

**DRAFT: SEPTEMBER 2007**

# *BASIN MANAGEMENT ACTION PLAN*

For the Implementation of Total Maximum Daily Loads  
Adopted by the Florida Department of Environmental Protection

*In The*

## **ORANGE CREEK BASIN**

***Developed by the Orange Creek Basin Working Group***

*In Cooperation with*

*The Florida Department of Environmental Protection*

*Division of Water Resource Management*

*Bureau of Watershed Management*

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## Acronyms

|                 |                                                                   |
|-----------------|-------------------------------------------------------------------|
| <b>BMAP</b>     | Basin Management Action Plan                                      |
| <b>BMP</b>      | Best management practice                                          |
| <b>BOD</b>      | Biochemical oxygen demand                                         |
| <b>BWG</b>      | Basin Working Group                                               |
| <b>CDBG</b>     | Community Development Block Grant                                 |
| <b>CDS</b>      | Continuous deflective separation                                  |
| <b>DACS</b>     | Florida Department of Agriculture and Consumer Services           |
| <b>DCA</b>      | Florida Department of Consumer Affairs                            |
| <b>DEP</b>      | Florida Department of Environmental Protection                    |
| <b>DO</b>       | Dissolved oxygen                                                  |
| <b>DOT</b>      | Florida Department of Transportation                              |
| <b>EMC</b>      | Event mean concentration                                          |
| <b>EPA</b>      | U. S. Environmental Protection Agency                             |
| <b>F.A.C.</b>   | Florida Administrative Code                                       |
| <b>F.S.</b>     | Florida Statutes                                                  |
| <b>FWCC</b>     | Florida Fish and Wildlife Conservation Commission                 |
| <b>FWRA</b>     | Florida Watershed Restoration Act                                 |
| <b>GIS</b>      | Geographic information system                                     |
| <b>LDRs</b>     | Land development regulations                                      |
| <b>MEP</b>      | Maximum extent practicable                                        |
| <b>MS4</b>      | Municipal separate storm sewer system                             |
| <b>NELAC</b>    | National Environmental Laboratory Accreditation Conference        |
| <b>NPDES</b>    | National Pollutant Discharge Elimination System                   |
| <b>NSRA</b>     | North Shore Restoration Area                                      |
| <b>NuRF</b>     | Nutrient reduction facility                                       |
| <b>PAHs</b>     | Polycyclic aromatic hydrocarbons                                  |
| <b>PLRG</b>     | Pollutant load reduction goal                                     |
| <b>PMRA</b>     | Pine Meadows Restoration Area                                     |
| <b>ppb</b>      | Parts per billion                                                 |
| <b>ppm</b>      | Parts per million                                                 |
| <b>QA</b>       | Quality assurance                                                 |
| <b>QC</b>       | Quality control                                                   |
| <b>SJRWMD</b>   | St. Johns River Water Management District                         |
| <b>SR</b>       | State Road                                                        |
| <b>SW</b>       | Stormwater                                                        |
| <b>SWCD</b>     | Soil and Water Conservation District                              |
| <b>SWIM</b>     | Surface Water Improvement and Management                          |
| <b>SWMP</b>     | Stormwater management program                                     |
| <b>TMDL</b>     | Total maximum daily load                                          |
| <b>TN</b>       | Total Nitrogen                                                    |
| <b>TP</b>       | Total Phosphorus                                                  |
| <b>TSI</b>      | Trophic State Index                                               |
| <b>TSS</b>      | Total suspended solids                                            |
| <b>UF- IFAS</b> | University of Florida–Institute of Food and Agricultural Sciences |

## Acronyms

|               |                                 |
|---------------|---------------------------------|
| <b>UORB</b>   | Upper Ocklawaha River Basin     |
| <b>USACOE</b> | U. S. Army Corps of Engineers   |
| <b>USDA</b>   | U. S. Department of Agriculture |
| <b>WBID</b>   | Waterbody identification        |
| <b>WMM</b>    | Watershed Management Model      |
| <b>WMP</b>    | Watershed Management Plan       |
| <b>WAV</b>    | Watershed Action Volunteers     |

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## ACKNOWLEDGMENTS

The Orange Creek Basin Management Action Plan was prepared as part of a five-year cycle to implement Total Maximum Daily Loads adopted by the Florida Department of Environmental Protection within the Orange Creek Basin. It was developed by the Orange Creek Basin Working Group (BWG), identified below, with participation from affected local, regional, and state governmental interests; elected officials and citizens; and private interests.

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## **Orange Creek Basin Draft BMAP**

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### BMAP OVERVIEW

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The Orange Creek Basin covers approximately 1040 km<sup>2</sup> including portions of the City of Gainesville, Alachua County, and Marion County. Lakes Newnans, Orange, and Lochloosa are the largest surface water bodies. A number of significant urban creeks are present in the Gainesville area. The Basin also includes Alachua Sink, which is located south of Gainesville on Paynes Prairie.

The Orange Creek Basin Working Group worked for over three years to develop a basin management action plan (BMAP) to address total maximum daily loads (TMDLs) adopted by the Florida Department of Environmental protection (DEP) for the Orange Creek Basin. This working group is comprised of a wide variety of stakeholders, including the following:

- |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| <ul style="list-style-type: none"><li>• Alachua County (Environmental Protection Department, Public Works, and Environmental Protection Advisory Committee)</li><li>• Marion County</li><li>• City of Gainesville</li><li>• Town of McIntosh</li><li>• Gainesville Regional Utilities</li><li>• Gainesville Clean Water Partnership</li><li>• Gainesville Water Management Committee</li><li>• University of Florida</li><li>• Women for Wise Growth</li></ul> | <ul style="list-style-type: none"><li>• Sustainable Alachua County</li><li>• Sierra Club</li><li>• Plum Creek Timber Company</li><li>• Florida Forestry Association</li><li>• St. Johns River Water Management District</li><li>• Florida Department of Transportation</li><li>• Florida Fish and Wildlife Commission</li><li>• Florida Department of Agriculture and Consumer Services (includes Division of Forestry)</li><li>• Florida Department of Health (Alachua County)</li><li>• Florida Department of Environmental Protection</li></ul> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

A significant outcome of the BMAP process in the Orange Creek Basin has been an unprecedented level of stakeholder participation and commitment. Dozens of working group members worked hard at long monthly meetings for over three years. The BMAP process in the Orange Creek Basin fostered positive communication and cooperation among basin stakeholders. They put aside some long-standing differences, finding common ground among competing interests. Together they identified creative solutions to complex water pollution issues, and are taking decisive steps toward realizing those solutions. These successful collaborations on behalf of the lakes would have been less likely without TMDLs and the BMAP process.

The Orange Creek BMAP represents this collaborative effort and significant commitment of stakeholder resources. Focusing on eight impaired waters within the Basin (Lakes: Newnans, Orange, and Wauberg; Alachua Sink; Creeks: Hatchet, Hogtown, Tumblin, and Sweetwater), the BMAP describes the current state of knowledge about these waterbodies, water quality issues, projects already completed or in progress to address these issues, and steps local, regional, and state entities will take in the future to address TMDL allocations. Management actions in the BMAP are directed toward the specific parameters for which each waterbody is impaired. It is crucial that stakeholder efforts in developing this plan be translated into actions that have a tangible effect on the community.

#### **Total Maximum Daily Loads (TMDLs)**

TMDLs are water quality targets established for waterbodies that do not meet state water quality standards. TMDLs are specific to both a waterbody and a pollutant (e.g. Total Nitrogen, Total Phosphorus, fecal coliforms). TMDLs, which DEP adopts by rule, establish the maximum amount of specific pollutants that a waterbody can assimilate while maintaining its designated uses. For waterbodies in the Orange Creek Basin, all Class III, “maintaining its designated use”

## Orange Creek Basin Draft BMAP

means that these waterbodies must have suitable water quality for recreational use and for the propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

DEP has adopted Total Maximum Daily Loads (TMDLs) for the following waterbodies:

- Newnans Lake
- Orange Lake
- Lake Wauberg
- Alachua Sink
- Hatchet Creek
- Hogtown Creek
- Tumblin Creek
- Sweetwater Branch

### Waterbody Summaries

Table 1 summarizes the management actions that have been completed, are in progress, or are under consideration to reduce target pollutants in these impaired waterbodies. Following this table, summaries of the state of knowledge, the key unknowns, future studies, and anticipated benefits of the management actions are identified for each waterbody.

## Orange Creek Basin - DRAFT BMAP

**Table 1 : Summary of Management Actions Being Implemented/Proposed in the Orange Creek Basin Management Action Plan**

| Management Actions                                 | Newnans Lake | Orange Lake | Lake Wauberg | Alachua Sink | Lake Lochloosa | Hatchet Creek | Hogtown Creek | Tumblin Creek | Sweetwater Branch |
|----------------------------------------------------|--------------|-------------|--------------|--------------|----------------|---------------|---------------|---------------|-------------------|
| Structural BMPs                                    | •            |             |              |              | •              | •             | •             | •             | •                 |
| Agricultural BMPs                                  | •            | •           | •            |              | •              |               |               |               |                   |
| Restoration and Water Quality Improvement Projects | •            | •           |              |              | •              |               | •             |               | •                 |
| Regulations, Ordinances, and Guidelines            | •            | •           | •            | •            | •              | •             | •             | •             | •                 |
| Special Studies and Planning Efforts               | •            | •           | •            | •            | •              | •             | •             | •             | •                 |
| Education and Outreach                             | •            | •           | •            | •            | •              | •             | •             | •             | •                 |
| Stormwater Permit Program Implementation           | •            | •           | •            | •            | •              | •             |               |               |                   |
| Land Acquisition                                   | •            | •           |              | •            | •              |               |               |               | •                 |

### Urban Creeks (Hatchet, Hogtown, Tumblin, and Sweetwater)

*Impaired parameter: Fecal Coliform Bacteria*

#### What We Know

- Elevated coliform counts are regularly observed in all four creeks throughout the year.
- Relative to the state standard of 800 counts/100mL, Tumblin Creek exceeded the standard 75% of the time, Sweetwater 48%, Hatchet 47%, and Hogtown 89%.
- Sources of coliforms include failing septic tank systems, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste material, domestic pets, wildlife.
- Secondary growth within stormwater systems and in creek sediments may also contribute to persistent elevated coliform levels.

#### Completed and Planned Management Actions

- Sediment bacteria evaluation
- Septic tank system management
- Illicit connection elimination
- Municipal Separate Storm Sewer System permit compliance
- Wastewater system integrity testing, rehabilitation/repairs, & routine operations/maintenance
- Bacteria source tracking study
- Expanded monitoring
- Stream restoration and vegetative enhancements
- Sediment removal and control (e.g. inlet protection, Duck Pond CDS units, hydrodynamic separators)
- Optical brightener studies
- Stormwater parks (4)
- Public education and outreach, including use of community based social marketing principles

#### Potential Management Actions

- Septic tank system evaluation and maintenance, repair, or removal
- Assessments of sediment bacteria load

#### Management Action Highlight

- Based on the results of ambient fecal coliform monitoring, microbial source tracking , alternative bacteriological monitoring, and optical brighteners analyses, ten sites with consistently high levels of fecal coliforms were identified. Human markers were detected during source tracking at eight of these sites.
- FDEP, Alachua County Environmental Protection Department (ACEPD), Alachua County Health Department (ACHD), City of Gainesville Public Works Department (COGPWD), Florida Department of Transportation (FDOT) and Gainesville Regional Utilities (GRU) have joined efforts to evaluate and remediate coliform sources in these “hot spot” areas. Resources have been committed by each of these entities and preliminary monitoring is underway.
- The approach includes:
  - Performing initial confirmatory baseflow fecal coliform sampling;
  - Assessing existing programs and activities focused on reducing coliforms in the creeks and identifying areas needing improvement;
  - Mapping infrastructure components into a GIS format within specific study areas;

## Orange Creek Basin Draft BMAP

- Conducting coordinated field evaluations of public and private sanitary sewer lines (including connection and laterals), septic systems, and storm sewer lines;
- Repairing infrastructure as necessary; and
- Performing post evaluative sampling to document water quality improvements.
- This approach will be tested in a pilot area before expanding to the full list of “hot spots.” If the approach is not producing the intended results, the project partners will modify the project for the remaining areas of concern.

### Key Unknowns

- Extent to which regrowth of bacteria occurs in creek sediments
- Relative magnitude of urban campsites as a source of fecal coliforms
- Relative magnitude of wildlife as a source of fecal coliforms

### Alachua Sink

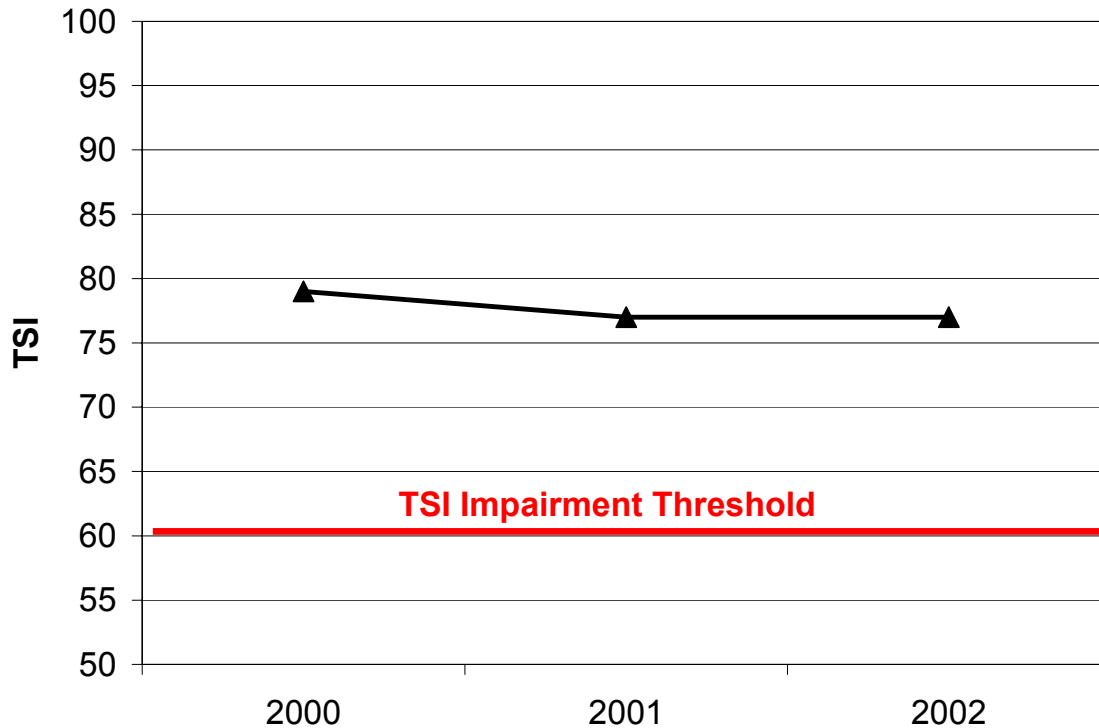
*Impaired parameter: TN*

### What We Know

- Alachua Sink (WBID 2720A) is located on the northern edge of Paynes Prairie, south of the city of Gainesville, and approximately 2.5 miles east of U. S. 441. It consists of a small lake, with a corresponding solution sink that recharges the Floridan aquifer.
- The surrounding drainage basin for Alachua Sink is approximately 2,758 acres. There are two well-defined inflows into Alachua Sink: Sweetwater Branch and a canal that connects Alachua Lake to Alachua Sink (a combined drainage area of 39,373 acres).
- Alachua Lake is the inundated portion of Paynes Prairie. Presumably, any runoff coming into Paynes Prairie that does not sink into the ground is incorporated into Alachua Lake and some portion is shunted to Alachua Sink during high-water conditions.
- Major sources of flow to Paynes Prairie include Bivens Arm, Prairie Creek (which connects the prairie to Newnans Lake), and Camps Canal.
- Based on long-term U. S. Geological Survey (USGS) flow measurements (1942–91), about 41% of the flow from Newnans Lake goes south into Paynes Prairie, and the rest flows towards Orange Lake by way of Camps Canal (Gottgens and Montague, 1988). The Alachua Sink waterbody has a outlet stream that discharges to the primary sinkhole.
- There are two point sources in the watershed: the Main Street Domestic Wastewater Reclamation Facility and the John R. Kelly Generating Station. The Main Street Water Reclamation Facility is an advanced secondary activated sludge domestic wastewater treatment facility that discharges treated wastewater to Sweetwater Branch. The John R. Kelly Generating Station discharges cooling tower and low-volume wastewater into Sweetwater Branch. Other discharges into Sweetwater Branch, and ultimately Alachua Sink, include stormwater from the eastern portions of Gainesville.
- Alachua Sink is verified as impaired for nutrients, based on TSI values well above the threshold of 60 (see Figure 1). Based on phytoplankton communities and the TN/TP ratio, Alachua Sink is considered nitrogen limited. Thus, the TMDL for Alachua Sink was expressed in terms of total nitrogen reductions to achieve water quality standards.

## Orange Creek Basin Draft BMAP

**Figure 1. Alachua Sink TSI Values, 2000-2002**



Source: Gao, et al., 2006. Nutrient TMDL for Alachua Sink. Table 1.

### What We Know

- TSI values in Alachua Lake have shown little seasonal or annual variation from 2000-2002. Average TSI during this time period was 78. Lakes with a TSI value above 60 are considered to have poor water quality.
- Hydrologic variation in Alachua Lake may affect TN and TP concentrations in the water column of Alachua Sink through oxidation of exposed sediment during periods of low water and resuspension of this material during high lake stage.
- Medium-density residential, forest, and water/wetland areas are the primary land use types in the full watershed (including Sweetwater and Alachua Lake watersheds). The land area that drains directly to Alachua Sink is 51% forest and 43% water/wetland.
- Significant land use changes and population growth are not anticipated in the Alachua Sink watershed in the next 5-10 years.

### Completed and Planned Management Actions

- Main Street Water Reclamation Facility upgrades to facilitate wastewater reuse
- Land acquisition

### Potential Management Actions

- Sweetwater Branch / Paynes Prairie Sheetflow Project

### Key Unknowns

- Detailed understanding of the Sink's hydrodynamics and response to nutrient inputs.

### Future Studies

## Orange Creek Basin Draft BMAP

- PLRG Studies: spatial nutrient loading dynamics, nitrogen fixation, and stormwater nutrient loading. This research will refine TN and TP source identification outlined in the TMDL. Specific research projects include a N-fixation study being conducted by SJRWMD on similar lakes in the region. Application of PLRG results in Newnans Lake would benefit nutrient levels in Alachua Sink because of the hydrologic connection through Paynes Prairie.

### Adequacy of Management Actions to Meet TMDL Reductions

- The Basin Working Group will work toward improvements in TSI values as a result of implementing management actions in the Alachua Sink watershed. At this time, it is expected that the Sweetwater Branch / Paynes Prairie Sheetflow project will meet the TN TMDL for Alachua Sink. However, confirmation of this expectation will require completion of project design and full implementation.

### Newnans Lake

*Impaired parameters: TN, TP*

### What We Know

- Newnans Lake has been hypereutrophic since at least 1999. The mean annual TSI for Newnans Lake from 1999-2003 was 93. Lakes with a TSI value above 60 are considered to have poor water quality.
- Newnans Lake has higher TN, TP, and chlorophyll-a concentrations than 75% of Central Valley region lakes.
- Water quality in Newnans Lake has shown a declining trend since 1969. Statistically significant decreases in secchi depth and increases in chlorophyll-a, TN, TP, and TSS have been observed since the late 1960s (late 1970s for TSS). Data for trend analysis prior to those time periods are unavailable.
- Tributary inflows from Hatchet and Little Hatchet Creeks are the next-largest source of TN and TP.
- Loading from onsite wastewater systems represents no more than 3% of the TN load.
- Blue-green algae are the dominant phytoplankton species in Newnans Lake (92%), at a biovolume consistently twice that of Orange and Lochloosa.
- A significant portion of the Newnans Lake watershed is commercial silviculture property. However, agriculture is a relatively minor source of nutrient to Newnans Lake, most of which is silviculture with limited acreage in other agricultural commodities. Thus, despite its prominence in acreage, silviculture land provides a very small portion of the overall nutrient load to Newnans Lake relative to the other land use types in the watershed.
- Most of the commercial silviculture acreage in the Newnans Lake watershed is managed by several large industrial silviculture operators. All of these large silviculture operators are participating in the Division of Forestry BMP implementation program.
- Significant land use changes are not anticipated in the Newnans lake watershed in the next 5-10 years.

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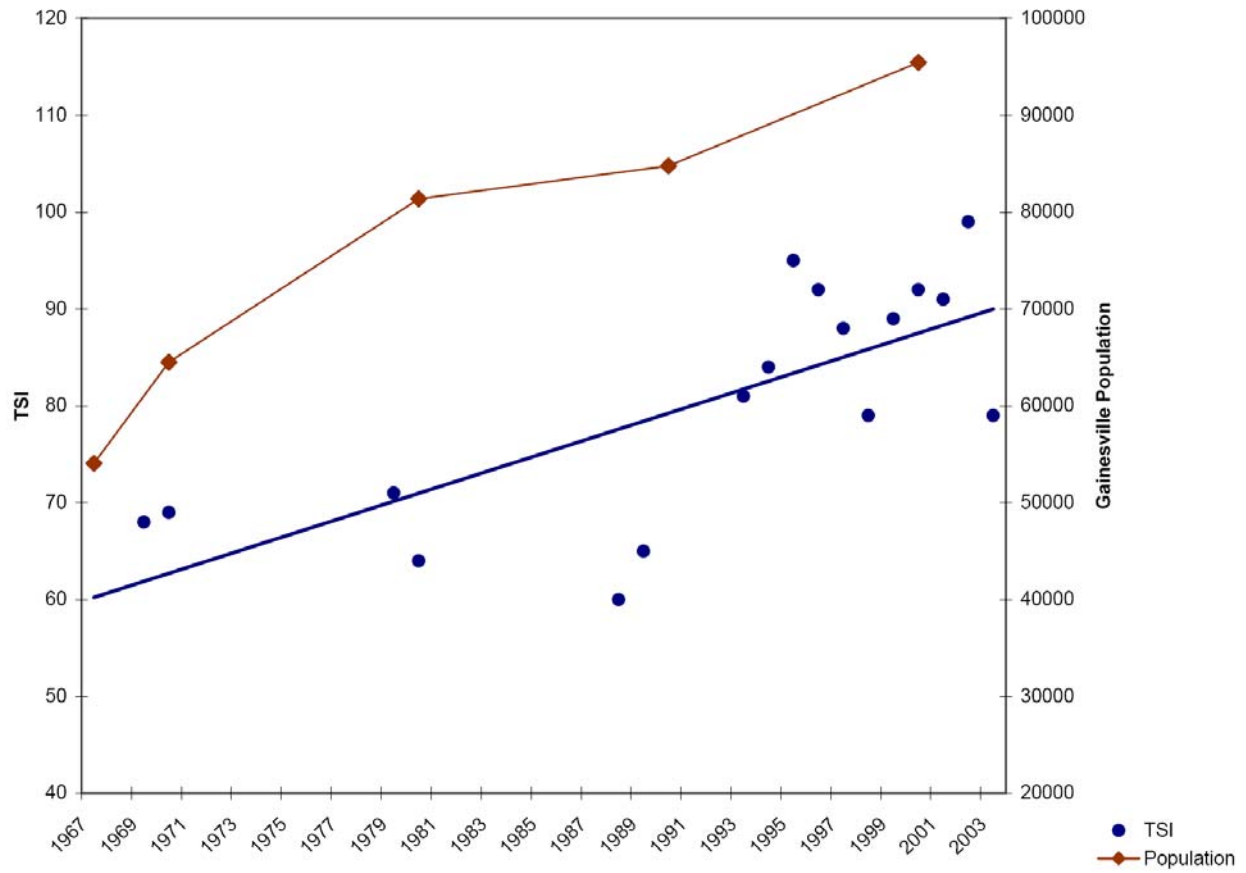


Figure 2: Newnans Lake Trophic State Index Trends, Relative to City of Gainesville Population

Source: Di, et al., 2006 (water quality); Hoge, Michael, pers. comm.. 2007 (population)

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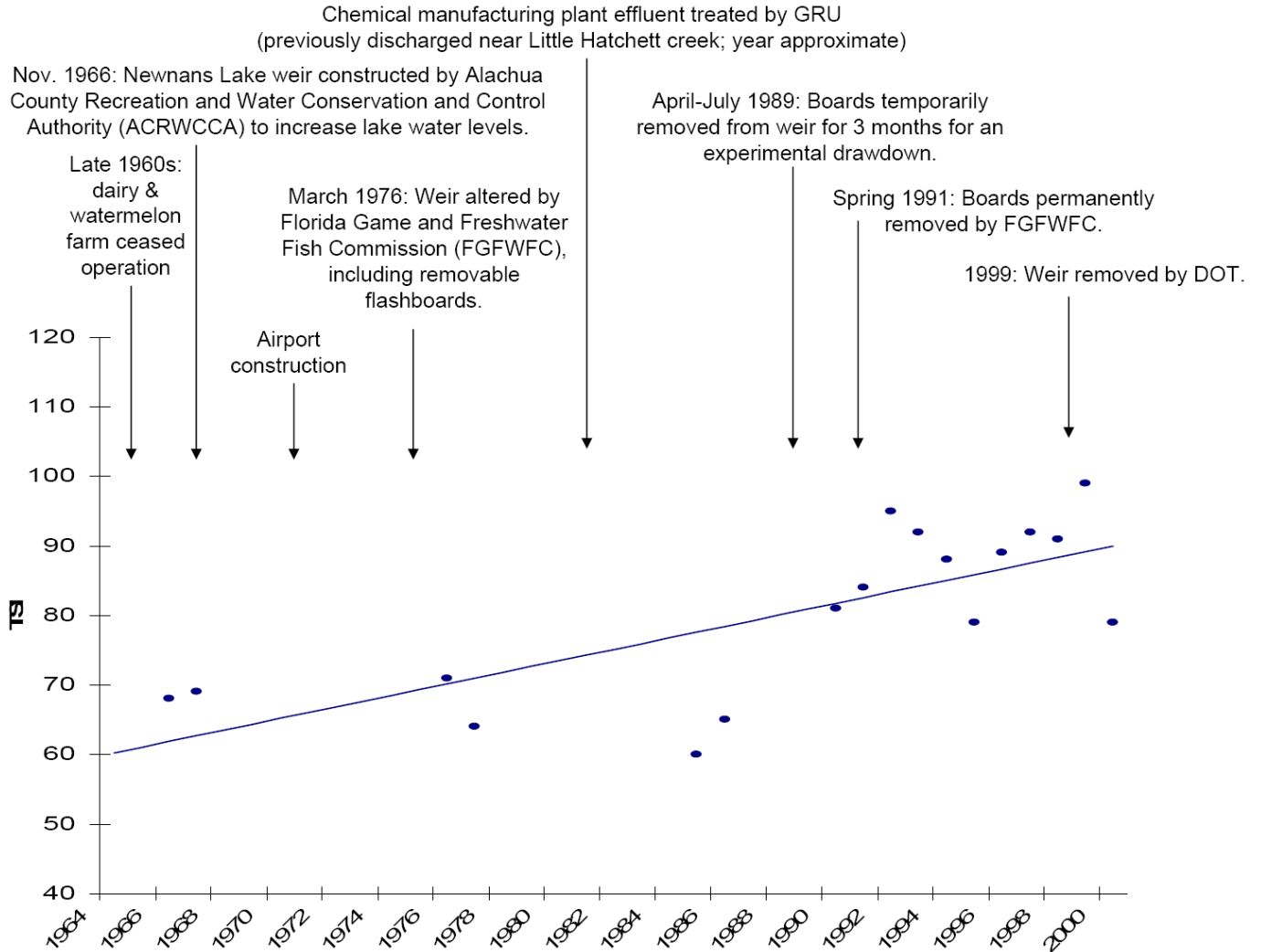


Figure 3: Historical Loading Sources and Hydrologic Modifications in Newnans Lake  
Note: Significant ditching also occurred during this time period.

Source: Orange Creek Basin Status and Trends Report, SJRWMD, 2006; Assessment of Pollution Sources in the Newnans Lake Watershed, Dyer, Riddle, Mills and Precourt, 2003.

### Completed and Planned Management Actions

- Land acquisition
- Silviculture and other agricultural BMP implementation, including 2004 fertilizer best management practices
- Additional outreach to small private forestry landowners for BMP implementation
- MS4 program
- Stormwater management improvements and studies
- DEP groundwater study
- Public education and outreach

### Potential Management Actions

- Brittany Estates Mobile Home Park wastewater upgrade

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- Implementation of a basin-wide shoreline buffer restoration program
- Restoration of disturbed wetlands
- Alachua County parks septic tank system upgrades
- Residential septic tank system inspections and upgrades

### Key Unknowns

- TN and TP nutrient load in lake sediment.
- Nitrogen fixation rates specific to Newnans Lake and relative magnitude of TN loading resulting from nitrogen fixation.
- Quantifiable load reductions from proposed management actions.
- Extent to which wildlife are a nutrient source.
- Effect of wetland alterations on water quality in Newnans Lake

### Future Studies

- PLRG Studies: spatial nutrient loading dynamics, nitrogen fixation, and stormwater nutrient loading. This research will refine TN and TP source identification outlined in the TMDL. Specific research projects include a N-fixation study being conducted by SJRWMD on similar lakes in the region.
- Internal recycling rates (i.e. TN and TP translocation between lake sediments and the water column). Internal recycling of nutrients stored in lake sediments was identified in the TMDL as the largest source of TN and TP loads (71.8% and 52.4%, respectively).
- Isotope study to investigate historic versus current loads, including which are industrial vs. domestic sources.
- Investigation of the effects of historic loads and hydrologic modifications on current water quality conditions.
- Investigation of shad harvesting as a nutrient management tool.
- Investigation of benefits that could be achieved through hydrologic restoration.

### Adequacy of Management Actions to Meet TMDL Reductions

The Basin Working Group will work toward improvements in TSI values as a result of implementing management actions in the Newnans Lake watershed. At this time, the degree of TSI improvement is difficult to predict, as insufficient data is available to quantify nutrient reductions. Project benefits will be evaluated through data collected during project implementation and application of the basin monitoring strategy. Future research that resolves current unknowns will allow for implementation of additional management actions with greater certainty regarding the anticipated outcome.

### Orange Lake

*Impaired parameter: TP*

### What We Know

- Orange Lake has been hypereutrophic since at least 1999, based on TN, chlorophyll-a, and secchi depth data. The mean annual TSI for Orange Lake from 1999-2003 was 77. Lakes with a TSI value above 60 are considered to have poor water quality.
- Orange Lake has higher TP and chlorophyll-a concentrations than 75% of Central Valley region lakes.
- Water quality in Orange Lake has shown a declining trend since 1985. Statistically significant decreases in secchi depth and increases in chlorophyll-a, TN, TP, TSS, and turbidity have been observed since 1985. Data for trend analysis prior to that date are unavailable.

## Orange Creek Basin Draft BMAP

- Orange Lake is unique in the dominance of agriculture as a TP source (21.5%). Loading from water and wetland areas as well as atmospheric deposition comprises 32% of the TP load into Orange Lake.
- Aquatic plant management may play a significant role in Orange Lake nutrient loading, translocation, and recycling.
- Blue-green algae are the dominant phytoplankton species in Orange Lake (87%).
- A large portion of the Orange Lake watershed is involved in commercial silviculture activity, with most of this acreage held by several large industrial silviculture operators. All of these large silviculture operators are participating in the Division of Forestry BMP implementation program mentioned above for Newnans Lake.
- Significant land use changes are not anticipated in the Orange Lake watershed in the next 5-10 years, with the exception of some condominium development and associated land clearing and septic tank system installation on the west side of the lake.

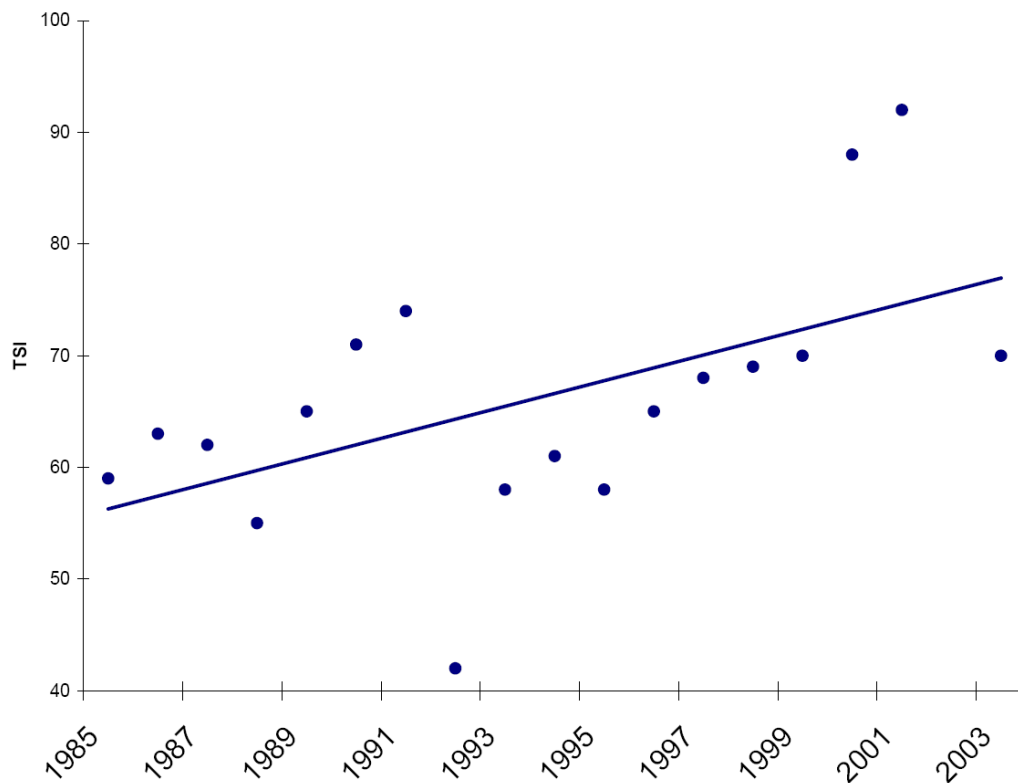
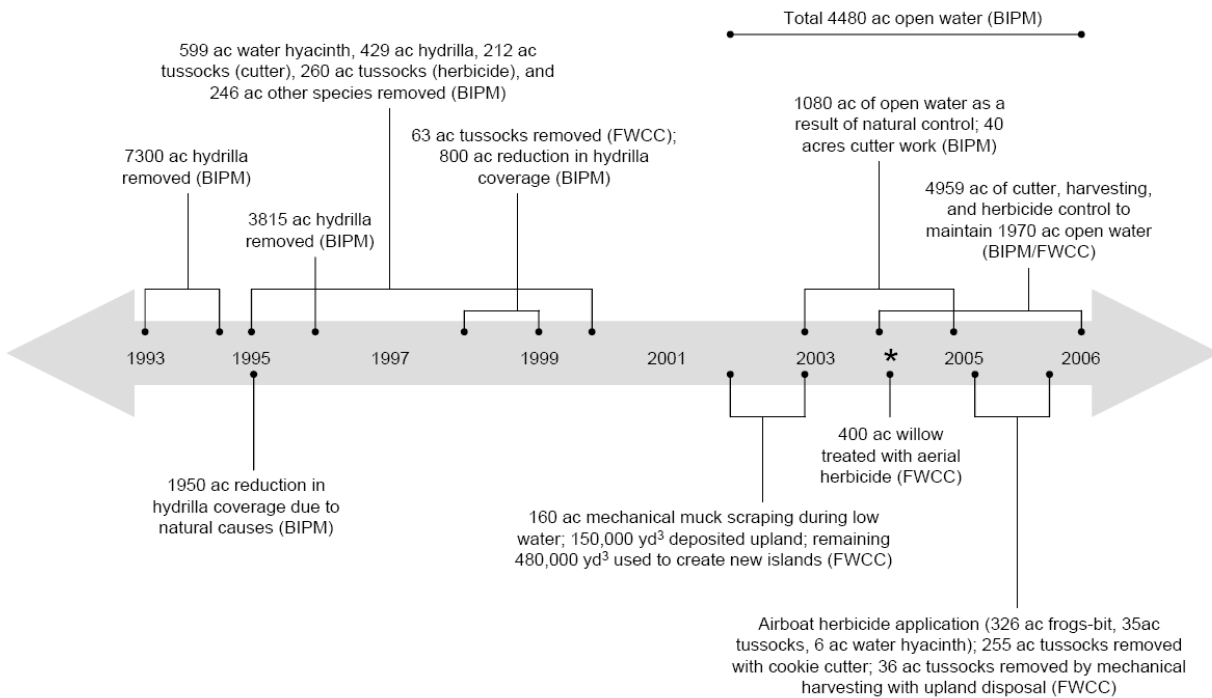


Figure 4: Orange Lake Trophic State Index Trend: 1985-2003  
Source: Di, et al., 2006

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★ 1500 acres new open water as a result of storms (BIPM)

BIPM = Department of Environmental Protection Bureau of Invasive Plant Management  
FWCC = Fish and Wildlife Conservation Commission

Figure 5: Aquatic Plant Management Activity Summary for Orange Lake

Source: Orange Creek Basin Working Group members

### Completed and Planned Management Actions

- Land acquisition
- Silviculture and other agricultural BMP implementation
- Additional outreach to small private forestry landowners for BMP implementation
- MS4 program
- DOT stormwater management improvements
- Marion County clean farms initiative
- Public education and outreach
- Better coordination of sampling and aquatic plant management activities to ensure that samples truly reflect ambient conditions

### Potential Management Actions

- Implementation of a basin-wide shoreline buffer restoration program
- Restoration of disturbed wetlands

### Key Unknowns

- Significant external loads of TN and TP remain to be identified.
- TN and TP nutrient load in lake sediment.
- Internal recycling rates (i.e. TN and TP translocation between lake sediments and the water column).

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- The effect of aquatic plant management activities on nutrient loading, translocation, and recycling.
- Nitrogen fixation rates specific to Orange Lake and relative magnitude of TN loading resulting from nitrogen fixation
- Quantifiable load reductions from proposed management actions
- Extent to which wildlife are a nutrient source
- Significance of Camps Canal to TP loads in Orange Lake (Camps Canal was identified as the most significant TP source in the TMDL)
- Benefits of upstream lake restoration

### Future Studies

- PLRG Studies: spatial nutrient loading dynamics, nitrogen fixation, and stormwater nutrient loading. This research will refine TN and TP source identification outlined in the TMDL. Specific research projects include a N-fixation study being conducted by SJRWMD on similar lakes in the region.
- Internal recycling rates (i.e. TN and TP translocation between lake sediments and the water column) and sediment flux.
- Much of the future research and studies for Newnans Lake will also be applicable to Orange.
- Literature review to document the benefits of aquatic plant management, including options for improving management strategies to promote natural lake functions.

### Anticipated Results of Management Actions

The Basin Working Group will work toward improvements in TSI values as a result of implementing management actions in the Orange Lake watershed. At this time, the degree of TSI improvement is difficult to predict, as insufficient data is available to quantify nutrient reductions. Project benefits will be evaluated through data collected during project implementation and application of the basin monitoring strategy

### Lake Wauberg

*Impaired parameters: TN & TP*

#### What We Know

- Lake Wauberg has been hypereutrophic since at least 1990, based on TN, TP, and chlorophyll-a data.
- From 1990-2000, water quality has been consistently poor, as indicated by a mean annual TSI of 72.3 during this time period. Lakes with a TSI value above 60 are considered to have poor water quality.

#### Completed and Planned Management Actions

- Septic tank system evaluation and repairs at private residences and University of Florida recreation area.

#### Potential Management Actions

- Expansion of the septic tank system evaluation and repairs

### Lake Lochloosa

*Impaired parameters: TN & TP*

#### What We Know

## Orange Creek Basin Draft BMAP

- Lake Lochloosa has been hypereutrophic since at least 1999, based on TN, chlorophyll a, and secchi depth data, with an average TSI of 85 (1999-2003).
- Lake Lochloosa has higher TN concentrations than 75% of Central Valley region lakes.
- Water quality in Lochloosa degraded from 1986-2000, as evidenced by increasing TSI values (see Figure 6).
- Water quality improvements have been observed in recent years, reflected in the downward TSI trend observed from 2000-2003 (see Figure 6).

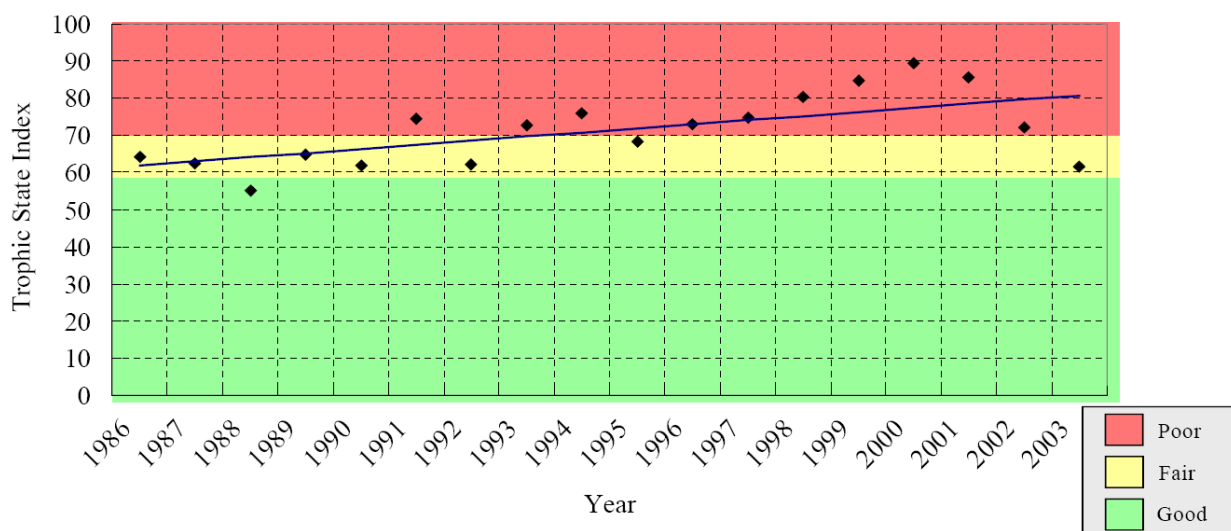


Figure 6: Lake Lochloosa Trophic State Index Trend: 1986-2003

Source: Di, et al., 2006

### Key Unknowns

- The extent to which the herbicide treatment benefited water quality has not been evaluated in detail.
- Data collected for TMDL purposes included a period when the Lake was herbicided and transformed from a macrophyte-dominated system to a more open-water system (1995-2001). There is a possibility that the lake may return to a more natural state without the reductions from anthropogenic sources,

Based on these two key unknowns, DEP elected to re-evaluate the status of the lake in the next watershed cycle and did not adopt a nutrient TMDL for Lake Lochloosa. As such, this Lake is only addressed briefly in this BMAP.

### Completed and Planned Management Actions

- Data collection on Lake Lochloosa will continue to allow for continued evaluation of water quality trends.
- Water quality conditions in Lake Lochloosa will be reevaluated in the next TMDL cycle.
- A number of land acquisition projects have occurred that will help maintain natural land cover and promote healthy water quality conditions (e.g. Lochloosa Wildlife Conservation Area).

### Anticipated Outcomes of BMAP Implementation

As a result of this BMAP, stakeholders expect the following outcomes:

- Enhanced understanding of Basin hydrology, water quality, and pollutant sources;

## **Orange Creek Basin Draft BMAP**

- The ability to systematically identify and evaluate management actions and predict their benefits;
- Improving water quality trends in both urban creeks and rural lakes;
- Decreased loading of TMDL target pollutants; and
- Enhanced public awareness of pollutant sources, impacts, and management actions.

### **BMAP Cost and Timeframe**

The management actions (completed, ongoing, and planned) identified in the BMAP are estimated to cost a total of more than \$\_\_\_\_\_ million. Funding sources range from local stormwater fees to regional and state cost-share grants. BWG members will be exploring new opportunities for funding assistance as they become available to meet the TMDLs in a reasonable time frame and an economically feasible manner.

### **BMAP Follow-up**

The BWG will track its implementation efforts and monitor water quality in the TMDL waterbodies (through existing water quality monitoring programs), to ensure that the BMAP is carried out and to measure its effectiveness. The BWG will meet periodically (approximately every six months) to discuss implementation issues, consider new information, and determine what other management actions are needed for the waterbodies not projected to meet their TMDLs.

**ORDER ADOPTING THE ORANGE CREEK BASIN MANAGEMENT  
ACTION PLAN**

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**TO BE DEVELOPED**

## CHAPTER 1: CONTEXT, PURPOSE, AND SCOPE OF THE PLAN

### 1.1 WATER QUALITY RESTORATION FRAMEWORK

#### 1.1.1 Water Quality Standards

Florida's water quality standards are designed to ensure that our waters can be used for their designated purposes, such as drinking water, recreation, and agriculture. Currently, most surface waters in Florida are categorized as Class III waters, which means they must be suitable for recreation and must support the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. Other designated use categories are shown in **Table 2**.

Under section 303(d) of the federal Clean Water Act, every two years each state must identify its "potentially impaired" waters, including estuaries, lakes, rivers, and streams, that do not meet their designated uses and are not expected to improve within the subsequent two years. The Florida Department of Environmental Protection (DEP) is responsible for developing this "303(d) list" of impaired waters.

**TABLE 2: DESIGNATED USE ATTAINMENT CATEGORIES FOR FLORIDA SURFACE WATERS**

| CATEGORY          | DESCRIPTION                                                                                         |
|-------------------|-----------------------------------------------------------------------------------------------------|
| <b>CLASS I *</b>  | POTABLE WATER SUPPLIES                                                                              |
| <b>CLASS II *</b> | SHELLFISH PROPAGATION OR HARVESTING                                                                 |
| <b>CLASS III</b>  | RECREATION, PROPAGATION AND MAINTENANCE OF A HEALTHY, WELL-BALANCED POPULATION OF FISH AND WILDLIFE |
| <b>CLASS IV</b>   | AGRICULTURAL WATER SUPPLIES                                                                         |
| <b>CLASS V</b>    | NAVIGATION, UTILITY, AND INDUSTRIAL USE ( <i>no current Class V designations</i> )                  |

\* *Class I and II waters include the uses of the classifications below them.*

#### 1.1.2 Verified Impairments and Total Maximum Daily Loads

Florida's 303(d) list identifies hundreds of water segments that fall short of water quality standards. The three most common water quality concerns are coliforms, nutrients, and oxygen demanding substances. These listed water segments are candidates for more detailed assessments of water quality to determine whether they are impaired according to state statutory and rule criteria. Waterbodies that are potentially impaired are identified on the DEP's Planning List (Table 3). Based on this Planning List, further water quality sampling occurs to verify these impairments. Using this data, waterbodies on the Planning List are evaluated to identify the subset that are impaired for individual water quality parameters. This Verified List of Impaired Waters identifies those waterbodies for which DEP will develop and adopt **Total Maximum Daily Loads** (TMDLs; Table 5) and the schedule on which TMDLs will be developed.

A **TMDL** is the maximum amount of a specific pollutant that a waterbody can assimilate while maintaining its designated uses.

The water quality evaluation and decision processes for listing impaired waters and establishing TMDLs are authorized by s. 403.067, Florida Statutes (the Florida Watershed Restoration Act), and contained in Florida's Identification of Impaired Surface Waters Rule, Chapter 62-303, Florida Administrative Code.

TMDLs are developed and implemented as part of a watershed management cycle, based on the state's fifty-two river basins. This approach uses a schedule that rotates through the

## Orange Creek Basin Draft BMAP

river basins over a five-year repeated cycle (see **Appendix A**) to evaluate waters, determine impairments, and develop and implement management strategies to restore impaired waters to their designated uses. The five phases of the watershed management cycle are summarized below in **Table 2**. Development of this BMAP constitutes completion of Phase 4. Phase 5, implementation, has already begun for a number of the projects outlined in this BMAP. As a Group 1 basin, the Orange Creek basin will return to Phase 1 during 2008 as the second 5-year cycle begins.

**Table 3. Orange Creek Basin Planning List Waterbodies**

| <b>WBID</b> | <b>Water Segment Name</b> | <b>Planning List Parameter</b> |
|-------------|---------------------------|--------------------------------|
| 2688        | HATCHET CREEK             | DISSOLVED OXYGEN               |
| 2688        | HATCHET CREEK             | LEAD                           |
| 2696        | POSSUM CREEK              | FECAL COLIFORMS                |
| 2698        | HOGTOWN CREEK             | TOTAL COLIFORMS *              |
| 2698        | HOGTOWN CREEK             | NUTRIENTS                      |
| 2705        | NEWNANS LAKE OUTLET       | TURBIDITY                      |
| 2705        | NEWNANS LAKE OUTLET       | UN-IONIZED NH <sub>3</sub>     |
| 2711        | SWEETWATER BRANCH         | TOTAL COLIFORMS *              |
| 2711        | SWEETWATER BRANCH         | NUTRIENTS                      |
| 2717        | KANAPAHA LAKE             | NUTRIENTS                      |
| 2720        | ALACHUA SINK OUTLET       | NUTRIENTS (TSI)                |
| 2747        | ORANGE CREEK              | LEAD                           |
| 2747        | ORANGE CREEK              | SILVER                         |
| 2749        | ORANGE LAKE REACH         | NUTRIENTS (TSI)                |
| 2749        | ORANGE LAKE REACH         | DISSOLVED OXYGEN               |
| 2754        | CROSS CREEK               | TSS                            |
| 2754        | CROSS CREEK               | BOD                            |
| 2705A       | PRAIRIE CREEK             | TURBIDITY                      |
| 2705B       | NEWNANS LAKE              | TURBIDITY                      |
| 2705B       | NEWNANS LAKE              | UN-IONIZED NH <sub>3</sub>     |
| 2713D       | LITTLE ORANGE LAKE        | NUTRIENTS (TSI)                |
| 2718A       | TUMBLIN CREEK             | DISSOLVED OXYGEN               |
| 2718A       | TUMBLIN CREEK             | BOD                            |
| 2738A       | LOCHLOOSA LAKE            | SELENIUM                       |
| 2749A       | ORANGE LAKE               | LEAD                           |
| 2749A       | ORANGE LAKE               | MERCURY IN FISH                |
| 2749A       | ORANGE LAKE               | SILVER                         |

\* Total coliforms were removed from state water quality standards after development of the Orange Creek Basin planning list.

## Orange Creek Basin Draft BMAP

**TABLE 4. PHASES OF THE WATERSHED MANAGEMENT CYCLE**

|                |                                                                         |
|----------------|-------------------------------------------------------------------------|
| <b>PHASE 1</b> | Preliminary Evaluation of Water Quality                                 |
| <b>PHASE 2</b> | Strategic Monitoring and Assessment to Verify Water Quality Impairments |
| <b>PHASE 3</b> | Development and Adoption of TMDLs for Waters Verified as Impaired       |
| <b>PHASE 4</b> | Development of Management Actions to Achieve the TMDL                   |
| <b>PHASE 5</b> | Implementation of TMDL(s), including monitoring and assessment          |

### 1.1.3 Impaired Waters and TMDLs in the Orange Creek Basin

All surface waters (including wetlands) in the Orange Creek Basin are designated as Class III waters in accordance with Rule 62-302, F.A.C. The Class III designation includes aquatic life use support, primary contact and recreation, and protection of human health. Within the Orange Creek Basin, nine waterbodies do not meet their designated uses and have been verified by DEP as impaired. For eight of the impaired waterbodies, the Department has determined the pollutant levels (TMDLs) that each can receive and still maintain its Class III designated use. Corresponding pollutant reductions needed to achieve the TMDLs have been developed.

In the intervening time period between TMDL development and BMAP development in the Orange Creek Basin, total coliform bacteria were removed from Florida's water quality standards (Environmental Regulation Commission meeting September 28, 2006). As such, total coliform TMDLs adopted in the Orange Creek Basin are no longer considered binding on stakeholders. From a practical perspective, management actions identified to decrease fecal coliform levels (Chapter 5) will also decrease total coliform levels. Fecal coliform management actions are also assumed to decrease nutrient inputs. This is a key assumption for management in the Hatchet Creek Subbasin. Hatchet Creek is verified as impaired for iron and total coliforms, not fecal coliforms. However, because Hatchet is a significant source of nutrient loading into Newnans Lake, coliform management actions will continue to be implemented in the Hatchet Creek Subbasin based on the assumption that management to decrease coliform levels in this subbasin will help achieve the Newnans Lake nutrient TMDL.

## 1.2 TMDL IMPLEMENTATION

Rule-adopted TMDLs may be implemented through basin management action plans (BMAPs), which contain actions to reduce and prevent pollutant discharges through various cost-effective means. During Phase 4 of the TMDL process, BMAPs or other implementation approaches are developed jointly by the Department of Environmental Protection (DEP, or the Department) and the affected stakeholders in the various basins. A basin may have more than one BMAP, based on practical considerations. The Florida Watershed Restoration Act (section 403.067, Florida Statutes) contains provisions that guide the development of BMAPs and other TMDL implementation approaches. **Appendix B** includes a summary of the statutory provisions related to BMAP development.

Stakeholder involvement is critical to the success of the TMDL program, and varies with each phase of implementation to achieve different purposes. The BMAP development process is structured to achieve cooperation and consensus among a broad range of interested parties. Pursuant to statute, DEP invites stakeholders to participate in the BMAP development process, and encourages public participation to the greatest practicable extent. DEP must hold at least one noticed public meeting in the basin to discuss and receive comments during the planning process. Stakeholder involvement is essential to develop, gain support for, and secure commitments to implement the BMAP.

### 1.3 THE ORANGE CREEK BASIN MANAGEMENT ACTION PLAN

#### 1.3.1 STAKEHOLDER INVOLVEMENT

Orange Creek Basin stakeholders chose unanimously to establish one Basin Working Group (BWG), with the option of creating small working groups to address specific concerns or issues. Members of the BWG comprise these subgroups, which meet separately from the BWG. These working groups present their findings to the BWG for consideration and consensus decision-making. This process generated one BMAP that addresses the current TMDLs in the Orange Creek Basin.

The BWG, comprised of stakeholder members representing a variety of entities, used a consensus-based collaborative approach when making decisions regarding the content of the BMAP. It was necessary to define what constitutes a consensus agreement for the BWG, short of unanimous agreement. However, the BWG concluded that accepting a proposal without full unanimity would be a default position, when necessary to move the process forward and to complete development of the BMAP on schedule. The BWG agreed to make every effort to develop proposals that all members could support. A discussion of the Orange Creek BWG organizational structure, process, membership, and citizen involvement efforts is in **Appendix C**.

With rare exception, the BWG met monthly from January 2005 until BMAP adoption. An additional broad stakeholder meeting was held on \_\_\_\_\_. All BWG and stakeholder meetings were held within the Basin and were open to the public.

***The Mission of the Orange Creek Basin TMDL Working Group is to develop a Basin Management Action Plan for the Orange Creek Basin based on consensus decision-making, using best available science.***

#### 1.3.2 PLAN PURPOSE

The purpose of this plan is to identify cost-effective projects and activities that contribute toward achieving DEP-adopted Total Maximum Daily Loads in the Orange Creek Basin, for the following waterbodies:

- Newnans Lake
- Orange Lake
- Lake Wauberg
- Alachua Sink
- Hatchet Creek
- Hogtown Creek
- Tumblin Creek
- Sweetwater Branch

The BMAP also serves to document the BWG's support of the management actions contained in it, and their intention to implement these actions equitably among responsible stakeholders in reasonable timeframes, contingent on available funding and acquisition of necessary approvals and permits.

The Basin Working Group agreed that development of the BMAP should:

- Involve the community and specific entities.
- Help develop a shared understanding of different points of view.
- Be within the context of the DEP five-year cycle
- Utilize adaptive management principles.
- Focus on achieving the TMDL load reductions.

## Orange Creek Basin Draft BMAP

### 1.3.3 PLAN SCOPE

The Orange Creek Basin Management Action Plan area is defined as the portion of the basin encompassing the eight subbasins within which TMDLs have been adopted by DEP: Newnans Lake, Orange Lake, Lake Wauberg, Alachua Sink, Hatchet Creek, Hogtown creek, Tumbler Creek, and Sweetwater Branch. The BMAP area is located entirely within Alachua and Marion Counties.

The Orange Creek Basin Management Action Plan addresses TMDLs adopted by DEP. The TMDL parameters in this Basin are nutrients, coliforms, and iron. Although other important water quality issues exist in the basin, they are beyond the scope of this BMAP (see Table 12). This was a conscious decision by the BWG in order to focus on a critical aspect of water quality in the basin (pollutant loadings), expedite plan development and implementation, and remain consistent with F.S. 403.067. It is anticipated that other water quality issues may benefit from the actions included in this BMAP. Despite the fact that four of the TMDL waters have nutrient TMDLs, while the other four have coliform TMDLs (and one iron TMDL), the BWG decided to create only one BMAP addressing the lake, creek, and Alachua Sink TMDLs in the Orange Creek Basin.

### 1.3.4 GEOGRAPHIC AREA

The Orange Creek Basin drainage area covers approximately 602 square miles and is located in central and eastern Alachua County, northern Marion County, and southwestern Putnam County (see **Figure 7**). The Basin is divided into six major subbasins: Hogtown Creek (*includes Tumbler Creek*), Payne's Prairie (*includes Lake Wauberg, Alachua Sink, and Sweetwater Branch*), Newnans Lake (*includes Hatchet Creek*), Lochloosa Lake, Orange Lake, and Orange Creek. The Hogtown Creek and Payne's Prairie watersheds receive the most urban drainage. The Lochloosa Lake and Orange Lake watersheds are largely rural. Each subbasin has unique issues influencing water quality, including the degree of existing and anticipated development, the number and type of sources, and geographic considerations.

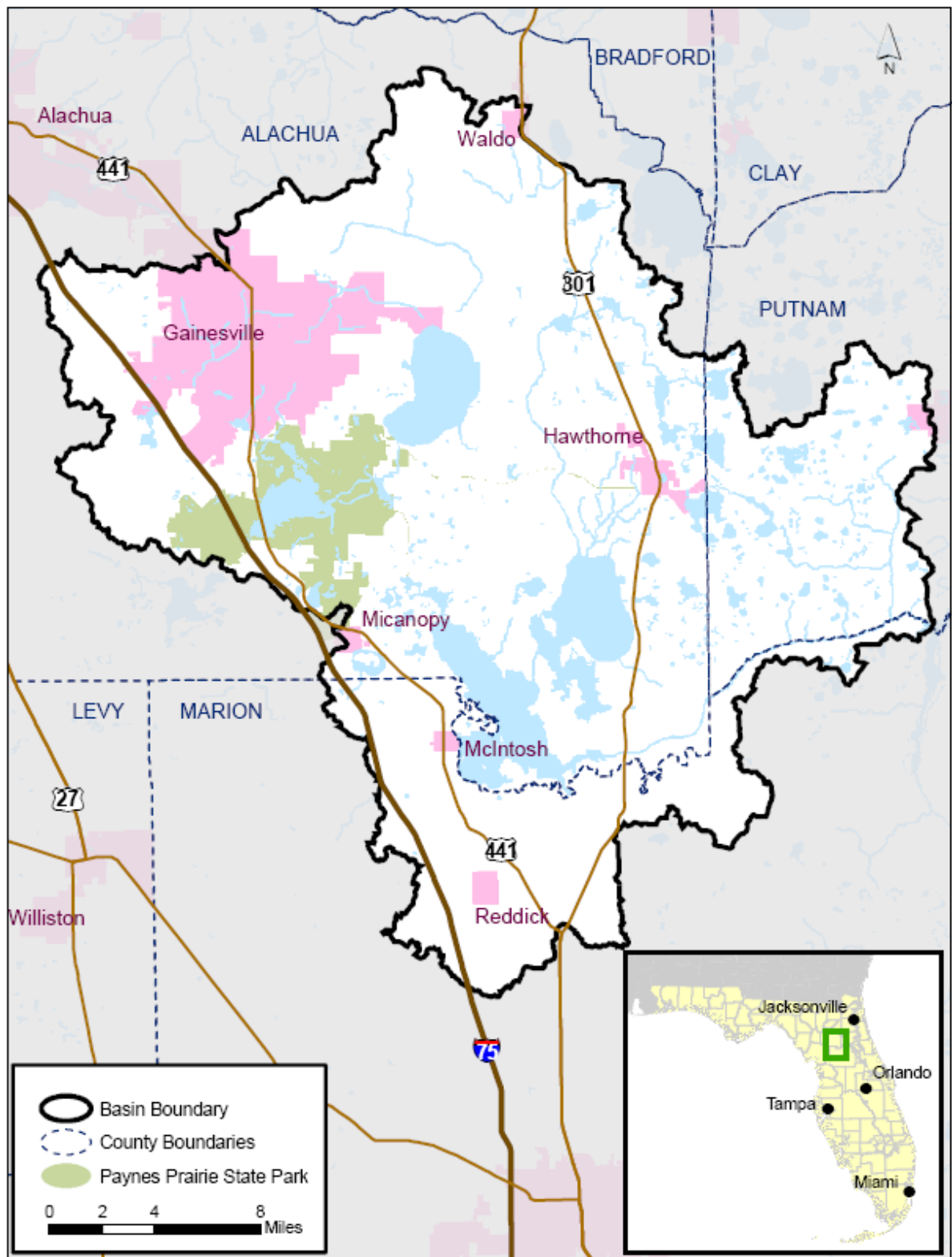
The subbasins identified above encompass nine impaired waterbodies, eight of which have DEP-adopted TMDLs (see Figure 10). DEP adopted or proposed TMDLs in 2003 for waterbodies within the Hogtown Creek, Payne's Prairie, Newnans Lake, Lochloosa Lake, and Orange Lake watersheds, representing approximately 471 square miles of the Orange Creek Basin. The Department and local partners are currently collecting data to further analyze the water quality impairments within the Basin.

### 1.3.5 Jurisdictions and Regulatory Responsibilities

The largest municipality in the Orange Creek Basin is Gainesville. The Urban Area of Gainesville as determined by the 2001 Census is 77.3 sq miles and situated virtually centered within Alachua County, Florida. The incorporated City of Gainesville city limits compose of 70% of the urban area. Most of the urban area lies within, and to the west of the City of Gainesville limits. The center of the Urban Area is at approximately 29°39'44" N and 82°22'26" W. A map of the Gainesville Urban Area is shown in Figure 8.

## Orange Creek Basin Draft BMAP

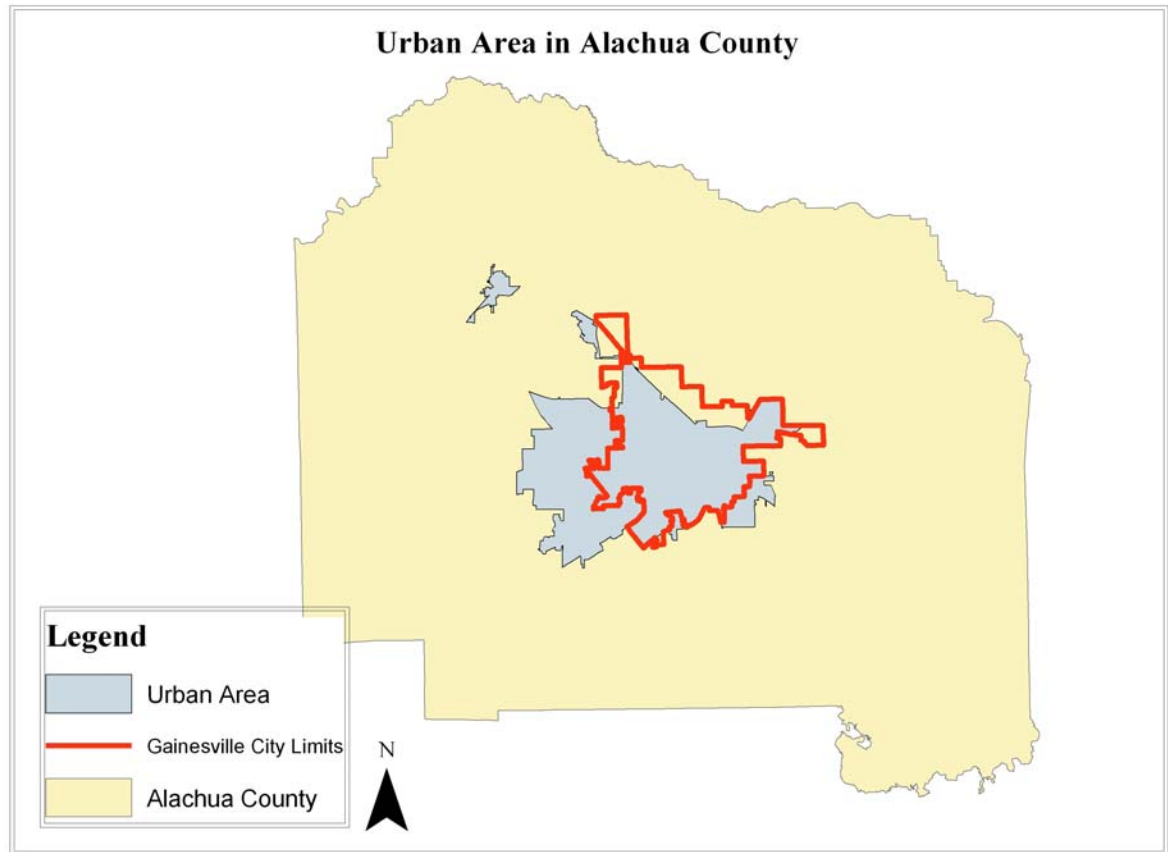
Figure 7. Orange Creek Basin Location



Source: Florida Department of Environmental Protection, Watershed Planning and Coordination Section, 2007.

