

FINAL

BASIN MANAGEMENT ACTION PLAN

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

in the

Lake Jesup Basin

developed by the

Lake Jesup TMDL Basin Working Group

in cooperation with the

Florida Department of Environmental Protection

Division of Environmental Assessment and Restoration

Bureau of Watershed Restoration

Tallahassee, Florida 32399

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LIST OF ACRONYMS

BMAP	Basin Management Action Plan
BMP	Best Management Practice
BOD	Biological Oxygen Demand
BWG	Basin Working Group
CDM	Camp Dresser and McKee
CDS	Continuous Deflective Separation (Unit)
CWP	Center for Watershed Protection
DO	Dissolved Oxygen
EMC	Event Mean Concentration
EPA	U. S. Environmental Protection Agency
ERP	Environmental Resource Permit
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
F.S.	Florida Statutes
FSA	Florida Stormwater Association
FWC	Florida Fish and Wildlife Conservation Commission
FWRA	Florida Watershed Restoration Act
FYN	Florida Yards and Neighborhoods Program
GIS	Geographic Information System
HSPF	Hydrologic Simulation Program – Fortran (model)
LEED	Leadership in Energy and Environmental Design
LID	Low Impact Development
MG	Million Gallons
MGD	Million Gallons Per Day
MS4	Municipal Separate Storm Sewer System
MSJR	Middle St. Johns River
MT	Metric Ton
NELAC	National Environmental Laboratory Accreditation Conference
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
OAWP	Office of Agricultural Water Policy
OOCEA	Orlando Orange County Expressway Authority
PBS&J	Post, Buckley, Schuh & Jernigan
PLRG	Pollutant Load Reduction Goal
PSA	Public Service Announcement
QA/QC	Quality Assurance/Quality Control
RSF	Regional Stormwater Facility
SCI	Stream Condition Index
SJRWMD	St. Johns River Water Management District
SOP	Standard Operating Procedure
STORET	STorage and RETrieval (Database)
TAZ	Transportation Analysis Zone

TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TSI	Trophic State Index
TSS	Total Suspended Solids
UF–IFAS	University of Florida–Institute of Food and Agricultural Sciences
USACE	United States Army Corps of Engineers
USGS	U.S. Geological Survey
WAV	Watershed Action Volunteers
WBID	Waterbody Identification
WWTF	Wastewater Treatment Facility

EXECUTIVE SUMMARY

THE LAKE JESUP BASIN

Lake Jesup is one of the largest lakes in Central Florida and is part of the St. Johns River system. Lake Jesup has a surface area of about 10,660 acres (16.7 square miles) and drains a watershed of about 86,382 acres (135 square miles), including a large portion of Seminole County, a small portion of Orange County, the entire City of Winter Springs, and portions of the following municipalities: Altamonte Springs, Casselberry, Eatonville, Lake Mary, Longwood, Maitland, Orlando, Oviedo, Sanford, and Winter Park. At high stage levels, Lake Jesup has surface area up to 16,000 acres.

TOTAL MAXIMUM DAILY LOADS

Total Maximum Daily Loads (TMDLs) are water quality targets, based on state water quality standards, for specific pollutants (such as nitrogen and phosphorus). The Florida Department of Environmental Protection (FDEP) identified Lake Jesup to be impaired by nutrients, and, in 2006, adopted TMDLs for Total Phosphorus (TP) and Total Nitrogen (TN) for the lake, as shown in the table below.

WBID(s)	TMDL (LBS/YR)	TARGET CONCENTRATION (MG/L)	WASTELOAD ALLOCATION NPDES STORMWATER	LOAD ALLOCATION (NONPOINT)
2981 (Including 2981A)	41,888 TP	0.096	34%	34%
2981 (Including 2981A)	545,203 TN	1.27	50%	50%

THE LAKE JESUP BASIN MANAGEMENT ACTION PLAN

Due to the extensive role of nitrogen fixation in Lake Jesup and the current lack of information related to in-lake nutrient cycling, the focus of this BMAP is to achieve reductions in TP loads from sources external to the lake. Reducing external TP sources is necessary to achieve and then maintain in-lake conditions, and is therefore a crucial component of restoring Lake Jesup's water quality. The total required TP reductions from stormwater runoff and septic tanks were allocated to the responsible entities in the basin. These entities include 11 cities and towns, two counties, three transportation agencies, and agriculture. Since there are several technical uncertainties that require additional information before they can be addressed, the required reductions are spread over a 15-year timeframe. This phased approach assigns one-third of the required reductions in each of three five-year periods. Therefore, this BMAP addresses the first one-third of the required reductions.

In order to obtain information about the uncertainties to revise the TMDL and BMAP allocations in future iterations, a water quality monitoring plan and research studies will be implemented over the next five years, concurrently with projects to reduce external TP loads. FDEP anticipates the need to recalculate the BMAP allocations upon completion of the first five-year implementation period at which time water quality data at a sufficient spatial and temporal resolution should be available to support new calculations.

KEY ELEMENTS OF THE BMAP

This BMAP addresses the key elements required by the Florida Watershed Restoration Act (FWRA), Chapter 403.067, Florida Statutes (F.S.), including the following:

- Document how the public and other stakeholders were encouraged to participate or participated in developing the BMAP (**Section 1.2.1** and **Appendix C**);
- Equitably allocate pollutant reductions in the basin (**Section 3.2.4** and **Section 3.3**);
- Identify the mechanisms by which potential future increases in pollutant loading will be addressed (**Section 3.2.5** and **Section 4.2.6**);
- Document management actions/projects to achieve the TMDLs (**Section 4.2** and **Appendix D**);
- Document the implementation schedule, funding, responsibilities, and milestones (**Appendix D**); and
- Identify monitoring, evaluation, and a reporting strategy to evaluate reasonable progress over time (**Section 5.1**).

ANTICIPATED OUTCOMES OF BMAP IMPLEMENTATION

With implementation of the projects outlined in this BMAP, reductions in the external phosphorus loads to Lake Jesup are expected to improve the water quality conditions of the lake. The following outcomes are anticipated from BMAP implementation:

- Improved water quality in Lake Jesup and its tributaries;
- Decreased concentration of TP in the water column, which leads to improvement in water quality characteristics of the lake;
- Greater understanding of the sources in the basin, in-lake nutrient cycling, and effectiveness of the management actions;
- Enhanced understanding of basin hydrology, water quality, and pollutant sources; and
- Enhanced public awareness of pollutant sources, impacts, and management actions.

BMAP COST AND TIMEFRAME

Costs were provided for 46% of the activities identified in the BMAP, with an estimated total cost of more than \$35 million. In addition, annual operation and maintenance costs were provided for 11% of the projects for a total of \$2.5 million. The funding sources range from local contributions to legislative appropriations. Technical stakeholders and Basin Working Group (BWG) members will continue to explore new opportunities for funding assistance to ensure that the activities listed in this BMAP can be maintained at the necessary level of effort.

BMAP FOLLOW-UP

As a part of BMAP follow-up, FDEP, the Basin Working Group, and technical stakeholders will track implementation efforts and monitor water quality in Lake Jesup. The results will be used to evaluate whether the plan is effective in reducing external TP loading and that the lake is responding to these reductions. The Basin Working Group will meet at least every 12 months to discuss implementation issues, consider new information, and determine what other management strategies are needed to meet the TMDLs, if necessary.

BENEFITS OF THE BMAP PROCESS

The Basin Working Group members provided endorsement of the BMAP on behalf of the entities they represent and are committed to ensuring the plan is implemented to achieve the required TP reductions. In addition to this endorsement, the entities are providing FDEP with letters of commitment or resolutions of support to ensure that as staff and board members change over time, the entity has a way to show support for the BMAP and the efforts included.

CHAPTER 1: PLAN CONTEXT, PURPOSE, AND SCOPE

Lake Jesup is one of the largest lakes in Central Florida and is part of the St. Johns River system. Lake Jesup has a surface area of about 10,660 acres (16.7 square miles) and drains a watershed of about 87,322 acres (136.4 square miles), including a large portion of Seminole County, a small portion of Orange County, the entire City of Winter Springs, and portions of the following municipalities: Altamonte Springs, Casselberry, Eatonville, Lake Mary, Longwood, Maitland, Orlando, Oviedo, Sanford, and Winter Park. At high stage levels, Lake Jesup has surface area up to 16,000 acres. This Basin Management Action Plan (BMAP) represents the joint efforts of multiple stakeholders to prepare a restoration plan for the lake to implement the adopted Total Maximum Daily Load (TMDL). This BMAP includes prioritized projects to limit external phosphorus loading into the lake and concurrent research projects to guide effective long-term restoration efforts. The BMAP was developed as part of the State of Florida TMDL program.

Stakeholder involvement is critical to success of the entire TMDL program. Stakeholder involvement is particularly essential to develop, gain support for, and secure commitments in a BMAP. The Florida Department of Environmental Protection (FDEP) invited all interested stakeholders to participate in Lake Jesup BMAP development, and facilitated participation to ensure that all voices were heard and opinions considered. This approach fostered a sense of cooperation among stakeholders and ultimately led to the development of a restoration plan that is scientifically defensible and expected to achieve real results through the use of a 15-year phased implementation approach.

1.1 WATER QUALITY STANDARDS AND TOTAL MAXIMUM DAILY LOADS

Florida's water quality standards are designed to ensure that surface waters can be used for their designated uses, such as drinking water, recreation, and shellfish harvesting. Currently, most surface waters in Florida, including Lake Jesup, are categorized as Class III waters, which mean they must be suitable for recreation and must support the propagation and maintenance of a healthy, well-balanced population of fish and wildlife.

Under Section 303(d) of the Federal Clean Water Act, each state must identify its "impaired" waters, including estuaries, lakes, rivers, and streams, which do not meet their designated uses. FDEP is responsible for developing the state list of impaired waters. The administrative and technical processes for listing impaired waters and establishing TMDLs are authorized by Section 403.067, Florida Statutes (F.S.) [known as the Florida Watershed Restoration Act (FWRA)] and the Identification of Impaired Surface Waters Rule, Chapter 62-303, Florida Administrative Code (F.A.C.). The FWRA contains provisions that guide the development of BMAPs and other TMDL implementation approaches. **Appendix B** contains a summary of the statutory provisions related to BMAP development.

FDEP develops and adopts TMDLs for impaired waterbodies. A TMDL is the maximum amount of a specific pollutant that a waterbody can assimilate while maintaining its designated uses. TMDLs are developed and implemented as part of a watershed management cycle, based on the state's 52 river basins. Lake Jesup is located within the Group 2 Middle St. Johns River (MSJR) Basin.

A nutrient TMDL was adopted for Lake Jesup in 2006, which identifies the Total Phosphorus (TP) and Total Nitrogen (TN) load the lake can receive and still maintain its Class III designated

uses. By establishing this assimilative capacity, the TMDL also established required reductions needed to meet the target. The Lake Jesup nutrient TMDL is described in more detail in **Section 1.2.3**.

The Lake Jesup BMAP contains strategies to implement the Lake Jesup nutrient TMDL through reduction and prevention of pollutant discharges through various means. The project types contained in the BMAP reflects the array of sources and stakeholder relationships that exist in this complex watershed. Although this is currently the only BMAP for the Lake Jesup Basin, other BMAPs may be developed in the future to address individual waterbody identification numbers (WBIDs) within the larger watershed or additional parameters.

1.2 THE LAKE JESUP BASIN MANAGEMENT ACTION PLAN

The focus of this BMAP is to achieve reductions in external TP loads to the lake. The focus on TP and external loads in particular was driven by the significant role of nitrogen fixation in Lake Jesup (refer to **Section 2.5.1** for additional detail) and the magnitude of unknowns regarding internal nutrient cycling in the lake (refer to **Section 2.4**).

Detailed allocations were calculated and assigned (see **Section 3.3**) to the responsible entities in the basin. These entities include 11 cities and towns, two counties, three transportation agencies, and agriculture. Allocations are spread over a 15-year timeframe with a phased approach that assigns required reductions in each of three five-year periods. Because one-third of the required reduction will be achieved in each five-year BMAP period, this BMAP addresses the first third of the TMDL reductions for TP. The BMAP outlines specific projects that will be implemented by local entities to achieve required external TP load reductions and a schedule for implementation. Concurrent with project implementation, water quality monitoring (refer to **Section 5.1**) will be used to track the reductions achieved by projects and the lake's response to the reduction in external TP loading and to determine what additional actions, if any, should be taken to achieve the TMDLs. A research plan (see **Section 5.2**) is also included to provide additional data for the basin to help refine the TMDL and BMAP allocations in future cycles, as necessary. FDEP anticipates the need to recalculate the BMAP allocations upon completion of the first five-year implementation period at which time water quality data at a sufficient spatial and temporal resolution should be available to support the calculations.

1.2.1 STAKEHOLDER INVOLVEMENT

Beginning prior to TMDL adoption the technical stakeholders provided input on the land uses, event mean concentrations (EMCs), best management practice (BMP) efficiency values, and other aspects of model development and restoration targets. The model used for the TMDL originated with Seminole County and was expanded during TMDL development for use in the entire Lake Jesup watershed. BMAP technical meetings began in 2006 to solicit stakeholder input on data collection, compilation and review of the model development and approach, and technical aspects of the BMAP.

In addition to discussions on the technical issues of TMDL development, FDEP solicited further input from key stakeholder groups at the management level by convening the Lake Jesup Basin Working Group (BWG) in July 2007. The BWG developed the following mission statement:

The mission of the Lake Jesup Basin Working Group is to make recommendations to the Florida Department of Environmental Protection to work toward restoring impaired waterbodies through development of an effective, equitable, and cost-efficient Basin Management Action Plan to implement the Total Maximum Daily Loads.

The BWG reviewed the major issues regarding the development of the BMAP and detailed allocations and made formal recommendations to FDEP for adoption in the BMAP. This BMAP document is a compilation of input from technical stakeholders, BWG members, and the general public as discussed at Lake Jesup BMAP workshops and meetings.

Florida's Government-in-the-Sunshine law (<http://myfloridalegal.com/sunshine>; Section 286, F.S.) provides a right of access to governmental proceedings at both the state and local levels. The Sunshine Law is intended to expose government's decision-making process to public scrutiny, including all of the deliberations that precede a final action. This philosophy is consistent with the transparent nature of the BMAP process. Basin Working Group and public meetings were formally publicized in accordance with Section 286, F.S., including publication of notices in the Florida Administrative Weekly. Informally, notification of all meetings was sent to a wide email distribution list and every attempt was made to meet on the same day (3rd Thursday), time (1:00 PM - 4:00 PM), and location (Lake Sylvan Park, Sanford, Florida) each month to facilitate attendance.

1.2.2 PLAN PURPOSE AND SCOPE

The purpose of this BMAP is to implement external load reductions to achieve the TP TMDL adopted by FDEP for the Lake Jesup Basin and build a solid scientific foundation that will provide for future consideration of key lake issues about which there is insufficient understanding. There are other water quality concerns that will benefit from the actions that address this TMDL; however, this BMAP does not address all the water quality issues in the basin.

This BMAP focuses on Lake Jesup (TMDL waterbody identification numbers [WBIDs] 2981 and 2981A), which is located in central Florida (**Figure 1**), on the northeast side of the MSJR Basin. The majority of the watershed lies within Seminole County, with a portion on the southwest end that extends into Orange County.

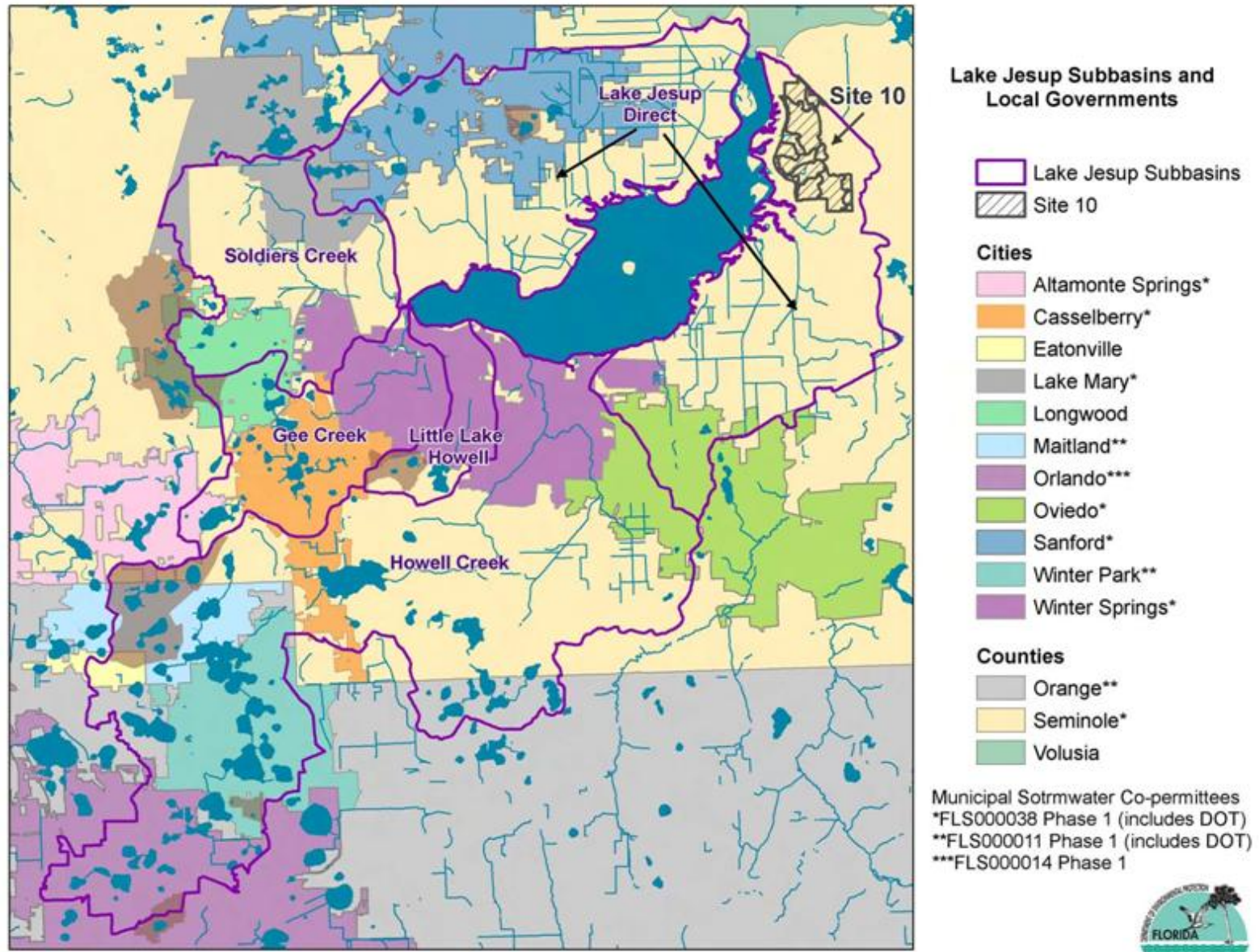


FIGURE 1: LAKE JESUP AND LOCAL GOVERNMENT JURISDICTIONS IN THE BASIN

1.2.3 MEASURABLE GOALS AND MILESTONES

With implementation of the projects outlined in this BMAP, reductions in the external phosphorus loads to Lake Jesup are expected to improve the water quality conditions of the lake. The following outcomes are anticipated from BMAP implementation:

- Improved water quality in Lake Jesup and its tributaries;
- Decreased TP concentrations in the water column, which leads to improvement in water quality characteristics of the lake;
- Greater understanding of the sources in the basin, in-lake nutrient cycling, and effectiveness of the management actions;
- Enhanced understanding of basin hydrology, water quality, and pollutant sources; and
- Enhanced public awareness of pollutant sources, impacts, and management actions.

The projects included in this BMAP are anticipated to reduce 10,167.5 lbs/yr of TP that were or currently are estimated to be entering Lake Jesup and its tributaries. This estimated reduction is 54% of the total TMDL nonpoint source required reductions based on current information. For the stormwater projects submitted, information on the area treated was provided for 49% of the projects for a total stormwater treatment area of 14,090 acres. Costs were provided for 46% of the activities identified in the BMAP, with an estimated total cost of more than \$35 million. In addition, annual operation and maintenance costs were provided for 11% of the projects for a total of \$2.5 million.

1.2.4 EFFORTS THAT AFFECT THE BMAP

In addition to this BMAP, there are other projects and efforts that are occurring in the Lake Jesup Basin and surrounding watershed, which will affect the benefits achieved by the BMAP. Although these projects support the goals of the BMAP, their expected impacts cannot be quantified at this time. Additional information about these projects will be provided in future iterations of the BMAP. The related efforts include:

- Lake Jesup Interagency Restoration Strategy (see **Section 4.2.3**);
- TMDLs and Pollutant Load Reduction Goals (PLRGs) for upstream waterbodies;
- U.S. Army Corps of Engineers (USACE) Lake Jesup outlet modification;
- State Road 46 bridge reconstruction; and
- Changes to the application of reuse water at Site 10.

1.3 LAKE JESUP NUTRIENT TMDL

TMDL development involves three primary steps: (1) establish a water quality target; (2) calculate existing loads; and (3) calculate load reductions needed to achieve the target. The Lake Jesup nutrient TMDL is based on achieving a target trophic state index (TSI) of 65 in the lake. Because the TSI is based on nitrogen, phosphorus, and chlorophyll concentrations, this translated into target concentrations for TP and TN of 0.094 mg/L and 1.32 mg/L, respectively. TP and TN loadings from the watershed were estimated with a pollutant loading model originally developed by Post, Buckley, Schuh & Jernigan (PBS&J) for Seminole County, but expanded for use in the Lake Jesup TMDL. This model uses runoff coefficients, soil types, and land uses to estimate TN and TP loading. Surface runoff loading was considered with loads from baseflow, septic tanks, precipitation directly onto the lake's surface (atmospheric deposition), and inflow from the St. Johns River in the TMDL to develop a full picture of nutrient inputs to the system. These loading estimates were then input into the Bathtub Eutrophication Model to establish the relationship between TN and TP loadings and in-lake TN, TP, and chlorophyll a concentrations.

The model was calibrated against the measured in-lake TN, TP, and chlorophyll *a* concentrations. The final step was to adjust the external loadings to the lake until the target TSI was achieved. The loadings that achieved the target TSI were used to calculate the required reductions in TP and TN in the TMDL (refer to **Table 1**). Additional detail about TMDL development can be found in the Lake Jesup TMDL report (FDEP, 2006).

1.3.1 POLLUTANT REDUCTION AND DISCHARGE ALLOCATIONS

Under the FWRA, the TMDL allocation in rule may be an “initial” allocation among point and nonpoint sources, with a “detailed” allocation to specific sources established in the BMAP. **Table 1** lists the TMDL and initial pollutant load allocations adopted by rule for Lake Jesup. These reductions were modified during the BMAP process as part of the development of detailed allocations. The detailed BMAP allocations are discussed in **Chapter 3**.

TABLE 1: TMDLS IN LAKE JESUP

WBID(s)	TMDL (LBS/YR)	TARGET CONCENTRATION (MG/L)	WASTELOAD ALLOCATION NPDES STORMWATER	LOAD ALLOCATION (NONPOINT)
2981 (Including 2981A)	41,888 TP	0.096	34%	34%
2981 (Including 2981A)	545,203 TN	1.27	50%	50%

CHAPTER 2: TECHNICAL FOUNDATION

2.1 JURISDICTIONS, POPULATION, AND LAND USE

The Lake Jesup watershed occupies a highly urbanized area within Seminole and Orange counties. Eleven municipalities are located in the watershed, including Altamonte Springs, Casselberry, Eatonville, Lake Mary, Longwood, Maitland, Orlando, Oviedo, Sanford, Winter Park, and Winter Springs. According to 2003 data from the U. S. Census Bureau, the population densities in Seminole and Orange counties were 1,184.9 and 987.8 person/square mile, respectively, which were significantly higher than the state average of 296.4 person/square mile. The area is also undergoing rapid population growth. From 1990 through 2000, the population of Seminole and Orange counties increased by 27.0% and 32.3%, respectively.

The Lake Jesup Basin drains about 86,382 acres into Lake Jesup. Land use categories were classified as shown **Table 2**. **Figure 2** shows the distribution of the major land uses in the watershed. As shown in the table, active land uses (agriculture, golf course, residential, commercial, institutional, industrial/utility, and transportation facilities) occupy 51,273 acres (59%) of the watershed. Over half of this area is medium-density residential. As shown in **Figure 2**, urban and built-up areas almost entirely cover the western and southern parts of the Lake Jesup basin. The remaining 41% of the watershed consists of natural areas, including undeveloped forest and rural land, open water, and wetlands.

Approximately 10% of the watershed is in public ownership. The St. Johns River Water Management District (SJRWMD) brought approximately 3,850 acres around the lake into public ownership since 1984 and has targeted additional areas for acquisition. Other government agencies, including local governments, have purchased an additional 4,700 acres of floodplain around the lake.

TABLE 2: LAND USE CLASSIFICATIONS IN THE LAKE JESUP BASIN

LAND USE	ACREAGE	PERCENT
Medium-Density Residential	26,194	30.3
Forest and Rural Open	11,965	13.9
Wetlands 1 (impacted)	11,359	13.1
Wetlands 2 (unimpacted)	7,917	9.2
Agriculture	5,582	6.5
Commercial	4,860	5.6
Transportation Facilities	4,044	4.7
Water	3,868	4.5
High-Density Residential	2,177	2.5
Low-Density Residential	2,598	3.0
Institutional	2,112	2.4
Site 10	1,252	1.4
Industrial/Utility	1,908	2.2
Golf Course	546	0.6
Total	86,382	100.0

2.1.1 OVERVIEW OF AGRICULTURE IN THE LAKE JESUP BASIN

The primary agricultural land uses in the Lake Jesup watershed are cow-calf operations, citrus groves, and field-grown palm nurseries. Other agricultural land uses include ornamental plant container nurseries, field crops, sod production, and equine operations. Most of the agricultural acreage is located within areas that drain directly to the lake (the Lake Jesup “proper” subbasin)

and within the Howell Creek subbasin. **Figure 3** shows the approximate location of agricultural lands in the Lake Jesup BMAP area. **Table 12** in **Section 4.2.5** provides a summary of these agricultural lands within the entire basin.

Citrus and palm nursery operations are concentrated primarily on the northwest side of the lake near the airport, and southeast of the lake in an area known as the Black Hammock. Due to urban encroachment, grove health issues (freeze/disease), and recent flooding, many citrus operations either have been abandoned or have significantly lowered their production acreage. In recent years, some of this citrus acreage has been shifted to field-grown palm production.

There are several commercial cow-calf operations in the watershed, consisting primarily of improved and woodland pastures. Most of the remaining land use that might be characterized as cow-calf operations are small, noncommercial plots scattered throughout residential areas.

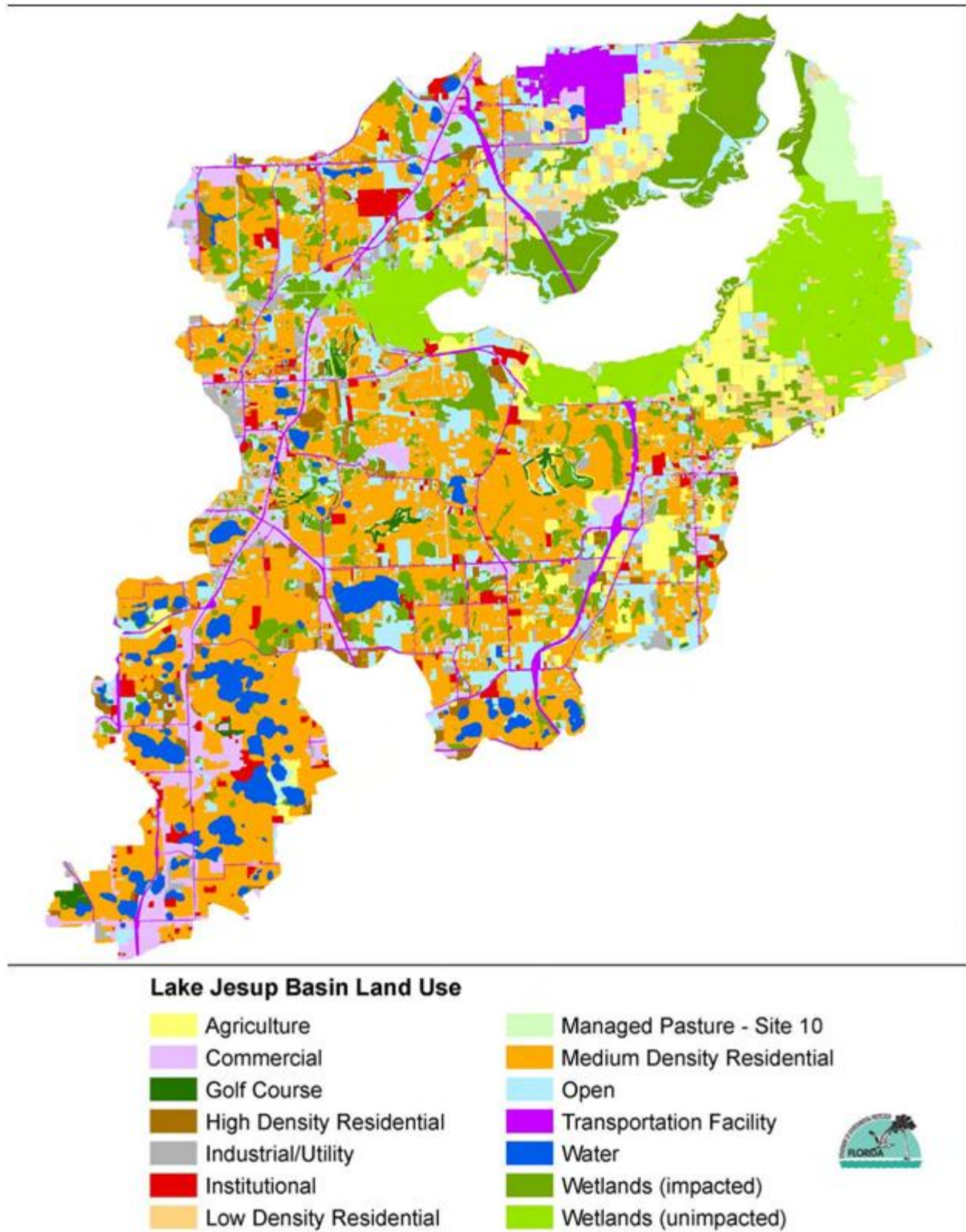


FIGURE 2: LAND USES IN THE LAKE JESUP BASIN

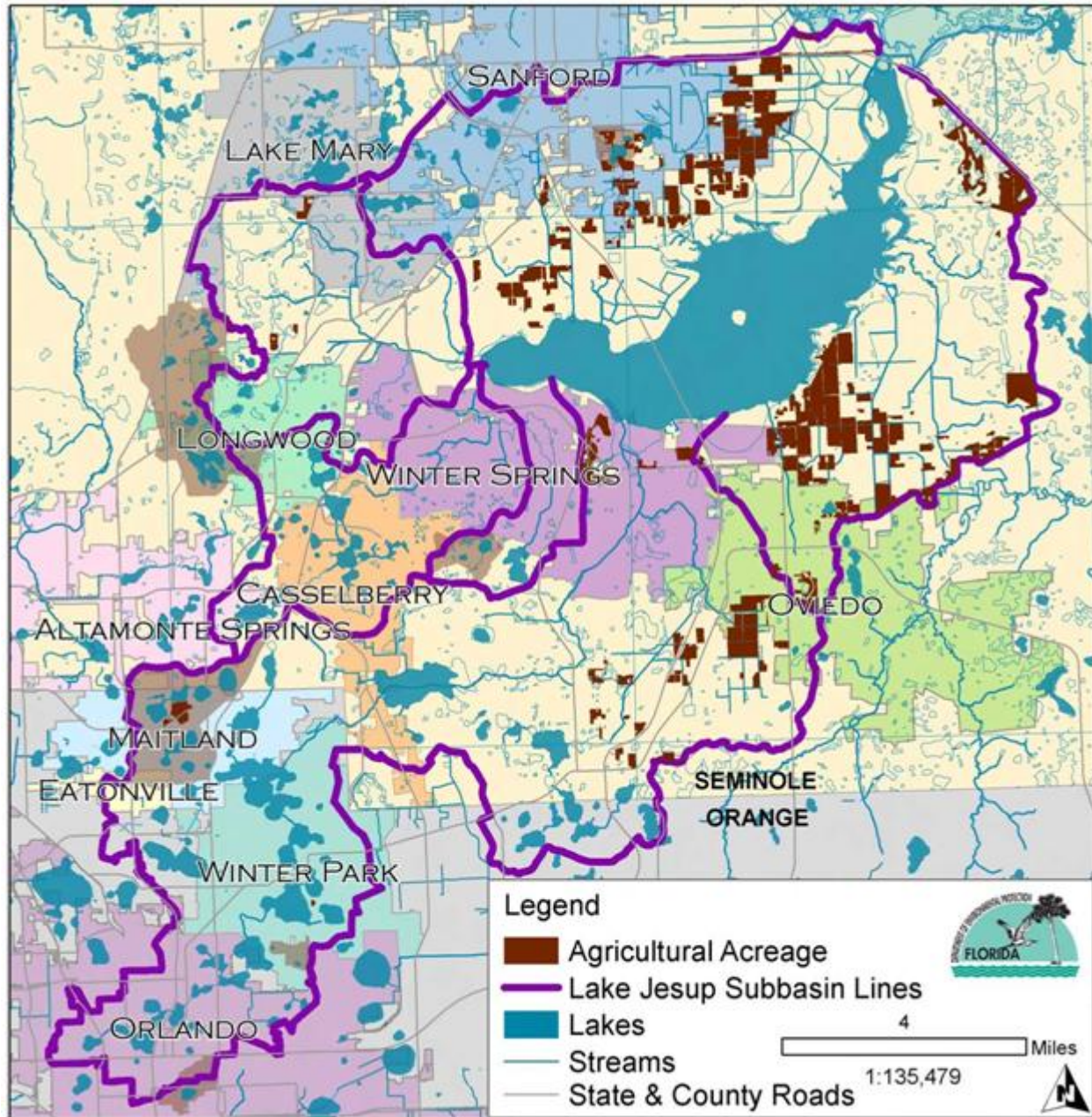


FIGURE 3: AGRICULTURAL ACREAGE IN THE LAKE JESUP BASIN (EXCLUDING SILVICULTURE)

2.2 HYDROLOGY

Lake Jesup is low-lying and shallow, with an average depth of approximately four feet (FDEP, 2006). Lake elevation follows the water surface elevations of the St. Johns River at its confluence with Lake Jesup. Although Lake Jesup usually discharges to the St. Johns River, when local rainfall is lower than regional rainfall (particularly to the south) the river rises, and water flows from the St. Johns River into the lake (Keesecker, 1992). Estimates of mean hydraulic residence time in the lake range from 82-99 days (Brezonik and Fox, 1976; U.S. Environmental Protection Agency, 1977; and Keesecker, 1992).

For the purposes of the TMDL modeling, the Lake Jesup watershed was split into five sub-basins that correspond to the primary tributaries: Gee Creek, Howell Creek, Lake Jesup (the area immediately connected to the lake), Little Lake Howell, and Soldiers Creek (**Figure 1**). A long-term average of about 70,052 acre-feet of surface runoff is discharged into Lake Jesup annually, based on data from 1995 through 2002. The area directly connected to Lake Jesup has the highest discharge, accounting for about 45% of the total surface runoff, followed by Howell Creek (34%), Soldiers Creek and Gee Creek sub-basins together (19%) and Little Lake Howell (3%) (FDEP, 2006).

Contributions of TP loadings from the different sub-basins show a trend similar to that of surface runoff. The long-term annual average TP discharge through surface runoff is about 14.5 metric tons. The watershed immediately connected to Lake Jesup produces about 37% of the total TP loading through surface runoff; the Howell Creek sub-basin contributes 41%; the Soldiers Creek and Gee Creek sub-basins contribute about 10% and 9%, respectively; and the Little Lake Howell sub-basin contributes the smallest amount, about 3% (FDEP, 2006).

2.3 SPATIAL AND TEMPORAL WATER QUALITY TRENDS

The annual average TP concentration in Lake Jesup ranged from 0.14 to 0.19 mg/L with an average concentration of approximately 0.16 mg/L from 1995-2002. The variation in the annual average TP during the period of record appeared to be relatively small. Larger variations were observed for annual average TN and chlorophyll *a* concentrations. Annual average TN and chlorophyll *a* concentrations from 1995 through 2002 ranged from 1.99 to 4.47 mg/L and from 51.3 to 159.9 µg/L, respectively. The long-term annual average TN and chlorophyll *a* concentrations were 2.93 mg/L and 93.3 µg/L, respectively. The long-term annual average TSI for the lake is 77.9 and equates to poor water quality.

During BMAP development, mean TP concentrations from the STORET database were calculated at various points in the tributaries to Lake Jesup. The purpose of these calculations was to determine those tributaries that had the highest concentrations of TP at their mouths and where concentrations increased substantially within each tributary. There were data available for eight tributaries: Howell Creek, Gee Creek, Soldiers Creek, Little Lake Howell Creek, Salt Creek, Six Mile Creek, Navy Canal, and Sweetwater Creek. With the exception of Little Lake Howell Creek and Navy Canal, the concentrations at the stations nearest the mouths of all tributaries were similar to or higher than the TP concentration in Lake Jesup. This indicates that control of phosphorus sources in these tributaries would likely be necessary if improvements in the lake were to occur.

Soldiers Creek and Sweetwater Creek had concentrations more than double those of Lake Jesup, and Salt Creek had concentrations about 1.5 times those of Lake Jesup. Although the concentrations in Sweetwater Creek and Salt Creek were high, these creeks have low flow, and consequently, low loads. However, this is an area of Lake Jesup that frequently had fish kills, suggesting that the nutrient inputs may have periodically led to algal blooms and low dissolved oxygen. There are alternative explanations (such as toxic inputs, discharge of low dissolved oxygen, or high biological oxygen demand) for this phenomenon; however, only nutrient data were analyzed in this study.

In Howell Creek, the tributary with the most monitoring stations, TP concentrations tripled below Lake Maitland and doubled again below Bear Creek, indicating significant sources of phosphorus upstream of these areas. In Gee Creek, concentrations doubled below Lake Triplett/Secret and slowly increased to the discharge into Lake Jesup. Soldiers Creek

downstream of State Road 419 had concentrations more than double those at State Road 419. Salt Creek TP concentrations declined by about one-third from the upstream-most station to the other station in the creek, although data for the upstream station were limited. Other tributaries either had similar concentrations at all stations or there was only one station upstream of Lake Jesup.

2.4 TECHNICAL UNCERTAINTIES ADDRESSED THROUGH MODIFICATION OF TMDL INFORMATION AND BMAP ASSUMPTIONS

The Lake Jesup TMDL and BMAP were developed with the best information available at the time (2004-2005 and 2006-2009, respectively). During these processes, a number of significant data gaps were identified, some of which were pertinent to the BMAP and others that need to be addressed prior to any future recalculation of the TMDL. The following text describes how each uncertainty was addressed. **Section 5.2** contains details of the research projects mentioned below.

- Nitrogen-fixation – At the time of the TMDL, information on the rate of nitrogen-fixation in Lake Jesup was not available. Instead, results from a study in Lake George were used to estimate nitrogen-fixation in Lake Jesup. To improve understanding of the lake dynamics and to obtain lake-specific data on nitrogen-fixation, several studies were completed and are planned in Lake Jesup. These studies will be used in future recalculation of the TMDL to revise the estimated rate of nitrogen-fixation and to help determine the relative loading from nitrogen-fixation versus external sources to the lake. This information will be included in the next cycle of the TMDL and will be used to revise the BMAP allocations, as necessary. Due to this uncertainty, this BMAP focuses on external TP load reductions. Upon recalculation of the TMDL, the need to modify the BMAP to include external TN load reductions will be evaluated.
- Sediment flux – Information varies widely about sediment flux (mineralization and resuspension from the sediments to the water column, mass deposition from the water column to the sediments, and diffusion) rates in Lake Jesup and the total loading that is contributed to the lake from this process. Studies have been and will be conducted to improve estimates of this rate and relative loading. This information will be used to refine the TMDL and BMAP, as necessary, in the next iteration.
- Water quality – Because of the uncertainties associated with the in-lake processes, the relationship between water chemistry and biological parameters in Lake Jesup is not understood in detail. This makes it difficult to predict the biological response associated with BMAP implementation. This relationship will be further studied as information from the in-lake processes is collected and may result in change to the TMDL target concentrations and TMDLs.
- Annexations – The boundaries of the cities and counties in the Lake Jesup BMAP have changed since the time of the TMDL due to annexation. The jurisdictional boundaries from the TMDL, as they existed in 2006, were used when allocating loads in this BMAP. However, in the next iteration of the BMAP, the revised boundaries will be considered and the allocations adjusted accordingly.
- Agricultural loads – Since the TMDL verified period, the total agricultural acreage and the distribution of acreage across the commodity types has changed. In the next iteration of the TMDL, updated land use information will be incorporated to reflect the current agricultural uses in the basin. In addition, any changes in land use from agriculture to development will be accounted for and the local government in which the development occurred will be responsible for any load reductions from that area. FDEP and the Florida Department of Agriculture and Consumer Services (FDACS) will work

together to determine how to account for loads from fallow agricultural land and will coordinate with any local governments that will be allocated loads from previous agricultural lands if the land use changes.

- Legacy agricultural loads – Portions of the basin had previously been used for agriculture and it is not known to what extent nutrients from fertilizers are still in the soils in these areas. In addition, the rate that these nutrients are leaching from the soils into the groundwater or surface runoff, and ultimately into Lake Jesup, is unknown.
- Attenuation – An attenuation factor was not applied to the allocations in this BMAP to account for assimilation in the watershed. The extensive spatial monitoring data that are necessary to determine this attenuation factor are currently not available. However, the primary objective of the monitoring strategy is to provide sufficient data to support recalculation of the allocations at a scale that incorporates natural attenuation (see **Section 5.1**). Further, ongoing monitoring will identify emerging “hotspots” (areas with high phosphorus concentrations). The allocations in the next TMDL cycle may be revised based on this information to address natural attenuation, hotspots, and sources not previously incorporated.
- Watershed loads – Two of the objectives of the BMAP monitoring strategy (**Section 5.1**) are to track trends in loading from the tributaries to Lake Jesup and to track inflow and outflow loads from each jurisdiction in the basin. The information gathered from this monitoring, in addition to research study efforts, will help improve the understanding of loads from different areas in the Lake Jesup watershed and refine the loading estimates in the TMDL during the next cycle to better reflect conditions in the Lake Jesup basin, specifically. This information will also be considered during the reevaluation of the BMAP allocations to ensure the estimated loading is attributed to correct jurisdiction.
- Noncontributing areas – Throughout the basin, there are areas that are considered to be “noncontributing” because the surface loads from these areas do not flow to Lake Jesup. For this BMAP, loads from these areas were removed from the required reduction calculations and load reduction efforts in these areas were not given credit. Loads associated with noncontributing areas are shown in a separate column of the allocation table. In the next iteration of the BMAP, additional information will be collected to refine the boundaries of the noncontributing areas and allocation recalculations will address the issue of noncontributing areas, both those identified currently and those that may be identified in the future by individual stakeholders.
- Site 10 – Consistent with the facility’s National Pollutant Discharge Elimination System (NPDES) permit, the City of Sanford is implementing a revised monitoring plan for Site 10. This will allow better calculation of loads from the site for refinement in the next iteration of the BMAP (refer to **Section 5.1.3.4** for details of the monitoring plan). The purpose of this monitoring is to obtain a better estimate of the nutrient loads in the runoff from the residuals and reuse applications on the site, and to determine if the measures implemented by the City are sufficiently reducing the loads from the site to the lake. In addition, FDEP and SJRWMD may study the effects of nutrient leaching from the residuals that have built up on the site and these residuals may need to be removed as part of future BMAP efforts. In this first iteration of the BMAP, a new EMC for stormwater from Site 10 was applied in the allocation calculations. Further, a groundwater study was completed to investigate the possibility of high phosphorus groundwater leaching from the site into the lake (FDEP, 2008; see **Appendix G**).
- Septic tanks – FDOH conducted a statewide inventory of septic tanks, which should provide better data about the number of tanks in the basin. In addition, FDEP is implementing a septic tank study, *Preliminary Evaluation of Septic Tank Influences on Nutrient Loading to the Lower St. Johns River Basin and Its Tributaries*. This study will

help to obtain better estimates of the concentration of nutrients from septic tanks and the distance from surface waters that septic tanks have a water quality impact. The information from these studies will be utilized in the next TMDL cycle to improve the estimated loading from septic tanks in the basin. The entities are also working to determine the locations of septic tanks within their jurisdictions in close proximity to surface waters to improve loading estimates in the next iteration of the TMDL. In addition, there are jurisdictional area issues related to placing some of the septic tanks on sewer. The utility boundaries do not always correspond with the jurisdictional boundaries and this issue will need to be resolved in order to effectively remove septic tanks that could be impacting surface waters. Local governments have also expressed concern that reductions associated with septic tanks have been allocated solely to them and not in part to FDOH. FDOH permitting rules are important for the control of loads from new septic tanks and proper maintenance of existing tanks. This will be a consideration in future iterations of the BMAP.

- Reclaimed water loads – Current watershed loading models do not address the loading associated with the use of reclaimed water for irrigation since the EMCs do not change in areas where it is likely that both fertilization and reclaimed irrigation occur. Available data from reuse studies will be considered for the next iteration of the TMDL modeling.
- Groundwater loads – Surficial groundwater loading is generally estimated from a limited number of samples, relative to surface water loads. Hot spots of nutrient loads in groundwater may exist in the basin. In addition to the Site 10 monitoring, SJRWMD and Seminole County are planning studies to determine the groundwater loading in the basin.
- EMCs – For the next iteration of the TMDL, the EMCs used in the model will be reevaluated and any updated information will be used to modify the EMCs, as necessary, for the land uses in the basin. For instance, the TMDL model included only one EMC for all agricultural land uses. In the next iteration of the TMDL and BMAP, consideration will be given to including more specific EMC values to match the commodity types and conditions in the Lake Jesup Basin. FDEP and FDACS will coordinate on appropriate values to include in the model. Monitoring work on Site 10 will also help to select an appropriate EMC for the site.
- Consumptive use projects – The focus of this BMAP is on external sources of loading to Lake Jesup. Studies are being conducted on lake processes, including sediment flux and nitrogen fixation, to determine the contributions of internal loading and how that loading should be addressed, if needed. Therefore, consumptive use projects are not considered for pollutant removal credit in this first iteration of the BMAP. Stormwater reuse projects are not considered “consumptive uses.” Because these projects reduce external loads to the lake, stormwater reuse projects may be considered for credit at FDEP’s discretion.
- In-lake treatment projects – There is a study underway to test a regional project that will draw water from the lake, clean the water, and return it to the lake. If this project, or something similar, is determined to be feasible, FDEP will consider providing credit for participation in this project. However, the main focus of this BMAP is on reducing external TP sources to the lake.
- Provisional BMP efficiencies – Several of the BMP activities included in the project lists were assigned provisional TP reduction estimates for the purposes of this first iteration of the BMAP. These provisional estimates were based on the best available information at the time. However, there are studies currently being conducted across the state, which will provide better estimates of the BMP efficiencies and this information will be used in the next iteration of the BMAP to revise the project reductions. These

provisional BMPs are: (1) street sweeping, (2) Stormceptor, (3) continuous deflective separation (CDS) units, and (4) public education and outreach efforts (see **Section 4.2.4**). If the new information on these BMPs indicates lower efficiencies than what was estimated for this BMAP, the entities that listed these BMPs may need to provide additional projects to make up for the difference in reductions. If new information shows a greater effectiveness than provided in the provisional values, this additional credit will be provided.

2.5 TMDL MODIFICATIONS

2.5.1 RATIONALE FOR THE TP FOCUS

As noted earlier, the Lake Jesup nutrient TMDL included reductions for TN as well as TP. However, nitrogen-fixation appears to be a significant percentage of the TN inputs to the lake and this contribution has not been quantified. In order to move forward with efforts to improve the lake water quality, this BMAP focuses only on the TP reductions. Concurrent with the BMAP process and implementation, studies to determine the effects of nitrogen-fixation have been completed and are being conducted (refer to **Section 5.2**). The information from these studies will be utilized to refine the TMDL and BMAP, as necessary, and to guide future project implementation efforts. Because nitrogen-fixation typically occurs in fresh waterbodies with high TP concentrations it is essential to reduce TP so that the lake's internal TN sources can be controlled. Also, as many management actions to reduce TP external loads will also reduce TN external loads, the focus on the TP TMDL in this BMAP should also partially address the TN TMDL.

2.5.2 TMDL REVISIONS DURING THE BMAP PROCESS

During the BMAP process, several modifications were made to the TMDL based on new information that was provided by the stakeholders in the basin. These changes fall into four main categories: (1) BMPs; (2) land uses; (3) load allocations; and (4) septic tanks. The modifications to the TMDL in each of these categories are described in detail below.

2.5.2.1 BMPs

The TMDL model estimated the starting point load for the surface runoff based on EMCs, land use, soil types, and rainfall. The original model also included estimated reductions associated with some of the BMPs that were in place at the time of the verified period. This suite of BMPs was based on information provided by the stakeholders. However, because BMP implementation is not uniform across the watershed, the model was updated during the BMAP process to focus on gross starting point loads, without any BMPs in place. This allowed credit to be provided for these BMPs as projects, thus applying credit directly to the entity which implemented the BMP instead of distributing credit across the entire watershed. The model included BMPs on the City of Sanford's Site 10 facility; however, these BMPs were related to the application of residuals on the site and not to stormwater controls. These BMPs were removed and not considered for BMAP credit because the Site 10 BMAP allocation only addresses stormwater loads and, therefore, only stormwater BMPs would be counted. In addition, the BMPs that were assigned to wetland areas were removed because most of the treatment occurred in a wet or dry pond before discharge to the wetland (Walter and Kelly, 2008).

2.5.2.2 Land Uses

Several revisions to the land use from the TMDL model were made during the BMAP process. It was determined that the Seminole County land use separated out internal subdivision roadways; whereas Orange County's internal roads were not separated. The internal roadways in Seminole County were converted to residential land uses because the residential land use types and EMCs include these roadways. This modification made the consideration of roadway runoff consistent throughout the basin. The model also included a land use category for agriculture/golf course. These two types of land use were separated out in the updated modeling to provide flexibility in assigning loading characteristics. However, since there are no EMCs specific to golf courses, the EMC remained the same as the one used for agriculture. In addition, after using aerial photography to compare Orange County's high density residential areas to the rest of the basin, an area of single family housing units in the Lake Burkett area of Orange County, identified as high density residential in the TMDL, was reclassified as medium density residential in the watershed to be consistent with density criteria applied to other jurisdictions (Walter and Kelly, 2008).

In addition to the land use changes described above, the City of Sanford Site 10 facility (refer to **Section 3.2.3** for additional information) was separated out as a distinct land use category. The loading estimate in the TMDL for Site 10 only accounted for the stormwater loads from the site and not the loads from application of reuse water and residuals. In order to recalculate the total TP loading from Site 10, several items were needed: (1) an updated land use map for the site; (2) an updated site boundary showing the portions that flow to the Lake Jesup Basin; (3) an updated runoff coefficient; and (4) an updated EMC. The updated land use information was based on the SJRWMD 2004 land use cover. The updated site boundary was provided by Camp Dresser and McKee (CDM), a consultant for the City of Sanford. Based on the site conditions from the reuse application activities, an updated runoff coefficient was calculated. An EMC that matched the specific conditions on Site 10 was not available; therefore, the EMC was calculated by extrapolating from information in two pasture runoff studies. Using the above information, a total TP loading for Site 10 was calculated as 4,121 lbs/yr of TP. Of this total load, approximately 632 lb/yr of TP is associated with surface runoff from the site while the remaining 3,489 lbs/yr of TP is attributed to the reuse water and residuals applications (Walter and Kelly, 2008). The estimate for the reuse water and residuals applications will need to be reevaluated in future iterations of the TMDL and BMAP because this load has been reduced by the City due to changes in the uses on site.

2.5.2.3 Load Allocations

When calculating the detailed allocations for the BMAP, FDEP, after discussions with the technical stakeholders, determined that all natural areas, including conservation areas, water, and wetlands, should be separated and not assigned an allocation. The loads from these areas are considered natural background and actions are not needed to reduce loading from these sites. Separating the water, wetland, and conservation areas in the allocation calculations benefited the jurisdictions that had taken an active role in wetland and other land conservation.

The Florida Department of Transportation (FDOT), Orlando Orange County Expressway Authority (OOCEA), and Turnpike Enterprise were identified as stakeholders and were assigned allocations. Adding these entities affected the allocations to the other stakeholders in the basin because loads from right-of-ways and roadways owned by these entities were allocated to the applicable transportation entity, not the local government in which the road exists. In addition, FDACS and agriculture were added as stakeholders. This change affected the other stakeholders in a similar way as the transportation break out. Loads from agricultural areas

were assigned to the “agriculture” allocation category, not the local government in which the area exists.

2.5.2.4 Septic Tanks

The TMDL included loading from functioning septic tanks that were within 200 meters of a surface waterbody. Information on the location and number of septic tanks in each jurisdiction is not consistently well known across all jurisdictions and, at the time of the TMDL, some of the needed data on septic tanks were not available. The TMDL septic tank loading estimate did not include Eatonville, Orlando, or Winter Park and did not include complete information for Maitland and Orange County. During the BMAP process, these entities (with the exception of Eatonville), provided information on septic tank counts and location in the basin based on their wastewater billing information. Information for Eatonville was obtained from the Florida Department of Health (FDOH) CENTRAX database, which tracks septic tank permits. The additional information from these entities was included in the calculations for the starting point septic tank load for the BMAP allocation calculations.

Also during the BMAP process, several stakeholders raised the issue that the FDOH regulation for permitting septic tanks is based on a 75 foot setback from surface waters, as opposed to the 200 meter (656 feet) distance used in the TMDL. The 75 foot setback was used in this BMAP while additional studies are ongoing throughout the state to determine a more appropriate septic tank setback distance that would be protective of water quality. The septic tank starting load for the BMAP allocations was revised to include septic tanks within 75 feet of surface waters throughout the watershed.

CHAPTER 3: PHOSPHORUS SOURCES AND DETAILED ALLOCATIONS

3.1 BMAP ALLOCATION PROCESS

The focus of this BMAP is on reducing external sources of TP (watershed surface runoff and near-field septic tanks). The detailed allocations described in this chapter were calculated by dividing the reduction required for each source to the entities based on their relative loading. The septic tank load reductions were only assigned to those entities that have jurisdiction over the loading (i.e., the cities, towns, and counties in the basin).

3.2 LOADING SUMMARY

3.2.1 STORMWATER

The major source of external loading in the Lake Jesup Basin is from surface runoff. During rain events, stormwater moves pollutants from sources such as fertilizers, pet waste, and roadways to the lake and its tributaries. An estimated total of 32,849 lbs/yr of TP enter the lake through stormwater runoff and reducing this load to the lake is a key component of the TMDL. The updated surface runoff starting load based on the TMDL modifications described in **Section 2.5.2** was used to allocate the 16,314 lbs/yr of TP reductions among the allocation entities.

3.2.2 SEPTIC TANKS

The total septic tank starting load that was recalculated during the BMAP process was similar to the starting load estimated in the TMDL. Therefore, the total reduction required from septic tanks (3,307 lbs/yr of TP) in the TMDL was allocated to the local governments that have jurisdiction over septic tanks. This allocation was determined based on the relative proportion of septic tank loads by entity, based on septic tanks located within 75 feet of a surface water. Stormwater and septic tank loads were then consolidated to provide a single nonpoint source loading from each entity.

3.2.3 CITY OF SANFORD “SITE 10” FACILITY

The Sanford Reuse Land Application Facility (“Site 10”) is located on the northeastern shore of Lake Jesup. Site 10 is approximately 1,868 acres, of which 1,252 acres are in the Lake Jesup Basin. Agriculture (pastures and citrus groves) and wetlands are the major land uses on the site. The City of Sanford NPDES permit allows discharge to a permitted capacity slow-rate reuse system on Site 10, including reclaimed water storage on site in two holding ponds. The water from the ponds is used to irrigate the hay fields and citrus groves on the site. In addition, the previous permit identified Site 10 as an area where land application of residuals occurred and this application began in May 1997 (CDM, 2007). Residuals application on Site 10 was discontinued in 2008 and the current permit prohibits land application of residuals on Site 10.

As noted above, the TMDL only accounted for the surface runoff loads from the site and did not estimate the TP loads associated with the reuse water and residual application activities. During the BMAP process, the stakeholders requested that the total loading from Site 10 be determined. To help accomplish this, two studies were conducted: one by CDM as a consultant for the City of Sanford (*City of Sanford Site 10 Data Evaluation*) and one by the FDEP Ground Water Protection Section (*Ground Water Assessment Report for Site 10*). CDM and FDEP used two different models with different assumptions and EMC values, which resulted in different loading estimates. Details on both of these studies can be found in **Appendix G**. The purpose of the CDM analysis was to model runoff from the site with revised land use

information. This analysis estimated that the site has a stormwater loading of 883 lbs/yr of TP or 573 lbs/yr of TP with BMPs in place (CDM, 2007). The FDEP assessment focused on shallow ground water conditions on Site 10. The purpose of this assessment was to provide current information for shallow groundwater in the hay field areas that drain to Lake Jesup. The TP concentrations from the monitoring wells ranged from non-detect to 5.3 mg/L, with a median for the four hay fields of 0.76 mg/L. A portion of the TP concentration was also attributed to natural conditions in the area (FDEP, 2008).

The 632 lbs/yr of TP that was calculated as the surface runoff load (refer to **Section 2.5.2.2**) was included in the allocation table as the starting point load for Site 10, which provided the basis for the required reduction. Since the load from the reclaimed water and residual applications were not originally considered in the TMDL, the 3,489 lbs/yr of TP from these sources was not included in the BMAP allocations. However, the City of Sanford has proposed projects to reduce the loading from these sources on Site 10 and also monitoring to determine water quality improvements. The projects to address these loads are discussed in **Section 4.1.2** and the proposed monitoring efforts are discussed in **Section 5.1.3.4**. In the next cycle of the TMDL, the monitoring data will be used to provide a better estimate of the total load from Site 10 and this information will be incorporated into the TMDL and allocations.

3.2.4 DERIVATION OF BMAP REQUIRED REDUCTIONS

The TMDL included estimates of TP loading from baseflow, groundwater (mainly from the surficial aquifer), and atmospheric deposition; however, the TMDL did not require reductions from any these sources. A portion of the load from these sources is considered natural background or is associated with upstream sources and is, therefore, an uncontrollable source in this BMAP. However, some of these sources originate in the basin and studies to determine the extent of groundwater and baseflow loading are planned (see **Section 2.4** and **Section 5.2**). The TP loading from the St. Johns River into Lake Jesup (associated with a 3,968 lbs/yr reduction identified in the TMDL) can be attributed to sources upstream of the basin. Therefore, the load reduction assigned to the river in the TMDL is not addressed in this BMAP. This load from the river should be reduced over the next five to ten years through projects in the Upper St. Johns River Basin and eventual projects related to other Middle Basin TMDLs. The starting loads, target loads, and required reductions in the TMDL are shown in **Table 3**, as well as the total reductions that will be addressed in a BMAP over the next 15 years.

TABLE 3: DERIVATION OF BMAP REQUIRED TP REDUCTIONS

SOURCE	STARTING LOADS FROM TMDL (LBS/YR)	LOADS TO MEET TARGET FROM TMDL (LBS/YR)	REQUIRED REDUCTIONS IN TMDL (LBS/YR)	TOTAL REQUIRED BMAP REDUCTIONS (LBS/YR)
Surface ¹	32,849	16,535	16,314	16,314
Baseflow	7,275	7,275	0	0
Septic Tanks	5,953	2,646	3,307	3,307
Groundwater	1,323	1,323	0	0
Atmospheric	6,834	6,834	0	0
River	11,244	7,276	3,968	0
Total	65,478	41,889	23,589	19,621

¹ The starting load from the TMDL includes the stormwater loads from urban areas, agriculture, and Site 10. Because the Site 10 facility does not have a permitted surface water discharge, there was no allocation provided in the TMDL for the wastewater facility. See Sections 2.5.2.2 and 3.2.3 for more information about how loads from the facility are addressed in this BMAP.

In addition to the sources included in the TMDL, there is the potential that in-lake processes are contributing TP loading. However, as noted in **Section 2.4**, there is currently not enough

information to quantify the loading contribution from these sources. For this reason, this BMAP focuses on reductions from external loads until more information is available on the in-lake processes. The 19,621 lbs/yr of TP reduction identified in **Table 3** was divided among the stakeholders in accordance with the load-based allocations.

3.2.5 LAND USE CHANGE AND POPULATION GROWTH IMPACTS

Future growth impacts from 2005 through 2025 were evaluated for the Lake Jesup Basin. In addition to the value of considering future growth from a resource standpoint, Paragraph 403.067(7)(a)(2), F.S., requires that BMAPs “identify the mechanisms by which potential future increases in pollutant loading will be addressed.” This 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, less rain filters into the ground, and runoff and the pollutants carried in that runoff increase. Population growth also affects pollutant loading by increasing the intensity of activities such as traffic, lawn fertilization, pet ownership, and others. 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, BMPs, personal habits, and other means.

3.2.5.1 Analysis of Future Growth

Transportation Analysis Zone (TAZ) data were selected as the primary data source for evaluating future population projections in the Lake Jesup Basin. The TAZ data for Orange and Seminole counties were provided by METROPLAN ORLANDO, which is the metropolitan planning organization for Orange, Osceola, and Seminole counties. 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. TAZ data are based on U.S. Census data and Bureau of Economic and Business Research projections, and the data are reviewed closely by local planners during their compilation. TAZ data include a variety of demographic and transportation statistics. For this analysis, only the population estimates were used. Population data were aggregated across all housing types (e.g., single family, multifamily). These future growth estimates do not include increases in commercial or industrial activities not associated with increases in residential population.

Population estimates for each TAZ in 2015, 2020, and 2025 were used to calculate population density by TAZ. 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. Population density and density change over time were then calculated using these revised TAZ acreages. The population density growth estimates provided a general sense of the location and intensity of increasing density in the basin. **Figure 4** through **Figure 6** show the population density estimates in 2015, 2020, and 2025 with areas highlighted that have a greater than 50% increase in population density over a five-year period.

