SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Planning Document

LOWER EAST COAST
WATER SUPPLY PLAN UPDATE

2013

Acknowledgements

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Furthermore, the South Florida Water Management District expresses appreciation to all staff who contributed to the development and production of this plan update.

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Executive Summary

The South Florida Water Management District's (SFWMD) strategic goal for all of its water supply plans is to ensure an adequate supply of water to protect natural systems and to meet existing and future reasonable-beneficial uses, while sustaining water resources for future generations. This document is the second update to the *2000 Lower East Coast Regional Water Supply Plan* (2000 LEC Plan) (SFWMD 2000). The first update, the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update), was finalized in 2007 (SFWMD 2007). This update presents twenty-year population and water demand projections, a review of water supply issues and evaluations, and water source options; examines local and regional efforts completed since the previous update; and evaluates future water resource and proposed water supply development projects for 2010–2030.

The Lower East Coast (LEC) Planning Area covers 6,100 square miles, including Palm Beach, Broward, and Miami-Dade counties, most of Monroe County, and eastern Hendry and Collier counties. The Everglades Agricultural Area, located in the LEC Planning Area, is a portion of the Lake Okeechobee Service Area. However, the entire Lake Okeechobee Service Area, which includes portions of Martin, Okeechobee, Glades, and Lee counties, is considered in the LEC water supply planning process because of its reliance on Lake Okeechobee.

A number of factors distinguish the LEC Planning Area from others regions of the state, including population, spatial extent of natural systems, availability of fresh water, and an extensive network of canals and related water works. The LEC Planning Area boundary encompasses three of the state's five most populous counties. Extensive natural systems such as Lake Okeechobee, the Everglades, Florida and Biscayne bays, the Northwest Fork of the Loxahatchee River, and Lake Worth Lagoon are found in the LEC Planning Area. It includes two national parks and four national wildlife refuges. The area typically receives abundant fresh water seasonally, with volumes exceeding human and natural system needs. Water availability also varies annually, including periodic drought. The regional water management system, the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project), is largely located in the LEC Planning Area. The C&SF Project plays a critical role in capturing wet season storm water and moving water between natural systems as well as delivering water to agricultural areas and the urbanized coastal communities.

Total water demand is projected to increase by 12 percent to 1,933 million gallons per day (MGD) by 2030. Public Water Supply (PWS) remains the LEC Planning Area's single largest water use category in 2030, representing 52 percent of the planning area's total water demand. It is followed by agriculture at 34 percent. The remaining four categories, domestic (residential) self-supply, recreation and landscaping, industrial, and power generation, account for the remaining 14 percent.

The LEC Planning Area traditionally has relied on fresh groundwater from the surficial aquifer system and surface water from Lake Okeechobee as primary water sources for urban, agricultural, and industrial uses. The Everglades provides groundwater and surface water recharge to the urban coastal communities, contributing to the water supply throughout most of this region. In 2010, fresh groundwater accounted for 94 percent of potable water produced by PWS utilities. The surficial aquifer system, including the Biscayne aquifer, provides more than 1 billion gallons a day for utilities, as well as agricultural production, landscape irrigation, and other uses. Since the last plan update, the SFWMD placed limitations on additional allocations from the freshwater sources in the region to protect the region's natural resources. As a result, use of alternative water sources has expanded.

This plan update was developed in an open public forum with water supply utilities, local governments, environmental organizations, agricultural interests, and other stakeholders through the SFWMD's Water Resources Advisory Commission. The process to develop the population and water demand projections began in 2010. Multiple meetings and workshops were held with water users, local governments, utilities, agriculture and other industry representatives, environmental representatives, and agencies to solicit input, provide information about planning results, and receive comments on draft sections of the plan.

PUBLIC WATER SUPPLY

This plan update represents a departure from the demand projections in the 2000 LEC Plan and the 2005–2006 LEC Plan Update. Subsequent to approval of the 2005–2006 LEC Plan Update in February 2007, the nation's economy fell into a long recession that had significant impacts on regional water supply planning, lowering population and demand forecasts. The dramatic slowdown in population growth occurred at the same time that consumption of potable water declined as measured in gallons per person per day. Likely reasons for this decrease in PWS consumption include short-term water shortage restrictions in response to droughts, long-term water conservation projects including SFWMD's year-round landscape irrigation conservation measures, and increased use of reclaimed water. Local actions, such as implementation by Broward and Miami-Dade counties of ordinances limiting landscape irrigation to two days a week, the Broward County Water Conservation Partnership, and individual utility conservation programs, have been key in lowering the water use rate. An indication of the resulting trend is the LEC Planning Area's population grew by 600,000 people between 2000 and 2010, but total potable water use declined by 87 MGD (10 percent) during the same decade.

This plan's twenty-year population and PWS demand forecasts are lower than the two previous plans' projections. Projections developed for this update indicate the planning area's population will increase over 18 percent, from approximately 5.6 million residents in 2010 to slightly more than 6.6 million by 2030. In contrast, the 2005–2006 LEC Plan Update projected the planning area's population to increase over 31 percent, to 7.3 million by 2025. The projected population growth varies widely between the counties: Palm Beach County

(+25 percent), Broward County (+14 percent), Miami-Dade County (+18 percent), and Monroe County (-5 percent).

The projected gross water demand for 2030 for the region's PWS is 1,008 MGD, a 20 percent increase from the volume used in 2010. Because the 2010 PWS water use was lower than the historical demand of the previous decade, the projected growth is within the available capacities for most utilities. Also, many utilities have been planning for the higher population growth rates and have secured twenty-year water use permit allocations and built the necessary treatment capacity. The cumulative volume of water currently allocated for PWS slightly exceeds the total projected demand for 2030 and the majority of the PWS water providers appear to be able to meet their 2030 projected demand without additional allocation or infrastructure. A few utilities will likely face a potential deficit on an average daily or peak demand basis within the next 20 years and have proposed projects in this plan for the deficit.

Utilities have diversified their water supply sources with development of alternative water supplies, including treatment and storage technologies, and water conservation programs. These alternatives include constructing brackish Floridan aquifer wells and reverse osmosis treatment plants, reclaimed water treatment and distribution facilities, and aquifer storage and recovery systems. Between 2007 and 2009, 41 MGD of potable water supply capacity was added. From 2010 to 2013, nine utilities built potable water supply projects with a capacity of 49 MGD. Approximately 14 percent of the current PWS allocation is now from an alternative water source, primarily brackish groundwater.

In this plan update, 10 utilities have proposed 13 new potable water supply projects totaling 76 MGD. Based on the 2030 demand projections, two utilities each appear to need one of their proposed potable water supply projects during the planning period. The two projects total 26 MGD. Local governments, in coordination with utilities, will address the proposed projects as they revise their water supply facilities work plans, which must be submitted to the State of Florida Department of Economic Opportunity and reviewing agencies within 18 months of approval of this plan update.

In addition to the 13 potable water supply projects, this plan update incorporates 15 nonpotable water projects proposed by utilities to meet future needs. Twelve of the nonpotable water projects are reclaimed water projects, including several to comply with the 2008 Leah G. Schad Ocean Outfall Program. Implementation of this program is expected to result in 178 MGD of additional reuse by 2025. If population growth accelerates faster than forecasted, reuse and other alternative water source projects could become more urgent for some water providers.

AGRICULTURAL WATER SUPPLY

Agricultural self-supply demand is projected to remain relatively stable over the planning horizon. It will continue to be the LEC Planning Area's second largest water user in 2030, accounting for 34 percent of the total water demand. Agricultural areas are projected to need supplemental irrigation water for approximately 575,897 acres in 2030 with a gross water demand of 668 MGD. The largest concentration of agricultural activity is located in the Everglades Agricultural Area and is dominated by sugarcane. The Everglades Agricultural Area, dependent on Lake Okeechobee and its connected conveyance canals for supplemental irrigation, is a fully developed, stable agricultural area where permitted acres and cropping practices are not expected to change over the next 20 years.

While urban development has reduced farmlands east of the Everglades, a robust agricultural industry remains in portions of Palm Beach, Broward, and Miami-Dade counties, which are within the LEC Service Area. Winter vegetables dominate the crops in eastern Palm Beach and Broward counties. Miami-Dade County has extensive nurseries and tropical fruit groves, in addition to vegetable crops. A modest increase of 581 acres is anticipated by 2030 for the agricultural operations in the LEC Service Area.

LAKE OKEECHOBEE

In the Lake Okeechobee Service Area, local conditions limit the volume of available fresh water. Specifically, Lake Okeechobee and hydraulically connected water bodies are limited sources as a result of the United States Army Corps of Engineers' (USACE) implementation of the 2008 Lake Okeechobee federal regulation schedule. The schedule change is intended to operate the lake at lower levels than recent regulation schedules to reduce the risk that the lake's dike might fail, as well as impacts to the lake ecology.

Studies supporting the 2008 Lake Okeechobee Regulation Schedule change assessed impacts on water supply performance. The analysis projected a decline in the physical level of certainty of agricultural users reliant on lake water supplies, from a 1-in-10 year to a 1-in-6 year drought return frequency. The new schedule also was expected to cause Lake Okeechobee to exceed its minimum flows and levels (MFL) criteria more frequently. In response, SFWMD developed a MFL recovery strategy in 2008. As one part of that strategy, SFWMD adopted regulatory criteria to limit future additional withdrawals from Lake Okeechobee and connected water bodies to protect the lake and prevent further erosion to the level of certainty for existing legal users.

USACE has started the rehabilitation of the Herbert Hoover Dike. The initial step—construction of a 21.4-mile cutoff wall component in Reach 1—is scheduled for completion in 2013, and satisfies the majority of the risk reduction goals. As part of this risk reduction approach, the 32 water control structures (culverts) operated by USACE will be replaced, removed, or abandoned by 2018. Rehabilitation to Reaches 2 and 3 is scheduled for completion by 2022. USACE has indicated it will consider revisions to the lake regulation schedule at that time. Any increase in the lake's regulation schedule as a result of the repairs will likely be evaluated by USACE through a National Environmental Policy Act analysis of multiple objectives including flood protection, water supply, and the ecological health of the lake and downstream ecosystems.

NATURAL SYSTEMS INCLUDING THE EVERGLADES

The water supply needs for natural systems limit water available for allocation and are addressed through a variety of regulatory mechanisms and water resource development projects. Construction of ecosystem restoration projects is vital to the health of the region's water resources, including elements identified in MFL recovery and prevention strategies. The Comprehensive Everglades Restoration Plan (CERP), a partnership between USACE and SFWMD, has long held a critical relationship with water supply planning in the LEC Planning Area and includes capital projects needed for restoration. The 2000 LEC Plan was developed on a parallel track with CERP during the 1990s and identified CERP projects to protect and restore natural systems and provide water supply for urban and agricultural communities alike. Implementation of many CERP projects has been delayed. In response, SFWMD initiated construction of CERP projects within the LEC Planning Area including the Loxahatchee River Watershed Restoration Project, Biscayne Bay Coastal Wetlands Phase 1, and C-111 Spreader Canal Western Project.

A number of CERP components are being formulated and evaluated as part of the Central Everglades Planning Project. This effort is identifying and planning for projects on land in public ownership to allow more water to be directed south to Water Conservation Area 3, Everglades National Park, and Florida Bay, while providing for other water related needs of the region. The recommended plan will require approval by SFWMD's Governing Board and the Florida Department of Environmental Protection, as well as congressional authorization and appropriations.

CONCLUSION

This update provides an assessment of the water supply demand and available sources for the LEC Planning Area through 2030. Meeting the 1-in-10 level of service for all water users and MFLs in the LEC Planning Area is not likely within the next five years due to the interrelationship of the federal projects outlined in the plan and current operations under the 2008 Lake Okeechobee Regulation schedule. Future LEC plan updates will address the progress of the water resource development projects based on project sequencing, project funding, and implementation partnerships as applicable. Until this occurs, this plan continues to rely upon the existing programs and regulations, along with the identified PWS development projects, and their correlation with water supply demands and available sources. The future water needs of the LEC Planning Area can be met with appropriate management, conservation, and implementation of projects identified in this plan. SFWMD anticipates any additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule could return the lake to MFL prevention status, enhance the level of certainty to existing permitted users, and support other environmental objectives. Meeting the future water needs is dependent on the following:

- Construction of two potable water supply development projects by PWS utilities.
- Utilization of the flexibility within the 2008 Lake Okeechobee Regulation Schedule as incremental dam safety improvements are completed; and in the longer term, completion of the seepage berm construction or equivalent repairs to the Herbert Hoover Dike for reaches 1, 2 and 3 by the USACE and implementation of a new Lake Okeechobee regulation schedule.
- Implementation of CERP and other projects identified in MFL prevention and recovery strategies.

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Acronyms and Abbreviations

2000 LEC Plan	*2000 Lower East Coast Regional Water Supply Plan*
2005–2006 LEC Plan Update	*2005–2006 Lower East Coast Water Supply Plan Update*
2008 LORS	2008 Lake Okeechobee Regulation Schedule
ac-ft	acre-feet
AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation
AGR Self-Supply	Agricultural Self-Supply
ASR	aquifer storage and recovery
Basis of Review	*Basis of Review for Water Use Permit Applications within the South Florida Water Management District, referred to as the Basis of Revie*w
BEBR	Bureau of Economic and Business Research
BBCW Project	Biscayne Bay Coastal Wetlands Project
BMP	best management practice
C&SF Project	Central and Southern Florida Project for Flood Control and Other Purposes
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
cfs	cubic feet per second
DBHYDRO	SFWMD's corporate environmental database
Decomp	Water Conservation Area 3 Decompartmentalization and Sheet Flow Enhancement project
DPM	Decompartmentalization Physical Model
DSS	Domestic Self-Supply
EAA	Everglades Agricultural Area
ERTP	Everglades Restoraton Transition Plan
ET	evapotranspiration
F.A.C.	Florida Administrative Code
FAS	Floridan Aquifer System
FDEP	Florida Department of Environmental Protection
FEB	flow equalization basin
FKAA	Florida Keys Aqueduct Authority
FPL	Florida Power & Light

F.S.	Florida Statutes
FY	Fiscal Year
ICI Self-Supply	Industrial/Commercial/Institutional Self-Supply
LEC	Lower East Coast
LECSA	Lower East Coast Service Area
LECsR	Lower East Coast Subregional Model
LOSA	Lake Okeechobee Service Area
MDWASD	Miami-Dade Water and Sewer Department
MFL	minimum flows and levels
MGD	million gallons per day
mg/L	milligrams per liter
ModWaters	Modified Water Deliveries to Everglades National Park
NGVD	National Geodetic Vertical Datum of 1929
PBCWUD	Palm Beach County Water Utility Department
PCUR	per capita use rate
PIR	project implementation report
PWR Self-Supply	Power Generation Self-Supply
PWS	Public Water Supply
REC Self-Supply	Recreational/Landscape Self-Supply
RO	reverse osmosis
SAS	surficial aquifer system
SFWMD	South Florida Water Management District
STA	stormwater treatment area
Support Document	*2011–2013 Water Supply Plan Support Document*
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Water CHAMP	Water Conservation Hotel and Motel Program
WaterSIP	Water Savings Incentive Program
WCA	water conservation area
WTP	water treatment plant
WWTP	wastewater treatment plant

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Introduction

The South Florida Water Management District (SFWMD) updates regional water supply plans to promote the availability of water to meet current and future water needs while protecting South Florida's water resources. This is the second five-year update of the *2000 Lower East Coast Regional Water Supply Plan* (2000 LEC Plan) (SFWMD 2000). This update builds on the information and analysis contained in the 2000 LEC Plan and the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2007). This current update assesses the Lower East Coast (LEC) Planning Area's existing and projected water needs and water sources to meet those needs from 2010 to 2030. The update also describes proposed water supply projects, regional water resource projects and implementation strategies for Fiscal Year (FY) 2010 through FY 2030.

CURRENT UPDATE

This update reflects the influence of significant fluctuations in the economy, residential and commercial development, and agricultural commodity markets on the projected population growth and water needs of the LEC Planning Area. **Chapter 2** of this update documents the population growth and water demand by each water use category. **Chapter 3** discusses regulatory protection of water resources and changes since the last plan update to the water resources, their availability, and issues facing the region. **Chapter 4** identifies water resource development projects that are primarily the responsibility of the SFWMD. **Chapter 5** evaluates the planning area's water source options. **Chapter 6** describes proposed water supply development projects that are primarily the responsibility of water suppliers and water users. **Chapter 7** provides future guidance and direction with emphasis on actions recommended prior to the next update.

NAVIGATE

This plan update consists of this Planning Document, an Appendices volume, and the *2011–2013 Water Supply Plan Support Document* (SFWMD 2013a).

LEGAL AUTHORITY AND REQUIREMENTS

The legal authority and requirements for water supply planning are primarily found in Chapter 373, Florida Statutes (F.S.). Chapters 163, 187, and 403, F.S. provide additional direction. In accordance with Chapters 163 and 373, F.S., regional water supply plans and local government comprehensive plans must ensure adequate potable water facilities are constructed and are concurrently available with new development. The water supply planning region identified in this plan shall be considered a Water Resource Caution Area for the purposes of section 403.064, F.S., and affected parties may challenge the designation pursuant to section 120.569, F.S.

LAW / CODE

Subsection 373.709(1), F.S.:

The governing board of each water management district shall conduct water supply planning for any water supply planning region within the district identified in the appropriate district water supply plan under Section 373.036, F.S. where it determines that existing sources of water are not adequate to supply water for all existing and future reasonable-beneficial uses and to sustain the water resources and related natural systems for the planning period.

GOAL AND OBJECTIVES

The goal for this water supply plan update is to identify sufficient water supply sources and future projects to meet existing and future reasonable-beneficial uses during a 1-in-10 year drought condition through 2030 while sustaining water resources and related natural systems. The following objectives provide an overall framework for this planning process:

- **Water Supply –** Identify sufficient water resource and water supply development options to meet projected 2030 water demands during a 1-in-10 year drought event.

- **Water Conservation and Alternative Source Development –** Increase levels of conservation, the efficiency of water use, and the development of alternative water sources to meet projected demand.

- **Natural Systems –** Protect and enhance the environment, including the Everglades and other federal, state, and locally identified natural resource areas.

- **Linkage with Local Governments –** Provide information to support local government comprehensive plans.

- **Compatibility and Linkage with Other Efforts –** Achieve compatibility and integration with the following:
  - Comprehensive Everglades Restoration Plan (CERP) and other environmental restoration projects

- Modifications to operating schedules for the regional system, including Lake Okeechobee
- Water use permitting process, minimum flow and level (MFL) criteria, and water reservations
- Other regional and local water resource planning efforts

PLANNING PROCESS

The planning process for developing this update is described in **Table 1**.

Table 1. Planning process for developing this plan update.

PLANNING PROCESS			
1	2	3	4
Planning and Assessment	**Data Collection, Analyses and Issue Identification**	**Evaluation of Water Resources and Water Source Options**	**Identify Water Resource and Water Supply Development Projects**
The update process incorporated extensive public participation, including a series of public workshops, as well as coordination with local governments, the Florida Department of Environmental Protection, and other appropriate state and federal agencies. A review of previous planning efforts in the region and documentation of activities since the approval of the 2005–2006 LEC Plan Update were key starting points of this process.	Using the 2005–2006 LEC Plan Update as a foundation, updating this plan involved collecting the latest information about population, water demand, (**Chapter 2**), water resources, water conservation, and land use. Analyses, such as groundwater and surface water evaluations; a review of regulatory information; mapping; wetland studies; and other related data (**Chapter 3**) confirmed the validity of previously identified issues and helped identify new issues.	The next phase of the planning process involved reviewing existing solutions or developing new solutions to address the identified issues. In areas where projected demand exceeds available supplies, solutions included alternative water supplies and water conservation (**Chapter 5**). In most cases, the 2005–2006 LEC Plan Update had identified more projects than needed to meet the projected demand for 2025. Source options were evaluated and appropriate responsibilities were identified.	In areas where water resource conditions warranted, water resource development projects were identified (**Chapter 4**). Water supply projects intended to meet water needs for the next 20 years were identified by utilities then compiled and evaluated by SFWMD with input from stakeholders, the public, and other agencies. The projects were also screened for permitting feasibility. With lower 2030 projections, some proposed projects may be downsized, delayed, eliminated, or substituted with different projects (**Chapter 6**).

