Comprehensive Wastewater Treatment Facilities Plan

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

LEON
FLORIDA'S CAPITAL COUNTY

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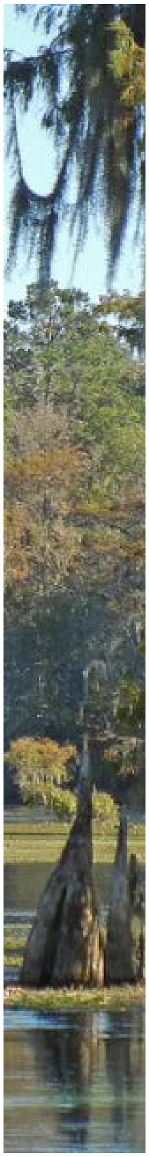

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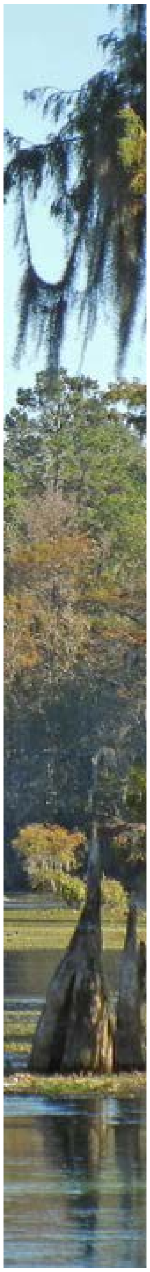

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ACRONYMS AND ABBREVIATIONS

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
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
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.

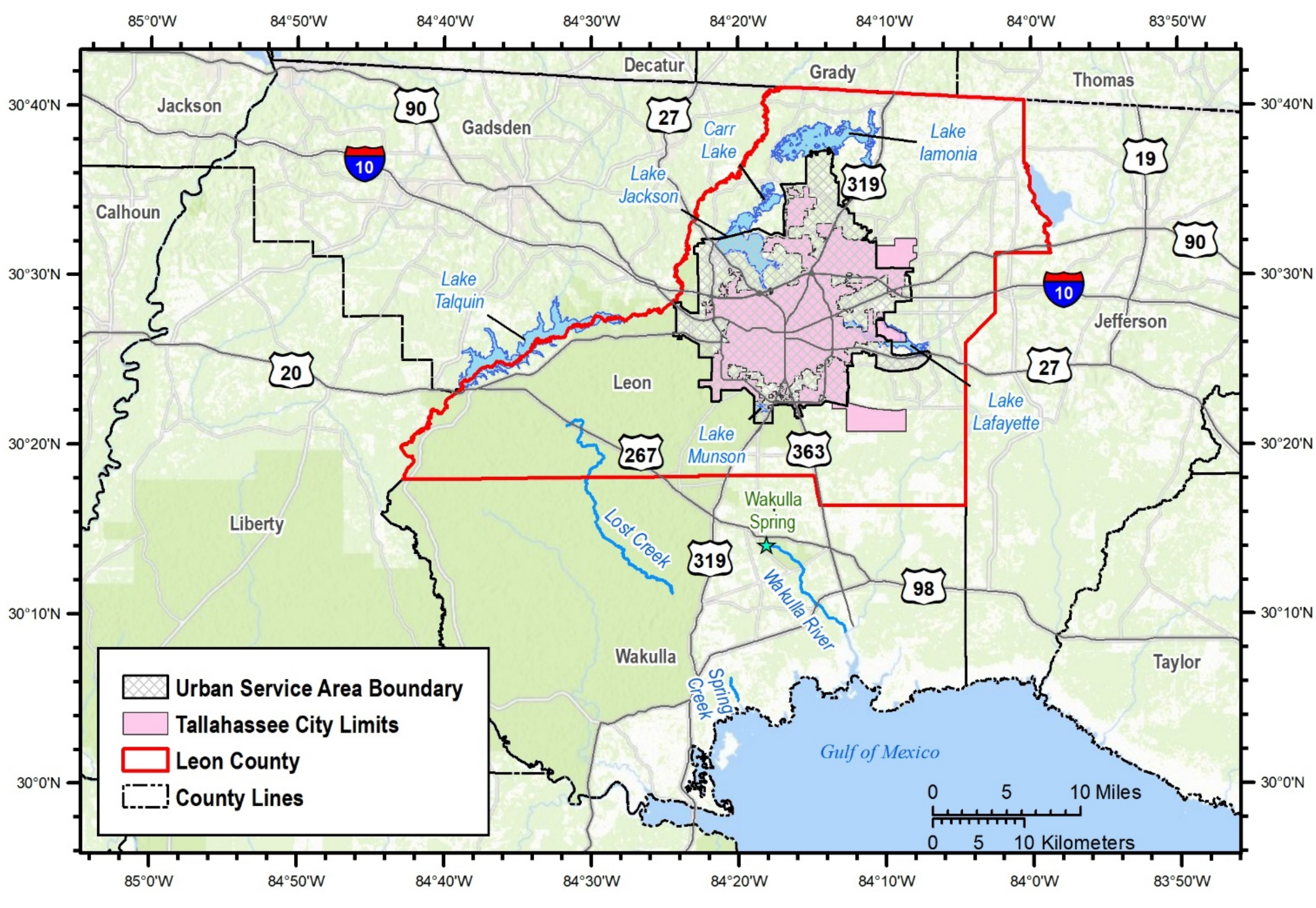

Figure 1. Unincorporated Leon County, surrounding counties, City of Tallahassee, the urban service area boundary, selected surface waters, and Wakulla Spring.

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).

