Orange County

Growth Management Department, Planning Division

Comprehensive Planning

Development Review

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Urban Design

Orange County, Florida

COMPREHENSIVE PLAN 2010 - 2030

DESTINATION 2030

Stormwater Management Element

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Planning Division

SECTION 9J-5.011

STORMWATER MANAGEMENT ELEMENT

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SECTION 9J-5.011

STORMWATER MANAGEMENT ELEMENT

I. INTRODUCTION

Stormwater management techniques are designed to protect urbanized areas from flood damage and control the quantity and quality of stormwater run-off into water bodies and drainage wells. The element discusses Orange County's ability to manage stormwater in each of the twelve major drainage basins. In addition, the plans, programs, and facilities to manage the flow of stormwater run-off resulting from a storm event are discussed.

Stormwater run-off is water that accumulates during and after a rainfall event. Stormwater run-off flows towards the lowest elevations, traveling along the ground surface to surface storage areas, such as lakes, ponds and depressions. Urbanization alters the natural drainage features and increases the amount of impervious surface. Therefore, rain cannot be absorbed as easily into the ground. Unless stormwater management controls are used, urban development will cause adverse distribution of stormwater and reduced water quality in lakes and streams.

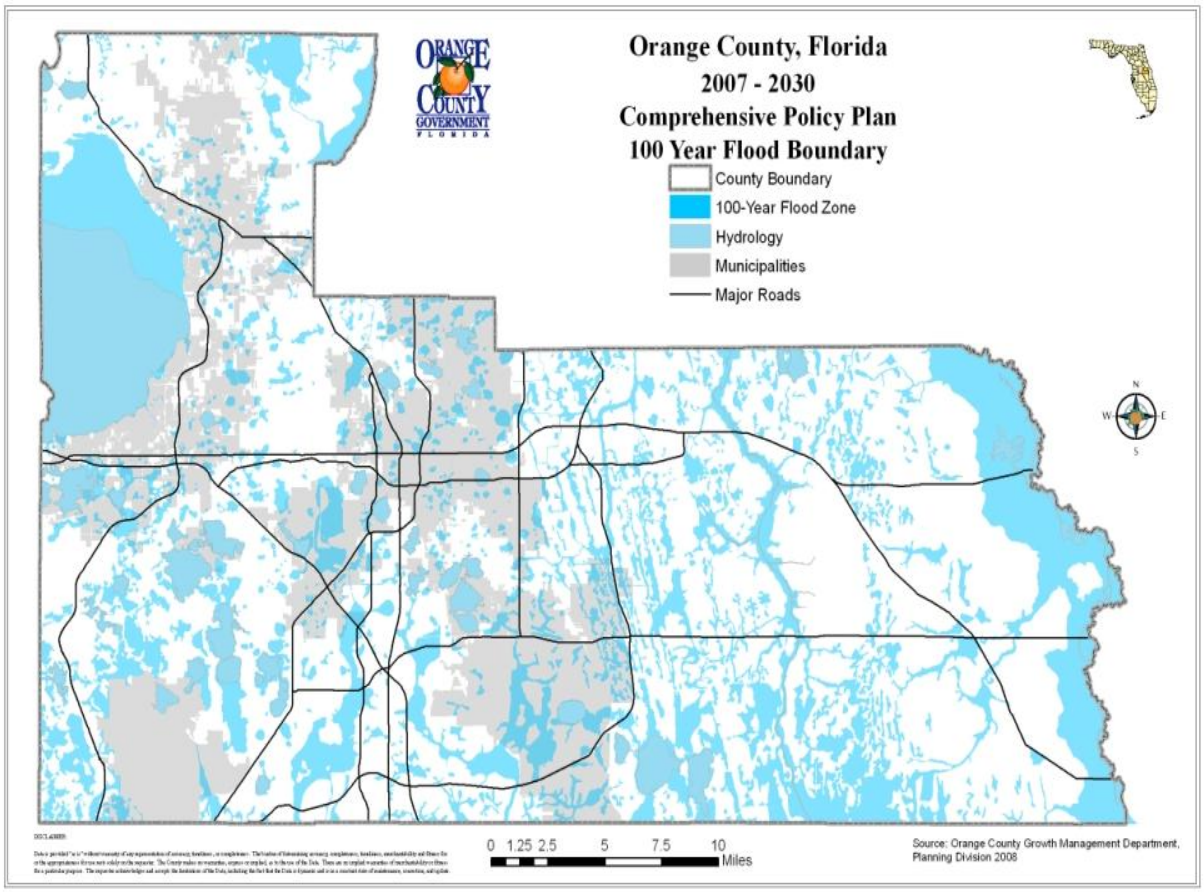
Flooding is often the result of unmitigated development when inadequate or no facilities are provided in a development to control the flow of run-off when major storm events occur. Orange County manages stormwater by requiring that the flow of run-off be directed to areas designed for storage.

Excessive runoff, generated by hurricanes or prolonged periods of rain, can conceivably overload the drainage system, and flood low lying areas such as depressions and areas surrounding water bodies. Also, property surrounding land-locked lakes is prone to flooding because no other outfall is available to control the water level. Flooding can also occur where drainage facilities become overloaded because the conveyance system cannot handle the run-off generated from the basin. The 100 Year Flood Boundary is shown in Map 1.

Although the amount of rainfall is the predominate factor of flooding, the volume and rate of surface run-off from any storm are also influenced by topography, land use , and soil type. Orange County has gently rolling terrain, with elevations ranging from a high of approximately (185) feet above mean sea level in northwest Orange County, to a low of (5) feet above mean sea level in easternmost Orange County along the St. Johns River. Floodplains are commonly located surrounding depressed areas.

Soil characteristics also affect the rate of surface run-off. Well drained, loose sands, common to the mid and northwest areas of the County have the capacity to absorb more water, which reduces run-off. Recharge, the absorption of liquids into the ground to replenish the underlying aquifer, is also affected by soil characteristics. When run-off is rapidly absorbed into the ground through well drained soils, run-off is reduced. Conversely, surface run-off will be much greater where soils are already saturated with water. Soil types and their characteristics are based upon the Soil Survey Report prepared by the National Resources Conservation Service. The Aquifer Recharge Element contains additional drainage information.

Map 1: 100 Year Flood Boundary



Source: Orange County Growth Management Department Planning Division 2008

When urbanization occurs, man-made drainage facilities are used in conjunction with natural drainage features to manage the flow of run-off and prevent flooding. These facilities primarily consist of ditches, canals, drainwells, pump stations, central structures (retention/detention ponds) and closed pipe systems. These systems are designed to store or convey stormwater run-off., Although the natural run-off patterns may be altered by these man-made conveyance systems, measures are taken to protect the environment. For example, some drainage facilities (detention ponds) are designed to temporarily hold run-off, releasing it into the drainage system over a period of time thereby. cleansing the stormwater of accumulated pollutants. These man-made facilities help to mitigate the stormwater impacts of development.

Different land use arrangements or development intensities create varying drainage improvement and maintenance needs and costs because soil and topography may differ from site to site. Measures have been taken in Orange County that require developers to control the peak rate of run-off from their sites. Orange County's 2000 Subdivision Regulations requires that the post-development peak rate of run-off be equal or less than the pre-development rate. The County's Floodplain Ordinance requires compensatory storage be provided for development in the 100 year floodplain. It also requires that first floor elevations be above the 100 year flood elevation, adequate setbacks be maintained in flood prone areas, and that storage areas are constructed properly.

Another issue of stormwater management is the maintenance of water quality. Stormwater pollutes water bodies by becoming a non-point source of pollution. It is estimated that 80 to 95 percent of heavy metals entering our waters comes from stormwater. Non-point source pollution occurs in both urban and rural areas of Orange County. In urbanized areas of Orange county, rainfall and the associated run-off move pollutants from land to receiving waters. In rural agricultural areas, run-off can move fertilizers and agricultural wastes into water bodies. Most of these sources predate the County's stormwater regulations but remain as problems.

Correcting non-point source stormwater problems created by older development is a complex and expensive task known as "retrofitting". Ideally, Orange County should address stormwater water quality concerns generated by new and older developments. New development needs are managed through the County's requirement that stormwater run-off be treated prior to discharge into area lakes through the use of techniques that are known as Best Management Practices (BMPs). Also, Orange County requires retention ponds in new development to filter the first flush, or the initial increment, of on-site run-off. Finally, discharged run-off shall not degrade receiving surface water bodies pursuant to Chapters 17-302 and 17-40.420, Florida Administrative Code. However, the non-point source pollution problem generated by older development is a potentially massive problem requiring extensive study and fiscal resources.

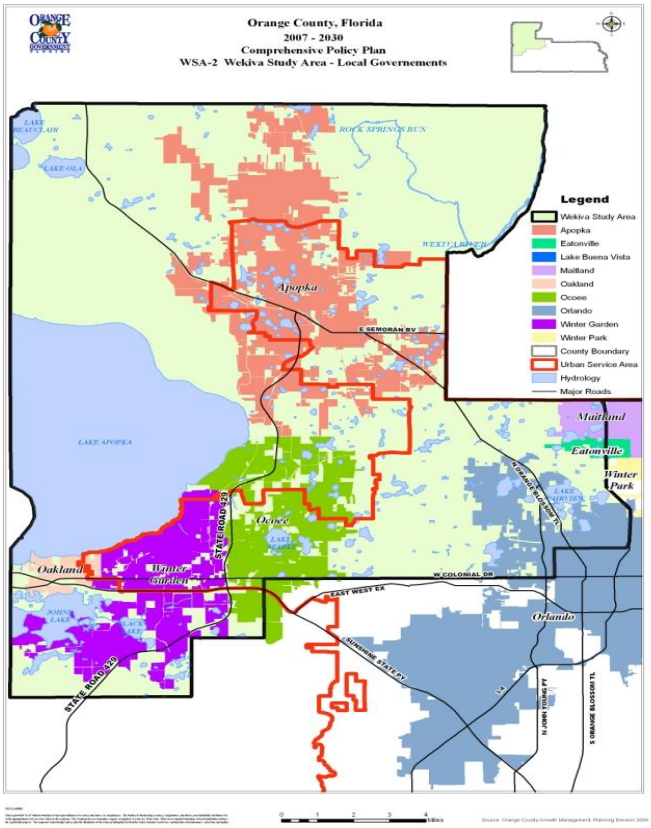
Master stormwater plans are completed for the following basins: Lake Apopka, Reedy Creek, Cypress Creek, Shingle Creek, Boggy Creek, Lake Hart, Little Econlockhatchee, and Big Econlockhatchee basins. The Big Wekiva basin is partially completed, whereas the Little Wekiva, Howell Branch basins are being studied by the SJRWMD. There is no current plan to study the St. Johns basin, since it is located primarily in an un-developed area of East Orange County. The St. Johns River Water Management District through its work with the Econlockhatchee Task Force, has adopted a protection and management plan that protects the Econlockhatchee River. Orange County participated in these efforts by supplying data and funding.

It is recommended that Orange County establish standards and inventories, and assess and prioritize the status of its lakes and rivers with consideration given toward future restoration programs. This effort will be recognizing that FDEP TMDL program effort to assess impaired water bodies is ongoing, and may open up opportunities for joint action with FDEP and other agencies in addition to providing the information necessary for master stormwater planning.

The Wekiva Parkway and Protection Act. The Wekiva Parkway and Protection Act was enacted by the 2004 Florida Legislature to implement the findings and recommendations of the Wekiva River Basin Coordinating Committee, which was appointed by Governor Bush. The Governor signed *The Wekiva Parkway and Protection Act,* Part III of Chapter 369, F.S., into law on Tuesday, June 29, 2004, at Wekiva Springs State Park, in Apopka. The Act authorizes building the Wekiva Parkway and provides protection to the Wekiva River system. It does not, however, provide for any budget appropriations.

The Act's overall purpose is to protect the groundwater discharging to the Wekiva River and its tributary springs, and it requires local governments in the Wekiva Study Area (WSA) (Map 2) to adopt certain amendments to their comprehensive plans. One of the required amendments is to adopt a master stormwater management plan for areas within the WSA (s. 369.319, F.S.). The Act specifies that this plan must be adopted by January 1, 2006 and that the consequent implementing land development regulations must be adopted no later than January 1, 2007.

Map 2: Wekiva Study Area



Source: Orange County Growth Management Department Planning Division 2008

There are 15 local governments located partially or entirely within the WSA: Lake County and the cities of Eustis and Mount Dora; Orange County and the cities of Apopka, Eatonville, Oakland, Ocoee, Orlando, Maitland, and Winter Garden; and Seminole County and the cities of Altamonte Springs, Lake Mary, and Longwood. These local governments, with the exception of Maitland, along with the St. Johns River Water Management District (District), formed a working group (Stakeholders Group).

MASTER STORMWATER MANAGEMENT PLAN

Chapter 369.319, F.S. of the WPPA requires the affected local governments to develop a Master Stormwater Management Plan (MSMP) for their portion of the WSA that:

1) Assess existing problems and deficiencies in the community;
2) Identify projects to meet long-range needs;
3) Establish priorities to address existing deficiencies;
4) Establish measures to address redevelopment;
5) Establish a schedule to complete needed improvements;
6) Evaluate the feasibility of stormwater reuse; and,
7) Include requirements for inspection and maintenance of facilities.
8) Identification of a funding source

Because of the complexity of the issues, the SJRWMD initiated an effort with CDM to Co-operatively work with the affected Stakeholders to develop a MSMP for the WSA that meet the requirements of the WPPA. This cooperative approach promoted the development of a consistent plan rather than developing a piecemeal approach by individual governments. The Florida Department of Community Affairs who is responsible for implementation of the Act was a cooperative partner in the Stakeholder effort. This cooperation was a key factor in the success of this project

Data Collection and Regional Information

CDM performed an extensive data collection and review effort in order to provide a better understanding of the regional issues related to both surface water and groundwater in the WSA. Characteristics of the WSA including topography, land use, soils, major watersheds and subbasins, rainfall, surface water stages and flows, water quality monitoring, total maximum daily loads (TMDLs), hydrogeology, groundwater flow, recharge, projected drawdowns, groundwater contamination, Wekiva Aquifer Vulnerability Assessment (WAVA), drainage wells and public lands are all described in detail in the MSMP. The data presented were used extensively in developing the subsequent portions of the MSMP.

Stakeholder Stormwater Management Policies

CDM reviewed comprehensive plans, code of ordinances, land development codes and permits, and obtained feedback from the Stakeholders in order to provide a summary of each individual Stakeholder's policies. Detailed information presented for each Stakeholder included the adopted level of service (LOS) for stormwater management facilities, National Pollutant Discharge Elimination System (NPDES) permitting for municipal separate storm sewer systems (MS~S) stormwater system inspection and maintenance, redevelopment control measures (as they relate to water quantity and quality) and current water resources funding mechanisms.

Assess and Prioritize Existing Deficiencies

CDM developed an inventory of existing stormwater master plans and drainage studies that have been completed or are in the process of being completed by the Stakeholders to date. These studies were then individually reviewed to identify existing problem areas. Some problem areas were also identified through correspondence with Stakeholders as they were not part of an existing study. Through the Stakeholder process, this list of deficiencies was refined and a ranking methodology were developed to prioritize problems based on their importance to the goals of the Act.

Identification of Regional Projects

CDM, with input from the Stakeholders, developed a methodology to evaluate and apply long-term management strategies in order to identify regional projects. Based on review of the goals of the WPPA, the following two regional strategies were considered:

1) Surface Water Conservation, Groundwater Protection and Reuse; and,
2) Surface Water Treatment and Flood Control.

Using a watershed approach, CDM developed a methodology for prioritizing subbasins within the WSA to apply these two strategies.

Once prioritized, CDM identified best management practices (BMPs) that could be applied to meet the goal of each strategy. BMPs identified under Management Strategy No. 1 include stormwater reuse, the use of reservoirs and ponds, no net loss of floodplains, stormwater infiltration basins (SIBS), the use of buffers, promotion of green development or low impact development (LID), and continuation of the SJRWMD recharge rule for development. BMPs identified under Management Strategy No. 2 include source controls, no net loss of floodplains, retention, detention, swales, buffers, end-of-pipe treatments, alum/chemical treatment, drainage well (recharge well) and treatment system, agricultural nonpoint source management, green roofs, water wise landscaping and reduced turf area, pervious pavement, public education/outreach of proper management and use of fertilizers, and green development or LID. As can be seen from this list for each strategy, there are some BMPs that if implemented, help meet the long-term goals under both management strategies, and are therefore repeated.

