not designed to remove nutrients from wastewater. Where available, connecting existing OSTDS to a central wastewater collection system is the most effective option to reduce nutrient loading. Where central wastewater collection is not a feasible option, ATUs, PBTSs, INRBs, and cluster systems provide an opportunity to improve nutrient removal.
- The purpose of the CWTFP and BMAP-specific plan is to identify appropriate AWTSs to reduce nitrogen loading from traditional OSTDS to the Upper Wakulla River and Wakulla Spring. By upgrading existing traditional OSTDS to AWTSs and planning for the use of AWTS in future development, nutrient loading to these sensitive and important waterbodies can be reduced thereby improving water quality. The estimated nutrient reductions presented in this plan were calculated using the methods that DEP developed for the NSILT and BMAP. While the actual load reductions achieved may not match these estimates exactly, the most important consideration is that using AWTSs in place of traditional OSTDSs will reduce nutrient loading.
- The recommended AWTS technologies in each target area were selected based on the best available information gathered through this project. Before moving forward with retrofits on these parcels, the site conditions will need to be confirmed in the field to verify the application of the recommended AWTS option.
- The estimated TN reductions assume that all property owners within the PFA participate in either upgrading their existing OSTDSs to AWTSs or connecting to the central sewer system to meet statutory and BMAP requirements.
- The use of AWTSs within Florida is still fairly new, but these technologies are becoming more common, especially in areas around Outstanding Florida Waters that must meet the requirements of the Florida Springs and Aquifer Protection Act. Several approved ATU and PBTS models are on the market and have been used in Florida for years. INRBs are newer systems that are currently being evaluated throughout Florida, including within Leon County. The estimated TN reductions were calculated using the best currently available information about AWTS performance. As these systems are more widely used and tested throughout Florida, better information about their performance will become available. Adjustments to the recommended technology for some of the target areas may be needed in the future based on this newer information.
- Leon County and DEP are testing different configurations of INRBs. Monitoring of these systems should continue to gather more information on how well they perform in conditions throughout the county and which type of INRB is most appropriate in various locations. The monitoring results should then be used to modify the recommendations in this plan, as needed, to maximize the nitrogen reduction benefits to the river and spring. The GIS database created in this project can be revised as new information on system performance becomes available.
- While this plan includes recommendations in target areas throughout Leon County, retrofits outside the PFA and PSPZ are not required at this time. OSTDS in other locations in the county contribute nitrogen loading to the river and spring and upgrades to AWTS or connection to the central sewer system should be made as opportunities arise and funding is available.

6.0 Public Input

Public meetings were held in August 2021 and again in October 2022 to present the findings of this project and allow for questions and comments. Each set of meetings included online Zoom meetings, in-person meetings at locations throughout Leon County, and a comment period after the meetings. Comments received from the general public ranged from questions about how AWTSs work to how the plan will impact the public and how it will be funded. The JSA team also received more technical questions from science advisory and similar groups. The team has attempted to respond to each of the questions received in this report. The JSA team recommends continued public outreach as the plan is implemented, to help promote public awareness of the need for and benefits of this plan.

7.0 References

DEP, 2018 (June). Upper Wakulla River and Wakulla Spring Basin Management Action Plan: Division of Environmental Assessment and Restoration, Tallahassee, FL, 126 p., accessed March 8, 2020, at https://floridadep.gov/sites/default/files/Wakulla%20BMAP.pdf.

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Hatch Mott MacDonald, 2016 (February). Excerpt from: 2035 Master Sewer Plan Update. Prepared for: City of Tallahassee.

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Appendix A. Task 1: Nitrogen Reduction Performance Criteria for Alternative Wastewater Treatment Systems Report

Comprehensive Wastewater Treatment Facilities Plan

Task 1: Nitrogen Reduction Performance Criteria for Alternative Wastewater Treatment Systems

LEON
FLORIDA'S CAPITAL COUNTY

Prepared by

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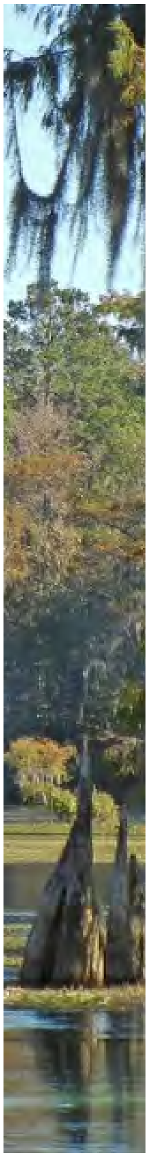
Magnolia Engineering, LLC

TETRA TECH

August 23, 2022



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ACRONYMS AND ABBREVIATIONS

ATM	Applied Technology & Management
ATU	aerobic treatment unit
AWTS	alternative wastewater treatment systems
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
FGS	Florida Geological Survey
GIS	geographic information system
in/hr	inches per hour
INRB	in-ground nitrogen-reducing biofilter
JSA	Jim Stidham & Associates
lb-N/yr	pounds of nitrogen per year
MGD	million gallons per day
mg/L	milligrams per liter
NRCS	Natural Resources Conservation Service
NSILT	nitrogen source inventory and loading tool
OSTDS	onsite sewage treatment and disposal system
PBTS	performance based treatment system
PFA	priority focus area
PSPZ	Primary Springs Protection Zone
RIB	rapid infiltration system
SF	spray field
TMDL	Total Maximum Daily Load
TN	total nitrogen
U.S.	Unites States of America
WWTF	wastewater treatment facility
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

Leon County is preparing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs), as well future development, to groundwater and surface waters. OSTDSs are also known as septic systems. The Florida Department of Environmental Protection found that nutrient loads from several sources—including OSTDSs in Leon County—impaired Upper Wakulla River and Wakulla Spring. Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are (1) to identify OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) to identify locations of future development that require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County is preparing the plan by progressing through eight major tasks. This report describes results of the first task: development of nitrogen reduction performance criteria for AWTSs. This report includes a nitrogen reduction score for each parcel in Leon County based on geologic criteria, a map of nitrogen reduction scores throughout the county, and a description of the geologic criteria used to calculate the score. The nitrogen reduction score is a measure of the vulnerability of groundwater and surface waters to OSTDSs. An OSTDS on a parcel with a relatively greater score likely loads more nitrogen to groundwater and surface waters than a system on a parcel with a lesser score. Parcels with relatively greater scores are more attractive for transition to alternative wastewater treatment than parcels with lesser scores.

Currently, Leon County requires that parcel owners upgrade OSTDSs to an AWTS or connect the parcel waste line to a centralized wastewater collection system. Upgrade or connection will be recommended in a subsequent task. All AWTSs will be required to meet a minimum nitrogen reduction of 65%. Current permitting requirements for AWTSs allow the use of aerobic treatment units, in-ground nitrogen-reducing biofilters, and performance-based treatment systems.

This Task 1 report documents the following preliminary findings:

Finding 1. Parcels south of Leon County Road 259 and east of U.S. Highway 319 (centered at about 30° 20′ N, 84° 10′ W) have greater nitrogen reduction scores than parcels in other parts of Leon County. Parcels south of Leon County Road 259 and east of U.S. Highway 319 are relatively more attractive—with respect to nitrogen reduction—for transition to alternative wastewater treatment than other parcels in Leon County.

Finding 2. Parcels north of U.S. Highway 90 and east of U.S. Highway 319 (centered at about 30° 35′ N, 84° 05′ W) scored relatively less than parcels in other parts of Leon County. Parcels north of U.S. Highway 90 and east of U.S. Highway 319 are relatively less attractive—with respect to nitrogen reduction—for transition to alternative wastewater treatment than other parcels in Leon County.

Finding 3. The nitrogen reduction score is more sensitive to soil hydraulic conductivity; proximity to wetlands and surface water; and aquifer confinement. Changes in these criteria caused relatively greater changes in the nitrogen reduction score than changes in other criteria.

Finding 4. The nitrogen reduction score is less sensitive to density of residential units and proximity to wastewater service areas. Changes in these criteria caused relatively less change in the nitrogen reduction score than changes in other criteria.

Finding 5. Leon County will reduce nitrogen loading to groundwater or surface waters by about 80% by connecting an existing or future OSTDS to a centralized wastewater collection system, or by upgrading the OSTDS to an AWTS.

Task 1 findings are preliminary and subject to refinement as development of Leon County's plan progresses.

1.0 Introduction

The Florida Department of Environmental Protection (DEP, 2018a) found that nutrient loads from several sources impaired Upper Wakulla River and Wakulla Spring (fig. 1). To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive each day, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore the river and spring by identifying actions that will reduce pollutant loads to the river and spring.

It should be noted that the Florida Geological Survey (2004) identified Wakulla Spring as the formal spring name because Wakulla Spring has only one spring vent. Alternatively, some governmental entities and publications refer to Wakulla Springs. The Florida Geological Survey nomenclature is used in this Task 1 report.

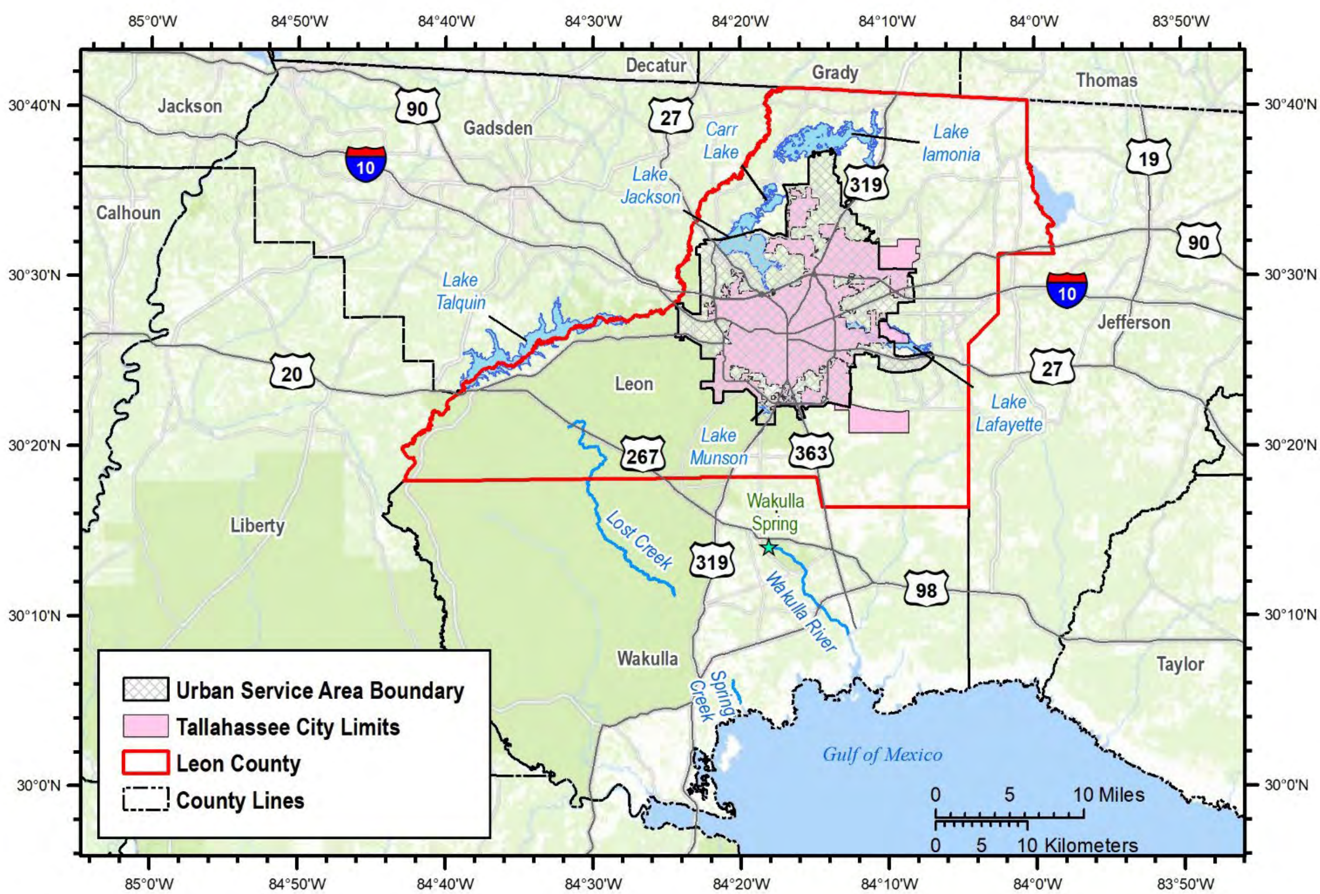

Figure 1. Unincorporated Leon County, surrounding counties, City of Tallahassee, the urban service area boundary, selected surface waters, and Wakulla Spring.

DEP worked with local governments to prepare the BMAP. The BMAP includes projects to achieve the TMDL and a monitoring plan to measure progress toward achieving the TMDL. The BMAP was adopted by DEP in June 2018. The BMAP required that Leon County reduce nitrogen loads to the river and spring from onsite sewage treatment and disposal systems (OSTDSs). OSTDSs are also known as septic systems. Leon

County contracted Jim Stidham & Associates (JSA) to develop the plan to reduce nitrogen loads from OSTDSs. JSA partnered with Advanced Geospatial, Applied Technology & Management (ATM), The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop the plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP facilities plan with a grant to the county.

About 40% of Leon County is served by OSTDSs, about 20% is served by five centralized wastewater treatment facilities (WWTFs), and about 40% is government land that will not likely be developed during the next few decades and will likely not require wastewater treatment (fig. 2).

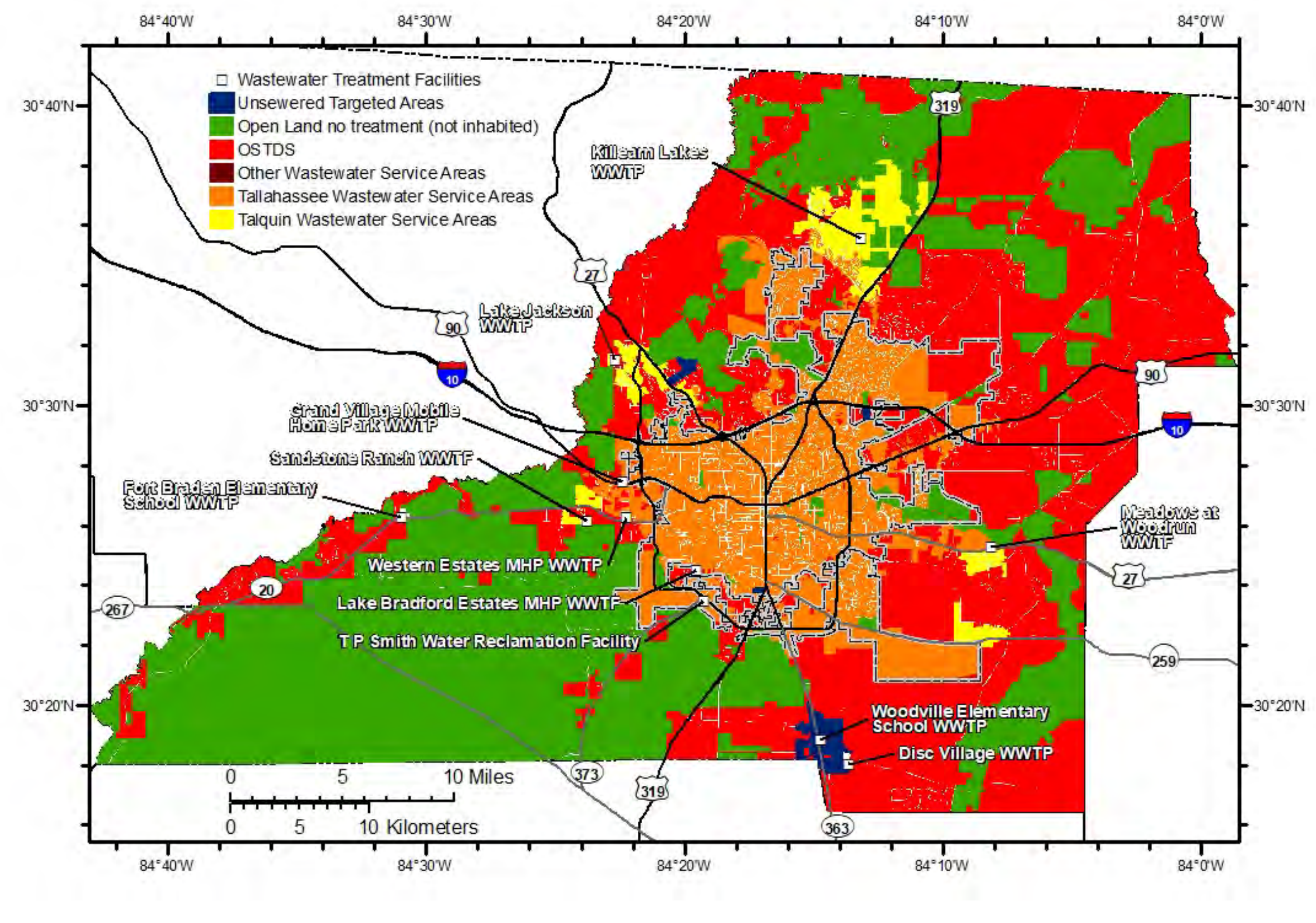

Figure 2. Parcels with onsite sewage treatment and disposal systems (OSTDSs), centralized wastewater treatment facilities (WWTFs) and wastewater treatment plants (WWTPs), parcels in the Tallahassee wastewater service area, and parcels in the Talquin service area.

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTSs), where the transition will most reduce nitrogen loads to the river and spring. The plan will produce guidance for retrofit of existing development as well as direct technology selection for future development.

Effluent is fluid discharged from an OSTDS, AWTS, and centralized WWTF. The concentration of nutrients and other constituents in effluent is a function of the level of treatment that the system or facility provides. In general, OSTDSs treat the waste stream less effectively than centralized wastewater treatment, such that the nutrient concentration in OSTDS effluent is greater than the nutrient concentration in effluent from a centralized WWTF. An AWTS removes more nutrients from the waste stream than an OSTDS. The nutrient concentration in AWTS effluent is less than the nutrient concentration in effluent from an OSTDS. Many different types of AWTSs exist; for example, some AWTSs have more tanks, multiple chambers in each system, or more robust drainfields; some AWTSs are clustered; and some AWTSs are connected to centralized WWTFs.

The JSA team will create the Leon County plan by performing the following tasks:

Task 1. Develop a nitrogen reduction score to identify likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTSs; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas

Task 2. Quantify cost-effectiveness of AWTSs

Task 3. Identify other factors that influence selection of an AWTS

Task 4. Provide education to the community regarding information compiled in Tasks 1 – 3 and survey opinions of the citizens of Leon County, with respect to this plan

Task 5. Analyze implementation scenarios for AWTSs

Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTS

Task 7. Provide additional education to the community regarding the information compiled in Tasks 1 – 7 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan

Task 8. Present the plan to the Leon County Board of County Commissioners

The final deliverables will include a report with the findings of the eight tasks and a geographic information system (GIS) map of the recommended nitrogen reducing criteria for existing development retrofit and minimum standards for new development. The GIS map will be integrated into the Leon County system to ensure the information is available for use by development reviewers and capital project managers.

This report describes Task 1 of the Leon County plan: the development of nitrogen reduction criteria to rank OSTDS transition to AWTS in delineated areas. Tasks 2 through Task 8 of the county plan will be described in future reports. In the present report, the JSA team describe the objectives of Task 1 (Section 1.1), summarize published investigations relevant to the county plan (Section 1.2), and summarize data used to develop a nitrogen reduction score (Section 2). Inputs to the score are summarized in Section 3. We present our preliminary findings in Section 4.

1.1 Task 1 Objective

The objective of Task 1 was to develop a nitrogen reduction score to identify likely contribution of nitrogen to groundwater and surface waters from OSTDSs, to use the score to quantify, rank, and identify OSTDSs to transition to AWTSs, and establish nitrogen reduction criteria for the AWTSs in delineated areas. This report summarizes criteria used as input to the score and includes a map.

To accomplish the objective, the JSA team built a geographic database with data from the following agencies:

- Leon County
- City of Tallahassee
- Talquin Electric Cooperative
- Northwest Florida Water Management District
- Florida Geological Survey
- DEP
- Florida Department of Health
- U.S. Department of Agriculture Natural Resources Conservation Service (NRCS)
- U.S. Geological Survey

1.2 Summary of Published Investigations

As an initial step in the plan, the JSA team reviewed the following documents:

- *Onsite Sewage Treatment and Disposal and Management Options*: Lombardo Associates, Inc. (2011) assessed primary sources of nitrogen loads to Wakulla Spring, in both Leon and Wakulla County. The Lombardo report is the initial framework for the Leon County plan, described in the present report.
- *The Leon County Aquifer Vulnerability Assessment*: Baker et al. (2007a, 2007b) built a science-based, water-resource management tool to identify adverse impacts to groundwater quality, including groundwater quality in sensitive areas, such as springsheds and groundwater recharge zones. They used weights of evidence to map aquifer vulnerability in Leon County. Areas of greater vulnerability are underlain by thin to absent confinement of the Upper Floridan aquifer, dense karst, and relatively greater soil hydraulic conductivity. Karst is a landform and geology created by the dissolution of limestone and other soluble rocks. Karst typically exhibits sinkholes; caves; and extensive, conductive groundwater flow systems that are capable of transmitting groundwater constituents and pollutants more efficiently than other, less conductive geology.
- *Upper Wakulla River and Wakulla Spring BMAP*: The Florida Springs and Aquifer Protection Act requires water quality protection for the Upper Wakulla River and Wakulla Spring. DEP (2018a, 2018b, 2018c, 2018d) described OSTDS requirements and restoration approaches including OSTDS nitrogen enhancement, transition of OSTDS to AWTS, sewer connection, and funding. DEP documented nitrogen sources and strategies to reduce nitrogen loads. DEP discussed source credits for OSTDSs, farm and turfgrass fertilizer, livestock waste, and centralized wastewater treatment. DEP developed a TMDL that established a nitrate target. With Nitrogen Source Inventory and Loading Tool (NSILT) analyses, DEP identified OSTDSs, atmospheric deposition, and farm fertilizer as significant nitrogen loads to groundwater.
- *Review of the Upper Wakulla River and Wakulla Spring BMAP NSILT*: Hearn (2018) reviewed and summarized loads after BMAP projects are implemented. The BMAP is focused on loads from OSTDSs, sports and urban turf fertilizer, farm fertilizer, and atmospheric deposition.
- *Draft Revised Nitrogen Source Inventory and Loading Estimates for the Wakulla BMAP Area*: Lyon and Katz (2017, 2018) identified nitrogen loads to groundwater by source from 2017 and 2018 assessments and compared each assessment to loads from a 2014 assessment. They identified a significant difference between 2014 and 2017 loads, and between 2014 and 2018 loads.
- *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: U.S. Geological Survey (2010) documents simulation of groundwater flow to Wakulla Spring and other springs, and simulation of nitrate-N fate and transport.

- *Wakulla County Septic Tank Study Phase II Report on Performance Based Treatment Systems:* Harden et al (2010) from the Florida State University Department of Earth, Ocean and Atmospheric Science conducted a study of 35 performance based treatment systems (PBTSs) (27 from the original study and 8 from this second phase) in Wakulla County. The study found that PBTSs reduce total nitrogen (TN) input to the watershed by 55%.
- *Wakulla Springs State Park Submerged Aquatic Vegetation Survey*: The Wakulla Springs Alliance measured the extent of the following submerged aquatic vegetation: algae, hydrilla, naiad, Illinois pond weed, *Sagittaria kurziana*, and *Vallisneria americana*. Measurements have been made quarterly since April 2013 on seven transects in the Upper Wakulla River.
- *Wekiva-Area Septic Tank Study*: DEP (2018e) reported bimonthly sampling of OSTDS effluent, soil pore water under drainfields, and background nutrient concentrations. They quantified minimal effects of OSTDS pumping and the influence of fertilizer. DEP evaluated a soil attenuation model. This report also includes summary information from recent groundwater monitoring.
- *Tidal Caloosahatchee BMAP Nitrogen Load Reduction Plan, Lee County, Florida*: ATM (2017) used load reductions and cost per pound per year of total nitrogen removal to prioritize projects using a ranking matrix with a weighted, point-based metric.

The publications listed above were used as reference material in the development of the initial scoring matrices. These references were also used to evaluate transport of nitrogen to Wakulla Spring.

2.0 Data Summary

The JSA team developed a database that includes OSTDS locations throughout the county, land use, soil type, hydrography, karst, and other factors that influence nitrogen loads to groundwater and surface waters.

The Leon County property appraiser delineated parcel boundaries in the county. The JSA team determined the centroid of parcels in unincorporated Leon County. To develop performance criteria, we used these centroids to determine the distance of each parcel to other relevant features, such as karst and surface water. Data used in Task 1 are described in Sections 2.1 through 2.10.

2.1 Potential Density of Onsite Sewage Treatment and Disposal Systems

The JSA team calculated potential OSTDS density on each parcel (fig. 3). We identified vacant residential parcels that most likely will use OSTDSs in the future, when construction eventually occurs. We averaged the anticipated minimum and maximum OSTDS density at buildout on these vacant parcels to estimate the density of OSTDSs at the built-out condition.

OSTDS density is an input to the nitrogen reduction score. Parcels with relatively greater OSTDS densities load more nitrogen to groundwater and surface waters than parcels with relatively less OSTDS densities. OSTDS transition to AWTS on parcels with relatively greater OSTDS densities will likely reduce nitrogen loads to groundwater and surface waters more than OSTDS transition to AWTS on parcels with relatively less OSTDS densities. These data were used in the scoring matrix to determine the areas with a greater nitrogen loading. This density is used as a real number value per parcel, which was then weighted and scaled to provide a priority score for future OSTDS projects in the County and/or future development. The segmented ranges illustrate greater and lesser densities, and not target areas (fig. 3).

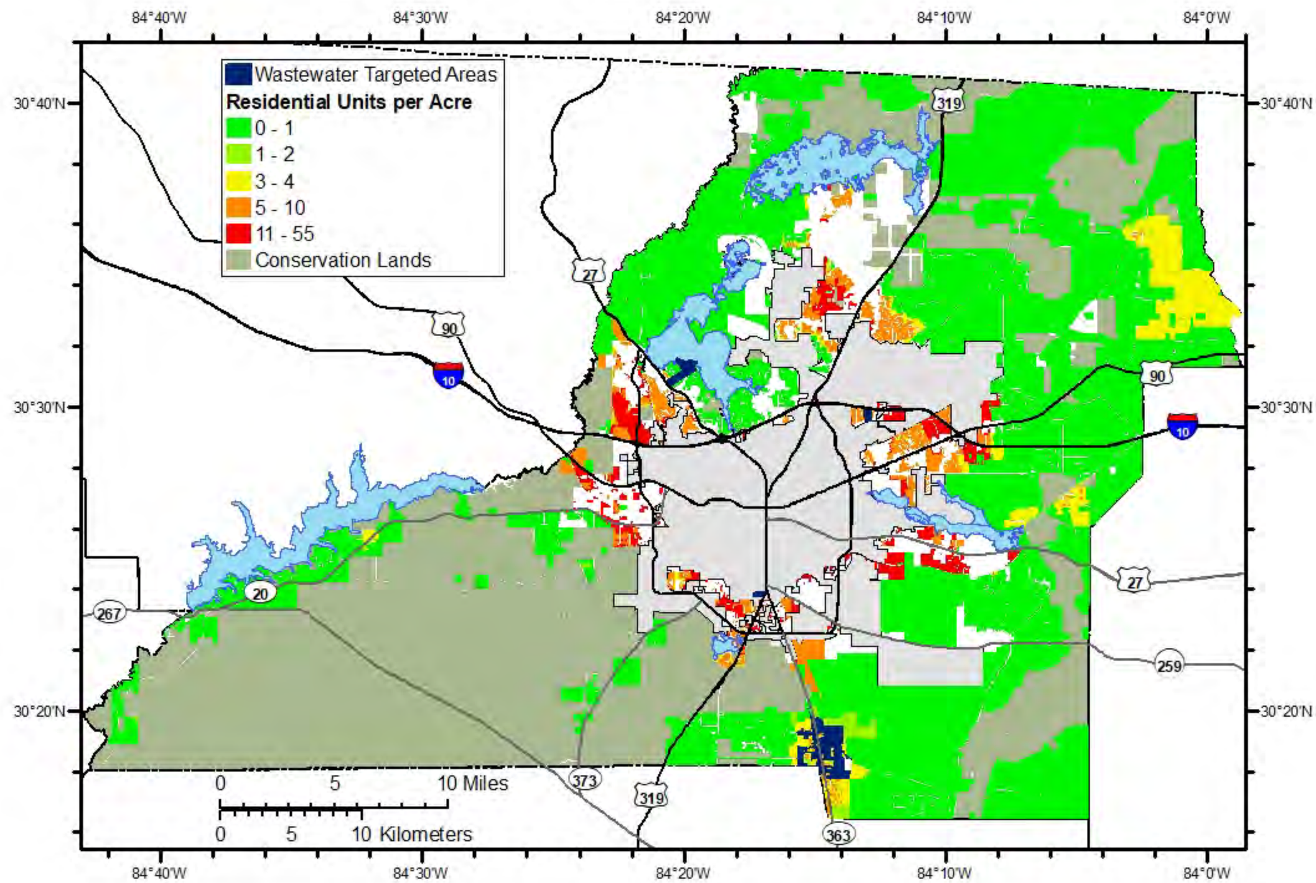

Figure 3. Potential OSTDS density, in development units per acre, at build-out, in unincorporated Leon County. Conservation lands are government land that will not likely be developed.

2.2 Priority Focus Areas and Primary Springs Protection Zone

DEP delineated two springs priority focus areas (PFAs) (fig. 4) in the Upper Wakulla River and Wakulla Spring BMAP. PFAs define vulnerable parts of the Upper Floridan aquifer, which load constituents to the spring. The aquifer is most vulnerable to contamination from pollution in PFAs. PFAs are in a part of the springshed in which the Upper Floridan aquifer is unconfined. PFAs are south of the Cody Scarp—an old shoreline that existed about 10,000 years ago, when the sea level was higher than today. It should be noted that the 2016 Florida Springs and Aquifer Protection Act restricts the placement of new OSTDSs on parcels less than one acre in a PFA.

In 2007, Leon County defined the Primary Springs Protection Zone (PSPZ) (fig. 4) in the Leon County Land Development Code. The county protects the PSPZ in the code with measures that reduce nutrient loads to the spring.

The nitrogen reduction score favors OSTDS transition to AWTS in PFAs and the PSPZ. OSTDS transition to AWTS on parcels inside PFAs and the PSPZ are more attractive than OSTDS transition to AWTS on parcels outside PFAs or outside the PSPZ. OSTDSs on parcels in PSAs or the PSPZ are likely to load more nitrogen to groundwater than OSTDSs on parcels outside PSAs or the PSPZ.

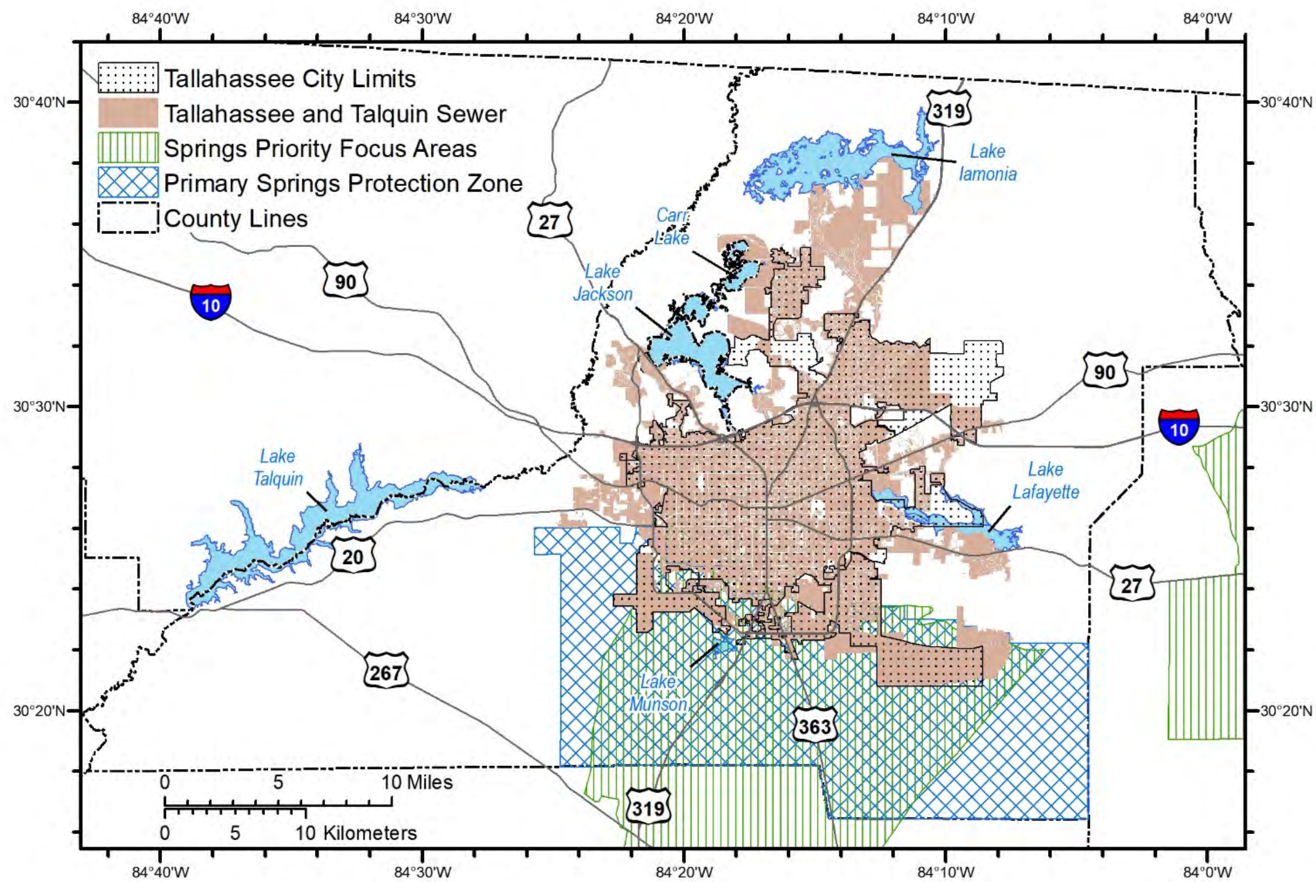

Figure 4. Priority focus areas, Primary Springs Protection Zone, and wastewater service areas.

Eleven WWTFs exist in Leon County (table 1, fig. 2). Lyon and Katz (2017) calculated annual average total nitrogen concentration and flow rate for each facility.

Table 1. Wastewater treatment facilities in Leon County.

Facility ID	WWTF Name	Treatment Type	Annual Average TN Concentration (mg/L)	Annual Average Flow Rate (MGD)
FLA010139	T.P Smith Water Reclamation Facility	Reuse	1.50	17.28
		Reuse	1.50	0.32
		SF	2.00	0.02
FLA010148	Lake Bradford Estates MHP WWTF	RIB	0.67	0.01
FLA010137	Disc Village Wastewater Treatment Plant (WWTP)	RIB	3.64	0.00
FLA010136	Woodville Elementary School WWTP	RIB	8.03	0.00
FLA010159	Meadows-at-Woodrun WWTF	RIB	1.27	0.03
FLA010167	Sandstone Ranch WWTF	RIB	1.32	0.05
FLA010152	Western Estates MHP WWTP	RIB	0.48	0.02
FLA010138	Fort Braden MHP WWTP	RIB	1.84	0.01
FLA010151	Grand Village Mobile Home Park WWTP	RIB	1.47	0.01
FLA010171	Lake Jackson WWTP	RIB	8.88	0.26
FLA010173	Killearn Lakes WWTP	SF	10.07	0.53

Notes:
TN Is total nitrogen
mg/L is milligrams per liter
MGD is million gallons per day
SF is sprayfield
RIB is rapid infiltration basin

The JSA team determined the proximity of each parcel to the nearest wastewater service area. Parcels presently served by OSTDSs that are relatively closer to a wastewater service area are more feasible for connection to wastewater service than parcels presently served by OSTDSs that are relatively farther from a service area.

2.3 Onsite Sewage Treatment and Disposal System Suitability

NRCS classifies soils based on suitability for specific uses, including suitability for OSTDSs (fig. 5). NRCS evaluates the suitability of soils between 24 inches below ground surface and 72 inches below ground surface, for use as OSTDS absorption fields. Ratings are based on soil properties, site features, and OSTDS performance. NRCS qualitatively specifies suitability with the following classifications:

- Not rated: Area not rated, such as surface waters
- Not limited: Soil has features that are very suitable for OSTDSs
- Somewhat limited: Soil has features that are moderately suitable for OSTDSs
- Very limited: Soil has one or more features that are not suitable for OSTDSs

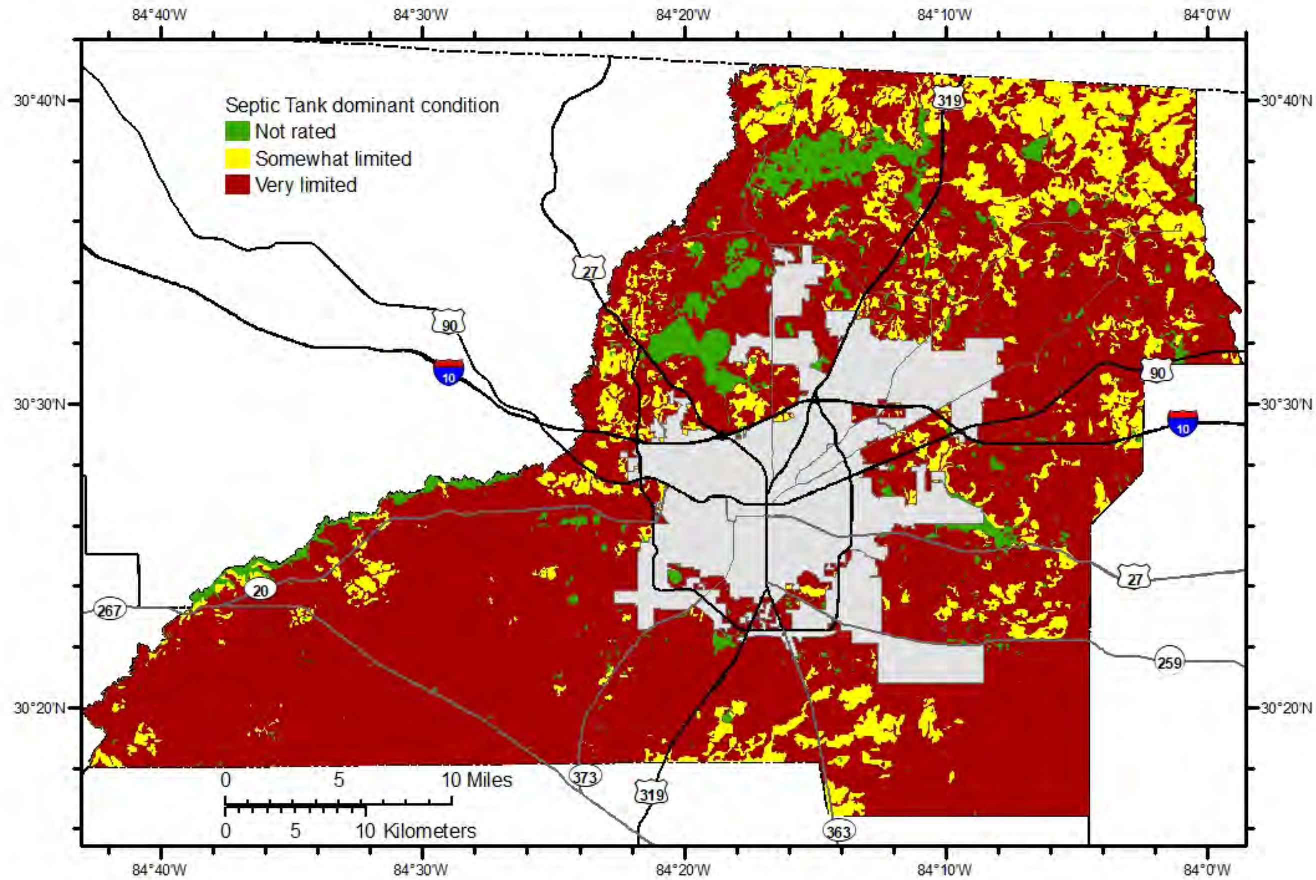

Figure 5. Dominant onsite sewage treatment and disposal system suitability condition in unincorporated Leon County.

The NRCS determined that most of Leon County is not suitable for OSTDSs (fig. 5). This NRCS determination suggests that protective measures should be implemented when using an OSTDS in these parts of Leon County, to minimize the potential for nutrient contamination of groundwater and surface waters.

The nitrogen reduction score favors OSTDS transition to AWTS in areas with the NRCS very-limited classification. OSTDSs on parcels with the NRCS very-limited classification are likely to load more nitrogen to groundwater than OSTDSs on parcels with the NRCS somewhat-limited classification. Parcels in areas with the NRCS very-limited classification are more attractive for OSTDS transition to AWTS than parcels in areas with the NRCS somewhat-limited classification. Areas with the NRCS not-rated classification are surface waters excluded from the nitrogen reduction score.

2.4 2018 Land Use Map

The Tallahassee-Leon County Planning Department delineated a 2018 existing land use (fig. 6). Retail/Motel/Medical includes parcels used for hotels, offices, religious organizations, and nonprofit organizations. Housing includes multi-family houses, single-family attached houses, single-family detached houses, mobile homes, and two-family dwellings. Greenspace includes open space, common areas, recreation facilities, parks, resource protection areas, and state and national forests. Transportation/Utility includes communications facilities. The Planning Department also identified vacant lands, warehouses, and surface waters.

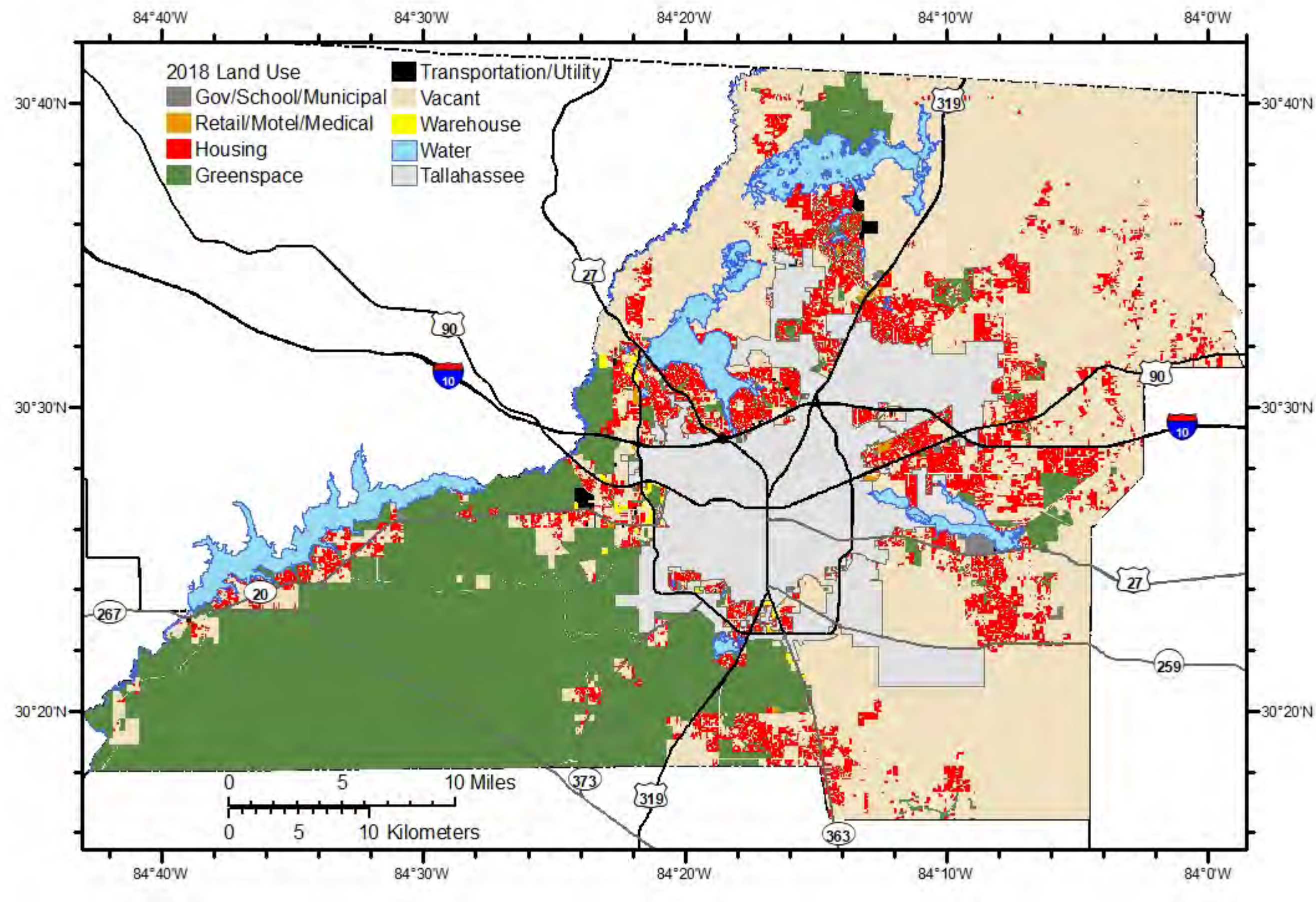

Figure 6. 2018 land use in unincorporated Leon County.

The nitrogen reduction score favors OSTDS transition to AWTS in areas with relatively greater development unit density. OSTDSs on parcels with relatively greater development unit density in 2018 were likely to load more nitrogen to groundwater in 2018 than OSTDSs on parcels with relatively less development unit density in 2018. Parcels in areas with relatively greater development unit density in 2018 are more attractive for OSTDS transition to AWTS than parcels in areas with relatively less development unit density in 2018.

2.5 Future Land Use

Through the Future Land Use Map of the local Comprehensive Plan, The Tallahassee-Leon County Planning Department also delineated future land use (fig. 7). The future land uses include activity center; agriculture; government and institutional; industry and mining; surface waters and protected areas; open space; rural, urban fringe, and residential; and suburban and residential. The Planning Department did not define a year that this future land use represents. The JSA team interprets future land use as a built-out condition.

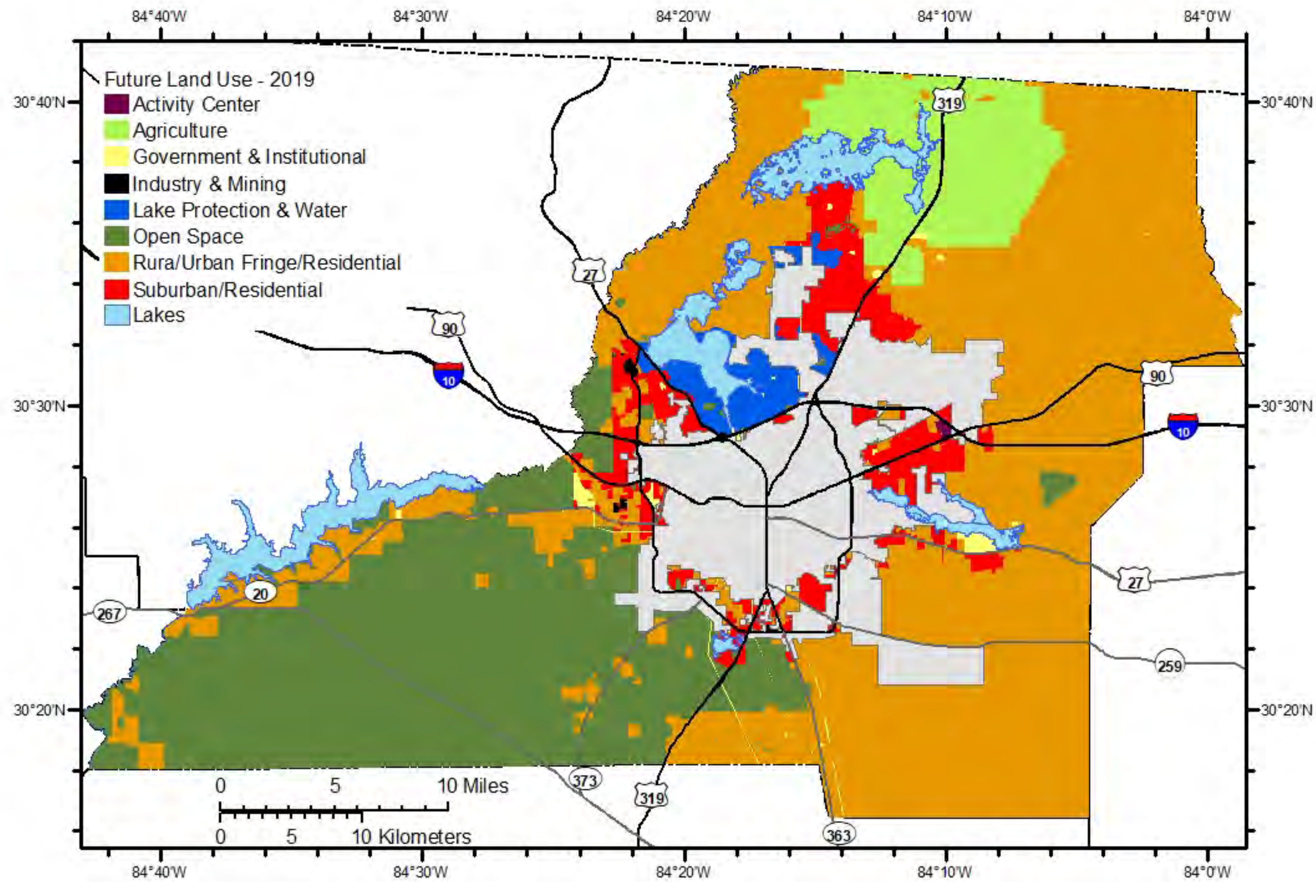

Figure 7*. Future land use in unincorporated Leon County.*

The nitrogen reduction score favors OSTDS transition to AWTS in areas with relatively greater development unit density. Table 2 identifies the density of each land use type as it relates to the 2020 Leon County Land Development Code. OSTDSs on parcels with relatively greater development unit densities in the built-out condition are likely to load more nitrogen to groundwater in the future than OSTDSs on parcels with relatively less development unit density in the built-out condition. Parcels in areas with relatively greater development unit density in the future, built-out condition are more attractive for OSTDS transition to AWTS than parcels in areas with relatively less development unit density in the future, built-out condition.

Table 2*. Land Use Densities in Leon County.*

Land Use Code	Land Use Description	Maximum Dwelling Units per Acre
AC	Activity Center	45.00
AG	Agriculture/Silviculture/Conservation	0.10
EF	Educational Facilities	0.00
GO	Government Operational	0.00
I	Industrial	0.00
LP	Lake Protection	0.50
MGN	Mahan Gateway Node	16.00
MU	Bradfordville Mixed Use	20.00

Land Use Code	Land Use Description	Maximum Dwelling Units per Acre
OS	Recreation/Open Space	0.00
PD	Planned Development	20.00
R	Rural	0.10
RC	Rural Community	4.00
RC-RPO	Rural Community with Residential Preservation Overlay	4.00
RP	Residential Preservation	6.00
R-RPO	Rural with Residential Preservation Overlay	0.10
SUB	Suburban	20.00
UF	Urban Fringe	0.33
UF-RPO	Urban Fringe with Residential Preservation Overlay	0.33
UR	Urban Residential	10.00
UR-2	Urban Residential 2	20.00
WRC	Woodville Rural Community	4.00
WRC-RPO	Woodville Rural Community with RP Overlay	4.00

2.6 Aquifer Vulnerability

Baker et al. (2007a) assessed aquifer vulnerability (fig. 8). Florida Geological Survey (FGS) (2017) made a similar statewide assessment. An aquifer is relatively more vulnerable to contamination where water and constituents at the surface infiltrate directly into the aquifer than where water and constituents at the surface must infiltrate through layers of soil and rock that exist between land surface and the aquifer. Baker et al. (2007a) classified parts of Leon County as least vulnerable, vulnerable, more vulnerable, and most vulnerable. Baker et al. (2007a) built these classifications using soil hydraulic conductivity, thickness of overburden, and known karst.

OSTDSs on parcels in areas classified as least vulnerable likely load less nitrogen to groundwater and surface waters than OSTDSs on parcels in areas classified as most vulnerable. OSTDS transition to AWTS on parcels classified as most vulnerable will likely reduce nitrogen load to groundwater and surface waters more than OSTDS transition to AWTS on parcels classified as least vulnerable.

The Baker et al. (2007a) assessment was not used as a direct input into the nitrogen reduction score because the assessment used karst, soil hydraulic conductivity, and aquifer overburden as inputs, and the nitrogen reduction score uses distance to karst, soil hydraulic conductivity and aquifer confinement. Inclusion of the Baker et al. (2007a) assessment as an input to the nitrogen reduction score will double-count karst and soil hydraulic conductivity. This assessment was used as an ad-hoc guide to fine-tune the nitrogen reduction score.

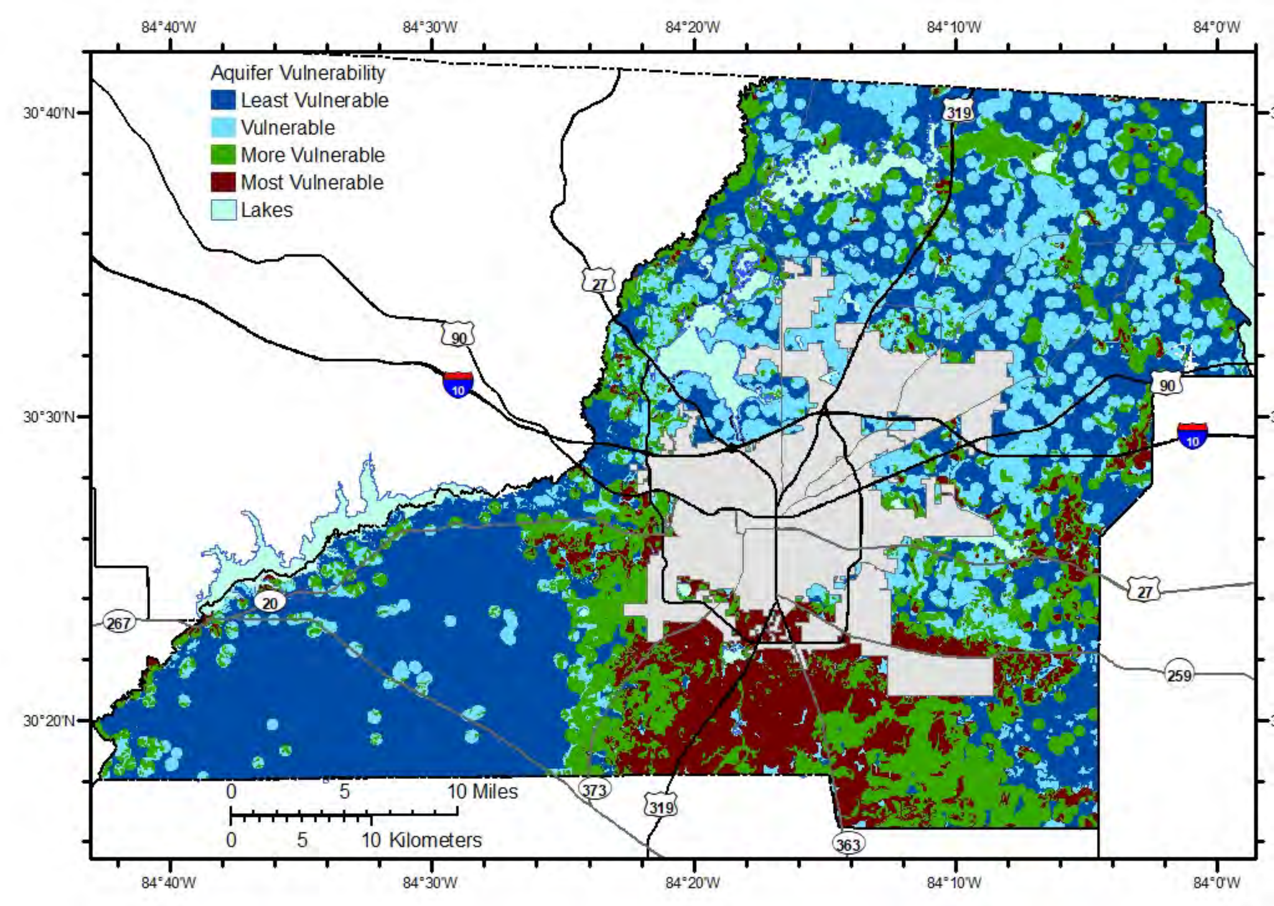

Figure 8. Aquifer vulnerability in unincorporated Leon County.

2.7 Aquifer Confinement

The U.S. Geological Survey (2016) mapped Upper Floridan aquifer confinement in the Floridan aquifer system, in Florida and parts of Georgia, Alabama, and South Carolina (fig. 9). A hydrogeologic unit is a soil layer or rock layer that influences the movement or storage of groundwater. Where an aquifer is confined, a hydrogeologic unit hydraulically separates an aquifer from other aquifers, such that groundwater and constituents in other aquifers do not flow to the confined aquifer, and groundwater and constituents in the confined aquifer do not flow to other aquifers. The layer of rock that prohibits groundwater flow is a confining unit. Where the Upper Floridan aquifer is confined, water and constituents at the surface do not infiltrate through the unit that confines the Upper Floridan aquifer, such that water and pollutants at the surface do not contaminate the Upper Floridan aquifer. Where groundwater can leak through a hydrogeologic unit that confines an aquifer, the aquifer is semi-confined. Aquifers below and above a semi-confined aquifer are distinct aquifers that may transmit groundwater and constituents through the semi-confining unit, from an adjacent aquifer to the semi-confined aquifer, or from the semi-confined aquifer to an adjacent aquifer. Where no hydrogeologic unit exists above an aquifer, between the aquifer and ground surface, the aquifer is unconfined.

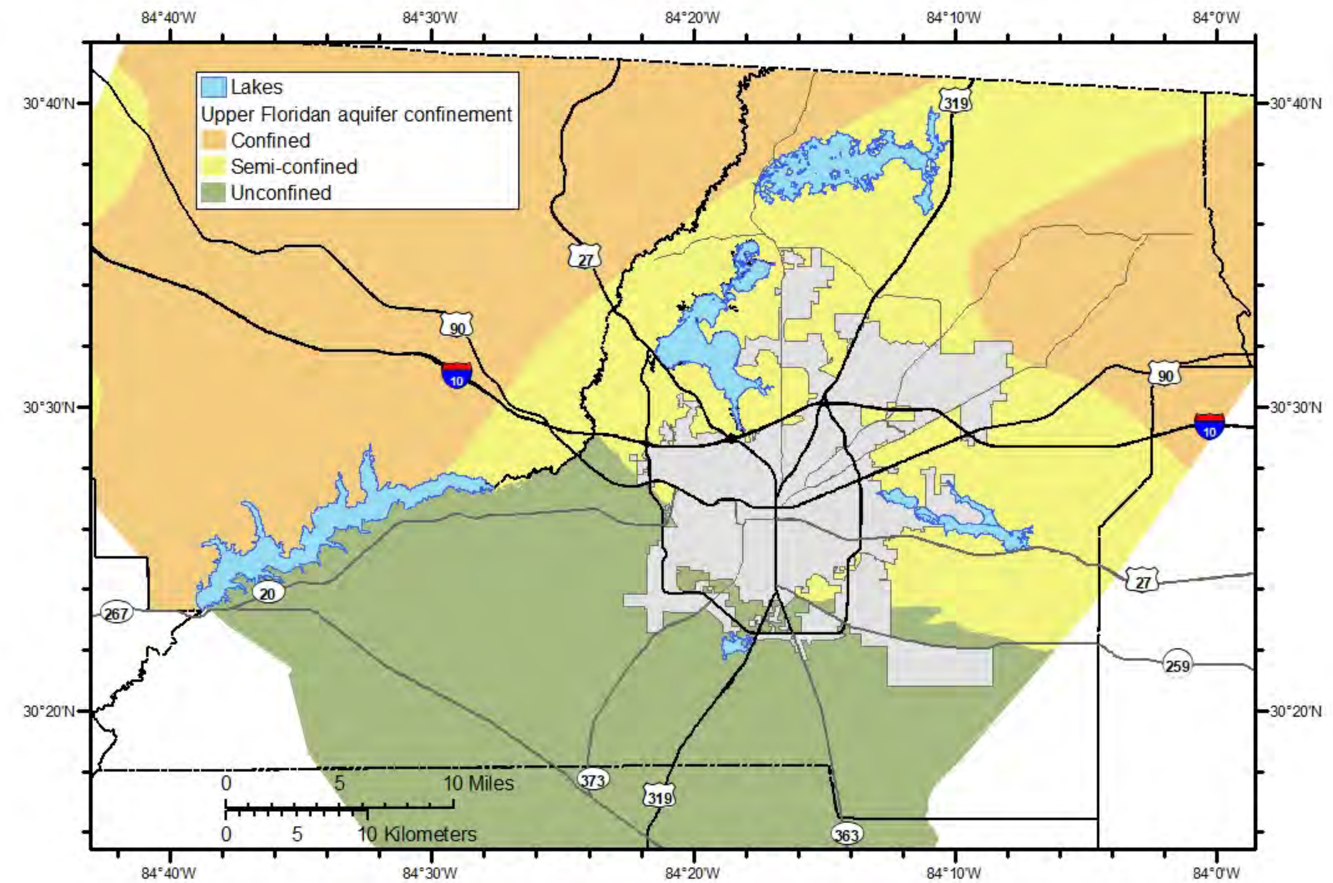

Figure 9. Upper Floridan aquifer confinement in unincorporated Leon County.

OSTDSs likely load more nitrogen to the Upper Floridan aquifer where parcels are underlain by unconfined parts of the aquifer, than where parcels are underlain by semi-confined parts of the aquifer. OSTDSs likely load more nitrogen to the Upper Floridan aquifer where parcels are underlain by semi-confined parts of the aquifer, than where parcels are underlain by confined parts of the aquifer. OSTDS transition to AWTS on parcels underlain by unconfined parts of the Upper Floridan aquifer will likely reduce nitrogen load to groundwater more than OSTDS transition to AWTS on parcels underlain by semi-confined parts of the Upper Floridan aquifer. OSTDS transition to AWTS on parcels underlain by semi-confined parts of the Upper Floridan aquifer will likely reduce nitrogen load to groundwater more than OSTDS transition to AWTS on parcels underlain by confined parts of the Upper Floridan aquifer.

2.8 Karst, Wetlands, and Surface Water

Baker et al. (2007a) identified karst areas (fig. 10). FGS (2017) made a similar assessment. Karst is a landform and geology created by the dissolution of limestone and other soluble rocks. Karst lands typically exhibit sinkholes; caves; and extensive, conductive groundwater flow systems that are capable of transmitting groundwater constituents and pollutants more efficiently than through other, less conductive geology.

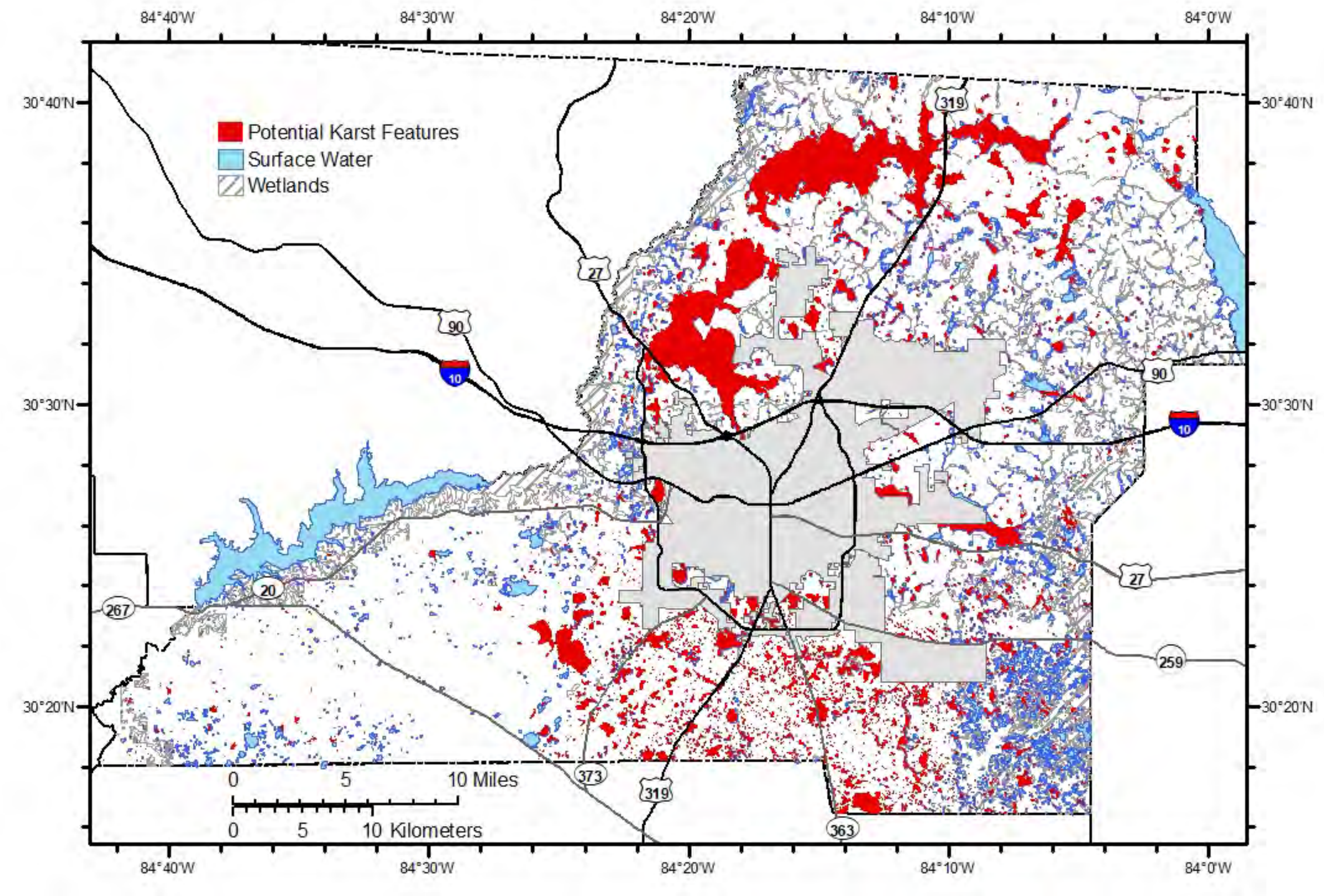

Figure 10. Karst features, wetlands, and surface water in unincorporated Leon County.

