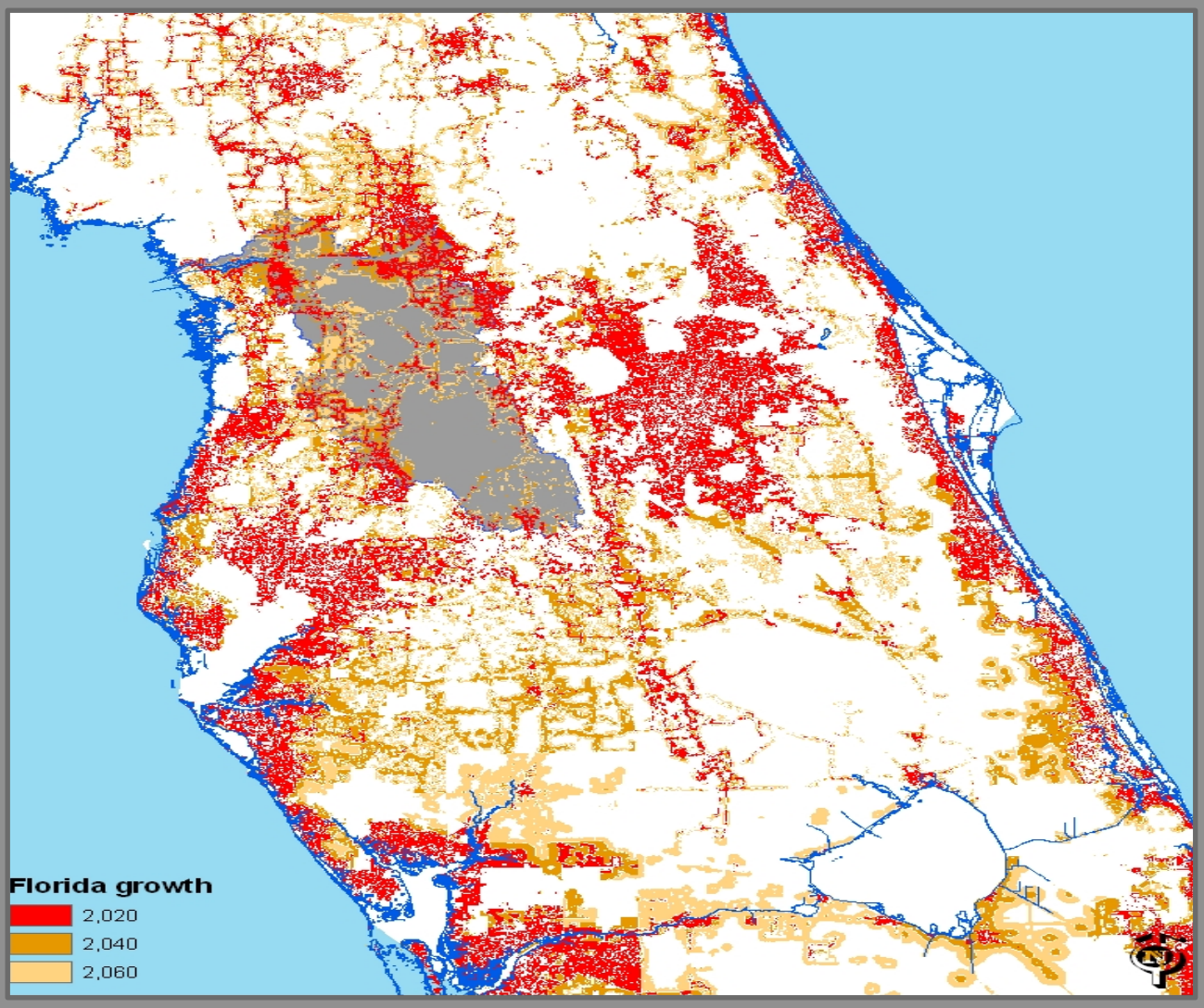

The Withlacoochee River Watershed: Biophysical & Regulatory Characteristics

Chad Bickerton, Susanna Blair, Anna Cathey, Byron Flagg, Hollie Hall, Dina Liebowitz, Michael Moretz, Megan Policastro & Tom Ankersen

A Collaboration of the University of Florida's Conservation Clinic and Adaptive Management of Water Resources IGERT

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The Withlacoochee River Watershed: Biophysical & Regulatory Characteristics

This report was produced by an interdisciplinary team of PhD and law students and faculty under the auspices of the Conservation Clinic at the University of Florida College of Law, and with the support of the University of Florida's NSF funded Interdisciplinary Graduate Education Research and Training Program for Water, Wetlands & Watersheds. Development of the report content was aided by input and discussions with associates of the Withlacoochee River Alliance. Based on existing available information, the report describes the Withlachoochee Riverine and Lake System watershed in its biophysical and policy context. The report includes discussion of the ecology, water quality, water quantity, land use and governance of the Withlacoochee River Watershed (HUC 12 # 03100208). The watershed's climate, hydrology, and habitat are discussed to lay a foundation for understanding how the limited resources and the regulations governing them can be used as guides for managing the watershed for a sustainable future. In addition to biophysical and regulatory information, maps, and data summary and analysis, the report includes conclusions and recommendations for managing the watershed for a sustainable future. An extensive list of references is provided.

Executive Summary

Overview

The Withlacoochee River flows in a northwesterly direction for 157 miles from the Green Swamp in Central Florida to the Gulf of Mexico near Yankeetown Florida. The River, its tributaries and its hydrologically connected lakes and wetlands are sometimes referred to as the Withlacoochee Riverine and Lakes System. The Withlacoochee River's surficial watershed drains approximately 2,100 square miles. In addition, Rainbow Springs, the watershed's only first order spring, and other smaller springs, contribute significant quantities of groundwater to the River. Some of the discharge from Rainbow and perhaps other smaller springs originates from outside the surficial watershed. The area of the Rainbow River Springshead is unknown, but likely extends beyond the boundaries of the topographically defined Withlacoochee River Watershed. Thus the boundaries of the Withlacoochee "*hydro-shed*" is more difficult to determine, but the extensive area of the springshed suggests that land use activity occurring outside the River's watershed could affect its ecological health.

Surface drainage, not coming from springs, contributes organic material and tannins that stains the water, making the Withlacoochee somewhat of a blackwater river. The Floridan Aquifer system underlies the watershed. The Hawthorn layer confines the aquifer but sinkholes and springs throughout the watershed provide direct conduits to the aquifer. The Green Swamp is the headwater of the watershed and also the highest pieziometric head in the state of Florida. The Withlacoochee River empties into the

Withlacoochee Bay Estuary, a large, shallow estuary that begins downstream of Yankeetown. Prevailing inshore currents in the Gulf flow counter-clockwise and as a result the discharge of the Withlacoochee River provides a primary source of fresh water to Waccasassa Bay to the north and to the southern reaches of the Big Bend Sea Grasses Preserve.

There are numerous lakes and impoundments throughout the Withlacoochee Watershed, but the three main ones are Lake Rousseau, Lake Tsala Apopka, and Lake Panasoffkee. Each of these has a hydrologic connection to the Withlacoochee River. Lake Rousseau is a 5.7-mile long impoundment regulated by the Inglis Dam (Spillway). Lake Tsala Apopka, actually a chain of impounded pools, is the largest lake system in the watershed. The Wysong Coogler Dam controls the water levels in Lake Tsala Apopka. Lake Panasoffkee is the third largest lake in Florida and has an important freshwater fishery associated with it. The Cross Florida Barge Canal intersects the Withlacoochee River 9 miles upstream from the estuary and 2 miles downstream from the Inglis spillway, diverting some of the River's historic flow. Construction on the canal began in 1965 and stopped in 1975 due to environmental concerns. A dredged channel is maintained from the mouth of the River through the estuary to the Gulf of Mexico.

Land Use

Land use in the watershed is equally distributed between urbanized areas, upland forests, agricultural activities, and wetlands. Wetlands and forests comprise nearly 50% of the Watershed, while agriculture and urban areas make up the rest. There are also extensive publicly owned or managed lands in the watershed. This mix of land use has contributed to the ecological health of the watershed.

Water Quality

The FDEP STORET database contains a statewide water quality data set reported by the FDEP, the Florida Fish and Wildlife Commission and Florida Lake Watch. This data is useful for assessing and monitoring point and nonpoint source pollution trends. According to this database, only two sampling locations show regular collections for the River. Water quality in the basin is assessed through the TMDL list of impaired water bodies and NPDES point source permits. In 2010, twenty-seven water body segments within the Withlacoochee River Watershed were placed on the verified impaired waters list due to their failure to meet water body classification parameters. The water quality impairments are for mercury, dissolved oxygen, nutrients (algal mats), and nutrients (Chlorophyll-a). There are 489 NPDES permits existing in the watershed (USEPA, 2010 and FGDL, 2010). Of these 489 permits in the watershed, only 29 of the facilities have been inspected within the last 5 years. There are approximately 42,000 septic tanks in the watershed, many of which may be beyond their anticipated lifespan.

Water Quantity

Water quantity data is not aggregated at the watershed level. The Withlacoochee watershed lies in the SWFWMD northern planning area, and data is aggregated for this larger planning unit. There are currently no significant surface water withdrawals from the Withlacoochee Riverine and Lakes System. Groundwater currently provides all water supply needs with the watershed. Florida State law establishes that Minimum Flows and Levels (MFLs) must be established for all water bodies in Florida in order to prevent "significant environmental harm." In 2006, Minimum Flows and Levels (MFLs) were set for Lakes Tsala Apopka (all 3 pools) and Panasofkee in 2006. Draft MFL's have been written for the Upper and Middle Withlacoochee River in 2010 by the SWFWMD (SWFWMD, 2010). This Draft has been peer reviewed by Locke et al. (2010), but no MFL has been established. MFLs for the lower Withlacoochee River, the Rainbow River and Rainbow Springs are scheduled for 2011.

Ecology

The diversity of the natural ecological communities of the Withlacoochee River Watershed creates a mosaic of habitats that supports a variety of wildlife. The Withlacoochee riverine and lake system provides aquatic habitat for several rare and imperiled fish species including the: Alabama shad, mountain mullet, iron-color shiner, Suwannee bass, and spotted bullhead. According to the Florida Fish and Wildlife Conservation Commission (2008), threats to the freshwater habitat include: the presence of invasive aquatic plants, agricultural activities, waterway modification, degraded water quality, road density, and/or groundwater use. The watershed also provides habitat for a number of upland threatened and endangered species including the Florida Black Bear, Gopher Tortoise, Eastern Indigo snake, Florida Scrub Jay, Bald Eagle, Snail Kite, and Florida Crested Caracara (Defenders of Wildlife 2011, FWC 2010, SWFWMD 2011).

Special Designations

The Withlacoochee River Watershed boasts a number of superlatives and special protections designed to recognize and preserve its ecological health. The Green Swamp is an "area of critical state concern," a special land use designation that recognizes its importance for groundwater recharge, wetlands, and flood detention. The Withlacoochee Riverine and Lake System, including the Withlacoochee River Estuary have been designated as "Outstanding Florida Waters," as has the Rainbow River and Springs. Rainbow Springs is also a designated "aquatic preserve."

Watershed Governance

The Southwest Florida Water Management District administers the water resources of the Withlacoochee River Watershed. The District has established basin boards at the watershed level. The Withlacoochee River Basin Board Basin Board "provide[s] guidance to District staff and basin cooperators in identifying for potential Basin Board funding projects that address the needs of each basin." However, the Green

Swamp, the headwaters of the Withlacoochee River, has been excluded from the jurisdiction of the Withlacoochee River Basin Board. The Withlacoochee Regional Water Supply Authority (WRWSA or "Authority") is a multi-county special district of the State of Florida charged with planning for and developing cost efficient, high quality water supplies for its member governments.

Local Governance

Local governments retain primary land use planning and development decision-making authority in Florida, with increasingly limited state oversight. Their decisions are a key factor in the ecological health of the Withlacoochee River Watershed. The watershed lies primarily within 5 counties - Polk, Marion, Sumter, Levy, and Citrus and includes 34 municipalities. The four most significant are Yankeetown, Dunnellon, Inverness, and Dade City. These local governments adopt comprehensive plans and land development regulations, including riparian buffers and development setbacks to protect the River. The Withlacoochee River Regional Planning Council, an umbrella organization comprised of elected officials from the five counties and their municipalities, provides technical support and non-binding land use planning review to the Watershed's local governments.

Citizen Stewardship

The Withlacoochee River Alliance is a consortium of non-governmental organizations established in 2008 to address the ecological health of the river at a watershed scale. The Alliance is comprised of 7 environmental groups whose members and interests span the watershed. Through its member organizations, the Alliance uses legal and policy advocacy and environmental education to achieve its goals.

Conclusions & Recommendations

Water Quality

In the TMDL process, the Withlacoochee Watershed is in the second period of water quality assessments. Impaired water bodies have been verified and listed.

> As of the 2010 assessments there are 27 water bodies segments impaired for either mercury, nutrients, or DO in the Withlacoochee Watershed. Only one, the Cross Florida Barge Canal, is impaired for both nutrients and mercury.

After waterbodies have been listed, the TMDL process requires the establishment of total maximum daily pollutant loads on a priority schedule.

For the Withlacoochee River Watershed, FDEP has prioritized mercury impairment for TMDL development over the next five years due to mercury's potential to affect human health.

Despite the emphasis on mercury impairment, FDEP has concluded, "excessive nutrients (total nitrogen and total phosphorus) constitute one of the most severe water quality problems facing the State. It shall be the Department's policy to limit the introduction of man-induced nutrients into waters of the State. Particular consideration shall be given to the protection from further nutrient enrichment of waters which are presently high in nutrient concentrations or sensitive to further nutrient concentrations and sensitive to further nutrient loadings" 62-302.400 F.A.C. (#13).

Waterbodies impaired by nutrients and DO have a lesser priority and are slated to be addressed in the next 5 to 10 years "as resources allow."

At this time, no TMDL for nutrients or DO in the Withlacoochee River has been established.

While it is important to address the mercury issue, the overall ecological health of the Withlacoochee Watershed is likely more affected by nutrient enrichment and low DO than mercury.

Recommendation: even in the absence of a state sponsored TMDL, watershed stakeholders should prioritize addressing the sources of nutrient and DO impairments for the Withlacoochee Watershed.

Best Policy Practice: The St. Marys River Management Committee has formed a water quality technical committee to coordinate water quality monitoring in 2 states and 4 counties and to identify and address sources of contamination, especially those coming from septic systems.

Best Policy Practice: Depending on the land use district, The Town of Yankeetown, within the Withlacoochee Watershed, has established a "nutrient setback" of from 150 feet to 50 feet for nutrient sources other than septic (which has its own setback) for the Withlacoochee River, creeks, streams and wetlands.

Best Policy Practice: A Basin Management Action Plan for nutrient pollution reduction has been developed for the Lower St. Johns River. The Plan sets for a list of projects and programs that cumulatively are expected to eliminate nutrient impairment in that water body.

Outstanding Florida Waters

The Withlacoochee River as well as its connected lakes and tributaries are designated as Outstanding Florida Waters (OFWs), which are held to the highest water quality standards achievable under Florida law.

Rainbow River and Rainbow Springs in Marion County were designated as OFWs on August 8, 1994.

Withlacoochee River Tracts within Sumter County were designated as OFWs on December 1, 1982.

The remaining Withlacoochee Riverine and Lake System was designated as OFW on March 10, 1989.

As a result of the OFW designation, water quality within the Withlacoochee Watershed cannot be degraded below its water level classification or ambient levels at the time of designation, whichever results in a higher water quality standard.

Available data (current and historic) suggests that the water quality of the Rainbow River and Rainbow Springs has degraded since the date of its OFW designation, therefore violating the anti-degradation standard set forth in Florida law. Additionally, neither Rainbow River nor Rainbow Springs are meeting their Class III waters designation due high nutrient concentrations, in further violation of the standard for OFWs.

Recommendation: Since OFWs are designated due to their "exceptional value," the TMDL development process should prioritize waters designated as OFW's, including the Withloochee River system.

Recommendation: The TMDL development priority within the Withlacoochee Watershed should be based on those pollutants that contribute to a reduction in water quality from levels at the time of designation, or which are otherwise impaired. Where there are multiple pollutants that have contributed to ambient water quality degradation, priority should be given to those most likely to provide the greatest contribution to restoring the ecological health of the waterbody.

Septic Tank Maintenance & Inspection

Antiquated and inadequately maintained septic tanks potentially pose a serious water quality concern. The primary contaminants of concern related to septic tanks are fecal coliforms and nitrogen.

According to the Florida Department of Health's 2007 data, there are more than 42,000 septic tanks in the Withlacoochee River watershed (FDOH, 2008). Statewide, most septic systems are likely greater than 30 years old, which is the average lifespan of a septic system in Florida (FDOH, 2008). This may also be the case in the Withlacoochee Watershed, suggesting that septic tanks pose or could pose a significant pollution problem.

> Presently, there are no identified water quality impairments in the Withlacoochee basin due to fecal coliforms, the primary pollutant, along with nitrogen, that results from failing septic tanks.

In 2010 the Florida Legislature created a statewide septic system inspection program, but it has yet to be implemented.

Several Florida counties, including Charlotte, Escambia, and Santa Rosa, have successfully implemented septic system inspection programs under their home rule authority. These programs require periodic mandatory inspections and maintenance or replacement as appropriate.

Recommendation: Local governments within the Withlacoochee River watershed should move forward with a septic tank inspection and maintenance program to ensure that septic systems are functioning and maintained according to manufacturer's guidelines. Consideration should be given to prioritizing environmentally sensitive areas, and incentives could be provided to accommodate low income owners of septic systems.

Best Policy Practice: At the local government level, Charlotte, Escambia, and Santa Rosa counties have implemented septic system maintenance programs that, according to DOH (2008), have been favorably received.

Best Policy Practice: At the watershed scale, the Wekiva River Parkway Protection Act requires local governments within the watershed to adopt septic tank maintenance and inspection programs.

Best Policy Practice: The St Marys River Management Committee has formed a "septic think tank" to identify and address this specific source of water quality degradation.

Buffers and setbacks

All municipalities and counties within the Withlacoochee Watershed have riparian buffers and/or development setbacks. However, only Citrus County and the City of Dunnellon appear to have sufficient buffers for the protection of all of the functions for a healthy watershed as described in the literature, and illustrated in Figure 25 of this report.

Recommendation: To the extent possible local governments within the watershed should harmonize riparian buffers and development setbacks to be at least as protective as those established by Citrus County and the City of Dunnellon.

The lower Withlacoochee River, from the Inglis spillway to the estuary has been extensively developed with single-family homes on both sides of the River. Much of the shoreline along the Lower Withlacoochee is armored with seawalls or revetments, and lawns and gardens extend to edge of wall in many cases.

Recommendation: Watershed stakeholders should promote the restoration of riparian buffers along the lower Withlacoochee through a combination of living shorelines waterward of seawalls and revetments where feasible, and voluntary "Withlacoochee-Friendly" riparian buffers landward of seawalls and revetments.

Best Policy Practice: Depending on the land use district, The Town of Yankeetown, within the Withlacoochee Watershed, has established a "nutrient setback" of 150 feet or 50 feet for nutrient sources other than septic (which has its own setback) for the Withlacoochee River, creeks, streams and wetlands.

Minimum Flows and Levels

No Minimum Flow or Level (MFL) is currently established for the Withlacoochee or its tributaries, though efforts are under way to complete this for the Upper and Middle Withlacoochee River.

Once minimum flows and levels have been established for the River, the River's water resources can more easily be developed for water supply, and that water supply can be made available to be exported outside the Withlacoochee Watershed, to supply surrounding urbanizing areas.

A draft MFL has been peer reviewed (Locke et al, 2010) for the upper and middle Withlacoochee that allows a reduction of between 7 and 16 percent of the ambient flows. The peer review concluded that generally the "the derived MFLs are reasonable

and likely to sustain the ecological health of the upper and middle Withlacoochee River" (Locke et al, 2010).

> However, the peer review also concluded that: "additional clarity with regard to defining the benchmark condition (natural vs. historic/existing condition) and how existing changes in flow were accounted for in the MFL evaluation are suggested" For example: "the Panel notes there was no quantification of the surface water changes due to the Wysong Dam AWCS structure and diversions to the Tsala Apopka Chain of Lakes" (Locke et al, 2010).

> The peer review panel also concluded that: "as with previous Panels, this Panel also believes that the adequacy of the low-flow threshold, and the use of a *de facto* significant harm criterion based on a 15% reduction in habitat availability from current or historical conditions has not been rigorously demonstrated. This *de facto* criterion requires further validation with regard to its application, in this case to Outstanding Florida Waters." (Locke et al, 2010).

This suggests that the 15% reduction in habitat availability significant harm criterion based on an unclear benchmark condition and uncertainty with regard to how alterations in the flow regime were accounted for would appear to introduce an element of arbitrariness to a "no significant harm" determination.

Recommendation: The concerns of the peer review panel concerning appropriate benchmarks and scientific rigor should be addressed before setting minimum flows and levels that will allow flow and level reductions to occur.

Research in the estuaries in close proximity to Withlacoochee Bay suggests that coastal forests are retreating due to the increased salinities that may be attributable to global and regional sea level rise, as well as historic changes in the River's upstream flow regime.

Reductions in flow through diversions and withdrawals authorized by the establishment of minimum flows and levels beneath current flows and levels will likely exacerbate estuarine change in Withlacoochee Bay.

Recommendation: Minimum flows and levels on the lower Withlacoochee River should consider the compounding effect that reduced freshwater flows and local sea level rise will have on the salinity gradient

Consumptive Use

Since 1997, the SWFWMD has not aggregated water quantity data at the watershed scale.

> However, the Withlacoochee Watershed lies within the SWFWMD Northwest Planning unit where data is aggregated. According to this data, public supply is by far the largest consumer (82%) of water followed by industrial/mining (23%) and agriculture (19%).

According to SWFWMD, consumptive water demand through 2030 can be met using groundwater "provided existing and anticipated local impacts are mitigated or avoided" (SWFWMD, 2010). SWFWMD does not identify the local impacts to be mitigated or avoided.

Recommendation: SWFWMD should identify "existing and local impacts to be mitigated and avoided and implement policies to ensure that these existing and anticipated local impacts are in fact mitigated and avoided, in order to ensure that high quality groundwater remains the sole source of drinking water within the watershed.

According to SWFWMD, no water will be required for restoration purposes in the Withlacoochee Watershed through 2030. This seems to be at odds with need to mitigate existing local impacts described in its report.

> Florida law authorizes the reservation of water for environmental purposes. However there are currently no existing or proposed reservations of water in the Withlacoochee Watershed.

Best Policy Practices: Reservations of water for environmental purposes have been adopted for specific waterbodies in three water management districts, including the Southwest Florida Water Management District. In SWFWMD, the Reservation reserves "all available water from the Morris Bridge Sink but not greater than 3.9 million gallons of water on any given day…to be used to contribute to achieving or maintaining the Minimum Flows for the Lower Hillsborough River."

Springs

Within the Withlacoochee River watershed there is one 1st magnitude spring, two 2nd magnitude springs, and many smaller springs that contribute to the surface water quantity and quality of the watershed.

> The boundaries of the contributing area for these springs (i.e. springsheds) are not clearly defined and some extend beyond the topographically defined watershed.

Recommendation: Watershed management decisions must take into account those

springshed boundaries that extend beyond the surficial watershed boundary. Priority should be given to improved mapping of springshed boundaries.