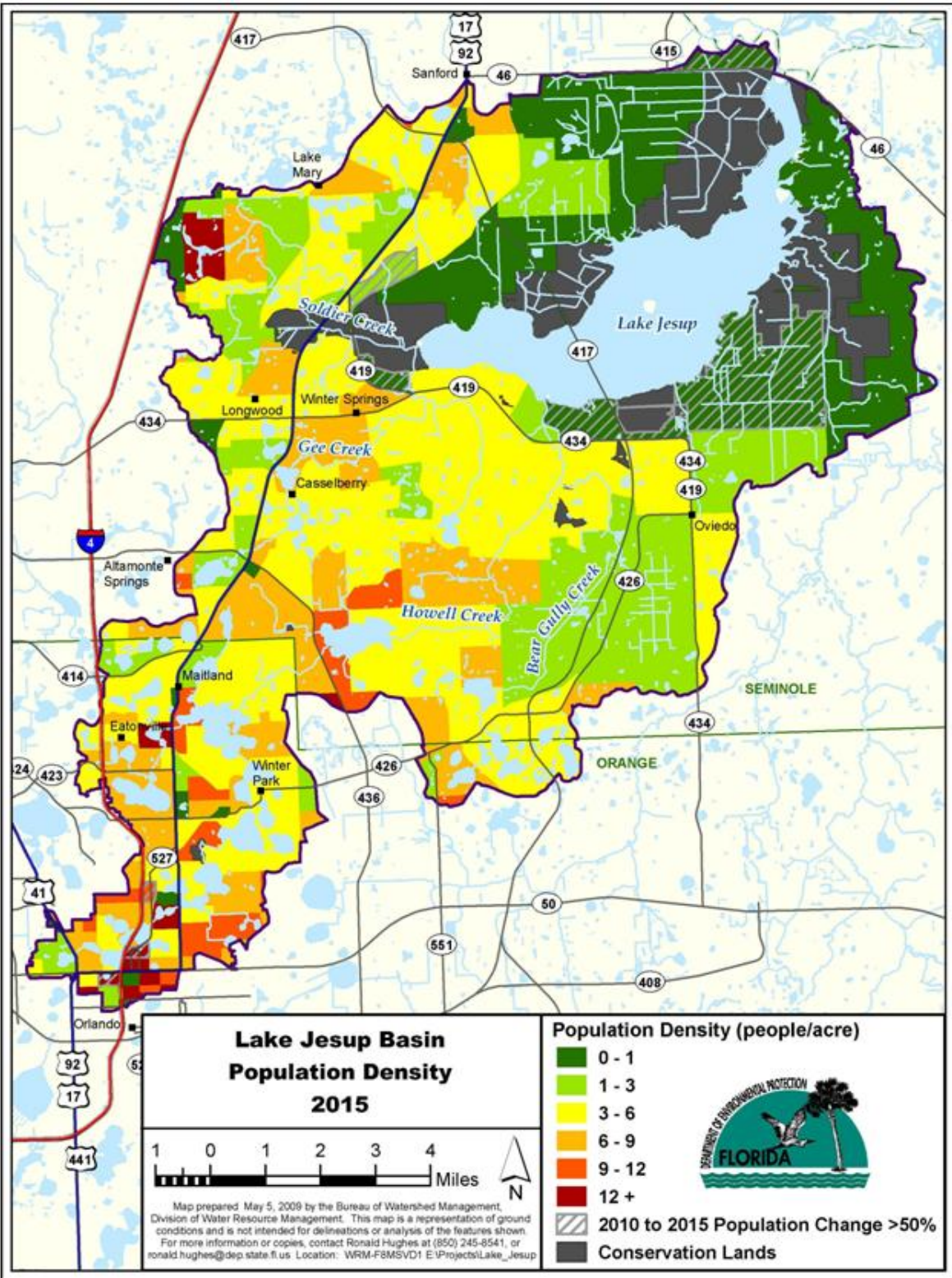


FIGURE 4: LAKE JESUP BASIN ESTIMATED POPULATION DENSITY IN 2015

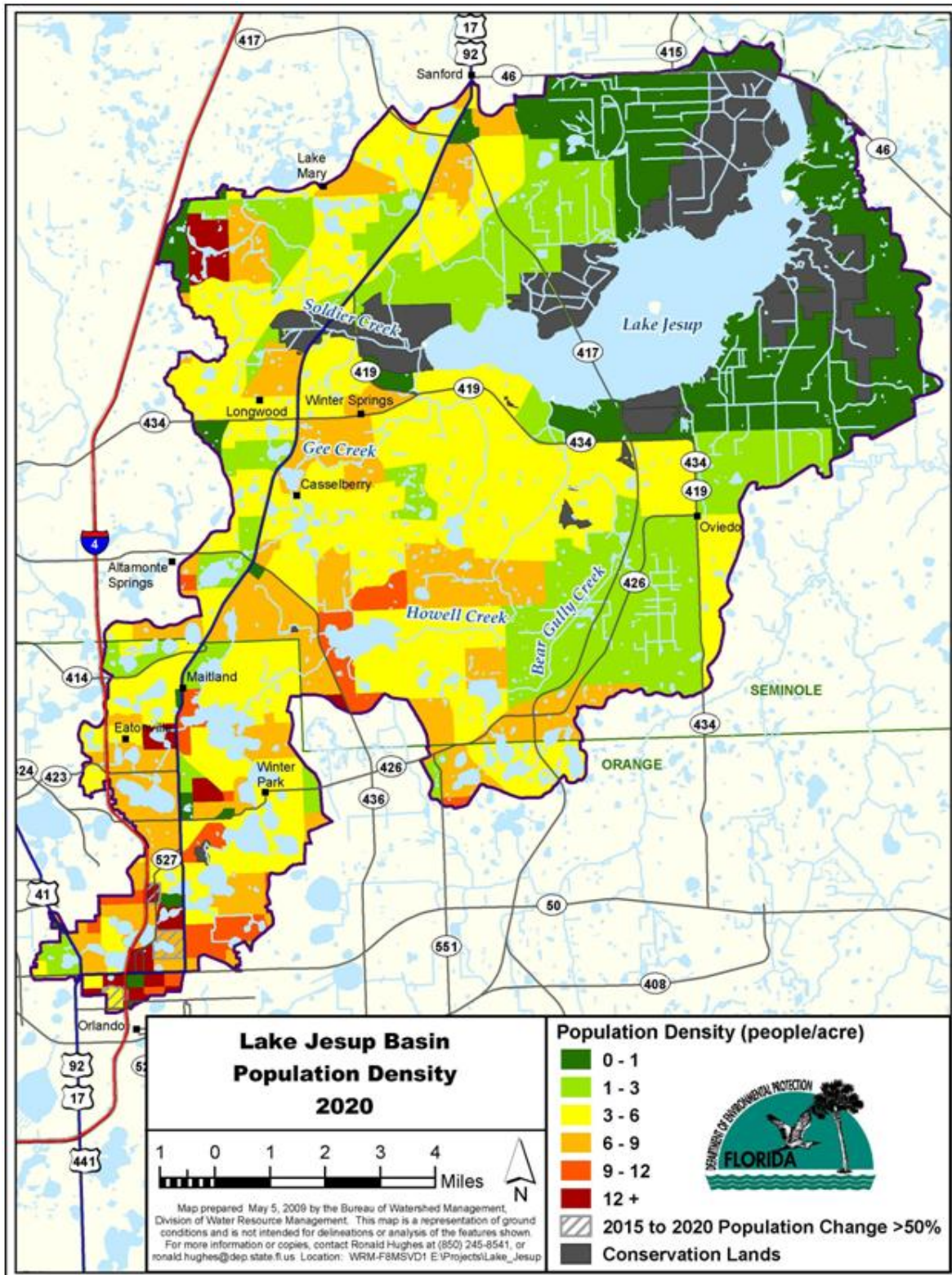


FIGURE 5: LAKE JESUP BASIN ESTIMATED POPULATION DENSITY IN 2020

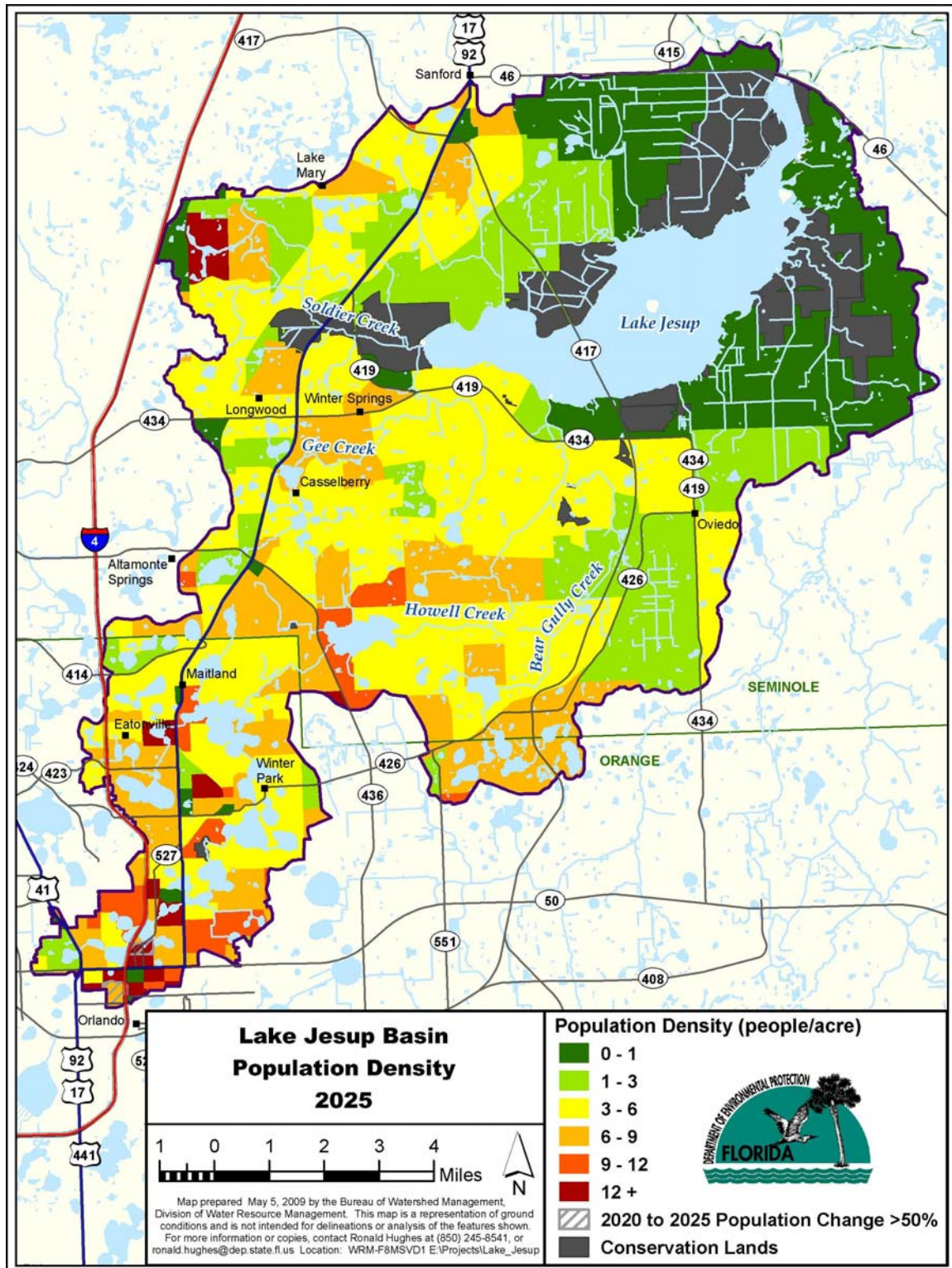


FIGURE 6: LAKE JESUP ESTIMATED POPULATION DENSITY IN 2025

3.2.5.2 Impacts of Future Growth

As shown in the above figures, there are some areas of expected growth greater than 50%. The projected growth between 2010 and 2015 includes several larger areas with high growth

potential; however, the population densities in these areas is expected to be 0 – 3 people per acre, which is a relatively low density. From 2015 to 2020 and 2020 to 2025, changes in density greater than 50% occur in much smaller areas of the southernmost extent of basin, furthest from Lake Jesup.

While increases in population are expected over the next 15 years, major increases in population densities in the basin are not expected. The entities in the basin have already taken steps to address TP loading from future growth, as well as efforts to reduce the impacts of existing development through stormwater retrofits and septic tank removals. **Section 4.2.6** summarizes the low impact development (LID) efforts, comprehensive plan amendments, and ordinances that each entity has implemented to reduce or prevent impacts from future growth. **Appendix E** provides additional detail on the LID measures in the basin. Given the extent of LID implementation and current build-out in the basin, the potential effect of future growth was not quantified nor allocated as additional reduction requirements in this BMAP. If the local and statewide efforts to abate the impacts of future growth are insufficient, further reduction requirements to address new nutrient loads could be incorporated in future BMAP allocations.

3.3 ALLOCATIONS

The need for detailed allocations by entity became clear early in the BMAP process. Stakeholders in the Lake Jesup Basin agreed that a fair approach would be to determine the relative contribution of each entity to the surface runoff and septic tank (if applicable) loadings and use this relative contribution to apportion the required reductions. This percentage was separately calculated for each entity for the surface runoff load and septic tank load. The percentages were then applied to the 16,314 lbs/yr (7.4 metric ton [MT]) surface reduction and 3,307 lbs/yr (1.5 MT) septic tank reduction specified in the TMDL. While the percent reduction in the TMDL was not directly applied, the total load reduction required by the TMDL was allocated to the entities.

During the BMAP process, several areas in the jurisdictions that do not contribute loading (“noncontributing basins”) to Lake Jesup were identified. These areas were removed and the loads associated with these locations (approximately 870 lbs/yr) set aside. Therefore, the total required reduction for the BMAP is 18,748 lbs/yr.

There are several major unknowns in the basin that could affect the TMDL calculations and detailed allocations in the BMAP (refer to **Section 2.4**). To allow time for additional monitoring and research studies to address these unknowns, the required reductions were split into three five-year time periods. This BMAP is the first of three phases that will each address one-third of the required reductions. When sufficient information becomes available, allocations and required reductions for the second and third five-year periods will be recalculated. The monitoring strategy outlined in **Section 5.1** provides details of the planned data collection efforts.

3.3.1 DETAILED ALLOCATIONS BY ENTITY

Table 4 shows the starting load and final required reduction for the responsible entities. The TMDL did not require reductions from atmospheric deposition, baseflow, and groundwater. As noted above, the TMDL did include a load reduction for inflows from the St. Johns River; however, that reduction is not addressed in this BMAP. In addition, when determining the detailed allocations, sources of natural background (water, wetlands, and conservation areas with no pasture lands) were not assigned load reductions.

TABLE 4: TP WASTELOAD ALLOCATIONS FOR 15-YEAR IMPLEMENTATION PERIOD

ALLOCATION ENTITY	TOTAL TP STARTING LOAD (LBS/YR)	NONCONTRIBUTING AREAS LOAD (LBS/YR)	TOTAL TP REDUCTION REQUIRED (LBS/YR)*
Agriculture	1,149	8	764
Atmospheric Deposition	6,834	0	0
Baseflow	7,275	0	0
City of Altamonte Springs	116	21	57
City of Casselberry	1,557	1	1,028
City of Lake Mary	1,229	4	793
City of Longwood	1,122	115	616
City of Maitland	906	212	374
City of Orlando	1,570	73	979
City of Oviedo	1,156	0	776
City of Sanford	2,722	22	1,807
City of Winter Park	1,771	72	1,111
City of Winter Springs	2,301	6	1,539
FDOT District 5	646	37	397
Groundwater	1,323	0	0
OOCEA	23	0	16
Orange County	2,746	1	1,707
Seminole County	10,151	239	6,411
St. Johns River Upstream	11,244	0	0
Town of Eatonville	194	60	70
Turnpike Authority	451	0	303
Water/Wetland/Conservation Areas	7,758	164	0
Total	64,244	1,035	18,748

* Reductions subject to change as new information on the noncontributing areas, natural attenuation, and lake assimilation become available.

This first BMAP will address one-third of the total load reductions shown in the table above. **Table 5** shows the required reductions for the first five-year period from 2010 to 2014. Atmospheric deposition, baseflow, groundwater, St. Johns River, and water, wetland, and conservation areas do not have a required reduction, as noted above.

TABLE 5: TP WASTELOAD ALLOCATIONS FOR 2010-2014

ALLOCATION ENTITY	2010-2014 TOTAL REQUIRED REDUCTION (LBS/YR)*
Agriculture	254.7
Altamonte Springs	19.0
Casselberry	342.7
Eatonville	23.4
FDOT District 5	132.3
Lake Mary	264.3
Longwood	205.3
Maitland	124.8
OOCEA	5.2
Orange County	569.0
Orlando	326.3
Oviedo	258.7
Sanford	602.2
Seminole County	2,137.0
Turnpike Authority	101.1
Winter Park	370.5
Winter Springs	513.0
Total	6,249.5

* Reductions subject to change as new information on the noncontributing areas, natural attenuation, and lake assimilation become available.

CHAPTER 4: MANAGEMENT ACTIONS

4.1 RELATED PERMIT PROGRAMS

4.1.1 MUNICIPAL STORMWATER PERMITS

Fifteen of the 17 allocation entities qualify as a “municipal separate storm sewer system” (MS4) and, as such, are regulated by the Florida NPDES MS4 Program. The majority of MS4 permittees in this basin are Phase I MS4s, the requirements of which are outlined in Chapters 62-4, 62-620, 62-621 and 62-624, F.A.C. The MS4s in the Lake Jesup Basin are listed in **Table 6**.

TABLE 6: LOCAL GOVERNMENTS IN THE LAKE JESUP BASIN DESIGNATED AS REGULATED MS4S

PERMITTEE	MS4 TYPE	PERMIT #
City of Orlando	Phase I	FLS000014
Orange County City of Maitland City of Winter Park Town of Eatonville FDOT	Phase I	FLS000011
Seminole County City of Altamonte Springs City of Casselberry City of Lake Mary City of Longwood City of Oviedo City of Sanford City of Winter Springs FDOT	Phase I	FLS000038
Turnpike Authority	Phase II	FLR04E049

To avoid the need for re-opening MS4 permits each time a TMDL or BMAP is adopted, the following language is included in Phase I MS4 permits that automatically require the implementation of any stormwater requirements in an adopted BMAP. This “TMDL” clause states: *“In accordance with Section 403.067, F.S., NPDES permits must be consistent with the requirements of adopted Total Maximum Daily Loads (TMDLs). Therefore, when a Basin Management Action Plan (BMAP) and/or implementation plan for a TMDL for a water body into which the permitted MS4 discharges the pollutant of concern is adopted pursuant to Section 403.067(7), F.S., the MS4 operator(s) must comply with the adopted provisions of the BMAP and/or implementation plan that specify activities to be undertaken by the permittee(s) during the permit cycle that are for the purpose of addressing discharges from the MS4 to meet the TMDL allocation.”*

Most Phase II MS4s are regulated under a generic permit. Operators of regulated Phase II MS4s must develop a Stormwater Management Program that includes 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. Section 62-624.200(2), F.A.C., defines an illicit discharge as “...any discharge to an MS4 that is not composed entirely of stormwater...,” except discharges pursuant to a NPDES permit, or those listed in rule that do not cause a violation of water quality standards. Illicit discharges can include septic/sanitary sewer discharge, car wash wastewater, laundry wastewater, improper disposal of auto and household toxics, 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 generally met through state stormwater permitting requirements under Part IV, Chapter 373, F.S., 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 Phase II generic permit [Section 62-621.300(7)(a), F.A.C.] also has a self implementing clause that compels a permittee to implement its stormwater pollutant load responsibilities within an adopted BMAP. It states: *“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.”*

4.1.2 CITY OF SANFORD SITE 10 WASTEWATER PERMIT

Since the initiation of the BMAP process, the City of Sanford has ceased applying biosolids to Site 10. The last application of residuals to the site occurred in May 2008. Sanford now distributes its Class AA biosolids to staff and residents who can use it as fertilizer. Under the Sanford/North wastewater treatment facility (WWTF) permit, future biosolids application on Site 10 will be prohibited. In emergency conditions, when the demand for the Class AA biosolids is not great enough, Sanford has a contract with a private processing facility that will accept the biosolids, which avoids the need to apply any additional residuals to Site 10 (CDM, July 2009).

Sanford has established an inter-local agreement with Volusia County to provide reclaimed water and the city is currently working on a pipeline design to deliver up to 1.5 million gallons per day (MGD) of reclaimed water to the county for irrigation purposes. Sanford also has an agreement with the City of Lake Mary and Seminole County to provide reclaimed water while they are both expanding their distribution systems. Reclaimed water sent to these other areas will result in less application to Site 10. Until those systems are in place and Sanford is able to measure the reduction in volume of reclaimed water applied to Site 10, a quantified TP load reduction to Lake Jesup can only be estimated at this time. From the 2007 memorandum prepared by CDM (refer to **Appendix G**), the TP loading to Site 10 from reclaimed water application resulted in approximately 4,202 lbs/yr. The average flow rate used in the 2007 analysis is consistent with the limits specified in the Volusia County agreement; therefore, there is a potential for this entire load to be removed from Site 10 (CDM, July 2009).

In addition to the inter-local agreements, Sanford has plans to modify the long-term use of Site 10 under the State Road 46 Alternative Water Supply Initiative, which will use the site for a potable alternative water supply treatment facility. Improvements may include expanding and lining the existing holding ponds on Site 10 to increase their capacity from 37 million gallons (MG) to 144 MG. The lining of these ponds may also reduce TP loadings to Lake Jesup through surficial groundwater. Additionally, Sanford has plans to upgrade their Mill Creek site with a pump station and other improvements so that they can store approximately 40 MG of reclaimed water during wet weather conditions (CDM, July 2009).

Sanford has also implemented Actiflo[®] high-rate clarification into their wastewater process, which has the capability to reduce TP concentrations. However, only pilot studies have been performed to date and the Actiflo is currently in use during periods of heavy flow, when the plant capacity is being stressed. Sanford will be collecting data over time in order to quantify the benefits of this new system and its potential load reduction capabilities as it pertains to Site 10 (CDM, July 2009). Additional details about these changes to the Sanford WWTF and Site 10 can be found in **Appendix G**.

4.2 MANAGEMENT ACTIONS

“Management actions” refers to the suite of activities that the Lake Jesup BMAP allocation entities will be conducting to achieve their required TP reduction. These include structural and nonstructural activities. The projects and timeframes for implementation submitted by the entities to achieve their first five-year BMAP reductions are summarized in the tables in **Appendix D**. These projects were submitted to provide reasonable assurance to FDEP that each entity has a plan on how they will meet their allocation. However, this list of projects is meant to be flexible enough to allow for changes that may occur over time, provided that the required reduction is still met within the specified timeframe. New projects may be substituted for those identified in **Appendix D** during the annual BMAP progress report process.

4.2.1 MANAGEMENT ACTION TYPES

The allocation entities in the Lake Jesup Basin provided information on projects and programs that they have in place or will be implemented to meet their BMAP reductions in the first five-year period. These management actions fall into one of four categories: (1) BMPs included in the TMDL; (2) completed and funded projects and programs; (3) planned projects and programs; and (4) participation in regional projects (either the *Interagency Strategy* projects or local cooperative projects) (see **Section 4.2.3**). A summary of the reductions each entity will achieve through these project categories is shown in **Table 7**.

TABLE 7: SUMMARY OF ESTIMATED TP LOAD REDUCTIONS BY MANAGEMENT ACTION CATEGORY

ENTITY	SUMMARIZED BY MANAGEMENT ACTION CATEGORY				TOTAL (LBS/YR)	CREDIT FOR FUTURE BMAPs (LBS/YR)
	TMDL BMPs	COMPLETED/ FUNDED	PLANNED	INTERAGENCY/ LOCAL COOPERATIVE		
Agriculture	29.9	-	206	18.8 ¹	254.7	0
Altamonte Springs	35	-	5.1	-	40.1	21.1
Casselberry	0	367.7	95.1	-	462.8	120.1
Eatonville	9.6	-	0.3	13.5	23.4	0
FDOT	101.9	109.4	126.9	-	338.2	205.9
Lake Mary	0	308.8	70.3	-	379.1	114.8
Longwood	58.9	24.8	45.5	69.7	198.9	-6.4 ²
Maitland	0.7	36.1	85.6	-	122.4	-2.4 ²
OOCEA	0	12.8	-	-	12.8	7.6
Orange County	31.5	170.1	178.4	189	569.0	0
Orlando	34.8	818.2	105.2	-	958.2	631.9
Oviedo	386.5	-	416.4	-	802.9	544.2
Sanford	504.7	16.5	112.5	-	633.7	31.5
Seminole County	1,749.1	859.3	576.5	-	3,184.9	1,047.9
Turnpike Authority	0	252.3	12.2	-	264.5	163.4
Winter Park	0.4	402.6	119.9	-	522.9	152.4
Winter Springs	765.2	230	403.8	-	1399	886.0
TOTAL (lbs)	3,708.2	3,608.6	2,559.7	291.0	10,167.5	3,918.0

¹ Reflects reductions that may be achieved by publicly funded projects, if needed. Refer to **Section 4.2.5** for discussion.

² Due to some project calculation adjustments done by FDEP, the remainder of the required reductions for this first BMAP will be met as part of the responsibilities in the second iteration of the BMAP.

The total project reductions in **Table 7** are greater than the required reductions for this first BMAP (see **Table 5**). Several entities provided sufficient projects to meet their first five-year required reductions along with additional projects to meet their second, and in some cases third, five-year requirements. **Table 7** and the tables in **Appendix D** show which entities have additional credits towards their obligations in future BMAPs.

4.2.2 ELIGIBILITY

Management actions had to meet several criteria to be considered eligible for credit in the BMAP. All projects and programs were required to address nutrient loads (specifically TP) to receive credit. The BMPs that were included in the TMDL as part of the modeling process to determine needed load reductions were given credit. Through the BMAP process, some of the information on the BMPs in the TMDL was refined to more accurately estimate expected TP reductions. Any completed projects that were missing from the TMDL were also included in the BMAP project list. However, since the effectiveness of these older projects is unknown, additional reductions may be needed in future BMAP iterations to achieve the necessary TMDL reductions. In addition, future management actions were given credit for the portion of the load reduction that was over and above any permit requirements. This criterion was needed since permit conditions are established to maintain the current condition (prevent further impacts from the development) and do not contribute to the improvement of water quality.

Based on these eligibility requirements, the entities submitted structural and nonstructural projects to reduce the nonpoint source loading from stormwater and septic tanks. **Table 8** summarizes the load reduction for each entity by project type (note: the total reductions shown in this table are the same as the total reductions in **Table 7**).

TABLE 8: SUMMARY OF TP LOAD REDUCTIONS BY PROJECT TYPE

ENTITY	SUMMARIZED BY PROJECT TYPE						TOTAL (LBS/YR)
	STRUCTURAL STORMWATER	PUBLIC EDUCATION	STREET SWEEPING	SEWERING	AGRICULTURAL BMPs	INTERAGENCY/ LOCAL COOPERATIVE	
Agriculture	N/A	N/A	N/A	N/A	235.9	18.8 ¹	254.7
Altamonte Springs	35	4.6	0.5	N/A	N/A	-	40.1
Casselberry	371.9	85.6	5.3	-	N/A	-	462.8
Eatonville	9.6	0	0.3	-	N/A	13.5	23.4
FDOT	241.4	6.5	90.3	N/A	N/A	-	338.2
Lake Mary	264.3	67.6	2.7	44.5	N/A	-	379.1
Longwood	61	44.9	0.6	22.7	N/A	69.7	198.9 ²
Maitland	74.2	40.8	7.4	-	N/A	-	122.4 ²
OOCEA	12.8	N/A	N/A	N/A	N/A	-	12.8
Orange County	191.6	151	37.4	-	N/A	189	569.0
Orlando	857.5	86.4	14.3	-	N/A	-	958.2
Oviedo	744.9	46.2	11.8	-	N/A	-	802.9
Sanford	521.2	108.9	3.6	-	N/A	-	633.7
Seminole County	2,613.50	558.3	13.1	-	N/A	-	3,184.9
Turnpike Authority	252.3	9	3.2	N/A	N/A	-	264.5
Winter Park	403.0	106.3	13.6	-	N/A	-	522.9
Winter Springs	1,299.70	92	7.3	-	N/A	-	1399
TOTAL (lbs)	7,953.9	1,408.1	211.4	67.2	235.9	291.0	10,167.5

¹ Refer to **Section 4.2.5** for additional details on the agriculture commitment to regional project participation.

² Due to some project calculation adjustments done by FDEP, the remainder of the required reductions for this first BMAP will be met as part of the responsibilities in the second BMAP.

4.2.3 REGIONAL PROJECTS

While the majority of the projects submitted for this BMAP are jurisdictional projects, the option was also provided to participate in larger scale, regional projects. The regional projects are located in areas of the basin that have high nutrient concentrations; therefore, they can achieve large reductions in a cost effective manner. The regional projects include both local cooperative projects and the projects identified in the *Lake Jesup Interagency Restoration Strategy* (FDEP, FWC, and SJRWMD, 2008).

An example of a local cooperative project is the Solary Canal project, which is being implemented by SJRWMD, Seminole County, Oviedo, and Winter Springs. SJRWMD purchased the land for this project and helped to fund the construction. The local government project partners will be equally responsible for the operation and maintenance of the project and each will receive a portion of the TP reduction credit based on their financial contribution to the total project cost. The project tables for Seminole County, Oviedo, and Winter Springs in **Appendix D** include this project. Other entities also have the opportunity to develop local cooperative projects and Seminole County has proposed several projects and is currently seeking partners.

Another option is for the entities to participate in the regional projects outlined in the *Lake Jesup Interagency Restoration Strategy* (FDEP, FWC, and SJRWMD, 2008). The *Interagency Strategy* was jointly developed by FDEP, SJRWMD, and the Florida Fish and Wildlife Conservation Commission (FWC). The strategy lays out a plan for the restoration of Lake Jesup that will be implemented in two phases. The first phase includes developing the BMAP, reducing external loads to the lake, and reducing nutrients in the lake water column. The second phase of the strategy will be implemented as necessary after the first phase is complete. The steps in the second phase include implementing additional projects to further improve water

quality, implementing projects to increase native vegetation and control exotic species, and implementing projects to establish healthy fish and wildlife habitat and populations. Throughout both phases, water quality monitoring will occur to track progress towards achieving the plan's five main goals:

1. Reduced external nutrient loads (phosphorus and nitrogen).
2. Reduced water column phosphorus and nitrogen concentrations.
3. Increased water clarity through reduction in phytoplankton abundance and turbidity.
4. Increased coverage of native submerged and emergent vegetation.
5. Improvements in fish and wildlife habitats and populations.

This BMAP, which focuses on reducing external sources of phosphorus, is consistent with the *Interagency Strategy* and should help achieve the five goals of the plan.

As part of this first iteration of the BMAP, Eatonville, Longwood, Orange County, and agriculture have committed to meeting part of their required reductions through participation in a regional project, either an *Interagency Strategy* project or a local cooperative project. Additional entities may participate in a regional project in a future BMAP to meet their reductions for 2015-2019 and 2020-2024.

For the five-year period of this first BMAP, the regional projects do not need to be completed by 2014 since cooperative projects are more difficult to coordinate than single-entity projects. Instead, projects that are cooperatively funded by two or more local governments must have the permit issued, funding commitments in place, and the bid document issued for the project by the end of 2014 to receive credit during this BMAP implementation period.

4.2.4 PROVISIONAL BMPs

Several of the BMP activities included in the project lists were assigned provisional TP reduction estimates for the purposes of this first iteration of the BMAP. These provisional BMPs are: (1) street sweeping; (2) CDS and Stormceptor units; and (3) public education and outreach efforts. Studies to estimate the efficiencies of these BMPs are currently being conducted across the state, which will provide better information on the expected reductions from these BMPs for use in the next iteration of the BMAP to revise the project reductions. If the new BMP information indicates lower efficiencies than what was estimated for this BMAP, the entities that listed these BMPs in their project tables may need to provide additional projects to make up for the difference in reductions. If the new BMP information indicates higher efficiencies, the entities will receive additional credit if they included these BMPs on their project list.

4.2.4.1 Street Sweeping

The method for calculating nutrient reductions from street sweeping used in this BMAP is based on a per roadway mile swept. These calculations were based on data from the U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (EPA) Center for Watershed Protection, University of South Florida, and Orange County's Stormwater Management Division. The efficiencies for different frequencies of sweeping are shown in **Table 9**. Allocation entities provided the total miles swept and the frequency in the Lake Jesup Basin and this information was used to calculate the estimated TP load reduction, as shown in **Appendix D**.

TABLE 9: STREET SWEEPING EFFICIENCY VALUES

SWEEPING FREQUENCY	TP REMOVAL EFFICIENCY
Daily or 2 times/week	7%
Weekly	5%
2 times/month	4%
Monthly	3%
Quarterly	2%
Annually	1%

4.2.4.2 CDS Units and Stormceptor

Provisional credit was also provided for CDS units and Stormceptor. A 5% reduction was assigned to CDS units and a 10% reduction was assigned to Stormceptor. The entities that included one or both of these BMPs in their project tables are shown in **Appendix D**.

4.2.4.3 Public Education and Outreach

Up to a 6% reduction in the starting point load was assigned based on the education and outreach efforts conducted by each entity. The 6% load reduction estimate was determined from the EPA Center for Watershed Protection (CWP) Watershed Treatment Model. Credit was given for the following applicable education activities:

1. Local funding to implement the Florida Yards and Neighborhoods (FYN) program within the city or county.
2. Local land development codes or ordinances that require Florida Friendly landscaping on all new developments; require commercial landscapers to obtain training and certification through the Green Industry BMP program; require irrigation systems per Sections 125.568 and 166.048, F.S. and Section 373.185, F.S.; and which specify fertilizer application rates and types. Local ordinances that control pet waste and require that residents pick up and properly dispose of pet wastes.
3. Implementation of public service announcements (PSAs) on local cable or commercial television and radio stations.
4. Informational pamphlets on pollution prevention, fertilizer application, Florida Friendly Landscaping, water conservation, septic tank maintenance, etc. Presentations on these topics to civic groups, local businesses, students, and the general public.
5. Websites to provide information on reducing nutrient pollution for homeowners and businesses.
6. Inspection program and public call-in number to address illicit discharges.

Credit was assigned to the entities for the above efforts as follows:

- If all six types of activities are conducted by an entity, then the full 6% reduction was assigned.
- If an entity only has FYN, they received a 3% reduction credit.
- If an entity only has the Florida friendly ordinances (irrigation, landscaping, fertilizer, and pet waste management), then they received a 2% reduction.
- If an entity only has the PSAs, websites, brochures, and the inspection program, they received a 1% reduction credit.
- Other combinations of efforts were analyzed on a case-by-case basis for credit.

Appendix D summarizes the public education activities conducted by each entity and the associated load reductions.

4.2.5 ADDRESSING AGRICULTURAL NONPOINT POLLUTION

Nutrient reductions from agricultural land uses will be achieved through the implementation of agricultural BMPs, as discussed below.

4.2.5.1 Agricultural BMPs

BMPs are individual or combined practices determined through research, field-testing, and expert review to be the most effective and practicable means for improving water quality, taking into account economic and technological considerations. Two categories included in FDACS-adopted BMPs are nutrient management and irrigation management. Nutrient management is the amount, timing, placement, and type of fertilizer. University of Florida Institute of Food and Agricultural Sciences (UF-IFAS) recommended fertilizer applications, soil and tissue 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 nutrient management BMPs. 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. In several areas of the state, FDACS-funded Mobile Irrigation Labs identify and demonstrate irrigation efficiency techniques to growers.

4.2.5.2 Agricultural Producers' Responsibilities under the FWRA

Section 403.067(7)(b), F.S., requires that nonpoint pollutant sources (such as agriculture) included in a BMAP demonstrate compliance with pollutant reductions needed to meet a TMDL, either by implementing appropriate BMPs (adopted by FDACS or FDEP, as applicable), or conducting water quality monitoring prescribed by FDEP or the applicable water management district. If these pollutant sources do not either implement BMPs or conduct monitoring, they may be subject to enforcement by FDEP or the applicable water management district.

Pursuant to section 403.067(7)(c), F.S., implementation of FDACS-adopted, FDEP-verified BMPs in accordance with FDACS rule provides a presumption of compliance with state water quality standards. In addition, growers who implement BMPs may be eligible for cost share from the water management district, FDACS, or others. Through the Office of Agricultural Water Policy (OAWP), Division of Forestry, and Division of Aquaculture, FDACS develops, adopts, and assists producers in implementing agricultural BMPs to improve water quality and water conservation. Recent research initiatives conducted by SJRWMD and other state and federal agencies have proven that BMPs can be implemented successfully, and can significantly reduce loads while sustaining production. The targets for enrolling agricultural acres in the basin are shown in **Table 10**.

TABLE 10: TARGETS FOR ENROLLMENT IN AGRICULTURAL BMPs

OAWP BMP PROGRAMS	ENROLLMENT TARGETS*	SUCCESS MEASURE
Citrus	100% of targeted agricultural operations within 5 years of BMAP adoption	Number of targeted operations enrolled, with associated acres on which applicable BMPs will be implemented
Container Nurseries		
Vegetable/ Agronomic Crops		
Sod Farms		
Cow/Calf Operations	100% of targeted agricultural operations within 5 years of manual adoption	
In-Ground Nurseries		
Equine/Horse Farms		

* Enrollment numbers will depend on the ability of field staff to identify and locate producers, and whether producers choose to implement BMPs or monitor their water quality. Also, specific agricultural land uses and number of

agricultural operations may change from year to year. Progress on enrollment, based on best available information, will be included in the annual BMAP report.

Based on information from county agricultural extension agents and FDACS/OAWP field staff, a rough estimate indicates there are between 50 and 60 agricultural operations that appropriately could be targeted for enrollment in the basin. As of June 30, 2009, nine producers within the Lake Jesup Basin counties had submitted notices of intent (NOIs) covering about 208 acres to implement FDACS-adopted BMPs. **Table 11** and **Table 12** show the adjusted estimated agricultural acreage in the watershed by land use, the current NOIs submitted, and the associated acres enrolled in related BMP programs. No producers are conducting water quality monitoring in lieu of implementing BMPs at this time.

It is important to understand that even if all targeted agricultural operations are enrolled, not all the agricultural acres shown in **Table 12** will be included. This is because land use data can contain non-production acres (buildings, parking lots, fallow acres, etc.) that will not be counted on the NOIs submitted to FDACS, and there may be some small farms (e.g., small-plot cow-calf owners not in commercial production) that it is not necessary to enroll. The NOIs will document the estimated total number of acres on which one or more of the selected BMPs are implemented, not the entire parcel acreage.

TABLE 11: SUMMARY OF AGRICULTURAL MANUALS AND PROGRAMS

AREA	ACRES	PERCENT OF WATERSHED
Lake Jesup Basin	87,346.3	100
Agriculture	4,824.2	5.5
AGRICULTURAL AREA	ACRES	PERCENT OF AGRICULTURAL ACREAGE
Without Adopted OAWP Manuals/Programs	92.9	1.9
With adopted OAWP Manuals/Programs*	4,731.3	98.1
Enrolled in adopted OAWP Manuals/Programs	208.5	4.3

* This figure may contain acres for which a BMP manual has not been adopted because of the aggregation of commodities within land use types.

TABLE 12: AGRICULTURAL ACREAGE AND BMP ENROLLMENTS FOR THE LAKE JESUP BMAP AREA

LAND USE CODE	LAND USE DESCRIPTION	TOTAL ACRES	RELATED FDACS BMP PROGRAMS	COMMENTS	ACREAGE ENROLLED	NUMBER OF NOIS
2120	Unimproved Pasture	17.4	Cow/Calf	Manual adopted (Spring 2009)	N/A	N/A
2130	Woodland Pasture	151.4				
2110	Improved Pasture	2,256.5	Future ¹	Vegetable/Agronomic under revision (Fall 2010)	N/A	N/A
2140	Row Crop	196.1	Vegetable/Agronomic	Manual Adopted (Winter 2006)	15.0	1
2150	Field Crops	16.0				
2160	Mixed Crops	0.0				
2210	Citrus	1,340.8	Ridge Citrus ²	BMP Adopted (Winter 1996)	100.0	2
			Flatwoods Citrus ²	Manual Adopted (Winter 2005)	0.0	0
2240	Abandoned Tree Crops (citrus)	0.0	N/A	Out of production/abandoned - no enrollment needed	N/A	N/A
2310	Cattle Feeding Operation	0.0	Future	Conservation Plan Rule under development (Spring 2010)	N/A	N/A
2330	Poultry Feeding Operation	2.5			N/A	N/A
2400	Nurseries and Vineyards	384.8	Container Nursery ³	Manual Adopted (Fall 2007)	See 2430	See 2430
			Future	Specialty Fruit & Nut under development (Fall 2010)	N/A	N/A
2200	Tree Crops	0.0	Future	Comprehensive Nursery under development (Fall 2010)	N/A	N/A
			Future	Specialty Fruit & Nut under development (Fall 2010)	N/A	N/A
2410	Tree Nurseries	0.0	Future	Comprehensive Nursery under development (Fall 2010)	N/A	N/A
			Future	Specialty Fruit & Nut under development (Fall 2010)	N/A	N/A
2430	Ornamentals	90.2	Container Nursery ³	Manual adopted (Fall 2007)	93.5	6
2431	Shade Ferns	0.0	Future	Comprehensive Nursery under development (Fall 2010)	N/A	N/A
2432	Hammock Ferns	0.0				
2450	Floriculture	2.3				
2420	Sod Farm	278.0	Sod	Manual adopted (Fall 2008)	0.0	0
2510	Horse Farm	88.2	Future	Equine manual under development (Spring 2010)	N/A	N/A
2610	Fallow Cropland	0.0	N/A	Acreage not in production as of land use survey	N/A	N/A
2540	Aquaculture	0.0	(FDACS Aquaculture Division)	Aquaculture Certification Program	N/A	N/A
N/A	TOTAL	4,824.2	N/A	N/A	208.5	9

Note: Acreages based in part on SJRWMD 2004 land use level II data.

¹Acreage included in this land classification that is exclusively in hay production will be covered in a future revision of the Vegetable & Agronomic Crop manual.

²To be included in development of comprehensive citrus manual.

³Acreage included in this land classification that is in non-containerized nursery production will be covered in a comprehensive nursery manual, under development.

4.2.5.3 Estimated Agricultural Load and Load Reduction Allocation

Table 13 contains the agricultural load estimates for nutrients used in establishing the TMDLs, and the reductions required of agricultural land uses in the Lake Jesup Basin. The acreage used to calculate the starting point agricultural nutrient load is based on 2004 land use information from the SJRWMD. FDACS adjusted this estimate to more accurately reflect the current agricultural land use acreage. The FDACS adjusted acreage had approximately 2,650 less agricultural acreage than the TMDL, which is about 42% less agricultural acreage. In addition, because of data limitations, all agricultural land uses were assigned the same loading rate (event mean concentration) in the TMDL model.

Due to these factors, the estimated total load shown in **Table 13** for agriculture is greater than the actual loading. In addition, the region is expected to have continuing shifts from agricultural to residential land uses. This will further reduce the agricultural load. More precise information will be incorporated into the next iteration of the TMDL, and the estimated agricultural load will be adjusted to reflect the updated acreage figure. In advance of that, during the first phase of BMAP implementation (2010-2014), FDACS will work with FDEP to determine the actual agricultural load and recalculate the remaining reductions needed.

4.2.5.4 Load Reduction Estimates for BMPs

The agricultural load reduction estimates, shown in **Table 13**, are based on commodity-specific methods developed for the Lake Okeechobee watershed. The Lake Okeechobee watershed methods were selected because the nature of the agricultural operations and the distribution of soil hydrologic groups share similarities with those in the Lake Jesup Basin. However, basin-specific methods with emphasis on assumed typical conditions have yet to be developed. An example of this is the field-grown palm acreage being assigned typical conditions associated with standard ornamental operations. These values may assume conditions, such as typical phosphorus fertilization rates, that differ from actual field conditions.

In addition, the agricultural load reduction estimates are based on updated acreage estimates, which total 2,650 acres less than the acreage used in the TMDL. Further ground-truthing of agricultural acreage, along with the potential refinement of a basin- and commodity-specific agricultural loading/reduction model should be considered during the first BMAP cycle.

TABLE 13: ESTIMATED AGRICULTURAL TP LOAD, LOAD REDUCTION ALLOCATION, AND REDUCTIONS

ESTIMATED LOADS	TOTAL	2010-2014 EXISTING BMPs	2015-2019 NEW BMPs	2020-2024 MAINTAIN
Estimated Total Load	1,149.0	N/A	N/A	N/A
Load Reduction Allocation	764.0	254.7	254.7	254.7
Estimated Load Reductions via BMPs	277.9	235.9	42.0	0.0
Remaining Reductions Needed	486.1	18.8	212.7	254.7
Estimated Load Reduction Based on Updated Acreage Adjustments	N/A	N/A	To be determined	To be determined
Remaining Load Reductions Needed	N/A	N/A	To be determined	To be determined

4.2.5.5 FDACS OAWP Role in BMP Implementation and Follow-Up

BMP Implementation

The OAWP assists agricultural producers enrolled in its programs in implementing BMPs. The OAWP employs field staff and contracts with service providers to work with producers to submit NOIs to implement the BMPs appropriate for their operations. Depending on the region of the

state, these providers include the soil and water conservation districts, UF–IFAS, and natural resource development and conservation councils. They also give technical assistance to producers and, as funding allows, help implement cost-share programs that leverage regional, state, and federal funds.

The OAWP will recruit producers within the Lake Jesup Basin to enroll in adopted BMP programs applicable to their operations. OAWP staff and contractors will identify existing growers, to the greatest extent possible, with the help of grower associations, information on county agricultural exemptions, field staff knowledge, and other means. Staff/contractors will assist producers in selecting the appropriate BMPs, with emphasis on nutrient management, irrigation management, sediment/erosion control, stormwater management, and record keeping.

As necessary, growers will be notified that if they choose not to implement BMPs, they are required by statute to conduct water quality monitoring prescribed by FDEP or SJRWMD in order to demonstrate compliance with the allocations in the TMDL.

Table 14 identifies the key nutrient-related BMPs that would most likely be applicable to operations in the Lake Jesup Basin. By definition, BMPs are technically and economically feasible. However, FDACS BMP manuals contain some BMPs that may only be affordable with financial assistance, depending on the economic viability of the operation. The BMP checklists allow producers to indicate whether a BMP is not economically feasible, on a case-by-case basis. As BMP cost share becomes available to the basin, FDACS will work with producers to implement applicable key BMPs that otherwise are not affordable.

TABLE 14: KEY NUTRIENT-RELATED BMPs ADOPTED BY THE FDACS OAWP

KEY NUTRIENT-RELATED BEST MANAGEMENT PRACTICES
Determining Nutrient Needs
Soil and Tissue Testing: Used to base fertilizer applications on plant needs and available nutrients in the soil; helps prevent over-application of fertilizer.
Nutrient Budgeting: Adjustment of fertilizer regime to account for other nutrient sources, such as bio-solids, legumes, manure, and nutrient-laden irrigation water; helps prevent over-application of fertilizer.
Managing Nutrient Application
Precision Application of Nutrients: Use of specialized equipment for precise placement of nutrients on targeted areas at specified rates; reduces total amount used and prevents stray applications.
Equipment Calibration/Maintenance: Ensures proper functioning of equipment; prevents misapplication or over-application of fertilizer materials.
Split Fertilizer Applications: Multiple applications timed with optimal growth stages; allows plants to assimilate nutrients more efficiently; reduces nutrient loss in leaching and runoff.
Fertigation: Application of fertilizer through irrigation water; allows for direct nutrient application to the crop root zone and more efficient assimilation by plants, reducing nutrient loss in leaching and runoff.
Controlled-Release Fertilizer: Use of fertilizer formulations that have a controlled nutrient release curve; reduces nutrient loss to leaching and runoff.
Fertilizer Application Setbacks from Waterbodies (wetlands, watercourses, sinks, springs, etc.): Establishes a zone where no fertilizer will be applied; reduces nutrient loadings to waterbodies.
Managing Irrigation
Irrigation Scheduling: Planning when to irrigate to reduce water and nutrient losses, based on available soil moisture content, evapotranspiration levels, recent rainfall, and time of day.
Monitoring Soil Moisture and Water Table: Use of devices that measure the water table level and the amount of water in the soil; is a key component of proper irrigation scheduling.
Tailwater Recovery: Use of down-gradient catchment ponds to trap irrigation tailwater to be reused on cropland; reduces offsite transport of nutrients and conserves water.
Treatment and Erosion Control
Filter Strips: Vegetated strips of land designed to reduce nutrients and sediments in surface water runoff from fields, pastures, and livestock high-intensity areas before it reaches downstream waterbodies.

KEY NUTRIENT-RELATED BEST MANAGEMENT PRACTICES
Vegetative Buffers: Establishment of riparian and/or wetland buffers to attenuate and assimilate nutrient- or sediment-laden surface flows coming from cropped/grazed areas.
Ditch Maintenance and Retrofits: Use of rip rap, sediment traps, staging structures, and permanent vegetative bank cover to minimize erosion and transport of nutrient-laden sediments.
Livestock Management (Applicable to Cow/Calf and Equine Operations)
Alternative Water Sources: Use of upland livestock watering ponds and/or water troughs; minimizes manure deposition in waterbodies.
Rotational Grazing: Movement of cattle to different grazing areas on a planned basis; prevents concentrated waste accumulations and denuding of pasture areas. May involve fencing.
High-Intensity Areas Location: Siting of cowpens, supplemental feed areas, etc., away from waterbodies to minimize nutrient loadings.
Operations Management
Fertilizer Storage: Proper location/storage of bulk fertilizer products to prevent nutrient loadings.
Fertilizer Mix/Load: Use of appropriate dedicated or temporary mix/load areas located away from waterbodies to prevent nutrient loading.
Employee Training: Training provided to farm workers on how to implement BMPs.
Record Keeping: Proper record keeping provides accountability in the implementation of BMPs, and assists the producer in making nutrient and irrigation management decisions.

OAWP BMPs and staff contact information are located at <http://www.floridaagwaterpolicy.com>. Printed BMP manuals can be obtained in the local extension office at county agricultural extension centers, or by contacting OAWP field staff.

Follow-Up and Reporting on BMP Enrollment and Implementation

In addition to enrolling targeted operations in the relevant BMP programs, the OAWP will:

- Document the submitted NOIs, which will include a list of the BMPs to be implemented.
- Document the amount of total agricultural acreage covered by the NOIs.
- Assist growers in understanding and implementing BMPs properly.
- Through the Implementation Assurance Program:
 - o On a rotating basis by program, mail written surveys to all operations in the Lake Jesup Basin under an active FDACS NOI, to evaluate BMP implementation and update information on ownership, land use, acreage, etc.
 - o Perform random site visits on operations in the basin that are under a FDACS NOI, to ensure that the BMPs are being implemented, providing assistance and reasonable opportunities to producers to correct any deficiencies. This will serve as a “spot check” for the surveys, and will not cover all operations because of resource limitations.
- Through regional field staff, follow up on identified areas/operations of particular concern (e.g., large-acreage operations, “hot spots,” etc.).
- Participate in annual BMAP reporting on enrollment efforts and results, follow-up activities conducted, new manuals adopted, any new efforts planned, and estimated load reductions.

The FWRA requires that, where water quality problems are demonstrated despite the proper implementation of adopted agricultural BMPs, FDACS must institute a re-evaluation of the practices, in consultation with FDEP, and modify them if necessary. Continuing water quality problems will be detected through the BMAP monitoring component and other FDEP and

SJRWMD activities. If a re-evaluation of the BMPs is needed, FDACS will also include SJRWMD and other partners in the process.

4.2.5.6 FDEP and SJRWMD Roles in BMP Implementation

The FWRA states that nonpoint source dischargers who fail either to implement the appropriate BMPs or conduct water quality monitoring prescribed by FDEP or a water management district may be subject to enforcement action by either of those agencies. In the case of continuous non-cooperation by an agricultural producer in implementing BMPs, FDACS will consult with FDEP and SJRWMD to determine whether it is necessary for one of those agencies to intervene.

FDEP and SJRWMD will work cooperatively with OAWP to determine the most appropriate action to take (site inspection, prescribed water quality monitoring, enforcement), based on the circumstances. FDEP and SJRWMD will provide an annual summary of the non-compliance reports they receive and any related actions they take.

4.2.5.7 Beyond BMPs

Under the FWRA, when FDEP adopts a BMAP that includes agriculture, it is the agricultural producer's responsibility to implement water quality BMPs adopted by FDACS and verified as being effective by FDEP. The Lake Jesup BMAP target for BMP implementation is to enroll all producers in the watershed in the relevant FDACS BMP programs. As shown in **Table 13**, implementation of agricultural BMPs on all operations (based on adjusted agricultural acreage figures) is estimated to achieve 248 lbs/yr of TP of the 771 lbs/yr of TP reduction required of agricultural sources.

As discussed previously, the agricultural loading estimate does not reflect the significant reduction in agricultural acreage since the period of record for the TMDL, so the load reduction needed may be significantly lower than calculated. However, if acreage adjustments and BMP implementation do not fully account for the current agricultural load reduction allocation, it will be necessary to develop and implement cost-assisted field- and/or regional-level treatment options that remove nutrients from farm discharges. As needed, FDACS will work with local, regional, state, and federal partners to explore opportunities and funding sources to develop and implement effective treatment projects. As appropriate to achieve agricultural load reductions, these might include *Interagency Strategy* projects or other cooperative initiatives in the basin.

4.2.6 ACTIONS TO ADDRESS LOADING FROM FUTURE GROWTH

The future growth analysis described above identified areas of population growth. To achieve pollution reductions in these high growth areas, the state and EPA want developers to look to LID and other green infrastructure practices to reduce the hard surfaces that prevent water from infiltrating the ground where it can be treated naturally. Stakeholders in the basin have a variety of programs in place to manage the water quality impacts of future growth. Each stakeholder operates under a specific set of guidelines, policies, and requirements that regulate development within their jurisdiction, as shown in **Table 15**.

TABLE 15: LAKE JESUP BASIN STAKEHOLDER DEVELOPMENT REGULATIONS

STAKEHOLDER	DEVELOPMENT REGULATIONS
SJRWMD	Environmental Resource Permit (ERP) Regulations
Altamonte Springs	Comprehensive Plan
	Code of Ordinances
	Land Development Code
Casselberry	Code of Ordinances
	Comprehensive Plan
Eatonville	Comprehensive Plan
	Land Development Code
Lake Mary	Comprehensive Plan
	Code of Ordinances
Longwood	Community Development Documents
Maitland	Comprehensive Plan
	Code
Orange County	Comprehensive Plan
	Code of Ordinances
Orlando	Growth Management Plan
	Code
Oviedo	Comprehensive Plan
	Land Development Code
Sanford	Comprehensive Plan
	City Code
	Land Development Regulations
Seminole County	Comprehensive Plan
	Land Development Code
Winter Park	Comprehensive Plan
	Land Development Code
Winter Springs	Comprehensive Plan
	Code of Ordinances

4.2.6.1 Low Impact Development

Conventional stormwater systems have typically been designed to collect, convey and discharge runoff away from development as efficiently as possible. The purpose of stormwater management was first and foremost to prevent flooding. The concept of LID in stormwater management was introduced in the late 1990s (U.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 the stakeholders are undertaking to maintain or improve water quality within the Lake

Jesup Basin. There are numerous creative LID techniques to treat, use, store, retain, detain and recharge stormwater runoff and new methods are evolving. **Appendix E** provides examples of how stakeholders in the Lake Jesup Basin are implementing LID principles and activities.

4.2.6.2 Other Development-Related Management Actions

Stakeholders in the basin are implementing other activities to address the impact of future growth. One example is that Orange County planners are working on including LID strategies in the update of the Urban Design Element of the Comprehensive Plan. They are also developing an infill master plan that may include LID building practices for re-development.

There are many opportunities that local governments in the basin can undertake to build on the current implementation of LID. Regulatory initiatives can be proposed to require increasing the amounts of on-site runoff retention, or to provide additional water quality treatment to remove suspended sediments. Orange County is considering expanding LID policies adopted as part of the Wekiva Parkway Protection Act to cover the entire county. Orange County Comprehensive Plan Policy 4.5.2 of the Future Land Use Element encompasses the full spectrum of LID concepts and strategies, providing a concise example that other jurisdictions can use as a model.

Legislatively, local governments can pursue changes in the SJRWMD, FDOT, and Florida Building Code rules to promote LID practices and provide support from the State level. Local governments can initiate or expand incentive programs for builders and developers. Permitting preferences, streamlined permitting, or reductions in permit fees may be given where LID practices are used over traditional techniques in complying with standards. Perhaps the greatest impact that local governments have had with regard to LID is through education and outreach. This activity could be expanded to include specific training for local building officials, planners, engineers and reviewers on LID. Such training will serve to overcome the reluctance on the part of staff to review and approve innovative practices. Similar outreach should be provided to developers, builders, and landscape architects.

Through continued implementation of LID principles listed in **Appendix E**, land acquisition, and continued regulatory support, the water quality effects of future growth will be minimized in the Lake Jesup 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 SJRWMD, local governments, and the development community have been built through implementation of the projects noted in the appendix. This foundation will be important to the ongoing success of LID and similar efforts in the Lake Jesup Basin.

4.3 SECTION 319 FUNDING NINE ELEMENTS

Although many different components may be included in a watershed plan, EPA has identified a minimum of nine elements that are critical for achieving improvements in water quality. EPA requires that these nine elements be addressed for watershed plans funded using incremental Section 319 funds and strongly recommends that they be included in all other watershed plans that are intended to remediate water quality impairments. This BMAP includes the recommended elements, as shown in **Table 16**, which benefits the entities applying for Section 319 funding for the projects in the BMAP. Additional information on these elements can be found in the “Draft Handbook for Developing Watershed Plans to Restore and Protect Our Waters,” located online at: http://www.epa.gov/owow/nps/watershed_handbook/.

TABLE 16: EPA ELEMENTS OF A WATERSHED PLAN

EPA ELEMENT	EPA ELEMENT	SECTION IN BMAP WHERE ADDRESSED
1	Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan.	Sections 1.3, 3.2, and 3.3
2	An estimate of the load reductions expected from management measures.	Sections 3.3 and 4.2 and Appendix D
3	A description of the nonpoint source management measures that will need to be implemented to achieve load reductions, and a description of the critical areas in which those measures will be needed to implement this plan.	Section 4.2 and Appendix D
4	Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.	Section 1.2.3 and Appendix D
5	An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.	Sections 1.2.1 and 4.2, Appendix C, and Appendix D
6	Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.	Appendix D
7	A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.	Sections 1.2.3 and 5.1 and Appendix D
8	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.	Sections 1.3 and 5.1 and Appendix D
9	A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item 8 immediately above.	Section 5.1

CHAPTER 5: MONITORING AND EVALUATION

Successful BMAP implementation requires commitment and follow-up. In the Commitment to Plan Implementation (**Chapter 6**), Basin Working Group members have expressed their intention to carry out the plan, monitor its effect, and continue to coordinate within and across jurisdictions to achieve water quality targets. The information gathered as part of this monitoring plan will be used to recalculate the TMDL and BMAP allocations in the next five-year cycle.

5.1 MONITORING STRATEGY

The Lake Jesup BMAP was developed with the best information available regarding in-lake processes, water quality conditions, nutrient sources, and project effectiveness. This monitoring strategy is designed to enhance the understanding of basin loads, track project implementation, and identify long-term water quality trends. This information will measure progress toward achieving the TMDL and provide a foundation for continued improvement in cost-effective project implementation. Sampling stations, parameters, frequency, and other elements of this strategy may be modified as appropriate to match changing environmental conditions and funding resources. However, any modifications made shall not affect the ability of the monitoring network to fulfill the objectives noted below, including quantification of trends in TP that will be used to evaluate progress toward meeting the TMDL.

5.1.1 OBJECTIVES

Focused objectives are critical for a monitoring strategy to provide the information needed to evaluate implementation success. The primary and secondary objectives of the monitoring strategy for both Lake Jesup and its tributaries are described below. Primary objectives are necessary to evaluate success of the BMAP and refine the TMDL model in the next iteration. Secondary objectives contribute to this evaluation, can help interpret data collected, and provide refinements for potential future refinements of the TMDL and/or BMAP.

Primary Objectives

1. Track trends in total phosphorus load in Lake Jesup and its tributaries through the ambient monitoring network.
2. Determine inputs to Lake Jesup.
3. Track trends in inflow and outflow nutrient loads from each jurisdiction for model refinement, attenuation calculations, and determination of reductions from BMAP projects.
4. Collect necessary information on nutrient loads to support future refinement of the TMDL (refer to **Section 5.2** for research studies).

Secondary Objectives

1. Identify areas within the watershed that exhibit unusually high loadings of total phosphorus (“hot spots”) to better focus management efforts.
2. Monitor trends in total nitrogen in Lake Jesup and its tributaries to determine to what extent reductions in total phosphorus is helping to control nitrogen fixation in the lake (see **Section 2.4** for a discussion of the relationship between TP and nitrogen-fixation).
3. Track ecological and limnological responses to BMAP implementation.
4. Verify the BMP effectiveness values used in the Lake Jesup BMAP (see **Section 2.4**).

5.1.2 WATER QUALITY INDICATORS AND RESOURCES RESPONSES

To achieve the objectives above, the monitoring strategy focuses on two types of indicators to track water quality trends: core and supplemental (**Table 17**). The core indicators are directly related to the parameters causing impairment in the lake and its tributaries. Supplemental indicators are monitored primarily to support the interpretation of core water quality parameters. At a minimum, the core parameters will be tracked to determine progress towards meeting the TMDL (see **Table 19**). In addition, resource responses to BMAP implementation will also be tracked (**Table 18**). Changes in water chemistry are expected to occur within a relatively short timeframe, depending on the actual rate of project implementation and rainfall conditions. A significant amount of time may be needed for the changes in water chemistry to be observed in the resource responses. However, resource responses represent improvements in the overall ecological health of Lake Jesup.

TABLE 17: CORE AND SUPPLEMENTAL WATER QUALITY PARAMETERS FOR AMBIENT MONITORING

CORE PARAMETERS	LAKE JESUP - ANTICIPATED TREND	TRIBUTARIES - ANTICIPATED TREND
Chlorophyll-a (corrected)	Decrease in concentration	Decrease in concentration
Total Phosphorus (as P)	Decrease in concentration	Decrease in concentration
Orthophosphate as P	Decrease in concentration	Decrease in concentration
Ammonium as N (NH ₄)	No trend anticipated	No trend anticipated
Nitrate/nitrite as N	No trend anticipated	No trend anticipated
Total Kjeldahl nitrogen (TKN)	Possible decrease in concentration*	Possible decrease in concentration*
Biological oxygen demand (BOD)	Decrease in concentration	Decrease in concentration
SUPPLEMENTAL PARAMETERS	LAKE JESUP	TRIBUTARIES
Specific conductance	Monitored to support interpretation of core indicators	Monitored to support interpretation of core indicators
Dissolved Oxygen (DO)	Monitored to support interpretation of core indicators	Monitored to support interpretation of core indicators
pH	Monitored to support interpretation of core indicators	Monitored to support interpretation of core indicators
Temperature	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

Note: Anticipated trends are only for the first 5-year BMAP implementation period.

* The focus in this BMAP is on reducing external TP loads to the lake. However, some of the projects in the BMAP to reduce TP may also result in a reduction in TN.

TABLE 18: ANTICIPATED RESOURCE RESPONSES FROM BMAP IMPLEMENTATION

RESOURCE RESPONSES	LAKE JESUP	TRIBUTARIES
Reduction in the trophic state index (TSI)	X	
Increase in stream condition index (SCI) score	X	X
Increase in Shannon-Weaver diversity index	X	X
Increase in key fish populations	X	

5.1.3 MONITORING NETWORK

The monitoring network for this plan builds on existing efforts in basin by:

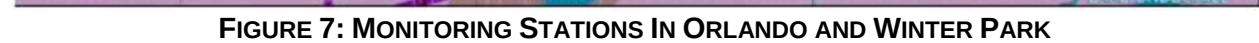
- Orange County
- Seminole County
- Altamonte Springs
- Casselberry
- Lake Mary
- Longwood
- Maitland
- Orlando
- Oviedo
- Sanford
- Winter Park
- SJRWMD
- FDEP

Table 19 lists the stations that are included in the BMAP monitoring network. The water quality monitoring will be conducted on a monthly basis to assess the conditions in the watershed and within Lake Jesup to determine changes in water quality from the actions implemented as part of the BMAP. The flow stations throughout the basin will take measurements every 15 or 60 minutes and this information will be used to calibrate the model. The storm event stations are described in further detail in **Section 5.1.3.2**. The stations in the monitoring network are also shown in **Figure 7** through **Figure 13**.

In addition to the BMAP monitoring network, the entities in the basin are also conducting sampling that will provide supplemental data to meet the monitoring strategy objectives. This additional monitoring is described in **Appendix F**. The research studies, as described in **Section 5.2**, will also provide information that will be utilized in the next iteration of the TMDL and BMAP.

5.1.3.1 FDOT Role in the Monitoring Network

Due to the fact that FDOT District Five's jurisdiction extends across multiple MS4 boundaries, FDOT District Five currently relies on the lead permittees (Orange County and Seminole County) for compliance with the water quality monitoring component of the respective Phase I MS4 permit. Additionally, stormwater runoff from FDOT District Five's right-of-way discharges to waterbodies monitored by the existing monitoring programs in place by Orange County and Seminole County. FDOT District Five has a joint-participation agreement with Seminole County to provide financial support for Seminole County's Watershed Atlas and five quarterly NPDES monitoring sites. FDOT District Five and Seminole County are negotiating the current agreement for FDOT to provide additional funds to assist with the County's monitoring program. FDOT District Five is also currently negotiating a similar agreement with Orange County to provide financial support for Orange County's water quality monitoring program. FDOT District Five will not be developing an independent monitoring program for the Lake Jesup BMAP and will continue to rely on Orange and Seminole County's monitoring program in support of the first iteration of the Lake Jesup BMAP. In the next iteration of the Lake Jesup BMAP, FDOT District Five will coordinate with Orange and Seminole County to evaluate proposed changes, if any, to the joint-participation agreements based on changes to the monitoring programs of each County.