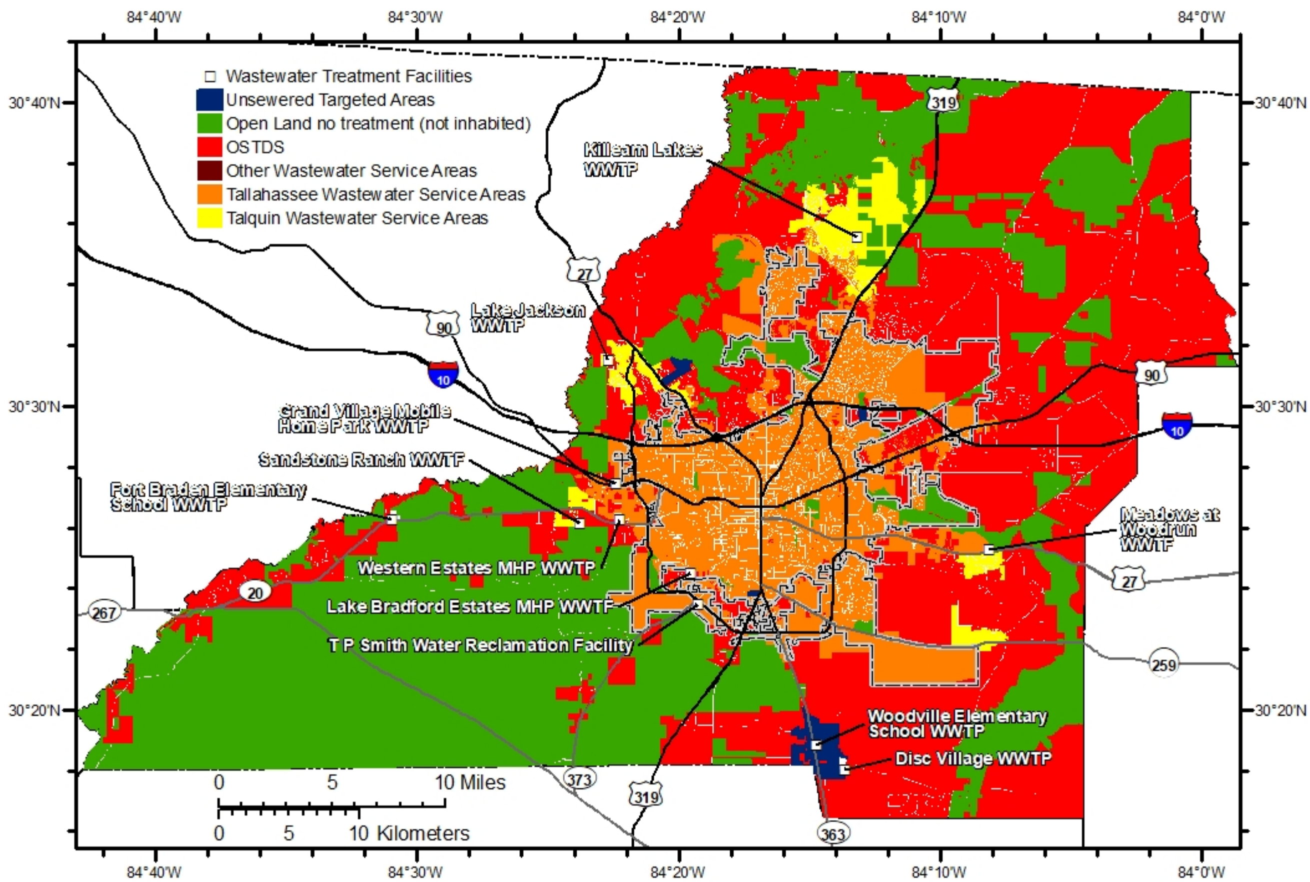

Figure 2. Parcels with onsite sewage treatment and disposal systems (OSTDSs), centralized wastewater treatment facilities (WWTFs) and wastewater treatment plants (WWTPs), parcels in the Tallahassee wastewater service area, and parcels in the Talquin service area.

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 the 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 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).

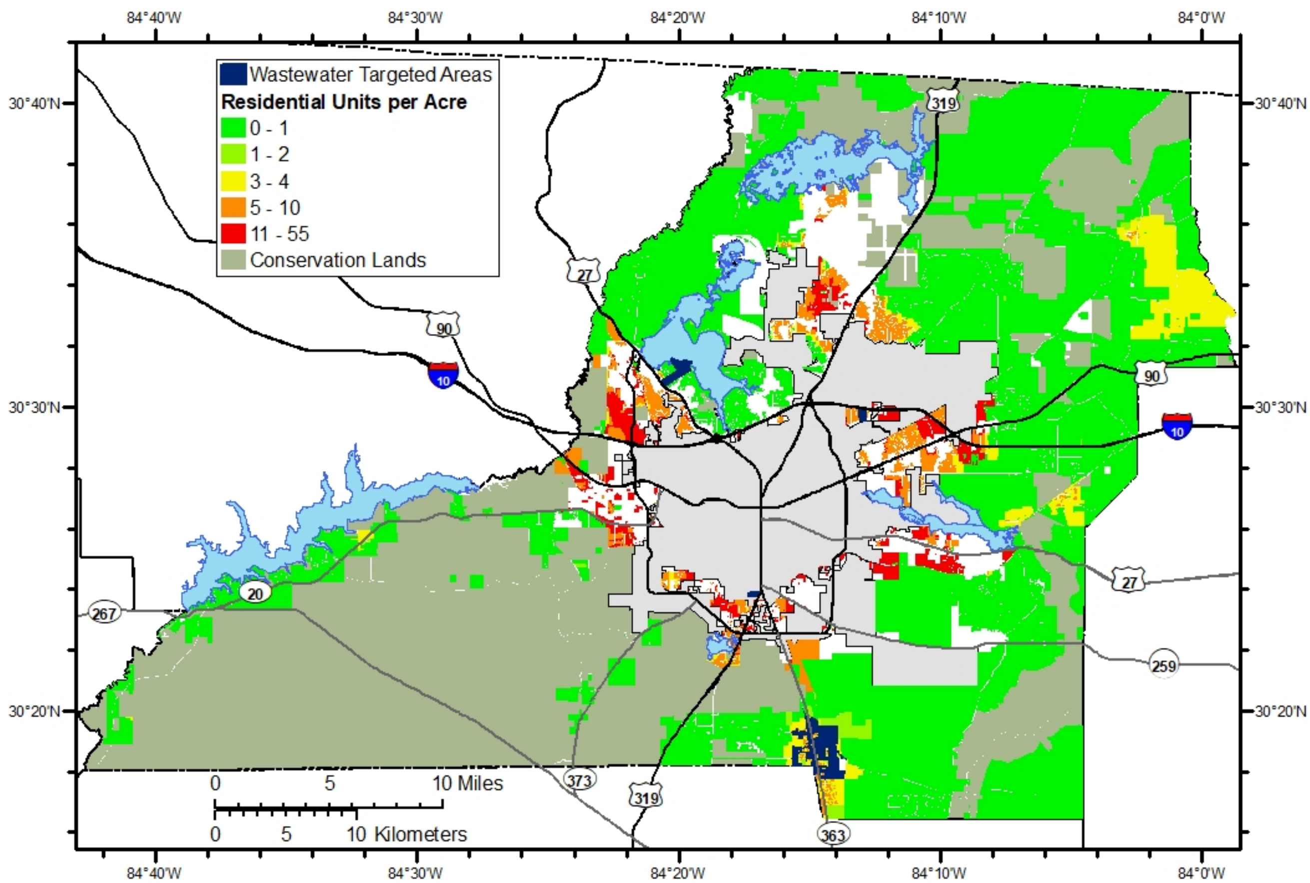

Figure 3. Potential OSTDS density, in development units per acre, at build-out, in unincorporated Leon County. Conservation lands are government land that will not likely be developed.

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.