The Stevenson (2004, 2007) EPA studies illuminate the uncertainty regarding the direct linkages between nutrient concentrations and algal cover in the springs of Florida. That study shows that the Rainbow Springs group contains high nitrogen concentrations and low algal cover as compared to other springs within the state, suggesting that additional factors may be responsible for ecosystem change.

Recommendation: The scientific understanding of the drivers of algal proliferation in springs is incomplete; therefore, an examination of a full suite of ecosystem factors should be conducted, focusing on: dissolved oxygen levels, food web interactions, sedimentation rates, and spring flows.

Despite this uncertainty, delivery of excess nutrients to the Withlacoochee estuary via the Rainbow River and other watershed tributaries can lead to estuarine degradation.

Recommendation: Actions for the reduction of nutrient contamination in the Rainbow River should continue in order to reduce nutrient transport to the Withlacoochee estuary.

Herbicide Use

The invasive aquatic plant hydrilla (*Hydrilla verticillata*) is considered a problem in Lake Rousseau. In the past the entire lake has been treated with floridone. Currently, the Lake is being spot treated using the contact herbicide diquat. The lower Withlacoochee is fed by Lake Rousseau through the Inglis Spillway.

There are anecdotal accounts of decreasing native submerged aquatic vegetation (SAV) and increasing turbidity in the River downstream from Lake Rousseau and concerns that the herbicide treatments may be responsible.

Currently, no monitoring for herbicides or their by-products is conducted downstream of the Inglis Spillway.

The issue of treating invasive aquatic plants with herbicides is a complex topic. Jason Evan's Ph.D. chapter on the issue "Ecosystem Implications of Invasive Aquatic Plants and Aquatic Plant Control in Florida Springs" is an in depth summary of the issue. It can be downloaded from this web address:

http://waterinstitute.ufl.edu/research/projects/downloads/p001-Ch5_SpringsNutrients.pdf

Recommendation: A monitoring plan in the river that investigates the levels of herbicides and turbidity that results from herbicide treatments and their effects on native SAV should be implemented.

Wetlands Mitigation

There are no wetland mitigation banks in the Withlacoochee River watershed. Additionally, there is very little overlap between mitigation service areas for banks located outside of the watershed and the watershed. Therefore, little opportunity exists for mitigating wetland impacts to the watershed through wetland banks that serve the watershed, potentially resulting in a net loss of wetlands to the Withlacoochee Watershed.

Recommendation: local governments within the Withlacoochee River watershed should require wetland mitigation as a condition of development approval to occur within the watershed to the extent permitted by law.

Recommendation: local governments should require that wetland impacts be mitigated on-site first if possible. When on-site mitigation is not possible, mitigation should occur within the sub-watershed unit most proximate to the impacts that is possible.

Best Policy Practice: The City of Gainesville requires that mitigation occur if possible on-site then within the sub-basin or basin within which the impacts are occurring. Only when these possibilities have been exhausted is it permissible to mitigate for wetland impacts beyond watershed boundaries.

Watershed Governance

The Withlacoochee River has a nested governance structure at the watershed level that creates an institutional framework for watershed management, and water supply development and delivery

> These institutions include the Southwest Florida Water Management District, the Withlacoochee River Basin Board and the Withlacoochee River Water Supply Authority.
>
> The statutory authority that governs these institutions positions the water resources of the Withlacoochee watershed for water supply development and other anthropogenic modifications, including, potentially, outside the watershed boundaries.

Recommendation: A watershed scale resource protection mechanism should be developed to complement the current institutional framework for water resource

development. This could be accomplished by expanding the mandate of the Withlacoochee Basin Board or through an Interlocal Agreement.

Note: At its May, 2011 meeting, the Southwest Florida Water Management District abolished all Basin Boards, including the Withlacoochee Basin Board.

Best Policy Practice: the Wekiva Parkway and River Protection Act creates the Wekiva River Basin Commission with a broad mandate to "protect the resources of the Wekiva River System." The Commission includes elected officials and watershed stakeholders.

Best Policy Practice: the St Marys River Management Committee was established as and advisory body pursuant to an inter-local agreement between four counties to develop consistent policies across the watershed. The Committee includes appointed and elected officials and meets regularly. The Committee promoted a uniform septic tank setback for its member counties, and this was adopted.

The Withlacoochee River Watershed: Watershed: Biophysical & Regulatory Characteristics

General Ecological Characterization

Climate

The Withlacoochee watershed has a humid subtropical climate characterized by mild winters and hot summers. The average annual temperature is approximately 70^{o}F with an average annual precipitation of approximately 52 inches (in Dunnellon) (Weather Channel, 2010). Summer is the wet season with approximately 40% of all precipitation in the basin falling during this time. Winter is the dry season receiving less than 20% of the annual precipitation.

Hydrology

The headwaters of the Withlacoochee River arise in the Green Swamp and flow northwest 157 miles to the Gulf of Mexico. The river network in the Withlacoochee Watershed is not the typical dendrite structure (tree-like) that is found in most watersheds. Rather, the linear and singular Withlacoochee River along with numerous springs, lakes, and wetlands located throughout the basin characterizes the watershed. Overall, surface water bodies cover approximately 25% of the watershed area (FDEP, 2006). Contributions to flow from springs are significant. The 25 identified springs in the basin contribute approximately 2.2 billion gallons of water per day to the river (FDEP, 2006).

There are nine United States Geologic Service (USGS) gauging stations on the Withlacoochee River including (starting upstream and moving down): Compressco, Dade City, Tribly, Croom, Floral City, Wysong Dam, Holder, Dunnellon, and Port Inglis. The gauge at Port Inglis experiences a strong tidal signal with a daily fluctuation of up to five feet (USGS, 2010). The average daily discharge from the spillway of the Inglis Dam at Dunnellon is 417 cubic feet per second (cfs) (USGS, 2010). The spillway of the Dam drains an area of approximately 2,020 mi^2 (USGS, 2010). Across the 41-year period of record the daily discharge ranged from a minimum of 70 cfs and a maximum of 6,030 cfs (USGS, 2010).

Upper Floridan Aquifer System

The Floridan aquifer system is the principal aquifer system and major source of water for human use in the basin. This system is composed primarily of layers of carbonate rocks with relatively high permeability in areas separated by relatively impermeable layers of clays. The Floridan aquifer has two main zones, the Surficial (or Upper) and the Intermediate (or Lower). Generally, most of the potable water comes from the Upper, as the lower can be brackish or highly mineralized. The Upper Floridan aquifer is the principle source of potable water in the SWFWMD and is used for major

industrial, mining, public supply, domestic use, irrigation, and brackish water desalination in coastal communities (SWFWMD, 2006). Recharge to the upper Floridan aquifer occurs where the confining clay layers are not present and where sinkholes create a direct hydraulic connection to the surficial aquifer system. These areas where the Upper Floridan aquifer are unconfined are the most susceptible to groundwater contamination, as there is no clay layer to block the pollution from entering this drinking water source. The overall water quality in the upper Floridan within the basin is very good (FDEP, 2006). However, increasing nitrates have been documented in the aquifer and springs (FDEP, 2006). The northern boundary of the intermediate aquifer crosses Polk, Hillsborough and Pinellas counties, and therefore is not a predominate feature in the Withlacoochee watershed. The intermediate aquifer system is composed of permeable lenses within the confining unit of the Hawthorn Formation. The thickness of this aquifer is highly variable and pinches out or combines with other aquifers and units. Where it is present in the SWFWMD it is primarily used for public supply, domestic use and irrigation (SWFWMD, 2006).

DRASTIC Assessment of Aquifer Vulnerability to Pollution

The EPA has developed the DRASTIC system to index aquifer vulnerability to pollution. The index is based upon hydrogeologic and physical characteristics that affect the ground-water potential pollution potential (EPA 2010). The index ranges from 0 to 10 with ratings of 10 having the potential for ground-water pollution in that area of the aquifer. Those factors are:

D – Depth to Water

R – (Net) Recharge

A – Aquifer Media

S – Soil Media

T – Topography (Slope)

I – Impact of the Vadose Zone Media

C – Conductivity (Hydraulic) of the Aquifer

The EPA conducted a complete DRASTIC indexing of the Floridan Aquifer Vulnerability to Pollution in 1998 (FGDL 2010). The DRASTIC indexing ranges from 0 to 224, with an index of 224 representing the greatest vulnerability. Figure 1 shows a map of the Floridan Aquifer Vulnerability to Pollution index. From it, one can see that the entire proportion of Pasco County within in the Withlacoochee watershed is moderate to highly vulnerable to pollution. This assessment of the moderate to high vulnerability for aquifer pollution supports stakeholder concerns that leakage from a landfill in that area could contaminate the aquifer.

Rainbow River & Rainbow Springs

The Rainbow River is a 5.7-mile long spring-fed tributary that originates in southwest Marion County and empties into the Withlacoochee River at Dunnellon. The headwater of the Rainbow River originates at Rainbow Springs in Rainbow Springs State Park. Because it is predominantly spring-fed, the Rainbow River's water is clear, stays at a relatively constant temperature of 72 degrees, and is well buffered (i.e. resists changes in pH). Rainbow Springs discharges approximately 493 million gallons per day (mgd) and is the only 1st order magnitude spring in the Withlacoochee Watershed (SWFWMD, 2009), meaning it discharges more than 64.6 million gallons of groundwater per day. Rainbow springs, along with 23 additional smaller springs within the basin cumulatively discharge an average of 2.2 billion gallons of water per day. The Rainbow River's natural beauty and ecological quality makes it an important resource relied on by both the people of Florida as well as diverse plant, fish and wildlife species. About 220,000 people visit the river annually to dive, swim, boat, and fish (SWFWMD, 2009).

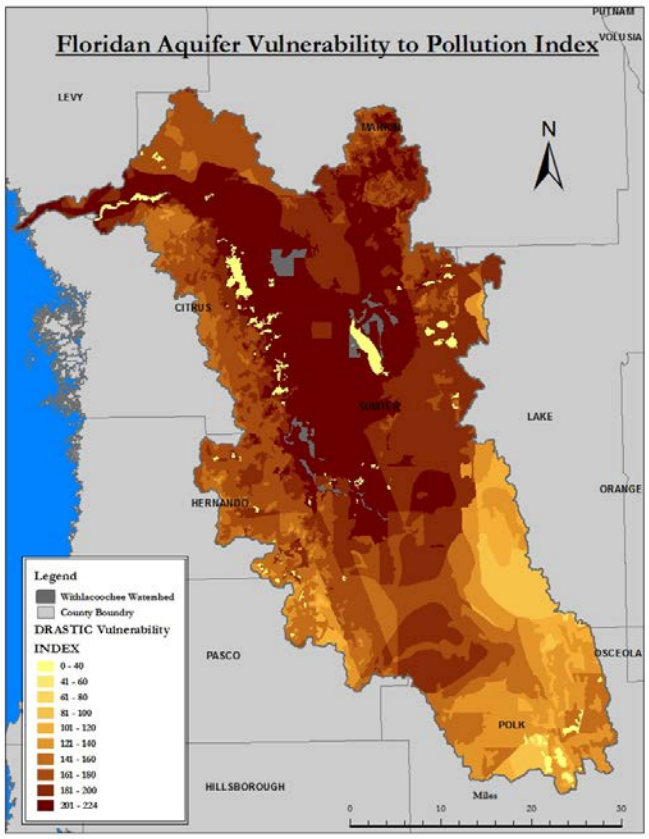

Figure 1. A map showing the vulnerability of the Floridan aquifer to contamination, from least (lightest yellow) to greatest (darkest red).

The entire length of the Rainbow River was designated as an Aquatic Preserve in 1986. Aquatic preserves are submerged lands of exceptional beauty that are to be maintained in their natural or existing condition. The Florida legislature created this designation under the 1975 Florida Aquatic Preserve Act (Section 258.35, F.S.). The designation translates into use of applicable federal, state, and local management programs to assist in appropriately managing the preserves. Under this designation, agencies reviewing, developing, and implementing management plans for the preserves are obligated (under enforcement by the DEP) to encourage the protection, enhancement or restoration of the biological, aesthetic, or scientific values of the preserves, and to discourage activities which would degrade these values, the quality, or the utility of a preserve. The Rainbow River is also an Outstanding Florida Water

(designated in 1994), a National Natural Landmark, and a SWIM priority water body (SWFWMD, 2009).

Overall, the ecology of the Rainbow River can be considered to be in relatively healthy condition, with low and stable phosphorus levels (0.03 mg/L), and dissolved oxygen levels that are healthy and among the highest within Florida's springs, generally ranging from 4.5-6.9 mg/L at the vent (Scott et. al. 2004, FDEP 2007), though lower DO levels have been documented in Rainbow Springs #1 (SWFWMD, 2006). The FDEP monitoring found the habitat to be in the "optimal" range, and the stream condition index (SCI) scores show that invertebrate populations in this area continue to be in the "healthy" range (FDEP 2007, FDEP 2008). However, the system is experiencing a number of changes and facing several threats. According to the SWFWMD (2008, 2009), Cowell (2005) and Stevenson et al. al. (2007) those threats are:

- Residential land use abuts the river's edge in some areas and future development is anticipated (SWFWMD, 2009).
- Nitrogen levels have increased almost an order of magnitude, from background conditions estimated to be ~ 0.01 mg/L, to 0.17 mg/L in 1974, to almost 2.0 mg/L at times (SWFWMD, 2008).
- Water clarity decreases with distance from the headspring. Research conducted by Cowell (2005) attributes the decline in water quality to the chlorophyll in phytoplankton, which increases with distance downstream of the vent, and may be associated with micronutrients.
- Native submerged aquatic vegetation in the river is being overtaken by invasive species such as *Hydrilla verticillata,* which occurs more densely in areas downstream containing nutrient enriched sediments (SWFWMD, 2008). The likely native but rapidly proliferating cyanobacteria *Lyngbya sp*. is of concern for the well being of the river as well. The most recent study directly measuring filamentous algae (vs. phytoplankton) in Rainbow Springs is the Stevenson et al. (2007) paper, which reported that the two monitored sites in Rainbow Springs had 24.7 and 19.8% cover of macroalgae, while the mean for the 60-site study was 47.4% algal cover. Future work, in which filamentous algae will be carefully mapped throughout the spring run, is currently in the planning stages through SWFWMD. It was scheduled for 2010-2011 but was delayed, and at the writing of this report, it was scheduled to begin.

Additional Springs

Approximately 25 known springs occur within the basin, as well as potential numerous undocumented fourth magnitude or smaller streams, particularly in the Lake Panasoffkee region (FDEP 2006). The second-magnitude springs (each discharging between 10-100 cubic feet per second), include the Gum Springs group, Fenney Spring, and Citrus Blue Spring. These smaller springs show slightly different chemistries than Rainbow Springs, with monitoring data (conducted infrequently) showing lower DO

(from 0.2-1.8 mg/L) as well as lower nitrates (0.3-0.9 mg/L) than in Rainbow Springs (Scott et. al., 2004). According to Scotte et al. (2004), USGS monitors flow periodically in Fenney and Citrus Blue Spring; therefore no trends can be assessed.

Wetlands

The SWFWMD (2006) has classified 8 different wetland types in the Withlacoochee Watershed, they are: cypress, wetland coniferous forests, wetland forests mixed, wetland hardwood forests, bay swamps, freshwater marshes, intermittent ponds, and bottomland swamps (Figure 2). The majority of the cypress, wetland coniferous forests, and wetland forests mixed occur in the Green Swamp area.

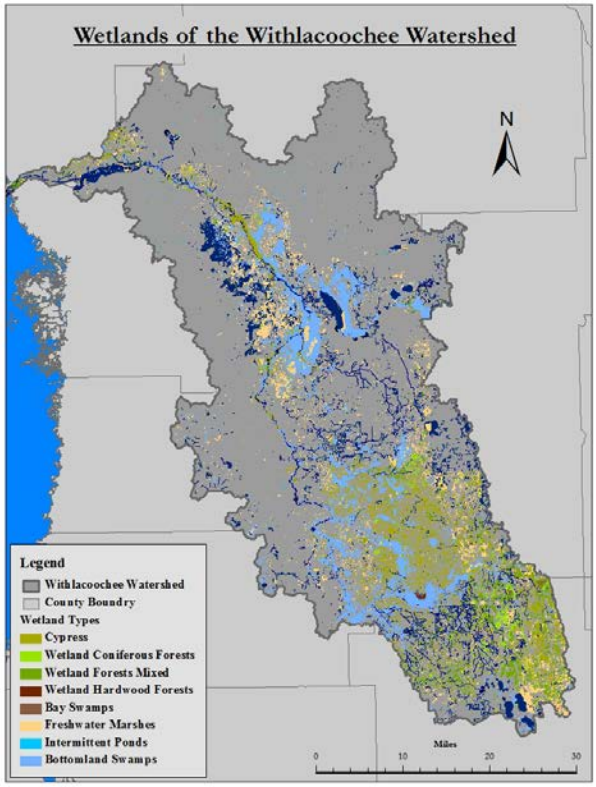

Figure 2. Wetland types and spatial extent within the Withlacoochee River Watershed (FGDL 2010).

The Green Swamp

The Green Swamp is the headwaters of the Withlacoochee River and is also the area of the highest pieziometric head in the state of Florida (SWFWMD 2006). The Green Swamp area is considered an important recharge area for the Floridian Aquifer (Kiker and Lynne 1981). It is a large area, encompassing parts of Hernando, Lake, Pasco, Polk, and Sumter counties whose boundary can be used to designate both an ecological system and The Green swamp Wilderness Preserve. As an ecological area, the Green Swamp is comprised of pinelands, hardwoods, pastures, and wetlands and in fact more than half of the area is not swamp (Kiker and Lynne 1981). The higher ridges and hills within the Green Swamp where the aquifer is unconfined are the primary areas for aquifer recharge. The extensive wetlands within the Green Swamp are essential for wildlife populations throughout west-central FL. About one-fifth of the state and federally listed vertebrate species have been documented as occurring in the Green Swamp (Green Swamp Task Force 1992).

As a political designation, the Green Swamp (503 sq miles) was identified as Florida's first Area of Critical State Concern (ACSC) in 1979 as defined under Ch. 380, Sec. 5 of the Florida Statutes. ACSC's are areas recognized as having a significant positive contribution to environmental, natural, historical, and/ or archaeological resources. The uncontrolled development of ACSC's would cause substantial deterioration of the valuable resources they provide. Therefore, under this designation, the state land-planning agency is granted the power to recommend actions that the local

government as well as state and regional agencies must accomplish in order to avoid the predicted negative results of uncontrolled or inadequate development of the area. For example, the state land planning agency can require actions such as revision of the local comprehensive plan as well as adoption of land development regulations, density requirements, and special permitting requirements. The Green Swamp was designated a ACSC for three primary reasons (1) recharge of the Floridan Aquifer, (2) wetlands, and (3) flood-detention (Kiker and Lynne 1981).

The Withlacoochee Bay Estuary

The Withlacoochee Bay Estuary is a large (52,000 acres) and shallow estuary at the mouth of the Withlacoochee River near Yankeetown. The River discharges into two distinct areas of the Bay, the River itself as well as the adjacent Cross-Florida Barge Canal. Along the Coast of the Bay there are five major intertidal habitats: brackish marches, salt marshes, intertidal flats, oyster reefs, and mangrove forests (FDEP 2006). These areas as well as the extensive sea grass beds are extremely important for commercial fishing with 90-97% of the total commercial catch in the Gulf of Mexico utilizing estuaries during some part of their life cycle (FDEP 2006). In the open water areas of the Withlacoochee Bay Estuary some of the important fish species for recreational and commercial purposes include: striped mullet (*Mugil cephalus*), red drum (*Sciaenops ocellatus*), spotted sea trout (*Cynoscion nebulosus*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), and striped anchovy (*Anchoa hepsetus*) (FDEP 2006). Four sea turtles: the kemp ridley (*Lepidochelys kempii*), green turtle (*Chelonia mydas*), Atlantic loggerhead (*Caretta caretta*) and the Atlantic leatherback (*Dermochelys coriacea*) are also found in the Estuary (Carr 1995; Younker et al. 1992; FDEP, 2006).

Prevailing inshore current flow in the Gulf of Mexico runs counter-clockwise (Wiseman et al., 1997) and as a result the discharge from the Withlacoochee is an important source of fresh water not only to the Withlacoochee Estuary but also to the Waccasassa Bay and southern reaches of the Big Bend Sea Grasses Preserve. Thus pollutant discharges from the Withlacoochee Watershed can be transported to the Withlacoochee Bay and by extension, to the Waccasassa Bay and Big Bend Sea Grasses Preserve areas (Wiseman et al., 1997).

Because of the engineered changes to the Withlacoochee River, the Bay no longer receives a natural flow. The flow has been bifurcated between the River and the Cross Florida Barge Canal and the Bay no longer receives a natural flood pulse due to the numerous water control structures such as the Inglis dam (Wiseman et al., 1997). At the time of writing this report, the development of Minimum Flows and Levels for the Lower Withlacoochee River and Bay are scheduled, but have not yet been drafted.

Lakes and Engineered Water Control Structures

There are many lakes throughout the Withlacoochee watershed, but this section will focus on the major lake systems. Lake Panasoffkee and the chain of lakes associated with Tsala Apopka, are thought to be remnants of a much larger lake system that occupied much of the current Withlacoochee River basin, called the Tsala Apopka Plain.

Tsala Apopka lake region comprises three distinct pools connected by thousands of acres of marsh system. The largest lake in the region is Lake Panasoffkee, and it has proved to be an important and unique surface water feature in the basin. Additionally, a variety of recent and historic changes to the Withlacoochee River watershed have affected the river's response to high and low flow conditions. Major engineering alterations to the hydrology of the river include the Wysong-Coogler Dam on Lake Tsala Apopka, The Inglis Dam on Lake Rousseau, and the Cross-Florida Barge Canal.

The Lake Tsala Apopka Chain of Lakes and the Wyson-Coogler Dam

Lake Tsala Apopka is the largest lake system in the Withlachoochee River basin, contained mostly in Citrus County. It is composed of ~19,000 acres of shallow, heavily vegetated marshes intermingled with open water pools, and has a watershed of 63,000 acres (FDEP, 2006). Water control structures separate the lake into three main pools named after nearby towns: Floral City, Inverness and Hernando (FWC, 2010). The lakes are used heavily for game fishing, and support a great deal of diversity due to the mixture of wetland, lacustrine, and riverine ecosystems. Before 1800 there was no open water connection between the lakes and the Withlacoochee River. At that time water movement between the two systems occurred via adjacent marshes. Currently the system is highly engineered and water levels are maintained by a variety of control structures. These canals and flow structures control both the water flowing into and out of the lake and are designed to maintain water in the lakes and river during low flow events (SWFWMD, 2004 and FDEP, 2006).

The main water control structure on Lake Tsala Apopka is the Wysong-Coogler Adjustable Water Conservation Structure (a.k.a. the Wysong Dam) which is located about 2.5 miles north of the Outlet River at Carlson's Landing. Built in 1966, the dam remained in use for 22 years. In 1988 the SWFWMD determined that it was having little to no effect on water levels and removed it. The dam was reconstructed in 2002 after the DEP determined it was needed to maintain Lake Tsala Apopka and Lake Panasoffkee water levels as well as to help groundwater recharge in the area. The Wysong dam is currently operated by the SWFWMD to extend high water levels upstream during the dry season. Local residents and environmental organizations have expressed concern regarding the decrease in flow downstream from the dam. (TetraTech, Inc., 2004).