## Orange Creek Basin Draft BMAP

**Figure 8. Gainesville Urban Area**

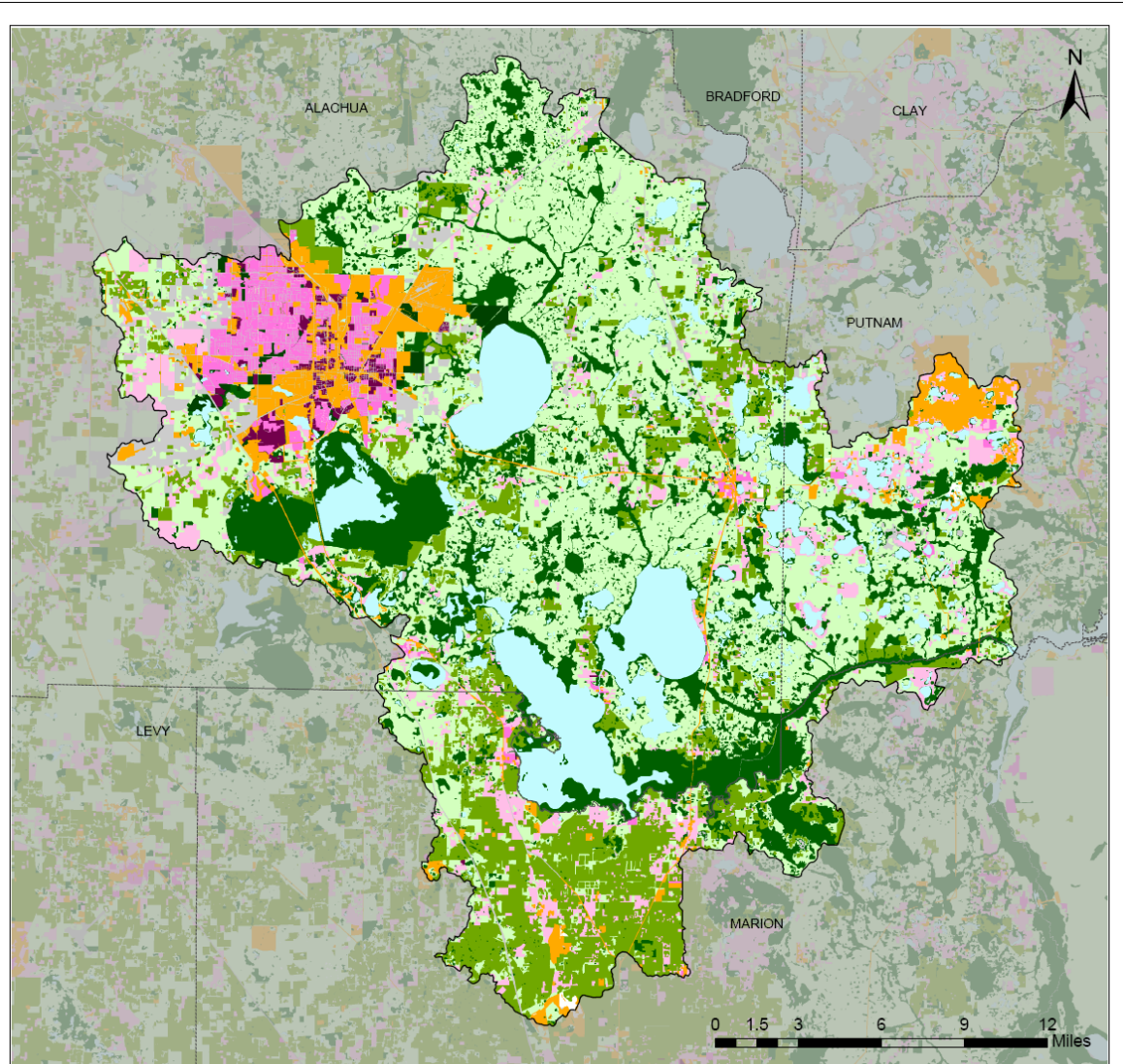


The towns of Micanopy, McIntosh, Reddick, and Hawthorne are also located within the Basin. Remaining portions of Alachua and Marion Counties are largely rural in character. Agriculture, silviculture, and low density residential land uses are most common.

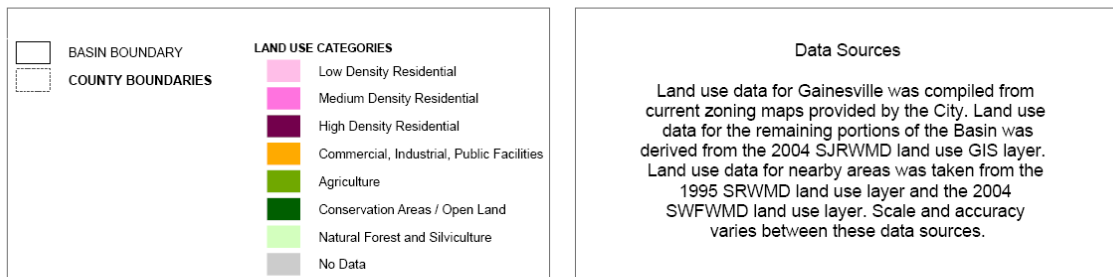
The portion of the BMAP area that lies within Alachua and Putnam Counties are covered by the Northeast DEP District Office. The BMAP area that lies within Marion County is covered by the Central DEP District Office. Most of the BMAP area lies within the St. Johns River Water Management District, but small portions in the northwestern and southwestern areas of the basin lie within the Suwannee River Water Management District and Southwest Florida Water Management District, respectively. The City of Gainesville, Alachua County, and Marion County are also considered Phase II Municipal Separate Stormwater System (MS4) permittees (see Section 3.4 for details and information on other MS4 permittees in the Basin).

## Orange Creek Basin Draft BMAP

FIGURE 9. Land Use in the Orange Creek Basin



### Orange Creek Basin Current Land Use

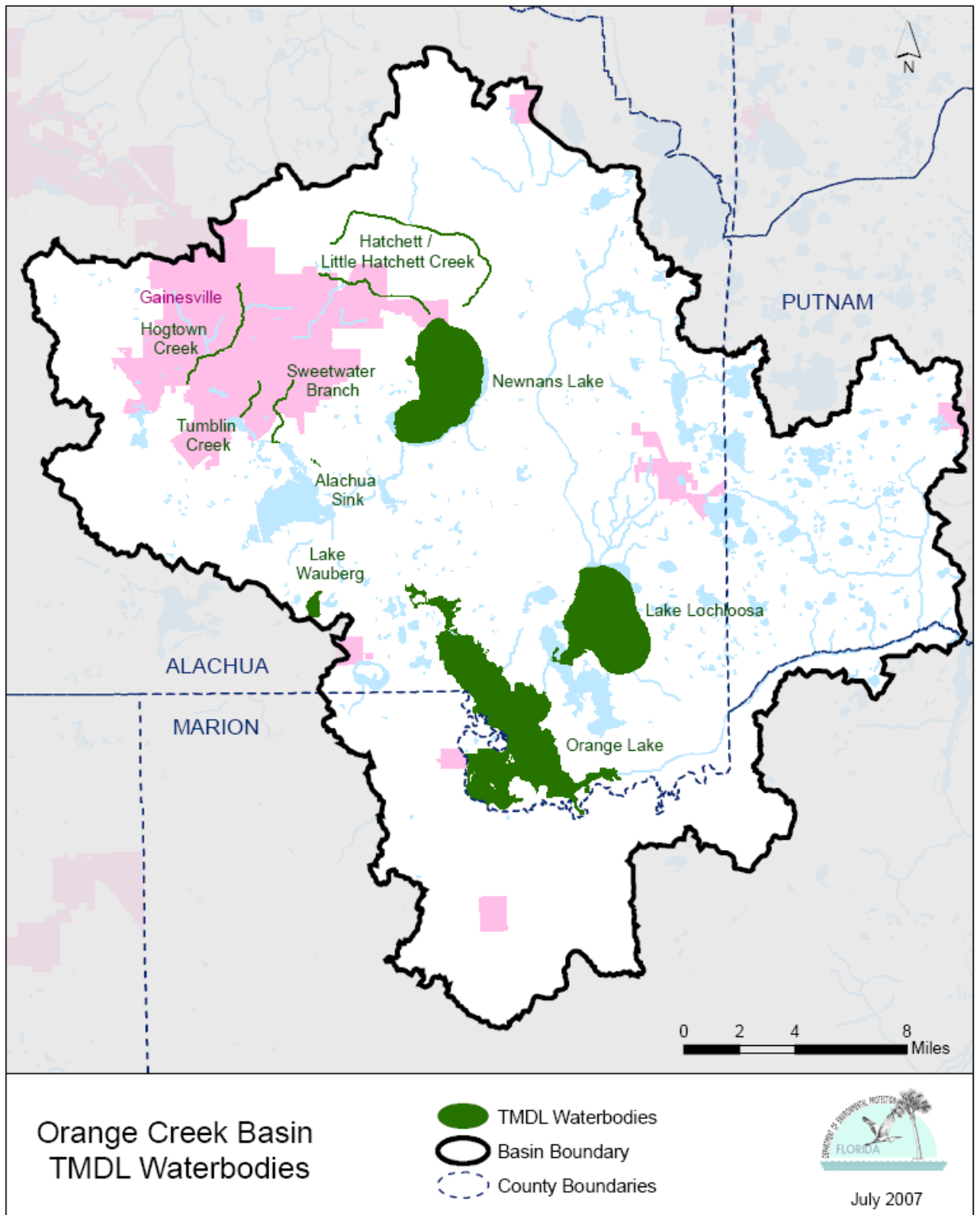


Map prepared July 17, 2008, by the Division of Water Resource Management. This map is not intended for delineations or analysis of the features shown. For more information, contact Jennifer Gihring at 850-245-8418 or Jennifer.Gihring@dep.state.fl.us



## Orange Creek Basin Draft BMAP

**FIGURE 10. Orange Creek Basin Management Action Plan Area and TMDL Waterbodies**



## Orange Creek Basin Draft BMAP

### 1.3.6 TMDLS WITHIN THE ORANGE CREEK BASIN

**Table 5** shows the TMDLs the Department has established for impaired waters in the Orange Creek Basin, with more detailed information in **Appendix C**.

DEP did not adopt a TMDL for Lake Lochloosa based on the following considerations:

- The relationship between the measured data and the empirical modeling was weak, due in large part to the data being collected during a period when the Lake was herbicided and transformed from a macrophyte-dominated system to a more open-water system.
- There is a possibility that the lake may return to a more natural state without the reductions from anthropogenic sources, therefore, DEP elected to re-evaluate the status of the lake in the next watershed cycle.

A TMDL was also adopted for Alachua Sink (WBID 2720A). This TMDL requires a 45% reduction in total nitrogen load to the sink.

**Figure 10** presents a map of impaired waters in the Orange Creek Basin where TMDLs have been adopted. **Figure 11** identifies the subbasins associated with these impaired waters. The Department and local partners continue to collect data to further analyze Planning List waterbodies in the Basin.

### 1.3.7 POLLUTANT ALLOCATIONS

#### ▪ Categories for Rule Allocations

The rules adopting TMDLs must establish reasonable and equitable allocations that will alone, or in conjunction with other management and restoration activities, attain the TMDL (403.067 F.S.). Allocations may be to individual sources, source categories, or basins that discharge to the impaired waterbody. The allocations in rule identify either how much pollutant discharge in pounds per year (lbs/yr) each source designation may continue to contribute (**discharge allocation**), or the lbs/yr or percent of its loading the source designation must reduce (**reduction allocation**). Currently, the TMDL allocation categories are as follows:

- o **Wasteload Allocation** - The allocation to point sources permitted under the National Pollutant Discharge Elimination System (NPDES) Program, which includes:
  - **Wastewater Allocation** – Allocation to industrial and domestic wastewater facilities.
  - **NPDES Stormwater Allocation** – Allocation to NPDES stormwater permittees that operate municipal separate storm sewer systems (MS4s) – see the discussion on MS4s in Section \_\_\_\_\_. These permittees are treated as point sources under the TMDL Program.
- o **Load Allocation** - The allocation to nonpoint sources, which includes agricultural runoff and stormwater from areas that are not covered by an MS4.

**Table 5** lists the pollutant load allocations adopted by rule for each of the Orange Creek Basin waterbodies with a TMDL. In Hatchet Creek, the NPDES stormwater allocation is a 30.8 percent reduction in loading (reduction allocation). The allocations for Alachua Sink include a 41,003 lbs/yr NPDES wastewater discharge allocation, and a 45 percent NPDES stormwater reduction allocation. Whether an

## Orange Creek Basin Draft BMAP

allocation is expressed as a needed reduction or an allowable discharge, the result is the same. The source must limit the amount of discharge for which it is responsible.

Under the Florida Watershed Restoration Act (FWRA), the TMDL allocation may be an “initial” allocation among point and nonpoint sources. In such cases, the “detailed” allocation to specific point sources and specific categories of nonpoint sources may be established in the BMAP. The FWRA further states that the BMAP may make detailed allocations to individual “basins” (i.e., sub-basins) or to all basins as a whole, as appropriate. Both initial and detailed allocations must be determined based on a number of factors listed in the FWRA, including cost-benefit, technical and environmental feasibility, implementation timeframes, and others (see Appendix B). Detailed allocations are most appropriate in Basins with multiple point sources, detailed source identification, and sufficient data to support division of the initial TMDL allocations.

The BWG agreed that, for purposes of the initial BMAP, it would not be appropriate or cost-effective to try to calculate detailed allocations. Therefore, detailed allocations were not developed, based on the following considerations:

- o There are only two major point sources in the Basin, as defined in the TMDL wasteload allocations: domestic wastewater (GRU) and municipal stormwater. This division is already reflected in the TMDL initial allocations. Therefore, the initial wasteload allocation cannot be further broken down.
- o Uncertainty about the sources of both coliform and nutrient TMDLs requires that there be more source tracking to determine whether it is necessary and feasible to allocate specific responsibility among nonpoint sources. Attempting to formulate allocations more detailed than those adopted in the TMDLs, particularly for bacteria TMDLs, would be speculative and time-consuming.
- o The pending development of Pollutant Load Reduction Goals by the St. Johns River Water Management District may provide additional information on sources and allowable loadings.
- o Although they have independent responsibilities, MS4 permittees cooperate closely on implementation of their permit responsibilities.

The BWG preferred to work cooperatively to identify the projects and activities that would most effectively achieve load reductions. Some of these activities involve additional research to identify and target pollutant sources, to ensure cost-effective solutions.

Due to the uncertainty and inability to identify and attribute detailed load allocations, the BWG was unable to assess whether activities contained within the BMAP will be sufficient to achieve each individual TMDLs. However as each 5 year basin cycle is completed and more information is gathered, it is anticipated the future revisions to the BMAP will include strategies that will ultimately achieve the TMDLs for each waterbody.

## Orange Creek Basin - DRAFT BMAP

Table 5. Total Maximum Daily Loads in the Orange Creek Basin

| TMDL Category | Waterbody WBID         | Parameter      | TMDL Baseline Loading (lbs/year)       | TMDL (lbs/year)       | Wasteload Allocation    |                                  | Load Allocation (lbs/year)                     | Percent Reduction Needed |
|---------------|------------------------|----------------|----------------------------------------|-----------------------|-------------------------|----------------------------------|------------------------------------------------|--------------------------|
|               |                        |                |                                        |                       | Wastewater (lbs/year)   | NPDES * Stormwater (% reduction) |                                                |                          |
| Nutrients     | Newnans Lake 2705B     | TN             | 315,510                                | 85,470                | 3,104                   | -                                | 82,366                                         | 74%                      |
|               |                        | TP             | 25,732                                 | 10,924                | 10,538                  | -                                | 10,538                                         | 59%                      |
|               | Orange Lake 2749A      | TP             | 27,889                                 | 15,262                | -                       | -                                | 15,262                                         | 45%                      |
|               | Lake Wauberg 2741      | TN             | 4,064                                  | 2,062.4               | -                       | -                                | 2,062.4                                        | 51%                      |
|               |                        | TP             | 748                                    | 374                   | -                       | -                                | 373.7                                          | 50%                      |
|               | Alachua Sink 2720A     | TN             | 462,550                                | 256,322               | 41,003                  | 45%                              | 215,319                                        | 45%                      |
| TMDL Category | Waterbody WBID         | Parameter      | TMDL Baseline Loading (counts / 100mL) | TMDL (counts / 100mL) | Wasteload Allocation    |                                  | Load Allocation (counts/100 mL or % reduction) | Percent Reduction Needed |
|               |                        |                |                                        |                       | Wastewater (counts/day) | NPDES Stormwater (% reduction)   |                                                |                          |
| Coliforms     | Hogtown Creek 2698     | Fecal Coliform | 1,633                                  | 800                   | -                       | 51%                              | 800                                            | 52%                      |
|               | Tumblin Creek 2718A    | Fecal Coliform | 3,077                                  | 800                   | -                       | 74%                              | 74%                                            | 74%                      |
|               | Sweetwater Branch 2711 | Fecal Coliform | 2,667                                  | 800                   | 2.27E + 11              | 70%                              | 70%                                            | 70%                      |
| TMDL Category | Waterbody WBID         | Parameter      | TMDL Baseline Loading (lbs/day)        | TMDL (lbs/day)        | Wasteload Allocation    |                                  | Load Allocation (lbs/day)                      | Percent Reduction Needed |
|               |                        |                |                                        |                       | Wastewater (lbs/day)    | NPDES Stormwater                 |                                                |                          |
| Iron          | Hatchet Creek 2688     | Iron           | 52                                     | 35.91                 | 5.6                     | -                                | 30.31                                          | 30.8%                    |

\* NPDES = National Pollutant Discharge Elimination System

## 1.4 BMAP ASSUMPTIONS AND CONSIDERATIONS

The water quality impacts of BMAP implementation are based on some fundamental assumptions and considerations. These assumptions and considerations are discussed below.

- **Multi-Parameter Impacts** - Actions in this BMAP that decrease coliforms will also decrease nutrients.
- **Quantifying Project Impacts** - Not all of the projects and activities contained in the BMAP can be quantified with regard to the reductions in coliforms or nutrients they might achieve. However, it is assumed that these actions will help reduce pollutant loads.
- **Future Growth** –Based on the information provided in Section \_\_\_\_\_, future growth is not expected to significantly increase pollutant loads in the Basin.
- **Water Quality Issues** – This BMAP will not address all water quality issues in the Basin. Programs to address other water quality issues are in place, or will be developed outside of BMAP implementation.
- **Implementation Schedule** - BMAP implementation will be a long-term process. While many of the projects and activities contained in the BMAP are recently completed or currently ongoing, there are some key projects and studies that may extend beyond the first five-year BMAP cycle. This means that the TMDLs established for this basin will not necessarily be achieved in the near term. Regular follow-up and continued coordination and communication by the Basin Working Group will be essential to ensuring that management actions are being carried out and that their incremental effects are assessed. As each 5-year basin cycle is completed and more information is gathered, it is anticipated that additional management actions to achieve TMDLs will be developed as part of BMAP adaptive management. This will reduce uncertainty and inform detailed source identification.

## CHAPTER 2: ORANGE CREEK BASIN SETTING, WATER QUALITY TRENDS, AND WATER QUALITY ISSUES

### 2.1 HYDROLOGY AND WATER MANAGEMENT

Lochloosa Lake, together with Orange and Newnans Lakes, are the main surface water bodies in the Orange Creek basin. The entire Orange Creek Basin covers about 1040 km<sup>2</sup> and is within the Central Lowlands topographical region (Clark et al, 1964). The area can generally be considered as having karst topography. In those portions of the basin overlain by the Hawthorne formation, the Floridan Aquifer is confined. In these conditions, natural discharge from the Floridan Aquifer can occur where the confining layer is thin or absent. Such conditions exist at Magnesia Springs north of Lake Lochloosa (Pyne, 1985).

#### 2.1.1 LAKE SURFACE AREA

Surface area of lakes in the Orange Creek Basin fluctuates widely due to drought and heavy rainfall. Table 6 includes lake stage and acreage estimates from the SJRWMD based on a Geographic Information System (GIS) analysis. Additional lake acreage work was completed for Orange Lake using direct observations (J. Hinkle, DEP, 2002). This study estimated the area of Orange Lake as 1,820 acres in 2002, significantly lower than the 2,745 acre minimum estimate noted below.

In the hydrologic descriptions below, lake acreages are taken from the Florida Lakes Gazetteer. However, the TMDL models were calibrated against measured data, including the measured lake surface area. Given variability in surface area measurements and the need to calibrate the model over time, surface areas used for TMDL development were the long-term annual average lake surface area, based on the annual average lake stages for the period of record for TMDL development.

Table 6 Orange Creek Basin Lake Statistics: Stage (ft NGVD) and Area (acres)

|                | Minimum |           | Median |           | Maximum |           | Period of Record |
|----------------|---------|-----------|--------|-----------|---------|-----------|------------------|
|                | Stage   | Lake Area | Stage  | Lake Area | Stage   | Lake Area |                  |
| Orange Lake    | 49.57   | 2,745     | 57.87  | 12,703    | 61.50   | 15,600    | 1933-2006        |
| Lochloosa Lake | 53.88   | 5,483     | 57.75  | 6,114     | 61.94   | 10,602    | 1936-2006        |
| Newnans Lake   | 60.86   | 4,730     | 66.50  | 6,399     | 71.21   | 8,087     | 1936-2006        |

Source: SJRWMD, 2006. These figures were obtained through a GIS analysis using detailed lake bathymetry (1 foot contours) in combination with stage data.

#### 2.1.2 SURFACE WATER FLOW

Rainfall recharges surface water directly and indirectly within the OCB. Groundwater from the surficial and intermediate aquifers or aquifer systems provides the primary source of baseflow to the streams in the OCB. There are five major watersheds within the OCB including Hogtown

## Orange Creek Basin Draft BMAP

Creek, Paynes Prairie, Newnans Lake, Lake Lochloosa and Orange Lake (See Figure 11). Surface water flow directions are shown in Figure 12.

The Hogtown Creek Watershed is a closed basin discharging to the Floridan aquifer system via Haile Sink on Hogtown Prairie west of the Cody Scarp. There are many tributaries to Hogtown Creek, the largest being Possum Creek. Hogtown and Possum creeks and their associated tributaries drain most of northwestern Gainesville. The direction of flow is generally south and west, although Possum creek flows south and east to its confluence with Hogtown. Hogtown Creek flows through a series of wetlands between SW 2<sup>nd</sup> Avenue in Gainesville and its terminus at Haile Sink. The median flow in Hogtown Creek measured at CR 30 upstream of Hogtown Prairie and Haile Sink under baseflow conditions from May 1994 through September 2002 was 9.50 cubic feet per second (cfs) (ACEPD 2004).

The Paynes Prairie watershed includes two major streams; Sweetwater Branch and Tumblin Creek. The median flow in Sweetwater Branch at SR 331 from February 1994 through April 2003 under baseflow conditions was 10.74 cfs (ACEPD, 2004). The median flow in Tumblin Creek downstream of Bivens Arm Lake (Bivens Arm Outfall) at SR 331 from September 1996 through August 2002 under baseflow conditions was 1.1 cfs (ACEPD, 2004). Paynes Prairie also receives water from Prairie Creek via Camps Canal. On the prairie itself there are two major water bodies, Alachua Sink and the associated Primary Sink Feature and Alachua Lake, a large wetland system. The water on Paynes Prairie discharges to the Floridan aquifer system via the Primary Sink Feature at Alachua Sink. The Paynes Prairie system can hold a large volume, after the hurricanes in 2004 the surface water on the prairie covered an area twice the size of Newnans Lake (Jim Weimer, 2006).

Newnans Lake receives water from three primary sources, Hatchet Creek, Little Hatchet Creek and Lake Forest Creek. Hatchet Creek, flowing east and south, contributes the greatest volume of water to Newnans Lake and has several large tributaries including Bee Tree Creek, which converges with Hatchet Creek north of SR 26 above the north end of Newnans Lake. The median flow in Hatchet Creek measured near SR 26 from May 1993 through March 2003 under baseflow conditions was 1.53 cfs (ACEPD, 2004). Little Hatchet and Lake Forest creeks enter Newnans Lake from the northwest and west, respectively. All three creeks are intermittently dry during drought periods. Newnans Lake discharges water to Prairie Creek on the southern side of the lake at SR 20. The water from Prairie Creek flows south toward Paynes Prairie and Orange Lake.

The primary surface water input to Lochloosa Lake is from Lochloosa Creek. Lochloosa Creek enters the lake on the north side of the lake. Lochloosa Creek flows south to Lochloosa Lake. The creek receives baseflow from large expanses of pine flatwoods and wetlands in the watershed. Smaller creeks, in the proximity to the City of Hawthorne, also flow south to the north end of Lochloosa Lake. Water exits Lake Lochloosa and enters Orange Lake through Cross Creek.

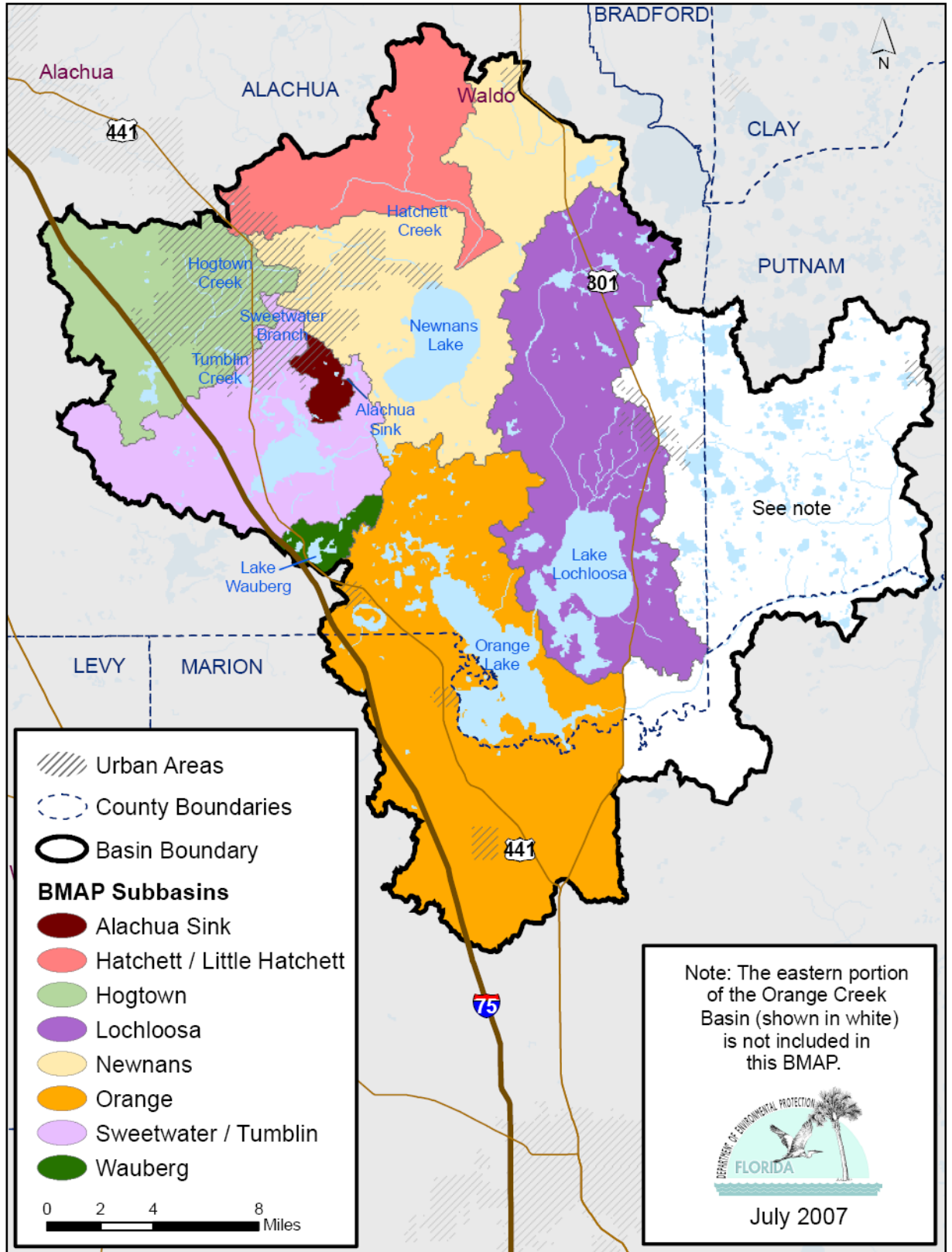
Orange Lake Watershed is located in southeastern Alachua and northern Marion counties. The major surface water inputs to Orange Lake are from River Styx on the north side of the lake and Cross Creek, which discharges from Lake Lochloosa. Water exits Orange Lake by groundwater discharge and surface water flow. Groundwater discharge to the Floridan aquifer system occurs via a sinkhole complex at the southwest end of the lake in the vicinity of Heagy Bury Park in Marion County. Surface discharge from the lake takes place through Orange Creek via a broad crested weir at US Hwy 301 on the southeast side of the lake.

## **Orange Creek Basin Draft BMAP**

Lake Wauberg receives most of its recharge directly from rainfall and the lake discharges to the east through Sawgrass Pond to Chacala Pond (Opper, 1982; see Figure 13). Opper (1982) reported that surface water outflow from the lake stopped when lake levels were below 66.60 feet above mean sea level. Under periods of low or normal water levels Lake Wauberg, Burnt Pond Marsh and George's Pond remain unconnected. The hydrology of the watershed may change during periods of extremely high water levels, with some of the waterbodies connected. Burnt Pond Marsh, located north of the University of Florida property, is connected by a ditch and culvert (under US Hwy 441) to George's Pond. During October 2006, the ditch was dry and no water flowed from the marsh to George's Pond. George's Pond is isolated under low water and normal water levels. Under extremely high water levels, George's Pond may be connected to Lake Wauberg through a series of wetlands and ditches on the south side of the pond that could allow water to flow beneath US Hwy 441 to the lake.

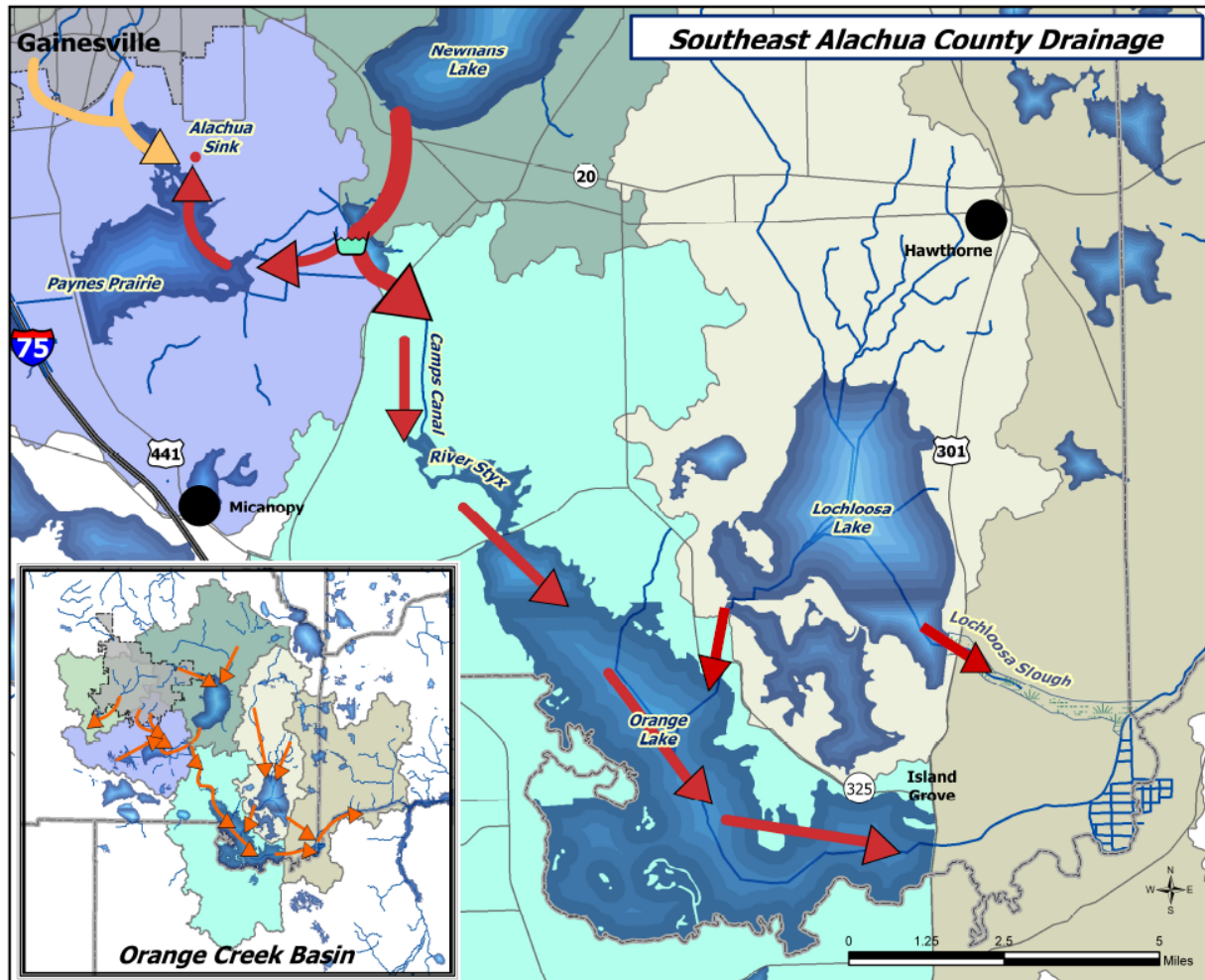
# Orange Creek Basin Draft BMAP

**FIGURE 11. Orange Creek Basin Subbasins**



## Orange Creek Basin Draft BMAP

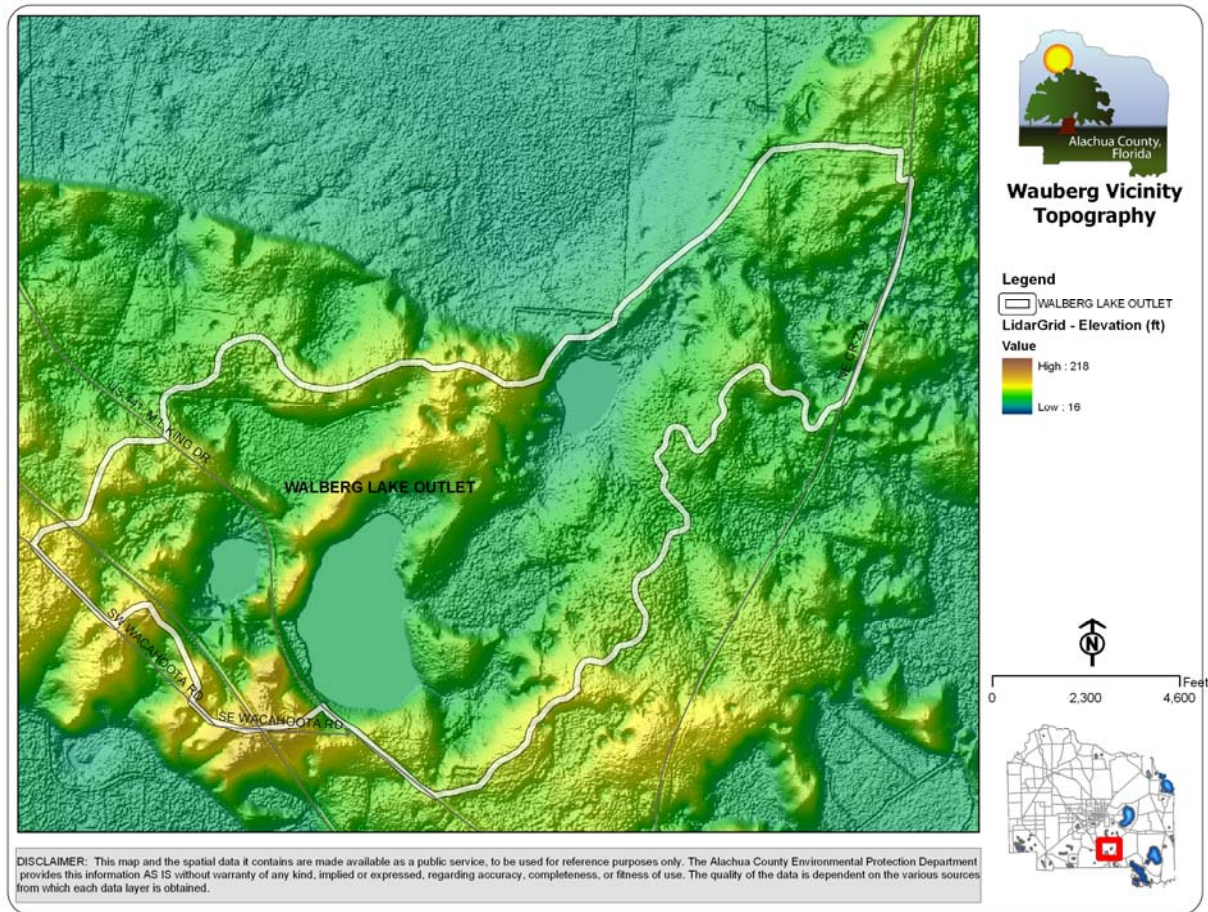
FIGURE 12. Surface Water Flow – Orange Creek Basin Lakes



Source: Alachua County Environmental Protection Department

## Orange Creek Basin Draft BMAP

**Figure 13. Lake Wauberg Inflow and Outflow**



### 2.1.3 SURFICIAL GROUND WATER FLOW

Rainfall recharges surface water and groundwater within the OCB. Groundwater from the surficial and intermediate aquifers or aquifer systems provides the primary source of baseflow to the streams in the OCB. The deeper Floridan aquifer system underlies all of Alachua County at depth, but only discharges to surface waters where the potentiometric surface (water surface) is higher than the land elevation. Examples of this include the flowing wells at Magnesia Springs in the Grove Park area and potential upward seepage into Lochloosa Lake. The surficial and intermediate aquifers discharge to the creeks as elevation drops and the streams down cut through the Hawthorn Group formations east of the Cody Scarp.

The surficial aquifer is comprised primarily of quartz sands, becoming clayey at depth. In most of eastern Alachua County the surficial aquifer exists under water table conditions and discharges to streams when they intercept the surficial aquifer. Where relief is high, such as the upper reaches of the Hogtown Creek Watershed, the surficial aquifer discharges to the creeks directly as small springs and seeps or indirectly through associated small wetlands. Where relief is low, such as in some areas of the Little Hatchet Creek Watershed, water from the surficial aquifer may discharge to streams during part of the year. In these areas of low relief,

## Orange Creek Basin Draft BMAP

the surficial aquifer may receive recharge during times of the year when surface water levels are high. Groundwater seepage to the creeks frequently occurs at the base of the surficial aquifer where the lower permeability Hawthorn Group clays are encountered. Groundwater flow in the surficial aquifer generally follows topography. Figure 14 identifies the general direction of surface water flow in the Orange Creek Basin.

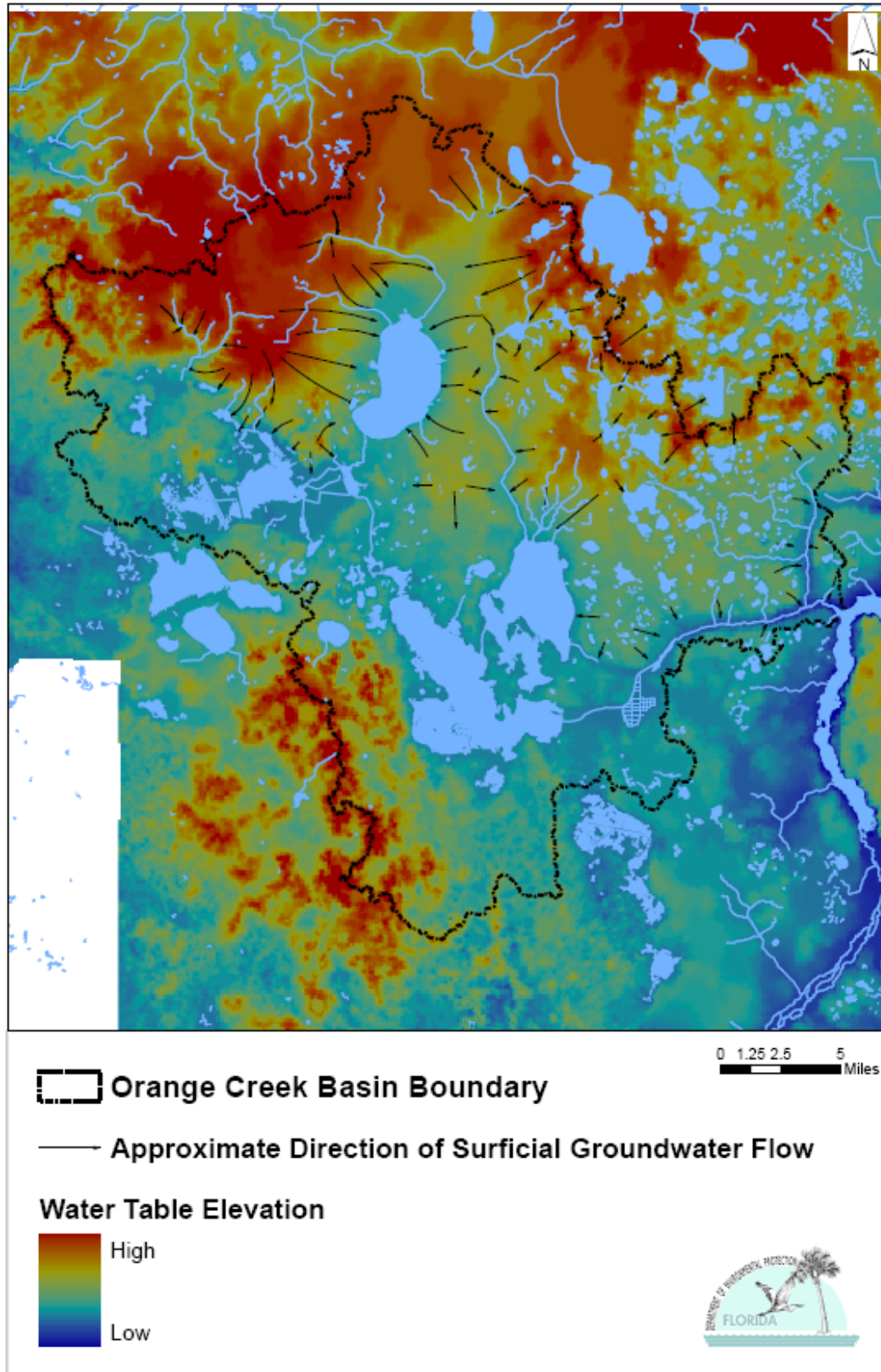
The surficial aquifer system is not present throughout much of western Alachua County. In this area water in the Floridan aquifer system is unconfined or very poorly semi-confined and exists under water table conditions. Areas within the OCB where a surficial aquifer may not be present include the western part of the Paynes Prairie Watershed and areas in the south and west parts of the Orange Lake Watershed. In the western portion of the OCB in the urban area of Gainesville there are many small closed or stream-to-sink watersheds or basins. In these areas, the surficial aquifer system may not exist or only exists as an intermittent perched water table discharging via sinks or swallets to the Floridan aquifer system during periods of high rainfall. Examples of these systems include the Smith Creek and Rutledge Drain system.

In Alachua County east of the Cody Scarp, the Hawthorn Group formations provide both a confining unit above the Floridan aquifer and discrete water bearing units collectively known as the intermediate aquifer or aquifer system. The intermediate aquifer by definition exists under confined conditions. Within the intermediate aquifer system, sands, clayey sands, carbonates (limestone and dolomite) and phosphatic materials can yield water. Through natural down cutting and dissection of the land surface by streams, these water-bearing units yield baseflow to many of the creeks. The Hawthorn Group formations are also exposed along the creek banks and stream beds as resistant beds that define the stream channels. Most water seeps out of the banks along seepage slopes, however some springs do exist. One named spring, Glen Springs, located in the upper reaches of Hogtown Creek, discharges from the intermediate aquifer. Glen Springs is a fourth magnitude spring with a mean historical discharge, from 1941 through 1972, of 0.35 cubic feet per second (cfs) (Rosenau et al 1977).

The Floridan aquifer or aquifer system does not contribute flow to the streams in the Gainesville urban area or to the Newnans Lake tributaries. The Floridan aquifer potentiometric surface and the Ocala Limestone, which is the uppermost geologic formation that constitutes the Floridan aquifer in Alachua County, are both lower in elevation than the creeks in the Gainesville urban area and the tributaries to Newnans Lake. Instead, the creeks that cross the Cody Scarp end in swallow holes or swallets that move surface water down recharging the Floridan aquifer. Two large swallets in the area are Haile Sink, the terminus of Hogtown Creek on Hogtown Prairie, and the Primary Sink Feature at Alachua Sink on Paynes Prairie, which receives water from Alachua Lake (on Paynes Prairie), Tumblin Creek and Sweetwater Branch. Phelps (1987) reported that water recharged Floridan aquifer system from Hogtown Creek at an average rate of 19.2 cubic feet per second (cfs) via Haile Sink and 15.3 to 35.7 cfs through Alachua Sink. Surface water also discharges to the Floridan aquifer system in Orange Lake via a sinkhole complex at the southwest end of the lake in the vicinity of Heagy Burry Park located in Marion County.

## Orange Creek Basin Draft BMAP

FIGURE 14. SURFICIAL GROUND WATER FLOW



## Orange Creek Basin Draft BMAP

### 2.1.4 NEWNANS LAKE

layer Newnans Lake is located in a topographical region of the state that is known as the Central Lowlands (Clark et al, 1964). The geology of the area is dominated by the Hawthorn Group formations, which are relatively impermeable and acts as a confining layer separating surface water from the influence of the Floridian Aquifer. Poorly drained soil and low elevation gradients of the area result in moderately high sheetflow and poorly defined channels. Ponds and wetlands occur throughout the area. The major sources of water to the lake include surface runoff, subsurface flow, and direct rainfall (Canfield 1981).

The lake is a typical shallow basin lake that covers 6,399 acres at median stage, and naturally fluctuates between 4,730 acres and 8,087 acres due to drought and heavy rainfall. The maximum depth is not more than 12 feet, and the mean depth is approximately 5 feet (Nordlie, 1979). A large drainage area north of the lake supplies inflow via three streams: Hatchet Creek, Little Hatchet Creek and Lake Forest Creek. Hatchet Creek provides the greatest inflow to the lake. The lake's single major surface water outlet is Prairie Creek. Once water leaves the lake, about 41 percent of the flow (long-term average) goes the south and into Paynes Prairie through three large culverts. The remainder flows into Orange Lake by way of Camp's Canal (Gottgens and Montague 1987).<sup>1</sup>

In 1966, the Alachua County Recreation and Water Conservation and Control Authority constructed a weir at the outlet of Newnans Lake to increase the water level. The weir was altered in 1976 by the Florida Game and Fresh Water Fish Commission (now the Florida Fish and Wildlife Conservation Commission) to include removable boards for lake management purposes. Boards were removed permanently from the weir in 1991 to increase lake level fluctuation. **Table 7** provides a history of the Newnans Lake outlet structure. **Figure 15** is a January 1992 photograph of the former weir.

The diversion of Prairie Creek from Paynes Prairie to Orange Lake, and construction of the Orange Lake Weir, Newnans Lake Dam, and three major highways (U.S. Highways 301 and 441, and I-75) have altered natural flow patterns and water level fluctuations in the Orange Creek planning unit. Newnans Lake has become hypereutrophic, and woody vegetation has spread over a part of Paynes Prairie as the result of some of these hydrologic alterations (SJRWMD, 2005).

**TABLE 7. HISTORY OF NEWNANS LAKE OUTLET STRUCTURE**

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| November 1966            | Newnans Lake weir constructed by Alachua County Recreation and Water Conservation and Control Authority (ACRWCCA) to increase lake water levels. The original concrete structure consisted of a fixed weir with a crest at 66.7 feet above mean sea level and a supplementary low-flow orifice (invert elevation unknown) designed to discharge 10 cubic feet per second with the lake at the crest elevation.                                                                                                                        |
| March 1976               | Weir altered by Florida Game and Freshwater Fish Commission (FGFWFC) to include removal flashboards to provide the option for lake level fluctuations. The 1976 modification was intended to allow better management of the lake, including drawdown and consisted of a cut in the existing structure approximately 70 feet wide and 6.8 feet deep, with slotted columns and flashboards for continued control options. However, during most of the structure's history, the flashboards were kept in place to maintain water levels. |
| April 24 - July 17, 1989 | Boards temporarily removed from weir for 3 months for an experimental drawdown of the lake to study the impact of lower water level on the sediment and biology of the lake. Results in Gottgens and Crisman 1992.                                                                                                                                                                                                                                                                                                                    |

<sup>1</sup> Flow into Paynes Prairie through the culverts was reserved by rule in 1995 by the Governone Board of the SJRWMD (see Appendix \_\_\_\_)

## Orange Creek Basin Draft BMAP

|                                                                                                                                                                                       |                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| Spring                                                                                                                                                                                | After meetings of the Newnans Lake Task Force, FGFWFC permanently removed      |
| 1991                                                                                                                                                                                  | boards from weir to allow natural lake level fluctuations.                     |
| 1999                                                                                                                                                                                  | Weir removed by DOT when they rebuilt State Road 20 bridge over Prairie Creek. |
| <i>Compiled by St. Johns River Water Management District, 2002 - Sources: Gottgens, 1993; Gottgens and Crisman, 1992; Nagid and Canfield, 2001; Robison et al, 1997; Weimer, Jim.</i> |                                                                                |

**FIGURE 15. PHOTOGRAPH OF FORMER WEIR AT THE OUTLET OF NEWNANS LAKE, STATE ROAD 20 BRIDGE, JANUARY 1992**



### **2.1.5 ORANGE LAKE**

Orange Lake is also located in the Central Lowlands (Clark et al, 1964). The geology of the area is dominated by the Hawthorn Group formations, which are about 50 feet thick where Orange Lake is located (Scott 1988a). The Hawthorn Group is relatively impermeable and acts as a confining layer to separate the surface water from the influence of the Floridian aquifer. However, a connection between the lake water and Floridan aquifer exists through a sinkhole system located in the southwest part of Orange Lake. Because the potentiometric surface of this area is about the same as or lower than the long-term average elevation of the lake surface (57.8 feet, Lasi 1999), the movement of the lake water is downward. Therefore, it is not anticipated that the Floridan Aquifer will have a significant direct influence on the lake water quality.

Orange Lake is a shallow lake with a relatively large surface area of 12,703 acres at median stage and naturally fluctuates between 2,745 acres and 15,600 acres due to drought and heavy rainfall respectively (SJRWMD, 2006). Minimum lake acreage estimates as low as 1,820 acres have been developed through direct observation (J. Hinkle, DEP, 2002). The maximum depth of the lake under average conditions is about 12 feet and the mean depth is approximately 5.5 feet (Deevey 1989). Major sources of water to the lake include: interflow via Camps Canal-River Styx from Newnans Lake and Cross Creek from Lochloosa Lake; surface runoff from the watershed; and direct precipitation into the lake. Water flows out of the lake through the sinkhole system located in the southwest part of the lake and through a notched fixed-crest weir at the Highway 301 bridge into the headwater wetlands of Orange Creek. Orange Creek drains into the lower Ocklawaha River Basin. The Orange Lake watershed drains an area of about 87,339 acres.

## **Orange Creek Basin Draft BMAP**

### **2.1.6 LAKE WAUBERG**

Lake Wauberg is located in the Central Valley of the Ocklawaha River Basin (Alachua County), approximately eight miles south of Gainesville. The lake is located in the Fairfield Hills physiographic province (White, 1970). Relief in the watershed is relatively high, with land surface elevations ranging from 58 to 136 feet above NGVD. It is a region dominated by erosional remnants and karst features. Shallow prairies, flat-bottomed lakes and hilly terrain characterize the surrounding area. Lake Wauberg is situated among remnant hills comprised of Hawthorn Group materials (White, 1970; Oppen, 1982). Lake Wauberg is a “perched lake,” with the lake bottom covered in organic matter and clay materials eroded from the surrounding Hawthorn Group formations (Oppen, 1982). In this area, the Hawthorn Group formations support a shallow surficial aquifer (or water table aquifer) and the lake (Oppen, 1982).

Lake Wauberg has a surface area of 248 acres, with a mean depth of 12 feet (LakeWatch). The watershed for the lake encompasses a total of 3,394 acres. The watershed includes other waterbodies, Burnt Pond Marsh (a marsh to the north covering 238 acres), George’s Pond (to the west of US Hwy 441 covering 32 acres), Sawgrass Pond (to the east of Lake Wauberg covering 241 acres) and Chacala Pond (53 acres). These estimates of area are based on GIS analysis of SJRWMD Land Use and Land Cover 2004 vector digital data (Gijssels, 2006). In this analysis of the data, Lake Wauberg itself was found to cover 235 acres and there were a total of 1,126 acres of wetlands in the watershed, covering approximately one-third of the total land area in the watershed (Gijssels, 2006).

### **2.1.7 ALACHUA SINK**

Alachua Sink (WBID 2720A) is located on the northern edge of Paynes Prairie, south of the City of Gainesville and approximately 2.5 miles east of U.S. 441. It consists of a small lake, with a corresponding solution sink, known as the Primary Sink Feature, that recharges the Floridan aquifer (Jones, Edmunds & Associates, Inc., 2003). Alachua Sink had a surface area of about 13.5 acres and a mean depth around 1 meter in 2003 before recent flooding of the prairie. Alachua Lake is the inundated portion of Paynes Prairie.

Alachua Sink, Alachua Lake and Paynes Prairie are part of a dynamic system where major changes in hydrology are observed in periods of extreme wet and dry conditions. Alachua Sink and Alachua Lake are separate waterbodies during periods of drought and/or low rainfall. In wet years the entire prairie is flooded and these two water bodies coalesce. The reported formation of Alachua Lake in 1876, when the prairie flooded, and the subsequent draining of the lake in 1891, has been a topic of discussion since the draining occurred. Heavy rains were noted prior to the formation of the lake (Jensen, 1985), and the possibility exists that the formation of the lake was related to a short-term climatic event (Ritter 1991). Alachua Lake reflooded in 1998 due to heavy rains and has remained a large and distinct surface waterbody through 2006 due to periodic heavy rainfall (J. Weimer, 2006).

The dominant, underlying geologic component of the area is the Ocala Formation, with younger overlying terrace deposits of undifferentiated sediments, sand and clayey sand (Gottgens and Montague, 1988). The Ocala Formation is a soft, porous limestone, interbedded with dense, hard limestone and dolomite (Clark et al, 1964). Sink formations have occurred in the area through subterranean erosion by ground water solution of the

## Orange Creek Basin Draft BMAP

limestone (McGrail et al, 1998). The Cody Scarp, roughly at the 100 to 110 NGVD elevations, is a significant geologic feature in the area. The scarp domain is dominated by karst features. The streams entering Paynes Prairie receive much of their water from surficial and intermediate aquifer seeps and springs.

**TABLE 8 . HISTORICAL WET AND DRY PERIODS – ALACHUA SINK**

| Date       | State of Prairie             |
|------------|------------------------------|
| 1823       | Flooded                      |
| 1824       | Dry                          |
| 1857       | Flooded                      |
| soon after | Dry                          |
| 1861       | Flooded                      |
| soon after | Dry                          |
| 1876       | Flooded to form Alachua Lake |
| 1880       | Alachua Lake Full            |
| 1891       | Dry                          |
| 1941       | Flooded                      |

*(Based on Jensen, 1985)*

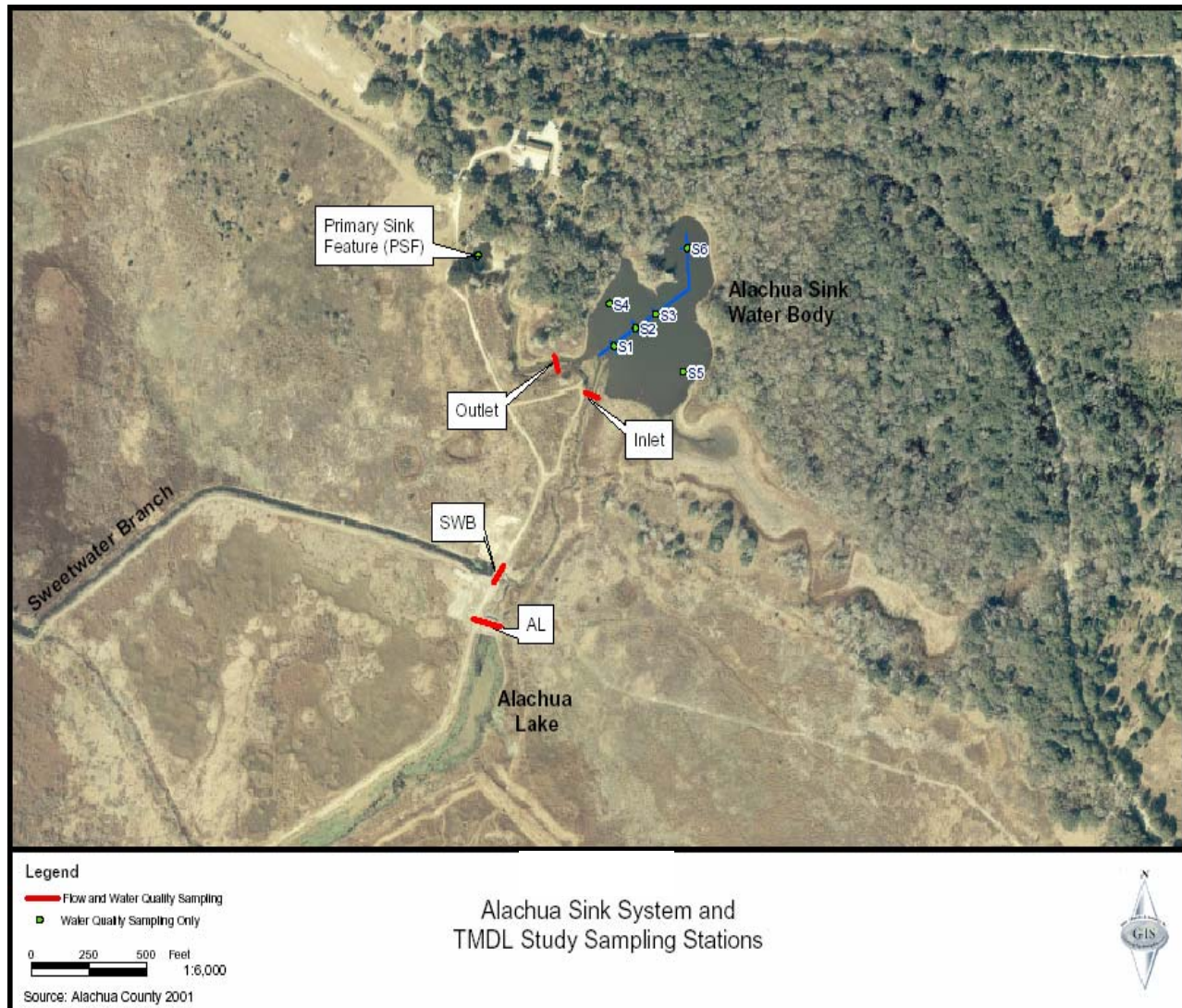
The surrounding drainage basin for the lake is approximately 2,758 acres. There are two well-defined inflows into the lake: Sweetwater Canal and a canal that connects Alachua Lake to Alachua Sink (combined drainage area of 39,373 acres). The Alachua Sink waterbody has an outlet stream that flows to the primary sink feature. Major sources of flow to Paynes Prairie include Sweetwater Branch (Bivens Arm) and Prairie Creek (which drains from Newnans Lake).. About 45 percent of the flow, as a long-term average, from Newnans Lake via Prairie Creek goes south into Paynes Prairie through three large culverts, and the rest flows towards Orange Lake by way of Camps Canal (Gottgens and Montague, 1987). Flow into Paynes Prairie was reserved under SJRWMD's "Reservation of Water Rule" to support of fish and wildlife.

The surface water on Paynes Prairie, including Prairie Creek, has been controlled by a series of channels, locks, and pumps that were installed in the Eastern part of the prairie during 1928 and 1929 to divert water away from Alachua Sink to Orange Lake (Jensen 1985). Before the locks and channels were installed, Paynes Prairie historically fluctuated between a lake and a dry prairie due to the infiltration rate of Alachua Sink and the changes in ground water levels (Pirkle, 1956a). It wasn't until the 1970's, after the State purchased the land that a control station was built to allow some water from Newnans Lake to again flow to Alachua Sink (Jensen 1985).

## **Orange Creek Basin Draft BMAP**

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**FIGURE 16 . AERIAL VIEW OF ALACHUA SINK AND INFLOW CANALS FROM SWEETWATER BRANCH AND PAYNES PRAIRIE/ALACHUA LAKE.**



### 2.1.8 LOCHLOOSA LAKE

Lochloosa Lake is located in the eastern part of Alachua County, approximately 15 miles southeast of Gainesville and four miles south of Hawthorne. The lake covers 6,114 acres at median stage and naturally fluctuates between 5,483 acres and 10,602 acres due to drought and heavy rainfall, respectively (SJRWMD, 2006). The lake has a maximum depth of 11 feet, and a mean depth of 7 feet (Langeland, 1982). The total acreage of the Lake's watershed is 52,000 acres. A large drainage area to the north supplies most of the surface water inflow through Lochloosa Creek. The primary outflow is through Cross Creek, although an unknown amount of drainage occurs when Lochloosa Lake is at high stage to Orange Creek through Lochloosa Slough in the southeastern corner of the Lake (Gottgens and Montague, 1987).

Cross Creek is the surface water connection between Lochloosa and Orange Lakes. The Creek is only about 1,600 meters long and has a watershed of about 321 acres.

## **Orange Creek Basin Draft BMAP**

Poorly drained soil and the low elevation gradients of the area result in moderately high sheetflow and poorly defined channels. Ponds and wetlands occur throughout the area. The major sources of water to Lochloosa Lake include surface runoff, subsurface flow, and direct rainfall (Canfield 1981). Ground water from deep aquifers is not a regular part of the overall water balance of the Lake (Deevy, 1987). This is supported by data that indicate low mineral content of the Lake waters (Gottens & Montague, 1987).

The primary mechanisms by which water is lost from Lochloosa Lake are drainage through the pervious sediments that make up the lake bottom, solution cavities, evapotranspiration, and discharge to surface streams, primarily Cross Creek. While the lake responds quickly to monthly net rainfall, annual or decade-long lake level variations appear to be controlled by changes in the artesian pressure affecting downward leakage through the lake bed (Deevy, 1987).

### **2.1.9 HATCHET CREEK**

Hatchet Creek is located northeast of the City of Gainesville. It is a tributary that leads to and essentially forms the headwaters of the Ocklawaha River in Alachua County, and drains into Newnans Lake. It is considered a blackwater stream (low pH and high color) and is approximately 10.8 miles long, with a contributing watershed of approximately 41,285 acres or 64.5 square miles. Two major tributaries in the watershed are Forest Creek and Bee Tree Creek. Forest Creek is in the western part of the basin and Bee Tree Creek drains the entire eastern part of the watershed. Bee Tree Creek joins the main channel of Hatchet Creek upstream of SR 26 in the vicinity of the Newnans Lake Conservation Area, which incorporates the former Gumroot Swamp Conservation Area. Land surface elevation ranges from 165 feet in the upper basin to 75 feet (NGVD) near Newnans Lake.

The Hatchet Creek watershed is located along the southern margin of the Northern Highlands physiographic province (White, 1970). Land surface elevations range from 165 feet to 75 (NGVD), decreasing as Hatchet Creek reaches the northern end of Newnans Lake. In the watershed, Plio-Pleistocene terrace deposits of sands, silts, clayey sands and sandy clays overlie the sediments of the Hawthorn Group formations (Spangler in Thomas et al, 1985).

In the headwaters, forested wetlands and pine flatwoods dominate the landscape. Forest and rural open areas (64%) dominate land use in the Hatchet Creek watershed. Other significant land uses include water and wetlands (22%), low density residential (5%) and agricultural (5%). Urban and built up land uses represented less than 8% of the watershed acreage. (Lassiter, 2003). Primarily due to its rural setting and the presence of conservation areas, several segments of Hatchet Creek have characteristics of a healthy ecosystem including good habitat for macroinvertebrates and other aquatic life.

### **2.1.10 HOGTOWN CREEK**

Hogtown Creek is located in the City of Gainesville (Central Alachua County) in the Orange Creek planning unit of the Ocklawaha Basin. The creek is approximately 5.7 miles long and receives stormwater runoff from the City of Gainesville, which it discharges to the Floridan aquifer through Haile Sink. Approximately 65 percent of the land use in the Hogtown Creek watershed and surround Hogtown Prairie is characterized as low density residential, 15 percent is commercial, with the remaining 20 percent is divided between mixed hardwood forest, forested wetlands, silvicultural, agricultural, and institutional uses (ACEPD 2004).

## **Orange Creek Basin Draft BMAP**

The Hogtown Creek watershed is located along the western and southern margins of the Northern Highlands physiographic province (White 1970). Relief is high in the watershed. In many areas the creek and tributaries are deeply incised, exposing Hawthorn Group materials consisting of sands, silts, clayey sands, sandy clays, carbonates (limestone and dolomite) and phosphates. Hogtown Creek crosses the Cody Scarp and discharges to Haile Sink in Hogtown Prairie, west of I-75.

Hogtown Creek has numerous tributaries, with four of the largest being Possum Creek, Springstead Creek, Rattlesnake Branch, and Elizabeth Creek. These four tributaries all join Hogtown Creek in the area between NW 39<sup>th</sup> Avenue and University Avenue. Approximately 65 percent of the land use in the Hogtown Creek watershed and surrounding Hogtown Prairie is characterized as low density residential, 15 percent is commercial, with the remaining 20 percent is divided between mixed hardwood forest, forested wetlands, silvicultural, agricultural, and institutional uses (ACEPD 2004).