Based on the resulting ranking, CDM selected example subbasins under each management strategy (for a total of 10 subbasins) to show how each management strategy could be applied to identify regional projects. These 10 example subbasins were then evaluated to show how various BMPs, depending on the characteristics of the subbasin, can help meet the long term goals of each strategy. It is the intent of this document to provide a protocol for each Stakeholder to follow in order to identify site specific BMPs that promote the goals of the WPPA that can then be integrated into a Capital Improvement Project (CIP) program. For the 10 example subasins, CDM then developed conceptual cost estimates for those BMPs that appear feasible. Conceptual costs ranged between $200,000 and $6,000,000 depending on the characteristics of the area.

Feasibility of Stormwater Reuse

As the future of a sustainable water supply in Central Florida becomes more uncertain, water conservation practices and reuse become more attractive. The idea of stormwater reuse as an alternative water supply for irrigation has been suggested as a viable option that would help promote recharge and lower consumptive use of potable water supplies. As part of the MSMP, CDM conceptually evaluated the feasibility of using stormwater runoff as a source of irrigation water. The result of the conceptual analysis indicated that stormwater reuse may be feasible on a continuous basis when demand is 50 percent or less of the available supply. Additionally, it does not appear possible to provide sufficient storage to completely equalize supplies and demands, based on a desire to reuse 100 percent of the available runoff. At commitments beyond 70 percent of the long term average runoff, the analysis suggests that it is unlikely that reuse at these levels would be feasible due to the volume of storage required to equalize seasonal differences in supply (runoff) and demand (irrigation).

As suggested by CDM's analysis and research done by others, stormwater reuse may be feasible up to a certain point, however additional study is needed to address the following concerns when considering this type of system in the WSA:

- The feasibility of stormwater reuse is site-specific and would need to be evaluated on a case by case basis as site conditions can vary greatly throughout the WSA (e.g.,soils, recharge capacity, temporal and spatial distribution of rainfall, and local irrigation demand); and
- The relationship of stormwater reuse to the proposed pre-development/post development match (Section 369.318 (4) of the WPPA) in the WSA would have to be assessed.

Evaluation of Stormwater Management Programs

CDM used the information documented under each Stakeholder's stormwater management policies to provide an evaluation for redevelopment, stormwater inspection and maintenance and current funding mechanisms.

Redevelopment

Each of the Stakeholders' regulations that address redevelopment was reviewed to identify current requirements as they relate to stormwater management for water quantity and quality.

Stormwater Maintenance and Inspection

The benefit of stormwater operations and maintenance (O&M) to a community is realized in three general ways:

- The useful life of the stormwater infrastructure is extended through proper operation and routine maintenance of these assets resulting in a cost savings by delaying the need for major rehabilitation or replacement of these assets.
- Cleaning of catch basins, culverts, and stream channels maintains the hydraulic capacity of these items, thus lessening the likelihood of flooding in the vicinity of these structures as compared to a non-maintained state.
- Regular removal of trash, debris, sediment, and excess vegetation from the stormwater system improves water quality of streams and downstream

waterways as well as the aesthetic value of these areas to the community. Regular street sweeping and greenway maintenance achieves similar results.

Information on the current stormwater inspection and maintenance practices was provided by each of the Stakeholders. Based on this feedback, CDM summarized the maintenance operations, inspections, contracted services and equipment for each Stakeholder. As O&M programs can vary greatly amongst Stakeholders based on individual needs and constraints (e.g., staffing, equipment, funding), it is recommended that each Stakeholder evaluate improvements to their maintenance programs based on the information presented in this MSMP and their own familiarity with their respective programs. The use of a standard rating system, such as a level of service for maintenance described in detail in the MSMP itself, could be used to evaluate such a program.

Funding Mechanisms

As part of the MSMP, a discussion of types of funding alternatives for stormwater services as well as their advantages and disadvantages was provided. Most of the funding sources discussed in the MSMP apply to cities and counties but are limited in their application to a multi-city and county program. Of course, all of the cities and county participants have revenues from ad valorem taxes collected within the three counties (Lake, Orange and Seminole). Many of the municipalities have stormwater utility fees; but none of the counties do. Thus, the use of an existing funding source to provide revenues for the entire WSA would be difficult to implement.

Therefore, in order to implement the recommendations made throughout the MSMF, a dedicated continuous funding source should be established for projects and programs in the WSA. Currently, 10 out of the 13 local governments have established such a funding mechanism in the form of a stormwater utility. The overall concept of a joint stormwater utility as a method of funding projects within the WSA would be too difficult to implement and faces several challenges. It is recommended that the affected Stakeholders that currently do not have a dedicated stormwater funding mechanism, such as a utility, consider developing one in order to fund the planning, implementation and O&M of projects within the WSA. In addition to a dedicated stormwater fund it is recommended that the Stakeholders develop a joint planning agreement that would allow them to plan and implement regional projects in the WSA that are part of the CIP.

Recommendations & Schedule

It is important to recognize the recommendations made throughout the MSMP are those for the Stakeholders to consider, however determining those recommendations which are feasible and affordable and which may be reflected in future policy changes are the responsibility of the local governments. Recommendations made throughout the report are summarized in Table 1 below which apply to unincorporated orange county and includes a recommendation schedule completed by CDM which details the time frames to complete the needed improvements for unincorporated orange county.

Recom. No.	Recommendation Description	Comments	2006	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
1	For those subbasins in the WSA with predicated percent increases in pollutant loads between existing and future conditions, evaluate the use of controls in addition to what is already required for stormwater treatment by local government and permitting agencies, where most beneficial and where feasible. A list of the types of BMPs to help reduce pollutants loading on MSMP.	Dependent on planning horizon for build-out condition for each stakeholder	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*					
2	Implement recommendations for existing deficiencies based on the prioritization developed as part of this MSMP	Implement identified for recommendations for 20% Of the prioritized deficiencies every 5 years	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4	Apply the Surface Water Conservation, Groundwater Protection & Reuse Management Strategies to the subbasins in the WSA using the methodology described in the MSMP to identify CIPs where most beneficial and where feasible.																										
4a	Apply the Surface Water Conservation, Groundwater Protection & Reuse Management Strategies to the subbasins in the WSA using the methodology described in Section 5.2 to identify CIPs where most. beneficial and where feasible	Evaluate and identify CIPs for subbasins receiving a rank of ‘1’ and ‘2’ in the first 5 years. Implementation of financially feasible projects the following 5 years	*	*	*	*	*	*	*	*	*	*															
4b	Apply the Surface Water Conservation, Groundwater Protection & Reuse Management Strategies to the subbasins in the WSA using the methodology described in Section 5.2 to identify CIPs where most beneficial and where feasible	Evaluate and identify CIPs for subbasins receiving a rank of '3' and '4' in the first 5 years. Implementation of financially feasible projects the following 5 years						*	*	*	*	*	*	*	*	*	*										
4c	Apply the Surface Water Conservation, Groundwater Protection & Reuse Management Strategies to the subbasins in the WSA using the methodology described in Section 5.2 to identify CIPs where most beneficial and where feasible	Evaluate and identify CIPs for subbasins receiving a rank of '5' and '6' in the first 5 years. Implementation of financially feasible projects the following 5 years																									
													*	*	*	*	*	*	*	*	*	*					

Recom. No.	Recommendation Description	Comments	2006	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
4d	Apply the Surface Water Conservation, Groundwater Protection & Reuse Management Strategies to the subbasins in the WSA using the Methodolody described in Section 5.2 to identify CIPs where most Beneficial and where feasible.	Evaluate and identify CIPs for subbasins receiving a rant of '7' and '8' In the first 5 years. Implementation of Financially feasible projects the following 5 years.																*	*	*	*	*	*	*	*	*	*
5	Apply the Surface Water Treatment and Flood Control Management Strategy for the subbasins in the WSA using the methodology described in the MSMP identify CIPs where most beneficial and where the MSMP identify CIPs where most beneficial and where																										
5a	Apply the Surface Water Treatment and Flood Control Management Strategy for the subbasins in the WSA using the methodology described in the 5.2 to identify CIPs where most beneficial and where feasible	Evaluate and identify CIPs for subbasins receiving a rant of '1' and '2' in the first 5 years. Implementation of financially feasible projects the following 5 years.	*	*	*	*	*	*	*	*	*	*															
5b	Apply the Surface Water Treatment and Flood Control Management Strategy for the subbasins in the WSA using the methodology described in the 5.2 to identify CIPs where most beneficial and where feasible	Evaluate and identify CIPs for subbasins receiving a rank of '3' and '4' In the first 5 years. Implementation of financially feasible projects the following 5 years.						*	*	*	*	*	*	*	*	*	*										
5c	Apply the Surface Water Treatment and Flood Control Management Strategy for the subbasins in the WSA using the methodology described in the 5.2 to identify CIPs where most beneficial and where feasible	Evaluate and identify CIPs for subbasins receiving a rank of '5' and '6' In the first 5 years. Implementation of financially feasible projects the following 5 years.											*	*	*	*											
5d	Apply the Surface Water Treatment and Flood Control Management Strategy for the subbasins in the WSA using the methodology described	Evaluate and identify CIPs for subbasins receiving a rank of '7' and '8' In the first 5 years.																*	*	*	*	*	*	*	*	*	*

Recom. No.	Recommendation Description	Comments	2006	2007	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
	in the 5.2 to identify CIPs where most beneficial and where feasible	Implementation of financially feasible projects the following 5 years.																									
6	For those areas not alreadyserved by reclaimed water,m identify large potential users (ie., golf courses, parks, recreational areas) and implement stormwater irrigation practice where practicable and financially feasible. Potental sites will have to be evaluated independently On a case-by-case basis based on actual conditions.	Evaluate 1 basin (i.e. watershed) every 5 years, reference watershed list.	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
8	Continue to implement stormwater maintenance and inspection activities as defined by the NPDES MS4 permit or by already established programs.		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10	Evaluate individual maintenance programs to identify areas where improvements can be made. The use of a standard rating system, such as a level of service for maintenance,could be used to evaluate such a program.	5 years duration	*	*	*	*	*																				
11	Establish a dedicated funding source,such as a stormwater utility, tht can be usedfor planning, implementation and O&M of regional projects within the WSA	10 year duration or as directed by the Wekiva Parkway & Protection Act Legislation.	*	*	*	*	*	*	*	*	*	*															
12	Establish a joint planning agreement between local governments in the WSA that will facilitate the planning and implementation of regional projects.	5 years duration	*	*	*	*	*																				

Source: Camp Dresser & Mc Kee (CDM) Wekiva Book Study & Protection Act Master Stormwater Management Plan November 2005

Implementation of the master plan will require long-term coordination and cooperation among the various local governments and state agencies. The FDEP and the SJRWMD currently are working toward development of pollutant load reduction goals (PLRGs) for the Wekiva Study Area and are modeling the WSA's surface watersheds. Section 62-40.432(5), F.A.C., *Minimum Stormwater Performance Standards*, establishes minimum treatment performance standards and requires reducing, on a watershed basis, the pollutant loading from older stormwater systems as needed to protect, maintain or restore the beneficial uses of the receiving water body. The amount of needed pollutant load reduction is known as a "Pollutant Load Reduction Goal," or PLRG. Florida's stormwater regulation is unique in having a performance standard for older stormwater systems that were built before the implementation of the Stormwater Rule in 1982. As seen above, Section 62-40.432 (5)(c), F.A.C., states that "the pollutant loading from older stormwater management systems shall be reduced as needed to restore or maintain the beneficial uses of waters." Furthermore, this rule requires the WMDs to establish stormwater PLRGs and adopt them as part of a Surface Water Improvement and Management (SWIM) plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. Pollutant loadings are generally estimated on the basis of land use, but many factors can affect the loadings from stormwater runoff.

The Total Maximum Daily Load (TMDL) Program is a federally required water quality program administered by the FDEP under the Florida Watershed Restoration Act (Section 403.067, Florida Statutes). Through the program, FDEP works closely with affected stakeholders to determine how to reduce targeted pollutant loadings to restore the legally designated uses (e.g., drinking water, fishing, swimming, shellfish harvesting) of the polluted waters. A TMDL is the maximum amount of a pollutant that a waterbody can receive and maintain its designated uses. A given waterbody may have several TMDLs – one for each targeted pollutant (phosphorus, coliforms, nutrients, etc.). The stormwater management master plan which has been completed by the Wekiva Study Area Stakeholders Group, referenced above, is part of the overall work needed to implement TMDL program requirements for the Middle St. Johns River Watershed. The master plan provides input for TMDL development, which, in turn, feeds back to create new stormwater master plans, BMPs, and projects to maintain and improve water quality.

The greatest impact to local governments of these programs likely will stem from the potentially sizable costs of implementing projects and activities to achieve TMDLs. Stormwater regulations to this point have largely addressed future development.

Reducing pollutant loadings to meet TMDLs may require retrofitting stormwater and wastewater systems. According to several studies, fiscal impacts on many city and county governments will generally range from $7,500 to more than $12,000 per acre to build stormwater treatment facilities to retrofit urbanized areas.

The Florida Stormwater Association estimates that the cumulative retrofit costs statewide would be between $1 billion and $5 billion, and probably much higher, if local governments were to achieve the current standards for future development in 90 percent of urban areas in Florida. These estimates do not consider the need to address discharges from wastewater treatment plants, septic tank systems, or agricultural lands.

There are two key steps in implementing TMDLs in a basin:

1. Allocating detailed pollutant load reductions, based on the initial allocations in the TMDL. To reduce pollutant loadings to achieve a TMDL, each point and nonpoint source discharging a pollutant of concern must be reduced in an equitable manner. TMDLs include an "initial allocation" of pollutant load reductions between point and nonpoint sources. In most cases, this initial allocation will need to be broken down into more detail to assign equitable responsibility for specific reductions. Future growth must be considered in the allocation process.
2. Developing a basin management action plan (BMAP) that reflects the detailed allocations and contains short-term and long-term projects and activities to achieve the applicable TMDLs in the basin, along with a strategy for monitoring, follow-up, and plan revision. Implementing corrective actions and achieving TMDLs may take many years, so it is important to keep up communications among stakeholders and property owners. A continuing educational effort is important to creating and maintaining a sense of ownership of the watershed among stakeholders and property owners. An important element of a BMAP will be the identification of funds and potential funding mechanisms to achieve load reductions. State and federal funds may be available to finance some projects and activities. Many of the management actions addressed in the BMAP may come from existing plans and projects. The load reductions reasonably expected from these existing or planned efforts may be credited toward the reductions needed to meet the applicable TMDL. Stakeholders will then identify additional projects and activities to complete the needed reductions. In some basins, a BMAP may incorporate or be incorporated into an existing watershed management plan.

To streamline the TMDL program, DEP adopted a five-year cycle that divides Florida into five groups of surface water basins in which different activities take place each year. The cycle is reiterated continuously to evaluate the success of clean-up efforts, refine water quality protection strategies, and account for the changes brought about by Florida's rapid growth and development. The Wekiva River Basin is located within the Middle St. Johns River Watershed, which is in Group 2. This group began Phase 1 of a five-phase program mid-year 2006 (each phase lasts 1 year). Portions of Orange County are in the Upper St. Johns Basin (Group 3) and the Kissimmee River Basin (Group 4) which began in 2007 and continues in 2008.

Since passage of the Watershed Restoration Act, FDEP has adopted an Impaired Waters Rule, which establishes the methods by which surface waters are evaluated and the need for TMDLs is determined. The principles established in that rule were endorsed by the National Academy of Sciences in 2001 after its review of the nationwide TMDL program.

The agency has publicly adopted verified lists of impaired waters for two of the five groups of surface water basins in Florida and is now developing the list for Group 3. Impaired waterbodies in the Middle St. Johns Basin in Orange County include portions of the Wekiva River, Blackwater Creek, the Little Wekiva River, The Econlockhatchee River, the Little Econlockhatchee River, Lake Howell, Lake Pickett, and Lake Fairview. The full list of impaired waters in Orange County may be found in the *Integrated Water Quality Assessment for Florida: 2004 305(b) Report and 303(d) List Update, 2004.*, published by the FDEP Bureau of Watershed Management.