The JSA team calculated the distance from each parcel to the nearest karst feature using the centroid of the parcel. OSTDSs on parcels relatively closer to karst are more likely to load nitrogen to groundwater than OSTDSs on parcels farther from karst. OSTDS transition to AWTS on parcels underlain by or relatively close to karst will likely reduce nitrogen load to groundwater more than OSTDS transition to AWTS on parcels relatively farther from karst.

The JSA team also calculated the distance from each parcel to the nearest surface waters or wetland. OSTDSs on parcels relatively closer to surface waters or wetlands are more likely to load nitrogen to these waters than OSTDSs on parcels relatively farther from surface waters or wetlands. OSTDS transition to AWTS on parcels relatively closer to surface waters or wetlands will likely reduce nitrogen load to these waters more than OSTDS transition to AWTS on parcels relatively farther from surface waters or wetlands.

2.9 Saturated Hydraulic Conductivity

Aquifer vulnerability is a function of the rate that water moves through soil (FGS, 2017). Where soil is relatively more conductive, water and constituents move through the soil relatively faster than where soil is less conductive. NRCS mapped saturated vertical hydraulic conductivity in Leon County soils (fig. 11). Hydraulic conductivity is a physical property of flow in porous media, and is both a function of the fluid and the porous media. Specifically, hydraulic conductivity is the proportionality constant that relates flow in porous media to the hydraulic gradient that forces the flow. Hydraulic conductivity governs the rate at which water will drain through saturated soil, rock, and other porous media, forced by a hydraulic gradient. Fluid moves relatively faster through media with a greater hydraulic conductivity than through media with a lesser hydraulic conductivity, forced by the same hydraulic gradient.

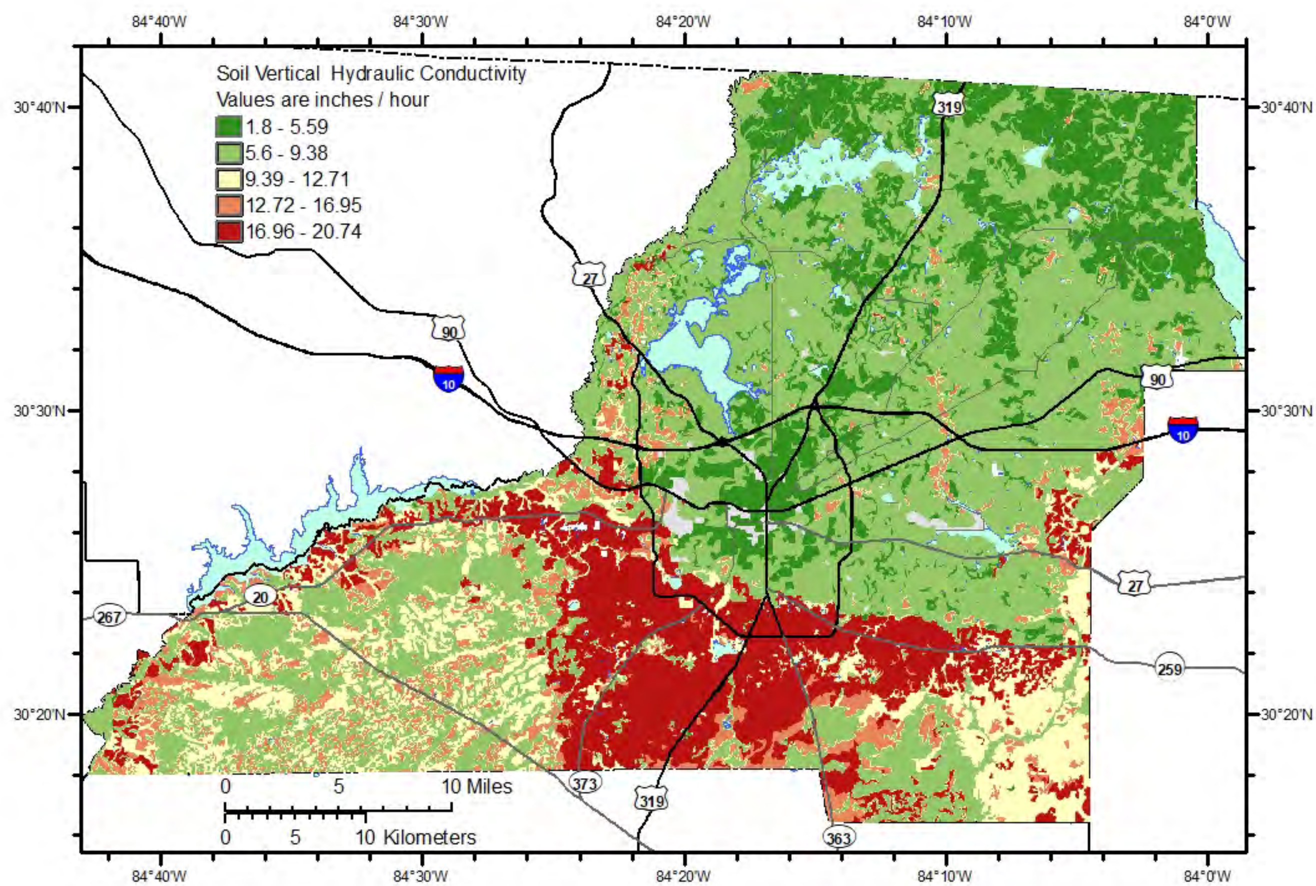

Figure 11. Saturated soil hydraulic conductivity, in inches per hour (in/hr), in unincorporated Leon County.

Hydraulic conductivity is a function of the intrinsic permeability of porous media, relative saturation of media, and density and viscosity of the fluid flowing through the media. Soil hydraulic conductivity ranges from 1.80 inches per hour (in/hr) to 20.74 in/hr across Leon County. Baker et al. (2007a) determined that aquifers in Leon County overlain by soils with saturated hydraulic conductivities that ranged from 12.72 in/hr to 20.74 in/hr were relatively more vulnerability to contamination from pollutants at the surface than aquifers overlain by soils with saturated hydraulic conductivities that ranged from 1.80 in/hr to 12.71 in/hr. The categorization of the soil hydraulic conductivity in figure 11 is used to better identify areas of relatively greater soil hydraulic conductivity and areas of relatively lesser soil hydraulic conductivity. A discrete hydraulic conductivity value for each parcel is used in the nitrogen reduction scoring matrix.

Greater hydraulic conductivity increases the rate at which effluent flows away from an OSTDS but decreases the contact time between in the effluent and denitrifying bacteria that treat the effluent. Lesser hydraulic conductivity decreases the rate at which effluent flows away from an OSTDS but increases the contact time between the effluent and denitrifying bacteria that treat the effluent. OSTDS transition to AWTS on parcels underlain by soils with relatively greater hydraulic conductivity will likely reduce nitrogen load to groundwater more than OSTDS transition to AWTS on parcels underlain by soils with relatively less hydraulic conductivity, due to the decreased contact time with denitrifying bacteria in soils with a greater hydraulic conductivity.

2.10 Location Relative to Urban Service Area, Rural Communities, and Unsewered Target Areas

The location of a parcel in an urban service area, rural community, or unsewered target area (fig. 12) was not incorporated into the nitrogen reduction score. The sewer service area was used to determine the likelihood for OSTDS transition to centralized wastewater treatment. Rural communities were accounted for in the 2020 and 2040 land use, and will be addressed in more detail, in Tasks 2 – 8. Unsewered target areas were not included in the nitrogen reduction score because these areas are identified by Leon County Public Works as septic-to-sewer areas.

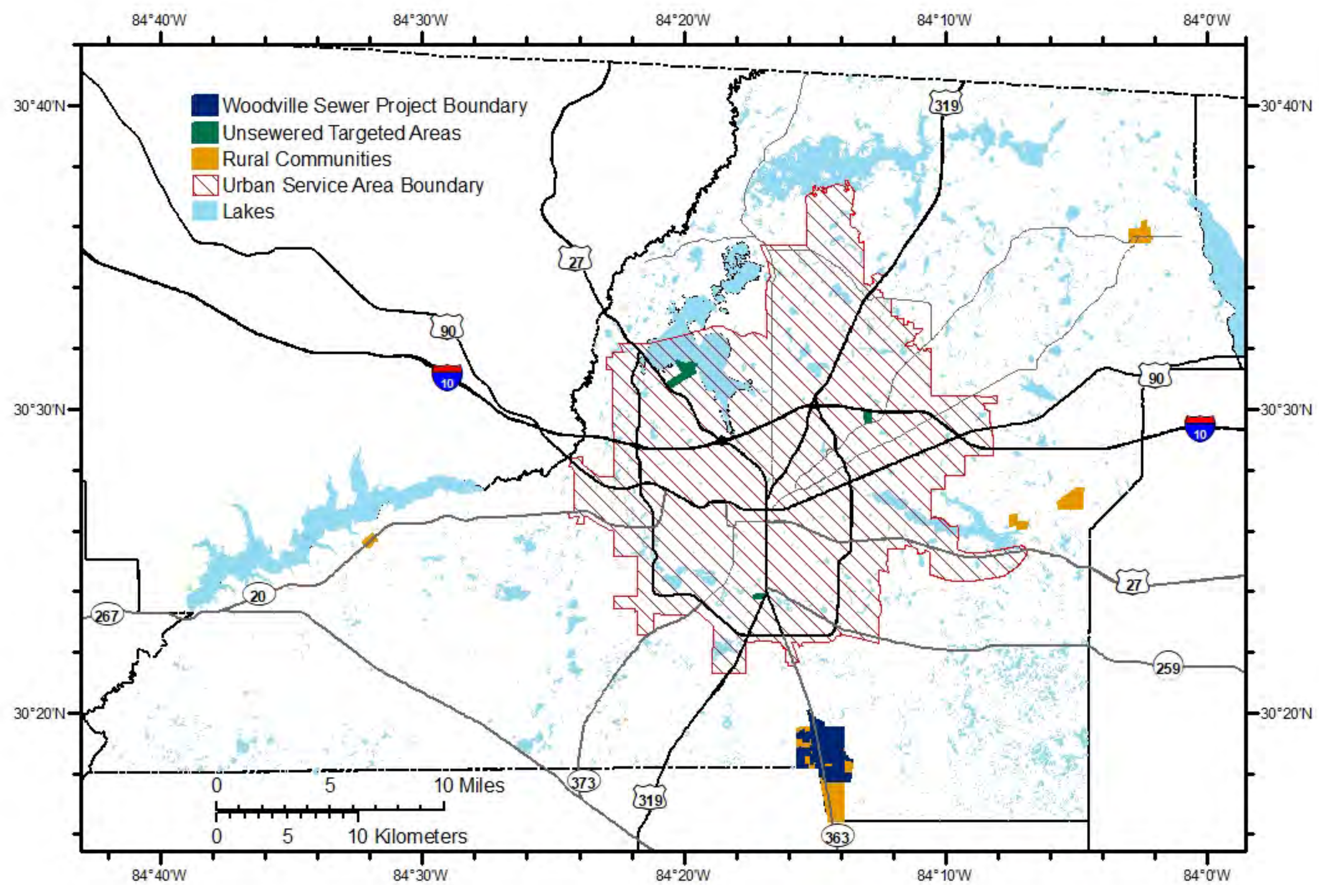

Figure 12. Location of the urban service area, rural communities, and unsewered target areas.

3.0 Nitrogen Reduction Criteria

The JSA team developed nitrogen reduction criteria by identifying inputs based on data, experience, and professional judgement. The method used to score each parcel is described in Section 3.1; the nitrogen reduction score is described in Section 3.2; and assumptions for this process are described in Section 3.3.

The JSA team will use these criteria to rank OSTDS transition to AWTS in subsequent tasks.

3.1 Method

The JSA team calculated a nitrogen reduction score for each parcel in unincorporated Leon County using the geologic criteria discussed in Section 2.0. Mitigation criteria will be developed and applied within Task 3 to incorporate mitigation options within the score. Additional inputs may be included within the criteria as this project proceeds. Currently, the nitrogen reduction score is based on the following seven geologic criteria (F_g) that influence nitrogen reduction and loading to groundwater (table 3):

1. Whether the parcel is in the PFA or the PSPZ
2. Current and future development units per acre based on a combination of the following:
    a. Development units per acre on the 2018 land use assigned to the parcel
    b. Development units per acre at the built-out condition assigned to the parcel
3. Whether the parcel is underlain by a confined part of the Upper Floridan aquifer, semi-confined part of the Upper Floridan aquifer, or unconfined part of the Upper Floridan aquifer
4. Distance from the parcel to the nearest wetlands or surface waters
5. Distance from the parcel to the nearest karst
6. The saturated hydraulic conductivity of the soil on the parcel

Table 3. *Nitrogen reduction geologic inputs, the associated figure in the present report, input type, input values, range of input values, scale of the range of input values, a percent contribution or weight, and the product of the scale and weight.*

Input	Reference Figure	Type	Value	Range	Scale	Initial JSA team weight = %contribution	Scale × %contribution
PFA/PSPZ	4	Binary	0: outside areas 1: inside area(s)	0–1	1	20/85 = 23.5%	2.4×10^{-1}
2018 land use density	6	Real	Development units per acre	0–45	2.2×10^{-2}	5/85 = 5.9%	1.3×10^{-3}
Future land use density	7	Real	Development units per acre	0–45	2.2×10^{-2}	5/85 = 5.9%	1.3×10^{-3}
Upper Floridan aquifer confinement	9	Integer	0: confined 1: semi-confined 2: unconfined	0–2	0.5	10/85 = 11.8%	5.9×10^{-2}
Distance to surface waters or wetlands	10	Real	Distance in feet	6,420–0	1.6×10^{-4}	10/85 = 11.8%	1.9×10^{-5}
Distance to karst	10	Real	Distance in feet	11,624–0	8.6×10^{-5}	15/85 = 17.6%	1.5×10^{-5}
Saturated soil hydraulic conductivity	11	Real	inches per hour	0–21	4.8×10^{-2}	20/85 = 23.5%	1.1×10^{-2}
					SUM	100%	

Inputs are either real numbers, binary numbers, or integer numbers. Inputs do not exhibit the same range of values. For example, the location within the PFA/PSPZ is a binary index with a value of 0 for outside and 1 for inside these areas, whereas the saturated soil hydraulic conductivity is a real number that ranged from 0 in/hr to 21 in/hr. Inputs also do not exhibit the same units. For example, 2018 and future land use density is measured in development units per acre and proximity to karst is measured in feet. Some inputs influence the nitrogen reduction score more at a maximum value, and some influence the nitrogen reduction score more at a minimum value. For example, greater land use density will lead to more nitrogen loading to groundwater than lesser land use density, while greater distance to karst will load less nitrogen to groundwater than lesser distance to karst. The JSA team scaled all inputs to a common magnitude between zero and one by multiplying the maximum value for each input by the inverse of the maximum value for each input, such that the maximum scaled value for each input is 1 and dimensionless. For example, the maximum saturated soil hydraulic conductivity is 21 inches per hour, the inverse of this maximum is 0.048 hours per inch, when these two numbers are multiplied to a dimensionless value of 1 is produced. Scaling inputs removes the influence of input type, range, and magnitude from the score.

The JSA team assigned a weight to each input, to incorporate opinion about the relative importance of each input to the nitrogen reduction score. We assigned an initial weight of 10 to all inputs. The JSA team used experience and judgement to estimate initial weights. For example, the JSA team initially determined that the soil hydraulic conductivity is twice as important as the proximity of a parcel to the nearest wastewater service area. Proximity of a parcel to the nearest wastewater service area has the weight of 10; and hydraulic conductivity has a weight of 20, which is twice the weight of 10.

The future and current land use criteria can be considered to be one and the same, so each was assigned a weight of 5. This results in an increase in score in the event future land use density for a particular parcel allows for an increased build-out density, but still accounts for the current land use density.

We calculated percent contribution of each input as the ratio of initial weight to the sum of all weights. For example, hydraulic conductivity contributes 19% to the nitrogen reduction score. Final weights, at the conclusion of Task 8, will be based on initial JSA team weights, input from Leon County staff, input from an advisory committee of experts, and input from Leon County residents. Leon County staff will dictate final weights to the JSA team.

The JSA team calculated a nitrogen reduction score for each parcel in unincorporated Leon County as the sum of scaled, non-dimensionalized, weighted inputs. This approach allowed the JSA team to combine inputs of different units to create a dimensionless score for each parcel, such that data, experience, and professional judgement related to likely nitrogen reduction are appropriately incorporated into the score and decisions based on the score.

3.2 Nitrogen Reduction Score

The JSA team calculated a nitrogen reduction score for each parcel in Leon County using the method described in Section 3.1. We then mapped the nitrogen reduction score (fig. 13). Scores were standardized on a range of 0 to 10, with 10 being a nitrogen reduction score for a parcel that likely loads groundwater and surface waters more than other parcels, and 0 being a nitrogen reduction score for a parcel that likely loads groundwater and surface waters less than other parcels.

Parcels in the southeastern part of Leon County generally exhibit relatively greater nitrogen reduction scores than other parts of the County. This southeastern part of Leon County is in a PFA and the PSPZ. This area has little to no confining layer, more karst, a higher groundwater table, greater density of surface water and wetlands, and relatively greater hydraulic conductivity than other parts of the county.

Nitrogen reduction scores in the northeastern part of the county are relatively less than the average nitrogen reduction score because the Upper Floridan aquifer is confined in the northeastern part of the county, less karst exists in this area, and soil hydraulic conductivity in this area is less than conductivity in other parts of the county.

Some parcels inside the urban service area and outside the corporate limits of the City of Tallahassee have relatively greater nitrogen reduction scores than other parcels in the county; these areas may be included in future OSTDS transition to centralized wastewater treatment at the Thomas P. Smith Water Reclamation Facility.

Findings are limited to data included in the analysis. Future analyses will include additional criteria that may change the nitrogen reduction score for each parcel. Mitigation approaches to address the higher loading areas and associated costs to implement those measures will be determined in Task 3.

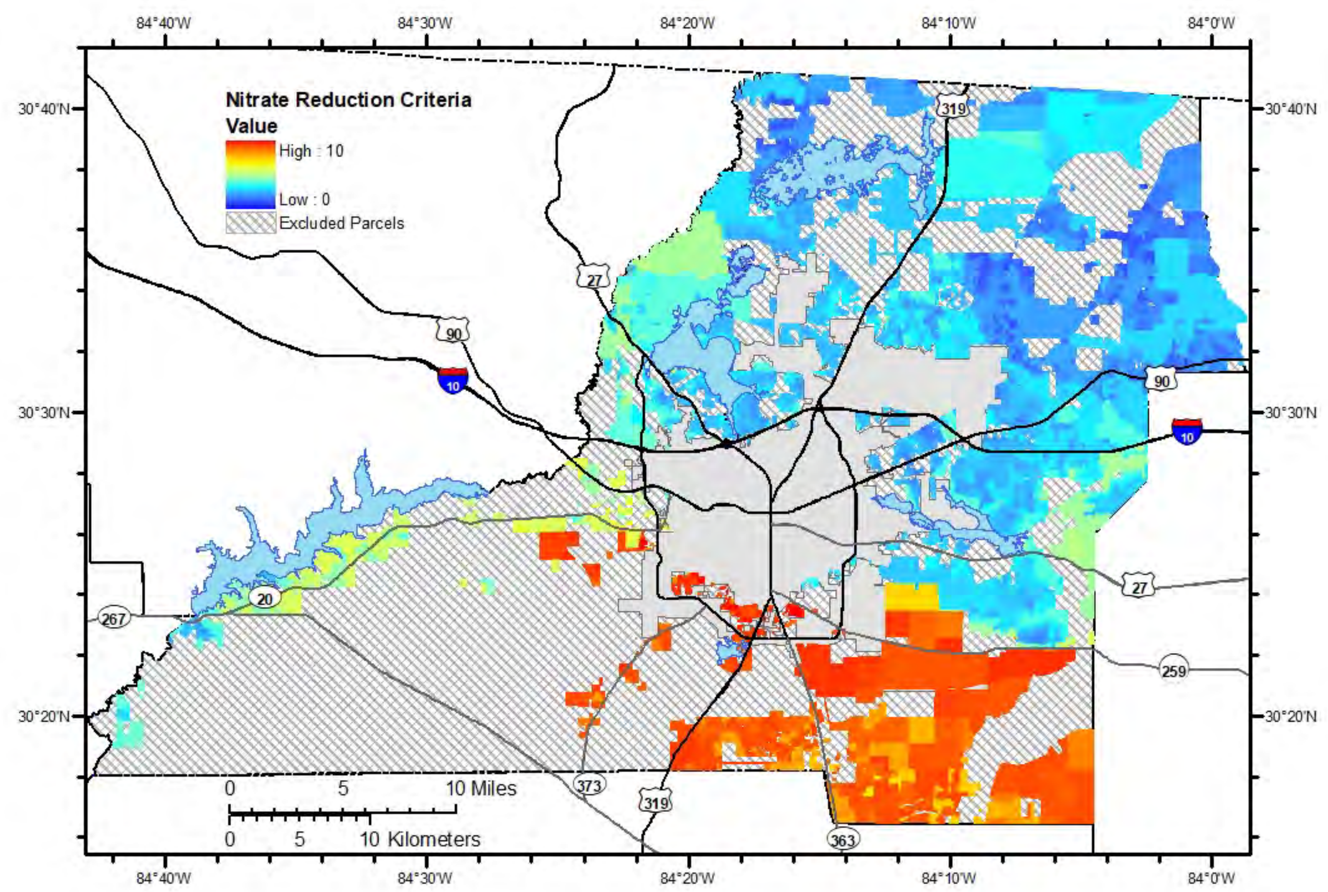

Figure 13. Nitrogen reduction score in unincorporated Leon County, based on initial, draft input weights.

3.3 Land Area Categories and Minimum Performance Criteria

The JSA team categorized nitrogen reduction land area in conformance with the following Upper Floridan aquifer confinement, as defined in DEP (2018a):

- Unconfined
- Semi-confined
- Confined

This categorization allows direct comparison between the BMAP and calculated existing nitrogen load rates to groundwater (table 4). The JSA team considered nitrogen load from the following treatment systems:

- WWTF–RIB: WWTFs that dispose of treated effluent with a rapid infiltration basin.
- WWTF–Reuse: WWTFs that reuse treated effluent, primarily by irrigation.

- WWTF–SF: WWTFs that dispose of treated effluent with spray field irrigation.
- OSTDS: Basic OSTDS that consists of a standard septic tank and drainfield, with no aeration or further treatment of the effluent.

Table 4. *Average existing load to groundwater with recharge factors applied by source category and nitrogen reduction land areas.*

Nitrogen Reduction Land Area	Hydrogeologic Attenuation Factor (%)	WWTF–SF (lb-N/yr)	WWTF–Reuse (lb-N/yr)	WWTF–RIB (lb-N/yr)	OSTDS (lb-N/yr)
Unconfined	90%	26	17,701	277	71,820
Semi-confined	40%	2,585	146	2,106	71,440
Confined	10%	0	0	0	2,505
Subtotal	N/A	2,611	17,847	2,383	145,765
Total Nitrogen Load (lb-N/yr)		**168,606**			

Notes: WWTF is wastewater treatment facility
SF is spray field
RIB is rapid infiltration basin
OSTDS is onsite sewage treatment and disposal system
lb-N/year is pounds of nitrogen per year

OSTDS counts for 2020 (table 5) are based on the data from the Florida Department of Health, and professional judgement in areas where data conflicted with adjacent treatment types. Projected 2040 OSTDS counts (table 5) are based on the most recent U.S. Census. The Census identifies a population of 275,487 for April 1, 2010 and 293,582 for July 1, 2019. Using the following formula, the calculated annual growth rate is 0.69%:

$$annual\ growth\ rate = \ln(N_t / N_o)/(\frac{T_t}{T_o})$$

The 20-year projection for the confined area is higher than the maximum build-out; therefore, 2,300 dwelling units will be used for projections in the area where the aquifer is confined. The maximum future dwelling units is based on the build-out of all parcels as allowed under the current Leon County and City of Tallahassee Land Development Codes.

Table 5. *Existing OSTDS counts and projected dwelling units by nitrogen reduction land areas.*

Nitrogen Reduction Land Area	2020 OSTDS Count	2040 Dwelling Units	Maximum Future Dwelling Units
Unconfined	7,287	8,361	22,889
Semi-confined	16,312	18,716	38,724
Confined	2,286	2,300	2,300

Notes: OSTDS is onsite sewage treatment and disposal system

The JSA team calculated total nitrogen load rates for the WWTFs and OSTDS based on Lyon and Katz (2018) (table 6). We calculated OSTDS loading rates using an average 2.43 persons per household (U.S. Census 2014 through 2018) and an average 9.012 lb/yr per person nitrogen loading rate (U.S. Environmental Protection Agency 2002; Toor et al. 2011; Viers et al. 2012).

Table 6. *Estimated existing nitrogen input to nitrogen reduction land areas*

Nitrogen Reduction Land Area	WWTF–SF (lb-N/yr)	WWTF–Reuse (lb-N/yr)	WWTF–RIB (lb-N/yr)	OSTDS (lb-N/yr)
Unconfined	72	78,672	411	159,600
Semi-confined	16,156	1,458	7,018	357,200
Confined	0	0	0	50,100
Total	16,228	80,130	7,429	566,900

Notes: WWTF is wastewater treatment facility
SF is spray field
RIB is rapid infiltration basin
OSTDS is onsite sewage treatment and disposal system

lb-N/year is pounds of nitrogen per year

The JSA team applied a biochemical attenuation factor as defined by DEP (2018a) to each type of treatment system (table 7). We calculated total nitrogen load rates for each treatment type as a function of unconfined, semi-confined, and confined nitrogen reduction land areas.

Table 7. Average existing biochemical attenuation factor by source category and nitrogen reduction land areas.

Nitrogen Reduction Land Area	WWTF–SF (lb-N/yr)	WWTF–Reuse (lb-N/yr)	WWTF–RIB (lb-N/yr)	OSTDS (lb-N/yr)
Biochemical attenuation factor (%)	60%	75%	25%	50%
Unconfined	29	19,668	308	79,800
Semi-Confined	6,462	365	5,264	178,600
Confined	0	0	0	25,050
Total	6,491	20,033	5,572	283,450

Notes: WWTF is wastewater treatment facility
SF is spray field
RIB is rapid infiltration basin
OSTDS is onsite sewage treatment and disposal system
lb-N/year is pounds of nitrogen per year

The JSA team applied hydrogeologic attenuation factors described in DEP (2018a) to each nitrogen reduction land area (table 4). OSTDS accounts for 86% of the nitrogen load from the treatment systems in table 4. Based on information presented in Lyon and Katz (2018), WWTF and OSTDS account for 34% of the total nitrogen load to groundwater in the BMAP area.

The options for OSTDS upgrades to nitrogen removing systems include:

- Aerobic Treatment Unit (ATU): Individual or cluster OSTDSs that converts chemical energy from oxygen molecules. These systems must be certified by the National Sanitation Foundation (NSF) International and be capable of providing, on average, at least 50% nitrogen reduction and 90% reduction under test conditions before (partially) treated wastewater is discharged to the drainfield. Traditional OSTDSs use an anerobic process, which does not involve oxygen.
- PBTS: Individual or cluster OSTDSs that use specialized technology and rely on engineering principles to achieve a specific and measurable established performance standard for carbonaceous biochemical oxygen demand, total suspended solids concentration, total nitrogen concentration, total phosphorus concentration, and removal of fecal coliform. PBTSs must be certified by NSF International and be capable of providing, on average, at least 50% nitrogen reduction (and 90% reduction under test conditions) before partially treated wastewater is discharged to the drainfield.
- In-Ground Nitrogen-Reducing Biofilter (INRB): Individual or cluster OSTDSs that use a passive INRB drainfield and reduce total nitrogen load by about 65%. An INRB drain field is a two-stage, passive biofilter based on ammonification and nitrification in the first stage and denitrification in the second stage.

The JSA team assumed that Leon County will connect 50% of parcels in each of the nitrogen reduction land area to a centralized wastewater collection system, and the remaining 50% of OSTDSs will be enhanced to achieve a minimum 65% reduction in nitrogen load rate (table 8). For this projection, the JSA team assumed a 2 mg/L nitrogen load from WWTF with reuse discharge. The calculated reduction is identified for 2020 OSTDSs and for 2040 projected dwelling units.

Table 8. Estimated nitrogen reduction rates for 2020 and projected for 2040.

Nitrogen Reduction Land Area	Unconfined 2020	Unconfined 2040	Semi-Confined 2020	Semi-Confined 2040	Confined 2020	Confined 2040
Number of OSTDS	7,287	8,361	16,312	18,716	2,286	2,300
2020 nitrogen load from wastewater (lb-N/yr)	89,824	N/A	76,277	N/A	2,505	N/A
Sewered connections (50% of OSTDSs)	3,644	4,181	8,156	9,543	1,143	1,150
Advanced OSTDSs (50% of OSTDSs)	3,643	4,180	8,156	9,542	1,143	1,150
Updated nitrogen load (lb-N/yr)	13,563	15,563	13,496	15,789	473	476
Nitrogen reduction (lb-N/yr)	76,261	74,261	62,781	60,488	2,032	2,029
Percent reduction from 2020 load	84.90%	82.67%	82.31%	79.30%	81.12%	81.01%
Percent of total reduction per nitrogen reduction land area	54.06%	54.29%	44.50%	44.22%	1.44%	1.48%

Notes: OSTDS is onsite sewage treatment and disposal system
lb-N/year is pounds of nitrogen per year

The current treatment criteria used for all the nitrogen reduction land areas is 50% connected to a centralized wastewater collection system and 50% converted to AWTS. AWTS will have a minimum nitrogen reduction of 65%. In subsequent tasks, the mitigation options will be further refined and the cost to convert OSTDSs to AWTSs will be compared with other costs to determine the feasible technologies.

3.4 Assumptions

The JSA team made the following assumptions to develop and calculate the nitrogen reduction score:

- OSTDS effluent infiltration to any karst feature loads nitrogen to the regional groundwater flow system. However, some karst features in Leon County may drain, locally, to hydrogeologic units that are hydraulically separated from the regional groundwater flow system.
- The NRCS representation of soil in Leon County is vertically continuous from the surface to the surficial aquifer, such that soils at the surface are not underlain by different soils, with different hydrogeologic properties; and OSTDS effluent infiltration to soils at the surface drain through this surface soil to the regional groundwater flow system. However, some surface soils in Leon County may be underlain by different soils that either enhance or impede infiltrated OSTDS effluent as this infiltrated effluent drains to the regional groundwater flow system.
- Areas that are both inside the urban service area and outside the corporate limits of the City of Tallahassee will not be connected to a centralized wastewater collection system, unless the Florida Department of Health OSTDS database explicitly identifies the area as connected to a centralized wastewater collection system.
- The JSA team assumed OSTDS for some parcels and centralized wastewater collection for other parcels. These assumptions must be verified with additional information or field inspection. The Florida Department of Health OSTDS database shows multi-dwelling developments outside the urban service area with OSTDSs for some dwellings in the development and connections to a centralized wastewater collection system for other dwellings in the development.
- The City of Tallahassee and Talquin Electric Cooperative agree to expanded limits of the Talquin wastewater service area. The JSA team assumed that the Talquin wastewater service area will expand to the limits defined by the agreement between the city and cooperative.
- Undeveloped lands currently owned by the City of Tallahassee, state of Florida, or federal government will remain undeveloped in the future.

4.0 Preliminary Findings

The JSA team determined the following:

Finding 1. Parcels south of Leon County Road 259 and east of U.S. Highway 319 (centered at about 30° 20′ N, 84° 10′ W) have greater nitrogen reduction scores than parcels in other parts of Leon County (fig. 13) because the Upper Floridan aquifer is unconfined in this area, more karst exists in this area, and wetland density is greater in this area. Karst typically exhibits sinkholes; caves; and extensive, conductive groundwater flow systems that are capable of transmitting groundwater constituents and pollutants more efficiently than other, less conductive geology. Parcels south of Leon County Road 259 and east of U.S. Highway 319 are relatively more attractive for transition to alternative wastewater treatment than other parcels in Leon County. The maximum nitrogen reduction score south of Leon County Road 259 and east of U.S. Highway 319 is about 9.

Finding 2. Parcels north of U.S. Highway 90 and east of U.S. Highway 319 (centered at about 30° 35′ N, 84° 05′ W) scored relatively less than parcels in other parts of Leon County (fig. 13) because the Upper Floridan aquifer is confined and less karst exists in this area. Parcels north of U.S. Highway 90 and east of U.S. Highway 319 are relatively less attractive for transition to alternative wastewater treatment than other parcels in Leon County. The maximum nitrogen reduction score north of U.S. Highway 90 and east of U.S. Highway 319 is about 7; the minimum is 1.

Finding 3. The nitrogen reduction score is more sensitive to soil hydraulic conductivity, proximity to wetlands and surface water, and aquifer confinement. Changes in these criteria caused relatively greater changes in the nitrogen reduction score than changes in other criteria.

Finding 4. The nitrogen reduction score is less sensitive to density of residential units and proximity to wastewater service areas. Changes in these criteria caused relatively less change in the nitrogen reduction score than changes in other criteria.

Finding 5. Leon County can reduce the nitrogen loading to groundwater or surface waters by about 80% by connecting existing OSTDSs and parcels that will be developed during the next 20 years to a centralized wastewater collection system, or by upgrading OSTDSs to AWTS.

The JSA team may refine these findings as the present Task 1 draft report is finalized, and as plan development progresses.

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Appendix B. Task 2: Cost-Effectiveness of Alternative Technologies Report

Comprehensive Wastewater Treatment Facilities Plan

Task 2: Cost-Effectiveness of Alternative Technologies

LEON
FLORIDA'S CAPITAL COUNTY

Prepared by

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ENGINEERING HYDROLOGY GEOLOGY

AGI

ATM

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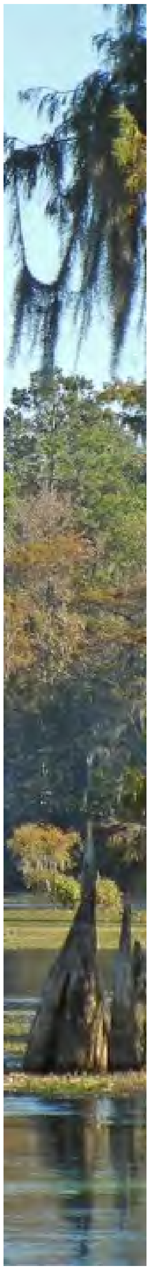
Magnolia Engineering, LLC

TETRA TECH

October 15, 2021



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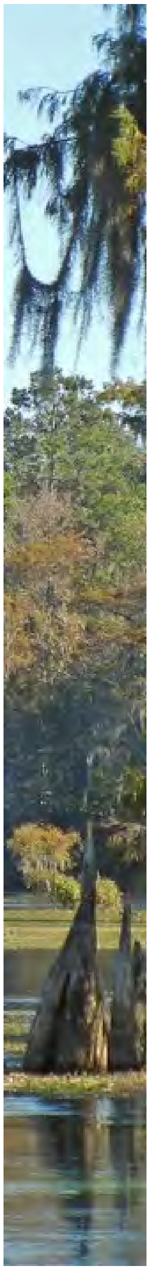

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Acronyms and Abbreviations

ANSI	American National Standards Institute
ATU	aerobic treatment unit
AWTS	alternative wastewater treatment system
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Florida Department of Environmental Protection
ETV	Environmental Technology Verification
F.A.C.	Florida Administrative Code
gpd	gallons per day
INRB	in-ground nitrogen-reducing biofilter
JSA	Jim Stidham and Associates
kW	kilowatt-hours
mg/L	milligrams per liter
NPDES	National Pollutant Discharge Elimination System
NWFWMD	Northwest Florida Water Management District
NSF	National Sanitation Foundation
NSILT	Nitrogen Source Inventory and Loading Tool
O&M	operation and maintenance
OSTDS	onsite sewage treatment and disposal system
PBTS	performance-based treatment system
PFA	priority focus area
ROW	right-of-way
RME	Responsible Management Entity
USEPA	U.S. Environmental Protection Agency
WSWT	wettest season water table
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

Leon County is developing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs) to groundwater and surface waters. OSTDSs are also known as septic systems. The plan also considers nitrogen load reduction associated with treatment alternatives for future development. The Florida Department of Environmental Protection (DEP) found that nutrient loads from several sources—including OSTDSs in Leon County—impaired the Upper Wakulla River and Wakulla Spring. Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for the part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are (1) to identify OSTDSs to transition to alternative wastewater treatment systems where the transition will most reduce nitrogen loads to surface waters and groundwater, and (2) to identify locations of future development that require alternative wastewater treatment systems to reduce nitrogen loads to surface waters and groundwater.

Leon County is preparing the plan by progressing through eight major tasks. This report describes the results of the second task. This task includes quantifying nitrogen reduction alternative costs; estimating nitrogen load reduction, as a mass, for each alternative; and quantifying the cost-effectiveness of each alternative, as a function of both direct costs to households and community benefits from improved water quality.

The purpose of this plan is to identify appropriate alternative wastewater treatment systems (AWTSs) to provide nutrient reductions in areas of Leon County that are identified as contributing to the Upper Wakulla River and Wakulla Spring. By upgrading existing traditional OSTDS to AWTSs and planning for the use of AWTS in future development, nutrient loading to these sensitive and important waterbodies can be reduced, thereby improving water quality. The estimated nutrient reductions presented in this plan were calculated using the methods that DEP developed for the Upper Wakulla River and Wakulla Spring Nitrogen Source Inventory and Loading Tool (NSILT) and Basin Management Action Plan (BMAP). While the actual load reductions achieved may not match these estimates exactly, the most important consideration is that using AWTSs in place of traditional OSTDS will reduce nutrient loading.

This Task 2 report includes the following preliminary findings:

Finding 1. Costs for OSTDSs are significant when calculated as a separate component of new construction and the expected, annualized costs of drainfield replacement are included.

Finding 2. In-ground nitrogen-reducing biofilters have the least cost per pound of nitrogen removed because these biofilters do not require hardware, electricity for equipment operation, annual maintenance, or annual monitoring.

Finding 3. Active systems are more cost-effective per pound of nitrogen removed than OSTDSs. Active systems include aerobic treatment units and performance-based treatment systems.

Finding 4. Different types of active cluster systems have similar benefit-cost ratios due to economies of scale and relatively greater total nitrogen removal rates. A performance-based treatment system is one example of an active cluster system.[1]

Finding 5. Connection to a centralized wastewater collection system is the most expensive option if all costs are paid by the developer or property owner. Centralized wastewater collection systems are also known as central sewers. Central sewers reduce nitrogen loads to groundwater more than

[1] Performance based treatment systems are generally installed to serve single residences and establishments, but could support a cluster if so designed.

other alternatives. If central sewer construction is funded by a municipal utility, central sewer is more attractive than other alternatives.

Finding 6. Clustered systems, whether active or passive, appear more cost-effective than individual systems where costs for land for the treatment system and drainfield are part of the business model. Land dedicated for this purpose during the design of a subdivision, while still part of development costs, can offset or eliminate the individual share of this expense. Cluster systems can offer efficiencies of scale for capital and operating costs.

Finding 7. The benefit-cost ratio of central sewer improves only marginally (0.08) if the connection fee is subsidized fully by a grant.

These Task 2 findings are preliminary and subject to refinement as development of Leon County's plan progresses.[2]

[2] Per the January 6, 2021 email discussion between Jim Stidham and Associates (JSA) and DEP, the scope of Task 2 does not include consideration of costs to address capacity upgrades of existing central wastewater treatment facilities. Prospective limitations of capacity beyond the 20-year horizon of this study could affect wastewater treatment options, and the cost and funding considerations of planning, designing, and constructing additional capacity should be evaluated by the County's wastewater utility providers.

1.0 Introduction

The Florida Department of Environmental Protection (DEP, 2018) found that nutrient loads from several sources impaired water quality in the Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore the river and spring by identifying actions that will reduce pollutant loads to the river and spring. DEP adopted the BMAP in June 2018 and requires that stakeholders, including Leon County, reduce nitrogen loads to the river and spring from onsite sewage treatment and disposal systems (OSTDSs). OSTDSs are also known as septic systems. An OSTDS is composed of a septic tank and a drainfield. Leon County contracted with Jim Stidham and Associates (JSA) to develop the plan to reduce nitrogen loads from OSTDSs. JSA partnered with Advanced Geospatial, Applied Technology & Management (ATM), The Balmoral Group, Magnolia Engineering, and Tetra Tech to create the plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP facilities plan with a grant to the county. About 40% of Leon County is served by OSTDS, about 20% is served by five wastewater treatment facilities, and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (Figure 1). Areas within the Tallahassee city limits are not included in these percentages.

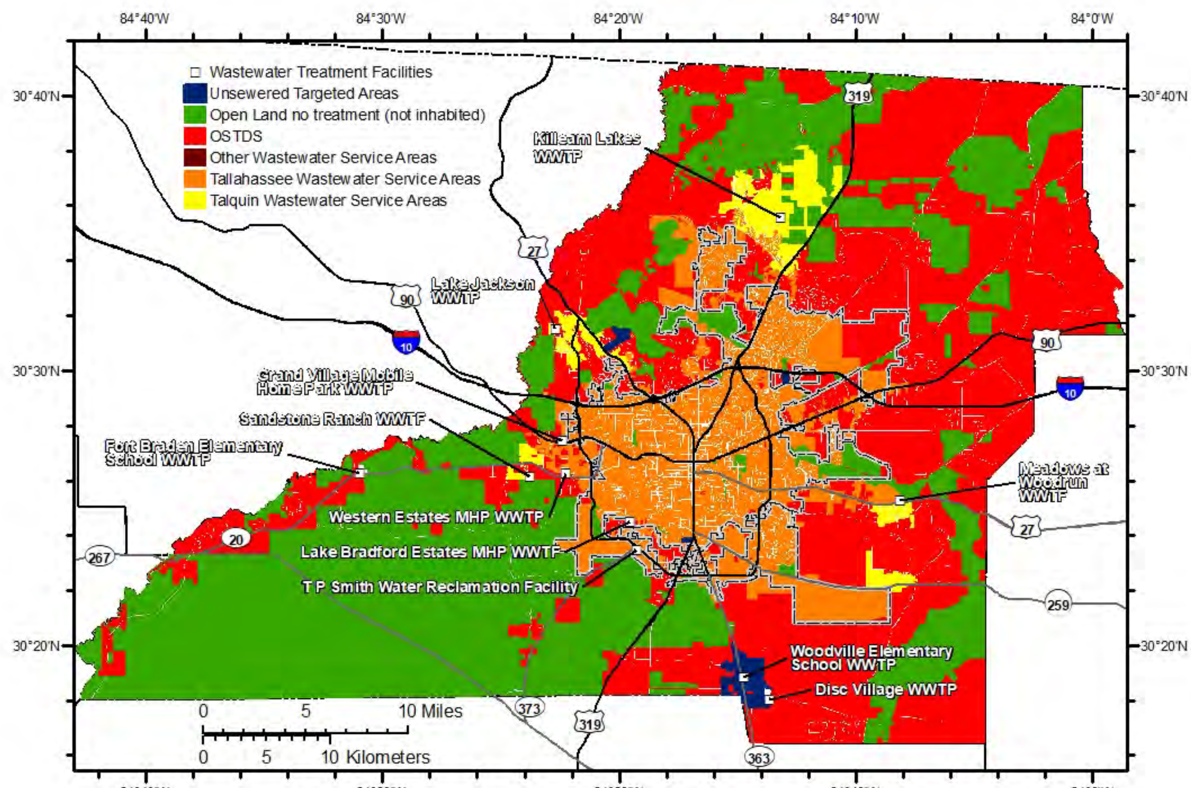

Figure 1. Parcels with OSTDS, five wastewater treatment facilities or wastewater treatment plants, the City of Tallahassee wastewater service area, and the Talquin Electric Cooperative service area.

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTSs), where the transition will most reduce nitrogen loads to the river and spring. To accomplish this objective, the JSA team is performing the following tasks:

Task 1. Develop a nitrogen reduction score to identify likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTSs; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated unsewered target areas (Completed)

Task 2. Quantify cost-effectiveness of AWTSs (Completed)

Task 3. Identify other factors that influence selection of an AWTS

Task 4. Provide education to the community regarding information compiled in Tasks 1 through 3 and survey the citizens of Leon County for their opinions of this plan

Task 5. Analyze implementation scenarios for AWTSs

Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTSs

Task 7. Provide additional education to the community regarding the information compiled in Tasks 1 through 7 and conduct an additional survey of the citizens of Leon County for their opinions of this plan

Task 8. Present the plan to the Leon County Board of County Commissioners

This report describes Task 2 of the Leon County plan: evaluate the cost-effectiveness of AWTSs.[3] In this report, the JSA team describes the objectives of Task 2 (Section 1.1), summarizes data used to evaluate cost-effectiveness (Section 2.0), presents the draft results of the cost-effectiveness evaluation (Section 3.0), and provides the preliminary findings of the evaluation (Section 0).

1.1 Task 2 Objectives

The objective of Task 2 is to evaluate the cost-effectiveness of AWTSs. Cost is a function of a target percent reduction in nitrogen load. This report summarizes data used to determine costs and nitrogen load reduction efficiency for each AWTS, as compared to OSTDS. The following AWTSs were evaluated as part of Task 2:

- In-ground nitrogen-reducing biofilters (INRBs) – These systems include a reactive media layer consisting of wood mulch, sawdust, or other organic material mixed with sand under a drainfield so that effluent in the drainfield percolates through the reactive media. The expected performance of INRBs as currently configured is about 65% above the baseline OSTDS.
- Aerobic treatment units (ATUs) – These systems introduce air into the wastewater to facilitate treatment. ATUs generally (but not in all cases) include a blower or pump to achieve this. Aeration converts ammonia in the wastewater to nitrate. Nitrogen-reducing ATUs generally include a means of recirculation to remove nitrate via de-nitrification. The expected performance of ATUs is 80% above the baseline OSTDS.

[3] Lombardo Associates (2011) addressed lifecycle costs for select nitrogen removal technologies and was used as reference in the thinking and development of the current study. The data in the Lombardo Associates report are at least nine years old (and select data were dated 2009 and not inflation adjusted), do not reflect current conditions, and do not include all options within this current study. This study includes the latest data, conditions, and treatment options since the Lombardo Associates study.

- Performance-based treatment systems (PBTSs) – PBTSs are an advanced system designed to treat (or reduce) specific pollutants to pre-defined levels. The structure and function of a PTBS may vary depending on the treatment goals. For example, a nitrogen-reducing PTBS may include a nitrogen-reducing ATU component or other means to reduce or remove nitrogen. For this study, the expected performance of PTBS with respect to nitrogen is 95% above the baseline OSTDS.
- Cluster systems – These are wastewater treatment systems designed to serve two or more dwellings or facilities with multiple owners. These systems require land and a system manager. For this study, cluster systems may include INRBs, ATUs or PBTSs.

In addition, the JSA team evaluated the cost of connecting wastewater services to a centralized wastewater collection system, where a collection system exists. The nitrogen reduction for a centralized wastewater collection system is 95%, which is based on the advanced wastewater treatment level for the City of Tallahassee's Thomas P. Smith Water Reclamation Facility. The Talquin Electric Cooperative Wastewater Treatment Plants (WWTPs) achieve an estimated 65% nitrogen reduction, which was not used in Section 3.0 (Cost-Effectiveness Evaluation) of this task of the study.

Traditional OSTDSs that are properly sited, designed, constructed, maintained, and operated are generally considered a safe means of disposing domestic wastewater and reducing pathogens. However, these systems are not designed to remove nutrients from wastewater. Where available, connecting existing OSTDS to a central wastewater collection system is the most effective option to reduce nutrient loading. Where central wastewater collection is not a feasible option, ATUs, PBTSs, INRBs, or cluster systems provide an opportunity to improve the nutrient removal efficiency of an onsite treatment system.

The purpose of this plan is to identify appropriate AWTSs to provide nutrient reductions in areas of Leon County that are identified as contributing to the Upper Wakulla River and Wakulla Spring. By upgrading existing traditional OSTDSs to AWTSs and planning for the use of AWTSs in future development, nutrient loading to these sensitive and important waterbodies can be reduced, thereby improving water quality. The estimated nutrient reductions presented in this plan were calculated using the methods that DEP developed for the Upper Wakulla River and Wakulla Spring Nitrogen Source Inventory and Loading Tool (NSILT) and BMAP. While the actual load reductions achieved may not match these estimates exactly, the most important consideration is that using AWTSs instead of traditional OSTDSs will reduce nutrient loading.

1.2 Treatments Options Evaluated

The JSA team evaluated the OSTDS and the following three primary categories of AWTSs:

- Advanced (Onsite) Wastewater Treatment
  - ATUs
  - PBTSs
  - INRBs
- Cluster Systems
  - ATUs
  - PBTSs
  - INRBs
- Centralized Wastewater Collection Systems
  - Pressure
  - Gravity

The following subsections describe each system.

1.2.1. Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

The basic OSTDS (Figure 2) is the base case for the cost-effectiveness element of Task 2; all other options are compared with the OSTDS, including lifetime costs, nitrogen load reduction, and cost per pound of nitrogen removed. The basic OSTDS consists of a standard septic tank and drainfield, with no aeration or further treatment of the effluent. The combined septic system, drainfield, and underlying soil processes reduce total nitrogen load by approximately 50%.

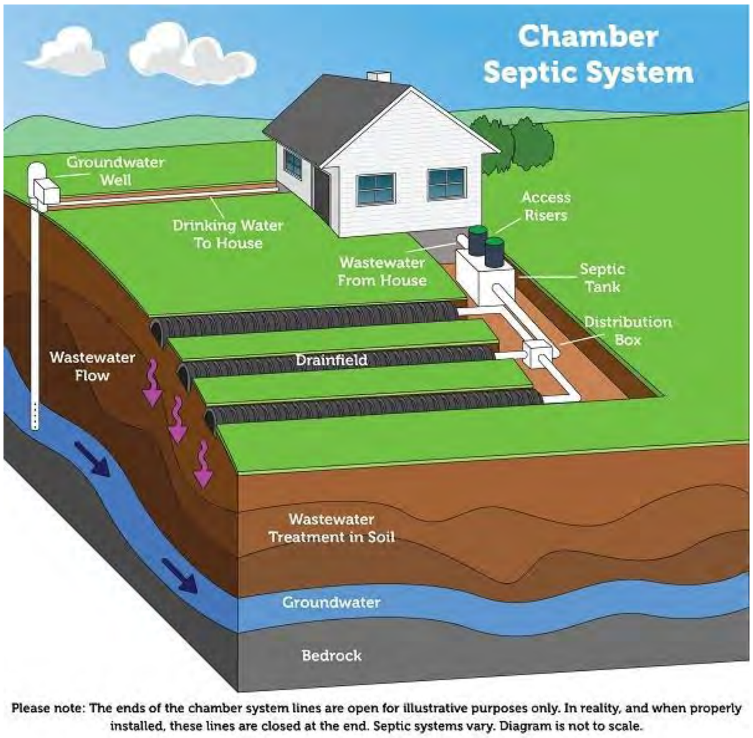

Figure 2. *OSTDS design and nitrogen processes, from [https://www.epa.gov/septic/types-septic-systems.](https://www.epa.gov/septic/types-septic-systems)*

1.2.2. In-Ground Nitrogen-Reducing Biofilters

An INRB (Figure 3) is a passive upgrade to an OSTDS. INRBs themselves do not require electrical components, such as pumps and aerators.[4] An INRB drainfield is a two-stage, passive biofilter based on ammonification and nitrification in the first stage and denitrification in the second stage. OSTDSs or cluster systems that employ a passive INRB drainfield reduce total nitrogen load by 65%[5] relative to OSTDS alone. The drainfield for an INRB can be implemented using various approaches: lined, non-lined, gravity-feed, low-pressure dosed, and others. The Florida Department of Health approved system with a gravity-fed non-lined drainfield is being used for this study. OSTDS upgrades to INRB can incorporate the OSTDS for pre-treatment and to buffer effluent discharge. INRBs require certain soil conditions and are not suitable for all areas. The presence of an INRB must be recorded in the public record as notification to any future property owners. However, they do not require an engineered design, maintenance contract, or operating permit from the county health department.

[4] As in conventional OSTDS, pumps may be required if the drainfield were higher than the septic tank.
[5] Hazen & Sawyer. 2015. Florida Onsite Sewage Nitrogen Reduction Strategies Study.

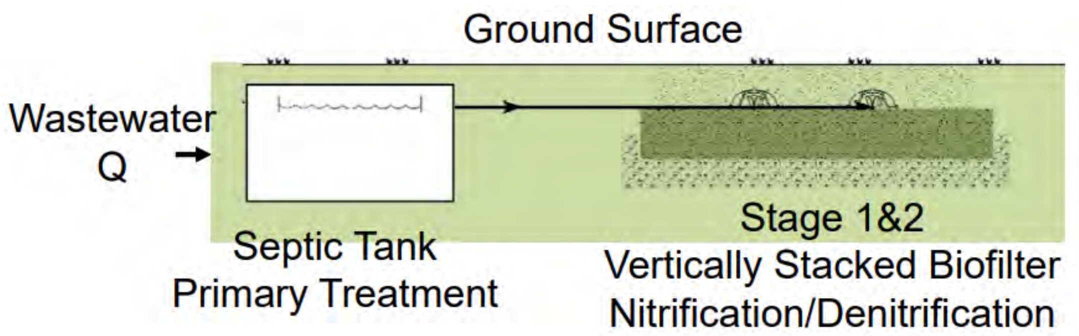

Figure 3. *Typical passive INRB design, from In-ground Nitrogen-Reducing Biofilter, Florida Department of Health, Bureau of Environmental Health, August 2018.*

1.2.3. Aerobic Treatment Units

ATUs are a significant share of the AWTS market. ATUs are active systems and have been used in Florida and elsewhere for nearly 30 years where an OSTDS fails to address wastewater treatment requirements and standards, especially for pathogens.[6] These systems include powered recirculation or some other method of decreasing nitrogen concentrations.

Per the Florida Department of Health, for an ATU product to be approved as a nitrogen-reducing ATU, it must meet and be certified to the National Sanitation Foundation (NSF) Standard 245, which requires testing showing that on average at least 50% nitrogen reduction is achieved before (partially) treated wastewater is discharged to the drainfield. All new construction using an ATU must have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. To meet springs protection BMAP requirements for OSTDS repairs, if the required separation between the bottom of the drainfield and the seasonal high water table is less than 24 inches, the nitrogen-reducing ATU must be capable of reducing nitrogen by at least 65% before discharge to the drainfield. In contrast to PBTS, ATUs with treatment capacity less than 1,500 gallons per day do not need to be designed by an engineer, but do require an operating permit from the county health department and at least semi-annual inspections from a maintenance entity certified by the product manufacturer. (Figure 4).[7]

[6] Department of Health and Rehabilitative Services, Onsite Sewage Disposal System Research in Florida (1993).
[7] DEP BMAP nitrogen-reducing requirements differentiate between systems that have 24 inches of separation between the bottom of the drainfield and the wettest season water table (WSWT) and those that do not. Existing systems (modifications/repairs) installed with less than 24 inches of water table separation between the bottom of the drainfield and the WSWT (as allowed per Rule 64E-6) must use systems that are capable of at least 65% nitrogen removal. New systems and modifications/repairs installed with at least 24 inches between the bottom of the drainfield and the WSWT may use any system capable of at least 50% nitrogen removal to comply with future BMAP requirements.

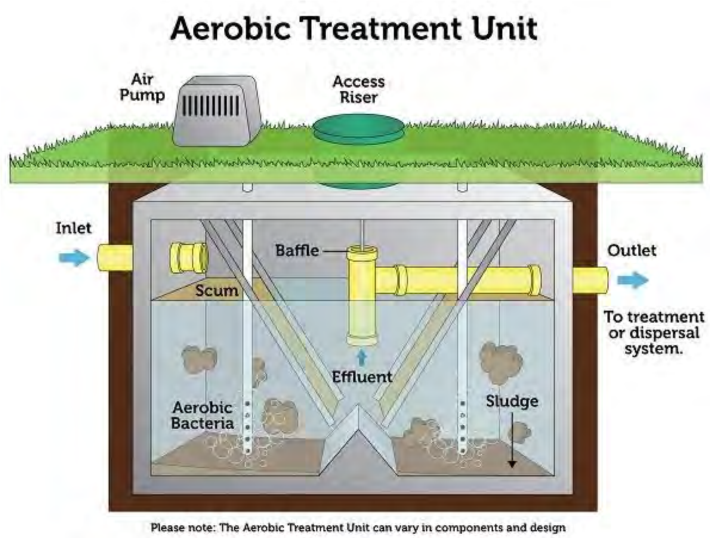

Figure 4. *Typical ATU design, from [https://www.epa.gov/septic/types-septic-systems.](https://www.epa.gov/septic/types-septic-systems)*

1.2.4. Performance-Based Treatment Systems

PBTSs dominate the AWTS market and are active systems. Since about 1990, PBTSs have been used where OSTDSs do not satisfy wastewater treatment requirements and standards, especially for pathogens.[8] PBTSs include (powered) recirculation or some other method of reducing nitrate concentrations.[9]

PBTSs must be designed by a professional engineer licensed in Florida and require a maintenance contract and operating permit from the county health department. The nitrogen-reducing PBTSs for springs protection must be approved by DEP and certified by the design engineer to be capable of providing, on average, at least 50% nitrogen reduction before partially treated wastewater is discharged to the drainfield. All new construction using a PBTS needs to have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. To meet springs protection BMAP requirements for OSTDS repairs, if the required separation between the bottom of the drainfield and the seasonal high water table is less than 24 inches, the nitrogen-reducing PBTS must be capable of reducing nitrogen by at least 65% before discharge to the drainfield. (Figure 5).

[8] Department of Health and Rehabilitative Services, “Onsite Sewage Disposal System Research in Florida” (1993).
[9] Per the Florida Department of Health (2015), PBTSs are a type of OSTDS that has been designed to meet specific performance criteria for certain wastewater constituents as defined by Chapter 64E-6.025(10), F.A.C. Nitrogen is only one of the possible constituents in wastewater that can be addressed by a PBTS. Other constituents that may be addressed include carbonaceous oxygen demand, total suspended solids, total phosphorus, or fecal coliforms as a pathogen indicator. Technologies used in a PBTS can have a range of complexity and energy intensity. Under current market conditions, most technologies used in PBTSs have been based on aerobic treatment units and include active aeration, where air is introduced into the sewage.

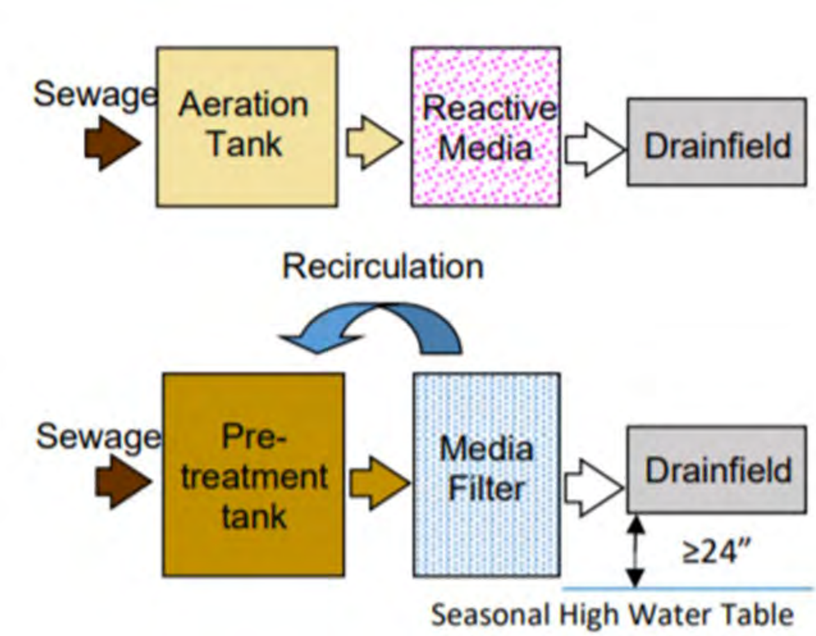

Figure 5. *Typical PBTS design (using either ATU or recirculation), from http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/bmap-n-reducing-tech-18-10-29.pdf.*

1.2.5. Cluster Systems

Cluster systems (Figure 6) are an alternative to individually owned and operated OSTDSs or connection to a centralized wastewater collection system. Cluster systems are also referred to as small community, decentralized wastewater collection systems. Decentralized treatment is emphasized under this option and may include any of the passive or active AWTS options described in Sections 1.2.2, 1.2.3, and 1.2.4. [10] The size of these decentralized systems ranges from serving as few as two units to several dozen. The U.S. Environmental Protection Agency (USEPA) notes that such systems are common in rural subdivisions.[11] Septic tanks, new or existing, are used to initiate denitrification and to provide buffering capacity for the cluster system, equalizing rates of flow among contributing units and thereby providing a more consistent and predictable waste product.

For purposes of this evaluation, *passive* cluster systems are assumed to rely solely on INRB technologies, with similar treatment effectiveness, such as a 65% reduction in nitrogen load. The key differences between individual and clustered INRBs relate to efficiencies of scale for the biofiltration components and drainfields. However, depending upon configuration, these potential savings may be offset by land and easement costs.

[10] Active cluster systems could use package plants, which are pre-manufactured facilities used to treat wastewater in small communities or on individual properties. Typically, such plants are designed to treat flow rates that range from 2,000 gallons per day (gpd) for about 10 homes to 0.5 million gallons per day. Most commonly, they treat flows rates between 0.01 and 0.25 million gallons per day (i.e., from 25 to 600 units). However, a package plant would be classified as a WWTP and would be required to be permitted as such. A package plant would also require a WWTP operator. Therefore, for the purposes of this project, package plants were not evaluated; the central wastewater alternative is intended to include only connection to either existing City of Tallahassee or Talquin utilities.
[11] https://www.epa.gov/septic/types-septic-systems#cluster.

For purposes of this evaluation, *active* cluster systems may rely on ATU or PBTS that can support as many as 16 households. The collection network considerations for either passive or active cluster systems are identical and, for the scales of service contemplated, are assumed to be driven by the forces of gravity.

The benefit-cost analysis includes an assessment of both passive and active cluster systems. The determination of a preferred option, depending on target area, will be part of Task 5 of this study.

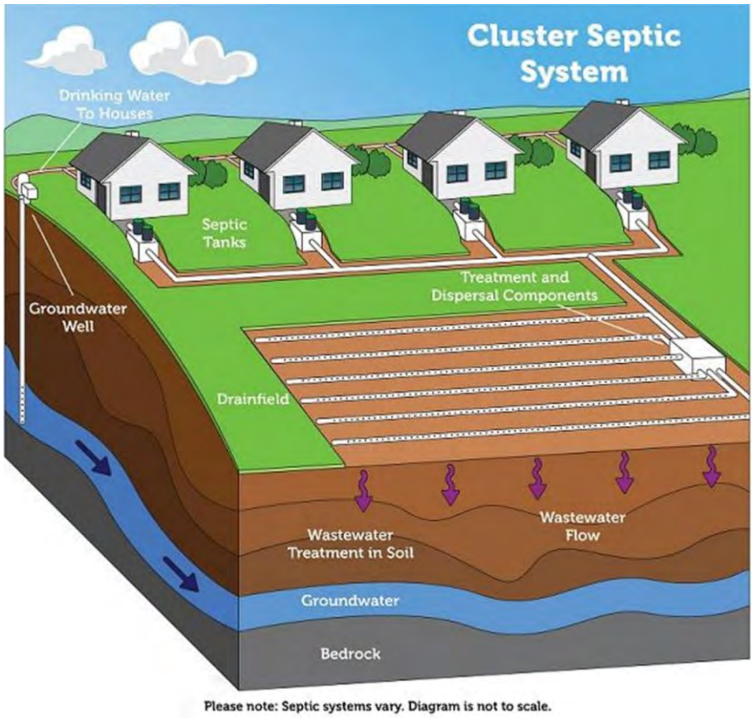

Figure 6. *Typical cluster design, from https://www.epa.gov/septic/types-septic-systems.*

1.2.6. Gravity Centralized Wastewater Collection Systems

Centralized wastewater collection systems are also known as central sewers. The Task 1 report considered centralized wastewater disposal alternatives based on the method of effluent disposal:

- Rapid infiltration basin
- Reuse, primarily via irrigation
- Spray field irrigation

For the evaluation of cost-effectiveness as an alternative to an OSTDS, rather than being defined by choice of effluent disposal as in Task 1, centralized wastewater collection systems are defined in Task 2 by their proximity to existing service networks: (1) those that adjoin or are sufficiently close to tie into existing service (City of Tallahassee or Talquin) using gravity, without the need for a lift station; and (2) those that are too remote from existing service and will require one or more lift stations.[12] Gravity centralized wastewater collection systems (Figure 7) transmit wastewater to treatment facilities by gravity flow alone and do not include pumps to force wastewater with pressure to the facility.