### **2.1.11 TUMBLIN CREEK**

Tumblin Creek is located in the city of Gainesville. It is approximately 2.3 miles long and is another of the smaller creeks in the Orange Creek Basin. Tumblin Creek flows to Bivens Arm Lake, whose outflow then travels to Paynes Prairie where it enters the Floridan aquifer via the Primary Sink Feature adjacent to Alachua Sink. The headwaters of the creek, which extend north from SW 5th Avenue to NW 8<sup>th</sup> Avenue, west to 13th Street, and east to Main Street, are channelized through underground concrete culverts of the municipal separate storm sewer system or MS4. Sources of baseflow include springs and seeps at the base of the surficial aquifer and, lower in the basin, permeable units within the intermediate aquifer system.

The Tumblin Creek watershed encompasses about 3.8 square miles of urban Gainesville. CH2M HILL (1985) reported 60 percent of this area to be impervious. The entire basin, except for the Bivens Arm floodplain, has been developed. In many cases, the development stops only inches from the creek channel. Urban and residential runoff appear to be the significant sources of bacterial contamination.

The Tumblin Creek watershed is located along the southwestern margin of the Northern Highlands physiographic province (White 1970). As the main stream channel flows southwest, elevations decrease, exposing recent sands as well as Plio-Pleistocene Terrace deposits (comprised of sands and clays) and Miocene age formations of the Hawthorn Group (Spangler in Thomas et al 1985). The Hawthorn Group formations are extremely variable but generally consist of sands, silts, clays, carbonates (limestone and dolostone), and phosphates (Scott 1988). Many of the more resistant beds can be observed outcropping along the bank or in the streambed.

### **2.1.12 SWEETWATER BRANCH**

Sweetwater Branch is an urban creek that flows through the City of Gainesville. It is approximately 2.8 miles long, drains 3.3 square miles, and is one of the smaller creeks in the Orange Creek Basin. Soils in the Sweetwater Branch watershed range from moderately well drained in the upper portion of the watershed to poorly drained in the lower reaches. The creek watershed is mainly contained within the limits of the City of Gainesville. It continues to flow into Paynes Prairie State Preserve and ultimately discharges to the Floridan aquifer via the Primary Sink Feature adjacent to Alachua Sink. Though there is one permitted domestic wastewater discharge, the GRU Main Street

## **Orange Creek Basin Draft BMAP**

Water Reclamation Facility (WRF), to Sweetwater Branch, urban and residential runoff are thought to be significant sources of bacterial contamination. Sweetwater Branch has one major tributary, Rosewood Branch, which is located in the northeastern part of the watershed.

The upper reaches of the Sweetwater Branch watershed are located in the Northern Highlands physiographic province (White 1970). As land surface elevations decrease toward Paynes Prairie, Sweetwater Branch crosses the Cody Scarp into the Alachua Lake Cross Valley in the Central Highlands physiographic province (White 1970). Mean elevations range from 180 to 59 feet (NGVD). Sediments of the Hawthorn Group formations are exposed along the stream banks in the lower reaches of the watershed where more recent Plio-Pleistocene terrace deposits of sands, silts, and clays have been eroded (Spangler in Thomas et al, 1985).

It is estimated that roughly 60 percent of the watershed is impervious (ACEPD, 2004). The upper third of the basin is highly developed and consists mostly of residential and commercial land uses. This portion of the basin includes the Duck Pond neighborhood and the areas surrounding the Rosewood Branch tributary. The housing is a mixture of single-family homes and high-density apartments and condominiums. The lower two-thirds of the watershed contains some residential development but is used largely for commercial, industrial, and institutional purposes.

### **2.1.13 STREAM FLOW**

The mean streamflow of Hatchet Creek, measured at the SR 26 crossing, was 5.9 and cubic feet per second (cfs) based on SJRWMD data for the period May 1993 through March 2003 (n=762) (ACEPD, 2004). Streamflow in Hatchet Creek ranges from zero, when the stream dries up, to a maximum 263.5 cfs for the 10-year period of record. Under stormflow conditions the mean streamflow was 37.5 cfs (n=12). The flow from Hatchet Creek is the largest inflow to Newnans Lake (ACEPD, 2004).

The mean streamflows in Hogtown Creek are the highest of all creeks in Gainesville (ACEPD, 2004). The mean streamflow at the CR30 (SW 24<sup>th</sup> Avenue) bridge is 18.59 cfs (n=11,274). The maximum streamflow recorded at this station over the 30-year period of record was 860 cfs in September 1988. The largest tributary to Hogtown Creek, Possum Creek, had a mean streamflow of 4.20 cfs (n=740) for the period of record September 1996 through September 1999 (ACEPD, 2004). It also receives an average discharge of 0.346 cubic feet per second from Glen Springs, an intermediate aquifer spring.

Streamflow data were collected on Tumblin Creek by the SJRWMD at both US 441 (TUM441) and at US 331 (TUM331), the outfall from Bivens Arm Lake. The mean streamflow at TUM441 is 1.6 cfs, while it is 2.6 cfs further downstream at TUM331 (ACEPD, 2004). It should be noted that although the mean flow for TUM331 is higher than TUM441, the prior site is characterized by intermittent flow, while the later flows continually through the seasons. The mean flows in Tumblin Creek are the lowest of all urban streams in Gainesville (ACEPD, 2004). Stormflows were higher than those on Possum Creek, but substantially less than those on both Sweetwater Branch and Hogtown Creek (ACEPD 2004).

Streamflow data were collected extensively on Sweetwater Branch at both the Depot Avenue (DEPOT) and SR 331 (SWB331) crossings by the SJRWMD (ACEPD, 2004).

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The mean streamflow at DEPOT is 1.2 cfs (n=1,119) for the period of record October 1999 through January 2003 (ACEPD, 2004). The mean discharge from the GRU Main Street WRF is 8.5 cfs. Downstream from the GRU Main Street WRF at SWB331, the mean streamflow is 12.7 cfs (n=1,856) for the period of record February 1994 through April 2003 (ACEPD, 2004).

Flow data for this time period (2004) is also available from SJRWMD for the following three sites: Lochloosa Creek at Grove Park, Camps Canal at Rochelle, and Orange Lake Outlet at Citra. The mean streamflow in Camps Canal from January 1, 2004, through December 31, 2004, was 38.46cfs. The mean streamflow in Lochloosa during this same time was 56.33 cfs. For the Orange Lake discharge, mean daily streamflow was 63.70cfs.

## 2.2 LAND USE CHANGE AND POPULATION GROWTH

This section of the Orange Creek BMAP evaluates future growth impacts from 2005 through 2015. In addition to the value of considering future growth from a resource standpoint, Chapter 403.067(7)(a)(2), Florida Statutes, requires that BMAPs “identify the mechanisms by which potential future increases in pollutant loading will be addressed.” The Orange Creek Basin analysis focuses on population growth as a measure of the location and intensity of future growth in the basin to address the potential future increases in pollutant loading.

As new land is developed, it becomes less able to filter rain into the ground and so increases runoff and the pollutants carried in that runoff. Population growth also affects pollutant loading from increased intensity of activities such as traffic, lawn fertilization, pets, and others. Where land is developed can significantly mitigate or magnify these impacts. In order to maintain the load reductions gained through BMAP implementation, local governments, businesses, citizens, and others will need to practice pollution prevention on a continuing basis through land use decisions, ordinance adoption and enforcement, public education efforts, best management practices, personal habits, and other means. Even with enhanced stormwater requirements for new development, future growth is likely to lead to increased pollutant loadings through increased stormwater from traffic and use of existing commercial and public facilities and increasing domestic wastewater discharges.

### 2.2.1 Data Sources

A variety of sources provide estimates of future population growth in the Orange Creek Basin. These include information from the North Central Florida Regional Planning Council, the Department of Transportation, the Alachua County Comprehensive Plan, the Marion County Comprehensive Plan, the City of Gainesville Comprehensive Plan, the St. Johns River Water Management District, and the U.S. Census Bureau. Additional information on future land use for the City of Gainesville, Alachua County, and Marion County is contained in **Appendix D**.

Based upon recommendations from local planning staff, Transportation Analysis Zone (TAZ) data from the Gainesville Metropolitan Transportation Planning Organization and Ocala/Marion County Transportation Planning Organization were selected as the primary resource for evaluating future population projections in the Orange Creek Basin. TAZs are areas delineated by state and/or local transportation officials for tabulating traffic-related data- especially journey-to-work and place-of-work statistics. A TAZ usually consists of one or more census blocks, block groups, or census tracts. TAZ data

## Orange Creek Basin Draft BMAP

is based on US Census data and Bureau of Economic and Business Research projections. TAZ data is reviewed closely by local planners during its compilation. The spatial extent of each zone is highly variable, ranging from one acre to over 15,000, roughly corresponding to population density.

TAZ data includes a variety of demographic and transportation statistics. For this analysis, only the population estimates were used. Population data was aggregated across all housing types (e.g. single-family, multi-family). These future growth estimates do not include increases in commercial or industrial activities not associated with increases in residential population.

Additional descriptions of land use, zoning, and future growth potential in the Orange Creek Basin can be found in Appendix D.

Basin Working Group members and associated staff, including Diana Gijsselaers (Alachua County), Kathleen Pagan (Alachua County), Michael Hoge (Gainesville), and Jimmy Massey (Marion County), provided significant assistance in developing TAZ population projections and figures.

### 2.2.2 Analysis Method

TAZ data was obtained from the Gainesville Metropolitan Transportation Planning Organization for the Gainesville and Alachua County portions of the basin and Ocala/Marion County Transportation Planning Organization for the Marion County portion. Although the general nature and purpose of TAZ data is the same, these organizations provided slightly different data sets for Alachua versus Marion County. Population estimates in Alachua County TAZs were available for 2000 and 2015, while Marion County estimates were available for 2000 and 2025. Population by TAZ for Alachua County was extrapolated out to 2015 based upon 1990-2000 population and growth rates. For Marion County, population growth was estimated through straight-line interpolation between the 2000 and 2025 endpoints. The result was an estimate of total population for each TAZ in five-year increments from 2000 through 2015.

The above population estimates were then used to calculate population density by TAZ, thus accounting for the wide variation in TAZ size. To provide a more accurate estimate of anticipated population density, land uses incompatible with development (open water and conservation areas) were removed from the total acreage of each TAZ. Conservation lands included areas managed by the St. Johns River Water Management District and those lands acquired by Alachua County through the Alachua County Forever program. Population density and density change over time were then calculated using these revised TAZ acreages.

These population density growth estimates provided a general sense of the location and intensity of increasing density in the basin. BWG members felt that quantitative estimates of pollutant loading from future growth were not needed for the Orange Creek Basin.

### 2.2.3 Future Growth Estimates

Figures 17 and 18 show 2010 and 2015 population density estimates by TAZ, respectively. Areas with greater than 50% increase in population density are also shown on these figures (hatched areas). Figure 17 identifies areas of rapid growth from 2005-2010, while Figure 18 shows the same for 2010-2015. The TMDL subbasins are also shown.

## Orange Creek Basin Draft BMAP

Population projections based on TAZ data are roughly comparable to projections in the City of Gainesville Comprehensive Plan, the Alachua County Comprehensive Plan, and those developed by the SJRWMD for water supply planning purposes (see Table 1). The Alachua County Comprehensive Plan projections are higher because they are based on a full-county population. Only a portion of the County is located within the Orange Creek Basin. Given the uneven distribution of population within the county, reduction of this projection based on the acres of the County contained within the Basin would not be accurate.

**TABLE 9. COMPARISON OF TAZ POPULATION ESTIMATES TO OTHER DATA SOURCES**

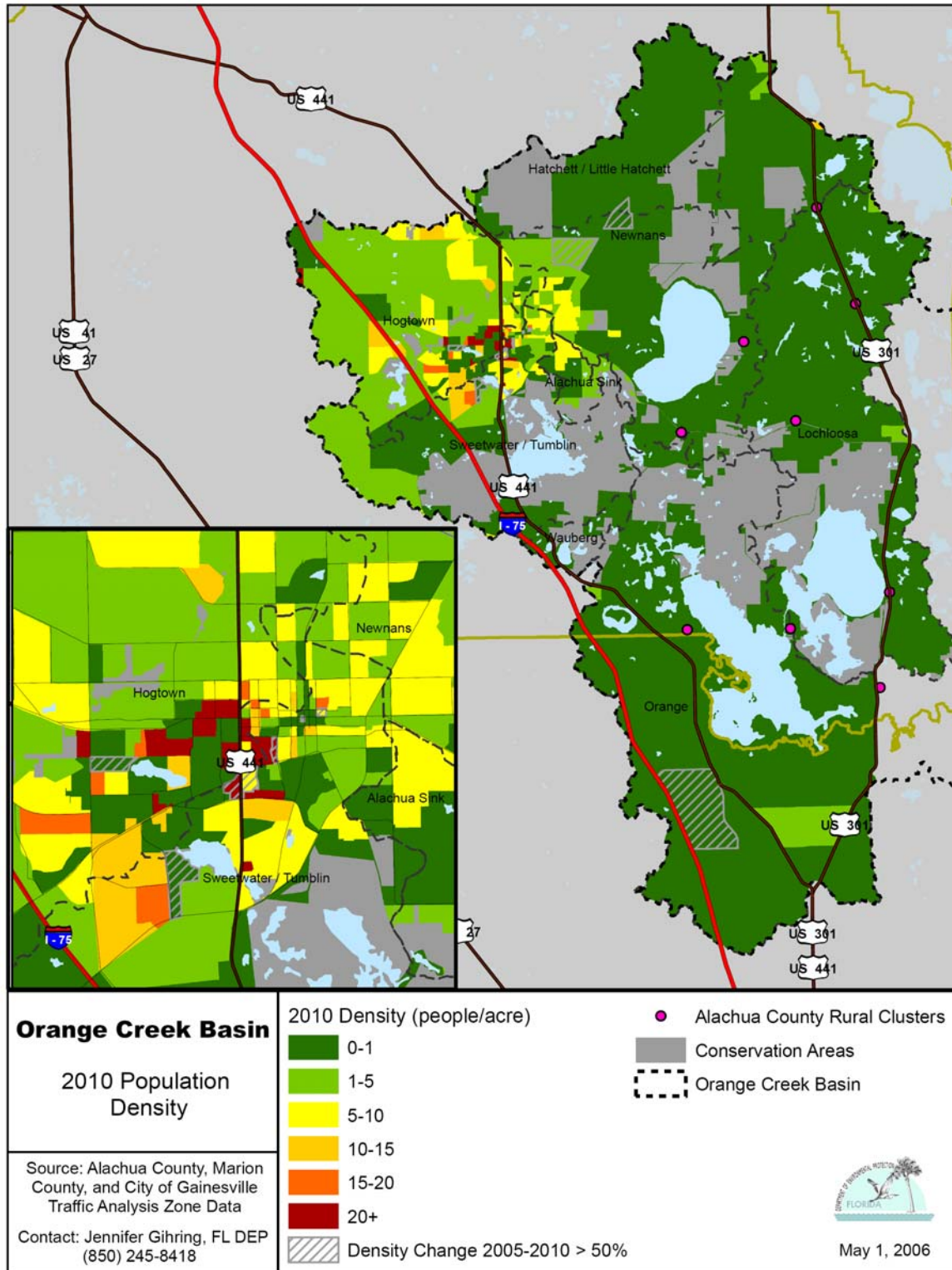
| YEAR | SOURCE                    | ALACHUA COUNTY<br>POPULATION ESTIMATE             | MARION COUNTY<br>POPULATION ESTIMATE |
|------|---------------------------|---------------------------------------------------|--------------------------------------|
| 2000 | Census                    | 180,206<br>(115,753 of this is in<br>Gainesville) | 8,781                                |
| 2005 | TAZ                       | 198,851<br>(118,142 of this is in<br>Gainesville) | 8,297                                |
|      | SJRWMD                    | 178,949<br>(includes Gainesville)                 | 8,698                                |
|      | Alachua Co.<br>Comp. Plan | 237,100<br>(106,677 of this is in<br>Gainesville) | N/A                                  |
| 2010 | TAZ                       | 212,668<br>(124,581 of this is in<br>Gainesville) | 8,687                                |
|      | SJRWMD                    | 190,506                                           | 9,894                                |
|      | Alachua Co.<br>Comp. Plan | 253,600<br>(113,279 of this is in<br>Gainesville) | N/A                                  |

Sources:

- *Alachua County Comprehensive Plan: 2001-2020 (Future Land Use Element). These estimates match those in the City of Gainesville Comprehensive Plan, February 6, 2001 (Future Land Use Element, Table 9).*
- *SJRWMD via Richard Doty, GIS Associates. June, 2006.*

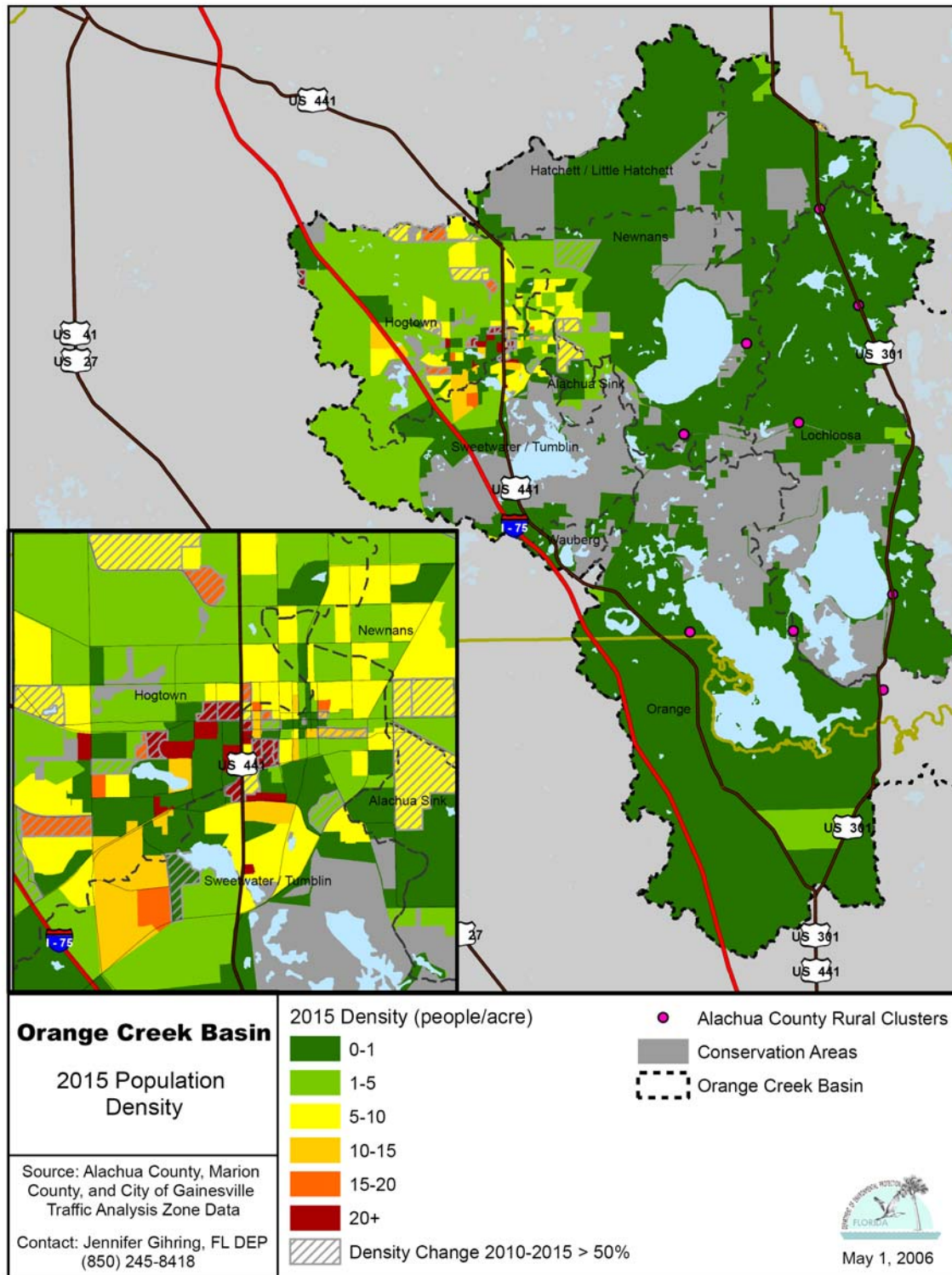
## Orange Creek Basin Draft BMAP

**FIGURE 17. ORANGE CREEK BASIN POPULATION DENSITY (2010) AND AREAS OF RAPID GROWTH (2005-2010)**



## Orange Creek Basin Draft BMAP

**FIGURE 18 . ORANGE CREEK BASIN POPULATION DENSITY (2015) AND AREAS OF RAPID GROWTH (2010-2015)**



## **Orange Creek Basin Draft BMAP**

### **2.2.4 Impacts of Future Growth**

Patterns of population growth are very similar from 2005-2010 versus 2010-2015. The majority of growth is anticipated within Gainesville and in areas directly north and west of the City. This includes portions of the I-75 corridor.

Covering most of the City of Gainesville, the Sweetwater Branch/Tumblin Creek and Hogtown Creek subbasins have the highest population density within the Basin. Furthermore, the majority of future growth is expected to occur in these subbasins as well (see inset in Figure 18). Portions of these subbasins are expected to increase more than 50% in population density from 2010-2015.

In the absence of pollution prevention activities, increasing population density further in urbanized portions of these subbasins may increase coliform levels in Hogtown Creek, Tumblin Creek, and Sweetwater Branch. However, management actions outlined in the BMAP, including control of pet waste, will minimize the effects of this future growth (see Chapter 3).

Growth in the eastern and southern portions of the Orange Creek Basin will be limited. Several rural areas show a rapid relative increase in density. However, these areas are starting from a very low population density (less than 1 person per acre). As such, significant water quality impacts of these population increases are unlikely.

Local governments in the Basin have a variety of programs in place to manage the water quality impacts of future growth. These management actions are discussed in Chapter 3. The combination of low overall population growth pressure, implementation of stormwater management for new development, and retrofitting older developed areas will minimize water quality impacts associated with future population growth in the basin.

## Orange Creek Basin Draft BMAP

### 2.3 WATER QUALITY TRENDS

The data for establishing TMDLs in the Orange Creek Basin was taken from the following data periods:

**TABLE 10 . TMDL DATA PERIODS**

| WATERBODY    | TMDL DATA PERIOD | WATERBODY         | TMDL DATA PERIOD |
|--------------|------------------|-------------------|------------------|
| Newnans Lake | 1996 - 2000      | Hatchet Creek     | 1995 - 2002      |
| Orange Lake  | 1/95 - 12/2000   | Hogtown Creek     | 1995 - 2002      |
| Lake Wauberg | 1990 - 2000      | Tumblin Creek     | 1995 - 2000      |
| Alachua Sink | 2000 - 2004      | Sweetwater Branch | 2000-2004        |

SJRWMD statistically analyzed trends in Trophic State Index for Newnans, Orange and Lochloosa lakes for the period of record through 2003, and found a significant deterioration in water quality since 1969 in Newnans and since 1986 in Orange and Lochloosa. In this analysis, SJRWMD used the recent four years (2003 –2006) average values of TN, TP, Chlorophyll a data, and calculated annual Trophic State Index (TSI) examining the water quality status in the three lakes.

Table 11 show the average concentration for TP, TN, Chlorophyll a, and TSI for the three lakes for the period of 2003 to 2006. These results indicate that Newnans Lake is hypereutrophic lake as indicated by very high TN, TP, and Chlorophyll a concentrations. Orange lake is hypereutrophic based on TN and TP, and it is eutrophic based on Chlorophyll a concentration. Lochloosa lake is hypereutrophic based on TN, and it is eutrophic based on TP and Chlorophyll a concentration. The TSIs indicate Lochloosa and Orange lakes water quality is in fair status condition and Newnans Lake is in poor status condition.

**Table 11. Average total phosphorus, total nitrogen and chlorophyll a concentration and TSI in three OCB lakes during 2003 – 2006**

| Lake      | TP (mg/l) | TN (mg/l) | Chlorophyll a (ug/l) | TSI |
|-----------|-----------|-----------|----------------------|-----|
| Lochloosa | 0.090     | 1.59      | 20                   | 62  |
| Newnans   | 0.140     | 2.43      | 65                   | 74  |
| Orange    | 0.160     | 1.92      | 33                   | 69  |

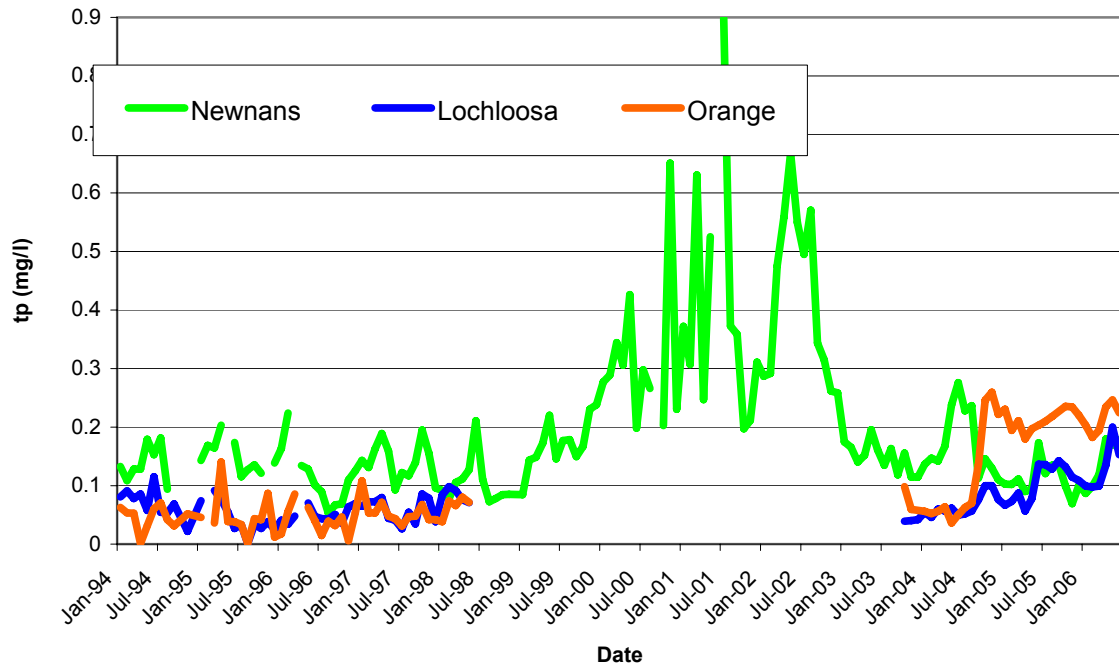
#### *Water quality trends*

The water quality trends are examined by plotting TP, TP, and Chlorophyll a monthly concentration data from 1994 to 2006. Figures 19 to 21 show the monthly TP, TN, and Chlorophyll a concentrations for all the three lakes. The data gap is due to the low water level in Lochloosa and Orange lakes for that period. From 1998 to late 2002 Newnans Lake had the worst water quality ever based on all the historical data we can find. Prior to 2004, Newnans Lake had the highest TP, TN, and Chlorophyll a concentration most of the time among the three lakes, and Orange Lake had the best water quality among the lakes. Since September, 2004, Orange lake has the highest TP concentration in all the

## Orange Creek Basin Draft BMAP

three lakes. TP concentration in Orange Lake reached in a historic high in the past two years.

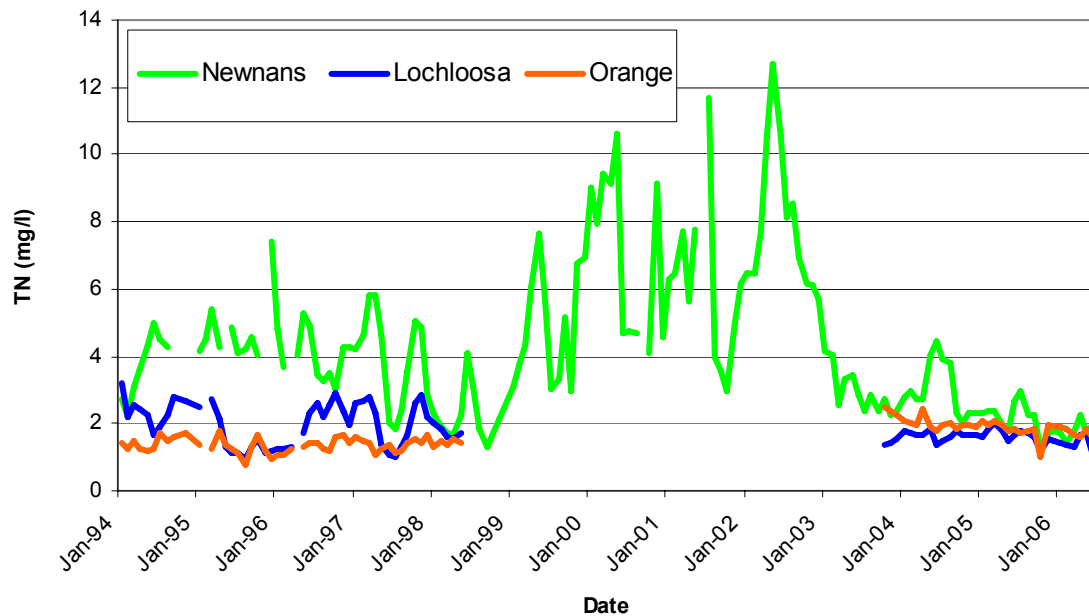
Figure 19. Total phosphorus concentration in three Orange Creek Basin lakes from 1994 - 2006



Source: SJRWMD, 2006

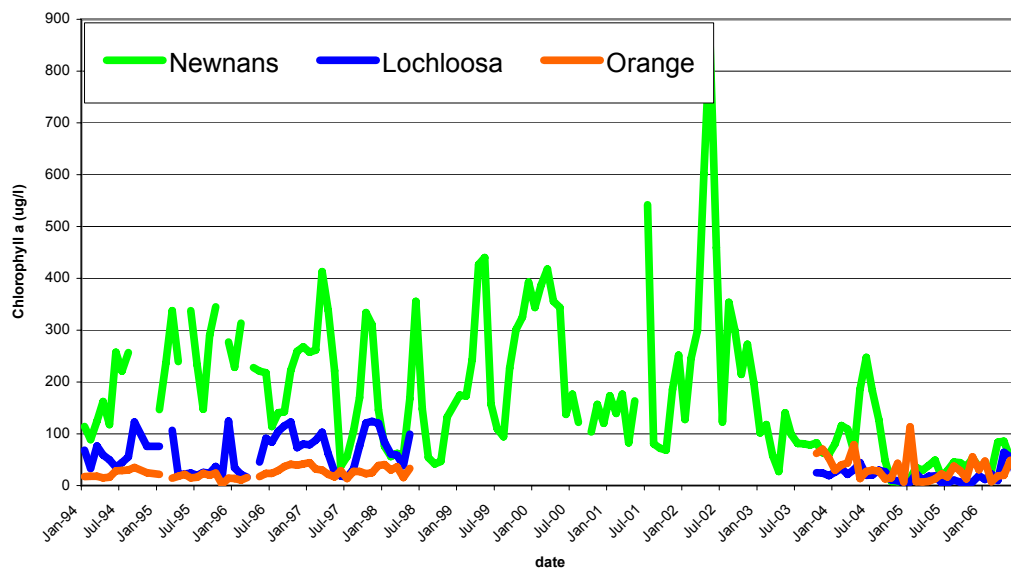
## Orange Creek Basin Draft BMAP

Figure 20. Total nitrogen concentration in three Orange Creek Basin lakes from 1994 - 2006



Source: SRJWMD, 2006

Figure 21. Chlorophyll a concentration in three Orange Creek Basin lakes from 1994 - 2006

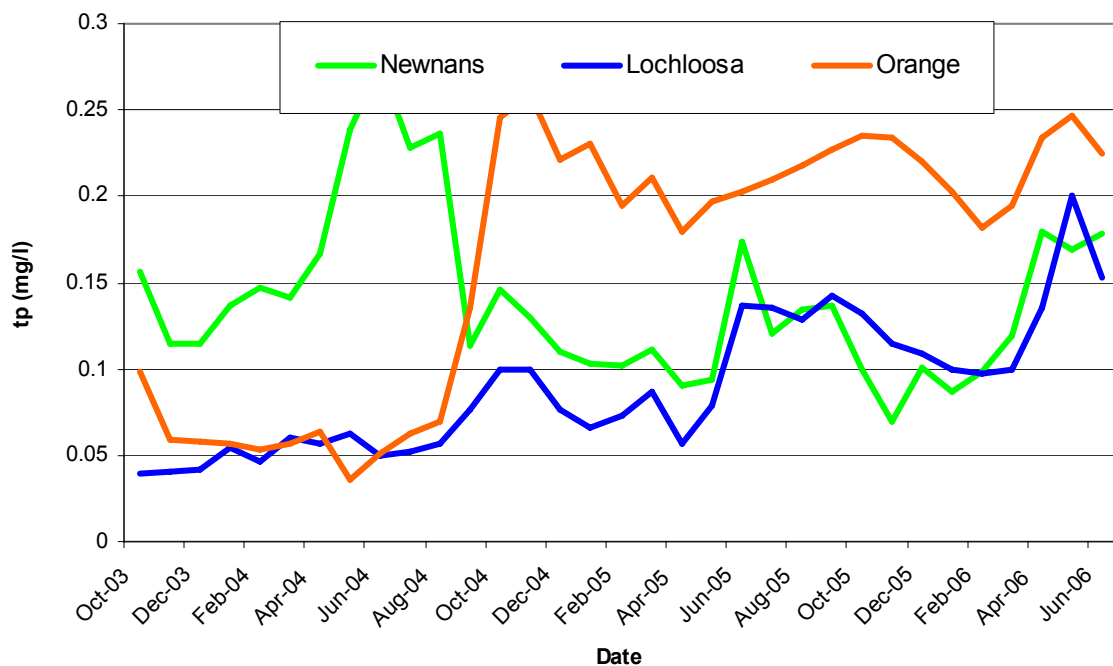


Source; SJRWMD, 2006

## Orange Creek Basin Draft BMAP

Water quality trends from 2003 to 2006 are illustrated in the figure 22 to 24. Based on TP and TN concentration charts (figure 22 and 23) and the TSI chart (figure 24), the water quality in Newnans Lake is on an improving trend. For Orange and Lochloosa lakes, the trend is not as clear as indicated by the data in the Newnans lake. Based on TP concentration chart (figure 25), it indicates that the water quality is deteriorating in both of the lakes. However, as Figure 25 shows, the TSI values from 2003 to 2006 indicate that the water quality is improving or not changing in these two lakes.

Figure 22. Total phosphorus concentration in three Orange Creek Basin lakes from 2003 - 2006



## Orange Creek Basin Draft BMAP

Figure 23. Total nitrogen concentration in three Orange Creek Basin lakes from 2003 - 2006

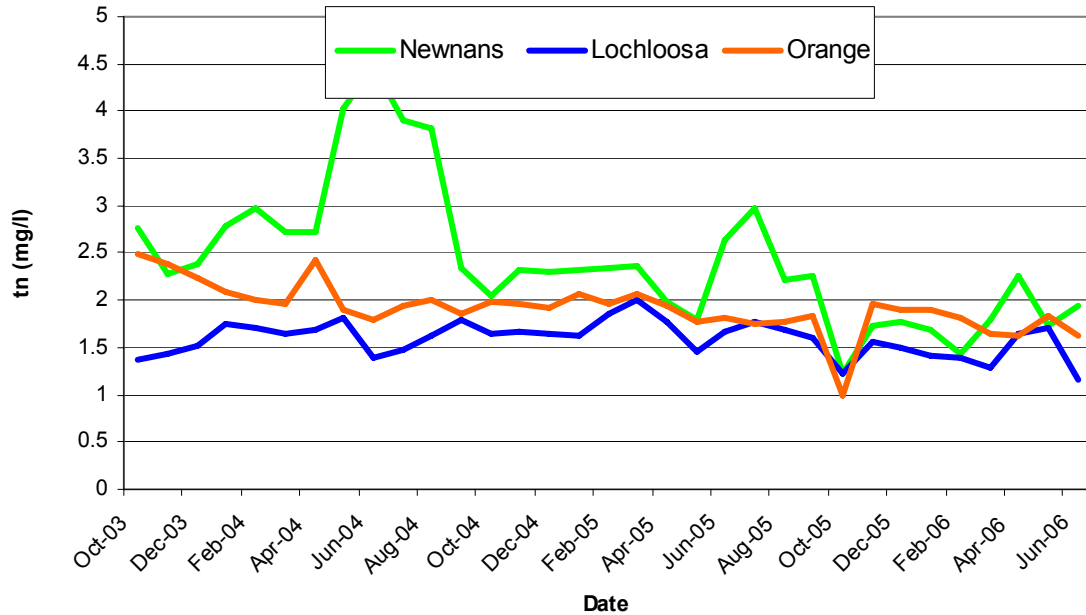
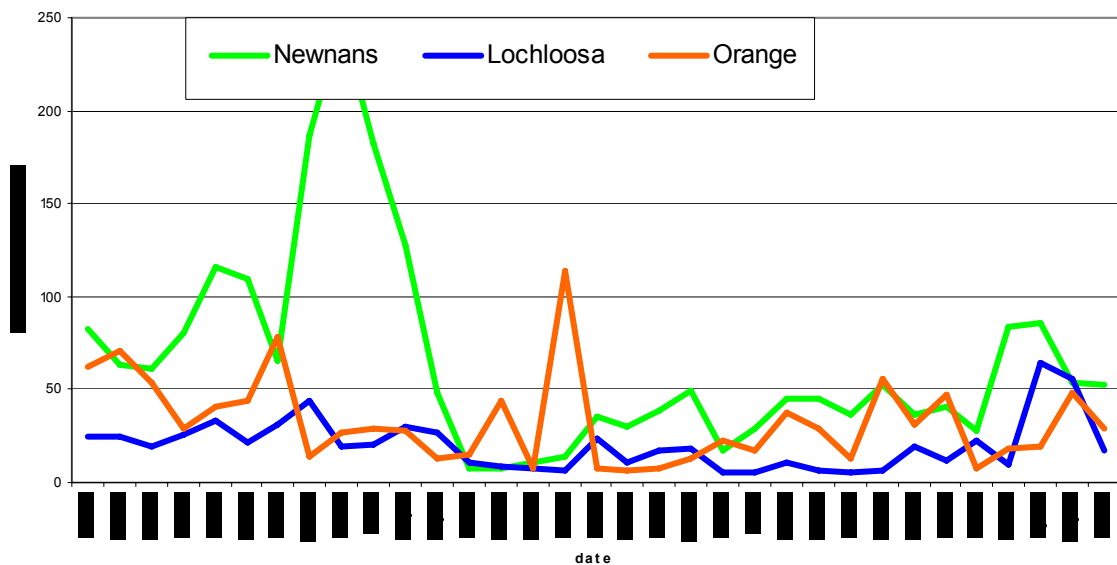
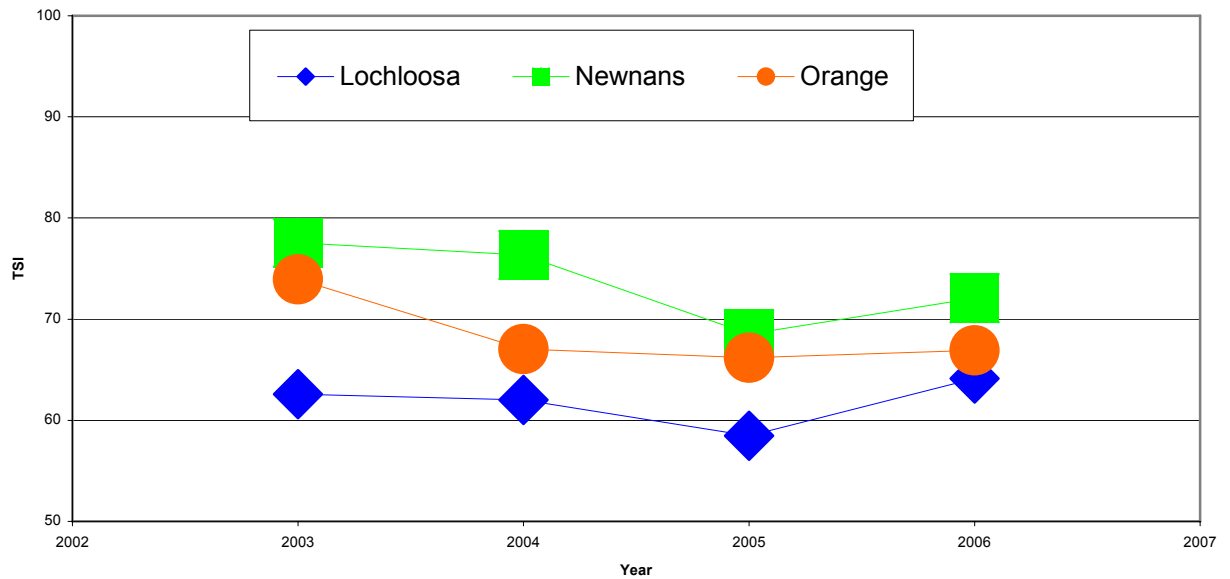


Figure 24. Chlorophyll a concentration in three Orange Creek Basin lakes from 2003 - 2006



## Orange Creek Basin Draft BMAP

Figure 25. Average annual TSI in three Orange Creek Basin lakes from 2003 -2006



### 2.4 WATER QUALITY ISSUES

The Orange Creek Basin Working Group categorized the current water quality issues in the basin for purposes of BMAP development, as follows:

- **Primary** - Issues most likely to be directly linked to the TMDLs established for the Orange Creek Basin that need to be addressed in the BMAP during this TMDL/BMAP cycle. These are generally the causes of DEP-verified impairments. The BWG identified the following primary issues:
  - Point source control
  - Municipal separate storm sewer systems
  - Nonpoint stormwater runoff
  - Aquatic plant management
  - Tributary inflows
  - Septic tank systems
  - Increased loading from future growth
- **Secondary** - Issues that either result from primary issues, or are not of significant enough impact to be categorized as primary issues. These issues are likely to be addressed indirectly through BMAP strategies developed for primary issues. The BWG identified the following as secondary issues:
  - Internal recycling of nutrients
  - Leakage from wastewater collection systems
  - Aquatic plant management
  - Altered hydrology
  - Discharges to groundwater

## Orange Creek Basin Draft BMAP

- **Other** - Issues least likely to be directly linked to the current TMDLs. These are issues that might be addressed indirectly through BMAP strategies or other (concurrent or future) broad-based efforts within the community, such as growth management and pollution prevention.

**Table 12** presents an issues table of primary, secondary, and other issues by subbasin. The entity primarily responsible for addressing each issue is identified. Further, each issue is identified as a high priority, low to medium priority, or impacts currently unknown. This prioritization is both issue- and subbasin-specific. This prioritized list of issues is based on extensive discussions, information from water quality-related plans and reports on the Orange Creek Basin (e.g., the DEP *Ocklawaha Water Quality Assessment Report*), and local knowledge. This list represents the priorities of the BWG at the time of BMAP development. These water quality issues and potential sources may not be identified in the adopted TMDLs for each waterbody. This table is meant to provide a general framework of water issues may need to be address or resolved to achieve the TMDLs in the Orange Creek Basin. The table is not intended to allocate load reductions specified in the adopted TMDLs to the potential sources or responsible parties listed.

# Orange Creek Basin - DRAFT BMAP

TABLE 12 . SUMMARY OF WATER QUALITY ISSUES/POTENTIAL SOURCES FOR ORANGE CREEK BASIN TMDLS

| ORANGE CREEK SUB-BASINS & WBID NUMBER                                                                                                             |                      |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------------------------|---------------------------|---------------------------------------|----------------------------|---------------------------------------------------------------|----------------------------|----------------------------|-----------------------------|------------------------|
| WATER QUALITY ISSUES <sup>1</sup><br>● <b>HIGH-PRIORITY ISSUE</b><br>○ <b>LOW- TO MEDIUM-PRIORITY ISSUE</b><br>◇ <b>IMPACTS CURRENTLY UNKNOWN</b> |                      | NEWNANS<br>LAKE<br>(2705B)            | ORANGE<br>LAKE<br>(2749A) | LAKE<br>WAUBERG<br>(2741)             | ALACHUA<br>SINK<br>(2720A) | LOCHLOOSA/<br>CROSS<br>CREEK<br>(2738A /<br>2754)<br>DEFERRED | HATCHET<br>CREEK<br>(2688) | HOGTOWN<br>CREEK<br>(2698) | TUMBLIN<br>CREEK<br>(2718A) | SW<br>BRANCH<br>(2711) |
|                                                                                                                                                   |                      | TOTAL<br>NITROGEN<br>& TOTAL<br>PHOS. | TOTAL<br>PHOS. /<br>CHL-A | TOTAL<br>NITROGEN<br>& TOTAL<br>PHOS. | PENDING                    |                                                               | TOTAL<br>COLIF. &<br>IRON  | FECAL<br>COLIF.            | FECAL &<br>TOTAL<br>COLIF.  | FECAL<br>COLIF.        |
| PRIMARY ISSUES                                                                                                                                    | ENTITY <sup>2</sup>  |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| Point Source Control                                                                                                                              |                      |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| ▪ Municipal Plant Discharges                                                                                                                      | GRU                  |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| – Main Street WW                                                                                                                                  |                      |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| – Kelly Power Plant                                                                                                                               |                      |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| ▪ Wastewater Infrastructure                                                                                                                       | GRU                  |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| – Leakage from WW collection systems                                                                                                              |                      |                                       |                           |                                       |                            |                                                               | ●                          | ●                          | ●                           | ●                      |
| – Illegal connections to SW                                                                                                                       | ACEPD                |                                       |                           |                                       |                            |                                                               |                            | ●                          | ●                           | ●                      |
| – Private collection systems (including overflows)                                                                                                | DEP/ACEPD            | ●                                     |                           |                                       |                            |                                                               | ●                          | ●                          | ●                           | ●                      |
| ▪ Package Plants                                                                                                                                  | DEP/ACEPD            | ●                                     | ●                         | ●                                     | ●                          | ●                                                             | ●                          |                            |                             |                        |
| MS4 SW systems (outfalls)                                                                                                                         | GCWP*                |                                       |                           |                                       |                            |                                                               |                            | ●                          | ●                           | ●                      |
| Nonpoint Stormwater Runoff                                                                                                                        |                      |                                       | ●                         |                                       |                            |                                                               |                            | ●                          | ●                           | ●                      |
| ▪ SW runoff from developed areas                                                                                                                  |                      |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| – Private roadways/parking lots                                                                                                                   | ACEPD                | ●                                     |                           |                                       |                            |                                                               |                            | ●                          | ●                           | ●                      |
| – Roads/rights of way                                                                                                                             | DOT/AC/MC/McIn./GWCP | ●                                     | ●                         |                                       | ●                          | ●                                                             |                            |                            |                             | ●                      |
| – Hawthorne stormwater                                                                                                                            | ACEPD                |                                       |                           |                                       |                            | ●                                                             |                            |                            |                             |                        |
| – Animal waste                                                                                                                                    | GCWP*                |                                       |                           |                                       |                            |                                                               |                            | ●                          | ●                           | ●                      |
| – Homeless populations along streambanks                                                                                                          | GCWP*/G'ville        |                                       |                           |                                       |                            |                                                               |                            | ●                          | ●                           | ●                      |
| – Landscaping/lawns                                                                                                                               | GCWP*/ACEPD          | ●                                     | ●                         | ●                                     | ●                          | ●                                                             | ●                          |                            |                             | ●                      |
| – SW system outfalls                                                                                                                              | GCWP*/ACEPD          | ●                                     | ●                         | ●                                     | ●                          | ●                                                             |                            |                            |                             |                        |
| ▪ Agricultural Runoff                                                                                                                             | DACS                 |                                       |                           |                                       |                            |                                                               |                            |                            |                             |                        |
| – Animal/livestock farms                                                                                                                          |                      | ●                                     | ●                         |                                       |                            | ◇                                                             | ◇                          |                            | ●                           |                        |
| – Crop farms                                                                                                                                      |                      | ●                                     | ●                         |                                       |                            | ◇                                                             | ◇                          |                            | ●                           |                        |

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TABLE 12 . SUMMARY OF WATER QUALITY ISSUES/POTENTIAL SOURCES FOR ORANGE CREEK BASIN TMDLS

| ORANGE CREEK SUB-BASINS & WBID NUMBER                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------|------------------------|------------------------------|-------------------------|---------------------------------------------|-------------------------|-------------------------|--------------------------|---------------------|
| WATER QUALITY ISSUES <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                             | NEWNANS LAKE<br>(2705B)      | ORANGE LAKE<br>(2749A) | LAKE WAUBERG<br>(2741)       | ALACHUA SINK<br>(2720A) | LOCHLOOSA/<br>CROSS CREEK<br>(2738A / 2754) | HATCHET CREEK<br>(2688) | HOGTOWN CREEK<br>(2698) | TUMBLIN CREEK<br>(2718A) | SW BRANCH<br>(2711) |
| ● HIGH-PRIORITY ISSUE<br>○ LOW- TO MEDIUM-PRIORITY ISSUE<br>◇ IMPACTS CURRENTLY UNKNOWN                                                                                                                                                                                                                                                                                                                                                                                  |                             | TOTAL NITROGEN & TOTAL PHOS. | TOTAL PHOS. / CHL-A    | TOTAL NITROGEN & TOTAL PHOS. | PENDING                 | DEFERRED                                    | TOTAL COLIF. & IRON     | FECAL COLIF.            | FECAL & TOTAL COLIF.     | FECAL COLIF.        |
| PRIMARY ISSUES                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                             | ENTITY <sup>2</sup>          |                        |                              |                         |                                             |                         |                         |                          |                     |
| <div>▪ Silviculture Activities</div> <div>Tributary Inflows</div> <div>– From Prairie Creek, Bivens Arm, Alachua Lake</div> <div>– From Lake Forest Creek alteration</div> <div>– From Hatchet Creek</div> <div>– From Little Hatchet Creek</div> <div>Septic tank systems (see density map for residential septic)</div> <div>– Lakeview</div> <div>– SW Corner – Uninc. Alachua Co.</div> <div>– Town of Windsor</div> <div>Increased Loading from Future Growth</div> | DACS/<br>LAND-OWNERS<br>N/A | ○                            | ○                      |                              |                         | ○                                           |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             |                              | ●                      |                              | ●                       |                                             |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | ●                            |                        |                              |                         |                                             |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | ◇                            |                        |                              |                         |                                             |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | ○                            |                        |                              |                         |                                             |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ACHD/<br>ACEPD              | ●                            | ●                      | ●                            | ●                       | ●                                           | ●                       | ●                       | ●                        | ●                   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | ●                            |                        |                              |                         |                                             |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | ●                            |                        |                              |                         | ●                                           |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | ●                            |                        |                              |                         |                                             |                         |                         |                          |                     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                             | AC/MC                        | ●                      | ●                            | ●                       | ●                                           | ●                       | ●                       | ●                        | ●                   |
| SECONDARY                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                             |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
| Internal Recycling of Nutrients                                                                                                                                                                                                                                                                                                                                                                                                                                          | N/A                         | ●                            | ●                      | ○                            | ●                       | ○                                           |                         |                         |                          |                     |
| Leakage from WW Collection Systems                                                                                                                                                                                                                                                                                                                                                                                                                                       | GRU                         | ●                            |                        |                              |                         |                                             |                         |                         |                          |                     |
| Aquatic Plant Management                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DEP                         | ◇                            | ◇                      | ◇                            |                         | ◇                                           |                         |                         |                          |                     |
| Altered Hydrology <sup>3</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                           | N/A                         | ●                            | ●                      | ●                            | ●                       | ●                                           | ●                       | ●                       | ●                        | ●                   |
| Discharges to Groundwater                                                                                                                                                                                                                                                                                                                                                                                                                                                | N/A                         |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
| ▪ Nitrate to aquifer through sinkhole                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |                              |                        |                              | ●                       |                                             |                         |                         |                          |                     |
| ▪ Discharge to aquifer via HaileSink                                                                                                                                                                                                                                                                                                                                                                                                                                     |                             |                              |                        |                              |                         |                                             |                         | ●                       |                          |                     |
| OTHER                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                             |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
| Recreational Use                                                                                                                                                                                                                                                                                                                                                                                                                                                         | N/A                         | ○                            | ○                      | ○                            |                         | ○                                           | ○                       |                         |                          |                     |
| Erosion and Sedimentation                                                                                                                                                                                                                                                                                                                                                                                                                                                | N/A                         |                              |                        |                              |                         |                                             |                         | ●                       | ●                        | ●                   |
| Overflows from GRU sewer system                                                                                                                                                                                                                                                                                                                                                                                                                                          | GRU/DEP                     | ○                            |                        |                              |                         |                                             | ○                       | ○                       | ○                        | ○                   |

## Orange Creek Basin Draft BMAP

TABLE 12 . SUMMARY OF WATER QUALITY ISSUES/POTENTIAL SOURCES FOR ORANGE CREEK BASIN TMDLS

| ORANGE CREEK SUB-BASINS & WBID NUMBER |                               |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
|---------------------------------------|-------------------------------|------------------------------|------------------------|------------------------------|-------------------------|---------------------------------------------|-------------------------|-------------------------|--------------------------|---------------------|
| WATER QUALITY ISSUES <sup>1</sup>     |                               | NEWNANS LAKE<br>(2705B)      | ORANGE LAKE<br>(2749A) | LAKE WAUBERG<br>(2741)       | ALACHUA SINK<br>(2720A) | LOCHLOOSA/<br>CROSS CREEK<br>(2738A / 2754) | HATCHET CREEK<br>(2688) | HOGTOWN CREEK<br>(2698) | TUMBLIN CREEK<br>(2718A) | SW BRANCH<br>(2711) |
| ●                                     | HIGH-PRIORITY ISSUE           | TOTAL NITROGEN & TOTAL PHOS. | TOTAL PHOS. / CHL-A    | TOTAL NITROGEN & TOTAL PHOS. | PENDING                 | DEFERRED                                    | TOTAL COLIF. & IRON     | FECAL COLIF.            | FECAL & TOTAL COLIF.     | FECAL COLIF.        |
| ○                                     | LOW- TO MEDIUM-PRIORITY ISSUE |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
| ◇                                     | IMPACTS CURRENTLY UNKNOWN     |                              |                        |                              |                         |                                             |                         |                         |                          |                     |
| PRIMARY ISSUES                        |                               | ENTITY <sup>2</sup>          |                        |                              |                         |                                             |                         |                         |                          |                     |
| Leakage from WW collection systems    |                               | GRU                          |                        |                              |                         |                                             |                         |                         |                          |                     |
|                                       |                               |                              |                        |                              | ○                       |                                             |                         |                         |                          |                     |

<sup>1</sup> These water quality issues and potential sources may not be identified in the adopted TMDLs for each waterbody. This table is meant to provide a general framework of water issues that may need to be addressed or resolved to achieve the TMDLs in the Orange Creek Basin. This table is not intended to allocate load reductions specified in the adopted TMDLs to the potential sources or responsible parties listed. This table is subject to review and revision during BMAP implementation.

<sup>2</sup> This column indicates who will be most likely to develop and implement a related BMAP strategy.

<sup>3</sup> Further study and discussion needed to determine the nature of the altered hydrology, whether alterations directly contribute to loadings, and whether to address in the BMAP

\* The Gainesville Clean Water Partnership (GCWP) does not function as a regulatory entity. It is a cooperative partnership of the City of Gainesville, Alachua County, and the Florida Department of Transportation, dedicated to working with the Gainesville community for healthy waterways.

## CHAPTER 3. BROAD-BASED MANAGEMENT ACTIONS

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A wide variety of management programs, projects, and activities are in place to achieve the load reductions required to meet the TMDL(s) for this basin. Table 13 summarizes programs that are in place to address TMDL(s) basin-wide. This table includes activities such as stormwater retrofit projects, urban stormwater BMPs, habitat restoration, land development regulations, public education/outreach, and others. Examples of current management actions include the following:

- **Stormwater Retrofits**
  - Paving and drainage upgrades
  - Failing infrastructure replacement and improvement
  - Sediment and debris collection boxes (baffle boxes)
- **Urban Structural BMPs**
  - Regional wet detention stormwater ponds
  - Dry retention stormwater ponds
- **Urban Nonstructural BMPs**
  - Street sweeping
  - Cleaning up pet waste
- **Agricultural BMPs**
  - Crop rotation
  - Filter strips
  - Exclusion of livestock from sensitive areas
- **Habitat Restoration**
  - Marsh construction
  - Wetland restoration
  - Gizzard shad harvesting
- **Ordinances and LDRs**
  - Development guidelines
  - Septic tank ordinances
  - Local stormwater rules more stringent than state or water management district rules
- **Education and Outreach**
  - Watershed Action Volunteers Program
  - Lakefront property owners' guides
  - Water Atlases

This subsection describes management programs, projects, and activities that are broadly applied across the Basin. Chapters \_\_\_ and \_\_\_ provide more detail on management actions that specifically address nutrient impairment in lake subbasins (Chapter \_\_\_) and coliform impairments in urban creeks (Chapter \_\_\_). Detailed project information can be found in Appendix E.

Regulatory permit programs under the authority of several entities are one mechanism used to reduce pollutant loading in the Orange Creek Basin. These programs address reduction of current loads (e.g. NPDES outreach efforts) as well as limiting the impact of future growth (e.g. SJRWMD Environmental Resource Permitting program). The non-regulatory programs discussed below also facilitate the reduction of pollutant loads. All of the following programs

seek cooperative solutions between administering agencies, local governments, and regulated entities.

**TABLE 13 . PRIMARY EXISTING PROGRAMS THAT ADDRESS POLLUTANT LOADINGS IN THE ORANGE CREEK BASIN**

| PROGRAM                                                 | LEAD ENTITY                    | BRIEF DESCRIPTION                                                                                                                                                                                                                           |
|---------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| POINT SOURCE PERMITTING                                 | DEP                            | Permits and associated effluent limitations for industrial and domestic wastewater facilities.                                                                                                                                              |
| ENVIRONMENTAL RESOURCE PERMITTING                       | SJRWMD                         | Permit provisions address construction activity that would affect wetlands, alter surface water flows, or contribute to water pollution.                                                                                                    |
| SURFACE WATER IMPROVEMENT AND MANAGEMENT PROGRAM        | SJRWMD                         | This plan describes various issues, goals, strategies, programs, and projects to restore water quality and aquatic and wetlands habitats in the major lakes and streams of the Orange Creek Basin.                                          |
| POLLUTANT LOAD REDUCTION GOALS                          | SJRWMD                         | PLRGs are intended to reduce external loadings of nutrient pollutants through the establishment and implementation of loading goals.                                                                                                        |
| NPDES                                                   | GCWP                           | Implement the six minimum control measures: public education and outreach, public participation, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention. |
| WATERSHED ACTION VOLUNTEERS PROGRAM                     | City of Gainesville/ ACEPD     | Train and equip volunteers to give pollution prevention presentations; use water quality monitoring field test kits; assist in stream surveys and other activities.                                                                         |
| CURRENT PROBLEMS PROGRAM                                | City of Gainesville/ ACEPD     | Involve county residents in pollution prevention through participation in cleanup and restoration activities.                                                                                                                               |
| OTHER POLLUTION PREVENTION PROGRAMS                     | GCWP                           | Public information campaigns, environmental festivals, partnerships with businesses/organizations.                                                                                                                                          |
| BEST MANAGEMENT PRACTICES PROGRAM                       | GCWP                           | Development of pollution prevention BMPs for government and business; distribution of fact sheets through existing programs.                                                                                                                |
| WATER QUALITY CODE COMPLAINT AND SPILL RESPONSE PROGRAM | ACEPD                          | Prohibitions on non-stormwater discharges into the MS4 system; 24-hours a day response to spills.                                                                                                                                           |
| ILLICIT DISCHARGE/ ELIMINATION PROGRAM                  | ACEPD                          | Detect and eliminate any non-stormwater discharges to the MS4                                                                                                                                                                               |
| FACILITY INSPECTION PROGRAM                             | ACEPD                          | Visual inspection of storm drains and stormwater management systems in the vicinity of regulated facilities; visual inspection of floor drains; collection of water quality samples, as necessary.                                          |
| SEPTIC TANK SYSTEM MANAGEMENT                           | Alachua County, Marion County, | Local studies and efforts to identify                                                                                                                                                                                                       |

| PROGRAM                                                         | LEAD ENTITY                                     | BRIEF DESCRIPTION                                                                                                                                    |
|-----------------------------------------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| LOW IMPACT DEVELOPMENT                                          | City of Gainesville, & GRU<br>Local Governments | Increasing infiltration, limiting site disturbance, limiting impervious surfaces, and other activities that decrease the impact of land development. |
| AGRICULTURAL BEST MANAGEMENT PRACTICES (INCLUDING SILVICULTURE) | DACS & Private Landowners                       | Implementation of approved best management practices for pollution prevention.                                                                       |

### 3.1 Point Source Permitting

Protecting the amount and quality of our water resources is the goal of proper wastewater management. The DEP issues wastewater permits for domestic, and industrial wastewater discharges.

The DEP issues permits for systems that treat and reuse by land application the treated effluent as reclaimed water. Other facilities provide treated effluent and discharge to surface waters and the DEP issues permits under the coordination of the federally delegated National Pollutant Discharge Elimination System (NPDES).

Domestic wastewater facilities are those principally designed to collect and treat sanitary wastewater or sewage from dwellings or homes, business buildings, institutions, and the like. Otherwise, individually permitted facilities are classified as industrial wastewater treatment facilities.

**TABLE 14 . ENTITIES IN THE ORANGE CREEK BASIN REGULATED UNDER DEP WASTEWATER PERMITS**

| PERMITTEE                                          | PERMIT COVERAGE DATES | PERMITTED CAPACITY ANNUAL AVERAGE DAILY FLOW (MGD) | PERMIT NUMBER | DISCHARGE                                                     |
|----------------------------------------------------|-----------------------|----------------------------------------------------|---------------|---------------------------------------------------------------|
| GAINESVILLE REGIONAL UTILITIES – MAIN STREET WWTF  | 9/15/2003 – 9/14/2008 | 7.50                                               | FL0027251     | Sweetwater Branch                                             |
| GAINESVILLE REGIONAL UTILITIES – KELLY POWER PLANT | 7/28/03-7/27/08       | 0.060                                              | FL0040215     | Sweetwater Branch                                             |
| GAINESVILLE REGIONAL UTILITIES – KANAPAHA          | 3/17/03 - 3/16/08     | 14.9                                               | FL0112895     | Reuse of reclaimed water: spray irrigation, aquifer recharge. |
| BRITTANY ESTATES WWTF                              | 9/25/06 – 9/24/11     | 0.060                                              | FLA011291     | Little Hatchet Creek                                          |

| PERMITTEE                    | PERMIT<br>COVERAGE<br>DATES | PERMITTED<br>CAPACITY<br>ANNUAL<br>AVERAGE DAILY<br>FLOW (MGD) | PERMIT<br>NUMBER | DISCHARGE                                                          |
|------------------------------|-----------------------------|----------------------------------------------------------------|------------------|--------------------------------------------------------------------|
| CITY OF<br>HAWTHORNE<br>WWTF | 5/3/06 – 5/2/11             | 0.150                                                          | FLA011307        | Land applied to rapid<br>infiltration basins                       |
| PRAIRIE VIEW<br>APTS. WWTF   | 8/26/05 –<br>8/25/10        | 0.0042                                                         | FLA011302        | Land applied to rapid<br>infiltration basins                       |
| CAMP<br>MCCONNELL            | 12/9/04 –<br>12/8/09        | 0.0075                                                         | FLA011291        | Land applied to rapid<br>infiltration basins                       |
| UNIVERSITY OF<br>FLORIDA     | 4/22/03 –<br>4/21/08        | 3.0                                                            | FLA011322        | Reuse of reclaimed<br>water: spray irrigation,<br>aquifer recharge |

### 3.2 Environmental Resource Permitting

Within the area addressed by the Orange Creek Basin Management Action Plan, activities that exceed SJRWMD permitting thresholds must be authorized by an Environmental Resource Permit (ERP) from the District (Chapters 40C-4 through 40C-400, FAC), which incorporates both stormwater treatment and mitigation of any wetland impacts. In order to obtain an ERP where existing ambient water quality does not meet state water quality standards, an applicant must demonstrate that the proposed activity will result in a net improvement in the parameters that do not meet standards.

### 3.3 Surface Water Improvement and Management Program

The TMDL effort in the Ocklawaha River Basin benefits from having three SJRWMD-designated Surface Water Improvement and Management (SWIM) waterbodies located within its boundaries: Orange, Newnans, and Lochloosa Lakes.

In 2003 the Governing Board of the SJRWMD designated the Orange Creek Basin as a priority watershed for protection and restoration under Florida's 1987 SWIM act (Chapter 373.453, FS). The "Orange Creek Basin Surface Water Management Plan" (Lasi, 1996) was approved by the Orange Creek Basin Advisory Council and SJRWMD Governing Board in 1996. This plan provides a comprehensive description of various issues, goals, strategies, programs, and projects to restore water quality and aquatic and wetlands habitats in the major lakes and streams of the Orange Creek Basin.

### 3.4 Pollutant Load Reduction Goal Program

Since 2001, one of the Water Management District's primary emphases in the Orange Creek Basin has been on development of Pollutant Load Reduction Goals (PLRGs) for Newnans, Lochloosa, and Orange lakes. The SJRWMD is developing PLRGs to reduce external loadings of nutrient pollutants (Total Phosphorus, Total Nitrogen) in these regionally significant lakes in the basin. PLRGs will assist DEP in refining their TMDLs for these lakes. PLRGs will also assist the District in designing external-load reduction projects to restore surface water quality to state water quality standards. Water management districts in Florida are required to develop PLRGs by the Water Resources

Implementation Rule (62-40, F.A.C.). PLRG development is part of SJRWMD policy pursuant to the District Water Management Plan.