Minimum flows and Levels (MFLs) were developed for the Tsala Apopka lakes in 2005 and accepted by the governing board in 2006. In 2009 new water management guidelines were developed and were first utilized in January 2010. The most recent amendment to the water level guidelines are designed to bring up the levels of the three main pools. This will affect the way water flows from the river into the pools and between the pools so that all pools share the water equally. The previous guidelines required that the first pool reach its minimum level before the downstream pool could receive any water (SWFWMD, 2010).

In some areas the lake bottom is hydraulically connected with the unconfined Floridan aquifer, allowing surface water and ground water to influence each other physically and geochemically. This area is overlain by a permeable sand bed that allows recharge from the surface to the Floridan Aquifer and it is because of this that the water

quality data show elevated levels of total dissolved solids, total organic carbon, chloride, and phosphorous. Nitrate levels are elevated (over 1 mg/L) in several nearby wells which is likely attributable to lake bottom sediments and nearby septic/wastewater systems (FDEP, 2006).

Plant surveys of emergent and floating-leaved vegetation in the lake system suggest that there is a desirable assemblage of submersed, emergent, and floating-leaved vegetative species. However, the lake has periodic overgrowth of dense mats of the invasive aquatic plant hydrilla, which has been treated with herbicide. Extensive growth of hydrilla can limit navigation and recreation, restrict native plant communities, lower DO levels, and affect fish habitats. Another vegetation problem are floating tussocks, which are large chunks of organic material, commonly sourced from the lake bottoms, which have broken free, and move independently in the water bodies. These tussocks can have a negative impact on boat access points and navigation on the lakes. Tussock removal techniques are commonly mechanical; time consuming and expensive, and tussock disposal is often a problem. Two proposed disposal methods are using the mats as amendment for sandy soils or affixing them to the lake bottom to create permanent islands. These islands provide new habitat for nesting or feeding (FDEP, 2006).

Lake Panasoffkee

Lake Panasoffkee is the third largest lake in Florida, with a surface area of 3,800 to 4,500 acres, depending on the season, and with a mean depth of 3ft. The state has recognized this lake as an Outstanding Florida Waterway (OFW) as well as a Surface Water Improvement and Management (SWIM) priority water body (FDEP, 2006). Due to the environmental and economic significance of the lake, in 1988 the SWFWMD ranked the lake as fifth on its SWIM priority list. The original SWIM plan was approved in 1989 and updated again in 2000. The goals of the SWIM plan are to restore public access and navigation, restore fisheries habitat, restore historic shoreline conditions, maintain or improve existing water quality, and maintain 60% coverage of desirable submerged aquatic vegetation (SWFWMD, 2000). Minimum flows and levels were established for Lake Panasoffkee in 2006 (SWFWMD, 2006).

The lake has a direct connection with the Floridan Aquifer, and therefore is a point of recharge, as well as a potential source of contamination for the aquifer (FDEP, 2006). The aquifer through groundwater and spring flow, accounts for approximately 40% of the annual lake water inflow. Other inflows are Big Jones Creek and Little Jones Creek, which enter at the northern end of the lake and account for about 45% of the water to the lake. The lake's only surface water outflow is the Withlacoochee River, via the 2-mile Outlet River, to which it provides about 20% of the river flow.

Along the Laker are extensive shoreline wetlands providing fish and wildlife habitat. The local and regional economy is greatly influenced by the freshwater fishery of the Lake. Historically, Lake Panasoffkee has supported one of Florida's most productive red ear sunfish, bass, and bluegill fisheries. More recently fishing has declined as evidenced by the declining number of operating fish camps. The extensive communities of submerged aquatic vegetation provide excellent habitat for game fish populations. However at times low water levels provide problems for navigation as do floating tussocks and vegetative mats.

Although spring water influx helps maintain good water quality, it is also the major contributor to sedimentation filling in this lake. The ground water naturally carries large amounts of dissolved calcium carbonate which, when mixed with the lake water, solidifies and produces sediments that settle on the lake bottom (TetraTech, 2004). These changes affect recreation and create navigational challenges within the lake. It is thought that the buildup of organic sediments in the bottom of the lake have destroyed historical fish-spawning areas as well as caused the sedimentation along the shoreline contributing the loss of almost 800 acres, 22% of the lake area. The Lake Panasoffkee Restoration Council was established in 1998 and was tasked with identifying strategies to restore the lake. Restoration projects include restoration of fisheries and the creation of emergent and submerged vegetation zones, mostly accomplished by dredging the bottom of the lake and canals (SWFWMD, 2005). By the end of 2008 this $26.9 million, ten-year project was complete. Approximately 8.3 million cubic yards of sediment were removed from over 1,744 acres of lake area, which restored historic fish bedding areas and the original shoreline (SWFWMD, 2008).

Lake Rousseau and Inglis Dam

The construction of the Inglis Dam in 1909 by the Florida Power Corporation created Lake Rousseau a 5.7-mile long man-made lake covering parts of Levy, Citrus, and Marion counties. This dam, and the subsequent lake, was constructed along the main course of the Withlacoochee River. Originally the dam discharged back into the main channel of the river.

The Inglis dam was built to provide hydroelectric power to the phosphate industry in the area. In 1965 hydropower operations ceased when the U.S. Army Corps of Engineers (USACE) took over the operation of the dam (Inglis Hydropower, 2007). The US Army Corps of Engineers currently manages the dam operations for the purposes of flood control and water level maintenance. The Inglis dam has decreased flow by 7-10 percent to the lower portion of the Withlacoochee River. This decrease is primarily due to the increased evapotranspiration from Lake Rousseau, as well as the increased recharge to ground water due to the increased head difference (Amy R. Hemley Foundation, 2011).

Lake Rousseau lays 11 miles inland of the mouth of the Withlacoochee River and receives water from both the Withlacoochee and Rainbow rivers. The Lake is a popular sport fishing lake. When the area was initially flooded in the early 1900s, the water inundated forested areas that now serve to provide cover for wildlife. Also contributing to wildlife habitat is the lakes abundant vegetative cover of cypress trees, water hyacinth, pennywort, and hydrilla. Sport fish range from bluegill, perch, shell crackers, red ear sunfish, catfish, black crappie, to largemouth bass (FWC, 2010).

It has been proposed to use Lake Rousseau as water supply for the Tampa area (Withlacoochee Regional Water Supply Authority, Jan, 2007). The Withlacoochee Regional Water Supply Authority conducted a study comparing the economic feasibilities of pumping water from the Lake to Tampa versus constructing a desalination plant to supply water to the Tampa area. Transferring water from Lake Rousseau to supply the Tampa area was determined to be economically unfeasible (Withlacoochee Regional

Water Supply Authority, Jan, 2007). More recently however the Regional Water Supply Authority was tasked by SWFWMD to determine alternate water supply sources for areas south of Marion County. It was concluded that well fields should be established in northwest Marion County and/or water should be siphoned from Lake Rousseau. This proposal has created a number of concerns for local groups because the northern regions of the county, as well as the lake, are important groundwater and spring recharge source locations (Rainbow River Conservation, 2010). A MFL assessment was scheduled for the lower Withlachoochee and Lake Rousseau in 2010; however it has yet to be released.

In 2009, Inglis Hydropower LLC submitted an application for installation of a hydroelectric plant, in the town of Inglis, just west of the Lake and the historic Inglis Dam. The proposed 2.0-megawatt hydroelectric plant would generate energy from the flow of water currently released by SWFWMD from Lake Rousseau (Federal Register, 2010). The plant was designed to generate energy without adding additional silt to the adjacent water bodies. The station will operate like a run-of-the-river structure, as mandated by the State of Florida, so as not to create standing water on the upstream side of the structure. Additionally, the structure is proposed to keep Lake Rousseau at a constant elevation of 27.5ft above mean sea level (amsl), however the structure can be shutdown if there is a threat of downstream flooding (Inglis Hydropower, 2010). It has also been proposed by the Inglis Hydropower LLC that this structure will allow for periodic drawdown of the lake for weed control purposes. The current structure allows for lake levels to be lowered to 20.5ft amsl however it is not able to increase flow downstream. The new structure will allow for lake levels to be lowered to 20.5ft amsl, with the additional 1000cfs of water to flow downstream. According to Inglis Hydropower LLC the benefits of drawdown include:

- Oxidation and consolidation of bottom sediments
- Temporary reduction in floating aquatic weeds- including hydrilla- thus decreasing the need for chemical weed control
- Increase in native plant diversity and coverage
- Improved game fish conditions
- Improved water quality
- Opportunities to improve and repair recreation facilities and perform spillway maintenance

As of June 2010 there are still plans to build the plant and the plan is currently under environmental analysis and solicitation of public comments (Inglis Hydropower, 2010 and Federal Register 2010).

Cross-Florida Barge Canal

Downstream from Lake Rousseau the character of the Withlacoochee River has been dramatically altered by the Cross-Florida Barge Canal (CFBC). The canal intersects the natural channel about 9 miles upstream from the estuary and about 2 miles downstream from the Inglis Dam. The USACE began construction of the canal in 1965 to provide a shortcut for barge traffic traveling between the Gulf of Mexico and the Atlantic Ocean. In 1971 President Richard Nixon halted work on the canal due to environmental and water resource concerns and in 1990 Congress officially deauthorized the project. The canal is now abandoned, however it still has affected water flow in the

lower Withlacoochee River. Before the canal was built, all waters exiting Lake Rousseau flowed to the Gulf of Mexico through the natural lower Withlacoochee channel.

According to the Amy R Hemley Foundation, the current operating schedule of the canal and Inglis Dam allows flows below 1,540 cfs to go through the bypass canal to the lower Withlacoochee River. When flows are above 1,540 cfs water is discharged through the Inglis Dam to the section of the Cross Florida barge Canal. These standards have changed the stream flow conditions of the lower Withlacoochee River by stabilizing seasonal variations in flow to the lower Withlacoochee River. This changes have limited fresh water delivery to the estuarine areas, while increasing upstream saltwater intrusion (Amy R Hemley Foundation, 2011).

Habitat

The Withlacoochee River Watershed hosts a rich diversity of habitat types that support many endemic, rare, and endangered animal and plant species. This diversity of the natural ecological communities of the Withlacoochee River Watershed creates a mosaic of habitat that supports a variety of wildlife. Abundant populations of animals including mammals, bird, freshwater and saltwater fish, vertebrate, amphibian, and reptile species live within the watershed (DEP 2011). Additionally, the watershed provides habitat for numerous threatened or endangered species including the: Florida Black Bear (*Ursus americanus floridanus)*, Gopher Tortoise *(Gopherus polyphemus)*, Eastern Indigo Snake *(Drymarchon corais couperi)*, Florida Scrub Jay *(Aphelocoma coerulescens)*, Bald Eagle *(Haliaeetus leucocephalus)*, Snail Kite *(Rostrhamus sociabilis)*, and Florida Crested Caracara (*Caracara cheriway)* (Defenders of Wildlife 2011, FWC 2010, SWFWMD 2011).

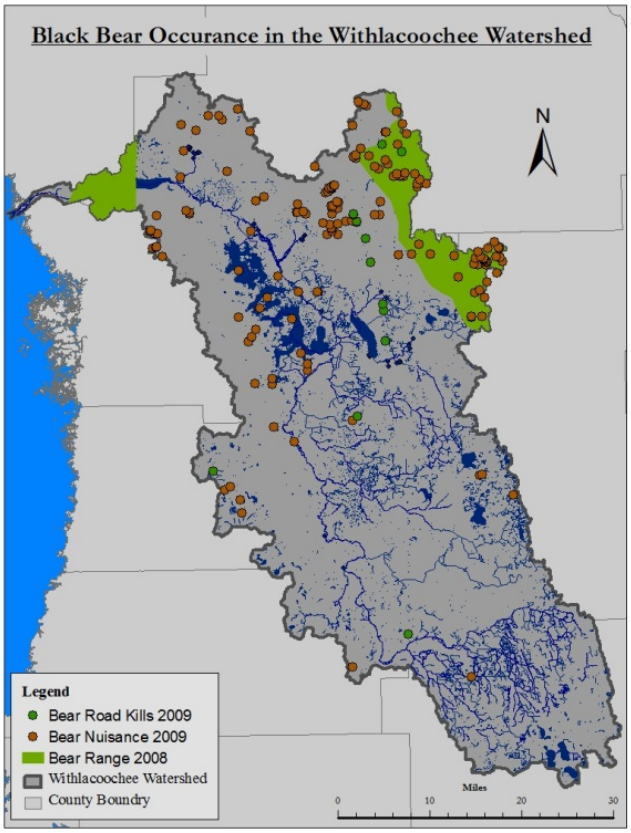

Figure 3. Florida Black Bear range (2004-2008), road kill incidents (1976-2009), and nuisance reports (1980-2009) in the Withlacoochee River Watershed (FGDL 2010).

Florida Black Bear

The Florida Black Bear (*Ursus americanus floridanus)* threatened sub-species of the American Black Bear (Ursus americanus) have an established range in the Withlacoochee River Watershed (Defenders of Wildlife 2011). The range of the Florida Black Bear across the state of Florida is shown in Figure 3. The known range (2004-2008), reported road kills (1976-2009), and reported nuisances of the Florida Black Bear activity (1980-2009) within the Withlacoochee River Watershed are also shown in Figure 3. The mapped range does not encompass the entire habitat used by bears in the Withlacoochee, extended range is indicated by the occurrences of bear road kills and bear nuisance reports well beyond the range and throughout the northern portion of the watershed (FGDL 2010).

Prior to European settlement, the entire mainland, some coastal islands, and the larger keys of Florida supported black bears. Now the Florida black bear range is limited to only the Eglin, Apalachicola, Osceola, Ocala, St. Johns, Big Cypress, Chassahowitzka, and Glades/Highlands areas (FWC 2009). The 2008 bear distribution data layer shown in Figure 6 includes primary and secondary black bear ranges. Black bears live throughout the range searching for food, water, and shelter. The primary range is the portion of the range that contains the core bears population, their habitat, and evidence of reproduction. While the secondary bear range is simply less optimal than the primary range (FGDL 2010). It is evident that the habitat provided by the Withlacoochee River Watershed extends the range and has the potential to create linkages between other fragments of bear habitat in the state. Threats to Florida Black Bear habitat include fragmentation due to: logging, urban area expansion, road-kills, and illegal killing. Conservation of habitat for the Florida Black Bear protects habitat for numerous other species. Within its territory the black bear is an umbrellas species, meaning that in protecting their populations and their habitat, many other species would benefit (SWFWMD 2011).

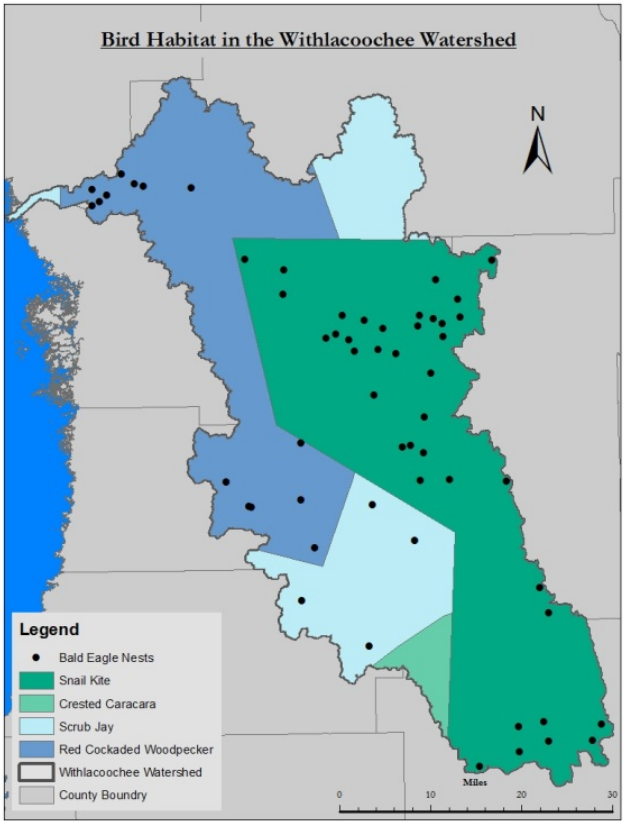

Figure 4. Threatened Bird Habitat within the Withlacoochee River Watershed (FGDL 2010).

Birds

The Withlacoochee Watershed provides habitat to several birds that have been or are listed as threatened including the Bald Eagle *(Haliaeetus leucocephalus)*, Florida Scrub Jay *(Aphelocoma coerulescens)*, Snail Kite *(Rostrhamus sociabilis)*, Red Cockaded Wood Pecker *(Picoides borealis*), and Florida Crested Caracara (*Caracara cheriway)*. Figure 4 shows known Bald Eagle nest sights as well as the overlapping Snail Kite, Crested Caracara, Scrub Jay, and Red Cockaded Woodpecker habitat within the Withlacoochee Watershed.

The Bald Eagle is our national bird, and nests throughout the Withlacoochee River Watershed. After near extirpation and the implementation of extensive management plans the Bald Eagle populations in Florida have rebounded. In 1973 only 88 active Bald Eagle nests were identified in Florida, as of 2009 there were more than 1,300 Bald Eagle nests counted (FWC 2010). The FWC determined that in the 2008 and 2009 the Withlacoochee River Watershed supported approximately 60 active Bald Eagle nests (FGDL 2010). This habitat provided by the Withlacoochee River Watershed is critical for maintaining stable Bald Eagle populations, as shown in Figure 7.

The extensive range of the Snail Kite within the Withlacoochee River Watershed is shown in Figure 4. Within the United States the Snail Kite lives only in Florida. The historic range of the snail kite in Florida ranged from the Everglades to just southeast of Tallahassee. However, habitat destruction such as wetland drainage and development have degraded the populations of the Snail Kites primary food, the apple snail to the point that the species was listed as endangered in 1967. While Snail Kite populations are considered to be stable they are still vulnerable due to continued pressures on their habitat (FWC 2011).

The Withlacoochee River Watershed's open grasslands, palm scattered prairies, and improved rangeland provide habitat for the Crested Caracara sub-species. The Florida Crested Caracara (*Polyborus plancus audubonii)* is listed as threatened (Koeppel 2011). Fragmentation, destruction, and loss of habitat are the primary threats to the Crested Caracara (Florida Audubon 2011). Currently there are no Crested Caracara management plans in place. Protection of their habitat (shown in Figure 4) within the Withlacoochee River Watershed is critical for maintaining and increasing the Florida Crested Caracara population.

The Withlacoochee River Watershed provides habitat to the threatened Florida Scrub-Jay which is unique in its habitat requirements as it is restricted to scattered, often small and isolated patches of sand pine scrub, xeric oak scrub, and scrubby flatwoods Scrub-Jays prefer their desired habitats to burn in such duration (approximately every 5 to 20 years) to allow management of tree heights ranging from 3 to 10 feet (FWC 2011). Dominant threats to Scrub-Jay habitat are conversion to suburban development and agricultural lands. Conservation of existing habitat is critical for the improvement of the Florida Scrub-Jay populations.

The mature pine forests of the Withlacoochee River Watershed provide habitat for the Federally endangered Red-cockaded Wood Pecker. The birds preferred habitat, the longleaf pine forest, has shrunk to a mere 3% of its original extent. The Red-cockaded Wood Pecker is prefers to live in longleaf pines that are 90 to 100 years old (FWC 2011). Conservation of the old growth long-leaf pine ecosystems within the Withlacoochee River Watershed will aid in the restoration of the Red-cockaded Wood Pecker population.

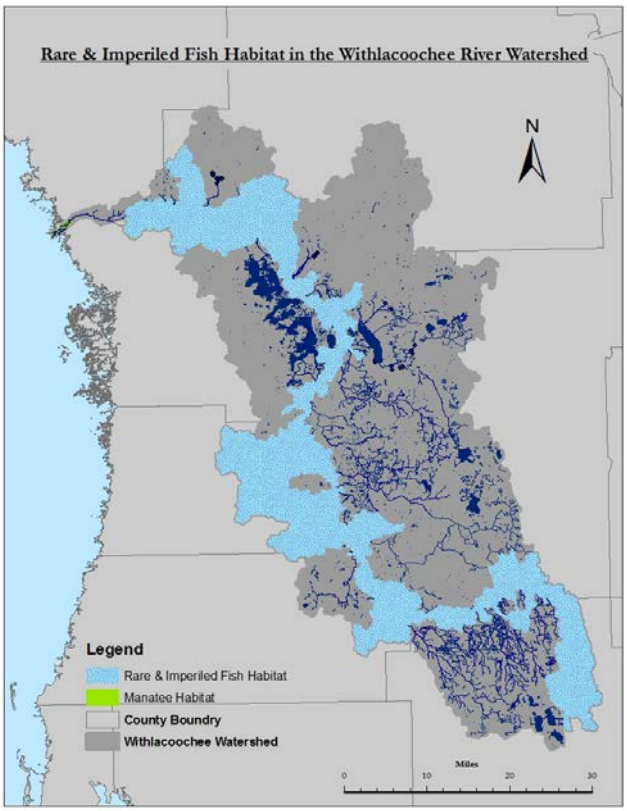

Figure 5 Rare & Imperiled Fish Habitat within the Withlacoochee River Watershed (FGDL 2010).

Fish

The entire Withlacoochee and Rainbow River system provide habitat for several rare and imperiled fish species, habitat shown in Figure 5 (FGDL 2010). The species of rare and imperiled fish utilizing Withlacoochee Watershed habitat are the:

- The Alabama Shad (Alosa Alabamae), once abundant enough to support commercial fisheries (NOAA 2008).
- The Mountain Mullet (Agonostom Monticola) (FWC 2010)
- The Ironcolor Shiner (Notropis Chalybaeus),
- The Suwannee Bass (Micropterus Notius),
- The Spotted Bullhead (Ameirus Serracanthu) (FGDL, 2010).

Along the Coast of the Waccasassa Bay there are five major intertidal habitats: brackish marshes, salt marshes, intertidal flats, oyster reefs, and mangrove forests (FDEP 2006). These areas as well as the extensive sea grass beds are extremely important for commercial fishing with 90-97% of the total commercial catch in the Gulf of Mexico utilizing estuaries during some part of their life cycle (FDEP 2006). In the open water areas of the Withlacoochee Bay Estuary some of the important fish species for recreational and commercial purposes include: striped mullet (*Mugil cephalus*), red drum (*Sciaenops ocellatus*), spotted sea trout (*Cynoscion nebulosus*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), and striped anchovy (*Anchoa hepsetus*) (FDEP 2006). Four sea turtles: the kemp ridley (*Lepidochelys kempii*), green turtle (*Chelonia mydas*), Atlantic loggerhead (*Caretta caretta*) and the Atlantic leatherback (*Dermochelys coriacea*) are also found in the Estuary (Carr 1995; Younker et al. 1992; FDEP, 2006).

Threats to Freshwater Habitat

The Florida Fish and Wildlife Conservation Commission identified dominant anthropogenic threats to Florida's freshwater habitats in an effort to manage those threats to improve habitat and to slow the decline of aquatic species (FWC 2008). Freshwater habitat within the entire Withlacoochee Watershed is threatened due to one or more of the following: the presence of invasive aquatic plants, agricultural activities, waterway modification, degraded water quality, road density, and/or groundwater use. Agricultural activities are the most common, while the presence of invasive aquatic plants are the second most common threat to freshwater habitat in the Withlacoochee River Watershed (FWC 2008). The spatial layout and combination of these threats in the watershed are shown in Figure 6.