[12] An evaluation of the costs associated with expansion of existing WWTPs was not included within this study. Exclusion of consideration of WWTP expansion applies to both gravity (Section 1.2.6) and pressure (Section 1.2.7) systems.

The analysis for a gravity collection system does not directly address the incremental costs for expanding central treatment facilities or for extending existing service lines within either the city or the Talquin sewer service areas (see Section 2.3.6). The Task 3 report documents existing treatment capacity. Extension of service is a policy consideration, and costs cannot be allocated to individual units without specification of locations of service.

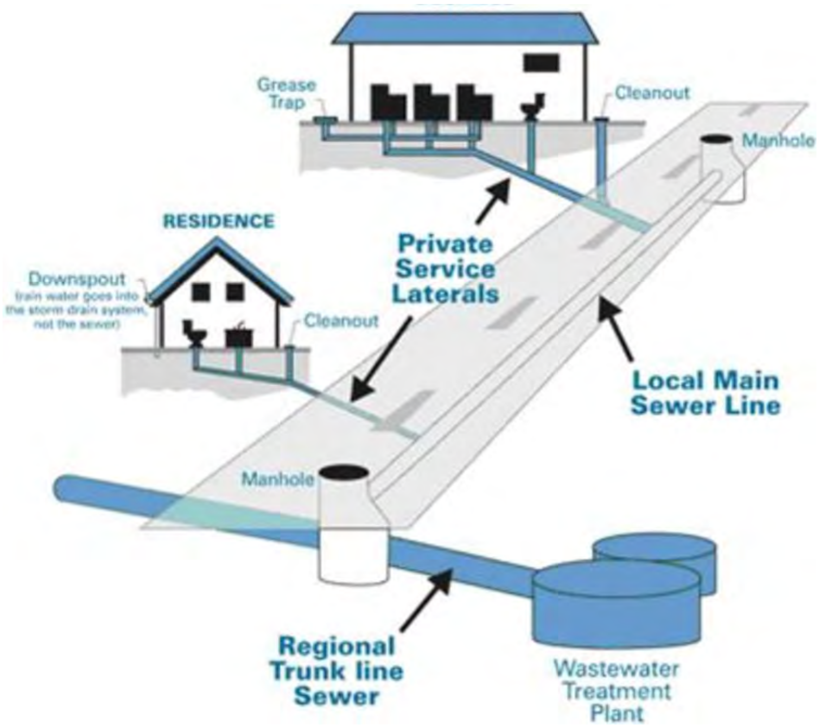

Figure 7. *Gravity centralized wastewater collection system, from* https://www.tn.gov/content/dam/tn/environment/water/documents/study_1203.pdf.

1.2.7. Pressure Centralized Wastewater Collection Systems

A pressure centralized wastewater collection system includes lift stations and force mains to deliver wastewater to treatment facilities. Pressure centralized wastewater collection systems (Figure 8) will be required where retrofit or new development is not adjacent to an existing collection system, and either distance or variable topography necessitates pumping of septage. Lift stations or pumps, force mains or pressurized pipes, and the length of the run to connect to existing service are significant cost factors, increasing the cost per new unit served. The exclusion of incremental costs for centralized wastewater system expansion is addressed in Section 1.2.6.

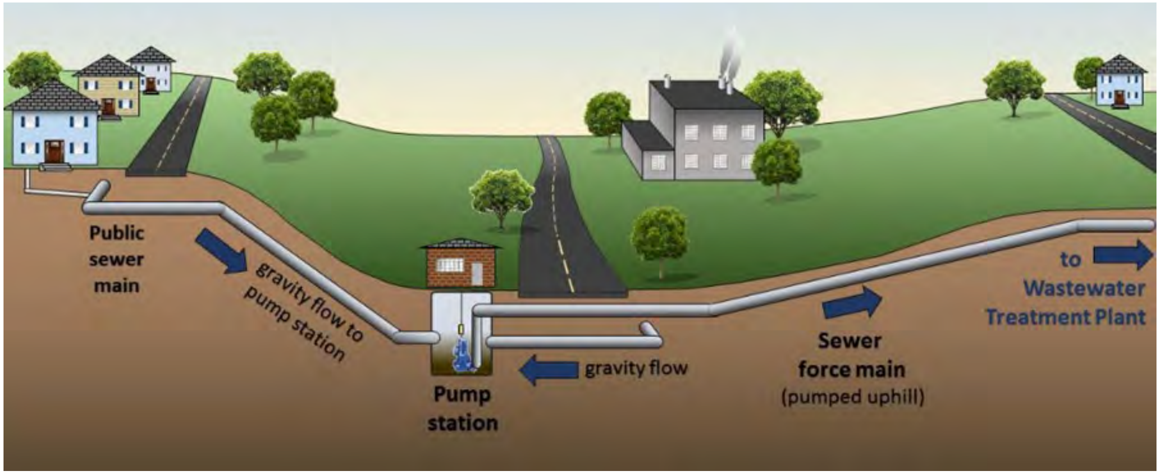

Figure 8. *Pressure centralized wastewater collection system, from https://www.trentonnj.org/447/Wastewater-Treatment.*

2.0 Data Summary

Detailed costs and references for the several options considered are included in the appendices. The cost analysis herein, especially for installation and operations, is intended to be general for the study area as a whole. Ultimately, these discrete cost elements may vary depending upon the levels of nitrogen removal to be achieved within any target area. Consequently, such refinements to costs will be reflected in later phases of this study, where treatments are matched with site conditions, opportunities, and constraints.

2.1 Permitting Costs

Design and permitting costs include typical expenses for engineering and obtaining the appropriate permits for installation from local and state government.

2.1.1 Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

Design costs for OSTDSs are integral to the construction costs described in the following sections and are generally not broken out as a discrete entry. The permitting cost through the Leon County Health Department for an OSTDS is $360. This cost is separate from any site evaluation costs incurred and typically charged under construction/installation. The Florida Department of Health can perform this service, which costs $150 in Leon County (2018). Plumbing permit fees, under the county's Department of Development Support and Environmental Management are $91.38 for issuance plus $8.51 per unit (about $100 total). Total permitting costs are $610 per unit.

2.1.2 In-Ground Nitrogen-Reducing Biofilters

The permitting cost through the Leon County Health Department for an individual INRB is $360. Plumbing permit fees are $91.38, plus $8.51 per unit—or about $100. The site evaluation cost as described under OSTDS is assumed to be $150. Total permitting costs are $610 per unit.

2.1.3 Aerobic Treatment Units

Design costs for ATUs are integral to the construction costs (described below) and are generally not broken out as a discrete entry. The permitting cost through the Leon County Health Department for an individual ATU is $360. This cost is separate from any site evaluation costs, which are typically charged under construction/installation. Plumbing permit fees are $91.38, plus $8.51 per unit—or about $100. Site evaluation cost, per above, is assumed to be $150. Total permitting costs are $610 per unit.

2.1.4 Performance-Based Treatment Systems

Design costs for PBTSs are integral to the construction costs (described below) and are generally not broken out as a discrete entry. However, PTBSs must be designed by a Florida-licensed engineer. The permitting cost through the Leon County Health Department for an individual PBTS is $360. This cost is separate from any site evaluation costs, which are typically charged under construction/installation. Plumbing permit fees are $91.38, plus $8.51 per unit—or about $100. The site evaluation cost, per above, is assumed to be $150. Total permitting costs are $610 per unit.

2.1.5 Cluster Systems

There are no unique permitting costs for cluster systems. These permitting fees will represent service connections reviewable by the Leon County Health Department and are assumed to be $360 per unit. Plumbing permit fees are $91.38, plus $8.51 per unit: the combined plumbing permit cost for an eight-unit system is $159. Site evaluation cost, per above, is assumed to be $150 for the one application (and not per unit). Total permitting costs for the example of eight units are $3,189, or $399 each. Table 1 illustrates the anticipated economy of scale for the permitting of cluster systems, from an average cost of $489 per unit for two units to an average cost of $384 per unit for 16 units.

Table 1. *Permit costs for cluster systems*

Units	Health Department	Plumbing Permit, Fixed	Plumbing Permit, Variable	Site Evaluation	Total	Average Cost
2	$720.00	$91.38	$17.02	$150.00	$978.40	$489.20
4	$1,440.00	$91.38	$34.04	$150.00	$1,715.42	$428.86
6	$2,160.00	$91.38	$51.06	$150.00	$2,452.44	$408.74
8	$2,880.00	$91.38	$68.08	$150.00	$3,189.46	$398.68
12	$4,320.00	$91.38	$102.12	$150.00	$4,663.50	$388.63
16	$5,760.00	$91.38	$136.16	$150.00	$6,137.54	$383.60

Source: Leon County Health Department; Leon County Department of Development Support and Environmental Management

Based upon other multiple-unit wastewater collection systems, engineering (design) costs for cluster systems, regardless of treatment option, are estimated to be 10% of the construction total (see Section 2.2.5). Costs in Table 1 are intended to address new installation but are applicable to retrofit. Design and permitting expenses for a retrofit would be proportional to system size as constrained by the property available to support the system.

For this study, the use of a cluster system is based on placement on vacant property. For currently established property to be used, the land required would either need to be purchased from the current owner or placed into an easement. The required cost to permit and design the treatment portion of the cluster system would be similar to a typical ATU. Additional costs would be associated with the collection system and right-of-way (ROW) acquisition, in lieu of the typical ATU.

2.1.6 Gravity and Pressure Centralized Wastewater Collection Systems

There are no unique permitting costs for connecting existing or future OSTDSs to the existing centralized wastewater collection system (the City of Tallahassee and Talquin Electric Cooperative). Leon County Health Department fees are not applicable; however, plumbing permit fees for the lateral connection are $91.38, plus $8.51 per unit—or about $100. There are no individual design costs for individual connections. System design costs are included under construction/installation (Section 2.3.6).

2.2 Construction of Treatment System

2.2.1 Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

The typical cost of conventional tank suitable for a three-bedroom home is between $2,100 and $9,500, with a median cost of $6,055.[13] The construction costs for a traditional OSTDS include excavation, septic tank, drainfield and installation of all pipe connections. It should be noted that the Upper Wakulla River and Wakulla Spring BMAP prohibits new conventional OSTDS on lots less than one acre within the priority focus areas (PFAs).

2.2.2 In-Ground Nitrogen-Reducing Biofilters

The DEP grant program allows up to $10,000 of reimbursement for the installation of the INRB system and the local contractors had been installing for this price. The cost appears to be weighted based on the funding available and not on the actual cost of installation. The estimated cost to install an INRB system, as part of the most recent bid solicitation, came close to the outside installers' cost.[14] For this reason, the estimate provided by outside installers seems more reasonable as a proxy for a local competitive bid situation. Based on discussions with installers elsewhere (where the grant program is not available), installation cost varies between $6,300 and $6,800. For purposes of this cost-effectiveness analysis, the upper bound of costs—$6,800—is assumed.

2.2.3 Aerobic Treatment Units

Based on costs adjusted for year and for Florida (versus elsewhere in the United States), purchase and installation of an ATU will cost $11,889, and adjusted costs ranged from $7,047 to $17,466 for different brands and differently sized models. Installers caution that every site is different.

Costs vary in north Florida, depending on the installer and the system purchased. For example, an AquaKlear 400 gpd system costs $2,805, but the price does not reflect excavation and setup. A Fuji Clean CEN5 system (500 gpd, nitrogen reducing) costs $5,000 for the unit alone, and installation cost is between $7,000 and $10,000.

For purposes of this evaluation, $11,889 is assumed for purchase, delivery, excavation, and installation. Several of the ATUs reviewed made use of an existing drainfield. Consequently, new development will require the inclusion of that cost, estimated to be $4,000, for a total construction cost of $15,889.

2.2.4 Performance-Based Treatment Systems

Based on inflation-adjusted costs for Florida (versus elsewhere in the United States), purchase and installation of an ATU or a PBTS will cost $13,216, and adjusted costs ranged from $9,499 to $17,058 for different brands and differently sized models. Almost all installations reviewed made use of an existing drainfield. Consequently, new development will require the inclusion of that cost, estimated to be $4,000, for a total of $17,216.[15]

As with ATUs (see Section 2.2.3), costs vary in north Florida depending on the installer and the system purchased. Several local vendors provided coarse estimates for purchase and installation, regardless of

[13] Code sizes are 900 gallons for 300 gpd and 1,050 gallons for flows between 300 and 400 gpd.
[14] The average unit cost of two bids in 2020 to retrofit 90 sites was $8,217, including tank replacement, and mounded drainfields among other site-specific needs.
[15] In contrast, the Lombardo Associates study indicated capital costs between $17,800 and $21,000 for a PBTS AWT system. Based on the Consumer Price Index, this range of costs would now be between $20,400 and $24,000. The current market price for purchase and installation costs for these systems has declined significantly.

whether the system was an ATU or PBTS. The primary costs were excavation, installation, and setup, and less so, the system of choice (system sizes being equal).

2.2.5 Cluster Systems

The treatment for cluster systems can be either passive (as an INRB) or active (as an ATU or PBTS). Relative to the treatment construction costs for individual installations, there are economies of scale inherent with cluster systems. For example, for one supplier of active systems (Bio-Microbics), the cost was reduced from $4,000–$5,500 to $3,500, a 26% decrease per unit, when used in a cluster system.[16] A regression of sizes and costs for Fuji Clean CEN systems (adjusted R^2 of 0.97) projects a cost of $39,500 for a 3,000-gallon system (10 units), or $3,950 per unit.[17]

Table 2 provides Florida dealer/installer costs for one brand of active system (PBTS) approved by the Florida Department of Health that offers multiple sizes capable of handling from 2 to potentially 20 households (at 300 gpd per household).

Table 2. *Capital costs for variably sized performance-based treatment systems*

Units	GPD	Cost	Cost/Unit
1	500	$8,750	$8,750
2	700	$10,000	$5,000
3	900	$14,250	$4,750
3-4	1000	$22,500	$5,625
6	1900	$30,000	$5,000
8-9	2700	$45,000	$5,000
18-20	6000	$99,549	$4,977

Source: Personal communication, Scott Samuelson, Fuji Clean USA on April 22, 2020

While the capital costs for such systems increase with successive sizes, the cost per unit decreases from $8,750 to about $5,000.[18] Economies of scale for system purchase are diminished in this specific instance because of significant shipping expenses. These costs are for the treatment system and do not include the cost of the drainfield.

Separate from raw land costs for the drainfield, the construction costs for cluster INRB systems include the installation of the INRB treatment medium and effluent distribution network in dimensions suitable for the number of units (and gallons) expected. The medium is about one-third of the total costs of installation for a single unit. Based on that relationship, total costs for an 8-unit system are estimated to be $23,000, or $2,875 per unit.

The costs for connections to the cluster system and the drainfield are included in Section 2.3.5 and Section 2.5.5, respectively.

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[16] A package plant (Bioclere™ Model 16/12) for a 27-unit clustered community reported savings of 45% (Washington Department of Health, 2005).

[17] The Fuji Clean CEN is currently approved as an NSF 245 certified nitrogen reducing ATU. The Fuji Clean CE is currently approved as a PBTS based on performance data obtained in Florida. Both may provide greater reductions than the required minimum of 50%. Fuji Clean CEN systems (as nitrogen reducing ATUs) and CE systems (as nitrogen reducing PBTS) provide greater rates of nitrogen reduction than the minimum required by the springs protection BMAPs and are more expensive for equivalent capacities.

[18] The capital costs for the 6,000-gpd CE style unit were estimated via regression.

2.2.6 Gravity and Pressure Centralized Wastewater Collection Systems

Construction costs are not assigned directly to the property owner to connect to a centralized wastewater collection system; however, the property must still be connected to the collection network via a private lateral. The cost for laterals varies by the distance between the house outfall and the collector network, and bypassing the existing septic tank, if any, in the case of a retrofit. Typical local (Leon County) cost for such installations on residential lots smaller than one-half acre is about $7,500.

As described in Section 1.2.6, this analysis excludes consideration of incremental or proportional expenses associated with expanding existing WWTPs (or constructing new ones).[19] The one-time connection charge of $4,500 (both City of Tallahassee and Talquin) supports such investments,[20] but the need, timing, and scale of expansion (and any additional associated costs) are beyond the scope of this study. These costs are included under Section 2.3.6 and Section 2.3.7.

2.3 Construction of Collection System and Connections

2.3.1 Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

No collection system is required; discharge is onsite.

2.3.2 In-Ground Nitrogen-Reducing Biofilters

No collection system is required; discharge is onsite.

2.3.3 Aerobic Treatment Units

No collection system is required; discharge is onsite.

2.3.4 Performance-Based Treatment Systems

No collection system is required; discharge is onsite.

2.3.5 Cluster Systems

For purposes of this analysis, the collection system for a cluster system is assumed to be proportional to that of a gravity centralized wastewater collection system, but does not include lift stations or force mains. Table 3 summarizes the cluster system data presented in Appendix G, reflecting the appropriate sizes of pipes and other infrastructure for collection systems smaller than those analyzed in Appendix E, a gravity centralized wastewater collection system serving 51 units.

Table 3. *Collection costs for variably sized cluster systems (cul-de-sac configuration)*

Units	Cost per Unit with Tank Abandonment	Cost per Unit without Tank Abandonment
4	$11,530	$10,580
8	$9,232	$8,283
16	$8,089	$7,139

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[19] Per January 6, 2021 email discussion between JSA and DEP, the scope of Task 2 does not include consideration of costs to address capacity upgrades of existing central wastewater treatment facilities. Prospective limitations of capacity beyond the 20-year horizon of this study could affect wastewater treatment options, and the cost and funding considerations of planning, designing, and constructing additional capacity should be evaluated by the County's wastewater utility providers. Further, such costs when established would be utility-wide, or service district-based, and not uniquely attributable to any one installation.

[20] While Section 21-151 of the City of Tallahassee Code of Ordinances describes the use of the sewer systems charge fund "to provide for the capital cost of construction and directly related costs required solely due to growth of the system," such one-time charges offset only a portion of the costs.

For collection systems, there are economies of scale, and about a 30% reduction may be expected in cost per unit as the system is expanded from 4 to 16 units served. Costs are provided for systems with and without the abandonment of septic tanks. Costs per unit for a linear configuration, e.g., 8 units per side of ROW, are 13 to 15% greater, respectively, than a cul-de-sac arrangement. For purposes of this benefit-cost analysis, the less costly configuration of 8 units was employed. Tanks are expected to be installed and retained for passive cluster systems relying on INRB, because the effluent requires the tank to filter the solids. Septic tanks will not be required for active cluster systems since the appropriately scaled aerobic treatment unit and other PBTS components will be included in the system. However, in a retrofit cluster system, tanks may be retained to remove solids and to buffer the rates of flow and improve system efficiency.

If an INRB is used for a cluster system, a central septic tank would be needed for collection and treatment of the sewage. This would be required for the regulation of flow to the INRB, particularly if a grinder pump is required. In the selection of a property for the use of a cluster system, the respective grades of the houses to be connected would need to be accounted for and would be used as a method for selection (i.e., gravity versus pressure). If a house does not meet the required grade requirements for the use of gravity flow, then a grinder pump station would need to be installed.

2.3.6 Gravity Centralized Wastewater Collection Systems

Costs of centralized wastewater collection systems vary significantly depending upon whether the system is strictly gravity or requires lift stations and force mains. Appendix E provides a summary of recent bids for a collection system serving 44 units, including costs for gravity components. The construction cost without design but including mobilization and lift-station tie-in for the gravity collection system is $30,558 per unit.[21] The City grant supported connection where a City-operated sewer main was adjacent to the property seeking connection.

In addition to the costs of collection, the City of Tallahassee requires a one-time connection fee and tap location fee. Outside the city limits, the Sewer System Charge is $4,500[22] and the tap fee is $275, for a total of $4,775. However, for a limited time, the State of Florida through the City of Tallahassee will fund the entire cost of connecting eligible properties in the county to the city's sewer system.[23] The cost for a new connection to the Talquin Electric Cooperative system varies based on water meter size.[24] The smallest connection fee is $4,500 for the typical three-quarter-inch water service.

2.3.7 Pressure Centralized Wastewater Collection Systems

Appendix F provides a summary of recent bids for a pressured collection system, including costs for pumps, force mains, and associated equipment, for service to 154 properties, the average total cost per unit is $29,771. The per-unit costs for this specific project reflect significant economies of scale relative to the bid for the gravity system described in Section 2.3.6.[25] The City grant supported connection where a City-operated sewer main was adjacent to the property seeking connection.

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[21] Unit costs for the gravity collection system reflect reductions in profit, design, and contingency expenses in addition to the costs of the master pump and force mains.

[22] Tallahassee Land Development Code Sec. 21-151. – Water systems charge fund and sewer systems charge fund established; functions; charges levied.

[23] DEP and the Northwest Florida Water Management District (NWFWMD) awarded $637,000 to connect about 130 properties currently on septic systems to the existing centralized wastewater collection system in the PFA inside the corporate limits of the City of Tallahassee. [https://www.talgov.com/you/seweroverseptic-grantdetails.aspx]

[24] https://www.talquinelectric.com/services/rate-schedule-s-wastewater/.

[25] The bid costs for a pressure system, excluding the pumps station and over 4,250 feet of force main installation, average $26,210 per unit, a 14% reduction relative to the 44-unit system in Section 2.3.6.

In addition to the costs of collection, the City of Tallahassee requires a one-time connection fee and tap location fee. Outside the city limits, the sewer system charge is $4,500[26] and the tap fee is $275, for a total of $4,775. However, for a limited time, the State of Florida through the City of Tallahassee will fund the entire cost of connecting eligible properties in the county to the city's sewer system.[27] The cost for a new connection to the Talquin Electric Cooperative system varies based on water meter size.[28] The smallest connection fee is $4,500 for the typical three-quarter-inch water service.

2.4 System (User) Charges

User charges reflect the typical monthly assessments incurred by wastewater treatment system users or beneficiaries. User charges may reflect incremental or marginal operating costs for an individual unit of treatment, such as the monthly cost of effluent volume, or greater costs, such as the sum of a customer's share of a system's administrative and operating costs, lifecycle and replacement costs, amortized costs of land and construction, and other costs.

2.4.1 Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

There are no user system charges for OSTDSs.

2.4.2 In-Ground Nitrogen-Reducing Biofilters

There are no user system charges for INRBs.

2.4.3 Aerobic Treatment Units

There are no user system charges for ATUs.

2.4.4 Performance-Based Treatment Systems

There are no user system charges for PBTSs.

2.4.5 Cluster Systems

For purposes of this study, there are no explicit user charges for cluster systems, passive or active. User charges are the vehicle by which annual operation and maintenance (O&M), monitoring and inspection, lifecycle replacement costs, and administrative overhead (if any) are captured from participants. These discrete charges are included in the respective sub-sections in this report. All routine expenses for system operation and upkeep could be consolidated into a comprehensive, single-user cost, assessed at regular intervals (e.g., monthly or annually), however, these will vary based on system size, site conditions, and choice of management model.[29] As costs for O&M, replacement, etc., as defined here would be incorporated into rates to support the selected management structure, the primary uncaptured cost would be administrative (e.g., billing, reporting, legal). Management structures will be recommended in a subsequent phase of this study, consistent with the needs of target areas, and costs will reflect the scale of operations expected.

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[26] Tallahassee Land Development Code Sec. 21-151. – Water systems charge fund and sewer systems charge fund established; functions; charges levied.
[27] DEP and NWFWMD awarded $637,000 to connect about 130 properties currently on septic systems to the existing centralized wastewater collection system in the PFA inside the corporate limits of the City of Tallahassee. [https://www.talgov.com/you/seweroverseptic-grantdetails.aspx]
[28] https://www.talquinelectric.com/services/rate-schedule-s-wastewater/.
[29] User charges would be determined by the Responsible Management Entity (RME) selected for the cluster system. Several models of RMEs are discussed in Appendix I.

2.4.6 Gravity and Pressure Centralized Wastewater Collection Systems

Regardless of the collection system, outside the city limits, the City of Tallahassee's current monthly rates include $30.14 customer charges plus $0.944 per 100 gallons. Using the 300 gallons per household per day benchmark, the variable, gallon-based cost is $84.96 per month, and the total costs are $115.10 per month or $1,381 per year. These costs exclude charges for potable water service, which is the basis for the facility charges. Further, service connection fees of $50 apply to new (or transferred) residential utility accounts.

Talquin Electric Cooperative provides a tiered rate structure. The facilities charge is $38.75, with rates of $2.85/1,000 gallons for the first 5,000 gallons, and $3.90/1,000 gallons above 5,000 gallons. The facility's cost is based on meter size and is greater for water meters connected to water supply pipes with diameters that are greater than three-quarters inch. At 300 gallons per household per day, the variable, gallon-based cost is $15.60 per month, and the total cost is $54.35 per month or $652 per year. This cost excludes charges for potable water service, which is the basis for the facility charges.

A one-time system charge of $4,500 for both the City of Tallahassee and Talquin is included under Sections 2.3.6 and 2.3.7 rather than as part of monthly or cyclical user charges of Section 2.4.

2.5 Land Acquisition (including Rights-of-Way or Easements)

The use of land and easements may be necessary for the siting, establishment, and maintenance of the collection network in cluster or centralized wastewater collection systems. No ROW should be necessary for systems that are on the parcel served by the cluster or collection system.

2.5.1 Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

The land required for an OSTDS is assumed to be on the parcel served by the system; no additional land or easement is required.

2.5.2 In-Ground Nitrogen-Reducing Biofilters

The land required for an individual INRB is assumed to be on the parcel served by the system; no additional land or easement is required.

2.5.3 Aerobic Treatment Units

The land required for an ATU is assumed to be on the parcel served by the system; no additional land or easement is required.

2.5.4 Performance-Based Treatment Systems

The land required for a PBTS is assumed to be on the parcel served by the system; no additional land or easement is required.

2.5.5 Cluster Systems

The need for land or easements for cluster systems (regardless of treatment option) is variable, depending on the configuration and the numbers of houses to be served. A buffer is necessary around the drainfield to avoid a potential liability issue for surrounding properties using private wells for potable water. Seventy-five feet is the minimum distance from a drainfield to a private well (per 64E-6, F.A.C.). As an example, using a 75-foot buffer for a drainfield size of 20 feet by 50 feet (required for two units), the outer dimension of the buffer will be 170 feet by 200 feet or 34,000 square feet (about 0.78 acre). A regression equation of required land area versus the number of units is:

Land area in acres = 0.639 acre + (0.772 acre per unit × the number of units)

The adjusted coefficient of determination (R^2) for the regression is 0.99.

Land prices are variable in Leon County, especially between the southern and northern regions. Table 4 provides the current Property Appraiser market values for vacant parcels within the study area.

Table 4. Leon County vacant land values

Category	Number of Parcels	Average Price per Acre	Median Price per Acre
All Vacant	6,353	$27,519	$14,000
>1 Acre	4,232	$18,911	$10,000
>2 Acre	2,967	$13,422	$8,000
>5 Acre	1,708	$8,576	$6,000

The Property Appraiser's valuations typically fall 5% to 15% below final sales prices, in part reflecting price inflation for the time between assessment and when sales occur, brokers' fees, etc. For the purpose of estimating land costs for a range of sizes for cluster systems, a 2-acre threshold and the median (not average) price of $9,200 per acre was applied. Using this cost as a basis, Table 5 presents the minimum land cost for the treatment system, as a function of the number of dwellings served, with the required land area determined using the regression equation given above. These land costs do not include land transfer costs, such as survey costs and legal costs. While land costs are estimated to be $1,461 per unit for the exact areas needed to support an 8-unit system, for purposes of costs here, 2 acres are assumed to be required ($18,400 or $2,300 per unit).

Table 5. Minimum land costs for cluster system drainfields

Number of Houses	Average Flow	Required Drainfield	Length of Drainfield	Width of Drainfield	Required Lot Size (acre)	Land Costs	Land Cost per Unit
2	600	1000	20.0	50.0	0.78	$7,176	$3,588
3	900	1500	21.0	71.4	0.87	$8,004	$2,668
4	1200	2000	22.0	90.9	0.95	$8,740	$2,185
5	1500	2500	23.0	108.7	1.03	$9,476	$1,895
8	2400	4000	23.6	168.5	1.26	$11,684	$1,461
10	3000	5000	24.0	208.3	1.43	$13,156	$1,316
15	4500	7500	25.0	300.0	1.81	$16,652	$1,110
16	4800	8000	26.0	307.7	1.85	$17,020	$1,064

Depending upon the location and the collection network configuration, additional easements may be necessary to connect homes to the cluster system drainfield. Easements may be designated on existing public or private land, in which case, no additional costs accrue. However, crossing of private property may be expected to require an easement. In general, easements, as less-than-fee-simple ownership, do not cost as much as property without encumbrances. For purposes of access or utility placement, easements may be expected to cost between 10% and 30% of the affected property value. Within the study area, where the median land value is $9,200 per acre and with a factor of 20%, easements—where necessary—will cost about $1,840 per acre. At a minimum width of 10 feet (to provide for maintenance), easement costs will be about $0.42 per linear foot of easement.[30]

[30] Note: If a cluster system were to rely on a package plant with discharge to surface water, an additional easement may be required if the facility is not located on property directly fronting the receiving water.

2.5.6 Gravity and Pressure Centralized Wastewater Collection Systems

For purposes of this review, land required to establish a connection to a centralized wastewater collection system is assumed to be on the parcel, so that additional land is not required. However, depending on the topography and network configuration, sewer mains or trunks may need to be sited on existing parcels and not in an existing easement. In these cases, utility easements will be required. Costs were not evaluated for this circumstance. Ordinarily, if the property owner providing the easement is among those receiving the service, the easement is granted to the utility. To the extent that the connection system does not impact or impede all other uses of the property (e.g., installing a swimming pool or other subsurface feature), there is no effect on property value. For connections other than service laterals, the city typically requires an easement width of 30 feet, or no less than 20 feet if 30 feet is not available.

In the event that public roadways are used, utility easements within the ROW already exist. In private subdivisions permitted after the implementation of the Tallahassee-Leon County Comprehensive Plan, utility easements are typically included in the shared roadways. Where ROW/easements must be acquired on private lands, the cost can range greatly, depending on the need to use eminent domain (and if attorney fees are included). In most situations, additional easement and ROW acquisition is not required for the installation of a central sewer system.

2.6 Operating, Maintenance, Repair, and Replacement Expenses

For this evaluation, O&M expenses are generalized to include all non-construction costs. These include the costs for routine system inspections, upkeep, and repair of minor damaged or non-functioning items, lifecycle replacement for major components[31], energy (e.g., electricity), and administration (including licensing).

2.6.1 Onsite Sewage Treatment and Disposal Systems (Conventional Septic Tank and Drainfield)

Minor maintenance for OSTDSs includes the occasional need for sewage to be pumped from the OSTDS when the OSTDS fails and sewage does not flow to the drainfield. Major maintenance costs for OSTDS are limited to the need to replace the drainfield; tank failures are rare, although baffles can become clogged or ineffective. There are no license fees.

Per "Homeguide"[32] the national average cost to clean and pump a septic tank is between $295 and $610, with a median cost of $375. However, depending on the size of the tank, pumping costs can range from $250 for a 750-gallon tank to $895 for a 1,250-gallon tank (2020 data).[33] USEPA and various state guidelines suggest septic tanks should be pumped out once every 3 to 5 years. Using the median cost and a frequency of 4 years, tank maintenance has an expected cost of $94 per year.

Baffle replacement is estimated to be $400, with a lifespan approaching 20 years, or $20 per year. Replacement costs for the septic tank depend on the failure rate (i.e., cracking), which in turn is governed by site conditions and the material used for the tank (i.e., concrete, fiberglass, or polyethylene), each of which has its own typical lifespan. The failed component must first be removed before a new tank can be installed and connected. Re-installation costs also vary depending on site conditions, access for heavy equipment, etc. For purposes of this analysis, tank replacement costs are conservatively taken to be $3,900, with an expected lifespan of 30 years. The pro-rated annual cost is $130 per year.

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[31] Lifecycle costs include replacement costs for system components expected to fail during the study economic planning horizon (20 years) and pro-ratable expenditures where literature value typical failure times are longer. Replacement costs may exceed the costs of original construction.
[32] https://homeguide.com/.
[33] Two local bids (2020) averaged $308 as part of a larger bid for multiple retrofits.

Complete drainfield replacement can cost between $2,000 and $10,000 (HomeAdvisor reports a range of $7,200 to $20,000).[34] Replacement of the distribution pipes alone can cost up to $5,000. The national average for the drainfield replacement is about $7,500, with a lifespan of 15 to 20 years, although well-maintained systems can last longer than 30 years. At 17.5 years, the pro-rated costs are about $429 per year. Combined replacement costs for an OSTDS are $579 per year (exclusive of taxes).

2.6.2 In-Ground Nitrogen-Reducing Biofilters

In addition to routine septic tank pump-outs similar to an OSTDS, in a lifecycle study of passive nitrogen reducing systems, Stage 2 media for nitrogen reduction were assumed to require replacement approximately every 15 years.[35] Table 6 describes key maintenance costs for several different designs for Stage 1 and Stage 2 media.

Table 6. *Select operations costs for in-ground nitrogen-reducing biofilters.*

System ID	System Description	Media Replacement Cost	Annual O&M Costs	Annual Compliance
BHS-2	In-tank Stage 1 with R, dual-media Stage 2	$2,000	$461	$170
BHS-3	In-ground stacked Stage 1 over Stage 2a ligno with supplemental Stage 2b sulfur	$4,357	$499	$270
BHS-4	In-tank SP Stage 1, dual-media Stage 2	$3,199	$273	$270
BHS-5	In-tank Stage 1 with R, dual-media Stage 2	$3,671	$453	$270
BHS-6	In-tank stacked Stage 1 over Stage 2a ligno with supplemental Stage 2b sulfur	$1,667	$505	$170
BHS-7	In-ground stacked SP Stage 1 over Stage 2 ligno	$861	$242	$170
	AVERAGE	**$2,626**	**$406**	**$220**

Source: Florida Department of Health, Florida Onsite Sewage Nitrogen Reduction Strategies Study (2015)

Annual O&M costs in Table 6 are a composite and reflect tankage, media, piping, and “appurtenance” costs. Consequently, a typical system may be assumed to cost an average of $406 per year, plus another $220 in compliance costs, for a total INRB drainfield O&M cost of $626 per year, plus septic tank maintenance of $94 per year.[36] Compliance includes inspection, monitoring and reporting and is separate from initial permitting. INRBs rely on septic tanks and replacement costs are $150 per year (Section 2.6.1). Total replacement costs for INRBs are estimated to be $325.

2.6.3 Aerobic Treatment Units

Operations costs for ATU systems include site visits for inspection (annual or semi-annual) and pump-outs as required by service guidance (and warranty), as well as replacement of parts with variable lifespans. These components, which vary by design, can include aerators, blowers, compressors, pumps, and control panels. There are no license fees.

Based on more than 35 installations of ATUs, maintenance costs average $324 per year, while the system lifecycle costs average $91 per year. Operating costs will include electricity. Based on average annual consumption of 809 kilowatt-hours (kWh) and the City of Tallahassee’s rate of $0.21636 per kWh, annual power costs are estimated at $175.[37] Including $94 tank operating costs, the total ATU operating costs are $499 per year.

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[34] Two local bids (2020) averaged $7/square foot (sf), or $2,100 for the basic installation of a 300-sf drainfield.
[35] Hazen & Sawyer, 2015.
[36] Per the Department of Health’s Florida Onsite Sewage Nitrogen Reduction Strategy study, these costs reflect several passive nitrogen reducing systems, of which BHS-7 is the only INRB (with costs significantly lower than the average provided). In sum, these costs may be over-estimated, depending on the media employed.
[37] The Lombardo Associates study (2011) assumed a rate of $0.11/kilowatt hour (kWH), $0.126 in 2020 dollars, significantly less than current rates.

For purposes of this benefit-cost analysis, the tank and drainfield lifecycle costs for an ATU system are assumed to be similar to that of a conventional OSTDS, i.e., pro-rated at about $579 per year (Section 2.6.1), although actual costs are likely less as the drainfield lifespan may be lengthened by the partial treatment provided by the ATU. Total ATU system replacement costs are $670 annually.

2.6.4 Performance-Based Treatment Systems

Operations costs for PBTSs include site visits for inspection (annual or semi-annual) and pump-outs as required by service guidance (and warranty), as well as replacement of parts with variable lifespans. These components, which vary by design, can include aerators, blowers, compressors, pumps, and control panels. There are no license fees.

Based on 30 installations, the breakdown of costs for PBTS is $273 per year for O&M, $94 per year for PBTS component lifecycle costs, and $131 per year for electricity. Including $94 for tank operating costs, total O&M cost for a PBTS is estimated to be $498 per year.

For purposes of benefit-cost analysis, the tank and drainfield O&M and lifecycle costs for a PBTS are assumed to be similar to that of a traditional OSTDS, i.e., pro-rated at about $579 per year (Section 2.6.1), although actual cost is likely less since the drainfield lifespan may be lengthened by the partial treatment provided by the PBTS. Total system replacement cost is $1,170 annually.[38]

2.6.5 Cluster Systems

Operation costs for active cluster systems will include site visits for inspection (annual or semi-annual) and pump-outs as required by service guidance (and warranty), as well as replacement of parts with variable lifespans. These components, which vary by design, can include aerators, blowers, compressors, pumps, and control panels. There are no license fees.

O&M of passive cluster systems, such as INRBs, include inspections of the collection network, maintenance of headworks and, most significantly, replacement of the nitrogen-reducing media (see Section 2.6.2). Consequently, with increasing numbers of units served, economies of scale would be realized for the fixed, non-variable O&M costs. However, costs for media replacement (less excavation and disposal) may be expected to be proportional to the number of units served. As with ATUs and PBTSs, replacement of individual tanks and the cluster drainfield itself would be required at appropriate intervals.

Table 7 provides annual O&M costs for one brand of active system (PBTS) that offers multiple sizes capable of handling from 2 to potentially 20 households (at 300 gpd/household). While the O&M costs for these systems increase with successive sizes, the costs per unit decrease from about $225 per year (for two units) to about $114 per year for a 20-unit system.[39] Including maintenance of the cluster drainfield and individual tanks increases the total annualized O&M cost per unit to $609 for 2 units and $478 for 20 units. The values for 8 units have been interpolated.

Table 7. *Annual O&M costs for variably sized performance-based treatment systems*

Units	GPD	Base O&M	Base O&M/Unit	Septic Tank	Drainfield	Drainfield/ Unit	Total O&M/Unit
1	500	$450	$450	$244	$200	$200	$894
2	700	$450	$225	$244	$280	$140	$609
3	900	$700	$233	$244	$360	$120	$597

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[38] In contrast, the Lombardo study (2011) estimated annual O&M costs for PBTS AWT systems to be between $486 and $596, and between $668 and $822 for Suspended Growth systems (Task 2, Table 3-3). Based on the Consumer Price Index, the change between 2011 and June 2020 is about 14.6%. At that rate, the “high” costs for O&M for the less costly designs would only be $683 per year, significantly less than the $1,040 estimated.

[39] O&M costs for the 6,000-gpd unit were estimated via regression.

Units	GPD	Base O&M	Base O&M/Unit	Septic Tank	Drainfield	Drainfield/ Unit	Total O&M/Unit
4	1,000	$700	$175	$244	$400	$100	$519
6	1,900	$900	$150	$244	$760	$127	$521
8	2,433	$1,100	$139	$244	$973	$122	$503
9	2,700	$1,200	$133	$244	$1,080	$120	$497
20	6,000	$2,284	$114	$244	$2,400	$120	$478

2.6.6 Gravity and Pressure Centralized Wastewater Collection Systems

All maintenance and system lifecycle and replacement costs are embedded in the user's monthly service charges (see Section 2.4.6). This is the case for both the City of Tallahassee and Talquin utilities. These costs assume that no grinder pumps (and separable related O&M costs) are required. The cost of any failure of the lateral between the home's wastewater drain(s) to the sewer main will be the responsibility of the individual homeowner.[40]

3.0 Cost-Effectiveness Evaluation

Cost-effectiveness was measured through several lenses: (1) the cost per pound of nitrogen removed, (2) the cost per pound of nitrogen removed relative to performance by a traditional OSTDS, and (3) the benefit-cost ratio of the treatment alternatives, including the market and non-market benefits of reductions in total nitrogen discharged from the wastewater systems.

3.1 Assumptions

The JSA team made the following assumptions in the cost-effectiveness and benefit-cost evaluations:

- The period of economic analysis is 20 years.
- Where applicable, the inflation rate is 3% and the discount rate is 7%.
- The volume of wastewater generated is 300 gallons per household or connection per day.
- The typical concentration of total nitrogen in OSTDS effluent is 23.97 milligrams per liter (mg/L), based on 2.43 persons per household and 300 gallons per day discharge. The Task 1 report defined OSTDS loads at an average of 9.012 pounds of total nitrogen per person per year.[41]
- Nitrogen reduction for a centralized wastewater collection system was 95%.[42]
- As part of the cost evaluation, penalties for BMAP non-compliance were set at zero.[43] Penalties may occur where or when nitrogen reduction targets are not met with OSTDS upgrades to AWTS.
- INRB drainfield nitrogen reduction is based on the values presented by Hazen & Sawyer (2015). That study used a lined low-pressured dosed drainfield, which is not permitted under the current

[40] City of Tallahassee Gravity Sewer Service Lateral Policy (Effective January 1, 1991; Revised July 11, 2016).
[41] University of Florida Institute of Food and Agricultural Sciences, Florida Department of Health report a total of 11.2 grams of total nitrogen per person per day, derived from USEPA documents.
[42] The value reflects that for the City of Tallahassee's T.P. Smith WWTP. Percent reduction in nitrogen load for Talquin systems is estimated at 65% and was not evaluated.
[43] Current DEP enforcement authority provides for "monetary penalties of up to $10,000 per day per violation." However, as a practical matter, the agency will pursue the use of a consent order to achieve compliance. This latter route still imposes administrative costs upon the County for legal and technical support (Personal communication, Kevin Coyne, DEP, April 8, 2020).

Florida Department of Health rule. If lined low-pressure dosed drainfield are permitted under rule or if amended nitrogen reduction values be determined, this study can be updated.

3.2 Approach

Appendix H presents the content and output of the benefit-cost analysis. The data described in Appendices A through G and throughout Section 2.0 were incorporated as expected annual or one-time costs, as applicable to produce total costs for each described treatment option. Total lifecycle costs over the 20-year economic horizon for each alternative were calculated using the indicated inflation and discount rates.[44]

The analysis includes both market items and non-market items. Market items (e.g., capital costs for treatment systems) reflect actual prices paid in the local economy. These may include, for example, documented installer prices for AWTS units or costs for electricity for system operations based on current prices per kilowatt-hour and specification sheet estimates on energy use. Non-market items, however, are not bought and sold directly, and pricing is not explicit. Consequently, professionally accepted non-market valuation methods must be employed. These typically include revealed preferences (e.g., hedonic pricing), stated preferences (e.g., contingent valuation, travel-cost methods, willingness-to-pay studies, etc.), and avoided costs, among other means. Non-market values are not hypothetical; they reflect the values that a community places on environmental outcomes and may require one or more methods to provide an objective estimate of that value. The analysis presented applied conservative measures to minimize overstating the scale of non-market costs and benefits and reduced the set of measures to avoid double-counting. The intent was to incorporate at least some of the economic consequences of the environmental changes expected under the treatment alternatives considered. These relate to the impacts of reduced total nitrogen in surface and ground waters in Leon County and the Wakulla springshed. Loss of select environmental values was based on work by Borisova (2012), Brown (1984), Lind (1986), Stanton (2012), and U.S. Geological Survey (2016), which suggest that turbidity is induced by algal growth linked to excess nutrients including nitrogen, in turn impacting environmental use.[45] Appendix J includes nutrient removal data from 40 DEP-funded stormwater management projects to support the non-market benefits (as avoided costs) associated with nutrient reduction.[46]

In the context of this study, direct costs for the options evaluated include land costs, capital or system costs, installation costs, connection fees, typical O&M costs, lifecycle/replacement costs, and utility rates where applicable. Indirect costs include those of compliance. Non-market costs include the costs of disease from well contamination[47] and diminished tourism, as measured by changes in water clarity at Wakulla Spring (measured here by the use of glass-bottom boats). Total costs—including out-of-pocket costs and costs imposed on resource users—are the responsibility of the property owner.

Benefits include utility revenues and connection fees, avoided treatment costs (for removing nutrients), and individual willingness to pay for water quality. In this study, the avoided costs were restricted to those

[44] In contrast, the Lombardo Associates study used an interest rate of 5% and system lifespans that were several times those indicated by current literature.

[45] Reduction in environmental use, such as the glass bottom boat tours at Wakulla Springs is also affected by dark water from flooding and loading of tannins in the watershed. No attempt was made to separate these discrete impacts other than to note that reduced water quality from nutrient loading also affects the springs and human use thereof.

[46] The avoided costs, as measured by stormwater treatment, are provided as one metric. Select stormwater treatment systems achieve nitrogen reduction using constructed wetlands, as do some wastewater treatment systems. There may be more cost-effective means of nitrogen reduction which would reduce this benefit.

[47] Via benefit transfer from other Florida locations. The Leon County Health Department has no records for boil-water advisories, although the Tallahassee Democrat reported several, including July 2007, December 2014, July 2017, and October 2018.

for nitrogen to ensure no double-counting of benefits.[48] These benefits accrue at the community (county-wide) level. Communications with the Leon County Property Appraiser's Office indicate that no increase in just (fair) market value (or assessed/taxable value) uniquely accrues to properties with connections to centralized wastewater collection systems, as compared to OSTDSs or other AWTSs. Consequently, property value enhancement and ad valorem revenues (property taxes) are zero for all options.[49]

Total discounted costs and benefits are calculated for all options. These are subtracted from the OSTDS case costs, for comparison. Net benefits and the benefit-cost ratio relative to OSTDS are also calculated.

3.3 Costs per Pound of Nitrogen Reduced

Based on the lifecycle costs determined as part of the benefit-cost tables (Appendix H), cost-effectiveness was calculated as the total costs per unit over the 20-year planning horizon divided by the expected pounds of nitrogen reduced (avoided discharges to groundwater or surface waters). Table 8 describes the expected annual differences between the several wastewater treatment options considered.[50]

Table 8. *Nitrogen load reduction by option, percent relative to OSTDS*

	Percent Nitrogen Reduction		
Treatment Option	**Base***	**Additional Treatment Relative to Base**	**Total Treatment**
OSTDS (Base Case)	50.0%	0.0%	50.0%
ATU		+80.0%	90.0%
PBTS		+95.0%	97.5%
INRB		+65.0%	82.5%
Central Sewer[51]		+95.0%	97.5%

* Base treatment efficiency includes reductions from the tank, drainfield, and underlying soil consistent with Lyon and Katz (2018).

Cluster systems will ultimately rely on one of the advanced technologies (ATU, PBTS, or INRB), so the percentage reduction relative to OSTDS will be equivalent to that choice. No change in efficiency is assumed based on the scale of the system. Note that between the nitrogen reduction achieved in the tank and that obtained by a traditional drainfield, a well-maintained PBTS can achieve reductions equal to that of a centralized wastewater collection system.

Table 9 translates the percent nitrogen reduction by each alternative into pounds of total nitrogen reduced, relative to the use of OSTDS. At 9.012 pounds per person per year and 2.43 persons per household,[52] the generation of nitrogen is 21.90 pounds per household per year (9.93 kilograms per household per year).

[48] Appendix J includes costs per kg/yr removed for both nitrogen and phosphorus.
[49] Personal communication, Curt Chisholm, Residential Analyst, Leon County Property Appraiser's Office, January 14, 2020.
[50] The efficiencies in Table 8 are those applied by DEP in the BMAP and confirmed by DEP BMAP staff during the preparation of this report.
[51] Central sewer effectiveness (Additional Treatment Relative to Base) applies to the City of Tallahassee (TP Smith facility).
[52] https://www.census.gov/quickfacts/leoncountyflorida.

***Table 9.** Nitrogen load reduction by option, in pounds nitrogen per household per year (lb-N/household/yr) and kilograms nitrogen per household per year (kg-N/household/yr).*

Treatment Option	Percent Reduction	Reduction lb-N/Household/yr	Reduction kg-N/Household/yr
OSTDS	50.0%	10.95	4.97
ATU	90.0%	19.71	8.94
PBTS	97.5%	21.35	9.68
INRB	82.5%	18.07	8.19
Central Sewer	97.5%	21.35	9.68

Table 10 estimates the total nitrogen reduced per unit, by option, over the 20-year economic planning horizon and calculates the cost per pound reduction based on the total direct costs, such as O&M and system replacement, from Appendix H.

***Table 10.** Direct cost per pound of nitrogen reduced, by option*

Treatment Option	Reduction lb-N/unit/yr	Total 20-Year Reduction lb-N	Expected Lifecycle Cost per Unit	Direct Costs Dollars per lb-N
OSTDS	10.95	219.00	$14,294	$65
ATU	19.71	394.20	$29,750	$75
PBTS	21.35	427.05	$31,100	$73
INRB	18.07	361.35	$19,256	$53
Cluster Active (ATU)*	(as above)	394.20	N/A	N/A
Cluster Active (PBTS)*	(as above)	427.05	$19595	$57
Cluster Passive (INRB)*	(as above)	361.35	$17,280	$58
Central Sewer (Gravity, Proximate)	21.35	427.05	$57,987	$136
Central Sewer (Pressure, Remote)	21.35	427.05	$59,067	$138

* The expected costs for cluster systems assume service for 8 units, as a midpoint in system size. For purposes of this analysis, costs for a cluster ATU are assumed to be similar to costs for a cluster PBTS.

At the household/connection level, inclusion of indirect costs (risk of waterborne disease from contaminated potable wells and diminished springs water clarity) has a minor impact on the costs per pound of nitrogen removed (Appendix H). Because of the significant capital investment for centralized wastewater collection systems, each of the OSTDS alternatives offers a more cost-effective approach to nitrogen reduction (as dollars per pound of nitrogen). It is emphasized, however, that each OSTDS alternative assumes a commitment to appropriate system O&M over the 20-year planning horizon. [53] Failure to adequately maintain or operate the systems as intended could increase the costs per pound of nitrogen removed, as the divisor (nitrogen) diminishes while overall costs remain constant. Risk of failure, where treatment levels fall to that of an OSTDS for part of the planning horizon, was not factored into the benefit-cost analysis.

Centralized wastewater collection systems are expensive at the individual connection level if the cost of system extension is borne entirely by the homeowner, as calculated here. However, barring system

[53] The Florida Department of Health (Roeder, 2013) documented frequencies of failure to operate ATUs and PBTSs, in part because of electricity costs, maintenance contracts, and intermittent occupation—such as at vacation homes. About one-third of randomly sampled systems were not operating.

outages, assurances of success in nitrogen reduction under centralized wastewater collection system options will remain constant over the planning horizon. The risk of being out of compliance is less, and repairs and restorative measures may be assumed to be prompt and already built into system charges, such that no additional costs accrue to the rate payer. Further, the costs for any future treatment system refinements to further reduce the nitrogen content of effluent or final discharge to groundwater will be carried by all system ratepayers, not just those in any newly served area.

Table 11 summarizes the costs and benefits of the several options at a 7% discount rate. No indirect costs were assigned; non-market benefits accrued to the options other than OSTDS. While all systems yielded more benefits than costs, primarily via avoided costs for removal of nitrogen, individual INRB systems and active (PBTS) cluster systems achieved the greatest benefit-cost ratios. The relative ranking of benefit-cost ratios was unaffected by other discount rates considered (4% and 10%), which will reflect the impact of timing of costs and benefits over the 20-year horizon. INRB and active (PBTS) clusters exhibited a greater benefit-cost ratio than the OSTDS.

Table 11. *Summary of costs and benefits, by option*

Option	Direct Costs	Non-Market Costs	Total Costs	Direct Benefits	Non-Market Benefits	Total Benefits	Benefit-Cost Ratio	Ratio Relative to Base
OSTDS	$14,294	$112	$14,406	$30,455	$0	$30,435	2.11	N/A
INRB	$19,256	$20	$19,276	$50,218	$1,006	$51,225	2.66	4.27
ATU	$29,750	$15	$29,765	$54,783	$1,006	$55,790	1.87	1.65
PBTS	$31,100	$9	$31,109	$59,349	$1,006	$60,355	1.94	1.79
Cluster (Passive)*	$20,864	$20	$20,885	$55,188	$1,006	$56,194	2.69	3.98
Cluster (Active)*	$24,325	$9	$24,335	$64,093	$1,006	$65,099	2.68	3.51
Central Sewer (Gravity)	$57,987	$2	$57,989	$93,338	$1,006	$94,344	1.63	1.47
Central Sewer (Pressure)	$59,067	$2	$59,069	$92,866	$1,006	$93,872	1.59	1.42

* The expected costs for cluster systems assume service for 8 units, as a midpoint in system size.

4.0 Preliminary Findings

The JSA team determined the following:

Finding 1. Costs for OSTDSs are significant when calculated as a separate component of new construction and the expected, annualized costs of drainfield replacement are included.

Finding 2. INRBs have the least cost per pound of nitrogen removed because these biofilters do not require hardware, electricity for equipment operation, annual maintenance, or annual monitoring.

Finding 3. Active systems are more cost-effective per pound of nitrogen removed than OSTDSs. Active systems include ATUs and PBTSs.

Finding 4. Different types of active cluster systems have similar benefit-cost ratios due to economies of scale and relatively greater total nitrogen removal rates. A PBTS is one example of an active cluster system.

Finding 5. Connection to a centralized wastewater collection system is the most expensive option if all costs are paid by the developer or property owner. At the same time, central sewer reduces nitrogen loads to groundwater more than other alternatives. If the central sewer construction is funded by a municipal utility, central sewer is more attractive than other alternatives.

Finding 6. Clustered systems, whether active or passive, appear more cost-effective than individual systems, where costs for land for the treatment system and drainfield are part of the business model. Land dedicated for this purpose during the design of a subdivision, while still part of development costs, can offset or eliminate the individual share of this expense. Cluster systems can offer efficiencies of scale for capital and operating costs.[54]

Finding 7. The benefit-cost ratio of central sewer improves marginally (0.08) if the connection fee is subsidized fully by a grant.

This Task 2 report reflects all comments received to date from Leon County. The JSA team may refine these findings as the plan develops further and when the final report is published.

[54] Appendix I summarizes the many considerations of managing a cluster system through a Responsible Management Entity.

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6.0 Appendices

Appendix A NSF standard 245 (nitrogen-reducing) certified aerobic treatment units in Florida (Rule 64E-6.012, F.A.C.)

Manufacturer	Equipment Series	NSF Tested Model	Third Party Certifying Organization	Florida-Approved NSF 245-Certified Models	Average Total Nitrogen Reduction NSF 245 Completion Report*	NSF 245 Report Date
Aquaklear, Inc.	AquaKlear	AK6S245	Gulf Coast Testing	AK6S245C, AK10S245C	51%	October 2010
Bio-Microbics, Inc.	BioBarrier	MBR 0.5	NSF International	MBR 0.5-N; MBR 1.0-N; MBR 1.5-N	79%	October 2011
Bio-Microbics, Inc.	MicroFAST	0.5	NSF International	MicroFast 0.5, 0.625, 0.75, 0.9, 1.5[1]	55%	October 2008
Clearstream Wastewater Systems, Inc.	Clearstream	500 D	Gulf Coast Testing	500D, 500DST, 600D, 600DT, 600DC3, 750D, 750DT, 800D, 800DT, 1000D, 1000DT, 1500D	53%	March 2013
Delta Treatment Systems, LLC.	ECOPOD-N	E50-N	NSF International	E50-N, E-60-N, E75-N, and E100-N	53%	February 2010
Fuji Clean USA	CEN	5	NSF International	CEN 5, 7, 10, 14	74%	April 2015
Jet	Jet-CF	500	Gulf Coast Testing	J-500CF, J-750CF, J-1000CF, J-1250CF, J-1500CF	67%	December 2008 (revised December 2018)
Norweco, Inc.	Singulair TNT	TNT-500	NSF International	TNT-500**, 750**, 1000, 1250, 1500	68%	November 2007
Orenco Systems	Advantex	AX20RTN	NSF International	AX20RTN, AX20N	55%	May 2015

Notes:

This appendix reflects the latest information available at the time of the preparing the Task 2 report.

[1]NSF approval for models of certain serial numbers only; see http://info.nsf.org/Certified/Wastewater/Listings.asp?Standard=040& for details.

Please note that Florida requires approval of treatment receptacles prior to sale and installations. A list of approved treatment receptacles for use with ATUs can be found at: http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/atu.pdf. Be aware that the model identification in that list is not always complete.

* DEP BMAP nitrogen-reducing requirements differentiate between systems that have 24 inches of separation between the bottom of the drainfield and the wettest season water table (WSWT) and those that do not. Existing systems (modifications/repairs) installed with less than 24 inches of water table separation between the bottom of the drainfield and the WSWT (as allowed per Rule 64E-6) must use systems that are capable of at least 65% nitrogen removal. New systems and modifications/repairs installed with at least 24 inches between the bottom of the drainfield and the WSWT may use any system capable of at least 50% nitrogen removal to comply with future BMAP requirements.

**Note that the TNT-500 is NSF 245 certified for a rated capacity of 500 gpd or 600 gpd; the TNT-750 is NSF 245 certified for a rated capacity of 750 gpd or 800 gpd.

Disclaimer: This list does not represent or imply an endorsement of any company, person, product, configuration, or technology. The list reflects the compiler's information as January 30, 2020.

Appendix B Capital costs at Big Pine Key (1998 dollars)

System Description	Estimated Capital Costs w/ SDI Effluent Disposal	O&M Costs	Minutes of Maintenance per year
Septic Tank with Subsurface Drip Irrigation (SDI) Bed	$7,872	$1,044	125
Bio-Microbics FAST with SDI Bed	$11,412	$1,507	235
Continuous Feed Cyclic Reactor AES-BESTEP with SDI Bed	$11,412	$1,284	260
Rotating Biological Contactor (RBC) with SDI Bed	$11,412	$1,246	215
Recirculating Sand Filter (RSF) with SDI Bed	$17,414	$1,333	235

Source: Ayres Associates (1998)

Notes: Capital costs include all equipment and installation and 20% contingency.
SDI system was AZTEX Products, Inc. Model 100.
O&M includes labor, energy at $0.10 per kilowatt-hour, permits, maintenance, repair, replacement (including SDI media), residuals disposal, and contingency

Appendix C Average performance data** for components of total nitrogen (TN) reducing performance-based treatment systems, where total nitrogen is expressed in milligrams per liter (mg/L).

Equipment Series	Equipment Tested	Type of Test	TN In (mg/L)	TN Out (mg/L)	TN Removal	Vendor	Innovative Status*
Advantex	Advantex 20x Mode 1	(%) N-testing concurrently with NSF-40, Squamish, B.C.	33	12	64%	Orenco Systems	Yes
	Advantex 20x Mode 3	N-testing after NSF-40, Squamish, B.C.	35	12	66%		Yes
Aerocell	Aerocell ATS SCAT-8-AC-C500	NSF+Nitrogen, Waco	40	9.3	77%	Quanics (Anua)	Yes
Aqua Safe	Aqua Safe 500	~31 N-tests during NSF-40 test	30.8	14.9	52%	Ecological Tanks, Inc.	Yes
Clearstream Model D	Clearstream 500 D	NSF 245 Prairieville, LA (June-November 2012)	42	19	53%	Clearstream Wastewater Systems, Inc.	Yes
		Prairieville, LA after NSF 245 (December 2013 – May 2014)	42.3	10.7	74.8%		
CE	Fuji Clean CE 5	NSF-40+Nitrogen, Waco	47.6	15.7	67%	Fuji Clean USA, LLC	Yes
CEN	Fuji Clean CEN 5	NSF 245, Waco TX (June – December 2014)	40	10.4	74%		Yes
Enviro-Guard	Enviro-Guard 0.75	NSF+Nitrogen with reduced sampling	46	20	57%	Consolidated Treatment Systems	n/a
MicroFAST	MicroFAST 0.5	Keys Study, Phase I (12 samples)	38.5	11.0	71%	Bio-Microbics	n/a
		Keys Study, Phase II (13- 14 samples)	48.0	11.5	76%		
		NSF 245 testing, Waco TX (September 2006 – April 2007)	38	17	55%		
	FAST	NSF40+Nitrogen	34.5	9.4	73%		
HOOT	HOOT H-500 AND	N-testing (25 samples) concurrent with NSF-40	26.3	9.63	63%	Hoot Aerobic Systems	n/a
Hydro-Kinetic	Hydro-Kinetic 600 FEU	NSF245, Norwalk OH (June 2011-December 2011)	36	8.7	76%	Norweco, Inc.	Yes
Nitrex	Nitrex (after LAI- specified pretreatment)	NSF-load, MASSTC 10/2001-03/2004	19.3	5.4	Additional 72%	Lombardo Associates, Inc.	Yes
		NSF-load, MASSTC 12/2004-10/2005	22.6	7.1	Additional 69%		
Singulair	Singulair 960 w/ Biokinetics phase 1 w/ recirc	16 N-tests at NSF-testing facility (Chelsea, MI)	25	6.8	73%	Norweco, Inc.	n/a
	Singulair 960 w/ Biokinetics phase 2 no recirc	8 N-tests at NSF-testing facility (Chelsea, MI)	25	11.8	53%		n/a
Septitech	Septitech Model 400	Environmental Technology Verification (MA)	39	14	64%	Septitech (Bio-Microbics)	Yes

*Yes = components are currently in innovative status (approval has occurred in a limited fashion, providing for a limited number of permits and additional testing); note construction permits for systems in innovative status must be reviewed by the Onsite Sewage Program office for compliance with the innovative system permit.
n/a indicates that the use of previously approved ATUs in nutrient-reducing systems is accepted based on third-party data.

**Average Testing Performance Data for Components of PBTS (see http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/pbts-components.pdf for average performance testing data for components of all PBTSs in Florida; this table is a subset of Table 2 of that document).

Construction permits for PBTSs must comply with Part IV of Rule 64E-6, Florida Administrative Code (for details, see memo HSES-10-001). For all PBTSs, the engineer will establish performance levels, and design the system to meet them. Approval of treatment receptacles is a separate matter and should be checked under the septic tank design approval listings http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/septic-tanks.pdf.

The table above summarizes test center testing results either associated with an NSF or USEPA Environmental Technology Verification (ETV) protocol or during the Big Pine Key study in Florida. These data have been used to evaluate treatment components that might be used as part of a nitrogen-reducing performance-based treatment system designed by engineers. These are systems that are designed to reduce nitrogen to specified levels. The components listed in the table have previously been reviewed by the Bureau (Onsite Sewage Programs) as indicated in the column “innovative status.”

DEP BMAP nitrogen-reducing requirements differentiate between systems that have 24 inches of separation between the bottom of the drainfield and the WSWT and those that do not. Existing systems (modifications/repairs) installed with less than 24 inches of water table separation between the bottom of the drainfield and the WSWT (as allowed per Rule 64E-6) must use systems that are capable of at least 65% nitrogen removal. New systems and modifications/repairs installed with at least 24 inches between the bottom of the drainfield and the WSWT may use any system capable of at least 50% nitrogen removal to comply with future BMAP requirements. To assess the engineer-specified performance level, refer to the total nitrogen removal (%) column.

Appendix D Aerobic treatment unit characteristics.

Manufacturer	Model	Size	Capital Cost	Total Nitrogen Reduction	Annual O&M Cost	Annual Electrical Consumption (kWh)	Lifecycle costs/year	Year Installed	Notes	Comments
Singulair	TT		$11,337	55%	$300 (2 visits)	979.66		2019	Capital cost = Installation and 2-year operation and maintenance permit using new tank. Estimated $ across Maryland	
AquaKlear	AK6S245		$12,016	54%	$250 (1 visit)	298.70		2019	Capital cost = Installation and 2-year operation and maintenance permit using new tank. Estimated $ across Maryland	
Fuji Clean	CEN 5		$13,516	77%	$185 (2 visits)	446.70		2019	Capital cost = Installation and 2-year operation and maintenance permit using new tank. Estimated $ across Maryland	
Fuji Clean	CEN 7		$15,010	77%	$185 (2 visits)	648.20		2019	Capital cost = Installation and 2-year operation and maintenance permit using new tank. Estimated $ across Maryland	
Singulair	TNT		$8,000	68%	Semi-annual, pump-outs as needed	1160.70	Aerator every 7-10 years $500	2016	Capital cost = system (+2-year service) and delivery only, no other material or install. No separate septic tank needed	
Bio-Microbics	MicroFAST		$3,331 - $7,449	70+%	Annually, pump-outs as needed	1825.00	Blower every 7-10 years at $500	2016	Capital cost = suggested retail price, no installation. Energy use is maximum estimated.	Works as simple septic system without power
Delta	EcoPod-N		$10,000 - $12,000	50%	Semi-annual, pump-outs as needed every 3-5 years	1401.60	Air compressor every 5-7 years at $400	2016	Capital cost = installed, unit = $3,800.	Pretreatment required; system does not replace discharge components. Works as simple septic system without power
Fuji Clean	CEN unsure		$10,000 - $12,000	74%	Semi-annual; pump-outs as needed (every 2-3 years)	456.00	Blower every 5-6 years at $200	2016	Capital cost may not include install, does not include dispersal system.	Separate septic tank not needed. Functions as simple septic tank without power.
Jet	J-1500CF		$7,500	73%	Semi-annual; pump-outs as needed (every 2-3 years)	1810.29	Blower every 6-8 years at $700	2016	Capital cost = estimate, does not include installation or dispersal system. J-500CF and J-750 incorporate primary treatment. J-1000 through	J500-J750 models can function as septic tank during power outage.