Public Participation

SFWMD established the Water Resources Advisory Commission to serve as an advisory body to the Governing Board. The commission is the primary forum for conducting workshops, presenting information, and receiving public input on water resource issues affecting South Florida. Commission members represent interests from all four of SFWMD's water supply planning areas.

SFWMD held Water Resources Advisory Commission issue workshops on the plan update throughout the water supply planning process. Stakeholders representing a cross-section of interests in the region—agricultural, industrial, tribal, environmental, utilities, local government planning departments, and state and federal agencies—were invited to attend the workshops as well as the public. During the workshops, participants reviewed and provided comments regarding projected demand and other key plan elements compiled by SFWMD staff. In addition to issue workshops, water demand projections were also coordinated through individual meetings with local government planning departments, utilities, and agricultural industry representatives. Workshop participants also reviewed and provided input on water supply issues, the condition of regional water resources, water source options, and the draft water supply plan documents. The public's comments on draft chapters of the plan were discussed in workshops and posted on SFWMD's website. Ultimately, the plan was presented to SFWMD's Governing Board for their consideration for approval at a publicly noticed meeting.

PLANNING AREA BACKGROUND

The LEC Planning Area includes all of Palm Beach, Broward, and Miami-Dade counties, most of Monroe County, and the eastern portions of Hendry and Collier counties (**Figure 1**). The inset in **Figure 1** shows the LEC Planning Area in relation to the three other regional planning areas within SFWMD boundaries. Some Palm Beach County utilities provide water to small portions of Martin County. Martin County population demands are included with the appropriate Palm Beach County utility information.

Figure 2 shows the location of the water supply service areas within the LEC Planning Area. The plan boundary encompasses the Lower East Coast Service Area (LECSA) and part of the Lake Okeechobee Service Area (LOSA). LECSA includes major metropolitan areas from West Palm Beach to Fort Lauderdale to Miami. LOSA includes portions of Palm Beach, Martin, Okeechobee, Hendry, Glades, and Lee counties that are dependent on Lake Okeechobee and connected conveyance canals for supplemental water supply. The Everglades Agricultural Area (EAA), the largest portion of LOSA, falls within the plan boundaries. While not included in the water demand totals, the water supply needs of LOSA located in Martin, Okeechobee, Hendry, Glades, and Lee counties are considered in LEC Planning Area analyses. The documentation and discussions of the portion of LOSA outside of the EAA are found in the SFWMD's other regional water supply plans. Likewise, discussions of the Caloosahatchee and St. Lucie estuaries are found in the Lower West Coast and Upper East Coast water supply plans, respectively.

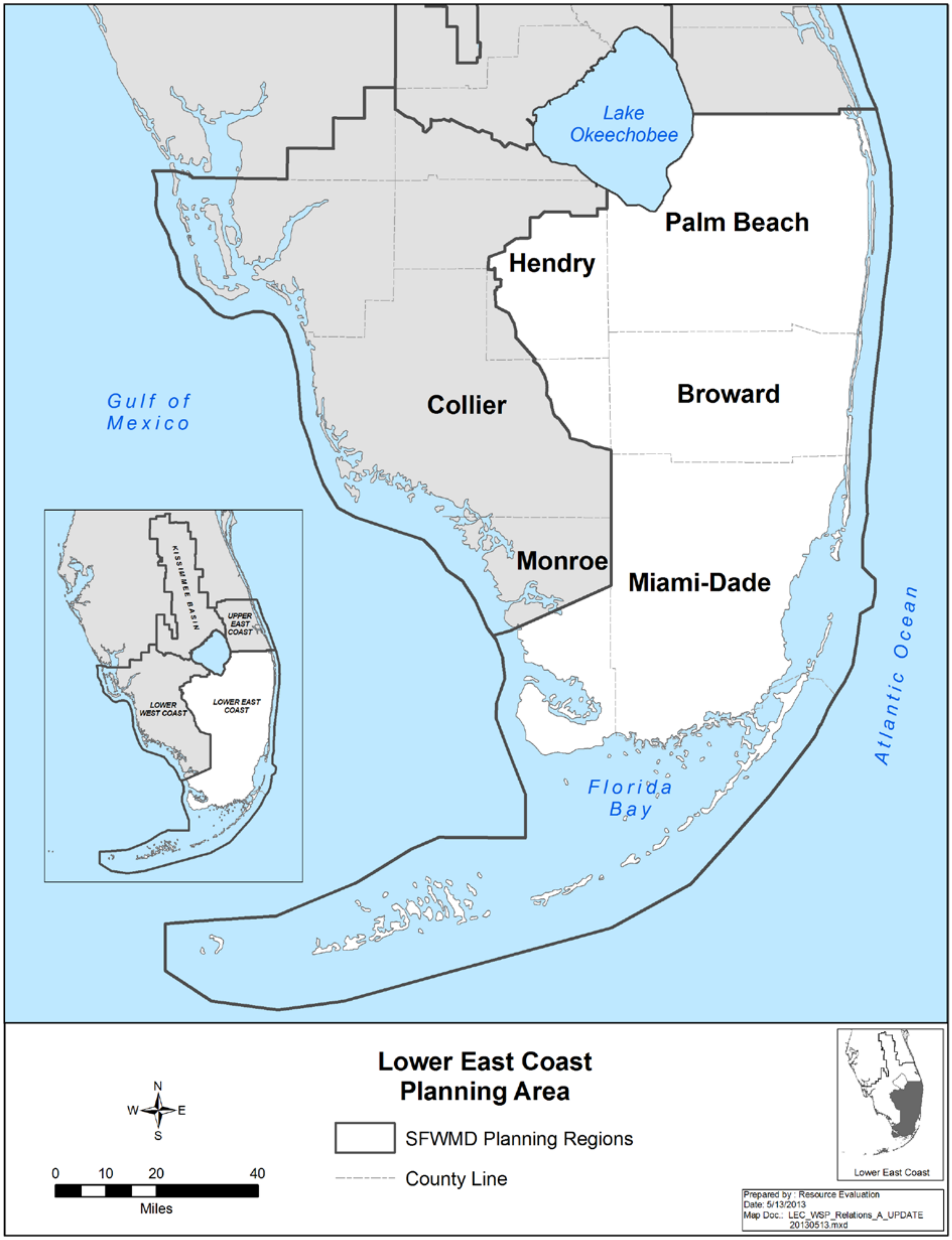


Figure 1. Map of the LEC Planning Area showing the counties within the planning area and its location relative to other planning areas within SFWMD boundaries.

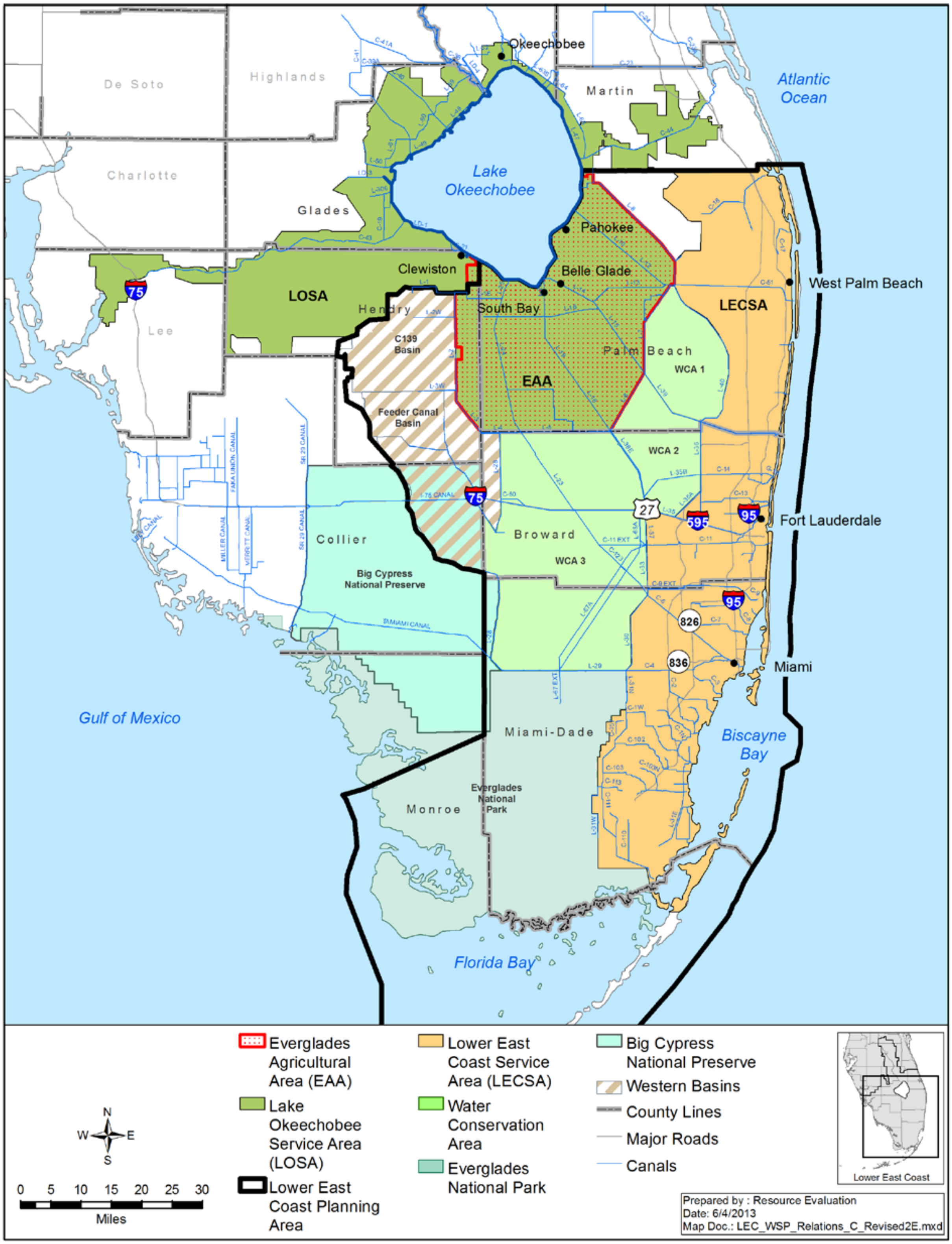


Figure 2. Location of LOSA, EAA, and LECSA in relation to the LEC Planning Area boundaries.

Because the LEC Planning Area is dependent on water from Lake Okeechobee and the Everglades—especially the Water Conservation Areas (WCAs)—for a portion of its supply, the LEC water supply planning efforts are inexorably linked with restoration efforts and management decisions concerning those unique water resources. The majority of restoration projects are part of CERP, a joint effort of SFWMD and the United States Army Corps of Engineers (USACE). In addition to Lake Okeechobee and the Everglades, the LEC Planning Area is home to an extensive agricultural industry, large urban communities (approximately 70 percent of SFWMD's total population), and other valued ecosystems that are generally connected to Lake Okeechobee or the Everglades.

The LEC Planning Area is described in detail in the *2011–2013 Water Supply Plan Support Document* (Support Document) (SFWMD 2013a). Additional background information is highlighted here:

- World-renowned ecosystems, such as the Everglades, Lake Okeechobee, Florida Bay, Biscayne Bay, and the Northwest Fork of the Loxahatchee River are located in the LEC Planning Area. The planning area includes two national parks (Everglades and Biscayne), a federally-designated Wild and Scenic River (Northwest Fork of the Loxahatchee River), and four national wildlife refuges.

- Palm Beach, Broward, and Miami-Dade counties are among the state's five most populated counties. In 2010, the LEC Planning Area represented 30 percent of Florida's total population.

- The 2005–2006 LEC Plan Update included a large set of alternative water supply projects due to the higher population growth projections and Public Water Supply (PWS) demand—1,286 million gallons per day (MGD) in 2025—as well as the anticipated effect of proposed SFWMD rules. In 2007, water use criteria was adopted, which limited direct and indirect withdrawals from Everglades and North Palm Beach County/Loxahatchee River Watershed water bodies and their integrated conveyance systems.

- Neither the growth in population nor demand materialized. PWS demand decreased over the past 10 years. While, the reasons are mixed, conservation efforts by the utilities and SFWMD, water shortage restrictions, year-round irrigation conservation measures, and the economic downturn, played a role. As a result, per capita water use rates continued to decline over the past five years.

- The combination of reduced per capita use rates and slower than anticipated population growth reduced actual PWS demand in 2010 (842 MGD) to less than the PWS demand in 2005 (912 MGD). The combined permitted water use allocation of 1,165 MGD enables most utilities to meet most or all of their future demand without additional projects.

- Some PWS utilities deferred construction of alternative water supply projects. Some alternative water supply projects recommended in the 2005–2006 LEC Plan Update may not be necessary until after the 2030 planning horizon.

- Within the LEC Planning Area, the portion of the EAA in Palm Beach County is ranked first in Florida and the United States in total sugarcane acres under cultivation. Palm Beach County accounted for 77 percent of the total sugarcane acreage in Florida. The county also ranked first in Florida in the value of vegetables, melons, potatoes, and sweet potatoes produced ($409 million). The county ranked first in Florida in combined vegetable acreage—79,792 acres—harvested for sale (USDA-NASS 2007).
- Although only a portion of Hendry County is within the LEC Planning Area boundary, in 2007, the entire county was ranked first in the state for orange grove acreage and the value of fruits, tree nuts, and berries produced ($407.7 million) (USDA-NASS 2007). Hendry County is second in terms of sugarcane acres under cultivation in Florida behind the Palm Beach County portion of the EAA.
- Miami-Dade County leads the state in the production of nursery and ornamental/greenhouse products. In 2007, Miami-Dade County produced $494 million in greenhouse and nursery sales.

Population Projections and Water Demand

Projections developed for this update estimate that the LEC Planning Area's population will increase by over 18 percent between 2010 and 2030, from approximately 5.6 million residents to almost 6.7 million. In contrast, the 2005–2006 LEC Plan Update estimated a population increase over 31 percent, or 7.3 million by 2025.

This update projects gross water demand for PWS in 2030 at 1,007 MGD. This demand projection is 20 percent more than the 842 MGD actually used in 2010. The change in PWS demand from 2010 to 2030 will require implementation of fewer water supply development projects by utilities than previously proposed. Most of the projected increased demand can be met with existing allocations and infrastructure.

In 2010, 52 PWS utilities were in the LEC Planning Area. By 2013, only 50 PWS utilities remained. The state closed the AG Holley Hospital in 2012, which had its own PWS facility. In 2013, the Palm Beach County Water Utilities Department took over the Glades Utility Authority, which serves the cities of South Bay, Belle Glade, and Pahokee.

Even at the lower demand projection, PWS is expected to remain the LEC Planning Area's largest water use category in 2030, representing at least 52 percent of the planning area's total water demand. The Agricultural (AGR) Self-Supply use category is projected to remain the second largest water use category in 2030. AGR Self-Supply water demand is estimated to increase from 655 MGD in 2010 to 664 MGD in 2030, representing at least 34 percent of the LEC Planning Area's total gross demand. The remaining 14 percent consists of Domestic Self-Supply (DSS), Industrial/Commercial/Institutional (ICI) Self-Supply, Recreational/ Landscape (REC) Self-Supply, and Power Generation (PWR) Self-Supply demands.

Overview of Water Resources

Water for urban and agricultural uses in the LEC Planning Area comes from groundwater and surface water. Water for the natural system comes from the same sources. Determining the condition and sustainability of water needed to meet projected urban and agricultural demands (**Chapter 2**), as well as environmental resources, requires consideration of the area's available water sources (**Chapter 3**). Also, the Support Document contains extensive information related to the LEC Planning Area and its water resources.

Groundwater Resources

The LEC Planning Area groundwater resources are the surficial aquifer system (SAS), and the Floridan aquifer system (FAS) (**Figure 3**).

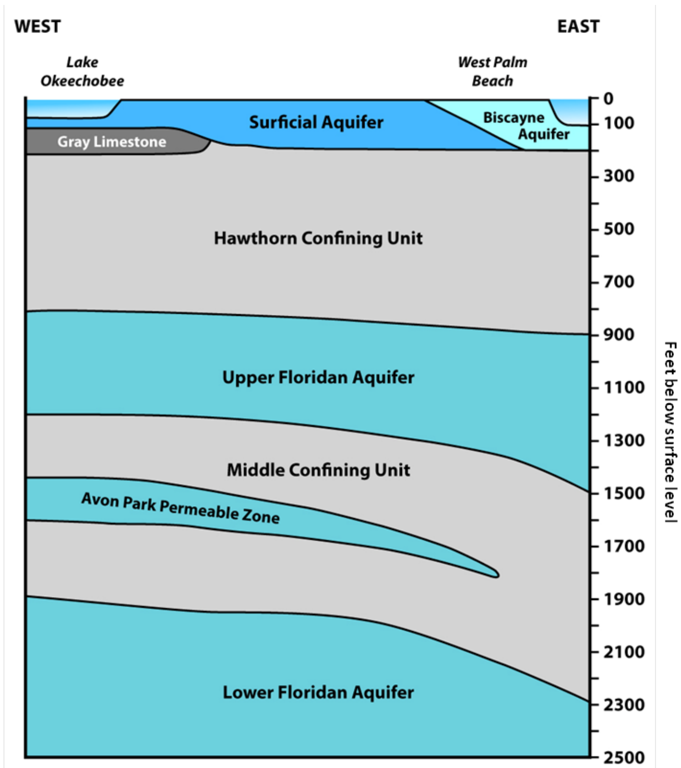


Figure 3. Generalized hydrogeologic cross-section of South Florida.

Surficial Aquifer System

The SAS, including the Biscayne aquifer, is shallow, predominately unconfined, and generally extends from land surface to 200 feet in depth. Rainfall and seepage from surface water bodies recharges the SAS. Surface water systems are canals, lakes, the Everglades, and other wetlands. The Biscayne aquifer is among the most productive in the world. It currently provides more than one billion gallons of water a day on average for potable and irrigation needs in the tri-county area. In 2010, fresh groundwater accounted for 94 percent of potable water produced by PWS utilities.

Floridan Aquifer System

The FAS is a thick, multi-layered sequence of predominantly carbonate rocks that underlies Florida and parts of Alabama, Georgia, and South Carolina. While the FAS is the primary source of fresh water for much of northern and central Florida, it contains brackish water in the LEC, Lower West Coast, and Upper East Coast planning areas. Until recent years, the Floridan aquifer was not widely developed as a water source in the LEC Planning Area due, in part, to the extensive availability of fresh groundwater. The brackish portions of the FAS is more extensively developed in the Upper East Coast and Lower West Coast planning areas due to the lower productivity of the SAS in those planning areas.

Surface Water Resources

The LEC Planning Area's surface water resources are integrally interconnected as part of the Kissimmee–Okeechobee–Everglades ecosystem. Historically, water flowed from the Kissimmee Chain of Lakes into the Kissimmee River, which then emptied into Lake Okeechobee. Overflow from the lake would move as sheetflow across the Everglades and into Florida Bay. Today, Lake Okeechobee, the WCAs, and an extensive network of canals are the principal sources of surface water in the LEC Planning Area.