II DATA

A. REGULATORY FRAMEWORK

The County's stormwater management efforts must be consistent with an extensive set of Federal, State and local regulations and rules. The following is a synopsis of the most relevant regulations.

1. FEDERAL

Public Law 92-500 and the Federal Water Pollution Control Act Amendments of 1972 are the most pertinent Federal programs involved with the management of stormwater run-off. The specific sections/programs of Public Law 92-500 that contain regulatory programs applicable in Orange County are listed below.

Section 101 defines the water pollution abatement goals and policies to be achieved through the implementation of Public Law 92-500, and identifies the need for adequate public participation.

Section 404 defines the responsibilities of the U.S. Army Corps of Engineers regarding the review and approval of permits to undertake dredge and fill activities affecting certain areas.

National Flood Insurance Program, administered by the U.S. Department of Housing and Urban Development, requires designated flood prone communities to undertake sound land use planning to minimize potential flood damage to future developments.

2. STATE

The Florida Air and Water Pollution Control Act (Chapter 403, Florida Statutes [ES]), which creates water quality standards and policies; and the Water Resources Act (Chapter 373, FS), which provides for the conservation, protection and management of water, are the key statutes regarding stormwater management. This legislation provides the framework on which the Florida Department of Environmental Regulation, the Water Management Districts, and local governments can implement programs and controls on stormwater management systems. Chapter 99-223, Laws of Florida, sets forth the process by which the 303 (d) list (from the Clean Water Act) is refined through more detailed water quality assessments. It is also establishes the means for adopting TMDLs, allocating pollutant loadings among contributing sources, and implementing pollution reduction strategies.

Chapter 373, FS, creates five Water Management Districts in Florida. Two of these districts, the St. Johns River and South Florida Water Management Districts have regulatory jurisdiction within Orange County for activities related to water use and pollution. Under the provisions of Chapter 373 ES, ad valorem taxes are collected to support both of the water management agencies. Chapter 403, FS, authorizes the Department of Environmental Regulation to protect water quality by preventing the degradation of water quality below numerical standards. Chapter 17-302, Florida Administrative Code (FAC), specifies ambient water quality standards in order to prevent further degradation of surface and groundwater by run-off from stormwater management facilities built prior to stormwater quality regulations taking effect. Rules may include stricter permitting and enforcement provisions within Outstanding Florida Waters, aquatic preserves, Areas of Critical State Concern and areas subject to Chapter 380 FS.

The Florida Department of Environmental Regulation (FDEP) can delegate the authority to treat stormwater systems to Water Management Districts. Chapter 17-25, FAC, is the FDEP stormwater management rule. In addition, the St. Johns River Water Management

District implements Rules 40C-42, 40C-4, and 40C-40, FAC, which are the District's stormwater rules. The South Florida Water Management District implements its stormwater Rules 40E-4 and 40E-40, FAC. DEP's authority to administer the National Pollutant Discharge Elimination system (NPDES) program is set forth in Section 403.0885, Florida Statutes (F.S.). The NPDES stormwater program regulates point source discharges of stormwater into surface waters of the State of Florida from certain municipal, industrial, and construction activities. As the NPDES stormwater permitting authority, DEP is responsible for promulgating rules and issuing permits, managing and reviewing permit applications, and performing compliance and enforcement activities.

Chapter 369, Part III (s. 369.314 – 369.324) Florida Statutes, the Wekiva Parkway and Protection Act of 2004, requires local governments in the Wekiva Study Area (WSA) to adopt Comprehensive Plan amendments incorporating a master stormwater management plan for areas within the WSA (s. 369.319, F.S.). The Act specifies that this plan must be adopted by January 1, 2006 and that the consequent implementing land development regulations must be adopted no later than January 1, 2007. Orange County has adopted the plan and currently is working on amending its land development regulations.

3. LOCAL

Orange County has adopted several regulations affecting stormwater management. Specifically, stormwater management is addressed in the Subdivision Regulations, the Commercial Site Plan Regulations, the Floodplain Ordinance, the Normal High Water Level Ordinance and the Dredge and Fill Ordinance. These regulations adequately protect natural drainage features. Natural drainage features can be defined as the naturally occurring aspects of an area that accommodate the flow of stormwater, including streams, rivers, lakes, and wetlands. These regulations, including ordinances protecting the Wekiva and Econ riverine systems, include requirements for compensatory storage, restoration/mitigation of wetlands, use of nonstructural techniques, setbacks, appropriate densities, and maximizing on-site detention. One regulatory aspect that could be improved would be the addition of sediment and erosion controls during development. The Stormwater Management Division, is responsible for administering these regulations, as well as the planning, construction, and operation and maintenance of drainage facilities developed by the County.

In addition, various County land use ordinances and regulations affect the management of stormwater including the Zoning Resolution, Transportation Improvement Plans, Building Codes, Right-of-way Utilization, and Shoreline Alternation Regulations. The provisions and adequacy of individual stormwater management systems for development are assessed in the development review process.

The Primary Water Control Board was created under the Water Conservation and Control Act, Chapter 36 of the 1965 Orange County Code. This act provided the needed authority to manage the primary drainage system (man-made drainage facilities) on a Countywide basis. It also provided funding capabilities for major capital improvement programs. Although the County relied mostly on ad Valorem taxes, and to some degree on Federal revenue sharing funds, Chapter 36 provided the County with funding mechanisms such as general obligation and assessment bonds, and special assessments to accomplish its capital programs. The Primary Water Control Board was disbanded in 1987 and its duties are now the responsibility of Orange County's Stormwater Management Division. In addition, Municipal Service Taxing Units (MSTUs) may be created to fund improvements within the area that will benefit from it. The County already uses municipal service taxing units to administer operational and maintenance responsibilities within secondary drainage systems. Finally, impact fees can also be used for capital improvements.

B. EXISTING CONDITIONS

1. GENERAL

Orange County uses both natural and man-made drainage systems for run-off conveyance and/or storage systems. Primarily, natural drainage systems consist of natural creeks and streams. Man-made systems used by Orange County consist of several types of improvements. Grading is used to reconfigure the natural landscape to eliminate problems of pond erosion and to control the direction of run-off to limit potential flooding hazards. Storm sewers and inlets are used to intercept stormwater run-off from street collection systems, then transferring it downstream to another component of the drainage system. Ditches and canals are used to transmit and contain large quantities of run-off. Retention/detention ponds also are used to control the amount of run-off from a development site.

The County maintains the primary control system, which consists of control structures, pumping stations, large canals and drainwells. This primary control system is not exclusive to the unincorporated areas of Orange County. It travels through several municipalities, including the cities of Belle Isle, Edgewood and Orlando. Orange County provides maintenance for the entire primary control system, regardless of the jurisdiction it is in. Water management drainage districts, as authorized in Chapter 298, Florida Statutes, also exist in Orange County. Some of these districts include portions of unincorporated Orange County. These districts provide maintenance to the primary and secondary control systems within their jurisdiction.

Drainage problems in Orange County have primarily occurred in older, established neighborhoods that were developed prior to implementation of the existing stringent stormwater management requirements. In addition, drainage problems that result in flooding are most common in areas characterized by soils with poor recharge capabilities due to a high water table, as in East Orange County, or neighborhoods developed in floodplains or flood prone areas. Some flood prone areas can be identified by the land-locked lakes or water bodies within a geographical location. The threat of flooding in these areas is increased by development because pervious surface is reduced and run-off accelerates from the alteration of natural drainage patterns. Many older developments do not provide stormwater management systems to retain run-off and control the amount of post development run-off from the site.

The County identifies the residential areas that experience flooding during major storm events, primarily through calls from residents in the impacted area and field surveys. After a complaint has been reported, the Stormwater Management Division begins an investigation to determine the cause, extent of the problem, and then recommends the necessary improvements. If the improvement is under the purview of the County (i.e., the drainage system is at fault), the project is placed on the Capital Improvements Program list. This list is upgraded annually. Problem areas are also identified as part of the countywide basin studies and during the FEMA re-studies.

Orange County's Subdivision Regulations, as amended in 2000, contain the County's current stormwater management requirements. Orange County initially adopted Subdivision Regulations in 1965, including the County's original stormwater management requirements. Revisions to the stormwater management requirements have been strengthened as data on the impacts of development on drainage have been obtained. The existing stormwater management standards require a system designed to provide for pollution abatement, recharge where possible, and protection from flooding.

These standards are to be accomplished through measures such as pre-treatment of run-off, retention/detention ponds, flood proofing, and increasing minimum pipe size in storm sewer systems. All developments and road projects are required to provide a drainage plan designed to County standards. Orange County's Subdivision Regulations contain minimum design storm requirements (see Table 2). Furthermore, the Subdivision Regulations require development to retain the first one half inch of run-off or run-off resulting from the first inch of rainfall, whichever is greater. This standard helps to improve the quality of stormwater discharge and meets the performance standard set by the State. To further the protection of surface water quality, the County shall require that discharged water not degrade receiving surface water bodies, pursuant to State and Water Management District standards. Finally, the Subdivision Regulations require the post-development peak rate of discharge permitted from the site to not exceed the pre-development peak rate of discharge from the site during a specified storm event. This requirement provides for flood protection. These regulations should serve as the basis for the level of service standard (LOS) for new developments in existing developed areas, in addition to serving as the LOS for all future development.

TABLE 2
DESIGN STORM (24 HOUR MINIMUM)

FACILITY	*DESIGN STORM*
Bridges	50 Year
Canals, ditches or culverts for drainage external to the development	25 Year
Crossdrains, storm sewers	10 Year
Roadside swales for drainage internal to the development	10 Year
Detention basins	25 Year
Retention basins (no positive outfall)	100 Year

Most of Orange County's precipitation occurs as short-duration rain showers and thunderstorms during the summer months of June through September. In the Orlando area, 77 percent of all storms are less than 1/2 inch in volume and ninety percent of the storms are less than one inch. Typical late afternoon thundershowers can produce between .5 and two inches of precipitation in a period of fifteen minutes to one hour. However, some summer thunderstorms produce rainfall in excess of four inches. Table 3 displays duration/depth/frequency information on rainfall occurring in the County.

Orange County, with its distinct wet and dry seasons, follows a rainfall pattern similar to most of Florida. After the summer storms, the remaining eight months are very dry. The quantity of rainfall fluctuates from year to year, resulting in frequent, although not normally severe, episodes of flooding and drought.

TABLE 3
DURATION VS. DEPTH OF RAINFALL (IN INCHES)

Frequency	*30 MIN*	*1 HOUR*	*2 HOUR*	*3 HOUR*	*6 HOUR*	*12 HOUR*	*24 HOUR*
1-year	1.04	1.52	1.96	2.24	2.60	3.14	3.65
2-year	1.21	1.76	2.30	2.64	3.12	4.00	4.51
5-year	1.45	2.16	2.72	3.27	4.00	4.94	6.00
10-year	1.69	2.40	3.20	3.76	4.84	5.93	7.18
25-year	1.93	2.72	3.61	4.30	5.53	6.88	8.26
50-year	2.07	3.04	4.00	4.70	6.14	7.70	8.60
100-year	2.21	3.28	4.34	5.20	6.80	9.12	9.98

SOURCE: Orlando Urban Stormwater Management Manual, Vol. 1, 1977.

Tropical storms also can produce intense rainfall. The occurrence frequency of tropical storms in east central Florida is approximately once in ten years. When a tropical storm occurs near the end of the wet season, flooding is more likely to occur. Rainfall in excess of ten inches may occur in a 24-hour period from a tropical storm, tropical depression, or hurricane. These major storms are estimated to occur once in a hundred years.

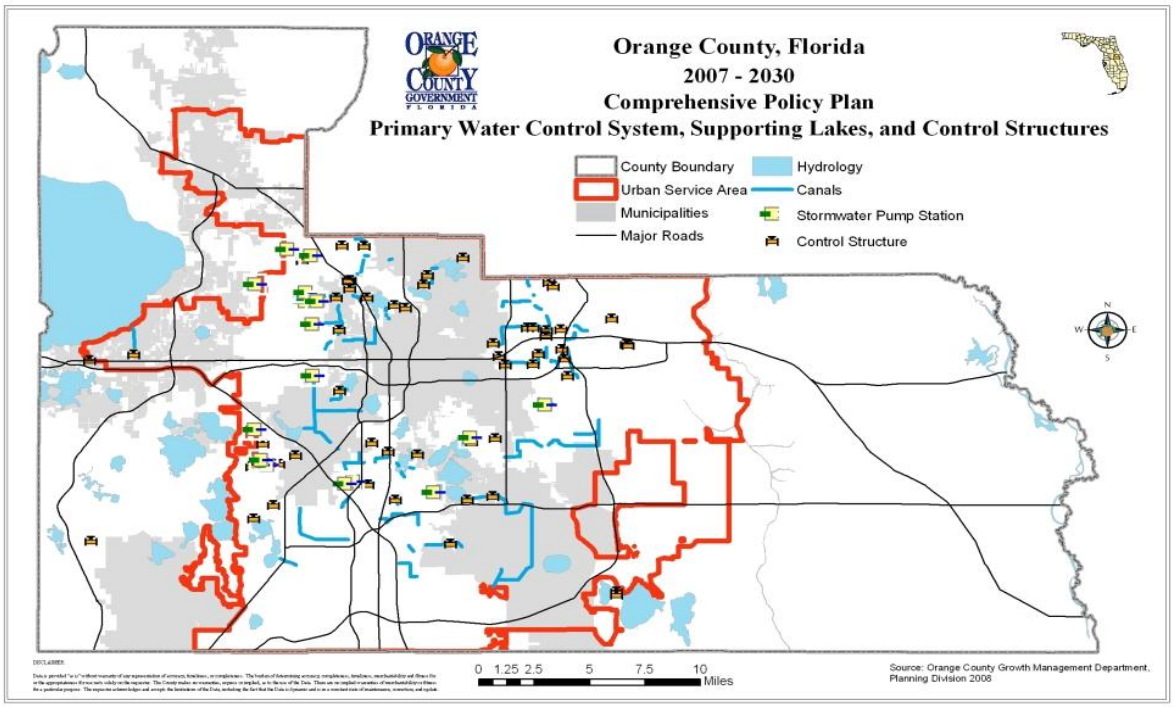
To manage rainfall during major storms, Orange County operates a Primary Water Control System. This system includes all primary drainage facilities within the major drainage basins designated by the Board of County Commissioners. The Primary Water Control System includes the lake interconnects, the lake outfalls, and the stormwater pump station outfalls. In addition, some stormwater is managed through drainwells. Maps 3 and 4 illustrate the County's primary water control and conveyance facilities. The following facilities comprise the Primary Water Control System:

- 17 pumping stations;
- 95 miles of open channels, canals, and closed pipe systems, which provide flood protection and outfall capabilities for numerous secondary stormwater systems;
- 53 control structures, which work in conjunction with the canals and channels making up the primary drainage system; and,
- 74 drainage wells.

Maintenance of these facilities is presently the responsibility of the Roads and Drainage Division.