### 3.5 National Pollutant Discharge Elimination System (NPDES) Stormwater Program

Several entities in the basin are regulated by the Florida National Pollutant Discharge Elimination System (NPDES) Stormwater Program. The basic requirements of this program serve as a foundation for the stormwater management efforts of these communities. The U.S. Environmental Protection Agency (EPA) developed the federal NPDES permitting program in two phases. Phase I, started in 1990, addressed large and medium Municipal Separate Storm Sewer systems (MS4s) located in incorporated places and counties with populations of 100,000 or more, as well as specific industrial activities. Phase II, which was started in 1999, addresses additional sources, including small MS4s. In October 2000, the EPA authorized DEP to implement the NPDES stormwater permitting program in the state. This permitting has remained separate from state stormwater/environmental resource permitting programs and local stormwater/water quality programs, which have their own regulations and permitting requirements.

Florida's rules for medium and large MS4s can be found in Chapter 62-624, F.A.C. Because the MS4s in the Orange Creek Basin are all Phase II, the following discussion will focus on those requirements.

#### *NPDES MS4 Phase II Stormwater Permit Requirements*

Under a generic permit, operators of regulated Phase II MS4s must develop a SWMP that includes best management practices (BMPs), with measurable goals, to effectively implement the following six minimum control measures:

- 1) **Public Education and Outreach:** Perform educational outreach regarding the harmful impacts of polluted stormwater runoff.
- 2) **Public Participation/Involvement:** Comply with state and local public notice requirements and encourage other avenues for citizen involvement.
- 3) **Illicit Discharge Detection and Elimination:** Implement a plan to detect and eliminate any non-stormwater discharges to the MS4, and create a system map showing outfall locations. Federal regulations define an illicit discharge as "...any discharge to an MS4 that is not composed entirely of stormwater..." and can include septic/sanitary sewer discharge, car wash wastewater, laundry wastewater, improper disposal of auto and household toxics, graywater, and spills from roadway accidents.
- 4) **Construction Site Runoff Control:** Implement and enforce an erosion and sediment control program for construction activities.
- 5) **Post-construction Runoff Control:** Implement and enforce a program to address discharges of post-construction stormwater runoff from new development and redevelopment areas. (NOTE: This minimum control is met through state stormwater permitting requirements under Part IV, Chapter 373, F.S., or Chapter 62-25, F.A.C., as a qualifying alternative program.)
- 6) **Pollution Prevention/Good Housekeeping:** Implement a program to reduce pollutant runoff from municipal operations and properly and perform staff pollution prevention training.

The generic permit [DEP Document 62-621.300(7)(a)] also states that: "If a TMDL is approved for any water body into which the Phase II MS4 discharges, and the TMDL includes requirements for control of stormwater discharges, the operator must review

its stormwater management program for consistency with the TMDL allocation. If the Phase II MS4 is not meeting its TMDL allocation, the operator must modify its stormwater management program to comply with the provisions of the TMDL Implementation Plan applicable to the operator in accordance with the schedule in the Implementation Plan.”

Local governments and other entities currently designated as Phase II MS4s that are part of the Orange Creek Basin are listed in **Table 15**. Designation is based on a combination of factors, including population, operation of a storm sewer system, discharge to TMDL waters, interconnection to another jurisdiction’s system, and others.

**TABLE 15 . ENTITIES IN THE ORANGE CREEK BASIN DESIGNATED AS REGULATED PHASE II MS4s**

| PERMITTEE                       | PERMIT COVERAGE DATES | REPORT DUE DATE* | MS4 PERMIT NUMBER |
|---------------------------------|-----------------------|------------------|-------------------|
| CITY OF GAINESVILLE             | 7/09/03-7/08/08       | January 8        | FLR04E006         |
| ALACHUA COUNTY                  | 7/09/03-7/08/08       | January 8        | FLR04E005         |
| MARION COUNTY                   | 7/28/03-7/27/08       | January 27       | FLR04E021         |
| UNIVERSITY OF FLORIDA           | 9/09/03-9/08/08       | March 8          | FLR04E067         |
| FLORIDA DEPT. OF TRANSPORTATION | 6/23/03-6/22/08       | December 22      | FLR04E018         |

\* Phase II MS4 reports are due annually during the first permit term. In subsequent permit terms, the reports are due for years 2 and 4 only, unless otherwise specified by DEP.

### 3.6 Gainesville Clean Water Partnership (GCWP)

On September 20th, 2001 Alachua County, the City of Gainesville, and the Florida Department of Transportation (FDOT) signed an interlocal agreement for the joint implementation of the National Pollutant Discharge Elimination System (NPDES) Phase II Municipal Separate Stormwater Systems (MS4) program in the Gainesville Urbanized Area. The agreement presented a financial plan for the implementation of the minimum control measures, including mapping requirements, public outreach, operations best management practices and illicit discharge detection and elimination program, required by the NPDES Phase II MS4 program. To view a copy of the agreement and budget, visit [www.gainesvillecreeks.org/agreement](http://www.gainesvillecreeks.org/agreement).

The agreement established the City of Gainesville as the lead agency for the joint implementation of the program. On July 8, 2002, the City hired a Program Coordinator to serve as a liaison for the three agencies involved in the agreement and to oversee the program. This includes overseeing the elements required of the permit and assisting involved divisions and departments in compliance with the permit standards. The coordinator is responsible for submitting Alachua County and City of Gainesville NPDES Phase II MS4 permits and all subsequent annual reports. The FDOT is responsible for submitting its own permits and reports, although some of the information presented in the City/County permits and reports is duplicated here. Individual NPDES Phase II MS4 permits were obtained by Alachua County, the City of Gainesville, and FDOT as listed below. All agencies have also submitted annual reports for permit years 1 and 2. To view copies of these permits and subsequent annual reports, please visit [www.gainesvillecreeks.org/permits](http://www.gainesvillecreeks.org/permits).

On August 27th, 2002 Alachua County adopted the Water Quality Code. The Water

Quality Code provided the regulatory framework for the implementation of an illicit discharge detection and elimination program in Alachua County as required by the aforementioned permits. Specifically, Section 77.10 contained regulations regarding prohibitions on non-stormwater discharges into the MS4 system. The Water Quality Code became effective on January 1st, 2003. To view this code, visit [www.municode.com](http://www.municode.com).

On June 24th, 2003 Alachua County and the City of Gainesville signed a "Supplement to Agreement Providing Joint Implementation of The National Pollutant Discharge Elimination System Program". This additional interlocal agreement was signed to establish the illicit discharge detection and elimination program. As part of the agreement, the Alachua County Environmental Protection Department (ACEPD) became the agency responsible for the implementation of the illicit discharge detection and elimination program to satisfy the NPDES Phase II MS4 permit requirements of Alachua County, City of Gainesville and FDOT. To view this agreement and associated budget and projects, visit

A new challenge was presented to the Partnership in 2003; Total Maximum Daily Loads (TMDLs). The Florida Department of Environmental Protection designated TMDLs for several watersheds within the Urban Area during this year. According to rule 62-621.300(7)(a)V.B., F.A.C., if a TMDL is approved for any water body into which a Phase II MS4 discharges, and the TMDL includes requirements for control of stormwater discharges, the operator must review its stormwater management program for consistency with the TMDL allocation. If the Phase II MS4 is not meeting its TMDL allocation, the operator must modify its stormwater management program to comply with the provisions of the TMDL Implementation Plan applicable to the operator in accordance with the schedule in the Implementation Plan. Because of this rule, members of the Partnership became active members of the Orange Creek Basin Working Group.

On September 14, 2004, Alachua County and the City of Gainesville signed a "First Amendment to the Contract for Establishment of an Illicit Discharge Detection and Elimination Program". This document allows excess funds paid by the County, if any, to be applied to the development and implementation of the Total Maximum Daily Loads (TMDLs) Basin Management Action Plans (BMAPs) upon approval by the County Engineer.

#### **Public Outreach Activities**

Since 2001, the GCWP has promoted pollution prevention through its own materials and has also contracted with several organizations. A brief description of the activities associated with each program is listed below. For a more detailed description, please visit the websites given. Information about specific activities performed by these programs are contained in the permits and annual reports, available from the Department of Environmental Protection NPDES Stormwater Section (<http://www.dep.state.fl.us/water/stormwater/npdes/>).

#### **Watershed Action Volunteers Program**

Watershed Action Volunteers (WAV) is a program overseen by the St Johns Water Management District. In Alachua County, the program is locally administered by the City of Gainesville and the Alachua County Environmental Protection Department. This program matches committed individuals with WAV coordinators, who train and equip volunteers for a variety of important tasks related to improving the health of watersheds within the district. WAVs are trained to prepare and give nonpoint source pollution prevention educational presentations to school groups, civic associations, clubs and other organizations. Volunteers are also trained by specialists to use field test kits for monitoring water quality. They also assist in stream surveys, storm drain marking

events, revegetation projects and shoreline cleanups.  
<http://sjr.state.fl.us/programs/outreach/education/wav/wav.html>

### **Current Problems Program**

Current Problems, Inc. (CP) is a non-governmental organization focused on the connection between our surface waters, pollution, and our drinking water supply and cleaning up local waterways. This organization is employed by the City of Gainesville and the Alachua County Environmental Protection Department to assist in involving county residents in pollution prevention through community outreach, creek, pond and sinkhole cleanups and shoreline restoration programs. These programs encourage and assist residents to better protect local waterways by providing tools to change landscaping, lifestyle and living habits.

<http://www.currentproblems.org/>

### **Elvis Otter Program**

In 2003, the Partnership worked with talented local puppeteer Nancy Kenton to develop an elementary level puppet show that would help to educate children about stormwater. Nancy Kenton Puppet Productions (NKPP) created “Elvis Otter & The Creekside Gang”, a 40-minute program aimed at elementary school age students to take place in an intimate classroom or small auditorium setting, for the Gainesville Clean Water Partnership to performed at 44 public and private schools in Alachua County each permit year. The purpose of the program is to teach elementary school age students about pollution prevention. Topics include but are not limited to watersheds, creeks, creek crossings, ditches and storm drains, littering, pets, pollution, lawns and gardens, trees and plants, leaves, groundwater/aquifer, and sinkholes. The students learn the connection between the storm drain system and waterways of Alachua County, how water pollution occurs, what they can do to help prevent it, and what they can do to help Elvis and friends stay alive and safe. NKPP uses audience participation and puppet and mask characters, music, stories, magic, and colorful illustrations to relay the above messages. In addition to visiting all of the schools, Nancy and Elvis perform at special events and also filmed 5 commercials for the GCWP. These commercials are still in production and should be finished by August, 2006 (still more background filming to do). The commercials, after Partnership approval, will air on Channel 12. Unfortunately, after 2 successful program years, Ms. Kenton has relocated to Virginia. She may be able to visit the City recording studio to film the show during permit year 4.

[http://www.gainesvillecreeks.org/get\\_involved/elvis1.htm](http://www.gainesvillecreeks.org/get_involved/elvis1.htm)

### **Additional GCWP Outreach Activities**

In 2004, the NPDES Partners developed and released a new logo and a more descriptive public name – the Gainesville Clean Water Partnership (GCWP). The Partnership makes additional public outreach efforts to work with the Gainesville community for healthy waterways. Through involvement in various public information campaigns, annual festivals, special event like “Creeks Summit” of 2002 and 2004 and “Creeks Week” of 2006, and partnerships with other Gainesville organizations and businesses, the partnership strives to acquaint Gainesville and Alachua County residents with the issues involved in caring for and protecting local waterways and recognizing the contributions which these waterways make every day to the community’s health, safety, comfort, and quality of life. Residents can find information about these activities and programs by visiting the Partnership’s webpage at [gainesvillecreeks.org](http://gainesvillecreeks.org). This site describes the interdependent creeks, watersheds and wetlands in Gainesville, Florida. Visitors to the site can learn how the Gainesville community cares for water

through stormwater management, and learn what they can do to help keep local waterways healthy.

### **Illicit Discharge Detection and Elimination Activities**

Alachua County Environmental Protection Department (ACEPD) is the agency responsible for the implementation of the illicit discharge detection and elimination program to satisfy the NPDES Phase II MS4 permit requirements of Alachua County, City of Gainesville and FDOT. This program strives to reduce coliform, nutrient and other pollutant loads in local waters.

### **Best Management Practices Program**

Pollution prevention Best Management Practices (BMPs) for governmental and business activities are developed and fact sheets are distributed by the Alachua County Environmental Protection Department (ACEPD) and the Partnership. ACEPD staff provides compliance assistance information and distribute Best Management Practices fact sheets as part of the facility inspection and complaint and spill investigation programs (see below). BMPs and fact sheets developed and distributed to relevant parties to date include (pollutants addressed in each fact sheet/bmp are in parentheses):

- Water Quality Code (nutrients and coliforms)
- Erosion and Sedimentation Control at Construction Sites (sediments)
- Controlling Runoff from Car Wash Fundraisers (nutrients)
- Controlling Runoff from Gas Stations (nutrients, other various pollutants)
- Controlling Runoff from Commercial Outdoor Car Washing (nutrients)
- Water Quality Protection at Apartment Complexes (nutrients and coliforms)
- Landscaping & Lawn Maintenance Services (nutrients)
- Controlling Runoff during the Remediation of Contaminated Sites (various pollutants)
- Managing Pet Wastes (coliforms)
- Residential Swimming Pool Maintenance (sediments, various pollutants)
- Pressure Washing Activities (sediments, various pollutants)
- Laundry Services (nutrients, other various pollutants)
- Food Service Industry (grease, other various pollutants)
- Paint contractor (various pollutants)

For an updated listing of BMPs and fact sheets, visit [gainesvillecreeks.org](http://gainesvillecreeks.org).

### **Facility Inspection Program**

In order to improve pollution prevention, ACEPD expanded its existing Hazardous Materials Management Code (HMMC) and Small Quantity Generator (SQG) inspection program to include compliance with the requirements of Section 77.10 of the Alachua County Water Quality Code. The expanded inspection program includes visual inspection of storm drains and storm water management system in the vicinity of each facility, visual inspection of floor drains inside the facility and when necessary collection of water quality samples.

### **Construction Pollution Prevention Activities**

The Gainesville Clean Water Partnership has been active in the construction community since the initiation of the respective agencies NPDES permits. In 2003-4, the partnership took part in seven erosion and sediment control related training sessions. During 2004-5, the partnership sponsored one erosion and sedimentation control class for utilities and took part in another E&S control training class at the Treeo Center. For the 2005-6

permit period, two erosion control related courses were held for local construction companies.

In addition to courses, the Alachua County Environmental Department's Illicit Discharge Detection and Elimination Program, the City of Gainesville's Stormwater Construction Program and the St John's Water Management District have all been active in educating the construction community on a daily basis. Through inspections, education and enforcement, members of the partnership are working together to make the local building community aware of pollution issues associated with construction.

### **Municipal Good Housekeeping Activities**

In 2003, good housekeeping Best Management Practices (BMPs) were determined for Alachua County and City of Gainesville. Since then, divisions have been following and reporting on the following BMPs:

#### **City of Gainesville Fleet Management Department BMPs**

- Fleet Management Facilities Maintenance
- Car Wash Facilities Maintenance
- Materials Management

#### **City of Gainesville Public Works Department, Engineering Division BMPs**

- Pre-Construction Meetings

#### **City of Gainesville Public Works Department, Operations Division BMPs**

- Public Works Center Maintenance
- Water Quality Treatment
- Materials Management
- Materials Inventory
- Materials Protection
- Small Engine Maintenance
- Vehicle Rinsing
- Hazardous Materials Storage
- Spill Response and Prevention
- Illegal Dumping Control
- Mosquito Control
- Mechanical Open Water Course Maintenance
- Integrated Management Open Water Course Maintenance
- Street Cleaning
- Roadway and Bridge Maintenance
- Stormwater System Cleaning
- Catch Basin Cleaning
- Sediment Trap Cleaning
- Stormwater Pond Cleaning
- Employee Training

#### **City of Gainesville Recreation and Parks Department BMPs**

- Dog Parks

#### **Alachua County Public Works Department, Engineering Division BMPs**

- Pre-Construction Meetings

#### **Alachua County Public Works Department, Operations Division BMPs**

Fleet Management Facilities Maintenance  
Public Works Center Maintenance  
Materials Management  
Materials Inventory  
Small Engine Maintenance  
Spill Response and Prevention  
Street Cleaning  
Stormwater System Cleaning  
Stormwater Pond Cleaning  
Employee Training

#### **Alachua County Public Works Department, Parks Division BMPs**

Dog Parks

Currently a BMP manual that will include and expand on the above BMPs is in production for use by City and County staff in municipal activities.

#### **Additional Pollution Prevention Outreach Programs**

The Partnership makes additional efforts to work with the Gainesville community for healthy waterways. Through various public information campaigns, annual festivals, and partnerships with other Gainesville organizations and businesses, the partnership strives to acquaint Gainesville and Alachua County residents with the issues involved in caring for and protecting local waterways and recognizing the contributions which these waterways make every day to the community's health, safety, comfort, and quality of life. Residents can find information about these activities and programs by visiting the Partnership's webpage at [gainesvillecreeks.org](http://gainesvillecreeks.org). This site describes the interdependent creeks, watersheds and wetlands in Gainesville, Florida. Visitors to the site can learn how the Gainesville community cares for water through stormwater management, and learn what they can do to help keep local waterways healthy.

#### **Illicit Discharge Detection and Elimination Program**

On June 24<sup>th</sup>, 2003 Alachua County and the City of Gainesville signed an interlocal agreement for the establishment of the illicit discharge detection and elimination program. As part of the agreement, the Alachua County Environmental Protection Department (ACEPD) became the agency responsible for this program to satisfy the NPDES Phase II MS4 permit requirements of Alachua County, the City of Gainesville and DOT. Individual NPDES Phase II MS4 permits were obtained by Alachua County on July 8, 2003, City of Gainesville on July 8, 2003, and DOT on June 23, 2003.

### **3.7 ALACHUA COUNTY BASIN-WIDE PROGRAMS**

#### **Water Quality Code Complaint and Spill Response Program**

The Water Quality Code (WQC) implements Alachua County Charter Amendment 1, passed in November 2000 that gave the Board of County Commissioners of Alachua County, Florida the authority to establish standards for protecting the environment by prohibiting or regulating air or water pollution. The WQC was adopted on August 27, 2002 and became effective January 1, 2003.

The code provides the regulatory framework for implementation of an illicit discharge detection and elimination program in Alachua County. The WQC prohibits the discharge of any material into surface water, groundwater or stormwater systems that result in a

violation of Florida's Surface Water Quality Standards in Chapter 62-302 FAC, Florida's Groundwater and Drinking Water Standards in Chapter 62-520 and 62-550 FAC and/or Florida's Groundwater and Surface Water Cleanup Target Levels in Chapter 62-777 FAC. The code authorizes ACEPD to order cleanup, abatement or monitoring and take other actions as needed to cleanup, abate or monitor pollutant discharges. The WQC prohibits direct discharges to surface water and groundwater of wastewater from cleaning operations, waste management, equipment storage and maintenance and litter. It also prohibits any person from discharging non-stormwater to a stormwater system; exceptions include approved discharges by the Florida Department of Environmental Protection or the ACEPD. The WQC requires use of best management practices (BMPs) for erosion and sedimentation control for all excavations. Erosion and sedimentation control BMPs must provide equal or better protection than those currently compiled by the DEP. The WQC requires that land excavation and/or filling activities, including dewatering, shall not have an adverse impact on surface water or groundwater quality. The WQC allows for reimbursement to the County of all investigative costs incurred by the County and allows the issuance of civil citations for code violations.

#### **Expanded Nutrient Monitoring**

ACEPD began expanded nutrient monitoring in the lower reaches of the Sweetwater Branch watershed and on Paynes Prairie in late 2003 and early 2004. The purpose of the expanded monitoring was to differentiate the nutrient contributions coming to Alachua Sink from differing inflows located in various areas on Paynes Prairie. Sites included the channelized section of Sweetwater Branch on the prairie upstream of Alachua Sink and before the confluence with the channel from Alachua Lake, Alachua Lake, Alachua Sink, and Alachua Channel (under low water levels the channelized stream section between Alachua Sink and the Primary Sink Feature). The high water levels associated with the 2004 hurricanes precluded continued sampling of many of these sites after August 2004. Water levels on the prairie remained high until fall 2006. ACEPD is currently re-evaluating the program and is coordinating with the SJRWMD on continued water quality monitoring of these and other selected sites. Additional information about watershed monitoring can be found in Chapter 6.

#### **Stream and Pond Buffer Restoration/Demonstration**

ACEPD began efforts to develop a stream and pond riparian zone restoration program as a result of an EPA Five-Star Restoration Grant received in 2004. The grant project focused on the educational aspects of shoreline restoration and implementation of these practices in a workshop format. Three workshops were held in 2005 at Poe Springs Park on the Santa Fe River. Workshops following this format were conducted in several locations in the OCB in 2005 and 2006. Each of workshops began with a technical discussion of shoreline restoration and maintenance by Dr. Mark Clark, IFAS Extension Specialist, Wetlands and Water Quality and Assistant Professor, Soil and Water Science Department at the University of Florida and concluded with the installation of shoreline plant materials at pre-selected restoration sites. In the OCB, workshops and associated shoreline restoration activities were conducted at Springhill Park and the 5<sup>th</sup> Avenue Stormwater Park in the Sweetwater Branch watershed.

ACEPD continues to maintain several restoration sites planted in 2004 and 2005 in conjunction with Current Problems, Inc./Adopt A River. These sites include a small area in Sweetwater Park in the Sweetwater Branch watershed and the stormwater pond at Forest Park in the Hogtown Creek watershed. ACEPD has requested funding for 2007/2008 from the FWCC for shoreline restoration at boat ramp canals on Newnans

Lake at Powers Park and the Windsor Boat Ramp, the canal at the County's Lochloosa Lake boat ramp and the boat ramp canal at MK Rawlings Park on Orange Lake.

ACEPD is currently working with Dr. Mark Clark and the Alachua County Communications Office to develop a series of videos on shoreline restoration and stormwater pond revegetation. We anticipate a series of 4 or 5 videos that can be used by staff or volunteers for presentations, home owners associations (HOAs), individuals and shown on local government television to inform the public about the water quality and wildlife benefits of shoreline restoration. The first restoration video, a shoreline and pond restoration overview, is scheduled for completion in spring 2007. It will be the second video in ACEPD's outreach series. The first video in this series, "Making the Connection - Alachua County's Water Resources," was developed by Karst Productions, Inc. and released in 2004.

### **3.8 Centralized Wastewater Management Programs**

#### **3.8.1 GRU Wastewater System Routine Operations and Maintenance**

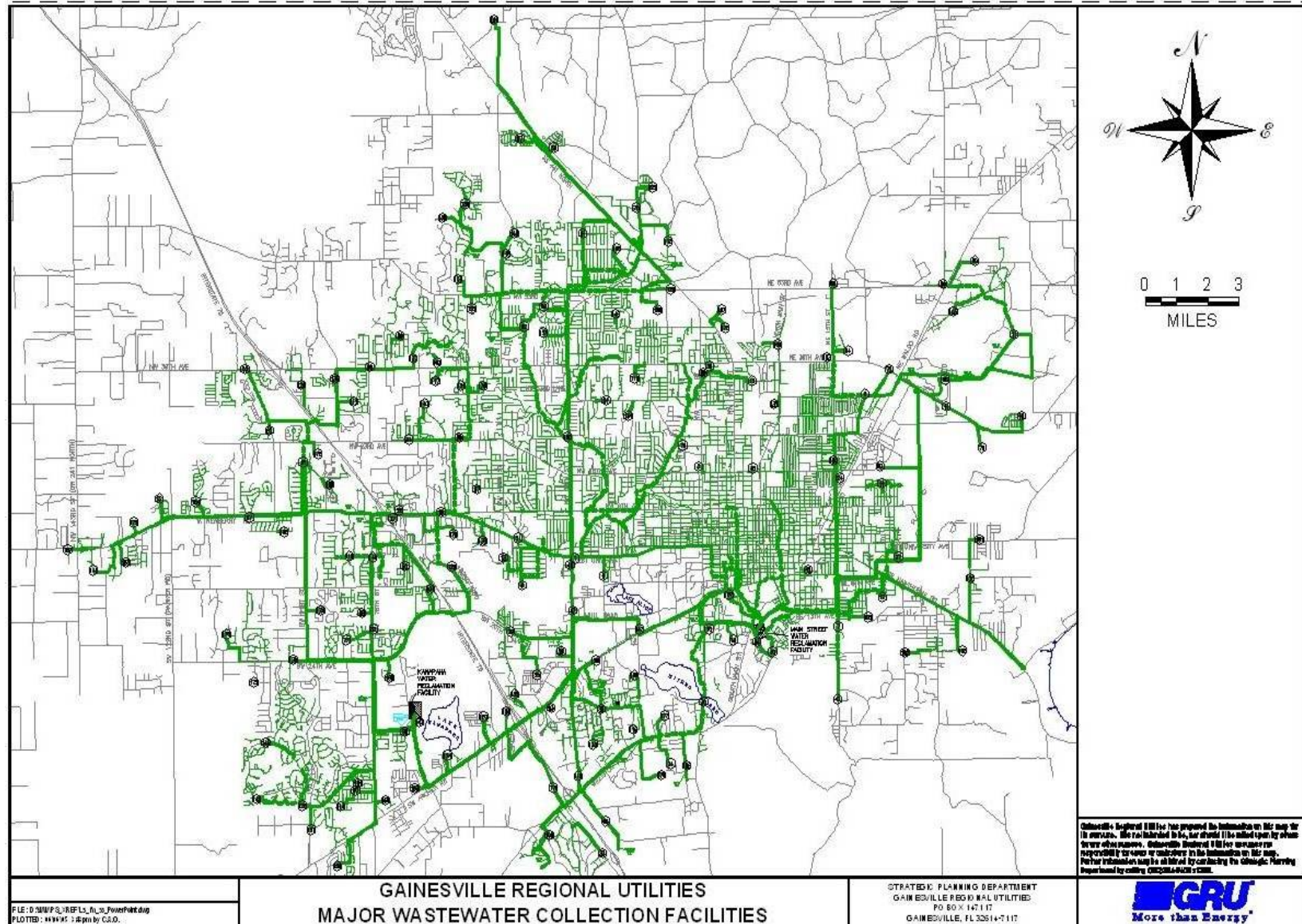
The following is a description of the Gainesville Regional Utilities (GRU) wastewater infrastructure and routine maintenance procedures. Additional details, including pictures of GRU's maintenance activities, can be found in Appendix G.

#### **Wastewater Treatment and Collection System**

The City of Gainesville's wastewater treatment facilities consist of the Kanapaha Water Reclamation Facility (KWRF) and the Main Street Water Reclamation Facility (MSWRF), which are permitted by the Florida Department of Environmental Protection at combined capacity of 22.4 MGD per day. KWRF provides advanced wastewater treatment to incoming wastewater that meets Primary and Secondary Federal Drinking Water Standards. MSWRF also provides advanced treatment, and meets Class III surface water standards. MSWRF was upgraded to advanced treatment in 1990 at a cost of \$16 million. KWRF was expanded by 5 MGD to 15 MGD in 2003 at a cost of \$13.92 million. KWRF and MSWRF have an Operations and Maintenance Budget of \$1.96 million for fiscal year 2007.

The City of Gainesville's wastewater collection system piping consists of 127 miles of force main where wastewater is conveyed under pressure by pumping stations, and 578 miles of gravity main where the wastewater flows by gravity; for a total of 705 miles of piping. The wastewater collection system also includes 160 Lift Stations (pumping stations) with 13,888 manholes, and covers a service area of 115 square miles. GRU's Water / Wastewater Systems has 171 budgeted full time positions and the wastewater collection and treatment system serves over 160,000 people. GRU wastewater collection system operations and maintenance costs are budgeted at \$1.58 million for fiscal year 2007. Figure 26 is a map of GRU major wastewater collection facilities serving Gainesville and areas of Alachua County.

Figure\_26. Gainesville Regional Utilities Major Wastewater Collection System



In 2006, GRU systems conveyed and treated over 5.5 billion gallons of wastewater (99.999% efficiency based on volume), and maintained a spill rate of less than 25-percent of the national average in 2004, 2005 and 2006 (See Figure27 and Figure28). The national average of 7.1 spills / 100 miles of collection system is based on a national survey of comparable utilities conducted by the Water Environment Research Foundation (2003). GRU's average spill rate from 2001 through 2006 was 2.3 spills / 100 miles.

**Figure 27. GRU Wastewater System Performance Compared to National Averages  
– Number of Spills per 100 Miles of Collection System Length, 2001-2006**

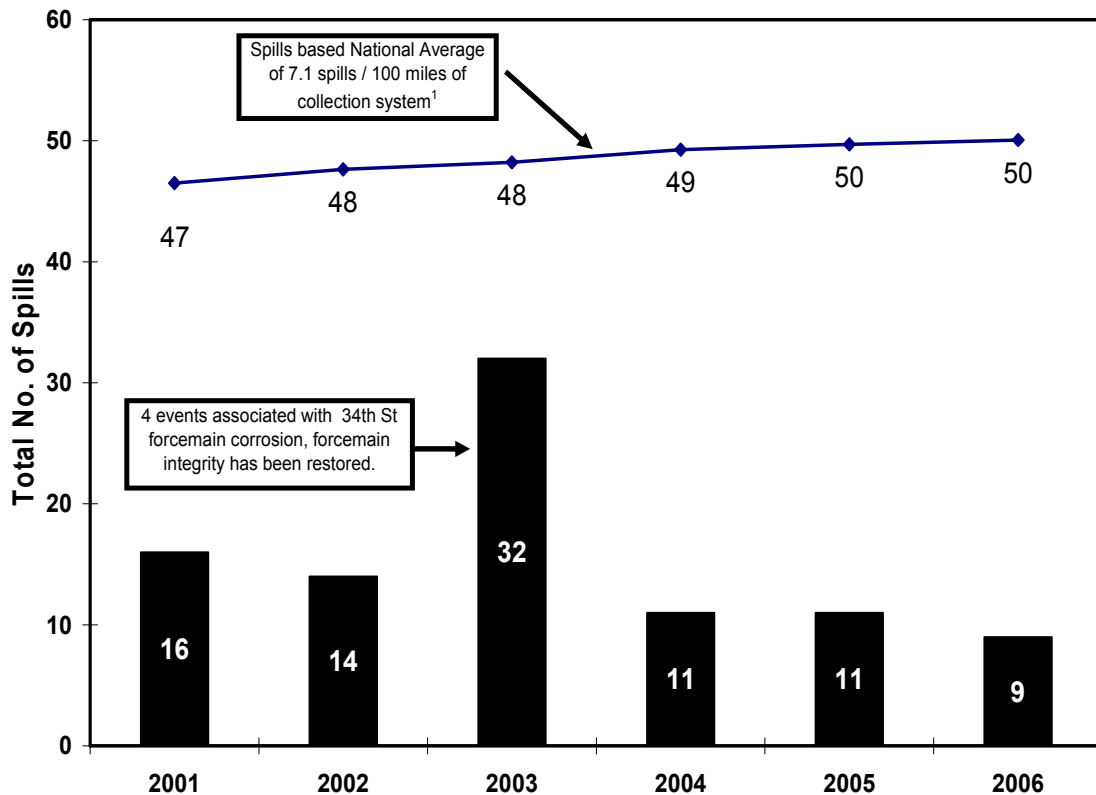
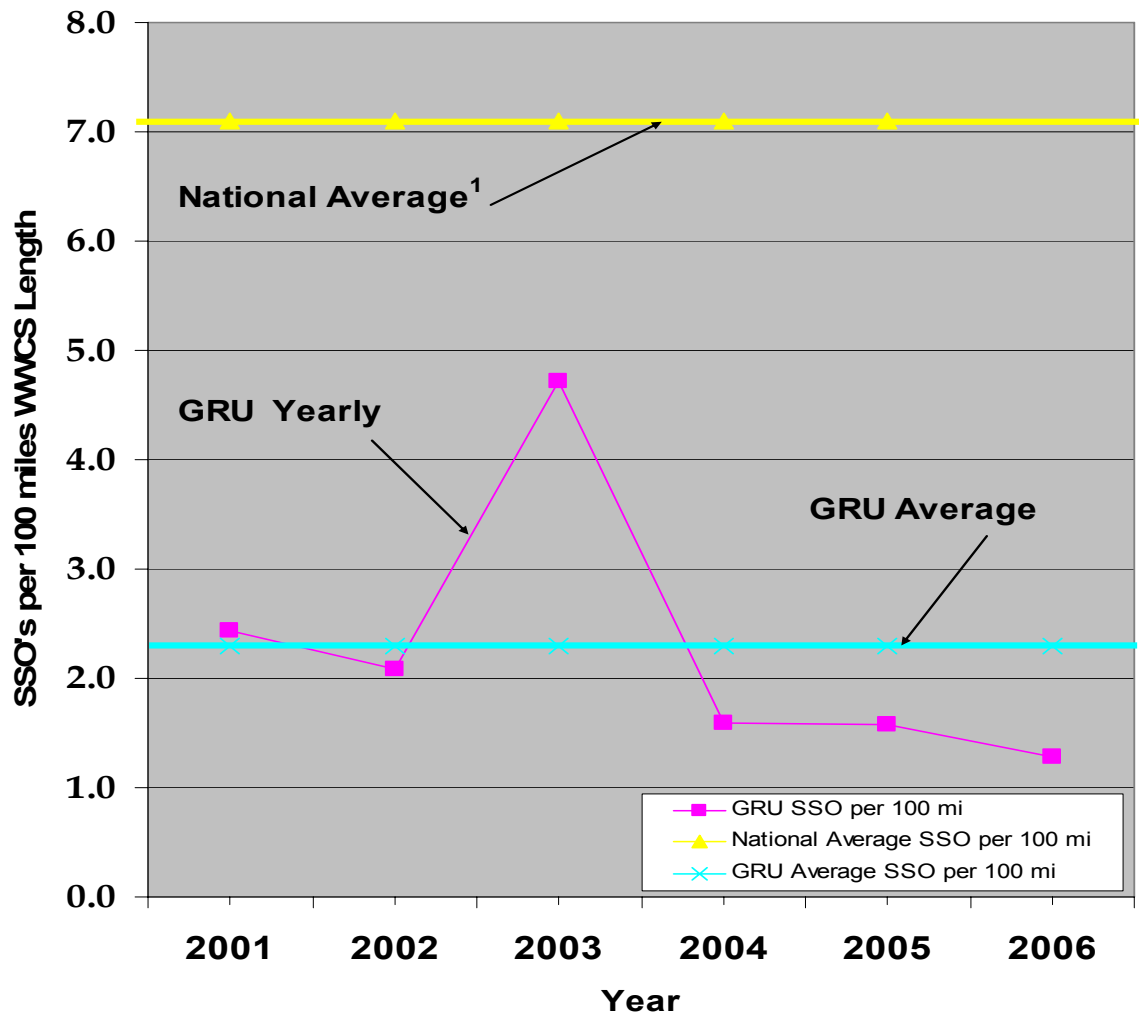


**Figure 28. GRU Wastewater System Performance Compared to National Averages  
– SSO's per 100 miles of Collection System Length, 2001 through 2006**



### 3.8.2 Centralized Wastewater Collection System Integrity Programs and Projects

GRU's integrity programs and projects continuously protect the public and the urban creeks from wastewater release from the publicly owned and operated wastewater collection system. These programs and projects include:

- Closed-Circuit TV Inspection / Repair and Cleaning
- Infiltration & Inflow (I & I) Testing
- Sliplining of Gravity Mains Adjacent to Urban Creeks
- Force Main Integrity Testing
- GIS Asset Management System – Mapping and Targeted Maintenance
- Plan Review and New Development Inspection – Redundancy, Oversizing and New Standard Practices to Improve Reliability
- Annual Water/Wastewater Engineering Operation and Maintenance Services
- Wastewater Spill Prevention Programs

Table 16 describes each of these programs. More details can be found in Appendix G. In addition to these programs, GRU participates in a number of specific projects independently (e.g. microbial source tracking) and in cooperation with other stakeholders

(e.g. Paynes Prairie Sweetwater Branch Sheetflow Restoration Project). These efforts are summarized in Chapters 4 (lakes) and 5 (coliforms) of this document.

Table 16. Summary of GRU Centralized Wastewater Infrastructure Operation and Maintenance Activities

| Activity                                           | Purpose                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Additional Details                                                                                                                                     |
|----------------------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Closed-Circuit TV Inspection / Repair and Cleaning | Identify and repair damaged pipes.                                                         | GRU has an ongoing closed-circuit TV inspection / repair and cleaning program, and recently added a new closed-circuit TV unit (truck and crew) in fiscal year 2006. Crews clean gravity mains with high pressure water jets prior to closed-circuit TV inspection. As the crews inspect the lines, they log any deficiencies that may inhibit the pipe's performance. A crew follows the inspection to make repairs to damaged pipelines as needed. If necessary, additional crews are dispatched to repair the pipe and restore it to optimum condition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Figure 29 GRU Closed-Circuit TV Inspection Unit<br><br>Figure 30 GRU Wastewater Collection System Maintenance Rate                                     |
| Infiltration & Inflow (I & I) Testing              | Identify and eliminate all non-wastewater flows entering the wastewater collection system. | <p>Infiltration is water that flows into the wastewater collection system via cracks and joints that are not completely sealed in the pipe system. Inflow is water that flows directly into the wastewater collection system through manholes lids, broken cleanouts, direct illicit connections, etc. Eliminating I&amp;I is a key component of wastewater collection system preventative maintenance.</p> <p>GRU crews utilize techniques including smoke testing, closed-circuit TV inspection, and dye testing to find potential locations where I&amp;I can occur. In August 2003, GRU commenced with I&amp;I Phase 3, where the focus was on the urban creek areas. Where collection system defects were found, crews immediately repaired each defect in the collection system area before moving on the next designated test area. GRU has tested over 71% of its wastewater collection system since January 2001, with the urban creek areas covered in Phase 3 of the project during 2003, 2004 and 2005. GRU has spent \$2.8 million since 2001 on I&amp;I, and has budgeted \$1.36 million to continue this effort for the 2007 to 2012 budget period.</p> | <p>Figure 31 : areas that have been tested since January 2001.</p> <p>Figure 32 : pictures of smoke testing being used to find sources of I&amp;I.</p> |

Table 16, cont.

| Activity                                             | Purpose                                                                                                                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Additional Details                                                                                                                                                                    |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sliplining of Gravity Mains Adjacent to Urban Creeks | Rehabilitate the wastewater gravity mains throughout its collection system and minimize the possibility of wastewater leakage. | <p>GRU utilizes sliplining technology to rehabilitate the wastewater gravity mains throughout its collection system. Sliplining pipelines protect the urban creeks by minimizing the possibility of wastewater leakage by essentially replacing old pipe with new pipe. Sliplining of gravity sewer interceptor tributary small diameter lines adjacent to creeks is ongoing. GRU sliplining projects have totaled \$4.7 million as of 2006 and the projected budget for continuing these efforts is \$681,000 over the 2007-2012 budget period.</p> <p>The sliplining process results in a seamless, jointless "pipe-within-a-pipe" with a smooth, continuous inner surface which usually increases flow capacity. Typically installations are completed in a single day. Since the collection system provides 24-hour per day service, crews construct "pump arounds" to allow isolation of GRU wastewater collection system lines for cleaning and sliplining. The sliplining process typically restores the hydraulic and structural integrity of the older pipe to that of a new pipe. While sliplining is an expensive technology, it is less invasive as compared to open trench construction along the urban creek corridors.</p> | <p>Figure33 pictures of the installation sequence of a Hogtown Creek sliplining project</p> <p>Figure 34. Sliplined Major Gravity Mains Adjacent to Hogtown Creek and Tributaries</p> |

Table 16, cont.

| Activity                     | Purpose                                                                                                                                                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Additional Details                                                                                             |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| Force Main Integrity Testing | Test the wall thickness of major force mains, perform pressure monitoring, and inspect air release valves to minimize the risk of infrastructure failures | <p>GRU staff have identified more than twenty-five miles of major force mains that were constructed with ductile iron or cast iron, and are 16-inches in diameter and larger, for inspection and wall thickness testing. A comprehensive program was developed and initiated to test the wall thickness of the ten major force mains at forty-eight locations, perform pressure monitoring at six strategic locations within the force main system, and inspect fifty-two air release valves. Nearly 1,700 pipe wall thickness test measurements have been collected to assess the overall condition of GRU's major force mains. The following conclusions can be made from this effort:</p> <ul style="list-style-type: none"> <li>• GRU's major force mains appear to be in relatively good condition based on the pipe wall thickness and system operating pressure data collected</li> <li>• No significant loss of pipe wall material was noted for the 10 major force main systems.</li> <li>• Air release valves that are not operating to specifications are to be replaced as part of a multi-year rehabilitation program.</li> </ul> <p>GRU has initiated a program to test 2nd tier force main systems, which have piping diameters of 14-inches or smaller. As of January 2007, 6 of the 15 miles of force mains has been identified and tested. In addition, GRU has adopted a Standard Operating Procedure (SOP) that requires pipe wall thickness testing prior to all taps (connections) to existing force mains, to ensure quality taps to the force main.</p> | Figure 35 pictures of engineers and crews performing pipe wall thickness testing after accessing the pipeline. |

Table 16, cont.

| Activity                                                                                                              | Purpose                                                                                                                                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Additional Details |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| GIS Asset Management System – Mapping and Targeted Maintenance                                                        | Maintain up-to-date records in a GIS format, providing increased accuracy in the location of underground utilities that reduces construction accidents      | GIS facilities mapping incorporates developer and GRU installed wastewater and reclaimed water systems into a GIS database format, including a creek crossing pipeline assessment project that logged the GRU wastewater system creek crossings and are being used for assessment of the infrastructure for targeted maintenance. The GIS based software system also stores mapping information and facility specific information such as age, material, maintenance history, and adjacent utilities.                                                                                                                                                                                 | ---                |
| Plan Review and New Development Inspection – Redundancy, Oversizing and New Standard Practices to Improve Reliability | Review new construction plans for compliance with all GRU design and construction standards to improve the reliability of the wastewater collection system. | GRU's requirements exceed industry standards in such areas as improved manhole connection methods, pipe materials and utility crossings (casings), and wastewater collection system oversizing and redundancy. Inspections during and after completion of construction projects are performed to assure compliance with construction standards. In addition, before any new gravity wastewater infrastructure is accepted by GRU for ownership and maintenance, it is inspected with closed-circuit TV cameras, flushed, smoked tested, and repaired as necessary. For force main systems, it is standard practice to pressure test all new systems before they are put into service. | ---                |

Table 16, cont.

| Activity                                                               | Purpose                                                                                             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Additional Details |
|------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Annual Water/Wastewater Engineering Operation and Maintenance Services | Ensure that wastewater infrastructure facilities are available and properly sized to handle demand. | GRU executes a five-year scheduling system for initiating and administrating wastewater capital projects, at an annual operation and maintenance cost of about \$650,000. GRU has budgeted \$70 million in capital improvements to the wastewater collection and treatment system over the 2007-2011 budget cycle. Projects are timed and prioritized to ensure that facilities are available in a timely manner to meet demands as needed. The major areas of capital improvements include wastewater treatment facilities, lift stations, and the wastewater collection system. | ---                |
| Wastewater Spill Prevention Programs                                   | Reduce releases from the wastewater collection system to the environment.                           | GRU has implemented an aggressive pretreatment program focused on commercial grease control. The program includes two inspectors that conduct inspections on all food service establishments. In addition, GRU has implemented a campaign focused on residential grease control. As part of the public outreach campaign, staff distributed 5,000 grease trappers; presented at local schools; distributed press releases where local media assisted in getting information out to the public; and provided spill prevention information in the GRU customer bulletin.            | ---                |

Figure 29. GRU Closed-Circuit TV Inspection Unit



Figure 30. GRU Wastewater Collection System Maintenance Rate

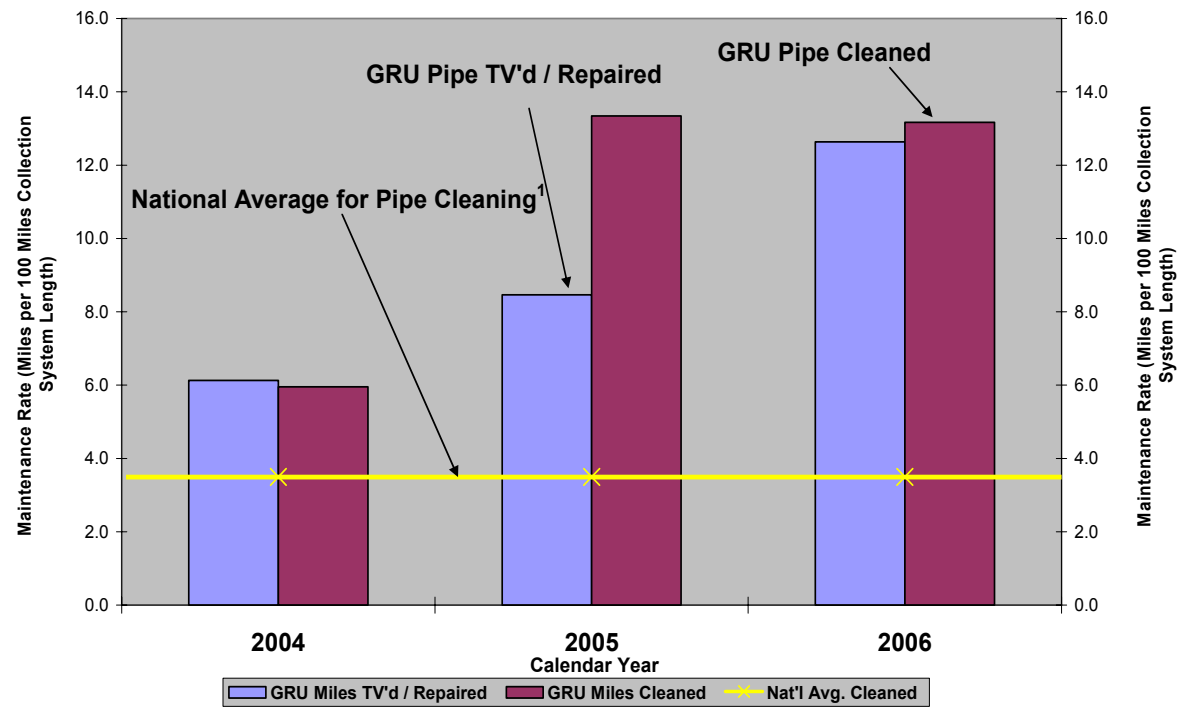


**Figure 31. GRU Sewer System Inflow and Infiltration (I&I) Elimination Program Status**

Note: Colored and shaded areas represent the designated wastewater collection system tested areas in the Hogtown, Sweetwater and Tumblin Creek basins. All of the GRU wastewater collection system in these urban creeks areas has been tested.

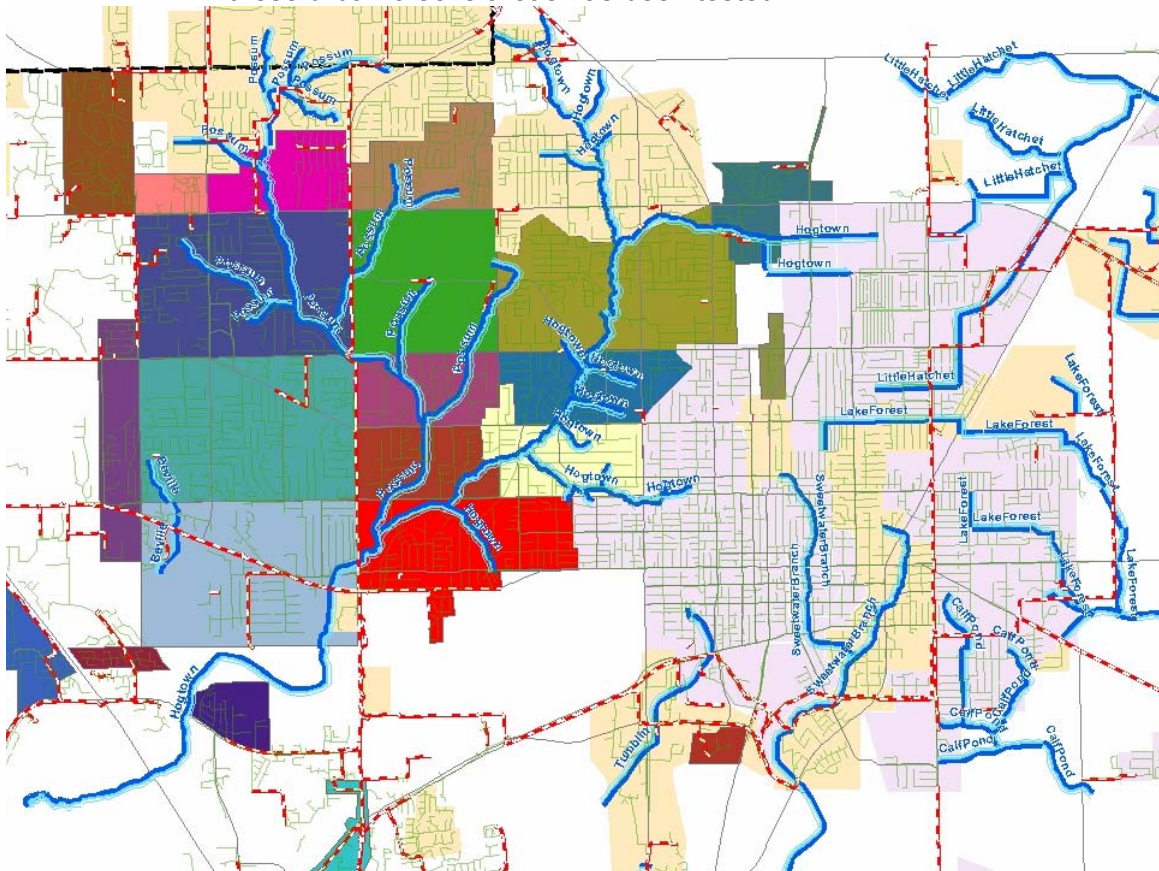


**Figure 32 . Pictures of Smoke Testing Used to Find I&I**



**Figure 33. Pictures of a Sliplined Pipe near Hogtown Creek**



**Figure 34 . Sliplined Major Gravity Mains Adjacent to Hogtown Creek and Tributaries**

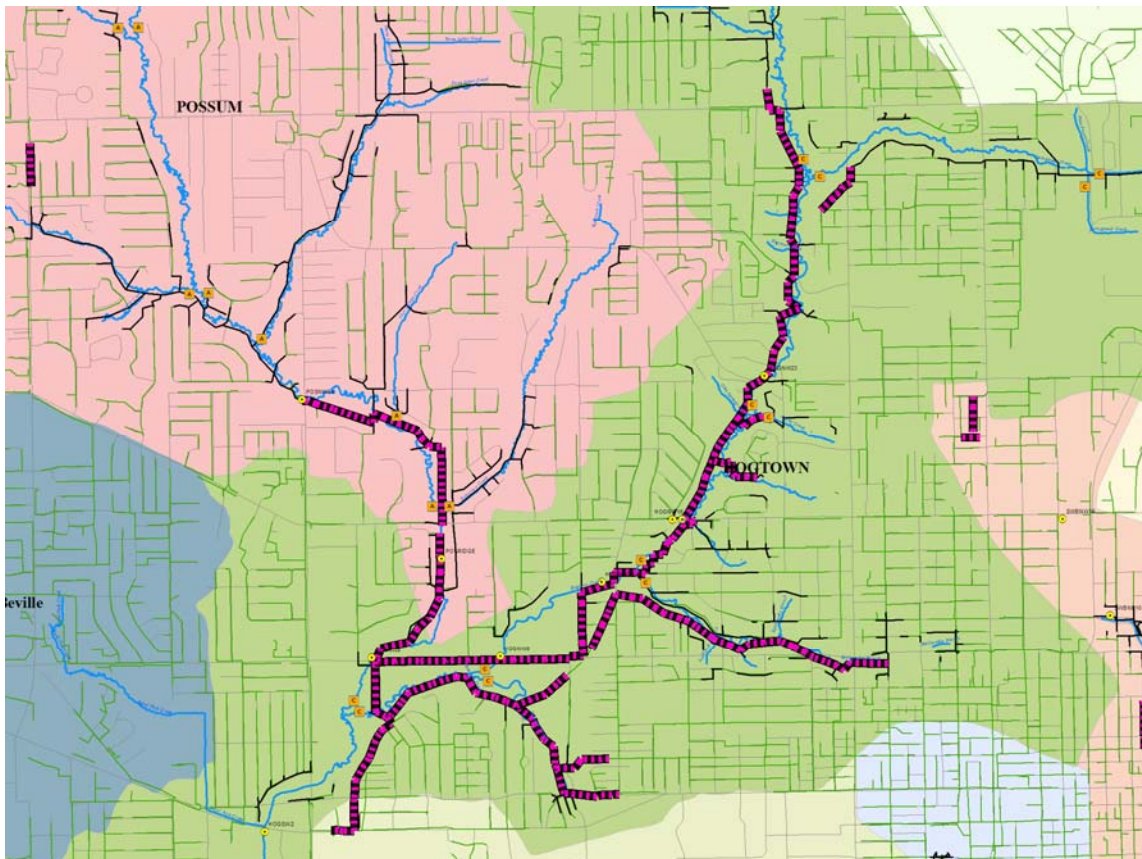


**Figure 35. GRU Engineers and Crews Performing Pipe Wall Thickness Testing**



### **3.9 *Septic tank system Management***

Septic tank systems have been identified as a potential issue needing further investigation in the Orange Creek Basin with regard to both coliform and nutrient loadings. **Appendix H** contains a recent analysis of nutrient loading from onsite wastewater treatment systems in the four lake sub-basins (including Lake Lochloosa, which does not have an adopted TMDL). The BWG will be exploring options for collecting more information on septic tank system impacts in targeted areas, and will be considering strategies regarding septic tank system use/restrictions that are already in place in other parts of the state. Other ongoing efforts include:

#### **Alachua County and GRU**

- The ACHD limits the adverse impact of OSTDS on water quality through its regulatory program. Enforcing vertical and horizontal setbacks, assessing and mitigating site specific OSTDS locations, and providing technical assistance to public and private interests all contribute to successful program implementation.
- ACHD is working with the Alachua County Environmental Protection Department to identify areas of concern with regards to OSTDS and to develop best practices to reduce nutrient and fecal coliform bacteria loading. Any ordinances requiring performance based systems adopted by the county will be managed by the ACHD with operating permits set forth in Chapter 64E-6.
- The ACHD responds to all complaints regarding failing systems and issues a “notice to abate a sanitary nuisance” for those found to be improperly maintained.
- The ACHD has applied for a grant from the Florida DEP to perform an in depth septic tank system inventory of the whole county. The County is also proposing a study to see if there is a need for a septic tank system maintenance program.
- ACHD and GRU are working together on a project to eliminate or upgrade septic tank systems along urban creeks which have been identified as either having a confirmed impact to creeks or having significant potential

to contribute fecal and total coliforms to creeks. The overall effort includes an intensive study by ACHD to identify and verify septic tank system locations along creeks and to assess the potential impacts of each of these septic tank systems to the creeks. The effort will also include a feasibility study conducted by ACHD and GRU to identify the best approach for upgrading or eliminating septic systems with confirmed or significant potential to impact creeks.

#### **Marion County**

- Marion County is concerned about the water quality impacts of septic systems, in particular with regard to the Springshed Protection Program. One of the County's proposed measures is to require an impact analysis for proposed development, redevelopment, or change to an existing development that increases density or intensity of use within the primary and secondary springs protection zones. This aquifer impact analysis would include a review of pre- and post-development nutrient loading and recharge rates, and discharge rates and volumes.
- With regard to domestic waste treatment and disposal, the County is considering requiring central system connections in all new urban development and limiting nutrient discharge concentrations. On-site septic systems in new construction would have to meet a Total Nitrogen concentration of 10 milligrams per liter. The County may also decide to require an annual operating permit for new on-site septic systems, with routine monitoring and inspection requirements. The County is also discussing requirements for maintenance, repairs, and upgrades of existing septic systems.

#### **DEP**

- DEP staff support the efforts of counties by responding to complaints. A complaint can become an enforcement issue, resulting in a pump station upgrade. A proactive approach is desirable in order to encourage (or require) the owners to inspect, maintain and/or upgrade facilities. Complaint response primary involves small privately owned sewer pump stations where the property owner owns and maintains the lift station. Many of these stations have been installed over the years, perhaps up to 30 years ago so the original permit requirements really vary from location to location.

**Appendix I** contains draft guidance on septic tank system maintenance and sewer hookup, which describes the legal authorities and limitations with regard to requiring maintenance and hookup.

### **3.10 MANAGEMENT ACTIONS TO ADDRESS FUTURE GROWTH**

The future growth analysis in Section 2.2 of this document identified isolated areas of population pressure and the need to implement management actions to minimize the impacts of this growth. Stakeholders in the Basin have a variety of programs in place to

manage the water quality impacts of future growth. This section discusses the programs and policies that are in place to manage future growth.

Each stakeholder involved in the management of future growth operates under a specific set of guidelines, policies, and requirements that regulate development within their jurisdiction. Table 17 identifies the documents that provide this guidance for each applicable stakeholder.

**Table 17. References for Orange Creek Basin Stakeholder Development Regulations**

| Stakeholder                               | Document (s)                              | Reference                                                                                                                                                   |
|-------------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| St. Johns River Water Management District | Environmental Resource Permit Regulations | <a href="http://www.sjrwmd.com/programs/regulation/erp/index.html">http://www.sjrwmd.com/programs/regulation/erp/index.html</a>                             |
| Alachua County                            | Comprehensive Plan                        | <a href="http://www.growth-management.alachua.fl.us/compplanning/amendments.php">http://www.growth-management.alachua.fl.us/compplanning/amendments.php</a> |
| Marion County                             | Comprehensive Plan                        | <a href="http://www.marioncountyfl.org/PL271/PL_Comp_Plan.htm">http://www.marioncountyfl.org/PL271/PL_Comp_Plan.htm</a>                                     |
| City of Gainesville                       | Comprehensive Plan                        | <a href="http://www.cityofgainesville.org/comdev/plan/compplandocs.shtml">http://www.cityofgainesville.org/comdev/plan/compplandocs.shtml</a>               |
| Alachua County                            | Land Development Code                     | <a href="http://www.growth-management.alachua.fl.us/ldr.php">http://www.growth-management.alachua.fl.us/ldr.php</a>                                         |
| Marion County                             | Land Development Code                     | <a href="http://www.municode.com/resources/gateway.asp?pid=13949&amp;sid=9">http://www.municode.com/resources/gateway.asp?pid=13949&amp;sid=9</a>           |
| City of Gainesville                       | Land Development Code                     | <a href="http://cityofgainesville.org/comdev/plan/landdevcode.shtml">http://cityofgainesville.org/comdev/plan/landdevcode.shtml</a>                         |
| Gainesville Regional Utilities            | Operating Policy                          | <a href="http://www.gru.com/">http://www.gru.com/</a>                                                                                                       |

### 3.10.1 Low Impact Development

Conventional stormwater systems have typically been designed to collect, convey and discharge runoff as efficiently as possible. The purpose of stormwater management was first and foremost to prevent flooding. The concept of Low Impact Development (LID) in stormwater management was introduced in the late 1990's (EPA 2000, <http://www.epa.gov/owow/nps/lid/lidlit.html>), and is an approach to land development that uses various land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs. The LID approach to land development meets flood prevention needs while also minimizing water quality impacts associated with growth.

The goal of LID is to replicate the pre-development water balance of surface runoff, infiltration and evapotranspiration on a site-specific basis, thereby minimizing or eliminating pollutant loads into surface waters. Stormwater storage, infiltration, and

ground water recharge, as well as the volume and frequency of discharges are maintained through the use of integrated and distributed small-scale stormwater retention and detention areas, reduction of impervious surfaces, and the lengthening of flow paths and runoff time (Coffman, 2000).. The basic principle is to manage runoff at the source using decentralized techniques at the scale of individual lots.

The incorporation of LID techniques into future development is an innovative management action that Alachua County, Marion County, the City of Gainesville, the University of Florida, and other entities are now beginning to undertake to maintain or improve water quality within the Orange Creek Basin. There are numerous creative LID techniques to treat, use, store, retain, detain and recharge stormwater runoff. The following tables summarize key LID principles (Table 18) and activities (Table 19) to provide local examples of how those principles are being put into place in the Basin. Table 20 identifies local projects that have used multiple LID principles and activities to achieve water quality benefits. Given the success achieved by local governments, the University of Florida, and local developers in implementing LID principles, it is reasonable to expect that these type of projects will continue to be developed in the Basin.