Significant Freshwater Systems

The Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project) links Lake Okeechobee and the Everglades with agricultural and urban areas and other major ecosystems. The C&SF Project divided the remaining Everglades south of Lake Okeechobee and north of U.S. 41 in Palm Beach, Broward, and Miami-Dade counties into three hydrologic units known as the WCAs. Everglades National Park lies south of U.S. 41. Descriptions of the significant freshwater systems within the LEC Planning Area are as follows:

- **Lake Okeechobee** is a key component of the South Florida hydrologic system. It serves multiple purposes, including flood protection, urban, agricultural, and environmental water supply, navigation, commercial and recreational fisheries, and fish and wildlife habitat. The lake is critical for flood control during wet seasons and water supply during dry seasons. Agriculture in LOSA is the predominate user of lake water. The Okeechobee Utility Authority (in the Kissimmee Basin Planning Area) is the only remaining PWS utility using water directly from Lake Okeechobee. Since the last plan update, Clewiston (in the Lower West Coast Planning Area), South Bay, Belle Glade, and Pahokee (**Figure 2**) discontinued the use of Lake Okeechobee as their supply source and now use FAS water treated by reverse osmosis.
- **WCAs** are the remaining portions of the northern and central Everglades that were diked as part of the C&SF Project. The WCAs are operated and maintained for flood control, while providing water supply to the LEC Planning Area and environmental habitat. Stormwater treatment areas treat runoff from the EAA and regulatory discharges from Lake Okeechobee before water is conveyed to

the WCAs. The WCAs serve as the first source of supplemental water to the coastal canals that recharge the Biscayne aquifer. WCA 1 is contained within the Arthur R. Marshall Loxahatchee National Wildlife Refuge.

- **Everglades National Park** is the nation's second largest national park. The park is home to a wide variety of endangered species and has several international preserve-style designations. Water from the WCAs enters Everglades National Park and flows through Taylor and Shark River sloughs to Whitewater and Florida bays and the Ten Thousand Islands area.

- **C&SF Project canals** move water from Lake Okeechobee and the WCAs to maintain coastal canal levels during dry times to augment water supplies. The canals are also a crucial component of the region's flood control system, discharging storm water to tide.

- **Wetlands** extend across approximately 2 million acres of the LEC Planning Area (USFWS 2010b). The remnant Everglades represent the majority of the region's wetlands. In addition to the WCAs and Everglades National Park, key wetlands in the LEC Planning Area include Holey Land and Rotenberger wildlife management areas, Pennsuco Area, and Grassy Waters Preserve and other wetlands in the Loxahatchee River Watershed. The region also has extensive constructed wetlands within the EAA that serve as stormwater treatment areas. Finally, isolated wetlands can be found throughout the LEC Planning Area.

Significant Coastal Ecosystems

Other important ecosystems in the region include the coastal systems of the Northwest Fork of the Loxahatchee River, Lake Worth Lagoon, Biscayne Bay, and Florida Bay. A brief description of each system is provided here:

- The **Northwest Fork of the Loxahatchee River** is a federally-designated Wild and Scenic River. The Northwest Fork of the Loxahatchee River flows from Palm Beach County north into Martin County and bends east through Jonathan Dickinson State Park. It then flows southeast back into Palm Beach County, where it enters the central embayment area of the Loxahatchee River Estuary. It is in the LEC Planning Area because the river's watershed includes a broad area of northern Palm Beach County.

- **Lake Worth Lagoon** is an estuarine system located in eastern Palm Beach County and extends for about 22 miles adjacent to heavily urbanized areas. It is connected to the Atlantic Ocean by the Lake Worth and South Lake Worth inlets.

- **Biscayne Bay** covers approximately 428 square miles located on the southeastern coast in Miami-Dade County. The bay is an aquatic preserve and an Outstanding Florida Water. The southern half of the bay is within Biscayne National Park. This is the largest marine park in the National Park system and supports diverse flora and fauna, including many endangered species.

- **Florida Bay** lies between the Everglades and the Florida Keys. Florida Bay covers 850 square miles, of which approximately 80 percent is within Everglades National Park.

HISTORY OF PLANNING EFFORTS

The 2000 LEC Plan concluded timely implementation of CERP projects would meet most of the environmental needs and water supply demands of the region by 2020. When the LEC plan was updated five years later, delays to CERP projects had already significantly changed the basis of that conclusion. The 2000 LEC Plan also recommended protecting water needed for CERP projects from allocation. SFWMD developed restricted allocation area criteria for the Everglades and North Palm Beach/Loxahatchee River Watershed water bodies to protect water needed for restoration projects. Additional discussion of the criteria is below and in **Chapter 3**. As a result, the 2005–2006 LEC Plan Update concluded that PWS would need to depend heavily on conservation and the development of alternative water sources and treatment facilities.

During the development of the 2005–2006 LEC Plan Update, local governments and water suppliers in the LEC Planning Area worked closely with SFWMD to identify and develop water supply projects to meet projected water demands. Many of the proposed projects were incorporated into local government comprehensive plans and water use permits. Since then, the economic downturn, slower population growth, and improved conservation significantly lowered demand projections. SFWMD also allocated fresh groundwater where appropriate local hydrologic conditions were present and regulatory requirements were met. As a result, many alternative water supply projects recommended in the last update have been postponed.

PROGRESS SINCE THE 2005–2006 LEC PLAN UPDATE

The 2000 LEC Plan and 2005–2006 LEC Plan Update identified several regional issues concerning water conservation, groundwater and surface water sources, regulatory criteria, and Everglades and ecosystem restoration. The Five-Year Water Resource Development Work Program, published in Volume II of the South Florida Environmental Reports (available online at www.sfwmd.gov/sfer) annually summarizes progress. At the time this update was developed, the most recent Five-Year Water Resource Development Work Program is published in Chapter 5A of the *2013 South Florida Environmental Report – Volume II* (Martin 2013). Several of the items represent long-term efforts to advance the understanding of the region's water resources or develop improved tools for future planning efforts after this plan update. Additional activities and programs implemented since the 2005–2006 LEC Plan Update are presented below.

Water Supply Development Projects

- SFWMD worked closely with staff from PWS utilities to modify population and demand projections and, where necessary, identify water supply development projects for this update. **Chapter 6** of this update discusses existing, ongoing, and proposed water supply development projects for the LEC Planning Area. **Appendix F** provides summary tables of key project information.
- When funding is available, the alternative water supply projects listed in this update are eligible for cost-sharing consideration through a separate annual funding process established by SFWMD's Governing Board that is consistent with the state's statutory requirements.
- Water supply development in the LEC Planning Area includes traditional (fresh surface water and groundwater) and alternative sources. Through the Alternative Water Supply Funding Program, SFWMD assisted permittees in the development of reclaimed water projects, water reclamation facilities, brackish water wellfields, reverse osmosis treatment facilities, and aquifer storage and recovery (ASR) well systems. From FY 2007 to FY 2012, SFWMD, in cooperation with the State of Florida, provided more than $123 million in alternative water supply funding for 212 projects. Ninety of these projects were within the LEC Planning Area.
- Between FY 2007 and FY 2011, projects funded by the Alternative Water Supply Funding Program created 72 MGD of new water capacity in the LEC Planning Area. The water sources include 27 MGD of brackish water, 21 MGD of reclaimed water, and 23 MGD of surface water/storm water.

Regulations and Operations

- In 2007, SFWMD adopted restricted allocation area criteria for the Everglades and North Palm Beach/Loxahatchee River Watershed water bodies. These criteria are a component of MFL recovery strategies for the Everglades and the Northwest Fork of the Loxahatchee River. The criteria limit allocations that affect the protected water bodies to levels that occurred as of April 1, 2006. Additional discussion of the restricted allocation area criteria is in **Chapter 3**.
- In 2008, USACE implemented 2008 LORS to address concerns about the integrity of the Herbert Hoover Dike surrounding Lake Okeechobee as well as high water impacts to the lake ecology. The dike provides flood control for developed areas around the lake. 2008 LORS (USACE 2007) is designed to regulate lake levels at a lower elevation, between 12.5 and 15.5 feet National Geodetic Vertical Datum of 1929, than previous regulation schedules. Analyses for the supplemental environmental impact statement for 2008 LORS indicated that existing legal users in LOSA would experience more frequent shortages than under the previous schedule. The analysis projected a decline in the physical level of certainty of agricultural users reliant on lake water supplies, from a 1-in-10 year to a 1-in-6 year drought return frequency.

- Analyses indicated that implementation of 2008 LORS would cause MFL criteria for Lake Okeechobee to be violated. Therefore, SFWMD changed the Lake Okeechobee MFL status from prevention to recovery. In October 2008, SFWMD adopted restricted allocation area criteria for LOSA as part of the lake's MFL recovery strategy.
- Shortly after implementation of 2008 LORS, SFWMD updated its Water Shortage Management Plan (Chapter 40E-21, Florida Administrative Code [F.A.C.]) to assure equitable distribution of available water resources among all permitted water users of the lake during times of water shortage.
- Adaptive protocols for Lake Okeechobee operations were updated in 2010 (SFWMD 2010) in response to 2008 LORS implementation. The protocols provide guidance to staff and SFWMD's Governing Board when making recommendations to USACE about Lake Okeechobee water releases in the base flow and beneficial use bands. Adaptive protocols are designed to identify potential "win-win" or "win-neutral" situations in which one or more environmental resource may benefit from a lake release and where minimal or no adverse effect on meeting permitted agricultural and urban water supply needs or impacts on Seminole Tribe water rights are anticipated.
- In 2007, USACE found the Herbert Hoover Dike to be a Class I risk, the highest risk for dam failure. The implementation of the 21.4-mile cutoff wall component in Reach 1 satisfies the majority of the risk reduction goals. This component will be complete in 2013. As part of this risk reduction approach, the 32 water control structures (culverts) operated by USACE are being replaced, removed, or abandoned with a scheduled completion in 2018. Rehabilitation of Reaches 2 and 3 is planned to be completed by 2022.
- 2008 LORS will be reexamined and possibly changed by USACE in connection to the completion of Reaches 1, 2, and 3.

Water Conservation

- In September 2008, SFWMD adopted the Comprehensive Water Conservation Program to foster demand management and save water throughout SFWMD.
- The Districtwide Year-round Landscape Irrigation Conservation Measures Rule became effective in March 2010 (Chapter 40E-24, F.A.C.), consistent with the Comprehensive Water Conservation Program. This rule supports the long-term sustainability of SFWMD's water resources. The rule limits landscape irrigation to three days a week within the LEC Planning Area. Broward and Miami-Dade counties adopted two-day-a-week limits by local ordinance.
- The Water Savings Incentive Program (WaterSIP) provides up to 50-50 cost-sharing funds for noncapital cost projects, such as the purchase and installation of high efficiency indoor plumbing fixtures, outdoor irrigation retrofits, and automatic distribution system line flushing devices. Utilities, municipalities, property owner associations, and large water users may participate in the

program. From FY 2005 to FY 2011, SFWMD allocated $2.35 million for LEC Planning Area WaterSIP projects. This represents an estimated potential savings of 3.9 MGD. For more information on water conservation, see **Chapter 5** and **Appendix D**.

Restoration Efforts by SFWMD

- The CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat (formerly known as the Acme Basin B Discharge Project) was completed in 2010. The project improves Everglades water quality by diverting the direct discharge of urban runoff into a stormwater treatment area before the water enters the Arthur R. Marshall Loxahatchee National Wildlife Refuge.
- Construction of the Deering Estate Flow-way Project, a component of the CERP Biscayne Bay Coastal Wetlands Project, was completed by SFWMD in 2012. The flow-way directs freshwater runoff away from existing canal discharges and redistributes it as sheetflow prior to discharge into Biscayne Bay.
- As of January 2013, four of 10 culverts planned for the L-31 East component of the CERP Biscayne Bay Coastal Wetlands Project were installed by SFWMD. This component reestablishes, at least in part, historical sheetflow and wetland hydroperiods downstream of the project area.
- The CERP C-111 Spreader Canal Western Project involves the construction of a hydrologic ridge along the eastern border of Taylor Slough. The purpose is to retain more water within the slough and increase water flow to Florida Bay. SFWMD began construction of major features in 2010, which were completed in 2012. Operational testing commenced shortly thereafter.

Water Storage

- An L-8 Basin site was originally anticipated to provide water storage as a component of the CERP Loxahatchee River Watershed Restoration Project (formerly known as the North Palm Beach County – Part I Project). As part of the Restoration Strategies Regional Water Quality Plan approved in 2012, the L-8 Basin site is now under construction for use as a flow equalization basin. The project will store water for consistent delivery needed to optimize performance of the Everglades stormwater treatment areas. While interim operations may provide for the delivery of dry season flows to the Loxahatchee River, a permanent replacement project feature is needed in the future. In 2013, SFWMD and Palm Beach County conceptually agreed to the acquisition of the approximately 1,800-acre site owned by the county. USACE is continuing to develop the project implementation report for the Loxahatchee River Watershed Restoration Project.
- In 2010, construction commenced on the CERP Fran Reich Preserve (formerly known as the Site 1 Impoundment) – Phase I Project by USACE. This project consists of a 1,660-acre aboveground impoundment located in the southwestern

portion of urban Palm Beach County. A federal contract for Phase I was terminated in 2012 due to difficulties encountered during construction. USACE restarted the project in May 2013 and anticipates finishing it in 2014. Phase II will require congressional authorization.

- In 2012, the testing of the CERP Hillsboro ASR Pilot Project, located in western Boca Raton, was successfully completed. Preliminary results indicate that high capacity ASR is feasible in the vicinity of the Fran Reich Preserve. However, the volume of storage and recovery has not been determined.
- Cycle testing continues at the CERP Lake Okeechobee ASR Pilot Project, located adjacent to the Kissimmee River just north of the lake. Results at that location indicate that ASR technology is feasible near Lake Okeechobee. The final report will be available by the end of 2013. The CERP ASR Regional Study is currently conducting analyses to determine the total number of ASR wells that may be constructed adjacent to the lake, which will be completed by the end of 2014.
- The City of Boynton Beach constructed a second ASR well and integrated it into the city's water treatment system. This project has successfully demonstrated that potable water ASR operation is feasible in the urban area of the LEC Planning Area.

Modeling and Monitoring Studies

- In 2005, SFWMD and the United States Geological Survey began a cooperative study to measure evapotranspiration (ET) in South Florida using the eddy covariance method. The cooperative study examined spatially extensive plant communities within Big Cypress National Preserve individually, including dwarf cypress, cypress swamps, pine uplands, wet prairies, and marsh as mapped by Duever et al. (1986). This study provided the first quantitative measurements of ET for the major natural plant communities in South Florida. The actual measured ET data from this study is being used to improve hydrologic models. As part of this same project, in 2007, the United States Geologic Survey installed five ET monitoring sites within differing vegetation communities in Big Cypress National Preserve and completed the construction of three towers. The fieldwork was completed in 2010 and the results from this study have been published in Shoemaker et al. (2011), available on the web at pubs.usgs.gov/sir/2011/5212/.
- SFWMD held an independent peer review of the Lower East Coast Subregional Model. The model simulates groundwater flow in the SAS in the LEC Planning Area. Five smaller groundwater models were used to develop the Lower East Coast Subregional Model following the adoption of the 2000 LEC Plan. Currently, the model is used to address site-specific issues pertaining to water use, permitting, and several CERP projects. Refinements to the model based on the peer review are expected to proceed in 2013.

- A study of the development and application of water quality modeling components that could be applied to SFWMD's Regional Simulation Model was completed in FY 2009. As a result, a spatially distributed water quality model for phosphorus transport and cycling in wetlands was developed for application throughout SFWMD (Jawitz et al. 2008).
- Three new FAS well sites in Palm Beach County have been equipped with instrumentation and have been transmitting water level data to SFWMD at 15-minute intervals. PBF-14 monitors the upper Floridan aquifer. Wells BOYRO-EXP and PBF-15, are multi-zone wells monitoring the upper and middle Floridan (BOYRO-EXP), and the upper, middle, and lower Floridan (PBF-15) aquifers.
- SFWMD developed a density-dependent model of the FAS that encompasses the LEC Planning Area (HydroGeoLogic, Inc. 2006), referred to as the Phase I Model. SFWMD completed the Phase II Model, which extended the Phase I Model to include the Upper East Coast Planning Area, in October 2008 (Golder Associates 2008). The model evaluates future effects of proposed use of the FAS. An independent peer review of the model was conducted in June 2011. Implementation of peer review recommendations is presently under way. The final transient, density-dependent model—now known as the East Coast Floridan Model—is scheduled for completion by the end of 2013, followed by model documentation.

OUTLOOK ON CLIMATE CHANGE

Climate change and its effects on hydrogeologic conditions should be considered in water supply planning. Long-term data and modeling project changes to sea levels, air temperatures, weather patterns including the frequency and intensity of rain, droughts, ET rates, and other parameters that will affect water availability. Southeastern Florida is especially vulnerable to the effects of climate change and sea level rise. The area is generally flat and low, with an average elevation of 15 feet above mean sea level. The regional economy has major investments within close proximity of the coast and about 30 percent of the population of Florida lives in Palm Beach, Broward, Miami-Dade, and Monroe counties. The 2000 LEC Plan identified saltwater intrusion as an issue for several utilities at risk. SFWMD worked with coastal utilities to develop inland freshwater sources and diversify water sources to reduce the risk of saltwater intrusion.

Responses to climate change are most effective when addressed by multiple levels of government. In 2011, Florida passed the Community Planning Act, which provides for adaptation action areas to improve infrastructure resilience to flooding by extreme high tides, storm surges, and sea level rise in low lying coastal areas. At the regional level, Palm Beach, Broward, Miami-Dade, and Monroe counties signed the Southeast Florida Regional Climate Change Compact in January 2010 to coordinate climate change mitigation and adaptation activities in the region. This compact allows local and county governments to establish their agenda for climate change adaptation while providing an efficient means for state and federal agencies to participate with technical assistance and support. In October 2012, the compact signatories published *A Region Response to a Changing Climate* to serve as a regional climate action plan (Southeast Florida Regional Climate Change Compact 2012a). Counties and their municipalities, numerous other governmental agencies, and subject matter experts participated in the development of this plan. Broward, Miami-Dade, and Monroe counties also developed individual county climate change action plans. SFWMD is jointly working with the Southeast Florida Regional Climate Change Compact signatories to evaluate sea level rise. See **Chapter 3** for more information.

WATER SUPPLY PLANNING FOR THE NEXT 20 YEARS

The stronger statutory link between local governments' comprehensive plans and SFWMD's regional water supply plans, data sharing, and collaborative planning are credited with improving the water supply planning process. Moreover, SFWMD's Water Supply Planning staff closely coordinates with the water use permitting staff during the water supply planning process. Coordination also increased through implementation of the Florida Department of Environmental Protection 2012 guidance memo. Water supply development projects included in this plan update underwent an initial screening for permitting feasibility. Updates to local governments' water supply facilities work plans, comprehensive plans, and SFWMD's next five-year update will continue to refine twenty-year demand estimates and projections.

2

Demand Estimates and Projections

This chapter discusses water demand estimates and projections for the Lower East Coast (LEC) Planning Area. The development of water demand estimates and projections is a complex process and accomplished in coordination with staff from local governments, utilities, agencies, and stakeholder groups. Data collection and analysis to support the projections began in 2010.

TOPICS
Water Use Categories
Population and Water Use Trends
Projected Demands
Demand Projections in Perspective

Previous estimates and projections for the LEC Planning Area were published in the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2007). Since its publication, a national economic downturn occurred and population growth in the LEC Planning Area slowed significantly. This led to a reduced rate of increase in future urban water demand. Agriculture is considered fully developed in most areas of the LEC Planning Area. It is a very stable agricultural area where permitted acres and cropping practices are not projected to change significantly over the next twenty years.

SUMMARY OF WATER USE CATEGORIES

The water demand for the six water use categories established by the Florida Department of Environmental Protection (FDEP) is calculated for a twenty-year planning horizon starting in 2010 and extending to 2030. A base year of 2010 is used for comparison in trend analyses. The percent usage for each water use category in this base year is described in **Figure 4**. In 2010, average annual gross water demand for all categories in the LEC Planning Area totaled 1,719 million gallons per year. By 2030, the projected average annual gross water demand is estimated to total 1,933 millions of gallons per day (MGD), an increase of 12 percent.