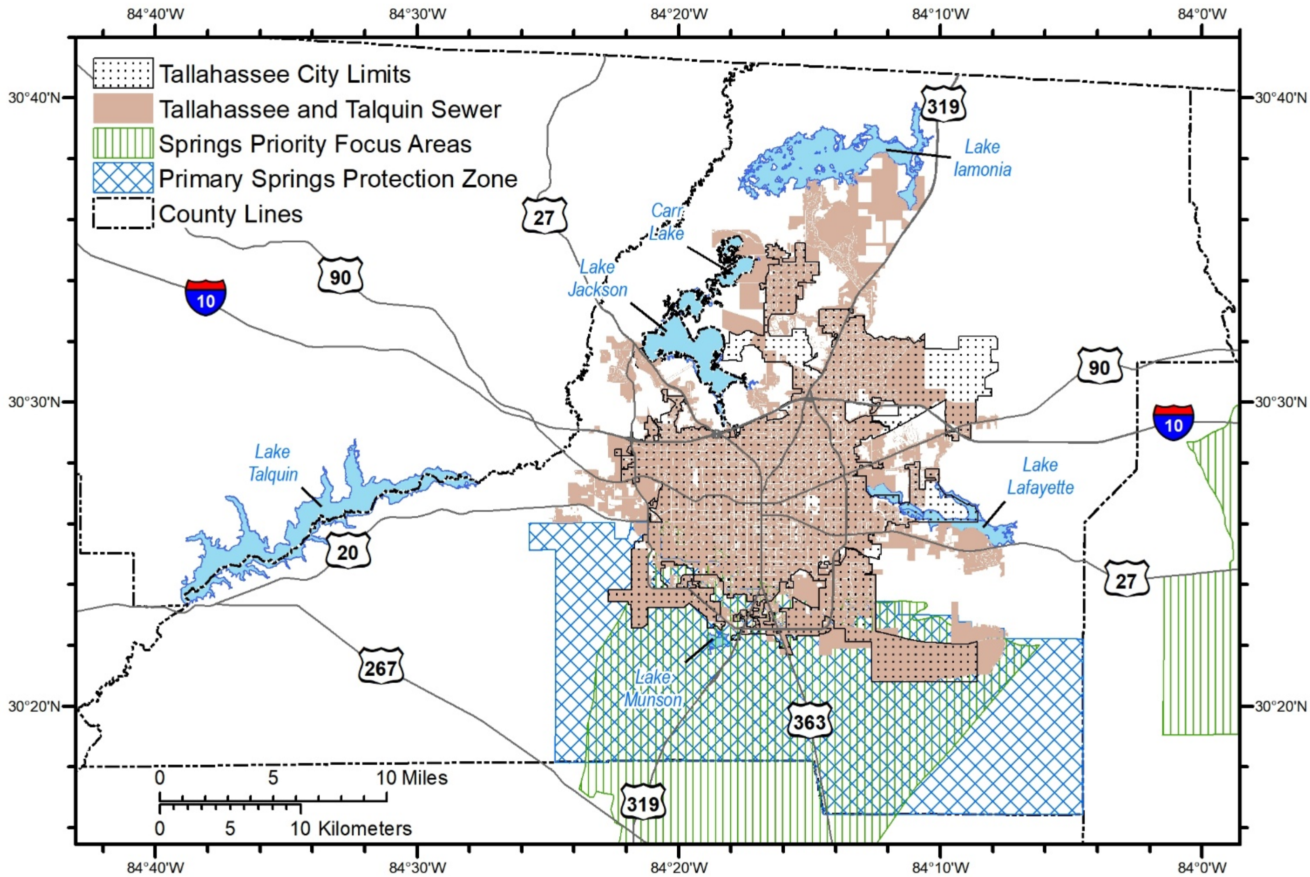

Figure 4. Priority focus areas, Primary Springs Protection Zone, and wastewater service areas.

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

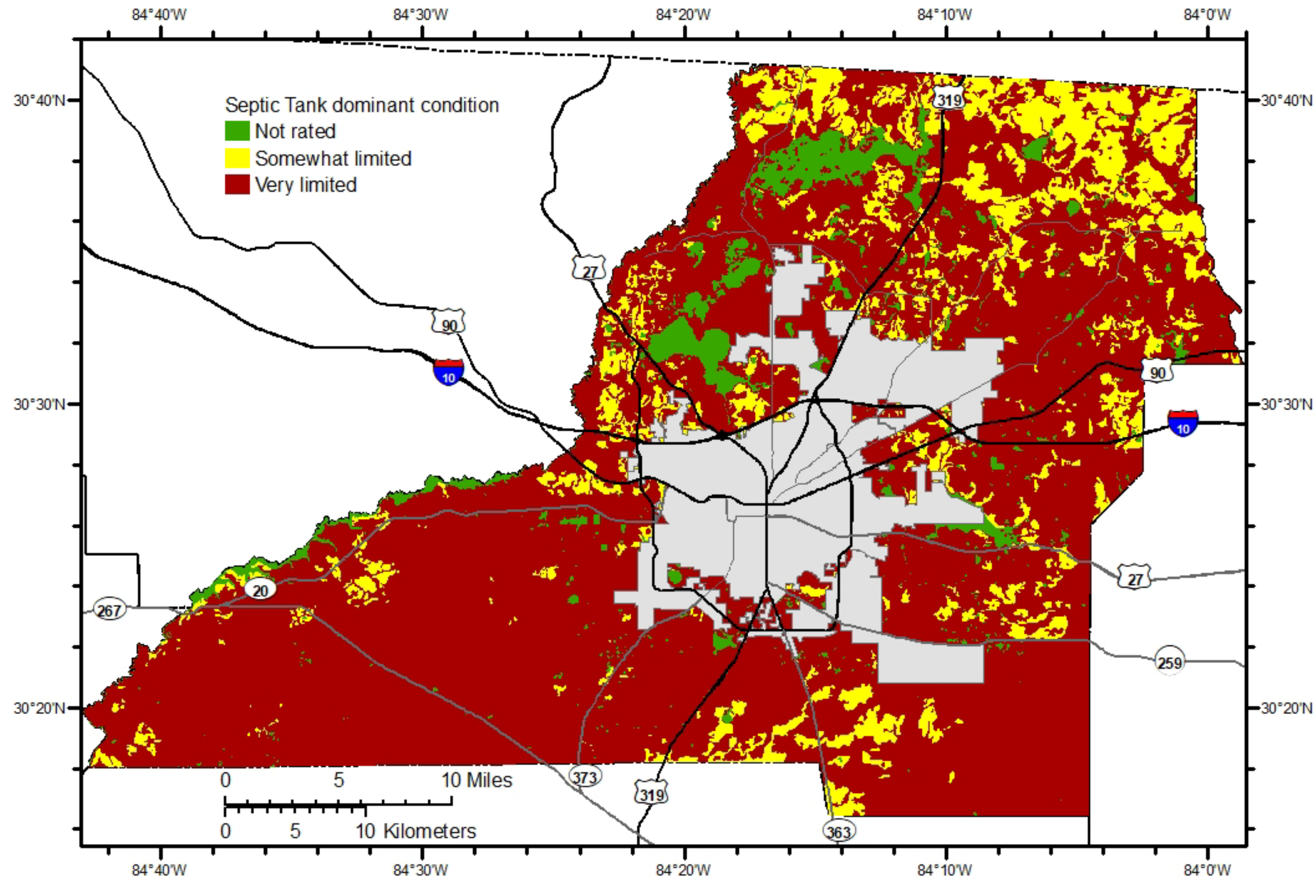

Figure 5. Dominant onsite sewage treatment and disposal system suitability condition in unincorporated Leon County.

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.