**Table 18. Low Impact Development –Application of Key Principles in the Orange Creek Basin**

| Key Principle                                                   | Description                                                                                                                                                                                                                                                                                                                                                                           | Application within the Orange Creek Basin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Preservation & protection of environmentally sensitive features | The preservation and protection of sensitive areas that affect the hydrology of site, including streams and their buffers, floodplains, wetlands, steep slopes, high-permeability soils, and woodland conservation zones is essential to minimizing hydrologic impacts. Requirements for protection occur primarily through land use rules established at the local government level. | <ul style="list-style-type: none"> <li>o The protection of strategic ecosystems within Alachua County is conducted through a special area planning process that can require 50% of the upland (and all wetlands) be protected. The rules can also require the clustering of development and protection of the system as a whole</li> <li>o Alachua County also has a Preservation Buffer Overlay District that is designed to protect the quality and integrity of preservation lands from impacts of adjacent development on wildlife, including listed species, wildlife habitat, and water quality. The Preservation Buffer Overlay District includes all real property within 660 feet of lands that are designated as Preservation according to the Future Land Use Map of Alachua County <a href="http://growth-management.alachua.fl.us/gis/compplanmaps/Flu_2020_AC_SAS.pdf">http://growth-management.alachua.fl.us/gis/compplanmaps/Flu_2020_AC_SAS.pdf</a>.</li> <li>o Marion County maintains an environmentally sensitive overlay zone map, available through the Marion County Planning Department (2710 East Silver Springs Boulevard, Ocala, Florida 34470) that includes Orange Creek and Orange Lake. The overlay zone is intended to protect environmentally sensitive lands, and provide criteria for the conservation and protection of certain lakes, rivers, shorelands, wetlands, natural habitats, native vegetation and associated uplands, and other environmentally sensitive areas from the adverse effects of development while protecting the rights of property owners. The design of the stormwater management systems within the Marion County environmentally sensitive overlay zone is required to imitate and use the features and functions of natural drainage ways, depressions, wetlands, floodplains, and highly permeable soils when possible. The use of swales, berms, or detention/retention areas is to be used when necessary to prevent direct flow of stormwater runoff to a receiving water body. There are currently no developments planned within this zone, within the Orange Creek Basin.</li> </ul> |
| Incorporation of small-scale stormwater treatment systems       | Lot-level and on-site treatment systems offer the best opportunities for maintaining more natural hydrologic functions, as well as reducing                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>o The Wood You Furniture Store, on the corner of North Main Street and 16<sup>th</sup> Avenue in Gainesville, has a small detention basin located within the property. Roof runoff is directed to the detention area rather than to the street.</li> <li>o The Burger King restaurant at Main Street and NE 16<sup>th</sup> Avenue in Gainesville has</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|                                  |                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| integrated at the lot level      | the concentration time needed to move water into larger off-site facilities, if necessary. The excessive land requirements for large-scale systems and the concomitant loss of terrestrial open space area is also avoided.                                                   | <p>curb cuts that direct parking lot runoff directed to a depressed grassy area surrounding the building.</p> <ul style="list-style-type: none"> <li>o The Woodbury Row apartment complex in Gainesville has roof drains that discharge onto a sidewalk, then into a landscaped area, ultimately to an infiltration basin. The adjacent parking lot also slopes toward this basin.</li> <li>o The Oxford Terrace Apartments have disconnected roof gutters that discharge into shallow depressional areas landscaped with native vegetation (Figure36)</li> </ul>                                                                                                                                                                                                                                  |
| Increasing infiltration          | Mechanisms that can retain stormwater on-site yet still provide percolation facilitate both the protection of surface water quality and aquifer recharge.                                                                                                                     | <ul style="list-style-type: none"> <li>o The Taylor Square apartment complex in Gainesville uses two infiltration trenches to infiltrate parking lot and roof runoff onto the soil and eventually the surficial aquifer. The trenches are Atlantis Water Management Tank systems that have a sump to capture sediment entering the system, preventing the introduction of pollutants associated with the sediment.</li> <li>o The Pep Boys Automotive Supercenter at 7725 W Newberry Road was developed with a vaulted stormwater system under parking lot to provide infiltration rather than discharge.</li> <li>o Infiltration trenches are also under construction at the Stratford Court Apartments, the Royal Palm Apartments, Oxford Terrace, and the Campus View I development.</li> </ul> |
| Reduction of Impervious Surfaces | Buildings, parking lots, sidewalks and other impervious surfaces generate large amounts of stormwater runoff that must be disposed of to prevent flooding. Reducing impervious surfaces within a site allows for more on-site retention of runoff, reducing off-site impacts. | <ul style="list-style-type: none"> <li>o Alachua County and the City of Gainesville require that at least 20% of the area of new development must be devoted to landscaping thus ensuring the preservation of open space and a reduction of impervious surface within a development.</li> <li>o Marion County allows only 70% impervious areas for Urban Commerce Districts, a 40% limit on commercial recreation, and publicly owned and operated recreational sites.</li> </ul>                                                                                                                                                                                                                                                                                                                  |

Figure 36. Disconnected roof gutters at the Oxford Terrace Apartments



**Table 19 Low Impact Development – Key Activities and Local Projects**

| Activities  | Description                                                                                                                                                                                                                                                                                   | Local Projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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| Site design | The consideration of LID strategies during the design phase of development is a way to minimize the impact of that development on water quality. Both regulatory and incentive-based approaches can be used to encourage development minimizes hydrologic impacts created by the development. | <ul style="list-style-type: none"> <li>o The United States Green Building Council is a coalition of leaders from the building industry working to promote buildings that are environmentally sustainable places to live and work. The Council developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ to recognize new construction or major renovations that meet a minimum standard. The system provides credits for maximizing open space, water quantity control, water quality control, the installation of water efficient landscaping, and water use reduction.</li> <li>• In 2001, the University of Florida adopted LEED criteria for all major new construction and renovation projects. The Facilities Planning &amp; Construction (FPC) Division of the University of Florida (<a href="http://www.facilities.ufl.edu/sustain/">http://www.facilities.ufl.edu/sustain/</a>) is responsible for submitting university projects for LEEDs certification. Currently, FPC projects registered for, or have already received LEED certification include Rinker Hall which has roof runoff directed to cisterns for storage and slow groundwater recharge, the Mary Ann Cofrin-Harn Pavilion which has an on-site stormwater pond and is landscaped with native vegetation, the Orthopaedics Surgery and Sports Medicine Institute, the McGuire Center for Lepidoptera and Biodiversity, and the Powell Structures and Materials Testing Laboratory. As of February 2007, there were 133 other projects in the state that are seeking LEEDs certification.</li> <li>o Alachua County's stormwater management rules are designed to maximize overland flow through natural drainage systems and grassed overland (roadside and lot line) swales. The use of plants and natural land forms are required to slow, hold, and treat runoff from development. Both design characteristics meet the LID strategies of providing water quality treatment and retaining stormwater runoff on-site rather than discharge to surface waters.</li> </ul> <p>The Alachua County code also requires the clustering of any development within the Agricultural zoning classification in which more than 24 units are proposed.</p> <ul style="list-style-type: none"> <li>o The City of Gainesville maintains an incentive program for developers to employ green building techniques in new developments. These incentives include fast-track permitting, fee reductions for building applications, and official green building designation by the City. Specific provisions of the program are found in Chapter 6,</li> </ul> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Article 1.5 of the City Code of Ordinances. The Gainesville Greens development, currently in the planning stages, has received this credit.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Green roofs              | Green roofs, also known as vegetated roof covers, are multi-beneficial structural building components that reduce roof runoff and maintain water quality by filtering, absorbing and detaining rainfall. They are constructed of a lightweight soil media, underlain by a drainage layer, and a high quality impermeable membrane that protects the building structure. The soil is planted with a specialized mix of plants that can thrive in the harsh, dry, high temperature conditions of the roof and tolerate short periods of inundation from storm events. | <ul style="list-style-type: none"> <li>o The Carrabba's Italian Grill on 3021 SW 34th Street in Gainesville, has a green roof.</li> <li>o The Charles R. Perry Construction Yard has the first green roof at the University of Florida. The Perry Construction Yard is a demonstration area which comprises a hands-on approach to expose building construction students to the training, techniques, tools and materials used by master craftspeople in various trades.</li> </ul>                                                                                                                                                                                                                                                                                                                                                 |
| Swales and filter strips | Swales and filter strips are bioretention systems that reduce runoff velocity, provide filtration and allow for infiltration and percolation of runoff.                                                                                                                                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>o The Entomology Center at the University of Florida has a large grassed depressed overland flow area in the front of the building that collects and treats roof and pavement runoff (Figure 37). Another side of the building has runoff moving overland to a Rain Garden</li> <li>o The Autozone store on NW 13<sup>th</sup> Street in Gainesville has no curb and gutter, and has all parking lot runoff moving across a grassed strip into a Rain Garden at the rear of the facility. The store also has two on-site detention facilities ensuring that no runoff moves off-site.</li> <li>o The Walgreens Pharmacy on NW 13<sup>th</sup> Street in Gainesville has roof runoff and parking lot runoff directed to large vegetated swales bordering the property (Figure 38).</li> </ul> |

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|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <ul style="list-style-type: none"> <li>o The parking lot at the University of Florida's O'Connell Center has swales situated in the median between each set of rows of parking (Figure 39). There are multiple curb cuts along each row to direct runoff from each of the parking areas into the swales.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Porous (permeable) pavement | <p>Permeable paver systems are assemblies of rigid blocks that contain drainage voids for passing runoff to the subsurface, where the water is further conveyed through base materials to secondary stormwater treatment systems. They particularly help in reducing the volume of rainfall runoff where they replace impermeable sidewalks and parking lots.</p>                                                                                                                                                         | <ul style="list-style-type: none"> <li>o Eng, Denman &amp; Associates an engineering firm at 2404 NW 43 Street in Gainesville constructed their parking lot out of pervious pavement.</li> <li>o The Heritage Oaks condominium has pervious pavers located where cars park. Traditional asphalt pavement abuts the pervious area but serves to collect runoff in a subsurface exfiltration basin.</li> <li>o The University of Florida installed permeable pavers in the parking lot at the Bat House located near Lake Alice on the University campus (Figure 39) The pavers serve to minimize runoff from the parking area by increasing percolation.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Bioretention                | <p>Bioretention facilities are small landscaped basins intended to provide water quality management by filtering stormwater runoff before release into secondary stormwater management systems. They use plants and soil to trap and treat petroleum products, metals, nutrients, and sediments. "Rain gardens" are well-known examples of bioretention areas. They are typically a planted depression that is designed to take all, or as much as possible, of the excess rainwater run-off from development and its</p> | <ul style="list-style-type: none"> <li>o Windsor Hall has roof runoff draining into an underground drainage network that empties into a rain garden. The garden is of sufficient size to store the peak flow of major storm events.</li> <li>o The Madera project, Heritage Oaks, and the Delta Zeta Sorority House in Gainesville all utilize rain gardens for water quality management. All three projects are discussed in more detail later in this section.</li> <li>o A commercial property located along NE 19<sup>th</sup> Terrace in Gainesville is employing the Filterra® stormwater bioretention filtration system. In this system, stormwater flows through a specially designed filter media mixture contained in a landscaped concrete container. The mixture immobilizes pollutants; those pollutants are then decomposed, volatilized and incorporated into the biomass of the Filterra® system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container, where the treated water is discharged.</li> <li>o The Gainesville Sun newspaper building, located on US 441 south, has a large</li> </ul> |

|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                              | associated landscape.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <p>naturally vegetated depressional area the serves as a Rain Garden.</p> <ul style="list-style-type: none"> <li>o The Gainesville Regional Utilities office in downtown Gainesville has a disconnected roof gutter system that discharges into a heavily landscaped Rain Garden along the entire front of the building.</li> <li>o The Royal Village Apartments in Gainesville has a Rain Garden established within a central courtyard area that retains roof runoff (Figure 40) The exterior of the complex is also surrounded landscaped , heavily mulched depressed areas that capture additional roof runoff</li> </ul>                                                                                                                                                                                                                                                                                       |
| Florida Friendly Landscaping | <p>The objective of Florida friendly landscaping is to establish and maintain healthy landscapes by matching the right plants with existing site conditions so that the use of additional resources, such as water, fertilizer, pesticides and labor, is minimized. Existing native-plant communities are typically the best suited for the climate. By using native plants during landscaping, homeowners can reduce the amount of fertilizers and pesticides used, conserve water, provide habitat for native wildlife and preserve water quality in adjacent waterbodies.</p> | <ul style="list-style-type: none"> <li>o The Florida Department of Environmental Protection (DEP) maintains an interactive Web site to provide information on Florida-friendly plants and landscaping (<a href="http://www.floridayards.org">www.floridayards.org</a>). The site provides basic information on Florida-friendly landscaping, including environmental benefits and guiding principles, and includes a database of native Florida plants.</li> <li>o Alachua County requires that retention/detention areas should be landscaped with native trees, shrubs, ground covers and native perennials appropriate to the function as a wet or dry basin. If the landscaped area is also designed to meet on-site stormwater management requirements, the area must be designed to provide an aesthetic focal point, or it must be preserved in such a manner as to maintain an existing wetland.</li> </ul> |
| Buffers                      | <p>The use of open space or vegetated buffers minimizes direct stormwater impacts to streams and wetlands. Vegetated buffers in particular,</p>                                                                                                                                                                                                                                                                                                                                                                                                                                  | <ul style="list-style-type: none"> <li>o Alachua County requires a 75 ft average development buffer to wetlands, a 100 ft average buffer for wetlands with regulated dependent species, and a 150 ft average buffer for Outstanding Florida Waters.</li> <li>o Marion County requires a vegetative buffer of at least 50 ft from any wetland.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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|                        | <p>slow overland runoff velocities. SJRWMD has permit requirements of a minimum development buffer of 25 ft adjacent to wetlands, as well as more stringent requirements for properties adjacent Outstanding Florida Waters or within special rule areas.</p>   | <ul style="list-style-type: none"> <li>o Gainesville has buffering standards for areas abutting surface waters and wetlands less than or equal to 0.5 acre that do not include Outstanding Florida Waters to be 50 foot average, with a 35 foot minimum. For areas abutting surface waters and wetlands greater than 0.5 acre that do not include Outstanding Florida Waters, the buffer size must a 75 foot average, with a 50 foot minimum. Finally, for listed Outstanding Florida Waters (OFWs) the buffer distance is 150 foot average, with a 100 foot minimum.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Education and Outreach | <p>Public education and outreach initiatives are the most direct means of providing the public and development community with an awareness and understanding of LID strategies and their role in providing for environmentally sound development practices.</p> | <ul style="list-style-type: none"> <li>o In April 2006, the Gainesville Clean Water Partnership and Sustainable Alachua County held an Urban Redevelopment and Water Management Issues Workshop that featured a field trip to local redevelopment sites to view firsthand ways that stormwater facilities are being integrated into smaller and smaller sites using LID techniques. The workshop also included a discussion panel on LID.</li> <li>o Alachua County, in collaboration with the University of Florida, and the St. Johns River Water Management District, has scheduled a local government workshop on LID and the benefit to water quality. The workshop, scheduled for March 22<sup>nd</sup>, 2007, focuses on surface, groundwater, and the sustainability issues associated with residential development. This type of workshop is consistent with Alachua County's Comp Plan policy that requires educational information to be made available to developers, homeowners, and other interested citizens concerning proper maintenance, management, restoration, and development in natural areas (for example, habitat creation, endangered species, management of development ponds, wetlands vegetation, xeriscape, water quality, and water conservation).</li> <li>o The Marion County Clean Water Program is the sponsor of an LID seminar for architects, developers, site planners, engineers, landscape architect, and contractors. This seminar, scheduled for April 5, 2007, includes discussions of site planning concepts, stormwater best management practices and LID systems, permitting LID in Florida, and developer experiences with LID.</li> <li>o Alachua and Marion County, the city of Gainesville, and SJRWMD are sponsors of the Watershed Action Volunteer (WAV) Program that provides educational outreach and volunteer water quality monitoring. The WAV program implements activities that promote "Rain Gardens", onsite management of stormwater quantity and quality,</li> </ul> |

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|  |  | <p>and Florida Friendly Landscaping methods, all LID implementation strategies.</p> <ul style="list-style-type: none"> <li>o Annual Rain Barrel Workshops are presented in Gainesville by the Alachua County WAV Program and the Alachua County Extension Service. The workshops are a hands-on opportunity for homeowners to make rain catchments for use in their landscapes. In addition to creating a rain barrel they can take to use in their yards, individuals who attend the workshops learn basic water-wise landscaping skills such as proper use of mulch, reduction of lawn, and using native plants. All participants take home a rain barrel and a list of plants for North Central Florida</li> <li>o In addition to the University of Florida's commitment to LID development on-campus the following faculty and programs are involved in the promotion of LID activities: <ul style="list-style-type: none"> <li>▪ The Program for Resource Efficient Communities (<a href="http://www.energy.ufl.edu/default.htm">http://www.energy.ufl.edu/default.htm</a>) integrates and applies the University of Florida's educational and analytical assets to promote the adoption of best design, construction, and management practices that <i>measurably</i> reduce energy and water consumption and environmental degradation in new residential community developments. Examples of these practices include the use of native vegetation in landscaping and minimal impervious surfaces surrounding structures. Dr. Pierce Jones (<a href="http://www.energy.ufl.edu/jones.htm">http://www.energy.ufl.edu/jones.htm</a>), whose experience and research focus includes green building principles and practices, manages the program.</li> <li>▪ Dr. Mark Clark, Assistance Professor of Wetland Ecology (<a href="http://www.energy.ufl.edu/clark.htm">http://www.energy.ufl.edu/clark.htm</a>), within the Department of Soil and Water Science is involved in ecological engineering design using wetland processes to improve water quality and enhance ecological function of altered landscapes.</li> <li>▪ Dr. John Sansalone, Associate professor with the Department of Environmental Engineering Sciences has research and inventive emphases on green materials and infrastructure systems in the urban environment,</li> </ul> </li> </ul> |
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|  |  | <p>unit operations for stormwater and wastewater, environmental hydrology, in particular modification of rainfall-runoff infiltration processes, and urban drainage systems and solidification/ stabilization.</p> <ul style="list-style-type: none"> <li>▪ Dr. Glenn A. Acomb, Associate professor with the Department of Landscape Architecture has areas of specialization that include sustainable community design and land development, water conservation the landscape, and community design and the role of open space.</li> <li>▪ Dr. James P. Heaney, Professor and Chair of the Department of Environmental Engineering has interests in the design and development of sustainable urban water infrastructure systems, water supply, wastewater, stormwater and simulation and optimization, and decision support systems.</li> </ul> <p>o Gainesville Regional Utilities (GRU) is a multi-service utility owned by the City of Gainesville. GRU serves Gainesville and portions of Alachua County, Florida, with electric, water, wastewater, natural gas and telecommunications services. GRU has a Green Building Program that maintains a reference guide with information on reducing water usage that can be applied to both new and existing development. Outdoor recommendations include rain shut-off devices on irrigation systems, irrigation zones for turf/plants/drought tolerant plants, automatic timers on irrigation system, rainwater catchment, and drip irrigation.</p> |
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**Figure 37.** The University of Florida Entomology Center's overland flow area.



**Figure 38.** Vegetated swales around the Walgreens Pharmacy on NW 13<sup>th</sup> Street, Gainesville, FL





Figure 39. Permeable pavement at the University of Florida Bat House parking lot



Figure 40. Rain garden within the courtyard at the Royal Village Apartments, Gainesville, FL



**Table 20. Local Multi-Strategy Low Impact Development Projects**

| Project                                                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Madera                                                                      | <p>The Madera Project (<a href="http://www.energy.ufl.edu/">http://www.energy.ufl.edu/</a>) in Gainesville consists of 88 single family homes built on a 44 acre site adjacent to the University of Florida. The University's Energy Extension Service has participated in the design and development of this eco-friendly, resource-efficient community under the direction of Professor Pierce Jones. The Madera project is being used to educate developers and contractors about specific environmental construction practices that can increase sustainability and construction efficiency, and reduce future homeowners' long-term maintenance costs.</p> <p>The Madera model center features a parking area with pervious pavers overlaying a wire mesh substrate to reduce compaction and maintain subsurface percolation. Roof downspouts are directed into infiltration cubes which provide temporary subsurface containment and percolation of runoff. A nearby retention area is situated in a natural depression area and landscaped as a rain garden. The roadway, with narrow right-of-way, has no curbs, with runoff directed into swales. The development is planted with native vegetation, and employs green building designs and materials. An irrigation system is fitted with moisture sensors to accurately gauge when to provide supplemental irrigation to the minimal turf area in the development. The development has restrictions to protect hardwood tree canopy and understory vegetation.</p> |
| University of Florida<br>Stormwater<br>Ecological<br>Enhancement<br>Project | <p>The Stormwater Ecological Enhancement Project (SEEP) began in 1995 with an objective to develop a management plan to enhance a stormwater retention basin located within the University of Florida Natural Area and Teaching Lab (NATL) for species diversity while optimizing the basin's use for research and education.</p> <p>The SEEP project consists of a 3-acre retention pond that is the low point of a 39.75 acre watershed. The total storage of the basin is 478,000 cubic feet. The primary goal of the project has been to increase the diversity of flooding depths and frequency of flooding since this is the primary factor regulating species composition in a wetland. To do this two depressions, one 4-foot, the other 5-feet deep, were dug at the southeastern end of the pond providing a deep, open-water habitat. At the north end a low berm was constructed to temporarily impound 80% of the entering stormwater. This forebay provides the first phase of treatment and was planted with species known to take up heavy metals and remove nutrients. Water from the forebay is then slowly released, first flowing through an area planted to resemble a bottom-land hardwood swamp, and move into a shallow freshwater marsh before entering the deep-water ponds. At the southeastern end of the pond another small berm was built to divert stormwater away from the deep-water</p>                                                                                                     |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
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|                                    | ponds, increasing treatment time. The basin was planted with species that resemble those found in wetlands of North Central Florida.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Gainesville Green Building Program | The purpose of the Gainesville Green Building Program is to provide the city community with a certification-based “Green Building” program to promote sustainable and environmentally friendly practices of construction and design based on an incentive strategy. It is expected that city-owned civic or office construction project will follow the program guidelines. This program will be voluntary for all others.                                                                                                                                                                                                                                                                                                                            |
| Heritage Oaks *                    | <p>The Heritage Oaks development in Gainesville has the majority of stormwater draining from roof drains to a landscaped area. Other roof runoff drains to a centralized infiltration trench system located under the hardscape parking lot. The system temporarily stores and treats rooftop and pavement runoff before infiltrating subsurface.</p> <p>A concrete sidewalk was narrowed to half its width, and a streetside bioretention strip infiltrates runoff generated from the sidewalk hardscape, and provides an aesthetically pleasing separation between sidewalk and roadway. A rain garden treats runoff from a no mortar brick sidewalk and from the disconnected roof. The development incorporates pervious parking (Figure 41).</p> |
| Delta Zeta Sorority House *        | The Delta Zeta Sorority House on the southeast intersection of SW 13 <sup>th</sup> Street and SW 9 <sup>th</sup> Avenue in Gainesville has a wide landscaped area providing a large infiltration capacity that treats runoff from the sidewalk inside the property. Runoff from the roof and parking lot of the facility is conveyed to a rain garden retention area. The rain garden provides enough vertical storage capacity to temporarily store very large storms, infiltrating it into the soil gradually.                                                                                                                                                                                                                                      |
| Alligator Crossing *               | Alligator Crossing, located at SW 10 <sup>th</sup> Street and SW 2 <sup>nd</sup> Avenue in Gainesville, has drainage from the roof flowing off the edges onto the landscape surrounding the buildings. There is no directly connected impervious area, and a strip of forested area approximately 20 feet wide is used to infiltrate water between this property and a property to the South during and subsequent to storm events.                                                                                                                                                                                                                                                                                                                   |

\* These projects were identified in the Tumblin Creek Watershed Management Plan (Jones, Edmunds, & Associates, 2006). Development of this report involved extensive evaluations of stormwater BMPs including LID for the Tumblin Creek watershed. The draft Plan includes a variety of case studies of LID in the watershed.

Figure 41. Pervious driveway into the Heritage Oaks Condominium Complex in Gainesville, FL



There are a number of planned redevelopment projects within the City of Gainesville in which LID strategies have been proposed (see Table 21). The city has also identified twenty potential Best Management Practices (BMP) retrofit sites within the Tumblin Creek Watershed in which LID strategies can be applied (Jones, Edmunds & Associates 2006). The city is also considering the construction of two subregional stormwater ponds that will include bioretention components. The ponds will be funded by local developers that can buy stormwater credits in the ponds on a first-come first-served basis. The intent is to minimize the scale necessary to provide both adequate treatment and retention.

The City of Gainesville and the Gainesville Community Redevelopment Agency have drafted an Urban Surfaces Loading proposal to quantify selected constituent loadings, on a statistically-significant event basis, for selected cover conditions with a specific focus on comparing loadings from selected roofing cover conditions to selected pavement cover conditions. The results of the study will allow quantification of load differences between roof and pavement surfaces, as a planning tool for stormwater management.

Table 21. Proposed Low Impact Development Strategies for Pending Redevelopment Projects

| Redevelopment Site                                                                    | Proposed LID Strategy |                 |                            |                   |                     |
|---------------------------------------------------------------------------------------|-----------------------|-----------------|----------------------------|-------------------|---------------------|
|                                                                                       | Grassed Swale         | Disconnect Roof | Infiltration/ Exfiltration | Permeable Parking | Natural Landscaping |
| 1122 SW 3 <sup>rd</sup> Ave.                                                          |                       | x               | x                          |                   | x                   |
| Visions                                                                               |                       | x               |                            | x                 |                     |
| Campus View North                                                                     |                       | x               |                            |                   |                     |
| Campus View III                                                                       |                       | x               | x                          |                   |                     |
| Estates at Sorority Row                                                               |                       | x               |                            |                   |                     |
| <b>BMP Retrofit Sites</b>                                                             |                       |                 |                            |                   |                     |
| 6 <sup>th</sup> St. between NW 7 <sup>th</sup> Ave & Depot Road                       | x                     |                 |                            |                   |                     |
| SW 7 <sup>th</sup> Avenue between SW 12 <sup>th</sup> St. and SW 10 <sup>th</sup> St. |                       |                 | x                          |                   |                     |

Note: This table was current as of May 2007. Subsequent changes to these projects may have occurred.

In sum, the implementation of low impact development and design strategies for stormwater management and water quality improvement is occurring at an increasing rate within the Orange Creek Basin. Alachua County, Marion County, the City of Gainesville, and the University of Florida are the major stakeholders within the Basin, and are receptive to and supportive of LID. These entities have specific regulatory requirements relating to LID, including the preservation and protection of environmentally sensitive features, reduction of impervious surfaces, site design, swales, landscaping and buffers.

A variety of completed projects within the Orange Creek Basin have been described herein that have utilized LID, and demonstrate the water quality environmental benefits of the LID system. The stakeholders have aggressively promoted LID through public education and outreach efforts, including seminars, workshops, and incentive programs.

### 3.10.2 Other Development-Related Management Actions

Stakeholders in the basin are implementing other activities to address the impact of future growth. These type of projects include the following:

- o Marion County addresses impacts of waterfront projects such as the above through its Environmentally Sensitive Overlay Zone (ESOV) for various areas in the county. Lands in Marion County adjacent to Orange Lake are in an ESOV one-half mile from the water's edge. Being within an ESOV requires, among other things, additional buffering, stormwater management, and stricter standards for sewage disposal systems. Provisions are also in place to promote open space and require larger buffers between water resources and intensive land uses.
- o Alachua County Forever and the SJRWMD are actively pursuing land acquisition projects throughout the Basin. These include the Newnans Lake acquisition, a

\$3.7million dollar cooperative effort between Alachua County, SJRWMD, and the U.S. Department of the Interior (Project NEW06) Funding is also in place for the Wainberg acquisition (Alachua County; Project NEW07) and expansion of the Newnans Lake Conservation Area (SJRWMD; Project NEW02/HAT02). Other land acquisition projects will be pursued as funding becomes available.

- o The Alachua County Comprehensive Plan has numerous policies and programs in separate elements that compliment one another in support of broad environmental protections aimed at, among other things, water quality and quantity for citizens and natural resources. Specific Land Development Regulations implement these policies from enforcing zoning and development activities through identified criteria for buffers and open space requirements. The County also has a stringent wetland protection ordinance in place.
- o The 2001-2020 Alachua County Comprehensive Plan now includes the land use of Preservation, which is defined as “An environmental land use category that consists of publicly owned lands which are intended for use as natural reserves or managed conservation lands for the preservation of natural resources. Preservation areas include lands owned in fee simple or less-than-fee simple title.” (Conservation and Open Space Element Definitions). It is appropriate for the parcels now in public ownership and managed for conservation to receive the land use classification of Preservation. Much of the land in the basin is designated Preservation, with management by St. Johns River Water Management District.
- o Similarly, a variety of programs are in place within the City of Gainesville to address water quality impacts of future growth. The City adopted a Stormwater Utility billing system in 1989 to help fund city-wide stormwater treatment improvements. Redevelopment of any existing impervious surfaces exceeding 4,000 square feet must meet current regulations for stormwater treatment.
- o The City's Land Development Code has strict setback and development requirements for properties adjacent to wetlands, creeks or lakes. The City has flood control, surface water, wellfield, gateway street, nature park, greenway and uplands districts designated as overlay districts. Development plans for lots within 150 feet of any regulated waterbody must demonstrate compliance with erosion and sediment control, runoff control and treatment, and protection of vegetation integral to the creek's ecological value. Chapter 406 of the City's development code outlines several of the City's natural resource, wetland, and floodplain protection requirements.

Through continued implementation of LID principles, land acquisition, and continued regulatory support, the water quality effects of future growth will be minimized in the Orange Creek Basin. Because most development occurs by private entities, public-private cooperation is vital if the effects of new development are to be mitigated. The foundation for this type of cooperation exists in the Basin. Relationships between the St. Johns River Water Management District, local governments, the development community, and the University have been built through implementation of the projects noted above. This foundation will be key to the ongoing success of LID and similar efforts in the Orange Creek Basin.

### 3.11 AGRICULTURAL BEST MANAGEMENT PRACTICES

According to the Alachua County Extension Service, as of March 8, 2007, agriculture in the Orange Creek Basin consisted of the following:

- Commercial pine plantings over much of the area
- Pasture, beef cattle, dairy
- Several large and small blueberry plantings on the east side
- Several pecan orchards on the east side
- Several citrus orchards on the east side
- A few watermelon and muskmelon plantings on the east side
- Several nursery/greenhouse operations
- Several small-scale mixed vegetable farms
- A couple of peach and persimmon orchards
- Various crops at IFAS Pine Acres Research Center near Citra

The two most common agricultural commodity groups in the Orange Creek Basin are cow/calf and silviculture, with silviculture being the dominant agricultural use (See *section 3.12 for more information on silviculture*). Nurseries and sod operations are also present, and equine operations are growing. There is some acreage in blueberries and non-commercial citrus. There is also a small amount of peanut acreage in this basin. In general, peanuts are not fertilized with direct nitrogen inputs because they are legumes and produce their own nitrogen from bacterial conversion in the root nodules. Peanuts are not double-cropped and are often grown using conservation tillage techniques, thus the pollution potential from this crop is minimal.<sup>2</sup>

In recent years, there has been a decrease in the total agricultural acreage in the Orange Creek Basin, following statewide trends in other urbanizing basins. Row crops, in particular, are on the decline in the basin. Acreage that once contained field corn and other agronomic crops has been sold to developers.

#### 3.11.1 Office of Agricultural Water Policy BMP Programs

Through the Office of Agricultural Water Policy (OAWP), the Department of Agriculture and Consumer Services (DACS) develops, adopts, and implements agricultural Best Management Practices (BMPs), other than for silviculture, to reduce water quality impacts from agricultural discharges and enhance water conservation. The OAWP has adopted by rule BMPs that address the following operations in the basin:

- Container Nurseries (Chapter 5M-6, F.A.C.)
- Vegetable and Agronomic Crops (Chapter 5M-8, F.A.C.)

The OAWP is currently developing and will be adopting BMP manuals of statewide application for cow/calf, equine, and sod operations. All of the commodity groups in this basin, with the exception of blueberries, are expected to have adopted BMPs in place by early 2008. However, blueberry growers can effectively use BMPs adopted for the nursery, citrus, and vegetable and agronomic crops.

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<sup>2</sup> D.L. Wright, B. Tillman, E. Jowers, J. Marois, J. A. Ferrell, T. Katsvairo, and E. B. Whitty, ***Management and Cultural Practices for Peanuts***. This document is SS-AGR-74, in the Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida: First published February 2000, revised September 2006. See: <http://edis.ifas.ufl.edu/AA258>

Although measures are not currently adopted by rule for some of the commodity groups in this basin, all agricultural groups use BMPs to some extent. The two major categories of commonly used BMPs are nutrient management and irrigation management. Nutrient management is the amount, timing, placement, and type (source) of fertilizer. University of Florida – Institute of Food and Agricultural Sciences (UF-IFAS) fertilizer rate recommendations, soil tests, fertigation (fertilizing through irrigation), split fertilizer applications, foliar applications, controlled-release fertilizer, fertilizer spreader shut-off valves, and variable-rate fertilizer spreaders are among the practices used for nutrient management. Irrigation management is the maintenance, scheduling, and overall efficiency rating of irrigation systems. It typically includes conversion to low-volume systems, soil moisture monitoring, scheduling according to rainfall, temperature and other climatic conditions, water placement, and plant groupings.

The key to successful BMP implementation is in educating landowners about integrating BMPs into their daily routine to reduce pollutant loading. A detailed explanation of adopted agricultural BMPs can be found at [www.floridaagwaterpolicy.com](http://www.floridaagwaterpolicy.com), and printed BMP manuals can be obtained in the local extension office at county agricultural centers, or by contacting OAWP field staff.

#### **3.11.2 OAWP Process of BMP Implementation**

The OAWP's BMP implementation role involves assisting agricultural producers in selecting, funding, properly implementing, and maintaining BMPs. The OAWP employs field staff and contracts with service providers<sup>3</sup> to work with producers to submit notices of intent (NOIs) to implement BMPs, which identify the measures appropriate for their operations. Service providers also give technical assistance to producers and help implement cost-share programs that leverage regional, state, and federal funds.

Although DACS BMP programs are non-regulatory in nature, subsection 403.067(7)(b), Florida Statutes, requires that nonpoint pollutant sources (such as agriculture) included in a basin management action plan demonstrate compliance with pollutant reductions established to meet a TMDL either by implementing rule-adopted BMPs or conducting water quality monitoring prescribed by DEP or a water management district. Within Alachua County as of August 2, 2007, NOIs had been submitted for 562 acres of container-grown plants and 1,495 acres of vegetable and agronomic crops, for a total of 2,057 acres under BMP implementation.

#### **3.11.3 Future Focus**

In order to meet the intent of the Florida Watershed Restoration Act with regard to agriculture in the Orange Creek Basin, during 2007 - 2012 the OAWP will, as necessary and feasible:

- Adopt BMP manuals for cow/calf, equine, container nursery, and sod operations.
- Intensify its efforts to sign up cow/calf and equine producers for BMP implementation in the Orange Creek Basin.
- Work with DEP to identify priority cow/calf and equine BMPs and verify their effectiveness.

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<sup>3</sup> Soil and Water Conservation Districts, University of Florida Institute of Food and Agricultural Sciences, Natural Resource Conservation and Development Councils, etc.

- Develop a BMP implementation assurance program to follow up with selected cow/calf and equine operations on whether they are implementing BMPs and keeping records according to their submitted NOIs.
- Provide or participate in training and educational opportunities for producers regarding BMP implementation and its importance to water quality, particularly TMDLs.
- Evaluate the need for BMP enrollment and implementation assurance for other commodities in the basin and conduct these on a priority basis, as needed and feasible.

### 3.11.4 Silviculture

BMPs for silviculture were developed in the mid-1970's, and BMP compliance has been monitored statewide since 1981. Since 1995, compliance with silviculture BMPs in the Orange Creek Basin and vicinity has ranged from 78 percent to 100 percent, with an average of 98 percent compliance. A February 2005 BMP Survey of active silviculture operations within the basin showed 100 percent compliance (see **Figure 42**).

In addition, an analysis of past BMP Survey data showed that approximately 2 percent of all Survey sites received fertilizer applications and that 80 percent of those applications were on forest industry lands. Compliance with this category of BMPs was 100 percent for all sites considered. Forestry fertilization usually consists of di-ammonium phosphate (DAP – a Total Nitrogen and phosphate/ Total Phosphorus compound), urea (an organic Total Nitrogen compound), or triple-super-phosphate (a phosphate/Total Phosphorus compound) applied at rates well below the maximum limits listed in the BMP Manual. For the forest industry lands in the basin, fertilizer is typically applied twice during a 22-25 year period. In addition, a survey in the middle Suwannee River basin (a much larger area), determined that approximately 10 percent of the total forested acres (industry and NIPF) received fertilizer in any one year (Florida Forestry Association, 2000).

Historically, mechanical site preparation occurs on well over half of the sites in any given BMP Survey (62 percent in the 2003 Survey). This is a common forestry practice, especially on lands that are managed intensively, and may include chopping, raking, piling, bedding, and burning. Research has shown that nutrients discharged from forestry sites may increase following timber harvesting and mechanical site preparation. However, much of the increase is attributable to higher total annual water yield resulting from the temporary reduction in evapotranspiration from trees. Nutrient export, when it occurs, is typically small (.6 kg/ha/yr<sup>-1</sup> or less) and short-lived (one year) (Fisher, 1981; Riekerk, 1983). In addition, such losses can be prevented because the nutrients are typically bound up in soil particles that are protected from erosion and sedimentation by BMPs, (Lowrance, et. al., 1984). Compliance with BMPs for site preparation has a long-term average of 97 percent.

Without BMPs, forestry activities can deliver sediment and nutrients to adjacent water resources at levels that may adversely affect aquatic ecosystems chemically, physically and biologically. However, Florida BMPs have been shown to be effective in protecting water quality and aquatic habitat by minimizing or eliminating the delivery of forestry-related sediment, nutrients, etc., and by maintaining or improving both in-stream and riparian habitats. BMP effectiveness research conducted in Florida reported no evidence of sediment delivery or other impacts to the aquatic ecosystem following intensive silviculture operations on a variety of sites and under varying site conditions (Vowell, 2001; Vowell and Frydenborg, 2004).

As authorized by Chapter 403.067, F.S., the Division of Forestry (DOF) promulgated Chapter 5I-6, Florida Administrative Code, effective February 11, 2004. This rule formally adopted the silviculture BMP Manual and provides a *notice of intent* to be submitted by forest landowners who elect to participate in the rule provisions. As of May 15, 2006, NOIs received in Alachua, Marion, and Putnam County amount to 82,814.65 acres; 21,747.99 acres; and 69,742.78 acres respectively, totaling 174,305.42 acres. The rule can be accessed at the DOF website as follows: <http://www.fl-dof.com/Conservation/hydrology.html>)

The locations for the 2005 silviculture BMP survey are shown in **Figure 43**. **Table 22** summarizes the management actions being implemented for silviculture activities in the Orange Creek basin.

Additional silviculture activities in the Basin are conducted by the University of Florida. The Austin Cary Memorial Forest (ACMF) is administered under the auspices of the School of Forest Resources and Conservation (SFRC) in the University of Florida's Institute of Food and Agricultural Sciences. The 2,040 acre forest, a typical north Florida pine flatwoods ecosystem, was acquired to meet accreditation requirements by the Society of American Foresters. Originally named the Austin Cary Demonstration Forest, it was later changed to the Austin Cary Memorial Forest. Management of the forest recognizes its unique composition of old stands mixed with pine plantations and strives to optimize the multiple use value of this resource while continually improving its ecological integrity, economic viability and associated management operations. Three uses of the ACMF are recognized in order of priority: 1) resident and continuing education, 2) extension and demonstration, and 3) research. The ACMF is managed primarily to teach and demonstrate forest ecosystem structure and function and the potential of a variety of sustainable land management principles and practices. A mosaic of stand conditions is requisite for reaching these objectives.

Although the Forest serves a variety of purposes, several areas provide an age sequence of pine plantations operationally managed with the best current practices. A 5-8 year interval between clearcut harvests is used, with a maximum 30-year rotation. The 30-year rotation will provide opportunities to demonstrate the variety of typical plantation products including pulpwood, poles, and sawtimber. Silviculture activities in the Forest will allow for comparisons of different spacing configurations, site preparation techniques, weed control, fertilization and/or thinning options.

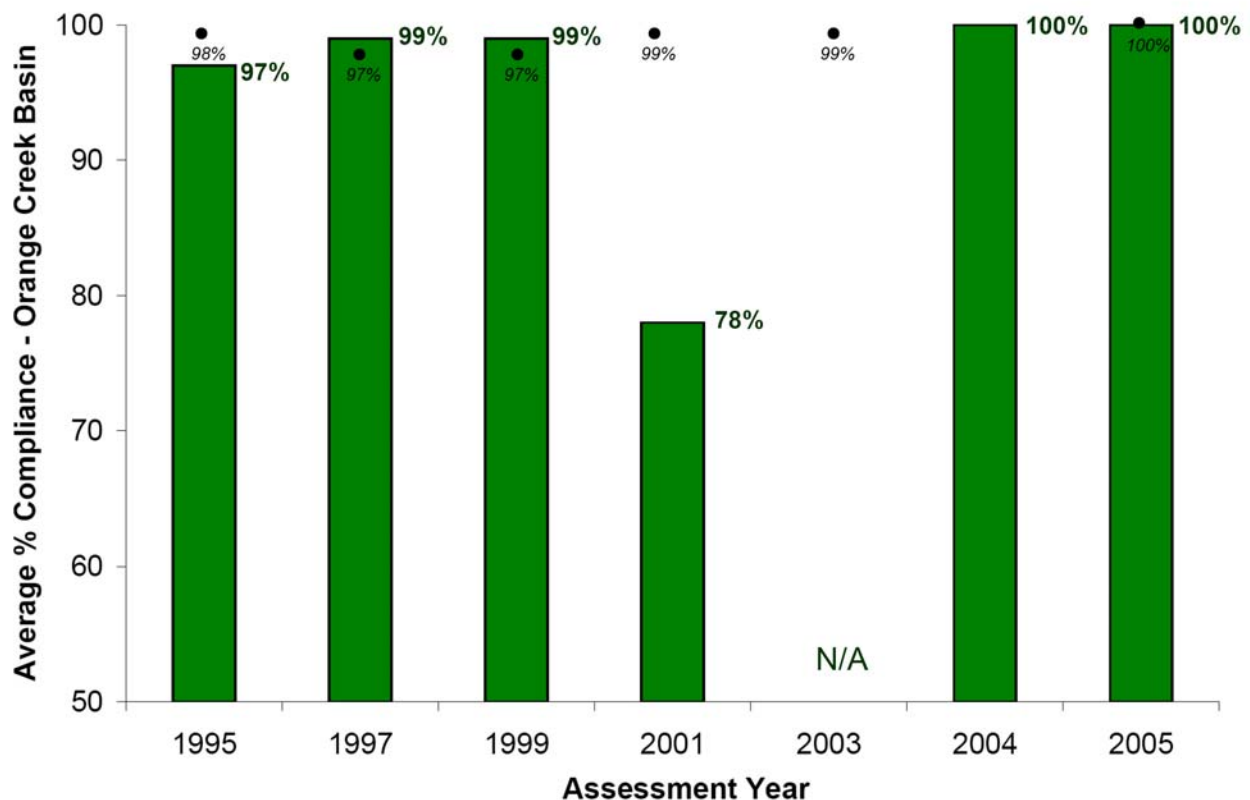
Forest management practices on the ACMF have generally been low-intensity in nature, involving fire protection and periodic harvesting to meet specific forest or university needs or provide for research installations. Until the 1990s, revenue generated on the forest was returned to university and state budgets and small annual allocations for the forest were only sufficient for maintenance level management. Silvicultural activities were limited to thinning in some compartments, replanting of harvested or burned stands and understory reduction, usually with prescribed burning.

Periodic pulpwood and timber harvests were conducted on the ACMF after 1950, with the early cuttings concentrating on thinning to remove old naval stores trees and for stand improvement. Several harvests involved sizeable acreages and appreciable income; e.g. the 1977 and 1982 harvests, to salvage fire damage and to meet IFAS needs, generated approximately \$450,000 in revenue. During the rest of the 1980's there were only a few small salvage cuts or thinnings. A policy change in the mid 1990's

allowed harvesting revenue to be returned to forest management, allowing for a more active approach to meeting new forest management objectives outlined in the 1989 Forest Management Plan.

Future ACMF management will be in a manner that meets all applicable standards and performance measures of the Sustainable Forestry Initiative Program, Forest Stewardship Council, American Tree Farm System, and Forest Stewardship Program. The full Austin Cary Memorial Forest Resource Management Plan (Long, et al., 2004) is available from the University of Florida.

**FIGURE 42 . FLORIDA SILVICULTURE BMP SURVEY DATA FOR ORANGE CREEK BASIN AND VICINITY - SUMMARY BY SURVEY YEAR**



- Average % Compliance of all survey sites in Alachua, Marion and Putnam Counties

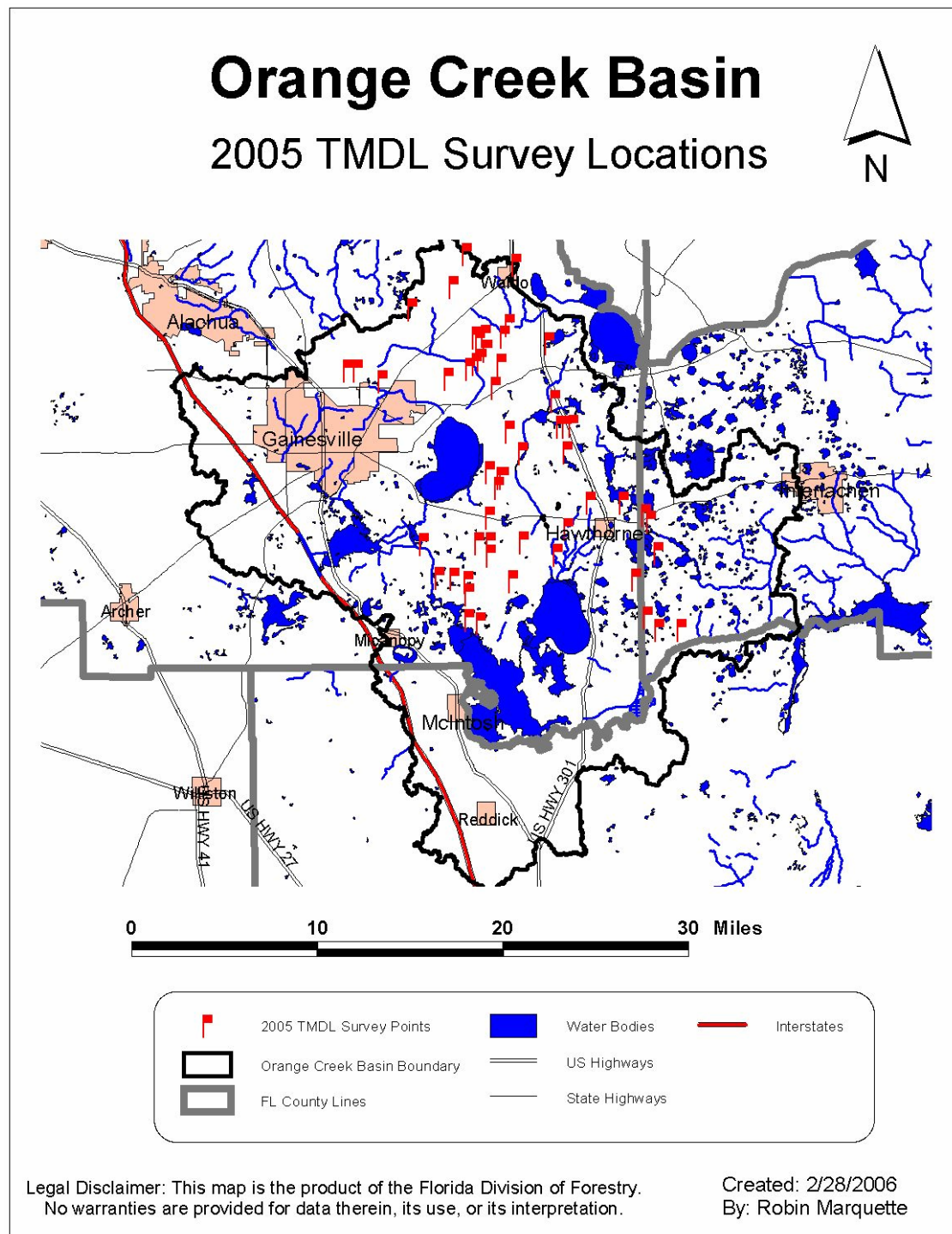
**TABLE 22 SILVICULTURE MANAGEMENT ACTIONS TO ADDRESS TMDLS IN ORANGE, NEWNANS, AND LOCHLOOSA LAKES**

| LEAD ENTITY/<br>PARTNER   | MANAGEMENT ACTION SUMMARY *                                                                                                                                    | START/END DATE        |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| DACS Division of Forestry | Conduct an historical analysis of compliance with silviculture BMPs in the Orange Creek Basin and vicinity, for fertilization and mechanical site preparation. | Completed spring 2004 |

|                                              |                                                                                                                                                                                                 |                                     |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| DACS Division of Forestry                    | Conduct a current assessment of BMP compliance in the Orange Creek Basin and vicinity to evaluate all active silviculture operations.                                                           | Completed spring 2004               |
| DACS Division of Forestry                    | Conduct basin-wide solicitation of forest landowners for BMP rule "sign-up," focusing on non-industrial ownerships. Verify compliance through monitoring as described above.                    | Completed                           |
| DACS Division of Forestry                    | Conduct bi-annual BMP compliance monitoring in the Orange Creek Basin and vicinity to capture future silviculture operations, focusing on forest fertilization and mechanical site preparation. | Ongoing                             |
| DACS Division of Forestry                    | Conduct basin-wide BMP training/education for forest landowners, loggers, site preparation contractors and fertilizer applicators.                                                              | Conduct three workshops by 12/31/06 |
| DACS Division of Forestry/<br>Alachua County | Coordinate joint notification of Intent to use silviculture BMPs to reduce duplication and increase awareness of silviculture operations.                                                       | Completed                           |
| Alachua County                               | Monitor logging activities, and enforce against operations not complying with applicable BMPs, according to county codes.                                                                       | Ongoing                             |

\* See Appendix E for additional project details.

**FIGURE 43. 2005 FORESTRY BMP COMPLIANCE SURVEY IN THE ORANGE CREEK BASIN**



## **CHAPTER 4: NUTRIENT TMDLS – BASELINE POLLUTANT LOADINGS AND MANAGEMENT ACTIONS BY SUB-BASIN**

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Including the basin-wide management activities described in Chapter 3, over 50 projects have been identified that will achieve nutrient load reductions in specific subbasins. For each subbasin in the Orange Creek Basin, this chapter identifies the background pollutant loading by source and highlights specific projects intended to reduce nutrient loads. The benefits of individual projects have been quantified to the greatest extent possible.

A detailed summary of the relative contribution of various sources to pollutant loading by subbasin is provided in Table 23. Data for this table was taken directly from the Newnans Lake, Orange Lake, and Lake Wauberg TMDL documents. These values form the basis of the subbasin-specific baseline pollutant loading discussions in this chapter (e.g. Section 4.1.1).

Due to deferment of the TMDL, quantitative source data was not considered valid to include Lake Lochloosa in Table 23. background loading estimates for Lake Lochloosa were not included in Table. However, management actions will be implemented to reduce nutrient loading to Lake Lochloosa (see Section 4.5).

### **4.1 NEWNANS LAKE SUB-BASIN**

#### **4.1.1 BASELINE POLLUTANT LOADINGS**

In the Newnans Lake TMDL, internal recycling of nutrients stored in lake sediments contributed a significant proportion of the TN and TP load and the subsequent observed degree of eutrophication (see Section 5.1 of the Newnans Lake TMDL). Figures 44 and 45 reflect the dominance of internal recycling as a nutrient source: 71.8% of the TN load and 52.4% of the TP load. Tributary inflows from Hatchet and Little Hatchet Creeks are the next significant source, contributing 17.1% of the TN load and 22.1% of the TP load into Newnans Lake. Atmospheric deposition is also a significant contributor of TP loading (12.4%).

In the TMDL document, TN loading from onsite wastewater systems (septic tank systems and package plants) was estimated to be 0.3% of the TN load to Newnans Lake. Onsite wastewater loading in the TMDL was based upon an estimate of the number of failing septic systems and load contributed by each. However, onsite systems that are designed, installed, and functioning properly contribute nutrient loading to groundwater, primarily TN. This TN loading can then enter surface waters through baseflow. Given the Working Group's concern about onsite systems, a wastewater analysis was conducted for the BMAP (Appendix H). This analysis estimated TN loading from functioning and failing onsite systems (septic tank systems and package plants) in close proximity to Orange Creek Basin lakes. TN loading from onsite wastewater systems into Newnans Lake was estimated at 2.6% (see Appendix H). The primary contribution was from functioning septic tank systems (Figure 1, Appendix H). Although this is greater than the 0.3% estimate from the TMDL, onsite wastewater systems are a small portion of the anthropogenic TN load to Newnans Lake.

**FIGURE 44 . BASELINE TOTAL NITROGEN LOADING TO NEWNANS LAKE**  
**1996-2000 total - 315,510 lbs/yr**

(TMDL is 85,470 lbs/yr)

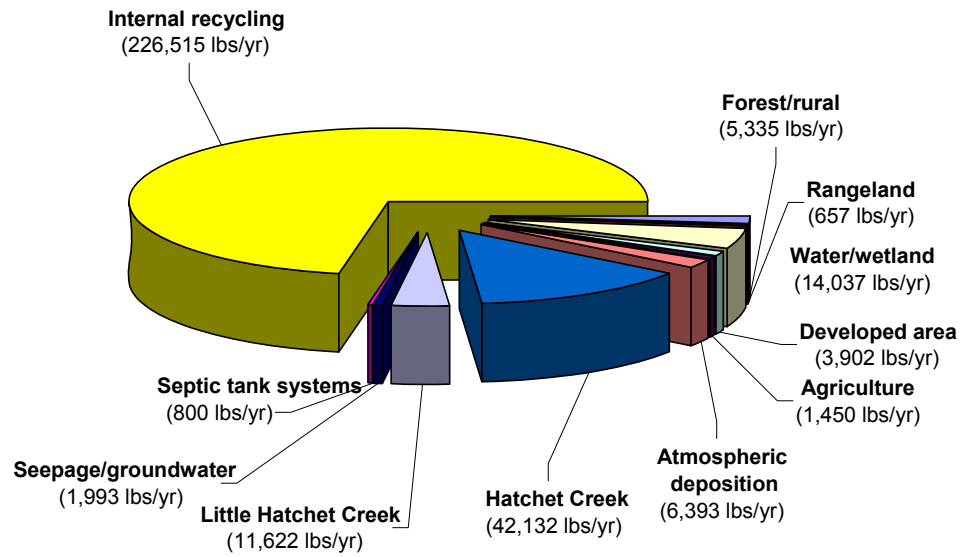


**FIGURE 45 . BASELINE TOTAL PHOSPHORUS LOADING TO NEWNANS LAKE**  
**1996-2000 total - 25,732 lbs/yr**

(TMDL is 10,924 lbs/yr)

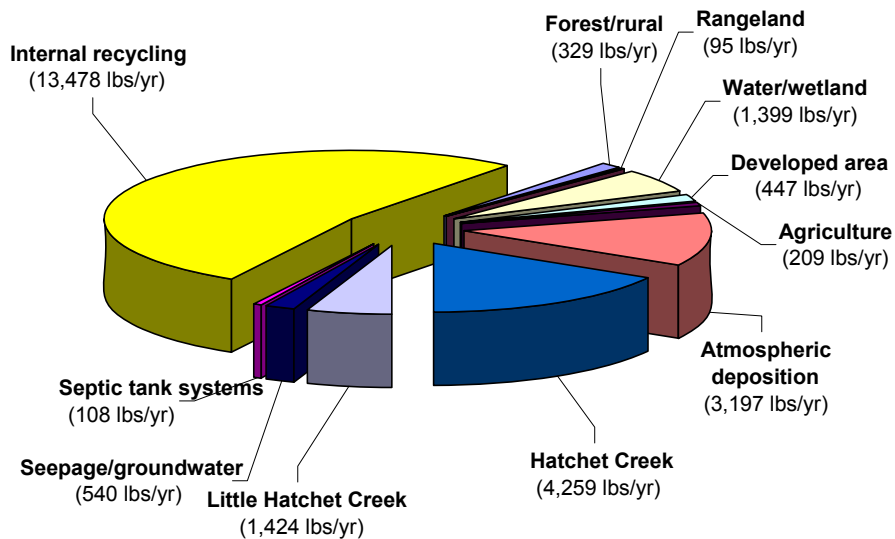


**TABLE 23 . TMDL BASELINE POLLUTANT LOADING AND PERCENT CONTRIBUTION FOR TMDL DEVELOPMENT PERIOD**

| SOURCES OF POLLUTANTS<br>(TMDL baseline loading in lbs/yr) | NEWNANS LAKE<br>(TOTAL PHOSPHORUS) |       | NEWNANS LAKE<br>(TOTAL NITROGEN) |       | ORANGE LAKE<br>(TOTAL PHOSPHORUS) |       | LAKE WAUBERG<br>(TOTAL PHOSPHORUS) |       | LAKE WAUBERG<br>(TOTAL NITROGEN) |       | ALACHUA SINK<br>(TOTAL NITROGEN) |       |
|------------------------------------------------------------|------------------------------------|-------|----------------------------------|-------|-----------------------------------|-------|------------------------------------|-------|----------------------------------|-------|----------------------------------|-------|
|                                                            | TMDL<br>baseline<br>loading        | %     | TMDL<br>baseline<br>loading      | %     | TMDL<br>baseline<br>loading       | %     | TMDL<br>baseline<br>loading        | %     | TMDL<br>baseline<br>loading      | %     | TMDL<br>baseline<br>loading      | %     |
| <b>Point sources</b>                                       | 145                                | 0.6%  | 655                              | 0.2%  |                                   |       |                                    |       |                                  |       |                                  |       |
| <b>Municipal plant discharges</b>                          |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| Main Street WWTP                                           |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       | 88,748                           | 19.2% |
| Kelly Power Plant                                          |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       | 802                              | 0.2%  |
| <b>Stormwater runoff</b>                                   |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| <b>Natural area runoff</b>                                 |                                    |       |                                  |       |                                   |       | 21                                 | 2.8%  | 123                              | 3.0%  |                                  |       |
| Silviculture                                               |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| Forest/rural                                               | 329                                | 1.3%  | 5,335                            | 1.7%  | 602                               | 2.2%  |                                    |       |                                  |       | 928                              | 0.2%  |
| Rangeland                                                  | 95                                 | 0.4%  | 657                              | 0.2%  | 24                                | 0.1%  |                                    |       |                                  |       | 98                               | 0.0%  |
| Water/wetland                                              | 1399                               | 5.4%  | 14,037                           | 4.4%  | 3,338                             | 12.0% |                                    |       |                                  |       | 2,308                            | 0.5%  |
| <b>Stormwater runoff/developed uses</b>                    |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| Urban open                                                 | 33                                 | 0.1%  | 347                              | 0.1%  | 97                                | 0.3%  |                                    |       |                                  |       | 2,166                            | 0.5%  |
| L-D residential                                            | 145                                | 0.6%  | 1,340                            | 0.4%  | 439                               | 1.6%  |                                    |       |                                  |       | 673                              | 0.1%  |
| M-D residential                                            | 204                                | 0.8%  | 1,702                            | 0.5%  | 185                               | 0.7%  |                                    |       |                                  |       | 21,700                           | 4.7%  |
| H-D residential                                            | 31                                 | 0.1%  | 200                              | 0.1%  | 4                                 | 0.0%  |                                    |       |                                  |       | 850                              | 0.2%  |
| Trans/comm                                                 | 34                                 | 0.1%  | 313                              | 0.1%  | 209                               | 0.7%  |                                    |       |                                  |       | 681                              | 0.1%  |
| Agriculture                                                | 209                                | 0.8%  | 1,450                            | 0.5%  | 5,987                             | 21.5% |                                    |       |                                  |       | 599                              | 0.1%  |
| <b>Atmospheric deposition (wet/dry)</b>                    | 3,197                              | 12.4% | 6,393                            | 2.0%  | 2,941                             | 10.5% | 486                                | 65.0% | 2,642                            | 65.0% | 23                               | 0.0%  |
| <b>Tributary inflows</b>                                   |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| Hatchet Creek                                              | 4,259                              | 16.6% | 42,132                           | 13.4% |                                   |       |                                    |       |                                  |       |                                  |       |
| Little Hatchet Creek                                       | 1,424                              | 5.5%  | 11,622                           | 3.7%  |                                   |       |                                    |       |                                  |       |                                  |       |
| Camps Canal                                                |                                    |       |                                  |       | 10,346                            | 37.1% |                                    |       |                                  |       |                                  |       |
| Cross Creek                                                |                                    |       |                                  |       | 3,327                             | 11.9% |                                    |       |                                  |       |                                  |       |
| Alachua Lake                                               |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       | 338,307                          | 73.1% |
| <b>Seepage/groundwater</b>                                 | 540                                | 2.1%  | 1,993                            | 0.6%  |                                   |       |                                    |       |                                  |       |                                  |       |
| <b>Septic tank systems</b>                                 | 108                                | 0.4%  | 800                              | 0.3%  | 390                               | 1.4%  | 241                                | 32.2% | 1,299                            | 32.0% | 4,667                            | 1.0%  |
| <b>Internal nutrient recycling</b>                         | 13,478                             | 52.4% | 226,515                          | 71.8% |                                   |       |                                    |       |                                  |       |                                  |       |
| <b>Adjustment</b>                                          | 102                                | 0.4%  | 19                               | 0.0%  |                                   |       |                                    |       |                                  |       |                                  |       |
| <b>Loading information</b>                                 |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| TMDL baseline P/N-loading and % (lbs/yr)                   | 25,732                             | 100%  | 315,510                          | 100%  | 27,889                            | 100%  | 748                                | 100%  | 4,064                            | 100%  | 462,550                          | 100%  |
| Total Maximum Daily Load (lbs/yr)                          | 10,924                             |       | 85,470                           |       | 15,262                            |       | 374                                |       | 2,062                            |       | 256,322                          |       |
| Reduction needed in loading and % (lbs/yr)                 | 14,808                             | 57.5% | 230,040                          | 72.9% | 12,627                            | 45.3% | 375                                | 50.1% | 2,002                            | 49.3% | 206,228                          | 44.6% |
| <b>Concentration information</b>                           |                                    |       |                                  |       |                                   |       |                                    |       |                                  |       |                                  |       |
| TMDL baseline average chlorophyll a                        | 249 ug/l                           |       | 249 ug/l                         |       | 59.2 ug/l                         |       | 76.9 ug/l                          |       | 76.9 ug/l                        |       |                                  |       |
| TMDL baseline TP/TN                                        | 160 ug/l                           |       | 4.34 mg/l                        |       | 53 ug/l                           |       | 111 ug/l                           |       | 1.62 mg/l                        |       |                                  |       |
| TMDL target for TP/TN                                      | 62 ug/l                            |       | 0.97 mg/l                        |       | 31 ug/l                           |       | 56 ug/l                            |       | 1.01 mg/l                        |       |                                  |       |
| TMDL target for chlorophyll a                              | 57.6 ug/l                          |       | 57.6 ug/l                        |       | 24.1 ug/l                         |       | 29.2 ug/l                          |       | 29.2 ug/l                        |       |                                  |       |

#### **4.1.2 MANAGEMENT ACTIONS TO REDUCE NUTRIENT LOADING**

Significant uncertainties remain regarding the sources of nutrient loading to Newnans Lake. Despite the precision to which the TMDL was calculated, a significant portion of the allocation was assigned to internal recycling. This assignment was based primarily on a lack of data. As stated in the TMDL, “No data were available on sediment TN and TP levels during the verified period or on how the rate of translocation of TN and TP from the sediment into the water column correlate with sediment TN and TP in this lake over this period. Given the lack of this information, the importance of the TN and TP internal recycling was examined by comparing the current TSI to the TSI calculated under the situation that the internal recycling of TN and TP was completely eliminated.” (DEP, 2003) In the absence of quantitative data, the nutrient recycling allocation was based on the assumption that recycling is responsible for the difference between nutrient loads from stormwater runoff versus in-lake concentrations. Although the BWG does not question that Newnans Lake is nutrient-impaired, BWG members have questioned the validity of this assumption.

The extent to which nutrient recycling acts as a nutrient load in Newnans Lake could significantly affect the selection of individual nutrient load reduction projects. However, stakeholders have proposed a variety of projects to decrease nutrient loading into Newnans Lake because of the general consensus that the Lake is nutrient impaired.

Management actions have been proposed to address specific nutrient sources in Newnans lake. The link between sources and management actions is outlined in Table 24. Details on all projects are provided in Appendix E. Where possible, load reductions from management actions were quantified. However, limited data was available to quantify anticipated phosphorus loading reductions in the Newnans Lake Subbasin. Regardless of the BWG’s ability to quantify the benefits of proposed management actions, these projects will help decrease nutrient inputs and meet stakeholders’ TMDL obligations.

**Table 24 Nutrient Sources and Management Action Categories for Newnans Lake**

| Nutrient Source                   | Management Action Category                         | Anticipated Results                                                                                                          | Comments                                                                                                                                          |
|-----------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Internal Recycling                | Restoration and Water Quality Improvement Projects | Reduced nutrient loadings through vegetative uptake                                                                          | Planting of maidencane, knotgrass, and giant bulrush.                                                                                             |
|                                   | Special Studies and Planning Efforts               | Improved scientific understanding of nutrient loadings due to recycling; better understanding of groundwater nutrient inputs | Examples: PLRG development, groundwater – surface water interaction study                                                                         |
| Hatchet and Little Hatchet Creeks | Land acquisition                                   | Minimized future loading increases by controlling future land development                                                    | Example: Newnans Lake Conservation Area                                                                                                           |
|                                   | Silviculture BMPs                                  | Reduced nutrient loadings                                                                                                    | All large industrial silviculture operators are participating in the BMP program, covering the majority of silviculture property in the watershed |
|                                   | Agricultural BMPs                                  | Reduced nutrient loadings                                                                                                    | Rowcrop BMP being implemented; BMP manuals for cow/calf, nursery, sod, and equine operations under development.                                   |
|                                   | Stormwater permit program Implementation           | Reduced nutrient loadings                                                                                                    | Includes education and outreach and other components of MS4 program implementation                                                                |
|                                   | Structural Stormwater BMPs                         | Reduced nutrient loadings                                                                                                    | Example: Dry detention ponds installed during SR20 widening.                                                                                      |
| Direct Stormwater Discharge       | Stormwater permit program implementation           | See above                                                                                                                    | See above                                                                                                                                         |
|                                   | Silviculture BMPs                                  | See above                                                                                                                    | ---                                                                                                                                               |
|                                   | Agricultural BMPs                                  | See above                                                                                                                    | ---                                                                                                                                               |
| Atmospheric deposition            | ---                                                | ---                                                                                                                          | Considered an uncontrollable source.                                                                                                              |

A number of projects are also planned but currently unfunded. The primary example of the Brittany Estates Mobile Home Park Wastewater Upgrade. This project would reduce nutrient concentration in the treated wastewater currently being discharged into Hatchet Creek, the primary tributary to Newnans Lake. Implementation of a basin-wide shoreline buffer restoration program has been proposed by Alachua County, in partnership with the GCWP, DEP, and SJRWMD (Project ALACHUA06). This project has the potential for significant water quality and habitat improvements. Alachua County has also proposed a project to restore disturbed wetlands basin-wide to improve the function of wetland areas in improving water quality (Project

ALACHUA08). These projects should be considered a high priority when they are being evaluated by funding agencies.

To address the broader issue of the unknowns associated with pollutant loads into Newnans Lake, including nutrient recycling, the SJRWMD is conducting the following two projects. The results of these projects will form the basis on which future project selection will be based through the adaptive management approach outlined later in this BMAP.

- **Spatial nutrient loading dynamics in the Newnans Lake watershed:** The purpose of this project, which is being conducted for SJRWMD by Dr. Matt Cohen at the University of Florida, is to examine the spatial distribution and transport of nutrients into Newnans Lake. The primary objectives are to quantify exogenous sources of nutrients, characterize the spatial distribution of loads, delineate cultural from geological enrichment, and identify pathways for nutrients fluxes to the lake. Tasks include developing a GIS-based screening system to strategically select the sample sites; evaluating effects of land use on water quality in the basin; quantifying the spatial pattern of watershed loading of critical water quality parameters; examining spatial distribution of stream sediment quality; and quantifying event-based loading at regional hot-spots using high-resolution temporal sampling. This data will be incorporated into models to improve estimates of watershed nutrient loading, critical to PLRG development. Completion date is scheduled for September 2008.
- **Stormwater nutrient loading into Newnans and Lochloosa Lakes:** The purpose of this project, being conducted for SJRWMD by Environmental Consulting and Technology, Inc., is to measure nutrient loading into Newnans and Lochloosa lakes via five selected tributaries during storms. Additionally, monthly base flow samples will be collected from two of the five tributaries. This data will be incorporated into models to improve estimates of watershed nutrient loading, critical to PLRG development. Completion date is scheduled for September 2008.

#### **4.1.3 ANTICIPATED REDUCTIONS IN NUTRIENT LOADING**

When implemented, all Newnans Lake and Hatchet/Little Hatchet Creek projects outlined in Appendix F are expected to decrease TN and TP loading to Newnans Lake. The Basin Working Group expects to see improvements in TSI values as a result. However, the degree of TSI improvement is difficult to predict, as insufficient data is available to quantify nutrient reductions. Project benefits will be evaluated through data collected during project implementation and application of the basin monitoring strategy (see monitoring strategy outlined in Chapter 6).

## **4.2 ORANGE LAKE SUB-BASIN**

The Orange Lake nutrient TMDL targets were based upon reductions in TP (Gao & Gilbert, 2003). As such, management strategies for Orange Lake also focused on TP.

### **4.2.1 BASELINE POLLUTANT LOADINGS**

Inflow from Newnans Lake via Camps Canal was the most significant TP source in Orange Lake, contributing 37.1% of the TP load (Table 23). Together with inflow from Lochloosa via Cross Creek (11.9%), loading from upstream lakes contributes 49% of the TP load into Orange Lake. Management actions proposed for Newnans and Lochloosa will help achieve the necessary TP load reductions that will promote downward trends in TSI values in Orange Lake.