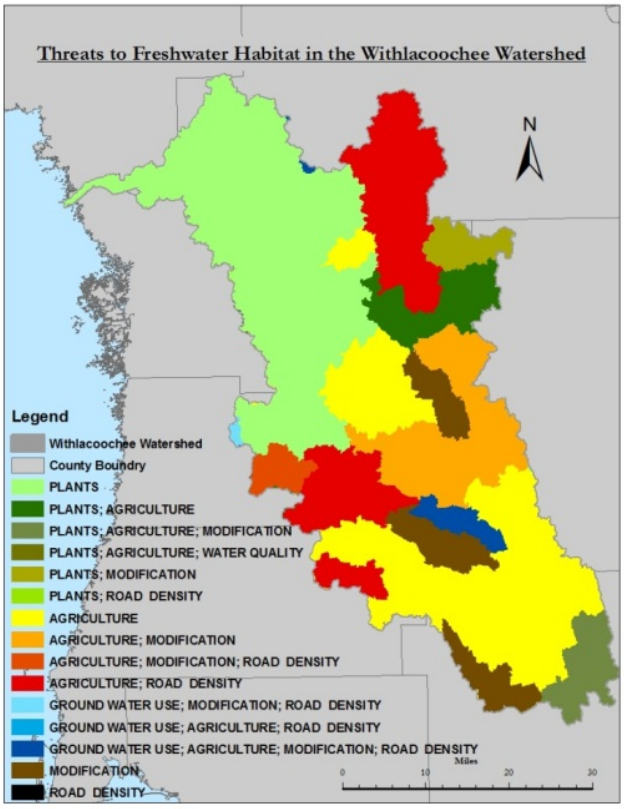

Figure 6. Threats to Freshwater Habitat in the Withlacoochee River Watershed (FGDL 2010)8.

Invasive Plants

A significant amount of the waterways in Florida have succumbed to invasive plants, the most common being the non-native hydrilla (*Hydrilla verticillata* L.f. Royle). These plants can lead to a variety of problems for surface water bodies in the Withlacoochee watershed, but also across the state. According to the FWC, invasive plants have the potential to "degrade and diminish Florida's conservation lands and waterways" (FWC, 2010). State law mandates management of hydrilla to the greatest degree practicable to prevent injury to non-target plants, animal life, and property (Hoyer et al., 2005). The Invasive Plant Management Section of FWC is responsible for coordinating and funding two state programs for controlling invasive aquatic plants in waterways, as well as upland plants on conservation lands (FWC, 2010).

Hydrilla first appeared in Florida's lakes and rivers in the 1950's and is now considered a pervasive species. To date, Florida has spent millions of dollars in attempts to control the species both through the use of herbicides, mechanical removal, and biological control (Hoyer et al., 2005). Mechanical removal has been used in rivers and canals; however mechanical removal of aquatic plants is expensive, time consuming, shore disrupting, and creates much waste that must be disposed of. A more popular method for removing unwanted aquatic vegetation from lakes is the use of the herbicide floridone. This herbicide is thought to offer selective treatment of the plant, and is

relatively low cost when compared to herbicides used directly on the plant or mechanical removal. Within the past decade hydrilla populations have become resistant low concentrations of floridone. At an increased cost, higher concentrations of the herbicide can be used, but have been shown to impact non-target native aquatic macrophytes. This decreases the practicality of using herbicides to manage unwanted aquatic plants. Other problems associated with this herbicide is that there is commonly a 3-day fishing restriction after application, and in a few cases the increased decay biomass has lead to very low DO levels and subsequent fish kills (Hoyer et al., 2005).

Water Use

The best water use data is available from the SWFWMD and from the Withlacoochee Regional Water Supply Authority (WRWSA). The WRWSA does not include the whole watershed, but only Marion, Citrus, Sumter and Hernando. The statements below only reflect this portion of the watershed. Water use in the Withlacoochee River Watershed is from both surface and groundwater withdrawals; however the majority of use is from groundwater (WRWSA, 2010). According to the SWFWMD (2010) Northern Region Water Supply Plan Five-in-10 (average condition) public supply is the primary user (47%) of water in the basin. Public supply includes water distribution by public water systems and private water utilities. Some non-residential use (commercial and industrial operations) is also included in this use. Non-residential users are not self-supplied and do not report their individual use to the district (WRWSA, 2010). Public use is followed by industrial/mining/power, agriculture, and finally recreation. Recreational use includes golf course, cemetery, and park irrigation water, with golf course irrigation water accounting for the greatest consumption from the recreational use category.

Using data from the SJRWMD, for Marion County, and from the SWFWMD for the Sumter, Hernando, and Citrus, the WRWSA developed projections for water use through 2030. These are based on projected population growth and associated water demand. Projected increases through 2030 also project an increase in public supply by nearly 70% (WRWSA, 2010). Domestic self-supply is projected to increase by 58%, industrial/commercial, mining/dewatering, and power generation by 19%, recreational use by 64% and agriculture demand by 15%. Overall, the current demand is about 174.36 mgd and is expected to increase by 54% in 2030 (WRWSA, 2010). Table 1 shows these projections through 2030 in mgd use by the different use categories (values are slightly different than those supplied by the WSWRA 2010 report.

Category	2005	2005-2010		2010-2015		2015-2020		2020-2025		2025-2030		Total	
	Base	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase	Decrease	Increase
Agriculture	19.0		0.6		0.7		0.8		0.8		0.1		**3.0**
I/C,M/D,PG	23.3	-8.7			1.0		0.5		0.5		0.5	**-8.7**	**2.4**
Public Supply	82.4		24.0		13.0		13.8		10.0		11.1		**72.0**
Recreation	18.6		2.7		2.2		2.3		2.0		2.2		**11.3**
Restoration	0.0		0.0		0.0		0.0		0.0		0.0		**0.0**
Decrease		**-8.7**										**-8.7**	
Increase			**27.3**		**16.9**		**17.4**		**13.3**		**13.9**		**88.7**

Table 1. Summary of Projected Increases/Decreases in Demand for the Northern Planning Region (mdg) (5-in-10) (SWFWMD 2010).

Land Use

The approximate 2,100 square miles of land in the Withlacoochee watershed consists predominantly of urban areas, upland forests, agricultural lands, and wetlands. Within these broader categories are sub-categories containing interesting LULC patterns. Following is a description of the sub-categories contained within each of the broad LULC categories, including the dominant LULC within the sub-categories.

Agricultural activities in the watershed include crop & pastureland, feeding operations, nurseries & vineyards, row crops, specialty farms, tree crops, and tropical fish farms (FGDL, 2010). Crop & pasture lands account for a full 21% of LULC in the watershed.

Upland forests are comprised of hardwood-conifer mixed forests, longleaf pine & xeric oak forests, pine flatwoods, tree plantations, conifer forests, and hardwood forests. Tree plantations cover 4% of the watershed and account for 16% of the upland forests.

The Urban & Built-Up category contains development activities such as: commercial & services, communications, disturbed land, mining, golf courses, industrial, institutional, low/medium/high density residential housing, transportation, utilities, open land, and recreation. Low-density residential housing (less than 2 dwellings per acre) accounts for 10% of the total LULC in the watershed and 41% of the Urban & Built-Up category. Open land accounts for 6% of the total LULC in the watershed and 22% of the Urban & Built-Up category.

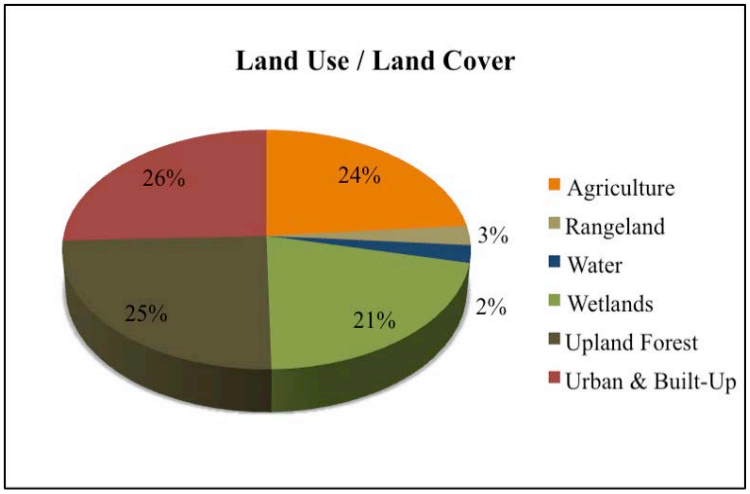

Figure 7. Land Use/ Land Cover in the Withlacoochee River Watershed in 2008 . The watershed LULC is comprised of primarily: urban development (26%), upland forests (25%), agricultural activities (24%), and wetlands (21%) (FGDL 2010).

Wetland types in the watershed include: bay swamps, cypress wetlands, freshwater marshes, saltwater marshes, wetland coniferous forests, wetland forests mixed, wetland hardwood forests, bottomland stream & lake swamps, emergent aquatic vegetation, and intermittent ponds. Freshwater marshes and bottomland streams & lakes swamps each account for a full 6% of the watershed LULC (28% of all wetlands). Cypress wetlands account for 5% of the watershed LULC and 25% of all wetlands.

Publicly Managed Lands

The Withlacoochee river watershed is recognized by the state of Florida for its recreational, conservation, and habitat values. Large swaths of the watershed are designated for special protection and management by numerous state agencies. Indeed the boundaries of special designations and public management projects in the Withlacoochee overlap to form partnerships between public land management agencies, all sharing the goal of protecting the wild nature of the Withlacoochee River Watershed. In Figure 8, the boundaries of specially designated lands (mostly public) are presented.

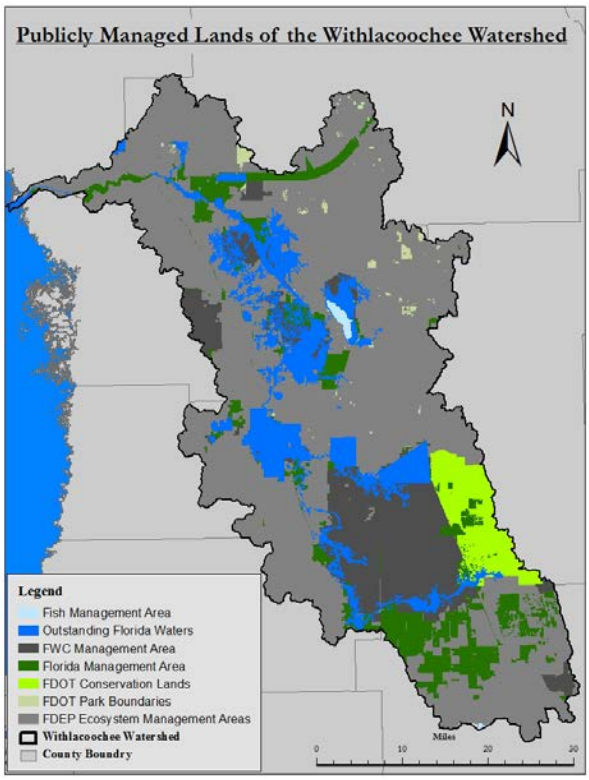

Figure 8. Public lands in the Withlacoochee River Watershed are managed as Fish Management Areas, Outstanding Florida Waters, FWC Management Areas, Florida Management Areas, FDOT Conservation Lands, FDOT Parks, and FDEP Ecosystem Management Areas (FGDL 2010).

The Florida Fish and Wildlife Conservation Commission (FWC) manage Wildlife and Fish Management Areas to sustain the widest possible range of native wildlife in their natural habitats. These lands are more rugged than parks, with less constructed infrastructure. The wildlife management area system provides wild space and hosts wild populations of fish and game to facilitate recreational fishing and hunting activities. Additionally the WMA's provide natural areas for recreational wildlife viewing, cycling, horseback riding, paddling, and hiking (FGDL 2010, FWC 2010).

The Florida Fish and Wildlife Conservation Commission (FWC) manage the 4,460-acre Lake Panasoffkee as a Fish Management Area. A FWC Fish Management Area is established for the management of freshwater fish as a cooperative effort with the local county, in this case Sumter County. Fish Management Areas are generally community-based fishing lakes and Commission-managed impoundments that contain managed fish populations to facilitate recreational fishing. The Lake Panasoffkee Fish Management Area is one of about 80 in the state (FGDL 2010, FWC 2010).

The FWC also manages 15 Wildlife Management Areas in the Withlacoochee Watershed. They are:

1. The Chisegut Wildlife Education Area located on the Brooksville ridge in Hernando County (FWC 2010).

2. The Citrus Wildlife Management Area, a 50,000-acre tract of high quality sand hills in Citrus and Hernando counties (FWC 2010).
3. The Croom Wildlife Management Area is a 20,000-acre tract of cypress and long leaf pine meandering along 13 miles of the Withlacoochee River. The Croom WMA hosts more than a hundred miles of hiking, bicycling and horseback riding trails (FWC 2010).
4. Flying Eagle Wildlife Management Area consists of a collection of lakes, marshes, and swamps along five miles of the Withlacoochee River in southeastern Citrus County (FWC 2010).
5. Goethe Wildlife Management Area consists of 45,000 acres of old growth longleaf pines in southeastern Levy County (FWC 2010).
6. Green Swamp Wildlife Management Area is part of approximately 110,000 acres of land that is protected to facilitate Green Swamp Basin's aquifer recharge and water supply services. The Green Swamp is a critical hydrologic resource, encompassing the headwaters of the Withlacoochee, Little Withlacoochee, Ocklawaha, Hillsborough and Peace rivers and serving as a major recharge area for the Floridan aquifer (FWC 2010).
7. Half Moon Wildlife Management Area is a 9,479-acre area of wetlands, hammocks, flatwoods, and improved pasture that are the site of the some of the spring fed tributaries of the Withlacoochee River. In this area the Floridan aquifer is exposed at the surface, so the lands water filtration services are valuable in this aquifer recharge area (FWC 2010).
8. The Hilochee Wildlife Management Area is within the Green Swamp and is an area of reclaimed citrus groves, timberlands, ranching lands and sand mines. Now it aids to protect, the Floridan aquifer from the negative impacts of the ongoing development of near-by private lands in Lake and Polk counties (FWC 2010).
9. The Jumper Creek Wildlife Management Area is a 10,000-acre tract of land that is mostly floodplain forest and oak-cabbage palm hammock. The Area is part of the Great Florida Birding Trail (FWC 2010).
10. The Lake Panasoffkee Wildlife Management Area is a 9,000-acre tract of land that was acquired to aid in the protection and preservation of Lake Panasoffkee and its floodplain forests (FWC 2010).
11. The Little Gator Creek Wildlife and Environmental Area is a 566-acre area purchased for the protection and management of one of the largest endangered wood stork nesting sites outside of south Florida. Wood storks have been nesting intermittently in the area for at least the past 70 years (FWC 2010).

12. The Perry Oldenburg Mitigation Park Creek Wildlife and Environmental Area provides 380 acres of critical upland habitat for the endangered gopher tortoise (FWC 2010).
13. The Potts Wildlife Management Area is 4,155 acres of floodplain forests, freshwater marshes, and scrub oak communities protecting the water resources along the Withlacoochee River and the Tsala Apopka Chain of lakes in northeast Citrus County (FWC 2010).
14. The Richloam Wildlife Management Area is 56,000 acres located in Hernando, Pasco, Sumter, and Lake Counties consisting of pine flatwoods, oak hammocks, bottomland hardwoods, and cypress swamps (FWC 2010).
15. The Ross Prairie Wildlife Management Area is 3,000 acres of lightly used hunting land that allows only persons age 16 or less and their adult supervisors to hunt (FWC 2010).

Florida Managed Areas are lands that the Florida Natural Areas Inventory (FNAI) has identified as having natural resource value and that are being managed at least partially for conservation purposes. The term "Managed Area" refers to a managed conservation land (FGDL 2010).

Water Quality

Water Quality Assessment 2010

In 2010, twenty-seven water body segments within the Withlacoochee River Watershed were placed on the verified impaired waters list due to their failure to meet water body classification parameters. The impaired water body segments are comprised of 8 lakes, 12 streams, 4 springs, 2 estuaries, and 1 blackwater. Refer to Table 1 for a full list of the Impaired Waters in the Withlacoochee River Watershed (DEP 2010). All of the verified impaired water bodies within the watershed have a Florida water body classification of 3F, which are those that shall support "recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in fresh water" (DEP 2010). Impaired waters are those that do not meet the water quality standards for their classification as parameterized in Chapters 62-302 and 62-4, F.A.C (DEP 2010). To be considered impaired the sources of impairment cannot be derived from ecologically inherent properties, rather, the impairments must be derived from point or non-point sources of pollution.

The water quality parameters causing impairment are (DEP 2010):

- Mercury (in Fish Tissue) indicates that the fish tissue from at least 12 fish collected from the water body segment contain more mercury than is safe for human consumption.
- Nutrients (TSI) are used for determination of lake water quality and refer to the *Trophic State Index (TSI)* for lakes. The TSI is based on lake water chlorophyll a, Total Nitrogen, and Total Phosphorus levels.

- Dissolved Oxygen (Nutrients) is used to indicate that the water body is impaired due to low dissolved oxygen levels, and that the cause of impairment is due to high nutrient levels.
- Nutrients (Algal Mats) are used to indicate, "Algal mats are present in sufficient quantities to pose a nuisance or hinder reproduction of a threatened or endangered species."
- Nutrients (Chlorophyll-a) is used to indicate that "chlorophyll-a levels have increased by more that 50% over historical values for at least two consecutive years, or are greater than 11ug/l for estuaries or 20 ug/l for streams."

Lake Water Quality

Water Quality in Lake Rousseau

At the time of publication the DEP lake classification project (Myers and Edmiston, 1983) listed Lake Rousseau as one of 50 lakes in the state most in need of restoration. The water quality of the Lake is an important consideration because lake water has been shown to directly recharge the Floridan Aquifer (DEP, 2006). In the 2006 Water Quality Assessment Report, Lake Rousseau was considered to have fair water quality. It has been recognized that construction, shoreline development, and septic tanks along the banks contribute sediment, nutrients, and bacteria to the lake. Previously, the lake had been classified as potentially impaired for DO and for mercury pollution (DEP, 2006), however after the most recent water quality assessment, the lake is only listed for mercury contamination in fish (DEP, 2010).

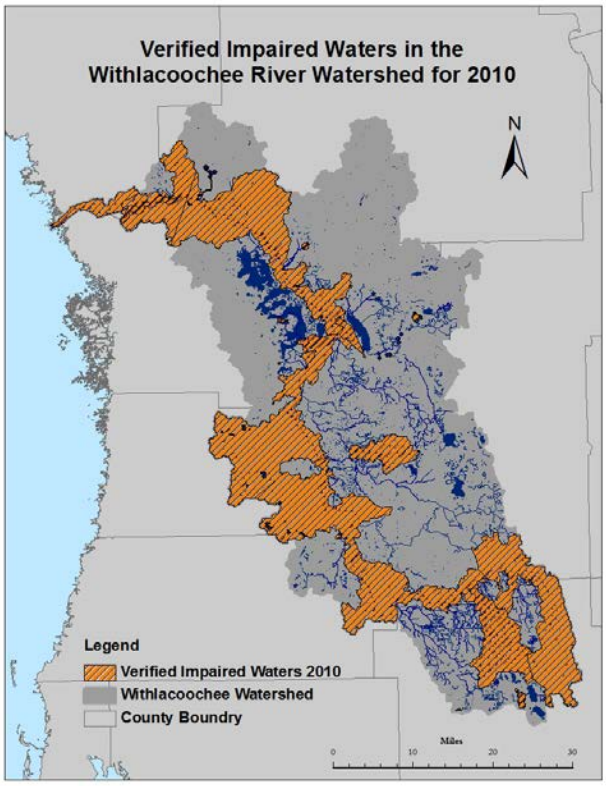

Figure 9. Verified Impaired Waters for 2010 in the Withlacoochee River Watershed (DEP 2010).

The incoming water from the Withlacoochee River influences the chemistry of Lake Rousseau. Seasonality also plays a role in the quality of the river and the lake. Water chemistry in Lake Rousseau fluctuates in response to seasonal flows dominated by high color and nutrient rich river water or by low color and nutrient poor spring inflows. During drier periods the flow to the river is dominated by the spring fed rivers in the Withlacoochee watershed, but during wet periods overland flow becomes increasingly

important (FDEP, 2006). The morphology of the lake also has implications for water quality. The deepest parts of the reservoir, corresponding to the original river channel prior to impoundment, have more rapid water turnover. The shallower areas, corresponding to the previously forested regions, have much slower water movement and generally are quite stagnant. These areas undergo increased sediment nutrient flux, organic decomposition, benthic oxygen demand and macrophyte metabolism plays a greater role in determining water quality (FDEP, 2006).

Artificially high water levels are maintained in Lake Rousseau based on levels deemed necessary during the Cross Florida Barge Canal construction. Artificially maintaining the lake levels may also affect water quality, both in the lake and in the lower Withlacoochee. The Inglis Dam and barge canal currently limit the water levels in the lower section of the river depriving the ecosystems of the river and the estuary in some circumstances and inundating the systems with water at other times. It has also been suggested, however there has yet to be a study conducted, that the effects of highly variable discharges from the dam and the canal both of which may cause ecological problems for both the river and estuary (FDEP, 2006).

The SWFWMD has concluded that the principal water quality problem in the reservoir is periodic low DO (FDEP, 2006). Most other measured water quality characteristics reflect those of the river, responding to differences in dry and wet seasonal flows. The following are possible pollutant sources:

- Construction and shoreline alterations (such as finger canals and docks)
- Structural and flow alterations to the lake
- Residential septic system failure
- Artificial water level maintenance
- Herbicide treatments
- Aquatic plant overgrowth

Water Quality in Tsala Apopka Chain of Lakes

In 1990 a study conducted by SWFWMD rated the overall water quality in the lake as good compared to other Florida lakes. This assessment was done to determine whether water levels were affecting the current quality of the lake's water and fisheries. In the southern reaches of the lake system water quality is most closely related to the Withlacoochee River. From south to north surface water in the system shows reduced color, increased pH, increased hardness, decreased total nitrogen and decreased chlorophyll *a* concentrations. Limiting nutrient assays indicated that, overall, the lakes are nitrogen limited for bioavailable nutrients and phosphorus limited for total nutrients (FDEP, 2006). This suggests a relatively healthy nutrient balance in the system.

In the 2006 Water Quality Assessment six water body segments in the Tsala Apopka Planning Unit were classified as potentially impaired: the outlet to Lake Tsala Apopka (DO, historical chlorophyll), Hampton Lake (TSI), Hernando Lake (TSI, iron), Little Henderson Lake (TSI), Henderson Lake (iron, TSI), and Tsala Apopka Lake (TSI). The primary water quality concern for the lake system is eutrophication. This may be contributed to low, stagnant lake levels that encourage the growth of emergent aquatic vegetation. Although groundwater is a major source of water to the lakes, it commonly

has very low nutrient concentrations, and is therefore not thought to be a contributor to the nutrient problem (FDEP, 2006).

Water Quality in Lake Panasoffkee

Lake Panasoffkee's good to fair water quality is attributable mainly to substantial groundwater inflow from the Floridan Aquifer (TetraTech, 2004). A regional nitrate increase in the Floridan aquifer appears to be the source of nitrate increases in lake tributaries. Nearby monitoring wells indicate that sources such as septic tanks and associated drain fields have nothing to do with increased nitrate concentrations (TetraTech, 2004). Nitrate levels in the lake itself remain unchanged, suggesting that emergent aquatic vegetation, attached algae, and phytoplankton are taking up the lake nitrogen load. Trophic State Index (TSI) values in the lake itself continue to fall within the average range for Florida lakes (FDEP, 2006).