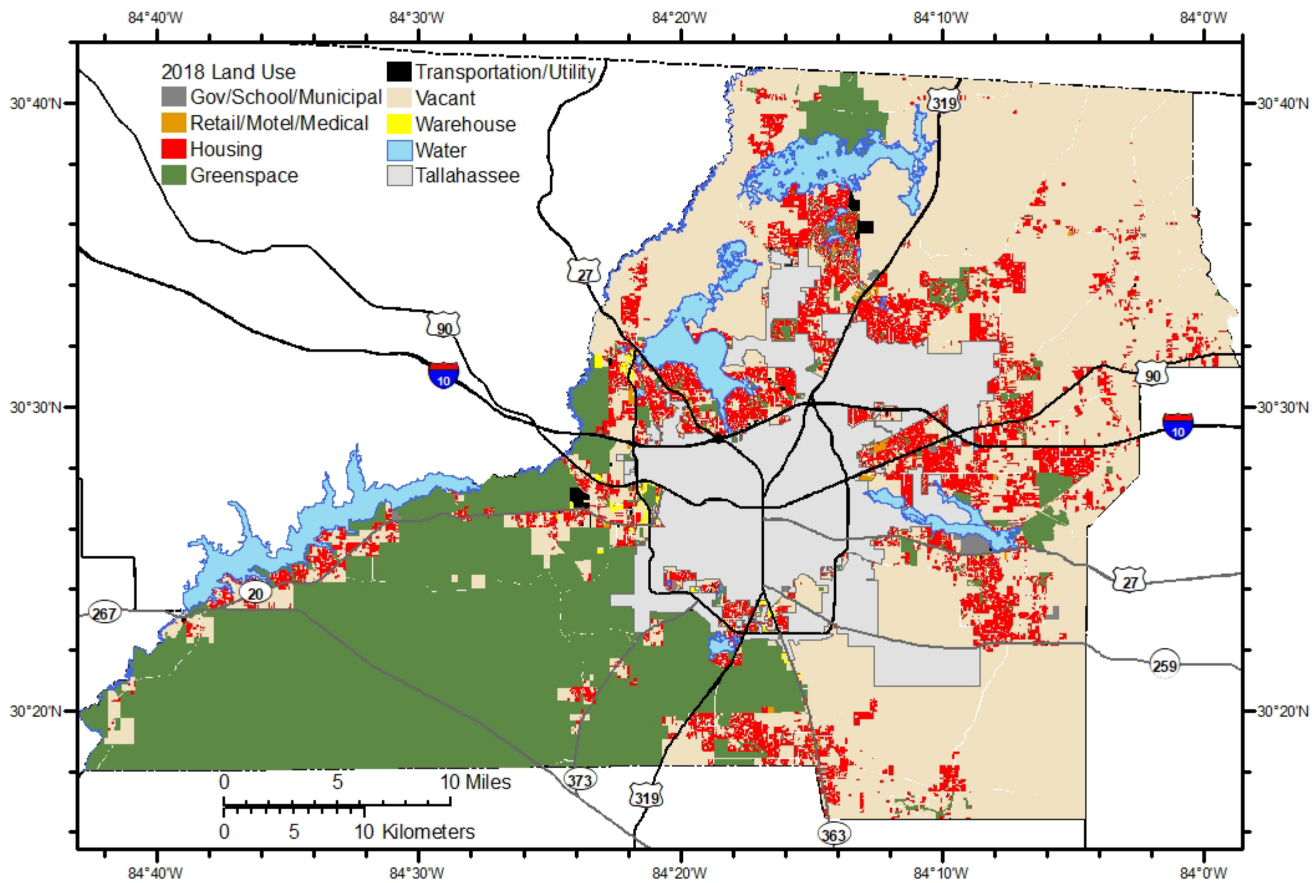

Figure 6. 2018 land use in unincorporated Leon County.

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.

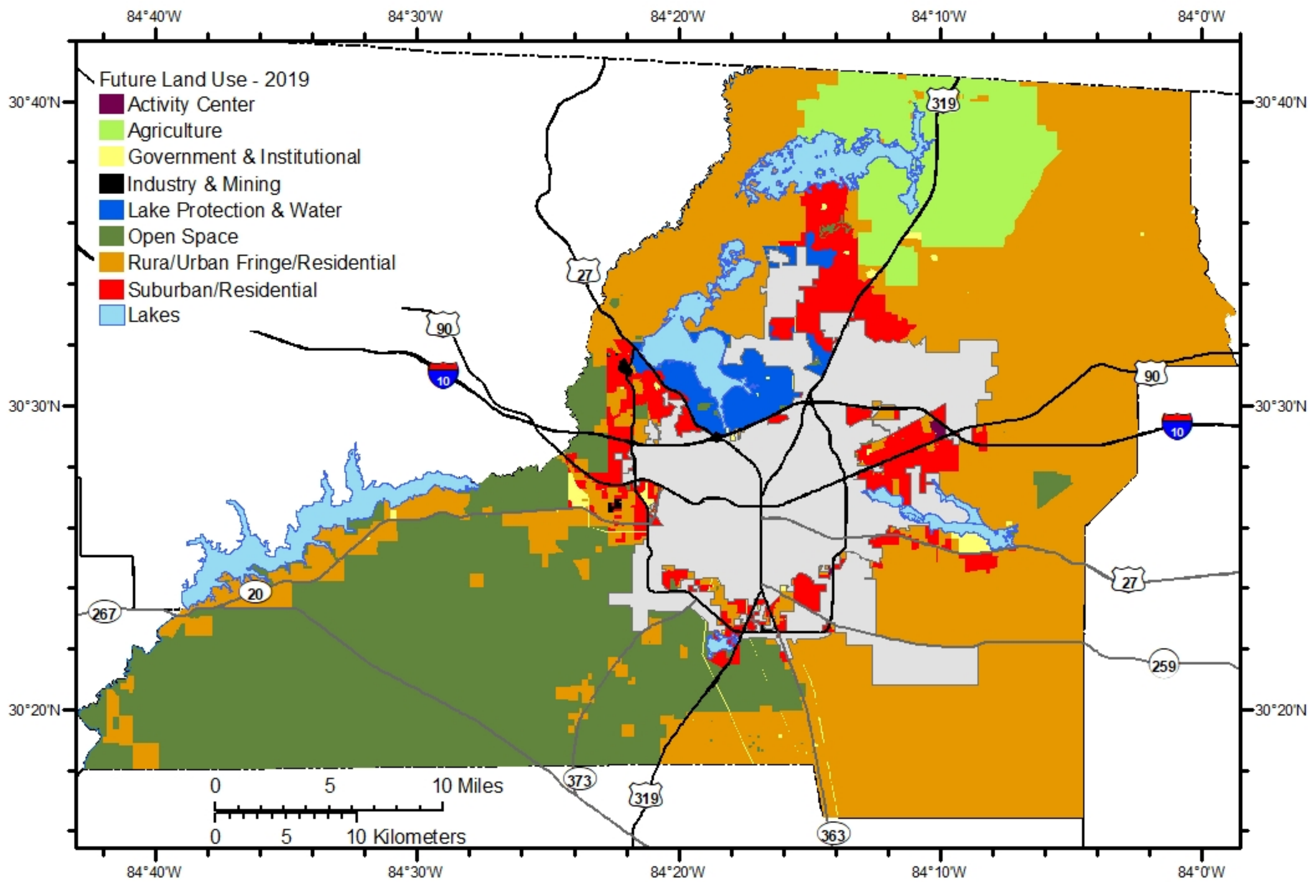

Figure 7. Future land use in unincorporated Leon County.