Manufacturer	Model	Size	Capital Cost	Total Nitrogen Reduction	Annual O&M Cost	Annual Electrical Consumption (kWh)	Lifecycle costs/year	Year Installed	Notes	Comments
									J-1500CF require separate septic tank	
Bio-Microbics	BioBarrier MBR		$7,140 - $16,650	96%	Semi-annual cleaning; pump-out as needed	1825.00	Membrane every 7 years at $1,295; pumps every 2-5 years at $200; blower every 7-10 years at $500	2016	Capital cost = recommended retail price, does not include installation. Energy use is maximum estimate. Total nitrogen reduction reported by manufacturer	Does not replace discharge components.
Singulair	TNT	(4br home)	$13,450		$315 (1-year contract)	979.66	Aerator every 10 years at $500, control panel replacement every 20 years at $1,200 (rare)	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Singulair	TNT	(4br home)	$16,097		$315 (1-year contract)	979.66	Aerator every 10 years at $500, control panel replacement every 20 years at $1,200 (rare)	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Singulair	TNT	(4br home)	$16,198		$315 (1-year contract)	979.66	Aerator every 10 years at $500, control panel replacement every 20 years at $1,200 (rare)	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Singulair	TNT	(4br home)	$18,149		$315 (1-year contract)	979.66	Aerator every 10 years at $500, control panel replacement every 20 years at $1,200 (rare)	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03

Manufacturer	Model	Size	Capital Cost	Total Nitrogen Reduction	Annual O&M Cost	Annual Electrical Consumption (kWh)	Lifecycle costs/year	Year Installed	Notes	Comments
Singulair	TNT	(4br home)	$18,664		$315 (1-year contract)	979.66	Aerator every 10 years at $500, control panel replacement every 20 years at $1,200 (rare)	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$13,975		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$15,586		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$16,481		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$16,958		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03

Manufacturer	Model	Size	Capital Cost	Total Nitrogen Reduction	Annual O&M Cost	Annual Electrical Consumption (kWh)	Lifecycle costs/year	Year Installed	Notes	Comments
Fuji Clean	CEN unsure	(4br home)	$17,067		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$17,309		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$18,409		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Fuji Clean	CEN unsure	(4br home)	$19,430		$300 (1-year contract)	463.55	Blower every 10 years at $320 or $420, blower rebuild every 10 years at $150, float replacement 5-10 years at $100, control panel replacement every 20 years at $400	2018	Capital cost includes installation of system using existing leaching structure/field	Avg costs for 17 projects (models unknown, varying site constraints, varying leaching field types): Installation: $15,932.41; leaching: $3,898.62; engineering: $2,500; TOTAL: $22,331.03
Singulair	TNT	(4br home)	$13,585			979.66		2017	Capital cost includes installation of system using existing leaching structure/field	Base engineering costs mostly $2,500 for up to 6br, max $5,200
Singulair	TNT	(4br home)	$16,241			979.66		2017	Capital cost includes installation of system with new gravity leaching structure/field	Base engineering costs mostly $2,500 for up to 6br, max $5,200

Manufacturer	Model	Size	Capital Cost	Total Nitrogen Reduction	Annual O&M Cost	Annual Electrical Consumption (kWh)	Lifecycle costs/year	Year Installed	Notes	Comments
Fuji Clean	CEN unsure	(4br home)	$13,750			463.55		2017	Capital cost includes installation of system using existing leaching structure/field	Base engineering costs mostly $2,500 for up to 6br, max $5,200
Fuji Clean	CEN unsure	(4br home)	$14,180			463.55		2017	Capital cost includes installation of system using existing leaching structure/field	Base engineering costs mostly $2,500 for up to 6br, max $5,200
Fuji Clean	CEN unsure	(4br home)	$16,730			463.55		2017	Capital cost includes installation of system using existing leaching structure/field	Base engineering costs mostly $2,500 for up to 6br, max $5,200
Singulair	TNT		$13,000		$300	$144/year operating cost		2016	Capital cost includes installation of system using existing leaching structure/field	
Bio-Microbics	MicroFAST		$14,500		$250-$500			2016	Capital cost includes installation of system using existing leaching structure/field	
Bio-Microbics	BioBarrier MBR		$19,300		$500-$1,300			2016	Capital cost includes installation of system using existing leaching structure/field	
Bio-Microbics	MicroFAST 0.5	500 gpd	$7,787					2012	Capital cost is list price for complete unit from WEBTROL	
Bio-Microbics	MicroFAST 0.75	750 gpd	$9,823					2012	Capital cost is list price for complete unit from WEBTROL	

unsure = model number not specified by source

Data as assembled by FL. Dept. of Health

Appendix E Gravity centralized wastewater collection system costs (Annawood Subdivision).

Contractor	Price	Units	$/unit
Dowdy	$1,281,215	44	$29,119
Hale	$1,107,465	44	$25,170
M, Inc	$1,645,012	44	$37,387
		Average	**$30,558**

The above represents the total project amounts for bids received by Leon County for the indicated project. Individual line item amounts are available as part of public record.

Appendix F Pressure centralized wastewater collection system costs (Woodside Heights Retrofit).

Contractor	Price	Units	$/unit
Allen	$4,603,906	154	$29,895
M, Inc.	$4,309,000	154	$27,981
Sandco	$4,841,261	154	$31,437
		Average	**$29,771**

The above represents the total project amounts for bids received by Leon County for the indicated project. Individual line item amounts are available as part of public record. A bid received by one contractor for more than $7.5 million was taken to be an outlier among bids and not included in the above average.

Appendix G Cluster system costs.

1. Estimated costs for a 4-home cluster system collection system.*

Pay Item Description	Units	Unit Price	Quantity	Total Price
Mobilization	LS	$2,100.00	1	$2,100.00
Temporary Traffic Control	LS	$250.00	1	$250.00
Temporary Erosion, Sedimentation, and Water Pollution Control	LF	$6.00	250	$1,500.00
Solid Sod	SY	$3.69	110	$405.90
Sewer Manhole, 4-ft dia., 0 to 6.0-ft depth	EA	$3,948.25	1	$3,948.25
Sewer Manhole, 4-ft dia., 6.1- to 8.0-ft depth	EA	$4,563.88	1	$4,563.88
Gravity Sewer Main, 6-inch, 0 to 6.0-ft depth, PVC (DR26)	LF	$28.00	250	$7,000.00
Sewer Services, 8-inch x 4-inch, PVC (DR26), 60- to 200-ft length	EA	$5,637.50	4	$22,550.00
Septic Tank Abandonment	EA	$950.00	4	$3,800.00
			Total	**$46,118.03**

- Cost per unit without septic tank abandonment: $10,580
- Cost per unit with septic tank abandonment: $11,530

2. Estimated costs for an 8-home cluster system collection system.*

Pay Item Description	Units	Unit Price	Quantity	Total Price
Mobilization	LS	$3,400.00	1	$3,400.00
Temporary Traffic Control	LS	$340.00	1	$340.00
Temporary Erosion, Sedimentation, and Water Pollution Control	LF	$6.00	250	$1,500.00
Solid Sod	SY	$3.69	110	$405.90
Sewer Manhole, 4-ft dia., 0 to 6.0-ft depth	EA	$3,948.25	1	$3,948.25
Sewer Manhole, 4-ft dia., 6.1- to 8.0-ft depth	EA	$4,563.88	1	$4,563.88
Gravity Sewer Main, 6-inch, 0 to 6.0-ft depth, PVC (DR26)	LF	$28.00	250	$7,000.00
Sewer Services, 8-inch x 4-inch, PVC (DR26), 60- to 200-ft length	EA	$5,637.50	8	$45,100.00
Septic Tank Abandonment	EA	$950.00	8	$7,600.00
			Total	**$73,858.03**

- Cost per unit without septic tank abandonment: $8,283
- Cost per unit with septic tank abandonment: $9,232

* Costs reflect a cul-de-sac lot arrangement.

3. Estimated costs for a 16-home cluster system collection system.*

Pay Item Description	Units	Unit Price	Quantity	Total Price
Mobilization	LS	$6,000.00	1	$6,000.00
Temporary Traffic Control	LS	$600.00	1	$600.00
Temporary Erosion, Sedimentation, and Water Pollution Control	LF	$6.00	250	$1,500.00
Solid Sod	SY	$3.69	110	$405.90
Sewer Manhole, 4-ft dia., 0 to 6.0-ft depth	EA	$3,948.25	1	$3,948.25
Sewer Manhole, 4-ft dia., 6.1- to 8.0-ft depth	EA	$4,563.88	1	$4,563.88
Gravity Sewer Main, 6-inch, 0 to 6.0-ft depth, PVC (DR26)	LF	$28.00	250	$7,000.00
Sewer Services, 8-inch x 4-inch, PVC (DR26), 60- to 200-ft length	EA	$5,637.50	16	$90,200.00
Septic Tank Abandonment	EA	$950.00	16	$15,200.00
			Total	**$129,418.03**

- Cost per unit without septic tank abandonment: $7,139
- Cost per unit with septic tank abandonment: $8,089

4. Estimated costs for a 16-home cluster system collection system (linear).

Pay Item Description	Units	Unit Price	Quantity	Total Price
Mobilization	LS	$6,000.00	1	$6,000.00
Temporary Traffic Control	LS	$600.00	1	$600.00
Temporary Erosion, Sedimentation, and Water Pollution Control	LF	$6.00	250	$1,500.00
Solid Sod	SY	$3.69	378	$1,394.82
Sewer Manhole, 4-ft dia., 0 to 6.0-ft depth	EA	$3,948.25	3	$11,844.75
Sewer Manhole, 4-ft dia., 6.1- to 8.0-ft depth	EA	$4,563.88	1	$4,563.88
Gravity Sewer Main, 6-inch, 0 to 6.0-ft depth, PVC (DR26)	LF	$28.00	850	$23,800.00
Sewer Services, 8-inch x 4-inch, PVC (DR26), 60- to 200-ft length	EA	$5,637.50	16	$90,200.00
Septic Tank Abandonment	EA	$950.00	16	$15,200.00
			Total	**$155,103.45**

- Cost per unit without septic tank abandonment: $8,744
- Cost per unit with septic tank abandonment: $9,694

Appendix H Benefit-cost summaries.

Benefit:Cost Analysis Summary

Base Case: Conventional OSTDS

			20 Year Horizon				
			Cost				
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Comments**
Land Costs	$ / system	-	$0	$0	$0	$0	No Land Costs; Existing Ownership
Design & Permitting Costs	$ / system	1	$610	$610	$610	$610	County Health Dept.; Site Evaluation; Plumbing Permit
System Purchase (CAPEX)	$ / system	1	$6,055	$6,055	$6,055	$6,055	The typical costs of a 900-1000 gallon tank – suitable for a three-bedroom home are between $2,100 to $9,500, with a median cost of $6,055 including appropriately sized drainfield; Section 2.21
Installation / Connection	$ / system	1	$0	$0	$0	$0	Included in System Purchase
O&M / Repair (OPEX)	$ / year	1	$94	$1,329	$1,066	$880	Combined O&M for OSTDS is $543/yr (exclusive of taxes).
System / Utility Rates*	$ / year	-	$0	$0	$0	$0	N/A
Replacement (Life-Cycle)	$ / year	1	$579	$8,184	$6,563	$5,422	National averages for drainfield/leachfield replacement and replacement of the distribution pipes are about $7,500, with a lifespan of 15-20 years (17.5 years applied); costs for tank replacement are estimated at $114 per year
Direct Cost Sub-Total:				$16,177	$14,294	$12,968	
			Cost				
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Comments**
Compliance Penalties (DEP)	$ / year	-	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	
			Cost				
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Comments**
Shadow Price of Nutrient Pollution	$ / yr	-	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/ yr	0.00167	$3,952	$93	$75	$62	Proportional to costs elsewhere in FL based on households at risk; costs include lost wages
Diminished Springs Tourism and other Recreation	$/HH/year	1	$3.26	$46	$37	$30	Loss of Wakulla Glass Bottom Boat usage based on 2020 OSTDS share of ~1990 Population
				$0	$0	$0	
Non-Market Cost Sub-Total:				$139	$112	$92	
Costs Total:				$16,317	$14,406	$13,060	
			Benefit				
Direct Benefits	**Units**	**Quantity**	**Unit Price**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Comments**
Grants; State/Federal Funds	$/system	-	$0	$0	$0	$0	
Property Value Enhancement	$/lot	-	$0	$0	$0	$0	N/A per Property Appraiser
Ad Valorem	$/year	-	$0	$0	$0	$0	N/A per Property Appraiser
Utility Revenues	$ / year	-	$0	$0	$0	$0	N/A
Avoided Treatment Costs - N	kg-N/HH/year	4.97	$541	$37,949	$30,435	$25,144	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$ / system	-	$0	$0	$0	$0	None Assumed
				$0	$0	$0	
Direct Benefits Sub-Total:				$37,949	$30,435	$25,144	
			Benefit				
Non-Market Benefits	**Units**	**Quantity**	**Unit Price**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Comments**
WTP for Surface Water Quality / Clarity	$/HH	-	$3	$0	$0	$0	EPA / Florida Study
WTP for Ground Water Quality	$/HH	-	$7	$0	$0	$0	EPA / Florida Study
Community values (aesthetics, recreation & springs tourism)	$/person	-	$32	$0	$0	$0	At 2.43 persons/HH
				$0	$0	$0	
Non-Market Benefits Sub-Total:				$0	$0	$0	
Benefits Total:				$37,949	$30,435	$25,144	

Results					
Net Benefits:		$21,632	$16,030	$12,084	
Benefit:Cost Ratio:		2.33	2.11	1.93	
Net present value per dollar of capital outlay					

Benefit:Cost Analysis Summary

Alternative 1a: In-Ground Nitrogen-Reducing Biofilter (Passive)

			20 Year Horizon							
				Cost						
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Land Costs	$ / system	-	$0	$0	$0	$0	$0	$0	$0	No Land Costs; Existing Ownership
Design & Permitting Costs	$ / system	1	$610	$610	$610	$610	$0	$0	$0	County Health Dept.; Site Evaluation; Plumbing Permit
System Purchase (CAPEX)	$ / system	1	$6,800	$6,800	$6,800	$6,800	$745	$745	$745	Average of current local bids; Section 2.2.2
Installation / Connection	$ / system	1	$0	$0	$0	$0	$0	$0	$0	Included in system purchase
O&M / Repair (OPEX)	$ / year	1	$720	$10,176	$8,162	$6,743	$8,848	$7,096	$5,862	Based on 30 installations, the breakdown of costs for PBTS is similar: $273/yr for O&M services; $94/yr for lifecycle costs; and $131/yr for electricity.
System / Utility Rates*	$ / year	-	$0	$0	$0	$0	$0	$0	$0	N/A
Replacement (Life-Cycle)	$ / year	1	$325	$4,594	$3,684	$3,044	-$3,590	-$2,879	-$2,379	Section 2.6.2; Media replacement included in O&M
Direct Cost Sub-Total:				$22,180	$19,256	$17,196	$6,003	$4,962	$4,229	
				Cost						
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Compliance Penalties (DEP)	$ / year	-	$0	$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	$0	$0	$0	
				Cost						
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Shadow Price of Nutrient Pollution	$ / yr		$0.00	$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/yr	0.00017	$3,952	$9	$7	$6	-$84	-$67	-$56	10-fold increase in pathogen removal relative to Conventional
Diminished Springs Tourism and other Recreation	$/HH/year	1	$1.14	$16	$13	$11	-$30	-$24	-$20	INRB Residual as Percent of Conventional
Non-Market Cost Sub-Total:				$25	$20	$17	-$114	-$91	-$75	
Costs Total:				$22,205	$19,276	$17,213	$5,889	$4,870	$4,153	

				Benefit						
Direct Benefits	**Units**	**Quantity**	**One Time/ Annual Value**	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Ad Valorem	$/year	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Utility Revenues	$ / year	-		$0	$0	$0	$0	$0	$0	
Avoided Treatment Costs - N	kg-N/HH/year	8.20	$541	$62,615	$50,218	$41,488	$24,667	$19,783	$16,344	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$	-	$0	$0	$0	$0	$0	$0	$0	None Assumed
Direct Benefits Sub-Total:				$62,615	$50,218	$41,488	$24,667	$19,783	$16,344	
				Benefit						
Non-Market Benefits	**Units**	**Quantity**	**One Time/ Annual Value**	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
WTP for Surface Water Quality / Clarity	$/HH	1	$3.48	$49	$39	$33	$49	$39	$33	
WTP for Ground Water Quality	$/HH	1	$6.56	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32.41	$1,113	$893	$737	$1,113	$893	$737	
Non-Market Benefits Sub-Total:				$1,255	$1,006	$831	$1,255	$1,006	$831	
Benefits Total:				$63,870	$51,225	$42,319	$25,921	$20,789	$17,175	

Results

Net Benefits:		$41,665	$31,948	$25,106	$20,033	$15,919	$13,022
Benefit:Cost Ratio:		2.88	2.66	2.46	4.40	4.27	4.14
Net present value per dollar of capital outlay							

Benefit:Cost Analysis Summary

Alternative 1b: Aerobic Treatment Unit

			20 Year Horizon							
Direct Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Land Costs	$ / system	-	$0	$0	$0	$0	$0	$0	$0	No Land Costs; Existing Ownership
Design & Permitting Costs	$ / system	1	$610	$610	$610	$610	$0	$0	$0	County Health Dept.; Site Evaluation; Plumbing Permit
System Purchase (CAPEX)	$ / system	1	$15,889	$15,889	$15,889	$15,889	$9,834	$9,834	$9,834	Section 2.2.3
Installation / Connection	$ / system	1	$0	$0	$0	$0	$0	$0	$0	Section 2.2.3
O&M / Repair (OPEX)	$ / year	1	$499	$7,053	$5,656	$4,673	$5,724	$4,591	$3,793	Based on 30 installations, the breakdown of costs for PBTS is similar: $273/yr for O&M services; $94/yr for lifecycle costs; and $131/yr for electricity. Section 2.6.3
System / Utility Rates*	$ / year	-	$0	$0	$0	$0	$0	$0	$0	N/A
Replacement (Life-Cycle)	$ / year	1.00	$670	$9,470	$7,595	$6,274	$1,286	$1,032	$852	Similar to Base Case Tank & Drainfield
Direct Cost Sub-Total:				$33,022	$29,750	$27,447	$16,844	$15,456	$14,479	
Indirect Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Compliance Penalties (DEP)	$ / year	-		$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	$0	$0	$0	
Non-Market Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Shadow Price of Nutrient Pollution	$ / yr			$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/yr	0.00017	$3,952	$9	$7	$6	-$84	-$67	-$56	10-fold increase in pathogen removal relative to Conventional
Diminished Springs Tourism and other Recreation	$/HH/year	1	$0.65	$9	$7	$6	-$37	-$30	-$24	ATU Residual as Percent of Conventional
Non-Market Cost Sub-Total:				$19	$15	$12	-$121	-$97	-$80	
Costs Total:				$33,040	$29,765	$27,459	$16,724	$15,360	$14,399	

Direct Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Ad Valorem	$/year	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Utility Revenues	$ / year	-		$0	$0	$0	$0	$0	$0	
Avoided Treatment Costs - N	kg-N/HH/year	8.94	$541	$68,307	$54,783	$45,259	$30,359	$24,348	$20,115	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$ / system	-	$0	$0	$0	$0	$0	$0	$0	None Assumed
Direct Benefits Sub-Total:				$68,307	$54,783	$45,259	$30,359	$24,348	$20,115	
Non-Market Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
WTP for Surface Water Quality / Clarity	$/HH	1	$3	$49	$39	$33	$49	$39	$33	
WTP for Ground Water Quality	$/HH	1	$7	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32	$1,113	$893	$737	$1,113	$893	$737	
Non-Market Benefits Sub-Total:				$1,255	$1,006	$831	$1,255	$1,006	$831	
Benefits Total:				$69,562	$55,790	$46,091	$31,614	$25,355	$20,947	

Results							
Net Benefits:		$36,522	$26,025	$18,632	$14,890	$9,995	$6,548
Benefit:Cost Ratio:		2.11	1.87	1.68	1.89	1.65	1.45
Net present value per dollar of capital outlay							

Benefit:Cost Analysis Summary

Alternative 1c: Performance Based Treatment System

				20 Year Horizon						
Direct Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Land Costs	$ / system	-	$0	$0	$0	$0	$0	$0	$0	No Land Costs; Existing Ownership
Design & Permitting Costs	$ / system	1	$610	$610	$610	$610	$0	$0	$0	County Health Dept.; Site Evaluation; Plumbing Permit
System Purchase (CAPEX)	$ / system	1	$17,216	$17,216	$17,216	$17,216	$11,161	$11,161	$11,161	Section 2.2.4
Installation / Connection	$ / system	1	$0	$0	$0	$0	$0	$0	$0	Section 2.2.4
O&M / Repair (OPEX)	$ / year	1	$498	$7,039	$5,645	$4,664	$5,710	$4,580	$3,783	Based on 30 installations, the breakdown of costs for PBTS is similar: $273/yr for O&M services; $94/yr for lifecycle costs; and $131/yr for electricity. Section 2.6.4
System / Utility Rates*	$ / year	-	$0	$0	$0	$0	$0	$0	$0	N/A
Replacement (Life-Cycle)	$ / year	1	$673	$9,512	$7,629	$6,303	$1,329	$1,066	$880	Similar to Base Case Tank & Drainfield
Direct Cost Sub-Total:				$34,377	$31,100	$28,792	$18,200	$16,806	$15,825	
Indirect Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Compliance Penalties (DEP)	$ / year	-		$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	$0	$0	$0	
Non-Market Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Shadow Price of Nutrient Pollution	$ / yr			$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/ yr	0.00017	$3,952	$9	$7	$6	-$84	-$67	-$56	10-fold increase in pathogen removal relative to Conventional
Diminished Springs Tourism and other Recreation	$/HH/year	1	$0.16	$2	$2	$2	-$44	-$35	-$29	PBTS Residual as Percent of Conventional
Non-Market Cost Sub-Total:				$12	$9	$8	-$128	-$102	-$85	
Costs Total:				$34,388	$31,109	$28,800	$18,072	$16,704	$15,740	

Direct Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Ad Valorem	$/year	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Utility Revenues	$ / year	-		$0	$0	$0	$0	$0	$0	
Avoided Treatment Costs - N	kg-N/HH/year	9.69	$541	$74,000	$59,349	$49,031	$36,051	$28,913	$23,887	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$ / system	-	$0	$0	$0	$0	$0	$0	$0	None Assumed
Direct Benefits Sub-Total:				$74,000	$59,349	$49,031	$36,051	$28,913	$23,887	
Non-Market Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
WTP for Surface Water Quality / Clarity	$/HH	1	$3	$49	$39	$33	$49	$39	$33	
WTP for Ground Water Quality	$/HH	1	$7	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32	$1,113	$893	$737	$1,113	$893	$737	
Non-Market Benefits Sub-Total:				$1,255	$1,006	$831	$1,255	$1,006	$831	
Benefits Total:				$75,255	$60,355	$49,862	$37,306	$29,920	$24,718	

Results

Net Benefits:		$40,866	$29,246	$21,062	$19,234	$13,216	$8,978
Benefit:Cost Ratio:		2.19	1.94	1.73	2.06	1.79	1.57
Net present value per dollar of capital outlay							

Benefit:Cost Analysis Summary

Alternative 2a: Cluster Treatment w/ INRB (Passive)

			20 Year Horizon							
			Cost							
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Land Costs	$ / system	1	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	Section 2.5.5; Based upon $9200 per acre; 8 units assumed
Design & Permitting Costs	$ / system	1	$435	$435	$435	$435	-$175	-$175	-$175	Section 2.1.5; 8 Units Assumed; Design @ 10%
System Purchase (CAPEX)	$ / system	1	$2,875	$2,875	$2,875	$2,875	-$3,180	-$3,180	-$3,180	Section 2.3.4; 8 units assumed
Installation / Connection	$ / system	1	$8,283	$8,283	$8,283	$8,283	$8,283	$8,283	$8,283	Section 2.3.5.; Per Unit Costs, Gravity System
O&M / Repair (OPEX)	$ / year	1	$503	$7,109	$5,702	$4,711	$5,781	$4,636	$3,830	Section 2.6.5; 8 Units Assumed
System / Utility Rates*	$ / year	-	$0	$0	$0	$0	$0	$0	$0	N/A incorporated into O&M
Replacement (Life-Cycle)	$ / year	1	$112	$1,583	$1,270	$1,049	-$6,601	-$5,294	-$4,373	8 Units Assumed
							$0	$0	$0	
		Direct Cost Sub-Total:		$22,585	$20,864	$19,652	$6,408	$6,570	$6,685	
			Cost							
Indirect Costs	**Units**	**Quantity**	**One Time/**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Compliance Penalties (DEP)	$ / year	-		$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
		Indirect Cost Sub-Total:		$0	$0	$0	$0	$0	$0	
			Cost							
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Shadow Price of Nutrient Pollution	$ / yr			$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/ yr	0.00017	$3,952	$9	$7	$6	-$84	-$67	-$56	10-fold increase in pathogen removal relative to Conventional
Diminished Springs Tourism and other Recreation	$/HH/year	1.00	$1.14	$16	$13	$11	-$30	-$24	-$20	
		Non-Market Cost Sub-Total:		$25	$20	$17	-$114	-$91	-$75	
		Costs Total:		$22,611	$20,885	$19,669	$6,294	$6,479	$6,609	

			Benefit							
Direct Benefits	**Units**	**Quantity**	**One Time/ Annual Value**	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Ad Valorem	$/year	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Utility Revenues	$ / year	-		$0	$0	$0	$0	$0	$0	
Avoided Treatment Costs - N	kg-N/HH/year	8.20	$541	$62,615	$50,218	$41,488	$24,667	$19,783	$16,344	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$/system	1	$4,970	$4,970	$4,970	$4,970	$4,970	$4,970	$4,970	30 yrs Residual Value
		Direct Benefits Sub-Total:		$67,585	$55,188	$46,458	$29,636	$24,753	$21,313	
			Benefit							
Non-Market Benefits	**Units**	**Quantity**	**One Time/ Annual Value**	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
WTP for Surface Water Quality / Clarity	$/HH	1	$3	$49	$39	$33	$49	$39	$33	
WTP for Ground Water Quality	$/HH	1	$7	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32	$1,113	$893	$737	$1,113	$893	$737	
		Non-Market Benefits Sub-Total:		$1,255	$1,006	$831	$1,255	$1,006	$831	
		Benefits Total:		$68,840	$56,194	$47,289	$30,891	$25,759	$22,145	

Results

Net Benefits:		$46,229	$35,310	$27,620	$24,597	$19,280	$15,536
Benefit:Cost Ratio:		3.04	2.69	2.40	4.91	3.98	3.35
Net present value per dollar of capital outlay							

Benefit:Cost Analysis Summary

Alternative 2b: Cluster w/ PBTS (Active)

			20 Year Horizon							
Direct Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Land Costs	$ / system	1	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	$2,300	Section 2.5.5; Based upon $9200 per acre; 8 units assumed
Design & Permitting Costs	$ / system	1	$893	$893	$893	$893	$283	$283	$283	Section 2.1.5; 8 Units Assumed; Design @ 10%
System Purchase (CAPEX)	$ / system	1	$4,938	$4,938	$4,938	$4,938	-$1,118	-$1,118	-$1,118	Section 2.2.5; System sized for ~10 units; allocated to 8 units
Installation / Connection	$ / system	1	$8,283	$8,283	$8,283	$8,283	$8,283	$8,283	$8,283	Per Unit Costs, Gravity System
O&M / Repair (OPEX)	$ / year	1	$503	$7,109	$5,702	$4,711	$5,781	$4,636	$3,830	8 Units Assumed
System / Utility Rates*	$ / year	-	$0	$0	$0	$0	$0	$0	$0	N/A incorporated into O&M
Replacement (Life-Cycle)	$ / year	1	$195	$2,756	$2,210	$1,826	-$5,427	-$4,353	-$3,596	Drainfiled Replace; 8 Units Assumed
Direct Cost Sub-Total:				$26,279	$24,325	$22,950	$10,102	$10,032	$9,982	
Indirect Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Compliance Penalties (DEP)	$ / year	-		$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	$0	$0	$0	
Non-Market Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Shadow Price of Nutrient Pollution	$ / yr			$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/ yr	0.00017	$3,952	$9	$7	$6	-$84	-$67	-$56	10-fold increase in pathogen removal relative to Conventional
Diminished Springs Tourism and other Recreation	$/HH/year	1.00	$0.16	$2	$2	$2	-$44	-$35	-$29	
Non-Market Cost Sub-Total:				$12	$9	$8	-$128	-$102	-$85	
Costs Total:				$26,290	$24,335	$22,958	$9,974	$9,929	$9,898	
Direct Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Ad Valorem	$/year	-		$0	$0	$0	$0	$0	$0	N/A per Property Appraiser
Utility Revenues	$ / year	-		$0	$0	$0	$0	$0	$0	
Avoided Treatment Costs - N	kg-N/HH/year	9.69	$541	$74,000	$59,349	$49,031	$36,051	$28,913	$23,887	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$/system	1	$4,970	$4,970	$4,970	$4,970	$4,970	$4,970	$4,970	30 yrs Residual Value
Direct Benefits Sub-Total:				$78,970	$64,318	$54,001	$41,021	$33,883	$28,857	
Non-Market Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
WTP for Surface Water Quality / Clarity	$/HH	1	$3	$49	$39	$33	$49	$39	$33	
WTP for Ground Water Quality	$/HH	1	$7	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32	$1,113	$893	$737	$1,113	$893	$737	
Non-Market Benefits Sub-Total:				$1,255	$1,006	$831	$1,255	$1,006	$831	
Benefits Total:				$80,224	$65,325	$54,832	$42,276	$34,890	$29,688	

Results

Net Benefits:		$53,934	$40,990	$31,875	$32,302	$24,960	$19,790	
Benefit:Cost Ratio:		3.05	2.68	2.39	4.24	3.51	3.00	
Net present value per dollar of capital outlay								

Benefit:Cost Analysis Summary

Alternative 3a: Central WWT w/out Lift Station

				20 Year Horizon						
			Cost							
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Land Costs	$ / system	-	$0	$0	$0	$0	$0	$0	$0	Use of existing ROW assumed
Design & Permitting Costs	$ / system	-	$100	$0	$0	$0	-$610	-$610	-$610	Plumbing Permit for lateral
System Purchase (CAPEX)	$ / system	1	$30,558	$30,558	$30,558	$30,558	$24,503	$24,503	$24,503	Gravity-only Collection System
Installation / Connection	$ / system	1	$11,775	$11,775	$11,775	$11,775	$11,775	$11,775	$11,775	Individual Laterals, plus outside city limit City System Charge ($4500) and Tap Location fee ($275); Section 2.3.6 and 2.3.7
O&M / Repair (OPEX)	$ / year	1	$0	$0	$0	$0	-$1,611	-$1,292	-$1,068	
System / Utility Rates*	$ / year	1	$1,381	$19,519	$15,654	$12,933	$19,519	$15,654	$12,933	Outside the city limits the City of Tallahassee's current monthly rates include $30.14 customer charges plus $0.944 per 100 gallons. Using the 300 gallons per household per day benchmark, the variable cost is $84.96 per month; total costs are $115.10 per month or $1,381 per year).
Replacement (Life-Cycle)	$ / year	-	$0	$0	$0	$0	-$5,300	-$4,251	-$3,512	Included in System Charges
Direct Cost Sub-Total:				$61,852	$57,987	$55,266	$48,275	$45,779	$44,022	
			Cost							
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Compliance Penalties (DEP)	$ / year	-		$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	$0	$0	$0	
			Cost							
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Shadow Price of Nutrient Pollution	$ / yr			$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/yr	-	$3,952	$0	$0	$0	-$93	-$75	-$62	
Diminished Springs Tourism and other Recreation	$/HH/year	1	$0.16	$2	$2	$2	-$44	-$35	-$29	Central Residual as Percent of Conventional
Non-Market Cost Sub-Total:				$2	$2	$2	-$137	-$110	-$91	
Costs Total:				$61,854	$57,989	$55,267	$48,138	$45,669	$43,931	
			Benefit							
Direct Benefits	**Units**	**Quantity**	**One Time/ Annual Value**	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot		$0	$0	$0	$0	$0	$0	$0	Per Leon County Property Appraiser, there is no evidence of increased value associated with central treatment
Ad Valorem	$/year		$0	$0	$0	$0	$0	$0	$0	No increment in ad valorem
Utility Revenues	$ / year	1	$1,381	$19,519	$15,654	$12,933	$19,519	$15,654	$12,933	City of Tallahassee
Avoided Treatment Costs - N	kg-N/HH/year	9.69	$541	$74,000	$59,349	$49,031	$36,051	$28,913	$23,887	Per DEP Stormwater Project Costs per kg (Appendix J)
Avoided Treatment Costs - P	kg-P/HH/year			$0	$0	$0	$0	$0	$0	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$/system	1	$18,335	$18,335	$18,335	$18,335	$18,335	$18,335	$18,335	30 yrs Residual Value
Direct Benefits Sub-Total:				$111,853	$93,338	$80,299	$73,905	$62,903	$55,155	
			Benefit							
Non-Market Benefits	**Units**	**Quantity**	**One Time/ Annual Value**	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**	**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
WTP for Surface Water Quality / Clarity	$/HH	1	$3	$49	$39	$33	$49	$39	$33	EPA
WTP for Ground Water Quality	$/HH	1	$7	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32	$1,113	$893	$737	$1,113	$893	$737	
Non-Market Benefits Sub-Total:				$1,255	$1,006	$831	$1,255	$1,006	$831	
Benefits Total:				$113,108	$94,344	$81,130	$75,160	$63,909	$55,986	

Results

Net Benefits:		$51,254	$36,355	$25,863	$27,021	$18,240	$12,055
Benefit:Cost Ratio:		1.83	1.63	1.47	1.56	1.40	1.27
Net present value per dollar of capital outlay							

Benefit:Cost Analysis Summary

Alternative 3b: Central WWT w/ Lift Station

			20 Year Horizon							
Direct Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Land Costs	$ / system	-	$0	$0	$0	$0	$0	$0	$0	Use of existing ROW assumed
Design & Permitting Costs	$ / system	1	$100	$100	$100	$100	-$510	-$510	-$510	Plumbing Permit for lateral
System Purchase (CAPEX)	$ / system	1	$29,771	$29,771	$29,771	$29,771	$23,716	$23,716	$23,716	Pressured Collection System; Lift Stations
Installation / Connection	$ / system	1	$11,775	$13,541	$13,541	$13,541	$13,541	$13,541	$13,541	Individual Laterals, plus outside city limit City System Charge ($4500) and Tap Location fee ($275); Section 2.3.6 and 2.3.7
O&M / Repair (OPEX)	$ / year		$0	$0	$0	$0	-$1,611	-$1,292	-$1,068	
System / Utility Rates*	$ / year	1	$1,381	$19,519	$15,654	$12,933	$19,519	$15,654	$12,933	Outside the city limits the City of Tallahassee's current monthly rates include $30.14 customer charges plus $0.944 per 100 gallons. Using the 300 gallons per household per day benchmark, the variable cost is $84.96 per month; total costs are $115.10 per month or $1,381 per year).
Replacement (Life-Cycle)	$ / year	0	$0	$0	$0	$0	-$5,300	-$4,251	-$3,512	Included in System Charges
Direct Cost Sub-Total:				$62,931	$59,067	$56,345	$49,355	$46,859	$45,101	
Indirect Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Compliance Penalties (DEP)	$ / year	-		$0	$0	$0	$0	$0	$0	Per DEP, no fines are expected to be imposed; compliance via consent order
Indirect Cost Sub-Total:				$0	$0	$0	$0	$0	$0	
Non-Market Costs	**Units**	**Quantity**	**Cost**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Cost	**Total Cost 4%**	**Total Cost 7%**	**Total Cost 10%**				
Shadow Price of Nutrient Pollution	$ / yr			$0	$0	$0	$0	$0	$0	
Water-borne Disease (potable well contamination)	occurrences/HH/ yr	-	$3,952	$0	$0	$0	-$93	-$75	-$62	
Diminished Springs Tourism and other Recreation	$/HH/year	1	$0.16	$2	$2	$2	-$44	-$35	-$29	Central Residual as Percent of Conventional
Non-Market Cost Sub-Total:				$2	$2	$2	-$137	-$110	-$91	
Costs Total:				$62,934	$59,069	$56,347	$49,218	$46,749	$45,010	

Direct Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
Grants; State/Federal Funds	$/system			$0	$0	$0	$0	$0	$0	
Property Value Enhancement	$/lot		$0	$0	$0	$0	$0	$0	$0	Per Leon County Property Appraiser, there is no evidence of increased value associated with central treatment
Ad Valorem	$/year		$0	$0	$0	$0	$0	$0	$0	No increment in ad valorem
Utility Revenues	$ / year	1	$1,381	$19,519	$15,654	$12,933	$19,519	$15,654	$12,933	City of Tallahassee
Avoided Treatment Costs - N	kg-N/HH/year	9.69	$541	$74,000	$59,349	$49,031	$36,051	$28,913	$23,887	Per DEP Stormwater Project Costs per kg (Appendix J)
Avoided Treatment Costs - P	kg-P/HH/year			$0	$0	$0	$0	$0	$0	Per DEP Stormwater Project Costs per kg (Appendix J)
Residual Value	$/system	1	$17,863	$17,863	$17,863	$17,863	$17,863	$17,863	$17,863	30 yrs Residual Value
Direct Benefits Sub-Total:				$111,381	$92,866	$79,827	$73,433	$62,431	$54,682	
Non-Market Benefits	**Units**	**Quantity**	**Benefit**				**Relative to Base Case 4%**	**Relative to Base Case 7%**	**Relative to Base Case 10%**	**Comments**
			One Time/ Annual Value	**Total Benefit 4%**	**Total Benefit 7%**	**Total Benefit 10%**				
WTP for Surface Water Quality / Clarity	$/HH	1	$3	$49	$39	$33	$49	$39	$33	EPA
WTP for Ground Water Quality	$/HH	1	$7	$93	$74	$61	$93	$74	$61	
Community values (aesthetics, recreation & springs tourism)	$/person	2.43	$32	$1,113	$893	$737	$1,113	$893	$737	
Non-Market Benefits Sub-Total:				$1,255	$1,006	$831	$1,255	$1,006	$831	
Benefits Total:				$112,636	$93,872	$80,658	$74,688	$63,437	$55,514	

Results

Net Benefits:		$49,703	$34,804	$24,311	$25,470	$16,688	$10,504
Benefit:Cost Ratio:		1.79	1.59	1.43	1.52	1.36	1.23
Net present value per dollar of capital outlay							

Note to Appendix H.

The benefit-cost analysis summaries comprising Appendix H are the output tables from an Excel workbook that includes references, original source values, adjustment factors for the dates of source data (i.e., using the Consumer Price Index), and factors for inflation and discounting across the study planning horizon (20 years). The entire workbook is included among the deliverables to Leon County. Comments provided in the individual project alternatives refer to supporting material in other tabs in the workbook and explain any adjustments to the calculations.

Appendix I Considerations for Responsible Management Entities (RMEs).*

Typical Applications	Program Description	Benefits	Limitations
Model 1 - Homeowner Awareness Model			
• Areas of low environmental sensitivity where sites are suitable for conventional onsite systems.	• Systems properly sited and constructed based on prescribed criteria. • Owners made aware of maintenance needs through reminders. • Inventory of all systems.	• Code-compliant system. • Ease of implementation; based on existing, prescriptive system design and site criteria. • Provides an inventory of systems that is useful in system tracking and area-wide planning.	• No compliance/problem identification mechanism. • Sites must meet siting requirements. • Cost to maintain database and owner education program.
Model 2 - Maintenance Contract Model			
• Areas of low to moderate environmental sensitivity where sites are marginally suitable for conventional onsite systems due to small lots, shallow soils, or low permeability soils. • Small clustered systems.	• Systems properly sited and constructed. • More complex treatment options, including mechanical components or small clusters of homes. • Requires service contracts to be maintained. • Inventory of all systems. • Service contract tracking system.	• Reduces the risk of treatment system malfunctions. • Protects homeowner investment.	• Difficulty in tracking and enforcing compliance because it must rely on the owner or contractor to report a lapse in a valid contract for services. • No mechanism provided to assess effectiveness of maintenance program.
Model 3 - Operating Permit Model			
• Areas of moderate environmental sensitivity such as wellhead or source water protection zones, shellfish growing waters, or swimming/water contact recreation. • Systems treating high-strength wastes or large-capacity systems.	• Establishes system performance and monitoring requirements. • Allows engineered designs but may provide prescriptive designs for specific receiving environments. • Regulatory oversight by issuing renewable operating permits that may be revoked for noncompliance. • Inventory of all systems. • Tracking system for operating permit and compliance monitoring. • Minimum for large-capacity systems.	• Allows systems in more environmentally sensitive areas. • Operating permit requires regular compliance monitoring reports. • Identifies noncompliant systems and initiates corrective actions. • Decreases need for regulation of large systems. • Protects homeowner investment.	• Higher level of expertise and resources for regulatory authority to implement. • Requires permit tracking system. • Regulatory authority needs enforcement powers.

Typical Applications	Program Description	Benefits	Limitations
Model 4 - Responsible Management Entity (RME) Operation and Maintenance Model			
• Areas of moderate to high environmental sensitivity where reliable and sustainable system O&M is required, e.g., sole-source aquifers, wellhead or source water protection zones, critical aquatic habitats, or outstanding value resource waters. • Clustered systems.	• Establishes system performance and monitoring requirements. • Professional O&M services through RME (either public or private). • Provides regulatory oversight by issuing operating or NPDES permits directly to the RME. (System ownership remains with the property owner). • Inventory of all systems. • Tracking system for operating permit and compliance monitoring.	• O&M responsibility transferred from the system owner to a professional RME that is the holder of the operating permit. • Identifies problems needing attention before failures occur. • Allows use of onsite treatment in more environmentally sensitive areas or for treatment of waste with relatively greater nutrient concentrations. • Can issue one permit for a group of systems. • Protects homeowner investment.	• Enabling legislation may be necessary to allow RME to hold operating permit for an individual system owner. • RME must have owner approval for repairs; may be conflict if performance problems are identified and not corrected. • Need for easement/right of entry. • Need for oversight of RME by regulatory authority.
Model 5 - Responsible Management Entity (RME) Ownership Model			
• Areas of greatest environmental sensitivity where reliable management is required. Includes sole-source aquifers, wellhead or source water protection zones, critical aquatic habitats, or outstanding value resource waters. • Preferred management program for clustered systems serving multiple properties under different ownership (e.g., subdivisions).	• Establishes system performance and monitoring requirements. • Professional management of all aspects of decentralized systems through public/private RMEs that own or manage individual systems. • Qualified, trained, owners and licensed professional owners/operators. • Provides regulatory oversight by issuing operating or NPDES permit. • Inventory of all systems. • Tracking system for operating permit and compliance monitoring.	• High level of oversight if system performance problems occur. • Simulates model of central sewer, reducing the risk of noncompliance. • Allows use of onsite treatment in more environmentally sensitive areas. • Allows effective area-wide planning/watershed management. • Removes potential conflicts between the user and RME. • Greatest protection of environmental resources and owner investment.	• Enabling legislation and/or formation of special district may be required. • May require greater financial investment by RME for installation and/or purchase of existing systems or components. • Need for oversight of RME by regulatory authority. • Private RMEs may limit competition. • Homeowner associations may not have adequate authority.

Source: USEPA, 2003, "*Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*"

** Based on a 1990s inter-agency assessment of applicability of alternative wastewater treatment systems for Leon County and the Wakulla Springs area (DEP in concert with TLCPD, Leon County Health Unit and Leon County Growth and Environmental Management Department – now Development Support and Environmental Management), Model 4 and Model 5 (RMEs) were considered appropriate for achieving desired treatment standards, but challenges of implementation (including billing, Health Department permitting constraints, and regulatory oversight) were recognized. Further research into the use of RMEs was not pursued as part of this current project.*

Appendix J Nutrient Removal Costs

Grant Number	Contractor	Total Project Cost	TN Reduction lb/yr	TN Cost lb/yr	TN Cost lb/yr/acre	TP Reduction lb/yr	TP Cost lb/yr	TP Cost lb/yr/acre
G0053	Titusville, City of	$1,655,169	1014.2	$1,631.99	$14.32	145.2	$11,399.24	$99.99
G0287	City of Palatka	$360,000	796.4	$452.03	$1.13	187	$1,925.13	$4.82
LP6779 A2	City of Ocala	$2,536,248	3995.2	$634.82	$0.86	649	$3,907.93	$5.29
S0096	Lee County	$2,194,520	4191	$523.63	$0.07	220	$9,975.09	$1.26
S0097	Escambia County	$701,833	470.8	$1,490.72	$1.08	473	$1,483.79	$1.08
S0098	Walton County	$265,836	105.6	$2,517.39	$68.04	26.4	$10,069.55	$272.15
S0162	Maitland, City of	$2,586,301	237.6	$10,885.11	$90.11	228.8	$11,303.76	$93.57
S0163	Seminole County	$3,019,227	1606	$1,879.97	$3.63	147.4	$20,483.22	$39.50
S0190	Lake Worth	$1,000,000	2635.6	$379.42	$1.36	83.6	$11,961.72	$42.72
S0191	Lake County Water Authority	$1,628,699	501.6	$3,247.01	$120.26	77	$21,151.94	$783.41
S0192	Ocoee, City of	$2,600,000	413.6	$6,286.27	$50.70	63.8	$40,752.35	$328.65
S0238	Winter Park, City of	$1,364,000	574.2	$2,375.48	$25.01	57.2	$23,846.15	$251.01
S0239	Port St. Lucie, City of	$1,822,000	4083.2	$446.22	$1.83	1430	$1,274.13	$5.22
S0257	Martin County	$2,902,518	286	$10,148.66	$94.85	90.2	$32,178.69	$300.74
S0261	Seminole County	$7,875,190	1133	$6,950.74	$2.48	200.2	$39,336.61	$14.04
S0262	Deltona, City of	$2,227,448	481.8	$4,623.18	$10.75	167.2	$13,322.06	$30.98
S0263	Leesburg, City of	$1,429,000	380.6	$3,754.60	$28.36	132	$10,825.76	$81.77
S0267	Pinellas County	$2,990,533	2761	$1,083.13	$1.18	871.2	$3,432.66	$3.73
S0269	Lake County	$311,000	501.6	$620.02	$14.76	77	$4,038.96	$96.17
S0271	Jacksonville, City of	$4,384,800	60585.8	$72.37	$0.05	545.6	$8,036.66	$5.32
S0278	Stuart, City of	$1,758,008	937.2	$1,875.81	$6.92	382.8	$4,592.50	$16.95
S0284	Marian County	$1,873,500	453.2	$4,133.94	$13.92	48.4	$38,708.68	$130.33
S0285	Rockledge, City of	$931,500	4122.8	$225.94	$0.33	752.4	$1,238.04	$1.81
S0286	Gulfport, City of	$1,290,715	178.2	$7,243.07	$125.97	63.8	$20,230.64	$351.81
S0309	Port Orange, City of	$4,000,000	827.2	$4,835.59	$2.81	272.8	$14,662.76	$8.52
S0314	Winter Garden, City of	$3,075,127	2987.6	$1,029.30	$1.87	671	$4,582.90	$8.35
S0317	Sarasota, City of	$16,873,000	1507	$11,196.42	$2.82	723.8	$23,311.69	$5.87
S0319	Ocoee Public Work, City of	$2,800,000	156.2	$17,925.74	$239.01	167.2	$16,746.41	$223.29
S0338	City of Titusville	$1,563,126	48.4	$32,295.99	$58.29	146.3	$10,684.39	$19.28
S0340	Tavares, City of	$7,400,000	69040.4	$107.18	*	10494	$705.16	*
S0361	Martin County Office of Wa	$6,825,000	1326.6	$5,144.73	$9.53	198	$34,469.70	$63.83
S0363	Martin County Office of Wa	$788,000	167.2	$4,712.92	$27.84	83.6	$9,425.84	$55.68
S0374	Town of Surfside	$1,747,000	1285.24	$1,359.28	$10.31	166.32	$10,503.85	$79.70
S0376	Atlantic Beach	$2,075,806	81.4	$25,501.30	$468.77	41.8	$49,660.43	$912.88
S0387	City of South Daytona	$4,417,977	226.6	$19,496.81	$40.96	83.6	$52,846.61	$111.02
S0434	City of Maitland	$1,098,365	37.4	$29,368.05	$1,446.70	8.14	$134,934.28	$6,647.01
S0435	Lake County Public Works	$2,340,000	596.2	$3,924.86	$31.27	107.8	$21,706.86	$172.96
S0436	SJRWMD	$3,000,000	33092.4	$90.66	$0.01	9504	$315.66	$0.04
S0439	Brevard County of Office R	$1,600,000	12.76	$125,391.85	$663.45	3.3	$484,848.48	$2,565.34
S0472	Lake County	$1,578,463	215.6	$7,321.26	$157.79	37.4	$42,204.89	$909.59

* Denotes "Not Applicable"

SJRWMD = St. Johns River Water Management District

Source: http://baysoundings.com/the-real-cost-of-fertilizer/#:~:text=The%20average%20cost%20to%20remove, Florida%20Department%20of%20Environmental%20Protection.

Appendix C. Task 3: Factors Other Than Cost-Effectiveness That Influence Selection of Treatment Technology Report

Comprehensive Wastewater Treatment Facilities Plan

Task 3: Factors Other Than Cost-Effectiveness that Influence Selection of Treatment Technology

LEON
FLORIDA'S CAPITAL COUNTY

Prepared by

JSA
ENGINEERING HYDROLOGY GEOLOGY

AGI

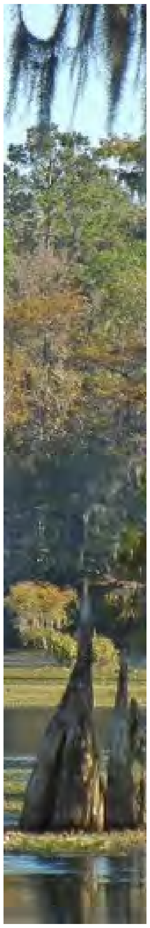
ATM

The Balmoral Group

Magnolia Engineering, LLC

TETRA TECH

November 15, 2021



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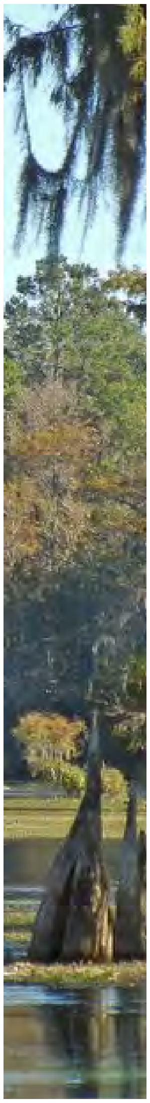

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Acronyms and Abbreviations

ATM	Applied Technology & Management
ATU	Aerobic Treatment Unit
AWTS	Alternative Wastewater Treatment Systems
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
INRB	In-Ground Nitrogen-Reducing Biofilter
JSA	Jim Stidham & Associates
LAVA	Leon County Aquifer Vulnerability Assessment
OFW	Outstanding Florida Water
OSTDS	Onsite Sewage Treatment and Disposal System
PBTS	Performance Based Treatment System
PFA	Priority Focus Area
PSPZ	Primary Springs Protection Zone
TMDL	Total Maximum Daily Load
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

Leon County is developing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs), as well as future development, to groundwater and surface waters. OSTDSs are also known as septic systems. The Florida Department of Environmental Protection found that nutrient loads from several sources—including OSTDSs in Leon County—impaired Upper Wakulla River and Wakulla Spring. Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are to: (1) identify OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) identify future development that require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County is developing the plan by progressing through eight major tasks. This report describes the results of the third task: evaluation of factors other than cost-effectiveness that influence selection of treatment technology. This task includes an evaluation of 15 factors that influence the selection of AWTSs. AWTSs are one mitigation approach to reduce nutrient loads to surface waters and groundwater. The task 3 evaluation was conducted on a countywide basis and will be applied to each area of the county in task 5.

This task 3 report describes the following preliminary findings:

Finding 1. On a countywide basis, in-ground nitrogen-reducing biofilters (INRBs) scored the highest, followed by aerobic treatment units (ATUs) and performance-based treatment systems (PBTSs) using the evaluation factors for mitigation criteria in task 3.

Finding 2. On a countywide basis, cluster systems scored the lowest using the evaluation factors for mitigation criteria in task 3. However, cluster systems may be the best option for specific areas of the county, which will be evaluated further in upcoming tasks.

Finding 3. The applicability of each of the evaluation factors is specific to the conditions in each part of the county.

Task 3 findings are preliminary and subject to refinement as development of Leon County's plan progresses.

1.0 Introduction

The Florida Department of Environmental Protection (DEP, 2018) found that nutrient loads from several sources impaired Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive each day, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore the river and spring by identifying actions that will reduce pollutant loads to the river and spring. The BMAP was adopted by DEP in June 2018 and requires that stakeholders, including Leon County, reduce nitrogen loads to the river and spring from onsite sewage treatment and disposal systems (OSTDSs). OSTDSs are also known as septic systems. Leon County contracted Jim Stidham & Associates (JSA) to develop the plan to reduce nitrogen loads from OSTDSs. JSA partnered with Advanced Geospatial, Applied Technology & Management (ATM), The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop the plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP plan with a grant to the county. About 40% of Leon County is served by OSTDSs, about 20% is served by five centralized wastewater treatment facilities (WWTFs), and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (fig. 1).

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTS), where the transition will most reduce nitrogen loads to the river and spring. The plan will produce guidance for retrofit of existing development as well as direct technology selection for future development. The JSA team is creating the Leon County plan by performing the following tasks:

- Task 1. Develop a nitrogen reduction score to identify likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTS; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas (Completed)
- Task 2. Quantify cost-effectiveness of AWTS (Completed)
- Task 3. Identify other factors that influence selection of an AWTS (Completed)
- Task 4. Provide education to the community regarding information compiled in tasks 1, 2, and 3 and survey opinions of the citizens of Leon County, with respect to this plan
- Task 5. Analyze implementation scenarios for AWTS
- Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTS
- Task 7. Provide additional education to the community regarding the information compiled in tasks 1 through 6 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan
- Task 8. Present the plan to the Leon County Board of County Commissioners

This report describes task 3 of the Leon County plan: factors other than cost-effectiveness that influence selection of treatment technology.

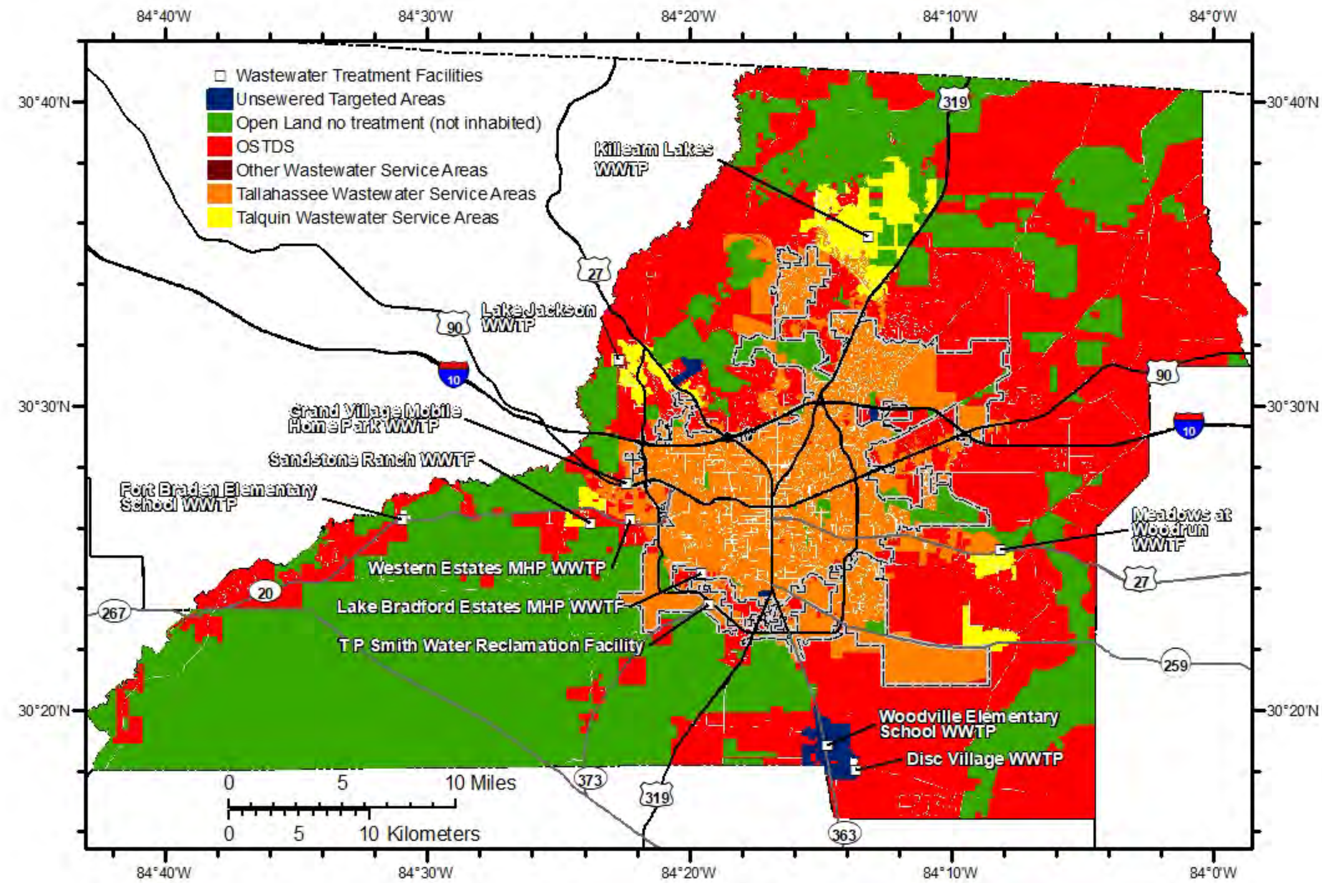

Figure 1. Parcels with an OSTDS, five centralized WWTFs, parcels in the Tallahassee wastewater service area, and parcels in the Talquin service area.

The objective of task 3 was to evaluate factors other than cost that influence the selection of the following alternative treatment technologies:

- Aerobic treatment unit (ATU) – In these systems, effluent passes through an aeration stage prior to discharge to the drainfield. This system is mechanical, with a blower to aerate the effluent, and sometimes includes recirculation.
- Performance-based treatment system (PBTS) – In these systems, effluent passes through two stages of treatment: (1) nitrification tank, and (2) one or more stages of denitrifying media. This system can also include recirculation.
- In-ground nitrogen-reducing biofilter (INRB) – These systems include a reactive media layer consisting of wood mulch, sawdust, or other organic material mixed with sand under a conventional drainfield so that effluent in the drainfield percolates through the media.
- Cluster systems – These are wastewater treatment systems designed to serve two or more dwellings or facilities with multiple owners. These systems require land to install and an entity that is responsible for managing the system. Cluster systems may use ATU, PBTS, or INRB.
- Central sewer systems – These are wastewater collection systems that connect to multiple residences and use a combination of gravity and pressure piping systems to transport wastewater to a central treatment plant.

The JSA team evaluated cost factors associated with these AWTSs in task 2.

In this report, the JSA team summarizes data used to evaluate other factors (section 2), presents the results of the treatment selection evaluation (section 3), and presents the preliminary findings of the evaluation (section 4).

2.0 Evaluation Factors

The JSA team evaluated 15 factors that influence the selection of AWTSs:

1. Site proximity to priority focus areas (PFAs) and the Primary Springs Protection Zone (PSPZ) (section 2.1)
2. Site proximity to the urban service area and rural communities (section 2.2)
3. Availability of land for cluster treatment systems (section 2.3)
4. Easement or right-of-way acquisition for wastewater collection systems (section 2.4)
5. 2020 population density and population density in the future (section 2.5)
6. Social and economic impacts to land use (section 2.6)
7. Technology performance history (section 2.7)
8. Scalability (section 2.8)
9. Suitability of an AWTS to previously constructed homes (retrofit) versus the suitability of an AWTS to the construction of new homes (section 2.9)
10. Capacity of existing WWTFs (section 2.10)
11. Proximity to a centralized wastewater collection system (section 2.11)
12. Property owner participation (section 2.12)
13. Implementation time (section 2.13)
14. Wastewater treatment components of the Leon County Comprehensive Plan (section 2.14)
15. State of Florida rules for OSTDS permits (section 2.15)

2.1 Site Location in Priority Focus Areas and the Primary Springs Protection Zone

DEP delineated two PFAs in the Upper Wakulla River and Wakulla Spring BMAP (fig. 2). PFAs define vulnerable parts of the Upper Floridan aquifer that contribute constituents to the spring. PFAs are in a part of the springshed in which the Upper Floridan aquifer is unconfined. In 2007, Leon County defined the PSPZ in the Leon County Land Development Code (fig 2.). The county protects the PSPZ in the code with measures that reduce nutrient loads to the spring. The location of a parcel in a PFA or the PSPZ is one of the most important factors in targeting the parcel for conversion to an AWTS or connection to centralized wastewater collection systems. Based on scientific review, land surface activities in the PFA and PSPZ of Leon County have the greatest impact on water quality in Wakulla Spring.

DEP prepared the Upper Wakulla River and Wakulla Spring BMAP to comply with the requirements of the Florida Springs and Aquifer Protection Act, which is intended to protect and restore Outstanding Florida Waters (OFW), including Wakulla Spring. Wakulla Spring was determined to be an impaired first magnitude OFW, and a TMDL was established for nitrate to further restoration of water quality in the spring. OSTDSs were determined to be one of the main sources of nitrogen contributing to the decline of water quality in Wakulla Spring. The BMAP states that nitrogen reduction efforts in PFAs will provide the most benefit toward restoration of water quality. A part of southern Leon County is in PFA1, which is the PFA with the greatest probability of regularly contributing nitrogen loads to Wakulla Spring.

The Florida Springs and Aquifer Protection Act was passed in the 2016 legislative session. The act prohibits conventional OSTDS on parcels less than one-acre within the PFA, unless the OSTDS includes enhanced treatment for nitrogen or a connection to the centralized wastewater collection system will be available within five years. When an existing traditional OSTDS must be repaired or replaced, the OSTDS must include nitrogen reducing enhancements, unless connection to the centralized wastewater collection system will be available within five years.

Leon County began studying the impacts of nitrogen to Wakulla Spring and other waterbodies in the early 2000s. Baker et al. (2007) completed the Leon County Aquifer Vulnerability Assessment (LAVA), a tool which identified areas of Leon County where the Floridan aquifer is most vulnerable to adverse impacts from activities on the land surface. This led to the development of specific measures to protect these vulnerable areas. For example, Policy 4.2.5 of the Conservation Element of the Tallahassee-Leon County Comprehensive Plan required the mapping of the PSPZ by 2010, based on the results of the LAVA study. The Comprehensive Plan further requires the City of Tallahassee and Leon County to adopt regulations to minimize adverse impacts to groundwater in the PSPZ. It requires connection to sewer with advanced WWTFs where feasible, and PBTSs where connection is not feasible.

In March 2009, the Leon County Board of Commissioners adopted the PSPZ (Section 10-6.710 of the Leon County Land Development Code). The PSPZ generally overlaps the PFA in Leon County and includes lands west and east of the PFA. The PSPZ boundary is coincident with roadways, section lines, and quarter-section lines.

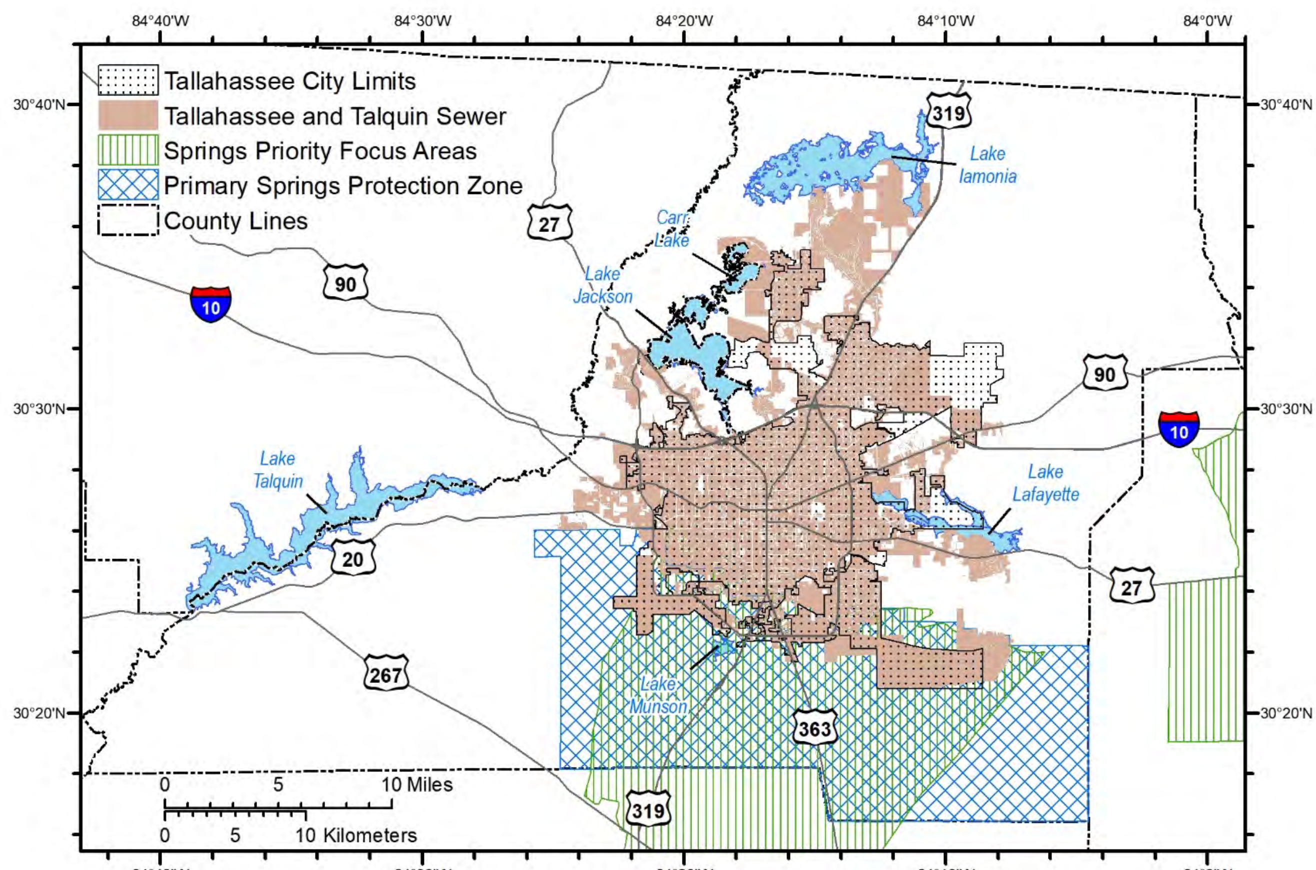

Figure 2. *Priority focus areas, Primary Springs Protection Zone, and wastewater service areas.*

2.2 Site Location Relative to the Urban Service Area and Rural Communities

A parcel's location relative to the urban service area will determine whether connection to a centralized wastewater collection system is feasible in 2020 and/or in the future. The purpose of the urban service area, as defined in the Comprehensive Plan, is to direct development toward the capital infrastructure needed to serve it, including sanitary sewer (central wastewater). The limits of the urban service area are determined based on the area necessary to accommodate 90% of new residential units anticipated during the planning period, the ability to provide capital infrastructure in this area, and the presence of environmentally sensitive lands and waterbodies requiring protection from the impacts of urban development. The plan prohibits capital improvement projects outside the urban service area, unless a demonstrated hardship is present, and such hardship may include failing septic systems, where the potential for severe environmental degradation is present. In the case of hardship, the capacity of new infrastructure to address the hardship is limited to development existing prior to February 1, 1990. The Comprehensive Plan allows for centralized potable water distribution and centralized wastewater collection in designated enclaves such as the Woodville Rural Community. In other rural communities, where development densities do not support capital infrastructure and centralized wastewater collection system is not planned, alternative methods of nitrogen reduction from OSTDSs must be considered. Additional details about the Comprehensive Plan limitations for wastewater, cluster systems, and OSTDS within the urban service area and rural communities are included in Section 2.14.