Figure 46 reflects the dominance of tributary inflows as a TP source. Orange Lake is unique in the dominance of agriculture as a TP source (21.5%). Loading from water and wetland areas as well as atmospheric deposition (“uncontrollable” sources) comprises 32% of the TP load into Orange Lake. Given the uncertainties associated with TP attenuation, TP load from onsite systems into Orange Lake was not included in the BMAP-specific wastewater analysis provided in Appendix H.

#### **4.2.2 MANAGEMENT ACTIONS TO REDUCE PHOSPHORUS LOADING**

Management actions have been proposed to address specific nutrient sources in Orange Lake. The link between sources and management actions is outlined in Table 25. Details on all projects are provided in Appendix E. Regardless of the BWG’s ability to quantify the benefits of proposed management actions, these projects will help decrease nutrient inputs and meet stakeholders’ TMDL obligations.

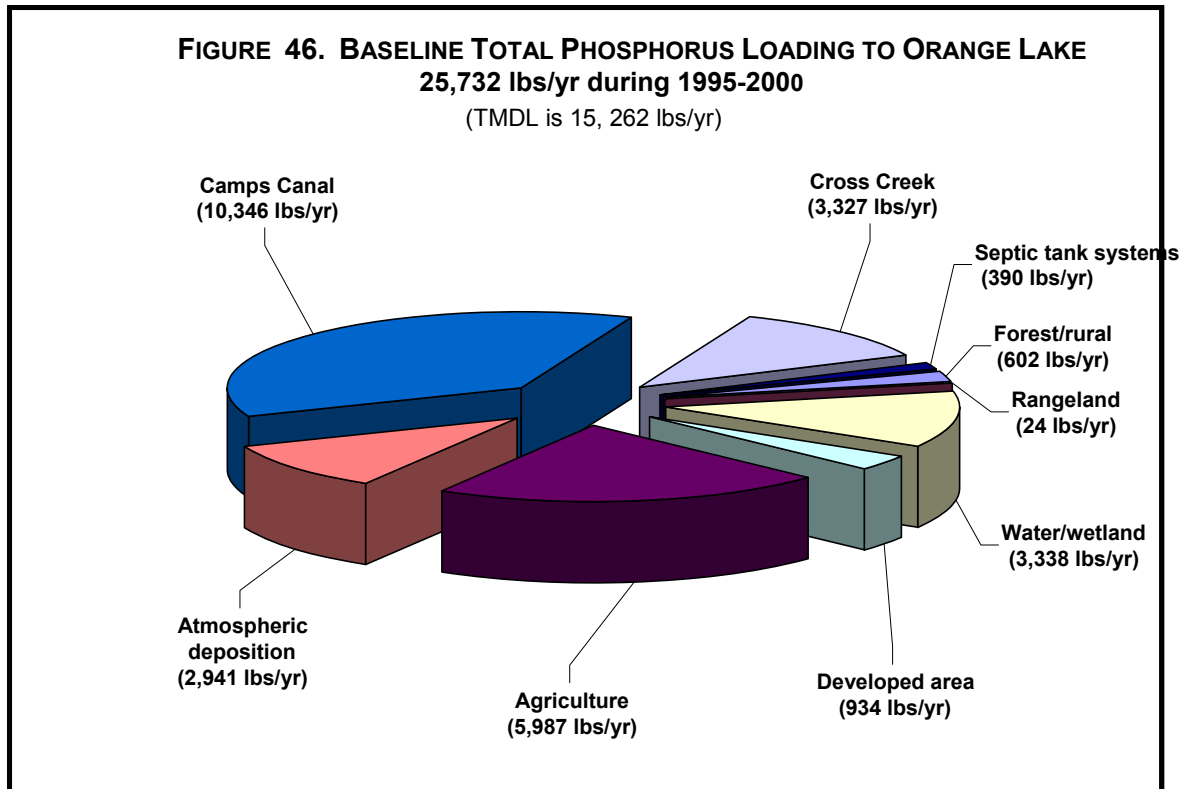
The unfunded projects discussed in Section 4.1.2 also apply to the Orange Lake Subbasin. These projects should be considered a high priority when they are being evaluated by funding agencies.

#### **4.2.3 ANTICIPATED REDUCTIONS IN PHOSPHORUS LOADING**

Where possible, load reductions from management actions were quantified. However, limited data was available to quantify anticipated phosphorus loading reductions in the Orange Lake Subbasin. When implemented, all Orange Lake projects outlined in Appendix E are expected to decrease TN and TP loading. As the recipient of water from both Lochloosa and Newnans Lake, projects implemented in these two subbasins will also benefit Orange Creek by decreasing nutrient loading through Cross Creek and Camps Canal. The Basin Working Group expects to see improvements in Orange Lake TSI values as a result. However, the degree of TSI improvement is difficult to predict, as insufficient data was available to quantify nutrient reductions from the majority of projects. As with Newnans Lake, project benefits will be evaluated through data collected during project implementation and application of the basin monitoring strategy (see monitoring strategy outlined in Chapter 6).

**Table 25. Nutrient Sources and Management Action Categories to Reduce Nutrient Loads to Orange Lake**

| Nutrient Source                                     | Management Action Category                         | Anticipated Results                                                                            | Comments                                                                                                                                          |
|-----------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Inflow from Newnans Lake via Camps Canal/River Styx | See Newnans Lake Management Actions                | Reduce TP inflow from Camps Canal/River Styx                                                   | ---                                                                                                                                               |
| Silviculture and other agricultural sources         | Silviculture BMPs                                  | Reduced nutrient loadings                                                                      | All large industrial silviculture operators are participating in the BMP program, covering the majority of silviculture property in the watershed |
|                                                     | Agricultural BMPs                                  | Reduced nutrient loadings                                                                      | Rowcrop BMP being implemented; BMP manuals for cow/calf, nursery, sod, and equine operations under development.                                   |
|                                                     | Land Acquisition                                   | Minimized future loading increases by controlling future land development                      | Example: Longleaf flatwoods preserve                                                                                                              |
| Water/Wetlands                                      | Restoration and Water Quality Improvement Projects | Reduce nutrient loadings through natural nutrient uptake and attenuation                       | ---                                                                                                                                               |
| Inflow from Lochloosa Lake via Cross Creek          | Land Acquisition                                   | Minimized future loading increases by controlling future land development                      | Example: Lochloosa Wildlife Conservation Area                                                                                                     |
|                                                     | Silviculture BMPs                                  | Reduced nutrient loadings                                                                      | All large industrial silviculture operators are participating in the BMP program, covering the majority of silviculture property in the watershed |
|                                                     | Agricultural BMPs                                  | Reduced nutrient loadings                                                                      | Rowcrop BMP being implemented; BMP manuals for cow/calf, nursery, sod, and equine operations under development.                                   |
|                                                     | Special Studies and Planning Efforts               | Better understanding of groundwater nutrient inputs in PLRG and future iterations of the TMDL. | Examples: PLRG development, groundwater – surface water interaction study                                                                         |
| Other Identified Sources                            | Stormwater permit program Implementation           | Reduced nutrient loadings                                                                      | Includes education and outreach and other components of MS4 program implementation                                                                |
|                                                     | Public Education and Outreach                      |                                                                                                |                                                                                                                                                   |
| Atmospheric deposition                              | None                                               | ---                                                                                            | Considered an uncontrollable source.                                                                                                              |



#### 4.2.4 Aquatic Plant Management

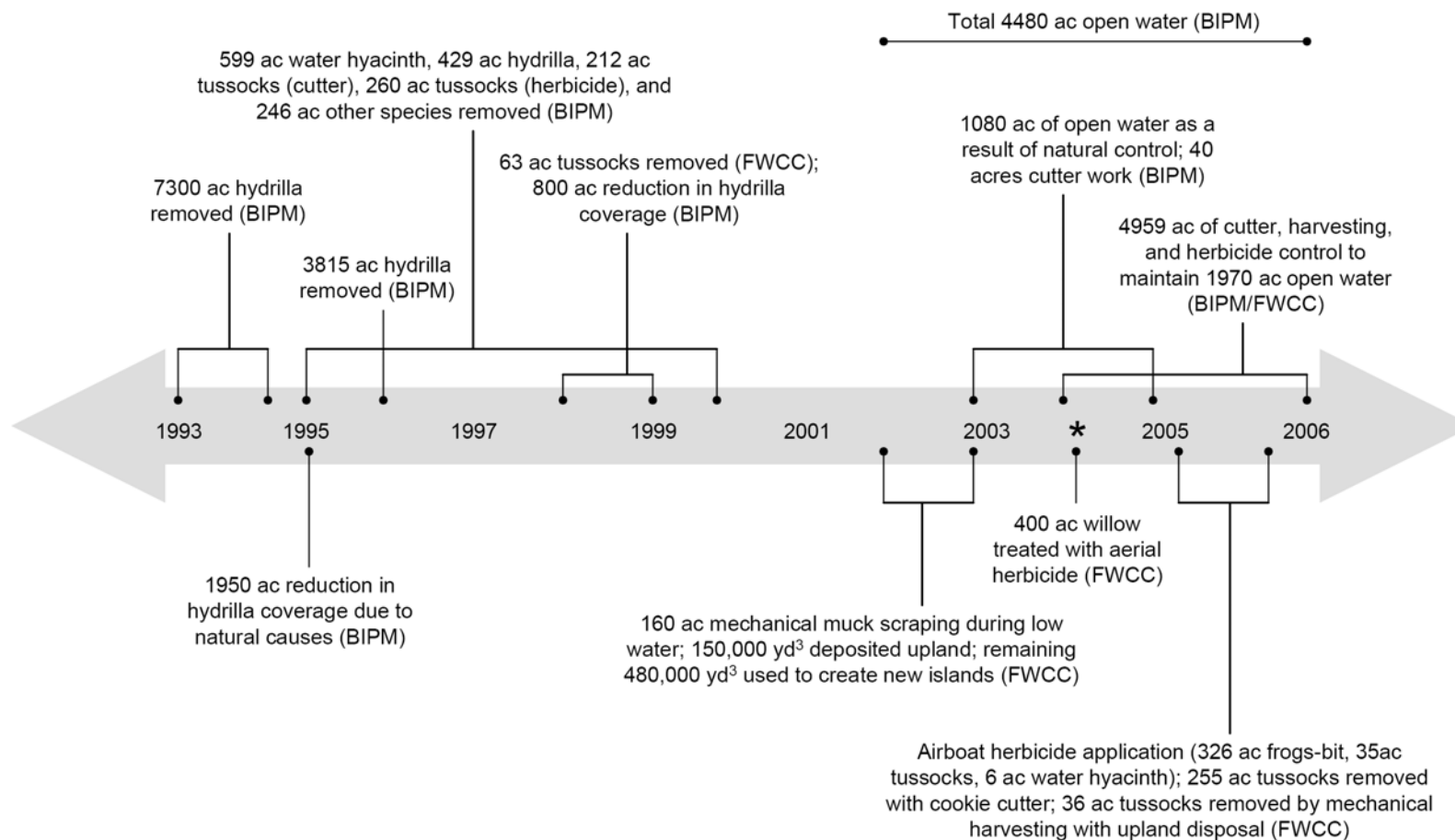
DEP conducts aquatic plant management pursuant to section 369.20 (2), F.S. Orange Lake has been the site of aquatic plant management activities extending back many decades. The lake is very popular for recreation (especially fishing), but the proliferation of both native and invasive aquatic plants often interferes with navigation and creates localized areas of very low oxygen conditions. "Floating islands," also known as tussocks, have at times occupied thousands of acres of Orange Lake and are especially abundant after abrupt rises in water level. Activities undertaken to control the accumulation of aquatic plants within Orange Lake have included herbicide treatment, tussock removal and cutting, muck scraping, and mechanical harvesting. Appendix O is a summary of the aquatic plant management review process.

The BWG questioned whether some of the pollutant loading attributed to external sources resulted from aquatic plant management activities within Orange Lake. Figure 47 identifies the key aquatic plant management activities that have occurred in Orange Lake from 1993-2006.

In some waterbodies, internal recycling of nutrients is a significant source of impairment that needs to be addressed, along with external discharges, in order to achieve and/or maintain those concentrations. In the course of the model calibration process, a significant omission of a nutrient source (such as internal loading) in the model will create a discrepancy between modeled and actual water quality. This discrepancy was not seen during the model calibration for Orange Lake, leading to the conclusion that internal nutrient loading was not significant in the period from 1995 to 2000. Based on

this information, neither aquatic plant management activities nor the existence of aquatic plants were considered as significant components of the TMDL (DEP, 2003). While internal loadings were considered in this way during TMDL development, allocations in the Orange Lake TMDL were assigned only to external point and nonpoint sources, with a margin of safety.

**Figure 47. Timeline of Aquatic Plant Management Activities in Orange Lake**



\* 1500 acres new open water as a result of storms (BIPM)

BIPM = Department of Environmental Protection Bureau of Invasive Plant Management  
FWCC=Fish and Wildlife Conservation Commission

Some questions remain as to whether large-scale aquatic plant management activities conducted subsequent to the TMDL data period may have contributed to lowered water quality in Orange Lake, especially with regard to TP. Such a determination is complicated by a significant rise in water level and a large influx of water from Camps Canal, among other observed events in 2004 and 2005. In addition, the ability to distinguish between internal recycling sources is technically elusive. In addition to water quality concerns, excessive aquatic plant growth can interfere with navigation and recreation. Thus, it is important to consider the impacts of non-management when balancing the benefits and drawbacks of aquatic plant management.

The BWG concluded that:

- Coordination and communication are needed among the agencies with state, regional, or local water management responsibilities in the basin (DEP, FWCC, SJRWMD, Alachua County, Marion County), so that potential adverse water quality impacts associated with aquatic plant management activities are minimized.
- There is a need in the Orange Creek Basin for public education regarding invasive aquatic plants and their management, including the potential impacts of aquatic plant management and non-management on water quality.

## 4.3 LAKE WAUBERG SUB-BASIN

### 4.3.1 BASELINE POLLUTANT LOADINGS

In the Lake Wauberg TMDL, atmospheric deposition of nutrients contributed 65% of both of the TN and TP load (Table 25). Figures 48 and 49 reflect the dominance of atmospheric deposition as a nutrient source. The other primary source was onsite wastewater, contributing 32.0% of the TN load and 32.2% of the TP load into Lake Wauberg. This reflects the character of the Lake Wauberg watershed as largely undeveloped with limited rural residential and University-owned recreation areas near the lake, all of which rely on onsite systems for wastewater management.

Using the alternative assumptions of the BMAP-specific wastewater analysis, TN loading from onsite wastewater systems was estimated to be 10% (see Appendix H), relative to the 32% estimate in the TMDL. Despite this difference, management of onsite wastewater systems remains as the primary controllable factor for nutrient load reduction in the Wauberg watershed.

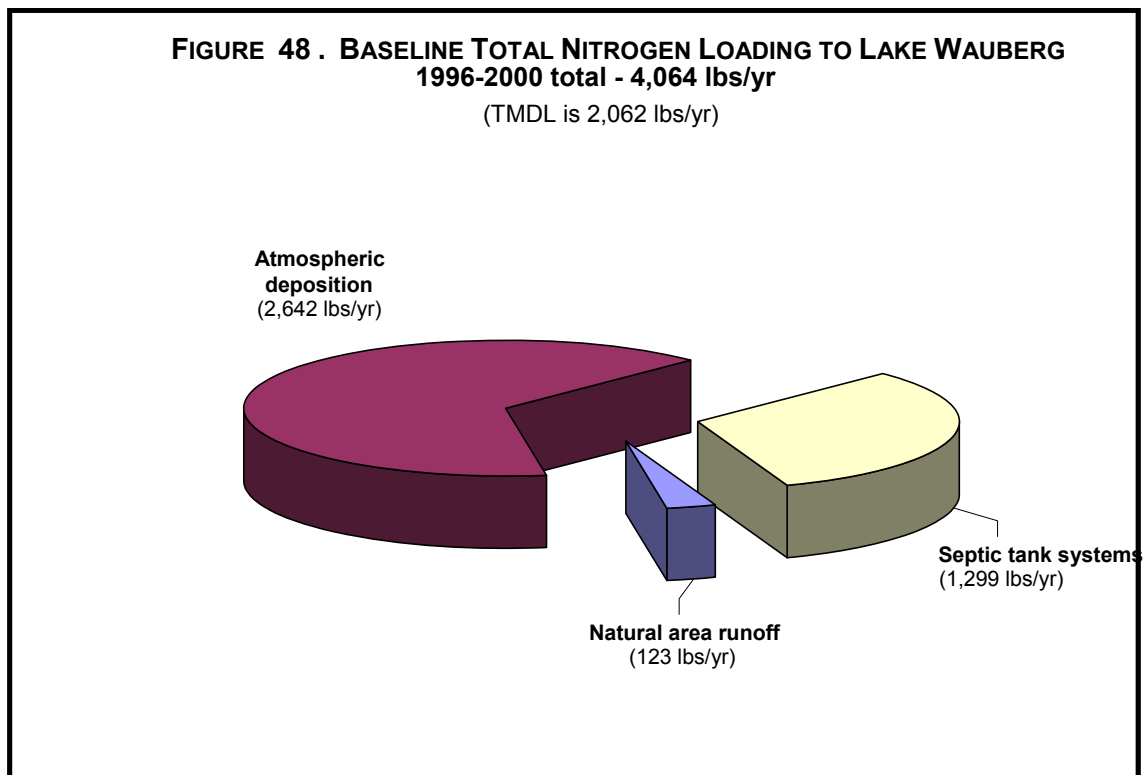
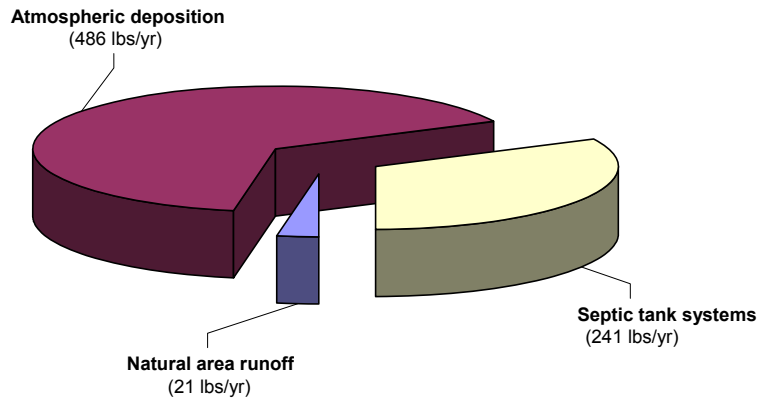


**FIGURE 49 . BASELINE TOTAL PHOSPHORUS LOADING TO LAKE WAUBERG**  
 1996-2000 total - 748 lbs/yr  
 (TMDL is 374 lbs/yr)



#### **4.3.2 MANAGEMENT ACTIONS TO REDUCE NUTRIENT LOADING**

Management actions have been implemented to address septic tank system nutrient loading in the Lake Wauberg watershed (Table 26). Additional projects proposed by the BWG also affect Lake Wauberg (see Appendix E).

**Table 26. Nutrient Sources and Management Action Categories to Reduce Nutrient Load into Lake Wauberg**

| Nutrient Source                         | Management Action Category           | Anticipated Results                                                                 | Comments                                                                                                                                                                                                                                                    |
|-----------------------------------------|--------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Septic tank systems (onsite wastewater) | Special Studies and Planning Efforts | Identification of prioritization of locations for onsite wastewater rehabilitation. | Septic tank systems identified as the primary controllable nutrient source for Lake Wauberg; University of Florida Lake Wauberg South shore facility septic tank system upgraded in 2000; Additional resources may be needed to rehabilitate failing tanks. |
| Atmospheric deposition                  | None                                 | ---                                                                                 | Considered an uncontrollable source.                                                                                                                                                                                                                        |

The primary project occurring in the Lake Wauberg Subbasin is an evaluation of onsite wastewater systems (Project WAU01). In cooperation with University of Florida (UF) and Paynes Prairie State Park staff, the Alachua County Health Department (ACHD) is in the process of completing a study of onsite wastewater systems (i.e. septic tank systems) for parcels along the shore of Lake Wauberg. The purpose of this study is to identify the potential water quality impacts of onsite wastewater systems near the lake. Although this study is focused on identifying coliform sources, this study will also inform the evaluation of septic tank systems as nutrient sources.

In late September / early October 2006, UF, Park, and ACHD staff reviewed septic tank systems and drainfields at the recreation areas near the lake that are managed by U.F. These drainfields appeared to be in compliance with state standards. Discussions are ongoing regarding the possibility of upgrading these systems. ACHD staff are continuing their evaluation of drainfields for restrooms and the camping area at Paynes Prairie State Park. ACHD staff have also contacted private landowners along the lake shore (see Figure 50). Their primary evaluation criteria focused on coliforms. However, systems that have potential coliform impacts may also have nutrient impacts. Thus far, ACHD has had difficulty accessing private property. Figure 51 shows the current results of this effort. ACHD, Paynes Prairie Park, and UF will continue with this project as resources allow.

The unfunded projects discussed in Section 4.1.2 also apply to the Lake Wauberg Subbasin. These projects should be considered a high priority when they are being evaluated by funding agencies.

**Figure 50. Form used by ACHD to Contact Private Landowners for Onsite Wastewater Evaluation**



Date - \_\_\_\_\_

To – Current Resident

\_\_\_\_\_  
\_\_\_\_\_

From – Alachua County Health Department

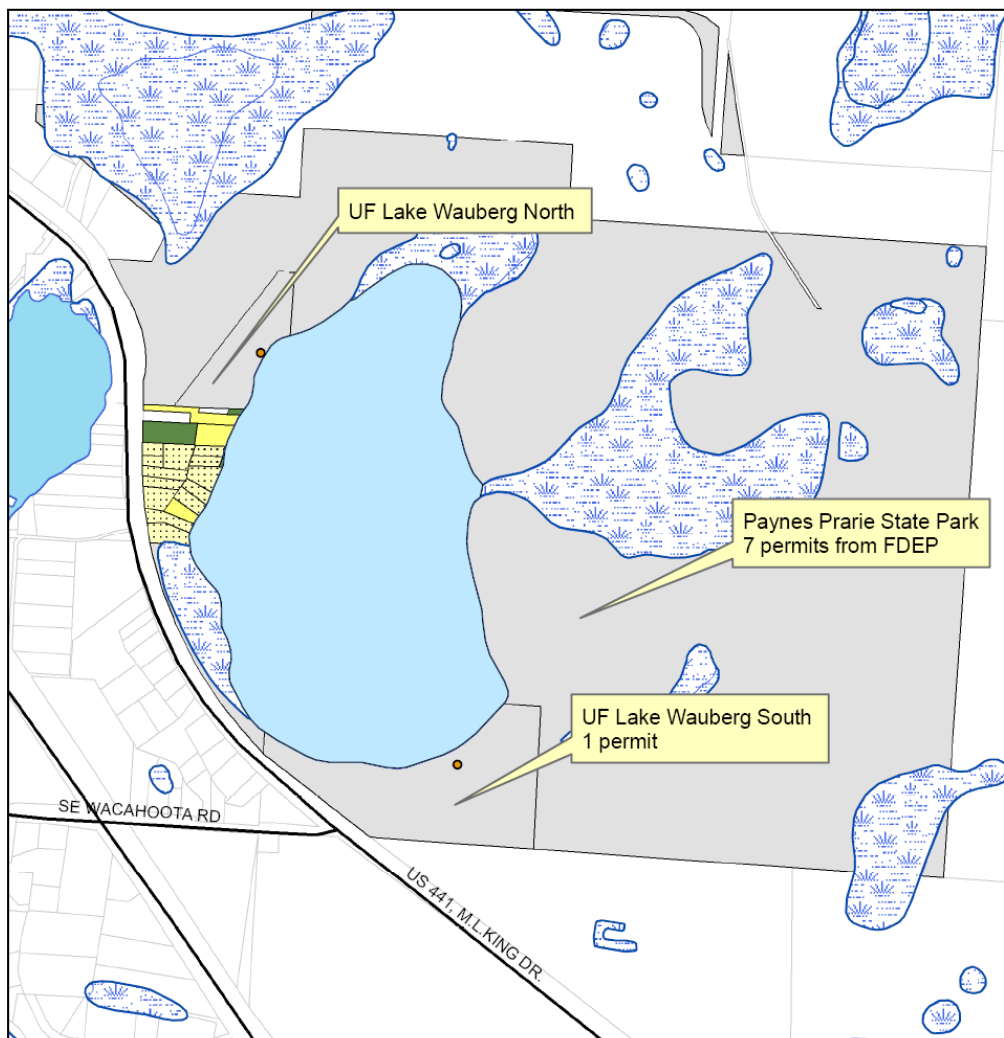
RE – Septic System Study

The Alachua County Health Department is currently conducting a study of septic systems that border certain impaired surface waters. The Lake Wauberg watershed is considered an impaired surface water, and as such, we need your help in establishing the level of impact on this pollution due to septic systems. A staff agent visited your property today, and we have left this flier to ask that you contact the Alachua County Health Department to receive further information in regards to this important study. Please contact us at your earliest convenience, and please note that your participation in this study is imperative to its success. We offer several testing services that can offer you peace of mind for the quality of your drinking water, and all testing and monitoring will be given to you free of charge if you agree to participate in this study.

**Please contact Paul Myers or Anthony Dennis at 352-334-7930, to grant access to our staff or for further information on this study.** Thank you in advance for contacting the Alachua County Health Department.

Alachua County Health Department  
Environmental Health Division  
224 SE 24<sup>th</sup> St  
Gainesville, FL 32641

**Figure 51. Parcels with Onsite Wastewater Systems Potentially Affecting Water Quality in Lake Wauberg**



**Legend**

● Facility000

Wauberg

**Wauberg\_parcel**

**Impact with regards to "fecal coliform"**

not granted access

minor

pending

significant

There are presently NO confirmed impacts

0 500 1,000 2,000 3,000 4,000 Feet



#### **4.3.3 ANTICIPATED REDUCTIONS IN NUTRIENT LOADING**

As UF, Paynes Prairie Park, and the ACHD continue to work on identifying and upgrading onsite wastewater systems, nutrient inputs to Lake Wauberg should decrease. Although no data is available to quantify anticipated nutrient loading reductions associated with Lake Wauberg management actions, it is expected that enhanced septic tank system management will limit nutrient load into Lake Wauberg.

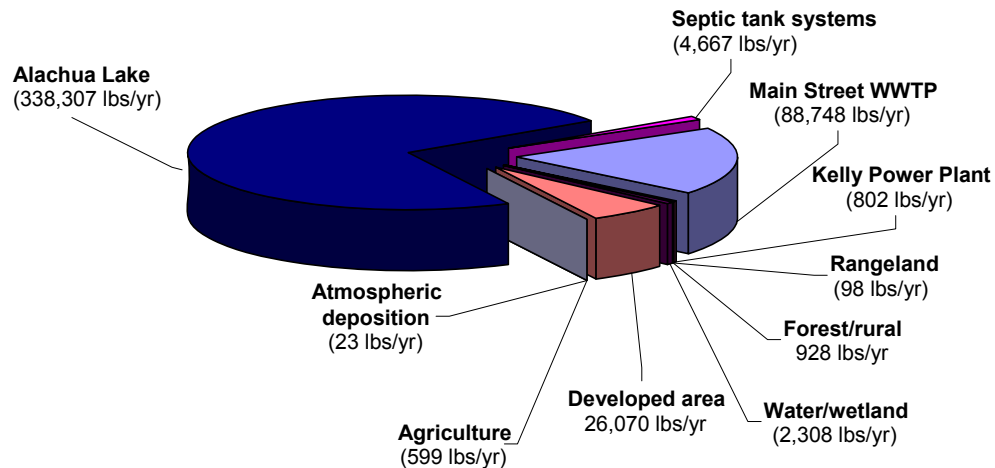
### **4.4 ALACHUA SINK SUB-BASIN**

#### **4.4.1 BASELINE POLLUTANT LOADINGS**

Nutrient inflows from Sweetwater Branch include point source discharges from the Main Street Wastewater Treatment Plant and J.R. Kelly Power Plant. Sweetwater Branch also conveys stormwater to Alachua Sink from portions of the urban watershed of east Gainesville. The point source nutrient loadings from Sweetwater Branch are conveyed to Alachua Sink through Paynes Prairie within the Sweetwater Canal. This canal prevents Sweetwater Branch flow from becoming a more diffuse sheet flow, as it did before canal construction. Prior to canal construction, unaltered sheet flow provided more opportunity for water and nutrient uptake to occur as water from Sweetwater Branch made its way to Alachua Sink.

The Main Street WWTP currently contributes 88,748 lbs/yr of TN to Alachua Sink, which represents about 23 percent of the total loading. Nonpoint sources make up most of the remaining TN load (see Figure 52). Near the Alachua Sink water body, discharge from the Sweetwater Canal combines with a large volume of flow from Alachua Lake, the inundated portion of Paynes Prairie (see Chapter 2). Alachua Sink and Alachua Lake are separate water bodies during periods of drought and/or low rainfall, but in wet years the entire prairie is flooded and these two water bodies coalesce. Even if the loading from wastewater sources is completely eliminated, nonpoint source reductions will be needed in order to reach the TMDL, particularly those that are contributed through Paynes Prairie/Alachua Lake. It is estimated that complete removal of the wastewater sources, will only result in an 11% reduction in total nitrogen in Alachua Sink (ATM, 2005).

**FIGURE 52 . BASELINE TOTAL NITROGEN LOADING TO ALACHUA SINK**  
**2000-2004 total 462,550 lbs/year**  
 TMDL is 256,322 lbs/year



#### **4.4.2 MANAGEMENT ACTIONS TO REDUCE NUTRIENT LOADING**

Potential management actions to reduce TN loading to Alachua Sink are complicated by the hydrology of Paynes Prairie and Alachua Sink, which periodically undergo extreme water level changes in relatively short periods. During prolonged wet periods, high water levels in Paynes Prairie create ecological conditions that are similar to a shallow lake, rather than the freshwater marsh system that is seen during more dry conditions. Water levels at Paynes Prairie during TMDL development were relatively low, although this changed in the latter half of 2004.

Despite this uncertainty, management actions were proposed to address known nutrient sources in Alachua Sink. The general categories of management actions are outlined in Table 27. Further details are provided below and in Appendix E.

**Table 27. Nutrient Sources and Management Action Categories to Limit Nutrient Load to Alachua Sink**

| Nutrient Source                                                           | Management Action Category                | Anticipated Results                                                                                                                                                                                        | Comments                                                                                                                                                                      |
|---------------------------------------------------------------------------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stormwater from Developed Areas (including nutrient load in Alachua Lake) | Restoration and Water Quality Improvement | Reduce TN loadings through nutrient uptake and attenuation                                                                                                                                                 | Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project                                                                                                                |
|                                                                           | Land Acquisition                          | Minimized future loading increases by controlling future land development                                                                                                                                  | Sweetwater Preserve                                                                                                                                                           |
|                                                                           | Structural Stormwater BMPs                | Reduce TN loadings                                                                                                                                                                                         | Example: hydrodynamic separators                                                                                                                                              |
|                                                                           | Special Studies and Planning Efforts      | Improve scientific understanding of nutrient loadings due to recycling; better understanding of groundwater nutrient inputs                                                                                | PLRG development for nearby waterbodies will improve understanding of Alachua Sink hydrology as well                                                                          |
|                                                                           | Stormwater permit program implementation  | Reduced nutrient loadings                                                                                                                                                                                  | Includes education and outreach and other components of MS4 program implementation                                                                                            |
| Main Street WWTP                                                          | Wastewater Infrastructure Maintenance     | Inspect and rehabilitate infrastructure to decrease wastewater exfiltration and spills.                                                                                                                    | GRU has achieved a 99.999% wastewater delivery efficiency rate (based on volume) and has maintained a spill rate of less than 25-percent of the national average (2004-2006). |
|                                                                           | Special Studies and Planning Efforts      | Facilitate use of reclaimed water to minimize discharges to Sweetwater Branch; improve scientific understanding of nutrient loadings due to recycling; better understanding of groundwater nutrient inputs | Reclaimed Water Master Plan; PLRG development                                                                                                                                 |
| Atmospheric deposition                                                    | None                                      | ---                                                                                                                                                                                                        | Considered an uncontrollable source.                                                                                                                                          |

#### 4.4.2.1 Sweetwater Branch / Paynes Prairie Sheetflow Restoration

Much of Paynes Prairie, a 16,000-acre watershed, was drained in the 1920s to expand cattle ranching. As a result, two highways were constructed across the prairie, State Road 441 and Interstate 75. A railroad line across the prairie was abandoned in the 1980s. The legacy of these drainage and transportation subprojects activities is 38 miles of dikes and 50 miles of canals in wetlands within Paynes Prairie Preserve State Park. To restore sheetflow across portions of Paynes Prairie, the state park during 2000–2004 removed 7 miles of dikes and filled 10 miles of canals. Dikes and canals channelize water, preventing the sheetflow of shallow water across

the wetlands. Sheetflow is beneficial because it increases the water residence time in the prairie, thereby increasing sediment retention and uptake of nutrients by wetland plants and the soil prior to this water reaching Alachua Sink and the Floridan aquifer. Sheetflow also increases the water storage capacity of the watershed.

A sheetflow restoration project that has been contemplated since the early 1970s is the restoration of Sweetwater Branch's discharge to Payne's Prairie. Sweetwater Branch is a natural stream which drains what is now the Gainesville urban area and flows into the Paynes Prairie. Tumblin' Creek is a tributary to Sweetwater Branch which also drains the Gainesville Urban Area. In its natural state, Sweetwater Branch discharged via sheetflow onto Paynes Prairie into the area of the Prairie known as Alachua Lake, which is actually a wet prairie. The natural sheetflow of Sweetwater Branch onto the Prairie has been disrupted by a man-made ditch that was constructed by ranchers in order to drain portions of the Prairie. The ditch diverts the Sweetwater Branch flow directly to Alachua Sink, and has resulted in the dehydration of over 1,000 ac of wetlands in the Paynes Prairie. In addition, the direct connection of Sweetwater Branch to Alachua Sink provides a more direct conduit into the Floridan Aquifer.

Since most of the urban development in the Sweetwater Branch drainage area occurred long before modern stormwater management and other pollution control regulations, Sweetwater Branch, and in turn the Prairie have been heavily impacted by stormwater runoff. The Main Street Water Reclamation Facility (MSWRF) also discharges treated effluent to Sweetwater Branch and is the main contributor of nutrients (nitrogen and phosphorus) to the stream. Sweetwater Branch also receives inputs of nutrients, sediments and other contaminants from stormwater runoff, septic tank systems and other non-point sources from the Gainesville urban area.

During the course of the TMDL adoption and the BMAP development, a stakeholder group was formed to rekindle the prospects of restoring Sweetwater Branch sheetflow to Paynes Prairie. The primary stakeholders include the Florida Department of Environmental Protection Division of Recreation and Parks (FDEP), St. Johns River Water Management District (SJRWMD), City of Gainesville Public Works Department (PWD), Gainesville Regional Utilities (GRU), and Florida Department of Transportation (FDOT). From this stakeholder group, several recent intensive studies have been conducted to evaluate the alternatives for restoring Sweetwater Branch sheet flow to Payne's Prairie. These efforts included the following:

- *Offline Sweetwater Branch Stormwater Wetland Analysis* An evaluation of stormwater Best Management Practices (BMPs) for improving water quality in Sweetwater Branch and specifically a stormwater management and water quality improvement wetland to be located near the point where Sweetwater Branch flows onto the Prairie basin (Jones Edmunds 2003),
- *Sweetwater Branch Sheetflow Restoration Feasibility Analysis* An evaluation of the sheetflow concept for distributing higher quality Sweetwater Branch flows over a larger area of Paynes Prairie to minimize hydrologic and water quality impacts as well as identifying the level of pre-treatment needed to adequately protect and restore the area of the Prairie receiving the inflow (WSI 2006a),
- *Main Street WRF Upgrade Analysis* An evaluation of technically and economically feasible alternatives for additional upgrades at the Main Street WRF to achieve additional nutrient removal prior to discharge into Sweetwater Branch (CH2M HILL 2006).
- *Detailed Water Quality Performance Assessment* Modeling of effects of Main Street WRF upgrade alternatives on Sweetwater Branch enhanced wetland sizing and on ultimate water quality (WSI 2006b).

Based these studies, the stakeholders have developed a conceptual approach to implementing the Sweetwater Branch/Paynes Prairie Sheetflow Restoration Plan (Plan). The Plan will include four (4) primary components as shown in Figure 53:

1. The MSWRF will be upgraded for optimized nitrogen (N) removal and enhanced phosphorus (P) removal;
2. An enhanced stormwater management and water quality improvement wetland (Sweetwater Branch Wetland) will be constructed, which will reduce levels of nitrogen, phosphorus, suspended solids and other pollutants from Sweetwater Branch to produce a high quality low nutrient water source to the Paynes Prairie;
3. Water from the Sweetwater Branch Wetland will be distributed to the Sweetwater Branch/Paynes Prairie Sheetflow Restoration Area, to restore the natural sheetflow to Paynes Prairie; and
4. Approximately 10,000 feet of existing canals and berms on PPPSP will be removed and the area will be re-graded to pre-development conditions, and re-planted with natural wetland vegetation.

At a minimum this proposed project is expected to provide the following benefits:

1. Restore (re-hydrate) of over 1,000 acres of formerly-impacted wetlands in PPPSP;
2. Attain regulatory TMDL requirements for reduction of total N discharges to Alachua Sink from City of Gainesville and FDOT stormwater runoff and from the GRU MSWRF;
3. Create over 100 acres of high-quality wetland wildlife habitat and a public use area for bird-watching and nature study within the Sweetwater Branch Wetland;
4. Naturally assimilate other nutrients, sediments and other pollutants in the Sweetwater Branch flow in order to protect the Sheetflow Restoration Area, Alachua Sink, and the Floridan Aquifer; and
5. Restore part of the overall water balance to Paynes Prairie, which has been impacted by diversion of water from the Prairie at other locations.

A comprehensive monitoring and evaluation program will be part of project implementation and will be used to quantitatively assess the environmental benefits of the project.

The full Conceptual Plan is in Appendix L. The proposed Sweetwater Branch/Paynes Prairie Sheetflow Restoration Project will require several years and considerable political resolve to implement. The following key milestones remain for this project to become reality. Given the complexities that remain and the need for approvals from multiple governmental agencies, all dates noted are tentative.

- Preliminary Engineering including surveys and geotechnical assessments to refine project assumptions, determine land requirements, and revise cost estimates: Anticipated completion date: April 2008.
- Purchase of land adjacent to Paynes Prairie, and approval by the Governor and Cabinet to exchange this parcel for state park land needed by for the Sweetwater Branch Wetland. Anticipated completion date: June 2008.
- Acquisition of funding: Funding will be provided by a combination of the project partners. However, given the significant burden on GRU, rate increases for their customers may

be required. Anticipated completion date: Ongoing throughout project permitting and design phases.

- Preparation of detailed construction plans for the wetland system that are compatible with extensive site-clearing and earthwork in a sensitive environment. Anticipated completion date: April 2009.
- Preparation of detailed construction plans for upgrades to the MSWRF. Anticipated completion date: April 2009.
- Negotiations for environmental permits and reviews allowing project construction. Anticipated completion date: April 2010.
- Final design and contractor procurement for multiple project components. Anticipated completion date: July 2010.
- Project construction at MSWRF and at the base of Sweetwater Branch which will accommodate existing wastewater flows and anticipated wet conditions while protecting the environmental resources of the Paynes Prairie, an Outstanding Florida Water. Anticipated completion date: July 2012.
- Development and implementation of a thorough monitoring program to quantify project benefits to water quality and ecological structure and functions on Paynes Prairie. Anticipated completion date: July 2013.

The proposed Sweetwater Branch/Paynes Prairie Sheetflow Restoration is an ambitious project which will require focused efforts and commitment from multiple organizations. However, the many valuable benefits that the project will provide to the environment and to the citizens of the State of Florida make this project well worthwhile.

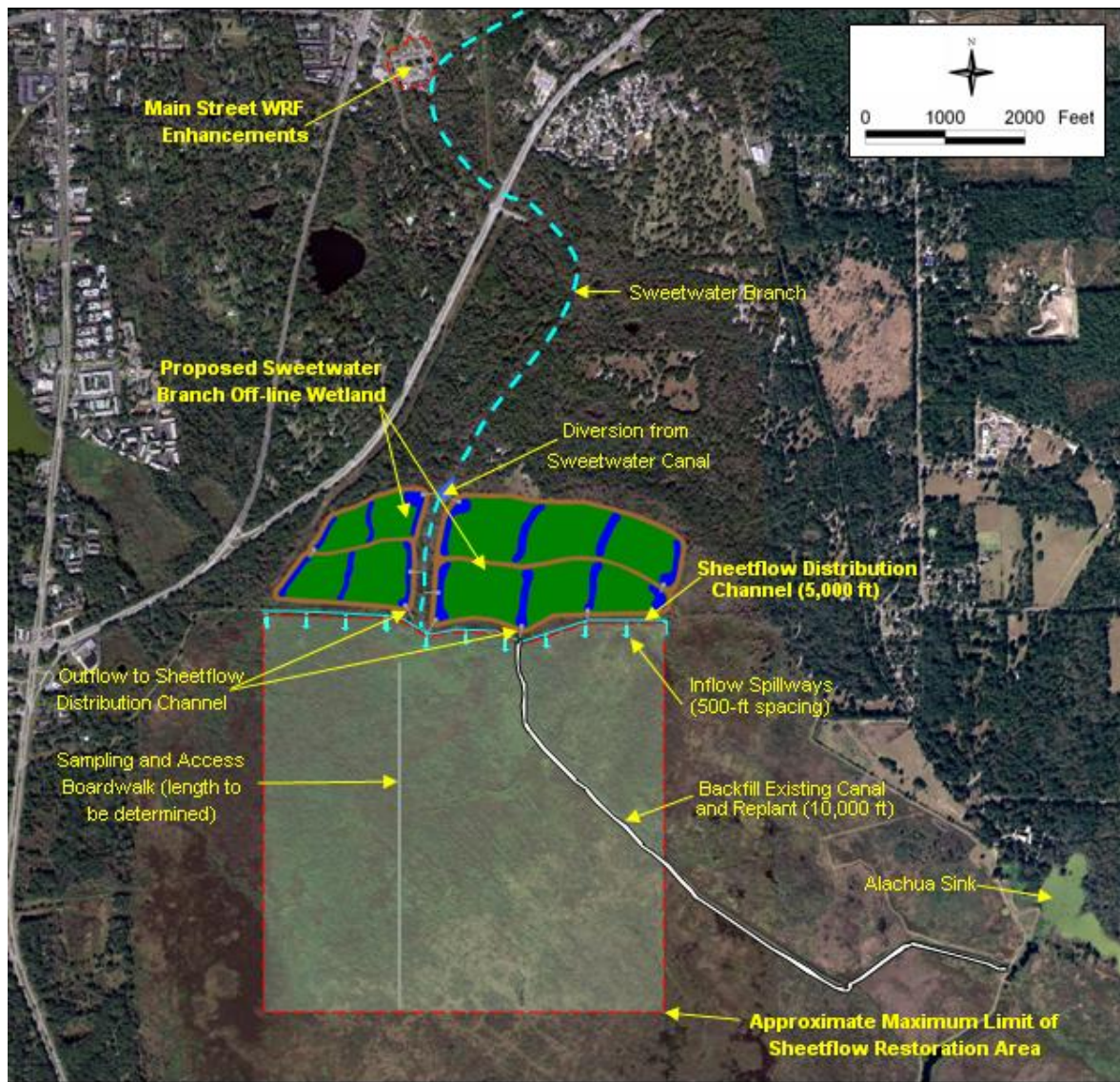


**FIGURE 53. Proposed Plan Illustrating the Conceptual Sweetwater Branch/Paynes Prairie Sheetflow Project**

(Including Upgrades at the Main Street WRF, the Sweetwater Branch Wetland, and the Sweetwater Branch/Paynes Prairie Sheetflow Restoration Area)

#### 4.4.2.2 Other Nutrient Load Reduction Activities

Details on selected additional projects that will reduce nutrient loads to Alachua Sink can be found in Appendix F.

#### 4.4.3 Anticipated Reductions in Nutrient Loading

The Sweetwater Branch / Paynes Prairie Project holds significant potential for reducing nutrient loads. If this project goes forward as designed, Alachua Sink is expected to meet its nitrogen TMDL. Although little data is available to quantify anticipated nutrient loading reductions associated with additional Alachua Sink management actions, it is expected that these actions will limit nitrogen loading into Alachua Sink.

### 4.5 LAKE LOCHLOOSA SUB-BASIN

DEP has deferred development of the Lake Lochloosa/Cross Creek TMDLs because of lack of data to establish whether the impairment is due to human impacts, either in whole or in part. Because of this, specific management actions were not developed for this subbasin. However, several of the basin-wide management activities and programs mentioned in Chapter 3 will help decrease nutrient loads into Lake Lochloosa. This anticipated decrease in nutrient loading will promote water quality enhancement in downstream waterbodies, specifically Orange Lake.

## CHAPTER 5: COLIFORM AND IRON TMDLS – BASELINE POLLUTANT LOADINGS AND MANAGEMENT ACTIONS

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Coliform bacteria are fecal pollution indicators used for monitoring water quality. The “indicator concept” is not new, and has been used to assess the sanitary condition of drinking water, recreational waters, and waters for shellfish propagation since the early part of the 20<sup>th</sup> century (Griffin et al, 2001; Scott et al, 2002). Fecal coliform bacteria originate from the digestive track of warm blooded animals; therefore their presence in water is more indicative of fecal pollution. Fecal coliform bacteria are a subset of the total coliform group, and are distinguished by their ability to grow and ferment lactose under incubation at 44.5 °C (Griffin et al, 2001; APHA, 1998). **Appendix J** contains additional detail on coliform bacteria characteristics and analyses.

Some total coliform organisms can live and reproduce in soil and water without a warm-blooded host, so their presence is not necessarily indicative of fecal pollution. Currently, there are state water quality standards for recreational waters for fecal coliform bacteria. Due to the lack of specificity of the total coliform group, DEP has withdrawn the standard for total coliform.

The use of fecal coliform bacteria to indicate microbial water quality is a nationwide standard. However, in the relatively warm waters of the southeast, fecal coliform bacteria can persist and regrow in the environment, thus breaking the direct link between fecal coliform levels and coliform sources. Desmarais et al. (2002) reported regrowth of *E. coli* in subtropical coastal waters. *E. coli* is a subset of the fecal coliform group and is another common indicator of fecal pollution. The potential regrowth of indicators may limit the use of fecal coliform and *E. coli* as indicators of recent microbial contamination. Due to limitations with the standard methods and the indicator concept, advanced scientific methods that trace microbes to their sources are being developed. These emerging methods are showing promise in helping communities understand sources of bacteria pollution in surface waters. These methods have been applied in the Orange Creek Basin alongside more traditional approaches for source identification, assessment, and remediation of elevated coliform levels in Tumblin, Sweetwater, and Hogtown Creeks.

### 5.1 Use of Source Identification to Guide Management Actions

Significant resources have been dedicated to identify sources and reduce bacteria levels in the urban creeks. However, several key unknowns remain, including quantified source identification. As such, it will be necessary to use a combination of source prevention and additional data gathering efforts under a phased approach to address coliform reductions. The basic approach, outlined in this chapter in more detail, is as follows:

- Existing monitoring data and source identification projects were used identify “hot spots”
- Primary coliform sources will be investigated in each of these hot spots through the coordinated effort of Alachua County, GRU, the City of Gainesville, and other affected parties to address all controllable sources of coliforms in one hot spot in a short time frame before moving onto another priority area.
- At the same time, individual coliform load management projects will continue to be implemented.
- Coliform monitoring will continue to help assess progress and guide the selection of future management actions.

Through use of this approach, Orange Creek Basin stakeholders are using the best information available from their source identification activities (e.g. the GRU microbial source tracking

project) to identify priority areas. In these priority areas, stakeholders are using a comprehensive approach to address known sources of coliforms. Uncertainties regarding precise sources remain to be resolved. However, resource commitments associated with individual projects and the cooperative “hot spot” project are expected to result in decreased coliform levels in the urban creeks over the next one to two years. Upon completion of these projects, the ongoing water quality monitoring results will be evaluated to identify the benefits achieved by these projects and guide selection of future projects.

## **5.2 BACKGROUND ON THE WATERBODIES**

In the Orange Creek Basin, three streams in urban Gainesville are designated by the Florida Department of Environmental Protection (FDEP) as Impaired Waters due to elevated levels of fecal coliform bacteria: Tumblin Creek, Sweetwater Branch, and Hogtown Creek. As shown in Table 5, Tumblin Creek, Sweetwater Branch, and Hogtown Creek each have TMDLs for fecal coliforms, calling for reductions in loading of 74 percent, 70 percent, and 51 percent, respectively. An iron TMDL was also developed for Hatchet Creek. This TMDL is discussed in detail in Section 5.5 at the end of this Chapter.

Fecal coliform bacteria, a microbiological indicator of human and warm-blooded animal fecal pollution, continue to be found at elevated levels in our streams and rivers. The presence of these organisms indicates that there may be other disease causing pathogens also present. Elevated coliform bacteria levels occur in both the rural and urban areas of the county, though the sources may be quite different.

### **5.2.1 Fecal Coliform Levels in Urban Creeks**

Fecal coliform levels vary widely in Alachua County’s waters under differing hydrologic conditions. Typically, baseflow levels in our streams are one or more orders of magnitude lower than samples collected under stormflow conditions (R. Hallbourg, ACEPD, unpublished data).

Quarterly median baseflow levels of fecal coliform concentrations from 2001 through 2005 (Table 28). ranged from <200 to 5,000 colony forming units per 100 milliliters (CFU/100 mL). Samples collected under stormflow conditions can exceed 100,000 CFU/100 mL. Both baseflow and stormflow levels often greatly exceed the one-time allowable maximum of 800 CFU/100 mL Class III Recreational Waters standard. The median value is a useful measure of central tendency for comparing results. The median value has the advantage of not being as influenced by the extreme values as the mean or average value. In a detailed analysis of 2004-2005 fecal coliform data conducted by ACEPD, the median value compared favorably with the geometric mean.

**Table 28. Median fecal coliform bacteria levels for the Hogtown Creek, Sweetwater Branch and Tumblin Creek watersheds 2001-2005.**

| Year | Hogtown Creek  |     | Sweetwater Branch |     | Tumblin Creek  |    | Rainfall<br>(inches) |
|------|----------------|-----|-------------------|-----|----------------|----|----------------------|
|      | Fecal Coliform |     | Fecal Coliform    |     | Fecal Coliform |    |                      |
|      | (CFU/100mL)    | N   | (CFU/100mL)       | N   | (CFU/100mL)    | N  |                      |
| 2001 | 290            | 42  | 1,700             | 47  | 1,300          | 27 | 44.55                |
| 2002 | 700            | 81  | 1,700             | 54  | 2,400          | 47 | 47.10                |
| 2003 | 1,300          | 52  | 1,110             | 30  | 2,000          | 18 | 43.04                |
| 2004 | 540            | 160 | 565               | 102 | 920            | 33 | 55.73                |
| 2005 | 685            | 46  | 720               | 29  | 800            | 13 | 25.94                |
|      |                |     |                   |     |                |    |                      |

Notes:

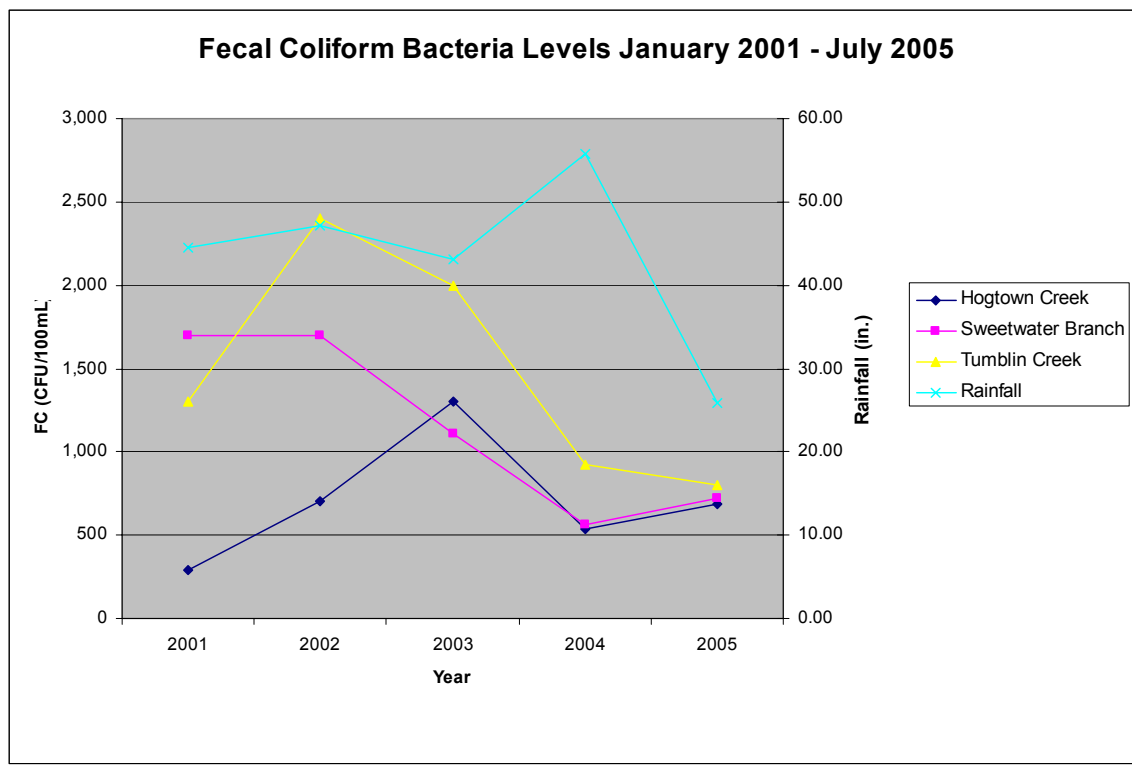
Median values for all stations on creeks

N = count of samples in median

2005 data up to June only

For the purpose of summary statistics, ACEPD has combined data for all stations along each of the three creeks. Data (Figure 54) show a decreasing trend of fecal coliform levels in all three creeks from 2003-2004. There are a number of possible reasons for the decline, including the extremely high rainfall events that occurred with the hurricanes in August and September 2004. These rains raised water level and scoured the creeks, moving and redistributing sediments that but have been a persistent source for the elevated levels of fecal coliform bacteria in some areas.

**Figure 54. Median fecal coliform bacteria levels for the Hogtown Creek, Sweetwater Branch and Tumblin Creek watersheds 2001-2005.**



### 5.2.2 Coliform Load Allocations

Due to the uncertainties and limitations with conventional testing methods for coliforms, detailed load allocations were not established in the adopted TMDLs and will not be developed in the initial BMAP cycle, with the exception of the Main Street Water Reclamation Facility. Detailed load allocations will not be possible until additional studies are performed that better identify sources of coliforms. Until such studies are completed, each stakeholder will need to develop and implement management strategies that provide reasonable assurances that the potential sources of coliform under their respective control are being mitigated or eliminated in a prudent and cost effective manner. The implementation of the coliform TMDLs will require a phased approach that will continually consider historic efforts and new water quality and source tracking data.

Regarding the Main Street Water Reclamation Facility (MSWRF), the TMDL for Sweetwater Branch allows for coliform counts based on the surface water standard permitted limits that allows for an average monthly arithmetic mean of 200 cfu/ 100 mL, and a single sample maximum of 800 cfu/ 100 ml. These limits are based on the facility average daily permitted flow of 7.5 million gallons per day. The MSWRF effluent is typically non-detect or near non-detect for fecal coliform and the daily permitted compliance monitoring data is submitted to the Florida Department of Environmental Protection in the monthly discharge monitoring reports. As discussed in Chapter 3, the MSWRF is not considered a source of coliform impairment in Sweetwater Branch under the TMDL and no reductions are required in the TMDL for this facility.

## 5.3 COLIFORM SOURCES – THE URBAN CREEKS

Prior to and during the initial TMDL and BMAP cycle, local stakeholders have dedicated significant resources to gather water quality data, conduct source tracking efforts, and verify system integrity of centralized and on-site wastewater systems to reduce coliform levels in the Gainesville Urban Creeks. This section highlights the key source identification projects, including two intensive microbial source tracking projects.

### 5.3.1 Completed Source Identification Projects

The following three projects provided the foundation for the current and future approach to coliform load management in the Orange Creek Basin. Results of these projects were considered alongside source information gathered during TMDL development to guide the type of activities and geographic priorities for the management actions identified in Section 5.4.

#### ***ALACHUA COUNTY ENVIRONMENTAL PROTECTION DEPARTMENT COLIFORM MONITORING AND MICROBIAL SOURCE TRACKING***

ACEPD has historically monitored fecal coliform bacteria in the urban creeks and Newnans Lake tributaries within the basin. In 2000, ACEPD contracted with the University of South Florida and Biological Consulting Services, Inc. to conduct antibiotic resistance analyses (ARA) and DNA ribotyping, respectively. This work was conducted in an effort to determine the sources of fecal coliform bacteria present in Tumblin Creek and Sweetwater Branch (Harwood, 2002a and 2002b). Results of these studies were inconclusive, likely in part due to the small number of sampling events and the lack of specificity in the techniques employed at the time. The use of ARA has not proven successful and has been replaced by more sophisticated testing. In an effort to find a reliable microbial indicator, ACEPD is evaluating analytical techniques for analyses of *E. coli*. Results from the initial samplings do not indicate that these data will be more useful than fecal coliform for source tracking. ACEPD continues to monitor levels of fecal coliform bacteria in the urban creeks and the tributaries to Newnans Lake. The urban creek sampling is currently conducted on a bi-monthly basis, and the Newnans Lake tributaries are sampled at least quarterly. In addition to the baseline monitoring, ACEPD will conduct source tracking studies at locations where elevated fecal coliform bacteria have been observed over the past two years. ACEPD will also evaluate storm event related fecal coliform levels in the urban watersheds of Tumblin Creek, Sweetwater Branch and Hogtown Creek.

#### ***GAINESVILLE REGIONAL UTILITIES MICROBIAL SOURCE TRACKING STUDY***

One study of particular significance is the Microbial Source Tracking Study being conducted by Gainesville Regional Utilities. Using previous conventional testing studies and land use coverages in tandem with advanced scientific microbial source tracking methods, the study provides an initial understanding of the relative contributions of various sources to coliform levels in the creeks and applies genetic markers to identify locations that identify the presence of human fecal pollution. The study was conducted in three phases, with the third phase applying advanced microbial source tracking methods to 40 samples taken over four events under wet and dry conditions. Further details about this study can be found in Appendix J.

The presence or absence of 3 different DNA markers were evaluated: **Human polyoma virus DNA Marker** (found in urine), **human enterococcus DNA marker**, and **human**

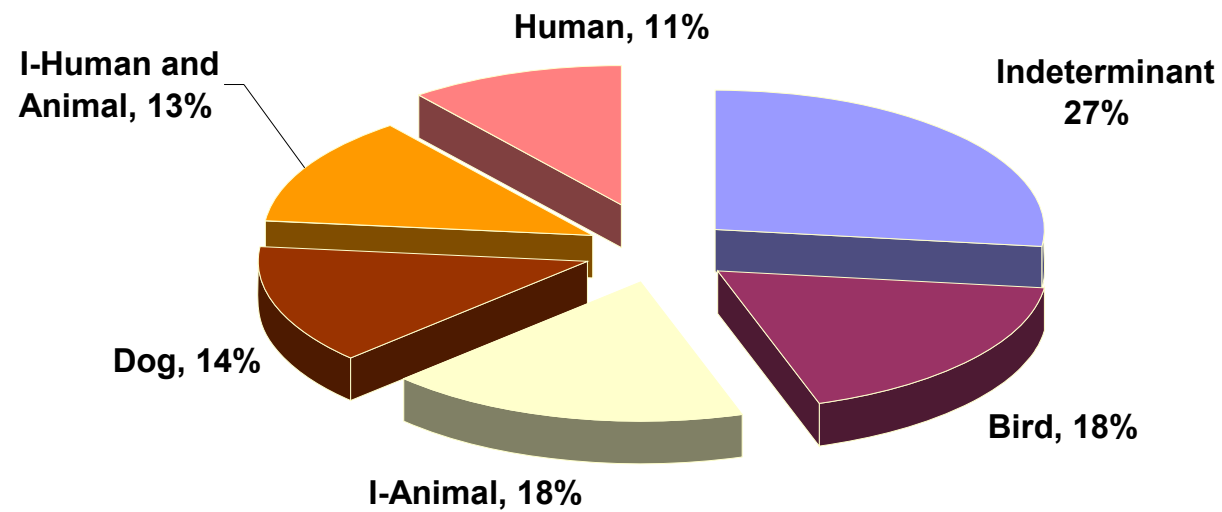
**bacteroides marker.** These markers are found under different conditions, in different proportions of the human population, and have different regrowth potential, so the **pattern** of presence/absence markers in a sample can provide clues to the source and timing of the fecal contamination.

The variables representing bacteria count data will be converted to presence/absence variables by using the E.P.A. thresholds of counts used to fail or pass a body of water for human use (high counts indicate failure and presence and vice versa). Using these regulatory thresholds of passing or failing water bodies to convert the bacteria counts to categorical variables will give us an indication of how well the conventional guidelines indicate a human source of contamination.

To determine the relative contribution of potential sources, DNA fingerprinting of *E.coli*, known as ribotyping, was performed. The ribotyping analysis involved, isolating *E.coli* from a number of sample sites in the study and comparing their genetic fingerprint with a database of over 5,000 human and non-human *E.coli* isolates. An initial analysis was performed to predict the source of an isolate as to the primary animal (human, bird, wildlife, etc.). A second analysis examined the ability of ribotype profiles, or genetic fingerprint, to predict the specific source of an isolate from a comparison of the animal and human-derived isolates collected in this study to our preexisting ribotype database. This second analysis resulted in either a direct match to a source isolate or an “indeterminate” classification in which the DNA profile matched several source isolates contained in the database. A broad classification of “indeterminate animal” was also assigned to a fingerprint that was shared by two or more animal sources in the library, but was not observed in human isolates. Finally, a classification “human/animal” was assigned to isolates that matched both human and animal sources. Figure 55 shows the summation of the ribotyping analysis performed at 20 locations. As shown in the figure, the non-human categories were the dominant sources found in the study.

In order to narrow in on the human contribution, the presence or absence of 4 different DNA markers were evaluated: Human enteric virus DNA marker, **Human polyoma virus DNA Marker** (found in urine), **human enterococcus DNA marker**, and **human bacteroides marker.** These markers are found under different conditions, in different proportions of the human population, and have different regrowth potential, so the **pattern** of presence/absence markers in a sample can provide clues to the source and timing of the fecal contamination. Table 29 summarizes the human markers and their characteristics and Table 30 describes the interpretative “toolbox” applied to determine whether area with human markers present was persistent or residual, a remnant of a past event. After 40 samples taken during 4 different events, the study identified seven areas that have persistent sources of human contamination and warrant further investigation by the local stakeholders.

**Figure 55. Results of GRU Microbial Source Tracking Ribotyping Analysis**



**I- Human and Animal means an indeterminate mixture of these DNA species.**

**I-Animal similarly means only animal DNA species was in the mixture.**

Table 29. Summary Characteristics For Genetic Markers Used In TIMS

| Type of Genetic Marker | Type of Analysis                                         | Occurrence       | Marker Specificity   | Test Sensitivity | Fate in the Environment                                                 | Potential for Regrowth                                       |
|------------------------|----------------------------------------------------------|------------------|----------------------|------------------|-------------------------------------------------------------------------|--------------------------------------------------------------|
| Human enteric virus    | Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) | Digestive system | Very highly specific | Moderate         | Persists in groundwater and surface water for 30 to 60 days             | Does not re-grow in environment due to lack of host          |
| Human Polyoma virus    | Polymerase Chain Reaction (PCR)                          | Urinary tract    | Very highly specific | Moderate         | Persistence in groundwater and surface water unknown                    | Does not re-grow in environment due to lack of host          |
| Human Enterococcus     | Polymerase Chain Reaction (PCR)                          | Digestive system | Very highly specific | High             | Can persist in surface water for 10 to 20 days                          | Regrowth in surface waters and sediments has been documented |
| Bacteroides            | Polymerase Chain Reaction (PCR)                          | Digestive system | Very highly specific | High             | Rapid die-off in aerobic surface waters                                 | Will not re-grow in aerobic environments                     |
| E. coli                | Ribotyping                                               | Digestive system | Moderate             | Moderate         | Can persist in surface water and sediments for extended periods of time | Regrowth in surface waters and sediments has been documented |

**Table 30. Signature Pattern Of Four Genetic Markers Used In TIMS**

| Category           | Enteric Virus | Polyoma Virus | Enterococcus | Bacteroides | Characteristics of the Signature |                           |                                                        | Comments           |
|--------------------|---------------|---------------|--------------|-------------|----------------------------------|---------------------------|--------------------------------------------------------|--------------------|
|                    |               |               |              |             | Strength Human Signature         | Recent or Residual Source | Other                                                  |                    |
| Quadruple Positive | Positive      | Positive      | Positive     | Positive    | Very strong positive             | Recent                    |                                                        |                    |
| Triple Positive    | Negative      | Positive      | Positive     | Positive    | Very strong positive             | Recent                    |                                                        |                    |
|                    | Positive      | Negative      | Positive     | Positive    | Very strong positive             | Recent                    |                                                        |                    |
|                    | Positive      | Positive      | Negative     | Positive    | Very strong positive             | Recent                    | Possible septic tank systems                           |                    |
|                    | Positive      | Positive      | Positive     | Negative    | Very strong positive             | Residual                  |                                                        |                    |
| Double Positive    | Negative      | Negative      | Positive     | Positive    | Strong positive                  | Recent                    | Strong signature based on realistic method sensitivity | Most common result |
|                    | Positive      | Negative      | Negative     | Positive    | Strong positive                  | Recent                    | Possible septic tank systems                           |                    |
|                    | Positive      | Positive      | Negative     | Negative    | Strong positive                  | Residual                  | Possible wastewater discharge                          |                    |
|                    | Positive      | Negative      | Positive     | Negative    | Strong positive                  | Residual                  |                                                        |                    |
|                    | Negative      | Positive      | Negative     | Positive    | Strong positive                  | Recent                    |                                                        |                    |

|                 |          |          |          |          |                        |                 |                                                        |            |
|-----------------|----------|----------|----------|----------|------------------------|-----------------|--------------------------------------------------------|------------|
|                 | Negative | Positive | Positive | Negative | Strong positive        | Residual        |                                                        |            |
| Single Positive | Positive | Negative | Negative | Negative | Strong positive        | Residual        |                                                        | Rare event |
|                 | Negative | Positive | Negative | Negative | Moderate positive      | Residual        | No evidence of human fecal contamination               |            |
|                 | Negative | Negative | Positive | Negative | Weak positive          | Residual        | Low evidence of human fecal contamination;<br>Resample |            |
|                 | Negative | Negative | Negative | Positive | Weak/moderate positive | Recent          | Possible septic tank systems;<br>Resample              |            |
| No Positive     | Negative | Negative | Negative | Negative | Very strong negative   | No human source |                                                        |            |

## **ALACHUA COUNTY HEALTH DEPARTMENT OSTDS SURVEYS AND COLIFORM**

### **MONITORING**

To address coliform TMDLs, the Alachua County Health Department (ACHD) sought to determine what role septic systems play in the fecal coliform loading of Sweetwater, Tumblin, and Hogtown Creeks. Of the eight watersheds in urban Gainesville, these three were considered a priority due to data indicating poor water quality.