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.

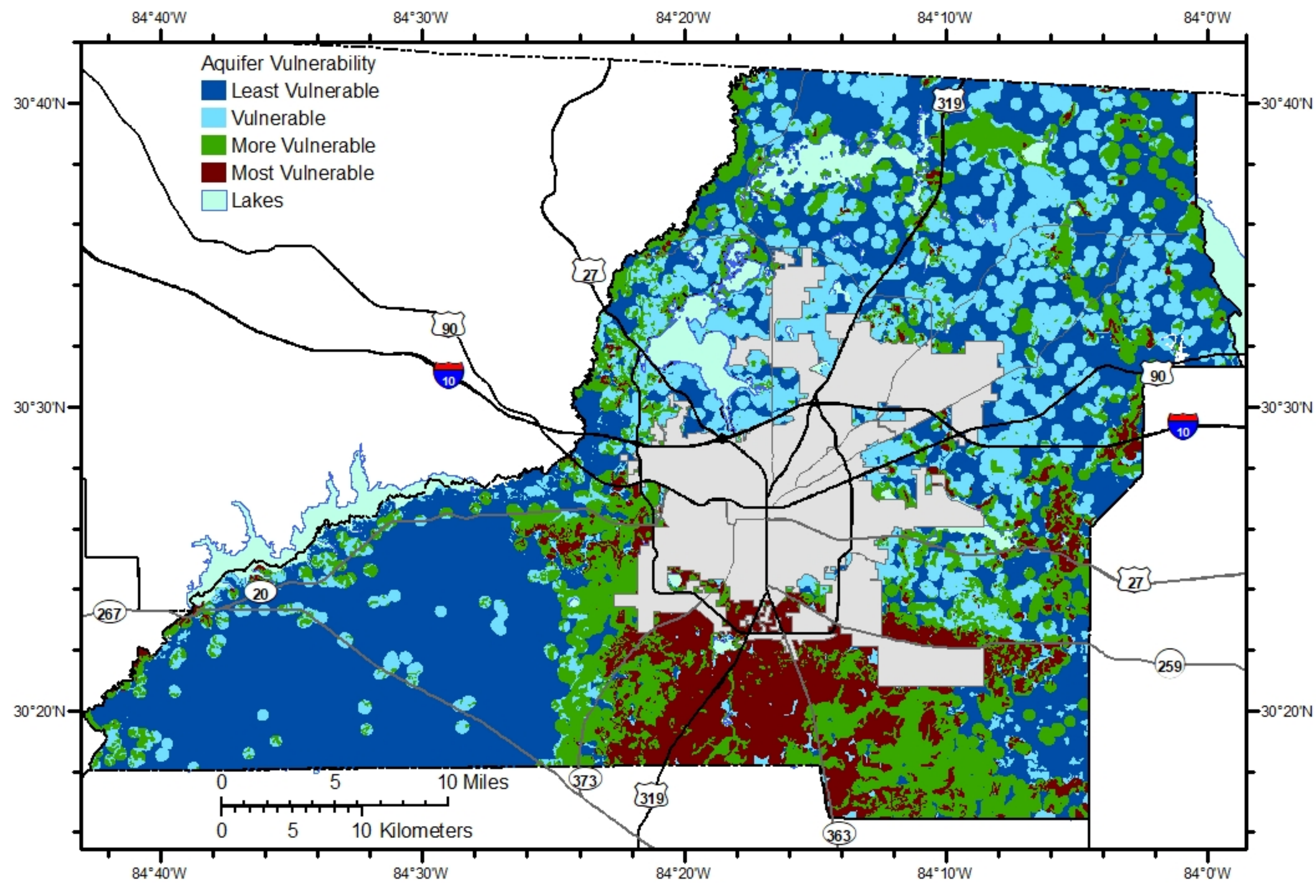

Figure 8. Aquifer vulnerability in unincorporated Leon County.

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.

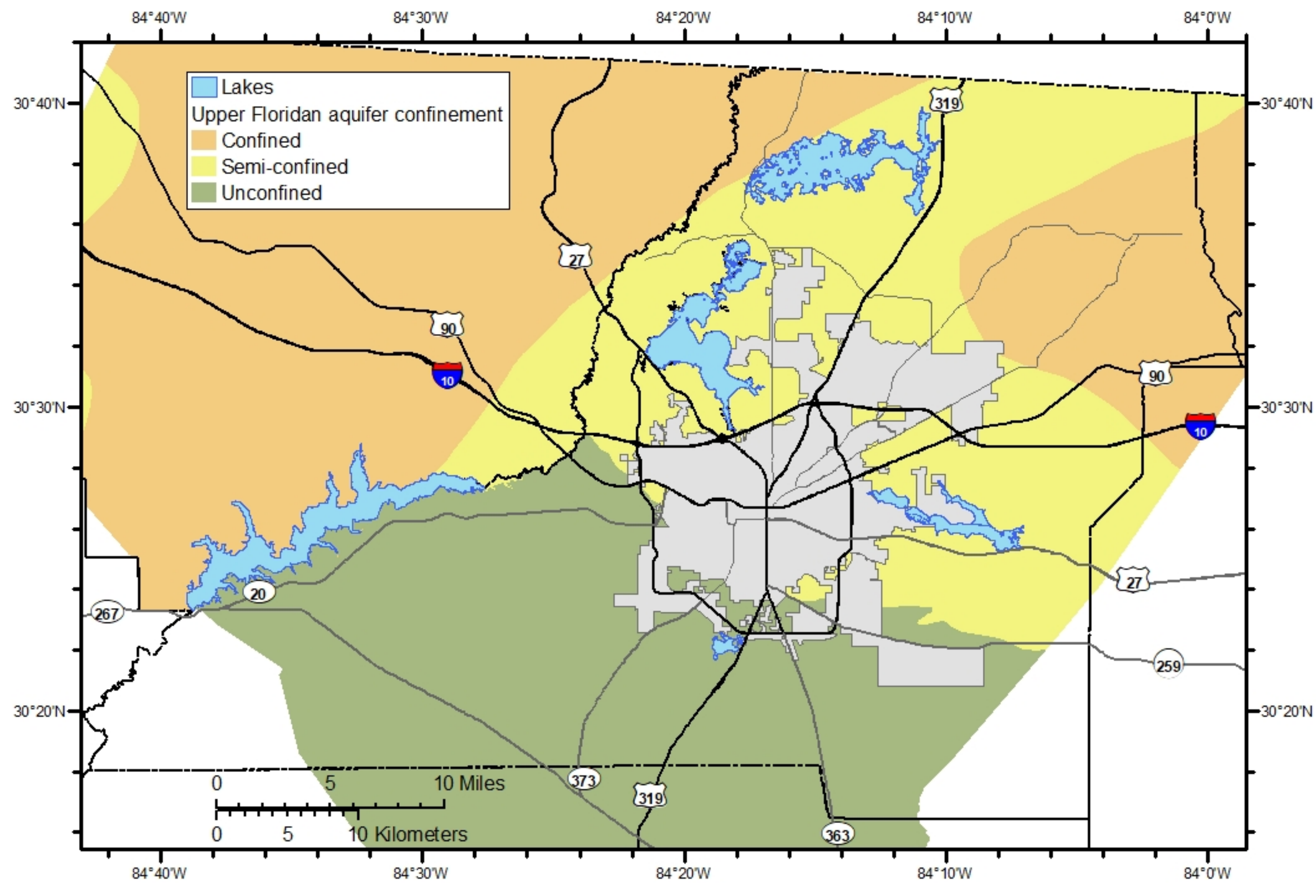

***Figure 9**. Upper Floridan aquifer confinement in unincorporated Leon County.*

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.