2.3 Adjacent Land Availability for Cluster Treatment Systems

Cluster treatment systems are used to treat wastewater from multiple homes. Therefore, these systems are not limited to one parcel and land will need to be acquired to install the cluster system. Cluster systems work best in residential areas with relatively greater density, where density reduces the amount of pipe needed to convey wastewater from each residence to the cluster system. For the purposes of this study, an upper limit of 16 residential units per cluster system is used.

For a cluster system to be most cost-effective, it should be placed near the parcels it will be treating. For this study, vacant parcels near multiple residential units on OSTDSs or near vacant parcels that will be developed in the future on OSTDSs were evaluated (fig. 3). Parcels colored green or yellow are closer to less developed parcels and more appropriate for cluster installation than parcels colored orange or red.

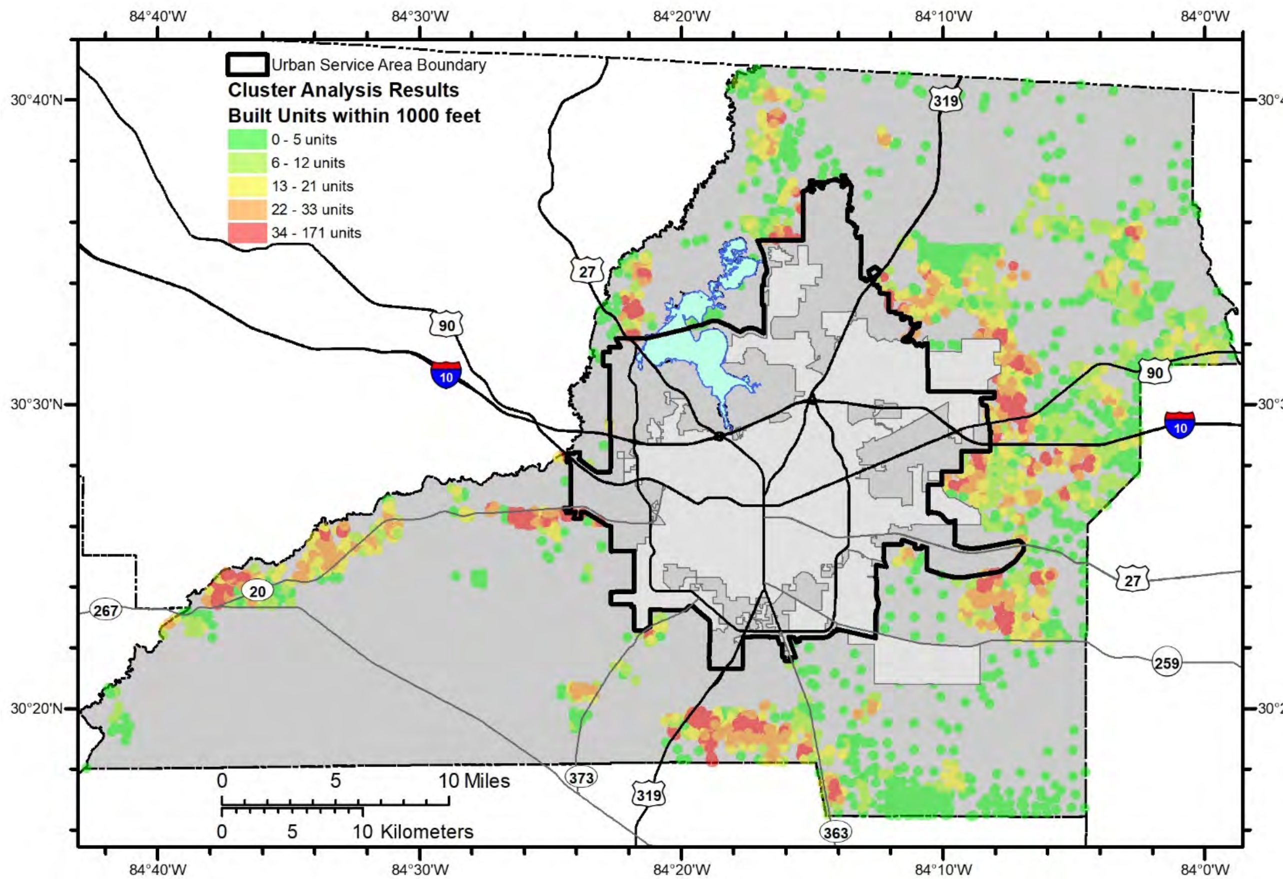

Figure 3. Vacant parcels within 1,000 feet of parcels with existing septic systems.

2.4 Easement Acquisition for Collection System Construction

Easements or rights-of-way may be necessary for cluster and centralized wastewater collection systems. Easements are not required for individual ATUs, PTBSs, or INRBs because these systems will be installed on individual properties.

For cluster systems, easement size may depend on the number and configuration of parcels served. Easements may be necessary to access collection system infrastructure from each parcel and for maintenance. An easement may also be necessary to provide the required 75-foot buffer (per Chapter 64E-6, Florida Administrative Code, Table V) between the treatment system drainfield and surrounding private water wells. Existing utility easements are typically used for centralized wastewater collection systems. However, if an easement does not exist, an easement must be acquired. In older developments where roadways are privately held and maintained, the acquisition of the utility easement can be difficult, time consuming, and costly. Sewer laterals to individual parcels will be located on the parcel and should not require easement acquisition.

2.5 Density of Existing Development and Future Land Use

Existing high density areas or future land use categories that allow for higher density developments provide a potential for nitrogen hotspots in the County. If these areas are located near existing wastewater infrastructure (e.g., lift stations), then the nitrogen impacts from development can be mitigated with additional nitrogen treatment provided by the existing WWTF. Many of the higher density areas are currently located near or in the urban service area. The configuration of higher development densities limits use of certain types of OSTDSs and may make centralized wastewater collection systems a more cost-effective approach for nitrogen reduction and sewage treatment.

As development continues, the existing wastewater infrastructure must be extended to serve the outward expansion of these higher density developments. Higher development densities should be limited to areas near the existing urban service area to allow for the most cost-effective expansion of the wastewater collection system. Where higher development densities are approved for construction in the outlying areas of the County, other treatment technologies will need to be used. In these areas, cluster systems may be a good option and can be planned to provide wastewater collection infrastructure for future conversion to sewer as the urban service area increases. Within task 5, these criteria will be evaluated in further detail in the location-specific analysis. Table 1 summarizes these general density considerations.

Table 1. *Pros and cons of development density for treatment options.*

Area	Pros	Cons
High Density	- More cost-effective for sewer use - Nitrogen treatment is less costly per household	- Limits use of an OSTDS due to lack of land to allow for adequate setbacks
Low Density	- Allows for use of an OSTDS	- Difficult to use central collection system - Nitrogen treatment more costly per household

2.6 Anticipated Impacts to Existing and Future Land Use Density

Two factors interact and contribute to the selection of feasible and optimal AWTS: (1) household density (measured as persons per household), and (2) housing density (measured as dwelling units per acre). The household density governs the expected wastewater nutrient loading at the individual parcel level as the greater the persons per household, the greater the nutrient loading. This factor may be constrained by site-specific conditions such as drainfield area, depth to groundwater, or distance to karst features and thus the choice of individual OSTDS. The housing density relates to the need for (and financial viability) of cluster or centrally-served systems. Areas with lower housing density will have higher capital costs per unit. The housing density by land use throughout the county is described in detail in the task 1 report. An understanding of Leon County's demographics, especially that of the PFA, will contribute to defining the feasibility and cost-effectiveness of AWTS options in each area to meeting BMAP objectives.

Leon County is diverse in its demographic and socio-economic makeup. Different census blocks and block groups, including parameters such as persons per household, median income, and median age, among others, will be positioned differently in terms of funding the construction (i.e., system purchase) and longer-term operation of AWTS. As an example, figure 4 denotes that persons per household (and corresponding wastewater demand and potential income) vary from 1.61 to 3.84 in the south and southeastern part of the County. The range is more than double that of the minimum value.

While greater median income is no assurance that a household can readily pay for an AWTS retrofit, it may be a proxy for the probability that such systems will be installed or that they will be installed earlier during the CWTFP timeline, and that BMAP objectives will be timely met. This same factor weighs the long-term cost of system operation and maintenance, which for ATUs and PBTSs is the crucial factor to achieve nitrogen reductions. Recognizing there is a learning curve with new systems, especially where homeowner operation and compliance with maintenance contracts and monitoring is an expectation, median education level (another demographic attribute) may also be a proxy for projecting nitrogen reduction success.

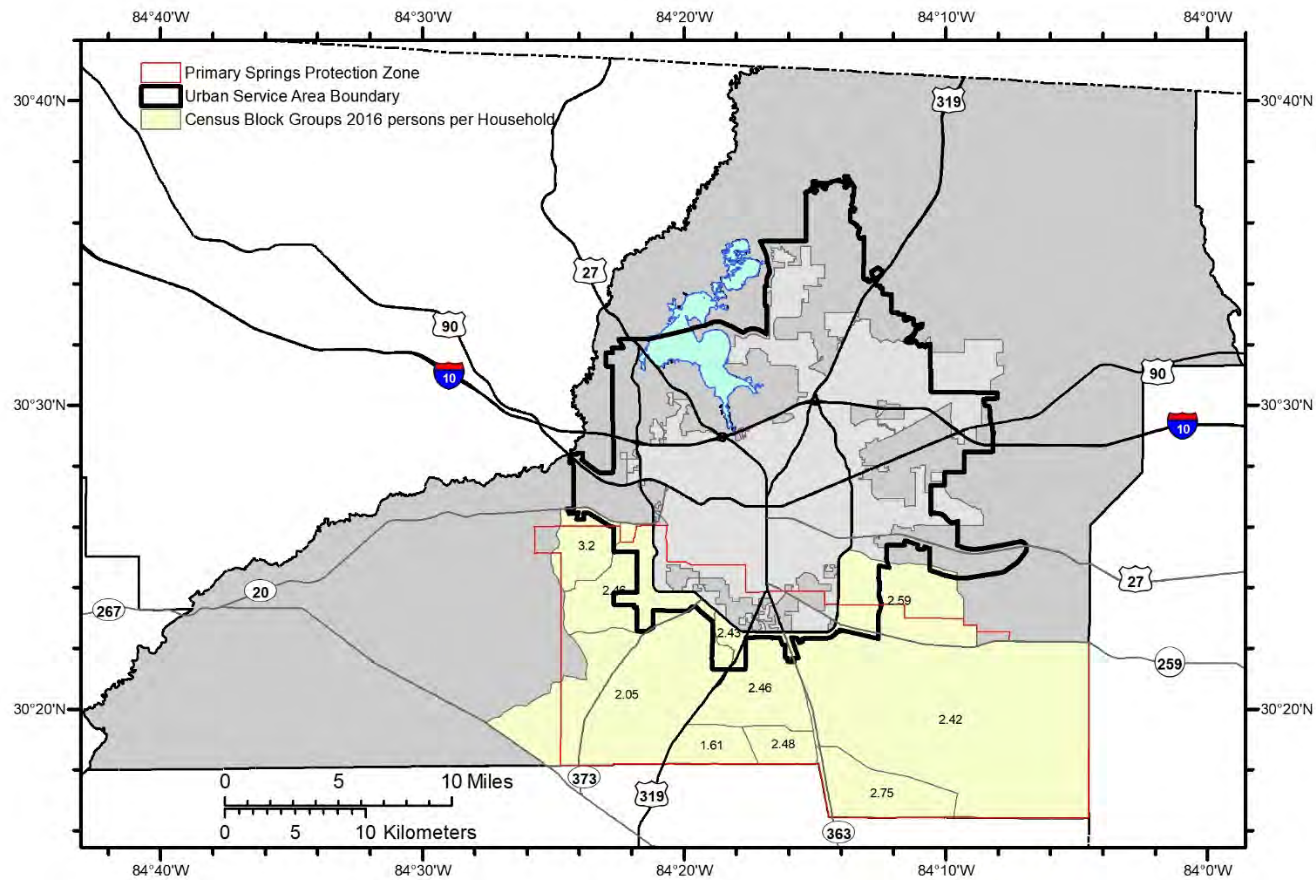

Figure 4. Leon County persons per household by block group (U.S. Census Bureau, 2017).

Median household income and education levels are above the county-wide average (and greatest in the PFA) in block groups 120730026041 and 120730026041, on either side of Tram Road, east and south of U.S. 319 (fig. 5). Outside of the city limits and wastewater services area, block group 120730046033 (at the county line east of U.S. 319) has a lesser than average median household income and relatively greater percentage of population without a high school diploma. Census block groups north of State Road 263/U.S. 319 that are between Springhill Road and Tram Road have below average household income and lower rates of high school graduation. These areas are likely to be served by centralized wastewater collection systems.

With respect to economic impact, there are 6,764 households in core census block groups in PFAs, external to the city wastewater services area. If all households upgrade to either an ATU or PBTS, total investment—at an average direct cost of $17,050 per household—will be greater than $115.3 million. Using Leon County-specific multipliers (IMPLAN economic impact assessment software) for water, sewerage, and other systems, that investment will generate 520 jobs, indirect economic impacts of about $43.8 million, induced impacts of $25.2 million, and a total economic impact of $184.4 million.

To help ensure a greater probability of nitrogen reduction and BMAP compliance, Leon County may look to amend Future Land Use Map categories (and the implementing zoning districts) in subareas of the PSPZ based on census data. Specifically, downzoning areas (reducing density) will reduce the need for wastewater treatment systems and connections and lower total system costs of meeting BMAP objectives. However, there will likely be the need for property owner compensation, which will have to be factored into total wastewater program costs. Reducing density will inflate land purchase costs and potentially engage homeowners with relatively more income or developers serving this income market and, based on the above argument, improve nitrogen performance whether among individual lots or as part of a cluster system. Conversely, upzoning (increasing densities) in areas that contribute less nitrogen to groundwater or are in proximity to existing WWTF service can reduce the costs of retrofit and connection because more properties can be served with fewer feet/miles of line, existing system capacity can be taken advantage of, and nitrogen reduction per property can be maximized.

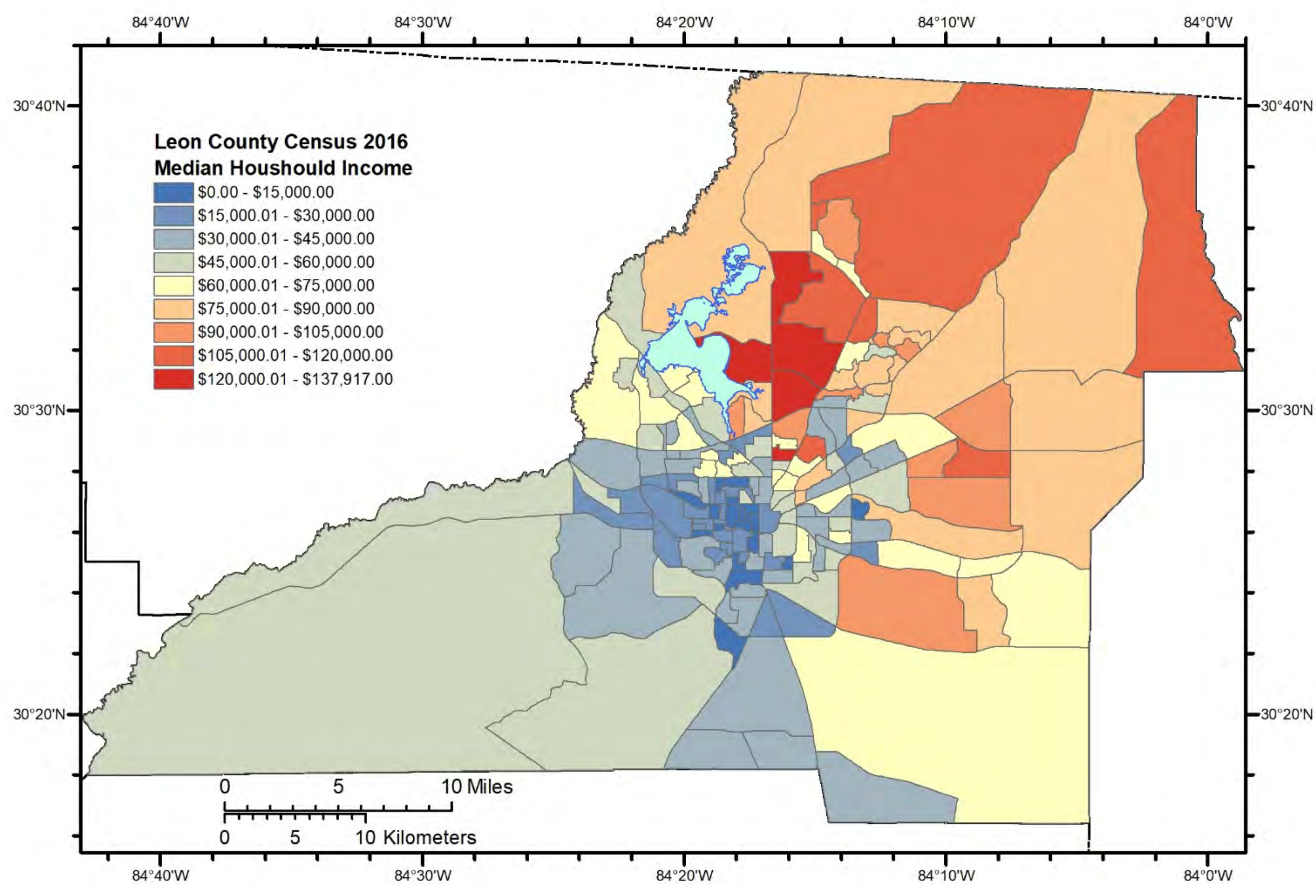

Figure 5. Leon County median income by block group (U.S. Census Bureau, 2017).

2.7 Technology Performance History of Reliability in Similar Site Conditions

The use of AWTSs in Florida is still fairly new, but these technologies are becoming more common, especially in areas around OFWs that must meet the requirements of the Florida Springs and Aquifer Protection Act.

ATUs and PBTSs have several approved models on the market and have been used in Florida for years. ATUs provide a nitrogen reduction in the range of 50%–79% in the tank, plus additional reductions in the drainfield. PBTSs provide a nitrogen reduction in the range of 52%–77% in the tank, plus additional reductions in the drainfield. However, both systems require power for the pump as well as operating permits. In applications of these systems in and around Leon County, many homeowners shut off the pumps to save energy and because of the noise. Without pumps, these systems function as conventional OSTDSs and additional nutrient reduction benefits are not achieved. The operational requirements of these systems need to be considered when identifying locations for implementation, and an education program may be needed in conjunction with the use of these systems.

INRBs are newer systems that are not as common in Florida. These systems can achieve nitrogen reductions of about 65%, which mostly occur in the drainfield. While the expected nitrogen reductions from INRBs are less than ATUs and PBTSs, these systems are passive, with no pumps or power requirements. Therefore, homeowners do not have to worry about operating the pumps, so the systems may more consistently achieve the nitrogen reductions than ATUs and PBTSs. However, the drainfield media will need to be replaced periodically, and INRBs require more space for installation and a greater separation from the water table than conventional drainfields, so potential sites for installation of these systems are more limited.

Table 2 provides a summary of the pros and cons for the ATU, PBTS, and INRB systems.

Cluster systems are not widely used in Florida. As these systems collect wastewater from multiple properties, they require a management entity, whether a utility or a Responsible Management Entity, to ensure proper maintenance and function. Cluster systems can use any of the above described nutrient removing technologies, depending on the design and construction of the collection tank and drainfield. When properly managed, these systems can achieve nutrient reductions up to 76% (including the drainfield) and avoid issues with individual homeowner operation.

Centralized wastewater collection systems are used throughout Florida, and a well-maintained collection system that conveys wastewater to a treatment facility results in a greater nutrient reduction than onsite systems. In areas with centralized wastewater collection systems infrastructure or where infrastructure can cost-effectively be extended, this option provides the greatest level of nutrient treatment. These systems can be difficult and costly to construct in level terrain, such as lower Leon County. The most cost-effective solution for these systems is gravity flow. However, in these level areas, pressure systems must be designed, which increases the construction cost substantially.

Table 2. *Summary of pros and cons of ATUs, PBTSs, and INRBs (adapted from information from the Florida Department of Health, 2020).*

Treatment Technology	Pros	Cons
ATU	Effective nitrogen removal. Approved systems provide 50% to 79% nitrogen removal plus additional treatment in the drainfield.	Require operating permits from the county health department, which is the homeowner's responsibility.
	Existing permitting pathway through county health departments.	Requires annual inspection by the health department and biannual maintenance by a certified contractor at the homeowner's expense.
	Many approved systems on the market. Some have been constructed and operated in Florida for many years.	Does not operate when the power is off. Depending on the system construction, it could result in backed up drains when the power is off.
	Installation does not require a new drainfield.	Lifetime costs are greater than INRBs. Overall costs include permits, construction, design, equipment purchase, maintenance/repair, inspection, and energy consumption.
		Aesthetic issues with blower/pump noise and odor from vents.
PBTS	Some designs remove more nitrogen. Approved systems range from 52% to 77% nitrogen removal plus additional treatment in the drainfield.	Must be designed by an engineer and constructed under engineering oversight, which is an additional cost.
	Existing permitting pathway through county health departments.	Require operating permits from the county health department, which is the homeowner's responsibility. Permits vary depending on the system installed.
	Several approved systems are on the market. Some have been constructed and operated in Florida for years.	Required inspection by the health department and maintenance by a certified contractor at the homeowner's expense. The maintenance frequency varies depending on the system.
	Septic system contractors in most areas of the state know how to install and maintain these systems.	Does not operate when the power is off. Depending on the design, it could result in backed up drains when the power is off.
	Installation does not require a new drainfield.	Lifetime costs are greater than INRBs. Overall costs include permits, construction, design, equipment purchase, maintenance/repair, inspection, and energy consumption.
INRB	Testing has shown they reduce nitrogen by at least 65%.	Not suitable for some sites because of depth and/or footprint limitations. Typically requires an excavation greater than 5 feet and a water table deeper than about 7 feet and enough room for excavating equipment and soil stockpiling.
	Can be constructed as a truly passive system with no pump or energy requirement so it will still operate when there is no power.	New technology that has not come into common usage yet. Few septic tank contractors have experience or training in installation.
	Uses commonly available materials (e.g., recycled wood mulch and soil) and straightforward design. No equipment needs to be installed.	Testing has shown that INRBs reduce nitrogen by about 65%, which includes treatment in the drainfield plus reactive media. Overall nitrogen removal may be less than ATUs or PBTS plus their drainfields.
	Requires only a construction or repair permit from the county health department. There is no operating permit, engineering design, inspection, or maintenance requirements.	Installation requires replacement of the drainfield.
	Lesser lifetime costs than ATUs or PBTSs. Costs include only initial construction permit and installation.	

2.8 Scalability of Technology

Wastewater loads to cluster systems is greater than loads to an OSTDS that serves one household. For this reason, cluster systems must be evaluated more thoroughly than OSTDSs designed for a single household. Selection of the design flow is more important. Cluster systems will have a larger hydraulic load impacting a larger area of soil, and the possibility of overwhelming the soil's infiltrative capacity is greater. Designs should be based on actual per capita flows, rather than on the number of bedrooms, and a safety factor should be incorporated into the design. In retrofit areas, individual septic tanks can be left in place on the properties to help buffer the flows to the cluster system. In addition, proper operation and maintenance become more important with larger systems and larger flows. A management entity is necessary to ensure good long-term functioning of cluster systems.

A cluster system may be constructed using any of the AWTS technologies. Passive cluster systems would use INRB technologies, with similar treatment effectiveness. Active cluster systems would use ATU or PBTS that can support as many as 16 households. The collection network considerations for passive or active cluster systems are identical. Additional details about the scalability of each AWTS technology for use in a cluster system are included in the task 2 report.

For the larger disposal areas necessary for cluster systems, the U.S. Environmental Protection Agency (2002) recommends a groundwater mounding analysis to determine whether the hydraulic load to the drainfield infiltration surface or the load to the saturated zone under the infiltration surface will govern the design. As previously noted, a safety factor should be incorporated into the design. A common practice is to design multiple cells that provide 1.5 to 2 times the minimum required drainfield size to service the number of units. This approach allows the cells to be rotated in and out of service, providing a resting period between loadings. It also provides for some standby capacity that can be used in the event of malfunction of one of the cells. In addition to multiple cells, timed dosing and flow monitoring are recommended. With multiple cells, smaller distribution networks combined with smaller and more frequent dosing can be used, thereby maximizing oxygen transfer in the soil, and preventing the natural hydraulic capacity of the soil from being overwhelmed.

2.9 Technology Suitability for Retrofit Versus New Development

The aforementioned technologies can be used in both retrofit and new development applications, although some technologies are more suitable than others. Technologies that do not require land external to the parcel served—such as individual ATUs, PBTSs, and INRBs—are more suitable for retrofits. Central sewer can be used within retrofit areas, although it can be more difficult and costly to construct within areas that do not currently have an established right-of-way or utility easement. As discussed above, in more level terrain, the practicality of gravity sewer installation can be limited and a more costly pressure system must be designed. Cluster system have some of the same limitations as central sewer with the addition of finding suitable land for the installation of the larger drainfield. In more dense areas or areas with smaller average parcel sizes, finding suitable land adjacent to the retrofitted parcels can be difficult and expensive. The opportunities to use these technologies for retrofit will be evaluated in specific areas of the county as part of task 5.

Where conventional OSTDSs exist, ATUs, PBTSs, and INRBs are constructed on the subject property within the spatial extent of the existing OSTDS, such that additional land is not necessary for construction. These technologies can be used in new developments when the cost to extend existing sewer laterals is greater than the cost for installing these technologies. In particular, ATUs and PBTSs can quickly outweigh the cost of extending an existing sewer lateral.

Where new development is proposed, the installation of the sewer collection system can easily be integrated into the proposed site development plan. Once the collection system is installed, the use of a cluster system or sewer main can be determined based on cost and location. For the purpose of cluster systems, the operating/maintenance authority needs to be established early on. In retrofit applications, this may be more difficult to set up and govern.

Table 3 shows the recommended technologies for retrofit applications and new development systems.

Table 3. Recommended technologies for retrofit and new development.

Retrofit Systems	New Development Systems
INRB	Centralized wastewater collection system
ATU	Cluster system
PBTS	
Cluster system	

2.10 Existing Wastewater Treatment Facility Available Capacity

Table 4 summarizes the available capacity of the existing WWTFs in Leon County. Average flow rates are based on the best available data from the monthly operating reports that each facility submits to DEP.

The City of Tallahassee's T.P. Smith Water Reclamation Facility accounts for approximately 92% of the total available capacity of the County. The additional capacity is divided by an average daily household flow rate of 300 gallons per day to determine number of potential households that could be converted to sewer. Currently, the average WWTF usage rate is 64.5% of the permitted capacity. This percentage increases during times of peak flows.

From the task 1 report, the number of existing OSTDSs in the County was estimated to be 25,885. If all these OSTDSs were converted to sewer, then the WWTF utilization rate will increase to 92.0%. The estimated number of OSTDSs in 2040 is 29,377, which will increase the WWTF utilization rate to 108%. Using the equivalent annual growth rate of 0.69% (task 1), the existing WWTF treatment capacity is estimated to be sufficient until 2028. WWTF expansion to serve all parcels within the unincorporated areas of Leon County have not been included in this analysis.

Table 4. WWTF capacity in Leon County.

Facility ID	WWTF Name	Design Capacity (MGD)	Average Flow Rate (MGD)	2020 Remaining Capacity (MGD)*	2040 Remaining Capacity (MGD)*	Additional 2040 Home Capacity**
FLA010139	T.P Smith Water Reclamation Facility	26.5000	17.28	9.2200	6.6630	22,210
FLA010148	Lake Bradford Estates MHP WWTF	0.0430	0.01	0.0330	0.0315	105
FLA010137	Disc Village Wastewater Treatment Plant (WWTP)	0.0200	0.00	0.0200	0.0200	67
FLA010136	Woodville Elementary School WWTP	0.0100	0.00	0.0100	0.0100	33
FLA010159	Meadows-at-Woodrun WWTF	0.0700	0.03	0.0400	0.0356	119
FLA010167	Sandstone Ranch WWTF	0.0707	0.05	0.0207	0.0133	44
FLA010152	Western Estates MHP WWTP	0.020	0.02	0.0000	0.0000	0
FLA010138	Fort Braden MHP WWTP	0.0110	0.01	0.0010	0.0000	0
FLA010151	Grand Village Mobile Home Park WWTP	0.0250	0.01	0.0150	0.0135	45
FLA010171	Lake Jackson WWTP	0.7500	0.26	0.4900	0.4515	1,505
FLA010173	Killearn Lakes WWTP	0.7000	0.53	0.1700	0.0916	305
Total		**28.2200**	**18.20**	**10.0200**	**7.3515**	**24,433**

*Remaining capacity is estimated using the average flow rate.

**Using an average home flow rate of 300 gallons per day.

2.11 Proximity to Centralized Wastewater Collection System

Transition from OSTDSs to a centralized wastewater collection system is more challenging where wastewater must be transported in the collection system a relatively long distance to a WWTF. Relatively longer extensions of the collection systems may require more land or easement, construction of additional wastewater pump stations, and use of additional construction materials than relatively shorter extensions. Longer extension may also result in more utility conflicts and a greater construction burden on the community, than shorter extensions. Therefore, transition of OSTDSs to ATUs, PBTSs, INRBs, or cluster systems may be more cost-effective on parcels that are relatively farther from a centralized wastewater collection system than parcels that are relatively closer to a centralized wastewater collection system.

Within task 5, this evaluation will be expanded to a location specific analysis and provide more detailed information as it relates to individual areas within the county.

2.12 Anticipated Property Owner Participation Rate in Retrofit Activities

The anticipated property owner participation rate in retrofit activities is difficult to predict. It is likely that the countywide participation rate is a function of grants or subsidies to fund transition from OSTDSs to AWTSs or centralized wastewater collection systems. If transition is fully funded, property owner participation is likely greater than if transition is partly subsidized or not funded. A state grant and Leon County funding currently cover the costs associated with retrofits; however, these funding sources may not be available to fully fund retrofits in the future. If the regional economy is healthy, and wages satisfy fundamental needs, property owners may be more willing to partly fund transition. If transition is subsidized or not funded, the countywide or regional property owner participation rate is likely a function of cultural value systems and opinions associated with water quality. In parts of the county where property owners value water quality, the property owner participation rate may be greater than in parts of the county where property owners do not value water quality.

Based on recent Leon County projects, the property owner participation rate varies from 52% to 90% (Table 5). Several of these projects are not complete.

Table 5. *Owner participation rates in Leon County septic-to-sewer projects.*

Project	Participation Rate
Woodside Heights (complete)	90%
Annawood	66%
Belair	62%
Northeast Lake Munson	60%
Woodville	52%

2.13 Time Required for Implementation

Time required to implement each of treatment technology varies from days to years (Table 6).

Table 6. *Time in months to design, permit, and construct five alternative wastewater treatment systems.*

System	Design (months)	Permit (months)	Construction (months)	Property Acquisition (months)	Total (months)
Centralized wastewater collection system	6	6	12	24	48
Cluster system (existing development)	3	6	6	24	39
Cluster system (new development)	2	3	4	24	33
ATU	1	1	2	0	4
PBTS	1	1	2	0	4
INRB	0.75	0.75	0.5	0	2

Time to construct a centralized wastewater collection system depends on the complexity and size of the system. Centralized wastewater collection systems require modeling, engineering design, permit acquisition, and selection of a contractor for construction. Centralized wastewater collection systems typically involve complex public funding mechanisms with associated time demands to establish and distribute funds. Easement acquisition may take months, when required to extend the centralized wastewater collection system. Construction materials normally require 6 to 12 weeks to obtain. As long as two years may be needed to acquire the necessary property to construct the system. Therefore, a centralized wastewater collection system in Leon County will require up to four years to design, permit, acquire property, and construct.

Cluster systems that serve more than one dwelling also require engineering design and permitting. Cluster systems could be integrated into the design of new multi-dwelling developments. Land must be acquired to construct (or retrofit) cluster treatment systems that will service existing multi-dwelling developments. Cluster system construction materials are typically available in less than six weeks. Construction requires four to six months. As long as two years may be needed to acquire the necessary property to construct the system. Therefore, cluster systems in Leon County may require up to 33 months to construct a new system that will serve new multi-dwelling developments, and up to 39 months to construct (or retrofit) systems for existing multi-dwelling developments.

ATUs and PBTSs do not require additional land for construction and installation. ATUs and PBTSs are typically funded by the property owner or by a grant. ATU and PBTS designs are less complex than centralized wastewater collection systems. ATUs and PBTSs require additional septic tank components and new or re-built drainfields. Septic tank contractors can install ATUs and PBTSs. Most ATU and PBTS components do not require unique, individual manufacture and are typically purchased from an existing inventory available from national companies and local distributors. ATUs and PBTSs require six to eight weeks of engineering design and permitting. ATUs and PBTSs require about four months to design, permit, and construct.

INRB systems are much simpler to install than other AWTSs and only require the replacement of the drainfield. Four to six weeks of engineering and permitting is required for INRBs. In some instances, OSTDS tanks will be replaced if the tank is not structurally sound. INRBs are privately funded or funded with a grant. INRBs require two to three weeks of construction. INRBs require two months to design, permit, and construct.

For the purposes of this analysis, property acquisition has been included for the installation of cluster and central sewer systems. This may not be required for the installation of all such systems, but can be a major time constraint when determining the practicality of these systems. In areas where existing easements, public right-of-way, and/or available land must be obtained, legal seizure of required land may be needed.

2.14 Local Comprehensive Plan Direction Regarding Wastewater Treatment

The Tallahassee-Leon County 2030 Comprehensive Plan includes several requirements related to use and siting of OSTDSs, and to the expansion of the centralized wastewater collection system, which must be considered when determining which treatment technologies to use in specific areas in the county.

Information on OSTDSs are found in several policies. Policy 1.2.1 [SS] states that the "minimum lot size for a septic tank shall be one-half acre." Policy 2.2.14 [C] states that "septic tanks…shall not be placed in the lake protection zone (100-year floodplain) unless there is no reasonable alternative. No part of a septic system may be located within 75 feet of the normal high-water line of a water body or jurisdictional wetland." Policy 2.3.2 [C] places limits on OSTDSs in the Lake Jackson Special Development Zone. In this area, no new OSTDSs can be installed on lots less than one acre, and no new septic systems can be placed in the 100-year floodplain. Policy 1.2.5 [SS] requires that "facilities other than traditional septic systems must be provided before development is allowed in areas where severe soil limitations exist for septic systems." Policy 1.2.6 [SS] requires the use of performance-based OSTDSs in the PSPZ where centralized wastewater collection systems are not available. Policy 4.2.5 [C] adds to Policy 1.2.6, requiring that a traditional OSTDS be upgraded to performance-based OSTDS when the OSTDS fails.

For centralized wastewater collection systems, Policy 2.2.14 [C] also applies, requiring that "... pump or lift stations, or sewer lines shall not be placed in the lake protection zone (100-year floodplain) unless there is no reasonable alternative." Policy 1.3.1 [SS] states that areas outside the urban service area—designated rural communities and urban fringe—"shall obtain sewage treatment through the use of an onsite system or a package plant." Policy 1.3.2 [SS] allows the extension of centralized wastewater collection systems to areas outside the urban service area but in the urban fringe to serve an existing residential subdivision "to correct an environmental or health problem associated with failing septic systems or to serve a new Conservation subdivision or permitting non-residential use that is in compliance with the Comprehensive Plan." This policy would apply as the Upper Wakulla River and Wakulla Spring BMAP identifies an environmental problem associated with the existing septic systems. Subdivisions meeting these criteria are shown in figure 6.

For cluster systems, Policy 1.3.1 [SS] states that "an onsite system may serve more than one parcel but only to correct an existing environmental problem." This policy would apply as the Upper Wakulla River and Wakulla Spring BMAP identifies an environmental problem associated with the existing septic systems. The capacity of these facilities shall be limited to that necessary to serve development existing on or prior to February 1, 1990."

In addition, the Upper Wakulla River and Wakulla Spring BMAP OSTDS Remediation Plan has requirements that must be considered. This plan prohibits new conventional OSTDSs on lots in the PFAs less than one acre, unless the OSTDS includes enhanced treatment for nitrogen or a connection to the centralized wastewater collection system will be available within five years. When an existing traditional OSTDS must be repaired or replaced, the OSTDS must include nitrogen reducing enhancements, unless connection to the centralized wastewater collection system will be available within five years.

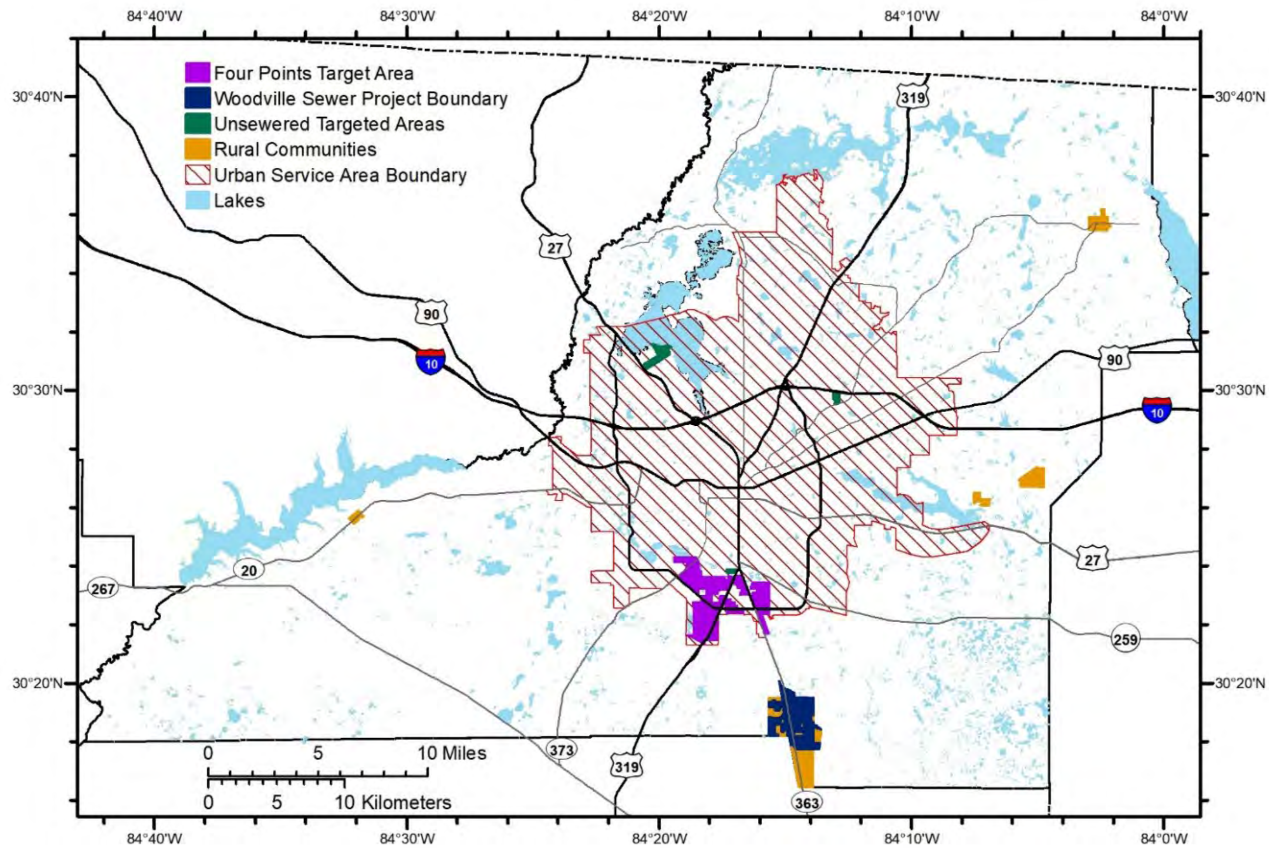

Figure 6. Urban service area, rural communities and unsewered target areas.

2.15 Current State Rules on Septic System Permit Requirements

Septic system permitting is currently administered by the Florida Department of Health. However, as part of the 2020 Clean Waterways Act (Senate Bill 712), the Onsite Sewage Program will be transferred to DEP by July 1, 2021.

For conventional OSTDSs, an application must be completed and submitted, along with a site plan, to the local county health department for approval. OSTDSs must meet requirements of Chapter 64E-6, Florida Administrative Code.

ATUs and PBTSs are required to have a biennial operating permit, have a maintenance contract with an approved maintenance entity, and allow inspection by the local health department in accordance with Chapter 64E-6, Florida Administrative Code. In addition, PBTSs must be engineer-designed for permit approval. ATUs must be certified by National Sanitation Foundation International as capable of providing at least 50% nitrogen reduction before treated wastewater is discharged to the drainfield. If there is less than a 24-inch separation between the drainfield and seasonal high-water table, the ATU must be capable of reducing nitrogen by at least 65% before discharge to the drainfield. For a PBTS installed with at least a 24-inch separation between the bottom of the drainfield and the seasonal high-water table, it must be capable of reducing nitrogen by at least 50% before discharge to the drainfield, for at least 65% overall treatment, including the drainfield. If there is less than a 24-inch separation, the PBTS must be capable of reducing nitrogen by at least 65% before discharge to the drainfield.

For INRBs, the provisions of Rule 64E-6.009(7), Florida Administrative Code, apply. This rule requires that the drainfield be installed over sand fill that is at least 18 inches thick and extends at least one foot beyond the perimeter of the drainfield. Below this sand layer, the media layer must be at least 12 inches thick and extend at least 24 inches beyond the perimeter of the drainfield. The media layer must also extend upward along the boundary of the sand fill material to about four to six inches below the bottom of the drainfield. The media layer cannot be installed when the observed water table is at or above the lowest depth of the media layer, and the bottom of the media layer must be at least 6 inches above the wet season water table. No media can be within 18 inches of the infiltrative surface of the drainfield. Upon completion of media layer installation, the local health department must inspect it before the media is covered. There is a fee for this inspection. Final approval must be provided by the local health department after all records have been completed and filed. These systems are not required to have an operating permit or a maintenance contract.

3.0 Treatment System Evaluation

In task 1, the JSA team calculated a nitrogen reduction score using the geologic criteria. As part of this task 3 report, the JSA team added another element to the nitrogen reduction score by including mitigation criteria. The mitigation criteria are the evaluation factors described in Section 2.0, and Table 8 provides a matrix to evaluate each of the mitigation factors for technology implementation. The scoring shown in this matrix was developed as a countywide evaluation for this task. The matrix will be applied to specific areas in the county, along with the geologic criteria, to determine appropriate technologies in task 5.

The evaluation factors with the greatest importance to this study were assigned a weight of 3 and factors with a lesser priority were assigned a weight of 1. An explanation of the weight assigned to each evaluation factor is included in Table 7.

Table 7. *Rationale for Weight of Each Evaluation Factor*

Evaluation Factor	Weight	Rationale for Weight
Site Proximity to PFA and PSPZ	3	The PFA and PSPZ are the most vulnerable areas to nitrogen loading from OSTDS.
Right-of-Way Acquisition	3	Acquisition can be time consuming and costly, affecting schedules and budgets to address the nutrient loading from OSTDS.
Technology Performance History	3	The performance history is a key factor in determining the expected nutrient reductions from each technology.
Suitability of Retrofit	3	The BMAP focuses on addressing nutrient loads from existing OSTDS so the ability to retrofit is important.
Time Required for Implementation	3	The BMAP includes a timeline for achieving nutrient reductions so options that can be implemented in a timely are important.
Local Comprehensive Plan Direction for Wastewater	3	The Comprehensive Plan details what technologies can be used in different locations and implementation requirements that must be considered.
Site Proximity to Urban Service Area	2	The proximity is important for determining which areas can be connected to the central sewer system.
Density of Existing Development and Future Land Use	2	The existing and planned densities will play a role in determining which technologies will work best to provide for treatment.
Impact to Existing and Future Land Use	2	The existing and future land uses will play a role in determining which technologies will work best to provide for treatment.
Suitability to New Development	2	It will be important to address future nutrient loading through implementation of AWTS.
Existing WWTF Available Capacity	2	Parcels can only be connected to the central sewer system if the WWTFs have available capacity.
Anticipated Property Owner Participation Rate	2	Nutrient reductions will only occur if property owners upgrade their traditional OSTDS.

Evaluation Factor	Weight	Rationale for Weight
State Rules on Septic System Permit Requirements	2	The state rules detail the requirements for AWTS implementation that must be considered.
Proximity to Centralized Wastewater Collection System	1	This factor is only a consideration in the ability to most cost effectively connect parcels to the central sewer system.
Scalability of Technology	1	Options for AWTS can be implemented at different scales depending on conditions in each area of the county.
Adjacent Land Availability	1	Land availability is mostly a consideration for cluster systems but may also be needed for central sewer easements.

Technologies were given a score of 1 or 2 for each evaluation factor. A score of 1 represented a con, such as the need for adjacent land availability for a cluster system. A score of 2 represented a pro, such as the known history of technology performance for sewer, ATUs, and PBTSs. No score was assigned when a factor was not applicable or considered neutral to the technology, such as the existing WWTF available capacity for ATUs, PBTSs, and INRBs.

The score were multiplied by the weight for each factor and then divided by the total weight to determine a weighted mean score for each technology. The total weight was calculated for each technology to remove factors that were not applicable to that technology. For this countywide evaluation, INRBs received the highest score, which means INRBs may generally be the most feasible technology for treatment throughout the county, where conditions are suitable. ATUs and PBTSs, sewer, and cluster systems followed in the scoring (see Table 8). While cluster systems scored lowest in this countywide evaluation, this technology may be the most appropriate in specific areas of the county and for new development, which will be further studied in task 5.

Table 8. *Matrix of pros and cons with weights for technology implementation*

Evaluation Factor	Weight	Sewer	ATU	PBTS	INRB	Cluster
Site Proximity to PFA and PSPZ	3	2	2	2	2	
Site Proximity to Urban Service Area	2	2				
Adjacent Land Availability	1					1
Right-of-Way Acquisition	3	1	2	2	2	1
Density of Existing Development and Future Land Use	2	2				2
Impact to Existing and Future Land Use	2	1	1	1	2	
Technology Performance History	3	2	2	2	1	1
Scalability of Technology	1	2	1	1	1	2
Suitability of Retrofit	3	1	2	2	2	1
Suitability to New Development	2	2	2	2	2	2
Existing WWTF Available Capacity	2	1				
Proximity to Centralized Wastewater Collection System	1	2				
Anticipated Property Owner Participation Rate	2	1	2	2	2	1
Time Required for Implementation	3	1	2	2	2	1
Local Comprehensive Plan Direction for Wastewater	3	2				1
State Rules on Septic System Permit Requirements	2		1	1	2	1
Score	-	*1.53*	*1.79*	*1.79*	*1.83*	*1.20*

2 (green)	Pro/Beneficial (2 points)
(yellow)	Not Applicable or Neutral
1 (red)	Con/Not Beneficial (1 points)

The JSA team made the following assumptions in this evaluation:

- The evaluation of treatment technologies was conducted on a countywide basis. An evaluation using all factors from tasks 1, 2, and 3 will be conducted for specific areas of the county in task 5.
- Items that were deemed not applicable are based on the likelihood that a factor and technology are not directly comparable in a pro/con scoring matrix. Some factors that were deemed not applicable may be used when making technology selections in task 5.

4.0 Preliminary Findings

The JSA team determined the following:

Finding 1. On a countywide basis, INRBs scored the highest, followed by ATUs and PBTSs, using the evaluation factors for mitigation criteria in task 3.

Finding 2. On a countywide basis, cluster systems scored the lowest using the evaluation factors for mitigation criteria in task 3. However, cluster systems may be the best option for specific areas of the county, which will be evaluated further in upcoming tasks.

Finding 3. The applicability of each of the evaluation factors is specific to the conditions in each part of the county.

The JSA team may refine these findings as the present task 3 report is finalized and as plan development progresses.

5.0 References

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Appendix D. Task 4: Public Input on Tasks 1 Through 3 Report

Comprehensive Wastewater Treatment Facilities Plan

Task 4: Public Input on Tasks 1 Through 3

LEON
FLORIDA'S CAPITAL COUNTY

Prepared by

JSA — ENGINEERING · HYDROLOGY · GEOLOGY

AGI

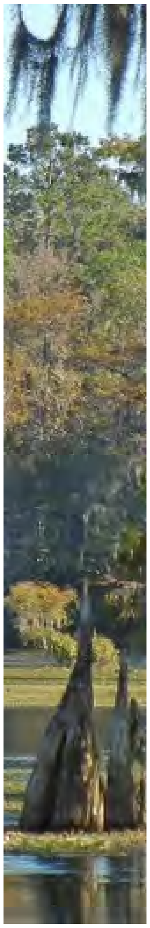
ATM

The Balmoral Group

Magnolia Engineering, LLC

TETRA TECH

August 23, 2021



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The cover photograph and the frontmatter margin photograph by PixelAnarchy (June 19, 2012), where the creator has released it explicitly under the license (https://pixabay.com/service/terms/#license): https://commons.wikimedia.org/wiki/File:Wakulla_Springs.jpg.

ACRONYMS AND ABBREVIATIONS

AWTS	Alternative Wastewater Treatment Systems
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
FDOH	Florida Department of Health
INRB	In-Ground Nitrogen-Reducing Biofilter
JSA	Jim Stidham & Associates
OSTDS	Onsite Sewage Treatment and Disposal System
TMDL	Total Maximum Daily Load
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

Leon County is developing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs), as well as future development, to groundwater and surface waters. OSTDSs are also known as septic systems. The Florida Department of Environmental Protection found that nutrient loads from several sources—including OSTDSs in Leon County—impaired Upper Wakulla River and Wakulla Spring.

Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are to: (1) identify OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) identify future development that will require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County is developing the plan by progressing through eight major tasks. This report describes the results of the fourth task: public input on tasks 1 through 3. This task involved a series of six public meetings with stakeholders throughout the county to obtain input on the tasks completed to date and to guide future project tasks.

1.0 Introduction

The Florida Department of Environmental Protection (DEP) found that nutrient loads from several sources impaired Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive each day, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore the river and spring by identifying actions that will reduce pollutant loads to the river and spring. The BMAP was adopted by DEP in June 2018 and requires that stakeholders, including Leon County, reduce nitrogen loads to the river and spring from onsite sewage treatment and disposal systems (OSTDSs). OSTDSs are also known as septic systems. Leon County contracted Jim Stidham & Associates (JSA) to develop the plan to reduce nitrogen loads from OSTDSs. JSA partnered with Advanced Geospatial, Applied Technology & Management, The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop the plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP plan with a grant to the county. About 40% of Leon County is served by OSTDSs, about 20% is served by five centralized wastewater treatment facilities (WWTFs), and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (fig. 1).

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTS), where the transition will most reduce nitrogen loads to the river and spring. The plan will produce guidance for retrofit of existing development as well as direct technology selection for future development. The JSA team is creating the Leon County plan by performing the following tasks:

- Task 1. Develop a nitrogen reduction score to identify the likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTS; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas (Completed)
- Task 2. Quantify cost-effectiveness of AWTS (Completed)
- Task 3. Identify other factors that influence selection of an AWTS (Completed)
- Task 4. Provide education to the community regarding information compiled in tasks 1, 2, and 3 and survey opinions of the citizens of Leon County, with respect to this plan (Draft Completed)
- Task 5. Analyze implementation scenarios for AWTS
- Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTS
- Task 7. Provide additional education to the community regarding the information compiled in tasks 1 through 6 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan
- Task 8. Present the plan to the Leon County Board of County Commissioners

This report describes task 4 of the Leon County plan: public input on tasks 1 through 3. Section 2 summarizes the public meetings held and section 3 summarizes the feedback received.

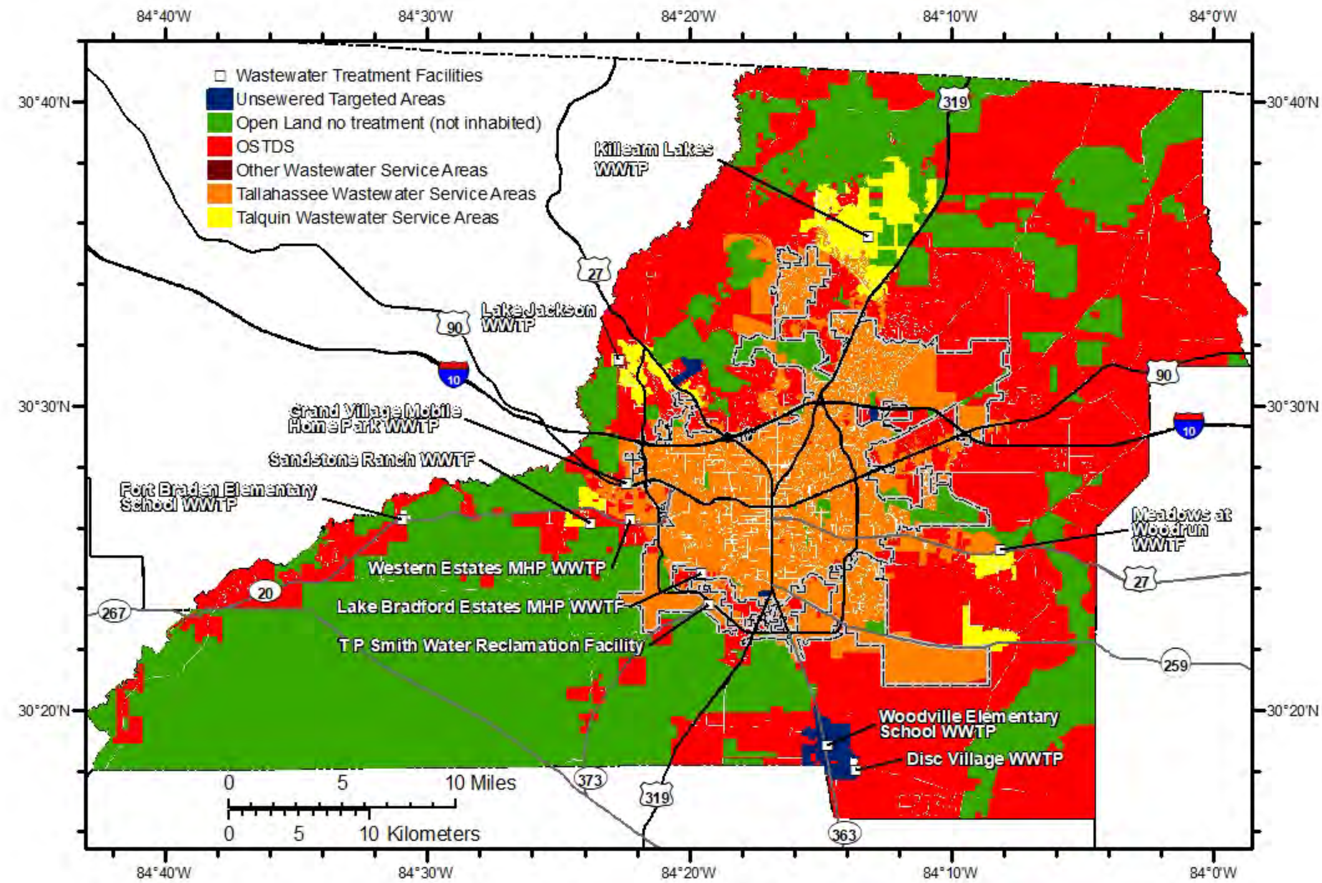

Figure 1. Parcels with an OSTDS, five centralized WWTFs, parcels in the Tallahassee wastewater service area, and parcels in the Talquin service area.

2.0 Public Meetings

Six public meetings were held to discuss the tasks 1 through 3 reports and findings. The first meeting was a virtual meeting held through Zoom on September 10, 2020 with technical stakeholders. This meeting focused on the task 1 report, which was the only completed task at that time. In-person public meetings were held on all three task reports during August 2–5, 2021 in different portions of Leon County to make attending the meeting more accessible. In addition, a follow-up virtual meeting was held on August 17, 2021 through Zoom. The virtual meeting was recorded and posted on the county's website at LeonCountyFL.gov/wastewater.

Table 1 summarizes the public meetings held on tasks 1 through 3.

Table 1. Public Meetings Held on Tasks 1 Through 3

Date	Meeting Location	Number of Participants
September 10, 2020	Zoom webinar (technical public meeting)	4
August 2, 2021	Fort Braden Community Center, 16387 Blountstown Highway	15
August 3, 2021	Woodville Community Center, 8000 Old Woodville Road	7
August 4, 2021	Red Cross, 1115 Easterwood Drive	1
August 5, 2021	Celebration Baptist Church, 3300 Shamrock Street East	1
August 17, 2021	Zoom webinar	6

2.1 Meeting Noticing

The Leon County Office of Community & Media Relations advertised the August 2–5, 2021 in-person public meetings through the following methods:

1. Issued a public notice
2. Advertised on Twitter, Facebook, and Nextdoor
3. Placed flyers at the Woodville and Fort Braden community centers and libraries where those meetings were held
4. Included information in the County Link in the Tallahassee Democrat
5. Placed variable message boards at Woodville, Fort Braden, Capital Circle/Easterwood Drive, and Centerville Road/Shamrock Street
6. Advertised on the Leon County website

The feedback received at the in-person meetings was that most of the participants heard about the meetings from the variable message boards placed near the meeting locations.

For the Zoom webinar held on August 17, 2021, the meeting was noticed through social media on Facebook, Twitter, and Nextdoor; direct email to key stakeholders; and other regular Leon County public notice channels.

3.0 Feedback Received

The first public meeting was held with technical stakeholders about the task 1 report. The feedback from the technical stakeholders was used to refine the task 1 report and was factored into the drafting of the tasks 2 and 3 reports. Therefore, the input received during that meeting is not summarized here.

During the in-person public meetings, feedback was obtained through a comment/question period following the project presentation, discussions between the participants and JSA team members during the open house portion of the meetings, and from comment forms that were distributed to the participants. The comments and questions that were raised during the meetings are discussed here, and the formal comments provided through the comment forms are included in Appendix A.

For the first meeting on August 2, 2021, many of the questions were related to the in-ground nitrogen reducing biofilter (INRB) option. There were also questions about the costs of implementation and other nutrient sources. The following questions and answers were discussed:

Q: What is the estimated cost to install a INRB system?
A: The costs for the INRB system are included in the Task 2 report. The estimated cost for construction used in the report was $6,800.

Q: For the INRB, how deep is it installed, what is it composed of, and how long does it last?
A: The INRB is installed at a similar depth as a standard drainfield; however, the media underlying the drainfield extends deeper. The system involves modifying the drainfield with media to promote bacterial growth that further promotes nitrogen breakdown. Testing is underway to determine how long the media will last before needing replacement.

Q: Am I going to have to replace my 3 year old drainfield with one of these new systems in the next few years?

A: Septic systems within the primary focus area delineated in the BMAP are being required to either upgrade to a nitrogen removing system or connect to central sewer. Other portions of the county will have more flexible requirements.

Q: For the INRB, how long has it been used, who invented it, and what studies say that it works?
A: The INRB is a relatively new technology in Florida, which has been studied by the Florida Department of Health (FDOH). It is currently being tested by counties throughout the state, including Leon County, in partnership with FDOH and DEP.

Q: Who mandated the improvement of the impaired waters and why is it required?
A: The Upper Wakulla River and Wakulla Spring were determined to be impaired by DEP as part of their Clean Water Act requirements. The TMDL was established to reduce nitrogen, and reducing nitrogen is required to help the river and spring meet water quality standards.

Q: If the planned nitrogen levels are not met, what will happen?
A: DEP will continue to require nitrogen load reductions from all sources until the nitrogen concentration target is met at the spring.

Q: What about nitrogen from all the rivers flowing from other counties and Georgia, including the Little River that flows into Lake Talquin?
A: The BMAP included nitrogen loading from all sources within the Upper Wakulla River and Wakulla Spring basin. The basin encompasses other counties but does not extend into Georgia.

Q: I am concerned about local residents on fixed incomes. Are they going to have to come up with $10,000 for a new drainfield?
A: The CWTFP will identify potential options to update or connect existing septic systems to the central sewer system to reduce nitrogen in different areas of the county. Leon County will then determine what options to implement in each area. There may be an opportunity to obtain a grant to help fund some or all the costs of the upgrade or connection to central sewer.

Q: Are we going to have a WWTF constructed and sewer lines installed? If a WWTF is constructed is it going to smell?
A: Depending on the area of the county, homes may be connected to central sewer. The local utilities (City of Tallahassee and Talquin) will determine if they will need to construct a new WWTF. WWTFs include components to minimize odors.

During the second in-person meeting on August 3, 2021, many of the questions were related to the central sewer plan for the county and cluster systems. The following questions and answers were discussed:

Q: Is the central sewer expansion plan presented several years ago still a working, viable plan? Where I can find the status of the sewer expansion projects?
A: Yes. The plan is detailed on the county's website. The county emailed the project website link to participants in this meeting.

Q: Does central sewer have a monthly charge?
A: Yes. Long-term and short-term costs are detailed in the Task 2 report. For example, the cost of a new sewer collection lateral from a house to the municipal collection system is included in the economic projection.

Q: Does the plan differentiate between 1 and 12 people households?

A: The Task 2 report focuses on an average, single family home size. As specific areas of the county are evaluated, these estimates can be refined to match the land use densities in the area.

Q: Will there be one CWTFP for the entire county, or one plan for each part of the county?
A: There is one plan for the entire county, and specific areas will be investigated.

Q: Are grant funds available for individual homeowners to transition from OSTDS to AWTS?
A: DEP and FDOH have some funds available, and Leon County will look for opportunities to obtain funding. State funds range from subsidy to full grants but there are no guaranteed monies. Leon County currently has a funded INRB pilot project with no cost to the property owner; however, all those funds have been allocated.

Q: Can a cluster system be used for an entire region? How many residences can be served by a cluster system?
A: Cluster systems cannot be used for an entire region. Cluster systems typically serve 2 to 16 residences.

Q: Could my house be placed on a cluster system and my neighbor be on their own OSTDS?
A: It is unlikely this situation would occur.

Q: What happens to cluster effluent?
A: The effluent discharges to the environment in the same manner as an OSTDS but the cluster system provides economies of scale and technology efficiencies that improve treatment.

Q: What does a cluster system involve?
A: A cluster system is similar to a traditional OSTDS with a septic tank and drainfield. However, the system will be larger to serve multiple homes and will be located on a separate parcel.

Q: Would using a cluster system allow for a smaller lot size?
A: The lot size is determined by zoning. By moving the OSTDS from a parcel to a separate location, this would allow use of more of the parcel.

Q: What is the size of a cluster system relative to the house size?
A: There is a table in the Task 2 report that provides this information. There is also a required buffer for the drainfield.

Q: Is a homeowner’s association necessary for a cluster system?
A: A homeowner's association, or some other joint authority, will likely be necessary to operate and maintain a cluster system.

Q: Are homeowners responsible to fund the sewer system lateral?
A: Homeowners may be responsible for funding the sewer system lateral. Depending on the funding mechanism, there may be funds to run the laterals.

The third in-person meeting on August 4, 2021 was attended by one person. The participant discussed the need for additional WWTFs, which would be a decision made by one of the utilities (City of Tallahassee or Talquin); use of sprayfields for effluent disposal; and stormwater treatment and flooding areas. The fourth in-person meeting on August 5, 2021 was also attended by one person who did not make any comments or ask questions.

For the Zoom meeting on August 17, 2021, the following questions and answers were discussed:

Q: Were you able to analyze information to the lot level? The people along Centerville on septic systems are interested in what will be required.
A: The initial approach was to review the data generally across the entire county. In Task 5, the data will be evaluated by individual areas and by parcels.