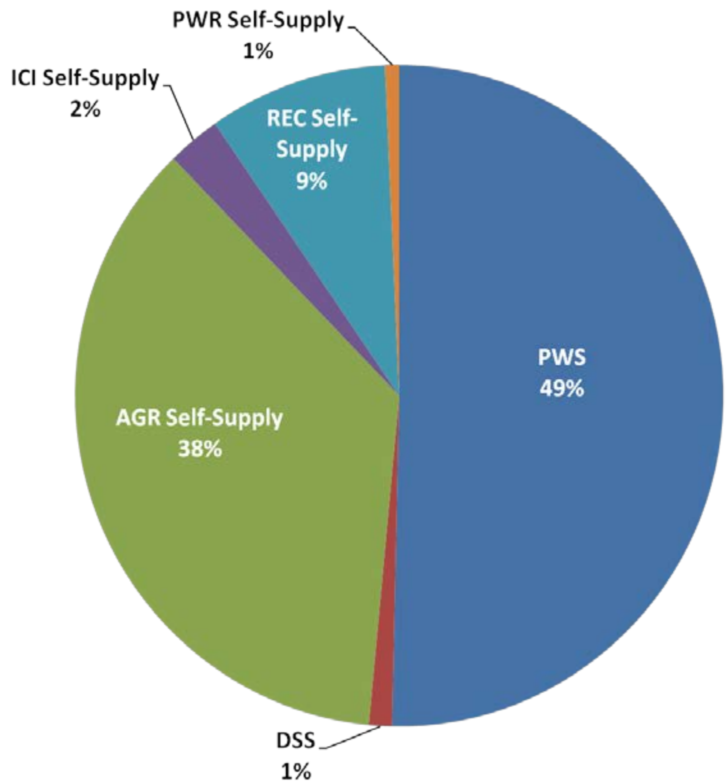


Figure 4. Percentage of estimated demand of each major water use category in 2010.

The average annual gross water demand projections for 2010 and 2030 for the water use categories are as follows:

- **Public Water Supply (PWS)** includes water supplied by water treatment facilities for potable use (drinking quality) with projected average withdrawals equal to or greater than 100,000 gallons per day or 0.1 MGD. PWS is projected to increase by 20 percent by 2030 (842 MGD in 2010 compared to 1,007 MGD in 2030).
- **Domestic Self-Supply (DSS)** includes households served by small utilities (less than 0.1 MGD) and private wells. DSS is projected to increase by 4 percent by 2030 (18 MGD in 2010 compared to 19 MGD in 2030).
- **Agricultural (AGR) Self-Supply** is water used for commercial crop irrigation, nurseries, livestock watering, and aquaculture. It is the second largest use in the LEC Planning Area. AGR Self-Supply is projected to remain stable with water demand increasing slightly by 1 percent (655 MGD in 2010 compared to 664 MGD in 2030).
- **Industrial/Commercial/Institutional (ICI) Self-Supply** includes self-supplied water consumed by business operations, such as mining and food processing, and institutions, such as schools, hospitals, and prisons, that have demand of 0.1 MGD or greater. ICI Self-Supply is projected to increase 28 percent by 2030 (44 MGD in 2010 compared to 57 MGD in 2030).

- **Recreational/Landscape (REC) Self-Supply** is used for irrigation of golf courses, parks, cemeteries, large common areas such as homeowner associations, schools, commercial developments, and other self-supplied irrigation uses with demand of 0.1 MGD or greater. REC Self-Supply is projected to increase by 3 percent (149 MGD in 2010 compared to 153 MGD in 2030).
- **Power Generation (PWR) Self-Supply** includes water consumed by power plants for use in the production of electricity, excluding use of seawater and reclaimed water sources. PWR Self-Supply is projected to increase 185 percent by 2030 (12 MGD in 2010 compared to 33 MGD in 2030).

Projections for each water use category are based on demand under average annual rainfall conditions and anticipated growth in the LEC Planning Area through 2030. As water use is impacted by weather, particularly rainfall, demands for 1-in-10 year drought conditions are estimated and projected. **Appendix A** presents both net and gross demands under average rainfall year and 1-in-10 year drought conditions through the 2030 planning horizon. **Appendix A** also contains additional details about the methods to estimate and project water demands for each water use category. For PWS and DSS, permanent population and, for PWS, demand by each utility are provided. For AGR Self-Supply, irrigated acreage and demand for each crop type are provided. Although not quantified in this chapter, environmental demand is addressed through resource protection criteria (**Chapter 3**).

POPULATION AND WATER USE TRENDS

Population projections form the initial and key step in developing water demand projections for PWS and DSS water use categories. Population estimates for the LEC Planning Area include the resident permanent populations of Palm Beach, Broward, and Miami-Dade counties, most of Monroe County, and the eastern portion of Hendry County (**Table 2**). A portion of Collier County is in the LEC Planning Area. However, that area is part of the Big Cypress National Preserve, which does not have any permanent residents.

Between 2010 and 2030, the LEC Planning Area's population is expected to increase by 18 percent with Palm Beach, Broward, and Miami-Dade counties attracting the greatest number of new residents. The projected population growth varies widely between the counties: Palm Beach County (+25 percent), Broward County (+14 %), Miami-Dade County (+18 percent), and Monroe County (-5 percent). Monroe County may experience a small reduction in permanent residents over the next 20 years. When aggregated, the total population is projected to increase by 1,027,862 people. This is a slower rate of growth than projected in the 2005–2006 LEC Plan Update, which was a 31 percent growth rate or an estimated increase of 1,745,488 people.

Table 2. Comparison of population projections published in the 2005–2006 LEC Plan Update and current projections presented in this plan update.

County	2010	2015	2020	2025	2030
2005–2006 LEC Plan Update Population Projections					
Palm Beach	1,415,809	1,549,635	1,679,326	1,804,188	
Broward	1,941,036	2,095,169	2,241,487	2,340,794	
Miami-Dade	2,600,263	2,769,725	2,921,389	3,066,750	
Monroe	84,100	85,800	87,200	88,600	
Hendry	1,279	1,279	1,279	1,279	
Total LEC Planning Area	**6,042,487**	**6,501,608**	**6,930,681**	**7,301,611**	
2013 LEC Plan Update Population Projections					
Palm Beach	1,320,134	1,402,101	1,484,067	1,566,034	1,648,000
Broward	1,748,066	1,809,881	1,871,696	1,933,510	1,995,325
Miami-Dade	2,496,435	2,610,526	2,724,618	2,838,709	2,952,800
Monroe	73,090	72,143	71,195	70,248	69,300
Hendry	1,279	1,320	1,360	1,401	1,441
Total LEC Planning Area	**5,639,004**	**5,895,971**	**6,152,936**	**6,409,902**	**6,666,866**

This trend is consistent with and based on the University of Florida's Bureau of Economic and Business Research (BEBR) medium range twenty-year projections completed over each of the last six years (**Figure 5**). Changes in population projections, in combination with reduced per capita water use, resulted in progressively declining PWS demand projections over the last three plans (**Figure 6**).

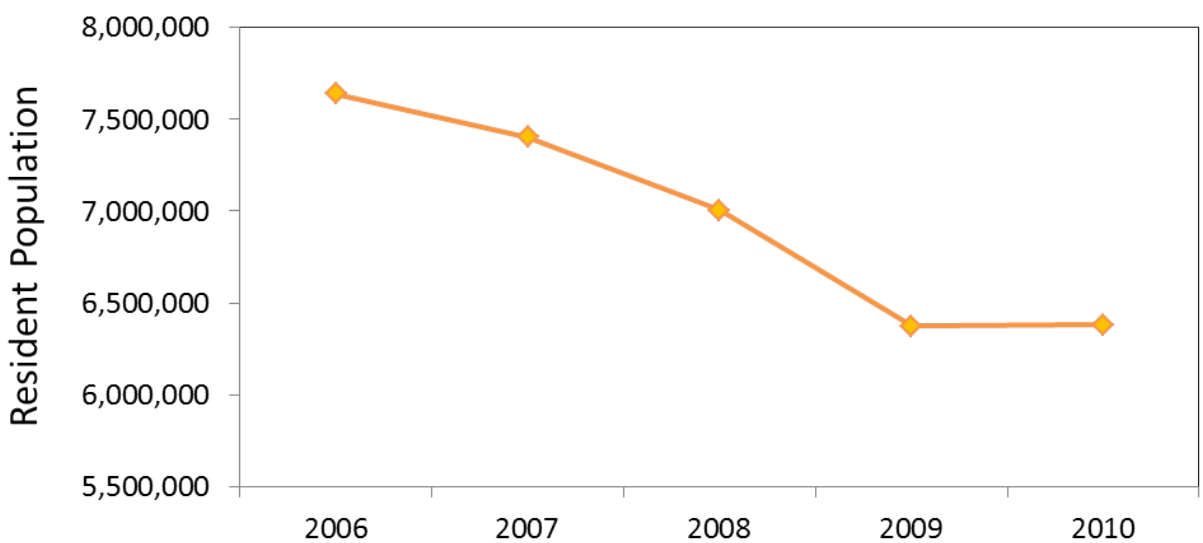


Figure 5. BEBR twenty-year population projections for 2030 over the last six years for the LEC Planning Area.

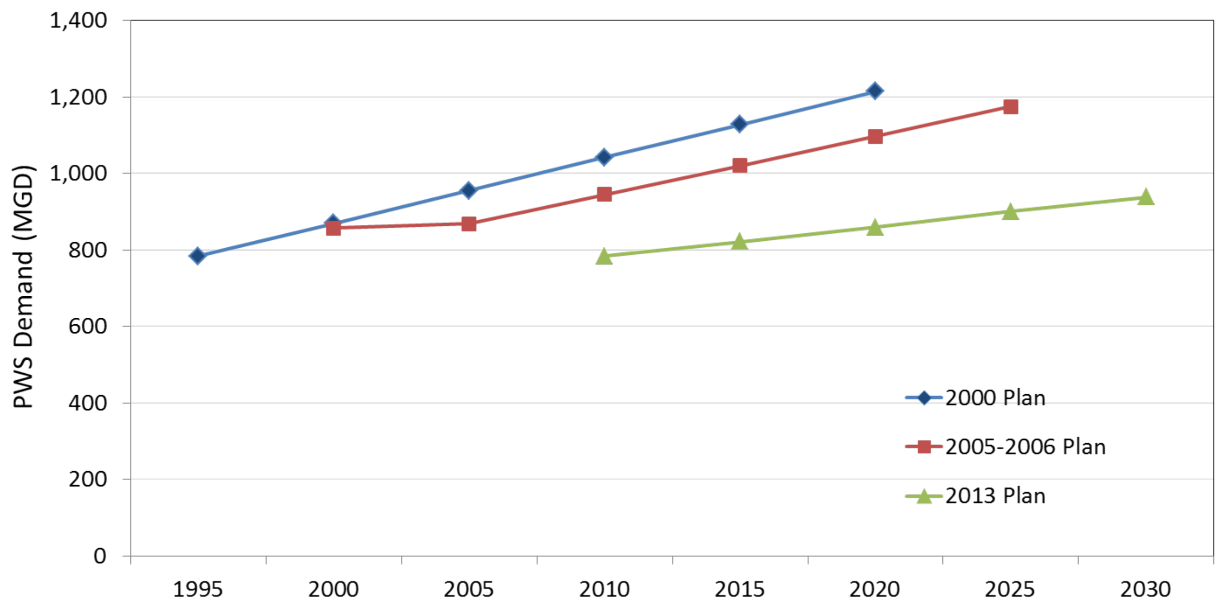


Figure 6. A comparison of PWS finished water demand projections in past plans and the current plan update.

PROJECTED DEMAND BY WATER USE CATEGORY

This section describes the gross water demand of the six water use categories. This plan update describes water demand using two methods, gross and net. Gross water demand or raw water demand, is the amount of water withdrawn from the source. Gross demand accounts for water lost during conveyance, transmission, and treatment. Gross demand is the volume of water allocated in a water use permit. Net or finished water demand is the volume of water that satisfies an end user, customer, or crop need. By definition, gross demand is greater than net demand, as most uses lose water through the treatment or transport of the water or system inefficiencies. A detailed description of both gross and net water demands is provided in **Appendix A**.

In 2010, daily gross water demand for an average rainfall year for all categories in the LEC Planning Area totaled 1,719 MGD. By 2030, the projected average annual gross water demand is projected to be 1,933 MGD, a 12 percent increase. The percent of projected demands for each water use category is provided in **Figure 7**. The percent change over the 20-year planning horizon is provided in **Table 3**.

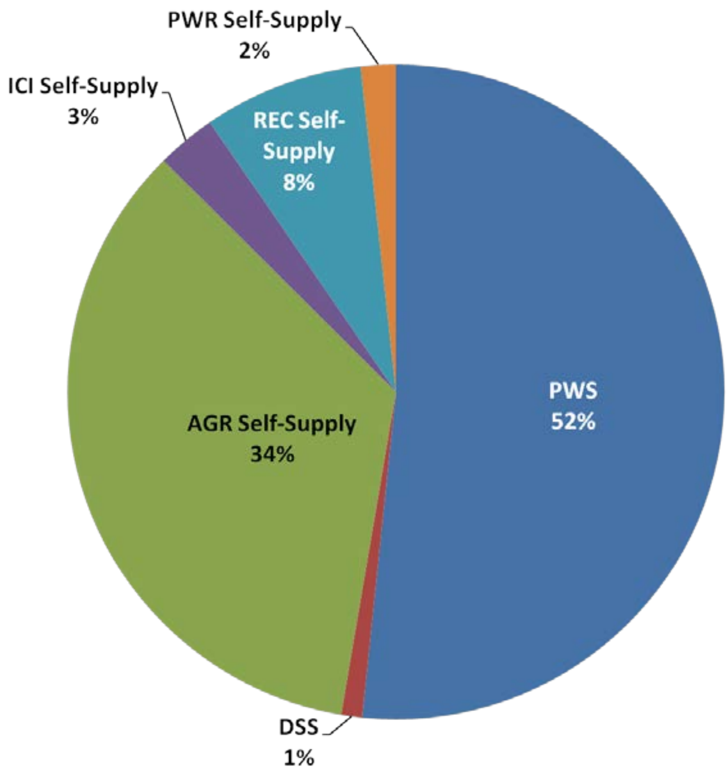


Figure 7. Percentage of projected demand of each water use category in 2030.

Table 3. Estimated gross (raw) water demand for an average rainfall year by water use category for 2010 and 2030.

Water Use Category	2010 Demand (MGD)	2030 Demand (MGD)	Change in Demand between 2010 and 2030 (MGD)	Percent Change in Demand between 2010 and 2030
Public Water Supply	841.7	1,007.5	165.8	20%
Domestic Self-Supply	18.0	18.7	0.7	4%
Agricultural Self-Supply	654.8	663.9	9.1	1%
Industrial/Commercial/Institutional Self-Supply	44.3	56.6	12.3	28%
Recreational/Landscape Self-Supply	148.9	152.8	3.9	3%
Power Generation Self-Supply	11.7	33.3	21.6	185%
LEC Planning Area Total	**1,719.4**	**1,932.8**	**213.4**	**12%**

Public Water Supply and Domestic Self-Supply

PWS is the water supplied by water treatment facilities for potable use (drinking quality) to users such as homes, offices, retail facilities, schools, and other institutions and facilities. Utilities with projected average withdrawals of 0.1 MGD or greater through 2030 comprise the PWS category. Water used by households or facilities served by small utilities (less than 0.1 MGD) or private wells are categorized as DSS.

Development of the water demand projections for the LEC Planning Area was a multistep process. The process began with development of maps showing the geographic areas currently served by each utility (PWS service areas). The 2010 United States Census data for population estimates (U.S. Census Bureau 2010) were then spatially distributed across PWS service areas utilizing the census block data.

The 2010 population estimates for each PWS utility were projected at the medium BEBR county growth rate to provide a preliminary 2030 population projection for each service area (BEBR 2011). It is important to note that the BEBR projections use permanent resident populations and do not include seasonal residents, tourists, and migrant workers. The 2030 service area populations were adjusted if the areas served by PWS were expected to change in the next 20 years. DSS population estimates for 2010 and 2030 were also calculated for each county. They represent the difference between the total county population and the PWS utility service area populations for the same county. A linear population growth rate was applied to distribute the initial projected population change from 2010 to 2030 in five-year intervals for each utility service area and county DSS population.

The 2010 population and net water use data, as reported to FDEP by the utilities, were then used to calculate the finished water per capita use per day. Per capita use rate (PCUR) is calculated as the total water use divided by the permanent resident population. It reflects all usage as these rates are based on finished water produced by each utility, including the water used by permanent and seasonal residents, tourists, and migrant workers. Next, the finished water PCUR was applied to the 2030 population to project future demand for each utility service area. This approach produced higher PCURs for utilities with large seasonal populations than other approaches that include a factor for seasonal residents. The initial draft of the projected demand for most PWS utility service areas assumed a constant PCUR based on 2010 for the twenty-year planning horizon. DSS demands were based on its countywide weighted average PCUR for PWS.

The draft PWS service area maps, treatment system descriptions, population, 2010 finished water use data, and projections for the PWS and DSS categories within the LEC Planning Area were provided to each utility and local government planning department. In several cases, the utilities were able to provide input on their respective maps and geographic information system coverages, system operational data, demands, and projections that resulted in adjustments to the projected population and/or demand. Many of these data exchanges took place during follow-up meetings, telephone conferences, and email correspondence. Revisions resulting from this coordination comprised the final projections for finished water published in this update.

These finished water projections were then converted to gross or raw water withdrawals to understand the total volume required to meet potable water demands. Each utility's finished water projections were multiplied by the raw to finished percent based on their treatment systems to calculate gross water demand.

During the next 20 years, the LEC Planning Area population is projected to increase from an estimated 5,639,004 in 2010 to 6,666,866 by 2030 (**Table 4**). PWS gross demand increases through the 2030 projection horizon are due to this anticipated population increase (**Table 5**). DSS demand growth rate is decreasing, as PWS systems will serve most new potable water demand.

By 2030, the PWS and DSS water use categories will account for 53 percent of the LEC Planning Area's total gross water demand, with PWS representing the vast majority of this 2030 demand. PWS is expected to remain the LEC Planning Area's single largest use category.

Table 4. Permanent resident population projections in the LEC Planning Area for 2010 and 2030.

County	2010 Estimated Population			2030 Projected Population		
	Total [a]	PWS	DSS	Total [b]	PWS	DSS
Palm Beach	1,320,134	1,242,621	77,513	1,648,000	1,570,891	77,109
Broward	1,748,066	1,740,468	7,598	1,995,325	1,986,996	8,329
Miami-Dade	2,496,435	2,472,741	23,694	2,952,800	2,924,775	28,025
Monroe [c]	73,090	73,090	0	69,300	69,300	0
Hendry [c]	1,279	0	1,279	1,441	0	1,441
LEC Planning Area Total	**5,639,004**	**5,528,920**	**110,084**	**6,666,866**	**6,551,962**	**114,904**

a. Source: BEBR 2011

b. Sources: U.S. Census Bureau 2010 and BEBR 2011

c. Portion of county within the LEC Planning Area

Table 5. Gross water demand in the LEC Planning Area for 2010–2030.

Lower East Coast Gross Water Demand Summary (in MGD)					
Gross Water Demand	2010	2015	2020	2025	2030
Public Water Supply	841.5	883.1	924.0	967.6	1,007.4
Domestic Self-Supply	18.0	18.2	18.6	18.5	18.7
LEC Planning Area Total	**859.5**	**901.3**	**942.6**	**986.1**	**1,026.1**

Agricultural Self-Supply

Importance of Agriculture to LEC Planning Area and Nation

Agriculture in the LEC Planning Area holds a unique place of importance to the region, the State of Florida, and the United States economy. The LEC Planning Area hosts the regions known collectively as the "Winter Bread Basket" and "Salad Bowl" to the nation. In addition, the LEC Planning Area's nursery and ornamental industry is the largest in the state and second largest in the United States. The southern Miami-Dade County portion of the LEC Planning Area is an ideal subtropical climate that is necessary and unique for the production of numerous varieties of tropical fruits including mangos, avocados, carambola, lychees, longan, mamey sapote, passion fruit, and others grown on varietal farms to meet this specialized demand. The planning area is known for growing fruit and vegetable crops that are well suited to meeting growing consumer tastes and preferences for nutrient rich diets (including antioxidants) and exotic cuisine (DCFB 2012). AGR Self-Supply in the LEC Planning Area also includes water used for commercial crop irrigation, livestock watering, and aquaculture.