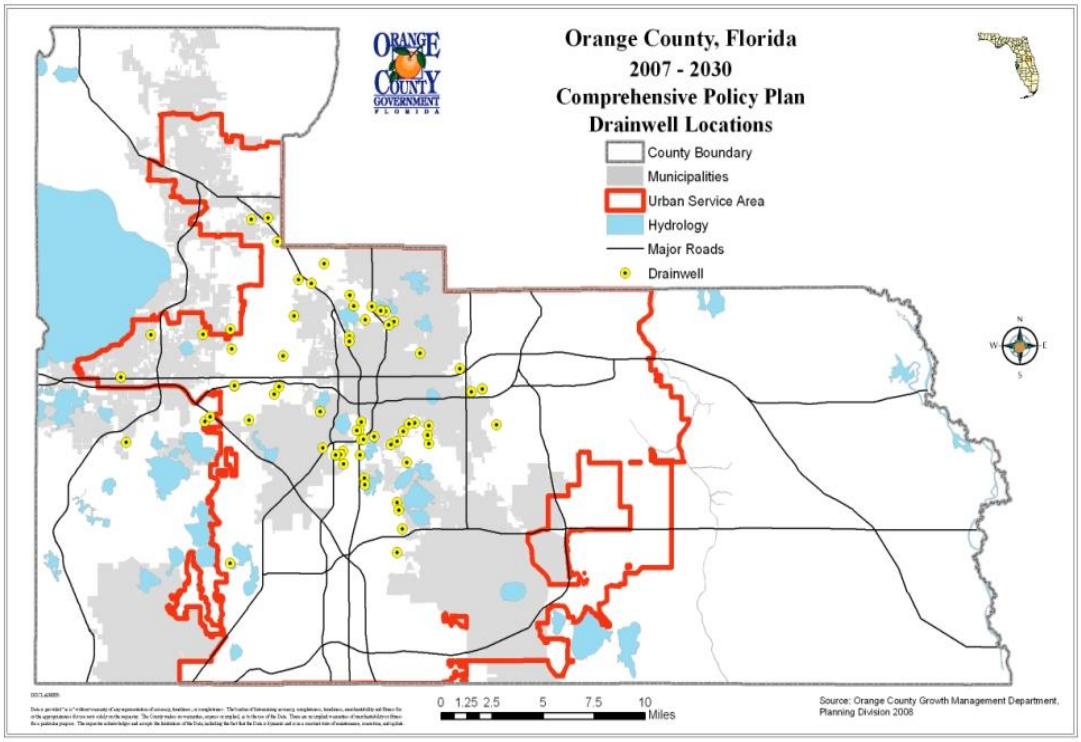
If these systems are not maintained, flooding can occur. Municipal Service Taxing Districts can be established for the maintenance of neighborhood drainage systems. In such cases, the taxes provide funding for County maintenance. Effective maintenance of development drainage systems contributes to better functioning of the entire drainage system within a basin.

Map 3: Primary Water Control System and Supporting Lakes and control structures



Source: Orange County Growth Management Department Planning Division 2008

Map 4: Drainwell Locations



Source: Orange County Growth Management Department Planning Division 2008

2. DRAINAGE BASINS

Orange County lies within two major riverine systems: The northward flowing St. Johns River and the southward flowing Kissimmee River. The St. Johns River and the Kissimmee River systems drain extensive portions of Orange County, in addition to being significant Statewide watersheds.

Within Orange County, these two major watersheds comprise twelve smaller drainage basins. There are seven drainage basins within the St. Johns system and five drainage basins within the Kissimmee River system. The following is a list of these basins.

St. Johns River System

- Lake Apopka
- Wekiva River
- Little Wekiva River
- Howell Branch Creek
- Little Econlockhatchee River
- Econlockhatchee River
- St. Johns River

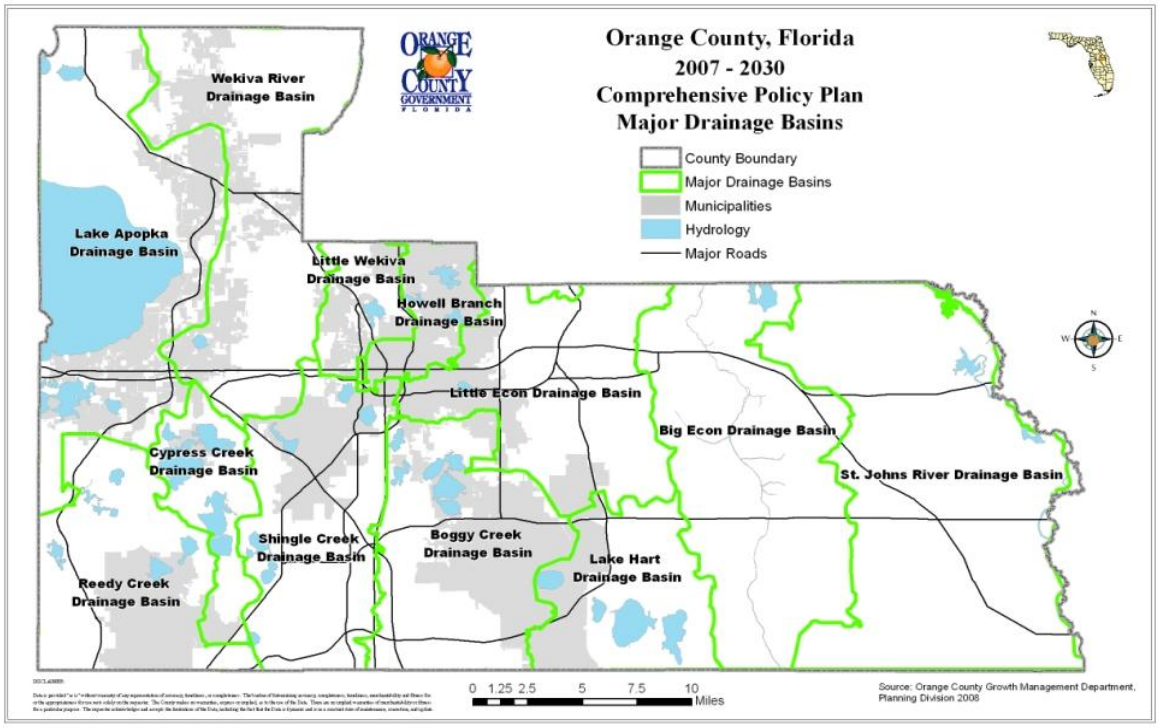
Kissimmee River System

- Boggy Creek

- Shingle Creek
- Reedy Creek
- Cypress Creek
- Lake Hart-Mary Jane

These twelve basins are shown by Map 4. The following is a more in-depth description of the characteristics and issues that relate to each basin.

MAP 4: Major Drainage Basins



Source: Orange County Growth Management Department Planning Division 2008

a. Lake Apopka Basin. The Lake Apopka Basin, which includes portions of Lake County, contains approximately 87,000 acres. Water in this basin flows in a northwestwardly direction. The basin's drainage stems from stream courses, but precipitation, natural spring discharge, and groundwater flow create Lake Apopka.

During World War II, portions of the original lake bottom were converted into mucklands to expand farming opportunities. Today soils in this basin range from very poorly drained (Everglades, Montverde, Fresh Water Swamp) immediately around the lake, to well drained soils (Astatula) on the high ground south of the lake.

The most important issue of the basin is its poor water quality and the severe eutrophic (oxygen depleted) condition of Lake Apopka. The St. Johns River Water Management District is addressing these concerns and implementing the restoration of Lake Apopka through the Surface Water Improvement and Management (SWIM) Program, which includes land acquisition, wetland restoration through the construction of a marsh flow-way to filter lake water, and numerous other water quality projects. The Stormwater Management Division completed the Lake Apopka Master Plan, which included the northern Lake Apopka and Johns Lake basins.

Through the FDEP TMDL process, a Basin Management Action Plan (BMAP) has been developed for the upper Ocklawaha Basin, which includes Lake Apopka. The BMAP details the approach for the local municipalities, FDEP, SJRWMD, FWC, and DAC to address pollutant load reduction in the area.

The Lake Apopka Basin, which includes portions of Lake County, contains approximately 87,000 acres. Water in this basin flows in a northwestwardly direction. The basin's drainage stems from stream courses, but precipitation, natural spring discharge, and groundwater flow create Lake Apopka. A portion of the Lake Apopka Basin lies within the Wekiva Study Area.

b. Wekiva River Basin. The Wekiva River Basin is approximately 88,500 acres and includes portions of Lake, Seminole and Orange Counties. The predominant soils in this area are Astatula and Apopka, which are well-drained and serve as recharge areas for the underlying aquifers. The land use within this area is primarily rural in character or under public ownership. Urban areas are located within the city limits of Apopka and Ocoee. The Wekiva River system consists of artesian spring flows, small creeks, numerous tributaries and secondary drainage facilities. Since the Wekiva is a tributary of the St. Johns River, it represents one of the major routes of surface drainage from portions of the three Counties.

The Wekiva River has been recognized as a river of Statewide significance, and is protected by the Wekiva River Protection Act of 1988. The primary concern in the basin is protecting the water quality of the Wekiva River system, in addition to ensuring that its natural values are preserved for future generations.

FDEP is in the process of developing TMDLs for this system, and a BMAP will be prepared in the near future to address any required pollutant load reductions.

The Wekiva River Basin is approximately 88,500 acres and includes portions of Lake, Seminole and Orange Counties. The predominant soils in this area are Astatula and Apopka, which are well-drained and serve as recharge areas for the underlying aquifers. The area of greatest aquifer recharge and the springshed lie predominantly to the west and south of the Wekiva River with the areas of greatest discharge (high potentiometric surface) near the river and springs, generally within the Wekiva Protection Area. The land use within this area is primarily rural in character or under public ownership. Urban areas are located within the city limits of Apopka and Ocoee. The Wekiva River system consists of artesian spring flows, small creeks, numerous tributaries and secondary drainage facilities. Since the Wekiva is a tributary of the St.

Johns River, it represents one of the major routes of surface drainage from portions of the three Counties. The Wekiva River has been recognized as a river of Statewide significance, and is protected by the Wekiva River Protection Act of 1988 (Ch.369, Part II, F.S.), which generally addresses protection of the surface features of the river, its tributaries, and their floodplains. The Wekiva Parkway and Protection Act of 2004 (Ch.369, Part III, F.S.) expands protection by recognizing the importance of protecting the springshed and the Floridan Aquifer that underlies and feeds the Wekiva River system. The primary concern in the basin is protecting the water quality of the Wekiva River system in addition to ensuring that its natural values are preserved for future generations.

Orange County is participating in the effort to protect the Wekiva River through its mandated role in the Wekiva River Protection Act and the Wekiva Parkway Protection Act. As a result of the County's adoption of the Wekiva River Small Area Study, the County has enacted more stringent land use controls along the river corridor, such as adopting one unit per five acre densities for the northernmost portion of the river. As a result of the Wekiva Protection Act, the County has adopted additional land use controls and site development requirements, more open space, more stringent standards for septic tanks and wastewater treatment facilities, and additional stormwater management requirements for new development and substantial redevelopment within the Wekiva Study Area. Please refer to the Aquifer Recharge Element for additional discussion on the role of stormwater in recharging the springshed, an area roughly twice the size of the surface watershed.

c. Little Wekiva River Drainage Basin. The Little Wekiva River is contained within an approximate 29,960 acre drainage basin. The soils in the Orange County portion of the basin (Myakka) retain moisture, contributing to the area's flood potential and low recharge characteristics. Run-off in the basin flows northward.

The Little Wekiva Basin has had a historic problem with erosion and sedimentation control due to the intensive urban development in the basin. The channelized portion of the river was constructed prior to 1947 to control the drainage flow of the Little Wekiva Basin to the north. In 1959 and 1960, several major storms affected Orange County resulting in substantial flooding throughout the drainage basin.

During the 1970s, the river's watershed was further developed and thereby increased runoff rates and volumes. A series of man-made drainage canals and pumping stations were constructed to connect land-locked lakes that historically would flood. Improvements were also made to improve water quality by reducing point source pollution through the elimination of sewage treatment plant effluents. Despite these actions, the Little Wekiva Basin continues to struggle to accommodate the increased discharge during storm events.

In effect, the river is enlarging itself to provide the capacity necessary to convey storm flows. This action has resulted in the erosion of its banks, thus threatening adjacent homes, roads and bridges

FDEP is in the process of developing TMDLs for this system, and a BMAP will be prepared in the near future to address any required pollutant load reductions.

The Little Wekiva River is contained within an approximate 29,960 acre drainage basin. The soils in the Orange County portion of the basin (Myakka) retain moisture, contributing to the area's flood potential and low recharge characteristics. Run-off in the basin flows northward. The Little Wekiva River Basin lies within the Wekiva Study Area.

d. Howell Branch Drainage Basin. Howell Branch Creek is the principal stream course within the Howell Branch Drainage Basin. Approximately 23,550 acres of the

basin lie in Orange County. The soils in this area are well-drained (Astatula) and aquifer recharge potential is high. Run-off in the basin flows northeastward.

The Howell Branch Basin is characterized by numerous lakes with minor topographic relief. Many of these lakes were interconnected through drainage structures to increase overall lake storage. Intensive development further contributes to flood concerns. The cities of Orlando, Maitland and Winter Park have made some improvements to minimize this flood potential.

FDEP is in the process of preparing the TMDL BMAP for this system, which will set the pollution reduction allocations to be accomplished by local, regional and state entities.

e. Little Econlockhatchee Drainage Basin. The Little Econlockhatchee Drainage Basin is about 51,754 acres in size. The "Little Econ" River is located in central Orange County, north of the Beeline Expressway. The soils in the riverbed are feldas or deposited soils. Scattered wetlands lie contiguous to the Little Econ that can be characterized as organic soils such as Sanibel Muck. However, well drained soils such as Bassinger Fine Sands predominate near the river, and are suitable for development.

The Little Econ River flows generally northeasterly to its confluence with the Big Econ River, and then to the St. Johns River upstream of Lake Harney. Although the majority of the basin is characterized by urban use, the southeastern portion of the basin is undeveloped due to the existence of a substantial amount of' wetlands. The Little Econ River is known as a source of pollution to both the Big Econ River and the St. Johns River. Urbanization and point source pollution have contributed to the Little Econ River's degradation.

The natural drainage patterns of many portions of the Little Econ Basin have been altered by man to improve its flow. This is especially evident in the areas drained by the East Goldenrod Canals. In many areas, extensive urbanization has occurred along the channelized portions of the stream and the natural floodway no longer exists. These areas experience the most severe flooding problems associated with the lack of flood storage volume that was available in the natural floodplain.

In the past, the Little Econ Basin and its tributaries have received discharges from eleven point sources, including ten wastewater treatment facilities and the Orange County Landfill. In February 1982, the Bennet Road Sewage Treatment Plant discontinued discharging into the "E-4" Canal, eliminating the biggest source of pollution. Four additional point sources have been taken off-line. Only two wastewater treatment plants at Park Manor and University Shores, both of which are required to upgrade treatment of their wastewater, and the Landfill will remain as a point source of pollution to the Little Econ River.

A study entitled Water Quality Characteristics and Nonpoint Source Pollutant loadings in the Little Econlockhatchee Drainage Basin (ERD, 1996), evaluated available water quality data and presented results of a pollutant loading analysis over the entire basin. It included typical pollutant loading rates for various land use types found in the basin and pollutant removal efficiencies of typical stormwater management systems that are used in the County. The report also made recommendations as to the types and locations of recommended stormwater treatment facilities.

The ERD water quality analysis was limited to lakes for which long-term monitoring data were available. Of the seven lakes analyzed, five were determined to be oligotrophic with "relatively good water quality including low to moderate levels of nutrients, good water column transparency and relatively low levels of chlorophyll-a" (ERD, 1996). None of these lakes showed evidence of decline in water quality and many of them exhibited better water quality in the 1990s compared to the 1970s or 1980s. The remaining two lakes were noted to have severely degraded water quality

including Lakes Oliva and Underhill. The Florida Department of Environmental Protection performed an investigation as part of an ongoing program to provide data at point source discharges. The specific focus of that investigation was to "determine the potential effects from stormwater and the Iron Bridge Road Water Pollution Control Facility receiving waters" (FDEP, 1996). Results of the FDEP study indicated a sharp increase in several parameters occurred between the VCC and Buck Road stations. Specifically, increases in nitrogen species and algal growth potential "implicates either stormwater inputs in that area (i.e., Park Manor) or the Park Manor WWTP as nutrient contributors" (FDEP, 1996 The existing condition pollutant loading analysis indicates that the Crane Strand (CS) system generally accounts for the greatest contribution of pollutants (on an areal basis). The Crane Strand system is followed, in decreasing order of overall contributions, by the East Orlando, Azalea Park, Park Manor systems and areas adjacent to the river.

A total of three new Regional Stormwater Facilities (RSFs) and improvements to a fourth existing facility are recommended. Two of the new RSFs are designed to provide treatment only and they are located in the Winter Park and Park Manor Systems. The remaining RSFs are designed to treat stormwater and provide attenuation or additional storage volume to alleviate flooding problems. In some areas, sufficient land was not available to permit design of an RSF. In such areas, alternate methods of stormwater treatment are recommended. These alternate methods include alum treatment systems or physical treatment devices such as baffle boxes or other commercially available devices. Relative cost and treatment efficiencies.