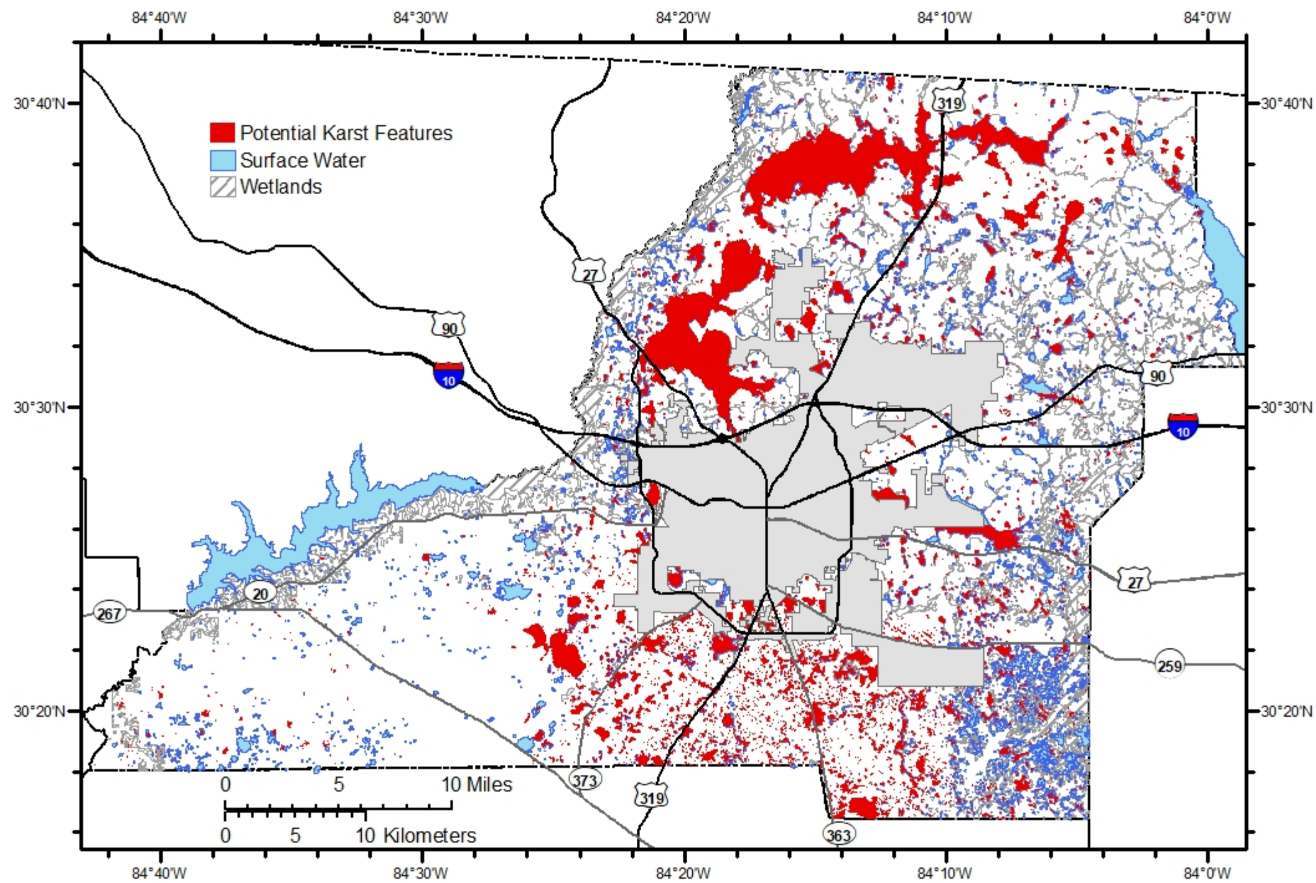

Figure 10. Karst features, wetlands, and surface water in unincorporated Leon County.

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.

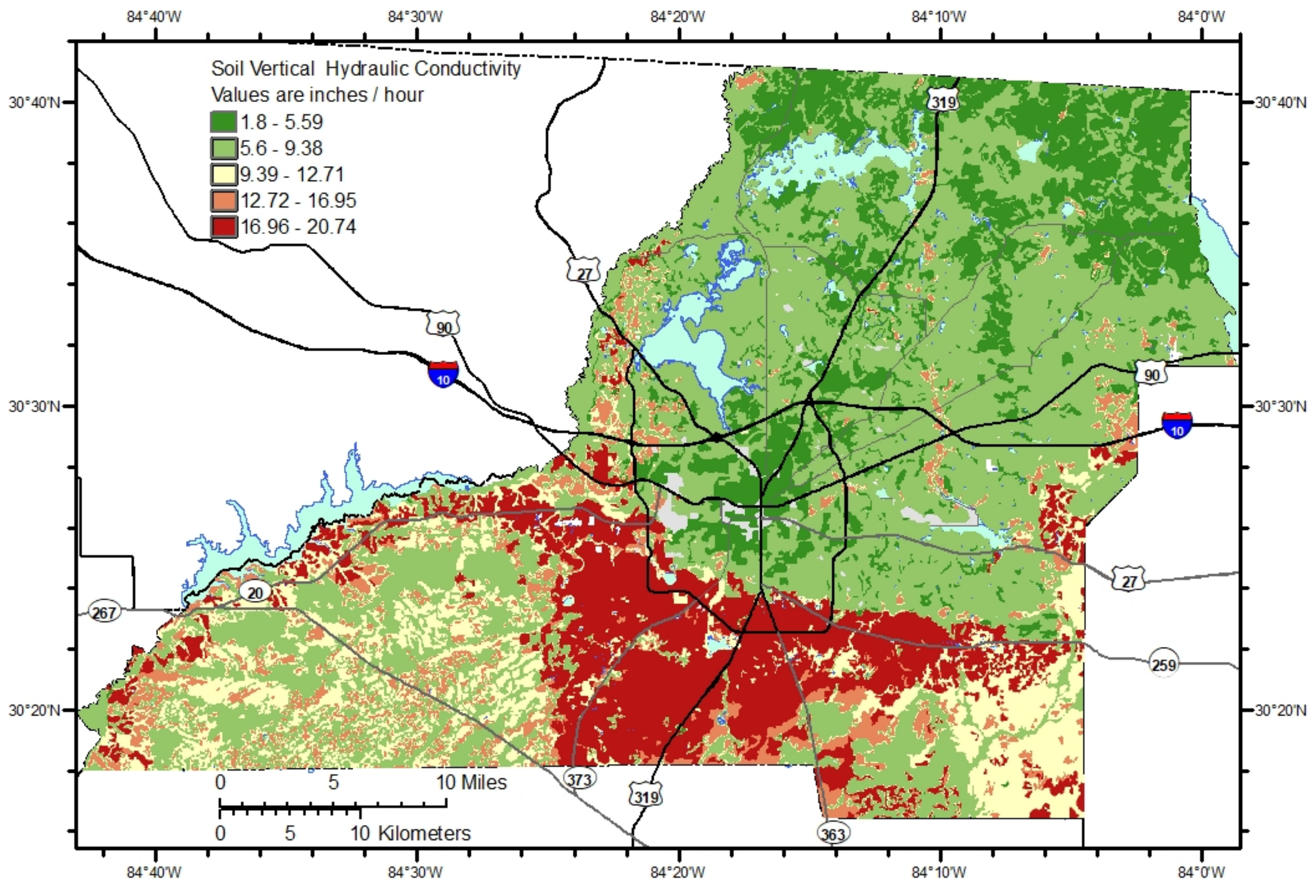

Figure 11. Saturated soil hydraulic conductivity, in inches per hour (in/hr), in unincorporated Leon County.