Key facts regarding agricultural production within the LEC Planning Area are as follows:

- The portion of the Everglades Agricultural Area (EAA) within Palm Beach County is ranked number one in the state and country in total sugarcane acres under cultivation.

- Palm Beach County accounted for 77 percent of the total sugarcane acreage in Florida (USDA–NASS 2007).
- Palm Beach County ranked first in Florida in the value of vegetables, melons, potatoes, and sweet potatoes produced ($409 million) (USDA–NASS 2007).
- Palm Beach County ranked first in Florida in combined vegetable acreage harvested for sale (79,792 acres) (USDA–NASS 2007).
- Miami-Dade County leads the state in the production of nursery and ornamental/greenhouse products.
- In 2007, Miami-Dade produced $494 million in greenhouse/nursery sales and ranked number two in the United States.
- Hendry County ranked number one in 2007 in terms of oranges acreage and number one in the value of fruits, tree nuts, and berries produced ($408 million) (USDA–NASS 2007).
- Hendry County is number two in terms of sugarcane acres under cultivation in Florida behind the portion of the EAA located in Palm Beach County.

Projection Methodology and Considerations

Agricultural acreage and associated water demand are challenging to project because of various market forces, land use patterns, growth, water management projects, environmental restoration activities, macroeconomic forces, weather, and disease issues that can impact the distribution, acreage, and production/yield over a twenty-year planning horizon. The projections are not parcel specific, but are presented by county and for specific growing regions (see the **Summary** section under the **Distribution of Agriculture across the LEC Planning Area** section below), and incorporate general economic and agricultural production trend information using best professional judgment.

The first step in the process identified the baseline or current agricultural coverage by major crop types using several data sources. For 2010, land use maps were compared to SFWMD permitted acres and various data sets from the United States Department of Agriculture. The most recent agricultural census (2007) data points, as well as select survey data for some crops since 2007 (i.e., citrus and sugarcane), were compared to the current land use and permitted acres to determine where the 2010 baseline would most likely fall in terms of irrigated acres.

To develop the acreage projections, a number of sources were used including the land use projection analysis completed by the South Florida Water Management District (SFWMD). Agricultural acreage estimates from the United States Department of Agriculture and SFWMD's Water Use Regulatory Database informed and revealed key patterns. Agricultural industry experts also provided review and input. Projected acreage by crop type are provided for each county in **Appendix A**. The projection methods applied are also discussed in more detail within **Appendix A**.

The projected agricultural acreage, aggregated across the regions and counties, results in a net rise of 581 acres by 2030. The small net rise in total acres by 2030 results in the retention of the region's agricultural base. **Table 6** shows that within the LEC Planning Area, acres under management are projected to remain stable, while some counties may show a slight decline or increase by 2030.

Table 6. Change between 2010 and 2030 in acres by area within the LEC Planning Area.

Area	2010 (acres)	2030 (acres)	Net Change
Palm Beach County – Coastal	21,647	22,820	1,173
Palm Beach County – EAA	424,152	424,152	0
Broward County	1,198	1,280	82
Miami-Dade County	47,805	46,954	(851)
Monroe County	20	20	0
Hendry County – EAA	34,058	34,058	0
Hendry County – Western Basins	46,436	46,613	177
LEC Planning Area Total	**575,316**	**575,897**	**581**

Conversion of the EAA for SFWMD Projects

The construction of stormwater treatment areas (STAs) within the EAA significantly affected the number of acres available to be farmed. Historically, the agricultural portion of the EAA has undergone periods of growth, but more recent trends indicated contraction of irrigated acres. Currently, within the EAA, approximately 458,500 acres are permitted for agriculture and this amount is expected to remain stable throughout the planning period. It is anticipated that, in the future, a portion of the remaining EAA acreage may be converted to STAs and Everglades restoration projects by SFWMD.

To fulfill the Everglades Forever Act of 1994, SFWMD constructed a series of STAs to further reduce phosphorus levels in stormwater runoff before it enters the Everglades Protection Area. In 2003, the STAs consisted of six large constructed wetlands—STA 1 East, STA 1 West, STA 2, STA 3/4, STA 5, and STA 6—totaling approximately 45,000 acres. The STAs footprint expanded by approximately 6,000 acres in 2006 with the construction of STA 2 Cell 4, STA 5 Cell 3, and STA 6 Section 2, and expanded again in 2012 by approximately 17,000 acres with the construction of Compartments B and C. The total area of treatment wetlands, including canals, distribution cells, and upland areas, is approximately 68,000 acres. Flow equalization basins and additional STAs will be constructed by 2025 as part of the Restoration Strategies Regional Water Quality Plan (**Chapter 4**), which will result in approximately 25,000 acres within the EAA being converted to water quality projects. Lastly, 14,000 acres under consideration for use as storage in the CERP planning process may be devoted to CERP projects. In total, it is anticipated that SFWMD projects may cover up to approximately 107,000 acres in the EAA by 2030. Only the 14,000 acres that may be used for a CERP project could reduce existing permitted agricultural acreage within the planning horizon.

Distribution of Agriculture Across the LEC Planning Area

The main areas under cultivation within the LEC Planning Area are the EAA (which includes portions of Palm Beach and Hendry counties), Hendry County (the Western Basins, outside of the EAA but within the LEC Planning Area), the Palm Beach Coastal subbasin (including the Agricultural Reserve Area), and agricultural areas in South Miami-Dade County (including the Redlands) (**Figure 8**).

Everglades Agricultural Area in Palm Beach and Hendry Counties

The EAA accounts for approximately 80 percent of the agricultural acreage within the LEC Planning Area. Sugarcane and supporting rotational crops are the dominant crops grown in the EAA. The EAA is a fully developed, stable agricultural area where permitted acres and cropping practices are not projected to change significantly over the next 20 years. Consequently, projected water demands for the EAA from 2010 to 2030 do not change because EAA cultivated acres are expected to be constant throughout the twenty-year planning horizon.

Western Basins Located in Hendry County

The eastern portion of Hendry County located adjacent to the EAA is referred to as the Western Basins since it is on the western fringe of the LEC Planning Area and the Everglades. The Seminole Tribe of Florida's Big Cypress Reservation and the Miccosukee Indian Reservation are located in the Western Basins and are included in this analysis. This portion of the LEC Planning Area, known for sugarcane and citrus, also hosts crops grown for use as biofuel feedstocks. These crops are used both to sustain cogeneration power requirements for sugarcane processing (i.e., residues are combined with bagasse and wood chips to fire boilers), within integrated operations, and for ethanol production. Crops grown for use as biomass feedstocks (i.e., sweet sorghum) and for ethanol production are one of the emerging trends within this region of the planning area and the acreage falls under the "Field Crops – Other" and "Field Crops – Sugarcane" categories of the plan update.

Hendry County is the dominant citrus producer within the planning area (28,437 acres in 2010). Because of the uncertainty associated with the recovery of citrus production, a low and high projection was prepared for this crop (see **Appendix A**). By 2030, the projected high scenario for total citrus acreage in the entire LEC Planning Area is expected to total 21,157. In the low scenario, citrus acreage continues to decline and, by 2030, accounts for only 7,093 acres and the formerly cultivated citrus land is assumed to be fallow. To estimate future gross water demand, the high projected acres for citrus was incorporated. The projected citrus acreage incorporates the removal of 10,774 acres as part of the C-139 Annex Restoration Project in Hendry County by 2018. As **Table 6** shows, on balance, the Western Basins total irrigated acreage is expected to increase by 177 acres by 2030 (less than 1 percent) reflecting net gains in vegetables, sugarcane, and greenhouse/ nursery acres.

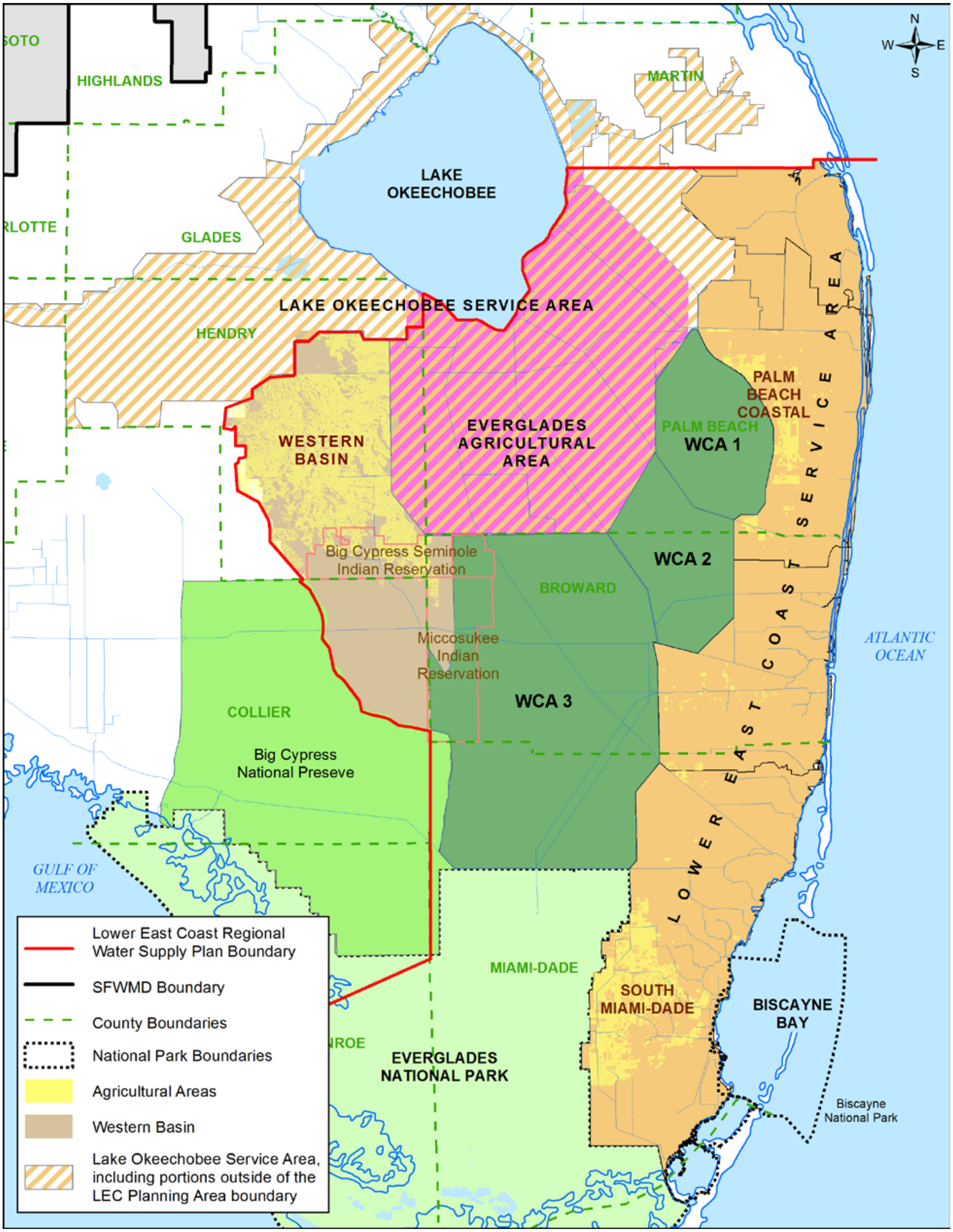


Figure 8. Main areas under cultivation within the LEC Planning Area.

Lower East Coast Service Area

Within the coastal portion of Palm Beach County located in LECSA, citrus, other fruits/nuts, sod, and greenhouse/nursery production are projected to rise 1,173 acres by 2030. The scale of sod and greenhouse/nursery production can vary positively with a recovery in housing. This projection incorporates historic commodity-based trends, regional specialization, and stakeholder preferences for sustainable agriculture visible in plans for the Agricultural Reserve Area.

For South Miami-Dade County, the projections assume a slight decline in acreage—851 acres out of an existing 47,805 acres under management. This stable projection assumes the retention of the Redlands agricultural heritage (an area of critical importance to national, state, and regional consumer markets), favorable consumption and commodity demand trends, and a relatively weak future demand for new housing (and encroaching subdivisions) by historic standards. However, as noted above, some relatively small acreage losses due to fallout from the economic downturn and eventual urban encroachment under a stronger recovery are expected by 2030.

For Broward County, the projections expect a slight increase of 82 acres reflecting greenhouse/nursery operations coming back with economic recovery. Monroe County's greenhouse/nursery operations are not expected to change over the planning horizon.

Summary

Total irrigated agricultural acreage within the LEC Planning Area is expected to rise slightly from 575,316 acres in 2010 to 575,897 acres by 2030 (**Table 7**). The agriculture in the LEC Planning Area is dominated by the EAA, which is a fully developed, stable agricultural area where permitted acres and cropping practices are not projected to change significantly over the next twenty years. Consequently, projected water demands for the EAA remain constant from 2010 to 2030. Citrus acreage and water use is expected to decline in the Western Basins in Hendry County, reflecting implementation of the C-139 Annex Restoration project and the associated removal of acres from agricultural production. The remaining crop types in Hendry County offset the loss of citrus resulting in an increase of 177 acres. For the LEC Planning Area as a whole, sugarcane, other field crops, sod, and greenhouse/nursery are expected to increase slightly over the planning horizon, while other fruits and nuts, and vegetables, melons, and berries are expected to fall slightly.

The expected loss of additional agricultural acres due to urbanization has been deferred to much later periods over the twenty-year planning horizon. The restrained housing market and a slow economic recovery in South Florida has diminished competition for agricultural land from developers compared to the 2005–2006 LEC Plan Update evaluation environment. More generally, the rapid loss of arable land over the last 10 years throughout the United States raised the relative value of existing agricultural lands and placed a renewed emphasis on sustainable land management and food security. Some small declines expected in the Palm Beach Coastal area and the loss of citrus acreage in the Western Basins portion of Hendry County will likely be offset by gains in other crops within the planning area (sod and nursery/greenhouse production in Palm Beach County and sugarcane in the Western Basins in Hendry County). Palm Beach County is expected to retain its agricultural acres over the twenty-year planning horizon and to slightly increase agricultural lands within the Agricultural Reserve Areas.

Table 7. Change between 2010 and 2030 in acres by crop type within the LEC Planning Area.

Crop Type	2010 (acres)	2030 (acres)	Net Change (acres)
Citrus	31,628	21,157	(10,471)
Field Crops – Sugarcane	409,622	418,868	9,246
Field Crops – Other	19,079	19,309	230
Vegetables, Melons, and Berries	82,530	81,918	(612)
Sod	9,885	10,781	896
Greenhouse/Nursery	14,270	15,670	1,400
Other Fruits and Nuts	8,302	8,194	(108)
Total for All Crop Types	**575,316**	**575,897**	**581**

Agricultural Water Demands

Agricultural water demand reflects projected irrigated acreage, crop and soil types, growing seasons, and irrigation system types and strategies. AGR Self-Supply demand calculations for this update were completed using the Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) model. The model calculates water demand for average rainfall and 1-in-10 year drought conditions using 30 years of daily rainfall and evapotranspiration records (Smajstrla 1990).

Gross irrigation requirements are the amount of water that must be withdrawn from the source in order to be delivered to the plant root zone. It includes the effect of losses due to inefficiencies in water application. The supplemental irrigation requirement water volumes projected reflect the soil type and irrigation system efficiency. Net demand reflects an estimate of the amount of water farmers need to place into the root zones of crops to sustain yields. **Appendix A** presents both net and gross irrigation demands by crop type under average rainfall year and 1-in-10 year drought conditions through the 2030 planning horizon.

Current agricultural water use accounts for 38 percent of the region's total gross demand Estimated agricultural irrigated acreages and gross demand for an average year by crop type for 2010 and 2030 are presented in **Table 8**. By 2030, the LEC Planning Area's total gross AGR Self-Supply demand is projected to remain essentially the same compared to 2010, increasing 1 percent from 655 MGD in 2010 to 664 MGD in 2030.

Table 8. Estimated irrigated acreages and gross demand for an average water year by crop type for 2010 and 2030.[a]

Crop Category	2010 Acres	2010 Demand (MGD)	2030 Acres	2030 Demand (MGD)
Citrus	31,628	47.5	21,157	26.8
Field Crops – Sugarcane	409,622	385.2	418,868	407.5
Field Crops – Other	19,079	36.3	19,309	36.5
Vegetables, Melons, and Berries	82,530	125.5	81,918	126.8
Sod	9,885	12.1	10,781	13.3
Greenhouse/Nursery	14,270	38.1	15,670	43.1
Other Fruits and Nuts	8,302	10.0	8,194	9.9
LEC Planning Area Total	**575,316**	**654.8**	**575,897**	**663.9**

a. Perceived discrepancies in totals between this chapter and **Appendix A** are due to rounding.

Industrial/Commercial/Institutional Self-Supply

The water demand projections for the ICI Self-Supply sector are expected to rise to 57 MGD by 2030 from 44 MGD in 2010. These projections are slightly lower than the 61 MGD projected for 2025 in the 2005–2006 LEC Plan Update and reflect the different economic environment and sustainable resource use applications. A large component of the water use projections for ICI Self-Supply assumed that growth in self-supply for this region is proportional to the underlying economic activity that generates water demand in the area. This assumption was developed based on observed historic correlations with industrial output and water inputs in key sectors.

The ICI Self-Supply use category comprises large facilities for production processing, with the largest uses consisting of mining (i.e., aggregates industry) and food processing (dominated by the sugar industry). Because of the importance of these large users, the projection methodology was based on isolating and assessing the relationship between water use and expected future growth for these sectors.

The projections also reflect trends in process efficiencies (less water input demanded per unit of output) over the past ten years observed in large ICI Self-Supply users. ICI Self-Supply projections assume demand for average rainfall year and 1-in-10 year drought conditions are the same, and that withdrawal demand is equal to user demand so that no distinction is made between net (finished) and gross (raw) water amounts. It should be noted, with some use types within the ICI Self-Supply group, a large share of water demand is quickly returned to the system for reuse/recycling purposes (i.e., rock washing in the aggregates industry).

Many other ICI Self-Supply facilities receive their water from PWS utilities and their needs are included in PWS use. Time series data of pumpage reports obtained from SFWMD's Water Use Regulatory Database were used to evaluate and calculate ICI Self-Supply water use demand in addition to other data described in **Appendix A**.

Recreational/Landscape Self-Supply

Gross demand for REC Self-Supply is projected to increase by 3 percent from the estimated 149 MGD in 2010 to 153 MGD in 2030 (**Table 3**). REC demand supplied by PWS utilities is included in the PWS demand. REC Self-Supply water use projections include landscape and golf course irrigation demand, as well as water needs for parks, communities, homeowner associations with common areas and consolidated irrigation systems, and areas with green spaces such as ball fields, stadiums, and cemeteries.

Estimated landscape and golf course acreage were projected separately. Projected golf course acreage was based on the total number of golf course acres identified through golf course inventories and review of the water use permits in SFWMD's Water Use Regulatory Database. Time series trends of irrigated golf course acreage within the LEC Planning Area by county were reviewed from 1985 through the present and were compared to development history, depicted by a time series of annual new privately owned residential building permits within each LEC Planning Area county. Given the recession and housing crisis, followed by a weak economic recovery restrained by a structurally troubled and weak housing market, the demand for new golf courses and existing course expansion has been, and will likely remain, stagnant. Based on the expected pace of economic recovery during the twenty-year planning horizon, golf course acreage is expected to gradually decline and then stabilize before gradually increasing. In 2010, total irrigated golf course acreage in the LEC Planning Area was estimated to be 25,253 acres. Approximately 30 percent of this total acreage was irrigated in part using reclaimed water (personal communication, Richard Nevulis, Reuse Specialist, SFWMD).