In the 2006 Water Quality Assessment Report, Lake Panasoffkee was listed for low DO levels and TSI. The outflow to the lake was designated as potentially impaired for Mercury in fish (FDEP, 2006). In 2010, the lake was still on the verified impairment list and listed as impaired for nutrients (Chlorophyll-a and algal mats), as well as Mercury in fish (FDEP, 2010). The FDEP has identified the following as possible pollutant sources:

- Shoreline development
- Low water levels
- Residential septic system failure
- Sediment accumulation
- Mining operations
- Aquatic plant overgrowth
- Stormwater runoff
- Nutrient inputs
- Artificial water level maintenance

Point Source Pollutants

To assess the possible impacts of point source pollution in the Withlacoochee River Watershed, a survey of the National Pollution Discharge Elimination Program (NPDES) permits was conducted. In the whole of the watershed there are 489 NPDES permits (USEPA, 2010 and FGDL, 2010). National Pollution Discharge Elimination Program permit locations within the Withlacoochee River Watershed are shown in Figure 10 (USEPA, 2010 and FGDL, 2010). These permits include all of the following permit types:

- Standard - A standard-issued individual NPDES permit.
- Pretreatment - An NPDES permit that prescribes for the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a publicly owned treatment works.

- Stormwater - An NPDES permit regulating storm water runoff, snowmelt runoff, and surface runoff and drainage.
- General - An NPDES permit that authorizes a category of discharges under the CWA within a geographical area. A general permit is not specifically tailored for an individual discharger.
- AFO/CAFO - An NPDES permit regulating discharge from Animal Feed Operations (AFOs) and/or Concentrated Animal Feed Operations (CAFOs). CAFOs are animal feeding operations where there are more than 1,000 animal units. All CAFOs are to receive permits, whereas permits are issued to AFOs with less than 1,000 animal units but with a point source discharge (USEPA, 2010).

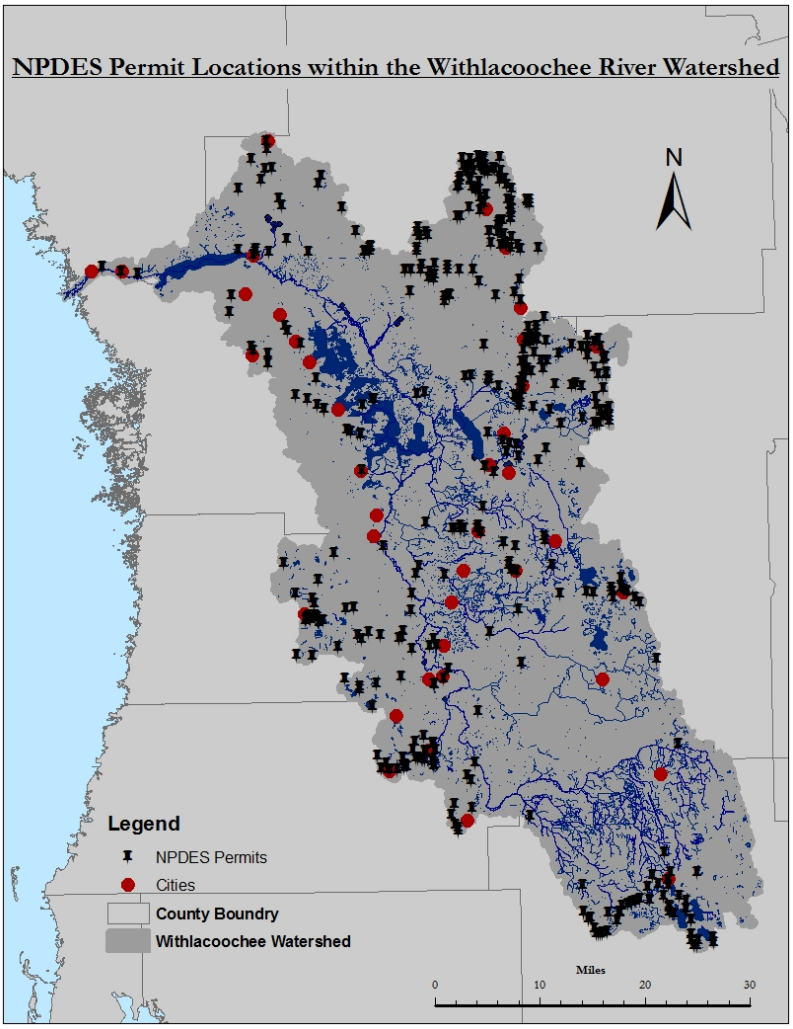

Figure 10. Location of NPDES permits and major cities within the Withlacoochee River Watershed (FGDL, 2010).

A NPDES permit is required of any facility - which can range from a water treatment plant to an auto parts store- that may discharge potentially polluted water into the environment. The EPA Enforcement and Compliance History Online (ECHO) database stores information related to the frequency of inspection and compliance of permitted discharges by permit holders. *Of the 489 permits in the watershed, only 29 of the facilities have been inspected within the last 5 years.* The ECHO database gives the following statement about the frequency of inspection of permit holders:

> *EPA and states consider several factors in determining what facilities to inspect, such as facility size, potential for environmental harm, citizen tips, geographic initiatives, statutory requirements, and protection of sensitive ecosystems, demographics, industry type, and violation history. It is not*

possible to inspect every regulated facility every five years. Smaller facilities may receive inspections less frequently than every five years. In addition, inspections conducted at smaller facilities may be tracked only in the state database and not be entered into the federal database. Because of this, a smaller facility may appear uninspected in the ECHO database. Even if a facility has not been inspected, EPA or the state may be aware of the facility's status and are using other means to assess compliance; e.g., facilities are required to self-report certain information (USEPA, 2010).

According to information gleaned from the ECHO database, of the 29 facilities that have been inspected only 2 have had penalties with the last 5 years. Neither of these facilities is adjacent to the river and their penalties were considered informal enforcement action.

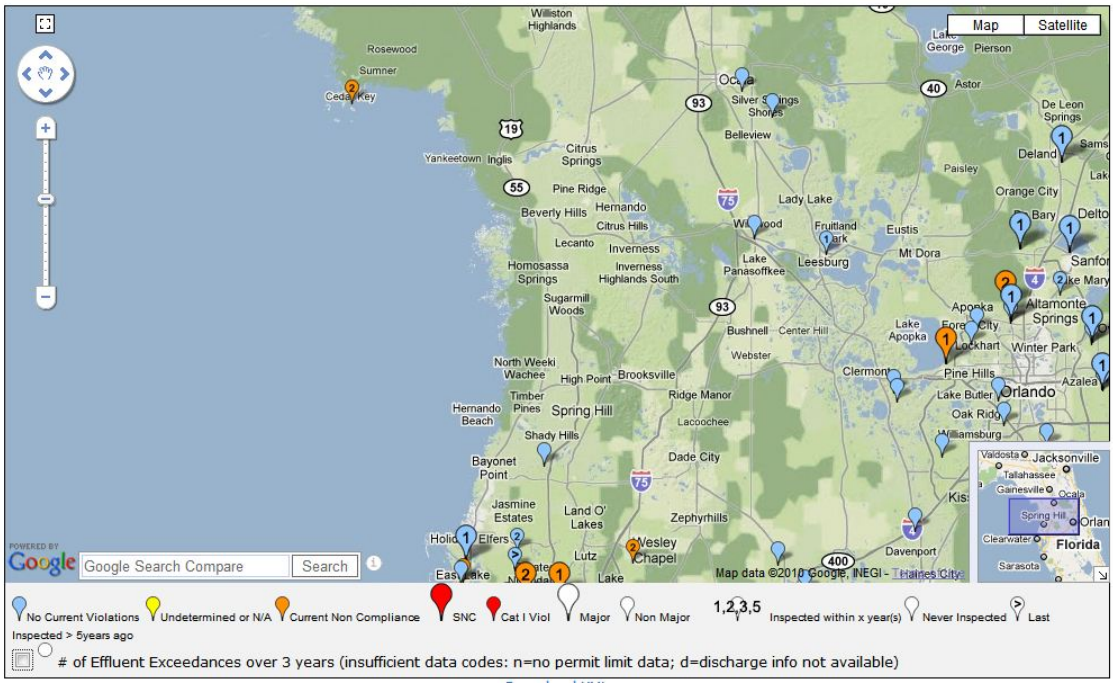

Figure 11. Map obtained from the EPA ECHO database showing the location of NPDES permits given to sewage treatment systems in western Florida. The area of the Withlacoochee River Watershed has not permits (USEPA, 2010).

Wastewater treatment facilities are one of the many facilities of concern for point source pollution. These facilities can be sources of excess nutrients as well as harmful bacteria. Interestingly, the Withlacoochee Watershed has very few municipalities that have NPDES permits for their water treatment facilities. Figure 11, is a map created in the EPA ECHO database showing the sewage treatment systems in western Florida. Within the area of the watershed, there are no permitted treatment systems. Upon further

investigation a number of the wastewater treatment facilities use a method of treatment known as land applied solids (LAS), where the waste from the treatment facility is applied to the ground, and natural attenuation removes excess nutrients. The Withlacoochee River is an OFW, and the regulation concerning discharge into the river is more stringent. Discharge to OFW's cannot alter water quality (Citrus County).

Non-Point Sources of Pollutants

Nonpoint sources of pollution are much harder to determine in a watershed, as they can be the product of a number of land-uses as well as anthropogenic activities. Nonpoint sources can include, but are not limited to, agricultural run-off, septic tank contamination, fertilizer runoff, and storm water from development activities such as road building or shoreline stabilization. In attempts to characterize this pollution, data was downloaded and assessed from the publically available Florida DEP STORET database (http://storet.dep.state.fl.us). STORET stands for STORage and RETrieval database and is a national water quality database created to gather and maintain statewide water quality data. At this time non-point sources of pollution are largely un-regulated

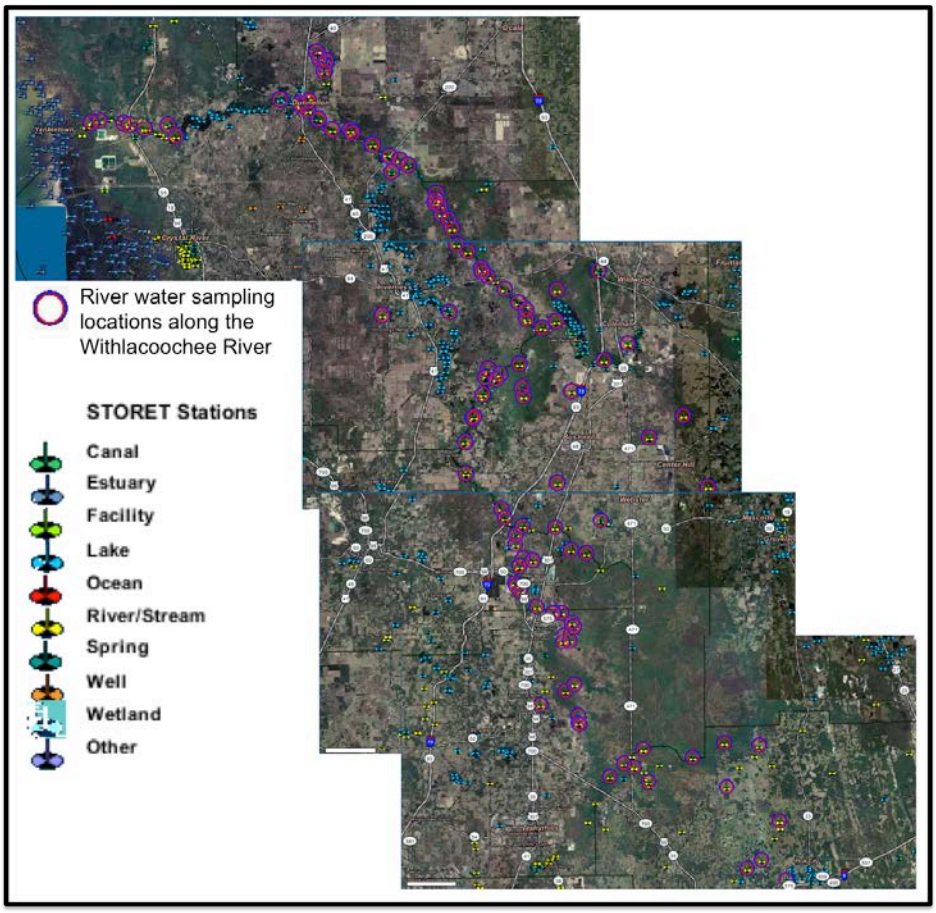

Figure 12. A map showing river water sampling locations along the Withlacoochee River. Sampling locations are indicated by the blue and red circles. Other symbols show locations of other water sampling locations (FDEP STORET, 2010).

and pose a threat to water quality throughout urbanized areas.

Florida Department of Environmental Protection STORET Data

The DEP STORET database contains a water quality data set reported by the DEP, the Florida Fish and Wildlife Commission, and Florida Lake Watch, Figure 12 shows the sampling locations of these agencies within the watershed. Although there appears to be a good distribution of locations in the watershed and a large number of sampling locations, upon closer inspection the distribution and quantity routinely collected data are fairly sparse. There are only two sampling locations that have been collected regularly, from monthly to at least 3 times a year, since 1989. One of these locations is in the northern end of the watershed at Stokes Ferry (sampling location 5315) and one at the southern end near Dade City (sampling location 3560) (figure 16). Most of the remaining locations represent one time sampling events either in 2003 or 2007, mostly likely collected for the water quality assessment reports. Appendix A lists each of these sampling locations, the date the sampling started and ended at each location, and the number of samples taken during the sampling time range.

Figure 13. A map showing the location of the two long-term sampling locations (yellow pins) in the Withlacoochee River Watershed. Location 5315 is in the northern portion of the watershed, and location 3560 is in the southeastern portion of the watershed.

The available data on the STORET database was analyzed for any long-term trends for a more complete picture of the watershed. Although a number of analytical techniques were examined, only a few are reported here. For this discussion data from the two long-term sampling locations were examined (Figure 13). For the remainder of this discussion, sampling site 5315 is from the northern end of the watershed, and sampling site 3560 is from the southern portion of the watershed.

Dissolved Oxygen

The FDEP rule for Class III waterways are that DO should not be below 5 mg/L. For both sampling locations measured DO values fell between less than 1 and 4 mg/l. In the northern sampling site 3513, the DO values average between 6 and 7mg/l, however there are some periods when the value has dropped below 5mg/l. It is important to remember that DO can be affected by a number of variables such as: the time of day that sample was taken, the depth of the sample in the water, and ambient temperature. DO values from the southern sampling site 3560 are relatively low, but this is most likely due to the influence of the headwaters of the river. The headwaters are in the Green Swamp, which due to inherent ecological factors tends to have very low DO levels. The DO trends seem relatively stable over the sampled time period.

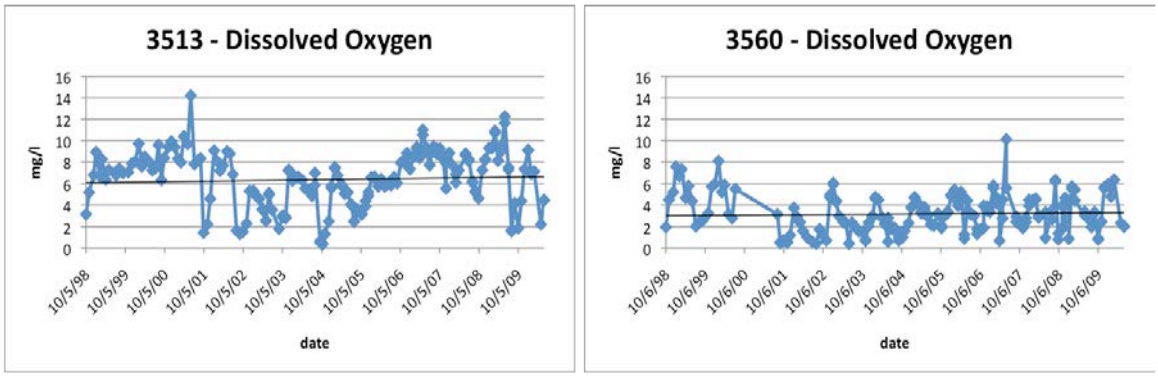

Figure 14. Dissolved oxygen data from the northern (3513) and the southern (3560) sampling locations along the Withlacoochee River. The black lines are trend lines for the data from each sampling location.

Nutrients

Nutrient pollution is a nationwide concern for many inland waterways. Using data collected from the STORET database, the long-term trends of both P and N were examined. There appears to be no increasing P trend at the two sampling locations identified. The P values ranged between less than 1 and 40mg/l (Figure 15). The values are relatively stable over the sampling time range, with a few peaks that appear to correlate with changes in the season. The P values are slightly lower (average 0.05mg/l) at the northern sampling location 3513, than in the southern 3560 (average 0.09mg/l). At both sampling locations the averages P concentrations are below the new EPA nutrient criteria.

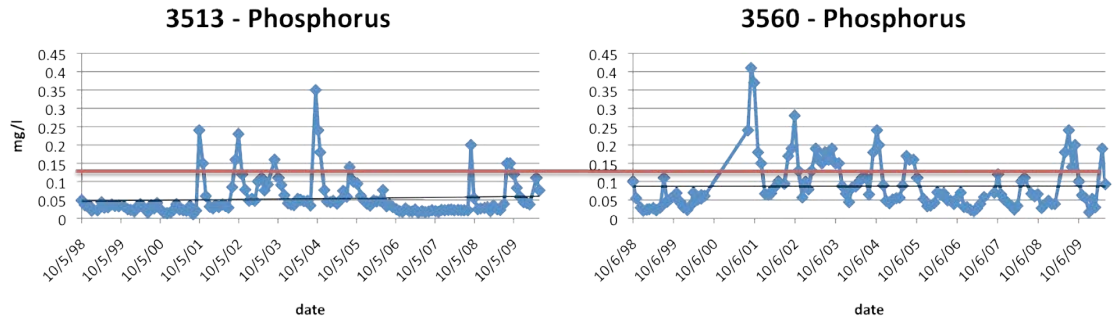

Figure 15. Phosphorus trends from the northern (3514) and southern (3560) sampling locations. The black lines are trend lines and the red line is the new EPA nutrient criteria of 0.12 mg/l for phosphorus.

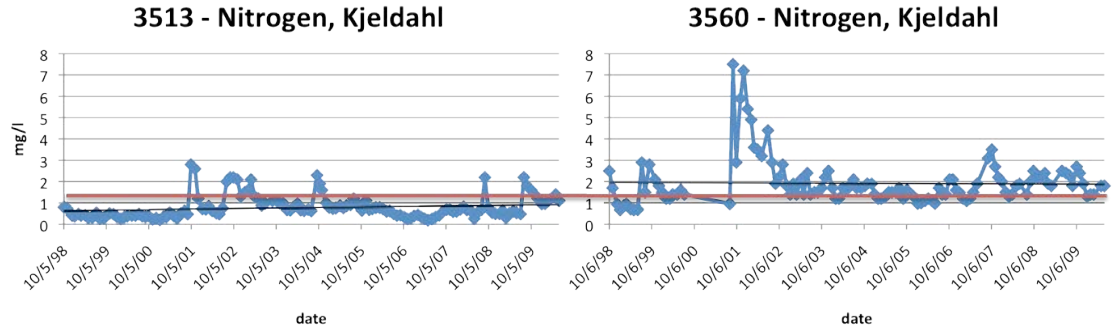

Figure 16. Nitrogen trends from the northern (3513) and the southern (3560) sampling locations. The black lines are trend lines and the red line indicates the new EPA nutrient criteria of 1.54 mg/L for nitrogen.

Nitrogen was also examined at the same locations and the values range from below 0 to 7.50mg/l (Figure 16). The values are relatively stable over the sampling time range, with a few peaks. The N values are lower, average 1mg/l, at the northern sampling location (3513), average 2mg/l in the south (3560). One possible explanation for this would be the input of the nutrient poor spring water in the northern portion of the watershed. Within the context of EPA's numeric nutrient criteria for Florida's flowing waters, the southern portion of the watershed would be considered impaired. At the northern sampling location, the baseline is very low, ~1mg/l, below the EPA nutrient criteria.

Overall, the concentrations of nutrients are quite low along the river. However it is important to continue observing concentrations due to the strong interaction between surface and groundwater, the increasing development in the watershed, and the unique and fragile nature of the springs within the watershed.

Septic Systems

Septic systems provide small-scale sewage treatment in rural areas that are not connected to municipal sewer systems. Septic systems consist of a tank and a drainage field as shown in Figure 17. Household wastewater flows into the septic tank where the solids sink, the scum floats and anaerobic bacteria begin the decomposition process. When the volume of the septic system reaches capacity the liquid waste flows out of the tank and into the drainage field via porous piping. Complete treatment of wastewater depends on in-tank processing and dispersal of effluent to the leach field. If not properly maintained, septic systems can become a source of organic matter, nutrients, oxygen demanding bacteria and pathogens to the environment. Proper functioning of the septic tank depends on the maintenance of tank volume and drain field function to allow for sufficient decomposition of waste. Maintenance requires the removal of accumulated partially decomposed solid waste from the septic tank every 3 to 5 years (Cogger, 2009).

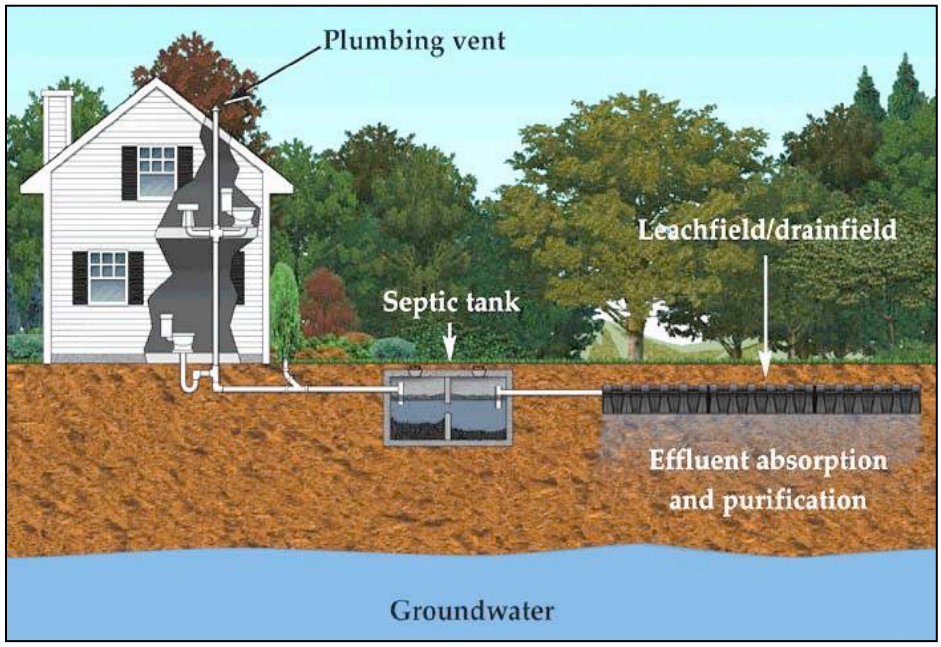

Figure 17. Diagram of a single home septic system including the plumbing vent, septic tank, leach field/ drain field, and effluent absorption and purification zone.