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 fig. 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.

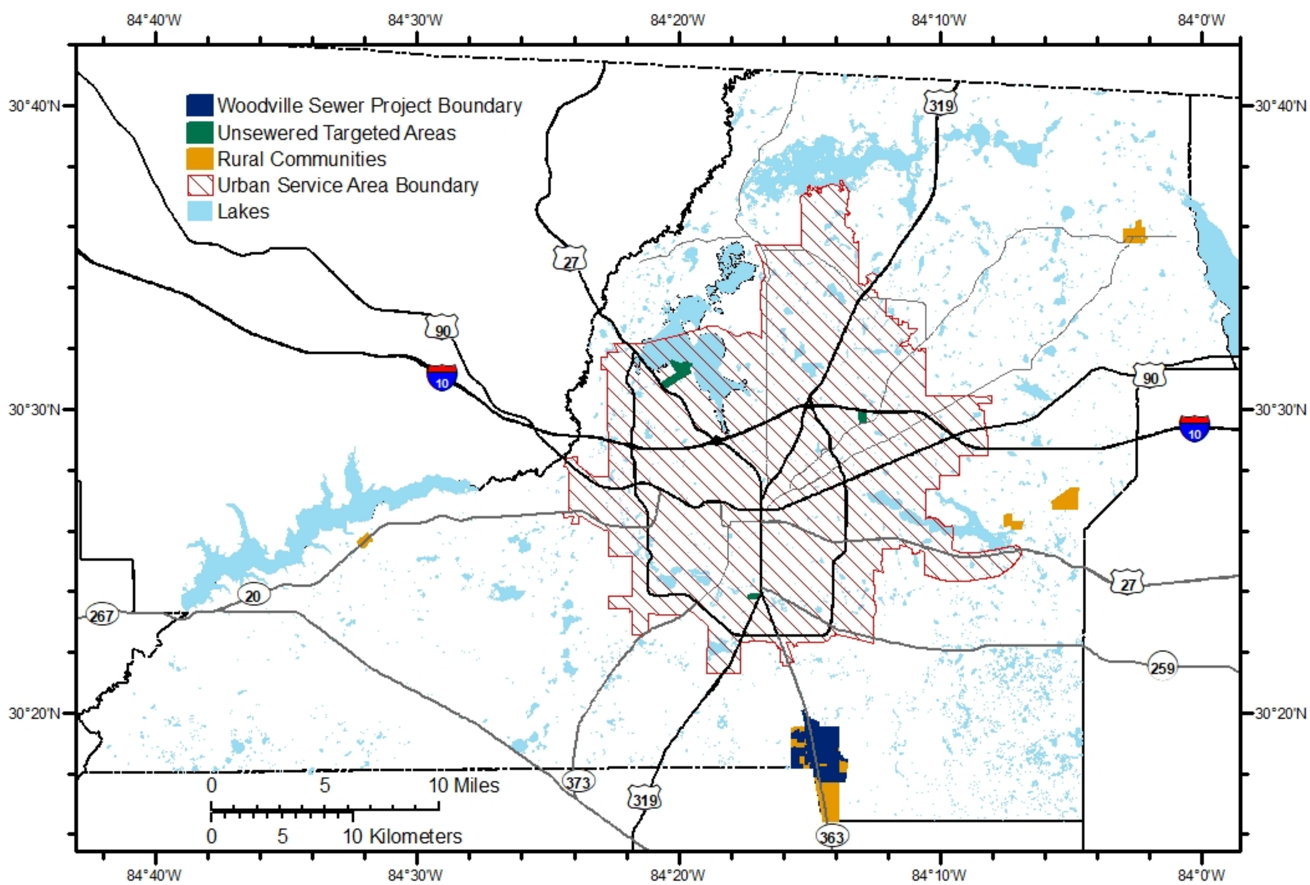

Figure 12. Location of the urban service area, rural communities, and unsewered target areas.

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 is the resultant of the maximum distance from any parcel minus the actual distance to the nearest wetlands of surface waters
5. Distance from the parcel to the nearest karst is the resultant of the maximum distance from any parcel minus the actual distance 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 hour per inch; when these two numbers are multiplied, 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 karst area. Proximity of a parcel to the nearest karst 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.