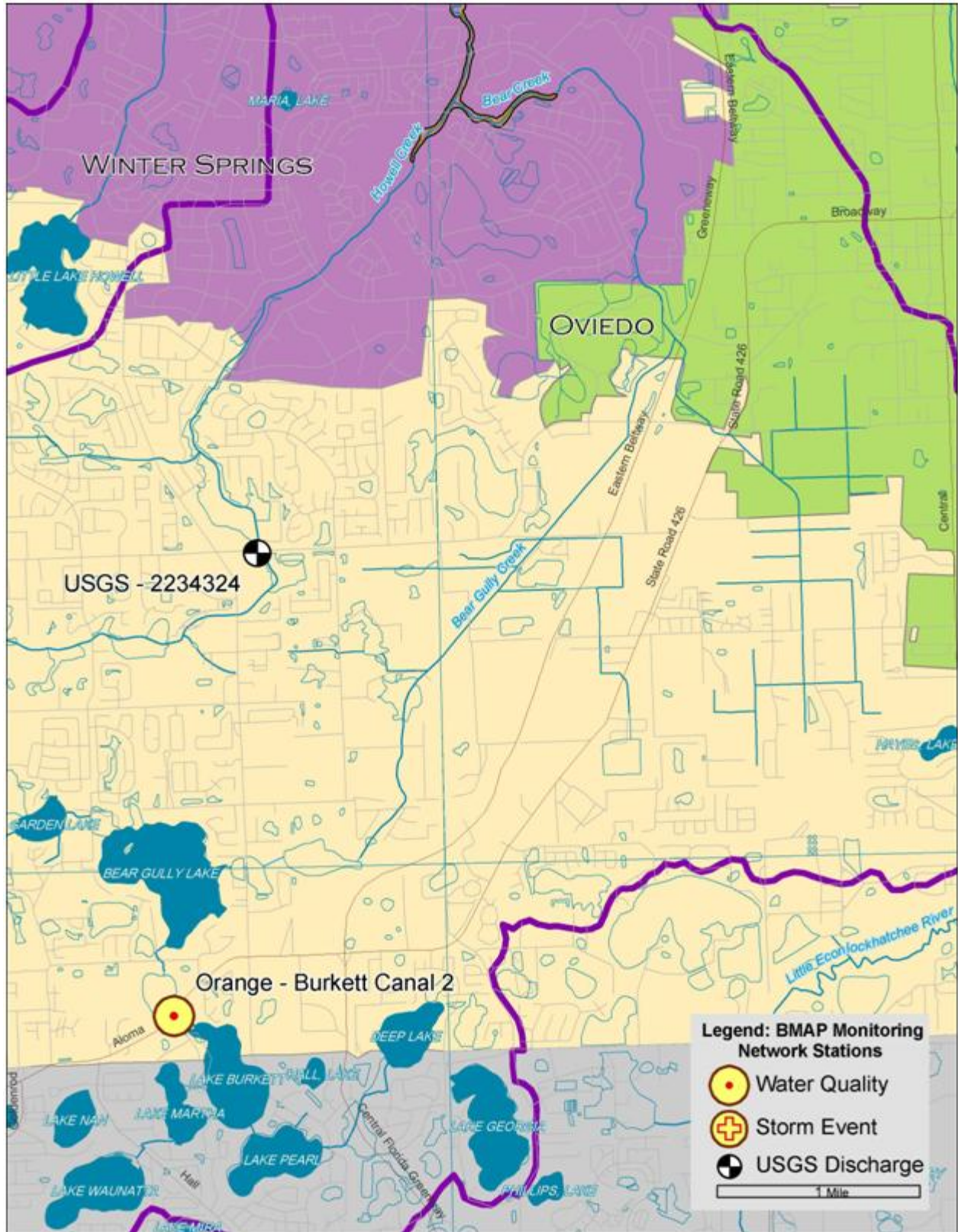


FIGURE 9: MONITORING STATIONS IN ORANGE COUNTY

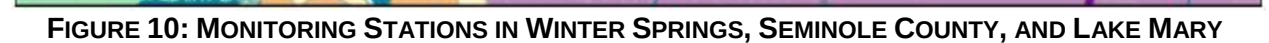




FIGURE 11: MONITORING STATIONS IN SEMINOLE COUNTY, SANFORD, AND LAKE JESUP

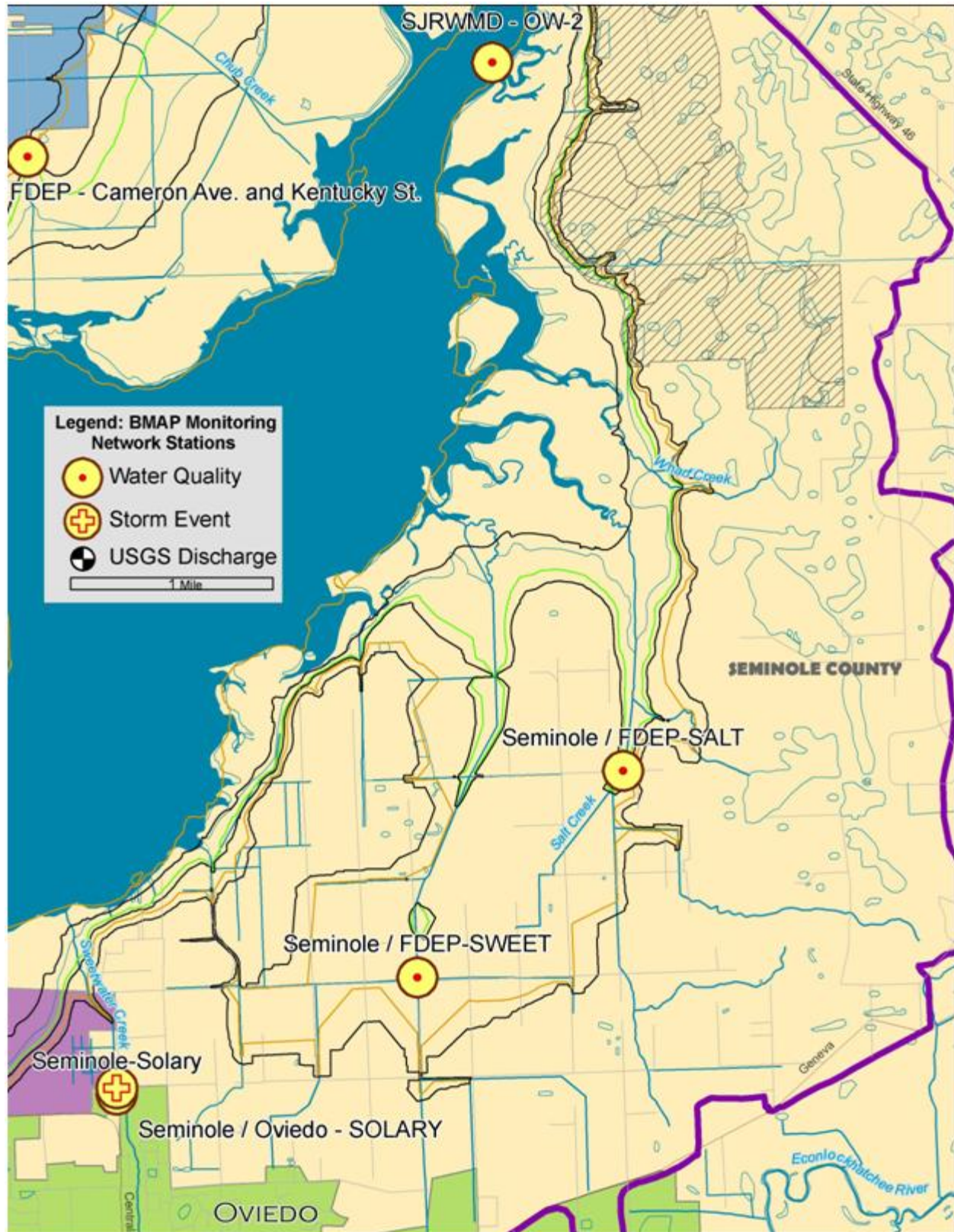


FIGURE 12: MONITORING STATIONS IN SEMINOLE COUNTY AND LAKE JESUP



FIGURE 13: MONITORING STATIONS IN LAKE JESUP

TABLE 19: BMAP MONITORING NETWORK

ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE ESTABLISHED	SAMPLING PARAMETERS
Casselberry	New station	Gee Creek northeast of Lake Kathryn	Water Quality	Monthly	New	Core and supplemental parameters
FDEP	New Station	Cameron Avenue and Kentucky Street	Water Quality	Monthly	New	Core and supplemental parameters
Lake Mary	Longwood Lake Mary Rd. downstream of culvert	Soldier's Creek Upstream	Water Quality	Monthly	2005	Core and supplemental parameters
Lake Mary	Behind Austin Street upstream of culvert	Soldier's Creek Downstream	Water Quality	Monthly	2005	Core and supplemental parameters
Lake Mary	New station	Outlet of Big Lake Mary	Water Quality	Monthly	New	Core and supplemental parameters
Longwood	New station	Fairy Lake	Water Quality	Monthly	New	Core and supplemental parameters
Maitland	Waumpi	Lake Waumpi	Water Quality	Monthly	2008	Core and supplemental parameters, secchi depth, water depth, coliform, alkalinity, total dissolved solids (TDS), volatile TSS
Orange County	Burkett Canal 2	Lake Burkett Discharge Upstream of Aloma	Water Quality	Monthly	2007	Core and supplemental parameters, flow, discharge, bacteria
Orlando	Rowena Canal	In the canal that connects Lake Rowena to Lake Sue	Water Quality	Monthly	2008	Core and supplemental parameters, volatile TSS, TDS, alkalinity
Seminole County*	HCCB	Howell Creek at County Border	Water Quality	Monthly	2007	Core and supplemental parameters, flow, water depth, coliform
Seminole County/Sanford	NAV	Naval Canal at Pineway	Water Quality	Quarterly/Fill in for monthly	2000	Core and supplemental parameters, secchi depth, water depth, coliform, alkalinity, TDS, volatile TSS, color
Seminole County/Oviedo	SOLARY	Solary Canal	Water Quality	Quarterly/Fill in for monthly	2004	Core and supplemental parameters, secchi depth, water depth, coliform, alkalinity, TDS, volatile TSS, color
Seminole County/Sanford	CHUBB	Chub Creek at E Lake Mary Blvd	Water Quality	Quarterly/Fill in for monthly	2007	Core and supplemental parameters, water depth, flow, coliform, alkalinity, TDS, color, volatile TSS, metals
Seminole County/Altamonte Springs	PRA	Prairie Lake	Water Quality	Quarterly/Fill in for monthly	1999	Core and supplemental parameters, secchi depth, water depth, coliform, alkalinity, TDS, volatile TSS, color
Seminole County/FDEP	SALT	Salt Creek at Packard Ave.	Water Quality	Quarterly/ Fill in for monthly	2003	Core and supplemental parameters, secchi depth, water depth, coliform, alkalinity, TDS, volatile TSS, color, metals

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ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE ESTABLISHED	SAMPLING PARAMETERS
Seminole County/FDEP	SWEET	Sweetwater Creek at Howard Ave.	Water Quality	Quarterly/ Fill in for monthly	2004	Core and supplemental parameters, water depth, flow, coliform, alkalinity, TDS, color, volatile TSS, metals
SJRWMD	T-3	Six Mile Creek at Sanford Ave Canal NE of LJ	Water Quality	Monthly	1995	Core and supplemental parameters, metals
SJRWMD	T-5	Howell Creek Delta on SW end of LJ	Water Quality	Monthly	1995	Core and supplemental parameters, metals
SJRWMD	T-8	Gee and Soldier Creek Delta west of LJ	Water Quality	Monthly	1995	Core and supplemental parameters, metals
SJRWMD	OW-2	LJ off Grassy Point	Water Quality	Monthly	1995	Core and supplemental parameters, metals, light attenuation, plankton
SJRWMD	OW-4	LJ W of bridge betwn Whites Lndg & Bird Island	Water Quality	Monthly	1995	Core and supplemental parameters, metals, light attenuation, plankton
SJRWMD	OW-6	LJ off center of Far W Arm	Water Quality	Monthly	1995	Core and supplemental parameters, metals, light attenuation, plankton
Winter Park	Weir at Howell Branch Rd	10' Upstream of Weir at Howell Branch Road	Water Quality	Monthly	1995	Core parameters
Seminole County	Howell	Howell Creek at W SR 434	Storm	Storm	2000	TSS, nitrate/nitrite as N, TN, ammonia as N, TKN, TP, BOD5, fecal coliform
Seminole County	Solary	Solary Canal at Deleon Street	Storm	Storm	2001	TSS, nitrate/nitrite as N, TN, ammonia as N, TKN, TP, BOD5, fecal coliform
Seminole County	Gee	Gee Creek at SR 434	Storm	Storm	2000	TSS, nitrate/nitrite as N, TN, ammonia as N, TKN, TP, BOD5, fecal coliform
Seminole County	Soldier	Soldiers Creek at SR 419	Storm	Storm	2000	TSS, nitrate/nitrite as N, TN, ammonia as N, TKN, TP, BOD5, fecal coliform
Seminole County	Six	Six Mile Creek at Myrtle Street	Storm	Storm	2000	TSS, nitrate/nitrite as N, TN, ammonia as N, TKN, TP, BOD5, fecal coliform
USGS	2234308	Howell Creek Near Altamonte Springs FL	Flow	60min	1996	Gage height, discharge
USGS	2234324	Howell Creek near Slavia FL	Flow	60min	1972	Gage height, discharge
USGS	2234344	Howell Creek at State HWY 434 near Oviedo FL	Flow	60min	1973	Gage height, discharge
USGS	2234384	Soldier Creek near Longwood FL	Flow	60min	1972	Gage height, discharge
USGS	2234400	Gee Creek near Longwood FL	Flow	60min	1972	Gage height, discharge
USGS	2234435	Lake Jesup outlet near Sanford FL	Flow	15min	1941	Gage height, velocity, discharge

*Note: Casselberry will help fund some of the sampling at the Lake Howell site (see Appendix F).

5.1.3.2 Storm Event Sampling

The event-based sampling will occur after storm events to provide information on what pollutant loads are entering the tributaries due to high runoff conditions. This information will be important to help calibrate the model for the next iteration of the TMDL and BMAP. The majority of the storm event data will be collected by Seminole County. They have operated and maintained permanent storm event monitoring stations on the five major tributaries to Lake Jesup, which include Six Mile Creek, Soldiers Creek, Howell Creek, Gee Creek, and Solary (Sweetwater) Canal. Each station is located at or near the downstream end of the subbasin, as close to the confluence with the lake as is structurally possible. All of the storm event sites have been in operation since 2000, with the exception of the Gee Creek site which came online in 2001. Seminole County will continue to monitor these stations as part of the BMAP network (see **Table 19**).

5.1.3.3 Performance-Based Monitoring

Measuring the effectiveness of specific BMPs in reducing target pollutant loads is a secondary objective of the monitoring strategy. Specific stations have not been identified at this time. As part of the BMAP implementation and follow-up process, BWG members will identify opportunities for BMP-specific monitoring on a project-by-project basis. This will involve individual entities monitoring the impacts of one of the BMPs included in their management actions identified in the BMAP. Although this is not feasible for every BMAP project, a few carefully selected 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. Performance-based monitoring will apply the same set of core parameters identified in **Table 17** and the appropriate supplemental parameters. In addition, the Florida Stormwater Association (FSA) has ongoing studies on the effectiveness of stormwater BMPs. Available information from these studies will be considered during the next BMAP iteration to help determine project credit.

5.1.3.4 Site 10 Monitoring

The City of Sanford has agreed to modify their existing monitoring on Site 10 to provide the information needed for the TMDL modeling in the next iteration. The Site 10 monitoring plan has been incorporated into the Sanford WWTF permit. The monitoring plan was added as a permit requirement to aid in enforceability because Site 10 was not included in the current TMDL model. However, future iterations of the TMDL will include the loading from this site based on the results of this monitoring. It is important to note that the sampling locations described below are not included in the BMAP monitoring network maps in **Section 5.1.3.2**. The Site 10 monitoring plan consists of three components: (1) groundwater; (2) storm event; and (3) in-lake sampling.

The City of Sanford currently has 13 groundwater monitoring stations. As part of the updated monitoring plan, Sanford will add two new stations on the western portion of the site and will add TP as a sampling parameter to the groundwater wells. In addition, FDEP has agreed to allow Sanford to remove several existing wells in the citrus groves where there is a large cluster of wells, which will help offset the cost associated with the new wells. **Figure 14** shows the locations of the groundwater wells on Site 10 (CDM, 2009).

Sanford is also adding a storm event sampler upstream of Pond B-2 (see **Figure 15**). This location was selected because it is the only area that has continuous streamflow; therefore, a sampler in this area could also provide data for base flow. In addition, this location is in an area that can be accessed by staff to collect the samples. The city will also consider moving the storm event sampler after one to two years of sampling near Pond B-2 to capture events in other areas of the site, if needed (CDM, 2009).

For the in-lake sampling, Sanford will rely on existing monitoring conducted by SJRWMD and Lakewatch. The two closest sampling locations near Site 10 are: (1) station 44055, which has been routinely monitored by the SJRWMD since 1995; and (2) Jesup North-Seminole, which is a Lakewatch station and has been routinely sampled since 2001 (see **Figure 16**). Both of these stations include nutrients in the sampled parameters. Sanford will coordinate with SJRWMD and Lakewatch to ensure these stations are continued to be sampled and to obtain the water quality data (CDM, 2009).

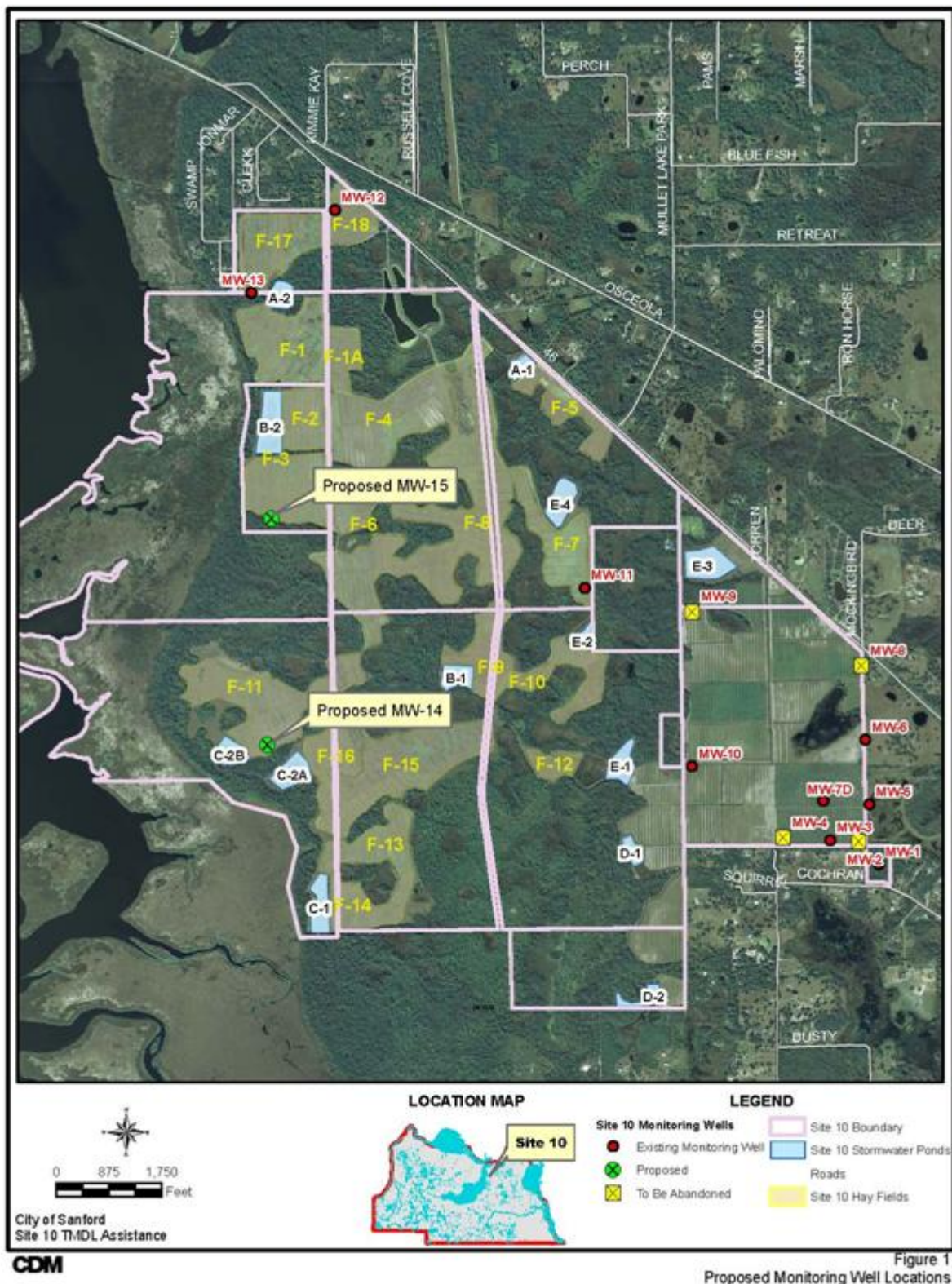


FIGURE 14: LOCATIONS OF SITE 10 GROUNDWATER MONITORING WELLS

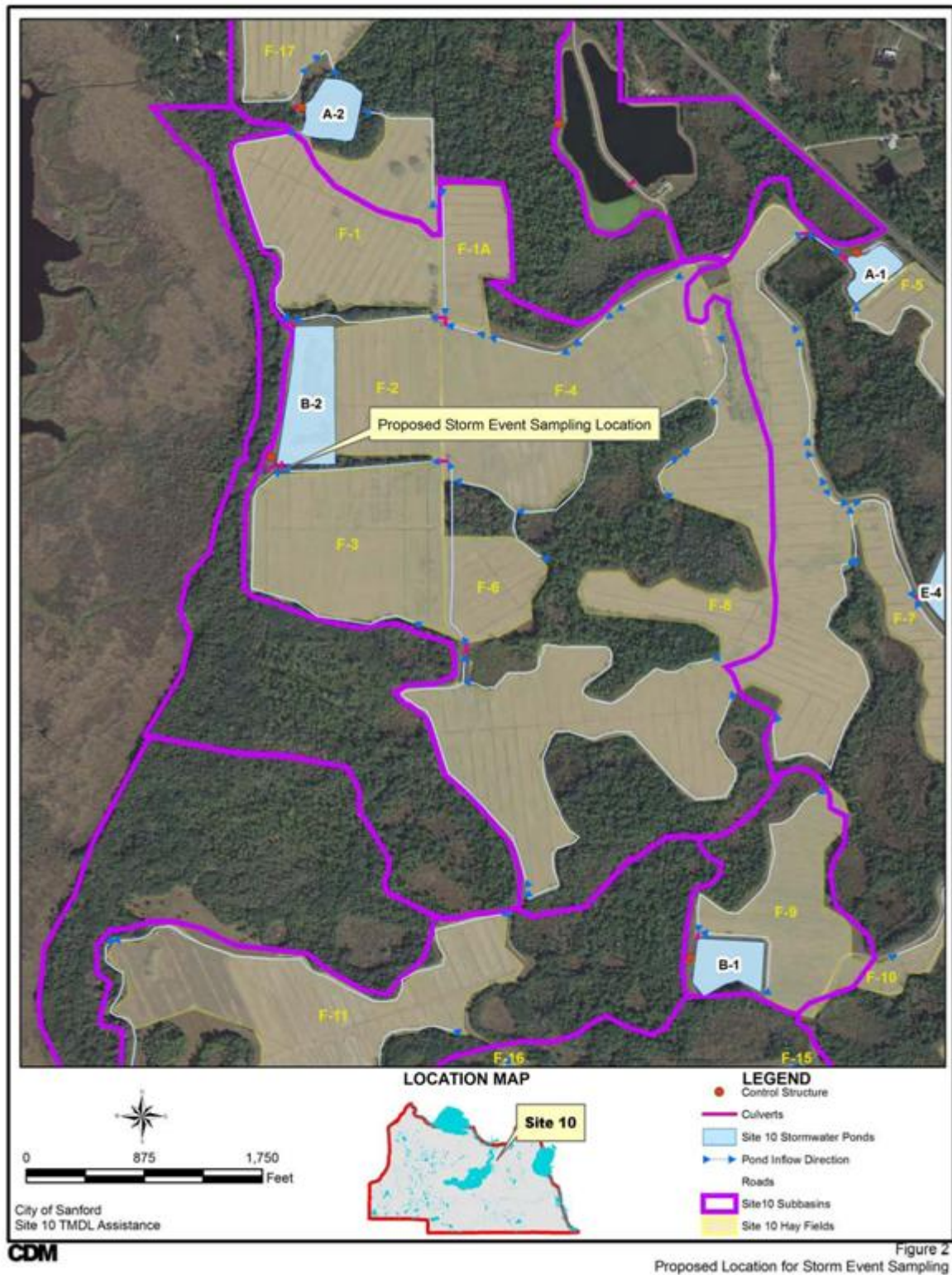


FIGURE 15: LOCATION OF THE SITE 10 STORM EVENT SAMPLING SITE

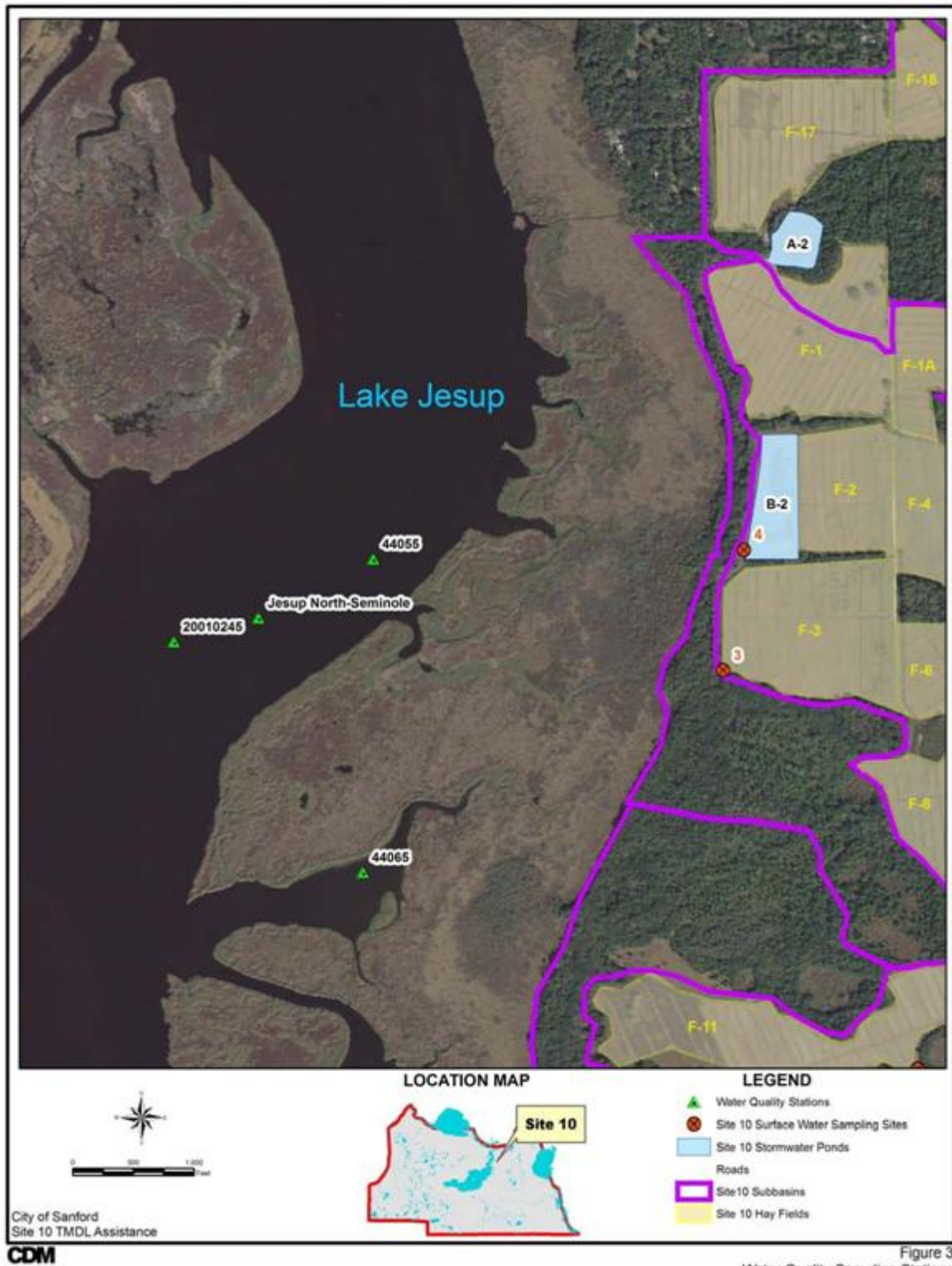


FIGURE 16: LOCATIONS OF IN-LAKE SAMPLING NEAR SITE 10

5.1.4 DATA MANAGEMENT AND ASSESSMENT

The Florida STORET database serves as the primary repository of ambient water quality data for the state of Florida. FDEP pulls water quality data used for impaired water evaluations and TMDL development directly from the STORET database. Ambient water quality data collected as part of the BMAP will be uploaded into STORET for long-term storage and availability. SJRWMD, FDEP, and local stakeholders currently upload water quality data into STORET. All BMAP data providers have agreed to upload ambient water quality data to STORET at least once every six months, upon completion of the appropriate quality assurance/quality control (QA/QC) checks. Local stakeholders will also use their existing water atlas platforms to store and disseminate data. Seminole County, Altamonte Springs, Casselberry, Lake Mary, Longwood, Oviedo, Sanford, Winter Springs, and SJRWMD support the Seminole County Water Atlas (<http://www.seminole.wateratlas.usf.edu/>). Orange County, Apopka, Belle Isle, Maitland, Orlando, Winter Garden, Winter Park, and the Valencia Water Control District support the Orange County Water Atlas (<http://www.orange.wateratlas.usf.edu/>; note that not all these jurisdictions are within the Jesup watershed).

Ambient flow conditions will also be monitored as part of this BMAP. Although instantaneous flow data can be uploaded, the STORET database is not equipped to handle high-frequency flow data. Flow data collected by USGS is stored in the Real-Time Water Database, accessible on the web (<http://waterdata.usgs.gov/nwis/rt>).

Data on biological parameters (e.g. SCI, algae speciation) will be collected at the stations noted in **Appendix F**. As with high-frequency flow data, the STORET database is not equipped to store biological data. 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.

Storm event data and possibly performance-based data for individual projects will be collected as part of this BMAP. Because these types of data are not representative of ambient water quality conditions, it is inappropriate to store this data in STORET. Storm event and performance-based data will be maintained by the entity that collected the samples. 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.

The water quality data will be analyzed after four years of BMAP implementation to determine trends in water quality in the lake and to assess attenuation in the basin. A wide variety of statistical methods are available for trend analyses. The selection of an appropriate data analysis method depends on the frequency, spatial distribution, and period of record available from existing data. Specific statistical analyses were not identified during BMAP development; however, the BWG will use commonly accepted methods of data analysis that are consistent with the TMDL model.

5.1.5 QUALITY ASSURANCE/QUALITY CONTROL

Through cooperation on TMDL-related data collection, the SJRWMD, FDEP, and stakeholders have used similar standard operating procedures (SOPs) for field sampling and lab analyses. This 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. The collection of water quality data will be conducted in a manner consistent with FDEP's SOPs for QA/QC. The most current version of these procedures can be downloaded from www.dep.state.fl.us/labs/qa/sops.htm. All stakeholders contributing data in support of the

BMAP agree to follow these SOPs. For BMAP-related data analyses, entities should use National Environmental Laboratory Accreditation Conference (NELAC) certified labs or other labs that meet the certification and other requirements outlined in the SOPs.

SJRWMD staff and contractors collect, process, and preserve samples according to the SJRWMD's Standard Operating Procedures for the Collection of Surface Water Quality Samples and Field Data–Feb. 13, 2004. Where SJRWMD and FDEP SOP's do not correspond to one another, SJRWMD staff and contractors defer to FDEP's SOPs.

5.1.6 MONITORING NETWORK SUFFICIENCY EVALUATION

The data collected as part of this monitoring plan are a critical component for re-evaluating the TMDL in five years. For the next iteration of the TMDL, a new model, the Hydrologic Simulation Program – FORTRAN (HSPF) model originally developed by EPA, will be used. The HSPF model in the next iteration will build upon previous modeling done by SJRWMD in this basin. Compared to the existing model, the SJRWMD HSPF model has a more detailed watershed loading calculation process, which allows the model to be calibrated using data from each sampling event. The HSPF model also addresses the in-stream assimilation of nutrients and, therefore, attenuation in the watershed and receiving water. In addition, the HSPF model will include both the watershed loading and in-lake process components in one model.

While the HSPF model has the ability to provide more detailed basin information than the current TMDL model, the results are dependent on the quantity and quality of the water quality data. At least four years of bimonthly or monthly data will be collected for the parameters listed in **Table 17** at each of the BMAP stations. The monitoring sites included in the BMAP monitoring network were selected to provide loading information for individual jurisdictions or subbasins (based on the preferences of the stakeholders) to determine load attenuation throughout the basin. Based on these considerations, the BMAP monitoring network is sufficient to meet the minimum data requirements for the model for the next iteration of the TMDL.

5.2 RESEARCH PRIORITIES

Several entities in the basin have completed research projects or are currently implementing studies that will provide information to address the current unknowns in the basin (refer to **Section 2.4**). The projects, sponsors, research objectives, and information gaps addressed are shown in **Table 20**. The status and results of each study will be discussed at the annual BMAP progress report meetings. In addition, these discussions will identify how the study results will be used in an adaptive management context for future iterations of the BMAP. The applicable data from these studies will also be used by FDEP in future re-evaluation of the TMDL.

TABLE 20: RESEARCH PROJECTS IN THE LAKE JESUP BASIN

INFORMATION GAP ADDRESSED	RESEARCH OBJECTIVE	PROJECT DESCRIPTION	PROJECT SPONSOR(S)	LOCATION	TIMELINE	KEY DELIVERABLES
Nitrogen-fixation	Quantify nitrogen-fixation	In-situ nitrogen-fixation study.	Seminole County	Lake Jesup	Completed 2006	Actual nitrogen-fixation rates studied during the peak annual season (i.e. worst case scenario).

INFORMATION GAP ADDRESSED	RESEARCH OBJECTIVE	PROJECT DESCRIPTION	PROJECT SPONSOR(S)	LOCATION	TIMELINE	KEY DELIVERABLES
Nitrogen-fixation	Quantification of nitrogen-fixation load and rates.	One year nitrogen-fixation sampling using several different methods for determining rates and species contributing; included diurnal, daily and seasonal testing.	SJRWMD	Lake Jesup	Final Report 09/30/08	Nitrogen-fixation rates in Lake Jesup and their relationship to environmental factors.
Sediment flux	Quantify flux.	<i>In situ</i> sediment flux study.	Seminole County	Lake Jesup	Completed 2006	Actual sediment flux values based on an <i>in situ</i> study.
Sediment flux	Assessment of the cycling and compartmentalization of nitrogen and phosphorus in saturated soils, sediments and the water column in Lake Jesup.	One year study to measure and assess the nature of both the downward and potential upward sediment (including organic material) flux within the system on different time scales (from weekly quarterly sampling, to daily sampling) and link transport dynamics with external forces and effects.	SJRWMD	Lake Jesup	Final Report Expected 05/01/10	Cycling and compartmentalization of nitrogen and phosphorus in saturated soils, sediments and the water column.
Groundwater loads	Integrated surface-groundwater modeling Middle St. Johns River Basin.	Phase 1: collect additional baseflow and aquifer water quality data required to complete supportable model results. Phase 2: modeling.	SJRWMD and Seminole County	Lake Jesup primarily, rest of Middle Basin eventually	Phase 1 estimate 10/01/09 Phase 2 TBD	Quantification of groundwater inputs to water bodies along with nutrient concentrations.
Groundwater loads	Determine the actual quality and quantity of surficial groundwater in the lake.	Conduct a seepage study on a large number of sample points throughout the lake to determine surficial groundwater quality and quantity/flow into and out of Lake Jesup.	Seminole County	Lake Jesup	Anticipated by 12/10	Actual surficial groundwater data (quality and quantity) for use in the water quality models; more accurate information.
Watershed loads	Delineate sub-basins where highest nutrients (especially TP) are originating, based on grab samples, in the Howell Creek tributary.	Add three storm event samplers to the Howell Creek sub-basin to better define pollutant loading sources.	Seminole County and SJRWMD	Lake Jesup Basin	12/09	Calculate actual storm event loading along the creek where it enters Seminole County, downstream of Lake Howell, and on Bear Creek just upstream of its confluence with Howell Creek.

INFORMATION GAP ADDRESSED	RESEARCH OBJECTIVE	PROJECT DESCRIPTION	PROJECT SPONSOR(S)	LOCATION	TIMELINE	KEY DELIVERABLES
Watershed loads	Develop a hydrologic and nutrient budget for Lake Howell.	Develop a detailed hydrologic and nutrient budget using measured data.	Seminole County	Lake Howell	10/09	A detailed hydrologic and nutrient budget for Lake Howell.
Watershed loads	Develop a hydrologic and nutrient budget for Bear Gully Lake.	Develop a detailed hydrologic and nutrient budget using measured data.	Seminole County	Bear Gully Lake	10/09	A detailed hydrologic and nutrient budget for Bear Gully Lake.
Watershed loads	Determine actual pollutant load being discharged from the City of Orlando into remaining Lake Jesup basin.	Determine pollutant loading using continuous elevation monitoring in conjunction with existing stage-discharge curve. Monthly water quality samples being collected.	City of Orlando	Lake Rowena	Ongoing	Actual nutrient load determination for City of Orlando.
Watershed loads	Determine loading from the Lake Charm basin to the Lake Jesup basin.	Determine agricultural loads and residential septic tank loads within basin.	City of Oviedo	Lake Charm	2010-2011	Master Study of Oviedo major stormwater conveyance systems and associated loading, and priority improvements.
Watershed Loads	Determine pollutant load being discharged from Orange County through Lake Burkett.	Determine pollutant load being discharged from Orange County through Lake Burkett from flow/discharge/ water quality data.	Orange County	Lake Burkett	2013	Actual nutrient load determination for Orange County.
Watershed Loads	Add storm event samplers to the Sweetwater Creek and Salt Creek area.	Add storm event samplers to the Sweetwater Creek and Salt Creek area to obtain load estimates for the ungauged portion of the basin.	To be determined	Sweetwater Creek and Salt Creek	To be determined	Storm event sampling will be added to this area if funding becomes available.
Non-contributing areas	Determine if Lake Killarney discharges into the Lake Jesup system via Howell Creek.	Determine if Lake Killarney discharges into the Lake Jesup system via Howell Creek via flow measurements and observations over the next 5 years.	Orange County	Lake Killarney	2014	Determination if Lake Killarney contributes loading to the Lake Jesup Basin.
Non-contributing areas	Determine if Lake Georgia discharges into the Bear Gulley sub-basin of Lake Jesup.	Conduct study to determine if Lake Georgia flows into Lake Jesup system or Econ River.	Orange County	Lake Georgia	2011	Determine if Lake Georgia contributes load to Jesup.

INFORMATION GAP ADDRESSED	RESEARCH OBJECTIVE	PROJECT DESCRIPTION	PROJECT SPONSOR(S)	LOCATION	TIMELINE	KEY DELIVERABLES
BMP efficiency	Determine feasibility of regional treatment projects suggested as first priorities in the <i>Lake Jesup Interagency Restoration Strategy</i> .	Four currently funded: in-lake water column treatment, floating islands as a tributary treatment, alum as an external load reduction, and use of existing wetlands to treat high concentration, low occurrence tributary loads (marsh diversion).	SJRWMD	Lake Jesup	9/30/2010	Feasibility of using alternative treatment processes as regional treatment projects for significant reduction of external loading.
BMP efficiency	Determine actual pollutant load removal for Navy Canal and Cameron Ditch regional stormwater facilities (RSFs); if not achieving anticipated efficiency, what can be done to improve and maximize the pollutant load removal rates.	Determine the actual pollutant load removal rates of two RSF that discharge directly into Lake Jesup.	Seminole County and FDEP	Lake Jesup	12/10	Actual pollutant load removal rates and ways to improve the rates, if necessary.
Septic tanks	Determine exact locations of tanks that meet the Orange County setback of 150 feet.	Determine exact locations of tanks that meet the Orange County setback of 150 feet versus the State Rule of 75 feet from surface waters.	Orange County	Orange County in Lake Jesup Basin	2013	Count of septic tanks in Orange County portion of basin that are setback 150 feet.
Reuse nutrient contributions	Quantify reuse water runoff.	Continue to build spatial model of reuse water using available data; generate empirical data about end use water quality.	SJRWMD	Entire Middle Basin	Initial estimates 03/2010	Empirical and modeling data for runoff of reuse water into Lake Jesup.
Model refinement	QUAL2K model.	Development of a more complex water quality model that includes kinetic modules such as sediment flux, groundwater quality, etc.	Seminole County	Lake Jesup	Completed 2006; updated model 10/10	A more detailed water quality model with improved existing conditions and predictive capabilities. Update utilizing additional data and information from Lake Apopka and Seminole County.

5.3 ADAPTIVE MANAGEMENT MEASURES

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

- Procedures to determine whether additional cooperative strategies 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 BWG 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 that the TMDLs for the basin are achieved.

The BWG will meet annually to review project status and water quality conditions in Lake Jesup. At this time, available information will be used to evaluate projects and monitoring efforts. Modifications from the original BMAP may occur at that time, if conditions warrant. For example, if a more feasible and/or effective alternative to a particular project listed in the original BMAP is found and proposed by a stakeholder as a substitute, such modifications to the project list may be made at these annual meetings. FDEP will also distribute an annual implementation report (refer to example in **Table 21**) to stakeholders for their review and input. This information and a periodic water quality trend analysis will form the basis of the annual review meetings.

5.3.1 ANNUAL ASSESSMENT OF MANAGEMENT ACTIONS

FDEP and stakeholders will organize the monitoring data and project implementation status and present this information to the BWG in an annual report. The BWG has agreed to meet at least once every 12 months 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. The types of activities that may occur at the annual meetings are described below.

Implementation Data and Reporting

- Collect project implementation and/or discharge information from MS4 permit reporting, agricultural NOI reporting, and other sources and compare to the BMAP schedule.
- Review summaries of estimated load reductions based on the data received and comparisons to the TMDL and individual allocations.
- Discuss the data collection process, including any concerns and possible improvements to the process.
- Review of the monitoring plan and research plan implementation as detailed in **Section 5.1** and **Section 5.2**.

Sharing New Information

- Reports on results from water quality monitoring and trend information.
- Reports related to the status of the biological health of the lake.
- Information on new technologies for reducing nutrients.

- Reports of progress on quantifying load reductions from urban stormwater and other nonpoint sources, including information on quantifying nonstructural BMPs and the effects of public education.

Coordination of TMDL-Related Issues

- Updates from FDEP and SJRWMD on the basin cycle and activities related to impairments, TMDLs, PLRGs, and BMAPs.
- Reports from other basins where tools or other information may be informative to the Lake Jesup TMDLs.

It is not required that all of these topics be covered during the annual BWG meetings. These topics are provided as examples of the types of information that should be considered for the agenda to assist with BMAP implementation and coordination among the agencies and stakeholders.

The activities planned as part of this BMAP are shown in **Figure 17** and will be discussed during the annual progress report meetings.

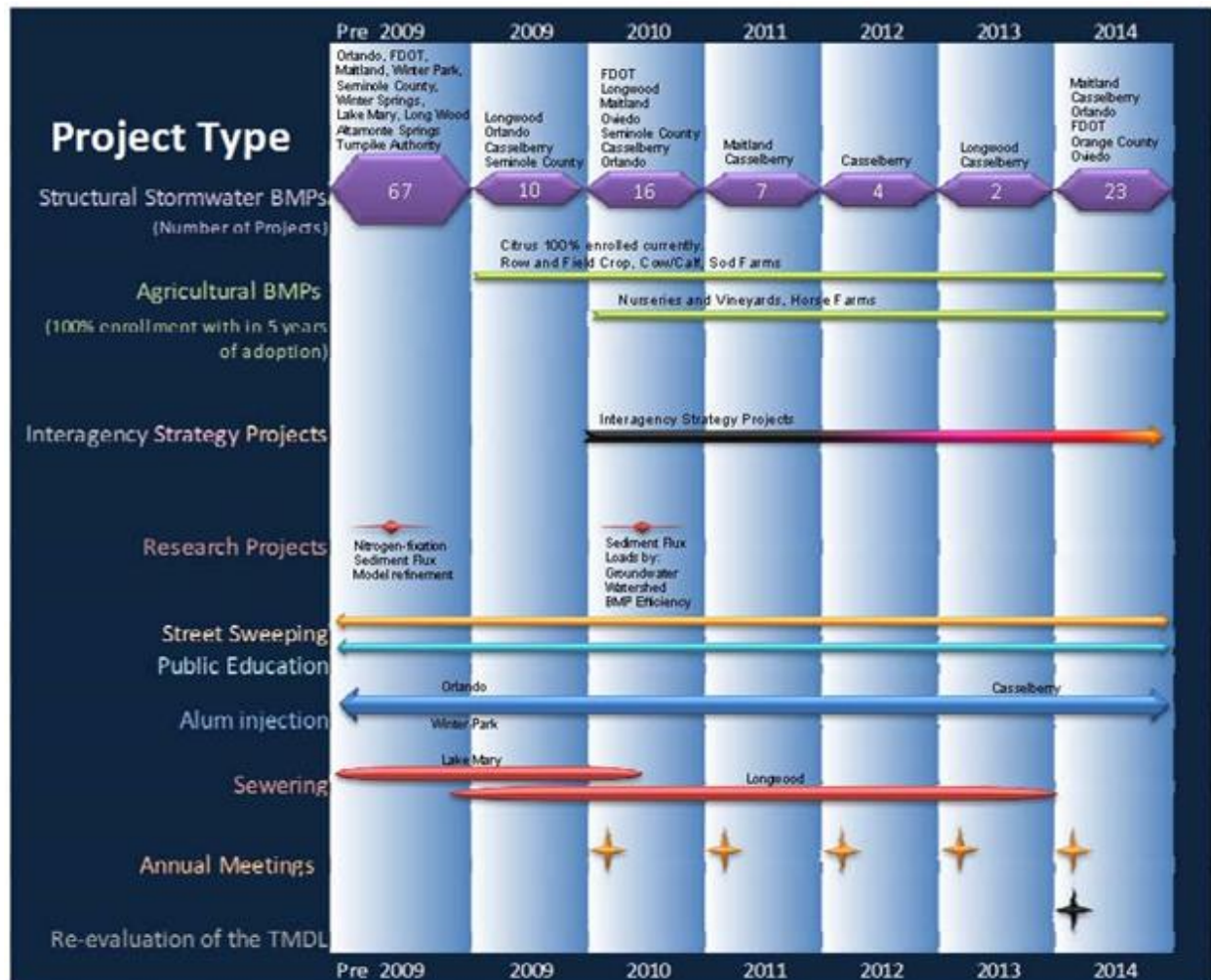


FIGURE 17: BMAP ACTIVITIES IMPLEMENTATION TIMELINE

5.3.2 FUTURE REVISION OF THE TMDL AND BMAP

As discussed in **Section 2.4**, there are several key uncertainties that were identified during the BMAP process that should be considered in future revisions of the TMDL and BMAP allocations. The information from the research studies and monitoring strategy will provide valuable information to better the understanding of these current issues. The appropriate data will be provided to FDEP for consideration in the re-evaluation of the TMDL, which will occur according to the watershed assessment cycle. Once the TMDL is revised, the BMAP will be revisited and the detailed allocations recalculated. While **Table 4** shows the allocations for each entity for the entire 15-year implementation period based on the current TMDL, these allocations will likely be adjusted in the future.

TABLE 21: DRAFT BMAP ANNUAL REPORTING FORMAT

2010 Lake Jesup Basin Management Action Plan

____YEAR____ ANNUAL IMPLEMENTATION REPORT

REPORTING ENTITY: _____

DATE: _____

Note: Relevant MS4 activities, whether contained in the BMAP or not, may be included in this report.

IMPLEMENTATION STATUS – BMAP MANAGEMENT STRATEGIES

¹ BMAP PROJECT #	AFFECTED AREA	² BRIEF DESCRIPTION	³ PROJECTED START/END	⁴ PROJECT/ACTIVITY STATUS	⁵ TP REMOVAL ESTIMATE		⁶ PROJECT MONITORING RESULTS	⁷ COMMENTS
					Total	Interim		

NEW MANAGEMENT STRATEGIES

¹ BMAP PROJECT #	AFFECTED AREA	² BRIEF DESCRIPTION	³ PROJECTED START/END	⁴ PROJECT/ACTIVITY STATUS	⁵ TP REMOVAL ESTIMATE		⁶ PROJECT MONITORING RESULTS	⁷ COMMENTS
					Total	Interim		

Directions for BMAP Annual Reporting Format (Draft):

¹ **BMAP Projects:** This includes projects and other management strategies. Use the project number assigned in the BMAP Projects/Activities Table (e.g., A-1). Please include all management strategies for which you have lead responsibility in the BMAP, regardless of their status. **New Management Strategies:** Include new projects/activities that are not included in the BMAP in the New Management Strategies table. Create a project number for new management strategies by using the prefix, then -N# (e.g., A-N1).

² Include a brief description of the management action being reported (e.g., street sweeping removing gross debris on all streets with "L curbs" - 5 miles performed each month).

³ 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).

⁴ 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 September 2010). Also, describe any significant changes to the management action that have taken place

⁵ Provide total and interim (to date) TP removal estimates, if available. Include removal estimate units (e.g., lbs/yr). Note whether the estimates are different from those contained in the BMAP for the specific management action.

⁶ As Applicable: 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.

⁷ 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 6: COMMITMENT TO PLAN IMPLEMENTATION

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 Lake Jesup BWG have demonstrated their willingness to confer with and support each other in their efforts.

The BWG members provided endorsement of the BMAP at their January 14, 2010 meeting on behalf of the entities they represent since they have been actively involved in the BMAP process. In addition to this endorsement, FDEP has asked for letters of commitment or resolutions of support for the BMAP from the entities to ensure that as staff and board members change over time, the entity has a way to show support for the BMAP and the efforts included. This process will occur concurrently with BMAP adoption. Written statements of commitment that have been provided are included below and additional statements will be added to this chapter of the BMAP as they are received.



March 25, 2010

The Honorable Michael W. Sole
Secretary
Florida Department of Environmental Protection
3900 Commonwealth Boulevard, Mail Station 49
Tallahassee, FL 32399

RE: Letter of Commitment to Support Plan Implementation

Dear Secretary Sole,

Please accept this letter as the City of Altamonte Springs' written support of the Lake Jesup Basin Management Action Plan (BMAP). As an active member of the Lake Jesup Basin Working Group (BWG), our representative voted to endorse the BMAP on January 14, 2010. By endorsing this plan, the City agrees to the following actions:

- Support the use of an equitable and cost-effective coordinated comprehensive watershed management approach to address and achieve total maximum daily load related pollutant load reductions and water quality improvements;
- Support the necessary approvals and funding needed to implement the consensus management actions identified in the BMAP, and assist implementation of those actions as required approvals and funding are secured;
- Track the implementation of management actions for which we are responsible to assure that the BMAP is carried out, pursuant to the process agreed upon by the BWG;
- Identify and advise the Florida Department of Environmental Protection and BWG of any issues or concerns that could be obstacles to carrying out management actions identified in the BMAP, including technical, funding and legal obstacles;
- Assist with water quality monitoring according to the BMAP monitoring strategy approved by the BWG, as appropriate;

March 25, 2010

The Honorable Michael W. Sole
Secretary
Florida Department of Environmental Protection

RE: Letter of Commitment to Support Plan Implementation

Page two

- Continue to communicate and coordinate actions and funding across community organizations, agencies and programs with regard to BMAP implementation.

Sincerely,

A handwritten signature in dark ink, appearing to read 'WRB', followed by a long horizontal line extending to the right.

William R. Baer
Director, Public Works and Utilities
City of Altamonte Springs
225 Newburyport Avenue
Altamonte Springs, FL 32701
WRBaer@altamonte.org
407-571-8340

RESOLUTION 10-2127

“A RESOLUTION OF THE CITY OF CASSELBERRY, FLORIDA, PROVIDING SUPPORT OF THE LAKE JESUP BASIN MANAGEMENT ACTION PLAN PROPOSED BY FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION; PROVIDING FOR CONFLICTS, SEVERABILITY, AND EFFECTIVE DATE.”

WHEREAS, the City of Casselberry contributes pollutant loads to the Lake Jesup watershed via stormwater runoff and is therefore a stakeholder in its watershed planning; and

WHEREAS, in 2006, the City of Casselberry began participating in multi-jurisdictional efforts to create the Lake Jesup Basin Management Action Plan (BMAP); and

WHEREAS, the proposed BMAP will address needed pollutant load reductions related to the Total Maximum Daily Load (TMDL) previously established for Lake Jesup; and

WHEREAS, the BMAP acknowledges technical uncertainties, provides flexibility, and includes a plan to gather additional data and further refine load allocations during its next iteration; and

WHEREAS, City staff have reviewed the proposed BMAP and find it to be reasonable and consistent with the City's adopted Stormwater, Lakes Management, and Water Quality Master Plan.

NOW THEREFORE, BE IT RESOLVED BY THE CITY COMMISSION OF THE CITY OF CASSELBERRY, FLORIDA, AS FOLLOWS:

SECTION I. The City Commission of the City of Casselberry hereby approves the Lake Jesup Basin Management Action Plan Statement of Commitment to Support Plan Implementation (attached as “Exhibit A”), and authorizes the Mayor to execute said document on behalf of the City.

SECTION II. Conflicts. All Resolutions or parts of Resolutions in conflict with any of the provisions of this Resolution are hereby repealed.

SECTION III. Severability. If any Section or portion of a Section of this Resolution proves to be invalid, unlawful, or unconstitutional, it shall not be held to invalidate or impair the validity, force, or effect of any other Section or part of this Resolution.

SECTION IV. Effective Date. This Resolution shall become effective immediately upon its passage and adoption.

PASSED and ADOPTED this 8th day of March, AD 2010.

ATTEST:


Donna G. Gardner
City Clerk


Charlene Glancy
Mayor/Commissioner

Exhibit 'A'

***LAKE JESUP BASIN MANAGEMENT ACTION PLAN
2010***

STATEMENT OF COMMITMENT TO SUPPORT PLAN IMPLEMENTATION

The Lake Jesup Basin Management Action Plan (BMAP) was endorsed on January 14, 2010, by authorized representatives of the agencies and organizations listed as members of the Lake Jesup Basin Working Group (BWG).

The signatories of the BMAP agree that, as applicable, their organizations will:

- Support the use of an equitable and cost-effective coordinated comprehensive watershed management approach to address and achieve total maximum daily load (TMDL)-related pollutant load reductions and water quality improvements.
- Subject to available funding mechanisms and available, reasonable funding levels, support the necessary approvals and funding needed to implement the consensus management actions identified in the BMAP, and assist implementation of those actions as required approvals and funding are secured.
- To the extent of available funds and pursuant to the process agreed upon by the BWG, track the implementation of management actions for which they are responsible to assure that the BMAP is carried out.
- Identify and advise the Florida Department of Environmental Protection (FDEP) and BWG of any issues or concerns that could be obstacles to carrying out management actions identified in the BMAP, including technical, funding, and legal obstacles.
- As appropriate, assist with water quality monitoring according to the BMAP monitoring strategy approved by the BWG.
- Continue to communicate and coordinate actions and funding across community organizations, agencies, and programs with regard to BMAP implementation.

Organization: City of Casselberry

Authorized Name/Title:


Charlene Glancy
Mayor/Commissioner

John C. Litton
City Manager
jlitton@lakemaryfl.com



City of Lake Mary

Incorporated in 1973

LAKE JESUP BASIN MANAGEMENT ACTION PLAN 2010

STATEMENT OF COMMITMENT TO SUPPORT PLAN IMPLEMENTATION

The Lake Jesup Basin Management Action Plan (BMAP) was endorsed on January 14, 2010, by authorized representatives of the agencies and organizations listed as members of the Lake Jesup Basin Working Group (BWG).

The signatories of the BMAP agree that, as applicable, their organizations will:

- Support the use of an equitable and cost-effective coordinated comprehensive watershed management approach to address and achieve total maximum daily load (TMDL)-related pollutant load reductions and water quality improvements.
- Support the necessary approvals and funding needed to implement the consensus management actions identified in the BMAP, and assist implementation of those actions as required approvals and funding are secured.
- Pursuant to the process agreed upon by the BWG, track the implementation of management actions for which they are responsible to assure that the BMAP is carried out.
- Identify and advise the Florida Department of Environmental Protection (FDEP) and BWG of any issues or concerns that could be obstacles to carrying out management actions identified in the BMAP, including technical, funding, and legal obstacles.
- As appropriate, assist with water quality monitoring according to the BMAP monitoring strategy approved by the BWG.
- Continue to communicate and coordinate actions and funding across community organizations, agencies, and programs with regard to BMAP implementation.

**APPROVED BY
CITY COMMISSION**

2/18/10


John C. Litton, City Manager
City Lake Mary

www.lakemaryfl.com • Phone: (407) 585-1419 • Fax: (407) 585-1498

CITY HALL, 100 N. Country Club Road, P.O. Box 958445, Lake Mary, FL 32795-8445

RESOLUTION NUMBER 2010-06

**A RESOLUTION OF THE CITY COMMISSION OF
WINTER SPRINGS, FLORIDA, AGREEING TO
IMPLEMENTATION OF A LAKE JESUP BASIN MANAGEMENT
ACTION PLAN; AND PROVIDING FOR AN EFFECTIVE DATE.**

WHEREAS, Lake Jesup has been verified by the Florida Department of Environmental Protection (FDEP) as impaired for nutrients and unionized ammonia.

WHEREAS, FDEP formally adopted a Total Maximum Daily Load (TMDL) report for Lake Jesup in 2006 which identified the nutrient loading sources and required reductions to meet water quality standards for total phosphorous (TP) and total nitrogen (TN) within the Lake Jesup Basin.

WHEREAS, The Lake Jesup Basin Stakeholders, including the City of Winter Springs, have prepared a Basin Management Action Plan, or BMAP, to reduce the amount of nutrients that caused the verified impairment of Lake Jesup.

WHEREAS, Under the BMAP, entities within the Lake Jesup Basin are required by the Florida Department of Environmental Protection to reduce phosphorous discharges to Lake Jesup from surface waters and/or septic systems by a combined total of approximately 15,000 pounds over the next 15 years.

WHEREAS, The Lake Jesup BMAP contains strategies to implement the Lake Jesup nutrient TMDL through reduction and prevention of pollutant discharges through various means, and the project types contained in the BMAP reflects the array of sources and stakeholder relationships that exist in this complex watershed.

WHEREAS, the Lake Jesup Basin Management Action Plan (BMAP) was endorsed on January 14, 2010, by authorized representatives of the agencies and organizations listed as members of the Lake Jesup Basin Working Group (BWG), including the City of Winter Springs.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COMMISSION OF WINTER SPRINGS, FLORIDA, AS FOLLOWS:

SECTION I – The City Commission of the City of Winter Springs hereby agrees that the City of Winter Springs will:

- a. Agree to the use of an equitable and cost-effective coordinated comprehensive watershed management approach to address and achieve total maximum daily load (TMDL)-related pollutant load reductions and water quality improvements.
- b. Agree to pursue the necessary approvals and funding needed to implement the consensus management actions identified in the BMAP, and assist implementation of those actions as required approvals and funding are secured.
- c. Pursuant to the process agreed upon by the Basin Working Group, track the implementation of management actions for which the City is responsible to assure that the BMAP is carried out.
- d. Identify and advise the Florida Department of Environmental Protection (FDEP) and Basin Working Group of any issues or concerns that could be obstacles to carrying out management actions identified in the BMAP, including technical, funding, and legal obstacles.

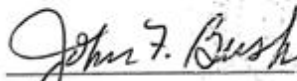
- e. As appropriate, assist with water quality monitoring according to the BMAP monitoring strategy approved by the Basin Working Group.
- f. Continue to communicate and coordinate actions across community organizations, agencies, and programs with regard to BMAP implementation.

SECTION II – The City Clerk of the City of Winter Springs is hereby directed to send copies of this Resolution to FDEP and all other persons as directed by the Mayor and City Commission.

SECTION III - This Resolution shall take effect immediately upon adoption by the City Commission.

Passed and adopted this 8th day of February, 2010.

CITY OF WINTER SPRINGS, FLORIDA



JOHN F. BUSH, MAYOR

ATTEST:



ANDREA LORENZO-LUACES, CITY CLERK

APPROVED
BY ORANGE COUNTY BOARD
OF COUNTY COMMISSIONERS
FEB 23 2010 *JBW*

RESOLUTION

of the

ORANGE COUNTY BOARD OF COUNTY COMMISSIONERS

regarding

THE LAKE JESUP BASIN MANAGEMENT ACTION PLAN

Resolution No. 2010- 14-15

WHEREAS, in an effort to improve water quality, Section 303(d) of the federal Clean Water Act requires the adoption of total maximum daily loads ("TMDLs") of pollutants that may be discharged into impaired surface water bodies in the United States; and

WHEREAS, to implement TMDLs for Florida's impaired water bodies, the Florida Department of Environmental Protection ("FDEP"), along with stakeholders within the watersheds of impaired waters, develops Basin Management Action Plans ("BMAPs"), which are to specify the activities, schedule, and funding sources that pollutant dischargers will undertake to achieve the TMDLs adopted by FDEP for each water body and thereby restore the water body; and

WHEREAS, FDEP has been working closely with Orange County and other stakeholders within the Lake Jesup watershed to develop the Lake Jesup BMAP; and

WHEREAS, on February 23, 2010, the Orange County Board of County Commissioners (the "Board") was briefed by Orange County staff on the current draft of the Lake Jesup BMAP and recognizes that, although there may be some minor revisions to the BMAP before it is adopted by order of the FDEP Secretary, the revisions are not expected to significantly change any fiscal or policy impacts to Orange County.

NOW THEREFORE, BE IT RESOLVED BY THE BOARD OF COUNTY COMMISSIONERS OF ORANGE COUNTY:

Section 1. The Board supports the continued development and finalization of the use of the Lake Jesup BMAP with the participation of representatives of Orange County.

28 *Section 2.* The Board supports the implementation of the Lake Jesup BMAP and intends
to seek the necessary approvals and funding to implement the management actions for Orange
30 County identified in the Lake Jesup BMAP.

Section 3. The Board supports Orange County's participation in the coordinated tracking
32 of BMAP implementation, continued coordination with the FDEP and other stakeholders, and
revising the BMAP as necessary to ensure the management actions are effective in meeting the
34 TMDLs.

Section 4. The Board endorses a coordinated and comprehensive watershed management
36 approach to address and achieve FDEP-adopted TMDLs for the Lake Jesup watershed.

Section 5. The Board authorizes the Mayor or his designee to represent the Board in
38 reviewing and approving the BMAP preliminary to its adoption by FDEP, provided that such
approval will not significantly change any fiscal or policy impacts to Orange County beyond those
40 presented in the February 23, 2010 BMAP briefing of the Board by Orange County staff. In the
event the Mayor, his designee, or Orange County staff determine that revisions to the Lake Jesup
42 BMAP, preliminary to its adoption by FDEP, significantly change any fiscal or policy impacts to
Orange County, they shall bring the matter to the Board and request further direction before
44 approving the plan.

Section 6. This Resolution shall take effect immediately upon the date of its adoption.

FEB 23 2010

ADOPTED this _____ day of February, 2010.



ORANGE COUNTY, FLORIDA

By: Board of County Commissioners

By: *Richard T. Crotty*
Richard T. Crotty
Orange County Mayor

ATTEST: Martha O. Haynie, County Comptroller
As Clerk of the Board of County Commissioners

By: *Martha O. Haynie*
Deputy Clerk
CESD-7-01



St. Johns River Water Management District

Kirby B. Green III, Executive Director • David W. Fisk, Assistant Executive Director

4049 Reid Street • P.O. Box 1429 • Palatka, FL 32178-1429 • (386) 329-4500
On the Internet at www.sjrwmd.com.

February 16, 2010

The Honorable Mr. Michael Sole, Secretary
The Department of Environmental Protection
3900 Commonwealth Boulevard, M.S. 49
Tallahassee, FL 32399

Re: Draft Lake Jesup Basin Management Action Plan (BMAP)
Statement of Commitment to Support Plan Implementation

Dear Secretary Sole:

FDEP has obtained endorsement of the draft BMAP for the Lake Jesup Basin. Lake Jesup, one of the largest lakes in Central Florida, is impaired by high levels of total nitrogen and total phosphorus (FDEP, Verified Impaired Waters). The focus of the Lake Jesup BMAP requires reductions from external TP sources. The total required reductions are allocated to the responsible entities in the basin.

St. Johns River Water Management District, as a member of the Lake Jesup Basin Working Group, supports the Lake Jesup Basin Management Action Plan, as indicated in the attached Statement of Commitment to Support Plan Implementation.

Sincerely,

A handwritten signature in blue ink, appearing to read 'Kirby'.

Kirby B. Green III
Executive Director

Attachment

KBG/rlm

c. Casey Fitzgerald
Maurice Sterling

GOVERNING BOARD

Susan N. Hughes, CHAIRWOMAN PORTE VEDRA	W. Leonard Wood, VICE CHAIRMAN FERNANDINA BEACH	Hersey "Herky" Huffman, SECRETARY ENTERPRISE	Hans G. Tandler III, TREASURER JACKSONVILLE
Douglas C. Bourmique VERO BEACH	Michael Eitel OVEED	Maryam H. Ghyabi ORMOND BEACH	Richard G. Hamann GAINESVILLE
			Arlen N. Jumper FORT MC COY

**LAKE JESUP BASIN MANAGEMENT ACTION PLAN
2010**

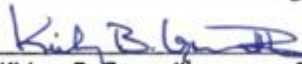
STATEMENT OF COMMITMENT TO SUPPORT PLAN IMPLEMENTATION

The Lake Jesup Basin Management Action Plan (BMAP) was endorsed on January 14, 2010, by authorized representatives of the agencies and organizations listed as members of the Lake Jesup Basin Working Group (BWG).

The signatories of the BMAP agree that, as applicable, St. Johns River Water Management District will:

- Support the use of an equitable and cost-effective coordinated comprehensive watershed management approach to address and achieve total maximum daily load (TMDL)-related pollutant load reductions and water quality improvements.
- Support the necessary approvals and funding needed to implement the consensus management actions identified in the BMAP, and assist implementation of those actions as required approvals and funding are secured.
- Pursuant to the process agreed upon by the BWG, track the implementation of management actions for which they are responsible to assure that the BMAP is carried out.
- Identify and advise the Florida Department of Environmental Protection (FDEP) and BWG of any issues or concerns that could be obstacles to carrying out management actions identified in the BMAP, including technical, funding, and legal obstacles.
- As appropriate, assist with water quality monitoring according to the BMAP monitoring strategy approved by the BWG.
- Continue to communicate and coordinate actions and funding across community organizations, agencies, and programs with regard to BMAP implementation.

St. Johns River Water Management District

 _____ <i>Kirby B. Green III,</i>	<i>Executive Director</i>	<i>2-17-10</i> _____ <i>Date</i>
--	---------------------------	--

Appendix A: TMDL BASIN ROTATION SCHEDULE

TMDLs are developed, allocated, and implemented through a watershed management approach (managing water resources within their natural boundaries) that addresses the state's 52 major hydrologic basins in five groups, on a rotating schedule. **Table A-1** shows the hydrologic basins within each of the five groups, with the DEP District office of jurisdiction. **Table A-2** illustrates the repeating five-year basin rotation schedule.

TABLE A-1: MAJOR HYDROLOGIC BASINS BY GROUP AND DEP DISTRICT OFFICE

DEP District	Group 1 Basins	Group 2 Basins	Group 3 Basins	Group 4 Basins	Group 5 Basins
NW	Ochlockonee-St. Marks	Apalachicola-Chipola	Choctawhatchee-St. Andrews Bay	Pensacola Bay	Perdido Bay
NE	Suwannee	Lower St. Johns		Nassau-St. Marys	Upper East Coast
Central	Ocklawaha	Middle St. Johns	Upper St. Johns	Kissimmee	Indian River Lagoon
SW	Tampa Bay	Tampa Bay Tributaries	Sarasota Bay-Peace-Myakka	Withlacoochee	Springs Coast
S	Everglades West Coast	Charlotte Harbor	Caloosahatchee	Fisheating Creek	Florida Keys
SE	Lake Okeechobee	St. Lucie-Loxahatchee	Lake Worth Lagoon-Palm Beach Coast	Southeast Coast Biscayne Bay	Everglades

Each group will undergo a cycle of five phases on a rotating schedule:

- Phase 1:** Preliminary evaluation of water quality
- Phase 2:** Strategic monitoring and assessment to verify water quality impairments
- Phase 3:** Development and adoption of TMDLs for waters verified as impaired
- Phase 4:** Development of basin management action plan (BMAP) to achieve the TMDL
- Phase 5:** Implementation of the BMAP and monitoring of results

The Middle St. Johns is a Group 2 basin. As such, the Cycle 1 list of verified impaired waters was developed in 2004, and the Cycle 2 update was in 2009. Subsequent TMDL and BMAP development is occurring on a schedule driven by the 1998 303(d) list (see <http://www.dep.state.fl.us/water/tmdl/> for more information) and FDEP staff resource availability. FDEP will re-evaluate impaired waters every five years to determine whether improvements are being achieved, and to refine loading estimates and TMDL allocations using new data. If any changes in a TMDL are required, the applicable TMDL rule may be revised. Changes to a TMDL would prompt revisions to the applicable BMAP, which will be revisited at least every five years and modified as necessary, regardless of whether the TMDL is modified.

Appendix B: SUMMARY OF STATUTORY PROVISIONS GUIDING BMAP DEVELOPMENT AND IMPLEMENTATION

SECTIONS 403.067(6) AND (7), FLORIDA STATUTES - *Summary of Excerpts*

ALLOCATIONS

- The TMDL shall include reasonable and equitable allocations of the TMDL between or among point and nonpoint sources that will alone, or in conjunction with other management and restoration activities, provide for the attainment of pollutant reductions established pursuant to paragraph (a) to achieve applicable water quality standards.
- The allocations may establish the maximum amount of the pollutant that may be discharged or released in combination with other discharges or releases.
- Allocations may also be made to individual basins and sources or as a whole to all basins and sources or categories of sources of inflow to the water body or water body segments.
- An initial allocation of allowable pollutant loads may be developed as part of the TMDL; in such cases detailed allocations to specific point sources and categories of nonpoint sources shall be established in the basin management action plan.
- The initial and detailed allocations shall be designed to attain pollutant reductions established pursuant to paragraph (a) and shall be based on consideration of:
 1. Existing treatment levels and management practices;
 2. Best management practices established and implemented pursuant to paragraph (7)(c);
 3. Enforceable treatment levels established pursuant to state or local law or permit;
 4. Differing impacts pollutant sources may have on water quality;
 5. The availability of treatment technologies, management practices, or other pollutant reduction measures;
 6. Environmental, economic, and technological feasibility of achieving the allocation;
 7. The cost benefit associated with achieving the allocation;
 8. Reasonable timeframes for implementation;
 9. Potential applicability of any moderating provisions such as variances, exemptions, and mixing zones; and
 10. The extent to which non-attainment of water quality standards is caused by pollution sources outside of Florida, discharges that have ceased, or alterations to water bodies prior to the date of this act.

GENERAL IMPLEMENTATION

- **DEP is the lead agency** in coordinating TMDL implementation, through existing water quality protection programs.
- **Application of a TMDL by a water management** district does not require WMD adoption of the TMDL.
- **TMDL implementation may include**, but is not limited to:
 - o Permitting and other existing regulatory programs
 - o Non-regulatory and incentive-based programs
 - o Other water quality management and restoration activities, such as Surface Water Improvement and Management (SWIM) plans or **basin management action plans**
 - o Pollutant trading or other equitable economically based agreements
 - o Public works
 - o Land acquisition

BASIN MANAGEMENT ACTION PLAN DEVELOPMENT

- DEP may develop a basin management action plan that addresses some or all of the watersheds and basins tributary to a TMDL waterbody.
- A basin management action plan **shall**:
 - Integrate appropriate management strategies available to the state through existing water quality protection programs.
 - Equitably allocate pollutant reductions to individual basins, all basins, each identified point source, or category of nonpoint sources, as appropriate.
 - Identify the mechanisms by which potential future increases in pollutant loading will be addressed.
 - Specify that for nonpoint sources for which BMPs have been adopted, the initial requirement shall be BMPs developed pursuant to paragraph (c).
 - Establish an implementation schedule.
 - Establish a basis for evaluating plan effectiveness.
 - Identify feasible funding strategies.
 - Identify milestones for implementation and water quality improvement, and an associated water quality monitoring component to evaluate reasonable progress over time.
 - Be adopted in whole or in part by DEP Secretarial Order, subject to chapter 120.
- A basin management action plan **may**:
 - Give load reduction credits to dischargers that have implemented load reduction strategies (including BMPs) prior to the development of the BMAP. (*Note: this assumes the related reductions were not factored into the applicable TMDL.*)
 - Include regional treatment systems or other public works as management strategies.
 - Provide for phased implementation to promote timely, cost-effective actions.
- An assessment of progress in achieving milestones shall be conducted every 5 years and the basin management action plan revised, as appropriate, in cooperation with basin stakeholders, and adopted by secretarial order.
- DEP shall assure that key stakeholders are invited to participate in the basin management action plan development process, holding at least one noticed public meeting in the basin to receive comments, and otherwise encouraging public participation to the greatest practicable extent.
- A basin management action plan shall not supplant or alter any water quality assessment, TMDL calculation, or initial allocation.