FDEP is in the process of preparing the TMDL BMAPs for portions of this river system, including Crane Strand/Drain and Long Branch. These documents will address the pollutant load reductions and further investigative actions necessary to improve the water quality of the Little Econ.

f. Reedy Creek Drainage Basin. This 37,700 acre basin is located in an area of high topographic relief and rolling terrain as compared to other parts of the County. Reedy Creek, the principal stream of the basin, flows southeastward. The area is characterized by well-drained soils such as St. Lucie and Astatula, making it an area of high aquifer recharge potential.

Except for Walt Disney World and its associated properties, the land use character of the area is progressively becoming more urban. Development and land use in this basin are regulated by the Reedy Creek Improvement District, which is a separate and independent authority from the County.

FDEP is in the process of developing the model to establish TMDLs in the basin. The BMAP to reduce the pollutant loads will be developed once the TMDLs are set.

g. Cypress Creek Drainage Basin. The natural flow of Cypress Creek has been modified by canals, detention areas and other control structures to increase storage area and reduce flood occurrence. Cypress Creek's primary tributary is the Bonnet Creek system, which includes Cypress Creek and the Butler Chain of Lakes. The area has well-drained soils such as St. Lucie and Astatula.

The Butler Chain of Lakes has been designated as Outstanding Florida Waters. This designation protects the lakes from adverse discharge. This basin is rapidly urbanizing, which combined with its natural features, gives the area a high-flood potential.

The FDEP is currently developing the model to establish TMDLs in this basin. The BMAP to reduce the pollutant loads will be developed once the TMDLs are set.

h. Shingle Creek Drainage Basin. The primary sources of flow in the Shingle Creek Basin are stormwater run-off, tributary drainage of swamps and sloughs, and base

flow. Many land-locked lakes exist within the northern section of the basin, primarily in the Orlando City Limits. This area is heavily urbanized in the northern portion (in Orange County) and contains a large amount of commercial and industrial land use, as well as residential. Extensive stormwater run-off results from the intensive land uses and vast amount of impervious coverage in the area.

The basin has relatively flat topography. The high water table in the basin, combined with poorly drained soils (Myakka) reduces recharge potential. Rainfall replenishes the groundwater table very slowly or evaporates. During prolonged rainy periods, extensive surface areas can become covered with standing water for periods up to several weeks.

Man-made facilities, such as drainage canals and pumping stations, have been constructed to accommodate lake overflow and urban stormwater run-off. One such facility is a south flowing channel spanning a distance of 11.5 miles ending in Lake Tohopekaliga.

The FDEP is currently developing the model to establish TMDLs in this basin. The BMAP to reduce the pollutant loads will be developed once the TMDLs are set.

i. Boggy Creek Drainage Basin. Boggy Creek is the primary stream course within this 55,860 acre basin. At some points, the stream is a channelized drainageway. The northern portion of the basin has well-drained soils such as Astatula and Apopka, making the aquifer recharge potential high. However, much of the southern portion of the basin is characterized by low lying areas, wetlands, and poorly drained soils like Myakka and Freshwater Swamp.

Surface drainage is derived from lake overflow and tributary drainage of the numerous swamps and sloughs along the stream course. The upper portion of the basin, from Lake Conway north, has a drainage area of about 27 square miles and is within the general urban area of Orlando. It has numerous small lakes surrounded by gently, rolling land. The lower portion of the basin has a number of depressions and swamps, many of which are connected to the main channel by natural sloughs or small drainage ditches. The largest of these, Boggy Creek Swamp, covers nearly two square miles and acts as a natural detention area for run-off from the basin.

The west branch of Boggy Creek is 1ocated in south central Florida and discharges to Boggy Creek and then to East Lake Tohopekaliga at the headwaters of the Kissimmee Basin. The West Branch of Boggy Creek Basin has experienced severe flooding problems in the past few years, particularly in the Regency Industrial Park area. The west branch of Boggy Creek flows generally to the south and east and, after discharging into Boggy Creek Swamp, joins the east branch of Boggy Creek. The combined east and west branches of Boggy Creek discharge into Lake Tohopekaliga at the headwaters of the Kissimmee Basin.

The natural drainage patterns of most of the West Branch of Boggy Creek have been significantly altered by man. In the 1920s, a system of drainage ditches was developed by the Taft Drainage District to drain swampy areas for development. Additional drainage ditches were constructed within the basin in the 1960s and 1970s. In most areas of the basin, extensive urbanization has occurred along the channelized stream reaches and the natural floodway no longer exists.

A system of drainage ditches was also developed by the U.S. Air Force to drain the land necessary to construct McCoy Air Force Base. These ditches extend from Lake Warren to Boggy Creek Swamp and include erosion and water-control structures. In other portions of the Boggy Creek basin, Orange County and others have added ditches from time to time to alleviate local flooding conditions. One such ditch connects Lake Conway and Lake Warren.

Orange County completed the study entitled – Basin Planning for Boggy Creek and Lake Hart Watersheds in 1996. This study recommended some drainage improvements primarily in the West Branch of the Boggy Creek and included structure replacement, channel improvements, and grading. At this time, none of the recommended improvements have been undertaken.

The FDEP is currently developing the model to establish TMDLs in this basin. The BMAP to reduce the pollutant loads will be developed once the TMDLs are set.

j. Lake Hart Drainage Basin (Lake Mary Jane). No prominent natural stream courses exist in this rural 31,000 acre basin, rather, surface drainage is facilitated through a series of canals that link the larger lakes. The land surface in the basin is relatively flat, and contains many wetland areas. Due to the soils, this drainage basin does not function as a significant recharge area.

The South Florida Water Management District operates water control structures in the Lake Whippoorwill region of the Lake Hart Drainage Basin.

There were no recommended drainage improvements in the 1996 study "Basin Planning for Boggy Creek and Lake Hart Watersheds".

The FDEP is currently developing the model to establish TMDLs in this basin. The BMAP to reduce the pollutant loads will be developed once the TMDLs are set.

k. Econlockhatchee River Drainage Basin. The Econlockhatchee River (Econ) Basin is 276 square miles in size. It drains approximately 206 square miles of the Orlando Metropolitan region and eastern Orange County. Numerous small swamps, sloughs and tributaries drain into this river. The topography within the basin is relatively flat. Poorly drained soils (Pompano, Iberia, Freshwater Swamp) are found in the area, especially the floodplains.

The Econlockhatchee River can be divided into two segments: The Upper and Lower portions of the river. The Upper Econ River drains mostly marshlands and cattle pastures. The Lower Econ River receives flow from the Little and Upper Econ Rivers, and drains mostly cattle pasture land.

The land uses within this area are of a rural character and the majority of the area is undeveloped. There are two distinct residential communities in the basin: Bithlo and Wedgefield. In Bithlo, the combination of poorly drained soils, flat terrain and numerous tributaries creates flood concerns. The County completed a drainage study of Bithlo and Christmas areas in 1987. Most of the recommended improvements have been constructed and have corrected most of the drainage deficiencies. This was confirmed by a follow-up study of the Bithlo area that was completed in 2002 entitled "Bithlo Area Stormwater Management Master Plan Update - Final Report".

Urbanization in this area is occurring, however, since new development must be in accordance with the existing stormwater management requirements, minimal flood damage is expected.

The water quality in the Little Econ River has improved since the Iron Bridge Road Wastewater Treatment Plant began operating in the early 1980s. Since that time, the treated wastewater from the Iron Bridge Road Wastewater Treatment Plant has been directed to an area outside the Econ River Basin. Another new wastewater treatment plant, the Eastern Orange County Regional Wastewater Plant, has been constructed and discharges tertiary treated effluent into a tributary of the Econ River just downstream of the Beeline Expressway (State Road 528). The degree of treatment ensures that pollution does not occur.

Increased urbanization has raised concerns about riverine protection. The St. Johns River Water Management District has completed a management and protection plan for the Econlockhatchee River that includes provisions for buffers and other protection mechanisms. In December 1990, Orange County adopted Ordinance 90-30, which protects this riverine system from development while land development regulations are being revised.

FDEP will be proceeding with TMDL development in this basin in the near future.

I. St. Johns River Drainage Basin. This 5,632,000 acre drainage basin incorporates portions of Seminole County, Osceola County, as well as Orange County. A number of tributaries from this river facilitate surface drainage, which flows into the St. Johns River. Its valley, a low, relatively featureless floodplain, comprises a majority of the basin. Elevations are commonly below 30 feet mean sea level (MSL).

Aquifer recharge within the area is minimal due to the poor drainage properties of the soils (Pompano, Iberia Okeechobee Fresh Water Swamp).

This area is mostly undeveloped and consists mainly of conservation and wetland properties. The Rural Settlement of Christmas is the largest residential area within the basin, but none the less is small. Tosohatchee State Reserve, which is located along the St. Johns River, serves as a wildlife preserve with limited recreational uses. The portion of the St. Johns River that is within Orange County is still in a natural state.

Due to the undeveloped nature of the portion of this basin in Orange County, there are not likely to be TMDLs developed, nor will there be a BMAP.

III. ANALYSIS

A. LEVEL OF SERVICE

Chapter 9J-5, FAC, sets forth the State's comprehensive planning requirements, of which Chapter 9J-5.011, FAC, requires the development and implementation of level of service (LOS) standards for all infrastructure. Traditionally, standards for stormwater management facilities have been based on anticipated facility performance rather than the quantity of infrastructure required per capita. Thus, level of service or level of protection for a particular type of stormwater management facility is based on the frequency of a rainfall event, the duration of the event, and the performance of the facility with regards to flood control and water quality treatment for the specified event.

Existing level of service for drainage defines the system wide and sub-system functioning of the system. There are two main categories in which the adequacy of a drainage system can be defined and analyzed, namely, flood control and water quality. Early efforts at managing stormwater run-off were geared toward controlling the amount of stormwater run-off; however, water quality is increasingly becoming a concern at the State, local and regional levels. An adequate stormwater management system should prevent flood damage and ensure run-off does not degrade the quality of existing water bodies.

The Chapter 9J-5, FAC, LOS definition requires that "capacity per unit demand for each facility be indicated." The adopted stormwater management level of service standard should include capacity as well as performance criteria for water quality and flood control for new and existing systems. Chapter 9J-5 FAC, through the definition of drainage facilities, describes the engineering-based operational characteristics that should address the facility's capacity to handle stormwater quantity (e.g., volume and

rate of run-off from site) and quality (e.g., reduction in the pollutant load of the run-off).

According to the FDEP, design storm conditions should be described as a part of the drainage LOS with regard to storm frequency, duration and soil antecedent conditions. FDER also recommends that local governments LOS criteria not conflict with the rules and regulations of the Water Management Districts. Because drainage requirements vary with development types, drainage LOS standards can be shown by using a tiered or matrix approach where the level of storm protection (design storm) for which a facility must be designed can be set relative to the type of development.

B. CURRENT LEVEL OF SERVICE FOR ORANGE COUNTY

Orange County must establish a LOS for existing and proposed stormwater systems. For proposed systems the County's Subdivision Regulations establishes stormwater requirements by specified storm event. These regulations reduce flooding potential by requiring peak discharge from a developed site to not exceed that from the site in an undeveloped condition. Pollution abatement shall be accomplished by requiring specific detention/retention and filtering capabilities for drainage facilities. In addition, the County's level of service standard for drainage will include a component protecting surface water bodies from degradation by run-off. For existing stormwater systems, however, the task is much more difficult because of the operational characteristics of many older developments built before enactment of the County's current Subdivision Regulations.

Based on the current level of information, significant flood problems in Orange County have been localized to developments in several of the drainage basins. Flood concerns in the drainage basins are, in part, the result of unmitigated development. In subdivisions where treatment is not provided, impervious surface area has increased the flow of run-off into area lakes, causing lake overflow. This normally occurs after major storm events during the rainy season. For example, flood concerns in the Big Econlockhatchee Basin are due to the high water table preventing effective recharge. In addition, the basin's flat terrain can create settling areas. To correct this, the County is taking measures to increase and direct the flow of run-off to better suited storage areas. This is being accomplished through road paving and grading.

Orange County addresses flood concerns by various means. Flooded lakes are connected to other water bodies that have storage capacity by drainage pipes, canals and channels. It is recommended that Orange County establish and reaffirm the flood elevations for all land-locked lakes in the County. Also, temporary storage areas, such as retention/ detention ponds, are provided to reduce the occurrence of flooding. When problem areas are identified, such as the Big Econ Basin, the Stormwater Management Division investigates the problem and determines the priority of necessary improvements.

Numerous miles of minor drainage channels are in place throughout the County and provide localized drainage for individual developments and older, unimproved street systems. As streets are improved, these drainage canals or ditches are replaced with pipes and inlets , or more routine maintenance is provided.

In regard to water quality, the Orange County Environmental Protection Division has not identified serious water quality problems due to aquifer recharge from drainage wells.

The FDEP has implemented several groundwater monitoring programs to determine if the water drained into the underlying aquifers, through drainage wells, has adverse impacts. The United States Geological Service also monitors some drainage wells in

Orange County, including the City of Orlando's wells. More information on drainage wells is found in the Aquifer Recharge Element.

The County manages stormwater management funds in two ways: Funds for deficiency correction and funds for projects designed to improve existing and anticipate future drainage needs in the area. In addition to these funds, drainage improvements also were achieved in conjunction with road improvement projects. Substantial sums of money have been committed towards stormwater management in Orange County.

The funds committed to correct system deficiencies are used to manage canals, retention or detention ponds, install pipes, create sufficient outfall areas, and purchase additional right-of-way. Funds allocated for drainage projects identified to improve the existing system and necessary to meet future demand include projects such as mapping floodplains Countywide, preparing drainage basin studies, and maintenance of existing facilities.

As flood and pollution problems emerge throughout Orange County, and corrective actions become more expensive, it will be necessary to increase funding levels. Therefore, the County should consider alternative funding mechanisms. A stormwater management utility assessment is one possible financing method that could help finance drainage concerns throughout the County. A utility fee system is user-oriented, with costs allocated according to the service received. The County adopted a stormwater utility and rate ordinance in 1997; however, no fee has been imposed or collected.

Managing stormwater run-off through the use of deep-water drainage wells raises concerns that the Florida Aquifer could become contaminated. Any new revenue source should also be used for studying drainage well problems as part of the master stormwater planning process. Drainage wells are discussed in more detail in the Aquifer Recharge Element.

Local governments have historically done little comprehensive planning for stormwater concerns. Orange County does not have a complete inventory of primary and secondary drainage facilities. This is an important step toward completing any type of basin analysis. The identification of primary and secondary facilities is a very labor intensive task; however, the County cannot analyze its existing level of service, or identify its drainage deficiencies unless this step is done. The County has begun a program to inventory its primary and secondary drainage facilities. After completion of the inventory , it is recommended that this information form the foundation for basin planning, then a basin needs and deficiencies analysis can be made. Due to fiscal constraints, it is recommended these improvements be phased with priority given to portions of those basins that could be a potential threat to the health and safety of Orange County's citizens.

A master stormwater plan for each individual basin, which details stormwater management information at the basin and sub-basin level, would improve the County's ability to comprehensively plan for system improvements. Master stormwater plans should include a detailed inventory of all drainage facilities, evaluate facility condition and assess replacement repair costs, identify predominant types of land use by watershed, provide level of service analyses (quality and quantity), include a needs assessment, and an evaluation of the problems and opportunities associated with improving the performance of the County's stormwater management facilities. In addition, the master plan should complement the Water Management Districts' efforts to correct drainage problems occurring in the County.

Several basin studies have already been completed and include the following basins: Lake Apopka, Reedy Creek, Cypress Creek, Shingle Creek, Boggy Creek, Lake Hart,

Little Econlockhatchee, and Big Econlockhatchee basins. The Big Wekiva basin is partially completed, whereas the Little Wekiva, Howell Branch basins are being studied by the SJRWMD. There is no current plan to study the St. Johns basin, since it is located in a primarily un-developed area of East Orange County.

C. PROPOSED LEVEL OF SERVICE FOR ORANGE COUNTY

As stated earlier, Orange County's Subdivision Regulations, as amended in 2000, contain the County's current stormwater management requirements. Orange County initially adopted Subdivision Regulations in 1965, including the County's original stormwater requirements. Revisions to the stormwater management requirements have been strengthened as data on the impacts of development on drainage have been obtained. The existing stormwater management standards require a system designed to provide for pollution abatement recharge (where possible), and protection from flooding.