Historical patterns of growth in acreage for nongolf course landscaping and recreational water use were also evaluated since the 2005–2006 LEC Plan Update. Between 2006 and 2011, community development expanded, increasing the landscape acreage requiring irrigation. This trend was visible in homeowners' association permit applications to irrigate common areas supporting developments rising considerably since the last plan update. The last ten years also witnessed a development phase characterized by unprecedented urban development, with community expansion moving westward in the LEC Planning Area prior to the housing price bubble bursting in 2007. With the housing correction and bubble burst, the projections assume some marginal declines in the landscape irrigated acreage category followed by a slight recovery to a plateau over the remainder of the planning horizon.

The estimated 2010 and 2030 projected gross demand were calculated using 2010 estimated acreage, 2030 projected acreage, and the AFSIRS model. The AFSIRS model calculates the net irrigation requirements of a given crop type given its type of irrigation system and efficiency. Details regarding the future acreage projections for permitted landscape irrigation for each county are contained within **Appendix A**.

Power Generation Self-Supply

The need for additional power supplies is expected to grow as the population in the LEC Planning Area and other portions of South Florida grow. The PWR Self-Supply water demand projections include input from Florida Power & Light (FPL), and consider expected load growth and power pool grid contributions within the LEC Planning Area. FPL utilizes an assessment method incorporating environmental, economical, and technical feasibility when selecting power generation and cooling technologies most appropriate for site-specific conditions, including water supply and wastewater disposal. Different technologies may require and utilize traditional and alternative water supply sources.

Currently, three power generation plants in the LEC Planning Area are permitted to withdraw fresh or brackish water: 1) the FPL West County Energy Center, which is currently the largest combined-cycle plant in the country, located in northwestern Palm Beach County; 2) the FPL Turkey Point plant located near Florida City in Miami-Dade County; and 3) the Homestead Municipal Power Plant in Miami-Dade County. The FPL West County Energy Center utilizes reclaimed water from Palm Beach County Water Utilities Department. FPL has not withdrawn water from surface or brackish water sources for this center since 2010. FPL uses water from the closed-cycle recirculation canal system and brackish Floridan aquifer water at Turkey Point Plant Unit 5. The Homestead Municipal Power Plant withdraws water from the Biscayne aquifer.

Another potential FPL plant may be sited in the LEC Planning Area, possibly in Hendry County where FPL has purchased land. The demand associated with this future plant is 22.8 MGD in 2030. Net PWR Self-Supply is projected to increase from 12 MGD in 2010 to 33 MGD by 2030 (**Table 3**) in the LEC Planning Area.

The projections do not include the Lake Worth Power Plant or other FPL facilities. The Lake Worth Power Plant uses fresh water provided by the City of Lake Worth Utilities. Therefore, PWS takes into account the Lake Worth Power Plant demand. The other FPL plants use or propose to use seawater or reclaimed waters, which do not require a SFWMD water use permit. The proposed Turkey Point Plant Units 6 and 7 expansions are expected to be added to FPL's South Florida grid system within the next 20 years. The planned source of cooling water for Units 6 and 7 is reclaimed water provided by the Miami-Dade Water and Sewer Department. Other FPL power generation plants in the LEC Planning Area use seawater, including Cutler and Lauderdale. FPL recently demolished the 1960s era Riviera and Port Everglades Plants and is replacing them with new, state-of-the-art high efficiency facilities. The new Riviera Beach plant will begin serving customers in 2014 when it returns to service as a "next generation clean energy center." The Riviera Plant will continue to use water from the Intracoastal Waterway for once-through cooling purposes, while the Port Everglades Energy Center may continue to use water from the Intracoastal Waterway for once-through cooling purposes or switch to reclaimed water.

The projections reflect process efficiencies associated with natural gas combined-cycle generation units. In the 2005–2006 LEC Plan Update, the estimated thermoelectric self-supply freshwater demand for 2005 was only 5 MGD, but expected to grow to 103 MGD by

2025 to support proposed new power generating facilities. However, FPL's continued use of seawater, the modernization of plants, and use of reclaimed water when available contributed to the decrease in water resources permitted by SFWMD for PWR Self-Supply.

DEMAND PROJECTIONS IN PERSPECTIVE

The demand projections presented in this update are based on the best information available. These projections reflect trends, circumstances, and industry plans that change over time. For example, this update expects slower population growth than was anticipated in the 2005–2006 LEC Plan Update. The timing and strength of economic recovery will play a role in future land use patterns and the relative water demand uses across sectors. During past economic recoveries, housing led the expansion by stimulating demand. In contrast, under the current expansion, the job of leading the recovery is falling on the cumulative contributions from other sectors. As a consequence, moderate economic growth trajectory is deferred until much later in the planning horizon. This expectation is based on housing conditions that restrained development and urban growth. Industries important to the LEC Planning Area, such as construction and the supporting materials industries, have been sidelined. With housing and construction remaining depressed, other sectors such as tourism and agriculture become relatively more important in lifting the economy closer to its long-term trend growth potential. **Table 9** shows the 2025 gross demand projected in the 2005–2006 LEC Plan Update compared to the 2030 demand projected in this plan update. The tables contrast the different planning environments (and expectations for future growth) existing at the time of the projections and plan development.

Table 9. Gross demand projected in the 2005–2006 LEC Plan Update versus this plan update.

Water Use Category	Projected 2025 Demand from 2005–2006 Plan Update (MGD)	Projected 2030 Demand from This Plan Update (MGD)	Percent Difference
Public Water Supply	1,286.5	1,007.4	(22)
Domestic Self-Supply	48.9	18.7	(62)
Agricultural Self-Supply	689.1	663.9	(4)
Industrial/Commercial/Institutional Self-Supply	61.3	56.6	(8)
Recreation/Landscape Self-Supply	84.8	152.8	80
Power Generation Self-Supply	102.6	33.3	68
LEC Planning Area Gross Demand Total	**2,273.2**	**1,932.7**	**(15)**

Since completion of the 2005–2006 LEC Plan Update, less water was used in 2010 for a number of reasons, including implementation of rules restricting lawn irrigation, water shortage restrictions, conservation education, and a decline in economic activity. These changes suppressed PCUR to varying degrees over the past ten years. It is uncertain if the newly learned behaviors or water use ethics that reduced water demand at the tap or effects of the economic downturn are permanent or temporary. Water conservation measures were not explicitly factored into the demand projections used in this chapter unless requested by a utility. Rather, water conservation was considered a water source option. The utilities implementing significant conservation projects included them on their utility profiles (**Chapter 6**) to meet their future needs.

With urbanization pressure diminished, the projections assume an opportunity for agricultural land use retention over the twenty-year planning horizon that is supported by market forces and rising trends in net farm incomes. The agricultural projections are uncertain for a number of reasons including industry-specific factors, such as weather and disease, which may continue to affect agricultural production within the LEC Planning Area. Agriculture is highly dependent on global market conditions and, as the economy eventually recovers at a faster rate further out in the planning horizon, pressure from urban development and competition for land to support ecosystem restoration projects is likely.

REC Self-Supply gross demand is expected to increase by 3 MGD in the course of the 2010–2030 planning horizon. The majority of future landscaped areas will be associated with the continued support and maintenance of residential developments (constructed under the past housing boom) and corresponding irrigation needs will be met using reclaimed water where feasible. REC Self-Supply demand increased significantly from the 2005-2006 LEC Plan Update with the inclusion of a number of developments and commercial properties that have a single irrigation system for the entire property and were recently permitted.

For the PWR Self-Supply use category, future load growth requiring capacity expansions of the FPL plants will increase the demand for cooling process water to more than 33 MGD by 2030, which is much lower than the 2005–2006 LEC Plan Update estimate for 2025 of 103 MGD. FPL's use of seawater, modernization of plants, and the use of reclaimed water when available contributed to the decrease compared to the previous plan in projected water demand for this use.

In summary, the population growth driving the LEC Planning Area's urban needs will be the major force behind the growth in water demand reflected in this update. Most of the population growth is expected to take place in Palm Beach, Broward, and Miami-Dade counties, which will mask the small decline expected in Monroe County's population.

3

Water Resource Analyses – Current and Future Conditions

This chapter provides an overview and status of the water resources within the Lower East Coast (LEC) Planning Area and the protections afforded water resources through regulatory criteria. Water supply to meet the demands described in **Chapter 2** is largely dependent on the availability of water resources. Understanding the relationship and effect of meeting water demands via withdrawals from water resources is critical to water supply planning.

TOPICS

- Regulatory Protection
- Water Resources by Region
- Climate Change

The current condition of the water resources is a product of a rich history of natural events and human alteration. With an annual precipitation average of 57 inches and nearly 75 percent of the rainfall occurring during the wet season of May through October (Abtew et al. 2013), the region is dependent on the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project). This regional water management system—with nearly 2,000 miles of canals and more than 2,800 miles of levees and berms, 69 pump stations, 645 water control structures, and more than 700 culverts—helps to provide regional water supplies and flood control. Canals move water from Lake Okeechobee and the Everglades to coastal counties to recharge the surficial aquifer system (SAS) during dry times. The canals are also a crucial component of the flood control system for the region. Canals discharge water to tide through bays, lagoons, and coastal estuaries, which support biological diversity. Maintaining this diversity is a key part of maintaining the health of Florida's ecological systems and resources.

Past analyses indicated that fresh water from the surficial and Biscayne aquifers and surface water from Lake Okeechobee and canals is not adequate to meet the growing needs of the LEC Planning Area during 1-in-10 year drought conditions. Potential impacts on wetlands, potential for saltwater intrusion, and other factors limit the sources available to meet water demands. Previous water supply plans identified a variety of alternative water supply development projects to avoid water resource impacts, avoid competition between water users, and provide a sustainable supply of water (SFWMD 2000, 2007). Implementation of these recommendations is well under way and includes increased water conservation, use of reclaimed water, surface water storage and management, and development and use of brackish water. Concurrently, the South Florida Water Management District (SFWMD) adopted two additional restricted allocation area rules to protect significant portions of water resources found in the LEC Planning Area.

The interaction between science, policy, and legal tools, as well as water supply regulatory programs, aid to protect water supplies for the natural systems mentioned above. Water use permit applicants must provide reasonable assurances that the proposed water use 1) is reasonable-beneficial, 2) will not interfere with any existing legal use of water, and 3) is consistent with the public interest. An existing legal use of water is a water use authorized under a SFWMD water use permit or existing and exempt from permit requirements. This chapter describes water use permitting criteria, minimum flow and level (MFL) criteria, water reservations, and water shortage plans designed to protect and manage water resources. This chapter also describes the major water resources and their current condition, future trends, and the effect of changed operational protocols. Water resource development projects that provide additional water and restore or improve water quality of our water resources will be discussed in **Chapter 4**.

REGULATORY PROTECTION OF WATER RESOURCES

The intent of Chapter 373, Florida Statues (F.S.), is to manage Florida's water resources to ensure their sustainability (Section 373.016, F.S.). SFWMD developed water resource protection standards consistent with the legislative direction. The levels of harm—"harm", "significant harm", and "serious harm"—are relative resource protection terms, each playing a role in the ultimate goal of achieving a sustainable water resource. For instance, programs regulating surface water management and water use permitting must prevent harm to the water resource. The conceptual relationship among the various harm standards, associated conditions, and water shortage severity is shown in **Figure 9** while **Table 10** summarizes statutory resource protection tools and definitions.

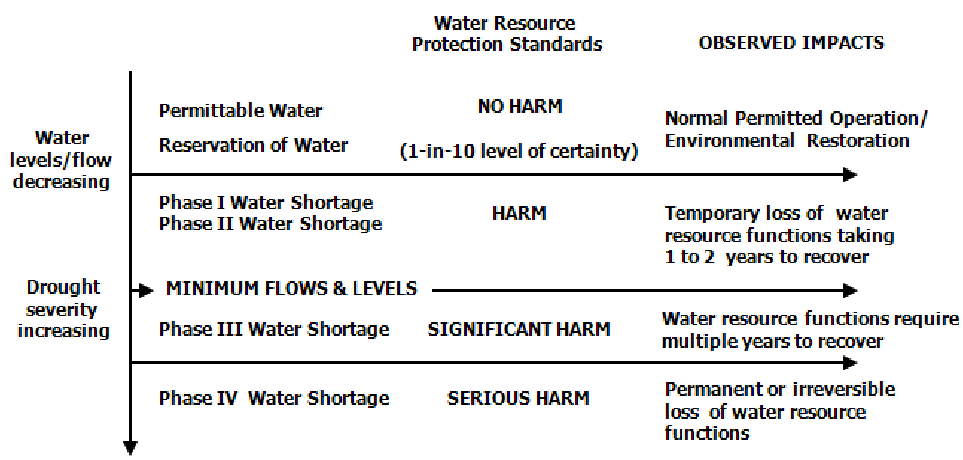


Figure 9. Conceptual relationship among the harm, significant harm, and serious harm water resource protection standards.

Table 10. Summary of statutory resource protection tools.

Tool	Description
Water Use Permitting	The right to use water is authorized by permit. The conditions of permit issuance are more specifically enumerated in Chapters 40E-2 and 40E-20, Florida Administrative Code (F.A.C.). In order to provide reasonable assurances that the conditions of permit issuance are met, applicants must meet the technical criteria in the *Basis of Review for Water Use Permit Applications within the South Florida Water Management District* (SFWMD 2012b). The technical criteria used to evaluate the quantity and the proposed water uses' impact on the source include the following: • Saltwater intrusion • Wetland and other surface water body impacts • Pollution • Impacts to off-site land uses • Interference with existing legal users • MFLs and their regulatory components
Minimum Flows and Levels	MFL criteria are the flows or levels at which the specific water resource would experience significant harm from further withdrawals. If water flows or levels are below the MFL criteria, or projected to fall below the MFL criteria within the next 20 years, SFWMD must expeditiously implement a recovery or prevention strategy (Subsection 373.0421(2), F.S.). These strategies may include the construction of new or improved water storage facilities, development of additional water supplies, implementation of water conservation, etc. The strategy is to be developed in concert with the water supply planning process and coincide with the twenty-year planning horizon for the area.
Water Reservations	A water reservation sets aside water for the protection of fish and wildlife or the public health and safety. When a volume of water is reserved, it is not available for allocation to consumptive uses. Water reservations can be developed based on existing water availability and/or consideration of future water supplies made available by water resource projects. The Water Resources Development Act of 2000 requires SFWMD to use its reservation or allocation authority to protect water made available by Comprehensive Everglades Restoration Plan (CERP) projects as necessary for the natural system. Any volume of water not necessary for the protection of fish and wildlife or public health and safety may be certified as available and allocated to consumptive uses.
Water Shortage	Water shortages are declared by SFWMD's Governing Board when available groundwater or surface water is not sufficient to meet users' needs or when conditions require temporary reduction in total use within the area to protect water resources from serious harm. SFWMD's Water Shortage Plans are contained in Chapters 40E-21 and 40E-22, F.A.C. The purposes of the plans are to protect the water resources of SFWMD from serious harm; assure equitable distribution of available water resources among all water users during times of shortage consistent with the goals of minimizing adverse economic, social, and health related impacts; provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and promote greater security for water use permittees.

To ensure the sustainability of Florida's water resources, Chapter 373, F.S., provides water management districts with several regulatory tools to protect water resources where the harm standards are applied:

- Water use permitting addresses the use of water resources to protect them from harm. Harm is defined as the temporary loss of water resource functions that results from a change in surface water or groundwater hydrology, and takes a period of one to two years of average rainfall conditions to recover (Rule 40E-8.021(9), Florida Administrative Code [F.A.C.]).
- MFL criteria define the point at which additional withdrawals will result in significant harm to the water resources or the ecology of the area (Sections 373.042 and 373.0421, F.S.). Significant harm is the temporary loss of water resource functions that results from a change in surface water or groundwater hydrology that takes more than two years to recover, but which is considered less severe than serious harm (Rule 40E-8.021(31), F.A.C.).
- Water reservations set aside water for the protection of fish and wildlife or public health and safety. Reserved water is not allocated to consumptive uses (Subsection 373.223(4), F.S.).
- Water shortage restrictions limit water use when sufficient water is temporarily unavailable to meet user needs or when conditions require temporary reduction in use to prevent serious harm to water resources (Sections 373.175 and 373.246, F.S.). Serious harm is the long-term loss of water resource functions resulting from a change in surface water or groundwater hydrology (Rule 40E-8.021(30), F.A.C.).

Changes to Water Use Permitting

The *2000 Lower East Coast Water Supply Plan* (2000 LEC Plan) (SFWMD 2000) recommended incorporation of resource protection criteria (MFLs and water reservations), level of certainty, special designations, and permit durations into the water use permitting criteria. A series of rulemaking efforts was completed in September 2003, resulting in amendments to Chapters 40E-1, 40E-2, 40E-5, 40E-8, 40E-20, and 40E-21, F.A.C. and the *Basis of Review for Water Use Permit Applications within the South Florida Water Management District,* referred to as the Basis of Review (SFWMD 2012b). Among the most significant changes were the amendments to permit duration, permit renewal, wetland protection, supplemental irrigation requirements, saltwater intrusion, aquifer storage and recovery, and model evaluation criteria.

A renewal process for irrigation class water use permits in the LEC Planning Area's urban corridor began in 2004 and was mostly complete in 2006. Most Lower East Coast Service Area (LECSA) Public Water Supply (PWS) permits were renewed between 2008–2011. Lake Okeechobee Service Area (LOSA) permit renewals began in 2009, with most permits issued by 2011. Many of the renewed permits are for twenty-year durations. The processing of permit applications, and the associated data and analysis to support and evaluate them, benefited the evaluation of current conditions for this plan update.

Additional Protection Afforded Water Resources

The water resource protection criteria contained in the Basis of Review includes three additional mechanisms to protect water supplies for natural systems from consumptive uses: 1) MFLs, 2) water reservations, and 3) restricted allocation area rules. In recent years, the SFWMD's priorities have focused on establishing water reservation and restricted allocation area rules to facilitate construction of the Comprehensive Everglades Restoration Plan (CERP) project components. Federal law requires natural system water provided by CERP projects to be protected by water reservation or restricted allocation area rules prior to executing a cost-share agreement to construct.

The SFWMD also continues to fulfill its statutory obligation to identify key water bodies for which MFLs should be developed or updated. Section 373.042(2), F.S. requires each of the five water management districts to provide an annual MFL priority list and schedule to the Florida Department of Environmental Protection (FDEP). The statute was modified in 2013 to require identification of proposed water reservations. Future submittals to FDEP will include lists and schedules for MFL and water reservation water bodies.

The priority list is based on the importance of the waters to the state or region and the existence of, or potential for, significant harm to the water resources or ecology of the state or region, and includes those waters that are experiencing or may reasonably be expected to experience adverse impacts. In addition, the SFWMD considers the CERP project schedule and the related federal and state requirements to protect water for the natural system using its reservation or allocation authority. To this end, in 2007 the SFWMD adopted restricted allocation area rules for the Lower East Coast Service Area and North Palm Beach County/Loxahatchee River Watershed to limit allocation of water and, in part, to support construction of CERP projects. Restricted allocation area and water reservation rules function similarly and limit allocations; therefore the SFWMD has removed initial water reservations for the Everglades and Loxahatchee River water bodies from its priority lists. In addition, the United States Army Corps of Engineers (USACE) has verified that federal requirements have been met for several CERP projects by virtue of the SFWMD's adoption of water reservations and restricted allocation area rules. Taken together, these rules function to afford protection for water resources across significant portions of the planning area.

Minimum Flows and Levels

MFL criteria define the point at which further withdrawals will result in significant harm to the water resources or ecology of the area. These criteria are applied individually to affected water bodies and define flow or stage, durations, and return frequency. When setting MFL criteria, the Governing Board must consider changes and structural alterations to watersheds, surface waters, and aquifers and the effects such changes or alterations had, and the constraints such changes or alterations placed on the hydrology of an affected watershed, surface water, or aquifer (Subsection 373.0421(1), F.S.).