BASIN MANAGEMENT ACTION PLAN IMPLEMENTATION

- NPDES Permits
 - Management strategies related to a discharger subject to NPDES permitting shall be included in subsequent applicable NPDES permits or permit modifications when the permit expires (is renewed), the discharge is modified (revised), or the permit is reopened pursuant to an adopted BMAP.
 - Absent a detailed allocation, TMDLs shall be implemented through NPDES permit conditions that include a compliance schedule. The permit shall allow for issuance of an order adopting the BMAP within five years. (***Note: Intended to apply to individual wastewater permits – not MS4s***)
 - Once the BMAP is adopted, the permit shall be reopened, as necessary, and permit conditions consistent with the BMAP shall be established.
 - Upon request by a NPDES permittee, DEP may establish individual allocations prior to the adoption of a BMAP, as part of a permit issuance, renewal, or modification (revision).
 - To the maximum extent practicable, MS4s shall implement a TMDL or BMAP through the use of BMPs or other management measures.
 - A BMAP does not take the place of NPDES permits or permit requirements.
 - Management strategies to be implemented by a DEP permittee shall be completed

according to the BMAP schedule, which may extend beyond the 5-year term of an NPDES permit.

- o Management strategies are not subject to challenge under chapter 120 when they are incorporated in identical form into a NPDES permit or permit modification (revision).
- Management strategies assigned to nonagricultural, non-NPDES permittees (state, regional, or local) shall be implemented as part of the applicable permitting programs.
- Nonpoint source dischargers (e.g., agriculture) included in a BMAP shall demonstrate compliance with the applicable TMDLs by either implementing appropriate BMPs established under paragraph 7(c), or conducting water quality monitoring prescribed by **DEP or a WMD**. (*Note: this is not applicable to MS4s, as they are considered point sources under the federal Clean Water Act and TMDL Program.*)
 - o Failure to implement BMPs or prescribed water quality monitoring may be subject to **DEP or WMD** enforcement action.
- Responsible parties who are implementing applicable BMAP strategies shall not be required to implement additional pollutant load reduction strategies, and shall be deemed in compliance with this section. However, this does not limit DEP's authority to amend a BMAP.

BEST MANAGEMENT PRACTICES

- DEP, in cooperation with WMDs and other interested parties, may develop interim measures, BMPs, or other measures for non-agricultural nonpoint sources to achieve their load reduction allocations.
 - o These measures may be adopted by **DEP or WMD** rule. If adopted, they shall be implemented by those responsible for non-agricultural nonpoint source pollution.
- DACS may develop and adopt by rule interim measure, BMPs, or other measures necessary for agricultural pollutant sources to achieve their load reduction allocations.
 - o These measures may be implemented by those responsible for agricultural pollutant sources. **DEP, the WMDs, and DACS** shall assist with implementation.
 - o In developing and adopting these measures, DACS shall consult with DEP, DOH, the WMDs, representatives of affected farming groups, and environmental group representatives.
 - o The rules shall provide for a notice of intent to implement the practices and a system to ensure implementation, including recordkeeping.
- Verification of Effectiveness and Presumption of Compliance -
 - o DEP shall, at representative sites, verify the effectiveness of BMPs and other measures adopted by rule in achieving load reduction allocations.
 - o DEP shall use best professional judgment in making the initial verification of effectiveness, and shall notify **DACS and the appropriate WMD** of the initial verification prior to the adoption of a rule proposed pursuant to this paragraph.
 - o Implementation of rule-adopted BMPs or other measures initially verified by DEP to be effective, or verified to be effective by monitoring at representative sites, provides a presumption of compliance with state water quality standards for those pollutants addressed by the practices.
- Reevaluation –
 - o Where water quality problems are demonstrated despite implementation, operation, and maintenance of rule-adopted BMPs and other measures, **DEP, a WMD, or DACS**, in consultation with DEP, shall reevaluate the measures. If the practices require modification, the revised rule shall specify a reasonable time period for implementation.

Appendix C: STAKEHOLDER INVOLVEMENT IN BMAP DEVELOPMENT

LAKE JESUP BASIN WORKING GROUP

The Lake Jesup Basin Working Group (BWG) is made up of responsible stakeholders in the watershed. The BWG was formed in July 2007 and has advised FDEP on major issues related to the BMAP and detailed allocations. The BWG played a critical role in the development of the BMAP to implement the Lake Jesup TMDL.

The BWG's mission statement is as follows: *"The mission of the Lake Jesup Basin Working Group is to make recommendations to the Florida Department of Environmental Protection to work toward restoring impaired waterbodies through development of an effective, equitable, and cost-efficient Basin Management Action Plan to implement the Total Maximum Daily Loads."*

During BMAP development, the BWG met in Sanford on the following dates:

- July 24, 2008;
- July 30, 2009;
- September 17, 2009; and
- November 19, 2009.

In addition to the input from the BWG, the stakeholders involved in the technical meetings provided valuable information during the BMAP process. The technical stakeholders began meeting prior to TMDL adoption to provide input on the land uses, event mean concentrations (EMCs) used in the TMDL modeling, best management practice (BMP) efficiency values, and other aspects of model development and restoration targets. BMAP-related technical meetings began in 2006 and continued through BMAP development to provide stakeholder input with data collection and compilation, identification of scientific uncertainties and needs for additional research, as well as input on existing monitoring sites and information for the monitoring plan.

PROCESS FOR PLAN RECOMMENDATION DEVELOPMENT

BASIN WORKING GROUP MEETING PROCESS

The BWG was asked to endorse the BMAP, to reflect the local commitment to implement load reductions towards achievement of the TMDLs prior to the Secretarial adoption of the BMAP as a rule. FDEP will also ask for letters of commitment or resolutions of support for the BMAP from the individual entities represented on the BWG. These letters and resolutions will provide an additional level of support for the BMAP efforts as staff and local elected officials change over time. The process to submit letters and resolutions of support will occur during and after BMAP adoption. The written statements of commitment will be added to the BMAP as they are received (when received prior to adoption) or in the BMAP annual reports (when received after adoption).

CONSENSUS

The technical stakeholder meetings were operated on an informal basis where the purpose of the discussions was to provide technical input. As such, there were no official members of designated group of technical representatives. The BWG, however, had designated representatives for the major stakeholder organizations and made specific recommendations to FDEP on BMAP issues. A consensus-based a voting procedure was used to make these recommendations to FDEP. Votes were held only in circumstances when a quorum of at least 50% of the voting members (or their designated alternates) was present at a publicly noticed

meeting. Consensus was achieved when all participants could support, agree to, or accept the recommendation.

PUBLIC PARTICIPATION IN BASIN WORKING GROUP MEETINGS

All BWG and technical meetings were open to the public and noticed in the Florida Administrative Weekly. Public comment was invited during the BWG meetings and the technical meetings were open to anyone interested in participating in the technical discussions. In addition, public meetings were held on the verified lists, the adoption of the TMDLs, and the BMAP document.

PUBLIC MEETINGS

Public meetings on the proposed verified list and the Lake Jesup TMDL were held before each was adopted. In addition, a public workshop on the BMAP was held on February 8, 2010.

PLAN RECOMMENDATION APPROVAL AND ADOPTION

The Basin Working Group approved the final recommended BMAP at its January 14, 2010 meeting. The final BMAP is to be adopted by FDEP secretarial order.

Appendix D: PROJECTS TO ACHIEVE THE TMDL

The projects and timeframes for implementation submitted by the entities to achieve their BMAP allocations are summarized in the tables below. The tables provide information on the nutrient reduction attributed to each individual project, shown in pounds per year (lbs/yr). These projects were submitted to provide reasonable assurance to FDEP that each entity has a plan on how they will meet their allocation; however, this list of projects is meant to be flexible enough to allow for changes that may occur over time, provided that the reduction is still met within the specified timeframe.

CITY OF ALTAMONTE SPRINGS

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	TP REDUCTION (LBS/YR)	STATUS
Altamonte Springs	A-1	Existing BMPs	BMPs in place at the time of the TMDL	35.0	Completed
Altamonte Springs	A-2	Street Sweeping	Street sweeping of 4.4 miles, two times per month	0.5	Ongoing
Altamonte Springs	A-3	Education Efforts	FYN, PSAs, pamphlets, presentations, website, illicit discharge program	4.6	Ongoing
Total Projects Reduction				40.1	
Total Required Reduction 2010-2014				19.0	
Credit for Future BMAPs				21.1	

CITY OF CASSELBERRY

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Casselberry	C-1	Lake Concord Stormwater Park/Anniversary Park - Plumosa Baffle Box	Redevelopment and retrofit of City-owned property into an educational stormwater park; 2 nd generation baffle box	10/2007	09/2009	0.5	\$43,250	8.5	Stormwater Retrofit	Started
Casselberry	C-2	Lake Concord Stormwater Park/Anniversary Park - Exfiltration Trench	Redevelopment and retrofit of City-owned property into an educational stormwater park; an exfiltration trench	10/2007	09/2009	0.4	\$143,200	1.7	Exfiltration	Started
Casselberry	C-3	Lake Concord Stormwater Park/Anniversary Park - Dry Detention	Redevelopment and retrofit of City-owned property into an educational stormwater park; dry detention	10/2007	09/2009	0.0	\$75,000	1.0	Dry detention pond	Started
Casselberry	C-4	Lake Concord Stormwater Park/Anniversary Park - Swale, Wetland Revegetation, & Boardwalk	Redevelopment and retrofit of City-owned property into an educational stormwater park; swale, lakeshore revegetation, educational boardwalk	10/2007	09/2009	0.1	\$742,000	1.7	Swales	Started
Casselberry	C-5	Lake Concord Stormwater Park/Anniversary Park	Redevelopment and retrofit of City-owned property into an educational stormwater park; baffle box, pervious pavement, bioretention/ parking lot	10/2007	09/2009	0.1	\$226,500	1.2	Stormwater Retrofit	Started
Casselberry	C-6	Anchor Road Reconstruction	Reconstruction of Anchor Road with drainage improvements including upgraded detention/retention ponds	10/2007	10/2009	2.9	\$2,000,000	60.7	Wet detention pond	Started

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ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Casselberry	C-7	North Lake Triplet Shoreline Revegetation	Remove existing nuisance vegetation from the north and west shores of North Lake Triplet and replace with beneficial species; install reverse berm and swale	12/2007	09/2014	0.8	\$80,000	16.2	Swales	Planned & Funded
Casselberry	C-8	Secret Lake Shoreline Revegetation	Remove existing nuisance vegetation from the east and southwest shores of Secret Lake and replace with beneficial species; install 2 reverse berms and swales	01/2008	05/2008	0.2	N/A	3.7	Swales	Completed
Casselberry	C-9	Fountain/Aeration and Revegetation for Grassy Lake	Installation of aeration for high BOD loading to this waterbody; includes shoreline revegetation for aesthetics and nutrient removal with swale construction as practicable	03/2009	07/2009	0.0	\$150,000	1.7	Aeration System	Planned & Funded
Casselberry	C-10	672 & 676 San Pablo Avenue 2nd generation Baffle Boxes	Replace existing storm manholes with two 2nd generation baffle boxes for removal of pollutants	03/2009	04/2010	1.3	\$300,000	28.0	Stormwater Retrofit	Planned & Funded
Casselberry	C-11	Madrid Drive at Desoto Drive 2nd generation Baffle Box	Replace existing storm manholes with 2nd generation Baffle Boxes for removal of pollutants	03/2009	04/2010	0.4	\$150,000	5.0	Stormwater Retrofit	Planned & Funded
Casselberry	C-12	Sonora Drive at Desoto Drive 2nd generation Baffle box	Replace existing storm manholes with 2nd generation baffle boxes for removal of pollutants	03/2009	04/2010	2.4	\$170,000	42.7	Stormwater Retrofit	Planned & Funded
Casselberry	C-13	Live Oaks Center 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutant	03/2010	04/2011	1.9	\$100,000	11.6	Stormwater Retrofit	Planned & Funded

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ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Casselberry	C-14	360 South Lake Triplet Drive 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2011	04/2012	1.7	\$140,000	27.8	Stormwater Retrofit	Planned & Funded
Casselberry	C-15	Lake Hodge Park 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2011	04/2012	3.3	\$170,000	53.2	Stormwater Retrofit	Planned & Funded
Casselberry	C-16	161 South Lake Triplet Drive 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2011	04/2012	5.5	\$170,000	89.9	Stormwater Retrofit	Planned & Funded
Casselberry	C-17	530 South Lake Triplet Drive 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2011	04/2012	1.3	\$140,000	20.7	Stormwater Retrofit	Planned & Funded
Casselberry	C-18	Carriage Hill Unit 4 2 nd generation baffle boxes at the 3 outfalls north of Violet Dell, Tulip Trail and Lowndes Square Queens Mirror	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2012	04/2013	3.3	\$400,000	72.5	Stormwater Retrofit	Planned & Funded
Casselberry	C-19	808 Osceola Trail 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2013	04/2014	1.2	\$140,000	25.2	Stormwater Retrofit	Planned & Funded
Casselberry	C-20	Park Drive Drainage/Wetland Improvements	Construction of stormwater retention area on Lots 10A & 11 on north side of Park Drive	03/2013	04/2014	4.2	\$36,000	46.4	Wet retention pond	Planned & Funded

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ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Casselberry	C-21	Alum Injection System for Carriage Hill Detention Pond	Construction of a feed system for the addition of alum to the influent to the new wet detention pond for removal of pollutants, especially phosphorus, from stormwater system influent to Queens Mirror and the Triplet Lake chain	03/2013	04/2014	16.5	\$120,000	98.3	Alum	Planned & Funded
Casselberry	C-22	Middle Lake Triplet Shoreline Revegetation	Remove existing nuisance vegetation from the north shore of Middle Lake Triplet and replace with beneficial species; install reverse berm and swale	12/2013	06/2014	0.3	\$33,000	3.4	Swales	Planned & Funded
Casselberry	C-23	Secret Way at canal 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2014	12/2014	0.7	\$170,000	16.4	Stormwater Retrofit	Planned & Funded
Casselberry	C-24	51 North Lake Triplet Drive 2nd generation Baffle Box	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2014	12/2014	1.2	\$140,000	27.4	Stormwater Retrofit	Planned & Funded
Casselberry	C-25	South Lake Triplet Swales	Replace existing storm manholes with baffle boxes for removal of pollutants	03/2014	12/2014	1.0	\$80,000	6.3	Swales	Envisioned but Not Funded
Casselberry	C-26	South Lake Triplet 2nd generation Baffle Box	Replace existing storm manholes with Baffle Boxes for removal of pollutants (sediment and detritus) (4.1)	03/2014	12/2014	0.8	\$140,000	18.3	Stormwater Retrofit (baffle box)	Envisioned but Not Funded
Casselberry	C-27	Street Sweeping	Monthly street sweeping of 72.5 miles	N/A	N/A	5.3	N/A	N/A	Street Sweeping	Ongoing

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ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Casselberry	C-28	Education Efforts	FYN, landscape and irrigation ordinances, PSAS, pamphlets/presentations, website, illicit discharge program	N/A	N/A	85.6	N/A	N/A	Education	Ongoing
Casselberry	C-29	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	319.9	N/A	N/A	N/A	Completed
Total Projects Reduction						462.8				
Total Required Reduction 2010-2014						342.7				
Credit for Future BMAPs						120.1				

TOWN OF EATONVILLE

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT TYPE	STATUS
Eatonville	E-1	Street Sweeping	Monthly street sweeping of 3.7 miles	N/A	N/A	0.3	Street sweeping	Ongoing
Eatonville	E-2	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	9.6	N/A	Completed
Eatonville	E-3	Regional Project	Participate in a regional project	2009	2014	13.5	Regional Project	Planned
Total Projects Reduction						23.4		
Total Required Reduction 2010-2014						23.4		
Credit for Future BMAPs						0.0		

FLORIDA DEPARTMENT OF TRANSPORTATION

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DESCRIPTION	START DATE	END DATE	TP REDUCTION (LBS/YR)	TREATMENT ACRES	PROJECT TYPE	STATUS
FDOT	FDOT -1	FM: 240167-1 SR434	Widen from 2 to 6 lanes from McCulloch Road to Mitchell Hammock; drainage improvements and treatment of existing impervious	2002	2007	3.6	83.47	Wet Detention	Completed
FDOT	FDOT -2	FM: 240196-1 SR17-92 Basin A&B	Proposed widening of SR 15/600 (US 17/92) from Shepard Road to Lake Mary Blvd; drainage improvements and treatment of existing impervious	Pending	2014	21.0	57.21	Wet Detention	Design
FDOT	FDOT -3	FM: 240196-1 SR17-92 Basin C&D	Proposed widening of SR 15/600 (US 17/92) from Shepard Road to Lake Mary Blvd; drainage improvements and treatment of existing impervious	Pending	2014	3.7	47.97	Dry Retention	Design
FDOT	FDOT -4	FM: 240163-1 SR 46	SR 46 Bridge Replacement over Lake Jesup; drainage improvements and treatment of existing impervious	2008	2010	5.4	50.50	Wet Detention	Construction
FDOT	FDOT -5	Street Sweeping	Monthly street sweeping of 1,232.6 miles	N/A	N/A	90.3	N/A	Street Sweeping	Ongoing
FDOT	FDOT -6	Education Efforts	Public Education efforts	N/A	N/A	6.5	N/A	Education	Ongoing
FDOT	FDOT -7	Existing BMPs	Varies	N/A	N/A	207.7	N/A	N/A	Completed
Total Projects Reduction						338.2			
Total Required Reduction 2010-2014						132.3			
Credit for Future BMAPs						205.9			

CITY OF LAKE MARY

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	ANNUAL O&M COST	FOOTPRINT (ACRES)	PROJECT TYPE	STATUS
Lake Mary	LM-1	Lake Mary Woods	Eliminate 18 septic tanks 75 feet from surface water, some of them were failing	5/2005	4/2006	44.5	\$3,700,000	\$2,056	6,260	Extend sewer line	Completed
Lake Mary	LM-2	Street Sweeping	Quarterly street sweeping of 52.3 miles	N/A	N/A	2.7	N/A	N/A	N/A	Street Sweeping	Ongoing
Lake Mary	LM-3	Education Efforts	FYN, ordinances, PSAs, pamphlets, presentations, website, illicit discharge program	N/A	N/A	67.6	N/A	N/A	N/A	Education	Ongoing
Lake Mary	LM-4	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	264.3	N/A	N/A	N/A	N/A	Completed
Total Projects Reduction						379.1					
Total Required Reduction 2010-2014						264.3					
Credit for Future BMAPs						114.8					

CITY OF LONGWOOD

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	PROJECT TYPE	STATUS
Longwood	L-1	South Grant Street Drainage Project	Drainage improvements on South Grant Street	2008	2009	0.7	\$300,000	Stormwater Retrofit	Planned & Funded
Longwood	L-2	North Grant Street Drainage Project	Drainage improvements on North Grant Street	2009	2010	1.4	\$300,000	Stormwater Retrofit	Planned & Funded
Longwood	L-3	Sewering projects to remove septic tanks	Sewering projects to remove tanks within 75 ft of surface waters (remove 20 septic tanks)	2009	2013	22.7	N/A	Wastewater plant improvements	Planned & Funded
Longwood	L-4	Street Sweeping	Quarterly street sweeping of 11.1 miles	N/A	N/A	0.6	N/A	Street sweeping	Ongoing
Longwood	L-5	Education Efforts	FYN, pamphlets, presentations, website, illicit discharge program	N/A	N/A	44.9	N/A	Education	Ongoing
Longwood	L-6	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	58.9	N/A	N/A	Completed
Longwood	L-7	Regional Project	Participate in a regional project	2009	2014	69.7	N/A	N/A	Planned
Total Projects Reduction						198.9			
Total Required Reduction 2010-2014						205.3			
Credit for Future BMAPs						-6.4*			

* Note: Due to some project calculation adjustments done by FDEP, the remainder of the required reductions for this first BMAP will be met as part of the responsibilities in the second BMAP.

CITY OF MAITLAND

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	ANNUAL O&M COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Maitland	M-1	Sybelia Parkway Regional Pond	Construct wet pond	2005	2007	33.7	\$4,400,000	\$3,000	125.2	Wet detention pond	Completed
Maitland	M-2	Lake Gem/Park Lake COOP BMP	Construct second generation baffle box	2010	2011	0.3	\$30,000	\$3,000	3.4	Stormwater Retrofit	Envisioned, but Not Funded
Maitland	M-3	Lake Gem/Park Lake COOP BMP	Construct second generation baffle box	2010	2011	3.1	\$30,000	\$3,000	20.0	Stormwater Retrofit	Envisioned, but Not Funded
Maitland	M-4	Lake Gem/Park Lake COOP BMP	Construct second generation baffle box	2010	2011	0.2	\$60,000	\$6,000	3.1	Stormwater Retrofit	Envisioned, but Not Funded
Maitland	M-5	Lake Gem/Park Lake COOP BMP	Construct second generation baffle box	2010	2011	18.9	\$60,000	\$6,000	178.9	Stormwater Retrofit	Envisioned, but Not Funded
Maitland	M-6	Lake Gem/Park Lake COOP BMP	Construct second generation baffle box	2010	2011	9.1	\$60,000	\$6,000	58.1	Stormwater Retrofit	Envisioned, but Not Funded
Maitland	M-7	Lake Maitland Basin - Ridgewood Area Quality Neighborhood Program City Street Improvement Plan	Construct infiltration trenches	2009	2010	0.5	\$60,000	\$2,500	3.9	Infiltration trench	Planned & Funded
Maitland	M-8	Lake Maitland Basin - Ridgewood Area Quality Neighborhood Program City Street Improvement Plan	Construct infiltration trenches	2009	2010	1.7	\$170,000	\$8,500	15.0	Infiltration trench	Planned & Funded
Maitland	M-9	Lake Maitland Basin - Ridgewood Area Quality Neighborhood Program City Street Improvement Plan	Construct infiltration trenches	2009	2010	0.6	\$100,000	\$5,000	9.2	Infiltration trench	Planned & Funded
Maitland	M-10	North Lake Maitland Leaf Trap Project	Install curb inlet leaf trap	2009	2010	0.1	\$3,000	\$6,000	16.8	Inlet	Planned & Funded

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ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	ANNUAL O&M COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Maitland	M-11	Lake Maitland Basin - Ridgewood Area Quality Neighborhood Program City Street Improvement Plan	Construct infiltration trenches	2009	2010	0.9	\$100,000	\$8,500	14.8	Infiltration trench	Planned & Funded
Maitland	M-12	Dommerich Lot Baffle Box	Construct second generation baffle box	2010	2011	1.1	\$60,000	\$5,000	24.7	Stormwater Retrofit	Envisioned, but Not Funded
Maitland	M-13	Chipewa Trail Baffle Box	Construct second generation baffle box	2007	2007	1.1	\$60,000	\$5,000	25.3	Stormwater Retrofit	Completed
Maitland	M-14	Horatio Avenue Infiltration Trench	Construct infiltration trenches	2012	2014	0.9	\$150,000	\$5,000	5.0	Infiltration trench	Envisioned, but Not Funded
Maitland	M-15	Minnehaha Park Stormwater Improvements Dry Stormwater Pond	Construct wet pond	2007	2008	1.3	\$65,000	\$2,000	9.9	Dry detention pond	Completed
Maitland	M-16	Street Sweeping	Street sweeping once every 2 weeks of 71 miles	2005	Ongoing	7.4	N/A	\$100,000	2898	Street Sweeping	Ongoing
Maitland	M-17	Education Efforts	Landscaping ordinance, PSAs, presentations/ pamphlets, website, illicit discharge program	N/A	N/A	40.8	N/A	N/A	N/A	Education	Ongoing
Maitland	M-18	Existing BMPs	BMPs in place at the time of the TMDL	N/A	N/A	0.7	N/A	N/A	N/A	N/A	Completed
Total Projects Reduction						122.4					
Total Required Reduction 2010-2014						124.8					
Credit for Future BMAPs						-2.4*					

* Note: Due to some project calculation adjustments done by FDEP, the remainder of the required reductions for this first BMAP will be met as part of the responsibilities in the second BMAP.

ORLANDO ORANGE COUNTY EXPRESSWAY AUTHORITY

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	TP REDUCTION (LBS/YR)	PROJECT TYPE	STATUS
OOCEA	OOCEA-1	Existing BMPs	BMPs that were in place at the time of the TMDL	12.8	N/A	Completed
Total Projects Reduction				12.8		
Total Required Reduction 2010-2014				5.2		
Credit for Future BMAPs				7.6		

ORANGE COUNTY

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT TYPE	STATUS
Orange County	OC-1	Hall Road Improvements	OC CIP Hall Road Improvements	Pending	2014	0.1	Stormwater Retrofit	Planned
Orange County	OC-2	OC CIP Lake Wauntta	OC CIP Lake Wauntta	Pending	2014	3.5	Stormwater Retrofit	Planned
Orange County	OC-3	Lake Sue Inlet Baskets	Lake Sue inlet baskets	N/A	N/A	0.7	Inlet Baskets	Completed
Orange County	OC-4	Street Sweeping	Street sweeping weekly of 78 miles and monthly of 360 miles	N/A	N/A	27.4	Street Sweeping	Ongoing
Orange County	OC-5	Education Efforts	FYN, ordinances, PSAs, pamphlets, presentations, website, illicit discharge program	N/A	N/A	151	Education	Ongoing
Orange County	OC-6	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	197.3	N/A	Completed
Orange County	OC-7	Regional Project	Participate in a regional project	2009	2014	189.0	Regional Project	Planned
Total Projects Reduction						569.0		
Total Required Reduction 2010-2014						569.0		
Credit for Future BMAPs						0.0		

CITY OF ORLANDO

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	ANNUAL O&M COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Orlando	ORL-1	Lake Dot Water Quality Restoration	Installation of Alum Treatment System, where aluminum sulfate (alum) is injected into stormline on a flow-proportioned basis	1988	07/1990	70.4	\$569,207	N/A	276	Alum	Completed
Orlando	ORL-2	Hazel Street Outfall Improvements	Installation of CDS Unit at Lake Winyah from 96" pipe	07/2000	07/2003	8.3	\$410,992	N/A	505	Stormwater Retrofit	Completed
Orlando	ORL-3	Lake Rowena Screening Facility & Alum Stormwater Treatment	Installation of underground, flow-actuated rotating bar screen on 108" outfall pipe to capture debris with additional treatment via alum system	1994	1996	55.0	\$596,512	N/A	470	Screening and Alum	Completed
Orlando	ORL-4	Lake Highland CDS Unit	Installation of CDS Unit at Lake Highland	1998	1999	1.0	\$60,000	N/A	45	Stormwater Retrofit	Completed
Orlando	ORL-5	Mills Avenue Retrofit	Construction of Storm Flo Litter Collection Screen on Mills Ave., adjacent to Lake Rowena to treat runoff from 36" and 24" stormlines	01/2009	04/2009	8.4	\$250,000	N/A	89	Stormwater Retrofit	Planned & Funded
Orlando	ORL-6	Overbrook Stormwater Improvements	Construct 2nd generation baffle box upstream of Lake Adair; Implement pollution prevention methods, including gravel bottom and check dams to settle out pollutants	10/2007	07/2008	1.8	\$400,000	N/A	236	Stormwater Retrofit	Planned & Funded
Orlando	ORL-7	Guernsey Park - Expansion of Wet Detention Pond	Expansion of wet detention pond to treat 61% of sub-basin drainage	N/A	N/A	0.1	\$425,000	N/A	80	Wet detention pond	Envisioned, but Not Funded
Orlando	ORL-8	Ivanhoe Plaza Park Exfiltration	Installation of exfiltration galleries to treat 100% of sub-basin drainage	N/A	N/A	1.3	\$1,100,000	N/A	49	100% on-site retention	Envisioned, but Not Funded

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Orlando	ORL-9	Don Dudley Park 2nd Generation Baffle Boxes	Construct two 2nd Generation Baffle Boxes upstream of Lake Concord and reroute flow to treat 30" and 24" outfalls from nearly 100% of two sub-basins	N/A	N/A	0.8	\$250,000	N/A	66	Stormwater Retrofit	Envisioned, but Not Funded
Orlando	ORL-10	Winyah (Westchester Ave/Wilkinson St) 2nd Generation Baffle Box	Construct 2nd Generation Baffle Box upstream of Lake Winyah to treat 71% of sub-basin	N/A	N/A	1.6	\$72,000	N/A	30	Stormwater Retrofit	Envisioned, but Not Funded
Orlando	ORL-11	Westmoreland 2nd Generation Baffle Box	Construct 2nd Generation Baffle Box upstream of Lake Adair	N/A	2006	0.1	\$35,000	N/A	5.3	Stormwater Retrofit	Completed
Orlando	ORL-12	Stormwater Filtration Systems / Inlet Baskets	Installation of 6 inlet baskets around perimeter of Lake Adair	N/A	2007	0.0	\$5,400	N/A	25	Inlet Basket	Completed
Orlando	ORL-13	Stormwater Filtration Systems / Inlet Baskets	Installation of 11 inlet baskets in Spring Lake basin	N/A	2007	0.0	\$9,900	N/A	25	Inlet Basket	Completed
Orlando	ORL-14	Stormwater Filtration Systems / Inlet Baskets	Installation of 13 inlet baskets in Lake Formosa basin	N/A	2007	0.1	\$11,700	N/A	14	Inlet Basket	Completed
Orlando	ORL-15	Stormwater Filtration Systems / Inlet Baskets	Installation of 29 inlet baskets in Lake Highland basin	N/A	2007	3.5	\$26,100	N/A	223	Inlet Basket	Completed
Orlando	ORL-16	Stormwater Filtration Systems / Inlet Baskets	Installation of 2 inlet baskets in Lake Rowena basin	N/A	2007	0.5	\$1,800	N/A	39	Inlet Basket	Completed
Orlando	ORL-17	Stormwater Filtration Systems / Inlet Baskets	Installation of 49 inlet baskets in Lake Ivanhoe basin	N/A	2008	0.6	\$44,100	N/A	242	Inlet Basket	Completed
Orlando	ORL-18	Stormwater Filtration Systems / Inlet Baskets	Installation of 4 inlet baskets in Lake Druid basin	N/A	2007	0.4	\$1,800	N/A	39	Inlet Basket	Completed
Orlando	ORL-19	Street Sweeping	2 times per week of 6.4 miles, weekly of 9.3 miles, and 2 times per month of 113 miles	N/A	N/A	14.3	N/A	\$1,800,000	N/A	Street Sweeping	Completed

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Orlando	ORL-20	Reading Dr (24" line) - 2nd Generation Baffle Box at Lake Adair	Construct 2nd Generation Baffle Box upstream of Lake Adair to treat approximately 13% of subbasin	N/A	N/A	0.5	N/A	N/A	26	Stormwater Retrofit	Envisioned, but Not Funded
Orlando	ORL-21	Spring Lake -2nd Generation Baffle Box at Rio Grande	Construct 2nd Generation Baffle Box upstream of Spring Lake to treat 100% of subbasin	N/A	N/A	0.6	\$128,000	N/A	39	Stormwater Retrofit	Envisioned, but Not Funded
Orlando	ORL-22	Spring Lake- 2nd Generation Baffle Box at Springdale Rd	Construct 2nd Generation Baffle Box upstream of Spring Lake to treat 100% of subbasin	N/A	N/A	0.1	N/A	N/A	21	Stormwater Retrofit	Completed
Orlando	ORL-23	DOT Pond Maintenance, west of Spring Lake	Removal of muck/sediment and expansion of wet detention pond to treat 95% and 5% of two sub-basins, respectively.	N/A	N/A	6.1	N/A	N/A	141	Wet detention pond	Envisioned, but Not Funded
Orlando	ORL-24	Weber Dr - 2nd Generation Baffle Box at Lake Druid	Construct 2nd Generation Baffle Box upstream of Lake Druid to treat approximately 7% of subbasin	N/A	2006	0.3	N/A	N/A	6	Stormwater Retrofit	Completed
Orlando	ORL-25	Educational Component	FYN, ordinances (landscape, irrigation, pet waste), PSAs, pamphlets, presentations, website, illicit discharge program	N/A	N/A	94.2	N/A	N/A	N/A	Education	Ongoing
Orlando	ORL-26	Hughey Avenue Retrofit	Divert stormwater from Lake Concord basin to Lake Dot Alum Treatment before discharging into chain of lakes	10/2010	12/2010	3.8	\$500,00	N/A	90.8	Stormwater Retrofit and Alum	Planned & Funded
Orlando	ORL-27	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	684.4	N/A	N/A	N/A	N/A	Completed
Total Projects Reduction						958.2					
Total Required Reduction 2010-2014						326.3					
Credit for Future BMAPs						631.9					

CITY OF OVIEDO

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Oviedo	OV-1	Aulin Regional Stormwater Pond	Aulin Regional Stormwater Pond	2009	2014	13.5	N/A	N/A	Wet detention pond	Envisioned, but Not Funded
Oviedo	OV-2	Lightwood Knox Canal Project	Lightwood Knox Canal Project	2009	2014	84.5	N/A	N/A	Dry detention pond, Swales	Envisioned, but Not Funded
Oviedo	OV-3	Sweetwater Creek Project	Sweetwater Creek Project	2009	2014	30.4	N/A	N/A	Dry detention pond, wet detention pond	Envisioned, but Not Funded
Oviedo	OV-4	Solary Canal Stormwater Treatment Area	Regional Stormwater Treatment Facility consisting of an 8.0-acre wet pond and 4.8-acre wetland	1/2010	9/2010	230.0	\$1,700,000	1,471	Wet detention pond, Wetland treatment	Planned & Funded
Oviedo	OV-5	Street Sweeping	Monthly street sweeping of 160.8 miles	N/A	N/A	11.8	N/A	N/A	Street Sweeping	Ongoing
Oviedo	OV-6	Education Efforts	FYN, illicit discharge program	N/A	N/A	46.2	N/A	N/A	Education	Ongoing
Oviedo	OV-7	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	386.5	N/A	N/A	N/A	Completed
Total Projects Reduction						802.9				
Total Required Reduction 2010-2014						258.7				
Credit for Future BMAPs						544.2				

CITY OF SANFORD

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	STATUS
Sanford	S-1	Street Sweeping	Weekly street sweeping of 25.3 miles	N/A	N/A	3.6	Ongoing
Sanford	S-2	Public Education	Public Education	N/A	N/A	108.9	Ongoing
Sanford	S-3	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	521.2	Complete
Total Projects Reduction						633.7	
Total Required Reduction 2010-2014						602.2	
Credit for Future BMAPs						31.5	

SEMINOLE COUNTY

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	FOOTPRINT (ACRES)	TREATMENT ACRES	PROJECT TYPE	STATUS
Seminole County	SC-1	Cassel Creek RSF	RSF to treat water in the sub basin upstream	1/2010	9/2010	156.8	\$ 1,700,000	10	830	Wet detention pond	Planned & Funded
Seminole County	SC-2	Lake Ann Outfall	Baffle box and pipe replacement	4/2001	10/2001	10.8	\$148,000	0.1	322	Stormwater Retrofit	Completed
Seminole County	SC-3	Red Bug Lake Road RSF	RSF to treat water in the sub basin upstream	6/2009	3/2010	93.0	\$ 1,400,000	9	1050	Wet detention pond	Planned & Funded
Seminole County	SC-4	Navy Canal RSF	RSF to treat water in the sub basin upstream	3/1/2005	10/14/2006	285.0	\$ 2,112,336	7	889	Wet detention pond	Completed
Seminole County	SC-5	Cameron Ditch RSF	RSF to treat water in the sub basin upstream	4/17/2006	10/14/2006	71.9	\$ 3,735,374	32	376	Wet detention pond, Wetland treatment	Completed
Seminole County	SC-6	Lake Howell Road Pond Retrofit	Retrofit of an old FDOT pond now under county jurisdiction that drains Howell Branch Road	5/2007	11/1/2007	7.1	N/A	4.0	23	Wet detention pond	Completed
Seminole County	SC-7	Solary Canal Stormwater Treatment Area	RST facility consisting of an 8.0-acre wet pond and 4.8-acre wetland	1/2010	9/2010	230.0	\$1,700,000	12.7	1471	Wet detention pond, Wetland treatment	Planned & Funded
Seminole County	SC-8	Anchor Road Reconstruction	Reconstruction of Anchor Road with drainage improvements including upgraded detention/retention ponds	10/2007	10/2009	5.1	\$2,000,000	13	60.7	Wet detention pond	Started
Seminole County	SC-9	Street Sweeping	Street sweeping monthly of 66.8 miles and quarterly of 160.2 miles	N/A	N/A	13.1	N/A	N/A	N/A	Street sweeping	Ongoing

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	FOOTPRINT (ACRES)	TREATMENT ACRES	PROJECT TYPE	STATUS
Seminole County	SC-10	Education Efforts	FYN, ordinances, PSAs, pamphlets, presentations, website, illicit discharge program	N/A	N/A	558.3	N/A	N/A	N/A	Education	Ongoing
Seminole County	SC-11	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	1,753.8	N/A	N/A	N/A	N/A	Completed
Total Projects Reduction						3,184.9					
Total Required Reduction 2010-2014						2,137.0					
Credit for Future BMAPs						1,047.9					

TURNPIKE AUTHORITY

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	TP REDUCTION (LBS/YR)	STATUS
Turnpike Authority	T-1	Existing BMPs	BMPs that were in place at the time of the TMDL	252.3	Completed
Turnpike Authority	T-2	Monthly street sweeping of 48 miles	Monthly street sweeping	3.2	Ongoing
Turnpike Authority	T-3	Education Efforts	Presentations, illicit discharge program	9	Ongoing
Total Projects Reduction				264.5	
Total Required Reduction 2010-2014				101.1	
Credit for Future BMAPs				163.4	

CITY OF WINTER PARK

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	ANNUAL O&M COST	TREATMENT ACRES	PROJECT TYPE	STATUS
Winter Park	WP-1	Lake Island Interconnect	First Flush bypass to Wet Retention Ponds	06/2002	09/2003	4.7	\$408,009	N/A	74.5	Wet detention pond	Completed
Winter Park	WP-2	Via Lugano Exfiltration	Off Line Exfiltration	10/1996	11/1997	1.3	\$200,000	N/A	25.3	Dry detention pond	Completed
Winter Park	WP-3	N. Park Ave. Exfiltration	Off Line Exfiltration	06/2004	10/2004	6.6	\$250,000	N/A	21.44	Dry detention pond	Completed
Winter Park	WP-4	Fairway 3 Exfiltration	Off Line Exfiltration	11/2006	10/2007	5.5	\$1,000,000	N/A	57.39	Dry detention pond	Completed
Winter Park	WP-5	McKean Road CDS	CDS Unit on 24" outfall	05/2004	06/2005	0.0	N/A	N/A	5.58	Stormwater Retrofit	Completed
Winter Park	WP-6	Pinetree Rd Outfall CDS	CDS unit on 42" outfall	05/2004	06/2005	0.6	N/A	N/A	64.78	Stormwater Retrofit	Completed
Winter Park	WP-7	1190 Park Ave CDS	CDS unit on 30" outfall	08/1998	11/1999	0.2	N/A	N/A	22.82	Stormwater Retrofit	Completed
Winter Park	WP-8	Moss/ Venetian Dry Capture 1 st Generation Baffle box	Baffle screen on 15" outfall	02/2000	03/2007	0.1	N/A	N/A	3.02	Stormwater Retrofit	Completed
Winter Park	WP-9	Green Cove Road 2 CDS Units	2 CDS units on two 24" outfalls	05/2004	06/2006	0.1	N/A	N/A	11.35	Stormwater Retrofit	Completed
Winter Park	WP-10	Courtland Alum Injection treatment	Alum injection at Lake Mizell outfall	N/A	N/A	21.2	N/A	N/A	88.08	Alum	Completed
Winter Park	WP-11	Partnership/ wet detention/ Windsong	Developer's agreement to treat Palmer ditch basin run off within site MSSW	N/A	N/A	5.8	N/A	N/A	84.55	Wet detention pond	Completed
Winter Park	WP-12	Lincoln Ave Alum Injection treatment	Alum injection at Lake Osceola outfall	N/A	N/A	37.7	N/A	N/A	17.59	Alum	Completed
Winter Park	WP-13	Alexander Place Alum Injection treatment with baffle box	Alum injection at Lake Osceola outfall	N/A	N/A	22.6	N/A	N/A	24.61	Alum	Completed
Winter Park	WP-14	Morse /Alum Injection treatment	Alum injection at Lake Osceola outfall	N/A	N/A	6.9	N/A	N/A	57.13	Alum	Completed

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Winter Park	WP-15	Trismen and Lakewood Drive Exfiltration	Off Line Exfiltration	N/A	N/A	0.4	N/A	N/A	7.35	Dry detention pond	Completed
Winter Park	WP-16	Trismen CDS Unit	CDS Unit on 24" outfall	N/A	N/A	0.0	N/A	N/A	0.39	Stormwater Retrofit (CDS)	Completed
Winter Park	WP-17	Trismen Dry 1st Generation Baffle Box	Baffle screen on 15" outfall	N/A	N/A	0.0	N/A	N/A	1.84	Stormwater Retrofit	Completed
Winter Park	WP-18	Elizabeth CDS treating Inlet at Bonita and Dale	CDS on 15" Pipe	05/2004	06/2006	0.0	N/A	N/A	2.35	Stormwater Retrofit	Completed
Winter Park	WP-19	Lake Chelton Outfall Improvement	4 Dry Capture Baffle inlets and boxes	09/2003	01/2004	0.0	N/A	N/A	28.65	Stormwater Retrofit	Completed
Winter Park	WP-20	Lakeview Road Bricking	CDS Installation on 24" Outfall	03/2006	03/2006	0.1	N/A	N/A	9.53	Stormwater Retrofit	Completed
Winter Park	WP-21	Mead Gardens Borrow Pit Pond Retrofit	Retrofit Screening devices (two baffle boxes) to existing MSSW	05/2006	09/2006	15.4	N/A	\$560,000	62.06	Stormwater Retrofit	Completed
Winter Park	WP-22	Glencoe Road Bricking	Stormwater capture and screening system (baffle box)	03/2007	06/2007	0.1	N/A	N/A	3.39	Stormwater Retrofit	Completed
Winter Park	WP-23	Laurel Road Dry Retention Pond	On Line Dry retention Pond	05/1999	03/2001	1.7	N/A	N/A	17.15	Dry detention pond	Completed
Winter Park	WP-24	Alum Injection Treatment/ Rollins	Alum injection At Outfalls to Lake Virginia	01/1995	1996	26.8	N/A	N/A	72.99	Alum	Completed
Winter Park	WP-25	9th Grade Center Pond Wet Detention	Wet Detention Pond Retrofit	Pre 1995	Pre 1995	7.6	N/A	N/A	110.8	Wet detention pond	Completed
Winter Park	WP-26	Lakeview Bricking	Stormwater capture and screening system (baffle box)	02/2005	11/2006	0.1	N/A	N/A	6.97	Stormwater Retrofit	Completed
Winter Park	WP-27	Oxford Road Bricking	Stormwater capture and screening system (baffle box)	08/2006	11/2006	0.1	N/A	N/A	5.28	Stormwater Retrofit	Completed

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Winter Park	WP-28	Lake Island Park	Created treatment volume in Lake Mednsen, construct control structures for wet detention treatment	06/1905	03/1996	83.8	N/A	N/A	256.00	Wet detention pond	Completed
Winter Park	WP-29	950 Palmer Ave Retrofit	Stormwater capture and screening system (baffle box)	07/2007	07/2007	0.3	N/A	N/A	18.33	Stormwater Retrofit	Completed
Winter Park	WP-30	Banchory Exfiltration	On-line Retention 0.25 treatment volume	2008	2008	0.4	N/A	N/A	N/A	On-line Retention	Completed
Winter Park	WP-31	Bryan CDS	CDS	2008	2008	0.2	N/A	N/A	N/A	Stormwater Retrofit	Completed
Winter Park	WP-32	E. Lake Sue CDS	CDS	2008	2008	0.1	N/A	N/A	N/A	Stormwater Retrofit	Completed
Winter Park	WP-33	Elizabeth Drive baffle box	Baffle box	N/A	N/A	1.1	N/A	N/A	N/A	Stormwater Retrofit	Completed
Winter Park	WP-34	Street Sweeping	Street sweeping two times per month of 130 miles	N/A	Ongoing	13.6	N/A	N/A	N/A	Street Sweeping	Ongoing
Winter Park	WP-35	Education Efforts	FYN, landscape and fertilizer ordinances, pamphlets, presentations, website, illicit discharge program	N/A	Ongoing	106.3	N/A	N/A	N/A	Education	Ongoing
Winter Park	WP-36	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	151.5	N/A	N/A	N/A	N/A	Completed
Total Projects Reduction						522.9					
Total Required Reduction 2010-2014						370.5					
Credit for Future BMAPs						152.4					

WINTER SPRINGS

ENTITY	PROJECT NUMBER	PROJECT NAME	PROJECT DETAIL	START DATE	END DATE	TP REDUCTION (LBS/YR)	PROJECT COST	ANNUAL O&M COST	STATUS
Winter Springs	WS-1	Solary Canal Stormwater Treatment Area	Regional Stormwater Treatment Facility consisting of an 8.0-acre wet pond and 4.8-acre wetland	1/2010	9/2010	230.0	\$1,700,000	N/A	Planned & Funded
Winter Springs	WS-2	Winding Hollow Wetland Treatment Area	Divert No Name Creek flow into wetland treatment system	2020	2020	210.1	\$357,000	N/A	Envisioned but Not Funded
Winter Springs	WS-3	Winter Springs and Wedgewood Filtration Devices	Retrofit stormwater outfalls with flow-through filtration devices	2020	2020	24.7	\$132,000	N/A	Envisioned but Not Funded
Winter Springs	WS-4	North Orlando Townsite Filtration Devices	Retrofit eastern and western outfalls with flow-through filtration devices	2020	2020	5.2	\$80,000	N/A	Envisioned but Not Funded
Winter Springs	WS-5	Highlands Regional Pond Enhancements	Expansion of existing wet pond and redirection of untreated stormwater runoff to the pond	2020	2020	64.5	\$1,385,000	N/A	Envisioned but Not Funded
Winter Springs	WS-6	Education Efforts - Update Local Codes and Ordinances (Fertilizer Rule, etc.), FYN	Maximize available public education credits through Code updates, fertilizer ordinance, FYN, etc.	N/A	N/A	92.0	N/A	\$3,000	Ongoing
Winter Springs	WS-7	Street Sweeping	Quarterly street sweeping of 142.7 miles	N/A	N/A	7.3	N/A	N/A	Ongoing
Winter Springs	WS-8	Existing BMPs	BMPs that were in place at the time of the TMDL	N/A	N/A	765.2	N/A	N/A	Completed
Total Projects Reduction						1,399.0			
Total Required Reduction 2010-2014						513.0			
Credit for Future BMAPs						886.0			

Appendix E: LID APPLICATION IN THE LAKE JESUP BASIN

The following tables summarize key LID principles (**Table E-1**) and activities (**Table E-2**) to provide local examples of how those principles are being put into place in the Basin. **Table E-3** identifies local programs and projects that have used multiple LID principles and activities to achieve water quality and/or environmental benefits. Given the success achieved by local governments, it is reasonable to expect that these types of projects will continue to be developed in the basin.

TABLE E-1: LOW IMPACT DEVELOPMENT –APPLICATION OF KEY PRINCIPLES IN THE LAKE JESUP BASIN

Key Principle	Description
Preservation and 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. The goal is to preserve natural features, such as wetlands, woodlands, and stream buffers, and retain their natural biodiversity. Protection occurs primarily through land use rules established at the local government level, and through Water Management District, state and local land acquisition programs.
Application within the Lake Jesup Basin • All of the communities within the Lake Jesup Basin have policies requiring minimum upland buffers from the edges of wetlands and Conservation Land Use categories that protect sensitive lands within their respective Comprehensive Plans. • Orange County established GreenPLACE (Park Land Acquisition and Conservation for Environmental Protection) to preserve and manage environmentally sensitive lands, and protect water resource lands. The program has invested \$10.2 million in purchasing 582 acres of environmentally sensitive lands thus far. • Altamonte Springs has a special Conservation District zoning category and protected land use classification for environmental sensitive land that is considered to be a conservation area. Conservation areas are the floodways of a river or a wetland of sufficient size to host a viable wetland habitat. • Orlando protects environmentally sensitive lands through the utilization of the Resource Protection Overlay Future Land Use Designation and the Resource Protection Overlay Zoning District, as well as environmentally sensitive lands regulations is Chapter 63 of the City's Land Development Code. • Casselberry has a special Conservation overlay that restricts both the density and intensity of construction within the boundaries of the overlay.	
Incorporation of small-scale stormwater treatment systems integrated at the lot level	Lot-level and on-site treatment systems offer the best opportunities for maintaining more natural hydrologic functions, as well as reducing the concentration time needed to move water into larger offsite facilities, if necessary, and enhance community character. The excessive land requirements for large-scale systems and the concomitant loss of terrestrial open space area are also avoided.
Application within the Lake Jesup Basin • Article XI of the City of Oviedo Code recommends stormwater retention or detention in surface facilities, such as grassed swales. To minimize runoff, developments must maximize the infiltration of natural rainfall into the soil and minimize direct overland runoff into adjoining streets and water courses. The Code further encourages infiltration of runoff from driveways, roofs, or other impervious areas through diversion so as to flow over grassed areas whenever possible. Within recharge areas post-development rates and volumes must achieve at least 70% infiltration of all on-site stormwater. Further, impervious surfaces cannot exceed 50% of the total site area. • A general requirement of the Seminole County land development code requires that runoff from driveways, roofs or other impervious areas should be diverted so as to flow over grassed areas prior to flowing into any drainage system whenever possible. The code also allows onsite wetlands for bioretention. • The City of Sanford has specific policies in its Comprehensive Plan encouraging infiltration, roof runoff disconnects, and overland flow.	
Increasing infiltration	Mechanisms that can retain stormwater on-site yet still provide percolation facilitate both the protection of surface water quality and aquifer recharge.
Application within the Lake Jesup Basin • The entire shorelines of Lake Lily and Long Branch Canal in Maitland have been fitted with Geo-tubes to maximize infiltration of runoff and	

Key Principle	Description
	minimize transport of runoff into the waterbodies. • The Casselberry stormwater Code specifically addresses and allows underground exfiltration trench systems for percolation of stormwater into the ground (Section 3-12.13). • Casselberry also requires the pre-post differential volumetric retention of all stormwater runoff for the 25 year 24 hour storm event. This requirement is more stringent than both Seminole County and SJRWMD. • The City Hall complex in Oviedo has no curb for parking, with runoff moving through vegetated areas into depressed grassed areas. • The City of Sanford has both Comprehensive Plan policies and land development regulations (Schedule M) that require swales, terraces, and berms. • Longwood is developing a regulation requiring that swales be used on at least one side of residential roadways. • Winter Springs encourages filter strips and the separation of sidewalks from curbs. • A new Winter Park ordinance allows and sets design criteria for underground stormwater systems.
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 offsite impacts.
Application within the Lake Jesup Basin • Seminole County encourages development to use joint or shared access and stormwater facilities to minimize impervious surfaces, as determined by the Development Review Manager. The County also has a “Conservation Village” area in the vicinity of Myrtle Street with a clustering of development/reduction of impervious incentive program. • Though not an official policy, the reduction of impervious parking within the City of Longwood’s historic district is strongly encouraged during the site plan process. The types of impervious parking currently in use in the Historic District include crushed rock, gravel, mulch, and grass. • The City of Orlando stormwater utility has an incentive for development to reduce impervious through fee reductions.	
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 that minimizes hydrologic impacts created by the development.
Application within the Lake Jesup Basin • 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. • Orange County has several LEED certified staff members within both the Environmental Protection, and Building and Planning Divisions, and the Orange County Coroner’s Office has been LEED accredited and certified. • The City of Sanford Downtown Overlay District requires LEED compliance for all re-construction, with two projects potentially being designed with green roofs. • Section 60.233 of the Orlando code provides landscaping requirements adjacent to lakes and wetlands that require native plantings in the littoral zone along at least 75% of the lake frontage. • Article XII of the Oviedo code has specific sections on Xeriscaping™ and lake edge landscaping, as well as tree planting and buffering requirements.	

TABLE E-2: LOW IMPACT DEVELOPMENT – KEY ACTIVITIES AND LOCAL PROJECTS

Activities	Description
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. Numerous studies have demonstrated that green roofs can provide stormwater management, economic benefits, improvements in air quality and moderation of the urban heat island effect.
Local Projects - Longwood staff are encouraging the inclusion of green roof provisions in the update of the City’s Comprehensive Plan. - A City of Maitland Community Redevelopment Area (CRA) proposal is considering five locations that may include green roof systems. - One of the goals of the Green Works Orlando Pillars program is to build a roof top/balcony garden at City Hall to raise awareness of green roofs and their benefits.	
Swales and filter strips	Swales and filter strips reduce runoff velocity, provide filtration and allow for infiltration and percolation of runoff.
Local Projects - Altamonte Springs has swale systems throughout the Ronald Reagan subdivision and along Robin Road. A brochure titled “Save Our Swales” discusses the LID concept behind swales, their purpose, and maintenance requirements. - The Casselberry North Lake Triplet West Shore Revegetation project included the removal of invasive and nuisance vegetation, the installation of a water quality swale, and revegetation with native trees, shoreline plants and aquatic plants. - Chapman Road in Oviedo has curb cuts with runoff going into roadside grassed swales. - Mitchell Hammock Road in Oviedo has a center grassed swale. - The Town of Eatonville library has disconnected downspouts with runoff directed through vegetation and a grassed area to shallow depressed area. The Town Hall parking lot has runoff directed to another grassed, depressed area. - The Maitland Center in Altamonte Springs has curb cuts with all lot runoff directed to grassed swales surrounding the complex. - The Spring Hill Apartment Complex in Maitland has lot runoff directed to areas of overland flow, then to shallow depressed areas. - The 7-11 convenience store at the corner of SR 434 and Chapman Road in Oviedo has depressed grassed areas that provide onsite retention.	
Terraces and berms	Terraces and berms surrounding surface water bodies provide a last opportunity for infiltration and treatment of overland flows.
Local Projects - Schedule M of the City of Sanford LDRs requires terraces around lakes. - The Orange County Lakeshore Protection Ordinance (OCC 34-132 requires pollution abatement swales upland of streams and canals and wetlands connected to lakes. - The stormwater management section of the Casselberry Code of Ordinances (Section 3-12.3-P) requires that “waterfront properties which drain	

Activities	Description
	directly into adjacent waterbodies shall utilize pre-berms, terracing, swales and natural vegetative buffers to divert, detain, and/or filter stormwater before it enters the receiving waterbody.”
Porous (permeable) pavement	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.
Local Projects • The parking area at Memorial Park in Sanford utilizes the Geogrid system as an underlayment to the grassed parking area. • A Flexi-pave sidewalk has been installed through a Xeriscape demonstration garden located on the southwest corner of the County Administrative Offices in downtown Orlando. The garden also includes native vegetation and a low-volume irrigation system. Flexi-pave is a pour-in-place paving system made from recycled tires by Firestone. Flexi-Pave can be used in new development, replacing traditional hardscapes and serving as an infiltration zone for capturing or controlling runoff. • Seminole County is installing Flexi-pave at its Geneva Wilderness Park. • Lake Mary is utilizing funds from its stormwater utility to pave all public dirt roads with cold-mix permeable pavement. • The Holy Cross Lutheran Church and the Lake Mary Events Center in Lake Mary both have grassed parking with only paved thruways. • The Aloma Baptist Church on SR 436, in Casselberry, utilizes grassed parking throughout the complex.	
Bioretention	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 depression area planted with native vegetation that is designed to take all, or as much as possible, of the excess rainwater run-off from development and its associated landscape.
Local Projects • The Maitland Springs Commercial Building complex has all lot runoff directed to a naturally vegetated retention area. • Orange County is designing a model rain garden at the Back to Nature Refuge in Orlando. • The Casselberry stormwater utility code provides an on-site retention credit of up to 50% for residential or commercial properties that exceed minimum requirements. Bioretention facilities qualify for this credit. • Facilities with rain gardens within Maitland are located at the end of George and Boynton Streets, along Packwood Street. • The Hamilton Place subdivision in Winter Park has a rain garden.	
Florida Friendly Landscaping	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.

Activities	Description
Local Projects - The Orange County landscape code requires water efficient landscaping, and specifically promotes Xeriscape™ design and maintenance principles. The code also encourages water use zones and allows no irrigation where either native plant habitat is retained, or where water efficient landscaping and irrigation is proposed. - Policy 5.7 within the Lake Mary Conservation Element discourages fertilizers and pesticides on lakefront property, and encourages the use of native and xeriscape plants as landscaping on lake front property. - Seminole County has a water conservation demonstration garden highlighting Xeriscaping and low flow irrigation methods. - The Maitland Public Works Building has an experimental irrigation test site used for investigating mechanisms to minimize landscape irrigation. - Winter Springs is a certified as “Tree City USA” through the National Arbor Day foundation. The City also funds a neighborhood improvement grant program to assist neighborhood groups within the City limits who desire to enhance landscape amenities in the community. - FDEP maintains an interactive Web site to provide information on Florida-friendly plants and landscaping (www.floridayards.org). The site provides basic information on Florida-friendly landscaping, including environmental benefits and guiding principles, and includes a database of native Florida plants.	
Buffers	The use of open space or vegetated buffers minimizes direct stormwater impacts to streams and wetlands. Vegetated buffers in particular, 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 to Outstanding Florida Waters or within special rule areas.
Local Projects - All of the communities in the Lake Jesup Basin have open space and yard regulations to provide open space around and between structures that serve to provide opportunities for overland flow of runoff. - The City of Lake Mary created an Environmental Buffer Zone adjacent to each Wetland Protection Zone that extends 25 feet landward of the boundaries of the Wetland Protection Zone (Chapter 160 – Resource Protection Standards). Commercial development must maintain a 200-foot setback from this secondary zone. In the case of single-family development a 75-foot setback is established. - Maitland is using volunteer groups to assist with the re-planting of native trees and undercanopy plants along the shoreline of Lake Nina. Signage along a boardwalk describes the vegetation and principles of LID. - The Longwood development code requires a 50 foot buffer on lakefront properties with no variances allowed. The City’s Comprehensive Plan also requires a minimum of 50% xeric or native plantings for landscape. Article III of the Longwood Code of Ordinances encourages clustering development as a means of preserving open space.	
Lakeshore Protection	Lakeshore protection, as an LID activity, is important in the Lake Jesup basin because of the large numbers of lakes within the basin boundaries. The water quality management of these lakes is a priority for the local communities.
Local Projects - Maitland has a full-time Lakes Management Coordinator that implements a Lakes Management Plan. A recent project was the installation of swales and reverse berms around Lake Sybelia. - Seminole County, Altamonte Springs, Casselberry and Orlando are all participants in the Florida LAKEWATCH program. Florida LAKEWATCH is a volunteer citizen lake monitoring program that facilitates "hands-on" citizen participation in the management of Florida lakes through	

Activities	Description
monthly monitoring activities - Altamonte Springs has a brochure on lakefront living that encourages shoreline berms or swales, and discusses the importance of shoreline vegetation and native plants for landscaping. Article IV of the Code of Ordinances specifically addresses lakeshore protection and has provisions for landscaping, water quality and buffering. - The Casselberry lakeshore protection ordinance requires that only native vegetation shall be planted and maintained within the shoreline and lakefront littoral zone. Further, a shoreline protection plan is required that shall include a plan that describes procedures to ensure minimal impacts to water quality. - The Casselberry Stormwater, Lake Management and Water Quality Master Plan includes many LID-related best management practices, plans for lakeshore revegetation, swale and reverse berm guidelines, and public outreach elements. As part of this, Casselberry has developed a Lake Management Guide for lakefront property owners and hosts targeted lakefront workshops for City residents. - The Winter Park Lakes Division manages and maintains all city lakes and waterways through aquatic weed control, access management, canal maintenance, and water quality monitoring. The Division also produces a quarterly “Waterways” newsletter. A city Ordinance requires a lakefront berm for all new and re-developed properties. - Orange County has an ordinance for Lakeshore Protection located in Chapter 15 Article VII of the county code.	
Education and Outreach	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.
Local Projects - The City of Longwood has produced two stormwater management guides that list numerous LID concepts. One of the guides is designed for homeowners while the other guide targets builders. The citizen’s guide encourages the planting and maintenance of vegetation on bare and sloped areas; the routing of roof drainage to lawns, paved driveways, or collection (rain) barrels; and the preservation of existing vegetation. - Orange County has a “Green Building” brochure that promotes water efficient landscaping using native plants, the use of an efficient irrigation system and landscaping designed to prevent water from running off property. A stormwater fact sheet promotes the installation of rain barrels and rain gardens to collect roof runoff. - Orange County also held an LID workshop on February 15, 2008, designed for local governmental staff, elected officials, and building, design, and engineering professionals. The workshop discussed water conservation, open space preservation, native tree canopies, rain gardens, green roofs, permeable paved surfaces, resource efficient landscaping and irrigation, and other LID stormwater management strategies used for water resource protection. - The Orange County Extension Office holds rain barrel workshops and maintains a model rain barrel at its office. - Both Orange and Seminole County participate in the Florida Yards and Neighborhoods Program (FYN). FYN is an environmental educational program of the University of Florida Extension Service, implemented at the county level, to inform homeowners on how they can be more environmentally friendly with their landscape practices, helping to protect Florida’s natural environment for future generations. The objectives of Florida Yards & Neighborhoods programs are to reduce stormwater runoff, decrease non-point source pollution, conserve water, enhance wildlife habitat, and create beautiful landscapes. Other partners include the cities of Sanford, Orlando, Casselberry, and Longwood. - Seminole County operates Seminole County Television (SCTV) that shows public service announcements instructing residents that only rain should go down storm drains, not oil or grass clippings. The County also produces a Citizens Guide to Understanding Stormwater that discusses permeable pavement, rain barrels, rain gardens, grassy swales, and vegetated filter strips. They produce a DVD titled the “Citizens	

Activities	Description
	Guide to Lake Management” that includes discussions of LID concepts. Finally, the County maintains a stormwater inlet marking program, a water resources atlas that discusses LID and operates a water conservation demonstration garden. • Orange County operates Orange TV, which provides many of the same types of commercials and programs as SCTV. • Orange County, Seminole County, 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, and Florida Friendly Landscaping methods, all LID implementation strategies. • Maitland is a strong proponent of phosphorus-free fertilizers and has established the “Maitland for Quality” zero phosphorus program to instruct applicators. The City currently has a zero fertilizer or phosphorus application policy on city properties. The City also has a citizen’s guide to the city’s lakes, and a guide to stormwater pollution prevention. • Casselberry has a how-to guide on designing a waterwise landscape that includes zoning of irrigation for more efficient watering. • The Orlando Stormwater Division has school outreach programs, the stormwater drain signs project, and a yearly training program on BMPs for landscaping for all city contractors. The City also has a public awareness specialist to promote rain gardens and other non-structural approaches to stormwater management. • SJRWMD is supportive of LID from an outreach and education perspective and developed an LID fact sheet for the public (http://sjrwmd.com/publications/pdfs/fs_lowimpactdevelopment.pdf). The District has provided both financial and staff support to the Orange and Seminole county LID workshops.

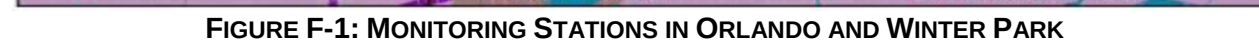
TABLE E-3: LOCAL MULTI-STRATEGY LOW IMPACT DEVELOPMENT PROGRAMS AND PROJECTS

Project	Description
Lake Mary City Park	The Lake Mary City Park, located on the northeast corner of Rinehart Road and Lake Mary Blvd, has a series of vegetated swales to collect parking lot runoff. The park also has a sizable rain garden planted with a variety of native wetland vegetation. This rain garden receives all the drainage from this major intersection and is likely fully inundated during storm events.
Casselberry	The City is re-developing Anniversary Park at the City Hall complex, and construction plans include demonstration rain gardens, pervious pavements, a model baffle box with a plexiglas cover for viewing the inside, model exfiltration trenches, extensive wetland re-vegetation, swales and berms, Florida-friendly landscaping, stormwater harvesting for irrigation, and an educational boardwalk. Construction is expected to be completed in 2009. Section 6.7.2 of the City’s Stormwater Master Plan, which was adopted in September 2007, specifically addresses additional city opportunities for post-construction stormwater management. The section provides a partial listing and descriptions of stormwater Best Management Practices contained in EPA literature (http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm) and elsewhere to reduce runoff volumes and improve downstream water quality. A brief description of reverse berms systems, roadway swales, wetland treatment systems, multi-component pollution abatement facilities, exfiltration trenches, inlets in grass, baffle boxes, LID, green roofs, and bioretention, among others, is given.
Maitland Lakes Management Incentive	The City of Maitland’s Lakes Management Division offers following lakes management incentive programs:

Project	Description
Programs	• Shoreline Revegetation Program - The City will reimburse qualified residents up to 50% of the cost to purchase and install aquatic plants along their property shoreline. A maximum one-time reimbursement of \$200 is being offered. • Wetland Tree Planting Program - Bald Cypress trees are native to Florida and provide valuable wildlife habitat, as well as beauty to your shoreline. The City is offering lakefront homeowners up to three, 8-10 foot tall, bald cypress trees at a cost of only \$25 per tree. A City representative will work with the homeowner to establish the ideal location for the trees to ensure that the trees will benefit the lake and the shoreline. • Environmental Swale Program - The construction of swales helps treat stormwater runoff, as well as prevent sediment, debris, and petroleum-based products, such as oil and grease, from entering our lakes. A City representative will help establish the best location for the swale to ensure that the lakes/canals have maximum benefit. The City of Maitland will pay for 20% of the cost to grade and sod the swale, or \$500 per property, whichever is less. • Fertigation Program - Fertigation is the application of frequent, but very small doses of fertilizer (phosphorus-free), through a homeowner's irrigation system. The fertigation system is inexpensive; locally available; and helps reduce the amount of phosphorus polluting our lakes. The City is offering new fertigation users a gift certificate redeemable from a local supplier for up to two (2) 40- pound bags of phosphorous-free fertilizer.
Orlando Green Programs	• Orlando Green Business Program - The goal of the Orlando Green Business Program is to reach out to the local business community through incentives and education, ensuring pollution prevention and water quality protection of the lakes within the City of Orlando. • Green Works Orlando - Green Works Orlando is an environmental action agenda designed to transform Orlando into an environmentally-conscious city. Immediate goals are to conserve natural resources and protect the environment and to increase the amount of trees and green spaces in the city.
Florida Green Building Coalition	Orlando, Orange County, and Seminole County are members of the Florida Green Building Coalition (FGBC), a nonprofit Florida corporation dedicated to improving the built environment. The mission of the coalition is "to provide a statewide green building program with environmental and economic benefits."The resources offered by the FGBC include five green building standards (listed below), the annual GreenTrends Conference, resources for finding green products and professionals, and education programs for industry professionals, consumers and government entities. FGBC Certification Programs • Green Home Standard • Green Development Standard • Green High Rise Standard • Green Local Government Standard for Green Cities and Counties • Green Commercial Buildings Standard

Appendix F: LAKE JESUP MONITORING PLAN SUPPLEMENTAL INFORMATION

Table F-1 outlines the BMAP monitoring network stations and additional stations that the stakeholders currently sample that could be used to supplement the information gathered from the BMAP monitoring network in order to achieve the objectives of the monitoring plan. The column “Station Type” identifies which type of monitoring (water quality, flow, storm event, or biology) will occur at the station. The table also identifies the responsible entity, frequency of sampling, the parameters that will be monitored, and the year the site was established. The sub-basin that each station is located in is identified along with the local station identifier. **Figure F-1** through **Figure F-7** show the locations of the monitoring sites in the basin.