These standards are to be accomplished through measures such as pre-treatment of run-off, retention/detention ponds, flood proofing, and increasing minimum pipe size in storm sewer systems. All developments and road projects are required to provide a drainage plan designed to County standards. Orange County's Subdivision Regulations contain minimum design storm requirements (see Table II.B-1). In addition, the Subdivision Regulations require development to retain the first one half inch of run-off or run-off resulting from the first inch of rainfall, whichever is greater. This standard helps to improve the quality of stormwater discharge. Furthermore, stormwater facilities should be required to not degrade receiving surface water bodies, pursuant to the standards established by the Water Management Districts and the Department of Environmental Regulation. The level of service standard includes a flooding component that limits the peak discharge of a developed site to that from the site in an undeveloped condition. The regulatory provisions discussed above ensure Orange County's level of service standard includes both qualitative and quantitative components as required by 9J-5, Florida Administrative Code. As master stormwater plans are developed, these may include different level of service standards related to the specific needs of a basin. These studies, which will include the criteria required by 9J-5, Florida Administrative Code, will be included in the Comprehensive Policy Plan, as amendments, once they are completed. Retrofitting of existing facilities will be based on the level of service standards set by the master stormwater plans.

An important component to the master stormwater plans discussed earlier should be an emphasis on nonstructural drainage improvements and maintenance. Nonstructural drainage improvements are often less expensive, in addition to being environmentally superior. Further, the County should ensure that its revised Land Development Code continues to protect its natural drainage features. This can be accomplished by including the Orange County Conservation Ordinance with the Land Development Code.

The revised Land Development Code should also ensure as part of the development process, an impact assessment that addresses the cumulative effects of new development on the existing stormwater system. In addition, the County should continue to assess and evaluate the effectiveness of its current stormwater system and criteria. Based on this information, the County will be in a position to evaluate where changes need to be made.

As part of the County's stormwater management process, the County should continue to develop its detailed basin-wide mapping, and continue the acquisition of drainage rights-of-way for the operation and maintenance of the County's drainage system. Further, the County should ensure that all stormwater management devices constructed and dedicated to the County are maintained at minimal cost. Finally, Orange County

should maximize the use of existing stormwater management facilities and available capacity through the implementation of appropriate technology.

In addition to all of these recommended actions, the County should join forces with other local governments to develop Interlocal Agreements related to establishing a communication network, sharing information, coordinating the management of existing projects and conducting joint master stormwater planning. This effort could ensure that the County's master stormwater plans would be developed in a more unified and cost-effective manner.

Thus, by completing master stormwater plans, phasing in the proposed solutions to the County's problems, systematically addressing the County's stormwater needs, and promoting good stormwater practices, the County will be better able to manage its stormwater.

D. STORMWATER MANAGEMENT AND AQUIFER RECHARGE ENHANCEMENT

Orange County is facing increasing potable water demands due to a rapidly increasing population base that is expected to increase by approximately 50 percent over the next 20 years. Increasing aquifer recharge is one approach that has been identified as an incremental water-supply strategy to increase the available amount of potable groundwater and prolong the sustainable yield of the Floridan Aquifer.

Aquifer recharge allows for a reduction or elimination of the impacts of increased groundwater pumping. These impacts include wetland dehydration, surficial aquifer and lake drawdowns, and lateral and vertical saltwater interface movement. Because of this recognition that aquifer recharge can prolong the sustainable yield of the Floridan Aquifer, Orange County Utilities (OCU) and the St. Johns River Water Management District (SJRWMD) are cooperating to implement the Central Florida Aquifer Recharge Enhancement Phase 2 (CFARE2) Project.

The purpose of the CFARE2 Project is to develop an aquifer recharge enhancement plan for Orange County. The plan, if implemented, will maximize recharge in the Orange County area and will minimize the impacts of groundwater withdrawals in order to increase the sustainable fresh groundwater supply and reduce or delay the need to develop more expensive alternative supplies.

The plan will also provide long-term flexibility and consistency with other plans being developed by neighboring cities and counties to the benefit of the overall East Central Florida region. Its objective is to designate how current and future available sources of reclaimed water, stormwater, and surface water can be used to enhance aquifer recharge in a way that allows for continued development of current and projected groundwater supplies in the region.

Part of the project-identification phase also involved an assessment of where various recharge technologies are potentially feasible. As part of this assessment, the use of land application (via rapid infiltration basins [RIBs] or retention ponds modified to accept recharge), lake augmentation, or direct application to the Floridan Aquifer (via recharge wells or injection wells) of available surface or reclaimed water to increase aquifer recharge were all evaluated. The result of the evaluation was GIS mapping of the areas where each of the different technologies may be feasible and a method for quantifying the potential recharge rate for a given candidate project. Potentially feasible areas for RIBs and modified retention ponds were determined based on soil type and depth to the water table. The mapping indicated that suitable conditions for efficient land application of recharge existed primarily in western and northwestern Orange County. Potential RIB recharge rates were calculated based on PB Water's operational experience, which indicates that 1 million gallons per day (MGD) requires

approximately 100 acres in the western part of the county near Water Conserv II and approximately 200 acres in the northwestern part of the county near Apopka.

Regulatory limits on the reclaimed-water recharge rate may be a limiting factor. Developing a modified retention pond will require keeping the recharged water from ponding to maintain the stormwater capacity of the pond. The calculation of the potential recharge rate was based on similar parameters as the calculation of potential RIB recharge rate.

Potentially feasible lakes for augmentation with reclaimed or surface water were evaluated based on lake leakiness. Using observed lake and Floridan Aquifer levels, maps were developed showing the variability in lake leakiness throughout the county. Leakier lakes may be more feasible for lake augmentation because this augmentation will be less likely to cause flooding and will be able to accept a higher flow rate. The potential recharge rate through lake augmentation is derived by evaluating the lake area and the modeled leakance of the confining unit underlying the lake.

Central Florida currently achieves a large volume of aquifer recharge through drain wells (recharge wells) used for flood control. Studies are underway to determine whether these wells are a net benefit to water resources and to quantify that benefit. Several types of recharge wells were considered, including maintenance activities to restore capacity and the construction of new wells. The current status of a recharge well determines if a recharge well maintenance project is feasible. A location where a recharge well has been abandoned may not be as feasible for use in a recharge project as a location where a well is operable.

Candidate projects were determined for different areas by assessing whether adequate water is available and whether a technology is potentially feasible. The GIS mapping produced for the source-water availability assessment and the recharge-technology assessment facilitated these analyses by simplifying the spatial display of these components. Projects will be preferentially identified in areas where the most benefit can be obtained while minimizing cost. In addition to project identification with the assistance of GIS mapping, input was solicited from utilities and public works providers within and adjacent to Orange County. CFARE2 Project ideas and concepts were also incorporated into the list of candidate projects.

The SJRWMD *District Water Supply Plan* identifies increased aquifer recharge as one method to “significantly increase available fresh groundwater supplies and thereby reduce or delay the need for development of alternative water supplies.” The purpose of the CFARE2 Project is to identify and evaluate potential projects that would allow for increased recharge to occur in the Orange County area. To assist with the identification of these projects, GIS-based analyses were performed and several meetings with interested agencies were held. In order to better evaluate the benefit of each project, a new assessment tool called the BRI was developed based on previous SJRWMD work. Upon completion of the project identification and evaluation, the SJRWMD has programmed funds to assist with the development of these projects.

IV. CONCLUSION

Flooding is a natural phenomenon that has environmental benefits when a system is left in a natural state. However, when intensive urbanization occurs, the amount and rate of stormwater run-off increases unless adequate stormwater management is provided.

Most drainage problems within the County can be associated with development that occurred prior to the adoption of effective stormwater management regulations. The existing regulations have reduced the potential for flood damage and the effects of

run-off pollution on water bodies. In addition, these regulations will be strengthened as more data becomes available.

Adequate stormwater management controls are in place to address drainage concerns in new and future development in Orange County. However, correcting drainage problems caused by older developments or stormwater control practices is still needed. Master stormwater plans help to identify these needs and some of this work is underway.

It is recommended that Orange County establish standards and inventories, and assess and prioritize the status of its lakes and rivers with consideration given toward future restoration programs. This effort will be recognizing that FDEP TMDL program effort to assess impaired water bodies is ongoing, and may open up opportunities for joint action with FDEP and other agencies in addition to providing the information necessary for master stormwater planning.

These concerns demonstrate the need for a comprehensive approach to address stormwater management in Orange County. Master stormwater plans identify and address all existing and anticipated drainage problems and issues and recommend a course of action to guide stormwater management throughout the next twenty years.

Section 9J-5.011

STORMWATER MANAGEMENT ELEMENT

GOAL, OBJECTIVES, POLICIES

GOAL SM1 **Orange County shall manage stormwater to prevent flood damage and protect water quality.**

OBJ SM1.1 **Orange County shall minimize the occurrence of flooding that is a threat to human health or property. This objective shall be made measurable by implementing the following policies.**

POLICIES

SM1.1.1 Orange County shall not approve for construction any road, street, or facility proposed to be constructed within a designated flood hazard area, unless mitigation measures as identified in the applicable regulations have been installed by the developer to overcome an identified flood hazard. All measures installed by the developer must be certified acceptable by the County prior to project completion. This policy shall be included in the floodplain regulations of the Land Development Code.

SM1.1.2 Orange County shall require stormwater management systems within all development to be designed and installed to provide adequate flood protection for all primary structures and to protect the structural integrity of all roadways. (Amend. 12/00, Ord.00-25)

SM1.1.3 Orange County shall require that all new stormwater management systems provide for the safe handling of all stormwater runoff that flows into, across, and is discharged from the site without creating any additional flooding to adjacent property owners. (Amend. 12/00, Ord.00-25)

SM1.1.4 Orange County shall have the authority to require the design of stormwater management systems to be compatible with those natural terrain or landscape barriers that protect the site against flooding. (Amend. 12/00, Ord.00-25)

SM1.1.5 Orange County shall require that retention/detention areas be designed and located so as to not adversely reduce the existing flood storage of the floodplain. (Amend. 12/00, Ord.00-25)

SM1.1.6 Orange County has established the flood elevations for all land-locked lakes within the basins for which stormwater master plans have been completed. Orange County shall continue to make progress in establishing flood elevations for the remaining area lakes through FEMA, localized studies and the remaining basin studies. Based upon new information, the County shall revise, as necessary, the minimum building pad elevations and modify existing land development regulations in the Land Development Code. (Amend. 12/00, Ord.00-25)

SM1.1.7 Orange County shall investigate reports of flooding in a timely manner. Response times, frequencies, durations and locations shall be noted and reported annually to the Board of County Commissioners.

SM1.1.8 Orange County shall acquire, through easements or acquisition, access to major outfall areas for maintenance and inspection. (Added 12/00, Ord.00-25)

SM1.1.9 Orange County shall continue to participate in the Community Rating System and strive to attain maximum discounts for the citizens of Orange County. (Amend. 12/00, Ord.00-25)

OBJ SM1.2 Orange County shall improve its ability to manage stormwater so as to minimize the degradation of surface and ground water. This objective shall be made measurable by implementing the following policies. (Amended 12/07, Wekiva 2006-1-B-CPP-1)

POLICIES

SM1.2.1 Orange County shall maintain and, where needed, improve the design standards, construction, and maintenance requirements of all stormwater retention/detention systems, and ensure compliance with these requirements to prevent degradation of receiving surface water bodies.

SM1.2.2 Orange County shall continue to identify and prioritize the need for designated riverine management plans for systems such as the Wekiva River and Econlockhatchee River systems on an ongoing basis. These should be conducted through interlocal agreements with neighboring counties and collaboration with the appropriate departments and management districts. Related land use planning and programmatic approaches shall be adopted after the management plans are completed. (Amend. 12/00, Ord.00-25)

SM1.2.3 Orange County shall require Best Management Practices to minimize contributions of poor quality stormwater run-off to both groundwater and surface water bodies as part of both construction and operational phases of a project.

SM1.2.4 Orange County shall continue to require that plans for expansion, modification, or replacement of existing development provide some effective form of stormwater treatment, where such stormwater treatment is currently inadequate. (Amend. 12/00, Ord.00-25)

SM1.2.5 Orange County shall continue to implement a program that monitors the effectiveness of County-maintained stormwater treatment systems to allow identification of possible system deficiencies. As part of this program, the possibility of including privately maintained facilities shall be evaluated. If there are deficiencies, Orange County shall develop a plan to improve its enforcement and maintenance procedures. This information shall be noted and included when the Division reports annually to the Board of County Commissioners, as referenced in Stormwater Management Policy SM1.4.9. (Amend. 12/00, Ord.00-25)

SM1.2.6 Orange County shall continue to require that erosion and sediment control plans be submitted and approved prior to a pre-construction conference as regulated through the Land Development Code. These plans shall be developed in accordance with the FDEP *Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual*. (Amend. 12/00, Ord.00-25)

SM1.2.~~8~~7 Orange County shall continue to participate with other involved agencies to develop and implement lake management plans for those water bodies determined to be in greatest need. If stormwater is determined to be a major water quality problem for a lake, planning shall be undertaken for corrective measures as part of the master stormwater planning process. The FDEP TMDL

BMAPs will set the pollution reduction allocations to be accomplished by local, regional and state entities. (Drainage wells are currently regulated by FDEP and any changes or modifications must comply with their strict regulations.)

SM1.2.8 Specific care shall be given to follow the FDEP TMDL program. This shall include an intra divisional review of the ongoing FDEP activities for listing water bodies. Those listed water bodies shall be targeted for retrofit projects and special stormwater quality enhancement projects. The watersheds of listed water bodies shall receive special stormwater and groundwater protection and enhancement consideration for all development and redevelopment. This shall include strict adherence to existing, environmentally sound land use requirements, as well as an implementation of alternative, proven, and more protective land use requirements, as they become available.

SM1.2.9 Within the Wekiva Study Area, new development and substantial redevelopment shall use best management practices (BMPs). At a minimum, use of these BMPs shall maintain surface and groundwater flow rates and volumes at pre-development levels. Water quality treatment shall reduce nutrients and other contaminants in discharges to historical background levels. Post-development peak rate of discharge must not exceed the predevelopment peak rate of discharge. The natural forms and functions of wetlands, surface water features, floodplains and other conveyance systems, as well as groundwater recharge areas shall be maintained. (Added 12/07, Wekiva 2006-1-B-CPP-1)

OBJ SM1.4 Orange County shall identify and correct existing stormwater/drainage facility deficiencies on a priority basis. Public health and safety shall be the foremost priority. This objective shall comply with FDEP TMDL BMAPs as developed and implemented and shall be made measurable by implementing the following policies.

POLICIES

SM1.4.1 Orange County shall continue to complete a formal listing that indicates the priority of drainage basin studies within the County, and coordinate any actions that are necessary to facilitate master stormwater plan completion by other entities. (Amend. 12/00, Ord.00-25)

SM1.4.2 Orange County shall adopt a stormwater utility ordinance and shall identify other alternative funding sources for drainage improvements and master stormwater planning to enhance current funding levels on an ongoing basis. These new funding sources shall be used to meet additional drainage demands such as implementing master drainage planning or mitigating threatening drainage wells. (Amend. 12/00, Ord.00-25)

SM1.4.3 Orange County shall complete primary and secondary drainage facility inventories for basins within the County and continue the completion of more detailed inventories through the development of drainage basin stormwater master plans.

SM1.4.5 Orange County shall update all of the stormwater master plans on an as-needed basis, as identified in Stormwater Management Policy SM1.4.1. These master stormwater plans shall include, at a minimum, all data and analysis requirements of Chapter 9J-5.011(1)(a) through (f), Florida Administrative

Code. To make these planning efforts more efficient, the level of detail for a specific basin can be targeted toward the prioritized needs referenced in Stormwater Management Policy SM1.4.7. (Amend. 12/00, Ord.00-25)

SM1.4.6 Orange County shall correct or mitigate the facility deficiencies identified as impacting the public's health and safety. These existing facility deficiencies shall be upgraded based upon adopted levels of service standards appropriate for each basin. Deficiencies shall include flooding or degradation of surface and groundwater quality.