Q: I am concerned with the 65% nitrogen removal assumption for INRBs. The 65% reduction from the Hazen and Sawyer report is only for INRBs with pressure dosing and liners and, without these additions, INRBs may not achieve more reductions than a traditional OSTDS. FDOH was working to revise their rule to include INRBs with pressure dosing and liners but I have not seen the status of the revision. Given this history, why are you using a 65% reduction for INRBs in the study?
A: The 65% nitrogen reduction was provided by DEP and the FDOH rule is still in process. If data are provided that show that the percent reduction should be different, the report can be revised. Leon County is currently finalizing a memorandum of understanding with DEP to install two lined and dosed INRB systems, which will be monitored. The county is also monitoring several non-lined INRB systems. If the data show that the reduction should be something other than 65%, the geographic information system database created in this project will be revised.

Q: Does it make sense to proceed with a number that is not substantiated since DEP said not to apply a 65% nitrogen reduction to INRBs?
A: In our meetings DEP and FDOH, they indicated that 65% is an acceptable estimate at this time, until sampling indicates otherwise. The county has initiated sampling on several systems.

Q: I live in Centerville Trace and the county contacted me a few months ago to see if our neighborhood would be interested in central sewer. What is the status of the grant the county submitted for this project?
A: The county has not heard back from the state about the watershed protection grants. As soon as the county has an update, they will reach out to the residents in that area.

Q: In the Task 2 report, there is a discussion about the non-market costs and benefits approach, which includes a reduction in glass bottom boat usage at the spring due to nitrogen. There are no empirical data that show a connection between nitrogen pollution and decreased water clarity at the spring. Why was this used as an assumed relationship and where can I find the details on the calculation?
A: The calculation is partially included in Appendix H of the Task 2 report and additional details can be provided. The assumption is that the spring and water quality are affected by nitrogen per the BMAP. Nitrogen does have an impact on submerged aquatic vegetation, which ties into attractiveness of the spring for glass bottom boat tours. The impact on the cost from this item is not very big.

4.0 Appendix A. Public Comments Received and Responses

The following table includes the formal comments received during the public review period on tasks 1 through 3, as well as the response to either provide clarification or explain how the comment will be addressed in future project tasks.

Task 4: Formal Public Comments Received on Tasks 1 Through 3

Commenter	Task	Location	Comment	Response
FDOH/FDEP	1	Page 8, Section 1.2	A suggested addition to the literature is the Wakulla County Septic Tanks Study by Harden et al (2010) (https://floridadep.gov/dear/water-quality-evaluation-tmdl/documents/wakulla-county-septic-tank-study)	This report will be reviewed for potential inclusion in the literature for the final project report.
FDOH/FDEP	1	Page 9	Please clarify the concept of multiple OSTDS on a parcel. Usually, one OSTDS serves one built parcel. Figure 3 on Page 10 shows the Potential OSTDS density, in development units per acre, at build-out, in unincorporated Leon County. The concept of OSTDS density as the number of OSTDS per acre would make more sense than the number of OSTDS per parcel. To confirm, does the OSTDS density mean the number of parcels served with OSTDS per acre?	The evaluation focused on the potential OSTDS per acre of future allowable development density based on parcel zoning. This will be clarified in the final project report.
FDOH/FDEP	1	Page 9	Please clarify how higher density is expected to load more nitrogen to groundwater and surface water and make upgrades to AWTS more effective for smaller parcels (higher densities). Does this statement assume that there is a density-dependent attenuation factor that is not included in NSILT? The NSILT-approach does not include density in load assessments.	This statement does not assume another attenuation factor. This statement is noting that where there are a higher concentration of septic systems, there will be more nitrogen loading (per unit of area) since there are more systems contributing to the load.
FDOH/FDEP	1	Page 13	The NRCS limitation rating for sanitary facilities is based on the soil permeability or percolation rate, but also depth to water table and ponding. Severely limited soil map units are classified as such based on assessed limited treatment in the soil (too sandy) or limited permeability of the soil (percs slowly) or high water table conditions (wetness). Some of these factors relate to treatment, some to hydraulic functioning. The classification is not related to the nitrogen treatment capability of the soil. For an assessment of nitrogen treatment of soil map units, see Otis' 2007 Task 2 report on the Wekiva Onsite Nitrogen Contribution Study (http://www.floridahealth.gov/environmental-health/onsite-sewage/research/_documents/wekiva-task2-final-report.pdf). This scoring component has little overall impact for the present study because Table 3 indicates that it was not used in the nitrogen reduction score and most of Leon County is rated as severely limited.	We will review the provided reference. The scoring in Table 3 uses the soil hydraulic conductivity.
FDOH/FDEP	1	Table 3, Page 22	Shouldn't the scale for the "Distance to surface waters or wetlands" and the "Distance to Karst" be negative? The Scale is calculated as the reciprocal of the upper boundary of the Range. For other input parameters, the upper boundary of the Range represents the condition of more nitrogen contribution. However, for the "Distance to Surface waters or wetlands" and the "Distance to Karst" input parameters, the upper boundary represents the condition of less nitrogen contribution. When adding the contribution from all input parameters, it appears that the contribution from land parcels located in larger distance to surface waters or wetlands and larger distance to Karst should be subtracted (effect of a negative sign) instead of being added to reflect that the parcels located in larger distance to surface water contribute less amount of nitrogen.	Some inputs influence the nitrogen reduction score more at a maximum value, and some influence the nitrogen reduction score more at a minimum value. For example, greater distance to karst will load less nitrogen to groundwater than lesser distance to karst. All inputs were then scaled.
FDOH/FDEP	1	Page 26	Comment throughout: we are unclear about where 90% reduction comes from with regard to NSF 245 testing, as the NSF 245 Standard does not reference this to our knowledge. Also throughout: PBTS are not required to be NSF certified (their performance level is generally based on innovative testing) and would need to be designed to meet 50% nitrogen reduction. See comments and suggested language below.	This language came from the FDOH handout "Nitrogen Reducing Systems for Areas Affected by the Florida Springs and Aquifer Protection Act" updated April 2020.
FDOH/FDEP	1	Page 26	ATU: There are at least two standards and there are several entities in addition to NSF that certify to the NSF standard. We believe what is intended here is : "….These systems must be certified to meet the National Sanitation Foundation (NSF) International/American National Standards Institute (ANSI) standard 245, which requires testing showing that on average at least 50% nitrogen reduction is achieved before (partially) treated wastewater is discharged to the drainfield…."	The definition will be updated for the final project report.
FDOH/FDEP	1	Page 26	PBTS: Comment: This seems closer to what is meant to replace the yellow-highlighted text: "….PBTSs designed to provide nitrogen reduction to meet springs BMAP requirements must be approved by the Department of Health and certified by the design engineer to be capable of providing, on average, at least 50% nitrogen reduction before partially treated wastewater is discharged to the drainfield…"	The definition will be updated for the final project report.
FDOH/FDEP	1	Page 26	INRB: Comment: Just for clarification, the 65% is the reduction from input through the drainfield and includes the biochemical attenuation factor.	The definition will be updated for the final project report.
FDOH/FDEP	1	Table 8	Table 8 includes a couple of what appear to be assumption errors: (1) The nitrogen reduction is calculated as "2020 nitrogen load from wastewater" - "updated nitrogen load". The 2020 nitrogen load from wastewater includes WWTF loads, while the updated nitrogen load only includes the successor load to OSTDS after upgrades and septic to sewer conversions. The updated nitrogen load is missing the original WWTF load. Therefore, the numbers are wrong and overestimate the nitrogen reduction.	The 2020 nitrogen load from wastewater is only from OSTDS, and does not include WWTFs.
FDOH/FDEP	1	Table 8	(2) The treatment effectiveness of upgraded OSTDS appears to be estimated as 65% before applying the biochemical attenuation factor. For ATUs and PBTS, this is slightly optimistic given the design value of 50% reduction. For the INRB the assumption of a treatment effectiveness including the biochemical attenuation factor of 82.5% is also more than the 65% usually estimated for this approach.	The calculations for nitrogen reduction were applied in a manner consistent with the FDEP approach in the BMAP, as confirmed with FDEP staff as part of preparing this report.
FDOH/FDEP	1	Table 8	(3) The "percent of total reduction per nitrogen reduction land area" appears to be calculated as "nitrogen reduction" divided by the "total nitrogen load" of Table 4. Given that the nitrogen reduction estimates are wrong and too high, the results are too high, as well.	Please see response to the comment above about the nitrogen reduction estimates.

Commenter	Task	Location	Comment	Response
FDOH/FDEP	1	Page 26	Please see earlier comment about ATUs and PBTSs. Proposed revision: Aerobic treatment units (ATUs) are a type of onsite sewage treatment and disposal system (OSTDS) that introduces air into the treatment of wastewater to help reduce organic pollutants and suspended particles. These systems must be certified to meet the National Sanitation Foundation (NSF) International/American National Standards Institute (ANSI) standard 245, which requires testing showing that on average at least 50% nitrogen reduction is achieved before (partially) treated wastewater is discharged to the drainfield.	The definition will be updated for the final project report.
FDOH/FDEP	1	Page 26	Proposed revision: PBTSs designed for springs protection must be approved by the Department of Health and certified by the design engineer to be capable of providing, on average, at least 50% nitrogen reduction before partially treated wastewater is discharged to the drainfield.	The definition will be updated for the final project report.
FDOH/FDEP	1	Page 30	Xueqing and Roeder listed as reference but not referred to	Noted.
FDOH/FDEP	2	v	Finding 4: Comment: in most cases a PBTS is not a cluster system but installed to serve a single establishment	Noted.
FDOH/FDEP	2	Page 2	Comment in general: the definitions here are different from the Task 1 report	The definitions will be updated for the final project report.
FDOH/FDEP	2	Page 2	INRB: Proposed revision: add something about expected performance as in task 1. Such as, The currently codified configuration for this type of system is estimated to reduce nitrogen in sewage by about 65%.	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 2	Proposed revision: Aerobic treatment units (ATUs) is a type of onsite sewage treatment and disposal system (OSTDS) that introduces air into the wastewater facilitate treatment. ATUs frequently but not always include a blower or a pump to facilitate this. The aeration also converts ammonia in the wastewater into nitrate. A nitrogen-reducing ATU frequently includes some form of recirculation of aerated wastewater to remove nitrate from wastewater through denitrification.	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 2	Proposed revision: Performance-based treatment systems (PBTS) is a type of advanced OSTDS that are designed to treat specific pollutants to a specific level. Structures and functions of PBTS can vary widely depending on the design goals. A nitrogen-reducing PBTS can sometimes include a nitrogen-reducing ATU and/or other components to remove nitrogen from the wastewater water.	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 2	Cluster systems: Proposed revision: ....They may include traditional septic systems, INRBs, ATUs or PBTSs. Depending on the circumstances they could be permitted as either an OSTDS or WWTF	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 3	Title for Section 1.2.1: Given that just about all of the analyzed options are categorized as OSTDS, use a more definitive term for this, such as Conventional Septic System. This also applies to 2.1.1, 2.2.1, 2.3.1, 2.4.1	The final report will clarify that these are traditional OSTDS.
FDOH/FDEP	2	Page 4	An INRB (Figure 3) is a passive upgrade to a conventional OSTDS. INRBs do not require electrical components for nitrogen treatment. Like a conventional system, however, a pump may still be needed if the drainfield is located higher than the septic tank. An INRB drainfield is a two-stage, passive biofilter based on nitrification in the first stage and denitrification in the second stage. OSTDS that employ a passive INRB drainfield can reduce the total nitrogen load by about 65%, which is higher than the nitrogen reduction of the drainfield in a conventional OSTDS which is estimated to remove 10-50% (50% per NSILT) of the wastewater nitrogen.	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 5	Proposed revision: Per the Florida Department of Health, for an ATU product to be approved as a nitrogen-reducing ATU, it must meet and be certified to the NSF Standard 245, which requires testing showing that on average at least 50% nitrogen reduction is achieved before (partially) treated wastewater is discharged to the drainfield. All new construction of OSTDS with ATU need to have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. To meet springs protection BMAP requirements, for OSTDS repairs, if the required separation between the bottom of the drainfield and the seasonal high water table is less than 24 inches, the nitrogen-reducing ATU must be capable of reducing nitrogen by at least 65% before discharge to the drainfield. In contrast to performance based treatment system (PBTS), ATU systems with treatment capacity less than 1,500 gallons per day do not need to be designed by an engineer. But they need an operating permit from the DOH County Health Department and at least semi-annual inspections from a maintenance entity certified by the product manufacturer.	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 6	Proposed revision: PBTS are less commonly used than ATUs. While typically active, involving aerators or multiple pumps, they could also be passive systems..........PBTSs must be designed by a professional engineer licensed in Florida and require a maintenance contract and operating permit from the county health department. The nitrogen-reducing PBTSs for springs protection must be approved by the Department of Health and certified by the design engineer to be capable of providing, on average, at least 50% nitrogen reduction before partially treated wastewater is discharged to the drainfield. All new construction of OSTDS with PBTS needs to have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. To meet springs protection BMAP requirements, for OSTDS repairs, if the required separation between the bottom of the drainfield and the seasonal high water table is less than 24 inches, the nitrogen-reducing PBTS must be capable of reducing nitrogen by at least 65% before discharge to the drainfield.	The definition will be updated for the final project report.
FDOH/FDEP	2	Page 10, Section 2.1.4	Of the described options, only PBTS require engineering, so it is unclear why there is no cost differential to a conventional septic system or INRB. ATUs can include drip irrigation, which also requires engineering.	The costs in this section focus on the permitting costs, which would be the same for each system that serves one home.
FDOH/FDEP	2	Page 11, Section 2.2.1	The code sizes are 900 gallon for a 300 gpd (3BR) house and 1050 gallons for a house with an estimated sewage flow exceeding 300 up to 400 gpd. Suggest to rephrase as: The typical cost of a conventional septic system for a 3 BR house	Noted. The cost presented is the average for a 1,000-gallon tank.

Commenter	Task	Location	Comment	Response
FDOH/FDEP	2	Page 12, Footnote 15	The Fuji Clean CEN is currently approved as an NSF 245 certified nitrogen reducing ATU. The Fuji Clean CE is currently approved as a PBTS based on performance data obtained in Florida. While both may provide greater reductions than the required minimum of 50% the reductions are not greater than approved by DOH. If the authors consider it necessary to emphasize the variation of performance between different treatment systems, we would suggest to rephrase as: 15 Fuji Clean CEN systems (as nitrogen reducing ATUs) and CE systems (as nitrogen reducing PBTS) provide greater rates of nitrogen reduction than the minimum required by the springs protection BMAPs and are more expensive for equivalent capacities"	The footnote was modified as suggested.
FDOH/FDEP	2	Page 19/20, Section 2.6.1	Please clarify the methodology for lifecycle vs O&M costs and how the assessment was consistent between the different technological solutions. Section 2.6.3 and 2.6.4 both give two different "total unit O&M costs" and "total system O&M costs" This discussion points to (1) the large uncertainty of the lifespan of a septic system (given current repair permitting rates of less than two percent, the life expectancy could be on the order of 50 years) and (2) that these costs include not just ongoing O&M but also replacement. It is unclear why a repair of a drainfield is going to be more expensive than the installation of a complete system discussed in 2.2.1	Noted. The sum of separable system components (tank, tank installation, pipes, pump if required, drainfield) is higher than that for an initial complete installation. Separable costs are relevant for O&M and lifecycle estimates. The lifecycle costs for tank replacement and drainfield replacement will be included in the revised estimates for OSTDS, ATU, PTBS, and INRB systems as part of the final report.
FDOH/FDEP	2	Page 20	The reading of the FOSNRS-report in Section 2.6.2 by the authors appears to include several misunderstandings. Table 6 reflects the operating, maintenance, repair and replacement expenses for INRB using the average costs estimated based on seven passive nitrogen-reducing systems constructed by DOH during the Florida Onsite Sewage Nitrogen Reduction Strategy (FOSNRS) study. Please note that, among these seven systems, system BHS-7 is the only inground nitrogen-reducing system. Other FOSNRS systems are either in-tank systems or hybrid systems that are permitted differently than the INRB system. The annual O& M (does not include the media replacement) for INRB should be similar to the conventional OSTDS. The long-term mean compliance cost for INRB are currently similar to that of a conventional OSTDS, i.e. no water quality sampling and operating permit are required. The annual O&M costs in Table 6 include annual inspection and maintenance as if these INRB were aerobic treatment units or PBTS, which they are currently not. Please note that in the FOSNRS report, a life-cycle period of 30 years is assumed, and that replacement of media for in-ground INRB is assumed to be needed every 30 years, so media replacement does not show up in replacement costs. By using completely separate estimating methods for a conventional septic system and an INRB, it is unlikely that the incremental additional costs of an INRB are accurately reflected. For example the conventional septic system cost estimate includes costs for a drainfield replacement, the INRB does not.	Noted. Disparities between the FOSNRS report and this analysis will be clarified in the final report to the extent the former document does not include elements of annuitized O&M, such as drainfield replacement.
FDOH/FDEP	2	Section 2.6.3 (and similar Section 2.6.4)	Please clarify, what are lifecycle costs in this context? Apparently not annualized installation , engineering design and permitting or compliance costs. Is it an average replacement cost for parts?	Installation, engineering, and permitting are addressed in prior portions of Section 2.6. Lifecycle costs will be amended, as appropriate, for any system elements not specifically addressed, and where different from those for conventional OSTDS.
FDOH/FDEP	2	Page 22, Section 3.2	Please clarify how the costs in Appendix H relate to the estimates derived in section 2	Appendix H uses in the information presented in Section 2 to determine a benefit-cost analysis for each option.
FDOH/FDEP	2	Page 23	Appendix H includes as direct benefit apparently the avoided treatment costs to achieve the same nitrogen removal with stormwater treatment. It seems this comparison would be clearer if the costs per nitrogen removed would be compared between wastewater treatment and stormwater treatment ($541/kg). Given the quantity of nitrogen that is supposed to be removed, it seems unlikely that this could be achieved with stormwater treatment at all, and not at a constant price.	Agree. The focus is OSTDS to meet the required nitrogen reductions.
FDOH/FDEP	2	Table 8, Section 3.3	We believe there are several issues with this table: 1. The nitrogen-reducing efficiency numbers listed in the "Additional Treatment Relative to Base" column are much higher than what are shown on the lists of approved nitrogen-reducing ATU and PBTS. The list of nitrogen-reducing ATUs approved in Florida and their nitrogen-reducing efficiencies can be found at http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/245cert-atu-18.pdf. The list of nitrogen-reducing PBTSs approved in Florida and their nitrogen-reducing efficiencies can be found at http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/npbts-components.pdf. Using the nitrogen-reducing efficiency numbers included in these documents, the mean nitrogen-reducing efficiencies for ATU and PBTS are about 63% and 67%, respectively, before discharge to the drainfield. Assuming 50% of the remaining portion of the nitrogen will be removed by the drainfield, the mean total nitrogen-reducing efficiencies for ATU-drainfield and PBTS-drainfield will be 74% and 77%, respectively. Please note that the 74% and 77% are the TOTAL treatment efficiencies from ATU-drainfield and PBTS-drainfield. They provide 24% (ATU-drainfield) and 27% (PBTS-drainfield) more nitrogen-removal than the conventional OSTDSs if we assume the OSTDS base is 50%.	The efficiencies were applied in the same manner as FDEP used for the BMAP, as confirmed with FDEP staff during report development.
FDOH/FDEP	2	Table 8, Section 3.3	2. The same issue applies to the INRB too. The 65% nitrogen-reducing efficiency is the TOTAL nitrogen treatment. The INRB provides about 15% more nitrogen-removal than the conventional OSTDS if we assume the OSTDS base is 50%.	The efficiencies were applied in the same manner as FDEP used for the BMAP, as confirmed with FDEP staff during report development.
FDOH/FDEP	2	Table 8, Section 3.3	3. Once the numbers in this table are corrected, Tables 9, 10, and 11 need to be updated.	The efficiencies were applied in the same manner as FDEP used for the BMAP, as confirmed with FDEP staff during report development.

Commenter	Task	Location	Comment	Response
FDOH/FDEP	2	Table 8, Section 3.3	4. Central sewer treatment effectiveness only applies to the City of Tallahassee not to Talquin.	Correct.
FDOH/FDEP	2	Table 8, Section 3.3	Comment on the base case: The analysis is based on total treatment rather than additional treatment relative to base. In this way it appears to assume that installing conventional OSTDS is already more than a baseline option. Rather than comparing incremental costs to incremental benefits relative to conventional OSTDS, the analysis compares cost effectiveness of conventional OSTDS to that of higher treatment option as if there was a no-treatment or direct injection option. Is that the same approach used for other treatment approaches?	A traditional OSTDS does have some nutrient removal benefits and the total benefits of the other options are compared to the total benefits of a traditional OSTDS.
FDOH/FDEP	2	Page 25	Table 11 contrasts "Cluster (Passive)" and "Cluster (Active)" while Table 10 lists Cluster systems in terms of previously discussed categories (INRB, ATU, PBTS). Please make consistent.	Noted.
FDOH/FDEP	2	Page 29	Comment on Appendix A NSF standard 245 (nitrogen-reducing) certified aerobic treatment units in Florida (Rule 64E-6.012, F.A.C.). This table is not the most up to date nitrogen-reducing ATU list. The most update list can be found from http://www.floridahealth.gov/environmental-health/onsite-sewage/products/_documents/245cert-atu-18.pdf.	The appendix reflects the latest available table at the time of report drafting.
FDOH/FDEP	3	Page 2	See comments in previous task reports on clarifications for the definitions.	The definitions will be updated for the final project report.
FDOH/FDEP	3	Page 11, Section 2.2.1	INRB cons for depth: Generally agreed, somewhat unclear why typical installations are so deep, but that may be due to local construction practices. For new systems, maximum drainfield surface depth is 30 inches, the two layers together are another 30 inches, and then another six inches to the water table are required, for a total of 5.5 feet to the water table. Minimum requirement on the seasonal high water table is 36 inches below the existing grade, not 7 feet. The system does also need at least 36 inches of slightly limited soil below the existing grade. In new systems and some repairs at least another 6 inches of slightly or moderately limited soil below the 36 inches slightly limited soil are required to meet effective soil depth requirements. The system footprint area cannot be excavated to overcome soil conditions. Mounds with the bottom of the drainfield at grade are acceptable, but drainfield cannot be lifted further to overcome unacceptable soil conditions or a water table that is too shallow.	Noted. This information will be considered as specific areas of the county are evaluated for applicability of different technologies.
FDOH/FDEP	3	Page 11, Section 2.2.1	INRB cons for reductions: This aligns with the previous comments on task 2 table 8 effectiveness estimates. The INRB effectiveness includes the drainfield effectiveness (or biochemical attenuation factor in NSILT).	Noted. The efficiencies were applied in the same manner as FDEP used for the BMAP, as confirmed with FDEP staff during report development.
FDOH/FDEP	3	Page 17	Proposed revision to emphasize the nitrogen reduction aspect: Nitrogen-reducing ATUs must be certified to meet the National Sanitation Foundation (NSF) International/American National Standards Institute (ANSI) standard 245, which requires testing showing that on average at least 50% nitrogen reduction is achieved before (partially) treated wastewater is discharged to the drainfield. Same nitrogen treatment level also applies to the nitrogen-reducing PBTS except that the PBTS must be approved by Florida Department of Health and certified by a professional engineer licensed in Florida. Construction for all new OSTDS with either ATU or PBTS must have at least 24 inches separation between the bottom of the drainfield and the seasonal high water table. To meet springs protection BMAP requirements, for repaired OSTDS, if the required water table separation is less than 24 inches, the nitrogen-reducing ATU or PBTS must be capable of reducing nitrogen by at least 65% before discharge to the drainfield.	The definitions will be updated for the final project report.
Dorothy McPherson	Tasks 1-3	N/A	Microphones would be nice.	Microphones were used in subsequent meetings, and will be used during the next round of public meetings.
Dorothy McPherson	Tasks 1-3	N/A	Are, or why aren't, studies being included that tell how much farming and other industries in other Florida counties (Liberty, Gadsden, Gulf, Franklin) and in Georgia affect the nitrogen content in the Ochlocknee Basin as well as Wakulla Basin, and any other basins that are relevant to the study.	The Comprehensive Wastewater Treatment Facilities Plan is being developed to address a FDEP requirement. FDEP evaluated nitrogen loading from a variety of sources within the Upper Wakulla River and Wakulla Spring basin, and determined that septic systems are the largest source. FDEP required that each local government prepare a remediation plan for septic systems, and this will be Leon County's plan.
Dorothy McPherson	Tasks 1-3	N/A	Our folks out Highway 20 need to know when they can expect any actions that will affect them financially and how as this is and shall affect the Wakulla Basin and its residents.	Agree. Another round of public meetings will be held before the plan is finalized and the county will coordinate with residents as plan components move forward.
Deborah McKee	Tasks 1-3	N/A	I would like to know if the County is monitoring and enforcing nitrogen released when people disconnect washers from septic systems, which is common in rural areas, as well as people who do not properly dispose of trash and hazardous waste. I think there should be a large effort in rural areas to inform people of the dangers to the water system as well as environment, with fines imposed for disregard.	Leon County works with the Florida Department of Health Environmental Health Unit to investigate and enforce ordinances prohibiting discharges from septic tanks.
Robert Deyle	Task 2	Page 23	The Task 2 report states (p. 23) that "Non-market costs include the costs of disease from well contamination41 and diminished tourism, as measured by changes in water clarity at Wakulla Spring (measured here by the use of glass-bottom boats)." As I said at the public meeting on 8/17/21, so far as I know, no one has proffered a scientifically-based hypothesis for a link between nitrate levels at Wakulla Spring and dark water conditions. The research that Sean McGlynn conducted for WSA demonstrated that dark water conditions are caused by various combinations of tannins and chlorophyll discharged through the vent into the spring. There is no evidence of any significant contribution from algae growing in the spring bowl since turbidity is not a statistically significant independent variable when tested against visibility depth. See http://wakullaspringsalliance.org/wp-content/uploads/2021/01/Why-is-the-Water-Dark.Part-I.WSA_.11-20-20.pdf and http://wakullaspringsalliance.org/wp-content/uploads/2021/01/Why-is-the-Water-Dark.Part-II.WSA_.12-18-20.pdf on the WSA website.	The assumption is that the spring and water quality are affected by nitrogen per the BMAP. Nitrogen does have an impact on submerged aquatic vegetation, which ties into attractiveness of the spring for glass bottom boat tours. The impact on the cost from this item is not very big.

Commenter	Task	Location	Comment	Response
Robert Deyle	Task 2	Page 23	I've identified four forcing functions that may be contributing to increasing frequency and duration of tannic inflows some of which also may be bringing additional chlorophyll into the spring as well: (1) More Frequent Lost Creek Flows to Wakulla Spring, (2) Accelerating sea level rise and head gradients, (3) Changes in rainfall patterns, and (4) Declining spring pool stage (head). See http://wakullaspringsalliance.org/wp-content/uploads/2016/11/Why-is-the-Water-Dark.Part-III.WSA_.Feb-2021.Deyle_.pdf and http://wakullaspringsalliance.org/wp-content/uploads/2016/11/Declining-Stage-Implications-for-Dark-Water-and-MFL.WSA_.Mar-2021.Deyle_.pdf on the WSA website.	Noted. The focus of this study is on reducing nitrogen to meet the BMAP requirements.
Robert Deyle	Task 2	Page 23	The principal impacts of excessive nitrogen are to the ecosystem, but it's hard to unravel the direct effects from other perturbations. Excess nitrogen promoted the proliferation of the hydrilla after its arrival in 1997 and contributed to the subsequent proliferation of algal mats following the herbicide treatments that facilitated algal colonization of habitat freed by loss of both hydrilla and native SAV. But the herbicide treatments had direct effects as well as did the arrival of the manatee. On top of that we now have declining river stage associated with ongoing stream channel erosion as well as increasingly larger and more frequent salinity spikes. Excess nitrogen also has resulted in heavy periphyton colonization of SAV leaves possibly resulting in lower productivity. The most readily observed proxy that I can think of is the decline in total animal abundance documented with data from the park's wildlife monitoring program started in 1992 and continuing today. It may be possible to construct a statistical causal model of nitrate levels and animal abundance. I haven't tried. There might then be a way to attach a value to the wildlife and/or the hedonic value of observing the wildlife.	Noted. The focus of this study is on reducing nitrogen to meet the BMAP requirements.
Jim Cheng	All	N/A	This is Jim from JDL Global Environmental Protection, which is specializing in municipal wastewater treatment based on FMBR (Facultative Membrane Bio-reactor) technology. I am looking for cooperation with Leon County for this potential wastewater treatment project. FMBR technology is a novel biological wastewater treatment process that removes carbon, nitrogen, and phosphorus simultaneously in a single reactor. It has a low capital cost, saves energy, and meets stringent nutrient discharge requirements with simple controls. We have a pilot project at the Plymouth Municipal Airport in Massachusetts that started in October 2019 and the MassCEC has posted the Plymouth FMBR study report on their website under Success Stories and Final Reports: https://www.masscec.com/water-innovation. It saves more than 70% energy cost compared with the original SBR system. I have attached a brochure to highlight what we do and how we can provide wastewater treatment solutions for you. If you would be interested in further information, I would be happy to schedule a Zoom meeting to discuss our technology and solution. We are also available to visit you on-site if you are convenient.	Thank you for sending information on your technology. The CWTFP focuses on technologies approved by FDOH and FDEP for use in Florida.
Robert Deyle	Task 3	N/A	Site-specific factors that should not be used to assess the different technologies independent of site context include the following: (1) site proximity to PFA and PFA2, (2) site proximity to USA, (3) adjacent land availability for cluster systems, (4) density of existing development and future land use, (5) impact to existing and future land use density, (6) existing WWTF capacity, (7) proximity to centralized wastewater collection system, (8) local comprehensive plan direction for wastewater treatment. These should be properly described and weighted in section 2 and should be applied in Task 5. Here I am offering comments on several of these factors for which I believe the characterization and/or scoring are problematic.	This factors in the matrix are being applied to site-specific areas of the county as part of Task 5.
Robert Deyle	Task 3	N/A	Site proximity to PFA and PSPZ: No rationale is offered for determining that site proximity to PFA and PSPZ is not applicable or neutral for cluster systems. This factor will be equally important for ranking sites regardless of the technology used in a cluster system. When site-specific assessments of technologies are conducted in Task 5, this factor should be split into two separate factors based on site location within or without of the area rather than proximity. There is no basis in the methodologies used to define the PFA or the PSPZ to justify rating sites outside one of these zones as being situated on more or less vulnerable substrates based solely on distance from the zone boundary. The BMAP has assigned greater ground water vulnerability to nitrogen pollution to areas within the PFA. Therefore areas outside the PFA but within the county' PSPZ should be scored lower than areas within the PFA.	Noted. The final assessment and report will be broken out to areas within the PFA/PSPZ and areas outside as there are additional requirements for OSTDS within the PFA/PSPZ.
Robert Deyle	Task 3	N/A	Site Proximity to USA: A similar criticism applies to this factor. Given current land use policies and regulations, the criterion is location within or outside the USA. Sites outside the USA are no more appropriate for central sewer if they are closer to the USA boundary. Again the scoring for cluster systems is unclear and not explained. Why is it not scored as "not applicable"?	This factor focused on proximity to the USA for connection to central sewer. The score for cluster systems was changed to Not Applicable.
Robert Deyle	Task 3	N/A	Density of Existing Development and Future Land Use: The treatment of this factor is inside-out. The issue is not the relative merits of higher versus lower density, it is the extent to which existing and planned densities favor central sewer versus cluster systems, versus onsite systems. Unit costs favor higher densities for central sewer. Cluster systems require some minimum localized densities to be cost-effective. Onsite systems will be more cost-effective when densities are too low for either central sewer or cluster.	Correct. This is the logic that was applied to this factor which is why density was rated as a pro for central sewer and cluster systems. This can be clarified in Task 5.
Robert Deyle	Task 3	N/A	Impact to Existing and Future Land Use Density: The treatment of this factor is a muddled morass that misses the point. This was one of the primary issues raised by Pam Hall and others in arguments against extending central sewer to Woodville, i.e. doing so would create pressure to densify land use in areas adjacent to the new trunk sewer. This factor therefore is site-specific. The factor description in section 2.6 does not offer any clear factor description. The term "house density" is a misnomer for household size and has nothing to do with this issue. Housing density is separately accounted for in section 2.5. The other demographic variables described also have nothing to do with this issue.	Noted. The use of this factor will be clarified in Task 5.

Commenter	Task	Location	Comment	Response
Robert Deyle	Task 3	N/A	Existing Wastewater Treatment Facility Available Capacity: The assessment of this factor entirely misses the point of this site-specific criterion. What needs to be assessed is whether there is adequate capacity at a WWTF to which existing onsite systems or future development in any given location can feasibly be connected. This factor must be considered in concert with location inside or outside of the USA and proximity to centralized wastewater collection system. Summing all of the WWTF capacity in the county and comparing that to all of the wastewater that would be produced from existing and future OSTDS provides no useful information.	This site-specific evaluation will be conducted as part of Task 5, when locations are identified for potential connection to central sewer.
Robert Deyle	Task 3	N/A	Local Comprehensive Plan Direction for Wastewater: The pertinent policies described in section 2.14 are those that address when, where, and/or how different technologies are applied. The policies described concerning OSTDS, and by extension, ATU, PBTS, and INRB, are all site-specific having to do with lot size and location within special planning areas, e.g. floodplains, the Lake Jackson Special Development Zone and the PSPZ. Inexplicably Table 8 designates the local comprehensive plan direction for wastewater factor as inapplicable or neutral for these technologies. The comp plan policies described for central sewer are likewise site-specific. Comp plan policy 1.3.1 governing cluster systems is both site-specific and technology-specific. It is site-specific because it essentially limits the use of cluster systems to the BMAP PFA. That policy should be treated as a 0/1 filter criterion in Task 5, i.e. cluster systems are ruled out entirely except within the PFA. It may, however, be desirable to amend that policy to differentiate between traditional OSTDS cluster systems and AWTS cluster systems. The clause that restricts the application of cluster systems to "that necessary to serve development existing on or prior to February 1, 1990" is a technology-specific constraint that also should be remedied with a comp plan amendment that differentiates between traditional OSTDS cluster systems and AWTS cluster systems. Comp plan policy 4.2.5 stands out as one that is technology-specific, requiring that a traditional OSTDS be upgraded to a performance-based OSTDS when the OSTDS fails. If applied to a comparison of technologies, this policy should be scored favorably for PBTS, but probably the policy also ought to be amended to encompass ATUs and INRBs.	The Comprehensive Plan components are being considered site-specifically as part of Task 5. The recommendations for proposed Comprehensive Plan amendments will be considered as part of the Task 6 report.
Robert Deyle	Task 3	N/A	Other factors described in section 2 are technology-specific and may offer a useful comparison independent of site context. However, two of the technology-specific factors are already addressed with specific costs in Task 2 and should not be accounted for again in Task 3: (1) right-of-way/easement and (2) state rules on septic system permit requirements. Right-of-way/easement acquisition costs for cluster systems are explicitly accounted for in Task 2 sec 2.5.5. In the discussion of central sewer in Task 2 section 2.5.6, the text states that "In most situations, additional easement and ROW acquisition is not required for the installation of a central sewer system" so this factor should not be included in Task 3 for the sewer option either. Task 2 sections 2.1 – 2.3 account for the cost implications of applicable state permitting requirements and design standards.	The costs for rights-of-way and easements are included in Task 2 but the location of these must be considered when evaluating locations to place technologies. The same applies for the septic permit requirements, which may limit locations of certain technologies (if there is not enough groundwater separation, for instance).
Robert Deyle	Task 3	N/A	Scalability of Technology: The treatment of this factor is off the mark. "Scalability is the property of a system to handle a growing amount of work by adding resources to the system" (https://en.wikipedia.org/wiki/Scalability). It is a term used most often in IT. As applied in this context it refers to the ability of a wastewater treatment technology to scale-up to meet additional demand. It only applies to cluster systems and centralized sewer and needs to be differentiated from capacity per se.	Noted. This can be clarified in the Task 5 report.
Robert Deyle	Task 3	N/A	Technology Performance History: The characterization of this factor is a clutter of irrelevant factors that goes way beyond the simple issue of performance history. Furthermore, the complete factor description includes the qualifier "in similar site conditions." Thus this factor also should be site-specific. Because it could be assessed independent of site conditions, it also could be treated a strictly technology-specific factor. Doing so leaves the following as appropriate for the sort of analysis presented in section 3: (1) technology performance history, (2) suitability of retrofit, (3) suitability to new development, (4) anticipated property owner participation, and (5) time required for implementation.	This factor is being considered in site-specific locations as part of Task 5.
Robert Deyle	Task 3	N/A	To be useful, the descriptions of these factors should explain the basis for assigning factor scores of 1 or 2. The logic is not evident for many of the scores presented in Table 8. Specific issues regarding the technology-specific factors follow.	Noted. This can be clarified in the Task 5 report.
Robert Deyle	Task 3	N/A	I would argue that the "not applicable/neutral" scoring of INRBs for "technology performance history" should be changed to a 1 since INRBs have no performance history and the absence of such history is a liability. We have no monitoring data for the stripped-down version that lacks pressure dosing and a liner. If changed to 1 the weighted mean score for INRBs would be 1.77.	The score for Technology Performance History for INRBs was changed to 1.
Robert Deyle	Task 3	N/A	It's unclear why Table 8 scores "anticipated property owner participation" as "not applicable/neutral" for cluster systems. Perhaps that is because the consultant has assumed that it might be less than that for onsite systems and better than that for sewer and hence is neutral. However, sources I have read suggest that acceptance may be even lower for cluster systems because of the ongoing maintenance requirements. If that were the case, this factor should be scored as a 1 and the weighted mean for cluster systems would be reduced to 1.20. Regardless, the rationale for this scoring should be explained.	The score for Anticipated Property Owner Participation for cluster systems was changed to 1.
Robert Deyle	Task 3	N/A	It's also unclear why Table 8 scores "time required for implementation" as "not applicable/neutral" for ATUs. The "time in months to design, permit, and construct" for ATUs reported in Table 6 is the same as that for PBTS, so presumably this factor should be scored as a 2. The resulting weighted mean score remains 2.00 with this correction.	The score for Time Required for Implementation for ATUs was changed to 2.

Appendix E. Task 5: Implementation Scenarios for Alternative Wastewater Treatment Systems Report

Comprehensive Wastewater Treatment Facilities Plan

Task 5: Implementation Scenarios for Alternative Wastewater Treatment Systems

LEON
FLORIDA'S CAPITAL COUNTY

Prepared by

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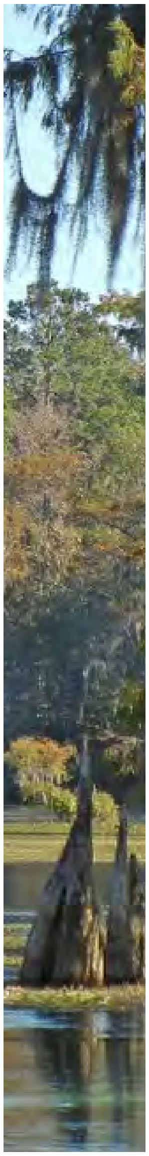
TETRA TECH

June 16, 2022



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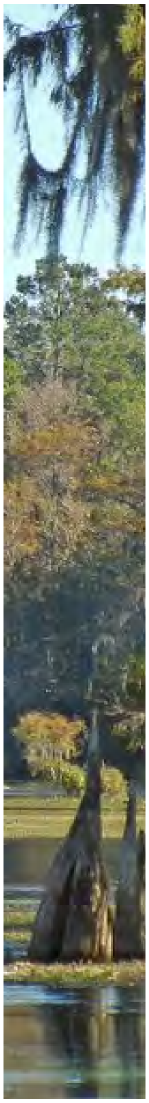

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ACRONYMS AND ABBREVIATIONS

ATU	Aerobic Treatment Unit
AWTS	Alternative Wastewater Treatment Systems
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
GIS	Geographic Information System
INRB	In-Ground Nitrogen-Reducing Biofilter
JSA	Jim Stidham & Associates
OSTDS	Onsite Sewage Treatment and Disposal System
PBTS	Performance Based Treatment System
PFA	Priority Focus Area
PSPZ	Primary Springs Protection Zone
TMDL	Total Maximum Daily Load
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

Leon County is developing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs), as well as future development, to groundwater and surface waters. OSTDSs are also known as septic systems. The Florida Department of Environmental Protection found that nutrient loads from several sources—including OSTDSs in Leon County—impaired Upper Wakulla River and Wakulla Spring. Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are to: (1) identify OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) identify future development that will require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County is developing the plan by progressing through eight major tasks. This report describes the results of the task 5: evaluation of implementation scenarios for AWTS. This task used the geologic criteria, cost-effectiveness data, mitigation criteria, and public input from the previous tasks to develop scenarios to retrofit existing OSTDS and recommendations for AWTS to reduce nitrogen loading from future development.

1.0 Introduction

The Florida Department of Environmental Protection (DEP, 2018) found that nutrient loads from several sources impaired Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive each day, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore the river and spring by identifying actions that will reduce pollutant loads to the river and spring. The BMAP was adopted by DEP in June 2018 and requires that stakeholders, including Leon County, reduce nitrogen loads to the river and spring from onsite sewage treatment and disposal systems (OSTDSs). OSTDSs are also known as septic systems. Leon County contracted Jim Stidham & Associates (JSA) to develop the plan to reduce nitrogen loads from OSTDSs. JSA partnered with Advanced Geospatial, Applied Technology & Management, The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop the plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP plan with a grant to the county. About 40% of Leon County is served by OSTDSs, about 20% is served by five centralized wastewater treatment facilities (WWTFs), and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (Figure 1).

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTS), where the transition will most reduce nitrogen loads to the river and spring. The plan will produce guidance for retrofit of existing development as well as direct technology selection for future development. The JSA team is creating the Leon County plan by performing the following tasks:

Task 1. Develop a nitrogen reduction score to identify likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTS; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas (Completed)

Task 2. Quantify cost-effectiveness of AWTS (Completed)

Task 3. Identify other factors that influence selection of an AWTS (Completed)

Task 4. Provide education to the community regarding information compiled in tasks 1, 2, and 3 and survey opinions of the citizens of Leon County, with respect to this plan (Completed)

Task 5. Analyze implementation scenarios for AWTS (Draft Completed)

Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTS

Task 7. Provide additional education to the community regarding the information compiled in tasks 1 through 6 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan

Task 8. Present the plan to the Leon County Board of County Commissioners

This report describes task 5 of the Leon County plan: scenarios for AWTS implementation. The objective of task 5 was to use the geologic criteria, cost-effectiveness data, mitigation criteria, and public input from the previous tasks to develop scenarios for retrofit of existing OSTDS and recommendations for AWTS to reduce nitrogen loading from future development.

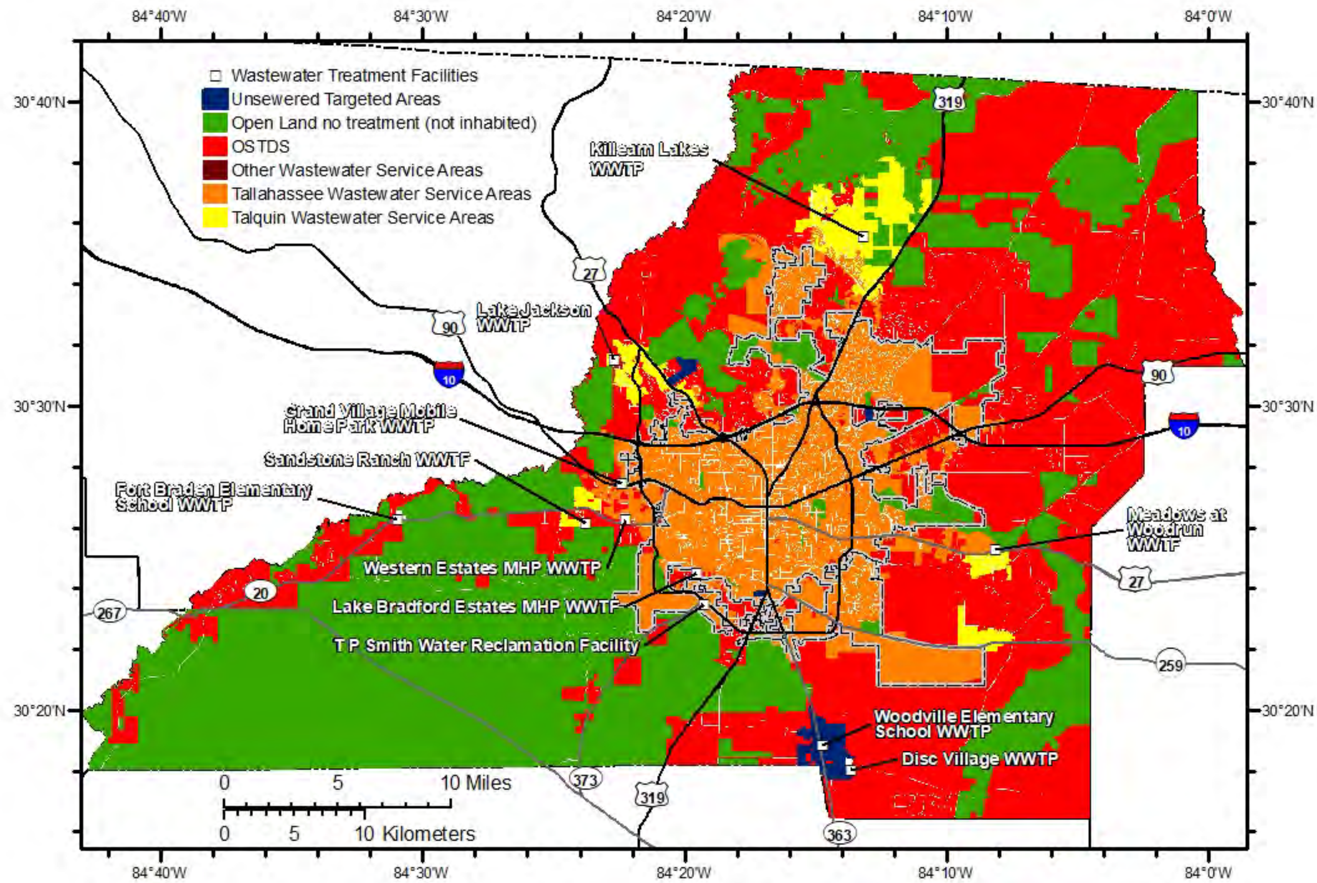

Figure 1. Parcels with an OSTDS, five centralized WWTFs, parcels in the Tallahassee wastewater service area, and parcels in the Talquin service area.

In this report, the JSA team summarizes the process used to evaluate potential OSTDS retrofit options (section 2.0), presents the OSTDS retrofit recommendations and target areas (section 3.0), and provides recommendations for new development standards (section 0).

2.0 Evaluation of Potential OSTDS Retrofit Options

The JSA team used the geographic information system (GIS) database that was developed in task 1 and augmented during task 3 to identify conditions throughout the county that were best suited to each AWTS technology. The nitrogen reduction score developed in task 1 was used to focus retrofits in the most vulnerable areas of the county. The mitigation criteria from task 3 were used to help determine which AWTS option would be most feasible in each location of the county. The GIS queries to identify potential AWTS technology options, based on the criteria from tasks 1 and 3, are summarized in Figure 2.

Once the potential AWTS options were identified, the costs developed in task 2, and updated based on feedback during task 4, were used to estimate the costs of retrofitting each area of the county based on the most feasible technology. The GIS queries used to add the cost-effectiveness factor to the decision process are summarized in Figure 3.

The GIS queries to identify locations where existing OSTDS are required to be upgraded to AWTS or connected to the central sewer systems are summarized in Figure 4.

Additional details about the process to assign recommended AWTS technologies to target areas throughout Leon County are provided in the subsections below.

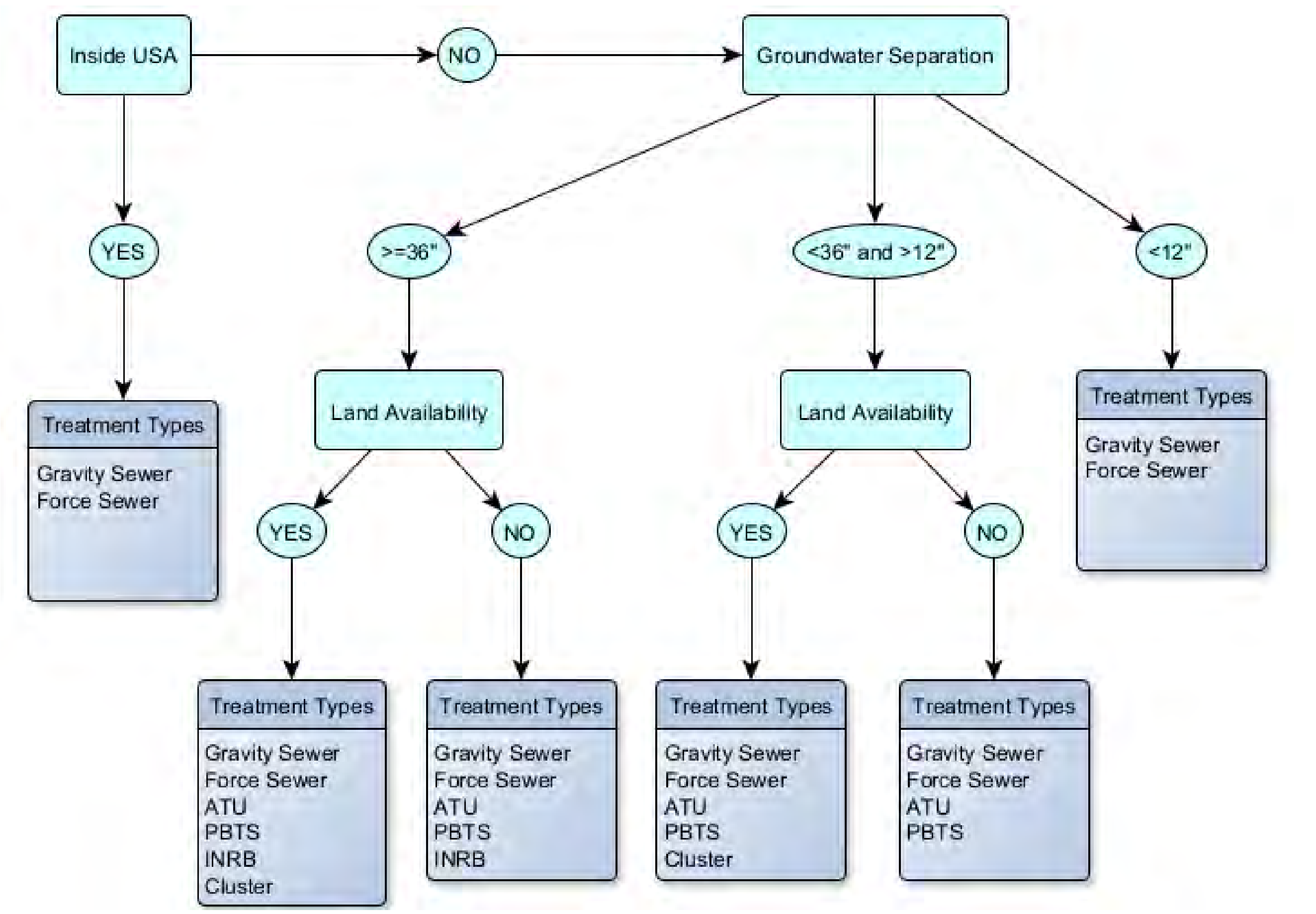

Figure 2. *Flow chart with queries to identify potential AWTS options for each parcel.*

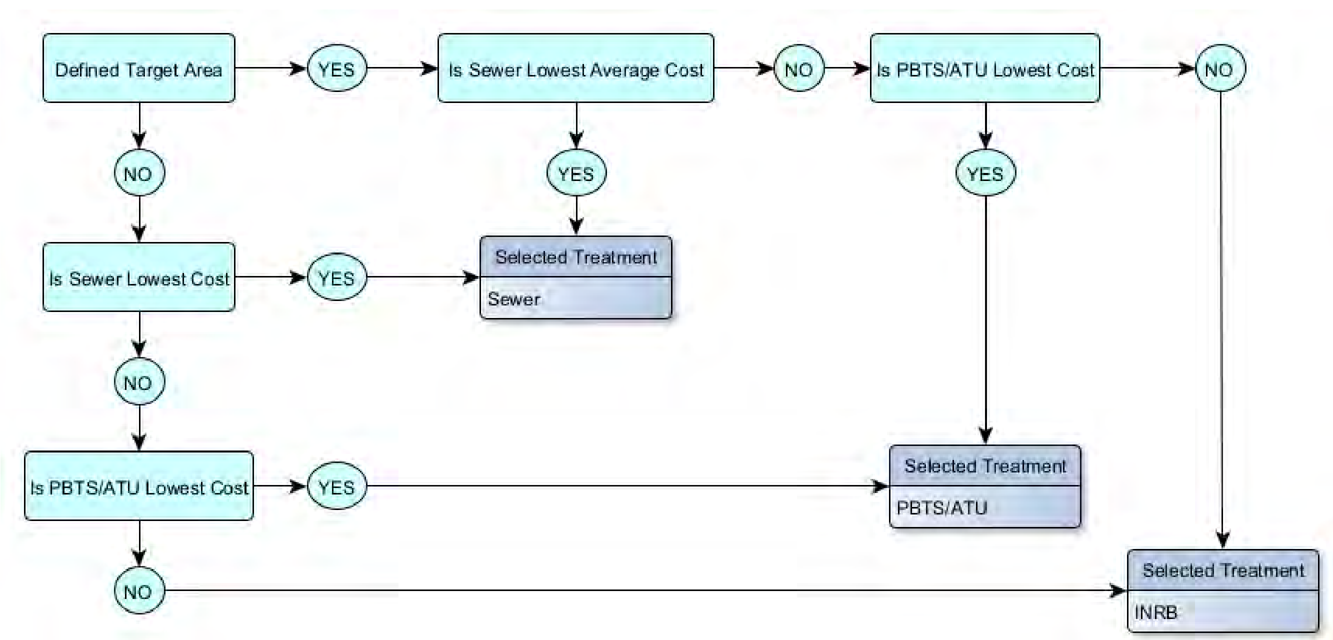

Figure 3. *Flow chart with queries to identify recommended AWTS based on cost-effectiveness.*

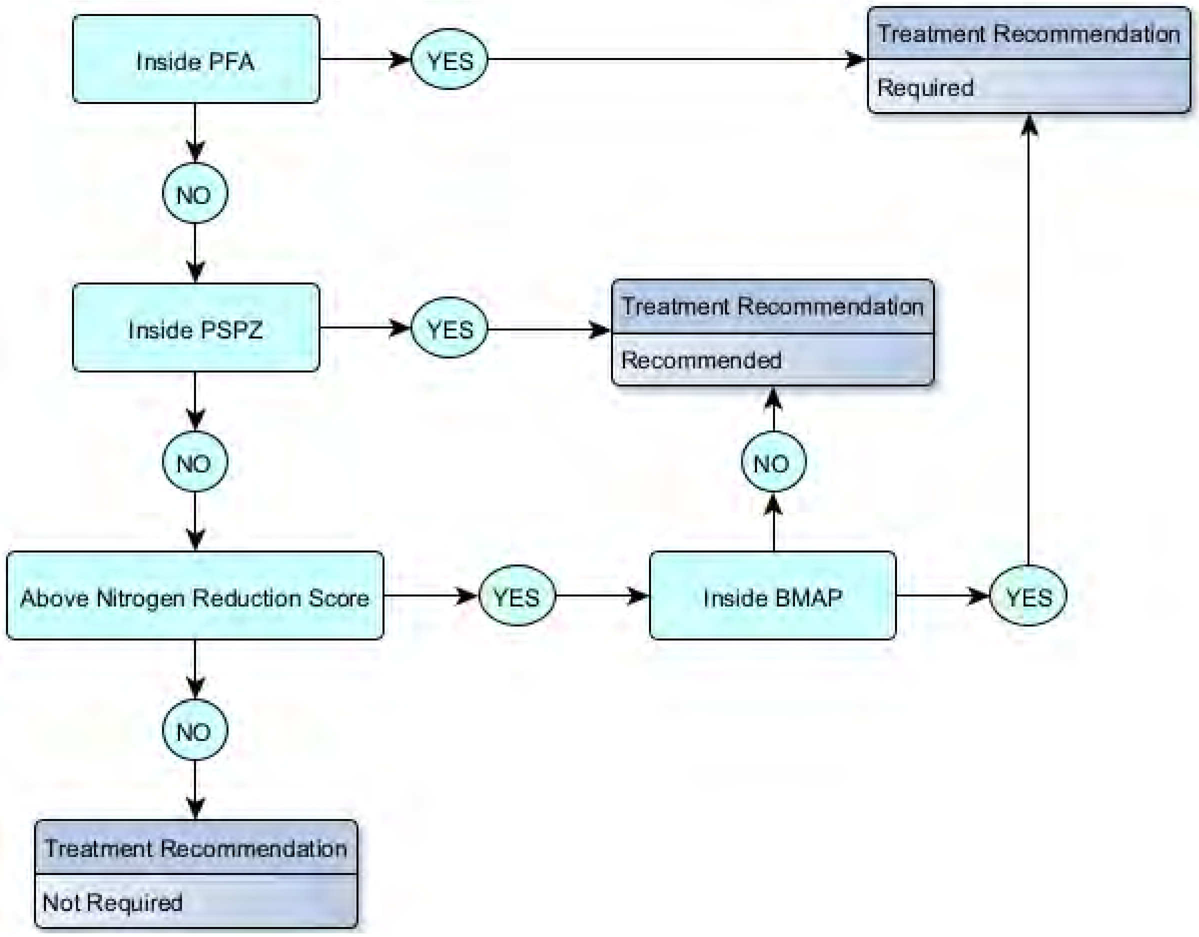

Figure 4*. Flow chart with queries to identify where OSTDS upgrades to AWTS or connection to central sewer are required.*

2.1 Site Location Relative to the Urban Service Area

The first step in the process was to identify whether parcels are within the urban service area (Figure 5). A parcel's location relative to the urban service area determines whether connection to a centralized wastewater collection system is feasible, both for retrofits and future development. The purpose of the urban service area, as defined in the Comprehensive Plan, is to direct development toward the capital infrastructure needed to serve it, including sanitary sewer. In the GIS database, if a portion of a parcel touches the urban service area, it was assigned a value of "Yes." All other parcels were assigned a value of "No." The result of this step found 14,458 parcels intersected with the urban service area, which should be connected to the central sewer system.

In addition, some areas of the county outside the urban service area have already been identified for sewer (Figure 5). These areas were also considered in this evaluation to determine target areas that could be connected to central sewer (see Section 3.1 for more details).

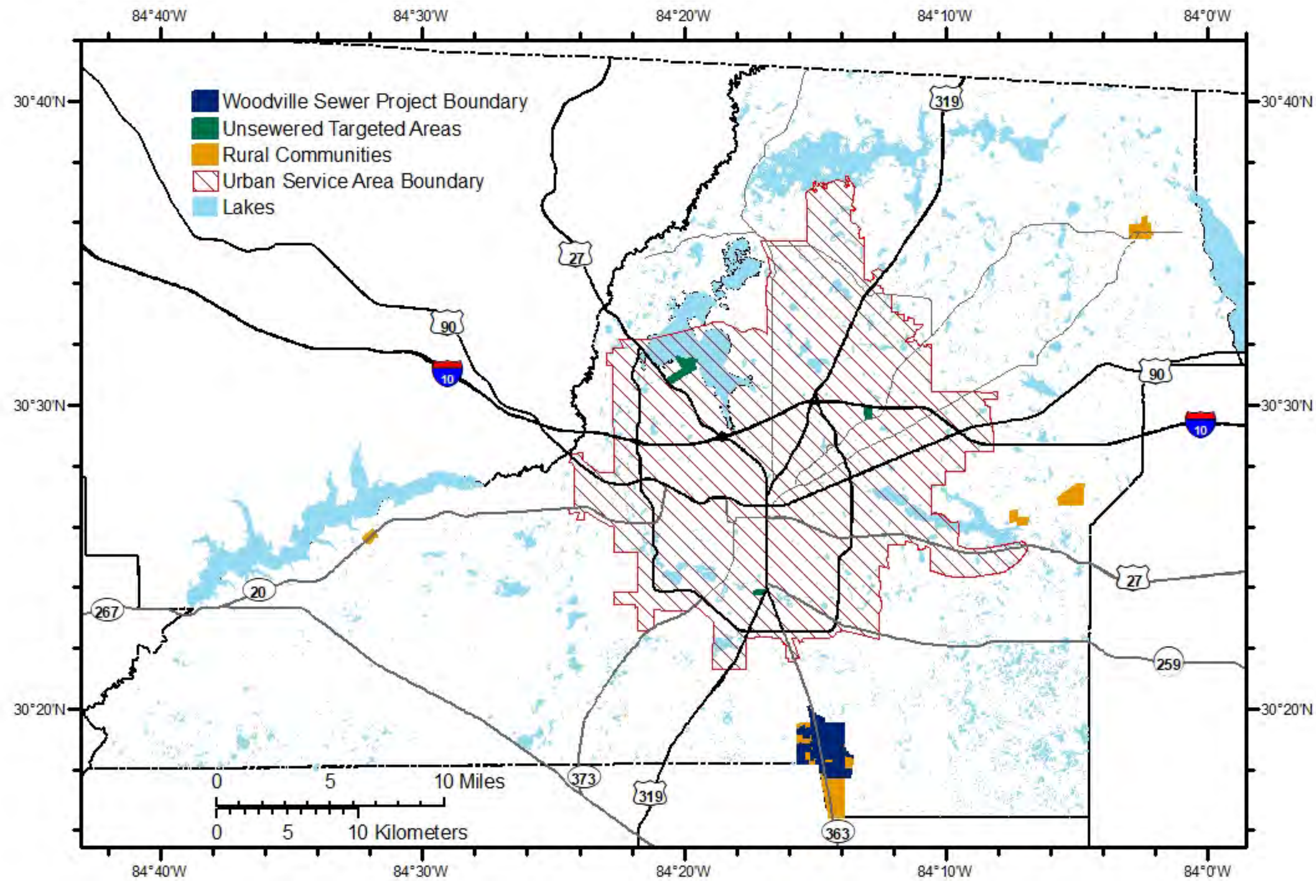

Figure 5. Location of the urban service area and unsewered target areas.

2.2 Site Location Relative to the Priority Focus Area (PFA) and Primary Springs Protection Zone (PSPZ)

The next step was to identify whether parcels are within the PFA and PSPZ (Figure 6). As part of the Upper Wakulla River and Wakulla Spring BMAP, DEP delineated two PFAs, one of which is within Leon County. The PFAs represent the areas where the Floridan aquifer is most vulnerable to adverse impacts from activities on the land surface. In 2007, the Leon County Board of Commissioners adopted the PSPZ into its Land Development Code. The PSPZ overlaps the PFA and also includes lands west and east of the PFA. In the GIS database, if a parcel touches the PFA and PSPZ polygons, it was assigned a value of "Yes." All other parcels were assigned a value of "No."

The location of a parcel within the PFA and PSPZ is one of the most important factors in targeting the parcel for conversion to an AWTS or connection to the central sewer system. DEP prepared the Upper Wakulla River and Wakulla Spring BMAP to comply with the requirements of the Florida Springs and Aquifer Protection Act. The Act prohibits conventional OSTDS on parcels less than one-acre within the PFA, unless the OSTDS includes enhanced nitrogen treatment or a connection to the central sewer system will be available within five years. When an existing traditional OSTDS must be repaired or replaced, the OSTDS must include nitrogen-reducing enhancements, unless connection to the central sewer system will be available within five years. In addition, the Leon County Comprehensive Plan requirements (Policy 1.2.6 [SS] and Policy 4.2.5 [C]) for the PSPZ include connection to sewer with advanced WWTFs where feasible, and PBTSs where connection is not feasible. Therefore, parcels on traditional OSTDS within the PFA and PSPZ should be upgraded to AWTS or connected to the central sewer system.