In July 2004, the State Health Office, Bureau of Onsite Sewage Programs, awarded the ACHD \$20,000 to implement a project titled: *Fecal Coliform Loading Attributed to Onsite Sewage Treatment and Disposal Systems in the Hogtown, Tumblin, and Sweetwater Branch Systems in Gainesville, Florida*. Project tasks included:

- a. Identification of parcels not served by Gainesville Regional Utilities (GRU) that abut creeks.
- b. Development of digital map of parcels identified in (a.).
- c. Recruitment, selection, and training of staff.
- d. Requisition and procurement of necessary equipment.
- e. GPS location of OSTDS on parcels abutting creek system in the study area, develop and generate accurate GIS maps of OSTDS locations in the watershed.
- f. Qualitative evaluation of OSTDS functionality:
  1. Are there visible signs of system failure? Y/N
- g. Evaluation of onsite soils to six feet below natural grade:
  1. Soil Series identification per Soil Survey of Alachua County.
  2. Textural soils assessment utilizing USDA methodology to six feet below natural grade.
  3. Seasonal high water table (SHWT) identification.
- h. Setback measurements of infiltrative absorption surface of drainfield:
  1. Horizontal setback determination to creek.
  2. Vertical separation to SHWT.
- i. Water quality assessment of creek at selected intervals measuring fecal coliform levels.

Sampling points for Hogtown Creek are shown in Figure 56. Data resulting from this sampling effort is shown in Table 31. Sampling points for Tumblin and Sweetwater are shown in Figure 57. Data from Tumblin and Sweetwater is shown in Table 32.

[illegible]

**Table 31. Results from ACHD Coliform Sampling in Hogtown Creek (fecal coliform/100mL using MPN)**

| Location                | 9/6/2005 | 11/29/2005 | 1/17/2006 | 1/30/2006 | 2/7/2006 | 2/21/2006 | 4/4/2006 | 5/1/2006 | ArithMean |
|-------------------------|----------|------------|-----------|-----------|----------|-----------|----------|----------|-----------|
| NW 53 AVE bridge        | 1400     | 14000      |           |           |          |           | 170      | 110      | 3920.00   |
| NW 19 ST bridge         | 700      | 2800       |           |           |          |           | 230      | 20       | 937.5     |
| NW 45 AVE               | 1100     |            |           |           |          |           | 70       | 140      | 436.6667  |
| NW 39 AVE               | 1700     |            |           |           |          |           | 500      | 500      | 900       |
| NW 36 PL, Publix        | 5000     |            |           |           |          |           | 50       | 1400     | 2150      |
| NW 36 RD, 912           | 2200     |            |           |           |          |           | 140      | 9000     | 3780      |
| NW 6 ST & NW 36 AVE     | 800      |            |           |           |          |           | 140      | 2800     | 1246.667  |
| NW 36 AVE, 426          | 2200     |            |           |           |          |           | 220      | 3500     | 1973.333  |
| NW 2 ST, lift station   |          |            |           |           |          |           | 300      | 20       | 160       |
| NW 14 ST & nw 32 AVE    | 900      |            |           |           |          |           | 20       |          | 460       |
| NW 18 TERR bridge       |          |            | 1300      |           |          |           |          |          | 1300      |
| NW 22 ST, 1122, bridge  |          |            | 700       | 2200      |          |           |          |          | 185       |
| NW 7 PL, 1902           |          |            | 300       | 70        |          |           |          |          | 185       |
| NW 15 ST & NW 8 AVE     |          |            |           | 1300      |          |           |          |          | 1300      |
| NW 18 TERR, 1230        |          |            |           |           | 1700     | 1700      |          |          | 1700      |
| NW 12 RD, 1748          |          |            |           |           | 900      | 2400      |          |          | 1650      |
| NW 19 CIR, DS           |          |            |           |           | 220      | 700       |          |          | 460       |
| NW 19 CIR, US           |          |            |           |           | 800      | 300       |          |          | 550       |
| NW 12 Ave, 1800, bridge |          |            |           |           | 900      | 3000      |          |          | 1950      |
| NW 8 AVE, 1715          |          |            | 2800      | 11000     |          | 500       |          |          | 4766.667  |
| SE 10 TERR bridge       |          | 28000      | 800       | 3000      |          |           |          |          | 10600     |
| Rosewood                |          | 50000      | 1700      | 2200      |          |           |          |          | 17966.67  |
| Rosewood footbridge     |          |            | 1100      | 1100      |          |           |          |          | 1100      |
| Sweetwater WWTP         |          | 30000      | 110       | 500       |          |           |          |          | 10203.33  |
| Depot Park              |          |            |           |           | 300      | 300       |          |          | 300       |
| Oakbrook Walk           |          |            |           |           | 800      | 800       |          |          | 800       |

**Figure 57. ACHD Sampling Points in Tumblin Creek and Sweetwater Branch**

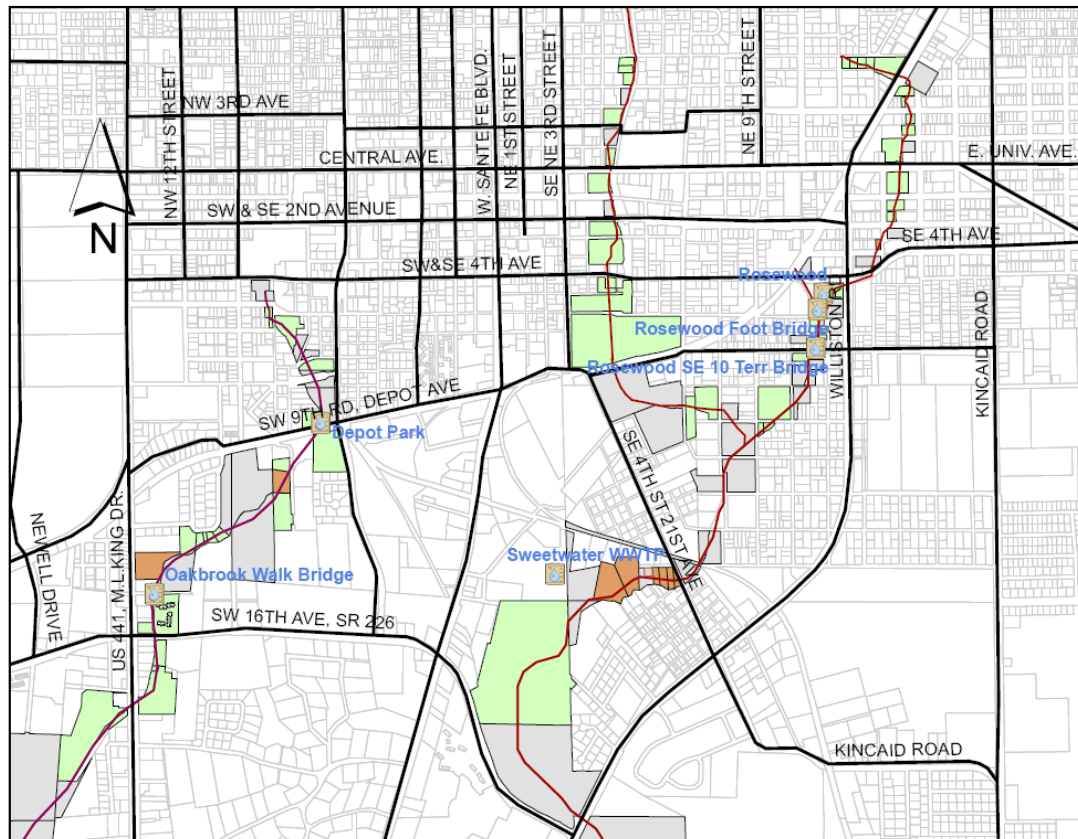


**Table 32. Results from ACHD Coliform Sampling in Tumblin Creek and Sweetwater Branch (fecal coliform/100mL using MPN)**

| Location                | 9/6/2005 | 11/29/2005 | 1/17/2006 | 1/30/2006 | 2/7/2006 | 2/21/2006 | 4/4/2006 | 5/1/2006 | ArithMean |
|-------------------------|----------|------------|-----------|-----------|----------|-----------|----------|----------|-----------|
| NW 53 AVE bridge        | 1400     | 14000      |           |           |          |           | 170      | 110      | 3920.00   |
| NW 19 ST bridge         | 700      | 2800       |           |           |          |           | 230      | 20       | 937.5     |
| NW 45 AVE               | 1100     |            |           |           |          |           | 70       | 140      | 436.6667  |
| NW 39 AVE               | 1700     |            |           |           |          |           | 500      | 500      | 900       |
| NW 36 PL, Publix        | 5000     |            |           |           |          |           | 50       | 1400     | 2150      |
| NW 36 RD, 912           | 2200     |            |           |           |          |           | 140      | 9000     | 3780      |
| NW 6 ST & NW 36 AVE     | 800      |            |           |           |          |           | 140      | 2800     | 1246.667  |
| NW 36 AVE, 426          | 2200     |            |           |           |          |           | 220      | 3500     | 1973.333  |
| NW 2 ST, lift station   |          |            |           |           |          |           | 300      | 20       | 160       |
| NW 14 ST & nw 32 AVE    | 900      |            |           |           |          |           | 20       |          | 460       |
| NW 18 TERR bridge       |          |            | 1300      |           |          |           |          |          | 1300      |
| NW 22 ST, 1122, bridge  |          |            | 700       | 2200      |          |           |          |          | 185       |
| NW 7 PL, 1902           |          |            | 300       | 70        |          |           |          |          | 185       |
| NW 15 ST & NW 8 AVE     |          |            |           | 1300      |          |           |          |          | 1300      |
| NW 18 TERR, 1230        |          |            |           |           | 1700     | 1700      |          |          | 1700      |
| NW 12 RD, 1748          |          |            |           |           | 900      | 2400      |          |          | 1650      |
| NW 19 CIR, DS           |          |            |           |           | 220      | 700       |          |          | 460       |
| NW 19 CIR, US           |          |            |           |           | 800      | 300       |          |          | 550       |
| NW 12 Ave, 1800, bridge |          |            |           |           | 900      | 3000      |          |          | 1950      |
| NW 8 AVE, 1715          |          |            | 2800      | 11000     |          | 500       |          |          | 4766.667  |
| SE 10 TERR bridge       |          | 28000      | 800       | 3000      |          |           |          |          | 10600     |
| Rosewood                |          | 50000      | 1700      | 2200      |          |           |          |          | 17966.67  |
| Rosewood footbridge     |          |            | 1100      | 1100      |          |           |          |          | 1100      |
| Sweetwater WWTP         |          | 30000      | 110       | 500       |          |           |          |          | 10203.33  |
| Depot Park              |          |            |           |           | 300      | 300       |          |          | 300       |
| Oakbrook Walk           |          |            |           |           | 800      | 800       |          |          | 800       |

Based upon data results of items (f) through (i) above, a characterization of the investigated OSTDS in terms of its potential impact to the creek were documented as the following:

- **Confirmed impact to creek** – There are visible signs of untreated effluent impacting the creek.
- **Significant potential for adverse impact to creek** – There are no visible signs of impact to creek but there exists a horizontal setback to creek of less than 75 feet and/or a vertical setback to SHWT of less than 24 inches.
- **Minor potential for adverse impact to creek** – There are no visible signs of impact to creek and horizontal setback of greater than 75 feet and vertical setback to SHWT of greater than 24 inches.

The basis for including setbacks with respect to fecal coliform loading are supported by the following references:

Vertical Setback:

- Lewis, A.L., Stark, L.M., 1993, Florida OSTDS Research Project.
- EPA, Onsite Wastewater Treatment Systems Manual, 2002, EPA/625/R-00/008

Horizontal Setback:

- Canter, L.W., Knox, R.C., 1985, Septic Tank System Effects on Groundwater Quality
- EPA, Onsite Wastewater Treatment Systems Manual, 2002, EPA/625/R-00/008\

Results of the Sweetwater Survey found nine parcels on OSTDS, eight with a **significant potential**, and one with a **confirmed impact**, which subsequently was connected to GRU central sewer. See map for Sweetwater. Results of the Tumblin'

Survey found three possible parcels on OSTDS, as ACHD was unable to gain access to one parcel, none with **minor potential**, two with **significant potential**, and none with a **confirmed impact**. See map for Tumblin. Results of the Hogtown Survey found 25 parcels on OSTDS, three to which ACHD was unable to gain access, two with **minor potential**, 20 with **significant potential**, and none with a **confirmed impact**. See maps for Hogtown. The combined results of the Hogtown, Tumblin, and Sweetwater Branches Project yielded the following summary; Of the 455 total parcels that abut the three creeks, 301 are on GRU Sewer (66%), 36 on OSTDS (8%), and 118 unimproved (26%).

The ACHD is still in the process of sampling the surface water of the creeks in areas upstream and downstream of the identified systems for fecal coliform using the MPN (SM9221E) standard. To date the ACHD has taken 64 surface water samples in these creeks in areas upstream and downstream of the identified systems for fecal coliform. Thirty-six additional sampling events are planned and will be reported when completed. Preliminary analysis of the data indicates that the implemented methodology is limited in its usefulness with this particular project. Rainfall events and associated stormwater runoff seem to influence the results.

ACHD and GRU are further evaluating each of the properties identified as either have confirmed or significant potential for adverse impacts, in order to determine on a case by case basis the most feasible approach for eliminating the potential impact. Alternatives include relocation and/or upgrading of the property's OSTDS to meet current standards, or abandonment of the OSTDS and connection of the property to GRU's centralized sewer system. The study will develop an overall plan and estimated costs. GRU and ACHD are seeking funding sources to assist in paying the costs to implement the program. As of FY2007 \$225,000 has already been requested through the SJRWMD SWIM program. Funds are also being sought through the EPA 319 funding program. The \$225,000 which has already been requested through the SJRWMD SWIM program was based on the assumption of connecting approximately 15 residences to sanitary sewer, at an assumed average cost of \$15,000 each. The requested funds would pay for extending the sanitary sewer line to each residence, plumbing connections, and abandonment of the septic system. As the detailed feasibility study described above is completed, costs and funding amounts requested will be refined as appropriate.

The ACHD is also in the process of completing a similar study for parcels along the shore of Lake Wauberg. The purpose of this study is to identify the potential of individual parcels to contribute coliforms to surface waters. Although this study is focused on identifying coliform sources, Lake Wauberg is verified as impaired for nutrients only, not coliforms. However, given the potential for septic systems to contribute elevated nutrients, this study will also inform source identification for nutrient impacts to Lake Wauberg. More details are provided in Section 4.3 above.

### **5.3.2 Known Urban Creek Coliform Sources**

Fecal coliforms in our surface waters originate from warm-blooded animals. Where animals such as raccoons, possums and rodents congregate along the streams, their feces may be a major source of fecal coliform pollution. The anthropogenic sources in the area include leaking central sewer lines and lateral connections to homes, failing septic tank systems, untreated or inadequately treated stormwater, livestock operations, pet waste and the homeless. Once in a stream, the warm Florida climate may allow these bacteria to persist or increase in number.

Known fecal coliform sources in the urban creeks can be placed into two categories: primary and secondary. Primary sources include:

- Ex-filtration and releases from public and private centralized wastewater collection and treatment systems,
- Malfunctioning on-site wastewater treatment facilities such as septic tank systems,
- Direct use of creeks for human sanitation,
- Runoff from urban campsites near creeks,
- Domestic animal waste (e.g. dogs), and
- Wildlife animal waste.

These sources can be delivered directly to a stream or can be delivered through accumulation on the land surface and subsequent transport to the stream via stormwater.

Fecal coliform bacteria are known to persist and reproduce in conducive environments outside of warm-blooded animals (Desmarais et al, 2000; Griffin et al, 2001). This secondary source can become a dominate load from nonpoint sources during rain events.

Based on the results of the projects discussed above and analyses conducted as part of TMDL development, each of these sources appears to be present in the urban creeks. Based on the detailed microbial source tracking analysis completed by GRU (Figure 55) roughly 50% of the coliforms in the urban creeks sampled are from non-human sources and 11% from human sources. The remaining 40% could not be classified clearly as human or animal. Markers of human coliform contamination were found throughout the urban creek system.

### **Wastewater**

GRU maintains an extensive centralized wastewater infrastructure in the City of Gainesville and nearby areas (see summary in Chapter 3). The system consists of 705 miles of piping, 160 lift stations, and 13,888 manholes covering a service area of 115 square miles with over 160,000 people. Exfiltration from the centralized sewer infrastructure and infrastructure failures are a potential source of coliforms in urban creeks. Significant resources have been and continue to be used to minimize direct and indirect wastewater leakage into urban creeks.

Leaking sewer lines on private property are potentially significant as a source of coliforms (and nutrients). Figure 58 is a map of private collection systems, which are of concern for the following reasons:

- o May have had limited to no inspection since they were installed.
- o May not be built to GRU's standards.
- o May only be "maintained" during emergency response situations.
- o May not report spills.
- o No regulatory constraints for operating and maintaining these systems beyond the DEP certificate of construction.

Residential plumbing could also be a potential source near creeks. If not properly installed or maintained, these system have similar issues as private collection systems, although they are less concentrated.

Based on the results of the Alachua County Health Department onsite wastewater surveys discussed above, parcels that use septic tank systems for wastewater disposal

can represent a source of coliforms to urban creeks (e.g. eight parcels with a significant potential for coliform discharge and one parcel with confirmed coliform discharge in the Sweetwater Branch watershed).

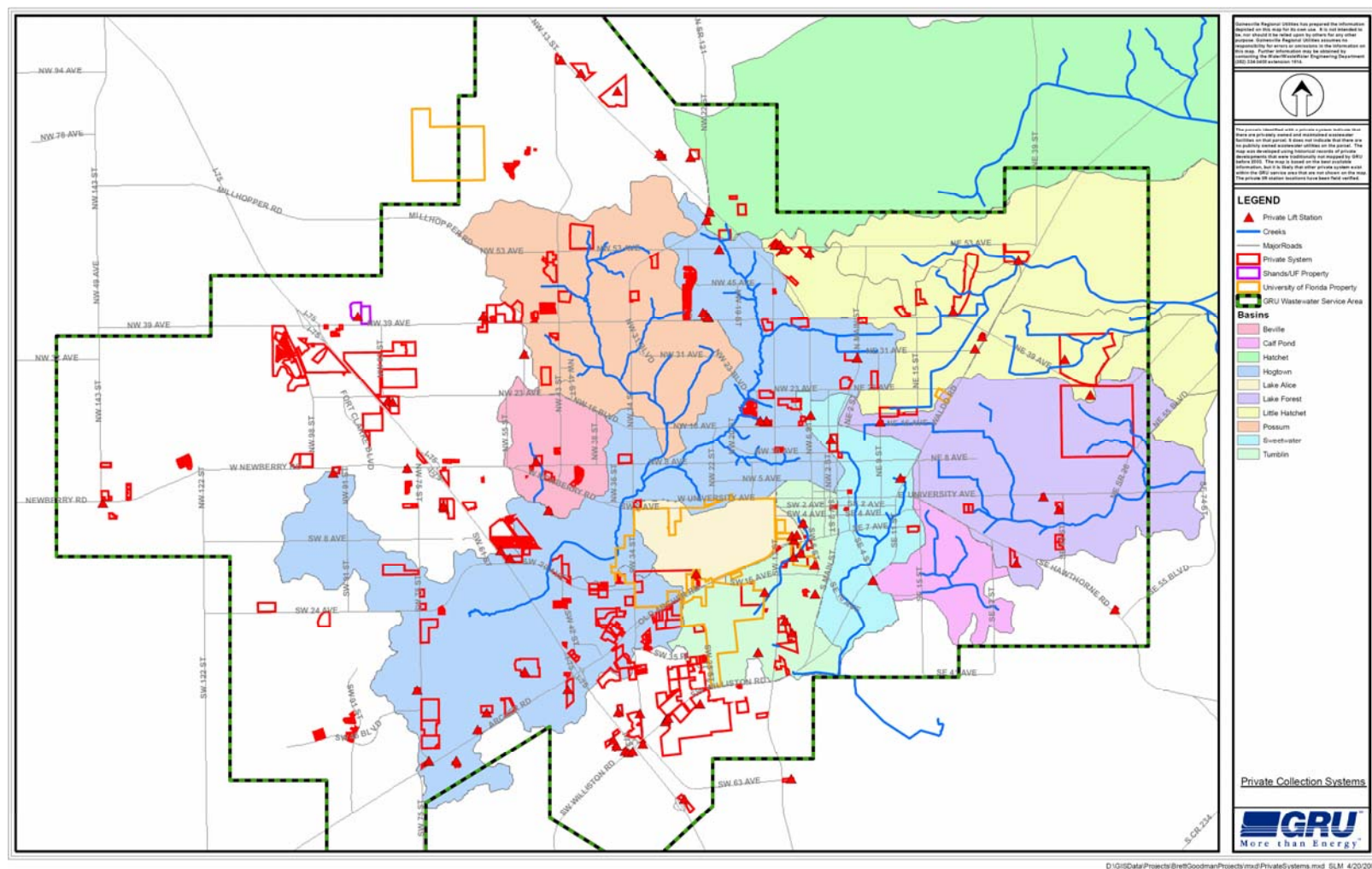
### **Urban Campsites**

Although data was unavailable to quantify the effects of this source, individuals living in campsites along these urban creeks are likely to be contributing coliform to the creeks, given that sanitation facilities in these areas are limited.

### **Animal Waste**

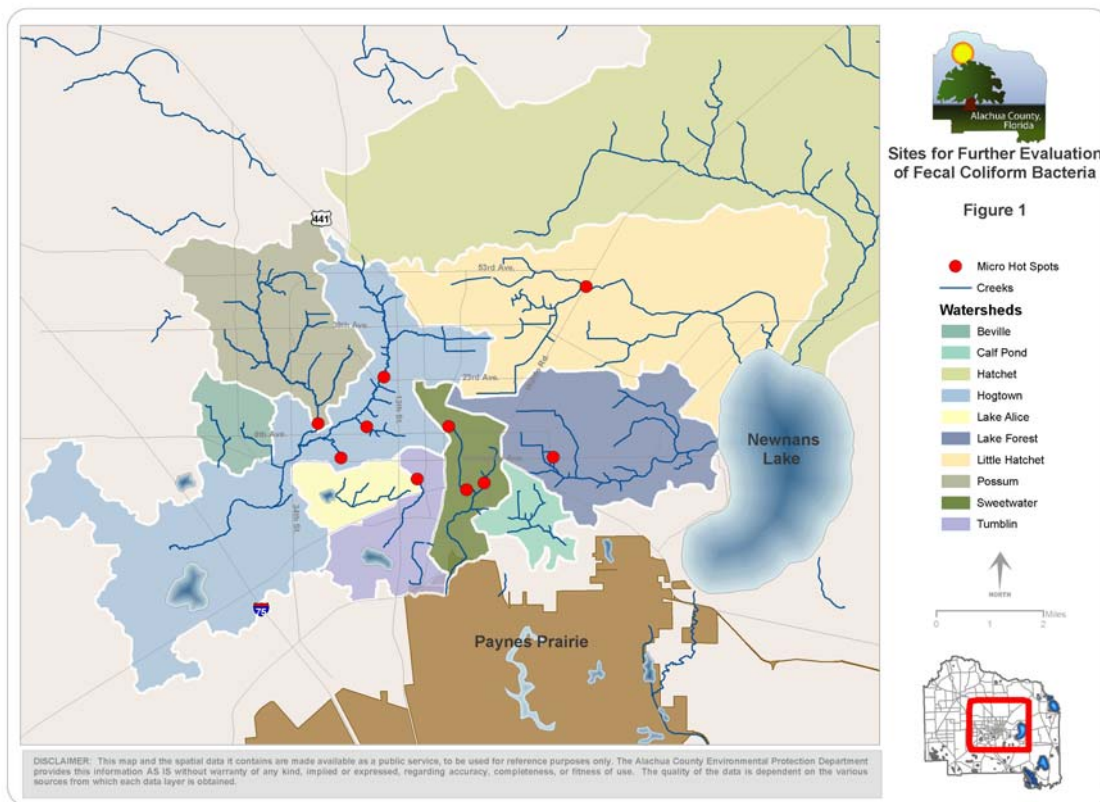
Improperly managed agricultural and domestic animal waste can lead to elevated coliform levels. In addition, heavy wildlife populations can contribute a majority of the coliform load in streams, even in areas with intensive human and domestic animal populations (Somarelli, et al., 2007). As demonstrated by the GRU microbial source tracking study results (Figure 55), each of these coliform sources is a factor in the Gainesville urban creeks. Human markers were found consistently throughout the urban creek system. However, 50% of coliform loads were attributed to non-human sources.

**FIGURE 58 . PRIVATE LIFT STATIONS CONNECTED TO THE GAINESVILLE REGIONAL UTILITIES WASTEWATER SYSTEM**



In addition to identifying the degree to which human sources contribute to coliform loads in the urban creeks, the GRU microbial source tracking study identified ten areas that have persistent sources of human contamination and warrant further investigation by the local stakeholders. These priority areas form the foundation of the ongoing cooperative coliform reduction “Hot Spot” project discussed in Section 5.4.2. Figure 59 identifies the key areas that will form the focus of stakeholder efforts to reduce coliforms.

**Figure 59 Priority areas for further evaluation of fecal coliform bacteria, based on GRU microbial source tracking study**



| Watershed     | Location ID | Area                                            |
|---------------|-------------|-------------------------------------------------|
| Hogtown Creek | ELIZNW7DS   | Headwaters near University Avenue               |
| Hogtown Creek | HOGNW23     | NW23 Avenue to 8th NW Avenue                    |
| Hogtown Creek | POSNW16     | NW 16th Avenue to confluence with Hogtown Creek |
|               | RATTLESNAKE | Entire creek                                    |

|                      |          |                                                          |
|----------------------|----------|----------------------------------------------------------|
| Hogtown Creek        |          |                                                          |
| Sweetwater Branch    | SWBNE10  | NE 10th Avenue to SE 1st Avenue                          |
| Sweetwater Branch    | SWBSE8   | SE 8th Avenue                                            |
| Sweetwater Branch    | ROSEWOOD | Mid-point in the watershed to confluence with Sweetwater |
| Tumblin Creek        | TUMBLIN  | SW 5th Avenue to PK Yonge School                         |
| Little Hatchet Creek | LHTWALDO | Vicinity of Waldo Road                                   |
| Lake Forest Creek    | LFCNE25  | NE 25th Street north of University Avenue                |

### 5.3.3 Unknowns Regarding Urban Creek Coliform Sources

As mentioned above, once bacteria enter a waterbody they can persist and regrow in conducive environments (Desmarais et al, 2000; Griffin et al, 2001). This secondary source can become a dominate load from nonpoint sources during rain events. Conventional testing methods for coliform bacteria do not distinguish between primary sources and secondary sources (Scott, 2002; Bitton, 2005; Harwood, 2006). This lack of specificity is problematic when attempting to use coliform source identification information to guide implementation of management actions.

The GRU microbial source tracking study provided a level of detail about coliform sources that was not previously available. It provided good direction for a path forward in management of elevated coliform levels and identified areas of high priority for management actions. However, at the completion of the project, roughly 40% of the coliform load in the urban creeks remained of indeterminate or mixed human/animal origin. Thus, even with the level of detail provided by this study, quantification of coliform sources in the watershed was not achievable. Although the general source categories and minimum contributions have been identified, the relative magnitude of these sources remains unknown.

## 5.4 Fecal Coliform Management Actions and Expected Outcomes

The ability to apply advanced scientific methods to accurately distinguish between sources of coliform in the urban creeks will be critical in developing appropriate management strategies and measuring progress for meeting the TMDL's in each creek. Until these advanced methods become more cost effective, local stakeholders will continue to develop and implement management strategies using a blend of conventional testing data and advance source tracking information. Federal, State and local support of the research and development of cost effective advanced microbial source tracking methods will benefit all stakeholders in reducing coliform levels in Gainesville's urban creeks.

A significant number of management actions have been completed and are in progress to address fecal coliforms in the Orange Creek Basin urban creeks. This section highlights the key individual management actions, the cooperative coliform remediation project, further research, and expected outcomes of these activities. These activities are based on the known sources identified above and local knowledge of the urban creeks.

### 5.4.1 Individual Management Actions to Decrease Coliform Loads

Coliform management actions in the Orange Creek Basin fall into four primary categories: septic tank system management, centralized wastewater system management, stormwater management, and public education. The stakeholders involved and general areas of responsibility are as follows:

**Alachua County Department of Health**

- On-site wastewater system permitting program
- Septic tank system evaluation near major urban creeks
- Incident response

**Alachua County Environmental Protection Department**

- Public education/outreach
- Ambient water quality monitoring
- County water quality code implementation and enforcement
- Stormwater illicit connection elimination program
- Microbial source tracking studies

**Florida Department of Environmental Protection**

- Public education/outreach
- Ambient water quality monitoring
- Funding support

**Gainesville Clean Water Partnership**

- Public education/outreach
- Illicit connection elimination program
- Pet waste management

**Gainesville Regional Utilities / City of Gainesville**

- Public education/outreach
- Inflow and Infiltration Program
- Wastewater collection system repair and restoration
- Force main integrity program
- Water quality sampling near facilities
- Microbial source tracking study
- Private collection system identification
- Incident response
- “Connect Free” program

**St. Johns River Water Management District**

- Public education/outreach
- Ambient water quality monitoring
- Funding support

Highlights of specific management actions are provided in Table 33. Full details can be found in Appendix E.

**Table 33. Highlights of Management Actions to Reduce Coliform Loads in Urban Creeks**

*Note: Additional management actions have been proposed to decrease coliform loads. Details of all management actions are provided in Appendix E.*

| <b>Project Name</b>                                                                | <b>Project Number</b>                  | <b>Description</b>                                                                                                                                                                                                                                               | <b>Primary Project Partners</b>                                                                             | <b>Anticipated Benefits</b>                                                                  |
|------------------------------------------------------------------------------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| MS4 Permit Implementation                                                          | MSPERMIT01<br>MSPERMIT02<br>MSPERMIT03 | Implementation of the 6 primary control measures, including public outreach, illicit discharge detection and elimination, mapping and modeling efforts, construction site pollution prevention programs, and municipal operations pollution prevention programs. | City of Gainesville<br>Alachua County<br>FDOT                                                               | Reduces coliform loads in stormwater runoff.                                                 |
| SW 11 <sup>th</sup> Avenue Storm Sewer                                             | TUM02                                  | Improvements to storm sewer system and creek outfall stabilization.                                                                                                                                                                                              | City of Gainesville                                                                                         | Reduces coliform load associated with suspended sediment                                     |
| Street Sweeping                                                                    | URBAN01<br>URBAN04<br>URBAN08          | Routine street sweeping and additional sweeping during special events.                                                                                                                                                                                           | City of Gainesville<br>DOT<br>Alachua County                                                                | Prevents debris, sediment, trash, and other pollutants from entering the storm sewer system. |
| Public Education and Outreach, including Community Based Social Marketing Workshop | ALACHUA02<br>OCB01                     | Written materials, public service announcements, workshops, and a wide variety of other forms of public outreach.                                                                                                                                                | Alachua County<br>City of Gainesville<br>FDOT (GCWP)<br>SJRWMD<br>Sustainable Alachua County<br>GRU<br>FDEP | Reduces coliform loads in stormwater runoff.                                                 |
| Vegetative Enhancement Projects                                                    | SWT22<br>TUM18<br>HOG26                | Public education workshop and enhancement of stormwater pond and seepage wetland buffers.                                                                                                                                                                        | City of Gainesville<br>Alachua County<br>FDOT (GCWP)                                                        | Reduces coliform loads in stormwater runoff.                                                 |

**Table 33 continued**

| <b>Project Name</b>                                                 | <b>Project Number</b>                                                                                        | <b>Description</b>                                                                                                                                                                                                                                     | <b>Primary Project Partners</b>                         | <b>Anticipated Benefits</b>                                                                                                  |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Alachua County Water Quality Code Implementation                    | ALCODE01                                                                                                     | Alachua County / Alachua County Water Quality Code Implementation for Tumblin Creek, Sweetwater Branch, and Hogtown Creek. Public education, outreach, and enforcement.                                                                                | Alachua County<br>City of Gainesville<br>FDOT<br>(GCWP) | Reduces coliform loads in stormwater runoff.                                                                                 |
| Duck Pond Restoration                                               | SWT03                                                                                                        | Creek restoration project, installation of two CDS units, pond rehabilitation, and removal of ducks.                                                                                                                                                   | City of Gainesville                                     | Reduces coliform load associated with suspended sediment and reduces direct discharge of coliforms associated with wildlife. |
| Hydrodynamic Separators                                             | HOG29<br>HOG30<br>HOG31<br>URBAN02<br>URBAN03<br>URBAN09<br>URBAN10                                          | Installation and operation of a Stormceptor unit.                                                                                                                                                                                                      | City of Gainesville                                     | Prevention of debris, sediment, trash, and other pollutants from entering the storm sewer system.                            |
| Stormwater Parks                                                    | SWT02<br>SWT04<br>TUM01                                                                                      | Improved stormwater treatment through wet detention.                                                                                                                                                                                                   | City of Gainesville<br>SJRWMD<br>FDOT                   | Reduces sediment load and associated bacteria.                                                                               |
| Centralized Wastewater Infrastructure Inspection and Rehabilitation | BACTERIA07<br>BACTERIA08<br>BACTERIA09<br>BACTERIA10<br>BACTERIA11<br>BACTERIA12<br>BACTERIA13<br>BACTERIA15 | Intensive wastewater collection system integrity testing, closed circuit TV camera inspection, visual inspection, lift station maintenance, and other efforts to identify problem areas and rehabilitate the centralized wastewater collection system. | GRU                                                     | Minimizes the possibility of wastewater releases.                                                                            |
| Sanitary Sewer System Geodatabase                                   | URBAN12                                                                                                      | Maintain a comprehensive geodatabase for all Gainesville Regional Utilities sanitary sewer system data.                                                                                                                                                | GRU                                                     | Minimizes the possibility of wastewater releases by better identifying infrastructure location.                              |

#### **5.4.2 Cooperative Coliform Management “Hot Spot” Project**

Based on the results of ambient fecal coliform monitoring, microbial source tracking (MST), alternative bacteriological monitoring, and optical brighteners analyses, a number of sites warrant further evaluation. There are 10 sites with consistently high levels of fecal coliform bacteria, eight of which have shown a presence of human markers in MST samples. The evidence of human markers is a specific concern, as there may be a continuing source of fecal coliform bacteria from humans, such as failing infrastructure, impacting the creeks. These sources of bacteria may be preventable and must be defined in order to develop strategies to reduce fecal pollution in the creeks.

ACEPD, Alachua County Health Department (ACHD), City of Gainesville Public Works Department (COGPWD), Florida Department of Transportation (FDOT) Gainesville Regional Utilities (GRU), and FDEP have initiated a cooperative project (BACTERIA16) to evaluate and remediate coliform sources.

The work conducted in evaluating the fecal coliform “hot spots” may cover large portions of a given watershed. It is estimated the approximately 30 to 40% of the Hogtown Creek watershed, including Elizabeth Creek and Rattlesnake Branch and excluding Possum Creek), will be evaluated. The area of concern for the Possum Creek watershed is in the area of the lower 10% of watershed; the upper 90% will be screened to further identify the area(s) of concern and percentage of the watershed to further evaluate. Approximately 30% of the Tumblin creek watershed will be evaluated. An estimated 50% of Sweetwater Branch watershed will be evaluated, including Rosewood Branch. The area of concern on Lake Forest Creek includes approximately 15% of the watershed. The area of concern on Little Hatchet creek is downstream of approximately 40% of the watershed; this area will also be refined based on additional baseflow monitoring. All these percentages are estimates and will be refined during GIS mapping the field activities.

The OCB TMDL stakeholders propose a series of tasks to further evaluate elevated fecal coliform bacteria levels and infrastructure in the Gainesville urban creek watersheds. Tasks include:

- Performing initial confirmatory baseflow fecal coliform sampling;
- Assessing existing programs and activities focused on reducing coliforms in the creeks and identifying areas needing improvement;
- Mapping infrastructure components into a GIS format within specific study areas;
- Conducting coordinated field evaluations of public and private sanitary sewer lines (including connection and laterals), septic systems, and storm sewer lines;
- Repairing infrastructure as necessary; and
- Performing post evaluative sampling to document water quality improvements.

These tasks will be conducted in the high priority areas identified in Figure 59 above. Each cooperating entity will attempt to conduct their portion of these tasks concurrently with the other entities in a specific watershed. Upon resolution of coliform issues in a specific watershed, the focus will then turn to the next priority. With this approach, the responsible parties will address all controllable coliform sources within an individual watershed at roughly the same time before shifting priorities to other areas. This cooperative approach is expected to yield significant decreases in coliform levels in the urban creeks. Additional detail about this approach can be found in the project scope (Appendix K).

### 5.4.3 Further Research and Source Tracking

Given the unknowns that currently exist for coliform sources in the urban creeks, a number of research and additional source tracking projects are in progress (see Table 34). These are in addition to the “hot spot” project discussed in detail above. The BWG expects that these projects will provide further guidance for continued coliform load reduction actions. Additional research and source tracking efforts may be conducted, pending the outcome of current research, current management actions, the “hot spot” coliform load reduction project, and funding availability. The need for additional coliform management actions and studies will be evaluated during the BMAP follow-up meetings.

**Table 34. Current Coliform Assessments and Research Projects**

| <b>Project Name</b>                         | <b>Project Number</b> | <b>Description</b>                                                                                         | <b>Primary Project Partners</b>                     | <b>Anticipated Benefits</b>                                                                                            |
|---------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Coliform Wet and Dry Season Assessment      | BACTERIA03            | Assessment of wet and dry season fecal coliform concentrations in surface waters at selected stations.     | Alachua County<br>City of Gainesville<br>DOT (GCWP) | Provide data for use in determining baseline conditions and achievable load reductions.                                |
| Expanded Fecal Coliform Bacteria Monitoring | BACTERIA04            | Expanded baseflow fecal coliform monitoring to better identify stream segments with high bacterial counts. | Alachua County                                      | Improve understanding of current conditions.                                                                           |
| Inlet Protection Pilot Projects             | HOG24<br>SWT29        | Assessment of stormwater drop inlet geotextile filtering devices                                           | Alachua County<br>City of Gainesville<br>DOT (GCWP) | Determine the effectiveness of drop inlet protection devices to determine utility of expanded use throughout the City. |

### 5.4.4 Expected Outcomes

Extensive management actions have been completed, are underway, and are planned for the future to decrease coliform loads into Tumblin Creek, Sweetwater Branch, and Hogtown Creek. Through these efforts, the BWG anticipates that coliform loads in the urban creeks will decrease over time. Given the often erratic behavior of fecal coliform bacteria in the environment, detailed quantification of load reductions is not possible at this time. However, the BWG will continue to evaluate coliform levels in the streams to track progress. Depending on the results achieved through implementation of the above management actions, an approach such as the cooperative coliform reduction “hot spot” project may be expanded to other parts of the watershed. This adaptive management approach will be used for the evaluation and selection of additional management actions in future iterations of the BMAP.

## 5.5 Hatchet Creek Iron TMDL

The Hatchet Creek watershed encompasses approximately 65 square miles in northeastern Alachua County. Two major tributaries in the watershed are Forest Creek and Bee Tree Creek. Forest Creek is in the western part of the basin and Bee Tree Creek drains the entire eastern part of the watershed. Bee Tree Creek joins the main channel of Hatchet Creek upstream of SR 26 in the vicinity of Gumroot Swamp Conservation Area. The primary site for water quality monitoring is on the north side of SR 26. This site, downstream of the confluence with Bee Tree Creek was selected by the SJRWMD to evaluate the entire watershed and its contribution to the water quality of Newnans Lake.

Hatchet Creek is routinely monitored for nutrients and general chemical characteristics by the SJRWMD (SJRWMD, 2006). ACEPD conducted both baseflow and stormwater monitoring of Hatchet Creek from February 1998 through September 2004 through a contract with the SJRWMD (ACEPD, 2004). The analyses primarily focused on nutrients and inorganic and organic indicator constituents. Current monitoring of Hatchet Creek is conducted by SJRWMD. ACEPD is conducting quarterly monitoring of fecal coliform bacteria and is conducting an additional study to evaluate coliform bacteria and iron concentrations within the watershed. FDEP adopted a TMDL for iron for Hatchet Creek. The standard for iron in Class III surface water (waters designated for recreation and propagation and maintenance of a healthy, well-balanced population of fish and wildlife) is 1.0 mg/L (FDEP, 2002).

Hatchet Creek is a “black water” stream with approximately 70 percent of the watershed forested, 20 percent in natural forest habitat and 50 percent in silviculture. Relief is low in much of the watershed and wetlands are numerous. The baseline water quality in Hatchet Creek reflects its landuse and physiography. As such, the waters of Hatchet Creek, at the SR26 sample site, are high in organic carbon and iron and relatively low in specific conductance, dissolved oxygen and pH. The median total organic carbon (TOC) concentration is 36.9 mg/L (n= 107, ACEPD 2004). The median total iron concentration is 0.987 mg/L (n=77, SJRWMD 2006). The median specific conductance is 99 microsiemens/cm2 (n=107, ACEPD 2004). Total suspended solids (TSS), chloride and sulfate are very low or non-detectable in these waters. The median pH concentration is 6.12 SU (n=108, ACEPD 2004). The median dissolved oxygen (DO) concentration is 5.46 mg/L (n=108, ACEPD 2004). Total Nitrogen is relatively high, with a median concentration of 1.120 mg/L, likely due to the abundance of wetlands and the forested nature of the watershed (ACEPD, 2004).

Iron is commonly occurring and is typically found associated with the oxyhydroxide coatings on the quartz sands and as a cation associated with silicate clays that comprise the surficial sediments in the watershed. Iron is typically present in its reduced or ferric ( $\text{Fe}^{3+}$  as  $\text{Fe}(\text{OH})_3$ ) form in oxyhydroxides, such as Goethite and Limonite. When oxidized iron is found in its ferrous form ( $\text{Fe}^{2+}$ ). The chemical behavior of iron in the surficial aquifer and associated wetlands (the primary sources of water to Hatchet Creek) is complex. The oxidation and reduction of iron in soils and in the shallow aquifer is controlled by microbial activity (Cullimore, 1992). The growth of iron bacteria, a common natural occurrence, can create a “biofilm” that allows accumulation of metals such as iron and increases iron mobility (Cullimore, 1992). Hem (1992) describes two processes in which bacteria may make iron more available in natural waters, (1) the oxidation of dissolved ferrous iron and (2) microbial mediated reactions that alter the iron concentration.

The significance of Hatchet Creek being a “black water” stream is that the humic substances from the decay of organic matter (in the form of humic and fulvic acids) have sites available in their structure to hold cations, such as iron ( $\text{Fe}^{2+}$ ). The analyses for total organic carbon (TOC) and color are measures of these humic and fulvic acids in surface waters. Iron that is released from sands and clays in the surficial aquifer is available to complex with these large organic

molecules. Analysis of iron measures “total iron,” which is iron present in any form in the water. Since the samples are acidified in the field, the laboratory results include any particulate iron present in the water sample.

The iron concentrations that ACEPD found in Hatchet Creek, 0.515 to 0.879 mg/L, appear to be related to the occurrence of iron in the natural environment. Based on sampling ACEPD conducted in February 2006 (Figure - February 2006 Total Iron Data for Hatchet Creek), all sites in Hatchet Creek watershed have iron concentrations <1.0 mg/L. The concentrations were similar upstream and downstream of the potential pollution sources in the watershed, such as the Fairbanks Sand Pit, the Alachua County North East and NE Auxiliary landfills and the Airport Landfill. These data are consistent with the results from the surficial aquifer monitoring well off CR 225 where concentrations in the groundwater range from 0.70 to 2.20 mg/L (n=3 ) (FDEP, 2006).

Many other waterbodies in Alachua County are “black waters.” Little Hatchet Creek, a “black water” creek (LHAT26) has a median iron concentration of 1.47 mg/L (n=14) and a median TOC value of 37.0 mg/L (n=101) (SJRWMD, 2006). Little Hatchet Creek (LHAT26E) has a median iron concentration of 0.67 mg/L (n=13) and a median TOC value of 37.6 mg/L (n=140) (SJRWMD, 2006).

The instream aquatic ecosystem of Hatchet Creek is in excellent condition. Two rapid bioassessments (BioRecons) conducted in 1997 and 2001 reported that Hatchet Creek was healthy, passing all three metrics (ACEPD, 2004). Hatchet Creek at CR225 had the highest Florida Index and Ephemeroptera, Plecoptera and Tricoptera (EPT) metrics of any stream site assessed in Alachua County from 2000-2003 (Water and Air Research, Inc., 2004).

ACEPD reconnoitered sites throughout the Hatchet Creek watershed in 2004 and began sampling these sites in late 2005. Initial samples were collected for fecal coliform bacteria, and since then iron has been added to the monitoring program. ACEPD plans to continue sampling iron on a bimonthly basis for the remainder of calendar year 2006. Manganese, another naturally occurring trace metal, TOC, total coliform, fecal coliform, *E. coli* and field parameters (pH, DO, temperature, specific conductance, and turbidity) will also be monitored. Based on the information collected thus far, ACEPD believes that the iron present in Hatchet Creek is naturally occurring and does not negatively impact the Hatchet Creek watershed aquatic ecosystem.

## CHAPTER 6: MONITORING, PROJECT TRACKING, AND ADAPTIVE MANAGEMENT

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This chapter outlines the steps stakeholders will take to track progress in implementing projects and observe the results of those projects in BMAP waterbodies. A process for communicating this information among stakeholders is also outlined within this chapter.

### 6.1 MONITORING WATER QUALITY AND POLLUTANT LOADS

Development of a surface water monitoring network is a critical element in the assessment, restoration, and protection of stream water quality. The Orange Creek BWG developed a strategy for monitoring water quality and measuring pollutant loads, which builds on existing programs being conducted by the DEP, SJRWMD, Alachua County, GRU, and others. The elements of the strategy include the objectives and anticipated benefits, contributing entities, ambient station and parameter information, performance-based monitoring details, quality assurance / quality control mechanisms, data management, and data analysis and reporting. Using an adaptive management approach, the BWG will continue to develop the details of the strategy based upon conditions and monitoring results.

#### 6.1.1 MONITORING OBJECTIVES AND ANTICIPATED BENEFITS

The overall purpose of this monitoring strategy is to support implementation of the BMAP. The objectives below reflect the BWG's priorities and provide further detail regarding the application of water quality monitoring data to support the BMAP. Both the primary and secondary objectives apply to waterbodies included as part of the BMAP.

##### Primary Objectives

1. Identify and track water quality trends in BMAP waterbodies to determine if water quality standards are being achieved.
2. Where feasible, measure the effectiveness of specific BMPs, in reducing external loadings of target pollutants.

##### Secondary Objectives

1. Measure reductions in watershed loadings of TMDL target pollutants
2. Refine understanding of the type and relative magnitude of pollutant loading sources

##### Use of Monitoring Activities and Data

- Evaluate progress toward achieving objectives
- Demonstrate stakeholder progress toward meeting their individual TMDL obligations
- Facilitate comparisons of water quality before and after BMP implementation
- Inform the selection of future BMPs.

#### 6.1.2 WATER QUALITY INDICATORS AND RESOURCE RESPONSES

To achieve the objectives above, the monitoring strategy is focused around two types of indicators: core and supplemental. Both types of indicators represent water quality parameters that affect the ability to track water quality trends. Core indicators are the minimum parameters that will be tracked. These indicators relate directly to the impaired parameters for lakes and creeks. Supplemental indicators are those parameters that support the interpretation of water quality data and broader waterbody health. Indicators are listed in Table \_35\_. As BMAP

implementation moves forward, changes in core indicators are expected. Changes in supplemental indicators may or may not be observed.

**Table 35. . Anticipated Trends in Core and Supplemental Water Quality Indicators**

| <b>Core Indicators</b>                                                   | <b>Lakes</b>                                           | <b>Creeks</b>                                          |
|--------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------------------|
| Chlorophyll-a                                                            | Decrease in concentration                              | ---                                                    |
| Phosphorus (as P)                                                        | Decrease in concentration                              | ---                                                    |
| Nitrogen, Nitrite (NO <sub>2</sub> ) and Nitrate (NO <sub>3</sub> ) as N | Decrease in concentration                              | ---                                                    |
| Nitrogen, Kjeldahl (TKN)                                                 | Decrease in concentration                              | ---                                                    |
| Fecal coliform                                                           | ---                                                    | Decrease in concentration                              |
| <b>Supplemental Indicators</b>                                           | <b>Lakes</b>                                           | <b>Creeks</b>                                          |
| Specific conductance                                                     | Monitored to support interpretation of core indicators | ---                                                    |
| Dissolved oxygen (DO)                                                    | Monitored to support interpretation of core indicators | ---                                                    |
| Alkalinity                                                               | Monitored to support interpretation of core indicators | ---                                                    |
| pH                                                                       | Monitored to support interpretation of core indicators | ---                                                    |
| Temperature                                                              | Monitored to support interpretation of core indicators | ---                                                    |
| Color                                                                    | Monitored to support interpretation of core indicators | ---                                                    |
| Turbidity                                                                | Monitored to support interpretation of core indicators | Monitored to support interpretation of core indicators |
| Total Suspended Solids (TSS)                                             | Monitored to support interpretation of core indicators | Monitored to support interpretation of core indicators |
| Total organic carbon (TOC)                                               | Monitored to support interpretation of core indicators | Monitored to support interpretation of core indicators |

These water chemistry indicators reflect the primary goal of the TMDL program – to restore waterbodies such that they meet water quality standards. However, broader resource responses are also important when evaluating waterbody health. Table 36 lists the resource responses that will be tracked for the BMAP waterbodies. Anticipated changes in resource responses may not be observed during implementation of this BMAP. Significant time may be needed for the changes in water chemistry to be translated into resource responses such as shifts in algae species. However, these resource responses represent long-term goals that would demonstrate improvements in ecological health of Orange Creek Basin lakes.

**Table 36. . Anticipated Resource Responses, Relative to TMDL Parameters**

| <b>Resource Responses</b>                                            | <b>Lakes<br/>(nutrients)</b> | <b>Creeks<br/>(coliforms)</b> |
|----------------------------------------------------------------------|------------------------------|-------------------------------|
| Changes in the Trophic State Index                                   | <b>X</b>                     |                               |
| Shifts in algae species                                              | <b>X</b>                     |                               |
| Shifts in zooplankton populations                                    | <b>X</b>                     |                               |
| Fewer than 10% exceedances of fecal coliform water quality standards |                              | <b>X</b>                      |

### **6.1.3 MONITORING PROGRAMS**

This section outlines existing monitoring programs in the Basin. Several of these programs will provide significant resources to meet the monitoring strategy objectives outlined in Section 6.1.1. Other programs may contribute to tracking water quality improvements in BMAP waterbodies, but will not be significant. This distinction is outlined in Table 37. These programs are described in more detail below.

**Table 37. Monitoring Programs to Track Water Quality in BMAP Waterbodies**

| <b>Program / Entity</b>            | <b>Primary Resource to Track Progress on Monitoring Objectives</b> | <b>Secondary Resource to Track Progress on Monitoring Objectives</b> |
|------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------|
| DEP – Tier I                       |                                                                    | <b>X</b>                                                             |
| DEP – Tier II                      |                                                                    | <b>X</b>                                                             |
| DEP – Tier III                     |                                                                    | <b>X</b>                                                             |
| SJRWMD                             | <b>X</b>                                                           |                                                                      |
| ACEPD                              | <b>X</b>                                                           |                                                                      |
| GRU (permit compliance monitoring) |                                                                    | <b>X</b>                                                             |
| WAV                                |                                                                    | <b>X</b>                                                             |
| Lakewatch                          |                                                                    | <b>X</b>                                                             |

#### **6.1.3.1 Department of Environmental Protection**

The DEP Integrated Water Resource Monitoring Network (IWRM) Program is composed of three tiers. Tier I monitoring is comprised of status and trend monitoring designed to answer state-wide to regional questions. Tier II monitoring includes basin assessments and monitoring required for TMDL development. This monitoring is more localized in nature than that occurring under Tier I monitoring, yet may encompass a broader area than that employed in Tier III. Tier III includes all monitoring tied to regulatory permits issued by DEP. In general, Tier I will address statewide and regional (within Florida) questions, Tier II will address basin-specific to stream-segment-specific questions, while Tier III will answer site-specific questions.

#### Tier I

Florida has embraced a random sample (probabilistic) based status monitoring network, and a fixed station “trend” or temporal variability monitoring program. The purpose of the Status Monitoring Network is to characterize environmental conditions of Florida’s fresh water resources and to determine how these conditions change over time. The overall statewide sample design provides for the sampling of the entire state within a five–year period. Status Network data are primarily designed to be used for evaluation of statewide water quality conditions present during the period of sampling. Status network sites are randomly assigned statewide. As such, status network sites may or may not fall within the Orange Creek Basin in a given year.

#### Tier II

Fixed network stations are sampled on the basin rotation cycle. As a Group 1 basin, the Orange Creek Basin will be in the first group to be revisited under the 5-year basin rotation cycle. The focus of this sampling is to meet the minimum data requirements to evaluate planning list (i.e. potentially impaired) waterbodies. This sampling program is not intended to track water quality in verified impaired waterbodies.

#### Tier III

Investigating site-specific water quality is a priority for the BMAP. However, for the Department, this type of sampling is a lower priority than Tier I and Tier II sampling. As such, the Department cannot make firm commitments to Tier III sampling in the Orange Creek Basin. This sampling will occur on an as-needed basis if resources are available after the Tier I and Tier II sampling is completed.

#### **6.1.3.2 St. Johns River Water Management District**

The SJRWMD has an extensive surface water quality monitoring program. Monitoring activities in the Orange Creek Basin are managed to achieve multiple goals:

- Analyze the water-quality status and trends for major lakes and streams
- Calibrate and verify water quality models for development of Pollution Load Reduction Goals (PLRGs);
- Design projects to improve water quality and aquatic habitats; and
- Monitor success of projects implemented to improve water quality and aquatic habitats.

To a great extent, these goals overlap with the BMAP monitoring objectives outlined above. From October 1, 2006, through September 30, 2007, SJRWMD will collect monthly field data, water quality and plankton samples at approximately 22 stations in the Orange Creek Basin.

Data generated under the program are uploaded to the U.S. Environmental Protection Agency's (EPA) National Water Quality Data Base (STORET) and used by DEP for Florida's biennial 305(b) report and development of total maximum daily loads. The program provides support for modeling efforts involving surface water quality and produces a biennial districtwide assessment of surface water quality status and trends, sediments, and benthic community health. This program also participates in DEP's IWRM Tier 1 Network.

#### **6.1.3.3 Alachua County Environmental Protection Department**

Alachua County Environmental Protection Department (ACEPD) monitors water quality in selected streams and lakes throughout Alachua County. The current program includes monitoring for nutrients, coliform bacteria and inorganic indicators throughout the Gainesville urban area and in the northern and western portions of the County.

ACEPD has been the primary agency monitoring water quality in the OCB in the Gainesville urban area since 1972. The ACEPD program focuses on the smaller streams and lakes that are not currently monitored by the SJRWMD. These efforts help protect water quality by establishing trends and allow ACEPD to assess problem areas in more detail. These sites are monitored for a number of field and lab parameters including temperature, pH, conductivity, dissolved oxygen, nutrients, inorganic ions, and selected metals. ACEPD, in conjunction with Water and Air Research, Inc. and the Alachua County WAV Program, conducts in-stream biological monitoring to investigate ecosystem health.

Between 1998 and 2004, ACEPD partnered with the SJRWMD and local governments to conduct monthly baseflow sampling and storm event monitoring in the urban creeks and Newnans Lake tributaries. Since that time, ACEPD has continued to focus efforts on Gainesville urban creek water quality. SJRWMD now concentrates their efforts on the large lakes within the OCB (Newnans, Lochloosa and Orange) and the tributaries to Newnans Lake (Hatchet, Little Hatchet and Lake Forest creeks). ACEPD's fecal coliform monitoring program includes Newnans Lake tributaries as well as the Gainesville urban creeks. ACEPD continues to regularly monitor approximately 31 sites in the Hogtown, Sweetwater/Alachua Sink, Tumblin Creek, and Newnans Lake subbasins, as well as targeted monitoring at selected sites on an as-needed basis.<sup>4</sup> All ACEPD's water quality data is uploaded to STORET.

#### **6.1.3.4 Alachua County Health Department**

To date the ACHD has taken 64 surface water samples in these creeks in areas upstream and downstream of the identified systems for fecal coliform using the MPN (SM9221E) standard. 36 additional sampling events are planned and will be reported when completed. The results of this sampling have been reported individually and as the arithmetic mean. See sample results map. Preliminary analysis of the data indicates that the implemented methodology is limited in its usefulness with this particular project. Rainfall events and associated stormwater runoff seem to influence the results.

#### **6.1.3.5 Lakewatch and Water Action Volunteers**

Several volunteer monitoring programs are also in place in the Orange Creek Basin. These include Lakewatch and the Water Action Volunteers.

Florida LAKEWATCH is a volunteer citizen lake monitoring program that facilitates "hands-on" citizen participation in the management of Florida lakes through monthly monitoring activities. Coordinated through the University of Florida's Institute of Food and Agricultural Sciences/Department of Fisheries and Aquatic Sciences, the program has been in existence since 1986. In 1991 the Florida Legislature recognized the importance of the program and established Florida LAKEWATCH in the state statutes (Florida Statute 1004.49). LAKEWATCH is now one of the largest lake monitoring

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<sup>4</sup> The number of sites monitored by the ACEPD depends on water levels in Paynes Prairie and other weather conditions.

programs in the nation with over 1800 trained citizen volunteers monitoring 600+ lakes, in more than 40 counties. Volunteers collect water quality samples for laboratory analyses total nitrogen (TN), total phosphorus (TP) and chlorophyll. The volunteers also measure Secchi depth, a measure of water clarity, in the field. At some locations samples are also obtained for laboratory analyses of pH, total alkalinity, specific conductance, color, chloride and coliform bacteria.

Throughout the OCB many lakes are monitored by Florida LAKEWATCH volunteers. The 2005 LAKEWATCH data report lists the following OCB lakes: Lake Alice, Bivens Arm Lake, Little Orange Lake, Lochloosa Lake, Newnans Lake, Orange Lake and Lake Wauberg. Typically, samples are obtained from three or four stations in the lake to account for water quality variability. Sample collection frequency varies, but many lakes are sampled monthly. Currently, data from Florida LAKEWATCH constitutes the primary data set for Bivens Arm Lake and Lake Wauberg. This program serves a vital function to fill in the gaps remaining between formal monitoring programs. Data from Florida LAKEWATCH will be used to the greatest extent possible. Florida LAKEWATCH data may be obtained at <http://lakewatch.ifas.ufl.edu/>.

The Alachua County Watershed Action Volunteer or WAV program has a participant water quality monitoring component. WAV water quality monitors collect monthly baseline data for dissolved oxygen (DO), alkalinity, chloride, pH and temperature at approximately 10 sites in the OCB. These data are verified by the water management district, and are available on the SJRWMD WAV web database at <http://www.sjrwmd.com/wav/>. In 2007, WAV water quality monitors will begin collecting nutrient and fecal coliform samples quarterly from sites in the Hogtown Creek, Sweetwater Branch and Little Hatchet Creek watershed. This data will supplement water quality data collected by ACEPD. The same certified laboratories used by ACEPD will be used for WAV program water quality monitoring.

WAV participants also assist with stream habitat assessments and collection of benthic macroinvertebrates (BMIs) to determine the overall ecological health of the aquatic system. Between 2000 and 2003 volunteers assisted biologists and environmental scientists with over 30 in-stream ecological assessments. Beginning in late 2007 or early 2008, additional biological assessments are planned for over 20 sites in the Gainesville area creeks.

#### **6.1.3.6 Gainesville Regional Utilities**

Gainesville Regional Utilities (GRU) samples Gainesville's urban creeks as necessary to evaluate the effectiveness of its wastewater collection system integrity programs. Monitoring is not typically on a routine frequency and is typically project related or is a part of a focused study.

#### **6.1.4 Sampling Stations, Parameters, and Frequency**

This section outlines details of the Orange Creek Basin monitoring plan (stations, parameters, frequency, entity, etc.). This plan is designed to meet the objectives discussed above. Additional sampling will be completed by individual entities for other projects, such as Alachua County's 2005 bacteriological monitoring to identify fecal coliform "hot spots." Additional parameters may also need to be collected to address unknowns that were highlighted during TMDL development (e.g. rates of

nutrient cycling). Programs specifically aimed at individual issues or to address unknowns will be implemented outside of this monitoring strategy.

The stations and parameters identified below are the plan. Individual sites / parameters may be added or removed, depending on environmental conditions, resources, and other pertinent factors. Careful consideration will be given before any site or parameter is removed.

#### **6.1.4.1 Water Chemistry and Coliform Data**

Monitoring associated with the above programs will help meet the first primary objective: Identify and track water quality trends in BMAP waterbodies to determine if water quality standards are being achieved.

The extensive sampling programs conducted by SJRWMD and ACEPD will be key to achieving this objective. SJRWMD and ACEPD monitor at approximately ## stations throughout the Orange Creek Basin.

Monitoring locations, parameters, and frequency of sampling for these programs are shown in Table 39 and Figure 60. SJRWMD AND ACEPD monitor these sites regularly as part of their routine monitoring programs. This site list is consistent with the monitoring plans of ACEPD and SJRWMD for calendar year 2007. It will be modified as needed to track changes in ambient water quality and make the best use of limited monitoring resources.

In addition to sites monitored by Alachua County and SJRWMD, WAV and Lakewatch program volunteers routinely monitor at the locations shown in Table 38. Sampling parameter for the WAV sites include nutrients and fecal coliforms. Lakewatch volunteers currently sample for TN, TP, chlorophyll, and Secchi depth. Currently, Lakewatch is the only program that routinely samples Lake Wauberg.

Any station modifications or presence of unusual conditions should be noted in the field notes associated with specific sampling events. Every effort should be made to communicate this information to other stakeholders to support the accuracy of future trend analyses.

A secondary objective of this monitoring strategy is to refine the source identification provided in the initial TMDL document. One way in which this will be achieved is by locating new sampling sites in areas that have a high probability of causing excessive pollutant loads. A high priority for new sampling sites is areas where human fecal contamination has been documented. Confirming these source areas through further investigation is a key step in refining the TMDL source identification. Specific locations for this additional coliform sampling will be identified on an as-needed basis.