SM1.4.7 Orange County shall prioritize and correct the deficiencies identified in the master stormwater plans through the subsequent stormwater sections of the Capital Improvements Program, with consideration given to the following criteria. (Amend. 12/00, Ord.00-25)

A. The first priority should be given to those deficiencies that threaten health, safety and welfare. This policy shall be interpreted to include drainwells identified to be a public threat to the aquifer or public drinking well water supply.

B. The second priority should be given to those improvements that represent opportunities to participate on "joint projects" (with other public or private entities), such as Lake Apopka Restoration, that will result in more efficient construction or replacement of stormwater improvements over time and shall follow the FDEP TMDL BMAPs as implemented.

SM1.4.8 Orange County Stormwater Management Division shall cooperate and consult with the City of Orlando, other municipalities, and adjoining governments for the completion and updates of the identified master stormwater plans and the subsequent improvements to these systems. This cooperation shall include provision of information and technical assistance, participation on joint technical committees, and attendance at appropriate meetings.

SM1.4.9 Orange County's Stormwater Management Division shall, as part of the budget process, continue to report annually to the Board of County Commissioners on prioritizing drainage concerns.

SM1.4.10 Orange County shall amend the comprehensive policy plan, including the stormwater management level of service, to incorporate the pertinent findings, data and analysis, and recommendations of all master drainage studies as they are completed.

SM1.4.11 Orange County shall cooperate and consult with the St. Johns River Water Management District, the Florida Department of Environmental Protection and adjoining local governments and municipalities for the development and implementation of the Wekiva Study Area regional master stormwater management plan. This may include establishment of a regional stormwater environmental utility to fund needed improvements and projects. The *Wekiva Parkway and Protection Act Master Stormwater Management Plan Support Final Report,* November 2005, is herein adopted by reference. This master stormwater management plan identifies areas of stormwater management deficiency and contains prioritized projects to correct deficiencies and implement strategies to accommodate long-term needs within the Wekiva Study Area. (Added 12/07, Wekiva 2006-1-B-CPP-1)

OBJ SM1.5 Orange County shall manage and coordinate its stormwater review and implementation process to meet future needs and protect the functions of natural drainage features. This objective shall be made measurable by implementing the following policies.

POLICIES

SM1.5.1 Orange County shall require that nonstructural drainage improvements be used to solve existing drainage problems where it is economically and/or physically possible. Where structural approaches must be used, the County shall ensure that environmental damage is minimized.

SM1.5.2 Orange County shall continue to ensure that the stormwater management regulations contained in the County Land Development Code protect natural drainage features by requiring compensatory storage, restoration/mitigation of wetlands, nonstructural techniques when feasible, erosion and sediment control, maintenance of natural hydroperiods, and maximization of on-site detention/retention. (Amend. 12/00, Ord.00-25)

SM1.5.3 As part of the development review process, an impact assessment will be required that addresses the effects of new development on existing stormwater management systems. This review process, as defined in the Land Development Code, considers how the stormwater management system will operate at build-out. (Amend. 12/00, Ord.00-25)

SM1.5.4 Orange County shall continue to evaluate the effectiveness of current surface water management criteria in the Land Development Code, including the applicability and effectiveness of swales, open channels, and culverts.

SM1.5.5 Orange County shall monitor and update the regulations in the Land Development Code to ensure the following criteria are met:

A. Where economically feasible and physically possible, a nonstructural approach shall be used to meet the County's surface water quantity and quality needs;

B. In new developments, Orange County shall require a retention/detention system that limits peak discharge of a developed site to the peak discharge from the site in an undeveloped condition for a specified design storm;

C. Stormwater collected in any development must be disposed of in a manner that will not cause personal or property damage to upstream and/or downstream property owners;

D. Any segment of a drainage system that is to be dedicated and made a part of the County's drainage system shall be designed to accommodate upstream flows through the system; and,

E. Each phase of any development shall exist as an independent unit capable of having its surface water management needs met by the drainage system design.

SM1.5.6 Orange County shall continue the acquisition of drainage rights-of-way necessary for the operation and maintenance of the County's drainage system.

SM1.5.7 Orange County shall require that all stormwater management devices constructed and dedicated to the County shall be designed so that they can be maintained at a minimal cost to the taxpayer.

SM1.5.8 Orange County shall maintain a level of service standard for new and existing development, based on the following stormwater quantity and quality criteria:

A. Design storm based on 24 hour minimum.

FACILITY	*DESIGN STORM*
Bridges	50 Year
Canals, ditches or culverts for drainage external to the development	25 Year
Crossdrains, storm sewers	10 Year
Roadside swales for drainage internal to the development	10 Year
Detention basins	25 Year
Retention basins (no positive outfall)	100 Year

B. Pollution abatement shall be accomplished by requiring stormwater management systems to retain or detain with filtration, the first one-half inch of run-off from developed sites, or the run-off generated from the first inch of rainfall on developed sites, whichever is greater.

C. Orange County shall require a retention/ detention system that limits peak discharge of a developed site to the discharge from the site in an undeveloped condition during a 25 year/24 hour frequency storm event.

D. Orange County shall require, prior to development approval that projects receive appropriate permits from State agencies to comply with the rules and regulations for stormwater facility design, performance and discharge.

E. Discharged stormwater run-off shall not degrade receiving surface water bodies below the minimum conditions as established by State water quality standards (62-302 and 62-40.432, Florida Administrative Code).

SM1.5.9 Orange County shall provide adequate primary and secondary drainage services to maintain the adopted level of service standards based upon, but not limited to, the following considerations:

A. Protection and maintenance of the lives and safety of County residents;

B. Protection and maintenance of the property of County residents;

C. Protection of existing public investment;

D. Consideration of pollution abatement;

E. Reduction of operating and maintenance costs; and

F. Achievement and satisfaction of regional, State, and Federal regulations.

SM1.5.10 Orange County shall seek, from Federal and State sources, additional opportunities for funding and joint projects to facilitate County-wide surface water management programs.

SM1.5.11 Orange County shall continue to establish and strengthen interlocal agreements with other government agencies that are involved in stormwater management practices that affect Orange County. Data sharing and exchange of drainage information shall continue to be emphasized in the interlocal agreements. As part of this process, Orange County shall encourage municipalities to enact surface water management criteria that are technically consistent with and meet State, regional, and County requirements for new development. Actions by municipalities that affect the Orange County drainage system should likewise be communicated to the County. (Amend. 12/00, Ord.00-25)

SM1.5.12 Within the Wekiva Study Area, no stormwater structure or facility shall be located within the specific distances of a karst feature shown below unless it is determined by a certified professional geologist or professional engineer experienced in geohydrology that the area is safe and that there is no subsurface connection that may cause contamination or damage to the groundwater. No stormwater runoff shall be allowed to drain directly through

any sinkhole or other karst feature. All runoff recharging the Floridan Aquifer shall be pre-treated to remove nutrients and other contaminants so that post-development water quality equals predevelopment recharge water quality to the greatest extent feasible. The Land Development Code will be amended by July 1, 2007 to include setbacks and specific performance standards for development within areas of sinkholes, karst features, drainwells, and any other feature with a direct connection to the Floridan Aquifer. (Added 12/07, Wekiva 2006-1-B-CPP-1)

Karst Feature Type	*Minimum Buffer in Feet*
Springs	300
Spring Runs	150
Sinkholes with direct connection to the aquifer	200, as measured from the drainage divide
Other sinkholes	100, as measured from the drainage divide
Caves	½ mile, as measured on the surface from the centerline of the cave system
Other karst features with a direct connection to the aquifer (swallet or stream to sink)	200, as measured from the drainage divide

SM1.5.13 Within the Wekiva Study Area, all stormwater management and drainage systems proposed to be constructed in karst sensitive areas, areas with known sinkholes, and areas with shallow depth to limestone bedrock, shall be evaluated for the presence of sinkholes through appropriate geotechnical testing. All proposed Drainage Retention Areas (DRAs) shall be tested for the presence of cavities and voids beneath them. No DRAs or other stormwater facilities, excluding conveyance facilities, shall be located over unfilled voids. The Land Development Code will be amended by July 1, 2007 to include specific performance standards for stormwater facilities within areas of sinkholes, karst features, drainwells, and any other feature with a direct connection to the Floridan Aquifer. Geotechnical testing requirements for the presence and extent of karst features shall be incorporated into subdivision and site development standards. (Added 12/07, Wekiva 2006-1-B-CPP-1)

SM1.5.14 If there is an existing sinkhole within or adjacent to a development site, or likelihood that a sinkhole may develop in the future, then a detailed geological/geotechnical investigation shall be required. This investigation must be conducted by a professional geologist or engineer experienced in geohydrology and a report submitted to the County for consideration. The geologic investigation shall be comprehensive enough that recommendations for site planning, engineering design and construction techniques may be made. The County shall approve, approve with conditions, or deny development proposals based upon the scale of the development and the hazards revealed within the investigation. (Added 12/07, Wekiva 2006-1-B-CPP-1)

SM1.5.15 The County shall cooperate with the Water Management District and will adopt in the Land Development Code, by July 1, 2007, appropriate, specific requirements for stormwater structures or facilities located within karst sensitive areas. Such requirements may include evaluations by professional geologists or engineers experienced in geohydrology that the area is safe and that there is no subsurface connection that may cause contamination or damage to the groundwater. (Added 12/07, Wekiva 2006-1-B-CPP-1)

OBJ SM1.6 Orange County shall maximize the use of existing stormwater management facilities and available capacity through the implementation of appropriate technology.

POLICIES

SM1.6.1 The shift to new technologies and operational procedures shall occur as they become feasible.

SM1.6.2 Orange County shall actively participate in the development of innovative stormwater management programs that protect and conserve the County's water resources. This shall include, but not be limited to, the use of Low Impact Design (LID) technology such as swales and porous pavement in parking lots to increase infiltration and minimize the sizing of stormwater ponds.

SM1.6.3 Orange County shall continue to investigate alternative management systems for providing efficient stormwater management service.

SM1.6.4 Orange County shall investigate innovative measures to reuse stormwater and for stormwater retention and detention. (Added 12/00, Ord.00-25)

SM1.6.5 The County will require Best Management Practices (BMPs) for all stormwater management systems located in the Wekiva Study Area. Systems in areas of high recharge, in Primary and Secondary WAVA Zones (Wekiva Aquifers Vulnerability Assessment), and karst sensitive areas shall be designed to address maintenance of water quality. Such BMPs may include lining of stormwater ponds, use of biological treatment trains for nutrient and contaminant removal, incorporation of stormwater management systems into landscaping and irrigation, and minimizing directly connected impervious surface areas. (Added 12/07, Wekiva 2006-1-B-CPP-1)

SM1.6.6 Orange County will continue to seek ways to expand its efforts in reusing stormwater for irrigation, aquifer recharge, and other non-potable uses. The County will evaluate and establish, as appropriate, a threshold wherein a project that generates sufficient quantities of runoff shall be required to reuse that stormwater. Such thresholds shall be included in the Land Development Code by July 1, 2007, as needed. The County will require all new development and redevelopment to use stormwater for irrigation where feasible. Use of stormwater for irrigation shall be credited towards a project's potable water concurrency requirements. (Added 12/07, Wekiva 2006-1-B-CPP-1)

SM1.6.7 Orange County shall complete an inventory of the primary and secondary drainage systems that are under their jurisdiction and store the information in the County's GIS system. A database will be developed to track maintenance related issues. The database also will be linked to a hydrologic/hydraulic computer model of the area in order to determine floodplain elevations and discharges. (New 10/08, 2009-1-B-EAR-CPP)

OBJ SM1.7 Orange County shall adopt Land Development Regulations that require stormwater management systems to be designed, constructed and maintained in an aesthetically pleasing manner and with greater efficiency, giving importance to the aesthetic characteristics of each pond, structure and other features of the system visible to the public. (Added 5/96)

POLICIES

SM1.7.1 Orange County shall continue to develop design guidelines for construction of stormwater ponds that are visually pleasing and safe. The design guidelines should consider items including, but not limited to, fencing, slope, construction materials, location within a tract, landscaping, and passive park uses. (Added 5/96, Ord.96-11)

SM1.7.2 Orange County shall consider including incentives as part of the LDRs for developers who design their stormwater ponds in an aesthetically pleasing manner. Incentives should consider, but not be limited to, density and open space credits. (Added 5/96, Ord.96-11)

SM1.7.3 Orange County shall work towards implementing a stormwater beautification program to integrate existing stormwater ponds with surrounding land uses in order to be more visually pleasing. (Added 5/96, Ord.96-11)

SM1.7.4 Orange County shall continue to implement guidelines to encourage master stormwater planning and the reliance on fewer larger ponds rather than a system of many smaller ponds. The overall master planning concept shall consider the impact to local aquifer recharge and potential for groundwater contamination clean-up. (Added 5/96, Ord.96-11)

Stormwater Management Appendices

Stormwater management is a vital component of the infrastructure in Orange County. Stormwater management techniques protect urbanized areas from flood damage and control quantity and quality of stormwater runoff into water bodies and drainage wells. The Stormwater Element presents policies, goals and objectives to further the provision of a cost effective stormwater management program that provides for the health safety and welfare of the citizens of Orange County.