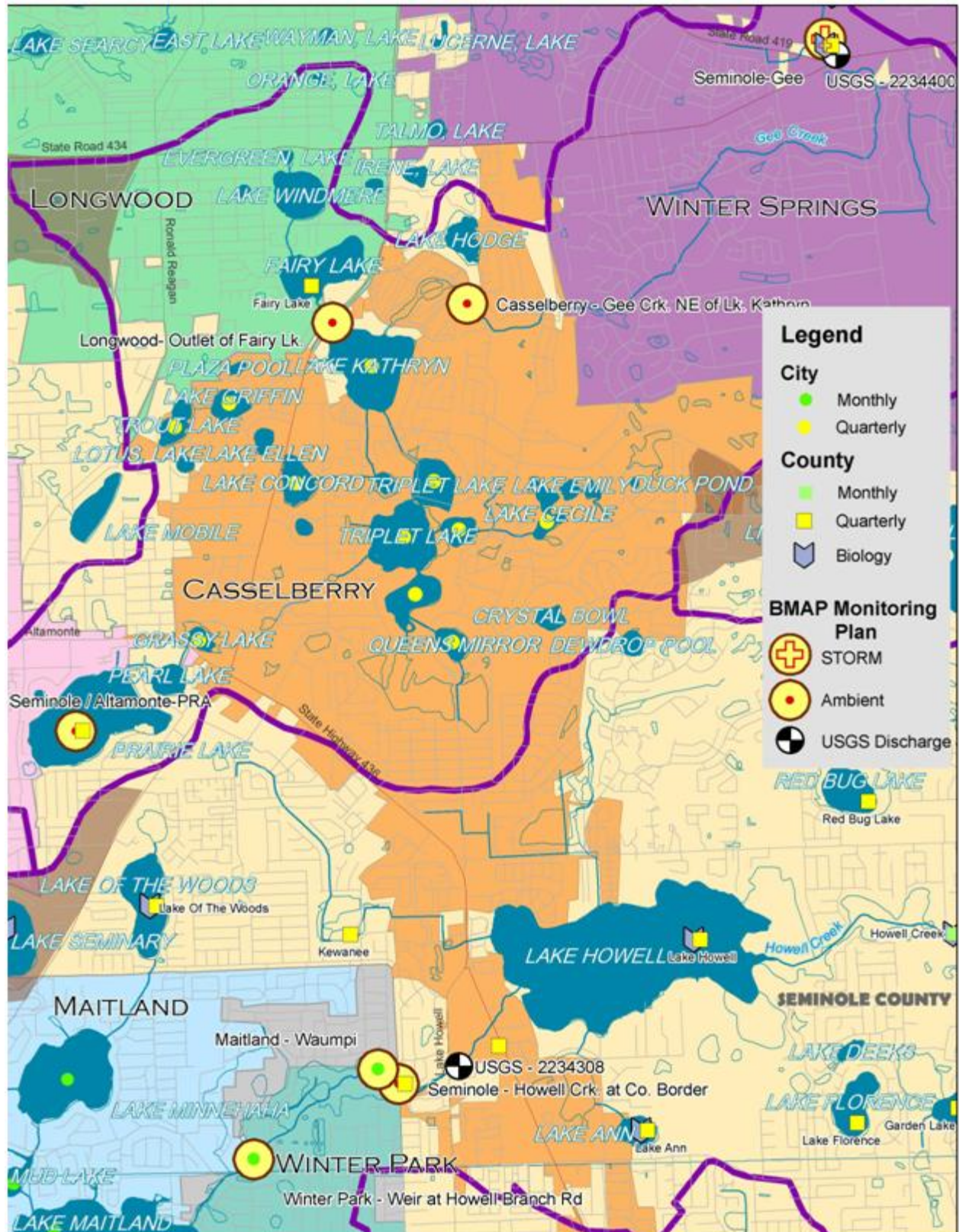


FIGURE F-2: MONITORING STATIONS IN MAITLAND, CASSELBERRY, LONGWOOD, WINTER SPRINGS, AND SEMINOLE COUNTY

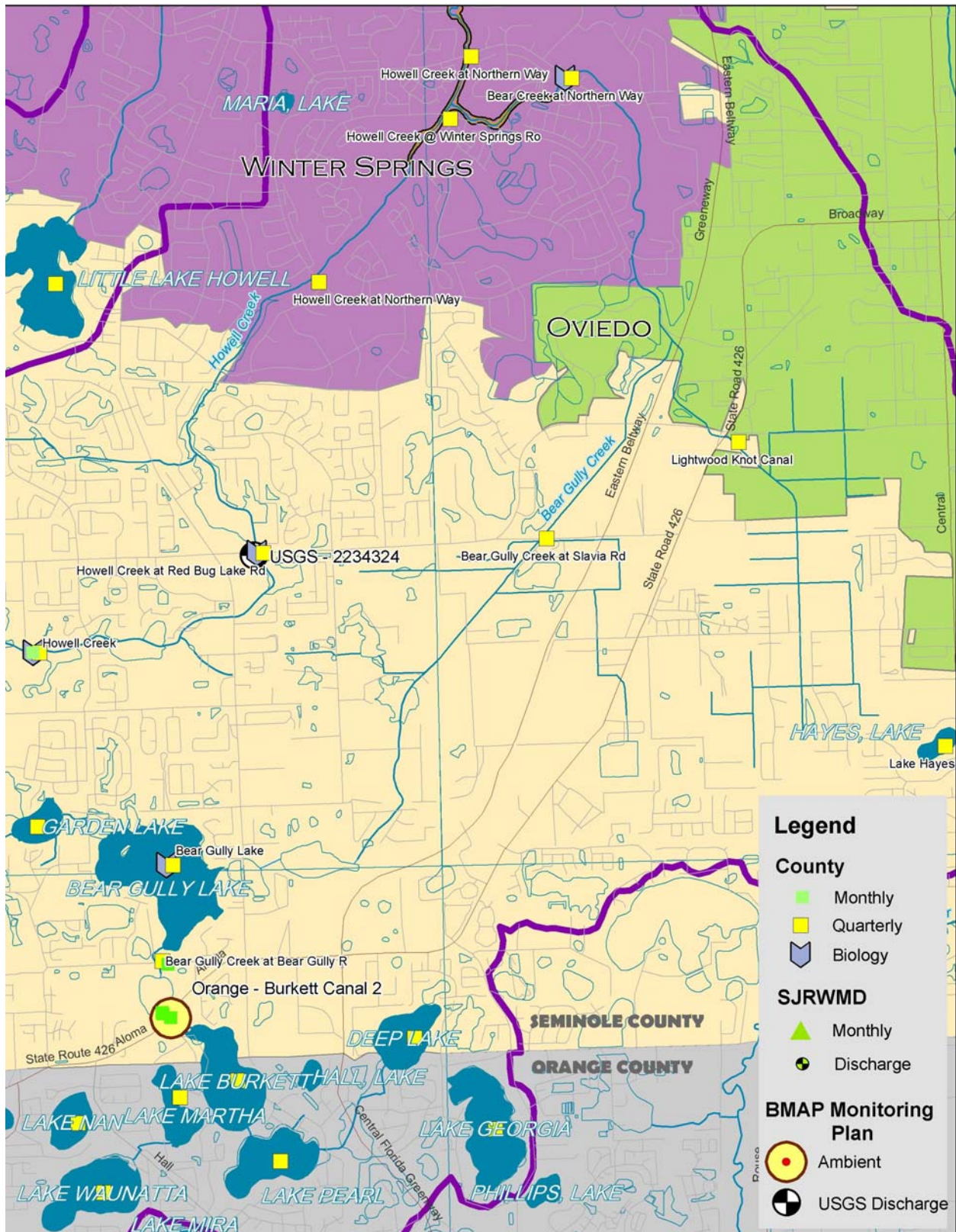


FIGURE F-3: MONITORING STATIONS IN ORANGE COUNTY, SEMINOLE COUNTY, WINTER SPRINGS, AND OVIEDO

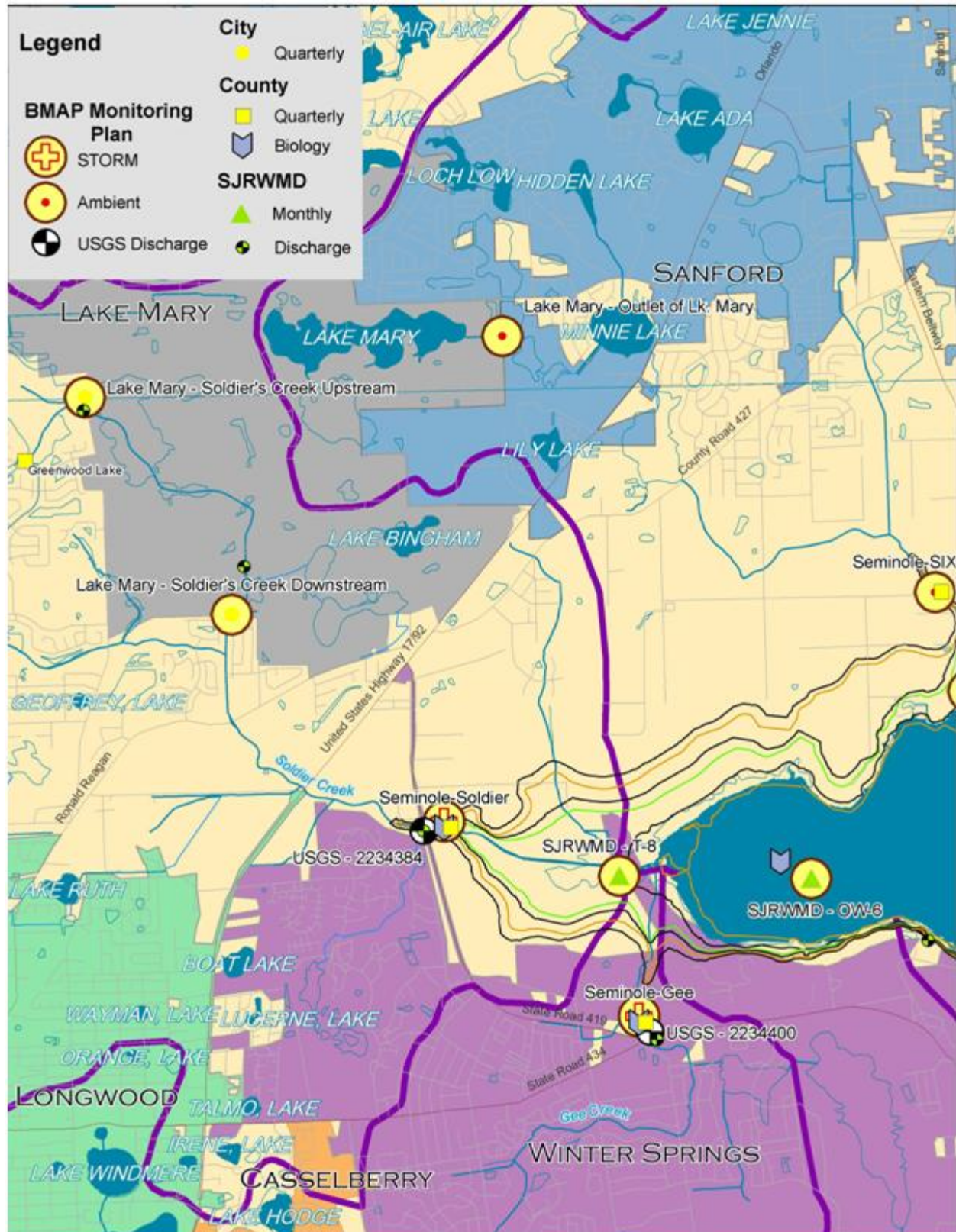


FIGURE F-4: MONITORING STATIONS IN WINTER SPRINGS, LAKE MARY, AND SANFORD

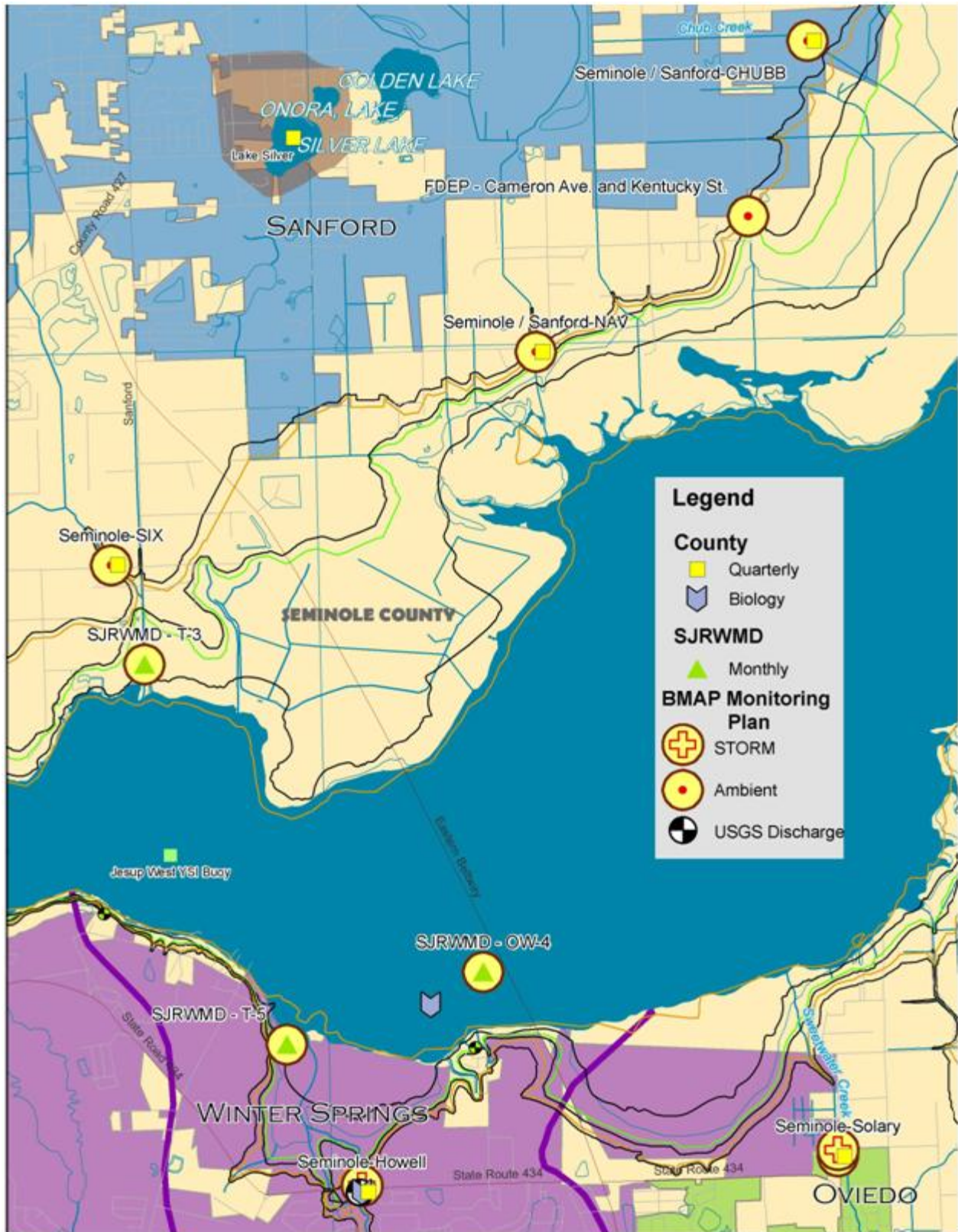


FIGURE F-5: MONITORING STATIONS IN SEMINOLE COUNTY, SANFORD, AND LAKE JESUP

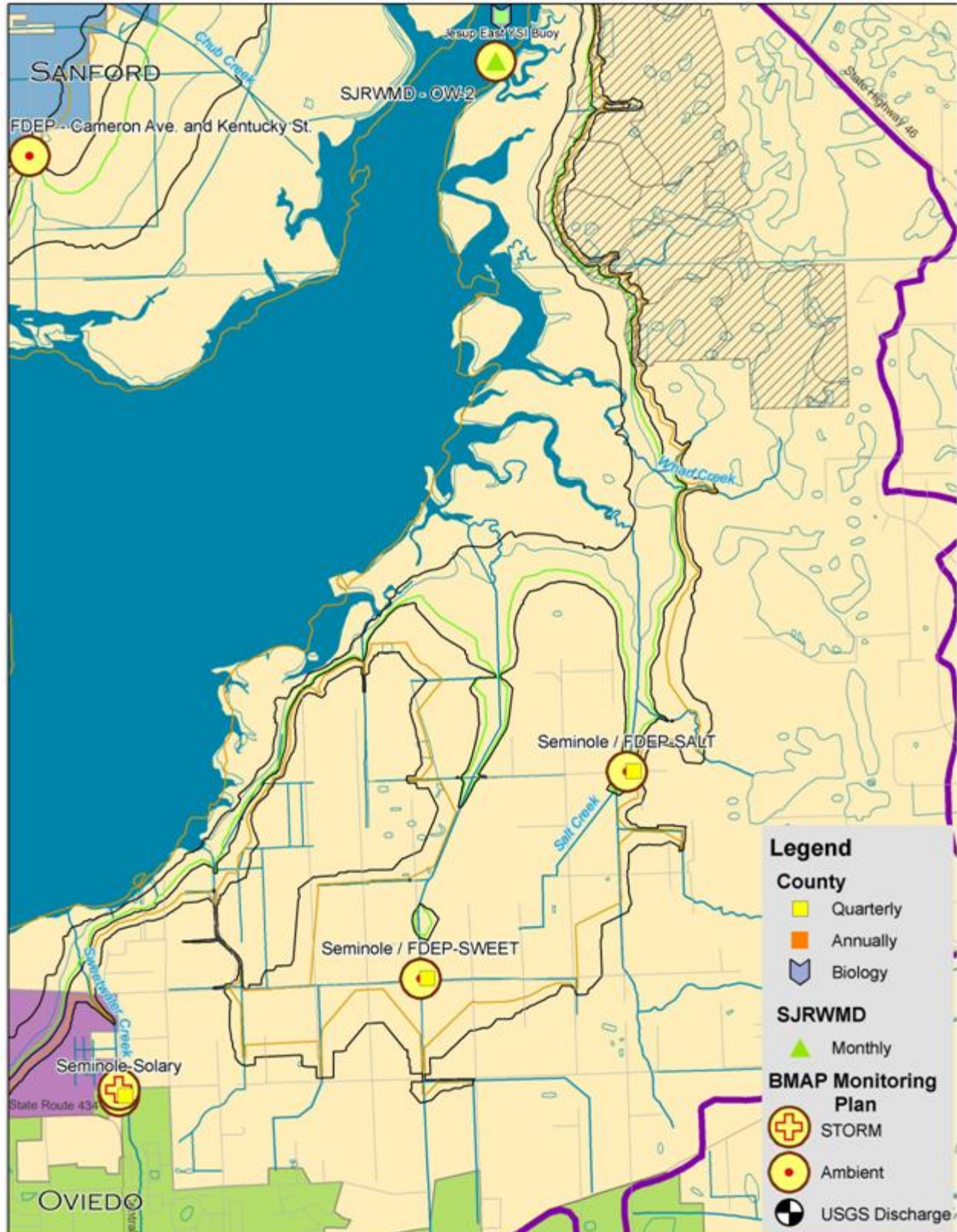


FIGURE F-6: MONITORING STATIONS IN SEMINOLE COUNTY AND LAKE JESUP



FIGURE F-7: MONITORING STATIONS IN LAKE JESUP

TABLE F-1: MONITORING STATIONS IN THE LAKE JESUP BASIN

SUB-BASIN	SAMPLING ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE EST.	SAMPLING PARAMETERS
Bear Gulley	Orange County	HB4	Lake Burkett Center	Water Quality	Quarterly	1967	Field parameters, water chemistry, nutrients, bacteria, metals, chlorophyll-a
		HB62	Lake Martha Center			2007	
		HB29	Lake Nan Center			1971	
		HB47	Deep Lake Center			1990	
		HB40	Lake Waunatta Center			1971	
		HB33	Lake Pearl Center			1971	
		HB14	Lake Georgia Center			1967	
Bear Gulley	Orange County	Burkett Canal 1	Burkett and FDOT pond discharge	Water Quality	Monthly	2007	Field parameters, flow, discharge, nutrients, bacteria
		Burkett Canal 2	Lake Burkett Discharge Upstream of Aloma			2007	
		Burkett Outfall	FDOT pond discharge			2007	
		Burkett Canal 3	FDOT Canal			2007	
Howell Creek	Maitland	Gem	Lake Gem	Water Quality	Monthly		Dissolved oxygen (DO), pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, total suspended solids (TSS), total dissolved solids (TDS), ammonia as N, nitrate/nitrite as N, phosphorous, TN, volatile TSS, orthophosphate as P, TKN
		Maitland	Lake Maitland				
		Minnehaha	Lake Minnehaha				
		Nina	Lake Nina				
		Park	Lake Park				
		Waumpi	Lake Waumpi				
Howell Creek	Orange County	HB21	Lake Killarney Center	Water Quality	Quarterly	1967	Field parameters, water chemistry, nutrients, bacteria, metals, chlorophyll-a, bathymetry
		HB2	Lake Bell Center			1995	
Howell Creek	Orange County	HBC	Howell Creek at 436	Water Quality	Quarterly	1972	Field parameters, water chemistry, nutrients, bacteria, metals, chlorophyll-a, invertebrates
Howell Creek	Orlando	Spn	Spring Lake NW	Water Quality	Annually	1994	Non-ultratrace metals: beryllium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, selenium, silver, zinc, hardness (calculation)
		Ad	Lake Adair			1994	
		Co	Lake Concord			1994	
		Ie	Lake Ivanhoe - East			1994	
		Im	Lake Ivanhoe - Middle			1994	
		Iw	Lake Ivanhoe - West			1994	
		Hi	Lake Highland			1994	
		Fm	Lake Formosa			1994	
		Wi	Lake Winyah			1994	
		Ee	Lake Estelle - East			1994	
		Ew	Lake Estelle - West			1994	
		Rw	Lake Rowena			1994	
		Su	Lake Sue			2000	

SUB-BASIN	SAMPLING ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE EST.	SAMPLING PARAMETERS
Howell Creek	Orlando	Dr	Lake Druid	Water Quality	Quarterly	1995	Field parameters: pH, specific conductance, DO, DO % saturation, temperature, depth, secchi + alkalinity, CBOD, nutrients, TDS, TSS, TVSS, chlorophyll a (corrected), turbidity, fecal coliform
		Dt	Lake Dot			1995	
		Pr	Park Lake			1994	
		Spn	Spring Lake NW			1989	
		Ad	Lake Adair			1989	
		Co	Lake Concord			1988	
		Ie	Lake Ivanhoe - East			1986	
		Im	Lake Ivanhoe - Middle			1987	
		Iw	Lake Ivanhoe - West			1987	
		Hi	Lake Highland			1989	
		Fm	Lake Formosa			1987	
		Wi	Lake Winyah			1986	
		Ee	Lake Estelle - East			1987	
		Ew	Lake Estelle - West			1988	
		Rw	Lake Rowena			1987	
		Su	Lake Sue			1988-1991; 2000-present	
		Dr	Lake Druid			1990	
		Dt	Lake Dot			1987	
		Pr	Park Lake			1988	
Howell Creek	Orlando	Rowena Canal	In the canal that connects Lake Rowena to Lake Sue	Flow	Monthly	2008	Flow
Howell Creek	Orlando	Lake Rowena	LCI Lake Rowena	Biology	Bi-annually	2008	Lake Condition Index
Howell Creek	Winter Park	Lake Sue	Lake Sue @ center of lake	Water Quality	Monthly	1995	TN,TKN, NOx, TP, temp, pH, DO, chlorophyll-a, fecal coliform, secchi depth
		Lake Virginia	Lake Virginia @ center of lake			1995	
		Lake Berry	Lake Berry @ center of lake			1995	
		Lake Mizell	Lake Mizell @ center of lake			1995	
		Lake Osceola	Lake Osceola @ center of lake			1995	
		Lake Maitland	Lake Maitland @ center of lake			1995	
		Lake Bell	Lake Bell @ center of lake			1995	
		Lake Killarney	Lake Killarney @ center of lake			1995	
Howell Creek	Winter Park	Howell Creek	10' Upstream of Weir at Howell Branch Road	Water Quality	Monthly	1995	TP

SUB-BASIN	SAMPLING ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE EST.	SAMPLING PARAMETERS
Soldier's Creek	Lake Mary	Longwood Lake Mary Rd. downstream of culvert	Soldier's Creek Upstream	Water Quality	Monthly	2005	Chlorophyll-a (corrected), TP, orthophosphate as P, ammonia as N, nitrate/nitrite as N, TKN, BOD, specific conductance, DO, pH, temperature, TSS
		Behind Austin Street upstream of culvert	Soldier's Creek Downstream			2005	
		New station	Outlet of Big Lake Mary			New	
Gee Creek	Casselberry	New Station	Gee Creek northeast of Lake Kathryn	Water Quality	Monthly	New	Chlorophyll-a (corrected), TP, orthophosphate as P, ammonia as N, nitrate/nitrite as N, TKN, BOD, specific conductance, DO, pH, temperature, TSS
	FDEP	New Station	Cameron Avenue and Kentucky Street	Water Quality	Monthly	New	Chlorophyll-a (corrected), TP, orthophosphate as P, ammonia as N, nitrate/nitrite as N, TKN, BOD, specific conductance, DO, pH, temperature, TSS
	Longwood	New station	Fairy Lake	Water Quality	Monthly	New	Chlorophyll-a (corrected), TP, orthophosphate as P, ammonia as N, nitrate/nitrite as N, TKN, BOD, specific conductance, DO, pH, temperature, TSS
	Seminole County	ANN	Lake Ann	Biology	Annually	2004	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, TDS, ammonia as N, nitrate/nitrite as N, phosphorous, TN, volatile TSS, Orthophosphate as P, BOD, color, TKN
		BGU	Bear Gully Lake			2005	
		HOW	Lake Howell			2004	
		LOW	Lake Of The Woods			2002	
		SEM	Lake Seminary				
	Seminole County	SOL	Soldiers Creek	Biology	Annually	2004	DO, pH, specific conductance, temp, water depth, flow, chlorophyll-a, coliform, alkalinity, TSS, TDS, color, ammonia as N, nitrate/nitrite as N, phosphorous, TN, volatile TSS, orthophosphate as P, BOD, TKN
		GEE	Gee Creek			2004	
	Seminole County	HCRB	Howell Creek at Red Bug Lake Rd	Biology	Annually	2004	DO, pH, flow, specific conductance, temp, water depth, chlorophyll-a, coliform, ammonia as N, nitrate/nitrite as N, TP, orthophosphate as P, TKN
		HCTF	Howell Creek			2004	
		HOWC	Howell Creek at W SR 434			2008	
		BERC	Bear Gully Creek at Northern Way			2007	
	Seminole County	J1	Jesup 1	Biology	Annually	2004	
		J2	Jesup 2	Biology	Annually	2004	
		J3	Jesup 3	Biology	Annually	2004	

SUB-BASIN	SAMPLING ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE EST.	SAMPLING PARAMETERS
	Seminole County	BERC	Bear Gully Creek at Northern Way	Water Quality	Quarterly	2007	DO, pH, flow, specific conductance, temp, water depth, chlorophyll-a, coliform, ammonia as N, nitrate/nitrite as N, TP, orthophosphate as P, TKN
		BGC	Bear Gully Creek at Bear Gully Rd			2007	
		BGSL	Bear Gully Creek at Slavia Rd			2008	
		HCCB	Howell Creek at County Border			2007	
		HCRB	Howell Creek at Red Bug Lake Rd			2007	
		HCTF	Howell Creek			2007	
		HCWS	Howell Creek @ Winter Springs Road			2008	
		HOWC	Howell Creek at W SR 434			1998	
		LKC	Lightwood Knot Canal			2008	
		NW-N	Howell Creek at Northern Way			2008	
		NW-S	Howell Creek at Northern Way			2008	
	Seminole County	BGU	Bear Gully Lake	Water Quality	Quarterly	1999	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, TDS, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, color, TKN
		FAR	Fairy Lake			2001	
		FLO	Lake Florence			1999	
		GAR	Garden Lake			1999	
		HAY	Lake Hayes			2000	
		KEW	Kewanee			2000	
		LOW	Lake Of The Woods			1999	
		RED	Red Bug Lake			1999	
		SIL	Lake Silver			2008	
		ANN	Lake Ann			1999	
	Seminole County/ Casselberry	HOW	Lake Howell	Water Quality	Bimonthly	1998	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, TDS, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, color, TKN
	Seminole County	ML01	Greenwood Lake	Water Quality	Quarterly	1997	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, TDS, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, color, metals, TKN

SUB-BASIN	SAMPLING ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE EST.	SAMPLING PARAMETERS
	Seminole County/FDEP	SALT	Salt Creek at Packard Ave.	Water Quality	Quarterly/Fill in for monthly	2003	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, TDS, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, color, metals, TKN
	Seminole County	JES	St John's/Jesup Confluence	Water Quality	Quarterly	1998	DO, pH, specific conductance, temp, water depth, flow, chlorophyll-a, coliform, alkalinity, TSS, TDS, color, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, TKN
	Seminole County/Oviedo	SOLARY	Solary Canal	Water Quality	Quarterly/Fill in for monthly	2004	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, Total Dissolved Solids, Ammonia as N, Nitrate/Nitrite as N, Phosphorous, TN, Volatile TSS, Orthophosphate as P, BOD, Color, TKN
	Seminole County/Altamonte Springs	PRA	Prairie Lake	Water Quality	Quarterly/Fill in for monthly	1999	DO, pH, secchi depth, specific conductance, temp, water depth, chlorophyll-a, coliform, alkalinity, TSS, total dissolved solids, ammonia as N, nitrate/nitrite as N, phosphorous, TN, volatile TSS, Orthophosphate as P, BOD, color, TKN
	Seminole County/FDEP	SWEET	Sweetwater Creek at Howard Ave.	Water Quality	Quarterly/ Fill in for monthly	2004	DO, pH, specific conductance, temp, water depth, flow, chlorophyll-a, coliform, alkalinity, TSS, TDS, color, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, metals, TKN
	Seminole County/Sanford	NAV	Naval Canal at Pineway	Water Quality	Quarterly/Fill in for monthly	2000	DO, pH, specific conductance, temp, water depth, flow, chlorophyll-a, coliform, alkalinity, TSS, TDS, color, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, TKN
	Seminole County	SIX	Six Mile Creek at Myrtle	Water Quality	Quarterly	2000	DO, pH, specific conductance, temp, water depth, flow, chlorophyll-a, coliform, alkalinity, TSS, TDS, color, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, TKN
		SOL	Soldiers Creek			1998	
		GEE	Gee Creek			1998	

FINAL Lake Jesup Basin Management Action Plan – April 2010

SUB-BASIN	SAMPLING ENTITY	STATION ID	STATION DESCRIPTION	STATION TYPE	SAMPLING FREQUENCY	YEAR SITE EST.	SAMPLING PARAMETERS
	Seminole County/Sanford	CHUBB	Chub Creek at E Lake Mary Blvd	Water Quality	Quarterly/Fill in for monthly	2007	DO, pH, specific conductance, temp, water depth, flow, chlorophyll-a, coliform, alkalinity, TSS, TDS, color, ammonia as N, nitrate/nitrite as N, TP, TN, volatile TSS, orthophosphate as P, BOD, metals, TKN
	Seminole County	Howell	Howell Creek at W SR 434	Storm	Storm	2000	TSS, nitrate/nitrite as N, TN, ammonia as N, TKN, TP, BOD5, fecal coliform
		Solary	Solary Canal at Deleon Street			2001	
		Gee	Gee Creek at SR 434			2000	
		Soldier	Soldiers Creek at SR 419			2000	
		Six	Six Mile Creek at Myrtle Street			2000	
	Seminole County	JESUP-E	Jesup East YSI Buoy	YSI	Every 15 Minutes	2003	DO, pH, specific conductance, temp, turbidity, chlorophyll
		JESUP-W	Jesup West YSI Buoy			2003	
		HOW	Howell YSI Buoy			2006	
	SJRWMD	T-3	Six Mile Creek at Sanford Ave Canal NE of Lk Jesup	Water Quality	Monthly	1995	Field parameters, water chemistry, metals
		T-5	Howell Creek Delta on SW end of Lake Jesup			1995	
		T-8	Gee and Soldier Creek Delta west of Lake Jesup			1995	
	SJRWMD	OW-2	Lk Jesup off Grassy Point	Water Quality	Monthly	1995	Field parameters, water chemistry, metals, chlorophyll-a, light attenuation, plankton
		OW-4	Lk Jesup W of bridge betwn Whites Lndg & Bird Island			1995	
		OW-6	Lk Jesup off center of Far W Arm			1995	
Howell Creek	USGS	2234308	Howell Creek near Altamonte Springs, FL	Flow	60-min	1996	gage height (recorded) --discharge (computed)
		2234324	Howell Creek near Slavia, FL			1972	
		2234344	Howell Creek at State Hwy 434 near Oviedo, FL			1973	
Soldier Creek	USGS	2234384	Soldier Creek near Longwood, FL	Flow	60-min	1972	gage height (recorded) --discharge (computed)
Gee Creek	USGS	2234400	Gee Creek near Longwood, FL	Flow	60-min	1972	gage height (recorded) --discharge (computed)
Lake Jesup	USGS	2234432	Lake Jesup at State Highway 417 near Oviedo, FL	Water Quality	60-min	2008	water temperature (recorded) --specific conductance (recorded) --dissolved oxygen (recorded)
Lake Jesup	USGS	2234435	Lake Jesup outlet near Sanford, FL	Flow	15-min	1941	gage height (recorded) --velocity (recorded) --discharge (computed)

Appendix G: SITE 10 ANALYSES

This appendix includes the following supporting documentation:

1. CDM Memorandum "City of Sanford Site 10 Data Evaluation" dated February 27, 2007.
2. FDEP "Ground Water Assessment Report: Site 10 Lake Jesup Watershed, Sanford Florida" dated March 10, 2008.
3. CDM Memorandum "City of Sanford Site 10 – Lake Jesup Basin Management Action Plan (BMAP) Activities" dated July 24, 2009.



Memorandum

To: Paul Moore, P.E.

From: Danielle Honour, P.E.

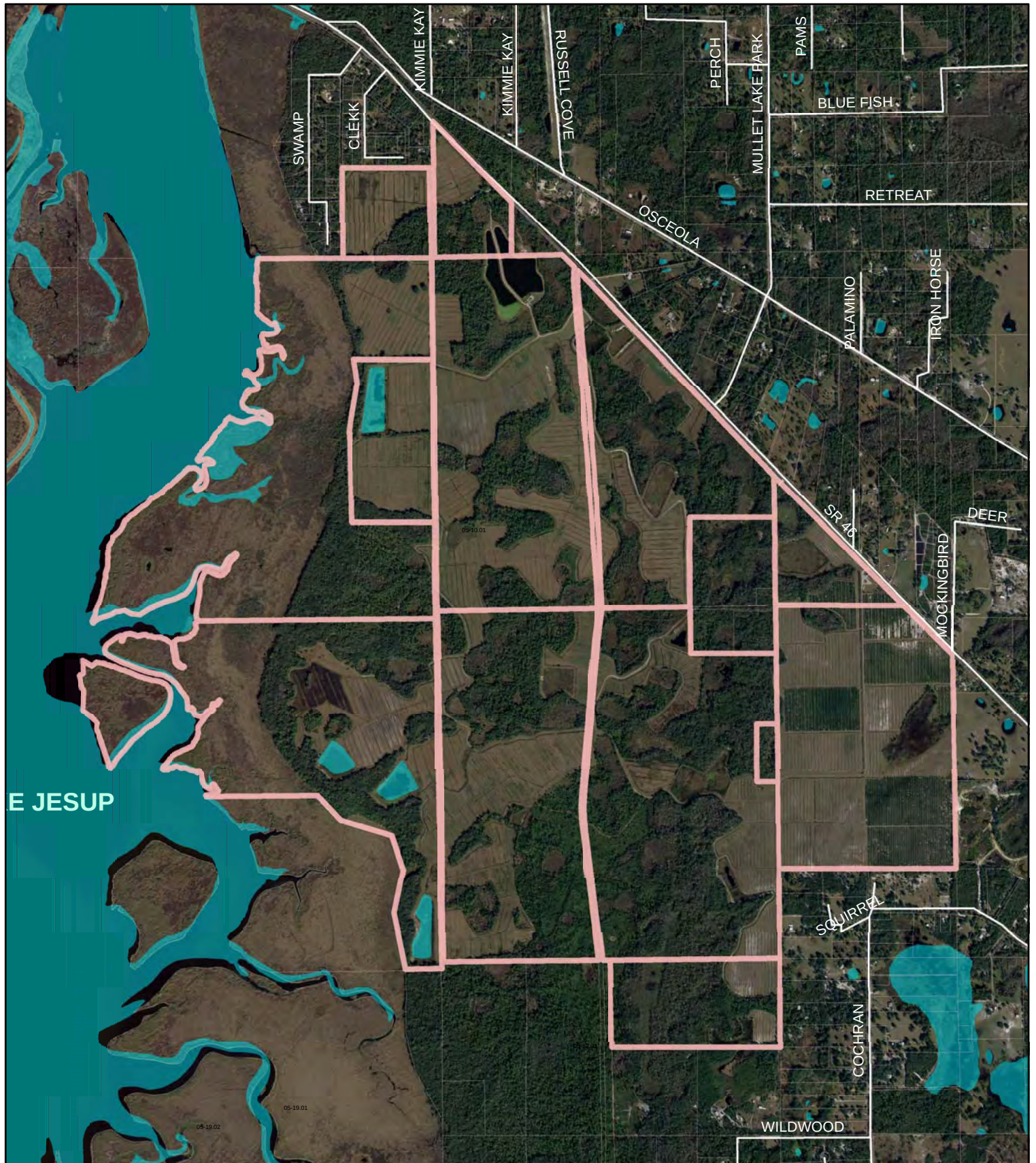
Date: February 27, 2007

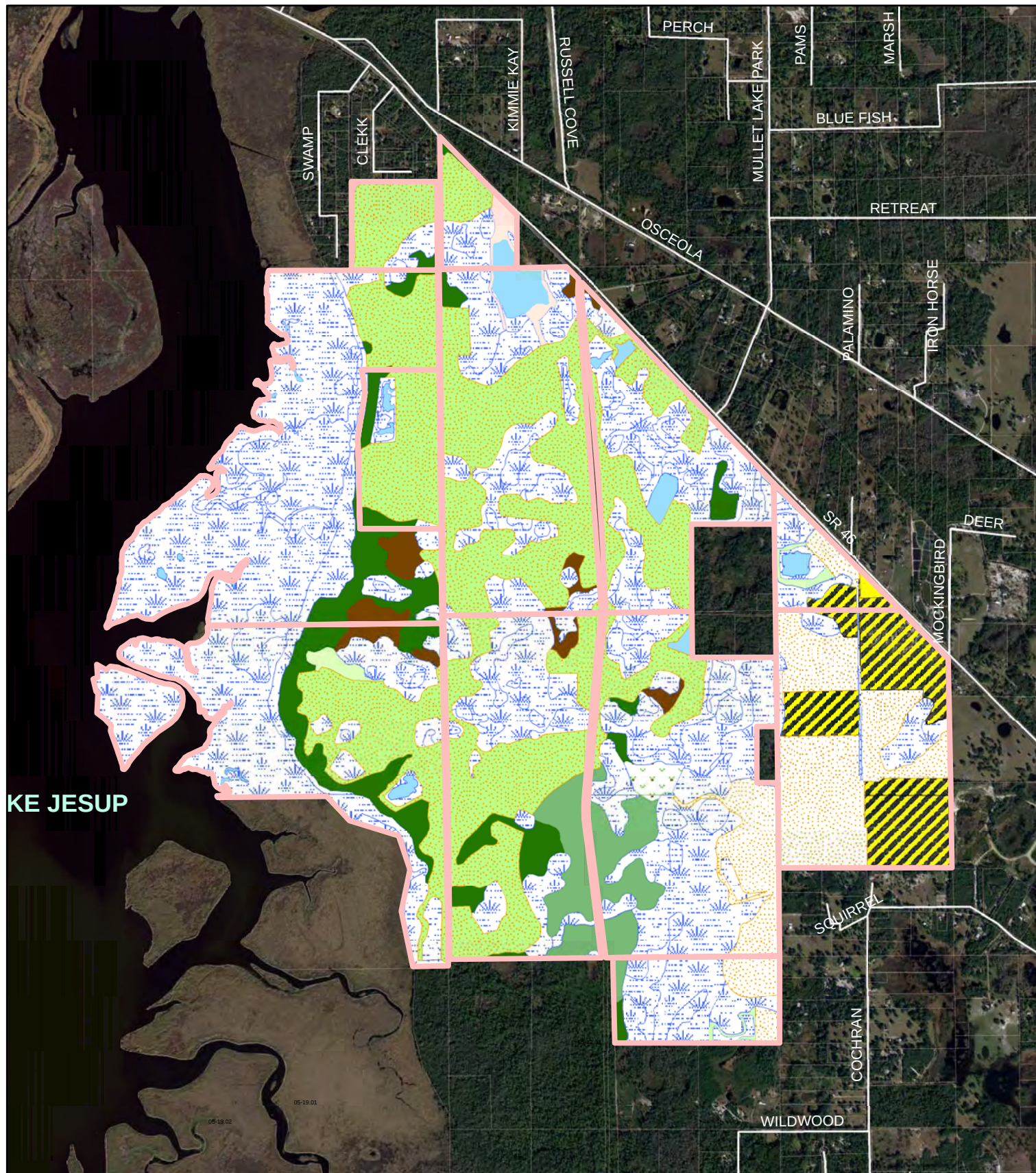
Subject: City of Sanford Site 10 Data Evaluation

The City of Sanford (the City) requested CDM's assistance with responding to a data request from the Florida Department of Environmental Protection (FDEP) for preparation of the Lake Jesup, Crane Strand and Long Branch Basin Management Action Plan (BMAP). FDEP has requested additional data from the City regarding the Sanford Reuse Land Application Facility (Site 10), as shown in **Figure 1**, located on the northeastern shore of Lake Jesup and its potential impact on the Total Maximum Daily Load (TMDL) that has been formulated for the lake for both total phosphorus (TP) and total nitrogen (TN). FDEP specifically requested information on the facility itself (i.e., description and operations), on-site nutrient loading due to reclaimed water operations and residuals applications and nutrient transport to the lake via groundwater and surface runoff. This memorandum summarizes the findings of the data evaluation as well as an updated pollutant load model developed specifically for Site 10.

Facility Description

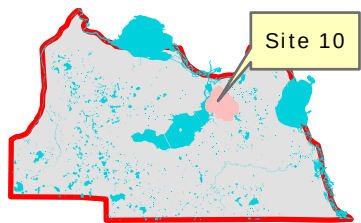
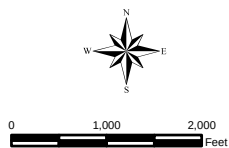
The City owns a number of parcels along the northeast shore of Lake Jesup, which total approximately 2,204 acres. On these parcels resides one of the City's permitted wastewater facilities known as Site 10, which itself is comprised of approximately 1,868 acres. The remaining area is occupied by the marsh fringe associated with Lake Jesup. Site 10 is generally bounded on the west by Lake Jesup, on the north and the east by SR 46, and on the south by the Lake Jesup Conservation Area owned by the St. Johns River Water Management District (SJRWMD). Agriculture (i.e., pastures and citrus groves) and wetlands are the dominating land uses on Site 10 as shown in **Figure 2**. Review of the Seminole County Soil Survey geographic information systems (GIS) layer, developed by the SJRWMD and the National Resource Conservation Service (NRCS), indicates that soils on Site 10 are dominated by B/D and D hydrologic soil groups.





LOCATION MAP

LEGEND



- | | | |
|---|--|---|
| <ul style="list-style-type: none"> Sanford Owned Parcels Parcels Roads Improved Pastures Citrus Groves Commercial | <ul style="list-style-type: none"> Disturbed Land Field Crops Herbaceous upland nonforested Low Density Residential Mixed upland nonforested Ornamentals Row Crops | <ul style="list-style-type: none"> Rural Residential Shrub and brushland Unimproved Pastures Upland Forests Water Bodies Wetlands |
|---|--|---|

City of Sanford
Wastewater Facility (Site 10) Data Evaluation



Figure 2
Site 10 Land Use

Wastewater and Reclaimed Water Operations

The City currently holds a Domestic Wastewater Facility National Pollutant Discharge Elimination System (NPDES) Permit from FDEP (Permit No. FL0020121), which was revised in February 2005. Under the NPDES permit, the City is allowed to discharge 2.84 million gallons per day (MGD) annual average daily flow (AADF) to a permitted capacity slow-rate public access reuse system consisting of 1,868 acres at Site 10. The reuse system also includes an additional 37 MG of reclaimed water storage at Site 10 in the form of two holding ponds



Figure 4 – East Holding Pond

located in the northeast area of the site. A pump station is located in the same area as the holding ponds in order to distribute reclaimed water to 620 acres of hay fields by seepage swales and 270 acres of citrus groves by a micro-jet irrigation system as shown in **Figure 3**. A photograph of east holding pond is shown in **Figure 4**. The hay fields are permitted to receive up to 1.94 MGD while the citrus groves can receive 0.9 MGD for irrigation purposes. During times of wet-weather and when the storage ponds have reached their capacity (i.e., 5.4 days of wet weather holding capacity), the City is permitted

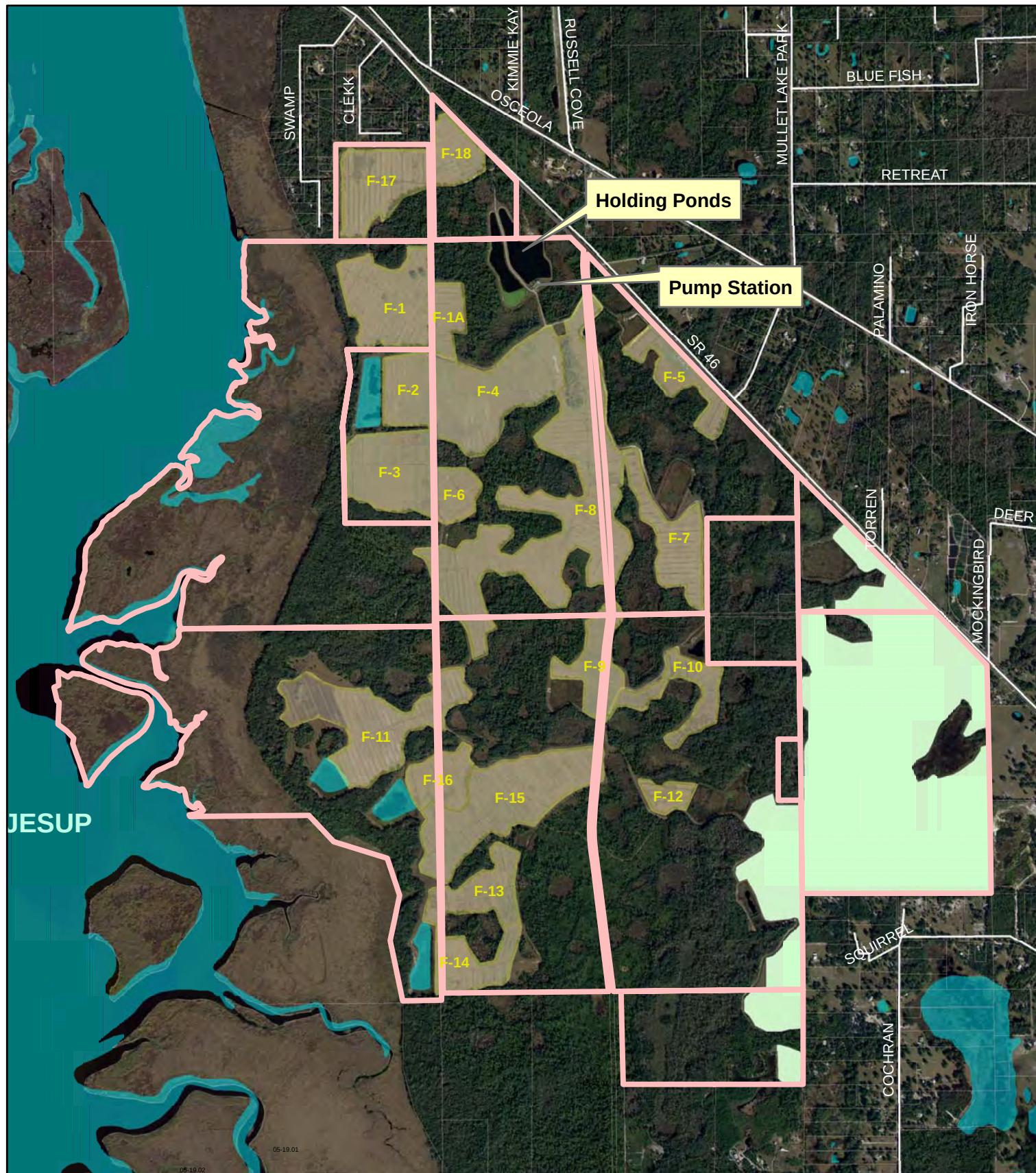
to discharge up to 1.0 MGD AADF to the St. Johns River. The discharge point is near the Interstate 4 bridge where it crosses Lake Monroe. The permit also identifies Site 10 as an area where landspreading of residuals may occur.

Reclaimed Water Application Points

A system of reclaimed water distribution lines emanate from the pump station near the holding ponds and run throughout Site 10 to provide irrigation to the various hay fields and citrus groves on the site. These lines are shown in detail on the *Irrigation and Stormwater Plan at Site 10* plans prepared by Conklin Porter and Holmes Engineers, Inc. (CPH, 1990). The individual fields are then served by subswales that distribute reuse water across the fields. The subswales that distribute reuse water are separate from the subswales that convey stormwater runoff to the stormwater ponds. The reuse swales dead end at each field and do not connect to the stormwater swales.

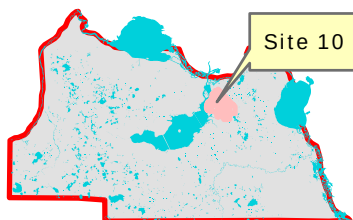
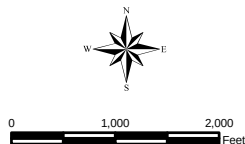
Residual Application Points

The City currently uses the hay fields for residuals application. Occasionally, the City will land apply to an empty grove field, but this is rare. On average, Seven to 10 loads of residuals are hauled to Site 10 every week and the biosolids are spread within 24 hours of land application. The weight of each load of sludge ranges between 13 to 15 tons per load.



LOCATION MAP

LEGEND



- Sanford Owned Parcels
- Parcels
- Site 10 Groves
- Site 10 Hay Fields
- Water Bodies
- Roads

Stormwater

The *Irrigation and Stormwater Plan at Site 10* plans prepared by CPH (1990) were reviewed to determine how stormwater is managed on Site 10. Site 10 is served by a series of wet detention ponds which provide stormwater treatment for the various hay fields and citrus groves on the site. The locations of these ponds were mapped using the GIS software package Arcview® Version 9.0 and are shown in **Figure 5**. The field subswales as well as culvert crossings were also mapped to show the direction of surface water flow into the stormwater ponds and are shown on Figure 5 as well. All of the stormwater ponds are served by overflow structures and bleed-down devices to allow the ponds to discharge into adjacent wetland and forested areas throughout the site, an example of which is shown in **Figure 6**.

CDM and the City conducted a field visit to Site 10 in November 2006 and visited two of the ponds located adjacent to Lake Jesup (Ponds A-2 and B-2). The overflow structures are in the form of concrete slabs that are set at a higher elevation than the pond control elevation. The two ponds visited are also equipped with bleed-down devices in the form of corrugated metal pipes (CMPs). Six 15-inch CMPs were observed at Pond A-2 and are consistent with what is shown on the CPH plans while the plans also indicate there is a 30-inch CMP bleeddown pipe associated with Pond B-2 (which was not visible at the time of the field visit but was confirmed by on the City staff members). Discussions with City staff who work at the site indicated that they have never seen the ponds stage up high enough so that overflow conditions would occur, even during the 2004 hurricane season. At the time of the field inspection, there was a continuous flow of water through the six 15-inch CMP bleed-down pipes from Pond A-2 (as shown in **Figure 7**). At the time of the inspection it was not clear where this water was flowing to, but based on review of the CPH plans, it appears this stormwater pond discharges to a wetland channel



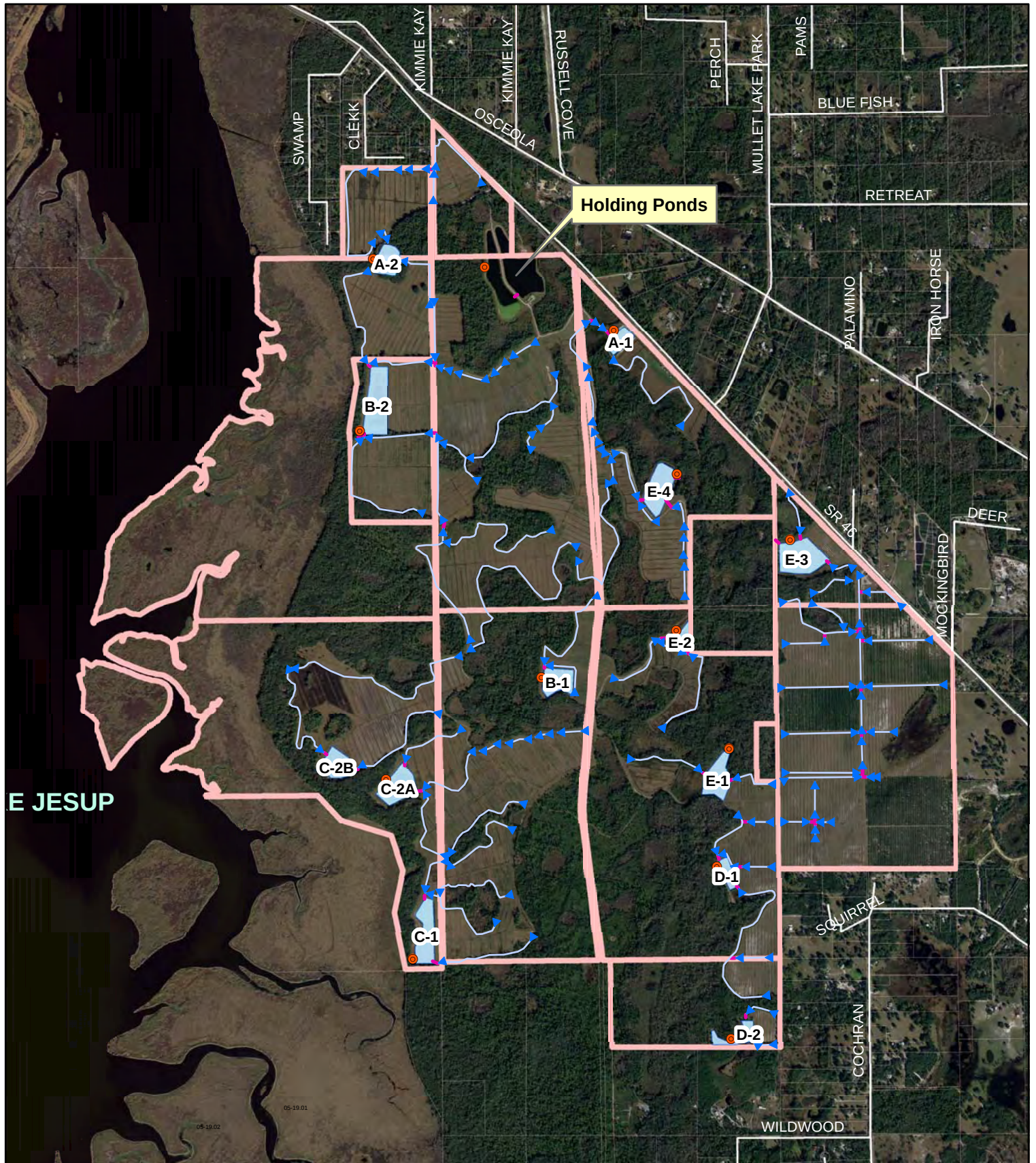
Figure 6 – Pond Overflow



Figure 7 – Bleeddown Pipes from Pond A-2

which eventually discharges to Lake Jesup. The CPH design engineer believes that this water is coming from a natural spring.

In addition to the CPH plans provided by the City, CDM also obtained and reviewed a copy of the Mullet Lake Park Road Outfall Study prepared by Inwood Consulting Engineers for Seminole County in 2004. This report provides an evaluation of the existing conditions and problems within the Mullet Lake Park Road drainage basin, which includes



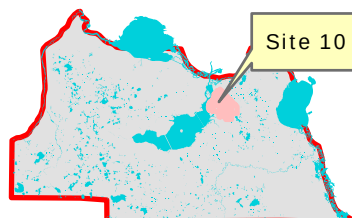
LOCATION MAP

LEGEND

- Pond Inflow Direction
- Culverts
- Control Structure
- Sanford Owned Parcels
- Parcels
- Roads
- Site 10 Ponds



0 1,000 2,000
Feet



portions of Site 10. This drainage basin discharges to the northeast towards Mullet Lake which is outside of the Lake Jesup watershed. The drainage basin delineations presented in Inwood's study were used by CDM to determine the contributing area of Site 10 to the Lake Jesup Watershed which is shown in **Figure 8**. Based on this delineation, the resulting area of Site 10 that is tributary to the Lake Jesup Watershed is 1,252 acres. The marsh fringe along the shore of Lake Jesup was not included in this delineation as the Site 10 operations do not expand into this land area and based on the plans developed by CPH, it does not show Site 10 occupying any of these areas. CDM then delineated this contributing area into 13 smaller subbasins within Site 10 based on the CPH plans as well as available 1-foot topographic contour data. These delineations are also shown on Figure 8.

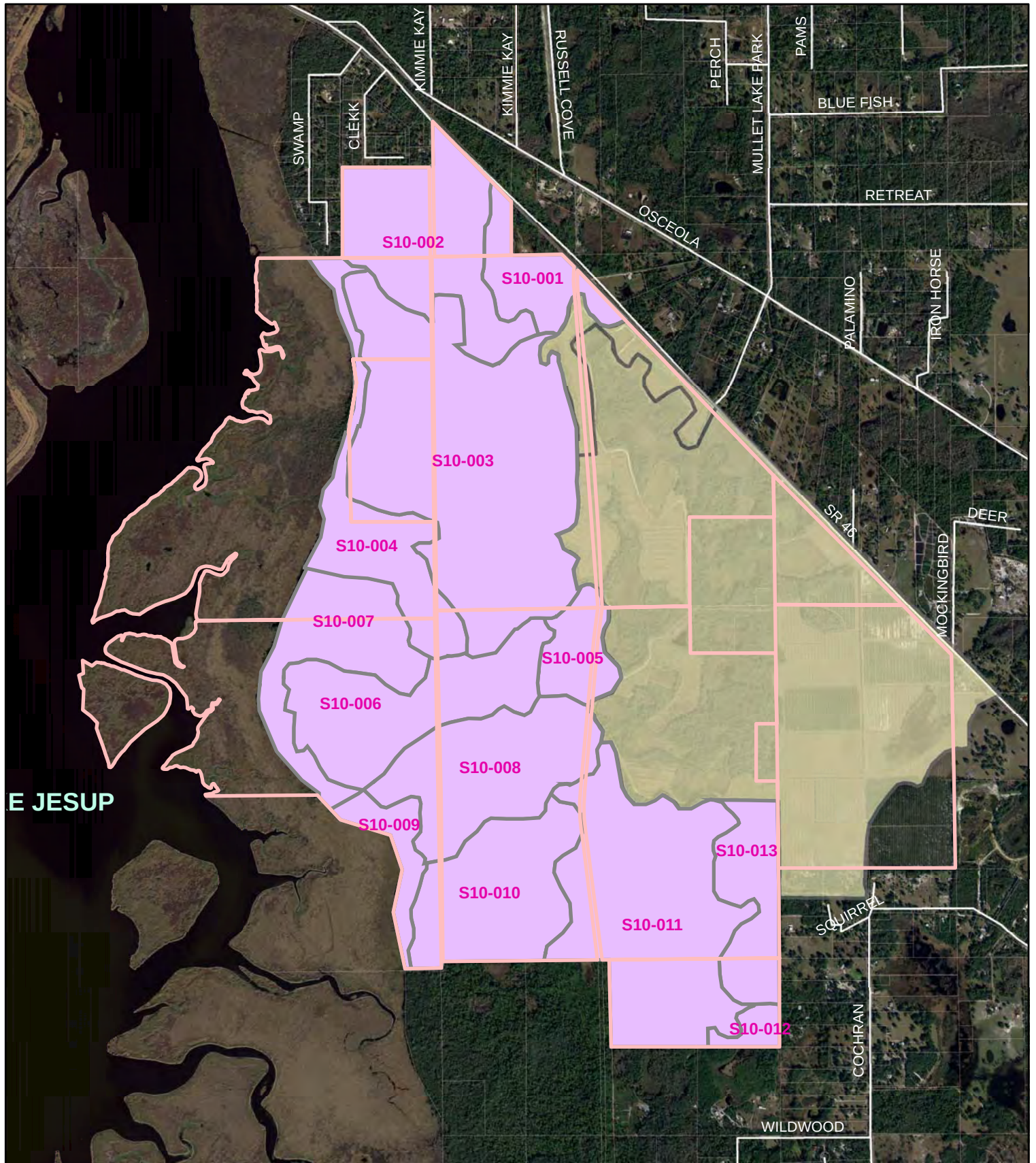
In addition to delineating the subbasins, CDM used available existing 1-foot topographic contour data and the CPH plans to map the overall direction of flow from each of the subbasins to determine which subbasins if any have the potential to discharge stormwater to Lake Jesup. These flow directions are shown in **Figure 9** and also corroborate the subbasin delineations. As can be seen in the figure, Subbasins S10-004, S10-007 and S10-009 have the potential to discharge directly to Lake Jesup. These subbasins however are dominated by forested areas, wetlands and shrub and brushland. With the exception of S10-001 and S10-011, the remaining subbasins are all equipped with wet detention facilities as can be seen on the figure. The holding ponds are located within Subbasin S10-001. The holding ponds are equipped with an emergency discharge structure on the west side of the ponds whose elevation is set at 19.5 ft-NGVD (the normal water level of the ponds is 15.0 ft-NGVD) and the ponds would discharge into the adjacent wetland areas in Subbasin S10-002. Subbasin S10-011 is dominated by wetland and forested areas and it appears that surface runoff would discharge via overland flow towards the south off of Site 10, and then southwest towards the lake. Based on review of the 1-foot topographic contour data, surface runoff would have to be conveyed approximately 1 mile before it reached Lake Jesup.

Nutrient On-Site Loading

An estimate of the on-site nutrient loading due to both reclaimed water as well as residuals land application was made using available data. As FDEP requires a TMDL for TN and total TP for Lake Jesup, these are the only constituents that will be addressed in this analysis. A description of how each was calculated and the results is described in the following paragraphs.

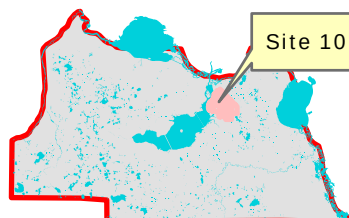
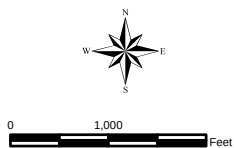
Reclaimed Water Nutrient Loading

As previously mentioned, the hay fields are permitted to receive up to 1.94 MGD of reclaimed water while the citrus groves can receive 0.9 MGD for irrigation purposes. From the City's discharge monitoring reports (DMRs), FDEP provided the average monthly flow to Site 10 and the associated water quality data (TN and TP) measured at the St. Johns River discharge for the years 2001 through 2006. For those months where there was no discharge to the St.



LOCATION MAP

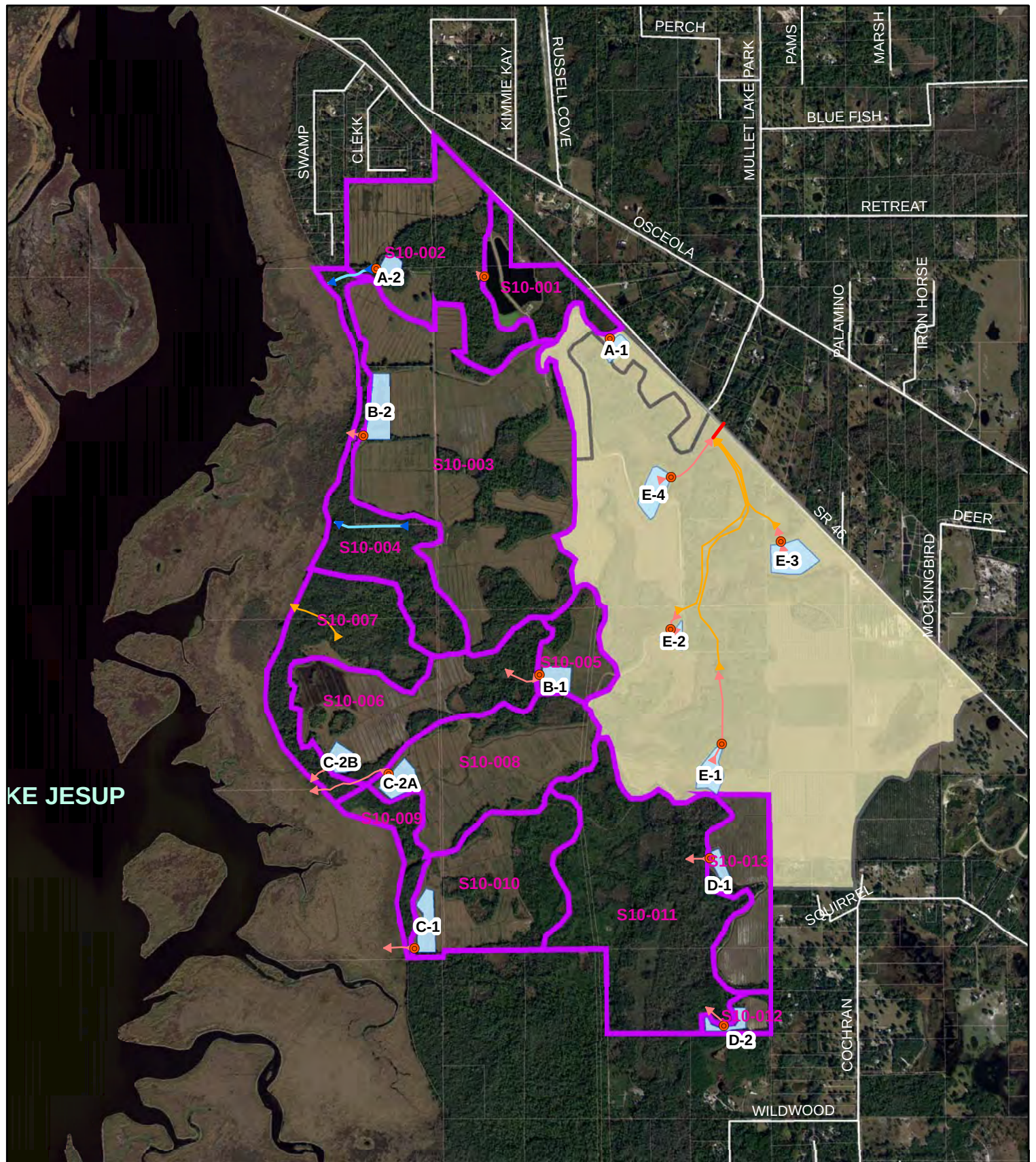
LEGEND



- Sanford Owned Parcels
- Site10 Subbasins
- Parcels
- Roads
- Mullet Lake Park Road Drainage Basin (Inwood, 2004)

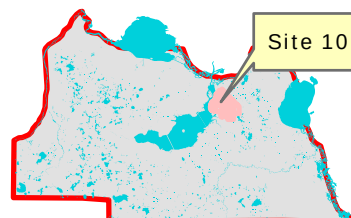
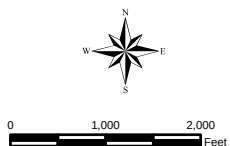
City of Sanford
Wastewater Facility (Site 10) Data Evaluation

CDM



LOCATION MAP

LEGEND



- Control Structure
- Site 10 Ponds
- Site 10 Subbasins
- Mullet Lake Park Road Drainage Basin
- Parcels
- Roads
- Outflow**
- 2'3"x8' CBCs
- Overland Flow
- Pond Overflow
- Wetland Channel

Johns River, water quality samples were not obtained, however, there was still flow to Site 10. Based on this information, CDM calculated the average TN and TP concentrations to Site 10 (it was assumed that the same concentration that is being discharged to the river during wet weather is also being received at Site 10) for the years 2003 through 2005. In FDEP's original data request that prompted this study, CDM's analysis of Site 10 is supposed to cover the time period of 2003 through 2006. However, since the DMRs were not available after September 2006, only data for the years 2003 through 2005 were used. CDM used these data as well as the permitted flow rates for the hay fields and the citrus groves to estimate an annual loading of TP to Site 10 due to reclaimed water (actual loading values for TN were available from FDEP and the City which are discussed later in this memorandum). From the discussion in the Stormwater subsection of this memorandum, it was determined that only a portion of Site 10 is within the Lake Jesup Watershed (i.e., 1,252 acres), therefore, only the acreages of the hay fields and citrus groves on these 1,252 acres were considered when estimating the loading due to irrigation with reclaimed water. These results are summarized in **Table 1**.