**Table 38. Stations Monitored by WAV and Lakewatch Volunteers**

| <b>Sampling Program</b> | <b>Location</b>                                            | <b>Frequency of Water Quality Sampling</b>       |
|-------------------------|------------------------------------------------------------|--------------------------------------------------|
| <b>WAV</b>              | Rosewood SE 3 <sup>rd</sup> Ave.                           | Quarterly                                        |
|                         | LFCSE43                                                    | Quarterly                                        |
|                         | Springstead at NW 39 <sup>th</sup> and 6 <sup>th</sup> St. | Quarterly                                        |
|                         | HogSW2                                                     | Quarterly                                        |
|                         | SWBSE1                                                     | Quarterly                                        |
|                         | Bouleware Springs                                          | Quarterly                                        |
|                         | PosNW39                                                    | Quarterly                                        |
|                         | ElizArbor                                                  | Quarterly                                        |
| <b>Lakewatch</b>        | Lake Alice                                                 | Quarterly                                        |
|                         | Lake Alto                                                  | Monthly                                          |
|                         | Bivens Arm                                                 | Monthly                                          |
|                         | Hidden Lake                                                | January                                          |
|                         | Holden Pond                                                | 6-8 times/year                                   |
|                         | Kingswood                                                  | 2 times/year                                     |
|                         | Little Orange Lake                                         | Monthly                                          |
|                         | Little Santa Fe Lake                                       | Monthly                                          |
|                         | Melrose Bay                                                | Monthly; Annual Vegetation Survey                |
|                         | Lochloosa Lake                                             | Monthly March-November; Annual Vegetation Survey |
|                         | Lake Mize                                                  | 5 times/year                                     |
|                         | Moss Lake                                                  | 5 times/year                                     |
|                         | Newnans Lake                                               | Monthly; Annual Vegetation Survey                |
|                         | Orange Lake                                                | Monthly March – November                         |
|                         | <b>Lake Wauberg</b>                                        | <b>Monthly</b>                                   |

**Table 39. Ambient Water Quality Monitoring Stations in the Orange Creek Basin**

| SUB-BASIN                    | ENTITY | STATION ID | STATION DESCRIPTION                                                         | LAT.     | LONG.     | STATION TYPE | SAMPLING FREQUENCY | YEAR SITE EST. | SAMPLING PARAMETERS *                                                         | WBID               |
|------------------------------|--------|------------|-----------------------------------------------------------------------------|----------|-----------|--------------|--------------------|----------------|-------------------------------------------------------------------------------|--------------------|
| NEWNANS LAKE & HATCHET CREEK | SJRWMD | NEW        | Newnans Lake center                                                         | 29.6453  | -82.22    | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry; Chlorophyll-a; Light attenuation; Plankton | 2705B              |
|                              | SJRWMD | NEWNLN     | Newnans Lake north                                                          | 29.6647  | -82.2197  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry; Chlorophyll-a; Light attenuation; Plankton | 2705B              |
|                              | SJRWMD | LFC329B    | Lake Forest Creek at 329B                                                   | 29.6517  | -82.2511  | Ambient      | Monthly            | 1998           | Field parameters; Water chemistry                                             | 2709               |
|                              | SJRWMD | HAT26      | Hatchet Creek at SR26                                                       | 29.68783 | -82.2063  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                                             | 2688               |
|                              | SJRWMD | LHT26E     | Little Hatchet Creek east                                                   | 29.68805 | -82.22063 | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                                             | 2695               |
|                              | SJRWMD | LHAT26     | Little Hatchet Creek                                                        | 29.67963 | -82.23443 | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                                             | 2695               |
|                              | SJRWMD | LHTNB      | North branch of Little Hatchet Creek, downstream of Airport Industrial Park | 29.69322 | -82.26565 | Ambient      | Monthly            | 1996           | Field parameters; Water chemistry                                             | 2695               |
|                              | SJRWMD | PC20       | Prairie Creek at SR20                                                       | 29.61116 | -82.24824 | Ambient      | Monthly            | 1998           | Field parameters; Water chemistry                                             | 2705A              |
|                              | ACEPD  | LFCNE25    | Upstream of University Ave on NE25th St                                     | 29.62845 | -82.30590 | Ambient      | Quarterly          | 1998           | Fecal coliform; Flow                                                          | 2709               |
|                              | ACEPD  | LFC329B    | Upstream of CR 329B between SR 26 and SE 70th St.                           | 29.65143 | -82.24968 | Ambient      | Quarterly          | 1998           | Fecal coliform; Flow                                                          | Sunland Drain/2885 |
|                              | ACEPD  | HAT225     | West side (downstream) of CR 225.                                           | 29.73537 | -82.27482 | Ambient      | Quarterly          | 1998           | Fecal coliform; Flow                                                          | Hatchet Creek/2688 |
|                              | ACEPD  | HAT26      | North side of SR 26 at bridge.                                              | 29.68783 | -82.20663 | Ambient      | Quarterly          | 1994           | Fecal coliform; Flow                                                          | Hatchet Creek/2688 |

| SUB-BASIN      | ENTITY | STATION ID | STATION DESCRIPTION                                                                 | LAT.     | LONG.     | STATION TYPE | SAMPLING FREQUENCY | YEAR SITE EST. | SAMPLING PARAMETERS *                                                         | WBID                      |
|----------------|--------|------------|-------------------------------------------------------------------------------------|----------|-----------|--------------|--------------------|----------------|-------------------------------------------------------------------------------|---------------------------|
| ORANGE LAKE    | ACEPD  | LHATWALDO  | East of Waldo Rd (SR 24) on Little Hatchet Creek, between NE 47th Ave and 49th Ave. | 29.69827 | -82.27998 | Ambient      | Quarterly          | 1998           | Fecal coliform; Flow                                                          | Little Hatchet Creek/2695 |
|                | ACEPD  | LHAT26     | North side of SR 26 before SR 26 intersects with SR 222 (39th Avenue).              | 29.67963 | -82.23443 | Ambient      | Quarterly          | 1998           | Fecal coliform; Flow                                                          | Newnans Lake Outlet/2705  |
|                | SJRWMD | OLC        | Orange Lake center (between Cow Hammock & Samsons Point)                            | 29.465   | -82.1775  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry; Chlorophyll-a; Light attenuation; Plankton | 2749A                     |
|                | SJRWMD | OLN        | Orange Lake north                                                                   | 29.4867  | -82.2008  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry; Chlorophyll-a; Light attenuation; Plankton | 2749A                     |
|                | SJRWMD | OLSW       | Orange Lake, southwest                                                              | 29.4342  | -82.205   | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry; Chlorophyll-a                              | 2749A                     |
|                | SJRWMD | OC301      | Orange Lake outlet west of US301                                                    | 29.4433  | -82.1086  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                                             | 2749A                     |
|                | SJRWMD | CCN325     | Cross Creek about 50 feet north of CR325 bridge                                     | 29.4911  | -82.1661  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                                             | 2754                      |
|                | SJRWMD | STX346     | River Styx at CR346                                                                 | 29.5172  | -82.2222  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                                             | 2744                      |
|                | SJRWMD | CC234      | Camps Canal at CR234                                                                | 29.57662 | -82.24972 | Ambient      | Monthly            | 2003           | Field parameters; Water chemistry                                             | 2705                      |
|                | SJRWMD | LOL        | Lochloosa Lake center                                                               | 29.52    | -82.1247  | Ambient      | Monthly            | 2003           | Field parameters; Water chemistry; Chlorophyll-a; Light attenuation; Plankton | 2738A                     |
| LOCHLOOSA LAKE | SJRWMD | LOCHLN     | Lochloosa Lake north-center                                                         | 29.5256  | -82.1272  | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry; Chlorophyll-a; Light attenuation; Plankton | 2738A                     |

| SUB-BASIN                 | ENTITY | STATION ID | STATION DESCRIPTION                                                   | LAT.     | LONG.     | STATION TYPE | SAMPLING FREQUENCY | YEAR SITE EST. | SAMPLING PARAMETERS *                             | WBID                   |
|---------------------------|--------|------------|-----------------------------------------------------------------------|----------|-----------|--------------|--------------------|----------------|---------------------------------------------------|------------------------|
| LAKE WAUBERG              | SJRWMD | CELC       | Tributary on north shore of Lake Lochloosa, east of Lochloosa Creek   | 29.5637  | -82.1248  | Ambient      | Monthly            | 2003           | Field parameters; Water chemistry                 | 2728                   |
|                           | SJRWMD | LC1LB      | Lochloosa Creek about 2 miles north of Lochloosa Lake                 | 29.565   | -82.1406  | Ambient      | Monthly            | 2003           | Field parameters; Water chemistry                 | 2693                   |
|                           | SJRWMD | LLS        | Lochloosa Slough                                                      | 29.4823  | -82.1073  | Ambient      | Monthly            | 2003           | Field parameters; Water chemistry                 | 2738A                  |
|                           | SJRWMD | LOCH20     | Lochloosa Creek at SR20                                               | 29.60022 | -82.14468 | Ambient      | Monthly            | 1994           | Field parameters; Water chemistry                 | 2693                   |
|                           | ACEPD  | LWAUBERG   | Center of Lake Wauberg east of US 441.                                | 29.55034 | -82.61136 | Ambient      | Semi-annually      | 2007           | Field; Fecal Coliform; Surface Water; Chlorophyll | Lake Wauberg/2741      |
| SWEETWATER BRANCH HOGTOWN | ACEPD  | HOGNW45    | South side of NW 45th Ave at Hogtown Creek.                           | 29.69558 | -82.34520 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water; Flow        | Hogtown Creek/2698     |
|                           | ACEPD  | HOGNW16    | Ring Park, north of NW 16 <sup>th</sup> Avenue                        | 29.66703 | -82.34863 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water              | Hogtown Creek/2698     |
|                           | ACEPD  | HOG30US    | North side of CR30 (SW 20 <sup>th</sup> Ave) upstream of bridge.      | 29.63839 | -82.39219 | Ambient      | Quarterly          | 1999           | Field; Fecal Coliform; Surface Water              | Hogtown Creek/2698     |
|                           | ACEPD  | HOGSINK    | Hogtown Creek approx. 100 meters upstream of Haile Sink.              | 29.62973 | -82.41117 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water ; Flow       | Haile Sink/2717A       |
|                           | ACEPD  | POSNW16    | South of NW 16th Ave west of NW 27th Terr.                            | 29.66662 | -82.36423 | Ambient      | Quarterly          | 1996           | Field; Fecal Coliform; Surface Water              | Possum Creek/2696      |
|                           | ACEPD  | SWBNE10    | Site is in the median at NE 10th Ave between N Main St NE 2nd Street. | 29.66107 | -82.32348 | Ambient      | Quarterly          | 2002           | Field; Fecal Coliform; Surface Water ; Flow       | Sweetwater Branch/2711 |
|                           | ACEPD  | ROSESE9    | Upstream of SE 9th St between SE 9th Ave and SE 10th Ave.             | 29.64292 | -82.31505 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water ; Flow       | Sweetwater Branch/2711 |

| SUB-BASIN | ENTITY | STATION ID                        | STATION DESCRIPTION                                                                   | LAT.     | LONG.     | STATION TYPE | SAMPLING FREQUENCY | YEAR SITE EST. | SAMPLING PARAMETERS *                                                                  | WBID                       |
|-----------|--------|-----------------------------------|---------------------------------------------------------------------------------------|----------|-----------|--------------|--------------------|----------------|----------------------------------------------------------------------------------------|----------------------------|
| TUMBLIN   | ACEPD  | SWBSE4                            | Site is east of SE4th St between SE 13th Lane and SE 11th Place.                      | 29.63805 | -82.31809 | Ambient      | Quarterly          | 2003           | Field; Fecal Coliform; Surface Water ; Flow                                            | Sweetwater Branch/2711     |
|           | ACEPD  | SWB331                            | West of SR 331 (Williston Rd) just north of SE 16th Ave.                              | 29.63040 | -82.32242 | Ambient      | Quarterly          | 1994           | Field; Fecal Coliform; Surface Water; Chlorophyll (if also sampling on Paynes Prairie) | Sweetwater Branch/2711     |
|           | ACEPD  | SWBALACH**                        | Upstream (at culvert) of the confluence of SWB and Alachua Lake.                      | 29.60319 | -82.30272 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water; Chlorophyll                                      | Alachua Sink Outlet/2720   |
|           | ACEPD  | ALACHLAKE**                       | Lake/marsh upstream of inlet to Alachua Sink.                                         | 29.60261 | -82.30286 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water; Chlorophyll                                      | Alachua Sink Outlet/2720   |
|           | ACEPD  | ALACHSINK**                       | Large water body east of the Primary Sink Feature at Alachua Sink on Payne's Prairie. | 29.60553 | -82.30064 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water; Chlorophyll                                      | Alachua Sink Outlet/2720   |
|           | ACEPD  | ALACHPSF**<br>(during high water) | Primary Sink Feature at Alachua Sink on Payne's Prairie.                              | 29.60650 | -82.30256 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water; Chlorophyll                                      | Alachua Sink Outlet/2720   |
|           | ACEPD  | TUMSW5                            | South of SW 5th Ave between SW 8th St and SW 10th St.                                 | 29.64705 | -82.33366 | Ambient      | Quarterly          | 2001           | Field; Fecal Coliform; Surface Water ; Flow                                            | Tumbling Creek/2718A       |
|           | ACEPD  | TUM441                            | West of SW 13th Street end of concrete channel.                                       | 29.63317 | -82.34058 | Ambient      | Quarterly          | 1998           | Field; Fecal Coliform; Surface Water ; Flow                                            | Tumbling Creek/2718A       |
|           | ACEPD  | BIVARM                            | Center of Bivens Arm Lake west of US 441.                                             | 29.62361 | -82.34389 | Ambient      | Semi-annually      | 1998           | Field; Fecal Coliform; Surface Water; Chlorophyll                                      | Tumbling Creek South/2718C |

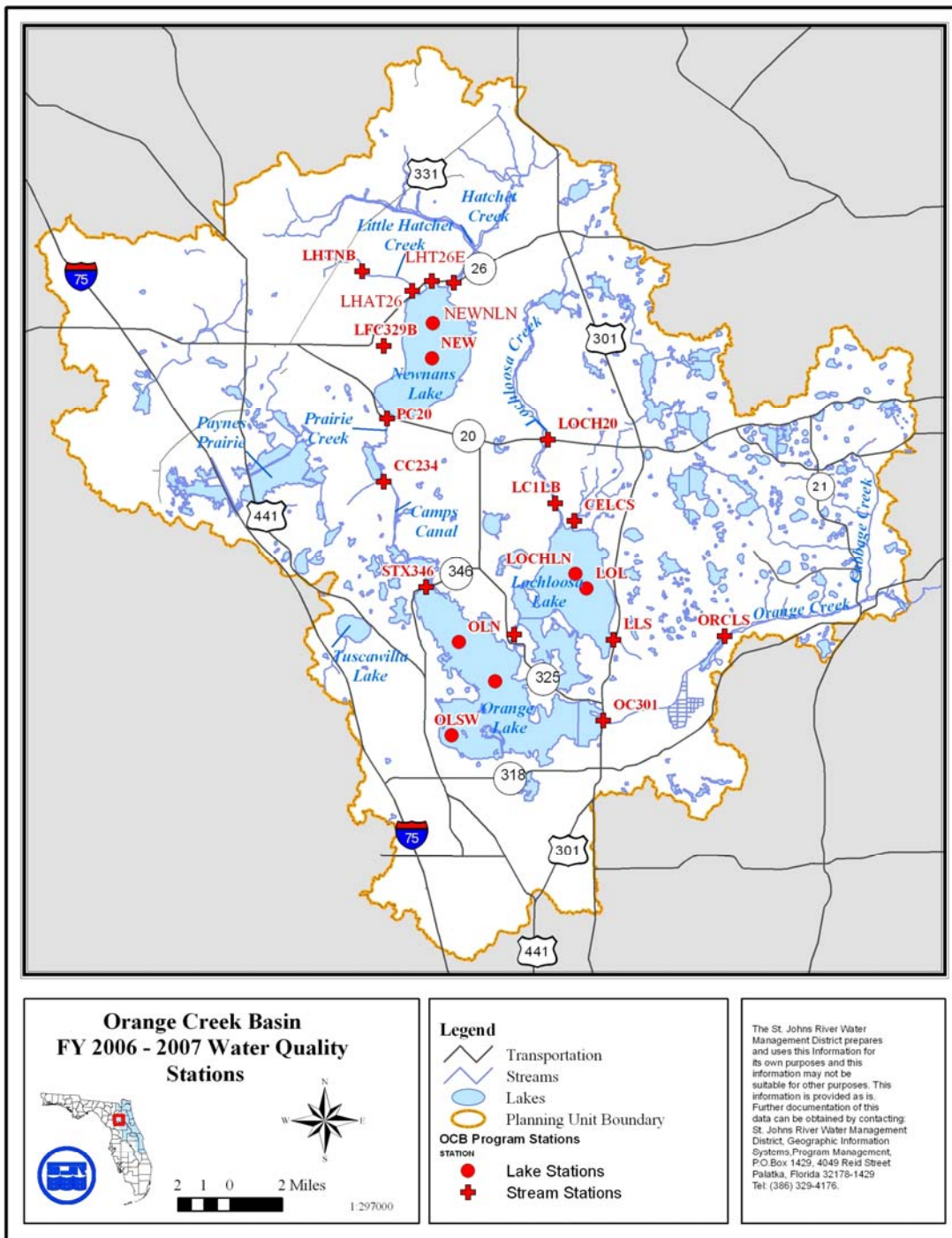
\* **ACEPD Field parameters:** pH, dissolved oxygen, conductivity, turbidity, Secchi depth, depth of collection, depth of water column, air temperature, weather, cloud cover (lakes only), wind speed (lakes only), wind direction (lakes only), water temperature.

\*\* Sampled during low water when the prairie is not flooded. When the prairie is flooded sample ALACHPSF. ACEPD sampling will cease if and when SJRWMD takes over sampling these stations.

**ACEPD Surface Water chemistry:** Full suite Surface Water parameters will be analyzed in the Winter and Summer quarters [Alk, Ca, Mg, K, Fe, TP, field filtered ORP, Cl, color, SO<sub>4</sub>, TSS, TDS, NH<sub>4</sub>, NO<sub>x</sub>, TKN, TN, TOC, Chlorophyll a at SWB331 and ALACH sites on Paynes Prairie]. Partial parameters alternating quarters [(TP, field filtered ORP, NO<sub>x</sub>, TKN, TN, NH<sub>3</sub>, and K.

**SJRWMD Plankton:** zooplankton and phytoplankton (identification, counts, biovolume/biomass)

**Figure 60. SJRWMD 2006-2007 Water Quality Sampling Stations**



Author: godfrey, Source: V:\ocb\all\projects\Water\_Quality\FY0607\mxd\ocb\_fy0607\_stations\_8.5x11\_April06.mxd

#### 6.1.4.2 Flow and Rain Data

Measuring reductions in watershed *loadings* of TMDL target pollutants is another secondary objective of this strategy. To achieve this, flow data is needed in conjunction with the above water quality parameters. SJRWMD's Hydrologic Data Services section monitors water levels

and flows throughout the District, including the Orange Creek Basin. They gather continuous level data for the three large lakes and flow data for the larger tributaries that discharge into these lakes. Table 40 and Figure 61 identify the locations of discharge and water level monitoring stations maintained by SJRWMD and ACEPD.

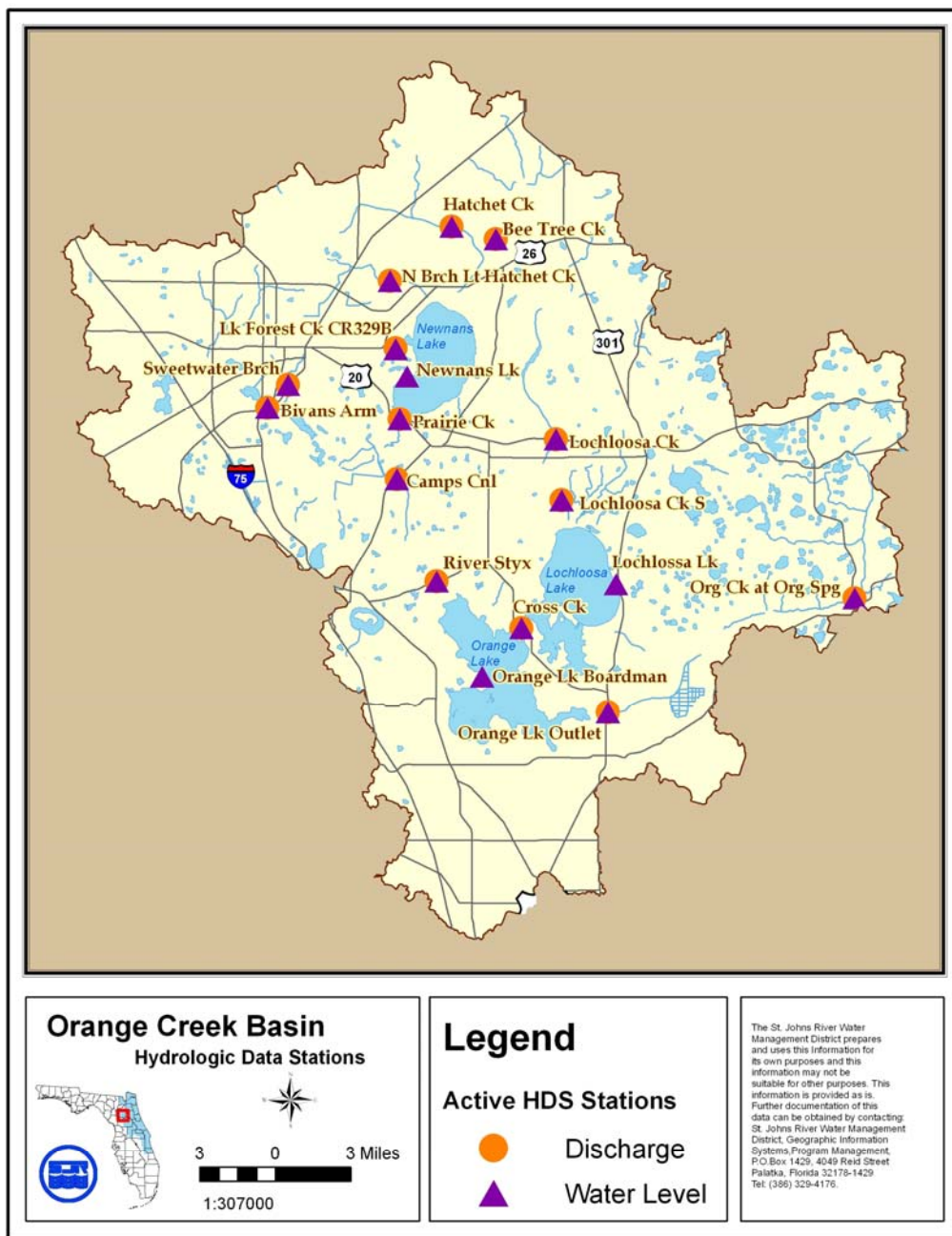
Two rain gauges are regularly monitored in the basin: Kelly Generating Station (GRU) and Gainesville Regional Airport (SJRWMD). In addition to these stations, NEXRAD radar data is also available to track rainfall amounts. NEXRAD data is compiled in 15-minute time increments and is available basin-wide. This data set may be the most reliable for use in future trend analyses.

Table 40. Discharge and Water Level Monitoring Stations in the Orange Creek Basin

| SUB-BASIN      | ENTITY | STATION ID | STATION DESCRIPTION               | LATITUDE   | LONGITUDE    | STATION TYPE | FREQUENCY | WBID |
|----------------|--------|------------|-----------------------------------|------------|--------------|--------------|-----------|------|
| SWEETWATER     | SJRWMD |            | Sweetwater Branch                 | 29.63021   | -82.32223    | Discharge    |           |      |
|                | SJRWMD |            | Bivens Arm                        | 29.61658   | -82.33581    | Discharge    |           |      |
| Newnans Lake   | SJRWMD |            | Bee Tree Creek                    | 29.716     | -82.18561    | Discharge    |           |      |
|                | SJRWMD |            | Lake Forest Creek CR329B          | 29.65194   | -82.25139    | Discharge    |           |      |
|                | SJRWMD |            | North Branch Little Hatchet Creek | 29.69078   | -82.25568    | Discharge    |           |      |
|                | SJRWMD |            | Prairie Creek                     | 29.61094   | -82.24815    | Discharge    |           |      |
|                | SJRWMD |            | Newnans Lake                      | 29.63584   | -82.24365    | Water Level  |           |      |
| Orange Lake    | SJRWMD |            | Camps Canal                       | 29.5763    | -82.24944    | Discharge    |           |      |
|                | SJRWMD |            | Orange Lake Outlet                | 29.44178   | -82.10851    | Discharge    |           |      |
|                | SJRWMD |            | Cross Creek                       | 29.4852778 | -82.16527778 | Discharge    |           |      |
|                | SJRWMD |            | River Styx                        | 29.5171083 | -82.2225472  | Discharge    |           |      |
|                | SJRWMD |            | Orange Lake Boardman              | 29.46198   | -82.19181    | Water Level  |           |      |
| Lake Lochloosa | SJRWMD |            | Lochloosa Creek                   | 29.60022   | -82.14468    | Discharge    |           |      |
|                | SJRWMD |            | Loochloosa Creek South            | 29.565     | -82.14056    | Discharge    |           |      |

| SUB-BASIN | ENTITY | STATION ID | STATION DESCRIPTION | LATITUDE | LONGITUDE | STATION TYPE | FREQUENCY | WBID |
|-----------|--------|------------|---------------------|----------|-----------|--------------|-----------|------|
|           | SJRWMD |            | Lochlossa Lake      | 29.51639 | -82.10389 | Water Level  |           |      |
| Hatchet   | SJRWMD |            | Hatchet Creek       | 29.72292 | -82.21499 | Discharge    |           |      |

**Figure 61. SJRWMD Discharge and Water Level Sampling Stations**



#### 6.1.4.3 Environmental Condition Data

Appropriate interpretation of water quality data depends on an understanding of the conditions under which the samples were taken. Conditions such as extreme weather events can significantly affect the utility of a particular sample to represent ambient conditions. **Table 41** outlines specific types of environmental condition data that should be considered when water quality data analyses are conducted in the Orange Creek Basin. Collection and use of environmental condition data will provide justification for the use or elimination of unusual water quality datapoints.

**TABLE 41 . ENVIRONMENTAL CONDITION DATA FOR THE ORANGE CREEK BASIN**

| DATA TYPE                              | DESCRIPTION/<br>EXAMPLE                                                                                                                                                 |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extreme Weather Events                 | Hurricanes, Droughts                                                                                                                                                    |
| Aquatic Plant Management Activities    | 2003: 400 acres of willow treated by aerial herbicide (FWCC)<br><br>Lakewatch annual vegetation surveys on Lochloosa and Newnans lake will contribute to this data set. |
| Changes in Consumptive Use             | Significant changes in consumptive use could increase the demand for reclaimed water                                                                                    |
| Storm Event Samples                    | Samples taken during or shortly after storm events are not considered representative of ambient conditions. This data is identified as storm event data by ACEPD.       |
| Significant Land Use Changes           | Permitting of large recreational vehicle park in McIntosh                                                                                                               |
| Locations of Significant Bird Colonies | Large cattle egret colony on southwest shore of Lake Wauberg                                                                                                            |

#### **6.1.4.4 Performance-Based Monitoring**

Measuring the effectiveness of specific BMPs in reducing target pollutant loads is the second primary objective of this monitoring strategy. As part of the BMAP implementation and follow-up process, BWG members will identify opportunities for BMP-specific monitoring. This will involve individual entities monitoring the impacts of one of the BMPs included in their management actions identified in the BMAP. Although this might not be feasible for every BMAP partner, even a few monitoring efforts would provide important data on the effectiveness of individual BMPs. Performance-based monitoring will occur on an as-needed basis as resources allow, as determined by the project sponsor. The data collected through this type of targeted monitoring will be used during BMAP evaluations to analyze the effectiveness of specific BMPs and adjust the implementation strategy, as appropriate. All performance-based monitoring that involves collection of water quality samples will be collected in accordance with the DEP SOPs for water quality sampling and analysis.

#### **6.1.4.5 Ability of Monitoring Network to Meet Strategy Objectives**

The monitoring network outlined in this strategy includes stations at the primary tributaries, outlets, and regions of the three large BMAP lakes: Newnans, Orange, and Lochloosa (see Table 39). A number of stations are also located on the urban tributaries (see Table 39). These sampling efforts are conducted primarily by Alachua County and SJRWMD. In addition, Lakewatch volunteers sample Lake Wauberg on a monthly basis. Given the parameters noted in Tables 28 and 39 and the monthly sampling frequency, this station network is considered sufficient for the purposes of future water quality trend analyses.

Regarding calculation of trends in pollutant loading, the current network of water quality and flow stations will provide sufficient data to calculate pollutant loading trends on a monthly basis. When trend analyses are being conducted in the future, stakeholders and staff will determine which stations are best suited to represent long-term trends.

This includes consideration of the station locations, sampling frequency, and station tenure. Future BMAP trend analyses will focus on stations with previous years of record. This will provide additional context and statistical confidence in apparent water quality trends.

As mentioned in Subsection 6.2.4.4, stakeholders may also choose to conduct performance-based monitoring for specific projects. Given the short duration of such sampling, it is unlikely that performance-based monitoring will contribute to the calculation of long-term water quality trends. However, this data will inform help individual stakeholders demonstrate the success of specific projects through the collection of flow and water quality data before and after project completion. This type of information is vital to the evaluation of past and selection of future BMPs in the watershed.

#### **6.1.5 QUALITY ASSURANCE (QA)/QUALITY CONTROL (QC) MECHANISMS**

Collection of both ambient and performance-based water quality data will be conducted in a manner consistent with DEP's Standard Operating Procedures (SOPs) for quality assurance / quality control. The most current version of these procedures can be downloaded from [www.dep.state.fl.us/labs/qa/sops.htm](http://www.dep.state.fl.us/labs/qa/sops.htm). All stakeholders contributing data in support of the BMAP agree to follow these SOPs. Table 42 lists the primary labs used by each entity, with their NELAC certification number. Entities are free to use other labs for BMAP-related data analyses, provided that they meet the certification and other requirements outlined in the SOPs. Other labs may also be used for analyses that are not covered under the NELAC program (e.g. advanced DNA analyses).

SJRWMD staff and contractors collect, process, and preserve samples according to the St. John's River Water Management District's "*Standard Operating Procedures for the Collection of Surface Water Quality Samples and Field Data – Feb. 13, 2004*" as well as the DEP's SOPs. Where the District and DEP SOP's do not correspond to one another, SJRWMD staff and contractors defer to the DEP SOPs. Sampling completed by ACEPD is also consistent with SOPs set by the DEP. Through cooperation on TMDL-related data collection, SJRWMD, ACEPD, and DEP have consistently used similar SOPs for field sampling and lab analyses. This consistency will continue into the future to ensure that data can be used not only for tracking BMAP progress, but also for future TMDL evaluations, and other purposes.

**Table 42 . Laboratories and NELAC Certification Numbers**

| ENTITY                              | LABORATORY                                                                                                                                         |
|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Alachua County<br>EPD and WAV       | Advanced Environmental Laboratories, Inc (formerly<br>PPB)<br>6815 SW Archer Road<br>Gainesville, FL 32608                                         |
|                                     | ABC Research Corp.3437<br>SW 24th Ave<br>Gainesville, FL 32607                                                                                     |
|                                     | Severn Trent Laboratories, Inc.<br>2846 Industrial Plaza Drive<br>Tallahassee, FL 3230                                                             |
| Alachua County<br>Health Department | Florida Department of Health Bureau of Laboratories<br>1217 Pearl Street<br>Jacksonville, FL 32202                                                 |
| SJRWMD                              | Water Chemistry<br>SJRWMD<br>4049 Reid St.<br>Palatka, FL 32178<br>NELAC Cert. #: E42206                                                           |
|                                     | Phytoplankton<br>Department of Fisheries and Aquatic Sciences<br>University of Florida<br>7922 NW 71 <sup>st</sup> Street<br>Gainesville, FL 32653 |
|                                     | Zooplankton<br>Bowling Green State University<br>312 Life Sciences Building<br>College Street<br>Bowling Green, OH 43403                           |
| DEP                                 | Florida Department of Environmental Protection<br>2600 Blair Stone Rd.<br>Tallahassee, FL 32399<br>NELAC Cert; #: <a href="#">E31780</a>           |

### **6.1.6 DATA MANAGEMENT MECHANISMS FOR DATA STORAGE AND RETRIEVAL**

#### **6.1.6.1 Water Quality Data**

Data collected through the above activities will need to be tracked, compiled, and analyzed in order for it to be useful in support of the BMAP. The Florida STORET database will serve as the primary resource for storing data and providing access for all stakeholders. SJRWMD,

ACEPD, and DEP currently store water quality data in the Florida STORET database. Stakeholders have agreed to upload data to STORET in a timely manner, after the appropriate quality assurance / quality control (QA/QC) checks have been completed. All applicable data will be uploaded to STORET regularly, at least every six months.

STORET uploads are only appropriate for data that is representative of ambient conditions. Performance-based data collected as part of a localized source identification project, BMP investigation, or similar activity is not representative of ambient water quality conditions. This data will not be uploaded into the STORET database. Similarly, it is inappropriate to store contextual data (discussed above) in STORET. Performance-based and contextual data will be maintained by the appropriate entity. Stakeholders agree to provide this data to other BMAP partners upon request and when appropriate for inclusion in BMAP data analyses and adaptive management evaluations.

Currently, volunteer monitoring data (WAV and Lakewatch) are not uploaded to STORET. WAV data is available from the SJRWMD Water Action Volunteers Water Quality Sampling Database: <http://www.sjrwmd.com/wav/>. Florida LAKEWATCH data may be obtained at <http://lakewatch.ifas.ufl.edu/>.

#### **6.1.6.2 Flow and Discharge Data**

ACEPD currently uploads flow data into the STORET database. SJRWMD flow data is available on the District website: <http://sjr.state.fl.us/programs/data.html>.

### **6.1.7 DATA ANALYSIS AND REPORTING**

The entities responsible for water quality monitoring in the basin will meet periodically to review the water quality data and evaluate the monitoring strategy's effectiveness. These meetings will be held concurrent with the annual BMAP reporting meetings. Data analyses will be conducted prior to each annual BMAP status meeting. The purpose of these analyses is to identify trends in improving water quality conditions and identify the benefits of specific projects (i.e. performance-based monitoring). A wide variety of statistical methods are available for trend analyses. Selection of an appropriate data analysis method is highly dependent on the frequency, spatial distribution, and period of record available from existing data. The BWG will use commonly accepted methods of data analysis that are appropriate for the period of record available for each BMAP waterbody.

For nutrients in Orange Creek Basin lakes, data analysis will focus on changes in TSI. Ideally, a Mann's one-sided, upper-tail test for trends will be used (Nonparametric Statistical Methods by M. Hollander and D. Wolfe (1999 ed.), pages 376 and 724) with a 95% confidence level. This test is consistent with TSI analysis methods outlined in the Impaired Waters Rule. Consistency in data analysis methods will facilitate comparison to delisting criteria. Additional data analyses may be conducted, as appropriate.

For coliforms in urban creeks, data analysis will focus on the number of exceedances (value greater than 800 mpn) at each sampling location. This is also consistent with provisions of the Impaired Waters Rule.

The party responsible for conducting these analyses remains to be determined.

In addition to the annual reporting meetings, DEP will update the Ocklawaha Basin Assessment Report Update (second cycle) by early 2009. Update of the assessment report will involve a

significant effort to compile and evaluate data collected under this monitoring strategy and related efforts.

#### **6.1.8 MONITORING STRATEGY FUNDING**

The monitoring strategy outlined above will involve significant investment of resources by involved stakeholders, primarily Alachua County, SJRWMD, and the GCWP. All stakeholders understand that resources are limited and extenuating circumstances can arise (e.g. extreme weather events).

SJRWMD will fund the sampling program outlined in this strategy through their annual budget. ACEPD will fund their water quality and flow monitoring through their general fund. GCWP funds will not be used for this sampling. ACEPD may use GCWP funds for special projects and to address citizen complaints.

### **6.2 TRACKING PROJECT IMPLEMENTATION**

The Florida Watershed Restoration Act requires progress in achieving BMAP milestones be conducted every 5 years and the plan revised, as appropriate, in cooperation with basin stakeholders. Revised BMAPs are to be adopted by secretarial order.

The BWG has agreed to meet regularly after the adoption of the BMAP in order to follow up on plan implementation, share new information, and continue to coordinate on TMDL-related issues. Implementation tracking measures developed by the BWG are described in this section

The BWG's priorities for tracking project implementation are as follows:

- All BMAP-related tracking measures are coordinated with existing reporting (e.g. DMRs, NPDES MS4 annual reports, etc.) to the greatest extent possible to eliminate duplication.
- BMAP tracking and reporting measures will effectively communicate the range and extent of BMAP project implementation to BWG members and other interested parties. Project information will be reported at a level of detail sufficient to meet this goal.
- BWG members will complete the form shown in Table 43 by the end of each calendar year. These forms will be submitted to DEP, who will then arrange a meeting to allow all BWG members to review the information provided.
- Information gathered through project tracking will be used to guide future efforts, consistent with principles of adaptive management.
- Only information relevant to the BMAP will be included in this reporting process. NPDES permit requirements not applicable to the BMAP will not be reported as part of BMAP project tracking.

### **6.3 ADAPTIVE MANAGEMENT**

Adaptive management involves setting up a mechanism for making course corrections in the BMAP when circumstances change or feedback mechanisms indicate a more effective strategy is needed. Adaptive management measures include:

- Procedures to determine whether additional cooperative actions are needed.

- Criteria/process for determining whether and when plan components need to be revised due to changes in costs, environmental impacts, social effects, watershed conditions, or other factors.
- Descriptions of what the role of the BMAP development group and/or individual will be subsequent to BMAP completion.

Tracking implementation, monitoring water quality and pollutant loads, and periodic BWG meetings to share information and expertise are key components of adaptive management. The information the BWG receives from implementation tracking and water quality monitoring will help the group decide what changes to the BMAP are needed to ensure the TMDLs for the basin are achieved. The BWG's most immediate task is to evaluate what additional efforts are necessary to meet the TMDLs in the waterbodies that are projected to fall short under the current BMAP.

The BWG will meet annually each January to review project status and water quality conditions in the BMAP waterbodies. At this time, available information will be used to evaluate projects and monitoring for the upcoming year. Modifications from the original BMAP may occur at that time, if conditions warrant. By October of each year, DEP will populate an annual implementation report such as that shown in Table 43 and will distribute such to stakeholders for their review. This information and water quality trend analysis will form the basis of each annual review meeting.

**TABLE 43 DRAFT BMAP ANNUAL REPORTING FORMAT**

***Orange Creek Basin Management Action Plan Year \_\_\_\_ Annual Implementation Report***

**REPORTING ENTITY:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

| <b>BMAP Project #</b> | <b>WBID / Waterbody</b> | <b>Related to NPDES Permit</b> | <b>Project Partners</b> | <b>Brief Description</b> | <b>Projected Start/End Dates</b> | <b>Project/Activity Status</b> | <b>Project Results</b> | <b>Comments</b> |
|-----------------------|-------------------------|--------------------------------|-------------------------|--------------------------|----------------------------------|--------------------------------|------------------------|-----------------|
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |
|                       |                         |                                |                         |                          |                                  |                                |                        |                 |

**Field Descriptions**

- **BMAP Project #:** This field will be populated by DEP with the project numbers from the BMAP project spreadsheets prior to annual form distribution. This includes projects and other management actions. New projects/activities that are not included in the BMAP can be identified on this form as well.
- **WBID/Waterbody:** This field will be populated by DEP prior to annual form distribution.
- **Related to NPDES Permit:** This field will be populated with the applicable permit number by DEP prior to annual form distribution, consistent with project and permit links identified in the BMAP.
- **Project Partners:** This field will be populated by DEP prior to annual form distribution.
- **Brief Description:** Include a brief description of the management action being reported (e.g., street sweeping - 5 miles each month).
- **Projected Start/End Dates:** If applicable, include the start and end dates for the management action. If not applicable, put "N/A" or, if it is a continuous activity, put "Continuous" and indicate how often the activity takes place (e.g., for street sweeping).
- **Project/Activity Status:** Give a clear summary of the status of the management action, in a way that makes sense for the item listed. For instance, for educational activities, list pertinent publications, events, etc., including name and/or topic for each. Include specific or general timeframes (e.g., 2 public workshops on lawn fertilizer in March 2007). Also, describe any significant changes to the management action that have taken place.
- **Project Results:** If monitoring is required as part of a management action (e.g., in a cost-share situation), or is conducted voluntarily (e.g., as part of an effort to collect BMAP effectiveness information) include the monitoring results to date, as practicable. For projects with quantifiable load reductions, these values can be reported here.

- Comments: Include comments on any implementation obstacles, including weather, funding, technical difficulties, etc. Identify needs for assistance from the BWG as a whole, or from individual entities represented on the BWG. Include any other comments you consider important.

## CHAPTER 7: PUBLIC EDUCATION AND OUTREACH

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Public education and outreach are important elements of any plan to restore water quality to the streams and lakes within the Orange Creek Basin. A wide variety of public education/outreach activities are currently implemented in this basin, many of them related to requirements for MS4 permits. The purpose of this chapter is outlined as follows:

- Provide a summary of current public education/outreach activities used by local governments, water management districts, silviculture industry, utilities, and nongovernmental organizations.
- Identify key issues related to implementation of TMDLs.
- Identify target audiences
- Identify opportunities (gaps within existing programs) for creating or modifying programs to address TMDL specific issues.

### 7.1 KEY PUBLIC EDUCATION ISSUES

What are the important issues in this basin? Reduction in nutrients introduced into waterbodies from homeowner activities. Managing animal waste. Better management of on-site disposal of human waste. Table 44 summarizes issues addressed by organizations in the basin.

<SHOULD THAT TABLE LIST ONLY PUBLIC OUTREACH CAMPAIGNS/PROGRAMS OR SHOULD IT CONSIDER THAT EVERY BROCHURE PRINTED ON A TOPIC IS EQUIVALENT TO THE PUBLIC OUTREACH CAMPAIGNS AND PUT AN "X" IN THE TABLE?>

### 7.2 TARGET AUDIENCES

<WHO IS THE AUDIENCE? WATERFRONT RESIDENTS? PET OWNERS? PEOPLE WHO RECREATE ON IMPAIRED WATERBODIES? OTHER USER GROUPS?>

### 7.3 SUMMARY OF CURRENT ACTIVITIES

Local governments are engaged in public education and outreach activities as a requirement of their MS4 permits.

#### 7.3.1 Alachua County

The ACHD regularly makes presentations on the function, performance, and maintenance of Onsite Sewage Treatment and Disposal System's, OSTDS, at the University of Florida, EPAC, and APHA.

The ACHD also makes presentations at various community meetings throughout the County when OSTDS are of concern.

The ACHD is continuously educating citizens on the function, performance, and maintenance of OSTDS verbally while onsite during the permitting process and through a variety brochure's we include with permits or are available at our office. These include the following: "Septic Tank Systems", "Tips for a Safer Septic System", "Homebuyer's Guide to Septic Systems", "Commercial Wastewater Onsite Systems, and "Onsite Sewage Research Program" all published by the Florida Department of Health and "The Magic Box" published by the Florida Septic Tank Association, Inc.

<INSERT DISCUSSION ABOUT NON-PERMIT EDUCATION AND OUTREACH PROGRAMS>

<OPTIONS: CHAPTER 3 ADDRESSES BROAD BASED MANAGEMENT ACTIONS. THERE IS TEXT IN CHAPTER 3 THAT DESCRIBES SOME PUBLIC EDUCATION ACTIVITIES, BUT IT DOES NOT COVER ALL ORGANIZATIONS. SHOULD WE

- A. ADD TEXT TO CHAPTER 3 AS NECESSARY AND REFERENCE THAT TEXT FOR THIS DISCUSSION?
- B. USE CHAPTER 3 TO PROVIDE A BROAD OVERVIEW OF PROGRAMS AND USE CHAPTER 7 TO PROVIDE DETAILS ABOUT PUBLIC EDUCATION ACTIVITIES. THIS ALLOWS FOR NON-GOVERNMENT INFORMATION TO BE INCLUDED IN A MORE INTEGRATED MANNER.
- C. MOVE THE DETAILED INFORMATION ABOUT EACH PUBLIC EDUCATION PROGRAM TO AN APPENDIX.>

#### **7.4 OPPORTUNITIES FOR PUBLIC EDUCATION AND OUTREACH**

<WHAT ARE THE GAPS IN CURRENT PROGRAMS? WHAT TYPES OF PROGRAMS ARE NEEDED TO ADDRESS TMDLS?>

#### **7.5 RECOMMENDED ACTIONS**

<IDENTIFY NEXT STEPS, POSSIBLE SUITE OF ACTIONS>

Table 44 Public Education Organizations and Issues in the Orange Creek Basin

| Issue                                               | Organization |                     |                  |                                      |               |                       |     |                           |                             |                             |
|-----------------------------------------------------|--------------|---------------------|------------------|--------------------------------------|---------------|-----------------------|-----|---------------------------|-----------------------------|-----------------------------|
|                                                     | ACEPD        | City of Gainesville | Current Problems | IFAS-Florida Yards and Neighborhoods | Marion County | University of Florida | GRU | Florida Forestry Industry | Alachua County Health Dept. | Watershed Action Volunteers |
| Erosion and sediment control                        | X            | X                   |                  |                                      | X             | X                     |     |                           |                             |                             |
| Proper lawn fertilization                           | X            | X                   | X                | X                                    |               |                       |     |                           |                             |                             |
| Proper septic tank system operation and maintenance |              |                     |                  |                                      | X             |                       |     |                           | X                           |                             |

|                                                               |          |          |          |          |          |          |  |          |  |          |
|---------------------------------------------------------------|----------|----------|----------|----------|----------|----------|--|----------|--|----------|
| <b>Increased use of advanced OSTDS for nutrient reduction</b> | <b>X</b> |          |          |          |          |          |  |          |  |          |
| <b>Management of animal waste</b>                             | <b>X</b> | <b>X</b> |          |          | <b>X</b> |          |  |          |  |          |
| <b>Shoreline restoration/protection</b>                       | <b>X</b> |          | <b>X</b> | <b>X</b> |          |          |  |          |  | <b>X</b> |
| <b>Low impact landscape design and management</b>             |          |          | <b>X</b> | <b>X</b> |          | <b>X</b> |  |          |  |          |
| <b>Minimizing stormwater impact</b>                           | <b>X</b> | <b>X</b> | <b>X</b> | <b>X</b> | <b>X</b> |          |  | <b>X</b> |  | <b>X</b> |

## **CHAPTER 8: PLAN IMPLEMENTATION: FUNDING AND COMMITMENT**

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This chapter outlines the commitments that stakeholders have made to implement the provisions outlined in this BMAP. These commitments take the form of financial resources and political support. Financial resources are discussed in Section 8.1. Political support is identified through the adoption of resolutions and development of commitment letters discussed in Section 8.2. The financial and political commitments alike represent a significant investment in the future health of the BMAP waterbodies.

### ***8.1 BMAP Funding Sources***

In many cases, funds from various sources are combined to implement joint projects that achieve water quality improvements. Table 45 presents a summary of key project funding sources. These include local and regional ad valorem funds, county stormwater assessment fees, land acquisition funds, state agency funds, SJRWMD cost-share grants, NOAA grants, EPA grants, and others. Funding sources come with specific requirements and are often limited; therefore, it is important that information on new or unknown potential funding sources be accessible and shared.

Implementation of the BMAP will rely on a mix of funding sources. At the same time, voluntary efforts of individuals and groups will also play a role. The Orange Creek BWG recognizes that management actions are contingent on securing necessary funding, resources, and legislative authorizations, where required, and are subject to applicable regulations. However, signatories to this BMAP have committed to putting forward their best faith efforts to implement the actions outlined in this plan, as shown through the commitment language at the end of this chapter.

Table 45. Key Funding Sources for Orange Creek BMAP Projects

| Program                                         | Sponsor | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | For More Information                                                                       | Orange Creek Basin Project Examples                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>STATE FUNDING SOURCES</b>                    |         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                            |                                                                                                                                                                                                                                                                                                                          |
| Section 319                                     | FL DEP  | <ul style="list-style-type: none"> <li>• Priority is given to projects or programs in impaired waters, TMDL waterbodies, SWIM watersheds, National Estuary Program waters, and watersheds with a comprehensive watershed plan as defined by EPA. This BMAP contains the nine elements required by EPA to qualify as a comprehensive watershed plan (see Table 46).</li> <li>• 40% nonfederal match required</li> <li>• Eligible projects include urban/ag BMPs, stormwater retrofits, public education, demonstration and evaluation of BMPs, ground water protection from nonpoint sources, public education programs, and other projects that help reduce nonpoint pollution</li> <li>• Eligible entities include state and local governments, colleges and universities, nonprofit organizations, public utilities, and Water Management Districts</li> <li>• Project proposals due each May</li> <li>• Project partnerships are strongly encouraged</li> </ul> | <a href="http://www.dep.state.fl.us/water/nonpoint">www.dep.state.fl.us/water/nonpoint</a> | <ul style="list-style-type: none"> <li>• NW 14<sup>th</sup> Avenue Stormwater Park</li> <li>• Rosewood Creek Trash Trap</li> <li>• Community Based Social Marketing Workshop (costs shared with local governments)</li> </ul>                                                                                            |
| Surface Water Improvement and Management (SWIM) | SJRWMD  | <ul style="list-style-type: none"> <li>• Focused on designated SWIM waterbodies (including Newnans, Orange and Lochloosa Lakes)</li> <li>• Supports a variety of water projects</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <a href="http://www.sjrwmd.com">www.sjrwmd.com</a>                                         | The primary SWIM project is development of Pollutant Load Reduction Goals (PLRGs) for Newnans, Orange, and Lochloosa Lakes. PLRGs are science-based estimates of nutrient (N and/or P) external load reductions needed to restore the lakes to state water quality standards. PLRGs assist FDEP in development of TMDLs. |

|                                                        |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                             |  |
|--------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Community Budget Issue Request (Water Project Funding) | SJRWMD & DEP | <ul style="list-style-type: none"> <li>• Funding provided from the legislature through the State budgeting process for stormwater, wastewater, and lake/river restoration projects</li> <li>• Focused on implementing SWIM or other water quality improvement plans</li> <li>• 50% local match required (may include funds from a WMD)</li> <li>• Solicitations occur in December-January for the following fiscal year</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Geof Mansfield<br>DEP Division of Water Resource Management<br>(850) 245-8339<br>Geoffrey.Mansfield@dep.state.fl.us                                                                                                                                         |  |
| TMDL Water Quality Restoration Grants Section          | DEP          | <ul style="list-style-type: none"> <li>• Focused on reducing pollutants to impaired waters</li> <li>• Projects will be selected based on reduction of pollutant loading, amount of anticipated load reduction, cost per pound, amount of matching funds, and presence of a dedicated funding source such as a stormwater utility.</li> <li>• Most projects will require storm event monitoring</li> <li>• \$17M available annually to address water quality impacts to nonagricultural nonpoint sources. In addition, DEP receives about \$8 million per year from Documentary Stamp Tax fees for TMDL water quality restoration grants, which can be used for urban nonpoint source research or stormwater retrofit projects.</li> <li>• 50% local match is required. Land acquisition, design, and permitting costs are eligible as matching.</li> <li>• Because the grants must be used within 3 years, they primarily are targeted to projects that are ready for construction in the next 6 to 10 months. Land acquisition, design, and permitting should be complete or nearing completion. While DEP will not fund these preliminary project elements, funds spent on these elements may be counted as local matching funds.</li> <li>• Applications continually accepted</li> </ul> | <a href="http://www.dep.state.fl.us/water/watersheds/tmdl_grant.htm">http://www.dep.state.fl.us/water/watersheds/tmdl_grant.htm</a><br><br>or<br><br>Eric Livingston<br>Bureau of Watershed Management<br>(850) 245-8430<br>Eric.Livingston@dep.state.fl.us |  |
| Clean Water State Revolving Fund (SRF)                 | DEP          | <ul style="list-style-type: none"> <li>• Low interest loans for point and nonpoint pollution control activities and facilities, including wastewater management, reclaimed water, stormwater management, and ag BMPs</li> <li>• Eligible project include wastewater management facilities, reclaimed wastewater reuse facilities, stormwater management facilities, BMPs associated with agricultural</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <a href="http://www.dep.state.fl.us/water/wff/cwsrf/index.htm">http://www.dep.state.fl.us/water/wff/cwsrf/index.htm</a><br><br>or                                                                                                                           |  |

|                                                      |        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                    |                                                                                  |
|------------------------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
|                                                      |        | <p>stormwater, and estuary protection activities and facilities.</p> <ul style="list-style-type: none"> <li>• Eligible parties include local governments (stormwater and wastewater projects) and non-governmental parties (ag BMPs)</li> <li>• Loan requests are accepted throughout the year.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>Bob Holmden<br/>State Revolving Loan Program<br/>Bureau of Water Facilities Funding<br/>(850) 245-8358<br/>robert.holmden@dep.state.fl.us</p>                                                                                                                   |                                                                                  |
| Cooperative Cost-sharing Program                     | SJRWMD | <ul style="list-style-type: none"> <li>• Focused on stormwater management efforts that contribute to achievement of PLRGs or TMDLs</li> <li>• Supports local government stormwater projects</li> <li>• Eligible parties include local governments, special districts, and other public entities. Private utilities and non-profit organizations may receive funds when partnering with an eligible party.</li> <li>• Applications accepted May-August.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                       | <p><a href="http://www.sjrwmd.com/programs/cost_share.html">http://www.sjrwmd.com/programs/cost_share.html</a></p> <p>or</p> <p>St. Johns River Water Management District<br/>4049 Reid Street, PO Box 1429<br/>Palatka, Florida 32178-1429<br/>(386) 329-4553</p> | Hogtown Creek Fluvial Geomorphologic Assessment and Preliminary Restoration Plan |
| Water Projects Grant Program (Section 403.885, F.S.) | FL DEP | <ul style="list-style-type: none"> <li>• Focused on water quality improvement, stormwater management, wastewater management, water restoration and other water quality projects as specifically appropriated by the Legislature.</li> <li>• Projects must protect public health of the environment and implement plans developed pursuant to the SWIM Act or other water restoration plans</li> <li>• Eligible parties include local governments, and special districts with legal responsibilities for water quality improvement, water management, stormwater management, wastewater management, lake and river restoration, and drinking water projects.</li> <li>• No local match is required. However, projects are rarely funded by the Legislature for their full cost. Therefore, local funded will almost certainly be needed to complete projects.</li> </ul> | <p><a href="http://www.dep.state.fl.us/water">http://www.dep.state.fl.us/water</a></p>                                                                                                                                                                             |                                                                                  |

|                                                             |                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                              |
|-------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                             |                                                           | <p>Funding is secured through the state budget process.</p> <ul style="list-style-type: none"> <li>• Requests for funds are solicited from about mid-December to mid-January for the next fiscal year.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                              |
| Florida Forever Land Acquisition Program                    | FL DEP<br>DACS<br>FWCC<br>SJRWMD<br>(and other Districts) | <ul style="list-style-type: none"> <li>• The Florida Legislature established the 10-year Florida Forever program in 1999.</li> <li>• Under this program, the state issued bonds for \$3 billion and annually distributes about \$300 million to various agencies -- the Department of Environmental Protection, the Department of Agriculture, the Florida Fish and Wildlife Conservation Commission and the state's five water management districts.</li> <li>• The funds are used for land acquisition, environmental restoration and water resource development.</li> <li>• Applications for acquisitions can be submitted at any time. Evaluation and selection of Florida Forever program acquisitions is a very competitive process.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                        | <p>FL DEP Division of State Lands,<br/>Office of Environmental Services<br/>(850) 245-2784</p> <p><a href="http://www.dep.state.fl.us/lands/acquisition/FloridaForever/">http://www.dep.state.fl.us/lands/acquisition/FloridaForever/</a></p> | <p>Lochloosa Wildlife Conservation Area and Newnans Lake Conservation Area. (Acquired under Preservation 2000, the predecessor to Florida Forever. Preservation 2000 was replaced by the Florida Forever program in 2000.)</p>               |
| State Transportation Trust Fund; Federal Highway Trust Fund | FL DOT                                                    | <ul style="list-style-type: none"> <li>• The Department of Transportation is a public works agency responsible for the development and maintenance of Florida's transportation system.</li> <li>• The Department operates primarily from federal and state dedicated sources of funding. The State Transportation Trust Fund and the Federal Highway Trust Fund receive revenue from specific tax sources earmarked solely for transportation purposes.</li> <li>• The Department, working with Metropolitan Planning Organizations, local governments, and input from the public and Legislature, develops and implements a State Transportation Five-Year Work Program. This Program provides a list of transportation projects (by phase) that is scheduled for implementation during the ensuing five year period. It includes all proposed project commitments classified by major program and appropriation category. Projects are scheduled in phases (i.e., planning, design and construction) because it usually takes several years to complete a project.</li> <li>• This Program is updated annually.</li> </ul> | <p>Alan Obaigbena<br/>FL DOT<br/>(386) 961-7064<br/><a href="mailto:alan.obaigbena@dot.state.fl.us">alan.obaigbena@dot.state.fl.us</a></p>                                                                                                    | <p>FL DOT is partnering with the City of Gainesville and Alachua County to fund projects committed towards meeting the TMDL goals. The amount committed by FL DOT towards this goal is about \$4,029,942 in projects and program funding</p> |
| General Inspection                                          | DACS                                                      | <ul style="list-style-type: none"> <li>• Supports implementation and verification of agricultural BMP implementation</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | DACS Office of Agricultural Water Policy                                                                                                                                                                                                      | Cow/calf, container nursery, and sod BMP                                                                                                                                                                                                     |

|                                                  |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                            |
|--------------------------------------------------|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trust Fund                                       |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <a href="http://www.floridaagwaterpolicy.com/">http://www.floridaagwaterpolicy.com/</a>                                                                                                                                                                                                      | implementation and effectiveness verification                                                                                                                                                                                              |
| <b>LOCAL FUNDING SOURCES</b>                     |                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                            |
| Local government ad valorem taxes (general fund) | Alachua County, Marion County, & City of Gainesville | <ul style="list-style-type: none"> <li>• Ad valorem taxes (i.e. property taxes) are the major source of revenues for state and municipal governments. These funds support programs, capital projects, municipal services, and are used to implement policies of the municipality's comprehensive plan.</li> <li>• SJRWMD also funds projects through the collection of ad valorem taxes</li> </ul>                                                             |                                                                                                                                                                                                                                                                                              | A wide variety of programs and projects are funded with ad valorem taxes, including Alachua County's water quality monitoring, the Hogtown Creek inlet protection project, water quality protection public education and outreach efforts, |
| Gainesville Clean Water Partnership              | Alachua County, City of Gainesville, and FDOT        | See section ## for a description of the Gainesville Clean Water Partnership                                                                                                                                                                                                                                                                                                                                                                                    | <p>Sally Adkins<br/>Gainesville Clean Water Partnership Coordinator<br/>(352) 334-5072<br/><a href="mailto:adkinss@ci.gainesville.fl.us">adkinss@ci.gainesville.fl.us</a></p> <p><a href="http://www.gainesvillecreks.org/sponsors.htm">http://www.gainesvillecreks.org/sponsors.htm</a></p> | <p>Water quality protection public education and outreach</p> <p>Springhill pond, Tumblin, and other vegetative enhancement projects</p> <p>Water quality code implementation</p> <p>Various MS4 permit requirements</p>                   |
| Alachua County Forever                           | Alachua County                                       | <p>Alachua County Forever is a land conservation program to acquire and protect environmentally significant lands. Though this program, Alachua County seeks to acquire, protect and manage environmentally significant lands, protect water resources, wildlife habitat, and natural areas suitable for resource-based recreation.</p> <p>As of July 2007, the Alachua County Forever program had protected 11,120 acres, with 110 additional acres under</p> | <a href="http://www.co.alachua.fl.us/government/depts/epd/land/">http://www.co.alachua.fl.us/government/depts/epd/land/</a>                                                                                                                                                                  | <p>Longleaf Flatwoods Preserve</p> <p>Freddy Wood Tract</p> <p>Sweetwater Preserve</p>                                                                                                                                                     |

|                                                 |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                 |                                                                                                                                                                                                                                   |
|-------------------------------------------------|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                 |                                                                | contract. 5,290 of these acres are directly managed by Alachua County. Purchases through this program total more than \$56 million, with \$20 million from the County and \$36 million from partners.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                 |                                                                                                                                                                                                                                   |
| User Fees                                       | Gainesville Regional Utilities and Customers                   | Gainesville Regional Utilities (GRU) is a multi-service utility owned by the City of Gainesville. GRU provides electric, natural gas, water, wastewater and telecommunications services to approximately 89,000 retail and wholesale customers in Gainesville and surrounding unincorporated areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <a href="http://www.gru.com/">http://www.gru.com/</a>                                                           | <ul style="list-style-type: none"> <li>• Main Street Wastewater Plant upgrades</li> <li>• Inflow and infiltration prevention</li> <li>• Slip lining</li> <li>• Ongoing infrastructure maintenance and capital projects</li> </ul> |
| Gainesville Stormwater Management Utility (SMU) | Gainesville and Owners of Developed Properties Within the City | <ul style="list-style-type: none"> <li>• The Gainesville SMU program helps maintain City stormwater conveyance systems, implement water quality and flood protection improvement projects, and protects the health of local creeks, ponds, and wetlands.</li> <li>• It provides an organized utility program with a revenue source to address the increasing stormwater management system requirement</li> <li>• The first stormwater fees were collected in the March 1989 GRU bill.</li> <li>• Rates are established by Ordinance by the City Commission. All residential properties are charged a fixed monthly rate that varies by the type of unit (single family attached, duplex, condominium, apartment or mobile home). Non-residential properties are assessed according to the amount of impervious area on the property.</li> </ul> | <a href="http://cityofgainesville.org/pubworks/stormwater">http://cityofgainesville.org/pubworks/stormwater</a> | <p>Depot Ave. Stormwater Park</p> <p>Hogtown Creek Sediment Project</p> <p>SW 11<sup>th</sup> Ave. storm sewer upgrades</p> <p>Hydrodynamic separators</p> <p>Various additional MS4 permit requirements</p>                      |

**Table 46. EPA's Nine Elements of a Comprehensive Watershed Management Plan**

| <b>WATERSHED MANAGEMENT PLAN<br/>PER EPA GUIDANCE</b>                                                                                                                                                                                                                                                                                                                                | <b>ORANGE CREEK<br/>BMAP</b>                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| a. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan.                                                                                                                                                                                                    | Chapter 4 (nutrients)<br>Chapter 5 (coliforms) |
| b. An estimate of the load reductions expected for the management measures described under Item (c) below.                                                                                                                                                                                                                                                                           | Chapter 4                                      |
| c. A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated under item (b) above and an identification of the critical areas in which those measures will be needed to implement the plan.                                                                                                                 | Chapters 3, 4, & 5                             |
| d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied on to implement the plan.                                                                                                                                                                                                       | Appendix E (detailed project tables)           |
| e. An information/education component that will be used to enhance public understanding of the project and encourage early and continued public participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.                                                                                                            | Chapter 7                                      |
| f. A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.                                                                                                                                                                                                                                                       | Appendix E (detailed project tables)           |
| g. A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.                                                                                                                                                                                                                       | Chapter 6                                      |
| h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a nonpoint source TMDL has been established, whether the TMDL needs to be revised. | Chapter 6                                      |
| i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under Item (h) above.                                                                                                                                                                                                                     | Chapter 6                                      |

## 8.2 Statements of Commitment

Section 403.067(7), F.S., lays out the mechanisms for BMAP implementation (see **Appendix B**). While the BMAP is linked by statute to permitting and other enforcement processes that target individual entities, successful implementation requires that local stakeholders willingly and consistently work together to achieve adopted TMDLs. This collaboration fosters the sharing of ideas, information, and resources. The members of the Orange Creek Basin Working Group have demonstrated their willingness to confer with and support each other in their efforts.

On a very practical level, BMAP implementation also depends upon adequate resources and necessary authorizations. The management actions contained in the BMAP are either under way or are planned in good faith. Both current and future actions are contingent upon necessary funding and approvals for their initiation and/or continuation.

BWG members have signed individual statements of commitment to implement and/or support the management actions outlined in the BMAP. The following table lists those groups, organizations, local governments, and agencies that signed official statements of commitment to implement provisions of the Orange Creek BMAP. Copies of these statements can be found in Appendix M.

## ***SIGNATORIES:***

| <b><i>ENTITY</i></b>                                          | <b><i>SIGNATORY</i></b> | <b><i>TITLE</i></b> | <b><i>DATE</i></b> |
|---------------------------------------------------------------|-------------------------|---------------------|--------------------|
| CITY OF GAINESVILLE                                           |                         |                     |                    |
| GAINESVILLE WATER MGT. COMMITTEE                              |                         |                     |                    |
| GAINESVILLE REGIONAL UTILITIES                                |                         |                     |                    |
| ALACHUA COUNTY ENVIRONMENTAL<br>PROTECTION DEPARTMENT         |                         |                     |                    |
| ALACHUA COUNTY PUBLIC WORKS                                   |                         |                     |                    |
| ALACHUA COUNTY HEALTH<br>DEPARTMENT                           |                         |                     |                    |
| ALACHUA COUNTY ENVIRONMENTAL<br>PROTECTION ADVISORY COMMITTEE |                         |                     |                    |
| TOWN OF MCINTOSH                                              |                         |                     |                    |
| MARION COUNTY                                                 |                         |                     |                    |
| FLORIDA DEPARTMENT OF<br>ENVIRONMENTAL PROTECTION             |                         |                     |                    |
| ▪ NORTHEAST DISTRICT                                          |                         |                     |                    |
| ▪ RECREATION AND PARKS                                        |                         |                     |                    |
| ▪ INVASIVE PLANT MGT.                                         |                         |                     |                    |
| ▪ WATER RESOURCE MGT.                                         |                         |                     |                    |
| FLORIDA DEPARTMENT OF<br>TRANSPORTATION                       |                         |                     |                    |
| FLORIDA FISH AND WILDLIFE<br>CONSERVATION COMMISSION          |                         |                     |                    |
| FLORIDA DEPARTMENT OF<br>AGRICULTURE<br>AND CONSUMER SERVICES |                         |                     |                    |
| ▪ DIVISION OF FORESTRY                                        |                         |                     |                    |
| ▪ OFFICE OF AGRICULTURAL<br>WATER POLICY                      |                         |                     |                    |
| FLORIDA DEPARTMENT OF HEALTH??                                |                         |                     |                    |
| ST. JOHNS RIVER WATER<br>MANAGEMENT DISTRICT                  |                         |                     |                    |
| UNIVERSITY OF FLORIDA                                         |                         |                     |                    |
| SIERRA CLUB                                                   |                         |                     |                    |
| WOMEN FOR WISE GROWTH                                         |                         |                     |                    |
| SUSTAINABLE ALACHUA COUNTY<br>FORESTRY INDUSTRY               |                         |                     |                    |
| PRIVATE SECTOR – BROWN & CULLEN,<br>INC.                      |                         |                     |                    |

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