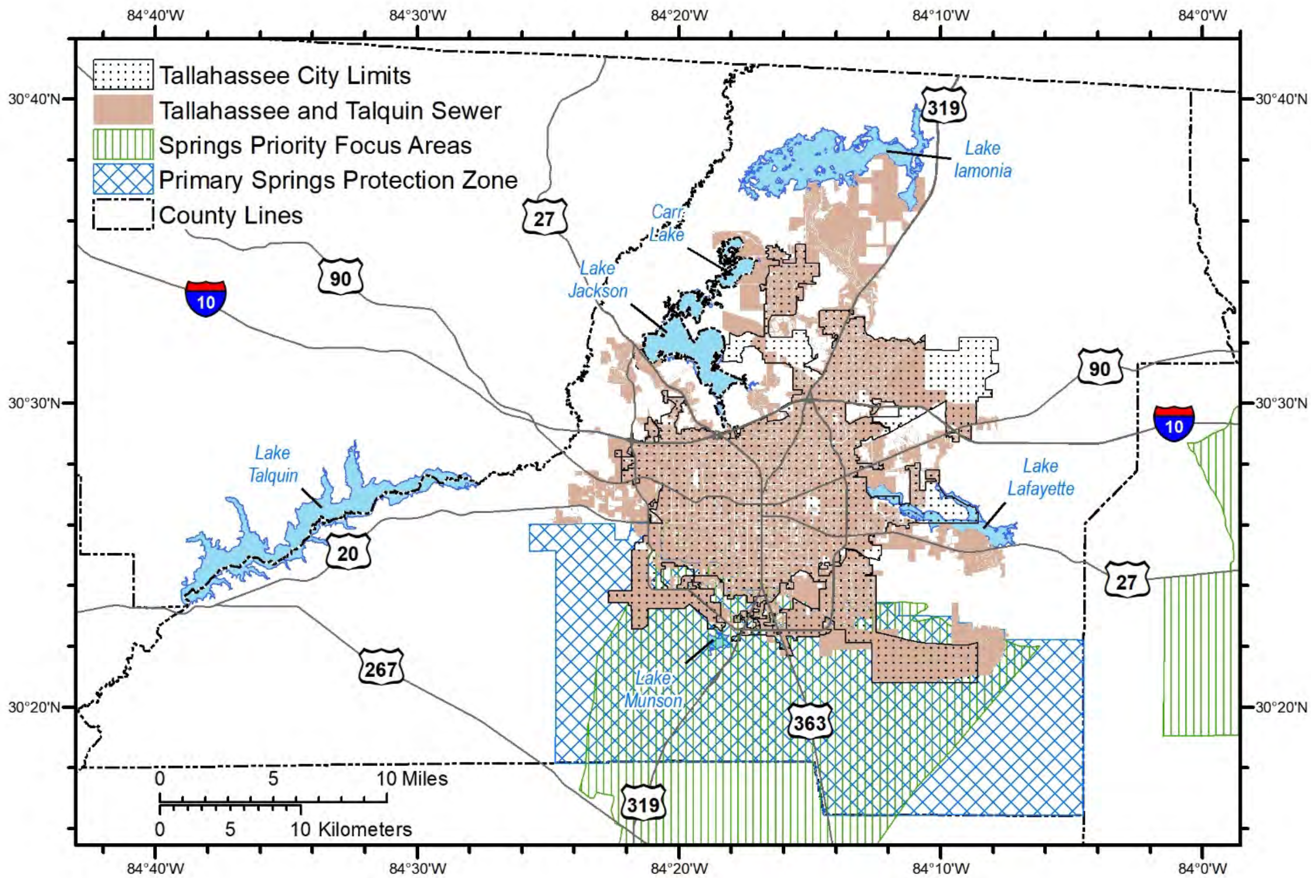

Figure 6. *PFA, PSPZ, and wastewater service areas.*

2.3 Adjacent Land Availability for Cluster Systems

Cluster systems are used to treat wastewater from multiple homes. Therefore, these systems are not limited to one parcel, and land must be acquired or dedicated to install the cluster system. For a cluster system to be cost-effective, it should be placed near the parcels it will be treating. For this study, vacant parcels within 1,000 feet of multiple residential units on OSTDS were evaluated (Figure 7). In addition, the number of parcels (vacant or developed) within 1,000 feet of a vacant parcel were identified. A total of 4,166 parcels were identified as having one or more parcels within 1,000 feet that could be potential locations for constructing a cluster system.

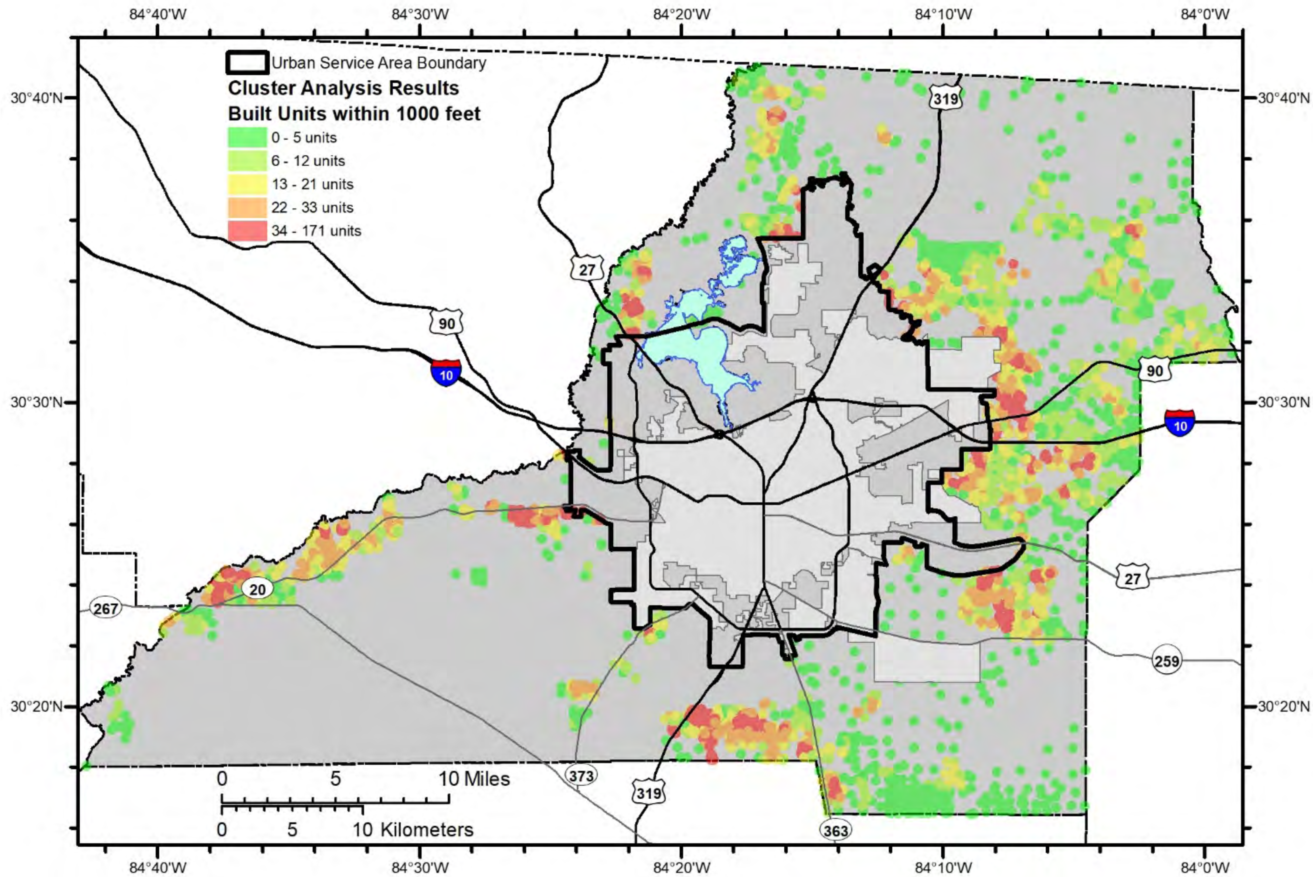

Figure 7. *Vacant parcels within 1,000 feet of parcels with existing septic systems.*

2.4 Separation from Groundwater

For each parcel, the depth to groundwater was evaluated to determine which technologies were applicable. Some technologies, such as in-ground nitrogen-reducing biofilters (INRBs), require greater separation from groundwater than other technologies to achieve optimal nitrogen removal. A countywide coverage to determine the separation from groundwater was not readily available, so the JSA team used the "depth to water" layer developed by the Florida Geological Survey as part of the Florida Aquifer Vulnerability Assessment. The raster grid in this file was converted to contour lines in one foot intervals. The contour lines were then joined to the parcels, and the average, minimum, and maximum values for the depth-to-groundwater lines on the parcels were calculated, as shown on the example in Figure 8. The average value for the parcel was used in the technology option evaluations. There were 1,223 parcels that did not intersect any polylines for the depth to water elevation. For these parcels, the JSA team assigned the nearest elevation contour.

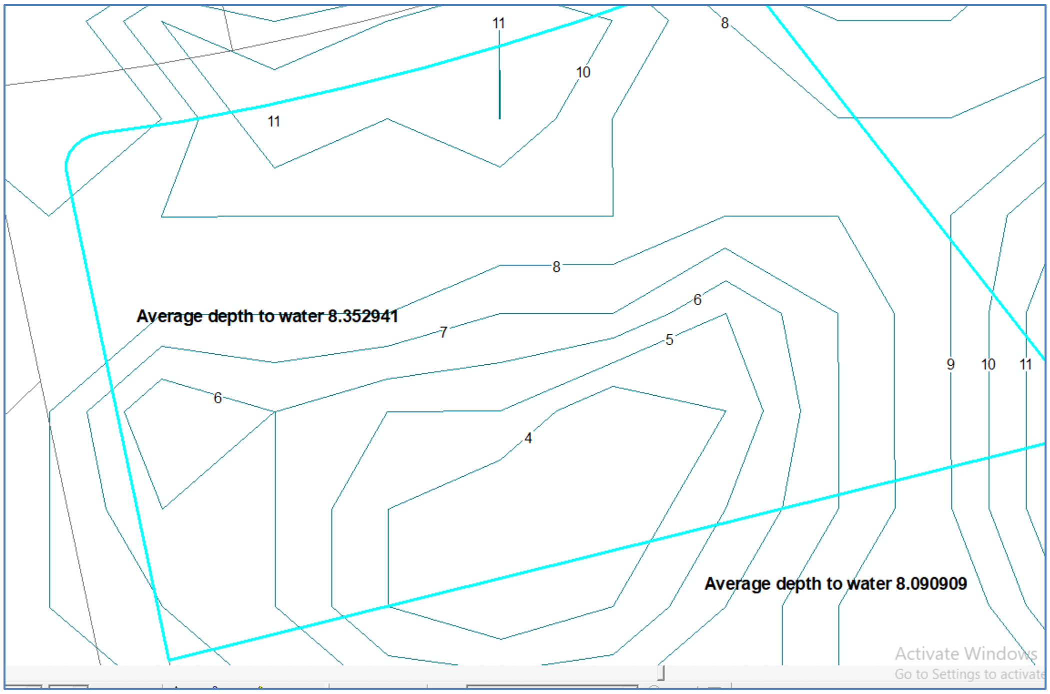

Figure 8. Example depth to groundwater elevation contours for a parcel.

2.5 Parcels with Wetlands or Conservation Easements

An evaluation was also made to determine which parcels had wetlands and/or easements and, therefore, may not have sufficient space to install an AWTS. A 75 foot buffer was drawn around the wetlands from the National Wetlands Inventory coverage. This buffer was applied based on the required separation from standing water per the Florida Department of Health Chapter 64E-6, Table V. The JSA team obtained a polygon coverage from Leon County that contained all county easements. The easements classified as conservation, conservation drainage, and drainage were used to create a layer that was merged with the 75 foot wetland buffer. The wetlands/easements layer was then intersected with the parcels to calculate the acres of wetlands/easements on the property and the remaining acres available for AWTS.

2.6 Assignment of Treatment Options

Based on the GIS data evaluations, the following treatment technologies were assigned to each parcel:

- Aerobic treatment unit (ATU)
- Performance based treatment system (PBTS)
- INRB
- Cluster system
- Central sewer system

The technologies were selected based on the best available information gathered in tasks 1 through 4 and the considerations noted in Table 1. Before moving forward with retrofits on these parcels, the site conditions will need to be verified in the field.

All potential technologies that would be feasible on each parcel are shown in Figure 9.

Table 1. Considerations used to determine which AWTS technologies could be used for OSTDS retrofits.

Technology	Potential Parcel Considerations
ATU	At least a 12-inch separation from groundwater At least 0.5-acre of the parcel is available with no wetlands and/or easements
PBTS	At least a 12-inch separation from groundwater At least 0.5-acre of the parcel is available with no wetlands and/or easements
INRB	At least a 36-inch separation from groundwater At least 0.5-acre of the parcel is available with no wetlands and/or easements
Cluster system	Available open parcel within 1,000 feet of multiple existing OSTDS Passive systems used where conditions allow for INRBs Active systems used where conditions do not allow for INRBs
Central sewer	Within the urban service area Within a 2,000 foot buffer of the urban service area or existing sewer lines Gravity sewer used within 2,000 feet of a sewer main Force main used for distances greater than 2,000 feet from a sewer main

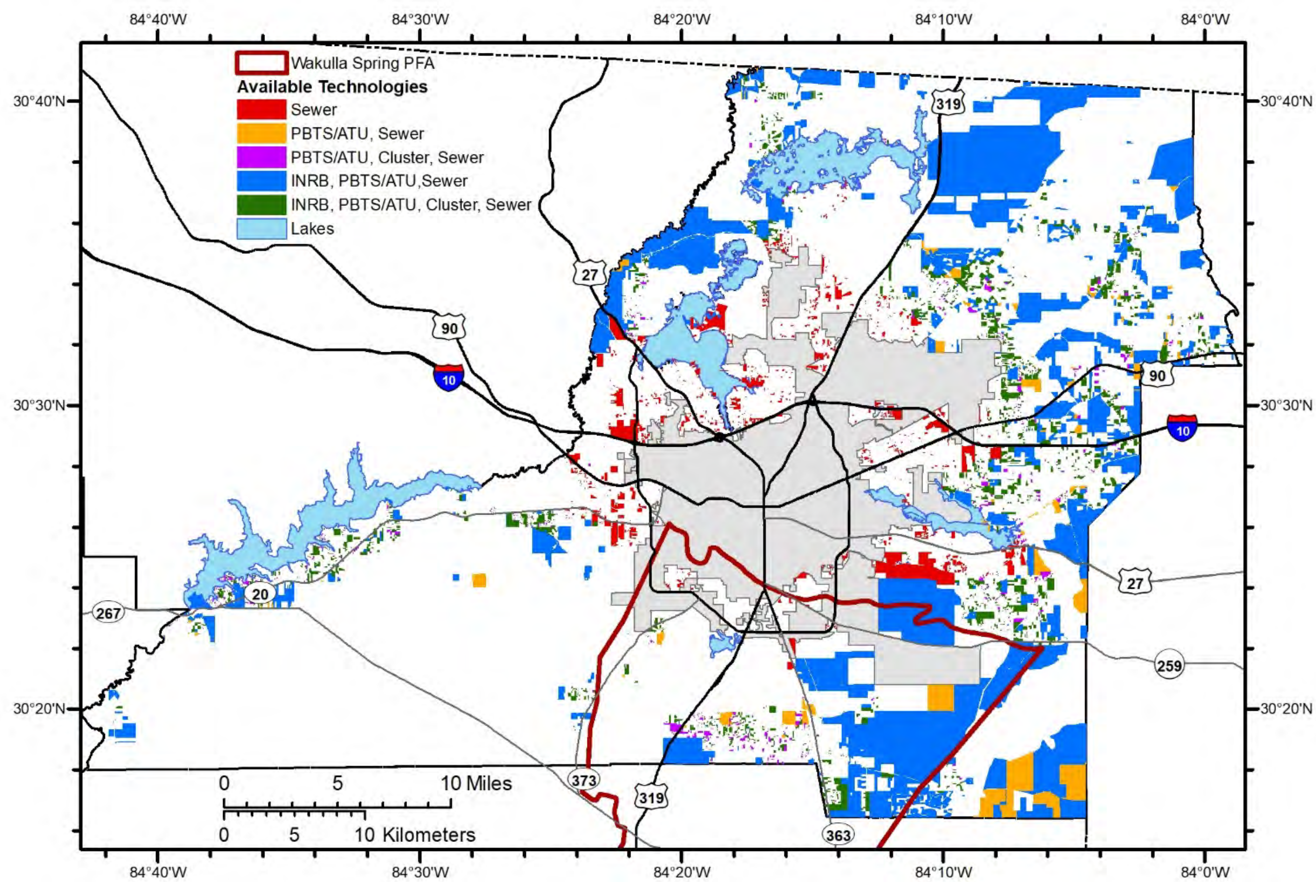

Figure 9. Potential applicable AWTS technologies by parcel.

The technologies in Figure 9 were further evaluated to determine the recommended alternative on a parcel-by-parcel basis. The costs to implement each technology were determined using the lifecycle costs estimated in task 2 and updated in task 4 based on stakeholder feedback (Table 2). In evaluating the costs to implement feasible technologies on each parcel, the primary type of AWTS for each parcel was determined (Figure 10).

Table 2. Estimated lifecycle cost per unit for each AWTS technology option.

Technology	Estimated Lifecycle Cost per Unit
ATU	$29,750
PBTS	$31,100
INRB	$19,256
Cluster (active)*	$19,595
Cluster (passive)*	$17,280
Central sewer (gravity)	$57,987
Central sewer (force main)**	$59,067

* The expected costs for cluster systems assume service for 8 units, as a midpoint in system size.

** The average distance for force main to the existing main was calculated and the cost was estimated.

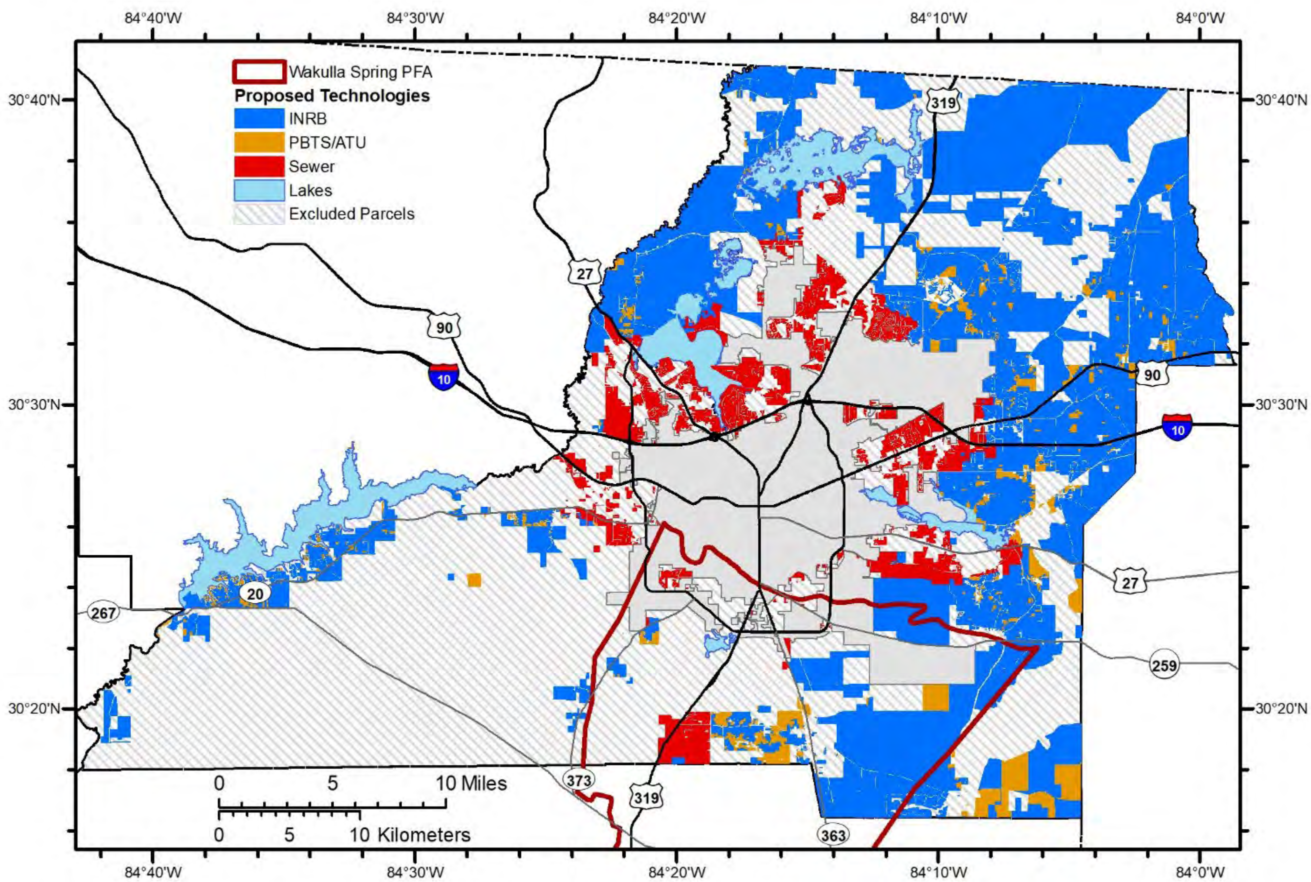

Figure 10. Proposed primary AWTS technology by parcel.

3.0 OSTDS Retrofit Scenarios

3.1 Target Areas

Once applicable technologies were assigned to each parcel, the JSA team identified large contiguous areas that had the same or similar best AWTS options. These areas were grouped by technology type and identified as "target areas" for the initial focus on retrofits. An overview of all the target areas is shown in Figure 11, and detailed maps for different areas of the county are shown in Figure 12 through Figure 15. Target areas were assigned identification numbers, which do not indicate priority. The identification numbers appear on the maps below.

All areas within 2,000 feet of existing central sewer are included in a target area. Many of these sewer target areas are included in the City of Tallahassee 2035 Master Sewer Plan Update (Hatch Mott MacDonald, 2016). Where sewer is the primary recommended technology to retrofit a target area, all parcels are recommended for connection to the central sewer system to make that option as cost-effective as possible, since the cost per household is lower with more connections to the same sewer line. In other target areas, the recommended technology may vary from parcel-to-parcel based on the conditions in that area, including soil type, depth to groundwater, presence of wetlands, and other factors.

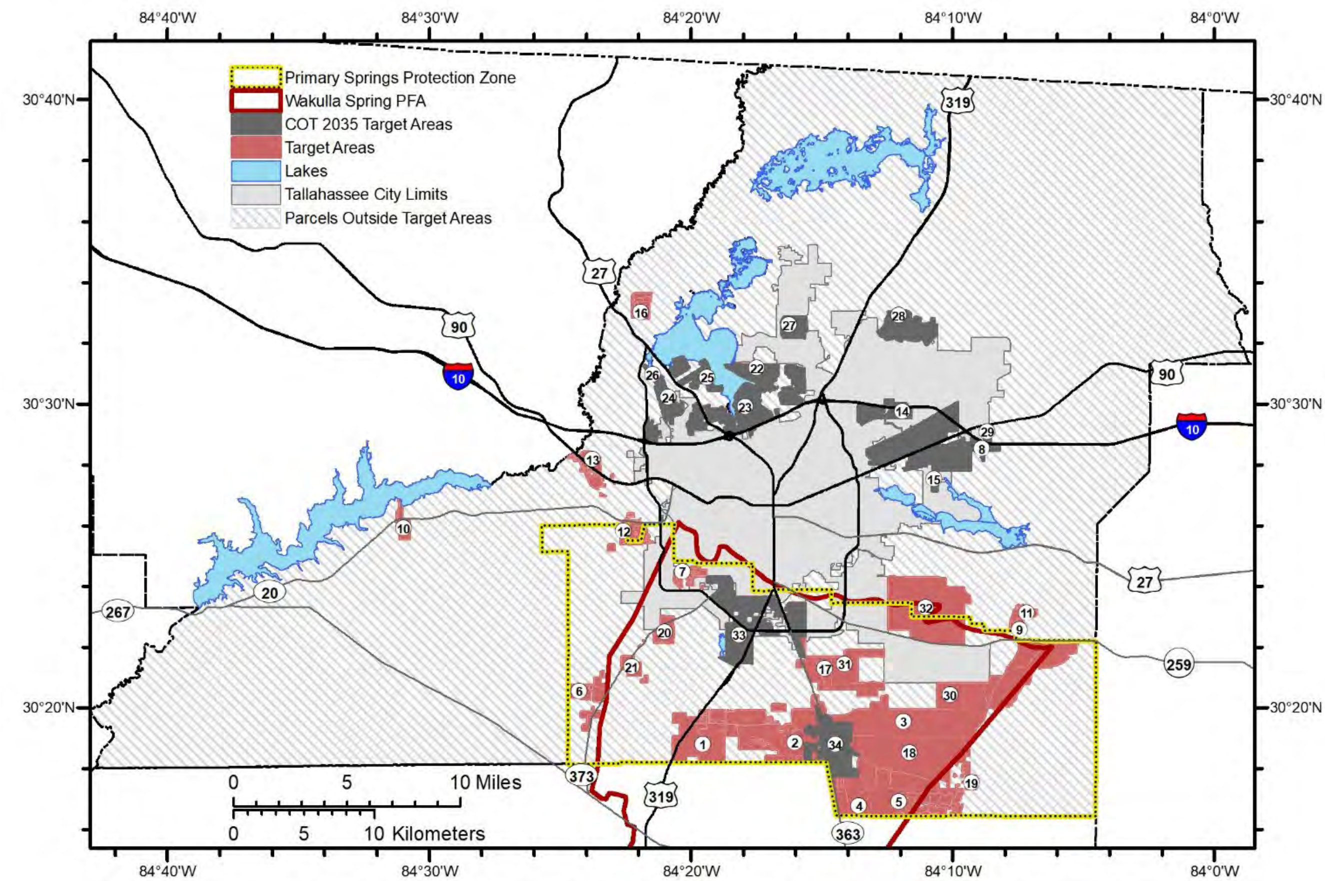

Figure 11. Overview of proposed target areas for AWTS.

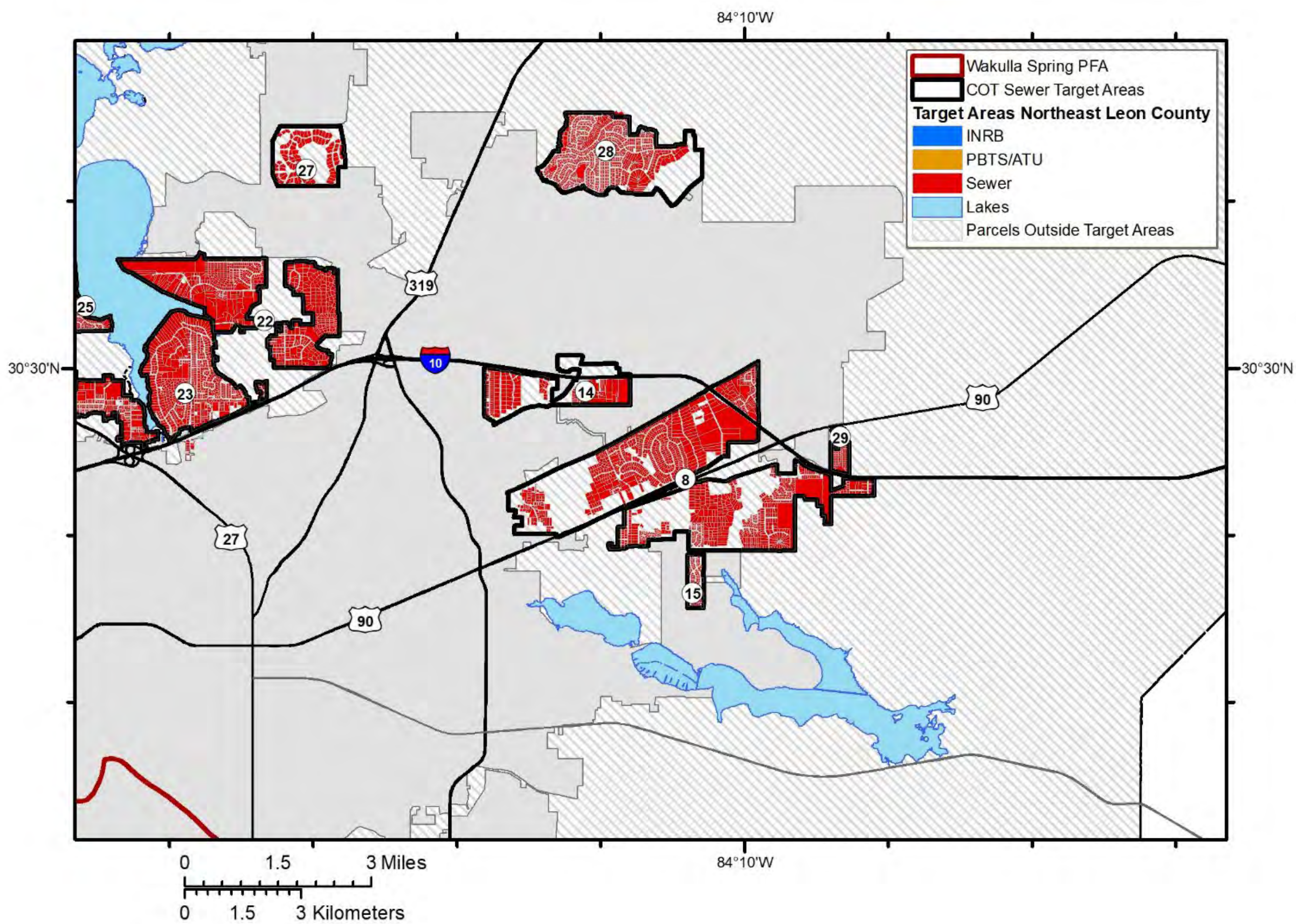

Figure 12. Proposed target areas for AWTS in northeast Leon County.

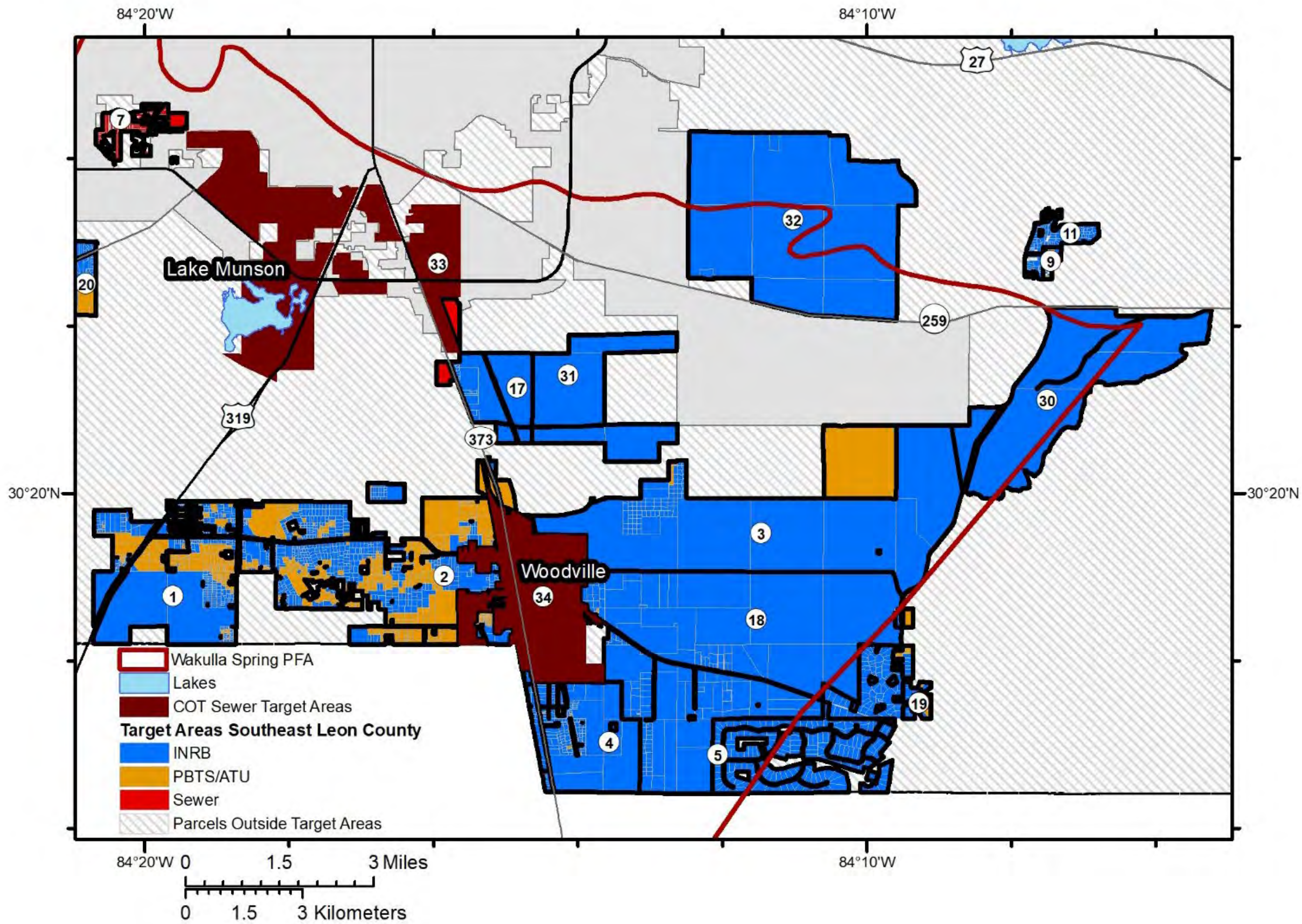

Figure 13. *Proposed target areas for AWTS in southeast Leon County.*

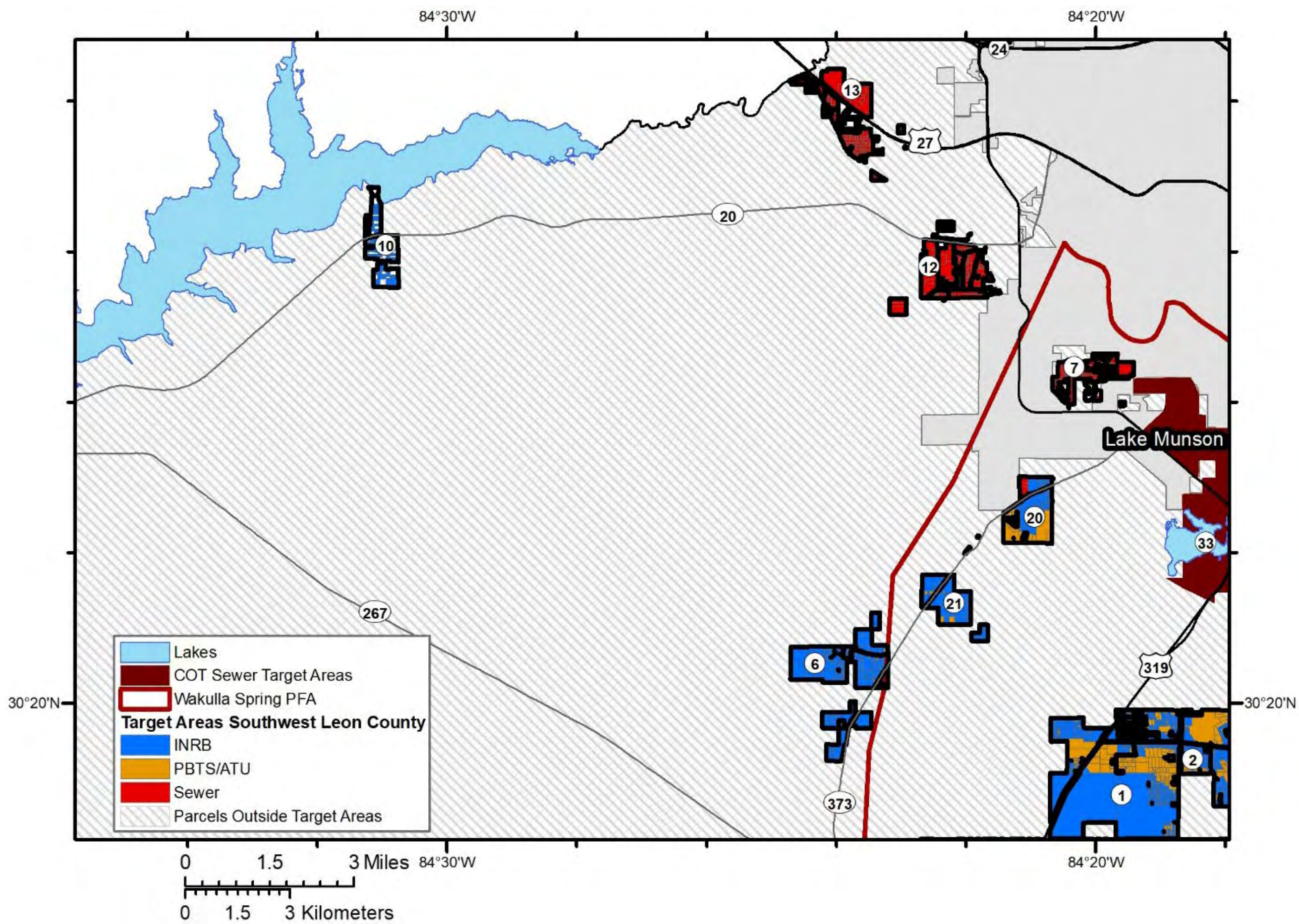

Figure 14. *Proposed target areas for AWTS in southwest Leon County.*

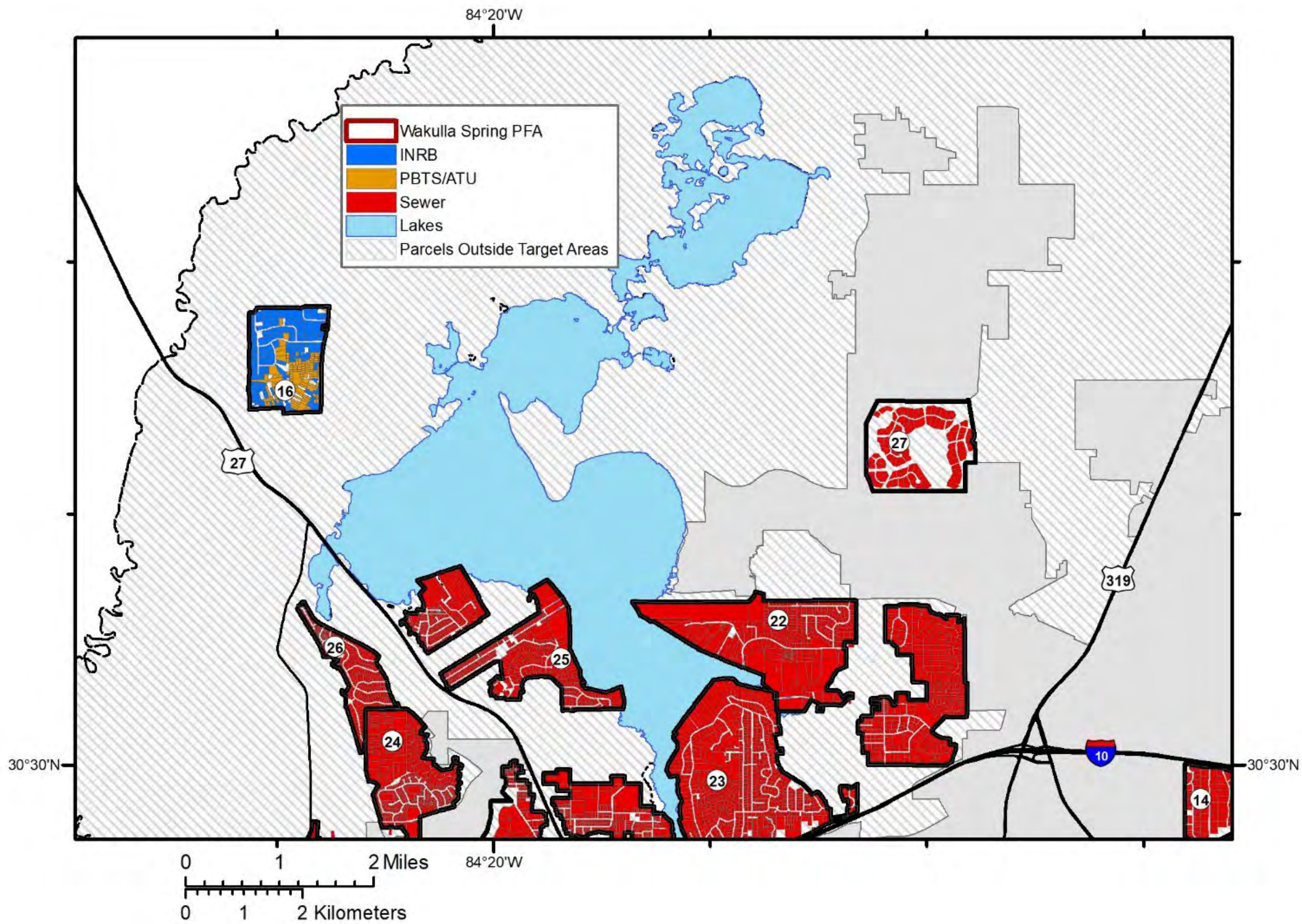

Figure 15. Proposed target areas for AWTS in northwest Leon County.

In addition, due to BMAP requirements, all parcels within the PFA are included in a target area with proposed AWTS options to achieve requirements. To meet Leon County Comprehensive Plan requirements for the PSPZ, AWTS recommendations are also provided for the parcels within the PSPZ. Figure 16 shows the proposed AWTS for the currently developed parcels that are on OSTDS within the PFA and PSPZ. Figure 17 shows the proposed AWTS for future development within the PFA and PSPZ.

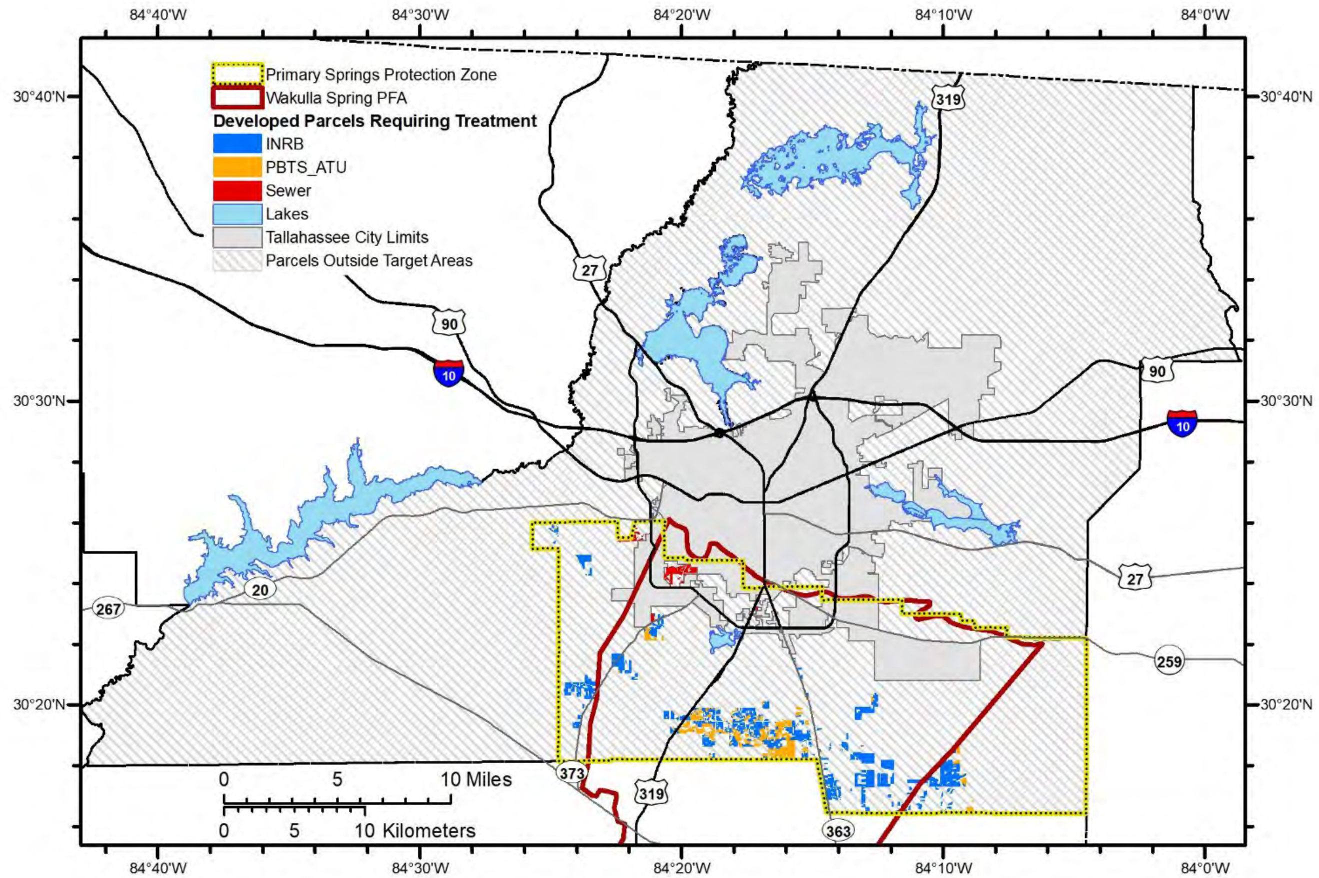

Figure 16. *Recommended treatment type for currently developed parcels within the PFA and PSPZ.*

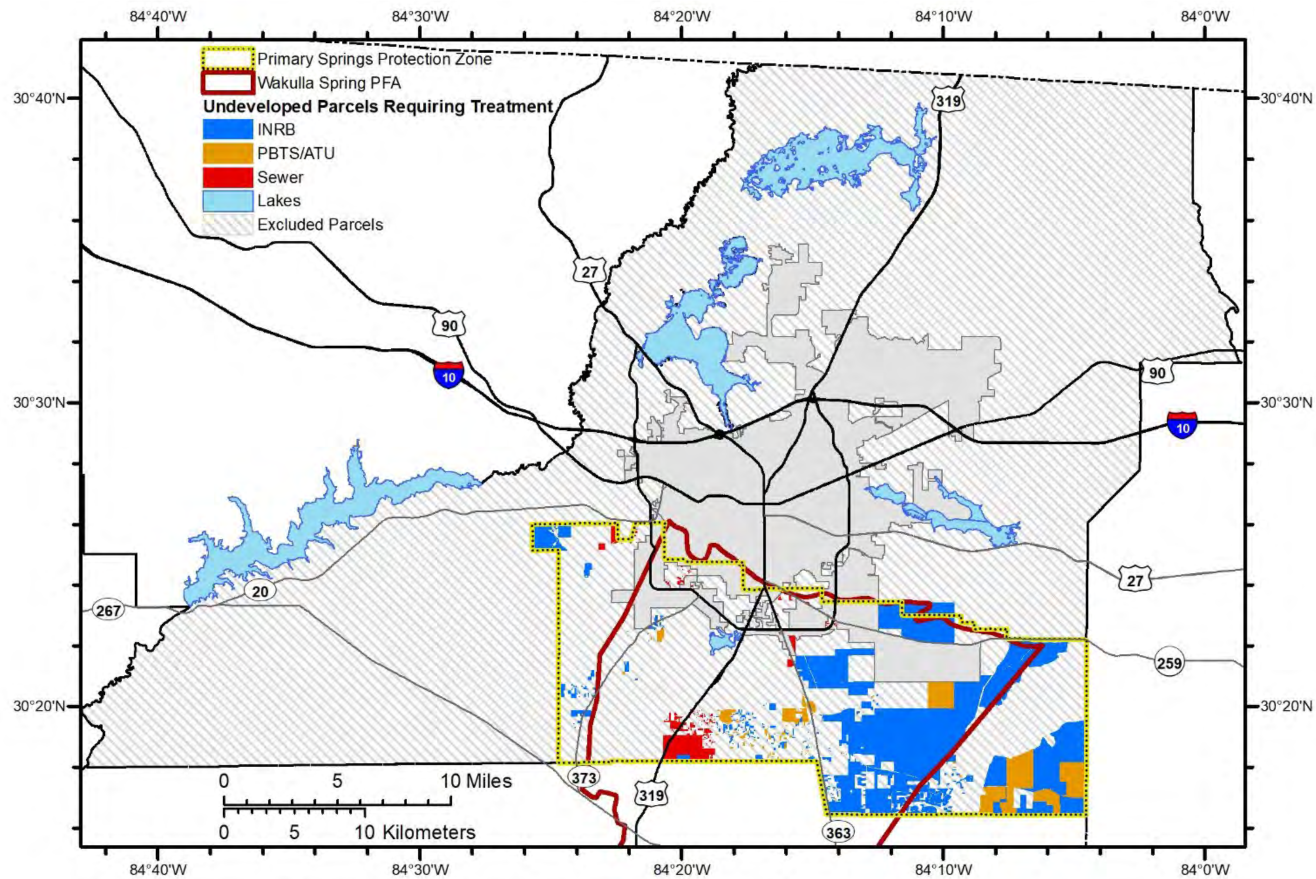

Figure 17. Recommended treatment type for undeveloped parcels within the PFA and PSPZ.

3.2 Estimated Costs for OSTDS Retrofit

The estimated costs to retrofit existing OSTDS to the recommended AWTS technology for each target area are summarized in Table 3. The cost of these conversions is not the responsibility of Leon County but of the property owner, much like the maintenance of the septic system is the responsibility of the property owner. The zoning breakdown for each target area is presented in Table 4. The number of OSTDS retrofits in each target area represent the number of developed parcels currently on septic systems.

***Table 3.** Estimated costs for OSTDS retrofit by target area.*

Target Area Number	Target Area Name	Recommended Technology	Number of OSTDS Retrofits	Total Target Area Cost	Average Cost Per OSTDS Retrofit*
1	Oak Ridge Road West	Sewer	812	$26,822,000	$33,032
2	Oak Ridge Road East	INRB or Sewer	1,138	$27,977,000	$24,584
3	Rhodes Cemetery Road	INRB or PBTS/ATU	97	$1,951,000	$20,113
4	Pine Acres	PBTS/ATU, INRB, or Sewer	253	$5,144,000	$20,332
5	Tallahassee Ranch Club	INRB or PBTS/ ATU	236	$4,544,000	$19,254
6	Spring Hill Trace/Cox Road	PBTS/ATU, INRB, or Sewer	174	$3,457,000	$19,868
7	Lake Bradford	Sewer	159	$5,001,000	$31,453
8	Buck Lake Woods	Sewer	1,501	$46,058,000	$30,685
9	Kelly Court/Louvenia Woods	PBTS/ATU, INRB, or Sewer	75	$2,060,000	$27,467
10	Nottingham Castle Estates/Tully Estates	INRB or PBTS/ATU	90	$1,733,000	$19,256
11	Kellywood Farms/Powder Horn Woods	INRB or PBTS/ATU	106	$2,041,000	$19,255
12	Pineridge Estates	Sewer	318	$9,822,000	$30,887
13	Geddie Road/Barineau Road	Sewer	246	$7,609,000	$30,931
14	Pemberton Road	Sewer	172	$5,366,000	$31,198
15	Benjamin's Run	Sewer	140	$4,341,000	$31,007
16	Farmview Estates/Box Wood Estates/North Lake Meadows	PBTS/ATU, INRB, or Sewer	284	$7,210,000	$25,387
17	Rhodes Subdivision	PBTS/ATU, INRB, or Sewer	45	$1,139,000	$25,311
18	Natural Bridge Road	PBTS/ATU, INRB, or Sewer	165	$3,319,000	$20,115
19	Natural Bridge Acres	PBTS/ATU, INRB, or Sewer	31	$727,000	$23,452
20	Lonnie Gray Road	PBTS/ATU, or Sewer	106	$2,596,000	$24,491
21	Robert Golden Road	PBTS/ATU, INRB, or Sewer	51	$1,112,000	$21,804
22	Rhoden Cove	Sewer	677	$20,417,000	$30,158
23	Lakeshore	Sewer	1,309	$40,197,000	$30,708
24	Huntington Estates	Sewer	603	$18,572,000	$30,799
25	Lake Breeze	Sewer	764	$23,096,000	$30,230
26	Duck Lake Point	Sewer	330	$10,430,000	$31,606
27	Rosehill	Sewer	92	$3,038,000	$33,022
28	Killearn Acres	Sewer	1,479	$44,295,000	$29,949
29	Plantation Forest Drive/Hill North Dale Drive North	Sewer	154	$4,845,000	$31,461
30	Plank Road/Tram Road	PBTS/ATU, INRB, or Sewer	7	$158,000	$22,571
31	Lutterloh Pond	INRB or PBTS/ATU	3	$58,000	$19,333
32	Verdura Plantation	INRB or PBTS/ATU	10	$193,000	$19,300
Total	-	-	***11,627***	***$335,328,000***	***$28,840***

Note: The total cost for each target area is rounded to the nearest $1,000.
* The cost of these conversions is the responsibility of the property owner.

***Table 4.** Zoning breakdown by target area.*

Target Area	Zoned	Percentage
1	Urban Fringe	51.10%
1	Residential Preservation	48.90%
2	Urban Fringe	40.93%
2	Residential Preservation	51.01%
2	Residential Acre	4.57%
2	Single Family Detached R-1	1.86%
2	Manufactured Home and Single Family Residential	1.55%
2	Mobile Home Park	0.08%
3	Rural	98.98%
3	Single Family Detached R-1	1.02%
4	Woodville Commercial District	0.64%
4	General Commercial	1.61%
4	Single Family Detached R-1	6.75%
4	Residential Preservation	53.05%
4	Manufactured Home and Single Family Residential	18.33%
4	Residential Acre	15.76%
4	Mobile Home Park	0.96%
4	Rural	2.89%
5	Residential Preservation	8.47%
5	Rural	91.53%
6	Residential Preservation	27.04%
6	Rural	72.96%
7	Single Family Detached R-1	8.47%
7	Residential Preservation	78.84%
7	Open Space	4.76%
7	Light Industrial	1.59%
7	Single Family Detached R-2	5.29%
7	Mobile Home Park	1.06%
8	Single Family Detached R-1	4.05%
8	Residential Preservation	91.90%
8	Activity Center	0.19%
8	Mahan Corridor Node	0.19%
8	Residential Acre	1.54%
8	Westminster Oaks PUD	0.90%
8	Open Space	0.06%
8	Single Detached, Attached and Two Family Residential	0.90%
8	Office Residential, Medium Density	0.13%
8	Urban Fringe	0.13%
9	Residential Preservation	85.23%
9	Urban Fringe	14.77%
10	Residential Preservation	68.75%
10	Urban Fringe	6.25%
10	Lake Talquin Recreational/Urban Fringe	25.00%
11	Urban Fringe	64.41%
11	Residential Preservation	35.59%
12	Single Family Detached R-1	35.57%
12	Manufactured Home and Single Family Residential	2.99%
12	Mobile Home Park	1.00%
12	Light Industrial	4.98%
12	General Commercial	0.75%
12	Single Detached, Attached and Two Family Residential	16.67%
12	Open Space	2.24%

Target Area	Zoned	Percentage
12	Residential Acre	3.98%
12	Residential Preservation	29.35%
12	Airport Vicinity	0.25%
12	Urban Fringe	0.25%
12	Rural	1.99%
13	Urban Fringe	23.62%
13	Single Family Detached R-1	6.75%
13	Single Detached, Attached and Two Family Residential	34.97%
13	Commercial Parkway	3.37%
13	Light Industrial	0.92%
13	The Gardens at Westlake PUD	0.61%
13	General Commercial	0.31%
13	Manufactured Home and Single Family Residential	0.31%
13	Residential Preservation	28.83%
13	Mobile Home Park	0.31%
14	Residential Preservation	55.03%
14	Single Detached, Attached and Two Family Residential	38.62%
14	Manufactured Home and Single Family Residential	5.82%
14	Welaunee Toe-East PUD	0.53%
15	Single Family Detached R-1	3.40%
15	Residential Preservation	96.60%
16	Residential Preservation	88.54%
16	Rural	11.46%
17	Woodville Commercial District	2.04%
17	Single Detached, Attached and Two Family Residential	4.08%
17	Light Industrial	2.04%
17	Rural	91.84%
18	Residential Preservation	2.26%
18	Single Family Detached R-1	10.17%
18	Woodville Retirement Community PUD AKA DISC Village	3.95%
18	Residential Acre	3.39%
18	Single Family Detached R-1	80.23%
19	Residential Preservation	79.41%
19	Rural	20.59%
20	Residential Preservation	35.20%
20	Government Operation - 2	2.40%
20	Rural	62.40%
21	Rural	100.00%
22	Lake Protection	99.85%
22	The Villages of Maclay PUD	0.15%
23	Lake Protection	81.64%
23	Residential Preservation	12.39%
23	Urban Residential District	0.88%
23	Commercial Parkway	0.52%
23	Office Residential, Medium Density	0.59%
23	Lake Jackson Station Postal Facility PUD	0.22%
23	General Commercial	0.29%
23	Single Detached, Attached and Two Family Residential	0.66%
23	Office Residential	0.44%
23	Medium Density Residential	1.92%
23	Tallahassee School of Math and Science PUD	0.22%
23	Light Industrial	0.07%
23	Open Space	0.07%

Target Area	Zoned	Percentage
23	Wal-Mart PUD	0.07%
24	Residential Preservation	76.28%
24	Neighborhood Commercial	1.12%
24	Open Space	0.48%
24	Single Detached, Attached and Two Family Residential	19.07%
24	Park Place PUD	1.44%
24	Single Family Detached R-1	1.44%
24	Residential Preservation-1	0.16%
25	Lake Protection	98.58%
25	Open Space	1.42%
26	Residential Preservation	76.42%
26	Single Detached, Attached and Two Family Residential	19.24%
26	Lake Protection	4.34%
27	Residential Preservation	74.77%
27	Lake Protection	25.23%
28	Residential Preservation	100.00%
29	Residential Preservation	88.00%
29	Interchange Commercial	10.29%
29	Residential Acre	1.71%
30	Rural	100.00%
31	Rural	100.00%
32	Urban Fringe	35.71%
32	Rural	64.29%

4.0 Recommendations for New Development Standards

As new development occurs in Leon County, the following recommendations are provided for the PFA and PSPZ for use of AWTS in lieu of adding new traditional OSTDS:

- Parcels within and adjacent to the target areas should use the same AWTS technology as the target area or nearby target area.
- Parcels within 2,000 feet of an existing central sewer main should be connected to central sewer where possible.
- Areas of higher development density with available parcels should be considered for cluster systems.

The recommended alternatives for currently undeveloped parcels within the PFA and PSPZ that could be developed in the future are shown in Figure 18.

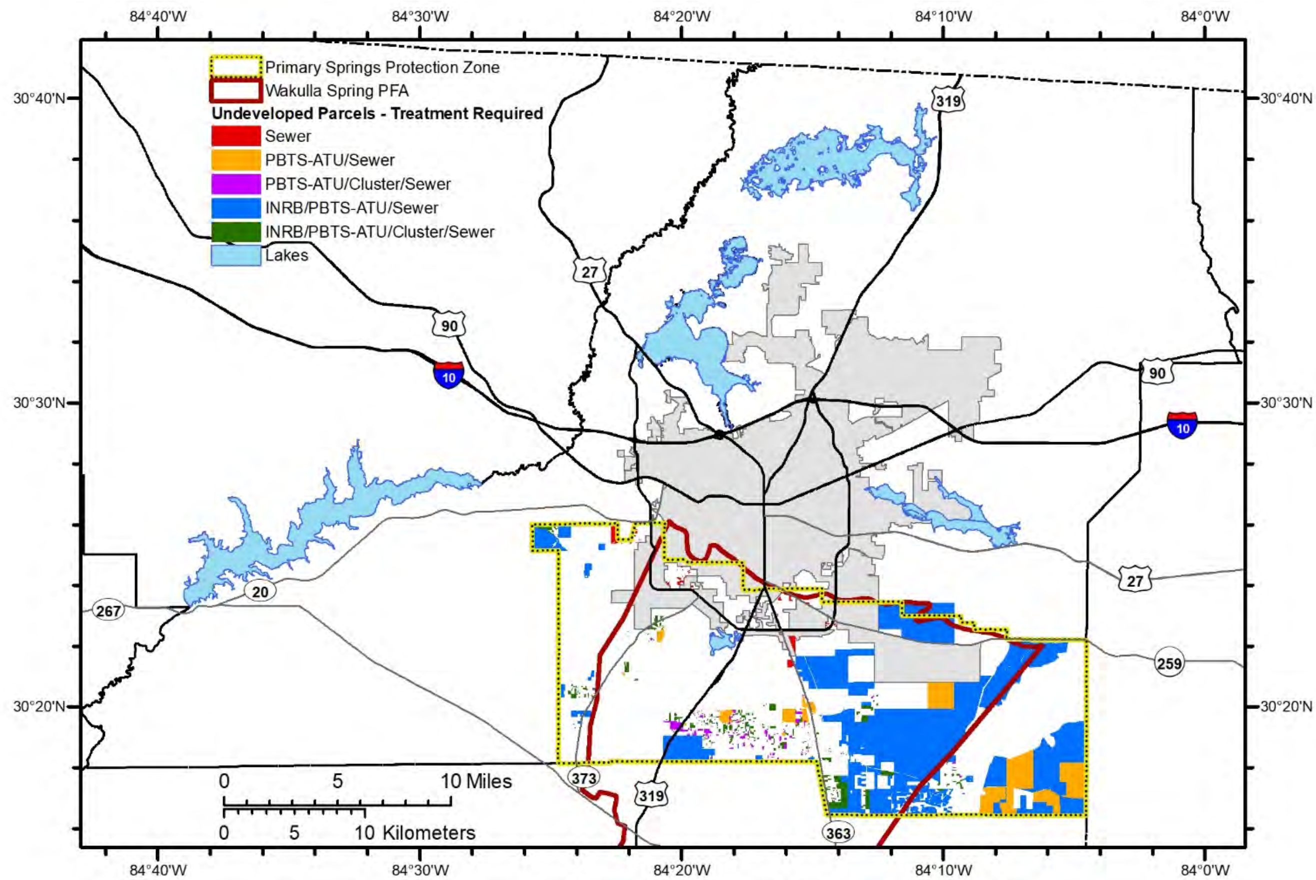

Figure 18. Recommended AWTS options for future development.

5.0 References

DEP, 2018 (June). Upper Wakulla River and Wakulla Spring Basin Management Action Plan: Division of Environmental Assessment and Restoration, Tallahassee, FL, 126 p., accessed March 8, 2020 at https://floridadep.gov/sites/default/files/Wakulla%20BMAP.pdf.

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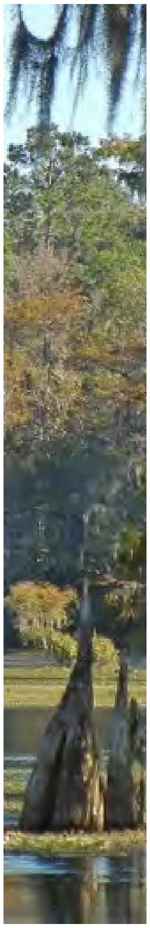
Appendix F. Task 6: Total Nitrogen Reductions Achieved Through Recommended Alternatives Report

Comprehensive Wastewater Treatment Facilities Plan
Task 6: Total Nitrogen Reductions Achieved Through Recommended Alternatives

Prepared by

October 10, 2022



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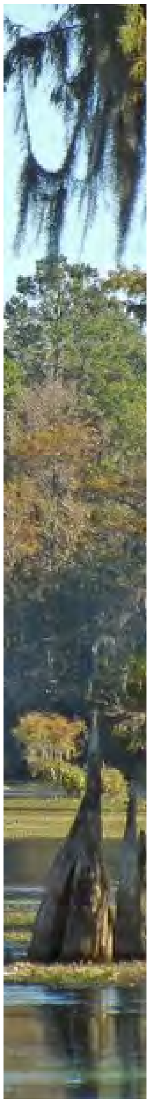

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ACRONYMS AND ABBREVIATIONS

ATU	Aerobic Treatment Unit
AWTS	Alternative Wastewater Treatment System
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
FDOH	Florida Department of Health
INRB	In-Ground Nitrogen-Reducing Biofilter
JSA	Jim Stidham & Associates
lbs/yr	Pounds Per Year
OSTDS	Onsite Sewage Treatment and Disposal System
PBTS	Performance Based Treatment System
PFA	Priority Focus Area
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
WWTF	Wastewater Treatment Facility

Executive Summary

Leon County is developing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs), as well as future development, to groundwater and surface waters. OSTDSs are also known as septic systems. The Florida Department of Environmental Protection (DEP) found that nutrient loads from several sources—including OSTDSs in Leon County—impaired Upper Wakulla River and Wakulla Spring. Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for the part of the county that loads nitrogen to the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) priority focus area (PFA). Objectives of the plan are to: (1) identify OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) identify future developments that require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County is developing the plan by progressing through eight major tasks. This report describes the results of task 6: total nitrogen (TN) reductions achieved through recommended alternatives. This task includes an evaluation of the estimated TN reductions from transitioning OSTDSs to the proposed AWTS technologies identified for the target areas in task 5. A phasing plan to achieve the DEP BMAP reductions for Leon County in the PFA is also included.

For each of the target areas within the PFA that includes Leon County, the Jim Stidham & Associates (JSA) team calculated nitrogen loads from existing OSTDSs in Leon County's portion of the PFA by following DEP's methodology used in the BMAP Nitrogen Source Inventory and Loading Tool and applying the percent nitrogen reduction for each AWTS technology. There are 2,438 parcels within Leon County in the PFA, which is 20% of the OSTDS within the two PFAs delineated by DEP in the BMAP. For these parcels, an estimated TN reduction of 17,512 pounds per year (lbs/yr) could be achieved by implementing the AWTS recommendations. This reduction falls within the range targeted for Leon County to meet BMAP requirements.

1.0 Introduction

The Florida Department of Environmental Protection (DEP, 2018) found that nutrient loads from several sources impaired the Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that these waterbodies can receive each day, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore the river and spring by identifying actions that will reduce pollutant loads to these waterbodies. The BMAP was adopted by DEP in June 2018 and requires that stakeholders, including Leon County, reduce nitrogen loads to the river and spring from onsite sewage treatment and disposal systems (OSTDSs), also known as septic systems. Leon County contracted Jim Stidham & Associates (JSA) to develop the plan to reduce nitrogen loads from OSTDSs. JSA partnered with Advanced Geospatial, Applied Technology & Management, The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop the plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP plan with a grant to the county. About 40% of Leon County is served by OSTDSs, about 20% is served by five centralized wastewater treatment facilities (WWTFs), and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (Figure 1).

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTSs), where the transition will result in the greatest reduction in nitrogen loads to the river and spring. The plan will produce guidance for the retrofit of existing development as well as direct technology selection for future development. The JSA team is creating the Leon County plan by performing the following tasks:

Task 1. Develop a nitrogen reduction score to identify likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTSs; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas (Completed)

Task 2. Quantify cost-effectiveness of AWTSs (Completed)

Task 3. Identify other factors that influence selection of an AWTSs (Completed)

Task 4. Provide education to the community regarding information compiled in tasks 1, 2, and 3 and survey opinions of the citizens of Leon County, with respect to this plan (Completed)

Task 5. Analyze implementation scenarios for AWTSs (Completed)

Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTSs (Draft Completed)

Task 7. Provide additional education to the community regarding the information compiled in tasks 1 through 6 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan

Task 8. Present the plan to the Leon County Board of County Commissioners

This report describes task 6 of the Leon County plan: total nitrogen (TN) reductions achieved through recommended alternatives. The objective of task 6 was to estimate the TN reduction from transitioning OSTDSs to the proposed AWTS technologies identified for the target areas in task 5. In addition, this task includes a phasing plan to achieve the BMAP reductions for Leon County.