Table 1
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Estimated TP Loading to Site 10 from Reclaimed Water (2003 - 2005)

Average Measured Flow to Site 10 (MGD)	1.5	
	Hay Fields	Citrus Groves
% Distribution of Flow based on Permit Limits (1.94 vs. 0.9 MGD)	0.68	0.32
Resulting Flow (MGD) to Hay Fields vs. Citrus Groves	1.02	0.47
Average Measured TP to Site 10 (mg/l)	1.6	1.6
Site 10 TP Loading ¹ (lbs/yr)	4,971.2	2,290.6
Total Acreage on Site 10	478.1	277.4
Total Acreage in Lake Jesup Watershed	368.3 (77.0%)	43.8 (16%)
Resulting TP Loading in Lake Jesup Watershed from Site 10 (lbs/yr)	3827.8	366.5
Resulting TP Loading in Lake Jesup Watershed from Site 10 (lbs/ac/yr)	10.4	8.4

1. Hay Fields: $(1.6 \text{ mg/l} \times 8.3454 \text{ lb/MG}) \times (1.02 \text{ MG/Day}) \times (365 \text{ Days/yr}) = 4,971.2 \text{ lb/yr}$
Citrus Groves: $(1.6 \text{ mg/l} \times 8.3454 \text{ lb/MG}) \times (0.47 \text{ MG/Day}) \times (365 \text{ Days/yr}) = 2,290.6 \text{ lb/yr}$

Residual Land Application Nutrient Loading

The City currently uses the hay fields for residuals application and on a very rare occasion, the citrus groves are used. Therefore the estimated loading from residuals application was only considered for the hay fields. According to the City, seven to 10 loads of residuals are hauled to Site 10 every week and the biosolids are spread within 24 hours of land application. The weight of each load of sludge varies between 13 to 15 tons per load. The FDEP Domestic Wastewater Facility permit requires the City to sample the residuals at least once every three months and report the TN and TP in terms of percent dry weight. The reported percent dry weights of the residuals for the period of 2002 through 2005 were available and are provided below in **Table 2**.

Table 2
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Residual TN and TP Concentrations (% Dry Weight)

Year/Parameter	TN (%)	TP (%)
2002	7.22	3.22
2003	7.32	3.15
2004	6.43	3.02
2005	8.05	3.94

Estimated On-Site Loading

Nitrogen

Some additional information was made available by FDEP on actual nitrogen loading rates due to both biosolids disposal as well as reclaimed water. These data were presented in memorandums from the City to FDEP for the years 2003 through 2005 and are summarized below in **Table 3**. Only the fields that are within the tributary area of Lake Jesup and their associated loading rates are provided in the table.

Table 3
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Field Nitrogen Loading Rates due to Biosolids and Reclaimed Water Application

Field No. ¹	Field Acreage ²	Field Acreage In Watershed	2003 Measured N Loading (lb/ac)	2004 Measured N Loading (lb/ac)	2005 Measured N Loading (lb/ac)	Average TN Loading Rate (lb/ac/yr)	TN Loading in Watershed (lb/yr)
F1	32.2	32.1	162.3	91.8	92.5	115.5	3,707.6
F2	15.3	15.3	371.0	91.8	92.5	185.1	2,832.0
F3	29.3	29.3	365.5	152.7	282.3	266.8	7,817.4
F4	42.5	41.6	398.7	91.8	373.7	288.1	11,985.0

Table 3
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Field Nitrogen Loading Rates due to Biosolids and Reclaimed Water Application

Field No. ¹	Field Acreage ²	Field Acreage In Watershed	2003 Measured N Loading (lb/ac)	2004 Measured N Loading (lb/ac)	2005 Measured N Loading (lb/ac)	Average TN Loading Rate (lb/ac/yr)	TN Loading in Watershed (lb/yr)
F6	9.5	9.5	162.3	91.8	365.2	206.4	1,960.8
F8	97.1	58.8	343.9	91.8	168.6	201.4	11,842.3
F9	16.8	16.3	363.9	361.3	247.8	324.3	5,286.1
F11	42.3	42.3	162.3	374.1	92.5	209.6	8,866.1
F13	17.0	17.0	314.9	317.9	307.45	313.4	5,327.8
F14	15.2	15.2	390.7	335.7	388.4	371.6	5,648.3
F15	47.8	47.8	389.3	347.1	370.3	368.9	17,633.4
F16	13.7	13.7	289.5	396.1	92.5	259.4	3,553.8
F17	24.7	24.7	162.3	91.8	92.5	115.5	2,852.9
F18	11.6	4.7	162.3	91.8	92.5	115.5	542.9
	Total:	368.3					89,856.4

1. Field 1A, although shown on Figure 3, was not included in the City memorandums that summarized TN loading rates by field.

2. Field acreages were obtained from a GIS layer originally provided by the City showing the field locations. These were then subsequently edited to match the extents shown on the CPH plans and verified using the 2004 aerial digital orthophoto quads available from the SJRWMD. Acreages were then calculated using GIS capabilities.

Phosphorus

As the same type of data shown in Table 3 were not available for actual TP loading, CDM used the values shown in Table 1 for reclaimed water application and the percent dry weight values shown in Table 2 to estimate the overall TP loading to Site 10. According to the City, seven to 10 loads of residuals are hauled to Site 10 every week and the biosolids are spread within 24 hours of land application. The weight of each load of sludge varies between 13 to 15 tons per load. It was assumed that the sludge has approximately 85 percent moisture content and therefore 15 percent solids content. Municipal biosolids available for land application in Florida can vary widely in moisture content and solids in de-watered materials is typically 15 percent. Based on this information, the following calculations were made and are summarized in **Table 4**. It was assumed, however that the residuals were applied to the same fields shown above in Table 3.

Table 4
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Estimated Phosphorus Loading due to Biosolids
Application

Average number of loads delivered per week (average of 7 to 10 loads per week)	8.5 loads/week
Average number of loads delivered per day	1.2 loads/day
Average ton of residuals per load (average of 13 to 15 tons per load)	14 tons/load
Total tons of residuals delivered per year ¹	6,132 tons/yr
Dry Weight of Solids Delivered per year ²	920 tons/yr
Average of 2003-2005 Percent Dry Weight Values of TP	3.33%
Average TP Loading ³	60,707 lb/yr
Average Loading Rate of TP applied to hayfields in watershed (lb/ac/yr) ⁴	164.8 lb/ac/yr

1. 14 tons/load X 1.2 loads/day X 365days/yr=6,132 tons/yr
2. 6,132 tons/yr X 15% solids content = 920 tons/yr
3. 920 tons/yr X 0.033 X 2000lb/ton = 60,707 lb/yr
4. (60,707 lb/yr) / (368.3 ac) = 164.8 lb/ac/yr

CDM used the same combination of biosolids and reclaimed application for each of the fields shown in Table 3 (i.e., in some years, certain fields received only biosolids, reclaimed water and/or both) as documented in the memorandums sent from the City to FDEP. Using this information and the estimated average loading TP rate shown in Tables 1 and 4 for reclaimed water and biosolids application, respectively, CDM calculated the average TP loading in the watershed as shown in **Table 5**. Based on Table 5, the total loading of TP in the Lake Jesup Watershed due to both biosolids and reclaimed water application is estimated to be 39,948 lb/yr.

Groundwater Nutrient Transport

This section provides a discussion of the potential nutrient loading to Lake Jesup through groundwater seepage. This discussion also provides some background on the geology and hydrogeology of the site as well as soil properties.

Table 5
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Field Phosphorus Loading Rates due to Biosolids and Reclaimed Water Application

Resulting TP Loading in Lake Jesup Watershed from Reclaimed Water (from Table 1): **10.4** lbs/ac/yr
Average Loading Rate of TP from Residuals applied to hayfields in watershed (Table 4): **164.8** lbs/ac/yr

Field No.	Total Acreage ¹	Acreage in Watershed	Estimated 2003 Loading Rate (lb/ac)	Estimated 2004 Loading Rate (lb/ac)	Estimated 2005 Loading Rate (lb/ac)	Average TP Loading Rate 2003-2005 (lb/ac/yr)	TP Loading in Watershed ² (lb/yr)
F1			R	R	R		
	32.2	32.1	10.4	10.4	10.4	10.4	333.8
F2			B&R	R	R		
	15.3	15.3	175.2	10.4	10.4	65.3	999.6
F3			B&R	B&R	B&R		
	29.3	29.3	175.2	175.2	175.2	175.2	5,133.4
F4			B&R	R	B		
	42.5	41.6	175.2	10.4	164.8	116.8	4,858.9
F6			R	R	B&R		
	9.5	9.5	10.4	10.4	175.2	65.3	620.7
F8			B&R	R	B&R		
	97.1	58.8	175.2	10.4	175.2	120.3	7,071.7
F9			B&R	B	B&R		
	16.8	16.3	175.2	164.8	175.2	171.7	2,799.3
F11			R	B&R	R		
	42.3	42.3	10.4	175.2	10.4	65.3	2,763.6
F13			B&R	B	B		
	17	17	175.2	164.8	164.8	168.3	2,860.5
F14			B	B&R	B		
	15.2	15.2	164.8	175.2	164.8	168.3	2,557.7
F15			B&R	B	B		
	47.8	47.8	175.2	164.8	164.8	168.3	8,043.1
F16			B&R	B	R		
	13.7	13.7	175.2	164.8	10.4	116.8	1,600.2
F17			R	R	R		
	24.7	24.7	10.4	10.4	10.4	10.4	256.9
F18			R	R	R		
	11.6	4.7	10.4	10.4	10.4	10.4	48.9
Total Acres in Watershed:		368.3	Total Loading in Watershed:				39,948.1

R - Reclaimed Only

B - Biosolids Only

B&R - Biosolids and Reclaimed

1. Field acreages were obtained from a GIS layer originally provided by the City showing the field locations. These were then subsequently edited to match the extents shown on the CP&H plans and verified using the 2004 aerial digital orthophoto quads available from the SJRWMD. Acreages were then calculated using GIS capabilities.

2. Product of loading rate (lb/yr/ac) x area

Hydrogeology

Based on published data, the surficial aquifer system (SAS) and the Floridan aquifer system (FAS) are the principal water-bearing units in Central Florida including Site 10. The two aquifer systems are separated by the Intermediate Confining Unit (ICU) of the Hawthorn Group Formation. The Floridan aquifer system has two major water-bearing zones, the Upper Floridan aquifer (UFA) and the Lower Floridan aquifer (LFA) which is separated by a less-permeable semiconfining unit known as the Middle semiconfining Unit. **Figure 10** illustrates the location of a north-south and an east-west cross section in Seminole County. The cross-sections are shown on **Figure 11**, and the geologic and hydrogeologic units are shown in **Figure 12**. The boring locations are soil illustrated in **Figure 13** while the boring profiles of Site 10, reported by Ardaman and Associates (1988) are shown in **Figures 14 and 15**.

Surficial Aquifer System

The (SAS) in Seminole County is unconfined and consists mainly of lenses of fine-to-medium quartz sand and varying amounts of shell and clay. The geologic units probably range between Pliocene and Holocene in age and consist of undifferentiated deposits.

In the swampy lowlands and flatlands, the water table generally is at or near land surface. The slope of the water table varies depending on the hydrologic conditions, such as antecedent rainfall and evapotranspiration. Thickness of the surficial aquifer system is variable. In the low-lying areas around Lake Jesup, and along the Econlockhatchee and St. Johns Rivers in Seminole County, the thickness of the SAS is about 10-20 ft (Murray and Halford, 1996). The surficial aquifer at Site 10 is composed primarily of 10 to 20 feet of surficial sand (Ardaman and Associates, 1988). The altitude of the water table in the SAS varies seasonally and responds to changes in rates of recharge and discharge. Water levels are generally highest in October and lowest in May. Recharge to the SAS is chiefly by the infiltration of the rainfall.

The water-bearing properties are dependent largely upon aquifer thickness, lithology, grain-size distribution, sorting, packing, and cementation of the sediments. Horizontal hydraulic conductivity values at Site 10 ranged from 3.58×10^{-3} cm/sec (10.07 ft/day) to 1.57×10^{-4} cm/sec (0.44 ft/day), determined from eight in-situ permeability tests (Ardaman and Associates, 1988). The average horizontal hydraulic conductivity is 3.5 ft/day.

Intermediate Confining Unit

The Intermediate Confining Unit (ICU), which forms the base of the SAS, consists primarily of the Hawthorn Group of late-to-middle Miocene age and, locally, low permeability beds of early Pliocene age. Thickness of the ICU is generally less than 25 ft around north of Lake Jesup (Murray and Halford, 1996). The confining units at the site consisted of a nine-foot thick silty fine sand to sandy clay 53 to 82 feet below land surface and a 2.5- to 5- foot thick mottled clay layer 8 to 25 feet below land surface in the southeastern part of the site

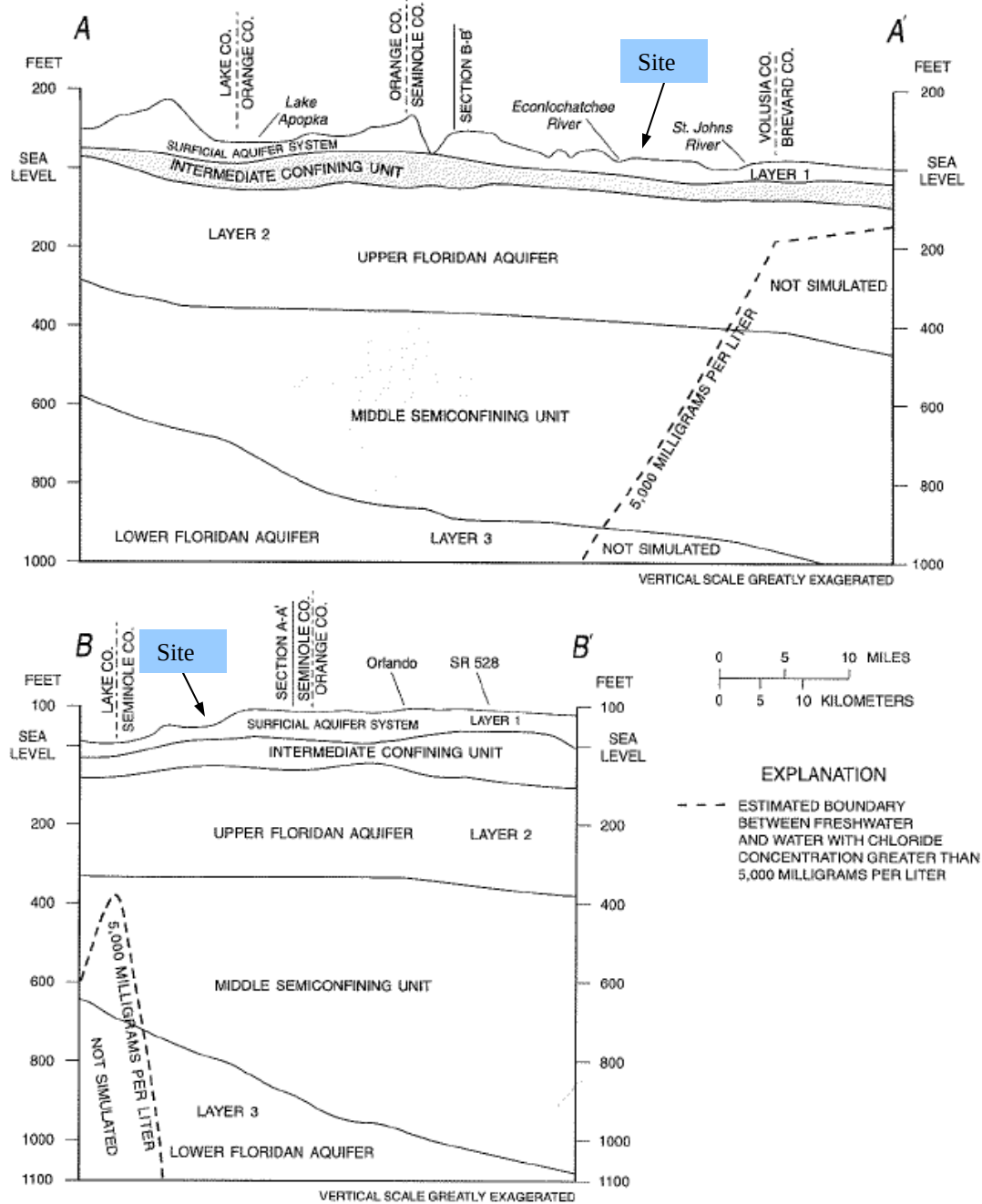


Figure 11 Generalized hydrogeologic sections A-A and B-B

Sources: Spechler, 2001; Miller, 1986.

HYDROGEOLOGIC UNITS,
EQUIVALENT LAYERS IN GROUND-WATER
MODEL, AND BOUNDARY CONDITIONS

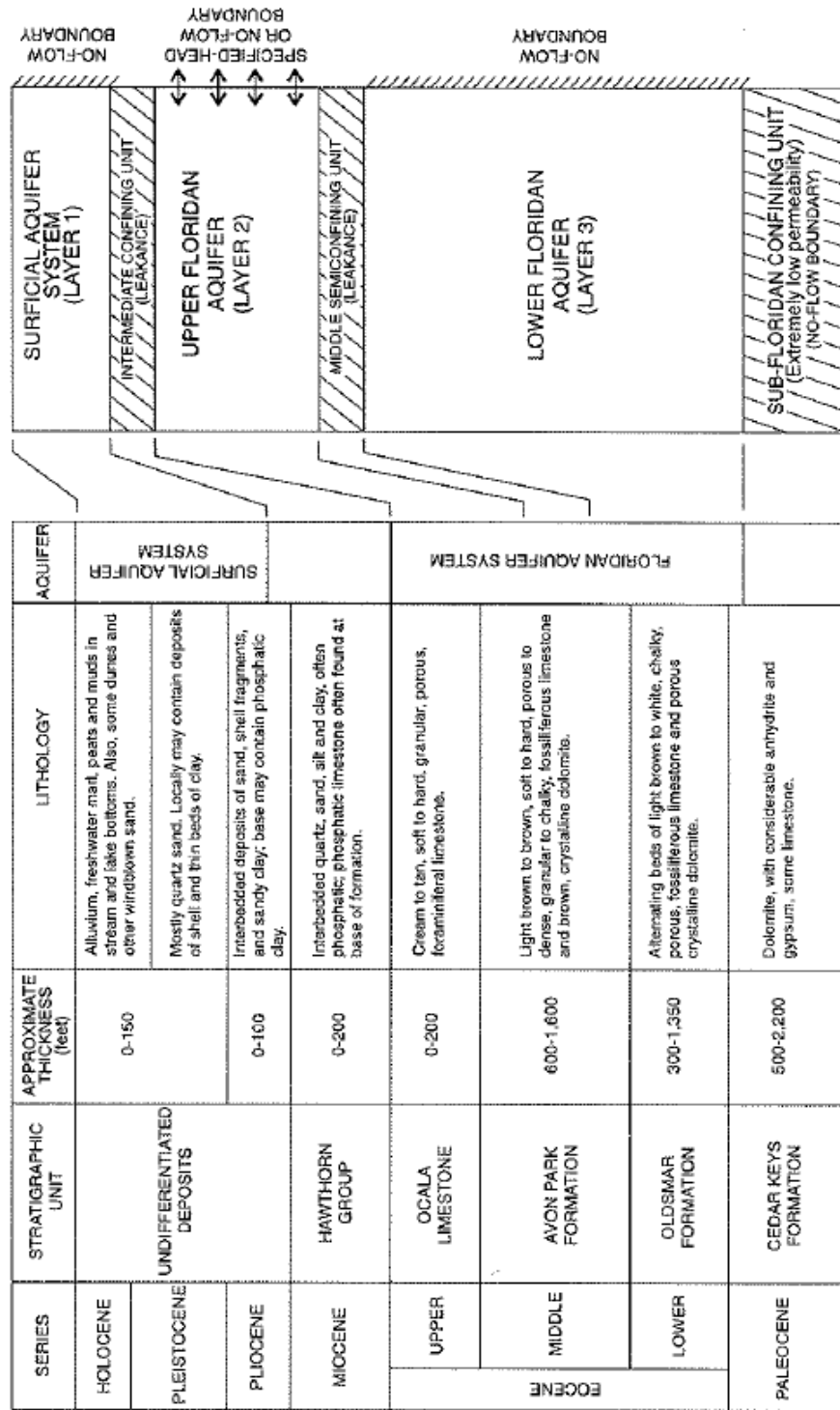
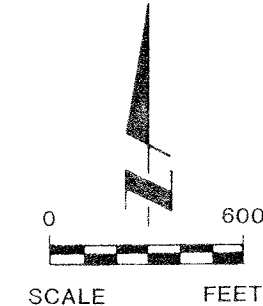


Figure 12 Geologic unit, hydrogeologic units, and equivalent layers
Sources: Spechler, 2001 ; Murray and Halford, 1996.



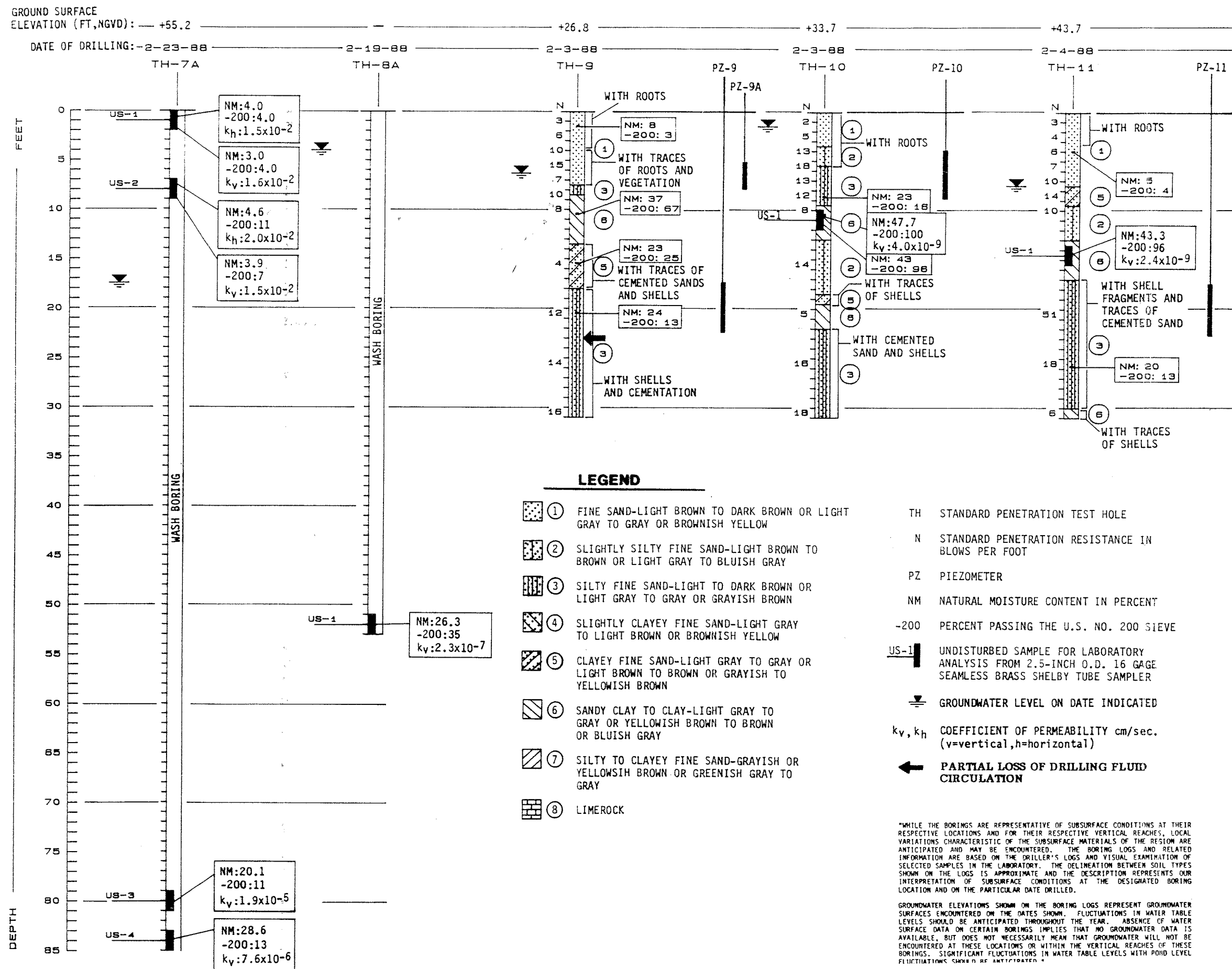
LEGEND

- TH-1 STANDARD PENETRATION TEST (SPT) BORING LOCATION
- AB-2 AUGER BORING LOCATION
- PZ-1 PIEZOMETER LOCATION

FIGURE 13

BORING LOCATION PLAN

Ardaman & Associates, Inc. Consulting Engineers in Soils, Hydrogeology, Foundations, and Materials Testing	
HYDROGEOLOGICAL SURVEY SITE NO. 10 SEMINOLE COUNTY, FLORIDA	
Prepared by: R.B.E.	Date: 5/5/88
File No.: 87-149	Sheet No.: 1



ENGINEERING CLASSIFICATION		
COHESIONLESS SOILS		
DESCRIPTION	BLOW COUNT 'N'	
VERY LOOSE	0 TO 4	
LOOSE	4 TO 10	
MEDIUM DENSE	10 TO 30	
DENSE	30 TO 50	
VERY DENSE	ABOVE 50	

COHESIVE SOILS		
DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, TSF	BLOW COUNT 'N'
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

FIGURE 14

BORING PROFILES

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics, Foundations, and Materials Testing

HYDROGEOLOGICAL SURVEY
SITE NO. 10
SEMINOLE COUNTY, FLORIDA

"WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATION AND ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS. SIGNIFICANT FLUCTUATIONS IN WATER TABLE LEVELS WITH POND LEVEL FLUCTUATIONS SHOWN ARE ANTICIPATED.

Taken from: Hydrogeological Survey, Land Application System Evaluation and Groundwater Monitoring Plan, Site No. 10, Seminole County, Florida, Ardaman and Associates, Inc.(1988)

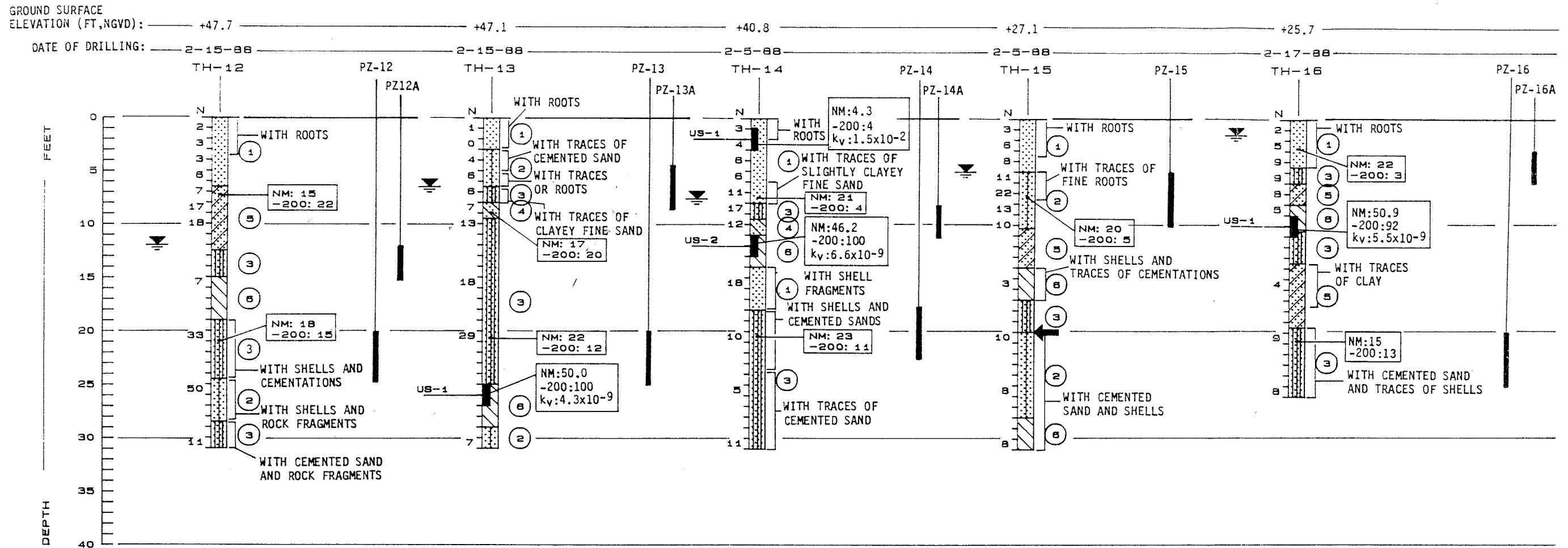


FIGURE 15
BORING PROFILES

Ardaman & Associates, Inc.
Consulting Engineers in Soil Mechanics,
Foundations, and Materials Testing

**HYDROGEOLOGICAL SURVEY
SITE NO. 10
SEMINOLE COUNTY, FLORIDA**

Taken from: Hydrogeological Survey, Land Application System Evaluation and Groundwater Monitoring Plan, Site No. 10, Seminole County, Florida, Ardaman and Associates, Inc.(1988)

(Ardaman and Associates, 1988). From the calibrated groundwater model of Seminole County (Spechler and Halford, 2001), leakance across the ICU, ranged from 1×10^{-4} to 1×10^{-3} day⁻¹ across most of Seminole County.

Floridan Aquifer System

The FAS, the principal source of groundwater in east-central Florida includes the following stratigraphic units in descending order: the Ocala Limestone, the Avon Park Formation, the Oldsmar Formation, and the upper part of the Cedar Keys Formation. The FAS ranges from about 2,000 to 2,600 ft in thickness in the county.

The Upper Floridan aquifer (UFA) consists of the Ocala Limestone and the dolomitic limestones of the upper one-third of the Avon Park Formation. In Seminole County, the altitude of the top of the Upper Floridan aquifer is less than 50 ft below sea level in much of the eastern, western and southern part of the county. Transmissivity for the UFA around the site was about 10,000 to 50,000 ft²/day in Seminole County (Murray and Halford, 1996). In 2005, the potentiometric surface of the UFA ranged from 13 ft to 20 ft NGVD (Kinnaman, 2005) in the vicinity of Site 10.

The middle semiconfining unit separates the UFA and Lower Floridan aquifers (LFA), and is composed of beds of relatively less permeable limestone and dolomitic limestone. In Seminole County, the unit ranges in thickness from about 400 to 550 ft (Miller, 1986). Reported leakance ranges from 1.2×10^{-5} to 1×10^{-3} day⁻¹ (Szell, 1993; Murray and Halford, 1996; and Barnes, Ferland and Associates, 1997).

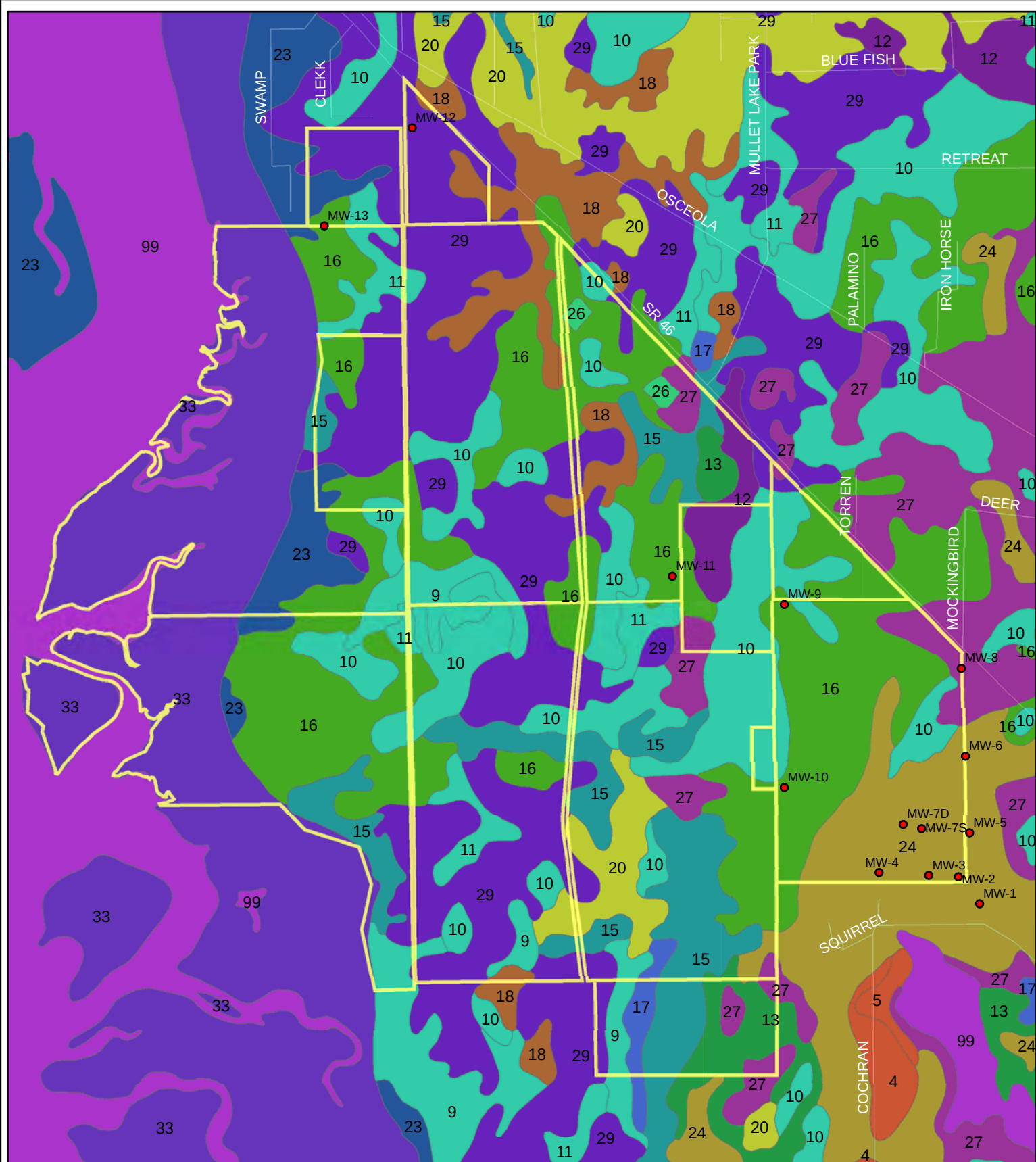
The LFA includes about the lower one-third of the Avon Park Formation and all of the Oldsmar Formation. This portion of the aquifer is highly productive. The unit ranges in thickness from about 1,300 to 1,500 ft in Seminole County (Miller, 1986). The model calibrated transmissivity of LFA ranged from 5,000 to 10,000 around the study site. The potentiometric surface of LFA was between 20 ft and 30 ft. Storage coefficient values from aquifer tests in both UFA and LFA range from 1×10^{-4} to 1×10^{-3} (Murray and Halford, 1996).

Soil Types and Characteristics

The Natural Resources Conservation Service (NRCS) soil types in the study area are illustrated on **Figure 16**. The data source is Soil Survey Geographic (SSURGO) database of Florida. As shown in the map, Site 10 is covered by numerous surficial soil types. The descriptions of detailed soil units are attached. The summary of the soil characteristics is shown in **Table 6**.

SAS Groundwater Levels and Flow Rates

From topography, the natural groundwater flow direction is from Site 10 towards Lake Jesup and its tributaries. The following data also support this conceptual model;



0 375 750 1,500 2,250 3,000 Feet

City of Sanford
Wastewater Facility (Site 10) Data Evaluation

LEGEND

● Site 10 MWs	BASINGER	FELDA	PAOLA	ST. JOHNS	WATER
Sanford Owned Parcels	BLUFF	GATOR	PINEDA	ST. LUCIE	ZOLFO
Roads	BRIGHTON	IMMOKALEE	POMELLO	TAVARES	
ADAMSVILLE	CANDLER	MALABAR	POMPANO	TERRA CEIA	
ARCHBOLD	CANNOVA	MANATEE	SAMSULA	UDORTHERS	
ARENTS	EAUGALLIE	MYAKKA	SEFFNER	URBAN LAND	
ASTATULA	EMERALDA	NITTAW	SMYRNA	WABASSO	

Table 6
Sanford Wastewater Facility (Site 10) Data Evaluation
Soil Characteristics Summary

Soil Name	Map Symbol	Depth (in)	USDA Texture	Classification Unified	Percentage Passing Sieve Number				Liquid Limit (pct)	Plasticity Index	Clay (pct)	Permeability (in/hr)	Available Water Capacity (in/in)	Organic Matter ¹ (pct)	Hydrologic Group	Flooding			High Water Table			
					4	10	40	200								Frequency	Duration ²	Months ²	Depth (ft) ³	Kind ⁴	Months	
St.Johns	29	0-12	Fine sand	SP,SP-SM	100	100	75-95	3-10	---	NP	1-4	6.0-20	0.10-0.15	2-4	B/D	None	---	---	0-1.0	Apparent	Jun-Apr	
		12-22	Sand, fine sand	SP, SP-SM	100	100	85-95	3-10	---	NP	1-3	6.0-20	0.03-0.08									
		22-54	Sand, fine sand, loamy fine sand	SP-SM, SM	100	100	85-95	5-20	---	NP	2-6	0.2-2.0	0.10-0.30									
		54-80	Sand, fine sand	SP, SP-SM	100	100	80-90	2-10	---	NP	1-4	6.0-20	0.03-0.08									
EauGallie		0-16	Fine sand, sand	SP, SP-SM	100	100	80-98	2-5	---	NP	<5	6.0-20	0.02-0.07	2-8	B/D	None	---	---	0-1.0	Apparent	Jun-Oct	
		16-35	Sand, fine sand	SP-SM, SM	100	100	80-98	5-20	---	NP	1-8	0.6-6.0	0.15-0.25									
		35-38	Sand, fine sand	SP, SP-SM	100	100	80-98	2-12	---	NP	1-5	6.0-20.0	0.02-0.05									
		38-72	Sandy loam, fine sandy loam, sandy clay loam	SM, SM-SC, SC	100	100	80-98	20-35	<40	NP-20	13-31	0.06-2.0	0.10-0.20									
		72-80	Sand, loamy sand, loamy fine sand	SP-SM, SM	100	100	80-98	5-25	---	NP	1-13	0.6-6.0	0.05-0.15									
Immokalee	16	0-6	Fine sand	SP,SP-SM	100	100	70-100	2-10	---	NP	1-5	6.0-20	0.05-0.10	1-2	B/D	None	---	---	0-1.0	Apparent	Jun-Oct	
		6-36	Fine sand, sand	SP, SP-SM	100	100	70-100	2-10	---	NP	1-5	6.0-20	0.02-0.05									
		36-56	Fine sand, sand	SP-SM, SM	100	100	70-100	5-21	---	NP	2-7	0.6-2.0	0.10-0.25									
		56-80	Fine sand, sand	SP, SP-SM	100	100	70-100	2-10	---	NP	1-5	6.0-20	0.02-0.05									
	Basinger	10	0-6	Mucky fine sand	SP, SP-SM	100	100	85-100	1-12	---	NP	1-6	6.0-20	0.15-0.20	8-20	D	None	---	---	+2-0	Apparent	Jun-Feb
6-18			Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	0-4	6.0-20	0.05-0.10									
18-35			Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	1-3	6.0-20	0.10-0.15									
35-80			Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	1-3	6.0-20	0.05-0.10	>20	B/D	+2-0					Jan-Dec	
0-26			Muck	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.25									
26-80		Sand, fine sand, loamy sand	SP-SM, SM, SP	100	100	80-100	2-20	---	NP	1-14	6.0-20	0.02-0.05										
Hontoon		0-80	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.30-0.50	75-85	B/D	+2-0		Jan-Dec				
Basinger		11	0-5	Mucky fine sand	SP, SP-SM	100	100	85-100	1-12	---	NP	1-6	6.0-20	0.15-0.20	8-20	D	None	---	---	+2-0		Jun-Feb
	5-15		Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	0-4	6.0-20	0.05-0.10									
	15-25		Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	1-3	6.0-20	0.10-0.15									
	25-80		Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	1-3	6.0-20	0.05-0.10									
	Smyrna		0-2	Fine sand	SP, SP-SM	100	100	80-100	2-12	---	NP	1-6	6.0-20	0.05-0.10	1-5	D				+2-0		Jun-Feb
			2-15	Sand, fine sand	SP, SP-SM	100	100	80-100	2-10	---	NP	0-3	6.0-20	0.02-0.05								
			15-25	Sand, fine sand, loamy fine sand	SM, SP-SM	100	100	80-100	5-20	---	NP	3-8	0.6-6.0	0.10-0.20								
	25-80	Sand, fine sand	SP, SP-SM	100	100	80-100	2-10	---	NP	1-6	6.0-20	0.03-0.07										
Basinger	9	0-5	Fine sand	SP	100	100	85-100	1-4	---	NP	0-4	6.0-20	0.03-0.07	0.5-2	B/D	None	---	---	0-1.0		Jun-Feb	
		5-30	Sand, fine sand	SP,SP-SM	100	100	85-100	2-12	---	NP	0-4	6.0-20	0.05-0.10									
		30-50	Sand, fine sand	SP,SP-SM	100	100	85-100	2-12	---	NP	1-6	6.0-20	0.10-0.15									
		50-80	Sand, fine sand	SP,SP-SM	100	100	85-100	2-12	---	NP	1-3	6.0-20	0.05-0.10									
		Delray	0-12	Fine sand	SP-SM, SM, SM-SC	100	100	95-100	5-20	<20	NP-5	3-13	6.0-20	0.10-0.15	2-5				B/D	0-1.0		Jun-Mar
			12-50	Fine sand, sand	SP-SM	100	100	95-100	5-12	---	NP	1-7	6.0-20	0.05-0.08								
			50-80	Sandy loam, fine sandy loam, sandy clay loam	SM,SM-SC, SC	100	100	95-100	20-35	<40	NP-15	13-30	0.6-6.0	0.10-0.15								
Pomello	27	0-31	Fine sand	SP, SP-SM	100	100	60-100	1-8	---	NP	<2	>20	0.02-0.05	<1	C	None	---	---	2.0-3.5	Apparent	Jun-Nov	
		31-40	Coarse sand, fand, fine sand	SP-SM, SM	100	100	60-100	6-15	---	NP	<2	2.0-6.0	0.10-0.30									
		40-80	Coarse sand, fand, fine sand	SP,SP-SM	100	100	60-100	4-10	---	NP	<2	6.0-20	0.02-0.05									
Terra Ceia	33	0-80	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.30-0.50	>60	D	Frequent	Long	Jun-Nov	0-1.0	Apparent	Jan-Dec	

Table 6
Sanford Wastewater Facility (Site 10) Data Evaluation
Soil Characteristics Summary

Soil Name	Map Symbol	Depth (in)	USDA Texture	Classification Unified	Percentage Passing Sieve Number				Liquid Limit (pct)	Plasticity Index	Clay (pct)	Permeability (in/hr)	Available Water Capacity (in/in)	Organic Matter ¹ (pct)	Hydrologic Group	Flooding			High Water Table					
					4	10	40	200								Frequency	Duration ²	Months ²	Depth (ft) ³	Kind ⁴	Months			
Felda Manatee	15	0-4	Mucky fine sand	SP, SP-SM	100	100	90-100	2-12	---	NP	1-6	6.0-20	0.15-0.20	10-20	D	None	---	---	+2-0	Apparent	Jun-Dec			
		4-28	Sand, fine sand	SP, SP-SM	100	100	90-100	2-5	---	NP	1-3	6.0-20	0.02-0.05											
		28-36	Sandy loam, fine sandy loam, sandy clay loam	SM, SM-SC, SC	100	100	90-100	15-35	<40	NP-15	13-30	0.6-6.0	0.10-0.15											
		36-80	Sand, fine sand, loamy sand	SP, SP-SM	100	100	80-100	2-12	---	NP	1-10	6.0-20	0.02-0.05											
		0-19	Mucky fine sand, fine sand, loamy sand	SP-SM, SM	100	100	85-100	8-15	---	NP	2-8	2.0-6.0	0.15-0.25	15-30	D				+2-0		Jun-Feb			
		19-50	Fine sandy loam, sandy loam	SM-SC, SC,SM	100	100	90-100	18-30	<30	NP-10	10-20	0.6-2.0	0.10-0.15											
		50-80	Fine sandy loam, sandy loam, loamy fine sand	SM,SM-SC, SC, GM	60-100	50-100	50-100	13-30	<30	NP-10	6-20	0.6-2.0	0.08-0.15											
Malabar	18	0-10	Fine sand	SP, SP-SM	100	100	80-100	2-10	---	NP	0-4	6.0-20	0.03-0.08	1-2	B/D	None	---	---	0-1.0	Apparent	Jun-Nov			
		10-35	Sand, fine sand	SP, SP-SM	100	100	80-100	3-12	---	NP	1-5	6.0-20	0.05-0.10											
		35-48	Sand, fine sand	SP, SP-SM	100	100	80-100	2-10	---	NP	1-5	6.0-20	0.02-0.05											
		48-70	Sandy clay loam, fine sandy loam, sandy loam	SC, SM-SC, SM	100	100	80-100	20-40	<35	NP-20	12-25	<0.2	0.10-0.15											
		70-80	Sand, fine sand, loamy fine sand	SP-SM, SM	100	100	80-100	5-20	---	NP	1-8	6.0-20	0.03-0.08											
Paola St. Lucie	24	0-3	Fine sand	SP	100	100	85-100	1-2	---	NP	0-2	>20	0.02-0.05	0-1	A	None	---	---	>6.0	---	---			
		3-25	Sand, fine sand	SP	100	100	85-100	1-2	---	NP	0-2	>20	0.02-0.05											
		25-80	Sand, fine sand	SP	100	100	80-100	1-4	---	NP	0-3	>20	0.02-0.05		A									
		0-2	Sand	SP	100	90-100	80-99	1-4	---	NP	0-1	>20	0.02-0.05		>6.0				---	---				
		2-80	Sand, fine sand	SP	100	90-100	80-99	1-4	---	NP	0-1	>20	0.02-0.03											
Myakka EauGallie	20	0-5	Fine sand, sand	SP, SP-SM	100	100	85-100	2-10	---	NP	1-3	6.0-20	0.05-0.15	2-5	B/D	None	---	---	0-1.0	Apparent	Jun-Oct			
		5-28	Fine sand, sand	SP, SP-SM	100	100	85-100	2-10	---	NP	0-2	6.0-20	0.02-0.05											
		28-45	Sand, fine sand, loamy fine sand	SM, SP-SM	100	100	85-100	5-20	---	NP	1-8	0.6-6.0	0.10-0.20											
		45-80	Sand, fine sand	SP, SP-SM	100	100	85-100	2-8	---	NP	0-2	6.0-20	0.02-0.10											
		0-18	Fine sand	SP, SP-SM	100	100	80-98	2-5	---	NP	<5	6.0-20	0.02-0.07	2-8	B/D				0-1.0	Apparent	Jun-Oct			
		18-30	Sand, fine sand	SP-SM, SM	100	100	80-98	5-20	---	NP	1-8	0.6-6.0	0.15-0.25											
		30-41	Sand, fine sand	SP, SP-SM	100	100	80-98	2-12	---	NP	1-5	6.0-20	0.02-0.05											
		41-60	Sandy loam, fine sandy loam, sandy clay loam	SM, SM-SC, SC	100	100	80-98	20-35	<40	NP-20	13-31	0.06-2.0	0.10-0.20											
60-80	Sand, loamy sand, loamy fine sand	SP-SM, SM	100	100	80-98	5-25	20-32	NP	1-13	0.6-6.0	0.05-0.15													
EauGallie Immokalee	13	0-18	Fine sand	SP, SP-SM	100	100	80-98	2-5	---	NP	<5	6.0-20	0.02-0.07	2-8	B/D	None	---	---	0-1.0	Appatrent	Jun-Oct			
		18-30	Sand, fine sand	SP-SM, SM	100	100	80-98	5-20	---	NP	1-8	0.6-6.0	0.15-0.25											
		30-45	Sand, fine sand	SP, SP-SM	100	100	80-98	2-12	---	NP	1-5	6.0-20	0.02-0.05											
		45-64	Sandy loam, fine sandy loam, sandy clay loam	SM, SM-SC, SC	100	100	80-98	20-35	<40	NP-20	13-31	0.06-2.0	0.10-0.20											
		64-80	Sand, loamy sand, loamy fine sand	SP-SM, SM	100	100	80-98	5-25	20-32	NP	1-13	6.0-20	0.05-0.15	1-2	B/D	None	---	---	0-1.0	Apparent	Jun-Oct			
		0-4	Fine sand	SP,SP-SM	100	100	70-100	2-10	---	NP	1-5	6.0-20	0.05-0.10											
		4-42	Fine sand, sand	SP, SP-SM	100	100	70-100	2-10	---	NP	1-5	6.0-20	0.02-0.05											
		42-62	Fine sand, sand	SP-SM, SM	100	100	70-100	5-21	---	NP	2-7	0.6-2.0	0.10-0.25											
		62-80	Fine sand, sand	SP, SP-SM	100	100	70-100	2-10	---	NP	1-5	6.0-20	0.02-0.05											

Table 6
Sanford Wastewater Facility (Site 10) Data Evaluation
Soil Characteristics Summary

Soil Name	Map Symbol	Depth (in)	USDA Texture	Classification Unified	Percentage Passing Sieve Number				Liquid Limit (pct)	Plasticity Index	Clay (pct)	Permeability (in/hr)	Available Water Capacity (in/in)	Organic Matter ¹ (pct)	Hydrologic Group	Flooding			High Water Table						
					4	10	40	200								Frequency	Duration ²	Months ²	Depth (ft) ³	Kind ⁴	Months				
Brighton Samsula Sanibel	17	0-8	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.50	60-90	B/D	None	---	---	+2-0	Apparent	Jan-Dec				
		8-80	Mucky peat	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.40												
		0-26	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.25												
		26-80	Sand, fine sand,loamy sand	SP-SM, SM,SP	100	100					1-14	6.0-20	0.02-0.05	>20	B/D				+2-0		Jan-Dec				
		0-6	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.50												
		6-8	Sand, fine sand, mucky fine sand	SP, SP-SM	100	100	85-95	5-12	---	NP	2-6	6.0-20	0.10-0.15	20-50	B/D				+2-0		Jun-Feb				
		8-80	Sand, fine sand	SP, SP-SM	100	100	85-95	5-12	---	NP	2-6	6.0-20	0.03-0.10												
Canova Terra Ceia	12	0-10	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.10-0.20	35-75	B/D	None	---	---	+2-0	Apparent	Jan-Dec				
		10-27	Sand, fine sand	SP, SP-SM	100	100	70-100	3-10	---	NP	1-6	6.0-20	0.02-0.05												
		27-30	Sandy loam, fine sandy loam, sandy clay loam	SM, SM-SC, SC	100	100	75-95	15-38	<40	NP-20	15-34	0.6-6.0	0.10-0.15												
		30-38	Sandy clay loam	SC	100	100	75-95	18-35	20-40	9-26	18-34	0.6-2.0	0.10-0.15												
		38-80	Sandy clay loam, fine sandy loam, sandy loam	SM, SM-SC, SC	100	80-100	65-95	15-35	<40	NP-20	15-25	0.6-6.0	0.10-0.15												
		0-80	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.30-0.50	60-90	B/D				+2-0		Jan-Dec				
Udorthents	26																								
Nittaw Okeelanta Rasinger	23	0-4	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.25	20-90	D	Frequent	Very long	Jun-Sep	0-1.0		Jun-Nov				
		4-9	Sand, fine sand, mucky fine sand	SP-SM, SM	100	100	85-100	5-20	---	NP	1-10	6.0-20	0.05-0.15												
		9-80	Sandy clay, clay	CH, CL	100	100	85-100	51-70	40-80	21-50	35-60	0.06-0.2	0.15-0.18												
		0-42	Muck	PT	---	---	---	---	---	---	---	6.0-20	0.20-0.45	60-85	D				0-1.0		Jan-Dec				
		42-80	Fine sand, sand, loamy sand	SP, SP-SM, SM	100	85-100	80-95	2-15	---	NP	1-5	6.0-20	0.05-0.10												
		0-22	Fine sand	SP	100	100	100	1-4	---	NP	0-4	6.0-20	0.03-0.07												
		22-38	Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	1-6	6.0-20	0.10-0.15	0.2-1.0	D				0-1.0		Jun-Nov				
		38-80	Sand, fine sand	SP, SP-SM	100	100	85-100	2-12	---	NP	1-3	6.0-20	0.05-0.10												

NOTES:
--- Absence of an entry indicates that data were not available or were not estimated
¹ Organic Matter applies only to the surface layer
² Absence of an entry indicates that the feature is not a concern.
³ The plus sign under "High water table -- Depth" indicates ponding.
⁴ Kind is defined as: (1) Apparent Water Table - a thick zone of free water in the soil. It is indicated by the level at which water stands in an encased borehole after adequate time time is allowed for adjustment in the surrounding soil.
(2) Perched Water Table - is water standing above an unsaturated water zone. In places an upper, or perched, water table is separate from a lower one by a dry zone.

Soil Site Characteristics are based on the following tables taken from the Soil Survey of Seminole County Area, Florida (Issued March 1990):
(1) Table 13 - Engineering Index Properties; (2) Table 14 - Physical and Chemical Properties of the Soil; and (3) Table 15 - Soil and Water Features.

- Water table elevations from 13 monitoring wells at site 10 (in the study area) (Figure 16) range from 6.9 ft to 45.8 ft NGVD during the monitoring period from March 2003 to September 2006 (**Table 7**).
- The water level in Lake Jesup fluctuated from 0.39 ft (May, 2004) to 7.36 ft (October 2004) NGVD between January 2003 to December 2006.
- The average water level at SEMCO_PWHYDRO station and SJRWMD_HYDRO station in Lake Jesup during 2003 -2006 was 2.51 ft-NGVD (**Table 8**).

The monitoring well closest the Lake Jesup is MW-13, which is located about 1,471 ft from the lake. The average groundwater level of well MW-13 was 8.6 ft NGVD. The altitude of the base of the SAS is about -25 ft NGVD (Murray and Halford, 1996). Therefore, the saturated thickness of the surficial aquifer is approximately 33.6 feet at MW-13.

The Dupuit equation can be used to estimate the groundwater flow rate in an unconfined aquifer, as follows:

$$q = \frac{K_h}{2x} (h_1^2 - h_2^2) = \frac{Q}{w}$$

Where:

- q = flow per unit width of aquifer or specific discharge (ft²/day);
- K_h = horizontal hydraulic conductivity of the aquifer (feet/day);
- x = the horizontal distance between two points h₁ and h₂ (feet);
- h₁ = head at location 1 above the impermeable unit (feet); and
- h₂ = head at location 2 above the impermeable unit (feet).

If the specific discharge (q) is multiplied by the cross sectional flow width (w) the volumetric groundwater flow rate (Q) between Site 10 and Lake Jesup can be estimated. The input data was taken from both published and site specific data. The input assumptions and calculated SAS groundwater flow rates between Site 10 and Lake Jesup are presented in **Table 9** and **Table 10**. The average flow per unit width calculated from the data of 13 monitoring wells is 0.43 ft²/day.

Table 7
Sanford Wastewater Facility (Site 10) Data Evaluation
Monitoring Well Data

Facility MW Name	Permit Builder MW ID	MWAFR ID/#		31-Mar-03		30-Jun-03		30-Sep-03		31-Dec-03		31-Mar-04		30-Jun-04		30-Sep-04		31-Dec-04	
			Total Phosphorus mg/L (Average 1992-97)*	Water Level Relative to ft- NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l
			SITE 10																
MW-1	MWB-1 Site 10	6778	0.29	24.99	<0.02	24.1	<0.02	25.45	<0.02	24.57	<0.02	23.63	<0.003	22.6	0.08	22.48	<0.003	24.63	<0.003
MW-2	MWC-2 Site 10	6777	0.05	41.83	0.02	41.02	<0.02	41.42	<0.02	40.16	<0.02	38.87	<0.003	37.97	0.01	41.3	<0.003	40.66	0.006
MW-3	MWC-3 Site 10	6776	0.04	44.22	0.11	43.4	0.04	43.78	0.34	42.43	0.05	41.11	9.7	40.24	6.4	43.86	1.48	43.28	2.82
MW-4	MWC-4 Site 10	6775	0.17	42.64	<0.02	43.89	<0.02	44.29	<0.02	43.11	<0.02	42.01	<0.003	41.83	0.004	45.77	<0.003	44.69	0.014
MW-5	MWC-5 Site 10	6774	0.22	30.07	10	28.99	8.42	29.54	0.49	27.63	1.36	26.19	0.21	25.59	0.22	29.87	1.78	29.11	0.008
MW-6	MWC-6 Site 10	6773	0.04	33.72	6.56	33.66	4.29	33.48	2.24	32.76	<0.02	32.14	<0.003	31.22	<0.003	33.87	<0.003	33.26	5.34
MW-7s	MWC-7 Site 10	6772	0.04	39.5	8.94	39.08	14.8	39.76	8.2	38.35	7.9	37.27	9.6	38.17	9.8	46.67	11.2	39.53	13.2
MW-8	MWC-8 Site 10	6771	0.04	27.53	0.02	27.79	0.27	27.63	0.04	26.94	<0.02	26.33	<0.003	25.65	<0.003	28.25	<0.003	29.08	<0.003
MW-9	MWC-9 Site 10	6770	0.45	18.65	<0.02	18.16	0.26	17.03	0.05	16.6	<0.02	15.89	<0.003	14.87	<0.003	14.52	<0.003	17.22	<0.003
MW-10	MWC-10 Site 10	6769	0.19	20.99	<0.02	20.23	0.04	0.05	20.51	19.6	<0.02	20.22	0.03	18.31	<0.003	21.04	<0.003	20.15	<0.003
MW-11	MWC-11 Site 10	6768	2.97	16.53	0.04	15.8	<0.02	16.02	0.09	15.02	<0.02	14.87	<0.003	13.79	<0.003	16.53	<0.003	15.41	<0.003
MW-12	MWC-12 Site 10	6767	0.24	13.87	0.02	12.6	0.05	13.25	0.05	12.86	<0.02	12.12	<0.003	11.44	<0.003	13.92	<0.003	12.53	0.006
MW-13	MWC-13 Site 10	6766	0.16	8.89	<0.02	8.08	0.05	8.89	0.07	7.85	<0.02	7.87	<0.003	6.93	<0.003	9.11	<0.003	7.34	<0.003

Facility MW Name	Permit Builder MW ID	MWAFR ID/#	31-Mar-05		30-Jun-05		30-Sep-05		31-Dec-05		31-Mar-06		30-Jun-06		30-Sep-06	
			Water Level Relative to ft- NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l
SITE 10																
MW-1	MWB-1 Site 10	6778	24.24	<0.005	23.82	<0.019	24.83	<0.019	25.62	0.019	24.43	<0.003	23.28	0.008	21.68	0.021
MW-2	MWC-2 Site 10	6777	39.36	0.023	39.17	0.019	39.88	<0.019	41.06	<0.019	38.65	0.01	37.62	<0.0075	36.45	0.005
MW-3	MWC-3 Site 10	6776	41.67	1.94	41.2	<0.019	42.92	0.019	43.33	9.8	41.17	11	40.41	7.1	39.1	6.3
MW-4	MWC-4 Site 10	6775	43.13	<0.003	42.94	<0.019	43.94	0.021	44.53	<0.019	42.78	0.005	41.62	0.051	40.6	<0.003
MW-5	MWC-5 Site 10	6774	26.63	0.041	26.67	0.689	27.58	3.98	29.21	2.5	26.37	0.66	25.67	0.3	24.84	0.14
MW-6	MWC-6 Site 10	6773	32.49	4.05	31.96	4.98	32.26	2.46	33.36	0.86	32.07	2.9	30.84	2.8	30.46	5.1
MW-7s	MWC-7 Site 10	6772	37.7	11.5	37.92	9.32	38.42	9.47	39.33	7.5	37.19	9.7	37.09	9.3	37.15	7.9
MW-8	MWC-8 Site 10	6771	26.29	0.09	26.5	<0.019	27.36	<0.019	27.76	<0.019	26.67	0.015	25.42	<0.0075	24.58	<0.003
MW-9	MWC-9 Site 10	6770	16.82	<0.003	16.6	<0.019	17.65	0.033	17.94	<0.019	17.12	<0.0030	14.97	0.01	13.35	<0.003
MW-10	MWC-10 Site 10	6769	19.47	<0.003	19.01	<0.019	20.26	0.02	20.4	<0.019	20.2	0.047	18.02	0.051	17.29	0.064
MW-11	MWC-11 Site 10	6768	15.51	0.021	16.03	<0.019	16.76	<0.019	15.91	<0.019	15.38	0.0042	13.34	0.023	12.18	<0.003
MW-12	MWC-12 Site 10	6767	11.64	<0.003	13.74	<0.019	13.14	<0.019	13.28	<0.019	12.59	<0.0030	10.97	0.008	10.82	<0.003
MW-13	MWC-13 Site 10	6766	7.9	0.033	9.21	<0.019	8.64	<0.019	8.39	<0.019	7.97	<0.0030	7.11	0.086	7.22	<0.003

MWB = Background; MWI = Intermediate; MWC = Compliance
* Phosphorus sampling was removed from Permit requirements post 1997.

Table 8
Sanford Wastewater Facility (Site 10) Data Evaluation
Lake Jesup Water Levels

Source	Station	Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Average
			Water Level Feet												
SJRWMD_HYDRO	1410650	2003	4.35	2.57	2.63	2.18	0.98	0.90	1.51	3.26	3.92	3.87	2.92	1.53	2.55
SJRWMD_HYDRO	1410650	2004	0.93	1.25	1.40	0.72	0.39	0.47	0.90	2.47	6.42	7.36	5.57	3.11	2.58
SJRWMD_HYDRO	1410650	2005	2.01	1.87	1.43	2.28	1.59	2.47	4.46	4.24	3.87	4.80	6.06	4.68	3.31
SJRWMD_HYDRO	1410650	2006	2.74	1.53	0.93	0.60	0.75	0.46	0.60	0.50	1.91	1.92	1.37	1.23	1.21
SJRWMD_HYDRO	1410650	Average	2.51	1.81	1.60	1.44	0.93	1.08	1.87	2.62	4.03	4.49	3.98	2.64	2.42
USGS_NWIS	2234435	2003	4.47	2.82	2.86	2.44	1.22	0.85	1.88	3.55	4.19	4.15	3.19	1.79	2.78
USGS_NWIS	2234435	2004	1.18	1.51	1.67	0.75	0.48	0.60	1.23	1.44	NV	NV	NV	NV	1.11
USGS_NWIS	2234435	2005	2.18	1.88	1.47	2.25	1.58	2.50	4.49	4.27	3.88	4.83	6.13	4.76	2.58
USGS_NWIS	2234435	2006	2.79	1.55	0.92	0.58	0.77	0.49	0.62	0.49	1.93	1.93	1.41	1.24	1.23
USGS_NWIS	2234435	Average	2.66	1.94	1.73	1.51	1.01	1.11	2.06	2.44	3.34	3.64	3.58	2.59	2.30
SEMCO_PWHYDRO	SCPW-L-jes2	2003	3.19	2.80	2.97	2.88	1.00	1.80	1.75	2.20	3.95	3.62	1.50	1.17	2.40
SEMCO_PWHYDRO	SCPW-L-jes2	2004	0.85	2.21	2.10	NV	0.43	0.43	1.05	3.80	6.65	6.50	4.55	2.60	2.83
SEMCO_PWHYDRO	SCPW-L-jes2	2005	2.30	1.34	1.53	2.52	1.44	4.77	4.55	3.97	3.99	5.29	5.56	4.26	3.46
SEMCO_PWHYDRO	SCPW-L-jes2	2006	2.28	1.34	1.06	0.57	0.64	NV	0.60	0.95	2.26	2.75	NV	NV	1.38
SEMCO_PWHYDRO	SCPW-L-jes2	Average	2.16	1.92	1.92	1.99	0.88	2.33	1.99	2.73	4.21	4.54	3.87	2.68	2.60

Table 9
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Groundwater Flow Rate Parameters

Parameter	Description	Units	Average Value
K_h	Horizontal hydraulic conductivity	ft/day	3.5
x	Horizontal distance between MW-13 and Lake Jesup	feet	1,471
h_1	Head in MW-13	feet	33.6
h_2	Head in Lake Jesup	feet	27.51
q	Flow per unit width to Lake	ft ² /day	0.44
w	Cross-section width	feet	12,000
Q	Volumetric GW flow rate	ft ³ /day	5173

Table 10
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Mass Loading of Nitrate to Lake Jesup

Well	Water Level (ft)	x (ft)	h_1 (ft)	h_2 (ft)	q (ft ² /d)	w (ft)	Q (ft ³ /day)	C (mg/l)	M (lb/day)
MW-1	23.3	10514.4	48.3	27.5	0.26	12000	3145.9	0.02	0.003
MW-2	41.2	10269.2	66.2	27.5	0.62	12000	7419.7	0.01	0.006
MW-3	42.5	9840.0	67.5	27.5	0.67	12000	8097.8	3.81	1.925
MW-4	45.2	9196.3	70.2	27.5	0.79	12000	9534.8	0.01	0.009
MW-5	29.3	10483.7	54.3	27.5	0.37	12000	4382.6	2.05	0.562
MW-6	32.4	10667.7	57.4	27.5	0.42	12000	5005.2	2.77	0.867
MW-7s	39.3	9778.7	64.3	27.5	0.60	12000	7250.9	9.89	4.476
MW-8	27.6	10851.6	52.6	27.5	0.32	12000	3887.1	0.04	0.009
MW-9	18.2	9012.3	43.2	27.5	0.21	12000	2577.1	0.03	0.005
MW-10	14.9	8062.2	39.9	27.5	0.18	12000	2174.5	1.39	0.189
MW-11	15.8	5119.3	40.8	27.5	0.31	12000	3724.1	0.02	0.004
MW-12	13.3	3126.7	38.3	27.5	0.40	12000	4743.5	0.02	0.005
MW-13	8.6	1471.4	33.6	27.5	0.44	12000	5306.7	0.02	0.008
Average					0.43	12000	5173.07	1.54	0.50

Nutrient Transport in SAS

Nutrient transport in groundwater occurs primarily through advection. Advection is defined as traveling with the average groundwater flow velocity. Also, the nutrient mass is assumed to travel as a conservative element that does not react with the aquifer matrix. The mass loading to Lake Jesup is calculated by multiplying volumetric groundwater flow rate by the groundwater nitrate concentration. The average nitrate concentration in the monitoring wells is 1.54 mg/l, and average nitrate mass loading to Lake Jesup is 0.50 lb/day or 182 lbs/year (Table 10).