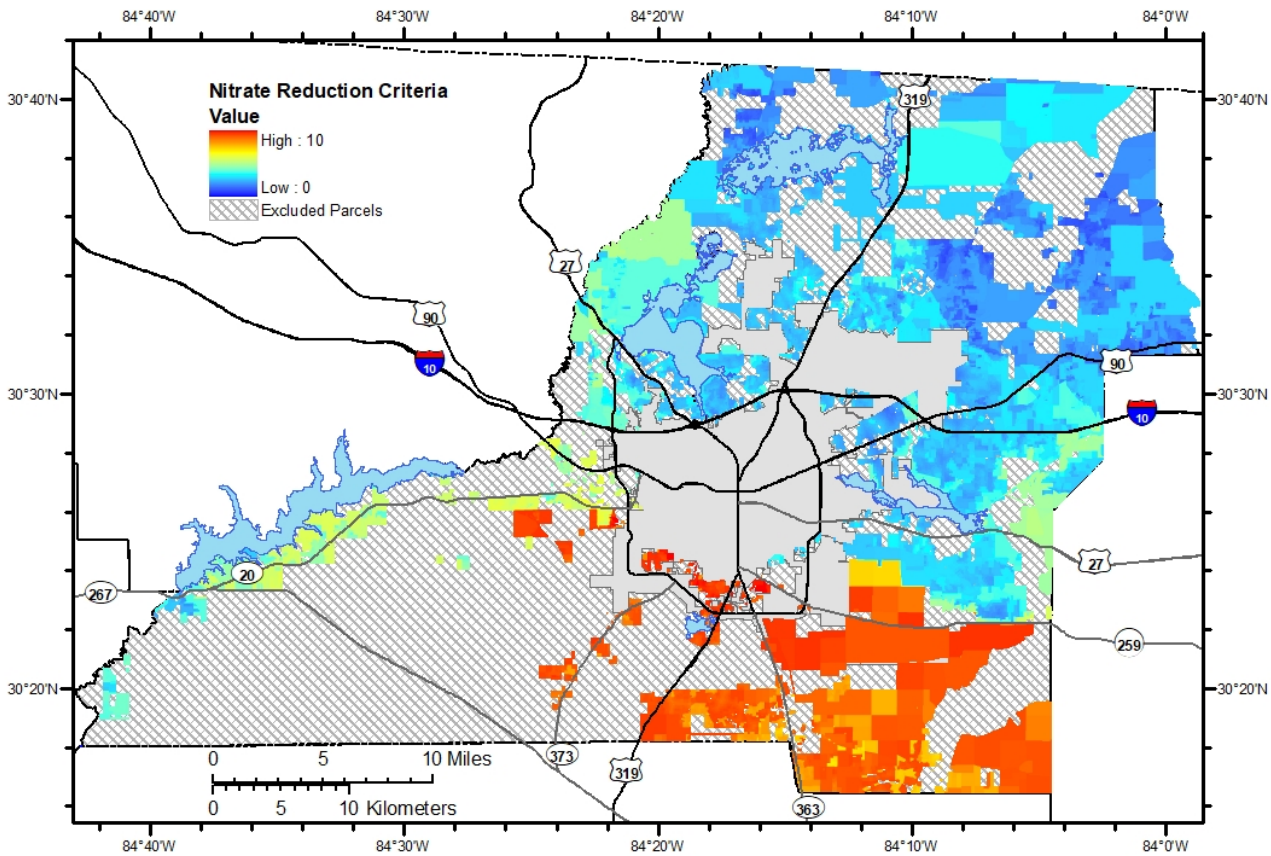

Figure 13. Nitrogen reduction score in unincorporated Leon County, based on initial, draft input weights.

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.
- Performance Based Treatment System (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	45.6%	45.8%	37.6%	37.3%	1.2%	1.2%

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.

5.0 References

ATM, 2017 (June). Tidal Caloosahatchee Basin Management Action Plan Nitrogen Load Reduction Plan, Lee County, Florida: Gainesville, FL.

Baker, A.E., A.R. Wood, J.R. Cichon and J.L. Johnson, 2007a (July). The Leon County Aquifer Vulnerability Assessment: Prepared for the Leon County Board of County Commissioners, Leon County Project No. BC-06-21-06-53.

Baker, A.E., A.R. Wood, J.R. Cichon and J.L. Johnson, 2007b (July). The Leon County Aquifer Vulnerability Assessment—A Groundwater Protection and Management Tool. Poster accompanying Report for Leon County Project No. BC-06-21-06-53.

DEP, 2018a (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-BMAP.pdf.

DEP, 2018b (January 16). Upper Wakulla River and Wakulla Spring Basin Management Action Plan Presentation, Division of Environmental Assessment and Restoration.

DEP, 2018c (March 6). Upper Wakulla River and Wakulla Spring Basin Management Action Plan Presentation: Division of Environmental Assessment and Restoration.

DEP, 2018d (May 17). Upper Wakulla River and Wakulla Spring Basin Management Action Plan Presentation: Division of Environmental Assessment and Restoration.

DEP, 2018e (January). Wekiva-Area Septic Tank Study: Division of Environmental Assessment and Restoration, Tallahassee, FL.

Florida Geological Survey, 2004. Springs of Florida: Florida Geological Survey Bulletin Number 66, 677 p., accessed March 8, 2020 at https://ufdc.ufl.edu/UF00094032/00001.

Florida Geological Survey, 2017. Florida Aquifer Vulnerability Assessment: Contamination potential models of Florida's principal aquifer systems: Florida Geological Survey Bulletin No. 67, authored by Arthur, J. D., Baker, A. E., Cichon, J. R., Wood, A. R., and Rudin, A., 148 p., 3 pl., accessed March 8, 2020 at https://ufdcimages.uflib.ufl.edu/UF/00/09/91/61/00001/FAVA_REPORT_MASTER_DOC_3-21-05.pdf.

Hearn, J., 2018 (February 28). Review of Wakulla Spring BMAP NSILT Loads, Memorandum to Mark Heidecker, City of Tallahassee: Gainesville, FL.

Leon County Board of County Commissioners, 2010 (December 14). Minutes from Workshop on Approval of the City of Tallahassee’s Updated Water and Sewer Master Plans, Tallahassee FL.

Lombardo Associates, Inc., 2011 (November 4). Onsite Sewer Treatment and Disposal and Management Options – Final Report.

Lyon, C and B.G. Katz, 2017 (November). Draft Revised Nitrogen Source Inventory and Loading Estimates for the Wakulla BMAP Area. Florida Department of Environmental Protection, Groundwater Management Section, Water Quality Evaluation and Total Maximum Daily Loads Program, Division of Environmental Assessment and Restoration, Tallahassee, FL.

Lyon, C and B.G. Katz, 2018 (February). Draft Revised Nitrogen Source Inventory and Loading Estimates for the Wakulla BMAP Area: Florida Department of Environmental Protection, Groundwater Management Section, Water Quality Evaluation and Total Maximum Daily Loads Program, Division of Environmental Assessment and Restoration, Tallahassee, FL.

Toor, G.S., M. Lusk, and T. Obreza, 2011. Onsite sewage treatment and disposal systems: Nitrogen. SL 348. Gainesville, FL: University of Florida Institute of Food and Agricultural Sciences.

U.S. Environmental Protection Agency, 2002. Onsite wastewater treatment systems manual. EPA/625/R-00/008. Washington, DC: Office of Water.

U.S. Geological Survey, 2010. 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 Scientific Investigations Report 2010-5099, authored by Davis, J. H., Katz, B.G., and Griffin, D.W., 90 p., accessed March 8, 2020 at https://pubs.usgs.gov/sir/2010/5099/pdf/sir2010-5099_davis_revised_3-2-2011.pdf.

U.S. Geological Survey, 2016. Revised hydrogeologic framework of the Floridan aquifer system in Florida and parts of Georgia, Alabama, and South Carolina (ver. 1.1, March 2016): U.S. Geological Survey Professional Paper 1807, authored by Williams and Kuniansky, 140 p., 23 pls., accessed February 29, 2020 at http://dx.doi.org/10.3133/pp1807.

U.S. Census Bureau, 2018. QuickFacts, Leon County, Florida accessed March 24, 2020 at https://www.census.gov/quickfacts/fact/table/leoncountyflorida/PST045219.

Viers, J.H, D. Liptzin, T.S. Rosenstock, W.B. Jensen, and A.D. Hollander et al., 2012. Nitrogen sources and loading to groundwater. Technical Report 2. California State Water Resources Control Board.

Wakulla Springs Alliance, 2016 (July 14). Wakulla Spring Dark Water Causes and Sources Phase I and II.

Wakulla Springs Alliance, no date a. Lake and Sinking Stream Nitrogen Loading Project

Wakulla Springs Alliance, no date b. Wakulla Springs State Park Submerged Aquatic Vegetation Survey Project.

Xueqing G. and E. Roeder, 2017 (November 3). Better Understanding the Impact of Onsite Sewage System on Quality of Florida Groundwater and Springs.: Florida Department of Health, Division of Disease Control and Health Protection, Bureau of Environmental Health, Tallahassee, FL.