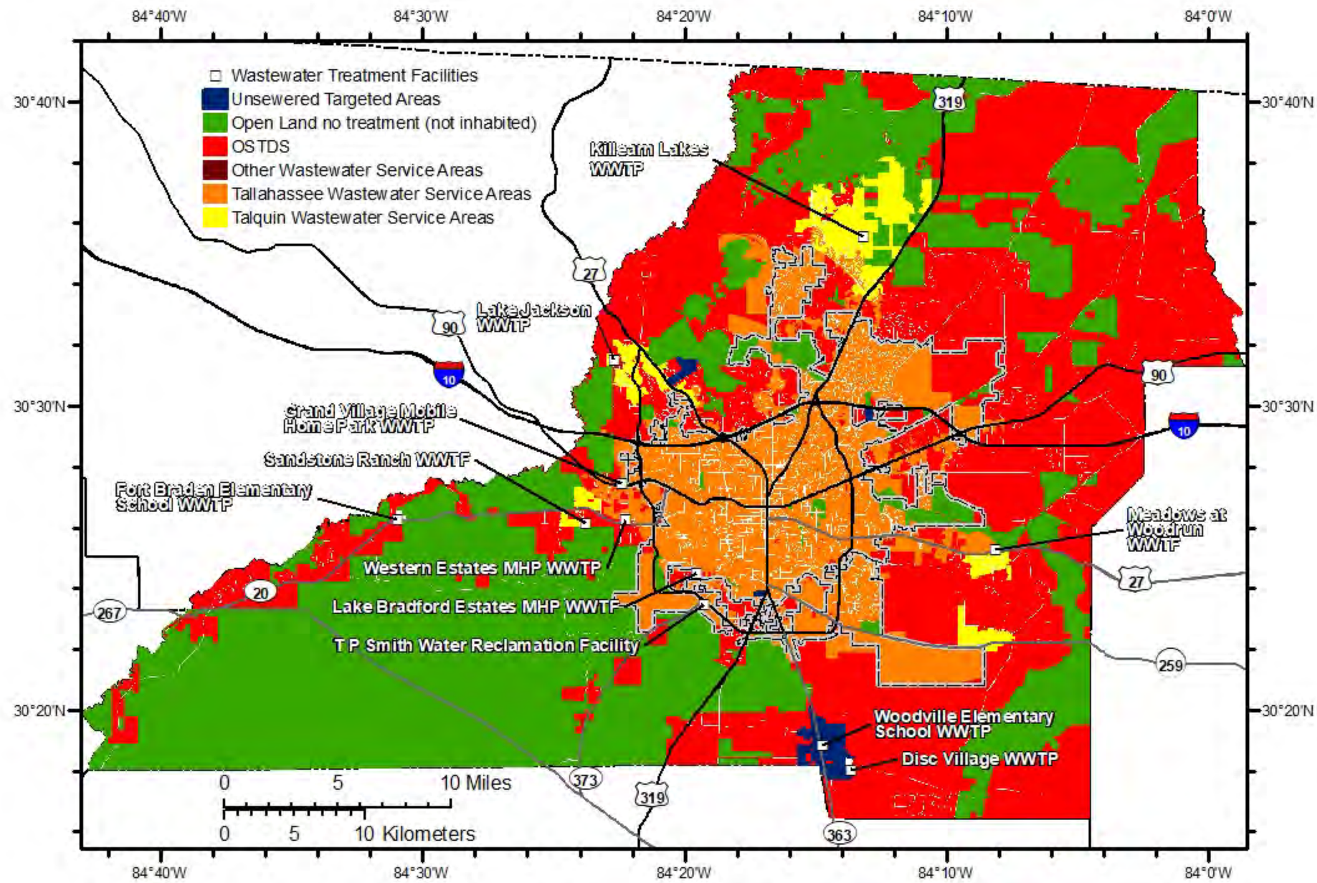

Figure 1. Parcels with an OSTDS, WWTF locations, parcels in the Tallahassee wastewater service area, and parcels in the Talquin service area.

In this report, the JSA team estimates the TN reductions from implementing the task 5 recommendations for the target areas (section 2.0), summarizes related assumptions to achieving the TN reductions (section 3.0), and recommends an approach for phasing AWTS implementation to achieve BMAP reductions (section 4.0).

2.0 Estimated TN Reductions

The Upper Wakulla River and Wakulla Spring BMAP includes an OSTDS Remediation Plan to address the nitrogen contributions from OSTDSs to the river and spring. As part of this plan, DEP estimated the potential reduction credits from upgrading existing OSTDSs to AWTSs or by connecting them to the central sewer system. DEP estimated that for the 11,917 OSTDSs in the two Priority Focus Areas (PFAs) identified in the BMAP, the potential TN reductions that could be achieved range from 77,277 pounds per year (lbs/yr), if all OSTDSs were upgraded, to 112,943 lbs/yr, if all OSTDSs were connected to the central sewer system (DEP, 2018). These estimated reductions are not an allocation and were not assigned to specific stakeholders and should be achieved by meeting statutory requirements for upgrade to an AWTS or connection to central sewer.

As noted in the task 1 report, the JSA team used Florida Department of Health (FDOH) information on OSTDS counts, which were then adjusted using professional judgement in areas where data conflicted with adjacent treatment types. Based on these updated count estimates, there are 2,438 OSTDSs within Leon County's portion of PFA1, which is about 20% of the total number of OSTDSs estimated by DEP in the two PFAs. Therefore, for this study, the JSA team targeted reductions of 20% for the Leon County

OSTDSs within PFA1 from upgrades to AWTSs or connection to the central sewer system. Based on the DEP range of reductions of 77,277 to 112,943 lbs/yr of TN, the range of reductions that Leon County should achieve to meet the TMDL requirements would be 15,455 to 22,589 lbs/yr of TN.

2.1. Target Area TN Reductions

In task 5, the JSA team identified "target areas" for the initial focus on OSTDS retrofits with recommended AWTS technologies (Figure 2). Target areas were assigned identification numbers, which do not indicate priority. Due to BMAP requirements, all parcels within the PFA are included in a target area with proposed AWTSs to achieve requirements. In addition, all areas within 2,000 feet of existing central sewer are included in a target area.

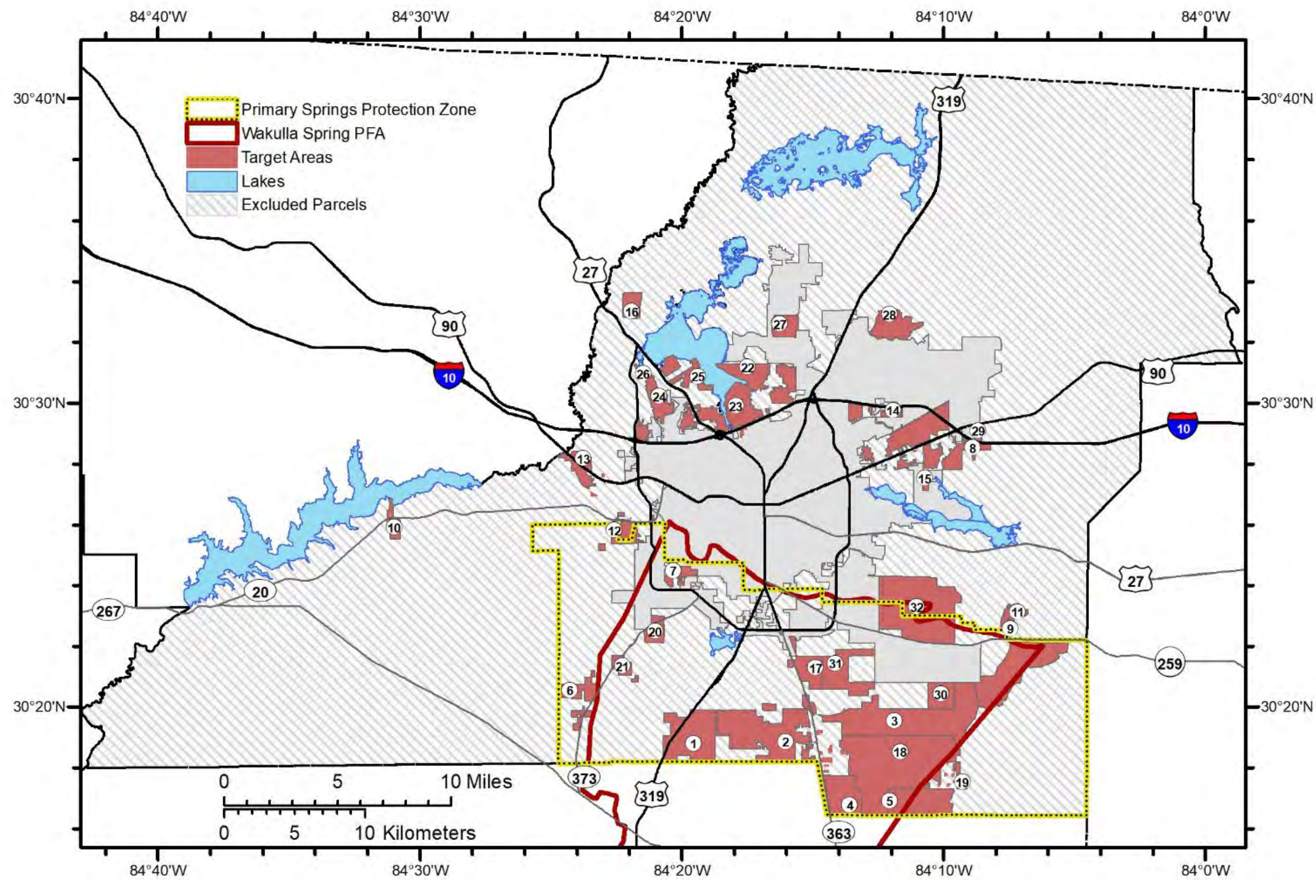

Figure 2. Overview of target areas for AWTSs.

2.1.1. PFA TN Reductions

For each of the target areas within the PFA, the JSA team calculated nitrogen loads from existing OSTDSs in Leon County's portion of the PFA following DEP's methodology used in the Upper Wakulla River and Wakulla Spring BMAP Nitrogen Source Inventory and Loading Tool (Lyon and Katz, 2018) and applying the percent nitrogen reduction from each AWTS technology shown in Table 1.

In discussions with DEP about this plan, DEP staff confirmed that the TN reduction calculations should be applied in a manner consistent with the approach currently presented in the BMAP, with the understanding that this methodology may change in the future as the BMAP is updated or revised. It should be noted that the BMAP used a 65% reduction compared to conventional OSTDSs (“Base Case” in Table 1) for all AWTSs. In this report, the efficiencies in Table 1 for aerobic treatment units (ATUs), performance based treatment systems (PBTSs), and in-ground nitrogen-reducing biofilters (INRBs) are based on information from FDOH (2020).

Table 1. Nitrogen load reduction by option, percent relative to OSTDS.

Treatment Option	Percent Nitrogen Reduction		
	Base*	Additional Treatment Relative to Base	Total Treatment
OSTDS (Base Case)	50.0%	0.0%	50.0%
ATU		+80.0%	90.0%
PBTS		+95.0%	97.5%
INRB		+65.0%	82.5%
Central Sewer		+95.0%	97.5%

* Base treatment efficiency includes reductions from the tank, drainfield, and underlying soil consistent with Lyon and Katz (2018).

The reductions for the existing OSTDS parcels within each target area in the PFA are summarized in Table 2 and shown in Figure 3. For the 2,438 parcels within the PFA, an estimated TN reduction of 17,512 lbs/yr could be achieved by implementing the AWTS recommendations. This reduction falls within the BMAP target range of 15,455 to 22,589 lbs/yr of TN as described in section 2.0.

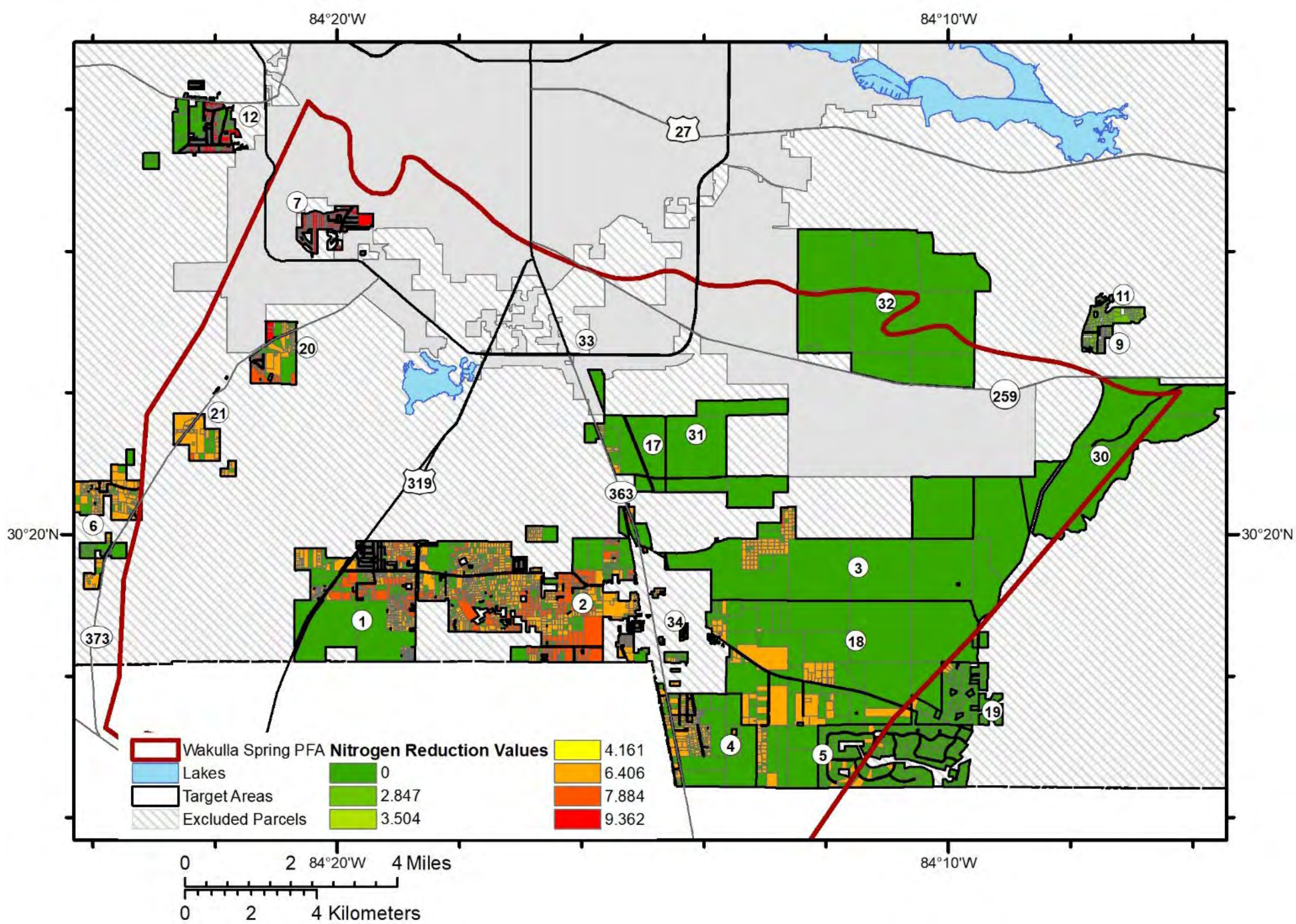

Figure 3. Estimated TN reductions for the target areas within the PFA.

2.1.2. Outside the PFA TN Reductions

For the target areas outside the PFA, the JSA team followed the same calculation methodology as outlined in section 2.1.1 to estimate the TN reductions. There are 7,630 existing OSTDS parcels within the target areas outside the PFA, which could achieve an estimated reduction of 33,353 lbs/yr of TN by implementing the AWTS recommendations. The estimated TN reductions for each target area outside the PFA are summarized in

Table **3** and shown in Figure 4.

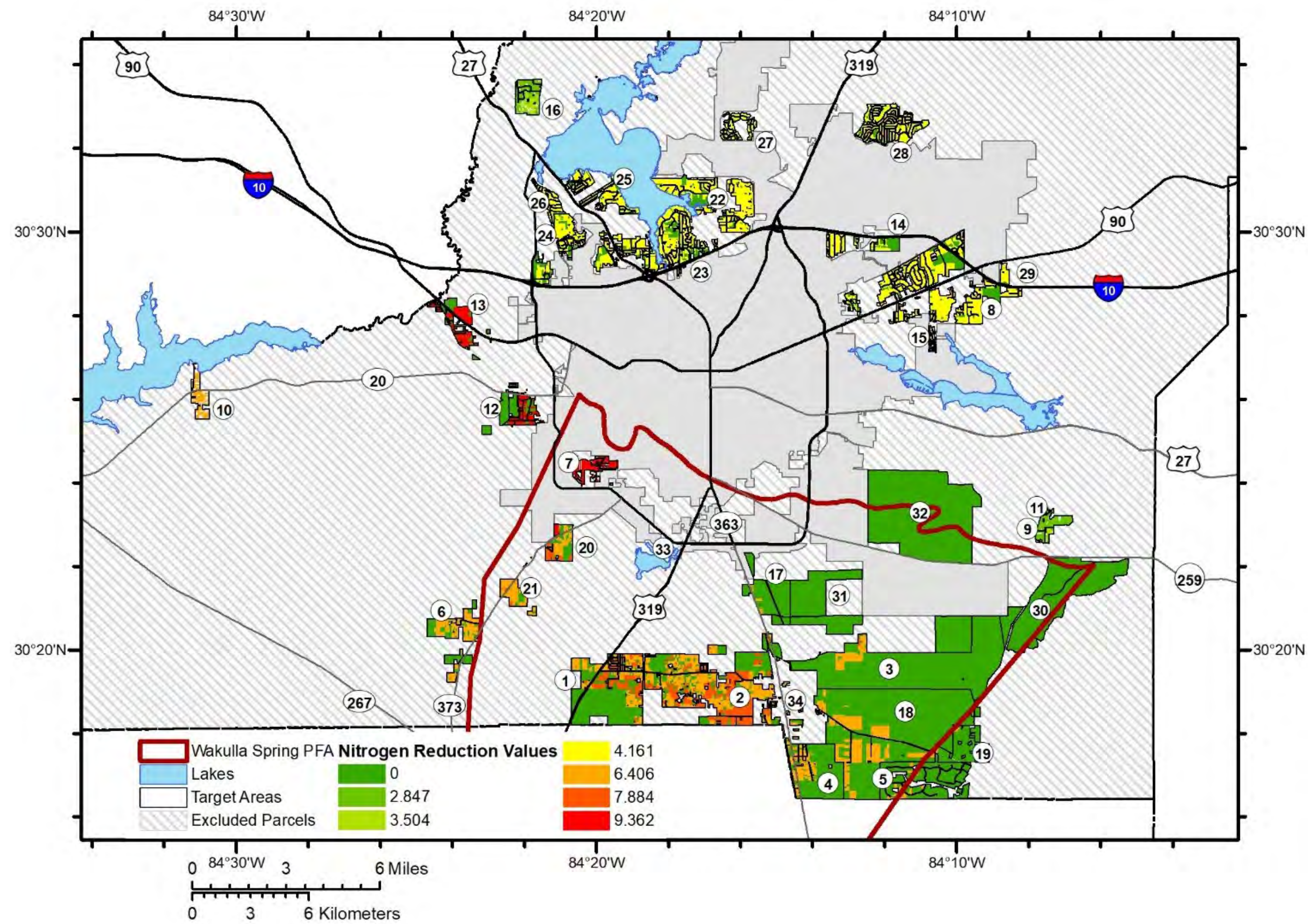

Figure 4. *Estimated TN reductions by target area.*

***Table 2.** Estimated TN reductions in the PFA by target area.*

Target Area Number	Target Area Name	Number of OSTDS Parcels	Existing TN Load (lbs/yr)	Future TN Load by Treatment Type (lbs/yr)			TN Reduction (lbs/yr)
				INRB	PBTS/ATU	Sewer	
1	Oak Ridge Road West	643	6,337	917	743	0	4,676
2	Oak Ridge Road East	854	8,416	1,624	755	0	6,037
3	Rhodes Cemetery Road	75	739	245	8	0	486
4	Pine Acres	190	1,872	593	35	0	1,244
5	Tallahassee Ranch Club	16	158	55	0	0	102
6	Spring Hill Trace/Cox Road	114	1,123	386	4	0	733
7	Lake Bradford	156	1,537	0	0	77	1,460
12	Pineridge Estates	60	591	0	0	30	562
17	Natural Bridge Road	25	246	59	16	0	172
18	Lonnie Gray Road	105	1,035	321	24	0	690
19	Robert Golden Road	1	10	3	0	0	6
20	Lakeshore	80	788	148	67	1	572
21	Huntington Estates	45	443	128	16	0	300
-	Not Applicable	74	642	153	11	8	471
Total	-	***2,438***	***23,939***	***4,633***	***1,678***	***116***	***17,512***

***Table 3.** Estimated TN reductions outside the PFA by target area.*

Target Area Number	Target Area Name	Number of OSTDS Parcels	Existing TN Load (lbs/yr)	Future TN Load by Treatment Type (lbs/yr)			TN Reduction (lbs/yr)
				INRB	PBTS/ATU	Sewer	
8	Buck Lake Woods	1,395	6,110	0	0	306	5,805
9	Kelly Court/Louvenia Woods	75	328	35	46	0	248
10	Nottingham Castle Estates/Tully Estates	90	887	310	0	0	577
11	Kellywood Farms/Powder Horn Woods	106	464	162	0	0	302
12	Pineridge Estates	168	1,656	0	0	83	1,573
13	Geddie Road/Barineau Road	194	1,912	0	0	96	1,816
14	Benjamin's Run	124	543	0	0	27	516
15	Farmview Estates/Box Wood Estates/North Lake Meadows	140	613	0	0	31	583
16	Rhodes Subdivision	284	1,244	210	129	0	905
22	Lake Breeze	597	2,615	0	0	131	2,484
23	Duck Lake Point	1,177	5,155	0	0	258	4,897
24	Rosehill	537	2,352	0	0	118	2,234
25	Killearn Acres	731	3,202	0	0	160	3,042
26	Plantation Forest Drive/Hill North Dale Drive North	325	1,424	0	0	71	1,352
27	Plank Road/Tram Road	84	368	0	0	18	350
28	Lutterloh Pond	1,455	6,373	0	0	319	6,054
29	Verdura Plantation	148	648	0	0	32	616
Total	-	***7,630***	***35,894***	***718***	***174***	***1,649***	***33,353***

2.2. Maintaining Target Reductions in Future Build Out

To maintain the target load reductions in future development within the PFA, it is important that AWTSs or central sewer be used in lieu of conventional OSTDSs. Where possible, parcels should be connected to the central sewer system to achieve the highest level of treatment. Where central sewer is not feasible, the most applicable and cost-effective AWTS technology (ATU, PBTS, or INRB) should be used to provide nitrogen reductions.

3.0 Assumptions

The following subsections discuss the assumptions related to the estimated TN reductions to achieve Leon County's portion of the requirements in the BMAP OSTDS Remediation Plan.

3.1. Property Owner Participation Rate

The anticipated property owner participation rate in retrofit activities is difficult to predict. It is likely that the participation rate is a function of grants or subsidies to fund transition from OSTDSs to AWTSs or the central sewer system. If transition is fully funded, participation would likely be greater than if transition is partly subsidized or not funded. A state grant and Leon County funding currently cover the costs associated with retrofits; however, these sources may not be available to fully fund retrofits in the future. If the regional economy is healthy and wages satisfy fundamental needs, property owners may be more willing to partly fund transition. If transition is subsidized or not funded, the property owner participation rate is likely a function of cultural value systems and opinions associated with water quality.

The estimated TN reductions provided in section 2.0 assume that all property owners within the PFA participate in either upgrading their existing OSTDSs to AWTSs or connecting to the central sewer system to meet statutory and BMAP requirements. Based on recent Leon County septic-to-sewer-projects, the property owner participation rate has varied from 60% to 96% (Table 4). Connections for several of these projects are still underway.

Table 4. *Owner participation rates in Leon County septic-to-sewer projects.*

Project	Participation Rate
Northeast Lake Munson	60%
Annawood	83%
Belair Phase 1	83%
Woodside Heights	96%
Woodville	61%

Property owner participation rates may be improved through education. Leon County may maximize participation rates in the target areas through a directed campaign to provide guidance to homeowners about the water quality benefits of transitioning to AWTSs. Such information could be attached to OSTDS repair permits and could be highlighted in within-district newsletters from the County Commissioners.

3.2. Conventional OSTDS Failure Rate

FDOH has been gathering information on domestic wastewater disposal methods throughout the state since 2014. FDOH used this information to create the Florida Water Management Inventory. The inventory for Leon County was last updated in October 2017 using parcel data from the 2016 tax assessment and the latest information from FDOH's Environmental Health database (FDOH, 2017). The inventory notes which parcels are known, likely, or somewhat likely to be served by septic systems, and provides information on construction, new, and repair permits. Based on the repair permit information, the septic system failure rate within Leon County is 19.5%. It is likely that there are more OSTDS failures than have been reported through the repair permits so the failure rate is likely higher. Additionally, 15.6% of the permits are noted as "predates 1998," which could indicate a higher likelihood of failure potential. The estimated TN reductions in provided section 2.0 assume that upgrading the existing conventional OSTDSs to AWTSs or connecting them to the central sewer system would help to reduce this failure rate and, therefore, reduce the introduction of additional nitrogen loading to the groundwater.

3.3. Reductions from Management of Conventional OSTDS

When properly sited, maintained, and operated, conventional OSTDSs are a safe means of disposing of domestic waste. However, conventional OSTDSs are not designed for nutrient removal, so even properly functioning systems will contribute high nitrogen concentrations to the system. Managing existing conventional OSTDSs to prevent failure will minimize additional nitrogen loading; however, the large nitrogen reductions needed to achieve the BMAP requirements cannot be achieved by proper management of conventional OSTDSs alone. Therefore, existing OSTDSs within the PFA must be retrofitted to AWTSs or connected to the central sewer system.

3.4. Technology Performance

The use of AWTSs within Florida is still fairly new, but these technologies are becoming more common, especially in areas around Outstanding Florida Waters that must meet the requirements of the Florida Springs and Aquifer Protection Act. Several approved ATU and PBTS models are on the market and have been used in Florida for years. INRBs are newer systems that are currently being tested throughout Florida, including within Leon County.

The estimated TN reductions in presented in section 2.0 are calculated using the best currently available information about AWTS performance. As these systems are more widely used and tested throughout Florida, better information about their performance will become available. Adjustments to the recommended technology for some of the target areas may be needed in the future based on this newer information.

4.0 Phasing to Achieve BMAP Reductions

The AWTS upgrades in the PFA target areas can be evenly distributed between now and the end of 2040 to help spread out the costs for meeting the BMAP requirements. This would result in an average of 132 OSTDS retrofits per year over the next 18.5 years. The retrofits should start in target areas 2 and 1, which combined are 62% of the existing OSTDS parcels within the PFA. The next target areas would be 4, 7, 6, and 18, which make up an additional 23% of the existing OSTDS parcels within the PFA. The remaining parcels in target areas 20, 3, 12, 21, 17, 5, and 19, plus several parcels outside a target area but within the PFA, should then be retrofitted. The cost of these conversions is not the responsibility of Leon County but of the property owner, much like the maintenance of the septic system is the responsibility of the property owner.

There are several technical and physical constraints for implementing these phasing recommendations that could affect the timing to achieve the BMAP target reductions.

- Owner participation – As noted in section 3.1, the estimated reductions in this report are based on 100% implementation, which would require that all property owners within the PFA upgrade their conventional OSTDSs to AWTSs or connect to the central sewer system. Without full participation, the total estimated reductions cannot be achieved, and additional target areas may need to be retrofitted to meet BMAP requirements to make up the difference.
- Funding availability – Owner participation is related to funding availability. If grants or other subsidies are available to help offset all or part of a property owner's cost to retrofit their existing OSTDSs to AWTSs or connect to the central sewer system, it is more likely that property owners will participate. In addition, funding will be needed for regional infrastructure for the cluster systems and central sewer system expansion. Without outside funding from state and/or federal sources, it will be difficult to achieve the BMAP reductions within the 20-year timeline.

- Technology feasibility – As noted in section 3.4, the estimated reductions are calculated using the efficiencies in Table 1. These efficiencies are based on the best information currently available. If any of the technologies are less efficient than estimated, alternative technologies may need to be used in a target area and/or additional target areas may need to be retrofitted to meet the BMAP requirements.
- Future development – As development continues within the PFA, the recommendations in section 2.2 must be implemented to reduce the amount of nitrogen loading associated with that new development. It is important that future development use nitrogen-reducing systems, instead of conventional OSTDSs, to prevent new nitrogen-loading sources to the river and spring.

If additional reductions are needed to meet BMAP requirements, transition to AWTSs within the target areas closest to the PFA will likely become a requirement, and these areas should be prioritized for retrofit after the PFA target area retrofits are completed.

For target areas outside the PFA that are not needed to meet BMAP reductions, the plan recommendations can be implemented as opportunities arise and funding becomes available. The cost of these conversions is not the responsibility of Leon County but of the property owner. The phasing for the target areas recommended for sewer connection should follow the timing in the City of Tallahassee 2035 Master Sewer Plan Update (Hatch Mott MacDonald, 2016).

5.0 References

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Appendix G. Task 7: Public Input on Tasks 1 Through 6 Report

Comprehensive Wastewater Treatment Facilities Plan

Task 7: Public Input on Tasks 1 Through 6

LEON
FLORIDA'S CAPITAL COUNTY

Prepared by

JSA
ENGINEERING HYDROLOGY GEOLOGY

AGI

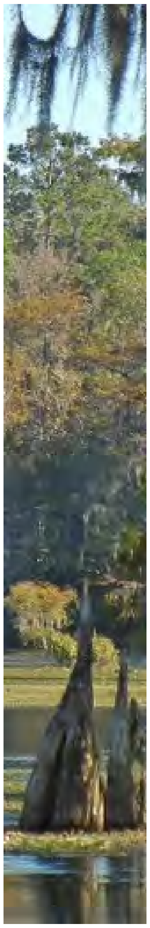
ATM
A Geosyntec Company

The Balmoral Group

Magnolia Engineering, LLC

TETRA TECH

October 23, 2022



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ACRONYMS AND ABBREVIATIONS

AWTS	Alternative Wastewater Treatment Systems
BMAP	Basin Management Action Plan
CWTFP	Comprehensive Wastewater Treatment Facilities Plan
DEP	Department of Environmental Protection
FDOH	Florida Department of Health
GIS	Geographic Information System
INRB	In-ground Nitrogen Reducing Biofilter
JSA	Jim Stidham & Associates
NSILT	Nitrogen Source Inventory and Loading Tool
OSTDS	Onsite Sewage Treatment and Disposal System
PFA	Priority Focus Area
PSPZ	Primary Springs Protection Zone
TMDL	Total Maximum Daily Load
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

Leon County is developing a plan to reduce nitrogen loads from existing onsite sewage treatment and disposal systems (OSTDSs), as well as future development, to groundwater and surface waters. OSTDSs are also known as septic systems. The Florida Department of Environmental Protection found that nutrient loads from several sources—including OSTDSs in Leon County—impaired Upper Wakulla River and Wakulla Spring.

Leon County's plan has two parts: (1) a comprehensive wastewater treatment facilities plan for the entire county, and (2) a more focused facilities plan for part of the county that loads nitrogen to the Wakulla River and Wakulla Spring. Objectives of the plan are to: (1) identify OSTDSs to transition to alternative wastewater treatment systems (AWTSs) where the transition will most reduce nitrogen loads to surface waters and groundwater; and (2) identify future development that will require AWTSs to reduce nitrogen loads to surface waters and groundwater.

Leon County is developing the plan by progressing through eight major tasks. This report describes the results of the seventh task: public input on tasks 1 through 6. This task involved a series of five public meetings with stakeholders throughout the county to obtain input on the findings from the project tasks.

1.0 Introduction

The Florida Department of Environmental Protection (DEP) found that nutrient loads from several sources impaired Upper Wakulla River and Wakulla Spring. To develop a plan to restore the river and spring, DEP calculated the maximum amount of nitrate that the river and spring can receive each day, while still satisfying water quality standards. This maximum amount is called a total maximum daily load (TMDL). DEP prepared the Upper Wakulla River and Wakulla Spring Basin Management Action Plan (BMAP) to restore these important waterbodies by identifying actions that will reduce pollutant loads to the river and spring. DEP adopted the BMAP in June 2018.

As part of the BMAP, DEP developed a Nitrogen Source Inventory and Loading Tool (NSILT) to provide information on the major sources of nitrogen in the BMAP area including atmospheric deposition, wastewater treatment facilities (WWTFs), urban fertilizers, onsite sewage treatment and disposal systems (OSTDSs) (also known as septic systems), livestock wastes, and agricultural fertilizers. The NSILT found that the largest contribution of nitrogen loading is from OSTDSs. Therefore, the BMAP requires that stakeholders, including Leon County, prepare a plan to reduce nitrogen loads to the river and spring from OSTDSs. Leon County contracted with Jim Stidham & Associates (JSA) to develop an OSTDS remediation plan. JSA partnered with Advanced Geospatial, Applied Technology & Management, The Balmoral Group, Magnolia Engineering, and Tetra Tech to develop this plan. JSA and these partners are referenced throughout this plan as the JSA team.

The Leon County plan has two parts: (1) a comprehensive wastewater treatment facilities plan (CWTFP), and (2) a more focused facilities plan for the part of the county governed by the BMAP. The CWTFP is funded through a grant from the Blueprint Intergovernmental Agency. DEP funded the BMAP plan with a grant to the county. About 40% of Leon County is served by OSTDSs, about 20% is served by five centralized WWTFs, and about 40% is government land that will not likely be developed during the next few decades and will not likely require wastewater treatment (Figure 1).

The objective of Leon County's plan is to identify existing OSTDSs to transition to alternative wastewater treatment systems (AWTSs), where the transition will most reduce nitrogen loads to the river and spring. The plan will produce guidance for retrofit of existing development as well as direct technology selection for future development. The JSA team is creating the Leon County plan by performing the following tasks:

- Task 1. Develop a nitrogen reduction score to identify the likely contribution of nitrogen from OSTDSs to groundwater and surface waters; use the score to quantify, rank, and identify OSTDSs to transition to AWTS; and establish nitrogen reduction criteria for AWTSs for each of the separate delineated areas (Completed)
- Task 2. Quantify cost-effectiveness of AWTS (Completed)
- Task 3. Identify other factors that influence selection of an AWTS (Completed)
- Task 4. Provide education to the community regarding information compiled in tasks 1, 2, and 3 and survey opinions of the citizens of Leon County, with respect to this plan (Completed)
- Task 5. Analyze implementation scenarios for AWTS (Completed)
- Task 6. Calculate the anticipated decrease in nitrogen load to the Upper Wakulla River and Wakulla Spring, between 2020 and 2040, due to OSTDS transition to AWTS (Completed)
- Task 7. Provide additional education to the community regarding the information compiled in tasks 1 through 6 and conduct additional survey of opinions of the citizens of Leon County, with respect to this plan (Draft Completed)
- Task 8. Present the plan to the Leon County Board of County Commissioners

This report describes task 7 of the Leon County plan: public input on tasks 1 through 6. Section 2.0 summarizes the public meetings held and Section 3.0 summarizes the feedback received.

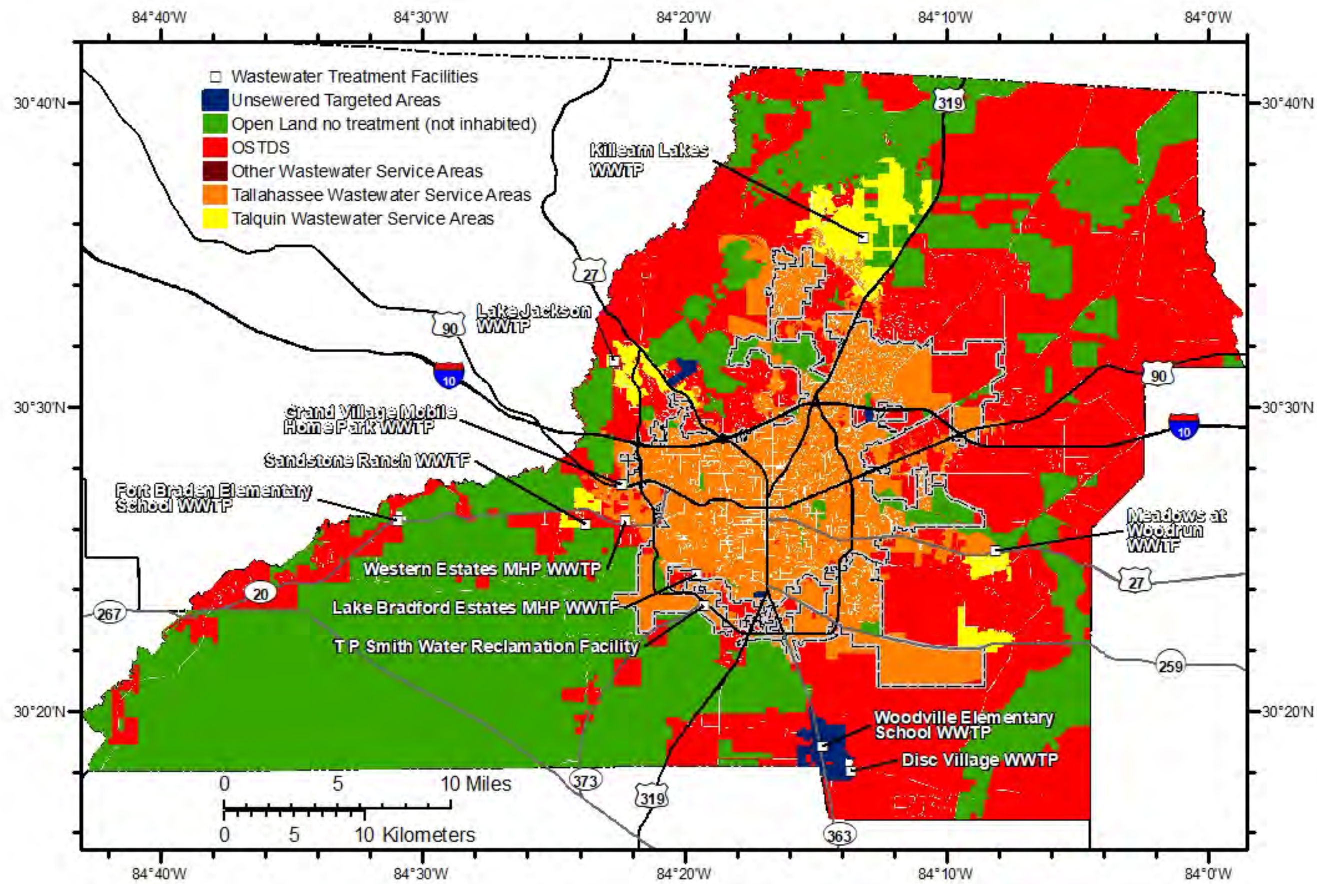

Figure 1. Parcels with an OSTDS, parcels in the Tallahassee wastewater service area, parcels in the Talquin service area, and WWTFs.

2.0 Public Meetings

Five public meetings were held to summarize tasks 1 through 3, which were previously presented to the public as part of task 4, and to discuss the tasks 5 and 6 reports and findings. The first meeting was a virtual meeting held through Zoom on October 17, 2022. In-person public meetings were held October 18 through October 20, 2022, in different areas of Leon County to make attending the meeting more accessible. A second virtual meeting was held on October 21, 2022, through Zoom. The virtual meetings were recorded and posted on the county's website at LeonCountyFL.gov/wastewater.

Table 1 summarizes the public meetings held as part of task 7.

Table 1. Task 7 public meetings.

Date	Meeting Location	Number of Participants
October 17, 2022	Zoom webinar	3
October 18, 2022	Oak Ridge Elementary School, 4530 Shelfer Road	8
October 19, 2022	Fort Braden Elementary School, 15100 Blountstown Highway	17
October 20, 2022	Celebration Baptist Church, 3300 Shamrock Street East	1
October 21, 2022	Zoom webinar	6

In addition, the JSA team presented the project findings to the Leon County Science Advisory Committee on August 5, 2022, through Zoom and to the Leon County Water Resources Committee on September 12, 2022, through Zoom.

2.1 Meeting Noticing

The Leon County Office of Community & Media Relations advertised the public meetings through the following methods:

1. Issued a public notice
2. Advertised on Twitter, Facebook, and Nextdoor
3. Placed variable message boards at locations near each of the in-person meeting venues including outside Fort Braden Elementary School, two locations near Celebration Baptist Church, Wakulla Springs Road, and two locations on Woodville Highway
4. Advertised on the Leon County website
5. Directly emailed the participants from the Task 4 meetings
6. Placed flyers at the Woodville and Fort Braden community centers and libraries

3.0 Feedback Received

During the public meetings, feedback was obtained through a comment/question period following the project presentation and from comment forms that were distributed to the participants. The comments and questions raised during the meetings are discussed here, and the formal comments provided through the comment forms are included in Appendix A.

For the first meeting, held via Zoom on October 17, 2022, none of the participants had any questions.

During the first in-person meeting on October 18, 2022, the following questions and answers were discussed:

Q: What do all these organizations [on the project team] do?
A: We are a group of engineers. Advanced Geospatial provides the geographic information system (GIS), database driven, support. This is where a lot of the maps and data came from for the algorithms used in the project. The Balmoral Group is looking at the costing and financial piece. Tetra Tech is public communications. JSA and Magnolia Engineering are civil engineering. Applied Technology & Management is environmental engineering.

Q: How did you calculate the additional load that will occur by extending sewer from above the Cody Scarp to below the Cody Scarp since that will add more load at the sprayfield?
A: The question is what happens if we take the nitrogen from the northern part of the county where it likely would not make it to the river and now send it to the T.P. Smith WWTF. We did not address this – we just looked at nitrogen reduction across the parcels. This is one of three plans to meet the BMAP requirements and this additional loading will be accounted for in the City of Tallahassee plan.

Q: How did you address growth? Even though the systems are going to advanced treatment, growth could increase the load.
A: We did have a population growth component where we looked at the number of dwelling units and the potential of growth for each parcel. This information was part of Task 2 where future growth was included to evaluate capacity at the WWTFs over a 20-year horizon.

Q: For the percent treatment from in-ground nitrogen reducing biofilters (INRBs), did your team have time to read the comments from around the country that were submitted to the Florida Department of Health (FDOH) during rulemaking? Not one said these are great systems and many said the systems are significantly flawed. Damon Anderson said the systems FDOH approved are not what he tested. There were two main differences: (1) liners, but the Wakulla Springs Alliance asked Leon County to include lined systems; and (2) pressure dosing since most systems locally are gravity systems. Those two factors have an impact on the efficacy of the systems and longevity. One of reasons the sawdust lasted so long in the testing is because of the anaerobic environment but this is now aerobic. Kevin Sherman, who was with FDOH and now is in the private sector, said his concern was the media would degrade and not only lose its ability to be a carbon source but also make people's yards a mess. My concern is that there are no tests. It will have an impact on these calculations if the systems go south.
A: INRBs are the passive systems discussed in the presentation, and these are one of most cost-effective options based on the numbers from the state. There are many people against this type of system. We have approached this as these systems are approved and permitted by the state of Florida so we will use these as allowed. Leon County has installed many of these systems and have been sampling them. DEP is also running a concurrent system side-by-side and sampling influent, each media layer, and discharge. The goal is to determine the actual treatment efficiency of these systems.
Q: You can put lysimeters in for pressure systems but where do you test to look at media? I have been asking the folks at DEP if they will provide a methodology for testing.
A: There will be preferential pathways in a gravity system. Leon County is also looking at the lined system, which does have more of a history of use. There is a memo of understanding with the county, DEP/FDOH, and Wakulla Springs Alliance to install some of these lined systems before the rule was out. These systems are being tested to determine treatment efficiency. If we find out that the efficiency is not what we have in the report, the GIS tool allows for updates to the values. This is a dynamic tool that can be updated as new are data available and parcels developed.

Q: I went to a meeting last year where some of these ideas were presented and there was mention of the cost to a homeowner. I filled out an application for grant funding and I had a lot of comments and a few phone conversations and that all disappeared with the change in administration. I looked at the chart of costs and appreciate you being realistic but where is the funding supposed to come from if no government funding is available? I heard that the Woodville project is being funded at no cost to them. In my part of the world, we are supposed to convert our systems so where is the money coming from?
A: This is a 20-year plan to go from where we are currently to fully converted. There have been some grants coming out to help with funding. If you could provide your contact information, Leon County staff will check where you are on the list because there is funding for pilot projects to test the INRB systems. There is a new grant coming from DEP that reimburses up to $7,500 but the homeowner can choose any system for upgrade, based on the conditions at your property and ideally what is recommended from the study. You would hire your own contractor and the county would reimburse you. There is a separate application that we can share with you. It would be up to the homeowner to pay until more grant funding is available.
Q: Is someone going after funds? I know my neighborhood and there is not a lot of money. I want to be part of solution but I do not want to bankrupt myself doing that.
A: Leon County is in constant contact with DEP about funding.

Q: How much is the new grant?
A: The grant is $1.11 million. It will cover 148 systems at a cost of $7,500 each. Leon County is not taking an administration fee from the grant.

Q: I am a homeowner nearby, and someone came into my yard with a tractor and placed a sewage line right in front of my door and are also putting meters in. What is going on?

A: Your area is part of the City of Tallahassee's sewer expansion project, so it sounds like they are installing the line in front of your house. Once they are finished, the city will approach you about connecting. I am not sure about their funding mechanism – sometimes they have grant funding and sometimes there is a fee.

Q: One of the things that set the price for INRBs was the original $10,000 grant. The installers loved them because they were able to install them at a great margin. Under Leon County's program, the average cost is about $16,000. I think when the $7,500 grant comes out it will drive down the prices. I am also very concerned about the Lake Munson extension. Our study estimated a cost of $20,000–$25,000 per household, and I am not sure how $7,500 will cover this. The big concern from homeowners is that they will have a monthly payment and will have to pay out of pocket to connect.
A: For any of the Leon County septic-to-sewer projects, if you sign up to connect to sewer while the project is under construction, there is no cost to the homeowner for the connection. Once the project is done and we leave, then the cost is on you as homeowner.
Q: What is the cost per home for the Woodville project?
A: The project has four phases including a master pump station and three or four smaller pump stations. When all the phases are completed there will be 1,000 homes connected.

Q: I live east of Woodville Highway. Will the city or county cover my area? I am part of an association that pays for everything so how does that affect me?
A: That area is part of the second phase of the Woodville sewer project. You should sign up to connect by either providing your contact information tonight or going to the county's website.

Q: What is the communication going to be? Will I wake up one day with a bulldozer in my yard or will you send a notice?
A: We will send you a notice and meet with you on your property before doing anything. Someone from JSA will contact you directly to perform soil borings to ensure that an INRB will work. Assuming that it does, we will go to the county for permitting. There are two contractors that will bid on the project and then we will set up a pre-construction meeting with you, county, and contractor before any work is done to discuss where everything will go and a timeframe. Construction usually takes about 4–5 days.

Q: One of the things that the county has done in the past, which is the reason why all the homes are not connected in Killearn, is that state law requires that a homeowner has to connect if they are notified that sewer is available. The county has not notified people so they did not have to connect.
A: In Leon County, a project like this requires notifying Development Services and they will notify everyone within the project area and hold meetings. For the Annawood project, public meetings were held in the subdivision and we went door-to-door and even made phone calls to get people signed up. The county does reach out to each property owner, and most grant funding requires a minimum participation percentage.

Q: If I am already connected to the city sewer, will there be another cost to me?
A: There will be no additional cost. As far as the state is concerned, connection to the sewer system is the best option for reducing nitrogen.

Q: When the Wakulla Springs Alliance helped get funding for this project, they did not think it would take this long or cost this much. The thought was existing information could be used to come up with a plan quickly.
A: We were hoping it would be a lot easier but, in getting into the project, we found that more information had to be brought into the process along with coordination with other groups. The end

goal is to improve the environment most cost-effectively. In addition, the BMAP was adopted that included other elements that had to be addressed.
Q: Blueprint set aside $2.8 million for this effort and only $500,000 was used for the plan. Can some of this funding be used to help offset homeowner costs?
A: This additional funding will not be available until 2035 and is allocated to other plans so it cannot be used for connections.

During the second in-person meeting on October 19, 2022, the following questions and answers were discussed:

Q: For the residents in the affected areas, will you be notifying them about the rule coming out and how they can apply for a grant? Will you provide them with reputable companies to install the systems? If they fail to install them, will you fine them?
A: There are grants available and an INRB project is underway now. A new grant will be coming soon from DEP that is $1.11 million for upgrading systems in the Priority Focus Area (PFA), since this is the area that is required to upgrade. For those homeowners within the PFA, DEP has list of contractors. The county generally does not recommend contractors. Outside the PFA, there is no funding available since upgrades are not a requirement. The county continues to have discussions with DEP about funding.

Q: There is one target area in the Fort Braden area. Is this the school?
A: No. This is a neighborhood that had a large density of septic systems where there would be good bang for the buck to upgrade the systems.

Q: This cannot be the first place this was implemented. How is it going in other areas?
A: There are some completed plans in central Florida. Wakulla County recently completed an implementation plan since they have a lot of septic system parcels. These plans are a requirement for all Outstanding Florida Springs throughout the state. In some areas, implementation is going well and in other areas, there is some push back on upgrading or connecting septic systems.
Q: In other areas, I am guessing the push back is coming from people who cannot afford it. Will they be fined or forced to connect?
A: There will likely not be a fine but if a septic system fails in the PFA, the owner will not be able to get a permit to repair it so they will have to upgrade. While the county has some regulations, they do not conduct septic system permitting. That occurs through FDOH/DEP. The county does work in close coordination with FDOH and DEP. As far as we know, they are not issuing fines but systems will be required to upgrade when they fail.

Q: Will this be required even if I do not live in the PFA?
A: No. If you live outside the PFA and your system fails, you can replace it with the same system.

Q: What is the extent of this project?
A: The requirements apply within the PFA and Primary Springs Protection Zone (PSPZ). Fort Braden is largely out this area.
Q: If Fort Braden is outside this area, why is a portion included in a target area?
A: The JSA team was tasked with looking at the entire county as part of this project. In task 1, we looked at variety of factors, such as development density, soil types, and how quickly water is going to the groundwater, to give an area a vulnerability score. Due to the number of homes and geologic conditions, this area received a higher score and was identified as a target area.

Q: Florida is getting 8,000 people moving in every month. My neighborhood has run out of property to build, which I see a lot around Lake Talquin. If any anyone builds new, will they have to comply with these requirements?

A: Not in the Fort Braden area because it is outside of the PFA. Any new development will have to meet county development codes that vary based on location. As part of this project, we developed a GIS system that is dynamic so if things change in terms of density, the county can put that information in and update the scoring.

Q: Is there an average cost to the homeowner?
A: The project does include estimates with the average cost by system type. The $7,500 grant reimbursement may cover most of an INRB upgrade but the costs for ATUs and PBTSs range up to $20,000. As soon as the rules and guidance went into place, the county jumped onto developing this plan to have as much of the 20-year timeline available to help get grants.
Q: If funding does not come through, will the homeowner have to pay?
A: Yes. This is not a county requirement but a state requirement. The county is trying to come up with a plan to help obtain grants. So far, the state has been forthcoming with funding.

Q: What happens with elderly people who are on a fixed income? Does the county help to find them financing?
A: The county only assists through the grant program. There are people on fixed incomes who have applied for funding and received funding through the existing grant program.

Q: In the presentation, you indicated that the state could expand the PFA. What would cause that?
A: If DEP made a change, it would be due to the target goals not being met. The reductions are being made to see improvements at the spring. However, if you think of how water is moving, this area flows to Lake Talquin so the PFA would likely not be expanded to Fort Braden.

Q: For the systems that were installed, have you seen a benefit?
A: It takes a while to see changes in the groundwater. There was an improvement in the water quality at the spring after the T.P. Smith WWTF was upgraded. When larger neighborhoods are fully converted, not just individual properties, we will be able to better see the benefits.

Q: I thought the major source was fertilizer. Am I wrong about that?
A: Fertilizer is a component of the loading but it has been addressed to an extent.
Q: How do you stop people from going to buy fertilizer and putting it down?
A: The county has a fertilizer ordinance that blacks out when fertilizer can be applied. The county also conducts public outreach to remind people about the fertilizer ordinance requirements.

Q: If I have a parcel in the PFA and I want to build a home, can I put in a traditional septic system?
A: No. You will have to install an upgraded system or connect to the sewer system.

Q: You mentioned that the city has a master plan. Did the county help with that plan?
A: The city's master plan is periodically updated to plan for potential sewer routes. The target sewer areas from that plan were added as target areas in this project. The county does work in conjunction with the city on sewer projects, such as in the Woodville area.

Q: I know that the state has put in a lot of test wells, including some near here in the forest. Have you looked at the water from these wells?
A: Those wells are for a different effort. For this project, we are using the BMAP approach to estimating the nutrient load reduction benefits.

Q: What is the timeline before the drainfield has to be retrofitted again?
A: ATUs and PBTSs have similar lifespans as traditional septic systems. INRBs are newer systems that are still being tested but the estimate is that they will also have the lifecycle.

Q: What is the cost to fix the system if it breaks?
A: The costs vary depending on the system. The estimated costs in the project include repair costs.

Q: For current septic systems, pump out is the normal maintenance routine. What is the routine for these systems and what is the cost?
A: The cost estimates in this project for each system include operation and maintenance, as well as repair costs. INRBs just have a modified drainfield so the pump out for the tank would be similar to a traditional system. ATUs and PBTSs involve changes to the tank with pumps and blowers so there are electrical costs and repair costs for those components. The estimated costs in the project include repair and replacement over a 20-year life cycle.

Q: The cost table shows that a central WWTF with a lift station that will handle 1,000 or 10,000 people has a permitting cost of $100. However, the INRB permit cost is $600.
A: The larger WWTF permitting fee is spread across multiple people, which is why the fee is $100. The cost of one permit is being applied to multiple homes instead of just one.

Q: Have you considered running sewer to those areas in the PFA that are close to the WWTF?
A: The county has run a line to Woodville for that purpose. The cost per homeowner for sewer is higher than an upgraded septic system but there is a large population and a large load that will be addressed. The county is working on several septic-to-sewer projects including Northeast Munson and recently completed Woodside Heights and one phase of Belair and Annawood. While those county projects are in design and construction, the county covers the cost for anyone who chooses to connect to sewer. The homeowner will only have the monthly sewer charge. The county is working to tie in more areas as funding becomes available.

Q: Is there a website where all this information can be found?
A: Leoncountyfl.gov/wastewater will take you to the page for this project. If you go to leoncountyfl.gov/waterresources, it will have the information on all the septic-to-sewer projects.

Q: What is the target date for presenting the plan to the Board of County Commissioners?
A: We are presenting at the December 13 meeting.

During the third in-person meeting on October 20, 2022, the following questions and answers were discussed:

Q: Even though Leon County wanted you to look at the entire county for this project, it seems that you are primarily looking at the southern portion.
A: The state requirements are for the southern portion of the county, and that part of the plan must be implemented by 2040. We did look at the entire county for reduction opportunities because nitrogen will be an issue as additional development occurs. The plan allows the county to know where focus areas should be moving forward.

Q: Is Killearn not an issue right now?
A: There is an issue in the Killearn chain of lakes but that area does not have as much of a focus from the state. The state is mostly focused on the springs, and there is state funding available for projects in the PFA.

Q: It will be interesting to see how you will address all the parcels in the south. Someone will have to pay for this.
A: The county has received some grant funding that people are taking advantage of to upgrade their systems.

For the second Zoom meeting, and final public meeting, on October 21, 2022, the following questions and answers were discussed:

Q: I wanted to confirm that the 33,353 pounds per year of additional nitrogen reductions is just within Leon County.
A: Yes. This is the estimated load reduction from the target areas within Leon County and outside the PFA.

Q: I have been trying to find the task 6 report but the link for task 6 keeps giving me the task 1 report.
A: The county will fix the link and send you an email once it has been corrected.

Q: Could you please provide the target nitrogen load reduction for the entire PFA?
A: DEP estimated that for the 11,917 septic systems in the two PFAs, the potential TN reductions range from 77,277 pounds per year, if all OSTDSs were upgraded, to 112,943 pounds per year, if all OSTDSs were connected to sewer. The 2,438 septic systems within Leon County in the PFA are about 20% of the total so our target range was 15,455 to 22,589 pounds per year.

Q: Are there discussions with Wakulla County to see how much they expect to do?
A: As part of the BMAP, each county had to complete a similar plan. Wakulla County recently completed their facilities plan, which has gone to their board for approval and has been submitted to DEP. When we selected the 20% target value, we talked with DEP and they appeared to be on board at that time. Since the estimated reductions fall within the middle of the target range of reductions, this plan should be sufficient.

4.0 Appendix A. Public Comments Received and Responses

The following table includes the formal comments received during the public review period for task 7, as well as the JSA team response.

Task 7: Formal Public Comments Received

Commenter	Task	Location	Comment	Response
Bill Landing	N/A	N/A	During the presentation I wondered how well we have quantified the various nitrogen sources to the springshed so I re-read Chapter 3 of the BMAP document. I think it would be very helpful to start your public meetings with a quick review of the loading data so that the public understands why sewage is the target of your evaluation and reporting. These data should also be included in any sort of "executive summary", once again to emphasize why sewage treatment is the important topic.	Additional detail about the nitrogen sources and why the focus is on septic systems was added to the Task 7 and Task 8 reports.
Bill Landing	N/A	N/A	I also think it is important to re-evaluate the impact of livestock on nitrogen loading. Livestock excrement cannot be a net source of nitrogen unless they are being fed with fodder that has been imported from outside the springshed. If they are eating from fertilized pastures then the input is from fertilizer and the livestock themselves serve to lower the net loading as they grow. If they are eating from unfertilized pastures then they are a net sink for nitrogen (as they grow). I think loading from livestock is improperly quantified (too large) in the BMAP Chapter 3.	Noted. This item would need to be addressed by the Florida Department of Environmental Protection (DEP) in future updates to the nitrogen loading estimates.
Scott Hannahs	N/A	N/A	A metric to show that this plan is effective and working is essential. A periodic repeat of the NSILT survey would tell us if we are reducing nitrate/nitrite loading into the ecosystem. This has shown in the past the city spray fields reduced from the major contributor to one of several and the current leading contributor to nitrate/nitrite at the Wakulla springs is now OSTDS in the area.	Noted. This item would need to be addressed by DEP through future updates to the Nitrogen Source Inventory and Loading Tool (NSILT).
Scott Hannahs	N/A	N/A	The INRB is a label that hides a host of issues. The original design called for a site specific engineered solution. Now it is whatever the local installer can do for the $10K allocation and still make a profit. These need a proven design and the capacity to monitor their functionality. Monitoring all the advanced treatment systems for correct installation and operation is essential. I know this is a future phase but starting to show the necessity of a Responsible Management Entity is necessary for any of this to make sense. Otherwise we are just helicoptering money and hoping it does some good. There are many assumptions in the operation of this Wastewater Treatment Plan and one needs to have actual data that the reality is matching the plan.	Leon County and DEP are monitoring several options for INRBs currently and the Task 8 report includes a recommendation to continue monitoring.
Scott Hannahs	5	Figure 3	Task 5, figure 3 is sort of confusing and trivial? It has multiple boxes but they all go to the same point. It could just be summarized that the lowest cost solution should be selected without a diagram. It is one of those things where the report writer was trying to make it look sciencey. Just be straight forward about the result. Which does turn out to be “lowest cost”. However, that should be lowest cost effectiveness, in that getting a cheap solution that doesn’t remove nitrate/nitrite is not really what you want. It should be the lowest cost/effectiveness solution.	This figure outlines the queries used in the GIS database to factor in cost in the selection of the technology. The text will be clarified to better explain what is occurring in this step.
Scott Hannahs	5	Section 4.0	And my last note that I have asks about if it is recommended that all future development that is new sewered be AWTS? Including other areas of the county outside the PFA and the PSPZ? These are lower infiltration as shown in the vulnerability maps, but there are always significant karst features nearby. Thus the vulnerability of the area is not controlled by just the underlying geology but by the nearest direct line to a karst feature. I don’t think there are hydrological maps that can show the underground direction of flow to each karst feature from any point so a direct line is the best guess for a uniform topology.	The report focus on future development is within the PFA and PSPZ since this portion of the County has requirements related to OSTDS. Application of the report recommendations for future development areas outside the PFA and PSPZ would be at the discretion of the County.
Sonia Nalon	N/A	N/A	This is a worthwhile project. While meetings have been informative, communication between meetings has been difficult for me.	Leon County staff took your contact information during the meeting and followed up by phone the next day.
Sonia Nalon	N/A	N/A	Nobody brought it up, but what about nitrogen runoff from fertilizer? Is that a part of your study? There are a lot of lawns & gardens in SW Leon County, plus some small scale farming.	As part of the basin management action plan (BMAP), DEP developed the NSILT to provide information on the major sources of nitrogen in the BMAP area including atmospheric deposition, wastewater treatment facilities, urban fertilizers, septic systems, livestock wastes, and agricultural fertilizers. The NSILT found that the largest contribution of nitrogen loading is from septic systems. Therefore, the BMAP requires that stakeholders, including Leon County, prepare a plan to reduce nitrogen loads from septic systems so those were the focus of this project.
Sonia Nalon	N/A	N/A	I’m concerned that so few homeowners or residents attended this week’s meeting, also the one last August. I know your responsibility is to present the information, but more people need to know about this.	The Leon County Office of Community & Media Relations advertised the public meetings through a variety of methods, and meetings were held throughout the county and via webinar to provide options for interested residents to attend. The meetings were noticed according to state requirements with at least two weeks' notice.
Wakulla Springs Alliance	N/A	N/A	Calculations do not adequately address the increase in Load for the capture of waste in Septic to Sewer projects from projects north of the Cody scarp that are in areas with a confining clay layer. Although the COT Wastewater treatment facility treats to a low concentration of N, any added waste from these areas adds pounds of N to the Target Area that may decrease the chances of achieving the 17K+ lbs. of N removal the plan is trying to achieve.	A portion of the loading from septic systems above the Cody Scarp does impact the river and spring. Treating that wastewater at the City of Tallahassee WWTF instead of through individual septic systems will have an overall benefit to the river and spring.

Commenter	Task	Location	Comment	Response
Wakulla Springs Alliance	N/A	N/A	Growth in the county in the 2040 window is not adequately addressed in the plan for both residential and commercial new Septic and sewer connects. The plan does recognize that any growth will be served by either advanced treatment Onsite systems or sewer that will generate low concentrations of N, these new generators of waste will add load to the target area.	New development within the PFA and PSPZ must connect to the sewer system or use nitrogen reducing septic systems per state requirements. The estimated load reductions presented in the plan focus on existing septic systems, consistent with the BMAP. The new development will contribute to the nitrogen loading but at a lesser amount than if it used traditional septic systems.
Wakulla Springs Alliance	N/A	N/A	Septic to sewer projects assume a high participation rate in the CWTFP to achieve targeted N reduction, but tie in rates have historically been low in past Leon County projects. This is exemplified by the very low tie in rate in Killearn Lakes sewer project.	As noted in the Task 6 report, the property owner participation rate has varied from 60% to 96%. Within the PFA and PSPZ, the connection to the sewer system or upgrade to nitrogen reducing systems is a state requirement, which should increase the participation rate.
Wakulla Springs Alliance	N/A	N/A	The use of INRBs as the primary, and almost exclusive, choice for conversions of conventional septic to Advanced treatment poses a significant risk of over-estimating the N reduction from the use of these types of systems for these reasons. These INRBs that do not conform to the systems that were designed in the Passive Nitrogen Study done for The State of Florida by Hazen and Sawyer. They lack both a liner and pressure dosing which the study systems had. Lacking a liner reduces the time the Effluent can come in contact with the ligneous carbon source media confined to this part of the drain field. Adequate time is need for the carbon source media to chemically interact with the effluent to reduce N discharge. Also, without a liner the ligneous carbon media source is in an aerobic environment instead of the anaerobic environment that the liner provides which will result in a much more rapid degradation of the carbon source which may result in Loss of efficacy of the carbon source as it degrades resulting in lower ability to remove N, As the carbon source degrades and shrinks in volume it may cause a depression in the drain field area causing the system to fail. Lacking pressure dosing INRBs, that distributes effluent to the entire drain field, there are challenges for even being able to test them properly. With installations using liners and pressure dosing it is possible to use proven testing methodologies by placing test well Lysimeter in various locations around the drain field to determine how much N is being reduced and discharged into the environment. DEP has yet to come up with an effective way of testing installations of INRBs without liners and pressure dosing, although some test sites are currently being set up. INRBs installed without liners and pressure dosing, even though this is a FL DEP approved design, have yet to be tested to determine their ability, in both the long and short run, to actually reduce N and to what degree. INRBs installed with liners and presser dosing have had some limited testing but not enough to demonstrate their efficacy in the short and long run either. Very few of these more robust INRB systems have even been installed.	The recommendations in the plan are made based on the best available information about the systems, local conditions, costs, and benefits. As new information is available, it can be incorporated into the plan GIS tool to evaluate any changes to the recommended technologies. Leon County and DEP are currently installing and monitoring several INRB systems, including those with liners, to obtain better information on the efficiency within the county conditions.