Class 1 Landfill at Green Swamp

In November of 2008, Angelo's Aggregate Materials sought permission to install a 90-acre Class I landfill just 1.5 miles from the Green Swamp and Withlacoochee River in eastern Pasco County (Audubon of Florida News Blog, 2009; FDEP, 2009). A portion of the Floridan Aquifer runs beneath this area and four major rivers flow out of the green swamp, providing drinking water too much of central Florida. A Class I landfill can receive an annual average of 20 tons or more of solid waste per day, per Rule 62-701.340(3), F.A.C. (FDEP 2010). The proposed landfill will be located in a Karst area prone to sinkholes. If a sinkhole forms under a landfill, it is possible that large quantities of leachate could pollute groundwater, the Green Swamp, and the rivers flowing from it.

On Thursday, February 12,2009 DEP issued a formal notice of intent to deny the permit. The reason for denial of the permit request is that the applicant has failed to provide reasonable assurance that:

(1) *"The site will provide structural support for the facility including total wastes to be disposed of and structures to be built on the site, as required by Rule 62-701.340 (4) (a), F.A.C.;*

(2) *The liners will be installed upon a base and in a geologic setting capable of providing structural support to prevent overstressing of the liner due to the settlements and applied stresses as required by Rule 62-701.400 (3) (a)2., F.A.C.; and*

(3) *The construction and operation of the proposed landfill at the proposed site will not violate the prohibition set forth in the Rule 62-701.3—(2)(a), F.A.C., that prohibits placing or disposing of solid waste in an area where geological formations or other subsurface features will not provide support for the solid waste" (FDEP 2009).*

The geotechnical investigation conducted by the applicant failed to identify a location for the proposed landfill that would provide adequate structural support to prevent the negative impacts should a sinkhole form (Andrews, 2009; DeCamp, 2009; FDEP, 2009).

Following the "Intent to Deny" statement from FDEP the landfill applicant has appealed to the Florida Department of Administrative Hearings to overturn FDEP's decision. To this date the Administrative Hearing has not occurred due to the following actions by the applicant: changes and updates to the permit (including changing the proposed landfill size from 90 to 30 acres), updating conditional land use requests to Pasco County, and filing of lawsuit against Pasco County to override comprehensive plan change rules (Trash to Ash 2010).

Minimum Flows and Levels

In 2010 the SWFWMD completed draft Minimum Flows and Levels (MFL's) for the Upper and Middle Withlacoochee River (SWFWMD, 2010). This draft has been peer reviewed by Locke et al. (2010). In setting the MFL's the SWFWMD used seasonal blocks that corresponded to high, medium, and low flows. Acceptable flow reductions are based on water depth for fish passage as well as aquatic and wetland habitat. The low flow threshold limits surface water withdrawals but does not address groundwater withdrawals. The SWFWMD draft cites the maximum allowable percent reductions in the Withlacoochee generally range between 7 and 16 percent of the current flows in the various blocks. The peer review of the Draft MFL's (Locke et al., 2010) concludes that overall, the methodologies that were used in the Draft are sound and the approach is defensible. However, the reviewers make two major suggestions for the draft. The first suggestion is to establish better-defined benchmark conditions. The second suggestion is

that the *de facto* threshold criteria of 15% reduction in habitat is not rigorous and is not scientifically based (Locke et al., 2010).

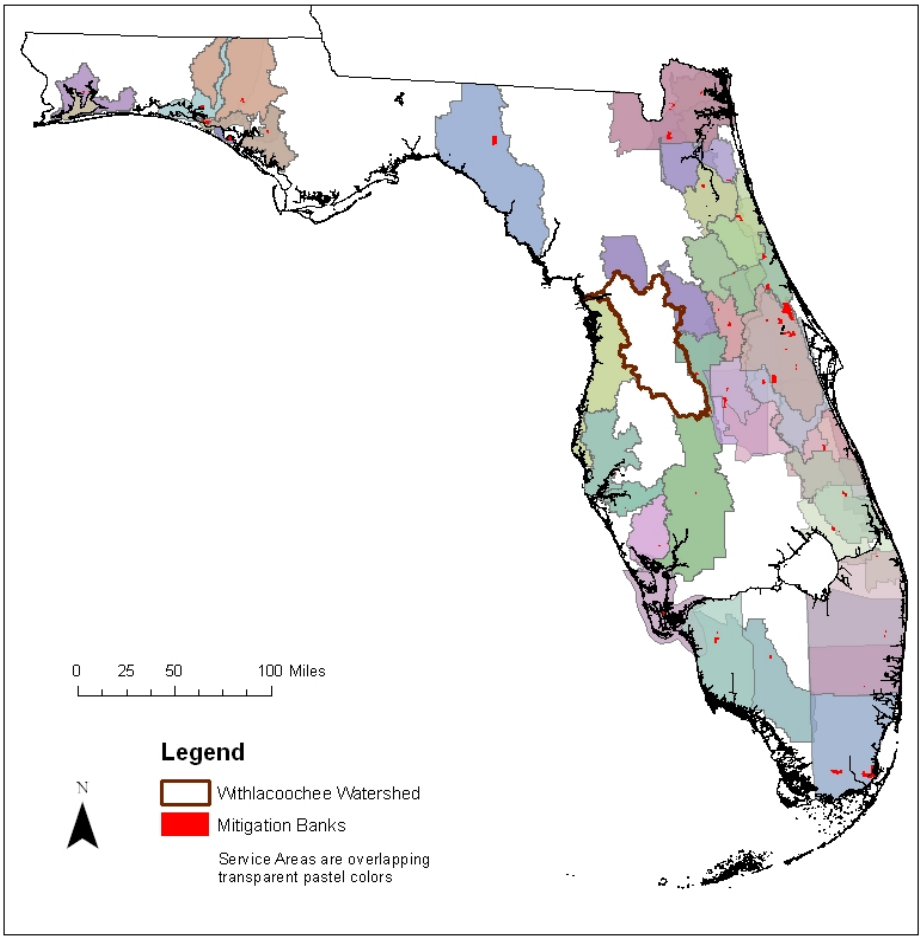

Figure 18. Mitigation banks and service areas of Florida. (FGGDL, 2010)

Mitigation Banking

There are 53 mitigation banks and corresponding service areas statewide (FGDL, 2010). The service areas vary in size, overlap, and do not cover the entire State (Figure 18). There are almost no service areas that fall within the Withlacoochee River watershed. Therefore, mitigation banking within the watershed is only a limited option within this watershed.

Local Government Policy & Regulation

Status of Landuse Policies

The Withlacoochee River Watershed flows through seven counties. However, the river primarily flows through and is affected by five major counties, Marion, Polk, Sumter, Citrus, and Hernando. The land use policies and procedures governing the counties in the Withlacoochee River Watershed are governed by comprehensive plans, and in most cases land development codes. The creation and implementation of a comprehensive plan is required by the 1985 Florida Growth Management Act (codified in Chapter 163 of the Florida Statutes) and is to be certified by the Florida Department of Community Affairs (Florida Statutes ss. 163.330-163.463). Florida's DCA has rules for setting up minimum criteria for the comprehensive planning process ("Division of Community Planning"). The Growth Management Act also requires comprehensive plans to contain mandatory elements such as intergovernmental coordination, public facilities, coastal zone management, and recreation and open space (Florida Statutes ss. 163.330-163.463). Every seven years the statute requires the local government to complete an Evaluation and Appraisal Report that it is submitted to DCA for review ("Division of Community Planning"). Comprehensive plans can offer guidance in analyzing the current land uses surrounding river and the objectives and policies in governing these uses.

Current Comprehensive Plans

The main counties surrounding the Withlacoochee River Watershed are Marion, Polk, Sumter, Citrus, and Hernando ("Withlacoochee River Watershed"). The comprehensive plans contain goals, objectives, and policies that the county will strive to achieve. The counties and municipalities have wide discretion is setting out their comprehensive planning choices and there is a wide array of different policies and objectives between the four counties surrounding the Withlacoochee Watershed.

County comprehensive plan policies and objectives in the Withlacoochee River Watershed include:

Marion County

Marion County's comprehensive plan reflects concern for the condition of the watershed by requiring the land development code to include methods to reduce the impact of development on water bodies and environmentally sensitive lands. Specifically, the comprehensive plan requires the land development code to protect, conserve, and enhance the quality and natural function of environmentally sensitive lands and outstanding Florida waters and rivers by incorporating protection measures (Marion County Comprehensive Plan Objective 2.0).

Under Policy 1.1, of the Conservation Element of the plan, environmentally sensitive areas are given special protection through the use of buffering measures to protect the lands from adverse impacts of development. Included in this policy are waters, scenic rivers, and wetlands. In addition, Policy 1.3 of the plan requires the

identification of “environmentally sensitive lands as part of all applications for development approval meeting designated thresholds, such as zoning change requests, preliminary plant approval, and site plan approval.” The plan also calls attention to “more intense land uses” in Policy 2.4 by requiring these uses to be buffered from natural resources. In addition through Policy 2.6 the County calls the development code to protect the surface waters of the state from degradation (Marion County Comprehensive Plan Policies 1.1, 1.3, 2.4, 2.6). Further, Marion County has enacted an Environmentally Sensitive Overlay Zone for the Rainbow River. This zone dictates specific areas where additional protection is needed along the Rainbow River and requires more in depth site inspection and permitting processes for development. (“Future Land use Element”, Appendix B, Marion County Comprehensive Plan).

Polk County

Polk County also has a well-developed comprehensive plan that emphasizes protection of the Withlacoochee River. Objective 2.123-F of the Conservation Element designates a Green Swamp Protection Area and limits the development and redevelopment that may occur inside this protected area. Also, through Objective 2.123-C the plan set outs goals for the protection of Wetland-Protection areas from over development (Polk County Comprehensive Plan Objective 2.123-F – 2.123-C).

Green Swamp Area of Critical State Concern

The Florida Green Swamp area covers over 560,000 acres and spans many counties and municipalities. The Water Management District is one of the main agencies that has regulatory jurisdiction over the Green Swamp area (“Interactive Green Swamp”). The protection of the Green Swamp is regulated and codified by Chapter 28-26 of the Florida Administrative Code, which is titled, Boundary and Principles for Guiding Development for the Green Swamp Area of Critical State Concern (Florida Administrative Code, Chapter 28-26).

Section 28.26.002 identifies and lays out the boundaries of the Green Swamp protection area throughout Lake and Polk Counties. Following the boundary description Section 28-26.003 offers objectives and principles for development in this protected area. The Code states that all development is to “minimize the adverse impacts of development on resources of the Florida Aquifer, wetlands, and flood-detention areas. Protect the quality and flow of ground water and surface water which are necessary for the protection of resources of state and regional concern.” (Florida Administrative Code, Section 28-26.003(1)(a-b)). This section also lays out the regulations for site platting, site alteration, soil exposure, ground water protection, storm water runoff regulation, solid waste, and structural requirements. Finally part 28-26.004 requires that “all land-development regulations adopted [be] pursuant to these guidelines [and] administered by the local government.”

Sumter County

The Sumter County plan also cites environmental protection as one of its fundamental goals (Sumter County Comprehensive Plan, Conservation Element). In Element 3 of the plan, which addresses conservation, Objective 3.1.3 states that the County "shall retain regulations to improve, maintain or restore surface water quality consistent with relevant Federal and State standards. No development order will be issued which results in degradation of the receiving water body below the minimum conditions necessary to assure the suitability of water for the designated use of its classification as established by the Department of Environmental Protection" (Sumter County Comprehensive Plan Objective 3.1.3). In addition, the plan has a specific policy addressing the Withlacoochee River; 3.1.6.1 sets out specific guidelines for the water body. The policy states that the Withlacoochee River, as a Florida outstanding water, shall be protected by allowing "residential development shall be permitted at a density of 1 unit per 10 acres" and "all clustered development must occur outside the 100 year flood elevation" (Sumter County Comprehensive Plan Objective 3.1.6.1.(1-2)).

Citrus County

The Citrus County Comprehensive Plan includes two chapters that play an important role protecting the Withlacoochee River Watershed. Chapter Three contains the county's Conservation Element that begins with an introduction discussing how Citrus County has experienced some of the highest growth rates in the nation for the past fifty years. The Introduction also notes that the "growth has drastically impacted the County's environment by direct conversion and loss of natural habitat and indirect alteration through fragmentation, control of fire and hydrology, and introduction of non-native plants and animals…[and] without appropriate protection measures, the County's continued growth may jeopardize [the] ground and surface waters, aquifer recharge…and recreational and economic use of natural resources" (Citrus County Comprehensive Plan Chapter 3-1). Policy 3.1.4 of the plan requires that a "mechanism" within the land development code be established to allow for setbacks and buffers when "environmental characteristics require additional protection measures", at this time there is not yet a measure reflecting this policy in the land development code (Citrus County Comprehensive Plan, Chapter 3-104).

Chapter Four of the Citrus County Comprehensive Plan is entitled, "Coastal, Lakes, River Management Element" and defines a Lakes and Rivers Management Boundary and Study Area. This includes "the major surface water bodies, wetlands, and land areas which are subject to freshwater flooding of the Tsala Apopka Plain and the Withlacoochee River system." Section IV of this element analyzes current land uses along the river while focusing on the water related or water dependent nature of these uses. Section IV also contains an inventory of current land uses along the Withlacoochee River and comments on the pollution potential that future land use development may have on the Withlacoochee River system. Under Section IV, C "Pollution" (3) "Future Land Use Impacts," this element states, "*Existing land uses in the LRA do not reflect the significance of the lake and river resources of the County. The development of the entire watershed for the Tsala Apopka Chain of Lakes and Withlacoochee River is not wise."*

Hernando County

Hernando County's comprehensive plan establishes conservation areas for the Weeki Wachee Swamp and floodways of the Withlacoochee River and promotes the protection and conservation of wildlife (Hernando County Comprehensive Plan, Chapter 10). The plan seeks to conserve, appropriately use, and protect the quantity and quality of ground and surface water as well as wetlands as designated by the South Florida Water Management District and the Florida Department of Environmental Protection (Hernando County Comprehensive Plan, Chapter 10, Goals 6.02, 6.05). Further, Objective 6.05A of the Plan restricts incompatible land use activities in wetlands. (Hernando County Comprehensive Plan, Chapter 10, Policy 6.05A(1)). Wetlands are identified in the Future Land Use portion of the Plan and are mapped. The Plan also notes that the "removal, alteration or encroachment" of the identified wetlands may only be allowed in cases where there is no alternative for Class I Wetlands and if encroachment is permitted in Class II or III Wetlands "habitat compensation or mitigation as a condition of development approval shall be required." (Hernando County Comprehensive Plan Chapter 10, Policy 6.05A(1-5)). In addition to the Comprehensive Plan provisions, Hernando County's Land Development Code includes Chapter 23, Article VI, "Riverine Protection." Section 23-202 lists several findings made by the Board of County Commissioners, which recognize that the river provides scenic, environmental, and flood control value. These findings also recognize the importance that buffers play in protecting these values and that the pressure of beneficial economic expansion can impact wildlife, habitat and water quality.

Levy County

Although not one of the main county's surrounding the Watershed, the last miles of the Withlacoochee River flow along the southern border of the county and empty into the Gulf of Mexico just west of Yankeetown. Levy County's comprehensive plan requires the land development code to enact measures that will limit specific and cumulative effects of development upon wetlands, water quality and water-related natural resources (Levy County Comprehensive Plan, Coastal Management Element, "Objective 5 – Coastal Resources Protection/Development Impacts). Several ordinances (discussed below) in the land development code include restrictions on water dependent land uses including the construction of new docks or the expansion of existing docks in both residential and industrial or commercial zones.

Withlacoochee River Watershed municipalities:

There are over 34 cities and towns in the watershed. Four of the main municipalities include Yankeetown, Dunnellon, Inverness, and Dade City.

Yankeetown, the largest municipality in this study based on landmass, is located in Levy County has a population of 680 (data recorded in 2009), with a population density of 87 people per square mile. The municipality is located near the Crystal River

and spans 7.82 square miles (City Data: Yankeetown, Florida, 2011). Dunnellon, located in Marion County, has a population of 1,933 people, with a density of 274 people per square mile. The municipality covers an area of roughly 7.05 square miles. Dunnellon is also located in the Northeast section of the watershed and is located near Lake Rousseau (City Data: Dunnellon, Florida, 2011). Inverness, located in Citrus County, located South of both Yankeetown and Dunnellon, is located near the center of the watershed. Inverness spans roughly 7.29 square miles. The population of Inverness was 7,151 in 2009 with a population density of 981 people per square mile (City Data: Inverness, Florida, 2011). Dade City, located in Pasco County is located in the Southeast corner of the watershed. Dade City has a population of 7,180 people with a density of 2,191 per square mile. The size of the city is roughly only 3.28 square miles and is thus the most densely populated municipality in this report (City Data: Dade City, Florida, 2011).

Buffers & Setbacks

In addition to comprehensive plan goals, policies and objectives, other regulatory tools are employed by local governments in the Withlacoochee River Watershed to prevent water quality degradation and to protect the river from the effects of new development. These regulatory tools are known as Buffers and Setbacks. By including buffers and setbacks in their land development codes, local governments can have a significant impact in preventing water quality degradation as well as maintaining a healthy ecosystem. Buffer zones and setback areas also help prevent nitrogen, phosphorous, pesticides, and other pollutants from entering a particular water body.

Riparian or vegetative buffers and setbacks can also be used to protect the watershed. A Riparian buffer can be described as the land adjacent to a water body where vegetation is influenced by the water.

Setbacks can also be used to protect the water body by mandating the distance a structure must be located away from the water body. This may regulate the distance of a house, a septic tank or other structures from a water body. Riparian or vegetative buffers currently in the Withlacoochee River Watershed include:

Marion County

The comprehensive plan and land development code require a riparian or vegetative buffer of no less than 50 feet landward of the ordinary high water line surrounding the river (Marion County Comprehensive Plan, Conservation Element, Policy 2.6). This buffer is also required to be consistent with the approved management practices of the Florida Department of Environmental Protection (Policy 2.6 Section (6)(f)(5)).

Polk County

The land development code requires an undisturbed vegetative buffer adjacent to all surface waters that have an average width of 25 feet and a minimum width of 15 feet. (Polk County Land Development Code Section 610(D)(2)).

Sumter County

The Withlacoochee River is specifically mentioned in the Sumter County Comprehensive Plan with regards to vegetative buffers. The Plan requires 100-foot buffers (Sumter County Comprehensive Plan, Policy 3.1.14.3).

Citrus County

The land development code for Citrus County requires a minimum 15-foot buffer from the ordinary high water line for tidal/nontidal waters and jurisdictional wetland. It also establishes a minimum 100-foot buffer of native vegetation from the ordinary high water line within the uplands surrounding springs. (Citrus County Land Development Code Section 4122(2)).

Hernando County

The Hernando County Comprehensive Plan includes buffer zones adjacent to rivers. These buffers will preserve vegetation and provide natural filtration of stormwater runoff (Hernando County Comprehensive Plan, Chapter 10, Policy 6.02B(2)). In addition, Hernando County's land development code requires a natural buffer of 75 feet to be added to the upland side of delineated wetlands (Hernando County Land Development Code Section 23-210(a)(1-3)). However, the code does contain a type of "grandfather" exception which states that if the lot was plotted prior to 1990, then the buffer must only be 15 feet from the wetland boundary (Hernando County Land Development Code Section 23-210(b)(1-2)). Variances for hardships claimed by single-family residences are permitted but must first be approved by the Board of County Commissioners (Hernando County Land Development Code Section 23-211).

Municipal Regulations

Yankeetown

The Yankeetown comprehensive plan requires a vegetative buffer of 50 feet adjacent to all water bodies. (Yankeetown Comprehensive Plan, 95) The town also prohibits the removal of any trees within 25 feet of the mean high water line (Yankee Town Municipal Ordinance 6-34).

Inglis

Located just east of Yankeetown, Inglis sits at the intersection of U.S. Highway 19 and the Withlacoochee River. Although not specifically referred to as a buffer zone or setback, the land development code for the Town of Inglis effectively includes what could be called a buffer provision. Section 34-534 is entitled, "Creation of protected environmentally sensitive zones." This ordinance creates both a wetlands protection zone and a shoreline protection zone that may allow development in these areas subject to special restrictions and protective measures included in development orders. The

boundary of the wetland protection zone is determined by the most landward extent of either federal, state, or water management district definitions for wetland jurisdiction – whichever is greater. The shoreline protection zone extends from the mean high water line landward to a point 30 feet landward of the water's edge.

Dunnellon

The land development code contains a river buffer requirement for new development that is proportional to the lot depth of the property. For instance, according to the code, if the property in question has a lot depth of 125 feet, then a buffer of 20% is required. The size of the buffer increases by five percent for every 25 foot increase in lot depth. The buffer size is capped in the code at 50% for lots that have a depth of over 300 feet (Dunnellon Land Development Code Section 78-74(1)). Conditions for such buffers include the maintenance of existing trees and vegetation within the buffer. In addition, no impervious surfaces are permitted in the buffer area to help control water run-off. (Dunnellon Land Development Code Section 78-74(2)).

Certain setbacks apply to new development in specially designated areas. If the property to be developed is located directly on the Rainbow or Withlacoochee Rivers, the property is classified as a Designated River Corridor Protection Area under Section 78-71(2) of the Dunnellon Land Development Code. This designation requires a setback of 150 feet from the ordinary high water line of the River unless this requirement limits all reasonable use of the property. (Dunnellon Land Development Code Section 78-74(1)).

Development Setbacks

Development setbacks currently in the Withlacoochee River Watershed include:

Marion County

The comprehensive plan and land development code both have regulations currently in place to protect the surface waters in the county from the ill effects of development. These include a required setback of 75 feet from the ordinary high waterline of wetlands and water bodies (Marion County Comprehensive Plan Policy 2.6 and Marion County Land Development Code Section (6)(f)(1-2)). However, the Code does contain a provision that allows the county's Board of Adjustment to offer a variance for the construction of a single family residence to decrease the setback size if it renders a lot unbuildable (Marion County Land Development Code Section (6)(f)(1-6)).

Polk County

Policy 2.131-K2 of the conservation element of the comprehensive plan requires building setbacks to be 50 feet from environmentally sensitive areas, such as rivers. The provision also leaves discretion to the county in determining if a wider setback is required. This is based on the area and the intensity of the development that is proposed

adjacent to the water body. The policy notes that a 200-foot wide setback could be required for a large project adjacent to a wetland in order to mitigate degradation and prevent dewatering of the wetland (Polk County Comprehensive Plan, Policy 2.131-K2).

Sumter County

There is no specific setback requirement for development near a water body in Sumter County. However, the code states that water bodies shall be protected from adverse effects by following guidelines set forth by the EPA, FDEP, and Water Management District (Sumter County Land Development Code 13(b)(1)(1-3)). In addition, the code notes that if there is to be development within 200 feet of an area of environmental concern (as defined in both the LDC and Comprehensive Plan), there must be additional water treatment through bio swales and there can only be a maximum of 1 dwelling per 10 acres on the property (Sumter County Land Development Code, 13-642).

Citrus County

The land development code dictates that all structures shall be developed at least 50 feet from the ordinary high waterline (Citrus County Land Development Code Section 4122(1)). The code also requires that if the structure is to be built "in the vicinity" of springs or spring runs open to the aquifer, the minimum setback that is required will be 100 feet from the ordinary high water line (Citrus County Land Development Code Section 4122(2)). However, the term "vicinity" is not defined in the code.