Within the LEC Planning Area, between 2001 and 2006, the Governing Board adopted MFL criteria for five water bodies. These water bodies include 1) Lake Okeechobee, 2) the Everglades, which includes Water Conservation Area (WCA) 1, WCA 2, WCA 3, Everglades National Park, and Rotenberger and Holey Land wildlife management areas, 3) the Biscayne aquifer, 4) the Northwest Fork of the Loxahatchee River and Estuary, and 5) Florida Bay (Chapter 40E-8, F.A.C.). **Figure 10** shows the location of both MFL and water reservation water bodies. MFL criteria must be reviewed periodically. SFWMD is currently reviewing the Caloosahatchee and Florida Bay MFL criteria as described in the 2013 priority water body list submitted to FDEP (Medellin 2013).

When SFWMD establishes an MFL, it must determine whether the existing flow or level in the water body is below or projected to fall below, the MFL criteria within the next 20 years. If it will, SFWMD must develop and expeditiously implement a recovery or prevention strategy. The strategy, when appropriate, should include development of additional water supplies, water conservation, and other efficiency measures consistent with the provisions in Sections 373.0421 and 373.709, F.S.

SFWMD develops a recovery strategy when the water body currently exceeds the MFL criteria. The goal of a recovery strategy is to achieve the established MFL as soon as practicable. The recovery strategy must include the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, and may include the development of additional supplies, construction of new or improved storage facilities, and implementation of conservation or other efficiency measures. A prevention strategy is developed when the MFL criteria is not currently violated, but is projected to be exceeded within the next 20 years. The goal of a prevention strategy is for the water body to continue to meet the established MFL in the future. Both recovery and prevention strategies must include phasing or a timetable that allows for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses. MFL recovery and prevention strategies are implemented in phases with consideration of SFWMD's missions in managing water resources, including water supply, flood protection, environmental enhancement, and water quality protection, as required by Section 373.016, F.S.

Presently, recovery strategies exist for Lake Okeechobee, the Everglades, and the Northwest Fork of the Loxahatchee River. Prevention strategies exist for the Biscayne aquifer and Florida Bay. Both types of MFL strategies are described in **Appendix B**. Details and the status of projects and programs identified in **Appendix B** can be found later in this chapter and in **Chapter 4**. Further details on MFLs are available on SFWMD's website at www.sfwmd.gov/mfls.

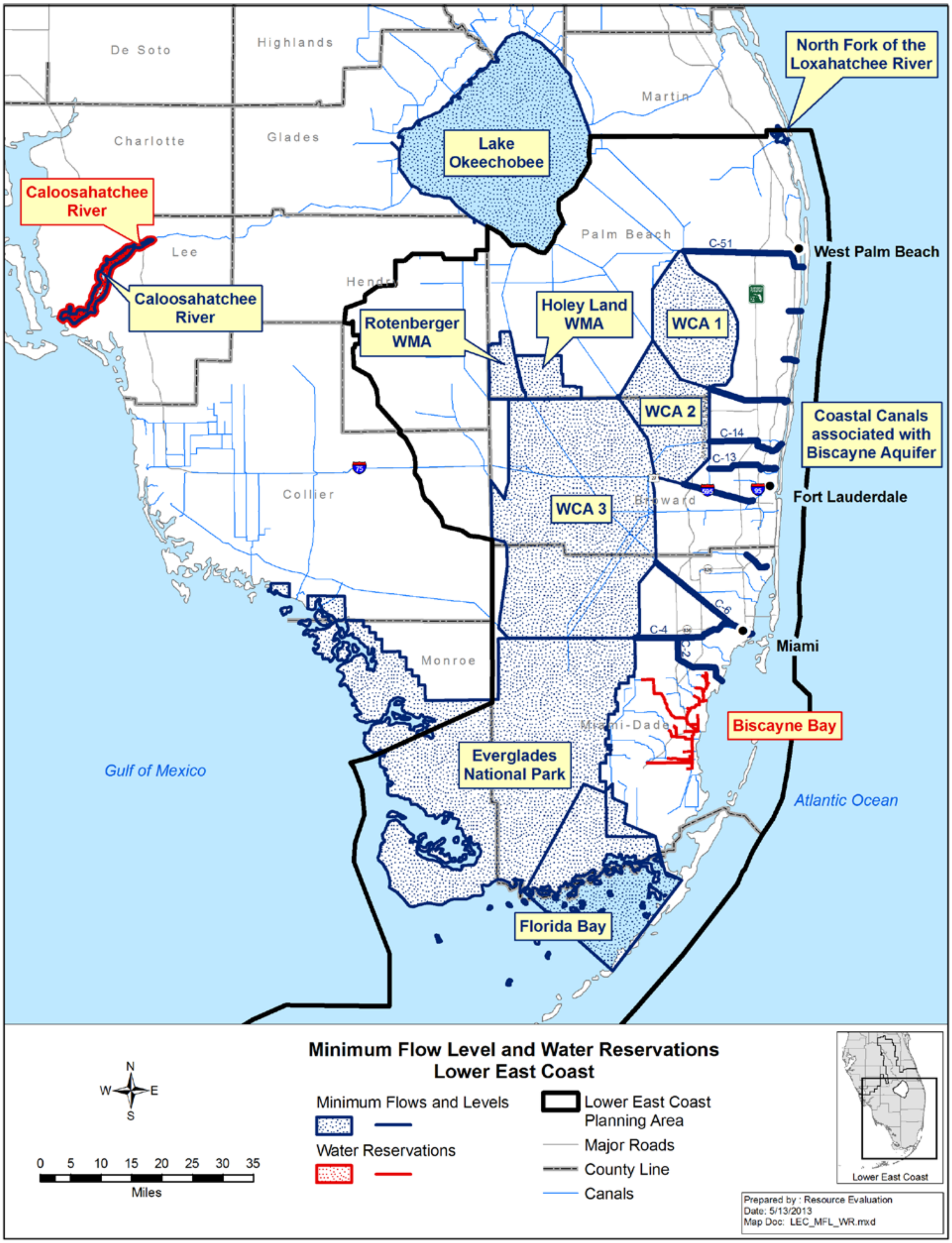


Figure 10. MFL and water reservation water bodies.
(Note: WMA – Wildlife Management Area.)

Water Reservations

Chapter 373.709(h), F.S. requires regional water supply plans to include water reservation rules adopted for the planning area. A water reservation rule sets aside water for the protection of fish and wildlife or public health and safety. When a volume of water is reserved, it is unavailable to allocate for consumptive uses. Water reservations are developed based on existing water availability and/or consideration of future water supplies that water resource projects make available. The Water Resources Development Act of 2000 and Section 373.470, F.S. require SFWMD to reserve or allocate the increase water supplies for the natural system identified in CERP project implementation reports. Water reservations rules became effective in support of the CERP Picayune Strand Restoration, the Indian River Lagoon – South, and Biscayne Bay Coastal Wetlands (BBCW) projects in 2009, 2010 and 2013. The Governing Board is expected to consider draft water reservation rules in 2014 for the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir.

Biscayne Bay Water Reservation

From 2003 to 2011, SFWMD evaluated different approaches to establish rules to protect Biscayne Bay. The approaches included evaluating whether to establish MFL criterion to establish the point at which further withdrawals would cause significant harm to the bay's resources, implementing a restricted allocation area rule or a water reservation to protect surface water flows to the bay. From 2003 to 2007, SFWMD completed a series of reports, which did not demonstrate a clear link between biological resources and salinity based on freshwater inflows, a necessary linkage for defining the MFL significant harm threshold. From 2008 to 2009, SFWMD refocused its efforts on measures needed to achieve restoration of Biscayne Bay and completed a peer reviewed report, *Adequacy of Technical Information to Support Minimum Inflow Needs for Biscayne Bay*, which concluded that additional salinity information needed to be developed (SFWMD 2009a). In 2012, SFWMD and USACE completed the project implementation report for the BBCW Phase I Project, which identified a specific quantity of surface water to be protected in order for the project to achieve its intended benefits. SFWMD-considered options to protect water for the bay, which included 1) a water reservation for surface water flows identified for the portions of the bay improved by the CERP project; 2) a water reservation for surface water flows for all of Biscayne Bay; and 3) a restricted allocation area rule for surface water flows for all of Biscayne Bay. The SFWMD Governing Board directed staff to undertake rule development for a water reservation for surface water associated with the CERP project.

SFWMD adopted a rule to reserve water to protect existing surface water flows up to the target flows, which is greater than the water provided by Phase 1 of the BBCW Project and identified in the CERP project implementation report (USACE and SFWMD 2012). Specifically, the proposed rule prohibits the allocation of surface water within certain reaches of the C-100, C-1, C-102, C-103, and associated canals to consumptive uses. Further details on water reservations are available on SFWMD's website at www.sfwmd.gov/reservations.

Restricted Allocation Area Rules

Restricted allocation areas limit allocations from water resources (e.g., lakes, wetlands, and canals) in defined geographic areas. Three areas have restrictions on allocations within the LEC Planning Area. The two largest areas and water users affected are the Lower East Coast and Lake Okeechobee service areas. By limiting allocation, restricted allocation area rules function similar to a water reservation that also limits allocations. To that end the SFWMD has removed initial water reservations for the Everglades and the Loxahatchee River Watershed water bodies from its priority lists. Additional areas include canals in eastern Hendry County and the North Palm Beach/Loxahatchee River Watershed. **Figure 11** shows the locations of restriction allocation areas within the LEC Planning Area.

In February 2007, SFWMD's Governing Board adopted restricted allocation area criteria for the Everglades and Loxahatchee River Watershed water bodies (Section 3.2.1.E, Basis of Review). This criteria limits allocations to conditions or withdrawals in the Lower East Coast Service Area and North Palm Beach County/Loxahatchee River Watershed, depending on the specific use class, that existed as of April 1, 2006, known as the "base condition water use." The rule only allows allocations over the "base condition water use" through alternative source development, implementation of offsets (e.g., recharge barriers and recharge trenches), or identification of terminated or reduced water uses that existed as of April 1, 2006. Wet season water can be allocated if the permit applicant demonstrates that such flows are not needed for restoration of the Everglades pursuant to CERP or for the Loxahatchee River Watershed water bodies, pursuant to the *Northern Palm Beach County Comprehensive Water Management Plan* (SFWMD 2002). This criteria is part of the MFL recovery strategies for both the Everglades and the Northwest Fork of the Loxahatchee River.

In October 2008, SFWMD's Governing Board adopted restricted allocation area criteria for LOSA (Section 3.2.1.G, Basis of Review). These criteria limit surface water withdrawals from Lake Okeechobee and all surface water hydraulically connected to the lake. The change in permit criteria was necessitated by the impacts to water supply and increased exceedances of the lake MFL criteria from implementation of the 2008 Lake Okeechobee Regulation Schedule (2008 LORS), which reduced stages in Lake Okeechobee by approximately one foot. When repairs by USACE to the Herbert Hoover Dike are complete and the lake's regulation schedule is revised through a National Environmental Policy Act analysis, the expectation is that the resulting schedule will raise lake levels. The additional water held in the lake is expected to return the lake from MFL recovery status to MFL prevention status, enhance the level of certainty to existing permitted users now receiving less than 1-in-10 level of certainty, and support environmental objectives. In the meantime, these criteria are part of the MFL recovery strategy for the lake.

The third restricted allocation area found in the LEC Planning Area is located just south of LOSA in eastern Hendry County. These basins have a limited network of surface water canals that are not connected to Lake Okeechobee. Canals in this area include the L-1, L-2, and L-3 canals, where no additional surface water can be allocated over the existing allocations (Section 3.2.1.C, Basis of Review).

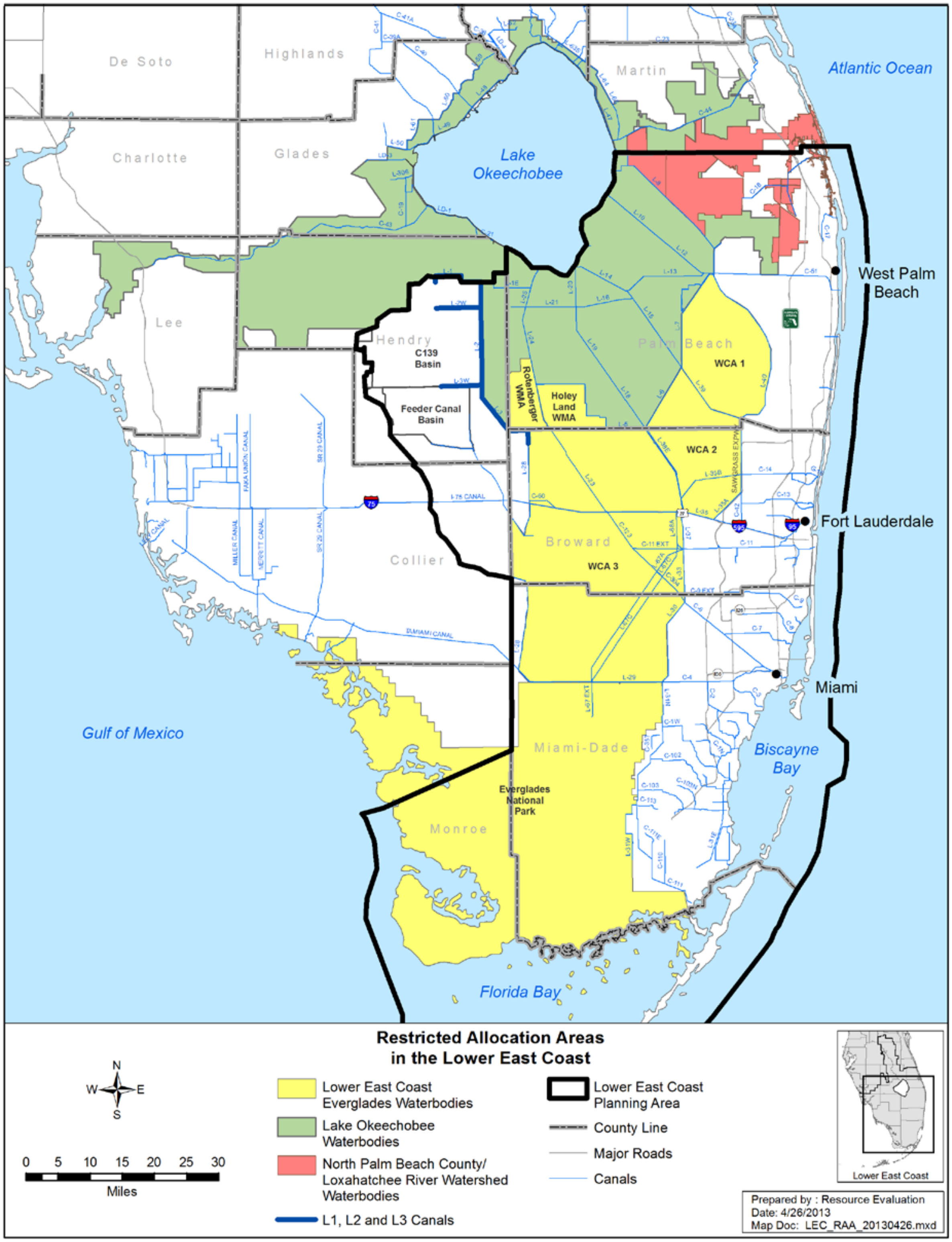


Figure 11. Restricted allocation areas in the LEC Planning Area. (Note: WMA – Wildlife Management Area.)

Water Shortage Criteria

In accordance with Sections 373.175 and 373.246, F.S., water shortage declarations are designed to prevent serious harm from occurring to water resources. Serious harm is defined as the long-term loss of water resource functions resulting from a change in surface water or groundwater hydrology. Observed impacts associated with serious harm can result in long-term, irreversible, or permanent loss of water resource functions (Rule 40E-8.021(30), F.A.C.).

The Water Shortage Plan laid out in Chapter 40E-21, F.A.C. is applied to manage water use when insufficient groundwater or surface water is available to meet user needs or when conditions require temporary reduction in use. The goal is to protect the remaining supply through demand management and ensure a fair distribution of this supply. Chapter 40E-22, F.A.C. is the SFWMD Regional Water Shortage Plan. It contains water shortage restrictions related to specific water bodies, including Lake Okeechobee. Further information on water shortage management is available in the *2011–2013 Water Supply Plan Support Document*, referred to as the Support Document (SFWMD 2013a).

OVERVIEW OF WATER RESOURCES BY REGION

Major regions of the LEC Planning Area include Lake Okeechobee and hydraulically connected surface water bodies; the Everglades Agricultural Area (EAA), which is located in LOSA; the Everglades, including the WCAs and Everglades National Park; Loxahatchee River and Estuary; Lake Worth Lagoon; Biscayne Bay; Florida Bay, and the Lower West Coast Service Area (**Figure 12**).

Lake Okeechobee

Lake Okeechobee serves multiple purposes, including urban, agricultural and environmental water supply, flood control, navigation, and commercial and recreational fisheries. It is also a key ecological component of the Greater Everglades ecosystem (Zhang and Sharfstein 2013). The lake has multiple inflows, including the Kissimmee River, and receives water from a watershed in excess of 4,600 square miles. However, the lake only has two major outlets for flood control purposes: one to the east coast via the St. Lucie Canal and another to the west coast via the Caloosahatchee Canal (SFWMD 2011b). The 143-mile long Herbert Hoover Dike encircles the lake to protect the surrounding communities from flooding. A technical review of the dike conducted by an expert panel in 2006 (Bromwell et al. 2006) indicated the need for a major rehabilitation.

MFL criteria and a prevention strategy were established for Lake Okeechobee in 2001. Significant harm criteria associated with the MFL criteria were based on the relationship between water levels in the lake and the abilities to 1) protect the coastal aquifer against saltwater intrusion, 2) supply water to Everglades National Park, 3) provide littoral zone habitat for fish and wildlife, and 4) ensure navigational and recreational access (SFWMD 2000).

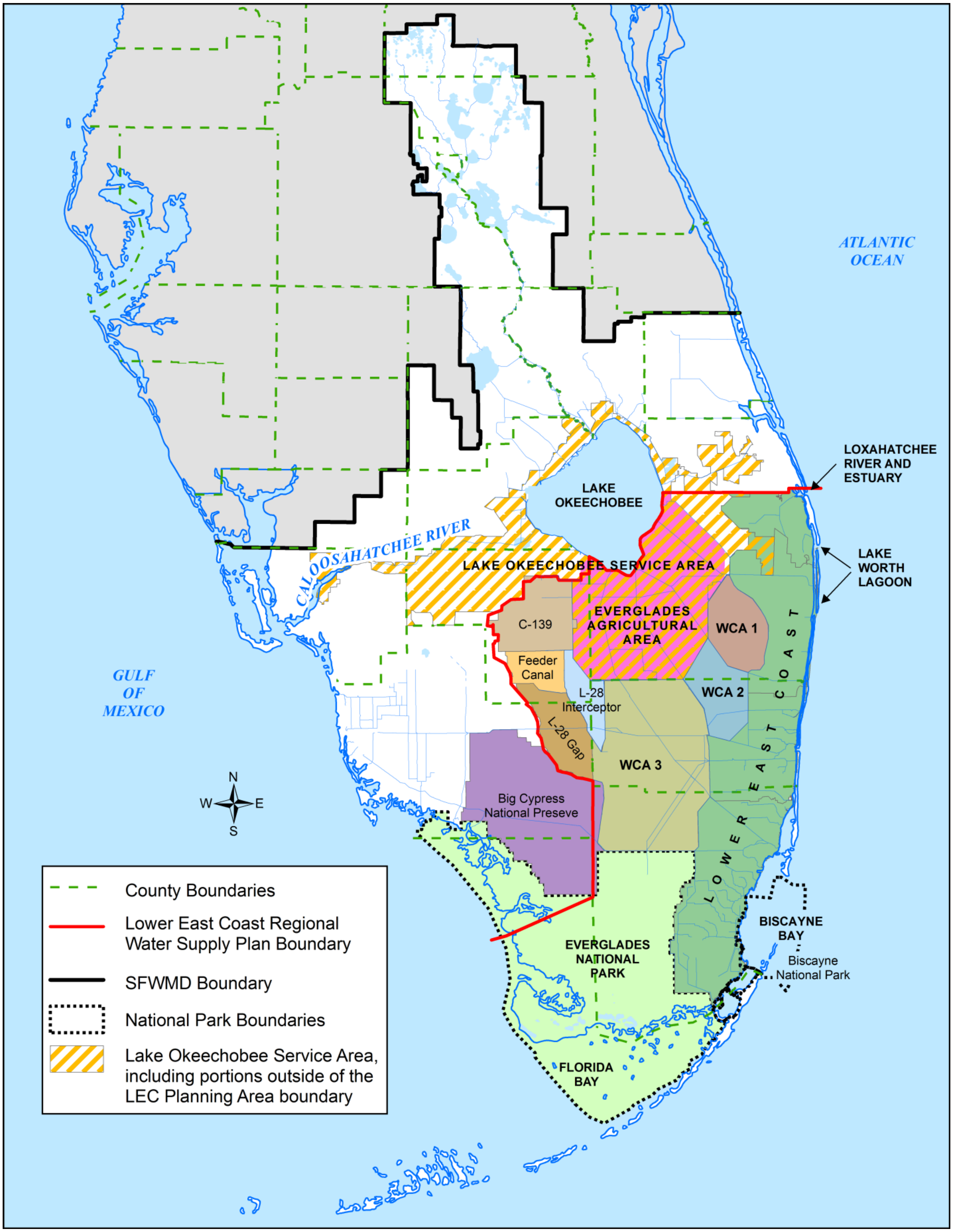


Figure 12. Major regions of the LEC Planning Area.