Surface Nutrient Loading Pollutant Load Analysis

CDM estimated the relative annual pollutant loads for Site 10 for existing conditions as of 2004 based on the most recent aerial photography and land use data. Nonpoint source (NPS) pollutant loads were estimated using the CDM Watershed Management Model (WMM), Version 4.24. The WMM was used to conceptually evaluate the TP and TN for each of the subbasins that are within the Lake Jesup Watershed as shown on Figure 8. The purpose of the evaluation was to update the pollutant load analysis that had been previously done by CDM for the *Lake Jesup Basin Engineering Study and Drainage Inventory* (2001) for Seminole County. In this previous analysis as well as the analysis used by FDEP to develop the TMDL, industrial land use had been assigned to a large portion of Site 10 as it was identified as a utility in Seminole County's existing land use coverage. Based on recent discussions with FDEP at the BMAP meetings, field visits, review of the 2004 aerial photography and the Land Use and Land Cover (2004) GIS layer available from the SJRWMD, Site 10 is dominated by agriculture (i.e., pastures and citrus groves) and wetlands as previously shown in Figure 2. The WMM also accounts for BMPs present on the site as previously discussed in this memorandum.

Watershed Management Model (WMM) Background

WMM uses a database platform to estimate annual or seasonal pollutant nonpoint surface loads within a basin. Data required for the WMM include stormwater event mean concentrations (EMCs) for each pollutant type, land use, and average annual precipitation. In addition, impacts due to failing septic systems, annual baseflow and average baseflow concentrations, point source flows and pollutant concentrations, and average number of combined sewer overflows (CSOs) and concentrations can also be taken into account in the WMM if applicable. The model is a "stand alone" application that runs in Microsoft Windows 95® or greater.

Within a given watershed, multiple subbasins can be evaluated. Subbasins are typically subdivided by tributary areas, outfalls, or other receiving water body within a basin. However, subbasins can be delineated based on non-hydrologic boundaries such as

jurisdictional limits. This provides decision makers with information regarding the relative contribution of pollution loadings from various areas within a basin which can be used for targeting control measures to those areas which are responsible for generating the majority of the pollutant load.

The WMM consists of three major computational modules, the import utility, and numerous related database records. WMM was developed using Visual Basic® and Microsoft Access®.

Rainfall/Runoff Relationships

NPS pollution loading factors (lbs/acre/year) for different land use categories are based upon annual runoff volumes and event mean concentrations (EMCs) for different pollutants. The EMC is defined as the average of individual measurements of storm pollutant mass loading divided by the storm runoff volume. One of the keys to effective transfer of literature values for nonpoint pollution loading factors to a particular study area is to make adjustments for actual runoff volumes in the basin under study. In order to calculate annual runoff volumes for each subbasin, the pervious and impervious fractions of each land use category are used as the basis for determining rainfall/runoff relationships. For rural/agricultural (nonurban) land uses, the pervious fraction represents the major source of runoff or stream flow, while impervious areas are the predominant contributors for most urban land uses.

Rainfall

The average annual rainfall data from 1995 through 2005 for the Sanford Weather Station (COOP ID: 087982) were used for the WMM analysis. Total rainfall from 1995 through 2002 was used in the analysis for the *Nutrient and Unionized Ammonia TMDLs for Lake Jesup, WBIDs 2981 and 2981A* (FDEP, 2005). CDM obtained annual rainfall totals for 2003 through 2005 and averaged the values from 1995 through 2005 resulting in an annual rainfall of 54.98 inches that was used in the WMM analysis.

Annual Runoff Volume

WMM calculates annual runoff volumes for the pervious/impervious areas in each land use category by multiplying the average annual rainfall volume by a runoff coefficient. A runoff coefficient of 0.95 is typically used for impervious areas (i.e., 95% of the rainfall is assumed to be converted to runoff from the impervious fraction of each land use). A pervious area runoff coefficient of 0.15 is typically used. The total average annual surface runoff from land use "L" is calculated by weighting the impervious and pervious area runoff factors for each land use category as follows:

$$R_L = [C_P + (C_I - C_P) IMP_L] * I; \quad (Equation 1)$$

where:

R_L = total average annual surface runoff from land use L (in/yr);

IMP_L = fractional imperviousness of land use L;

I = long-term average annual precipitation (in/yr);

C_P = pervious area runoff coefficient; and

C_I = impervious area runoff coefficient.

Total runoff in a basin is the area-weighted sum of R_L for all land uses.

Nonpoint Pollution Event Mean Concentrations

The WMM estimates loads from pollutants which are most frequently associated with nonpoint pollution sources. For the purposes of the WMM updated by CDM, only TP and TN were evaluated as these are the parameters that the TMDL is set for.

The event mean concentration (EMC) is a flow-weighted average concentration for a storm event and is defined as the sum of individual measurements of stormwater pollution loads divided by the storm runoff volume. The EMC is widely used as the primary statistic for evaluations of stormwater quality data and as the stormwater pollutant loading factor in analyses of pollutant loadings to receiving waters.

Nonpoint pollution loading analyses typically consist of applying land use specific stormwater pollution loading factors to land use scenarios in the basin under study. Runoff volumes are computed for each land use category based on the percent impervious of the land use and the annual rainfall. These runoff volumes are multiplied by land use specific mean EMC load factors (mg/L) to obtain nonpoint pollution loads by land use category. Selection of nonpoint pollution loading factors depends upon the availability and accuracy of local monitoring data as well as the effective transfer of literature values for nonpoint pollution loading factors to a particular study area.

To be consistent with the work that FDEP used to develop the TMDL for Lake Jesup, CDM used the same EMC values as identified in the *Nutrient and Unionized Ammonia TMDLs for Lake Jesup, WBIDs 2981 and 2981A* (FDEP, 2005). These are shown below in **Table 11**. Much of the area previously assigned industrial land use is comprised mainly of agricultural, wetland, forested and open areas.

Table 11
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Event Mean Concentrations

SJRWMD Land Use Land Cover (2004)	Consolidated WMM Land Use	TP (mg/l)	TN (mg/l)
Improved Pastures	Agriculture – Pasture ¹	0.48	2.48
Row Crops	Agriculture – Row Crops ¹	0.56	2.68
Herbaceous upland nonforested; Shrub and brushland; Mixed upland nonforested; Pine flatwoods; Upland mixed coniferous/hardwood	Forest/Rural Open	0.05	1.25
	Industrial	0.31	1.79
Low Density Residential	Low Density Residential	0.44	1.97
Reservoirs	Water	0.11	1.28
Bay swamp; Mixed wetland hardwoods; Cabbage palm hammock; Cypress; Hydric pine flatwoods; Wetland forested mixed; Freshwater marshes; Emergent aquatic vegetation; Mixed scrub-shrub wetland – these areas represent impacted wetlands based (FDEP 2005)	Wetlands	0.19	1.60
Unimpacted wetlands (taken from FDEP 2005)	Wetlands 2	0.06	1.25

1. Taken from *Stormwater Loading Rate Parameters for Central and South Florida* (Harper, 1994).

To estimate annual pollutant loads discharged to receiving waters from a municipality, median EMCs are converted to mean values (USEPA, 1983b; Novotny, 1992) by the following relationship:

$$M = T * ((1 + CV^2))^{1/2}; \quad (\text{Equation 2})$$

where:

M = arithmetic mean;

T = median; and

CV= coefficient of variation = standard deviation/mean.

Nonpoint Pollution Loading Factors

WMM estimates pollutant loadings based upon nonpoint pollution loading factors (expressed as lbs/ac/yr) that vary by land use and the percent imperviousness associated with each land use. The pollution loading factor M_L is computed for each land use L by the following equation:

$$M_L = EMC_L * R_L * K; \quad (\text{Equation 3})$$

where:

M_L = loading factor for land use L (lbs/ac/yr);

EMC_L = event mean concentration of runoff from land use L (mg/l); EMC_L varies by land use and by pollutant;

R_L = total average annual surface runoff from land use L computed from Equation 1 (in/yr); and

K = 0.2266, a unit conversion constant.

By multiplying the pollutant loading factor by the acreage in each land use and summing for all land uses, the total annual pollution load from a subbasin can be computed. The EMC coverage is typically not changed for various land use scenarios within a given study basin, but any number of land use data sets can be created to examine and compare different land use scenarios (e.g., existing versus future) or land use management scenarios.

BMP Pollutant Removal Efficiencies

The WMM applies a constant removal efficiency for each pollutant to all land use types to simulate treatment BMPs. The BMPs used on Site 10 consist of wet detention ponds and the removal efficiencies used for this type of BMP are shown in **Table 12**.

Table 12
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
BMP Removal Efficiencies

BMP Type/Parameter	TP (%)	TN (%)
Wet Detention ¹	65	25

1. Literature Values from "Pollutant Removal Efficiencies for Typical Stormwater Management Systems in Florida", Harper, 1999

Calculation of Pollutant Loading Reduction from BMPs

The effectiveness of BMPs in reducing nonpoint source loads is computed for each land use in each subbasin. Up to five BMPs per land use can be specified. The percent reduction in nonpoint pollution per pollutant type in each subbasin of the basin is calculated as:

$$P_{L, SB} = (AC_{1, SB} (REM_1) + (AC_{2, SB} (REM_2) + (AC_{3, SB} (REM_3) + (AC_{4, SB} (REM_4) + (AC_{5, SB} (REM_5) \quad (\text{Equation 4})$$

where:

$P_{L,SB}$ = percent of annual nonpoint pollution load captured in subbasin SB by application of the five BMP types on land use L;

$AC_{1,SB}$; $AC_{2,SB}$;

$AC_{3,SB}$; $AC_{4,SB}$; = fractional area coverage of BMP types 1 through 5 on subbasin SB; $AC_{5,SB}$

REM_1 ; REM_2 = removal efficiency of BMP types 1 through 5 respectively; REM ;

REM_3 ; REM_4 ; varies by pollutant type but not by land use or subbasin.

REM_5

Equation 4 enables the user to examine the effectiveness of various BMPs and the degree of BMP coverage within a basin. Coverage might vary depending upon whether the BMP is applied to new development only, existing plus new development, etc. Also, topography may limit the areal coverage of some BMPs.

The nonpoint pollution load from a basin is thus computed by combining Equations 3 and 4 and summing over all land uses and all subbasins; i.e.,

$$MASS = \sum_{SB=1}^N \sum_{L=1}^{15} M_{L, SB} (1 - P_{L, SB}); \quad (Equation 5)$$

where:

MASS = annual nonpoint pollution load washed off the basin in lbs/yr with BMPs taken into account.

N = number of subbasins

The resultant model is a very versatile yet simple algorithm for examining and comparing nonpoint pollution management alternatives for effectiveness in reducing nonpoint pollution.

Model Limitations

The WMM was developed to estimate the relative changes in nonpoint source pollutant loads (average annual or seasonal) due to changes in land use or from the cumulative effects of alternative basin management decisions (e.g. treatment BMPs). The models should be applied to appropriate spatial (basin-wide) and temporal (average annual or seasonal) scales. It is not appropriate to use these input/output models for analysis of short-term (i.e., daily, weekly) water quality impacts. It is also not appropriate to use WMM to estimate absolute loads for a given outfall system without specific monitoring data for that system.

WMM Results

The WMM was used to evaluate the delineated subbasins previously shown in Figure 8 under existing land use conditions (i.e., 2004) to estimate annual pollutant loads. The results of the WMM analysis for existing land use conditions with and without BMPs considered under annual rainfall are included in **Table 13**. Pollutant loading estimates are calculated in units of lbs/yr. However, when comparing subbasins using these units, the size of the subbasin has a large effect on the estimated load (i.e., one will typically see larger pollutant loads associated with larger subbasins). Therefore, in an effort to normalize the estimates, the loading rate was calculated using the subbasin tributary area (i.e., lb/ac/yr). This provides a better basis for comparison to determine where the generated loads are more concentrated. As can be seen from the table, the amount of loading (in terms of lbs/ac/yr) are comparable across all subbasins and range from 4 to 7 lbs/ac/yr for TN and 0.2 to 0.7 lbs/ac/yr for TP, with Subbasin S10-001 generating the highest estimated load of TN and TP.

Stormwater Sampling

The City currently collects water quality samples at 6 locations every other month throughout Site 10. The approximate locations of the sampling sites are shown in **Figure 17**. Water quality sampling data for nitrogen and phosphorus are provided in **Table 14** for 2003 through 2006. Based on Figure 17, Sites 2, 3, 4 and 6 are all located within the area of Site 10 that is tributary to Lake Jesup. Samples for Sites 2, 3 and 6 appear to be taken from the stormwater sub-swales that eventually discharge into a stormwater treatment pond. Flows from ponds discharge via bleeddown pipes. The sampling location at Site 4 is associated with Pond B-2. The average TN and TP values for each of the sites are also shown in Table 14. These average concentrations are much higher than the target TN and TP concentrations for Lake Jesup of 1.32 and 0.094 mg/l, respectively as identified in the *Nutrient and Unionized Ammonia TMDLs for Lake Jesup, WBIDs 2981 and 2981A* (FDEP, 2005) to achieve the TMDL for Lake Jesup.

Flow is not measured in the subswale systems on Site 10, therefore no flow data were available for the site. There are no known flooding problems on the site (i.e., areas that are inundated). Based on inspection of the 1-foot topographic contours, there are some depressional areas associated with wetlands on the site that may have the potential to become inundated. There are areas located in Subbasin S10-004, S10-006 and S10-011.

Summary and Conclusions

The results of the various loading analyses that were performed and conclusions that can be drawn from this evaluation are summarized in the following paragraphs.

Table 13
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Pollutant Load Analysis Results

Annual Pollutant Load Estimate w/o BMPs

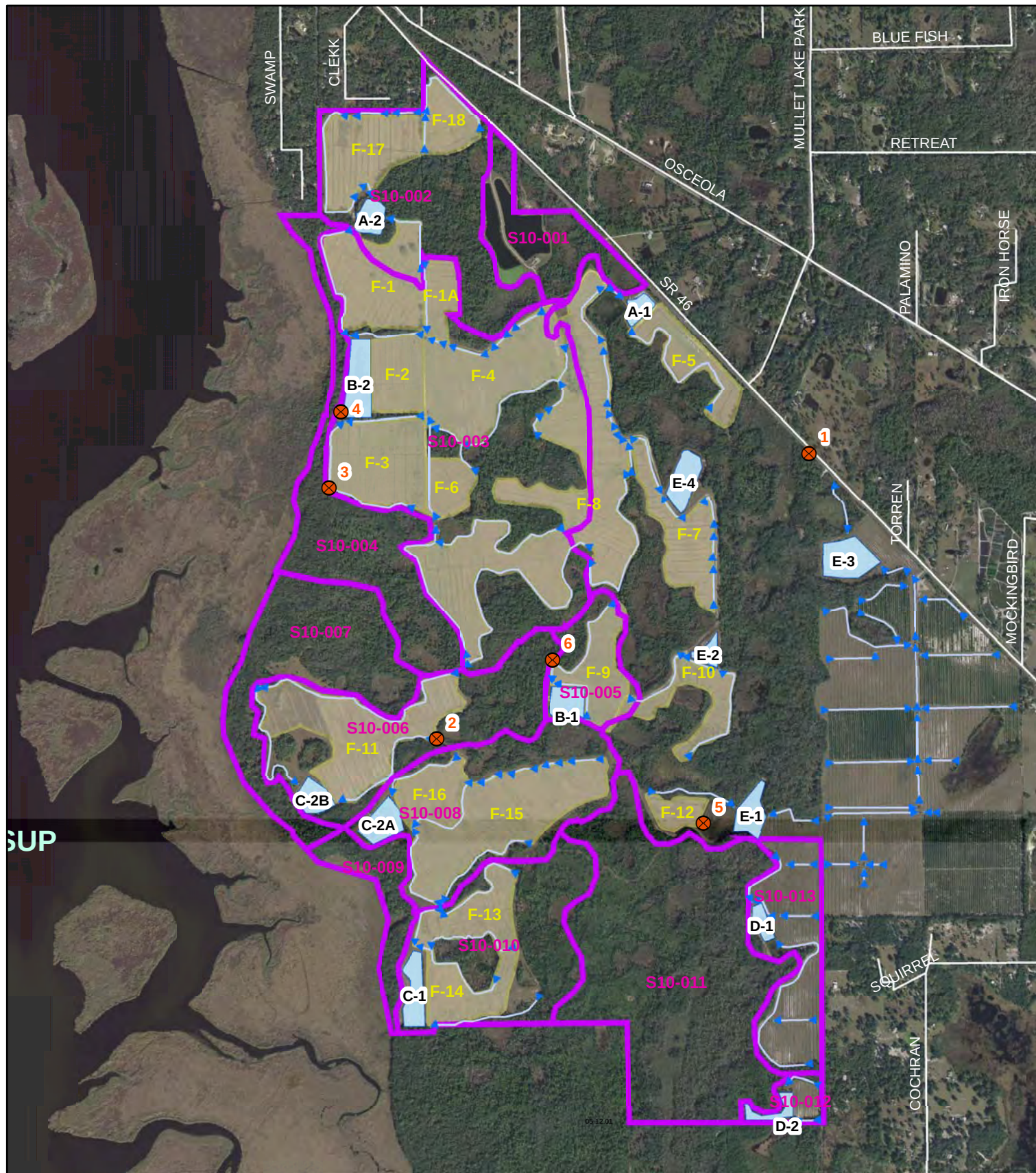
Basin Name	Drainage Area (acres)	DCIA Drainage Area (acres)	%DCIA	Flow (ac-ft/yr)	TN (lbs/yr)	TN (lbs/ac/yr)	TP (lbs/yr)	TP (lbs/ac/yr)
S10-001	39	10	26.0	64	257	7	29	0.7
S10-002	114	15	12.9	132	663	6	97	0.9
S10-003	292	23	7.9	286	1605	5	267	0.9
S10-004	80	14	18.0	107	455	6	51	0.6
S10-005	34	3	7.8	33	179	5	29	0.9
S10-006	108	13	11.6	120	615	6	92	0.9
S10-007	84	15	17.9	113	468	6	49	0.6
S10-008	110	8	7.5	106	580	5	94	0.9
S10-009	25	7	26.3	42	145	6	8	0.3
S10-010	102	8	8.1	100	454	4	54	0.5
S10-011	195	38	19.6	274	933	5	44	0.2
S10-012	15	2	12.6	17	80	5	11	0.7
S10-013	55	2	4.4	47	298	5	57	1.0

Annual Pollutant Loads w/ BMPs

Basin Name	Drainage Area (acres)	DCIA Drainage Area (acres)	%DCIA	Flow (ac-ft/yr)	TN (lbs/yr)	TN (lbs/ac/yr)	TP (lbs/yr)	TP (lbs/ac/yr)
S10-001	39	10	26.0	64	257	7	29	0.7
S10-002	114	15	12.9	132	599	5	65	0.6
S10-003	292	23	7.9	286	1355	5	142	0.5
S10-004	80	14	18.0	107	455	6	50	0.6
S10-005	34	3	7.8	33	154	5	17	0.5
S10-006	108	13	11.6	120	546	5	59	0.5
S10-007	84	15	17.9	113	468	6	49	0.6
S10-008	110	8	7.5	106	491	4	50	0.5
S10-009	25	7	26.3	42	145	6	8	0.3
S10-010	102	8	8.1	100	389	4	27	0.3
S10-011	195	38	19.6	274	933	5	44	0.2
S10-012	15	2	12.6	17	75	5	8	0.5
S10-013	55	2	4.4	47	240	4	25	0.5

Annual Pollutant Loads - Percent Reduction Due to BMPs

Basin Name	Drainage Area (acres)	DCIA Drainage Area (acres)	%DCIA	Flow (ac-ft/yr)	BOD (%)	COD (%)
S10-001	39	10	26.0	64	0.0	0.0
S10-002	114	15	12.9	132	9.7	33.1
S10-003	292	23	7.9	286	15.6	46.7
S10-004	80	14	18.0	107	0.0	0.1
S10-005	34	3	7.8	33	13.7	42.5
S10-006	108	13	11.6	120	11.3	36.3
S10-007	84	15	17.9	113	0.0	0.0
S10-008	110	8	7.5	106	15.4	47.0
S10-009	25	7	26.3	42	0.0	0.1
S10-010	102	8	8.1	100	14.4	50.8
S10-011	195	38	19.6	274	0.0	0.0
S10-012	15	2	12.6	17	6.7	24.3
S10-013	55	2	4.4	47	19.6	55.7



SUP

LOCATION MAP

LEGEND

- Surface Water Sampling Sites
- Site 10 Ponds
- Pond Inflow Direction
- Roads
- Site10 Subbasins
- Site 10 Hay Fields

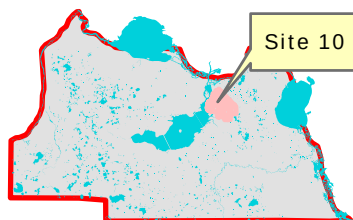
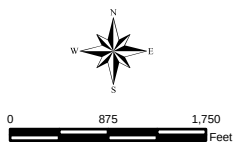


Table 14
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Surface Water Sampling Results

Station	Year	JAN		MAR		MAY		JUL		SEP		NOV	
		TP	TN	TP	TN	TP	TN	TP	TN	TP	TN	TP	TN
		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
#2	2003	0.070	2.340	0.200	5.450	Dry		0.020	1.450	0.130	2.370	Dry	
#3		1.100	2.430	0.240	3.110	0.240	1.370	0.310	2.270	0.340	3.680	0.955	0.458
#4		0.860	4.000	0.500	1.430	0.190	0.176	1.140	3.090	1.050	3.050	1.730	3.740
#6		0.130	1.610	0.150	1.840	Dry		0.450	1.750	0.190	1.850	0.772	1.480
#2	2004	Dry		Dry		Dry		0.050	2.522	0.508	2.120	Dry	
#3		1.750	7.260	0.680	1.950	1.930	5.960	0.203	3.017	1.450	2.740	0.264	2.347
#4		1.620	2.570	0.341	0.119	0.462	1.170	1.130	1.869	1.390	2.677	1.560	5.420
#6		0.354	3.430	5.140	11.900	Dry		0.248	1.589	0.218	1.630	0.104	1.660
#2	2005	Dry		Dry		Dry		0.132	2.460	0.097	1.510	0.098	2.360
#3		0.180	0.851	0.140	1.900	N/A	N/A	0.214	2.620	0.384	1.840	0.090	2.084
#4		0.670	0.938	1.490	4.200	N/A	N/A	0.854	3.304	1.510	4.340	1.240	1.650
#6		0.150	1.775	0.560	2.200	N/A	N/A	0.096	1.620	0.076	1.660	0.094	1.120
#2	2006	N/A	N/A	Dry		Dry		Dry		Dry		N/A	N/A
#3		N/A	N/A	1.200	1.900	Dry		Dry		1.200	5.111	N/A	N/A
#4		N/A	N/A	1.700	3.070	0.980	2.012	0.490	2.209	Dry		N/A	N/A
#6		N/A	N/A	Dry		Dry		2.500	1.900	Dry		N/A	N/A

N/A = Not Available

Station	Average	
	TP	TN
	mg/L	
#1	0.21	1.58
#2	0.15	2.51
#3	0.68	2.78
#4	1.05	2.55
#5	0.08	1.59
#6	0.70	2.44
Average Concentration of Stations 2,3,4 & 6	0.64	2.57
Median Concentration for Stations 2,3,4 & 6	0.35	2.10

Those stations within the Lake Jesup watershed.

Nutrient On-Site Loading

Based on actual data made available from the City and FDEP, the total average loading of TN at Site 10 due to both biosolids and reclaimed water application is 89,856 lb/yr. As actual data were not available for phosphorus, several assumptions were made to estimate the loading of this parameter as previously discussed. The total average loading of TP in the Lake Jesup Watershed due to both biosolids and reclaimed water application is estimated to be 39,948 lb/yr. It should be noted that these values do not account for plant uptake or soil absorption and those should be considered when determining the overall potential net loading to the watershed.

Groundwater Loading

The average nitrate concentration in the monitoring wells on Site 10 is 1.54 mg/l, and average nitrate mass loading to Lake Jesup is estimated to be 0.50 lb/day or 182 lbs/year. Monitoring data for phosphorus were not available as this parameter is not required to be monitored over the period of interest (i.e., 2003 through 2006).

In the *TMDL Report, Nutrient and Unionized Ammonia TMDLs for Lake Jesup, WBIDs 2981 and 2981A* (FDEP, 2005), a baseflow analysis was used to separate surface runoff from the ground water contribution. FDEP found that baseflow in the Lake Jesup Watershed is primarily from the surficial aquifer. Based on the baseflow separation analysis, about 17 percent of the total stream flow in the Lake Jesup watershed comes from baseflow. In their analysis, FDEP estimated that the annual loading of TN to the Lake Jesup watershed due to baseflow is 8.4 tons/year or 16,800 lbs/yr. Nitrate loadings were not estimated as part of FDEP's analysis. As only nitrate levels are measured in the Site 10 wells, a comparison between the nitrate loadings estimated by CDM and the TN loadings estimated by FDEP was not made.

Background concentration data for nitrate levels were available from the *1993 Annual Report for Groundwater Monitoring at Site 10 Land Application System Site, FDEP Permit Number DC59-186526, City of Sanford, Florida* (Ardaman & Associates, Inc., 1993) and are presented in **Table 15**. CDM then compared average readings for each well from 2003 through 2006 to these background concentrations, which is also shown in Table 15. Background concentration data for TP levels were also available from the 1993 report and included in the table. The City was not required to monitor the groundwater wells for TP after 1997, so there is limited information available for this parameter.

Table 15
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Groundwater Monitoring Data Comparison

Well	Average Nitrate Background Concentration (mg/l) From May 1992 through June 1993	Average Nitrate Background Concentration (mg/l) From March 2003 through September 2006	Difference (mg/l)	Average TP Background Concentration (mg/l) From May 1992 through June 1993	Average TP Background Concentration (mg/l) From 1992 through 1997	Difference (mg/l)
MW-1	0.10	0.02	-0.08	0.33	0.29	-0.04
MW-2	1.60	0.01	-1.59	0.03	0.05	0.02
MW-3	0.60	3.81	3.21	0.03	0.04	0.01
MW-4	0.14	0.01	-0.13	0.22	0.17	-0.05
MW-5	1.52	2.05	0.53	0.13	0.22	0.09
MW-6	0.17	2.77	2.60	0.03	0.04	0.01
MW-7s	4.28	9.89	5.61	0.05	0.04	-0.01
MW-8	0.07	0.04	-0.03	0.03	0.04	0.01
MW-9	0.29	0.03	-0.26	0.57	0.45	-0.12
MW-10	0.20	1.39	1.19	0.39	0.19	-0.20
MW-11	0.32	0.02	-0.30	6.54	2.97	-3.57
MW-12	0.33	0.02	-0.31	0.22	0.24	0.02
MW-13	0.38	0.02	-0.36	0.24	0.16	-0.08

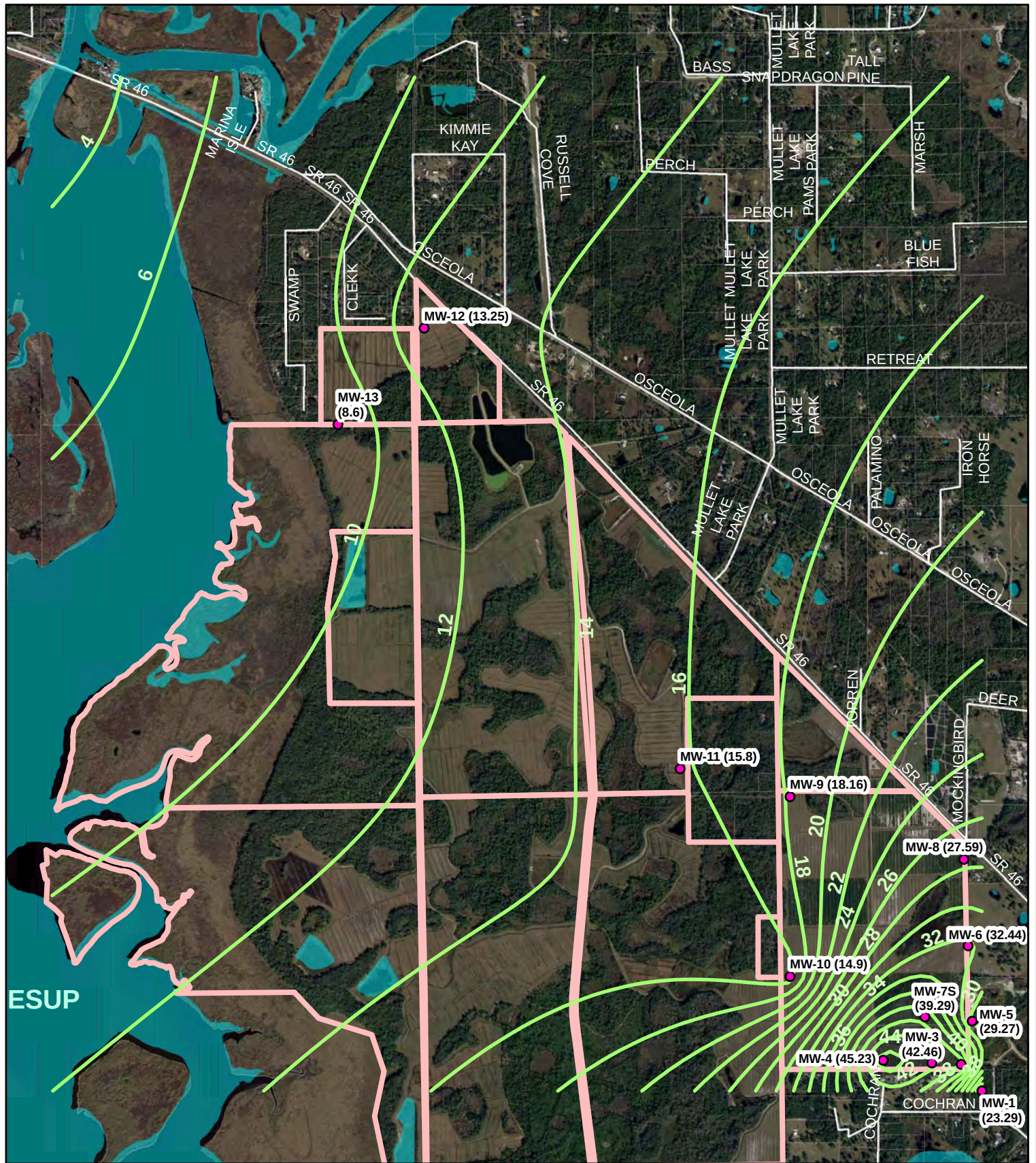
Compared to the background conditions, nitrate concentrations in several of the wells have decreased over time while levels have increased in others. Nitrate levels measured in wells MW-5 and MW-7s have consistently been significantly higher under both background as well as current conditions. Intermittent irrigation occurred in the latter half of 1993 along with fertilization of the citrus groves. Reclaimed water was applied on a regular basis starting in January 1994, which may explain the higher background concentration in these wells. Under current conditions (i.e., 2003 through 2006), wells, MW-3, MW-5, MW-6, MW-7s and MW-10 have exhibited levels significantly higher than those of other wells. For wells, MW-3, MW-5, MW-6 and MW-7s, this may be explained by the fact that in addition to reclaimed water application, the City continues to apply fertilizer to the citrus groves, which could result in higher nitrate readings. The wells closest to the lake (MW-12 and MW-13) have consistently had relatively low levels of nitrate (i.e., 0.02 mg/l) over the last few years.

As CDM has documented throughout this evaluation, a portion of the surface flow from Site 10 discharges to the northeast towards Mullet Lake and not entirely to Lake Jesup as originally thought in previous studies. CDM explored the same possibility as it relates to groundwater. Although surface water basins and groundwater basins typically do not coincide, the question was raised if all or only a portion of the groundwater encompassed by Site 10 is discharged as baseflow to Lake Jesup. In order to make this determination, a potentiometric map of the surficial aquifer contour elevations would be needed to determine if this groundwater divide exists. A detailed map showing these elevations was not available for Site 10, so CDM used the average water levels from each well to estimate the potentiometric contours for Site 10 using the contour mapping software package Surfer®. The resulting contour lines are shown in **Figure 18**. From the limited monitoring well data available, it appears that there may be a peak in groundwater levels in the southeast corner of Site 10. This is also the same area where the highest average of nitrate concentrations was reported. Based on the estimated contours, there could be a possible divide in this area where groundwater is flowing in a radial direction (i.e., a portion of it may be flowing to the west and northwest towards Lake Jesup, but it may also be flowing in other directions away from the lake). Again, this is a suggestion and additional data within and surrounding Site 10 would be needed to draw definitive conclusions regarding the groundwater flow patterns on the site.

Stormwater Loading

CDM updated the pollutant load analysis for Site 10 so that the analysis was more reflective of actual land cover and not land uses previously assigned to the site for the purposes of developing the TMDL (i.e., industrial land uses). The estimated amount of loading (in terms of lbs/ac/yr) due to stormwater runoff was comparable across all subbasins and ranged from 4 to 7 lbs/ac/yr for TN and 0.2 to 0.7 lbs/ac/yr for TP, with Subbasin S10-001 generating the highest estimated load of TN and TP. The total estimated loading for the portion of Site 10 tributary to Lake Jesup was 6,107 and 573 lbs/yr for TN and TP, respectively.

The City also performs surface water sampling at 6 locations on Site 10. Of these 6 stations, four stations are located in the Lake Jesup Watershed. As shown in Table 14, average measured TP concentrations at these 4 stations range from 0.15 to 1.05 mg/l while average TN concentrations range from 2.4 to 2.8 mg/l. These particular stations are located in either stormwater ponds or the subswales that receive runoff from agricultural areas, primarily pasture lands (i.e., hay fields). CDM compared the measured values to the typical EMC values for agricultural pasture lands. This comparison is shown below in **Table 16**.



LOCATION MAP

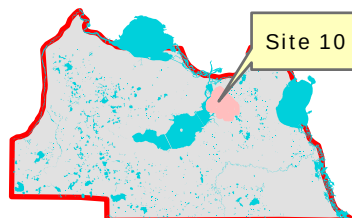
LEGEND

- Site 10 Monitoring Wells
- Estimated Potentiometric Contours (SAS)
- Sanford Owned Parcels
- Parcels
- Water Bodies
- Roads

* Average water level is shown in parentheses



0 950 1,900
Feet



City of Sanford
Wastewater Facility (Site 10) Data Evaluation

CDM

Table 16
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Surface Water Concentration Comparisons

	TP	TN
EMC (mg/l)	0.48	2.48
Range of Measured Concentration (mg/l)	0.15 to 1.05	2.4 to 2.8
Median Concentration (mg/l)	0.35	2.10
Mean Concentration (mg/l)	0.64	2.57

As shown in Table 16, the measured TN concentrations for Site 10, where both reclaimed water and biosolids are applied on a routine basis, are fairly consistent with the EMCs reported for unaffected pasture (i.e., where such activities are not occurring). The measured TP concentrations have a wider range and the EMC falls within that measured range of concentrations. The mean TP concentration is somewhat higher than the EMC, while the median concentration is lower.

Site 10 is located within the Lake Jesup sub-watershed that was identified in the *TMDL Report, Nutrient and Unionized Ammonia TMDLs for Lake Jesup, WBIDs 2981 and 2981A* (FDEP, 2005). The estimated loadings for the Lake Jesup sub-watershed presented in that report are summarized in **Table 17**. These loading were compared to the Site 10 loadings to who relative comparisons between Site 10 and the sub-watershed. CDM also contacted FDEP to request additional information regarding the original loading estimates done as part of the Lake Jesup TMDL for Site 10, which is shown in **Table 18**. This original loading estimate done by FDEP was compared to the Site 10 loadings done by CDM as part of this effort to show the difference in loadings using different methodologies.

Table 17
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Surface Loading Comparisons to the Lake Jesup Subwatershed

	Lake Jesup Subwatershed (FDEP)	Site 10 (CDM)	Percent of Total Estimated Loading
Simulated Mean TN loading¹ (tons/yr)	61.3	3.05	5.0%
Simulated Mean TP loading¹ (tons/yr)	5.1	0.29	5.7%

1. Lake Jesup Subwatershed loadings are mean loadings from 1995 – 2002.

Table 18
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Surface Loading Comparisons FDEP Predicted Loadings for Site 10

	Site 10 (FDEP)	Site 10 (CDM)	Percent of Total Estimated Loading
Simulated Mean TN loading¹ (tons/yr)	9.5	3.05	32.1%
Simulated Mean TP loading¹ (tons/yr)	0.62	0.29	47%

1. Site 10 FDEP loadings were estimated by FDEP using the Lake Jesup TMDL model. For this analysis, Site 10 loadings were not simulated for every year from 1995 through 2002. Instead, the 2001 rainfall, which was 52.7 inches and close to the long-term average 53 inches for the period from 1995 through 2002, was used to simulate the loadings.

As shown in Table 17, the current Site 10 loadings for TN and TP are estimated to be 5.0 and 5.7 percent, respectively of the total surface loadings estimated for the Lake Jesup sub-watershed. According to Table 18, the current Site 10 loading estimates are predicted to be almost one third and one half for TN and TP, respectively of the original predictions for Site 10 made by FDEP as part of the Lake Jesup TMDL.

cc: Migdalia Hernandez, P.E., City of Sanford

GROUND WATER ASSESSMENT REPORT

SITE 10

Lake Jesup Watershed, Sanford Florida

March 10, 2008

*prepared by Richard Hicks, Paul Z. Lee and Edgar Wade
Ground Water Protection Section, Bureau of Watershed Management,
Florida Department of Environmental Protection*

The FDEP Ground Water Protection Section, assisted by the FDEP Site Investigation Section, conducted an assessment during the week of December 10, 2007 to document shallow ground water conditions at the City of Sanford's Site 10 wastewater residuals and reclaimed wastewater application site. The assessment was conducted to ground truth existing nutrient concentrations and ground water flow conditions and provides current information for shallow ground water in hay field areas that drain to Lake Jesup. This information will be used to assist development of the Lake Jesup Basin Management Action Plan (BMAP).

Background

The Site 10 wastewater facility is located on 1,868 acres of land bounded on the west by Lake Jesup, on the north and east by SR 46 and on the south by the Lake Jesup Conservation Area owned by the St. Johns River Water Management District (SJRWMD). A fringe of marsh and wetland vegetation separates the site from the open water of Lake Jesup. Land cover on the site consists of wooded wetland and drainage-modified pasture and citrus groves.

The City of Sanford holds a Domestic Wastewater Facility National Pollutant Discharge Elimination System (NPDES) permit to discharge 2.84 million gallons per day (MGD) of treated wastewater to a permitted capacity slow-rate public access reuse system at the Site 10 facility. The facility includes two storage ponds (37 million gallon capacity) and a pumping station that distributes the wastewater to 620 acres of improved pasture via flood irrigation and 270 acres of citrus groves via a micro-jet irrigation system.

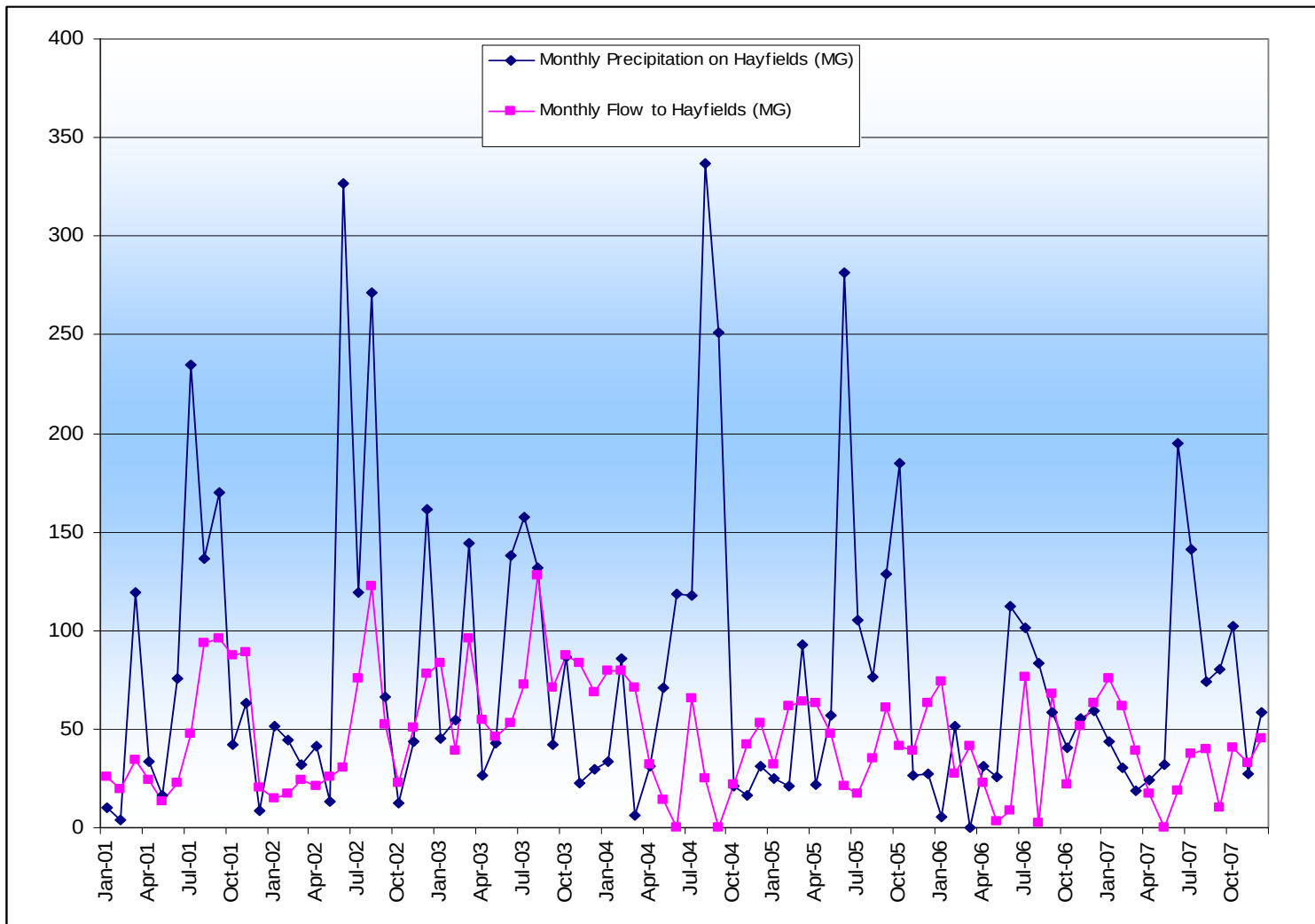
In a recent report by Camp Dresser and McKee (Danielle Honour, P. E., February 27, 2007 memorandum to Paul Moore of the City of Sanford), Camp Dresser and McKee (CDM) provided a data evaluation and simple ground water transport model to obtain an estimate of the ground water loading of nitrate from the site to the lake. While the approach taken has merit and was a good effort

based on available ground water quality data, the ground water monitoring wells available for the study were not properly located to provide ground water quality and elevation data representative of the residuals/reclaimed water application areas near the lake. These wells were installed for regulatory monitoring years before the recent CDM Site 10 analysis was conducted. Only 2 of the 13 monitoring wells available for the CDM evaluation appear to be located in areas that drain to the lake and these two wells provided results for only the northern edge of the site (per **Figures 9 and 16** in the CDM memo, which are in **Appendix A**). In addition, the CDM report did not evaluate the potential for phosphorus from the site to impact the lake via ground water discharge. Ground water quality and flow data from fields that drain to the lake were needed to refine the data set used in the CDM model.

Recent Usage of Site 10 for Reuse Water Application

The City of Sanford Wastewater Utilities Department maintains records of reclaimed water application to the hay fields and citrus groves at Site 10. Prior to the assessment, the City provided FDEP with a tabular summary of reuse water received by Site 10 and distributed to the hay fields and citrus groves. **Figure 1** is a chart that shows monthly flows to the hay fields and monthly rainfall at the site. **Table 1** provides a summary of the distribution of reuse water to the hay fields and citrus groves and precipitation for the month of December, 2007. According to the City, application of water to the hay fields is balanced against the need for water to irrigate the citrus groves on the site, which received most of the water during the fall months of 2007. Most of the hay field area is in the Lake Jesup watershed, whereas most of the citrus groves are not.

Some of the hay fields received a significant amount of reuse water during the week prior to this assessment. Field 1 received water most recently based on moisture in the ditches and the elevated water table in comparison to the other fields at the time of the assessment. Reuse water is applied via flood irrigation to major longitudinal ditches in the fields. Transverse ditches perpendicular to the longitudinal ditches disperse the water across the field so that it can be assimilated. Excess water is routed to perimeter ditches and then to adjacent stormwater ponds. There was no evidence of recent application of residuals at any of the fields that were sampled as part of this assessment.



Source: Richard Casella, City of Sanford Utilities

Figure 1 Summary of Reclaimed Water Application to Hay fields at Site 10

Table 1 Precipitation and Reclaimed Water Application Summary for Site 10 in December 2007

Date	Precipitation (in/dy) ¹	Reuse Water Flow to Site 10 Retention Pond (MGD) ²	Flow to Citrus Grove on Property (MGD) ²	Flow to Hay Fields, not differentiated (MGD) ²
1 Sat	0	3.935	0	0
2 Sun	0	2.014	0.216	0
3 Mon	0	2.128	0.2	0
4 Tue	0	1.128	0.487	0
5 Wed	0	0	0	2.417
6 Thu	0	1.081	0.138	3.918
7 Fri	0	1.175	0	3.824
8 Sat	1.4	0.971	0	1.314
9 Sun	0	1.857	0.289	0
10 Mon	0	1.39	0.683	0
11 Tue	0	1.147	0.575	0
12 Wed	0	0.602	0.615	0
13 Thu	0	1.048	0.235	0
14 Fri	0	0.343	0.134	0
15 Sat	0	1.106	0.765	0
16 Sun	1.15	2.709	0.247	0
17 Mon	0.01	3.036	0.155	0
18 Tue	0	2.253	0	1.444
19 Wed	0	2.014	0	3.591
20 Thu	0	1.799	0	3.535
21 Fri	0	2.667	0	3.502
22 Sat	0.5	1.822	0	3.446
23 Sun	0	3.162	0	3.414
24 Mon	0.02	1.602	0	3.4
25 Tue	0.06	1.316	0	3.376
26 Wed	0.16	1.341	0	3.347
27 Thu	0.02	1.141	0.382	3.362
28 Fri	0	1.548	0.479	1.119
29 Sat	0	2.083	0.469	0
30 Sun	0.15	1.992	0.482	0
31 Mon	0.02	2.295	0.487	0
Sum	3.49	52.705	7.038	45.009
Avg	0.11258065	1.70016129	0.22703226	1.45190323
Max	1.4	3.935	0.765	3.918
Min	0	0	0	0

Note: Highlighted rows represent conditions when FDEP assessment was conducted.

¹ Inches per day

² Million gallons per day

Source: Richard Casella, City of Sanford Utilities

Field Activities

This project included collection of ground water samples representative of hay fields in the western part of the site, which is in the Lake Jesup drainage basin. The fields where monitoring was performed are shown in **Figure 2**. These fields have been used for application of treated wastewater and some have received residuals. In addition, information on depth to ground water and flow gradient was obtained to estimate the ground water flow gradient across the portion of Site 10 that drains to the lake. The ground water quality and flow gradient data were collected to help better understand the potential for nutrients to migrate from the site toward the lake. The specific field activities included installation of temporary wells; ground water sampling; an elevation survey and water level measurements; and an assessment of the contribution of a potential spring or flowing well at the north end of the site. In addition to activities performed by

FDEP staff, representatives of Seminole County also collected two surface water samples from surface water streams draining from the site toward Lake Jesup. In addition to these activities, SJRWMD conducted a reconnaissance at Site 10 to search for evidence of a spring or flowing well that was postulated as a source of surface water flow in the northern part of the site.

Temporary Well Installation

A total of 13 shallow temporary monitoring wells were installed to provide ground water quality data representative of the fields shown in **Figure 2**. These small-diameter “micro” wells were installed in the hay fields in such a manner as to provide east-west coverage of ground water quality as well as provide measuring points to establish a generalized ground water flow gradient. These were installed by the FDEP Site Investigation Section’s direct-push rig. In addition to well installations, the direct-push rig was used to collect continuous core samples from four well locations (one at each field). Depths of the temporary wells ranged from 12 to 15 feet below land surface or 6 to 11 feet below the water table. Well completion depths are summarized in **Table 2**. The hay fields are numbered by the City and FDEP used the same naming convention in our assessment. Three wells each were installed in Fields 1, 3, 4 and 16. In addition, one well was installed in the eastern end of Field 2. Geologic descriptions and well completion information are provided in **Appendix B**.



Figure 2- Site 10 Sampling Locations

Ground Water Sampling

Each of the temporary wells was sampled by certified staff in accordance with FDEP sampling standard operating procedures and analyzed at the FDEP Central Laboratory. Laboratory and field parameters included the following:

- Nitrate+nitrite (as nitrogen)
- Ammonia nitrogen
- Total phosphorus
- Chloride
- Specific Conductance
- pH

The results of laboratory analyses and field screening are discussed in a following section.

Surface Water Sampling

The Seminole County Water Quality Section collected two surface water samples from Site 10 on December 13, 2007. These were collected from the outfall streams from two stormwater ponds that receive overflow from hay fields (“Jes E” and “Jes H” on **Figure 2**). The surface water sampling results are discussed in a following section.

Elevation Survey and Water Level Measurement

This assessment included an elevation survey and water level measurements to estimate a ground water flow direction and gradient across each of the hay fields being monitored. The elevation survey was conducted using standard leveling techniques, tying-in the top-of-casing elevations of the wells in each field. Water levels were then measured and converted to elevations to establish the ground water flow gradient between wells in each field, giving a generalized gradient across the site that can be used for modeling purposes. Approximate well locations were established using global positioning system equipment.

Investigation of Artesian Well/Spring Flow

The CDM Site 10 analysis identified the possibility of an artesian well or spring located on the site near Pond A-2. A representative of the St. Johns River Water Management District conducted an investigation on June 20, 2007 to look for the possibility of an uncapped artesian well or spring on the site (Curtis, 2007). At the time of the inspection, rainfall levels were very low and the site was atypically dry and there was no flow coming from the area suspected as being the source of the spring or flowing well. The standing water (and vicinity) did not exhibit obvious movement, sand boils or sulfur reducing (white) filamentous bacteria which is often associated with flow from the Floridan aquifer. No conclusive evidence of Floridan aquifer springs or flowing artesian wells was observed. The standing water exhibited some tannin discoloration consistent with surface water

seepage and runoff. If a point location of water discharge such as a trickling rivulet or sand boil is observed at some point in the future, SJRWMD will be available to return to the site for additional investigation.

Findings

Site Geology and Ground Water Flow

Most of Site 10 is a mosaic of drained pasture and wooded wetlands. Natural soils in the area are mainly spodosols, which have a sandy surface horizon and a spodic or organic horizon at a depth of approximately 2 feet or less. Two core samples from each of the fields that were collected in this assessment were reflective of native soil conditions in some areas, but cores at two other locations (F4-MW1 and F1MW1, **Figure 2**) contained highly organic material from ground surface to depths of up to several feet. Based on their location and odor, these may be locations where residuals were applied and incorporated into the soil. Below the soil zone, cores representative of the four fields contained interbedded layers of sand, clayey sand and clay. The clay content and depth of clay layers were observed to vary from site to site but in general, clay content appeared to increase with depth. Monitoring wells in this assessment were set in the sandy material which represents the surficial aquifer.

According to the CDM report, the surficial aquifer extends up to 25 feet in thickness and the lithologies encountered in this assessment agree with CDM's findings. CDM also reported that an intermediate confining unit, composed of clayey material, was encountered from 8 to 25 feet below land surface (BLS) in the southeastern part of the site. For their conceptual model, CDM chose a surficial-aquifer thickness of 25 feet, which is conservative and would perhaps lend toward a higher estimate of flow and loading in the calculation. FDEP did not encounter a distinct confining unit, but as mentioned above, there was a gradational increase in clay content with depth. CDM estimated a ground water hydraulic conductivity (permeability) of 3.5 feet per day (ft/day) for the surficial aquifer, which is reasonable and perhaps somewhat high for the interbedded sand and clayey sand of the surficial aquifer at this site.

During this assessment, depth to ground water varied between sites, from a high of 0.9 feet BLS at Field 1 to a low of 5.9 feet BLS at Field 4. The ground water gradients (slope) beneath all four sites are generally toward the lake or to the nearest stormwater pond that drains to the lake, which generally agreed with topographic slope and the flow directions in the ditch networks that carries excess water to the nearby stormwater ponds. **Tables 2 and 3** provide the depths to ground water and elevation data and the estimated ground water gradients based on the elevations from this assessment. Contour maps for the four fields are provided as **Figures 2 through 5**. The overall gradient and flow direction across the hay fields that were derived by FDEP are similar to the

potentiometric surface contours estimated by CDM for the hay field portion of the site (Figure 18 in CDM report, in **Appendix A**).

Table 2 Ground Water Elevation Data Summary for December 13, 2007

Field/Well	Total Depth (feet)	Depth to Ground Water (feet below land surface)	Depth to Ground Water (feet below well casing)	Well Casing Elevation (feet) ¹	Ground Water Elevation (feet) ¹
Field 1					
F-1-MW1	12	0.9	4.17	20.00	15.83
F-1-MW2	12	1.7	4.89	19.76	14.87
F-1-MW3	12	1.7	5.03	20.17	15.14
Field 3					
F-3-MW1	15	4.4	6.87	20.00	13.13
F-3-MW2	15	4.4	7.32	18.27	10.95
F-3-MW3	15	5.1	7.99	21.03	13.04
Fields 4 and 2					
F-4-MW1	12	4.9	8.10	20.00	11.90
F-4-MW2	12	3.2	6.39	19.99	13.6
F-4-MW3	12	5.9	8.91	19.75	10.84
F-2-MW1	12	4.7	7.87	18.56	10.69
Field 16					
F-16-MW1	12	5.4	8.52	20.00	11.48
F-16-MW2	12	3.7	6.90	20.07	13.17
F-16-MW3	12	3.8	7.08	21.24	14.16

Notes:

¹Top of casing and ground water elevations are in feet relative to an arbitrary elevation established at MW1 for each field. Elevations between fields are not comparable.

Table 3 Estimated Ground Water Gradients for Site 10 fields.

Field	Gradient (foot/foot)	Direction
Field 1	0.0019	NW
Field 3	0.0035	W
Field 4	0.0027	W-SW
Field 16	0.0048	SW
Average Gradient	0.0032	W

Note: Gradients based on ground water elevation data for December 13, 2007.



Figure 3 – Ground water contour map for Field 1, December 13, 2007.

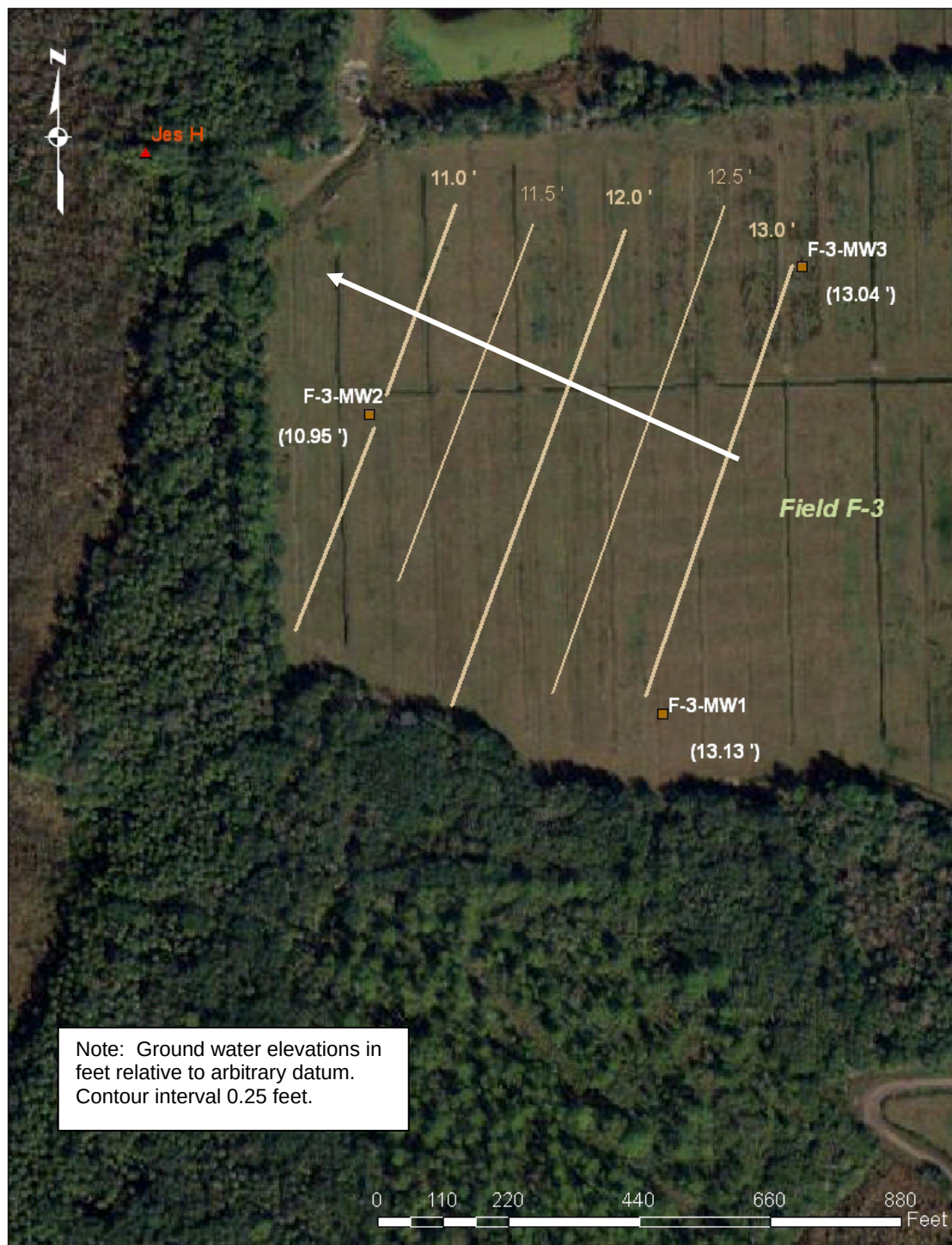


Figure 3 – Ground water contour map for Field 3, December 13, 2007.

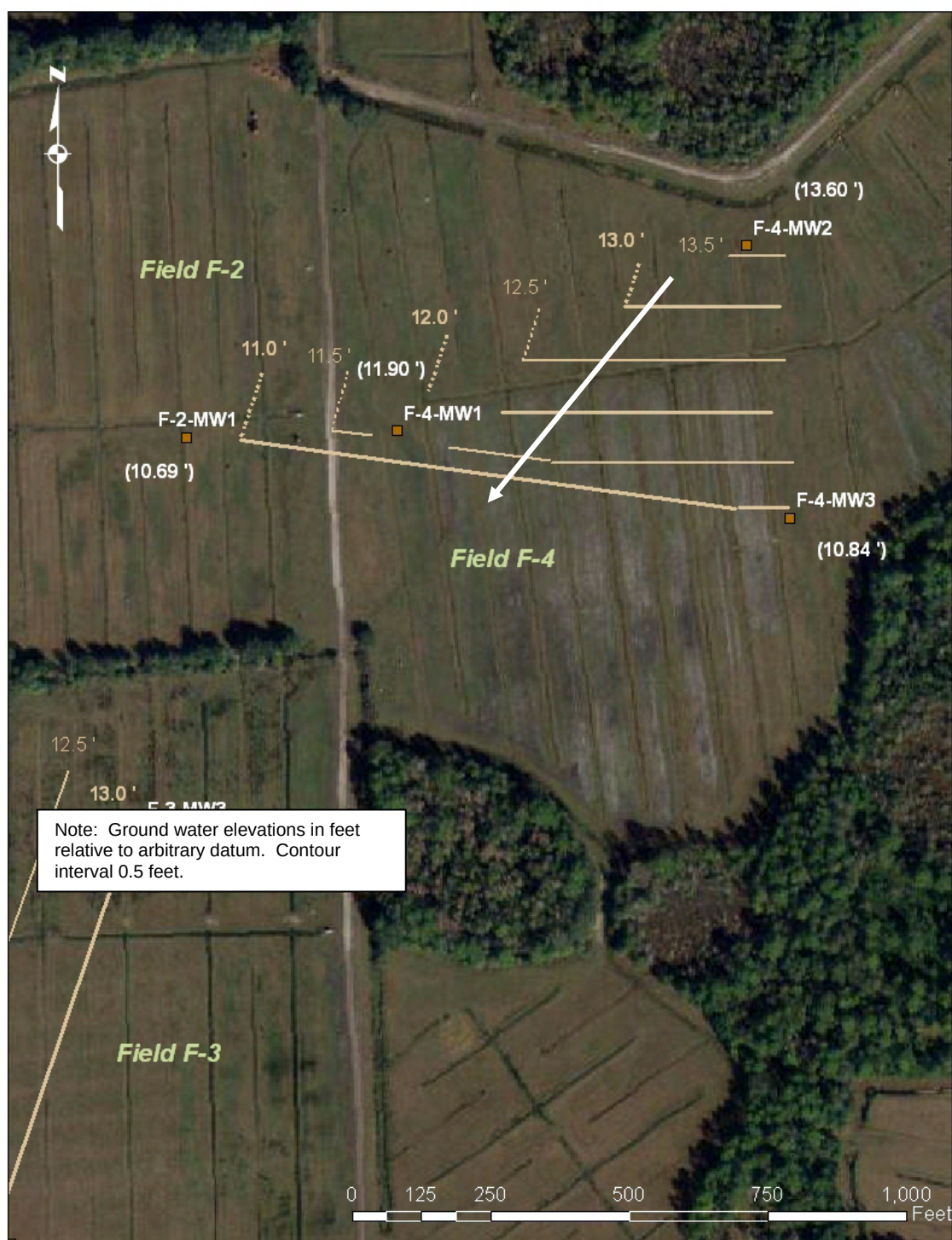


Figure 5 – Ground water contour map for Field 4, December 13, 2007.



Figure 6 – Ground water contour map for Field 16, December 13, 2007.

Ground Water Quality

Water quality samples were collected from the monitoring wells for nutrients (nitrate+nitrite, ammonia, and phosphorus) and chloride. The laboratory results as well as field parameters are presented in **Table 4**.

Table 4 Ground Water Quality Data

Field/Sample	Nitrite+Nitrate as N	Ammonia and N	Total Phosphorus	Chloride	Specific Conductance	pH
Field 1						
F-1-MW1	0.024	25	0.36	400	1754	5.65
F-1-MW1(F) ¹	0.022	26	0.15	410	1754	5.65
F-1-MW2	0.012	0.33	0.15	130	966	6.77
F-1-MW3	0.008	0.19	0.52	250	1428	7.55
Field 3						
F-3-MW1	0.053	0.11	0.88	77	551	6.76
F-3-MW2	0.053	0.54	0.78	170	735	5.18
F-3-MW2(F) ¹	0.049 I	0.6	0.17	180	735	5.18
F-3-MW3	0.075	0.36	0.23	1200	4151	6.54
F-3-MW3 duplicate	0.074	0.37	0.27	1200	4151	6.54
Fields 4 and 2						
F-4-MW1	0.078	1.6	0.37	440	3238	6.37
F-4-MW2	0.074	0.34	0.14	1300	4856	6.92
F-4-MW3	0.028	0.68	0.2	2100	6975	6.63
F-2-MW1	0.032 I	0.23	0.17	210	1768	7.67
Field 16						
F-16-MW1	0.033	1.1	0.76	94	614	6.04
F-16-MW2	0.02	4	0.16	810	3569	6.52
F-16-MW3	0.1 I	0.27	5.3	65	486	6.72
F-16-MW3(F) ¹	0.039 I	0.22	0.038 I	66	486	6.72
Median for All Fields³	0.033	1.1	0.76	94	614	6.04
Historical Median for Lake Jesup²	0.008	0.025	0.148	170	802	8.79

Notes: All analyte concentrations in milligrams per liter except specific conductance (micromhos per centimeter) and pH (standard units)

¹ Filtered replicate sample.

² Data obtained from Impaired Waters Rule 2007 dataset used for run 28.1.

³ Excluding filtered samples and duplicates

I - the reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.

Nitrate+nitrite, ammonia and phosphorus were the key nutrients evaluated because of their potential to exist in ground water beneath the site and adversely affect the lake. Chloride was evaluated as a potential indicator of wastewater.

This assessment shows that nitrate+nitrite concentrations (generally equivalent to nitrate alone due to the minor contribution of nitrite) are low in the wells monitoring the four hay fields, with a median concentration of 0.033 milligrams per liter (mg/L). These findings are similar to 2003-2006 nitrate concentrations in the City of Sanford hay field wells (MWC-11, MWC-12 and MWC-13 in the CDM

report, Table 7 in **Appendix A**). The median background concentration for nitrate+nitrite in the surficial aquifer in Seminole County is 0.017 mg/L (from FDEP Oracle-based Ground Water Information System [OGWIS] water quality database). Nitrate is the most stable and most mobile form of nitrogen in ground water and it migrates at the same rate as ground water.

Ammonia was detected in one well in Field 1, which was most recently flooded, at a concentration of 25 mg/L (**Table 4**). In addition to the elevated level in Field 1, two other fields (Fields 4 and 16) had ammonia detections above 1 mg/L. These exist as not-unexpected artifacts of the wastewater application and/or waste from the cattle that are pastured on site if the water table is high, particularly when the fields are intermittently flooded (efficient mineralization of ammonia to nitrite and nitrate depends on aerobic conditions). The median background concentration for ammonia in the surficial aquifer of Seminole County is 0.092 mg/L (from OGWIS database), which is considerably lower than the median ammonia concentration for the four fields, 0.37 mg/L.

Total phosphorus concentrations ranged from non-detect to as high as 5.3 mg/L, with a median for the four hay fields of 0.76 mg/L (**Table 4**). Total phosphorus includes both dissolved and suspended concentrations of phosphorus. To evaluate the suspended versus dissolved concentrations of phosphorus, replicate samples from three of the wells were analyzed for dissolved (filtered) phosphorus. Filtered samples were many times to several times lower than their unfiltered replicates and the median dissolved phosphorus concentration was 0.15 mg/L for the three filtered samples. Historically, phosphorus was included as a ground water monitoring parameter at Site 10, but monitoring for phosphorus was removed from the permit in 1997 (CDM report). The historical average phosphorus concentrations in Seminole County wells MWC-11, MWC-12 and MWC-13 for 1992-1997, are 2.97, 0.24 and 0.16 mg/L, respectively, which are similar to the concentrations detected in this assessment. Median background total and dissolved phosphorus concentrations in the surficial aquifer of Seminole County are 0.3 and 0.18 mg/L, respectively (from OGWIS database).