Hernando County

Hernando County's Comprehensive Plan implements a density restriction on all new development of one residential unit per forty acres in classified wetlands (Hernando County Comprehensive Plan, Chapter 10, Policy 6.05(A)(12)).

Levy County

Levy County's Comprehensive Plan specifically addresses setbacks for all water dependent land uses which occur on any land adjoining surface waters including the Withlacoochee River. Objective Eight of the Coastal Management Element creates a 75 foot setback under Policy 8.6, which states: "A minimum construction setback line of seventy-five (75) feet will be maintained on any land adjoining surface water including rivers and the Gulf of Mexico. Water dependent structures such as boats, wharfs, marinas, etc., will be exempt from this setback requirement."

Even though the Levy County Comprehensive Plan exempts water dependent land uses such as wharfs and marinas from the setback requirement, the county's land development code has several restrictions on the construction or expansion of docks on the Withlacoochee River. Article V, "Environmental and Resource Protection," of the Levy County Land Development Code contains several regulatory ordinances which create "dock densities" for new or expanded facilities and very specific construction standards restricting the size and location of docks. These construction standards have an

emphasis on manatee protection as well as water depth and waterward extension limits. (Levy County Land Development Code, Sections 50-166 through 50-171).

Yankeetown

The land development code dictates a development setback of 50 feet from the median high water line, however this may be reduced to 25 feet with approval from the Board of Adjustment (Yankeetown Land Development Code, page 34, Waterfront Setback Chart).

Dunnellon

The land development code requires that for any development to occur along the rivers, the minimum setback required for all structures is 25 feet from the ordinary high water line and not less than 100 feet from the Rainbow River (Dunnellon Land Development Code Section 98-162(d)). The code also requires that any land greater than one acre that is to be developed shall be required to provide a habitat management plan (Dunnellon Land Development Code Section 78-73(b)).

Inverness

The Inverness land development code sets forth a 50-foot setback requirement from all water bodies for all new development (Inverness Land Development Code Section 1.1(d)).

Septic Setbacks

One way to protect a water body from negative effects of septic tanks is to include a septic tank setback provision within the land development code or to incorporate a setback restriction through county or city ordinance. A setback dictates the distance where the septic tank may sit from the river, flood plain, or water body. For regulation of septic tanks surrounding the Withlacoochee River, many of the policies are found in the land development code of the county or municipality.

Marion County's land development code contains an Environmentally Sensitive Overlay Zone (ESOZ) that "protects the environmentally sensitive lands depicted in the comprehensive plan and …provide[s] criteria for the conservation and protection of lakes, rivers, [and] wetlands" (Marion County Land Development Code, Section 6.2). The ESOZ in Marion County has a unique septic tank regulation for new development that is tied directly to the minimum lot size that may be developed and the maximum density for the project.

Section 6.2(6)(a)(1-3) lays out the requirements for new development. It states:

1. Within 1,000 feet of a water body and when a conventional or aerobic septic system with on side secondary sewage treatment such as rapid sand filters, or enhanced drain fields are utilized:

- Minimum lot size required: 1 acre
- Density Maximum: 1 dwelling unit per gross acre

2. Over 1,000 feet from a water body when enhanced conventional or enhanced aerobic systems are utilized

- Minimum lot size required: 1/2 acre
- Density Maximum: 2 dwellings units per gross acre

3. If the central sewer systems are available and utilized, density may be that of the underlying land use category

Pursuant to Section (6)(f) of the Marion County Land Development Code, septic tanks and leach fields are prohibited in the areas between the structures and the ordinary high water line or the wetland boundary, whichever is greater. The code also prohibits any part of any septic tank or drain field to be located on land lying between the ordinary high water line and the 100 year flood plain elevation (Marion County Land Development Code, Section (6)(f)(6). Thus in Marion County's land development code and ESOZ, density and lot sizes for new projects are directly tied to the distance from the water body and the type of septic system to be used.

Polk and Citrus Counties' septic regulations are less developed than that of Marion County and do not offer the same density bonus for utilizing a healthier septic system for the land. However, Sumter County has incorporated a septic regulation that is related to density and lot size requirements.

Additional county septic regulations in the Withlacoochee River Watershed include:

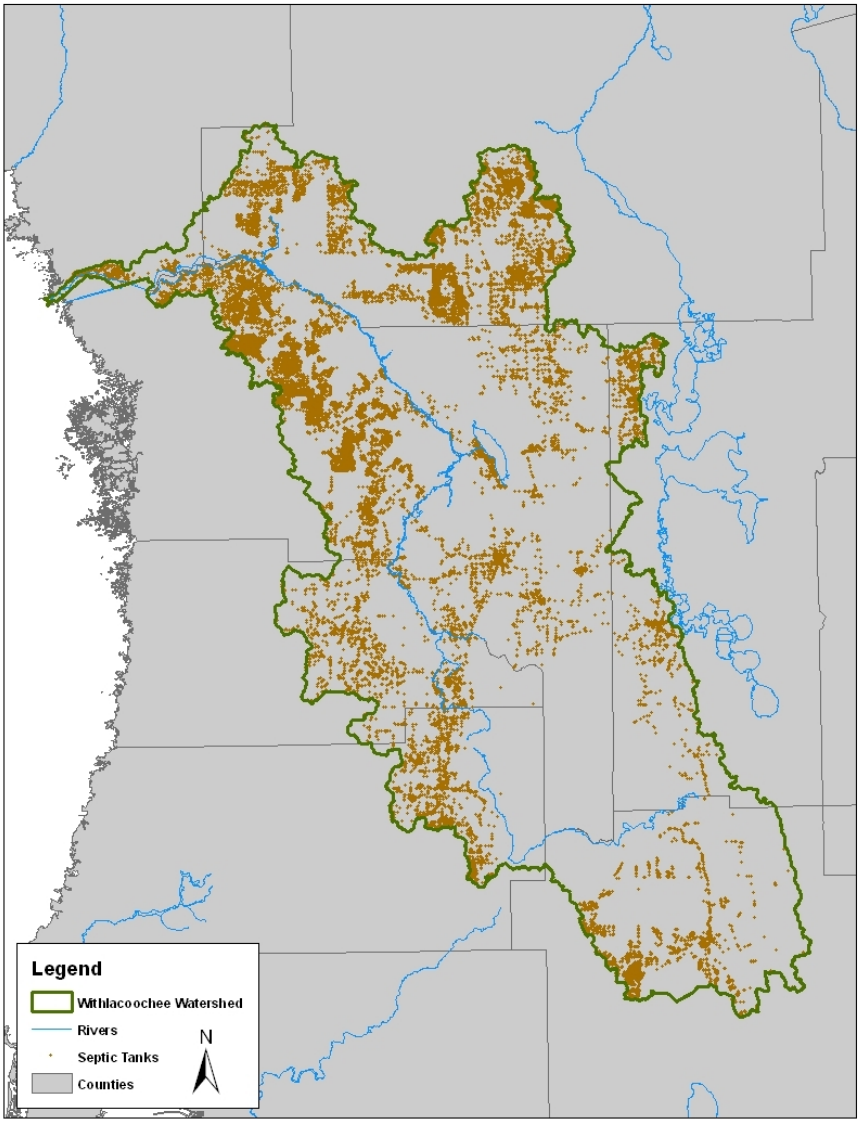

Figure 19. Onsite sewage treatment systems in the Withlacoochee River watershed. (FGDL, 2010)

Polk County

Septic absorption fields in the county are prohibited within 150 feet of the ordinary high water line (Polk County Land Development Code, Chapter 610, Section D).

Sumter County

Development with neither central water or central sewer is limited to one dwelling per five gross acres, developments with central water and individual septic tanks are limited to one dwelling per two and one-half acres, and developments with both central

water and central sewer are limited to the density/intensity/use limitations allowed by the applicable zoning classification (Sumter County Land Development Code Section (2)(b)(1-3)).

Citrus County

Policy 3.20.2 of the comprehensive plan requires that all new subdivisions built in the county that are not served by central sewer are to use performance based septic systems with at least 10 mg per liter treatment standard for nitrogen by 2010. (Citrus County Comprehensive Plan, Chapter 3-120) The same requirement is also put in place for undeveloped lots of record not served by central sewer by 2012.

Hernando County

Policy 6.02(C)(2) evaluates new development proposals for its effect on the quantity and quality of surface waters from prospective septic take discharge (Hernando County Comprehensive Plan, Chapter 10, Policy 6.02(C)(2)). Additionally the land development code notes that septic tanks associated with new development may not be installed within the riverine system or within the required vegetative buffer (Hernando County Land Development Code Section 23-208(b)).

The main municipalities surrounding the river (Yankeetown, Dunnellon, Inverness, and Dade City) have septic regulations in their comprehensive plans and land development codes as well. Municipal septic tank regulations in the Withlacoochee River Watershed include:

Yankeetown

The comprehensive plan for Yankeetown designates the Withlacoochee River as an area of concern (Yankeetown Comprehensive plan, 82) and requires the use of aerobic septic tanks for all development within the conservation area that includes the Withlacoochee River (94).

Dunnellon

The Dunnellon land development code designates both the Rainbow River and Withlacoochee River as a river corridor protection area and sets out regulations for septic tanks, requiring a setback of 100 feet from the ordinary high water line (Dunnellon Land Development Code, Chapter 78-71). All development in the river corridor protection area is required to connect to central water and central sewage (Chapter 78-73, Section (b)(5)). In addition, Sec. 98-162 of the Code also prohibits the use of septic tanks or laterals below the 25-year floodplain.

Inverness

The land development code in Inverness is lacking specific regulations for septic tanks for new development or existing structures. The Code simply states that the city shall "work with the county to provide adequate sewer facilities in the lake areas to eliminate septic tanks and in conjunction with the county to provide protection for all public supply wells" (Inverness Land Development Code Section 1.1(e)).

Dade City

According to the Conservation Element of the Dade City Comprehensive Plan there is no requirement for a ground water monitoring plan or regulations on septic tanks within the area. The plan simply defers to Florida Administrative Codes' "Principles for Guiding Development" for the Green Swamp Protection Area (Dade City Comprehensive Plan, Conservation Element, 5-15).

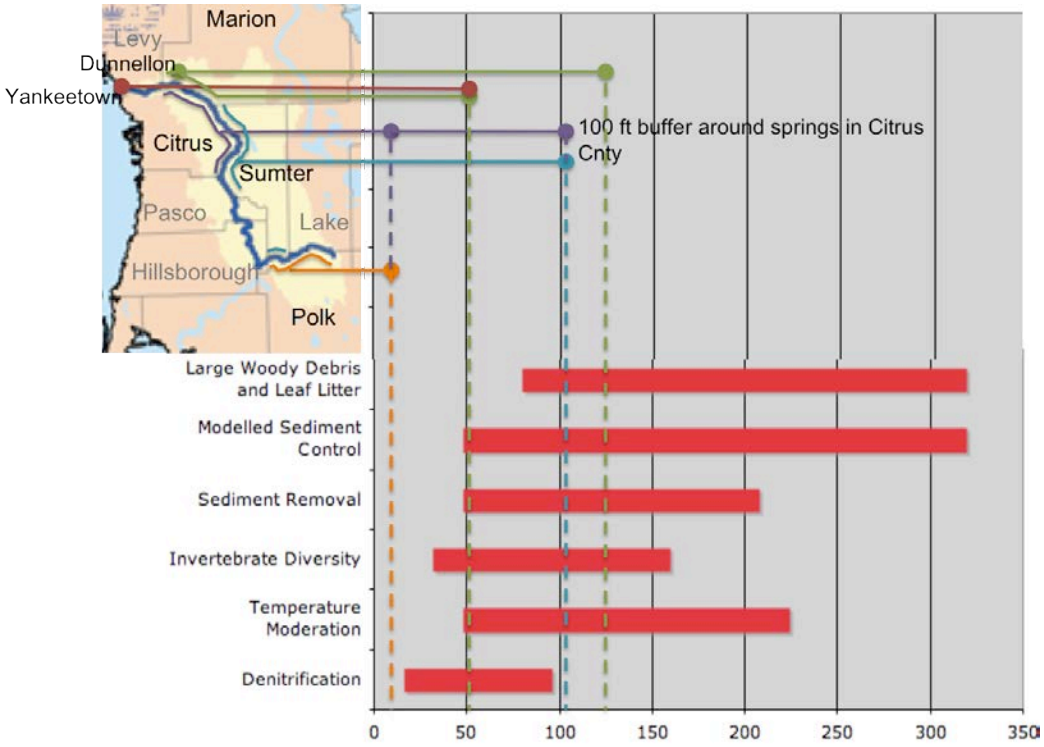

Figure 20. Comprehensive plan designated minimum buffer widths for counties and municipalities, compared to the range of riparian woodland buffer widths reported in the literature (adapted from Broadmeadow and Nisbet, 2004).

Buffers in Practice

Using exiting literature, Broadmeadow and Nisbet (2004) developed a graph of the required woodland buffer width for the adequate performance of several specific buffer functions. These buffer functions include; providing enough large woody debris and leaf litter to the stream, sediment control, sediment removal, suitable habitat for invertebrate diversity, temperature moderation, and denitrification. On figure 20, the red

bars show the range of widths cited in the literature that are suitable to perform these specific functions. For example, it has been shown that a buffer width between 50 and 225 feet is adequate to moderate temperature in streams. As previously mentioned many of the counties and two municipalities within the Withlacoochee watershed have comprehensive plans that include minimum river buffer widths. In figure 23, these have been superimposed on the work done by Broadmeadow and Nisbet (2004). Each color reflects an individual county or city (red – Yankeetown, Green – Dunnellon and Marion County, Purple – Citrus County, Blue – Sumter County, Orange – Polk County). For example the minimum buffer width for Marion County is 50 feet. A buffer of 50 feet is wide enough to provide denitrification and invertebrate diversity. Fifty feet is the smallest width to provide temperature moderation, sediment removal, and sediment control. A width of 50 feet would not be wide enough to provide an appropriate source of large woody debris and leaf litter. These buffer widths could be considered in the future development of minimum buffer widths for other counties.

Additional Land Use Regulations

In addition to riparian buffers, vegetative buffers and development setbacks, some local governments within the Withlacoochee Watershed have adopted a variety of land use controls to help protect the river.

For example, one common form of land use regulation is the designation of a maximum allowable land use density for an area designated as a wetland or conservation area. In Marion County all areas designated as wetland areas have a base density maximum of 1 unit per five acres (Policy 2.7). This type of restriction prevents clustered development and negative effects of intense development near a water body. This density can also be regulated by a "tract width regulation" to prevent structures from being too close together on the water body. Sumter County also limits density in the Withlacoochee River Watershed area. Sumter County restricts any residential development to a gross density of 1 dwelling per 10 acres in order to prevent high-density development (2 C code).

Open space requirements also promote conservation and water protection in areas that anticipate future planned development. Polk County's land development code requires a 50% set aside for open space in any wetland protection area (620 code).

Sea wall regulations are also included in land development codes to address erosion control issues. For example, in Yankeetown, riverbanks and other shorelines may only be preserved by the use of riprap embankments and vegetation. No sea walls may be constructed to prevent property erosion (Ordinance 6-37). Dunnellon also prohibits the use of new seawalls or bulkheads on properties and requires any existing sea walls in need of repair to be faced with rip rap for stabilization only, no filling of the existing sea wall with concrete or other non-permeable material is permitted (Code (b4)). Water Quality Policy & Regulation

Policy and regulation guiding the management of surface water quality in the United States is guided by the Clean Water Act, which was enacted by Congress in 1972 (EPA, 2010). The goals of the Clean Water Act are to restore and maintain the "chemical, physical, and biological integrity of the nation's waters" (33U.S.C. § 1251[a]). The ultimate goal of the act is to eliminate the "discharge of [all] pollutants into navigable

waters" (33 U.S.C. § 1251[a][1]). The Clean Water Act requires the state to report to the EPA on water quality, including the physical, chemical, biological, and cultural features of each river basin in Florida. The Clean Water Act further requires the state to submit to the EPA a list of surface waters that do not meet applicable water quality standards for their designated uses and are thus defined as impaired.

The 1999 Florida Watershed Restoration Act (Chapter 99-223, Laws of Florida) required the DEP to develop methods especially for identifying impaired waters (DEP, 2010). In response, the State's Impaired Surface Waters Rule (ISWR) describes the process for the development and implementation of Total Maximum Daily Loads (TMDLs) to establish a process for identifying waters of low quality (DEP, 2001). The federal Clean Water Act and the Florida Watershed Restoration Act describe impaired waters as those water bodies or water body segments that do not meet applicable water quality standards. 'Impairment' is a broad term used based on designated uses, water quality criteria, the Florida antidegradation policy, and moderating provisions, defined as follows:

> ***"Designated uses,*** *comprise the five classifications applied to each of the state's surface water bodies.* ***Water quality criteria*** *comprise numeric or narrative limits of pollutants.*
>
> ***The Florida Antidegradation Policy*** *(Sections 62-302.300 and 62-4.242, F.A.C.) recognizes that pollution that causes or contributes to new violations of water quality standards or to the continuation of existing violations is harmful to the waters of the state. Under this policy, the permitting of new or previously unpermitted existing discharges is prohibited where the discharge is expected to reduce the quality of a receiving water below the* ***classification*** *established for it. Any lowering of water quality caused by a new or expanded discharge to surface waters must be in the public interest (that is, the benefits of the discharge to public health, safety, and welfare must outweigh any adverse impacts on fish and wildlife or recreation). Further, the permittee must demonstrate that other disposal alternatives (for example, reuse) or pollution prevention are not economically and technologically reasonable alternatives to the surface water discharge.*
>
> ***Moderating provisions*** *(provided in Subsection 62-302.300[10] and Rules 62-4 and 62-6, F.A.C., and described in Sections 62-302.300, 62-4.244, 62-302.800, 62-4.243, F.A.C., and Sections 403.201 and 373.414, F.S.) include mixing zones, zones of discharge, site-specific alternative criteria, exemptions, and variances. These provisions are intended to moderate the* ***applicability*** *of water quality standards where it has been determined that, under certain special circumstances, the social, economic, and environmental costs of such* ***applicability*** *outweigh the benefits (FDEP, 2005)."*

Through TMDLs the Impaired Surface Waters Rule (ISWR) provides science based water quality evaluation and impaired waters identification methods using specific criteria for impairment. Impairment is based on: chemical parameters, the interpretation of narrative nutrient criteria, biological impairment, fish consumption advisories, and

ecological impairment. Total Maximum Daily Loads must be developed for all waters that are defined as impaired (DEP, 2010).

The TMDL process provides an excellent basis for the Adaptive Management of Water Quality. The elements of this management plan that reflect an Adaptive Management Approach are in blue. TMDL establishment is only required for water bodies on the verified impaired list. According to process specific criteria, if a pollutant could not be linked to a causative source, the impaired water body is not designated as 'verified impaired. Once a water body is verified as being impaired, Florida depends on its Water Management Districts to develop Basin Management Action Plans. These BMAPS are developed with extensive stakeholder input. Once implemented the effectiveness of the BMAP is monitored, evaluated, and adjustments are made if management is not working. The inclusion of stakeholder input and the monitoring and evaluation of BMAP effectiveness stake this is a truly Adaptive Management Approach to Watershed management.

For purposes of the TMDL Program pollutants are defined as chemical and biological constituents, introduced by humans into a water body, which may result in water quality impairment. While there may be other causes of water quality impairment - such as water diversion, canals, or dams- TMDLs are established only for impairments caused by pollutants (a TMDL quantifies how much of a given pollutant a water body can receive and still meet its designated uses).

As part of the DEP mandated Total Maximum Daily Load (TMDL) Program, various basins throughout the state have been placed in one of five groups developed to represent all regions of Florida. Basins in Group 4 include Pensacola Bay, St. Marys-Nassau Rivers, Kissimmee River, Fisheating Creak, Withlacoochee River, and Southeast Urban Coast. The Withlacoochee River Basin has been broken into multiple planning units, which are then divided further into segments. The planning unit segments are individually considered in the identification of impaired waters. TMDL development is a five-phase process:

Phase 1 - Preliminary Evaluation is the phase during which potentially impaired water bodies are identified through various standardized water quality analysis techniques and placed on the Planning List.

Phase 2: Strategic Monitoring and Assessment is the phase during which water bodies on the planning list are further examined and placed on a list as verified impaired (or not) and slated for mandatory TMDL establishment.

Phase 3: Development and Adoption of TMDLs

Phase 4: Development of Basin Management Action Plan

Phase 5: Implementation of Basin Management Action Plan

This entire process is intended to take five years, after which the cycle will begin again (Hodges, 2004).

Regional Governance

Region Water Management Authority

Florida is divided into regional water management districts[1], which are charged with the primary responsibility of managing and regulating water supply, flood control, water quality, and the protection of natural eco-systems (Angelo 2009). The water management districts are responsible for the implementation of two regulatory programs to aid in the realization of Florida's water management policy; the consumptive use program (CUP)[2], which focuses on regulating water consumption, and the Environmental Resource Permitting system (ERP)[3], which regulates the quantity and quality of surface waters[4] (Angelo 2009). The water management districts are additionally charged with the implementation of several non-regulatory programs such as land acquisition, water restoration, and planning (§ 373.036(2), Fla. Stat.). These include the development of district-wide, regional water management plans, providing technical assistance to local government planning, and commenting on local government comprehensive plans (Angelo 2009; Klein, Angelo, & Hamann 2009). With these tools, water management districts implement the management policies of the Water Resources Act.

Additionally, Florida water law permits counties, municipalities, or special districts to create, by interlocal agreement, regional water supply authorities. These authorities are created "for the purpose of developing, recovering, storing, and supplying water for county or municipal purposes in such a manner as will give priority to reducing adverse environmental effects of excessive or improper withdrawals of water from concentrated areas" (§ 373.713(1), Fla. Stat.). Such agreements must be both approved by DEP and must be consistent with the Florida Interlocal Cooperation Act of 1969 (§ 373.713(1), Fla. Stat.).

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[1] *See* § 373.069, Florida Statutes (2010). The Water Resource Act, as amended, divides the state into five total water management districts delineated by hydrological boundaries: the Northwest Florida Water Management District, the Suwannee River Water Management District, the St. Johns River Water Management District, the Southwest Florida Water Management District, and the South Florida Water Management District. *Id.*

[2] Part II, Chapter 373, §§ 373.203 - 373.250, Florida Statutes (2010).

[3] Part IV, Chapter 373, §§ 373.403 - 373.468, Florida Statutes (2010).

[4]The regulation of the consumptive use of water lies exclusively with the regional water management districts and it is thus beyond the scope of local government authority (Angelo 230). The ERP program is very broad, regulating essentially all land development above a particular size. (Angelo 227). The ERP program regulates developments in connection with "surface water management systems", including buildings, parking lots, roads, and upland or wetland land development systems (Angelo 227).

The water management districts also engage in regional water supply planning. Under the Water Resources Act, water management districts are required to develop twenty year regional water supply plans for areas identified as having insufficient water to meet usage needs within that time period (Laws of Florida, Chapter 97-160, 1997). These plans are designed to identify available sources of water, including alternative sources, and associated costs in meeting the current and projected reasonable-beneficial uses within the twenty-year planning period (Laws of Florida, Chapter 97-160, 1997; Klein, Angelo, & Hamann 2009). Additionally, local governments and interested stakeholders participate in the regional water supply planning process ((Laws of Florida, Chapter 97-160, 1997 (now § 373.709(1), Fla. Stat.)).[5] Specifically, the Water Resources Act requires that any component of SWFWMD's RWSP that impacts areas served by a regional water authority must be developed conjunctively between SWFWMD and that regional water authority (§ 373.709(3), Fla. Stat.).