Figure 1: 100 year flood boundary

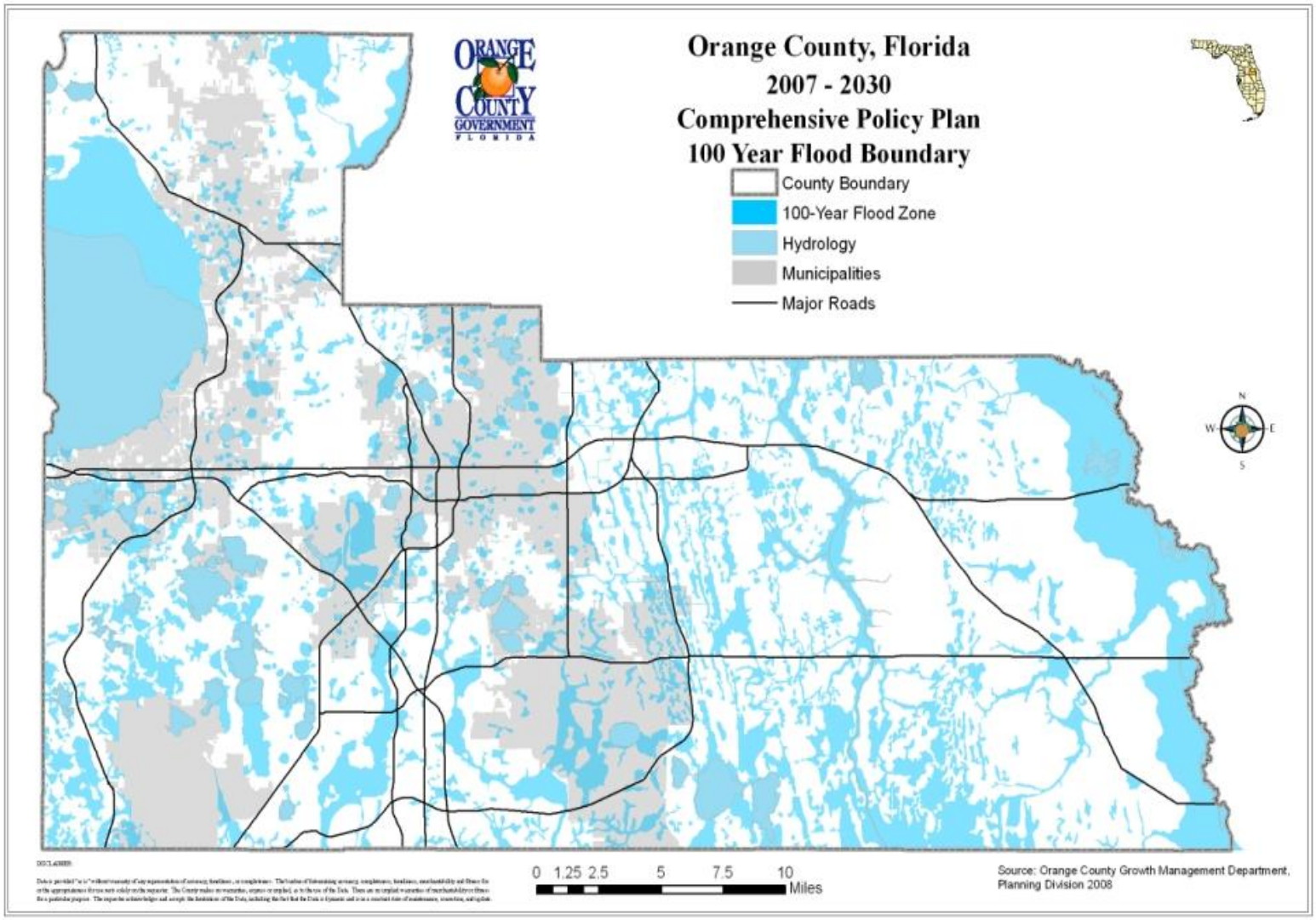


Figure 2: Primary Water Control Systems, supporting lakes and control structures

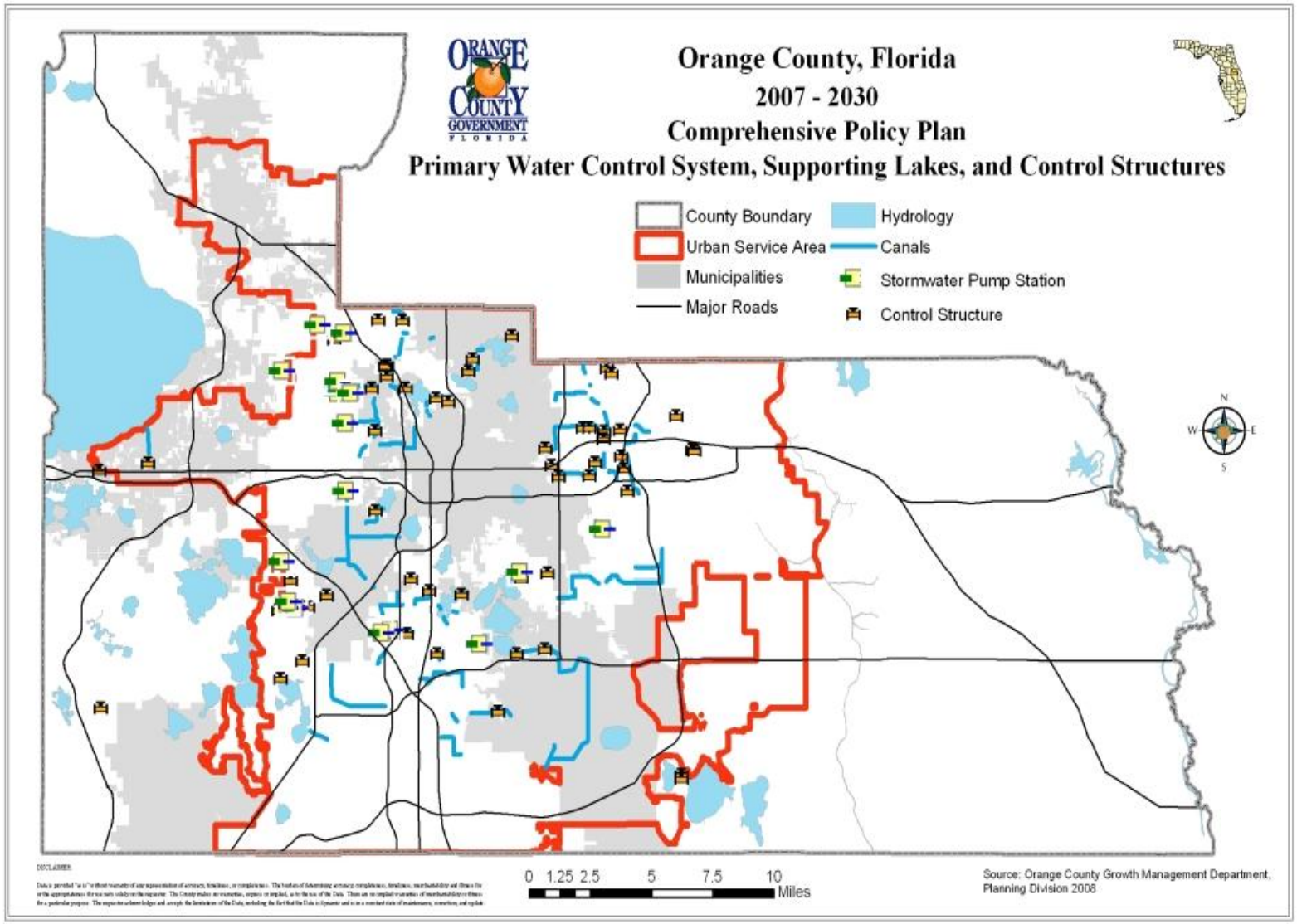


Figure 3: Drainwell Locations

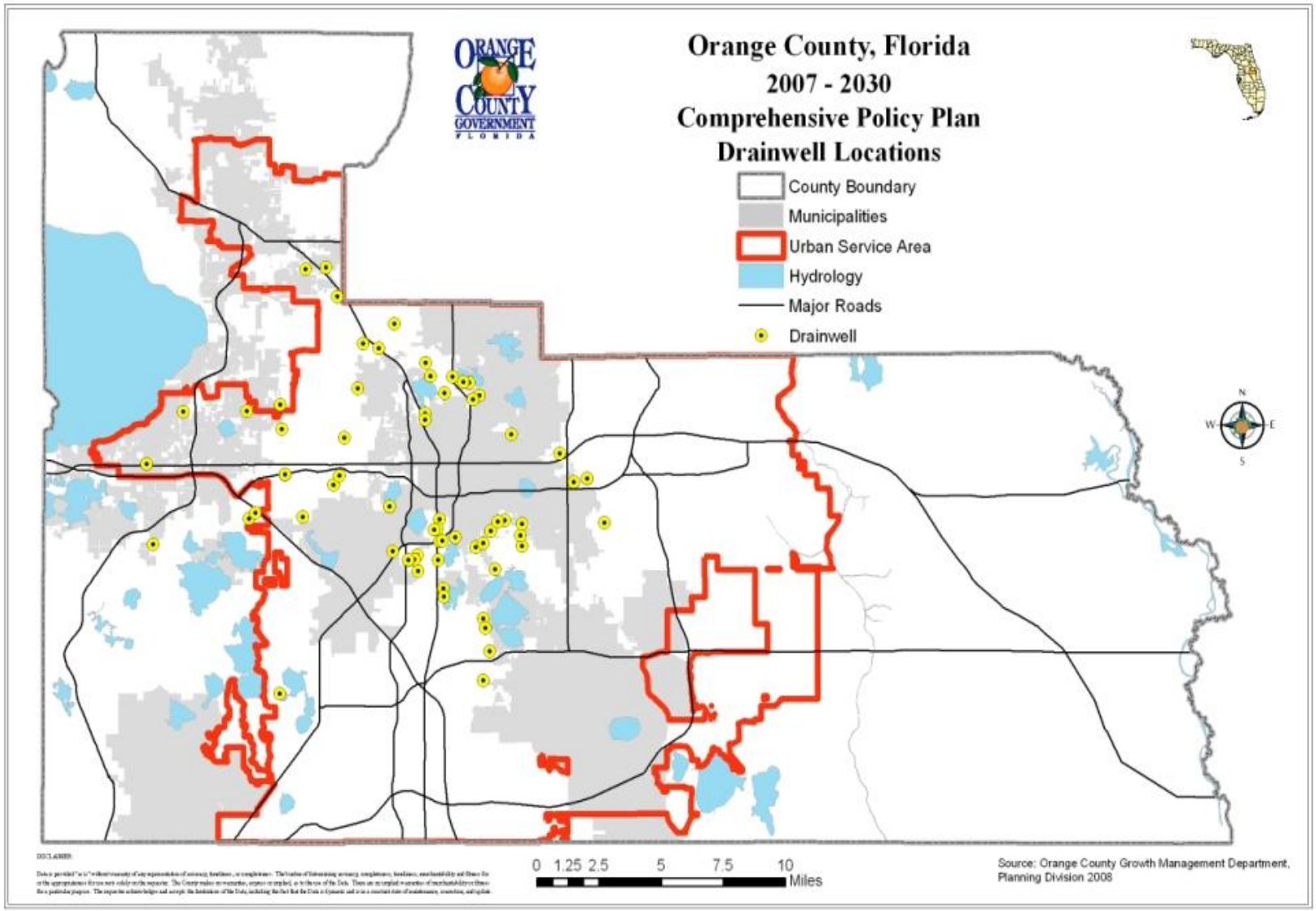


Figure 4: Major drainage basins

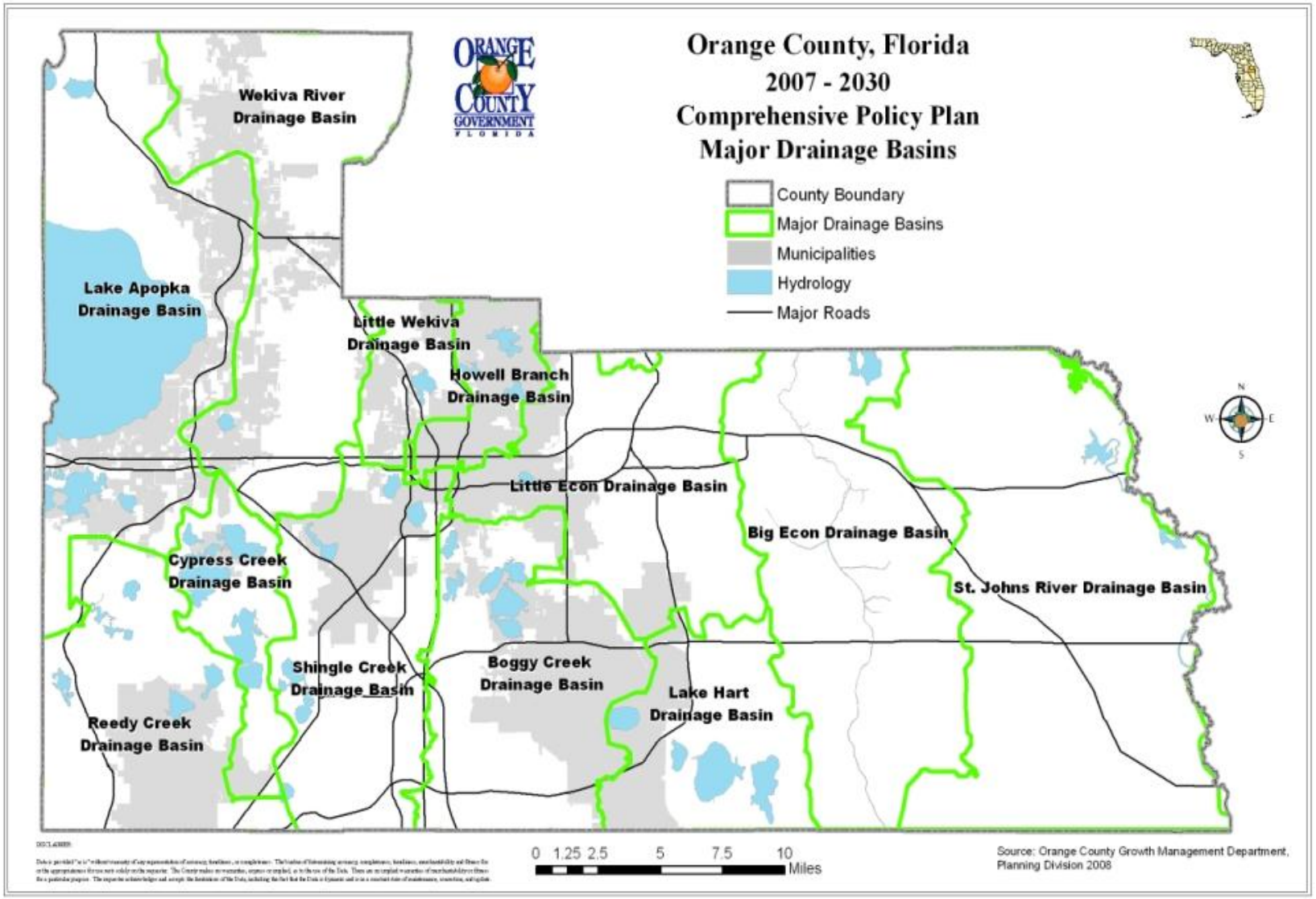


Figure 5: Wetland vegetative communities

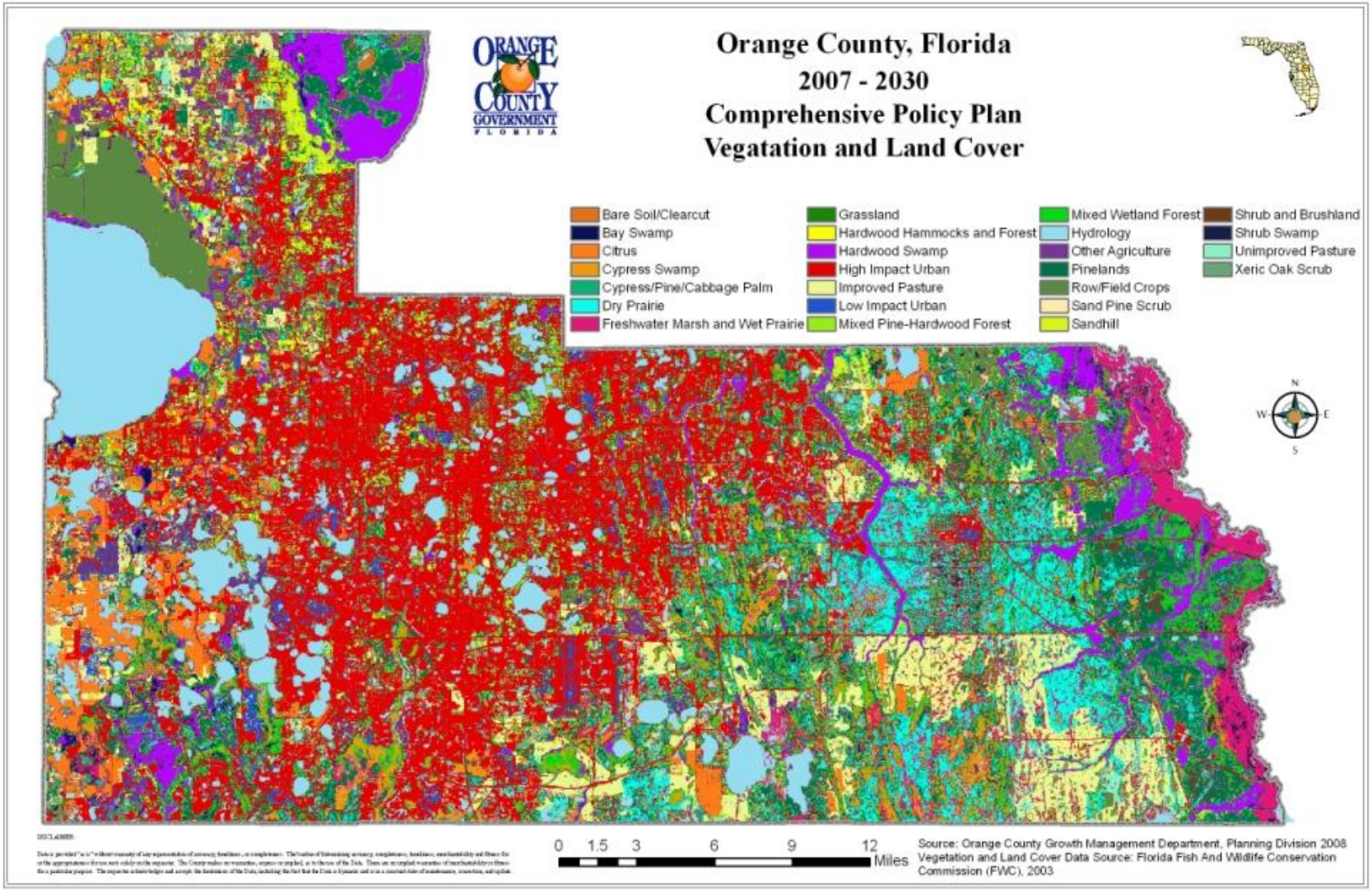


Figure 6: Generalized soils