Chloride is a typical constituent of wastewater and it was found at elevated concentrations in most of the wells. Across the site, concentrations ranged from 77 to 2,100 mg/L, with a median for all wells of 250 mg/L. According to Watts (1989), 100 mg/L is a typical chloride concentration for secondarily treated municipal wastewater. Several of the concentrations in wells at this site exceed that concentration by an order of magnitude. Therefore another source for elevated chloride must be considered. Publications and personal communications (Barraclough, 1962; Spechler and Halford, 2001; Toth and Boniol email communication, 2008) on the condition of the surficial aquifer in this part of Seminole County have indicated that ground water in the Site 10 vicinity has naturally elevated chloride concentrations. Lake Jesup is documented as a discharge area for the Floridan aquifer, which is highly brackish (chloride concentrations 1,000-15,000 mg/L) in an area that includes the northern part of

Lake Jesup and a larger area to the southeast (Boniol, 2008). Upward seepage of high-chloride water from the upper Floridan aquifer in this area is a well-known local phenomenon and is apparent in the elevated chloride concentrations in the lake. The historical median chloride concentration in Lake Jesup is 170 mg/L, 3 times higher than the statewide median for lakes (56.3 mg/L, in FDEP, 2004). Points where chloride is highest could be those where the intermediate confining unit is less competent and upwelling from the Floridan is greater. The top of the Floridan aquifer is at an elevation of -50 feet (Spechler and Halford, 2001) or approximately 65 feet below land surface at the site, but its potentiometric surface is at an elevation of approximately +20 feet (Kinnaman, 2005). The head difference between the surficial and Floridan aquifers and the permeability and thickness of clay between the surficial aquifer and the Floridan would dictate the rate of seepage.

Surface Water Quality

Seminole County's surface water results for samples collected at and near Site 10 are summarized in **Table 5**. The two sampling stations on Site 10 are at very small discharges from culverts at the outfall ends of stormwater ponds. Station JES E is downgradient of pond A-2, which would receive excess water from Fields 1 and 14. Station JES H is downgradient of Pond B-2, which would receive drainage from Fields 2, 3 and 4. At the time of sampling, both ponds contained some water but there was not enough water in the ponds to overflow. The similarity between specific conductance and pH values for these two stream samples and the shallow ground water samples suggests that the water from the streams is primarily from ground water seepage. Total phosphorus was high in both of the two onsite surface water samples collected in December 2007, an order of magnitude higher than the median for Lake Jesup. Phosphorus concentrations in the two outfall samples were also considerably higher than the ground water concentrations beneath the hay fields. Total nitrogen and total Kjeldahl nitrogen concentrations in the two samples were slightly lower than the median for Lake Jesup and similar to the previous surface water samples (**Table 5**). Fecal coliform counts from the two onsite samples were elevated, particularly in the sample from JES E and these could be possibly due to the cattle grazing. Ground water samples collected in this assessment were not analyzed for total nitrogen, TKN or fecal coliform, so these results could not be compared.

Table 5 Seminole County's Surface Water Sample Results from Site 10 Vicinity.

Sample Site	Un-ionized Ammonia (mg/L)	Color (CU)	Total Kjeldahl Nitrogen (mg/L)	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Chlorophyll-A (mg/L)	Fecal Coliform CFU/100mL	Conductivity (uMhos/cm)	Total Dissolved Solids (g/L)	Water Temperature (°C)	pH (std units)	Dissolved Oxygen (mg/L)	Turbidity (NTU)
November 13, 2006													
JES-A	0.009	66	4.0	4.0	0.16	0.0930	40	889	0.576	20.65	8.16	0.88	12.1
JES-C	0.015	56	1.3	1.7	0.98	0.0013	4000			20.00	7.78		
JES-E	0.009	210	2.4	2.5	1.50	0.0040	13000	1323	0.860	17.74	7.35	8.16	8.3
JES-H	0.009	76	1.7	1.8	0.32	0.0044	270	3653	2.375	19.02	7.34	6.34	4.5
JES-J	0.009	150	1.9	1.9	0.12	0.0230	34	525	0.341	18.35	6.40	0.96	13.3
December 13, 2007													
JES-E	0.009	250	2.1	2.1	1.20	0.0110	3500	1784	1.161	18.64	6.79	7.21	15.50
JES-H	0.009	84	1.4	1.4	2.60	0.0100	350	2075	1.349	19.23	6.85	4.63	0.00
Historical Median for Lake Jesup¹	0.004	80	2.4	2.4	0.148	54.4	5.5	802	NA	24.09	8.79	9.22	11

Notes:

JES-A=main canal of Orange Boat Club boat ramp just west of SR417

JES-C=small agricultural ditch immediately east of Black Hammock Fish Camp boat ramp

JES-E=outfall tributary from large concrete weir at edge of Site 10 property

JES-H=outfall tributary from fields of Site 10, sample taken within wetland area under canopy

JES-J=at end of environmental studies center boardwalk just north of Soldiers Creek

Locations of all sites are shown in **Appendix C**.

mg/L=milligrams per liter

CU=color units

CFU/100 ml= colonies per 100 milliliters of sample

Umhos/cm=micromhos per centimeter

°C=degrees Celsius

NTU=nephelometric turbidity units

¹ Data obtained from Impaired Waters Rule run 2007-28.1.

Data provided by Shannon Wetzel, Seminole County.

Ground Water Loading of Nutrients

Nitrogen

A main purpose of this assessment was to provide ground water quality and flow information that can be used to fill data gaps and help calibrate CDM's ground water transport model for predicting nitrate loadings of ground water to Lake Jesup from Site 10. In this assessment, FDEP provided the ground water gradient information and nitrate concentrations in the shallow ground water beneath hay fields representative of the area that drains to Lake Jesup, which was not available for use in the CDM model.

The CDM model was partly based on monitoring wells installed in the citrus groves in the southeastern part of Site 10 and there was initial concern that many of these wells were actually in an area that does not drain to Lake Jesup. Because of that, the ground water gradient and nitrate loading developed from them may not have been representative of the part of the site inside the Lake Jesup drainage basin. This assessment was conducted to evaluate the ground water flow gradient and ground water quality inputs from the hay fields in the Lake Jesup Basin, adjacent to the lake.

The ground water gradients calculated for the 12 FDEP monitoring wells in the hay field area (representative of December 2007) ranged between 0.0048 in Field 16 to 0.0019 in Field 1, with an average of 0.0032. In comparison, CDM calculated linear gradients between individual monitoring wells and the lake calculated that were between 0.0015 and 0.0046, with an average of 0.0030 (Table 10 in **Appendix A**). These "long range measured gradients" are very consistent with the hay field-specific results that were calculated from the December 2007 FDEP data.

The December 2007 nitrate concentrations measured in the 12 shallow ground water locations in the hay fields were actually considerably lower than the concentration used for the CDM model, which was based on nitrate levels from wells mainly in the citrus grove area. The median nitrate concentration for the FDEP hay field wells was 0.033 mg/L in comparison to the 1.54 mg/L used for the model. The citrus groves are fertilized and the higher nitrate concentrations in the grove monitoring wells are most likely due to the fertilizer.

Based on these findings, any modeling scenario that would use the nitrate concentrations representative of the December 2007 data and a similar gradient or flow rate would produce very low loadings of nitrate to the lake via ground water. The calculation by CDM that was based on the higher nitrate concentration produced an estimated loading of 0.50 lbs/day (182 lbs/year) (estimated value in Table 10, **Appendix A**), is orders of magnitude higher than one based on a nitrate concentration of 0.033 mg/L. Under the conditions

observed in the December 2007 sampling, nitrate loading via ground water would be insignificant. FDEP used the median nitrate+nitrite concentration from the December 2007 sampling and CDM's rough estimate of ground water flow of 5173.7 cubic feet per day (ft³/day) to roughly estimate the potential nitrate loading based on hay field representative values. This calculation is shown in **Table 5**. The potential loading of nitrate is only 3.85 lb/year.

Table 5 Calculation of Potential Nutrient Loads to Lake Jesup via Ground Water Discharge

Nutrient	Median Concentration (mg/L)	Flow (ft ³ /day) ¹	Potential Load to Lake Jesup (lb/year)
Nitrate+nitrite	0.033	5173.07	3.85
Ammonia	1.1	5173.07	129.66
Phosphorus	0.76	5173.07	89.43

Notes:

Basic calculation is Concentration X Flow = Load

Conversion factors for units-

1 mg = 2.205 x 10⁻⁶ lb

1 L = 0.035 ft³

1 year = 365 days

¹-Flow was obtained from CDM report and derived from an aquifer thickness of 25 feet, a hydraulic conductivity of 3.5 feet per day, a gradient of 0.0030, and a flow path width of 12,000 feet (representing the western boundary of the site).

Nitrate is the form of nitrogen that is most stable and moves most readily in ground water. However, this assessment found that, in comparison to nitrate, ammonia is in significantly higher concentrations in the ground water beneath the hay fields and it must be considered as a nutrient source to the lake. U. S. Geological Survey monitoring and modeling of the transport and fate of ammonia in ground water found that ammonia migrated at a somewhat slower rate than ground water but was stable as long as it remained under anaerobic conditions (Böhlke et al, 2006). If the median ammonia concentration from the December 2007 sampling is used (1.1 mg/L) and retardation was not taken into account in the flow rate developed by CDM, the potential nitrogen loading via ammonia could be as high as 129.66 lb/year (**Table 5**).

Phosphorus

CDM did not calculate phosphorus loadings from Site 10 to the lake via ground water because they did not have recent phosphorus data for ground water at the site. Modeling phosphorus transport in ground water is much more complicated than modeling the transport of nitrate due to the difference between chemical behaviors of the two nitrogen forms. Nitrate is conservative, migrates with ground water in a dissolved state and is less susceptible to attenuation by the

aquifer media. Phosphorus on the other hand exists in both the solid and dissolved state, and is readily adsorbed to iron and aluminum oxides and organics. Also, phosphorus is not always a pollutant and a portion of the phosphorus in the ground water at this site is very likely from the aquifer matrix. Regardless of source, total phosphorus concentrations in the shallow ground water beneath the hay fields were much higher than the historical median concentration for Lake Jesup (0.148 mg/L) and almost five times the restoration target concentration selected for the Lake Jesup TMDL (0.073 mg/L, in Gao, 2005). The difference between the phosphorus concentrations in the ground water at the site and the lake make it important to understand its potential for impacting the lake.

The median total phosphorus concentration for the 12 hay field wells was 0.76 mg/L and the median concentration for the three dissolved phosphorus replicate samples was 0.15 mg/L. The dissolved phase samples are technically more representative of the ground water because phosphorus can also be detected in the suspended sediment and colloidal material in the samples. However, colloidal phosphorus can also be transported with ground water. The retardation and adsorption of phosphorus migrating in the aquifer is a function of its capacity to be adsorbed to iron and aluminum oxides in the matrix or to organic material. When phosphorus is present at high concentrations in the ground water, it is more likely to be mobile (Walter, et al., 1999).

Discounting the potential for attenuation along its pathway, assuming a median total phosphorus concentration of 0.76 mg/L and using the average volumetric flow from the CDM report, a highly conservative (assuming no retardation by the aquifer material) potential loading of phosphorus via ground water would be 89.43 lbs/year (**Table 5**).

Conclusions

The December 2007 ground water assessment provided information related to the potential ground water contribution to nutrient enrichment of Lake Jesup under conditions similar to this measured on that date. The following conclusions are offered.

- The hydrogeologic data used by CDM for the simplified ground water flow and transport model are valid and loads calculated using this methodology are conservative.
- This site was evaluated under near-optimum conditions for nutrient attenuation and maintenance of discharged water. The December 2007 assessment was preceded by several months of below-average rainfall, and use of the site for reclaimed water application was lower than normal. Under different conditions, ground water discharge and nutrient loading could be different than what is represented by the data from this assessment.

- Nitrate does not appear to be an issue at this site. Nitrate+nitrite concentrations beneath the hay fields that were monitored were all very low, including Field 1 which had received reclaimed water a few days prior to the assessment.
- Chloride concentrations in the shallow ground water samples from beneath the hay fields were high, but according to SJRWMD and other sources of information chloride is naturally elevated in this area and high concentrations of chloride cannot be linked to reclaimed water application at the site.
- Ammonia is the form of nitrogen that was found at highest concentrations in the ground water beneath the site. In general, these concentrations are not high, but they are significantly higher than regional background concentrations. It is expected that ammonia would be attenuated to some extent as it migrates from the site and that it would most likely migrate at a slower rate than nitrate. More assessment work would be needed to provide an accurate characterization of ammonia loading, but a conservative estimate {considering no retardation or attenuation} would be 126.66 lb/year.
- Phosphorus is the nutrient of greatest concern for Lake Jesup restoration and was elevated in the shallow ground water samples from beneath the hay fields (0.76 mg/L median) and several times higher in the on-site stream samples collected by Seminole County (up to 2.60 mg/L). These concentrations may also include some naturally-occurring phosphorus, based on regional background data. Phosphorus is readily adsorbed to iron and aluminum oxides, but can still migrate from the site via ground water transport under certain conditions. A conservative loading of 89.43 lb/year was estimated for phosphorus loading to ground water.
- Site 10 is a potentially significant source of phosphorus inputs into the lake. However, of the potential pathways that exist for phosphorus transfer from the site to the lake, surface water discharge related to storm events is considered the most significant. Estimates of surface runoff total phosphorus load are in the range of 1,000 to 1,300 lbs/year (Gihring, FDEP, pers. comm., February 2008). Ground water total phosphorus loading was estimated as 89.43 lbs/year in this study. Although this ground water loading is not negligible, restoration efforts at Site 10 should first focus on managing surface water runoff from storm events as a higher priority. Some of the management action to address stormwater loading will also reduce nutrient loading via ground water.

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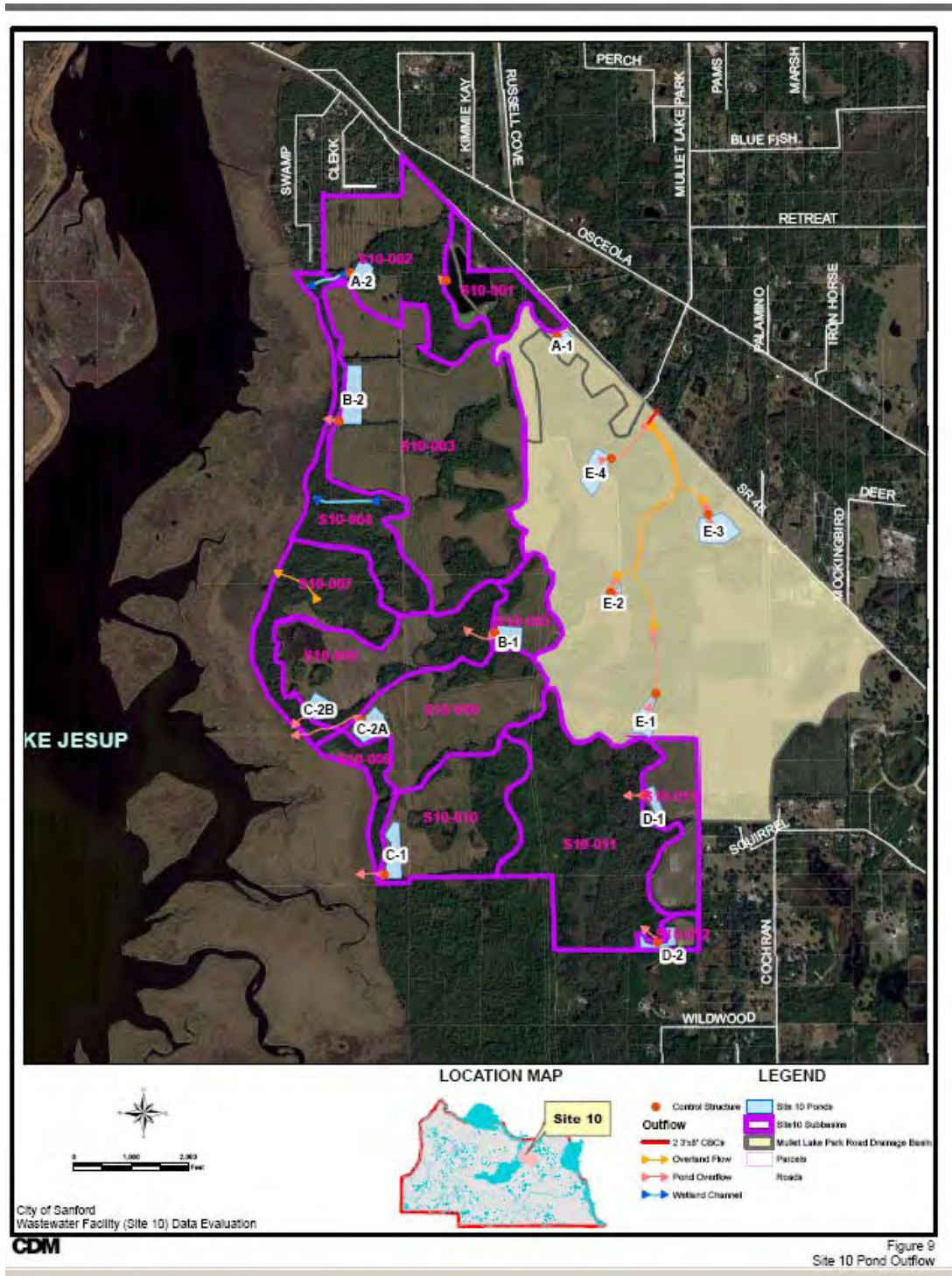
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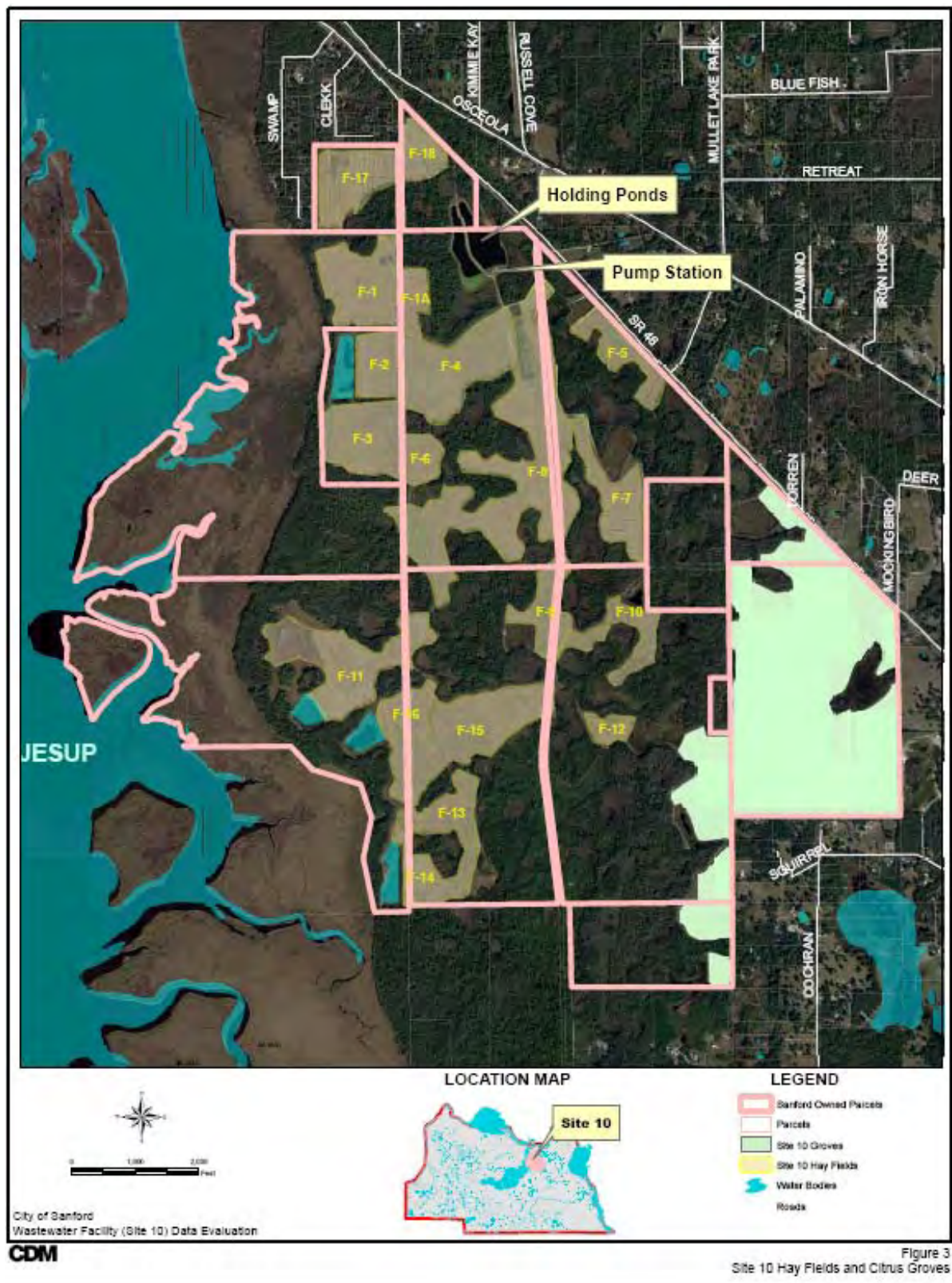
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Appendix A – Excerpted Figures and Tables from CDM Memo



CDM Memo, Figure 9



CDM memo, Figure 3

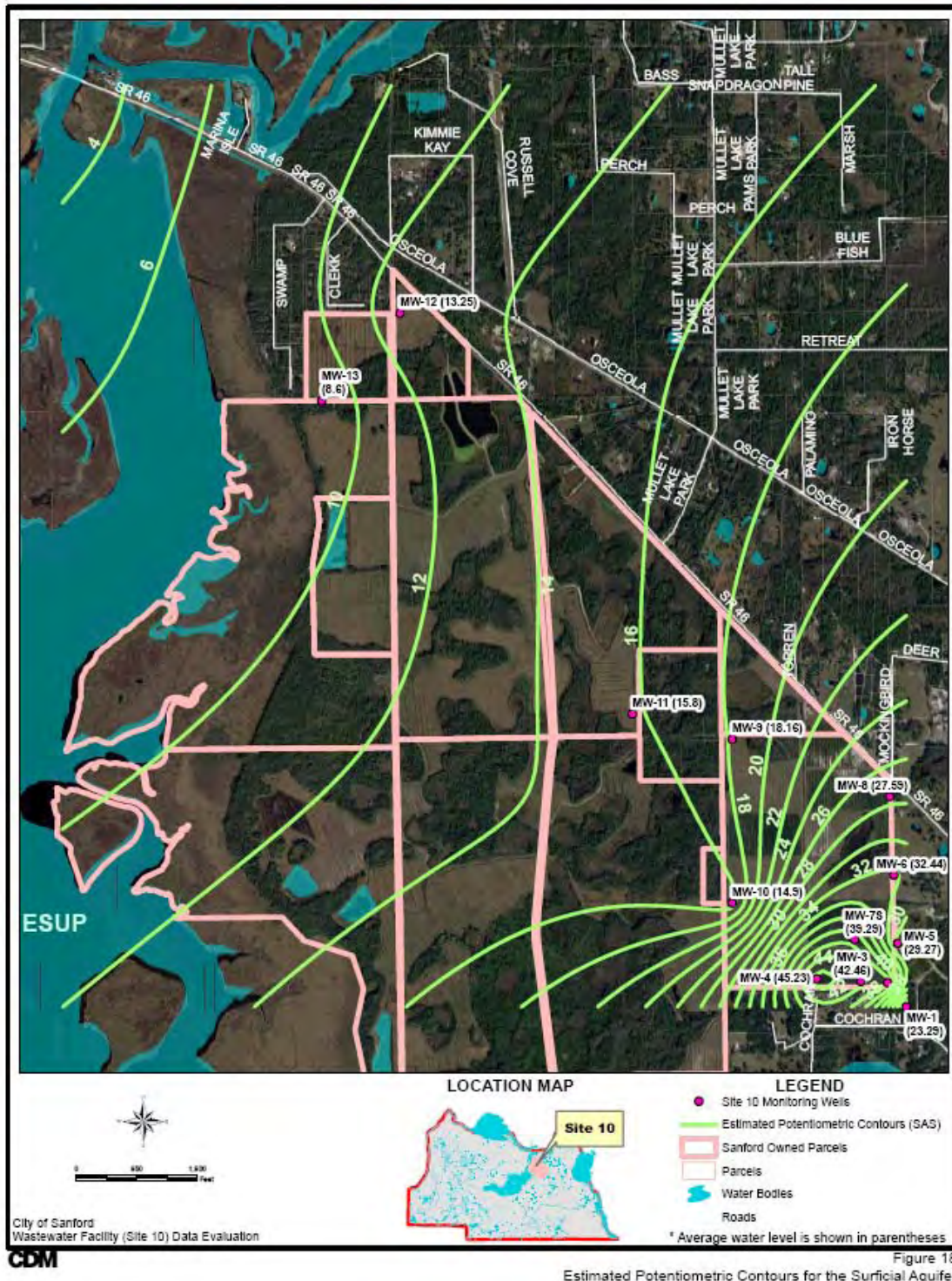


Figure 18
Estimated Potentiometric Contours for the Surficial Aquifer

CDM memo, Figure 18

CDM report, Table 7

Table 7
Sanford Wastewater Facility (Site 10) Data Evaluation
Monitoring Well Data

Facility MW Name	Permit Builder MW ID	MWAFR ID/#	Total Phosphorus mg/L (Average 1992-97)*	31-Mar-03		30-Jun-03		30-Sep-03		31-Dec-03		31-Mar-04		30-Jun-04		30-Sep-04		31-Dec-04	
				Water Level Relative to ft- NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l
SITE 10																			
MW-1	MWB-1 Site 10	6778	0.29	24.99	<0.02	24.1	<0.02	25.45	<0.02	24.57	<0.02	23.63	<0.003	22.6	0.08	22.48	<0.003	24.63	<0.003
MW-2	MWC-2 Site 10	6777	0.05	41.83	0.02	41.02	<0.02	41.42	<0.02	40.16	<0.02	38.87	<0.003	37.97	0.01	41.3	<0.003	40.66	0.006
MW-3	MWC-3 Site 10	6776	0.04	44.22	0.11	43.4	0.04	43.78	0.34	42.43	0.05	41.11	9.7	40.24	6.4	43.86	1.48	43.28	2.82
MW-4	MWC-4 Site 10	6775	0.17	42.64	<0.02	43.89	<0.02	44.29	<0.02	43.11	<0.02	42.01	<0.003	41.83	0.004	45.77	<0.003	44.69	0.014
MW-5	MWC-5 Site 10	6774	0.22	30.07	10	28.99	8.42	29.64	0.49	27.63	1.36	26.19	0.21	25.69	0.22	29.87	1.78	29.11	0.008
MW-6	MWC-6 Site 10	6773	0.04	33.72	6.58	33.86	4.29	33.48	2.24	32.76	<0.02	32.14	<0.003	31.22	<0.003	33.87	<0.003	33.26	6.34
MW-7s	MWC-7 Site 10	6772	0.04	39.5	8.94	39.08	14.8	39.76	8.2	38.35	7.9	37.27	9.6	38.17	9.8	46.87	11.2	39.53	13.2
MW-8	MWC-8 Site 10	6771	0.04	27.53	0.02	27.79	0.27	27.63	0.04	26.94	<0.02	26.33	<0.003	25.65	<0.003	28.25	<0.003	29.08	<0.003
MW-9	MWC-9 Site 10	6770	0.45	18.65	<0.02	18.16	0.26	17.03	0.05	16.6	<0.02	15.89	<0.003	14.87	<0.003	14.52	<0.003	17.22	<0.003
MW-10	MWC-10 Site 10	6769	0.19	20.99	<0.02	20.23	0.04	0.05	20.51	19.6	<0.02	20.22	0.03	18.31	<0.003	21.04	<0.003	20.15	<0.003
MW-11	MWC-11 Site 10	6768	2.97	16.53	0.04	15.8	<0.02	16.02	0.09	15.02	<0.02	14.87	<0.003	13.79	<0.003	16.53	<0.003	15.41	<0.003
MW-12	MWC-12 Site 10	6767	0.24	13.87	0.02	12.6	0.05	13.25	0.05	12.86	<0.02	12.12	<0.003	11.44	<0.003	13.92	<0.003	12.53	0.006
MW-13	MWC-13 Site 10	6766	0.16	8.89	<0.02	8.08	0.05	8.89	0.07	7.85	<0.02	7.87	<0.003	6.93	<0.003	9.11	<0.003	7.34	<0.003

Facility MW Name	Permit Builder MW ID	MWAFR ID/#	31-Mar-05		30-Jun-05		30-Sep-05		31-Dec-05		31-Mar-06		30-Jun-06		30-Sep-06	
			Water Level Relative to ft- NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l	Water Level Relative to ft-NGVD	Nitrogen, Nitrate Total (as N) mg/l
SITE 10																
MW-1	MWB-1 Site 10	6778	24.24	<0.005	23.82	<0.019	24.83	<0.019	25.62	0.019	24.43	<0.003	23.28	0.008	21.68	0.021
MW-2	MWC-2 Site 10	6777	39.36	0.023	39.17	0.019	39.88	<0.019	41.06	<0.019	38.66	0.01	37.62	<0.0075	36.46	0.006
MW-3	MWC-3 Site 10	6776	41.67	1.94	41.2	<0.019	42.92	0.019	43.33	9.8	41.17	11	40.41	7.1	39.31	6.3
MW-4	MWC-4 Site 10	6775	43.13	<0.003	42.94	<0.019	43.94	0.021	44.53	<0.019	42.78	0.005	41.62	0.051	40.6	<0.003
MW-5	MWC-5 Site 10	6774	26.63	0.041	26.67	0.689	27.58	3.98	29.21	2.5	26.37	0.66	25.67	0.3	24.84	0.14
MW-6	MWC-6 Site 10	6773	32.49	4.06	31.96	4.98	32.26	2.46	33.36	0.86	32.07	2.9	30.84	2.8	30.46	5.1
MW-7s	MWC-7 Site 10	6772	37.7	11.5	37.62	9.32	38.42	9.47	39.33	7.5	37.19	9.7	37.09	9.3	37.15	7.9
MW-8	MWC-8 Site 10	6771	26.29	0.09	26.5	<0.019	27.36	<0.019	27.76	<0.019	26.67	0.015	25.42	<0.0075	24.58	<0.003
MW-9	MWC-9 Site 10	6770	16.82	<0.003	16.6	<0.019	17.65	0.033	17.94	<0.019	17.12	<0.0030	14.97	0.01	13.36	<0.003
MW-10	MWC-10 Site 10	6769	19.47	<0.003	19.01	<0.019	20.26	0.02	20.4	<0.019	20.2	0.047	18.02	0.051	17.29	0.064
MW-11	MWC-11 Site 10	6768	15.51	0.021	16.03	<0.019	16.76	<0.019	15.91	<0.019	15.38	0.0042	13.34	0.023	12.18	<0.003
MW-12	MWC-12 Site 10	6767	11.84	<0.003	13.74	<0.019	13.14	<0.019	13.28	<0.019	12.59	<0.0030	10.97	0.008	10.82	<0.003
MW-13	MWC-13 Site 10	6766	7.9	0.033	9.21	<0.019	8.84	<0.019	8.39	<0.019	7.97	<0.0030	7.11	0.086	7.22	<0.003

MWB = Background; MWI = Intermediate; MWC = Compliance

* Phosphorus sampling was removed from Permit requirements post 1997.

Table 9
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Groundwater Flow Rate Parameters

Parameter	Description	Units	Average Value
K_h	Horizontal hydraulic conductivity	ft/day	3.5
x	Horizontal distance between MW-13 and Lake Jesup	feet	1,471
h_1	Head in MW-13	feet	33.6
h_2	Head in Lake Jesup	feet	27.51
q	Flow per unit width to Lake	ft ² /day	0.44
w	Cross-section width	feet	12,000
Q	Volumetric GW flow rate	ft ³ /day	5173

Table 10
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Mass Loading of Nitrate to Lake Jesup

Well	Water Level (ft)	x (ft)	h_1 (ft)	h_2 (ft)	q (ft ² /d)	w (ft)	Q (ft ³ /day)	C (mg/l)	M (lb/day)
MW-1	23.3	10514.4	48.3	27.5	0.26	12000	3145.9	0.02	0.003
MW-2	41.2	10269.2	66.2	27.5	0.62	12000	7419.7	0.01	0.006
MW-3	42.5	9840.0	67.5	27.5	0.67	12000	8097.8	3.81	1.925
MW-4	45.2	9196.3	70.2	27.5	0.79	12000	9534.8	0.01	0.009
MW-5	29.3	10483.7	54.3	27.5	0.37	12000	4382.6	2.05	0.562
MW-6	32.4	10667.7	57.4	27.5	0.42	12000	5005.2	2.77	0.867
MW-7s	39.3	9778.7	64.3	27.5	0.60	12000	7250.9	9.89	4.476
MW-8	27.6	10851.6	52.6	27.5	0.32	12000	3887.1	0.04	0.009
MW-9	18.2	9012.3	43.2	27.5	0.21	12000	2577.1	0.03	0.005
MW-10	14.9	8062.2	39.9	27.5	0.18	12000	2174.5	1.39	0.189
MW-11	15.8	5119.3	40.8	27.5	0.31	12000	3724.1	0.02	0.004
MW-12	13.3	3126.7	38.3	27.5	0.40	12000	4743.5	0.02	0.005
MW-13	8.6	1471.4	33.6	27.5	0.44	12000	5306.7	0.02	0.008
Average					0.43	12000	5173.07	1.54	0.50

Appendix B - Lithologic Descriptions from Monitoring Well Borings

FIELD F-16 @ SITE 10

Field F-16 is comparably dry with cattle in field

Well ID # F-16-MW1, F-16-MW2, & F-16-MW3

F-16-MW1

N 28°45'04.774"

W 81°09'56.375"

Located on E side of Pond C-28

Soil Core Description (Lithology)

0 - 4 ' Sand w/ organics	very fine	dark gray (1.5')	
Over - Sand	si	dark brown - black	highly organic w/ weak cementation
4' - 8 ' Sand	fine - medium	med. brown grading to gray	moist to saturated, wet @ ~ 6 '
8' - 12 ' Sand (slightly clayey)	very fine - fine	gray	clay content increasing with depth few clay streaks near 12 ' , saturated
12' - 16 ' Sand (clayey)	very fine - fine	gray	
16' - 20 ' Sand (slightly clayey)	very fine - fine		decrease in clay content

Well set @ depth of 12 '

F-16-MW2

N 28°45'01.675"

W 81°09'49.002"

Located E-SE of F-16-MW1 in Field F-16

Well installed w/ Geoprobe to 12 ' , no Lithology

Water table @ ~ 7 '

F-16-MW3

N 28°45'07.184"

W 81°09'50.708"

Located N of F-16-MW2 in Field F-16

Well installed w/ Geoprobe to 12 ' , no Lithology

* All LAT/LONG coordinates captured w/ Trimble Geo XT GPS unit
Temporary wells consist of 5 ' prepack screen w/ solid riser & no sand pack or plug

FIELD F-3 @ SITE 10

Well ID # F-3-MW1, F-3-MW2, & F-3-MW3

Field F-3 is mowed w/ no cattle visible

*Evidence found on-site of an unknown study including boreholes flagged w/ stakes & 2" wells/piezometers

F-3-MW1

N 28°45'42.987"

W 81°09'59.156"

S side of Field F-3

Located just W of unknown 2" well (ID # TH3-11) w/ piezometer marked @ "10"

Soil Core Description (Lithology)

0 - 4 ' Topsoil (3") over Sand	fine - medium	pale gray	loose
Over - Sand	si	dark brown	highly organic w/ weak cementation
4' - 8 ' Sand (slightly clayey)		clay - gray w/ orange mottles	clay content increases with depth to a clayey sand @ 8 ' - very moist
8' - 12 ' Sand (clayey)	very fine - fine	gray-green-gray	saturated
12' - 16 ' Sand	very fine - fine	gray	saturated & runny
16' - 20 ' Sand	very fine - fine	gray	saturated & runny

Well set @ depth of 15 '

F-3-MW2

N 28°45'48.065"

W 81°10'04.560"

Located W side of Field F-3, ~ 300' S of unknown piezometer (TH3-1)

Well installed w/ Geoprobe to 18 ', no Lithology

F-3-MW3

N 28°45'50.345"

W 81°09'56.330"

Located NE side of Field F-3

Well installed w/ Geoprobe to 15 ', no Lithology

* All LAT/LONG coordinates captured w/ Trimble Geo XT GPS unit
Temporary wells consist of a 5 ' prepack screen w/ solid riser & no sand pack or plug

W side of Field F-4, just E of access road and Field F-2 pump station
 *Strong organic odor present in well hole

Soil Core Description (Lithology)

0 - 4 '	Sand	si	dark brown	highly organic w/ weak cementation moist - w/ appearance of residuals application
4 - 8 ' Over -	Sand grading to Sand (clayey) Clay (sandy)	very fine - fine	pale yellow - gray gray - green (7-8 ')	saturated - clay content increases w/ depth to 8 ' roots & organics present
8 - 12 ' Over - Over -	Sand (very clayey) Sand Sand (slightly clayey)	very fine - fine	gray-green (9 ') clean pale green - white yellow - tan	saturated @ 10 '
12 - 16 ' Over -	Sand (slightly clayey) Clay	plastic (14.5 - 16 ')	gray-green green-gray	saturated & runny

well set @ depth of 12 '

F-4-MW2

N 28°46'00.466"

W 81°09'43.774"

Located E-NE of F-4-MW1 in Field F-4
 Well installed w/ Geoprobe to 12 ', no Lithology

F-4-MW3

N 28°45'55.592"

W 81°09'43.011"

Located E-SE of F-4-MW1 on S edge of Field F-4
 Located ~ 200 ' W of unknown piezometer (TH4-9)
 Well installed w/ Geoprobe to 12 ', no Lithology

F-2-MW1

N 28°45'57.281"

W 81°09'55.232"

Located W side of Field F-2 pumping station, just W of access road & F-4-MW1
 Located near unknown piezometer (TH2-5)
 Well installed w/ Geoprobe to 12 ', no Lithology

* All LAT/LONG coordinates captured w/ Trimble Geo XT GPS unit
 Temporary wells consist of a 5 ' prepack screen w/ solid riser & no sand pack or plug

FIELD F-1 @ SITE 10

Well ID # F-1-MW1, F-1-MW2, & F-1-MW3

Field F-1 is mowed w/ no cattle visible

Field F-1 is comparably wet - signs of recent wastewater application & past residuals application

*Evidence found on-site of an unknown study including boreholes flagged w/ stakes & 2" wells/piezometers

F-1-MW1

N 28°46'06.376"

W 81°09'58.125"

S side of Field F-1

Soil Core Description (Lithology)

0 - 4 '	Sand (silty)	medium	dark brown	moist w/ organics present
4 - 8 '	Sand (silty) 4 - 4.5 '	medium	dark brown	moist w/ organics present
Over -	Silt 4.5 - 5 '	peat-like	dark brown - black	highly organic
Over -	Sand	very fine - fine	brown	moist
8 - 12 '	Sand	very fine - fine	medium brown	saturated
Over -	Sand	very fine - fine	brown	saturated & runny
12 - 16 '	Sand	very fine - fine	brown	saturated & runny
16 - 20 '	Sand 16 - 18 '	very fine - fine	brown	saturated & runny
Over -	Sand (clayey)	medium	brown	saturated & runny
				clay content increases w/ depth

Well set @ depth of 12 '

F-1-MW2

N 28°46'11.024"

W 81°10'00.375"

Located SW side of large Live Oak tree in center of Field F-1, N-NW of F-1-MW1

Well installed w/ Geoprobe to 12 ', no Lithology

F-1-MW3

N 28°46'12.713"

W 81°09'54.396"

Located N-NE of F-1-MW1 near 2 Live Oak trees in NE corner of Field F-1

Well installed w/ Geoprobe to 12 ', no Lithology

* All LAT/LONG coordinates captured w/ Trimble Geo XT GPS unit
Temporary wells consist of a 5 ' prepack screen w/ solid riser & no sand pack or plug

Appendix C – Surface Water Sampling Locations





Memorandum

To: Migdalia Hernandez, M.S.E.

From: Danielle Honour, P.E., D.WRE 

Date: July 24, 2009

Subject: City of Sanford Site 10 – Lake Jesup Basin Management Action Plan (BMAP) Activities

The Florida Department of Environmental Protection (FDEP) is currently preparing the Lake Jesup Basin Management Action Plan (BMAP), which when implemented, will address the Total Maximum Load that has been adopted for the lake. As part of the BMAP process, the FDEP assigned a detailed load allocation for total phosphorus (TP) to the individual entities within the watershed. The City of Sanford (the City) was assigned an allocation for the area within its municipal boundaries (stormwater loading) as well as a separate allocation for Site 10. Site 10 was addressed separately due to the types of activities (reclaimed water and residual application) that take place on the site. Based on the TP load allocation prepared by FDEP, the City will be required to reduce TP loading at Site 10 by 424 pounds over 15 years. During the BMAP process, FDEP estimated a total TP load from Site 10 to be approximately 4,000 lbs/yr with approximately 3,400 lbs/yr attributed to wastewater and residuals application. This total load was not included in the detailed allocation for Site 10 because it was not accounted for in the original TMDL for the City. Therefore only the stormwater load (424 lbs) was included as part of the detailed allocation. The intent of this memorandum is to summarize the City's activities, planned and current, that are intended to reduce the loading associated with reclaimed water and residuals application to Site 10. Load reductions associated with these activities that could be quantified at this time are presented in this memorandum.

Estimated Load Reductions due to Planned Activities

Since the initiation of the BMAP process, the City has ceased applying biosolids to Site 10. The last application of residuals to the site occurred in May 2008. The City now distributes its Class AA biosolids to staff and residents who can use it as fertilizer. Under the draft Sanford/North WWTF Wastewater Permit, future biosolids application on Site 10 will be prohibited. Under emergency conditions for the demand for the Class AA biosolids is not great enough, the City has a contract with a private processing facility that will accept the biosolids.

In a technical memorandum to the City dated February 27, 2007, CDM calculated a TP loading application rate to Site 10 due to residuals application based on data provided by the City for 2003 through 2005 (**Table 1**).

Table 1
City of Sanford Site 10
Phosphorus Loading due to Biosolids Application

Average number of loads delivered per week (average of 7 to 10 loads per week)	8.5 loads/week
Average number of loads delivered per day	1.2 loads/day
Average ton of residuals per load (average of 13 to 15 tons per load)	14 tons/load
Total tons of residuals delivered per year ¹	6,132 tons/yr
Dry Weight of Solids Delivered per year ²	920 tons/yr
Average of 2003-2005 Percent Dry Weight Values of TP	3.33%
Average TP Loading ³	60,707 lb/yr
Average Loading Rate of TP applied to hayfields in watershed (lb/ac/yr) ⁴	164.8 lb/ac/yr

1. 14 tons/load X 1.2 loads/day X 365days/yr=6,132 tons/yr
2. 6,132 tons/yr X 15% solids content = 920 tons/yr
3. 920 tons/yr X 0.033 X 2000lb/ton = 60,707 lb/yr
4. (60,707 lb/yr) / (368.3 ac) = 164.8 lb/ac/yr

CDM then calculated the average annual loading of biosolids to the Site 10 hayfields (**Figure 1**) as shown in **Table 2**. Depending on the year, either reclaimed water, biosolids or combinations of both were applied to the hayfields. Table 2 shows the calculated loading due to biosolids only (reclaimed water loading is not included in these calculations). An annual average of approximately 37,000 lbs/yr of TP is applied to Site 10 hayfields due to biosolids. Based on the acreage of hayfields within the Lake Jesup watershed, this equates to an annual average application rate of 120.3 lbs/ac/yr of TP.

According to the City, the hayfields are planted mostly with bahiagrass but may be mixed with other varieties of grasses. Nutrient uptake rates for phosphorus for selected forage crops were reported in Crites et.al, 2000. Although bahiagrass is not specifically reported, the uptake rates shown for all forage crops are all within the same order of magnitude. Therefore CDM used the average uptake rate 38 lb/ac/yr of the ranges reported and applied it to Site

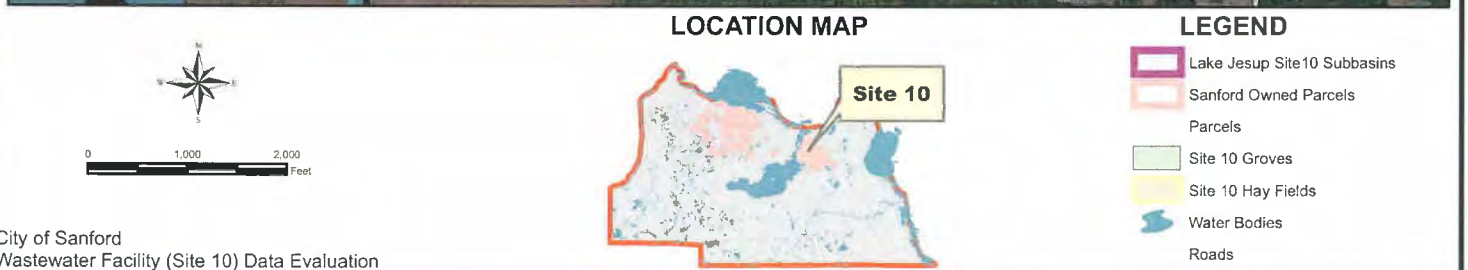


Table 2
City of Sanford Site 10
Field Phosphorus Loading Rates due to Biosolids Application

Average Loading Rate of TP from Residuals applied to hayfields in watershed (from CDM Technical Memorandum (2007))::

164.8 lbs/ac/yr

Field No.	Total Acreage ¹	Acreage in Watershed	Estimated 2003 Loading Rate (lb/ac/yr)	2003 TP Loading in Watershed ² (lb/yr)	Estimated 2004 Loading Rate (lb/ac/yr)	2004 TP Loading in Watershed ² (lb/yr)	Estimated 2005 Loading Rate (lb/ac/yr)	2005 TP Loading in Watershed ² (lb/yr)	Average TP Load 2003-2005 (lb/yr)
F2		15.3	B&R		R		R		
			164.8	2,521	N/A	0	N/A	0	840
F3		29.3	B&R		B&R		B&R		
			164.8	4,829	164.8	4,829	164.8	4,829	4,829
F4		42.5	B&R		R		B		
			164.8	6,856	N/A	0	164.8	6,856	4,570
F6		9.5	R		R		B&R		
			N/A	0	N/A	0	164.8	1,566	522
F8		97.1	B&R		R		B&R		
			164.8	9,690	N/A	0	164.8	9,690	6,460
F9		16.8	B&R		B		B&R		
			164.8	2,686	164.8	2,686	164.8	2,686	2,686
F11		42.3	R		B&R		R		
			N/A	0	164.8	6,971	N/A	0	2,324
F13		17	B&R		B		B		
			164.8	2,802	164.8	2,802	164.8	2,802	2,802
F14		15.2	B		B&R		B		
			164.8	2,505	164.8	2,505	164.8	2,505	2,505
F15		47.8	B&R		B		B		
			164.8	7,877	164.8	7,877	164.8	7,877	7,877
F16		13.7	B&R		B		R		
			164.8	2,258	164.8	2,258	N/A	0	1,505
Watershed Acres Receiving Biosolids:		306.8		42,024		29,928		38,810	36,921

R - Reclaimed Only

B - Biosolids Only

B&R - Biosolids and Reclaimed

1. Field acreages were obtained from a GIS layer originally provided by the City showing the field locations. These were then subsequently edited to match the extents shown on the CP&H plans and verified using the 2004 aerial digital orthophoto quads available from the SJRWMD. Acreages were then calculated using GIS capabilities.

2. Product of loading rate (lb/yr/ac) x area

10. Based on plant uptake, CDM calculated the remaining load and hence the load that will be removed due to the City's cessation of biosolids application on the site. These values are provided in **Table 3**. A quantification of the soil-nutrient dynamics is beyond the scope of this exercise, and therefore it is important to emphasize that load removal previously cited is an estimate based on the best available data at the time.

Table 3
City of Sanford Site 10
Phosphorus Loading due to Biosolids Application

Watershed Acres Receiving Biosolids (ac)	306.8
Average Annual TP Load (lbs/yr)	36,921
Average TP Loading Rate (lbs/ac/yr)	120.3
Forage Crop Uptake Rate (lbs/ac/yr)	37.8
TP Removal through uptake (lbs/yr)	11,584
Net TP Loading Rate (lbs/ac/yr)	82.6
Remaining TP Load in Watershed (lbs/yr)	25,337

Based on this analysis, it is estimated the City will be removing approximately 25,337 lbs TP/yr due to the cessation of biosolids application on Site 10. It should be noted that this loading estimate differs greatly from FDEP's loading estimate from the site. FDEP assigned an event mean concentration that was extrapolated based on literature values for the entire site (which is mostly comprised on forested uplands, wetlands and pasture) to estimate the TP loading for Site 10. CDM's analysis is based on actual data provided by the City that is specific to biosolids application to the hayfields and therefore it was felt that this was more appropriate to use in loading calculations.

The City has established inter-local agreements with Volusia and Seminole Counties and the City of Lake Mary to provide reclaimed water. The City is currently working on a pipeline design to deliver up to 1.5 million gallons per day (mgd) of reclaimed water to Volusia County for irrigation purposes. The City also has an agreement with the City of Lake Mary and Seminole County to provide reclaimed water while they are both expanding their distribution systems. Reclaimed water sent to these other areas will result in less application to Site 10. Until those systems are in place and the City is able to measure the reduction in volume of reclaimed water applied to Site 10, a quantified TP load reduction to Lake Jesup can only be estimated at this time. From the 2007 memorandum previously prepared by CDM, the TP loading to Site 10 as a result of reclaimed water application (based on an average flow rate of 1.5 mgd) resulted in approximately 4,202 lbs/yr (as shown in **Table 4** below). The average flow rate used in the 2007 analysis is consistent with the limits specified in the Volusia County agreement, therefore there is a potential for this entire load to be removed from Site 10.

Table 4
City of Sanford
Wastewater Facility (Site 10) Data Evaluation
Estimated TP Loading to Site 10 from Reclaimed Water (2003 – 2005)

Average Measured Flow to Site 10 (MGD)	1.5	
	Hay Fields	Citrus Groves
% Distribution of Flow based on Permit Limits (1.94 vs. 0.9 MGD)	0.68	0.32
Resulting Flow (MGD) to Hay Fields vs. Citrus Groves	1.02	0.48
Average Measured TP to Site 10 (mg/l)	1.6	1.6
Site 10 TP Loading ¹ (lbs/yr)	4,971	2,339
Total Acreage on Site 10	478.1	277.4
Total Acreage in Lake Jesup Watershed	368.3 (77.0%)	43.8 (16%)
Resulting TP Loading in Lake Jesup Watershed from Site 10 (lbs/yr)	3828	374
Resulting TP Loading in Lake Jesup Watershed from Site 10 (lbs/ac/yr)	10.4	8.5

1. Hay Fields: $(1.6 \text{ mg/l} \times 8.3454 \text{ lb/MG}) \times (1.02 \text{ MG/Day}) \times (365 \text{ Days/yr}) = 4,971.2 \text{ lb/yr}$
 Citrus Groves: $(1.6 \text{ mg/l} \times 8.3454 \text{ lb/MG}) \times (0.48 \text{ MG/Day}) \times (365 \text{ Days/yr}) = 2,339.4 \text{ lb/yr}$

Based on the analysis of load reduction to due biosolids applications management, it appears that the application of biosolids already exhausts the crop uptake potential and therefore no additional plant uptake would occur through reclaimed water application.

It should be noted that this loading estimate differs greatly from FDEP's loading estimate from the site. FDEP assigned an event mean concentration that was extrapolated based on literature values for the entire site (which is mostly comprised on forested uplands, wetlands and pasture) to estimate the TP loading for Site 10. CDM's analysis is based on actual flow rate and measured concentrations provided by the City that is specific to reclaimed water application to the hayfields and citrus groves and therefore it was felt that this was more appropriate to use in loading calculations.

In addition to the interlocal agreements, the City has plans to modify the long-term use of Site 10 under the SR46 Alternative Water Supply initiative which will use the site for a potable alternative water supply treatment facility. Improvements may include expanding and lining the existing holding ponds on Site 10 to increase their capacity from 37 million gallons (MG) to 144 MG. The lining of these ponds may also reduce TP loadings to Lake Jesup due to

groundwater. Additionally, the City has plans to upgrade their Mill Creek site with a pump station and other improvements so that they can store approximately 40 MG of reclaimed water during wet weather conditions.

The City has also implemented Actiflo® high-rate clarification into their wastewater process, which also has the capability to reduce TP. However, only pilot studies have been performed to date and the Actiflo is currently in use during periods of heavy flow, when the plant capacity is being stressed. The City will be collecting data over time in order to quantify the benefits of this new system and its potential load reduction capabilities as it pertains to Site 10.

Summary

Based on the loading analyses presented in this memorandum, **Table 5** summarizes the estimated load reduction on Site 10 due to planned activities by the City to manage both biosolids and reclaimed water application.

Table 5
City of Sanford Site 10
Summary of TP

Biosolids Application	
Average Annual TP Load (lbs/yr)	36,921
Average TP Loading Rate (lbs/ac/yr)	120.3
Forage Crop Uptake Rate (lbs/ac/yr)	37.8
TP Removal through Plant Uptake (lbs/yr)	11,584
Net TP Loading Rate (lbs/ac/yr)	82.6
Remaining TP Load in Watershed (lbs/yr)	25,337
Reclaimed Water Application	
TP Loading in Lake Jesup Watershed from Site 10 (lbs/yr) based on an average flow rate of 1.5 mgd	4,202
Estimated TP load (lbs) reduction	29,539

References

Crites, Ronald W., Sherwood C. Reed, and Robert K. Bastian. Land Treatment Systems for Municipal and Industrial Wastes. New York: McGraw-Hill, 2000.

Appendix H: GLOSSARY OF TERMS

303(d) List: The list of Florida's waterbodies that do not meet or are not expected to meet applicable water quality standards with technology-based controls alone.

305(b) Report: Section 305(b) of the CWA requires states to report biennially to the USEPA on the quality of the waters in the state.

Atmospheric deposition: Pollutants, from a variety of sources, which settle out of air by gravity or are deposited onto land or into lakes, rivers and other bodies of water by wind and rain.

Background: The condition of waters in the absence of man-induced alterations.

Baffle box: An underground stormwater management device that uses barriers (or baffles) to slow the flow of untreated stormwater, allowing particulates to settle out in the box before the stormwater is released into the environment.

Baseline period: A period of time used as a basis for later comparison.

Baseline loading: The quantity of pollutants in a waterbody, used as a basis for later comparison.

Basin Management Action Plan (BMAP): The document that describes how a specific TMDL will be implemented; the plan describes the specific load and wasteload allocations as well as the stakeholder efforts that will be undertaken to achieve an adopted TMDL.

Basin status report: For the Middle St. Johns, this document was published in March 2003 by the Florida Department of Environmental Protection. The report documents the water quality issues, list of water segments under consideration for a TMDL, and data needs in the Middle Basin.

Best available technology (BAT) economically achievable: As defined by 40 CFR, §125.3, outlines technology-based treatment requirements in permits.

Best management practices (BMPs): Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Biochemical oxygen demand (BOD): The amount of dissolved oxygen utilized by aquatic microorganisms.

Biomass: The total living biological material in a given area.

Clean Water Act (CWA): The Clean Water Act is a 1977 amendment to the Federal Water Pollution Control Act of 1972, which set the basic structure for regulating discharges of pollutants to waters of the United States.

Continuous deflective separation (CDS) Unit: A patented stormwater management device which uses the available energy of the storm flow to create a vortex to cause a separation of

solids from fluids. Pollutants are captured inside the separation chamber while the water passes out through the separation screen.

Designated use: Uses specified in water quality standards for each waterbody or segment (such as drinking water, swimmable, fishable).

Detention pond: A stormwater system that delays the downstream progress of stormwater runoff in a controlled manner, typically by using temporary storage areas and a metered outlet device.

Development of regional impact (DRI): A large development (such as a regional transportation facility, shopping center, commercial building, large subdivision, etc.), which generates effects that cross political jurisdictional lines.

Dissolved oxygen (DO): The amount of oxygen gas dissolved in a given volume of water at a particular temperature and pressure, often expressed as a concentration in parts of oxygen per million parts of water.

Dry season: The dry part of the year when rainfall is low; in the Lake Jesup basin the dry season is defined as November through May.

Environmental Protection Agency (EPA): The United States Environmental Protection Agency was created in December 1970 to address the nation's urgent environmental problems and to protect the public health. The majority of FDEP's regulatory programs has counterparts at the EPA or is delegated from the EPA.

Event mean concentration: The flow-weighted mean concentration of an urban runoff pollutant measured during a storm event.

Exfiltration: Loss of water from a drainage system as the result of percolation or absorption into the surrounding soil.

External loading: Pollutants originating from outside of a waterbody that contribute to the pollutant load of the waterbody.

Florida Department of Environmental Protection (FDEP): The Florida Department of Environmental Protection is Florida's principal environmental and natural resources agency. The Department of Natural Resources and the Department of Environmental Regulation were merged together to create the Department of Environmental Protection effective July 1, 1993.

Ground water or groundwater: Water below the land surface in the zone of saturation where water is at or above atmospheric pressure.

Impairment: The condition of a waterbody that does not achieve water quality standards (designated use) due to pollutants or an unknown cause.

Land development regulations (LDRs): Ordinances enacted by governing bodies for the regulation of any aspect of development and includes any local government zoning, rezoning, subdivision, land assembly or adjustment of platted or subdivided lands, building construction, or sign regulations or any other regulations controlling the development of land.

Load allocations (LA): The portions of a receiving water's loading capacity that are allocated to one of its existing or future nonpoint sources of pollution.

Load capacity: The greatest amount of loading that a waterbody can receive without violating water quality standards.

Loading: The total quantity of pollutants in stormwater runoff which contributes to the water quality.

Macrophyte: Rooted and floating aquatic plants that are large enough to be perceived or examined by the unaided eye.

Margin of safety (MOS): An explicit or implicit assumption used in the calculation of a TMDL, which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. An explicit MOS is typically a percentage of the assimilative capacity or some other specific amount of pollutant loading (e.g., the loading from an out-of-state source). Most DEP-adopted TMDLs include an implicit MOS based on the fact that the predictive model runs incorporate a variety of conservative assumptions (they examine worst-case ambient flow conditions, worst-case temperature, and assume that all permitted point sources discharge at their maximum permissible amount).

Middle Basin: Refers to the Middle St. Johns River Basin.

National Pollutant Discharge Elimination System (NPDES): The permitting process by which technology-based and water quality-based controls are implemented.

Notice of Intent (NOI): The NOI provides formal notification to the Florida Department of Agriculture and Consumer Services (FDACS) of the commitment to implement selected practices or best management practices (BMPs) from a Best Management Practice Program adopted by DACS. It is a form of registration with FDACS of the intention to participate in a particular BMP Program. Furthermore, the submittal of the NOI is required by law if participating landowners desire eligibility for the waiver of liability, the presumption of compliance with water quality standards, and cost share funds for BMP implementation.

Nonpoint sources (NPS): Diffuse runoff without a single point of origin that flows over the surface of the ground by stormwater and is then introduced to surface or ground water. NPS include atmospheric deposition and runoff or leaching from agricultural lands, urban areas, unvegetated lands, on-site sewage treatment and disposal systems, and construction sites.

Nonpoint source pollution: Nonpoint source pollution is created by the flushing of pollutants from the landscape by rainfall and the resulting stormwater runoff, or by the leaching of pollutants through the soils into the ground water.

Particulate: A minute separate particle, as of a granular substance or powder.

Pollutant Load Reduction Goals (PLRGs): PLRGs are defined as estimated numeric reductions in pollutant loadings needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable state water quality standards. PLRGs are developed by the water management districts.

Point source: An identifiable and confined discharge point for one or more water pollutants, such as a pipe, channel, vessel, or ditch.

Pollutant: Generally any substance, such as a chemical or waste product, introduced into the environment that adversely affects the usefulness of a resource.

Pollution: An undesirable change in the physical, chemical, or biological characteristics of air, water, soil, or food that can adversely affect the health, survival, or activities of humans or other living organisms.

Removal efficiency: A description of how much of a given substance (metals, sediment, etc.) has been extracted from another substance.

Retention pond: A stormwater management structure whose primary purpose is to permanently store a given volume of Storm Water runoff, releasing it by infiltration and /or evaporation.

Runoff curve: A calculated number representing the percentage of rainfall which becomes runoff for a given area.

Quality assurance (QA): An integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, product, or service meets defined standards of quality.

Quality control (QC): The overall system of technical activities that measures the attributes and performance of a process, product, or service against defined standards to verify that they meet the established data quality objectives.

Septic tank: A watertight receptacle constructed to promote separation of solid and liquid components of wastewater, to provide limited digestion of organic matter, to store solids, and to allow clarified liquid to discharge for further treatment and disposal in a soil absorption system.

Silviculture: The science of controlling the establishment, growth, composition, health, and quality of forests to meet diverse needs and values of landowners and society on a sustainable basis.

Starting points: The pollutant concentrations and flows used as a basis from which nutrient reductions must be achieved.

STORET: The U.S. Environmental Protection Agency's STOrage and RETrieval database, used nationally for water quality data storage.

Stormwater: Water that results from a rainfall event.

Stormwater runoff: The portion of rainfall which hits the ground and is not evaporated, percolated or transpired into vegetation, but rather flows over the ground surface seeking a receiving water body.

Submersed: Growing or remaining under water.

Sub-basin: Hydrologic units within a watershed that function as a mini-watershed, the boundaries of which are defined by topography and drainage patterns.

Surface water: Water upon the surface of the earth, whether contained in bounds created naturally or artificially or diffused. Water from natural springs is classified as surface water when it exits from the spring onto the earth's surface.

Surface Water Improvement and Management (SWIM) Waterbody: A waterbody designated by statute or by a water management district for priority management to restore and maintain water quality, habitat, and other natural features of the waterbody. The Middle Basin has this special designation.

Total Maximum Daily Loads (TMDLs): The sum of the individual wasteload allocations for point sources and the load allocations for nonpoint sources and natural background. Prior to determining individual wasteload allocations and load allocations, the maximum amount of a pollutant that a waterbody or waterbody segment can assimilate from all sources while still maintaining its designated use must first be calculated. TMDLs are based on the relationship between pollutants and in-stream water quality conditions.

Total nitrogen (TN): TN is the combined measurement of nitrogen in nitrate (NO_3), nitrite (NO_2), ammonia, and organic nitrogen found in water. Nitrogen compounds function as important nutrients to many aquatic organisms and are essential to the chemical processes that occur between land, air, and water. The most readily bio-available forms of nitrogen are ammonia and nitrate. These compounds, in conjunction with other nutrients, serve as an important base for primary productivity.

Total phosphorus (TP): TP is the combined measurement of phosphorus in phosphate (PO_4) and organic compounds found in water. TP is one of the primary nutrients that regulates algal and macrophyte growth in natural waters, particularly in fresh water. Phosphate, the form in which almost all TP is found in the water column, can enter the aquatic environment in a number of ways. Natural processes transport phosphate to water through atmospheric deposition, ground water percolation, and terrestrial runoff. Municipal treatment plants, industries, agriculture, and domestic activities also contribute to phosphate loading through direct discharge and natural transport mechanisms. The very high levels of TP in some of Florida's streams and estuaries are usually caused by phosphate-mining and fertilizer-processing activities.

Total suspended solids (TSS): The measurement of TSS consists of determining the dry weight of particulates in the water column. Both organic and inorganic materials contribute to TSS in water.

Trophic state index (TSI): The TSI measures the potential for algal or aquatic weed growth, and is used to indicate the water quality of lakes and estuaries. Its components include Total Nitrogen, TP, and chlorophyll.

Turbidity: The presence of suspended material such as clay, silt, finely divided organic material, plankton, and other inorganic material in the water.

Wasteload allocations (WLAs): Pollutant loads allotted to existing and future point sources, such as discharges from MS4s.

Waterbody identification (WBID) numbers: WBIDs are numbers assigned to hydrologically based drainage areas within a river basin.

Water column: The water within a waterbody between the surface and sediments.

Water quality index: Determines the quality of Florida's streams, black waters, and springs. Categories include: water clarity, dissolved oxygen, oxygen-demanding substances, nutrients, bacteria, and macroinvertebrate diversity.

Water quality standards (WQS): (1) Standards comprised of designated most beneficial uses (classification of water), the numeric and narrative criteria applied to the specific water use or classification, the Florida Anti-degradation Policy, and the moderating provisions contained in Chapters 62-302 and 62-4, F.A.C. (2) State-adopted and EPA-approved ambient standards for waterbodies. The standards prescribe the use of the waterbody (such as drinking, fishing and swimming, and shellfish harvesting) and establish the water quality criteria that must be met to protect designated uses.

Watershed: Topographic area that contributes or may contribute runoff to specific surface waters or an area of recharge.

Watershed management approach: The process of addressing water quality concerns within their natural boundaries, rather than political or regulatory boundaries. The process draws together all the participants and stakeholders in each basin to decide what problems affect the water quality in the basin, which are most important, and how they will be addressed.

Wet season: The rainy part of the year; in the Lake Jesup basin the wet season is defined as June through October.

Appendix I: BIBLIOGRAPHY OF KEY REFERENCES AND WEBSITES

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WEBSITES:

TABLE I-1: STORMWATER AND WATER QUALITY PROTECTION WEBSITES

LOCAL AND REGIONAL SITES	
SJRWMD Programs	http://www.sjrwmd.com/programs.html
<i>Outreach information</i>	http://www.sjrwmd.com/programs/outreach.html
Orange County Water Atlas	http://www.orange.wateratlas.usf.edu/
Seminole County Water Atlas	http://www.seminole.wateratlas.usf.edu/
STATE SITES	
General Portal for Florida	http://www.myflorida.com
FDEP	http://www.dep.state.fl.us/
<i>Watershed Management</i>	http://www.dep.state.fl.us/water/watersheds/index.htm
<i>TMDL Program</i>	http://www.dep.state.fl.us/water/tmdl/index.htm
<i>BMPs, public information,</i>	http://www.dep.state.fl.us/water/nonpoint/pubs.htm
<i>NPDES Stormwater Program</i>	http://www.dep.state.fl.us/water/stormwater/npdes/index.htm
<i>NPS funding assistance</i>	http://www.dep.state.fl.us/water/nonpoint/319h.htm
<i>Middle St. Johns River Basin Water Quality Assessment Report</i>	http://www.dep.state.fl.us/water/basin411/sj_middle/assessment.htm
FDACS Office of Agricultural Water Policy	http://www.floridaagwaterpolicy.com/
FDACS Division of Forestry	http://www.fl-dof.com
University of Florida/ Institute of Food and Agricultural Sciences	http://lake.ifas.ufl.edu/
NATIONAL SITES	
Center for Watershed Protection	http://www.cwp.org/
US EPA Office of Water	http://www.epa.gov/water
<i>EPA Region 4 (SE US)</i>	http://www.epa.gov/region4
<i>Clean Water Act history</i>	http://www.epa.gov/Region5/water/cwa.htm
United States Geological Survey: Florida Waters	http://sofia.usgs.gov/publications/reports/floridawaters/#options