Under Florida's water law, it can be difficult to clearly define the respective roles of the water management districts and the regional water supply authorities (Bilenky 2009). In its current state, the Water Resources Act contemplates two categories of water projects; "water resource development" and "water supply development", with the former focused on regional water management strategy and the latter on the consumptive use, collection, and treatment of water ((Laws of Florida, Ch. 97-160, 1997 (§ 373.019 (19) & (21), Fla. Stat.)). "Water resource development" is charged primarily to the water management districts, and its principal concern is increasing the amount of water available for consumption (Laws of Florida, ch. 97-160, 1997 (now § 373.705(3), Fla. Stat.); Matthews & Nieto 1998). Pursuing "water supply development" is primarily the role of local governments and regional water supply authorities, and its main intent is to ensure the availability of water for usage demands (Laws of Florida, Chapter 97-160, 1997 addition of § 373.0831(1)(b) (now § 373.705(1)(b), Fla. Stat.); Matthews & Nieto 1998).

The regional water management authority for the Withlacoochee River watershed is the Southwest Florida Water Management District (§ 373.069(2)(d), Fla. Stat.). Beginning in 2001, SWFWMD has developed a regional water supply plan for the entire district, which is updated every five years (SWFWMD website, "A Framework for the Future"). Under SWFWMD's RWSP, the district is divided into different planning regions based in part on existing regional water authority service areas where water supply planning is already conducted and on areas important for SWFWMD's strategy of recovering groundwater levels (SWFWMD 2006 PRWSP 2-3,7). These planning areas are the Northern Planning Area[6], the Northern Tampa Bay Planning Area[7], the Southern

[5] "The planning must be conducted in an open public process, in coordination and cooperation with local governments, regional water supply authorities, government-owned and privately owned water and wastewater utilities, multijurisdictional water supply entities, self-suppliers, reuse utilities, the department, and other affected and interested parties." (Laws of Florida, Chapter 97-160, 1997 (now § 373.709(1), Fla. Stat. (2010))).

[6] Comprised of portions of Levy, Marion, Citrus, Sumter, Hernando, and Lake Counties.

[7] Including portions of Pasco, Hillsborough, and Pinellas Counties.

Water Use Caution Area (SWUCA) Planning Area, and the Heartland Water Alliance (HWA) planning area [8]. Additionally, the Water Resources Act requires that any component of SWFWMD's RWSP that impacts areas served by a regional water authority must be developed conjunctively between SWFWMD and that regional water authority (§373.709(3), Fla. Stat.).

There are three regional water supply authorities located within SWFWMD's district; the Withlacoochee Regional Water Supply Authority, Tampa Bay Water[9], and the Peace River Manasota Regional Water Supply Authority.

The current member governments to the Withlacoochee Regional Water Supply Authority include Citrus County, Hernando County, Sumter County, Marion County, and the City of Ocala. (WRWSA 2010).

Tampa Bay Water is the sole and exclusive wholesale potable water supplier to Hillsborough County, Pasco County, and Pinellas County, and to the cities of Tampa, New Port Richey, and St. Petersburg (§ 373.715(1)(b)(2), Fla. Stat.; TBW 2010). There are two legal agreements in place governing Tampa Bay Water. The first is the "Northern Tampa Bay New Water Supply and Ground Water Withdrawal Reduction Agreement Between West Coast Regional Water Supply Authority, Hillsborough County, Pasco County, Pinellas County, City of Tampa, City of St. Petersburg, City of New Port Richey, and Southwest Florida Water Management District (1998)" (referred to as the "Partnership Agreement") (Hillsborough County website, "Legal Agreements"). The second is the "Amended and Restated Interlocal Agreement Reorganizing the West Coast Regional Water Supply Authority (1998)" (referred to as the "Governance Agreement") (Hillsborough County website, "Legal Agreements").

The Peace River Manasota Regional Water Supply Authority supplies water to its member governments of Charlotte County, DeSoto County, Manatee County, and Sarasota County (PRMRWSA website).

Basin Boards[10]

Under Florida's Water Resources Act, a water management district is permitted to designate areas within the district as basins ((§ 373.0693(1)(a), Florida Statutes (2010)).[11] Pursuant to statute, each basin created will be under the control of a basin board ((§ 373.0693(2), Florida Statutes (2010)) that is charged with planning authority, authority to receive ad valorem tax revenue levied by the water management district ((§

[8] Including Hardee and portions of Polk and Highlands Counties.

[9] Tampa Bay Water was formerly called the West Coast Regional Water Supply Authority. Additionally, § 373.715 relates to Tampa Bay Water and its member governments.

[10] §§ 373.0693-373.0698, Florida Statutes (2010).

[11] But not the St. Johns River Water Management District. § 373.0693(1)(b), Florida Statutes (2010).

373.0697, Florida Statutes (2010))[12], and to adopt and maintain works of the district ((§ 373.0695(2)&(3), Florida Statutes (2010)). A basin board is a subdistrict of its respective water management district ((§ 373.0693(1)(a), Florida Statutes (2010)).

Each basin board is responsible for implementing the following functions:

> "(a) The preparation of engineering plans for development of the water resources of the basin and the conduct of public hearings on such plans.
>
> (b) The development and preparation of overall basin plan of secondary water control facilities for the guidance of subdrainage districts and private land owners in the development of their respective systems of water control which will be connected to the primary works of the basin to complement the engineering plan of primary works for the basin.
>
> (c) The preparation of the annual budget for the basin and the submission of such budget to the governing board of the district for inclusion in the district budget.
>
> (d) The consideration and prior approval of final construction plans of the district for works to be constructed in the basin.
>
> (e) The administration of the affairs of the basin.
>
> (f) Planning for and, upon request by a county, municipality, private utility, or regional water supply authority, providing water supply and transmission facilities for the purpose of assisting such counties, municipalities, private utilities, or regional water supply authorities within or serving the basin" ((§ 373.0695(1), Florida Statutes (2010)).

Expenditure of Basin Board monies are authorized for the accomplishment of those works enumerated at § 373.0695(2), Florida Statutes (2010).

There are eight hydrologic basins in the SWFWMD, and seven of them have Basin Boards (SWFWMD, "Basin Boards"). Those basin boards are the following:

- **Alafia River Basin,** 684 square miles in southern Hillsborough County and western Polk County;
- **Coastal Rivers Basin**, 809 square miles in the coastal region of Citrus, Hernando, and Pasco County;

[12]"[T]he taxes are levied for the use and benefit of the basin for statutorily prescribed basin purposes and in proportion to the benefits to be derived by the properties within the basin." (Attorney General Opinion 077-17).

- **Hillsborough River Basin**, 914 square miles that in portions of Hillsborough, Pasco, and Polk County;
- **Manasota Basin**, 1,318 square miles, in Manatee County and Sarasota County;
- **Peace River Basin,** 3,030 square miles including portions of Polk, Hardee, DeSoto, Highlands and Charlotte County;
- **Pinellas-Anclote River Basin,** 369 square miles including all of Pinellas County and the southern portion of Pasco County; and
- **Withlacoochee River Basin**, 2,000 square miles, covering portions of Pasco, Sumter, Hernando, Citrus, Marion and Levy County (SWFWMD, "Issue Paper: Basin Boards").

SWFWMD reports that the basin boards and the District are partners in the New Water Sources Initiative (NWSI), an investment program whose goal is "to develop alternative water sources to meet and balance the vital needs of all water users, including the environment" (*Id*.). While contemplated statewide by the Water Resources Act, basin boards are currently unique to the SWFWMD.

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Appendix A: Water Quality sampling locations for the Withlacoochee River Watershed.

Station ID	County	Latitude	Longitude	Sampling Start Date	Sampling End Date	Number of samples taken from sampling start to end date*
3513	MARION	28 59 18.771	82 20 59.438	10/5/98	6/2/10	145
3560	PASCO	28 21 7.9971	82 7 33.9922	10/6/98	6/3/10	128
17944	CITRUS	28 48 31.949	82 10 52.432	6/3/03	6/3/03	1
17945	MARION	29 0 6.809	82 22 16.63	5/27/03	5/27/03	1
17946	PASCO	28 26 58.075	82 8 11.198	6/12/03	6/12/03	1
17947	HERNANDO	28 30 24.532	82 12 25.291	6/12/03	6/12/03	1
17949	SUMTER	28 34 30.841	82 11 50.42	5/21/03	5/21/03	1
17950	SUMTER	28 49 36.688	82 11 28.218	6/25/03	6/25/03	1
17953	SUMTER	28 44 52.722	82 12 53.673	6/4/03	6/4/03	1
17956	CITRUS	29 2 39.484	82 27 29.406	5/28/03	5/28/03	1
17957	POLK	28 19 12.159	82 2 25.16	6/17/03	6/17/03	1
17958	HERNANDO	28 30 2.867	82 12 4.324	6/12/03	6/12/03	1
17959	SUMTER	28 35 2.802	82 13 10.898	5/20/03	5/20/03	1
17960	CITRUS	28 55 33.719	82 17 13.97	5/27/03	5/27/03	1
17961	CITRUS	28 45 33.04	82 11 26.87	6/4/03	6/4/03	1
17962	SUMTER	28 35 42.823	82 13 26.306	5/20/03	5/20/03	1
17964	SUMTER	28 51 19.9	82 13 45.5	6/23/03	6/23/03	1
17965	CITRUS	28 40 30	82 15 36.8	6/23/03	6/23/03	1
17966	CITRUS	28 43 36.835	82 14 13.598	6/3/03	6/3/03	1
17967	MARION	29 4 51.666	82 25 43.756	5/28/03	5/28/03	1
17968	CITRUS	28 53 30.4	82 16 2.2	6/23/03	6/23/03	1
17969	HERNANDO	28 30 33.25	82 12 29.802	6/19/03	6/19/03	1
17970	SUMTER	28 51 51	82 14 11	6/23/03	6/23/03	1

17971	PASCO	28 23 23.139	82 8 35.215	6/25/03	6/25/03	1
17972	PASCO	28 28 31.278	82 9 29.757	6/19/03	6/19/03	1
17973	HERNANDO	28 31 43.26	82 12 5.977	6/19/03	6/19/03	1
20041	SUMTER	28 43 42.879	82 7 33.984	8/7/03	8/7/03	1
20042	POLK	28 13 27.119	81 59 26.543	8/19/03	8/19/03	1
20044	SUMTER	28 45 43.1	82 5 8.8	8/19/03	8/19/03	1
20045	POLK	28 17 53.566	81 54 44.061	--	--	--
20046	POLK	28 17 23.242	81 47 18.894	--	--	--
20047	SUMTER	28 40 35.055	82 1 48.968	9/8/03	9/8/03	1
20048	POLK	28 20 27.276	81 49 38.923	--	--	--
20049	POLK	28 13 31.669	81 51 34.432	--	--	--
20052	SUMTER	28 37 16.992	81 57 28.575	8/21/03	8/21/03	1
20053	POLK	28 17 59.723	81 52 9.237	--	--	--
20054	POLK	28 11 15.113	81 53 5.427	8/18/03	8/18/03	1
20055	SUMTER	28 54 37.91	82 16 30.968	9/18/03	9/18/03	1
20057	POLK	28 10 39.235	81 54 14.628	8/18/03	8/18/03	1
20058	SUMTER	28 37 43.528	82 8 43.751	9/16/03	9/16/03	1
20059	POLK	28 13 57.871	81 51 34.915	9/10/03	9/10/03	1
20060	POLK	28 19 19.5	81 53 7.6	9/16/03	9/16/03	1
20064	LEVY	29 1 30.99	82 37 17.751	9/9/03	9/9/03	1
20065	POLK	28 12 51.354	81 52 1.985	--	--	--
20066	SUMTER	28 42 .133	81 59 13.478	9/8/03	9/8/03	1
20067	HERNANDO	28 32 47.891	82 8 4.332	9/15/03	9/15/03	1
32783	SUMTER	28 51 37.058	82 14 8.25	6/13/07	6/13/07	1
32784	CITRUS	29 1 51.05	82 42 18.199	5/15/07	5/15/07	1
32785	HERNANDO	28 32 15.81	82 11 50.835	7/11/03	7/11/03	1
32786	PASCO	28 28 29.119	82 8 55.025	7/11/03	7/11/03	1

32787	LEVY	29 1 17.712	82 38 59.717	5/16/07	5/16/07	1
32788	PASCO	28 26 54.992	82 8 44.29	7/12/07	7/12/07	1
32789	MARION	29 2 20.945	82 26 58.788	5/21/07	5/21/07	1
32790	HERNANDO	28 33 53.704	82 12 20.279	7/10/07	7/10/07	1
32791	SUMTER	28 44 33.656	82 13 14.378	7/9/07	7/9/07	1
32792	CITRUS	28 59 5.847	82 20 16.295	6/11/07	6/11/07	1
32793	MARION	29 5 42.13	82 26 3.08	5/14/07	5/14/07	1
32794	HERNANDO	28 38 24.166	82 15 34.921	6/26/07	6/26/07	1
32795	MARION	29 1 5.308	82 25 10.704	5/23/07	5/23/07	1
32796	CITRUS	29 1 42.382	82 42 55.42	5/15/07	5/15/07	1
32797	SUMTER	28 50 29.775	82 12 28.053	6/13/07	6/13/07	1
32798	SUMTER	28 42 8.001	82 14 54.718	6/26/07	6/26/07	1
32799	SUMTER	28 56 5.639	82 17 22.576	6/12/07	6/12/07	1
32800	MARION	29 3 4.418	82 29 .668	5/17/07	5/17/07	1
32801	SUMTER	28 56 17.247	82 17 44.154	7/19/07	7/19/07	1
32802	CITRUS	29 2 49.848	82 27 31.084	7/25/07	7/25/07	1
32803	SUMTER	28 42 1.193	82 14 58.494	7/18/07	7/18/07	1
32804	PASCO	28 27 32.398	82 7 55.368	7/17/07	7/17/07	1
32805	MARION	29 1 1.973	82 23 51.822	7/24/07	7/24/07	1
32806	LEVY	29 1 38.928	82 40 31.579	7/24/07	7/24/07	1
32807	HERNANDO	28 33 13.418	82 12 24.467	7/17/07	7/17/07	1
32808	SUMTER	28 49 5.648	82 10 54.193	7/23/07	7/23/07	1
32809	SUMTER	28 52 59.784	82 15 11.962	7/19/07	7/19/07	1
32810	MARION	29 5 15.208	82 25 39.9	7/26/07	7/26/07	1
32811	HERNANDO	28 31 39.553	82 12 11.986	--	--	--
32812	CITRUS	29 0 6.816	82 22 15.479	7/31/07	7/31/07	1
33440	SUMTER	28 56 53.839	82 17 35.677	7/31/07	7/31/07	1
33441	SUMTER	28 43 59.706	82 11 17.293	10/10/07	10/10/07	1

33442	SUMTER	28 43 26.492	82 11 11.77	10/10/07	10/10/07	1
33443	POLK	28 16 25.063	81 55 46.035	9/27/07	9/27/07	1
33444	POLK	28 9 48.925	81 51 8.814	9/27/07	9/27/07	1
33445	SUMTER	28 56 28.42	82 17 38.019	10/2/07	10/2/07	1
33446	SUMTER	28 51 35.347	82 5 24.508	10/3/07	10/3/07	1
33447	POLK	28 16 54.633	82 2 1.51	10/8/07	10/8/07	1
33448	SUMTER	28 55 10.267	82 16 43.769	10/11/07	10/11/07	1
33449	POLK	28 19 32.268	81 55 54.302	10/11/07	10/11/07	1
33450	SUMTER	28 47 53.2	82 9 42.928	10/15/07	10/15/07	1
33451	CITRUS	28 58 19.247	82 20 51.1	10/16/07	10/16/07	1
33452	SUMTER	28 48 20.487	82 8 37.667	10/16/07	10/16/07	1
33453	LEVY	29 1 35.409	82 36 56.877	--	--	--
33454	SUMTER	28 50 21.743	82 8 34.972	10/23/07	10/23/07	1
33455	SUMTER	28 46 47.695	82 3 18.452	10/17/07	10/17/07	1
33456	CITRUS	28 44 42.149	82 14 1.057	10/23/07	10/23/07	1
34399	SUMTER	28 18 34.56	81 58 27.328	10/15/07	10/15/07	1
34400	CITRUS	28 49 2.068	82 16 38.786	10/16/07	10/16/07	1
34401	PASCO	28 17 20.056	82 5 7.016	10/17/07	10/17/07	1
34402	HERNANDO	28 32 6.665	82 11 2.904	10/23/07	10/23/07	1
37002	MARION	29 1 46.612	82 26 12.269	4/20/09	4/20/09	1
37007	MARION	29 0 53.067	82 23 43.703	4/29/09	4/29/09	1
37943	CITRUS	29 1 45.994	82 26 12.02	10/14/09	10/14/09	1
37948	MARION	29 0 52.922	82 23 43.732	10/27/09	10/27/09	1
38455	MARION	28 58 44.42	82 19 38.066	4/14/10	4/14/10	1
38457	PASCO	28 21 40.374	82 7 35.72	4/20/10	4/20/10	1
38610	POLK	28 17 56.543	82 3 9.973	5/6/10	5/6/10	1
23010032	CITRUS	29 0 48	82 36 42	--	--	--

23010038	CITRUS	28 48 54	82 21 40	--	--	--
23010055	MARION	29 2 55	82 26 58	--	--	--
23010404	MARION	29 2 58.7	82 26 53.5	3/1/04	12/15/04	6
23010404	MARION	29 2 58.7	82 26 53.5	--	--	--
23010405	LEVY	29 1 33.9	82 40 8.5	3/9/04	10/18/04	4
23010405	LEVY	29 1 33.9	82 40 8.5	--	--	--
23010409	MARION	29 5 34.1	82 25 34.3	3/16/98	11/27/00	3
23010409	MARION	29 5 34.1	82 25 34.3	--	--	--
23010416	HERNANDO	28 28 55.3	82 10 48.7	1/27/98	1/27/98	1
23010417	SUMTER	28 35 30.9	82 13 20.7	--	--	--
23010428	HERNANDO	28 34 21	82 9 17	1/27/98	11/9/09	11
23010436	PASCO	28 22 28.4	82 10 35.9	1/27/98	6/27/05	6
23010437	SUMTER	28 34 47.2	82 5 42.5	2/9/98	4/5/10	16
23010438	CITRUS	28 45 14.2	82 13 47.8	--	--	--
23010438	CITRUS	28 45 14.2	82 13 47.8	--	--	--
23010442	PASCO	28 23 50.9	82 7 50.9	7/26/99	7/26/99	1
23010444	PASCO	28 27 48.7	82 8 4.8	7/27/99	7/27/99	1
23010445	PASCO	28 28 28.8	82 9 32.1	7/27/99	7/27/99	1
23010446	PASCO	28 18 13.9	82 4 .1	7/28/99	7/28/99	1
23010464	PASCO	28 21 0	82 7 28.2	9/30/98	12/15/03	4
23010465	CITRUS	28 59 20.9	82 21 1.4	--	--	--
23010465	CITRUS	28 59 20.9	82 21 1.4	--	--	--
23010466	HERNANDO	28 32 33.9	82 6 53.1	2/9/98	8/10/04	5
GATOR CREEK1	POLK	28 9 55.9	81 55 20.2	--	--	--
GATOR CRK2	POLK	28 18 8	82 3 22.2	--	--	--
PONY CRK1	POLK	28 18 39.5	81 53 30.6	--	--	--
WITHLACOO RVR1	POLK	28 18 45	82 3 20.6	--	--	--
WITHLACOO RVR2	POLK	28 19 33.5	81 55 54.7	--	--	--

* This number is the number of samples taken only for Dissolved Oxygen, Fecal Coliform, Nitrogen, Phosphorous, and Total Suspended Solids.
-- Although this is a sampling location samples were not recorded here for Dissolved Oxygen, Fecal Coliform, Nitrogen, Phosphorous, and Total Suspended Solids.

Appendix B: Impaired Waterbodies in the Withlacoochee Watershed 2010 FDEP Assessment

Planning Unit	Water Segment Name	WBID	Waterbody Type	Reason for Impairment	TMDL Development Priority
Upper Withlacoochee	Withlacoochee River	1329 E	Stream	Mercury (in fish tissue)	High
Upper Withlacoochee	Withlacoochee River	1329 F	Stream	Mercury (in fish tissue)	High
Upper Withlacoochee	Withlacoochee River	1329 G	Blackwater	Mercury (in fish tissue)	High
Lower Withlacoochee	Bypass Channel	1337 A	Stream	Mercury (in fish tissue)	High
Lake Panasoffkee	Lake Okahumpka	1347	Lake	Mercury (in fish tissue)	High
Lower Withlacoochee	Cross Florida Barge Canal	1329 A	Estuary	Mercury (in fish tissue) / Nutrients (Chlorophyll-a)	High
Lower Withlacoochee	Lake Rousseau	1329 B	Lake	Mercury (in fish tissue)	High
Lower Withlacoochee	Lake Rousseau Drain	1329 B1	Stream	Mercury (in fish tissue)	High
Lower Withlacoochee	Withlacoochee River	1329 C	Stream	Mercury (in fish tissue)	High
Lower Withlacoochee	Withlacoochee River	1329 D	Stream	Mercury (in fish tissue)	High
Lower Withlacoochee	Withlacoochee River	1337	Stream	Mercury (in fish tissue)	High
Lower Withlacoochee	Bypass Channel	1337 A	Stream	Mercury (in fish tissue)	High
Upper Withlacoochee	Big Gant Canal	1378	Stream	Nutrients (Chlorophyll-a)	Medium
Upper	Pony Creek	1426	Stream	Dissolved Oxygen	Medium

Withlacoochee				(Nutrients)	
Upper Withlacoochee	Lake Deeson	1449 A	Lake	Nutrients (TSI)	Medium
Upper Withlacoochee	Lake Tennessee	1484 A	Lake	Nutrients (TSI)	Medium
Upper Withlacoochee	Lake Juliana	1484B	Lake	Nutrients (TSI)	Medium
Lower Withlacoochee	Gum Springs (Alligator Springs)	1338 A	Spring	Nutrients (Algal Mats)	Medium
Lower Withlacoochee	Leslie-Hefner Canal	1357	Stream	Nutrients (Chlorophyll-a)	Medium
Rainbow River	Rainbow Springs Group	1320 A	Spring	Nutrients (Algal Mats)	Medium
Rainbow River	Rainbow Springs Group Run	1320B	Stream	Nutrients (Algal Mats)	Medium
Tsalo Apopka	Davis Lake	1340 A	Lake	Nutrients (TSI)	Medium
Tsalo Apopka	Little Lake Consuella	1340 E	Lake	Nutrients (TSI)	Medium
Tsalo Apopka	Cooter Lake	1340 L	Lake	Nutrients (TSI)	Medium
Lake Panasoffkee	Outlet River	1351 A	Stream	Nutrients (Chlorophyll-a)	Medium
Lake Panasoffkee	Canal 485A Springs Group	1351 B2	Spring	Nutrients (Algal Mats)	Medium
Lower Withlacoochee	Wilson Head Spring	1329 R	Spring	Nutrients (Algal Mats)	Medium