2008 LORS and Adaptive Protocols

As mentioned earlier in the chapter, USACE adopted a new lake schedule, 2008 LORS, to reduce the risk of the dike failure (USACE 2007) until it is rehabilitated. The schedule includes operating guidelines designed to maintain Lake Okeechobee water levels approximately one foot lower than the previous schedule to protect the integrity of the dike and enhance lake ecology. Under 2008 LORS, water levels are primarily maintained between 12.5 and 15.5 feet National Geodetic Vertical Datum of 1929 (NGVD). Overall, the changes under 2008 LORS result in an average loss of approximately 430,000 acre-feet (ac-ft) of water storage for all uses. The new schedule increased the frequency of low lake stage exceeding the MFL criteria.

As a result of the impacts to water supply and the water resource, SFWMD changed the MFL status from prevention to recovery and developed a recovery strategy, which can be found in **Appendix B.** The strategy includes a regulatory component that limits future additional withdrawals from Lake Okeechobee and all surface water hydraulically connected to the lake (referred to in the Florida Statutes as the "Lake Okeechobee Waterbody") in order to prevent further degradation of the level of certainty for existing legal users or change in lake MFL performance.

To assist managing the lake under 2008 LORS, adaptive protocols for Lake Okeechobee operations were revised (SFWMD 2010). The key goals of the revisions are to improve water supply, flood protection, and ecosystem benefits within the constraints of 2008 LORS and the *Central and Southern Florida Project Water Control Plan for Lake Okeechobee and Everglades Agricultural Area* (USACE 2008). Adaptive protocols provide guidance to water managers for discretionary releases for ecosystem benefits or to improve conditions related to the operation of the C&SF Project when the lake stage is in the low, base flow, and beneficial use sub-bands. For further discussion of these changes, see **Appendix B**.

Lake Okeechobee's response to changing levels and stage ranges has been quite dynamic. However, a number of trends appear to be emerging. The emergent and submerged vegetation communities appear to have moved lakeward (towards previously deeper water areas); with the upper, short hydroperiod marsh becoming progressively more terrestrial in character. Additionally, many of the large shallow bays, particularly at the southern end of the lake, are shifting from being dominated by submerged vegetation towards being dominated by emergent species; while submerged plant beds extended further offshore (**Figure 13**). For the most part, faunal responses to these changes have been positive. Both sport and commercial fish species appear to be thriving (Zhang and Sharfstein 2012, 2013). The lake had more nesting activity of the endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*) in 2012 than in any year since 1992 (Kitchens et al. in press). Use of the lake by waterfowl remained high. However, wading bird foraging and nesting success (with one exception) has been relatively poor in the last several years. This may be due to low lake levels preventing adequate development of the required prey base in areas of suitable depth in the marsh (Zhang and Sharfstein 2012, 2013, Chastant and Gawlik 2011).

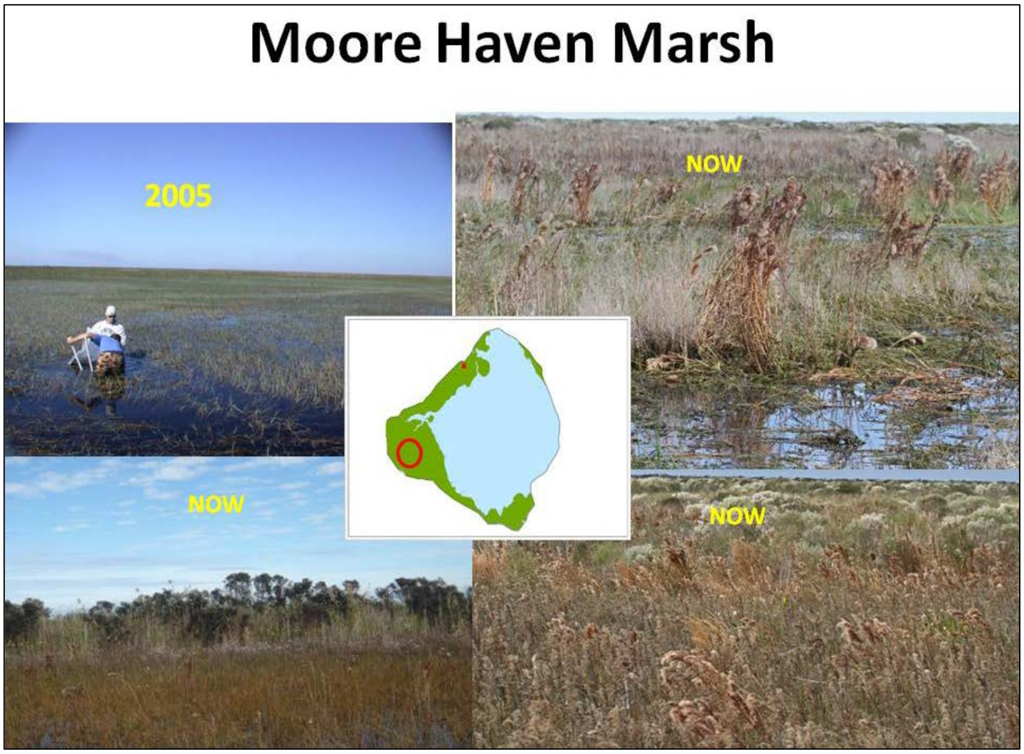


Figure 13. Major shifts in the Lake Okeechobee marsh vegetation community occurred over the past seven years in response to recent droughts and implementation of 2008 LORS, which strives to maintain the lake at least a foot lower than the previous operating schedule.

Water quality in Lake Okeechobee remains relatively unchanged and appears to be insensitive to both the change to 2008 LORS schedule and the relatively modest nutrient abatement projects that have been implemented to date. The main driver for annual phosphorus load continues to be volume and source of inflow to the lake (Zhang and Sharfstein 2013), which is directly related to annual rainfall in the watershed. Even though high nutrient levels, lower lake levels, and clearer water occurred over the past several years, cyanobacterial (blue-green algae) blooms and their associated toxins remained low since 2005 (Zhang and Sharfstein 2012, 2013).

Because of the climatic variability of South Florida, coupled with large differences between the lake's inflow and outflow potential and the lack of additional water storage features both upstream and downstream of the lake, the overarching driver for lake ecology continues to be stochastic or naturally occurring events like droughts and hurricanes (Havens et al. 2001). Their dominance was clearly demonstrated by years like 2001, 2007, and 2011 (droughts), and 2004 and 2005 (major hurricanes).

Everglades

The Everglades, which includes the WCAs and Everglades National Park (**Figure 14**), are managed for flood control, water supply, regional groundwater control (including prevention of saltwater intrusion), recreation, and enhancement of fish and wildlife, including endangered and threatened species (Abtew et al. 2013). As a natural ecosystem, it contains the globally rare and last remnant ridge and slough patterning, tree islands that are considered important habitat for subtropical and tropical plant and animal species, marl marshes, and coastal mangrove forests and marshes. The Everglades is the focus of one of the largest ecological restoration projects in the world.

The Everglades is a peatland, a type of wetland with soils composed of organic matter that builds up by accumulating decaying vegetation. Natural peatlands stay saturated and the peat generally remains wet year-round. Within the Everglades is a patterned peatland, called ridge and slough, consisting of long, linear patterns of alternating sawgrass ridges among sloughs populated by water lilies. The entire landscape pattern is oriented parallel to water flow. These peatlands provided a wide variety of habitat for fish and other aquatic species, reptiles and amphibians, such as alligators and frogs, wading birds, and migratory birds. They were very low nutrient (especially phosphorus) wetlands.

The Everglades were initially drained to encourage use for farming. Then, as the peat was over-dried and burned, water supply became an issue for the growing coastal human population. Beginning in the 1950s and 1960s, the wetlands were compartmentalized to retain water for water supply as part of the C&SF Project (Alexander and Crook 1973), radically altering these depths. Compartmentalization required intensive water management. The WCAs are impoundments that confine water over a sloped surface (sloping generally southward from Lake Okeechobee towards Florida Bay). Therefore, water depths in the northern regions are lower than in the southern regions of each WCA.

Prior to human development, water flowed unimpeded out of Lake Okeechobee over what is now the EAA, bounded by the coastal ridge to the east and the higher lands west of what is now WCA 3A and Big Cypress National Preserve (McVoy et al. 2011). Historically, this flow wound its way to Biscayne or Florida bays. Under natural flows, water levels across the landscape were generally equally deep.

Now, the primary inflows and outflows from the WCAs are rainfall and evapotranspiration (Abtew et al. 2013), which is evaporation plus water released by vegetation. Additional inflows come from the stormwater treatment areas (STAs) and through gates that connect one WCA to another (S-10 structures from WCA 1 to WCA 2, S-11 structures from WCA 2A to WCA 3A, and S-12 structures from WCA 3A to Everglades National Park). Storm water from the EAA moves south through STAs constructed by SFWMD and into the Everglades Protection Area. The STAs include STA 1 East, STA 1 West, STA 2, STA 3/4, and STA 5/6 as of September 2012. Expansion of STA 2 (known as Compartment B) and STA 5/6 (known as Compartment C) are complete and are permitted to operate. These two STA expansion projects increase the total effective treatment area to 57,000 acres.

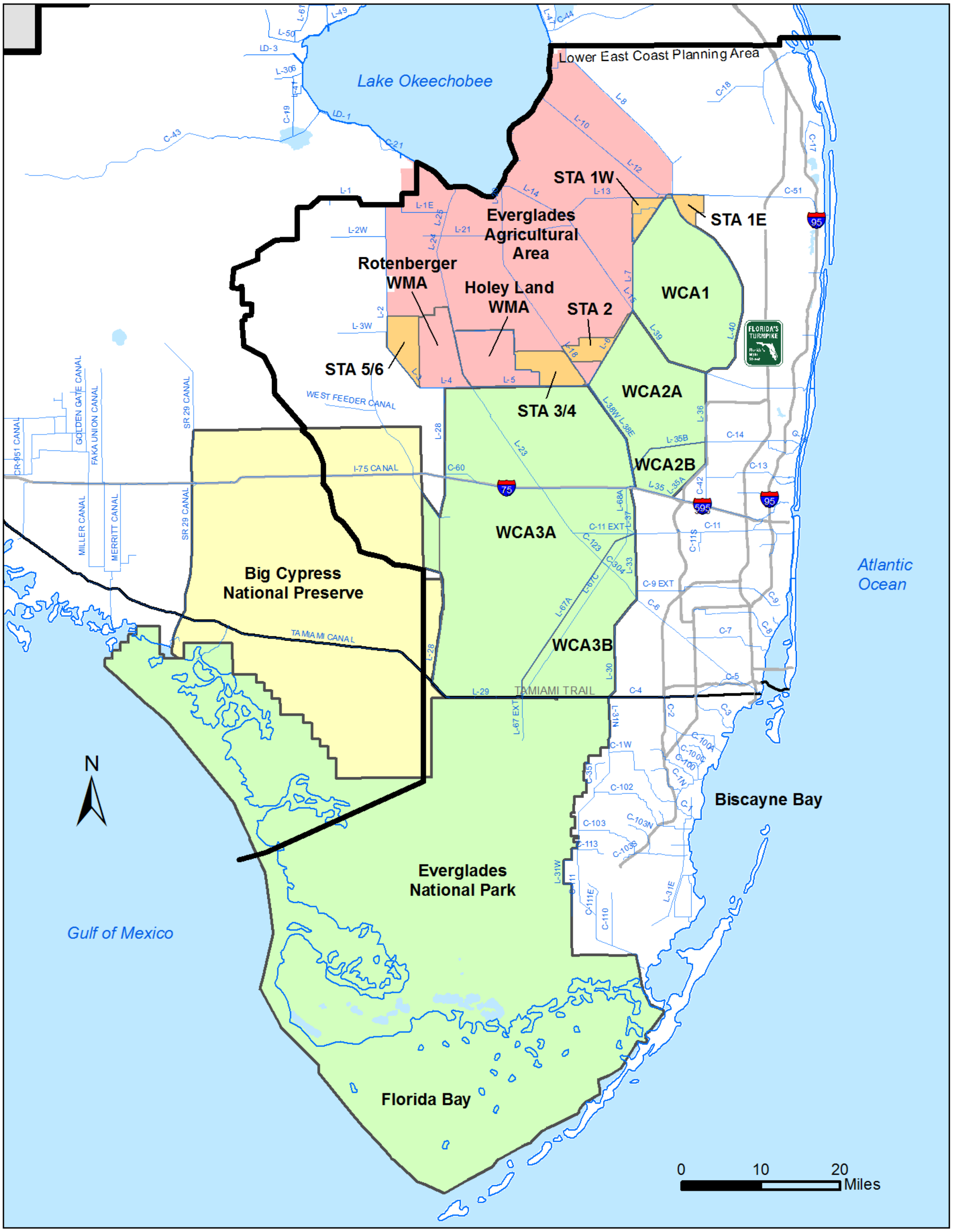


Figure 14. Map of the Greater Everglades region.
(Note: WMA – Wildlife Management Area.)

Water levels in most of the WCAs are managed via inflow and outflow control structures using a set of regulation schedules established by USACE (USACE 1996). These schedules allow for different water levels under different conditions. These ranges can provide storage of runoff during the wet season for subsequent use during the dry season, and flood control during the wet season.

Everglades MFL criteria were established in 2001. Impacts associated with significant harm include increased peat oxidation, frequency of severe fires, soil subsidence, loss of aquatic refugia, loss of tree islands, and long-term changes in vegetation or wildlife habitat. The MFL criteria for the Everglades were based on protecting the two dominant soil types, peat-forming and marl-forming wetlands, found within the ecosystem. An MFL recovery strategy has been in place since 2001 when the criteria were adopted. This strategy can be found in **Appendix B**. In 2007, regulatory criteria limited additional withdrawals, whether direct or indirect, from Everglades water bodies to the levels permitted as of April 1, 2006.

Everglades Restoration Transition Plan

The Everglades Restoration Transition Plan (ERTP) (USACE 2011) defines water management operating criteria for the C&SF Project features and the constructed features of the Modified Water Deliveries to Everglades National Park Project and the C-111 South Dade Project until the Combined Operational Plan is implemented, which incorporates more flexible operating criteria to better manage WCA 3A. The ERTP is intended to improve conditions for the Everglades snail kite, the wood stork (*Mycteria americana*), and wading birds and their habitats while maintaining protection requirements for the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), along with C&SF Project purposes.

The limited flexibility within the current system was evaluated by reviewing hydrological, meteorological, and ecological data from 1998 to 2009. Specifically, this time frame corresponds to several efforts: evaluation of the protection of the Cape Sable seaside sparrow (USACE 1999, 2000a, USACE and SFWMD 1999), development of the 2000 and 2001 Interim Structural and Operational Plans (USACE 2000a), and development of the 2002 and 2006 Interim Operational Plans (USACE 2002, 2006). Recommendations within the United States Fish and Wildlife Service's (USFWS) *Draft Multi-Species Transition Strategy for Water Conservation Area 3A* (USFWS 2010a) formed the basis for the ERTP performance measures and ecological targets.

Through the ERTP, the USFWS and USACE implemented a Multi-species Management Plan for WCA 3A to manage hydrology to better address the needs of multiple species. These species included the endangered wood storks, Everglades snail kites, and wading birds. Habitats included wet prairies and tree islands. During this process, concern over levee integrity led USACE to replace the flood regulation schedule for WCA 3A with the 1960 flood regulation schedule. The 1960 schedule reduces the three-gauge average wet season stages by 0.25 foot and the dry season stages by 0.5 foot relative to the existing schedule (USACE 2011).

Following the approval of the ERTP final environmental impact statement (USACE 2011), the ERTP replaced the Interim Operating Plan when the Record of Decision Central and Southern Florida Project Everglades Restoration Transition Plan was signed on October 19, 2012 (USACE 2012). This reduced dry season schedule may significantly decrease water supply for natural ecosystems and downstream uses and has already produced stages lower than those of the previous year.

Response to Recent Droughts

An additional water supply concern is the recent droughts. The Everglades experienced two relatively severe droughts in 2009 and 2011, when water levels in the five WCAs fell below ground over 87 to 100 percent of their areas. In WCA 3A, where water levels along the L-67 and L-29 canals usually remain aboveground throughout the dry season, water levels fell belowground and exceeded MFL criteria (**Figure 15** and **Figure 16**). Peat fires can result in catastrophic loss of peat, which took decades to centuries to form. In June 2011, the Prairie Fire burned 68,300 acres of WCA 3B and was extinguished by rainfall a few days later (**Figure 17**). Of additional concern was that water depths in west central WCA 3A, the location of the best ridge and slough patterning, was up to 2 feet underground, leading potentially to significant peat loss through exposure to air, leading to high rates of decomposition.

Figure 15. Wetland conditions were similar throughout most of WCA 3A with dried and cracked peat. This photo, taken on June 6, 2011, was from an area immediately adjacent to the L-67 Canal that is nearly always inundated. (Photo by M. Nungesser, SFWMD.)

Figure 16. Wetland conditions on June 6, 2011, in southern WCA 3A about one mile north of Tamiami Trail. Sawgrass ridges are exposed and mud is cracking. Sloughs are exposed or with a very shallow cover of water, which is unusual for southern WCA 3A. (Photo by M. Nungesser, SFWMD.)

Figure 17. Prairie Fire in WCA 3B during June 2011 which burned over 107 square miles over five days. (Photo by M. Kobza, SFWMD.)

South Florida is facing climate change in the form of increased temperatures and effects on evapotranspiration, increased or decreased rainfall, and sea level rise. These alterations may affect water supply for the natural ecosystems of the Everglades (see the **Outlook on Climate Change** section at end of this chapter for more information).

Loxahatchee River and Estuary

The Loxahatchee River and Estuary lie in southern Martin County and northern Palm Beach County on the east coast of Florida (**Figure 18**). The Loxahatchee River is referred to as the "last free flowing river in southeastern Florida" and represents one of the last vestiges of native cypress river swamp within southeastern Florida. In 1985, 9.5 miles of the Northwest Fork was federally-designated as Florida's first National Wild and Scenic River. Large sections of the river's watershed and river corridor are within Jonathan Dickinson State Park, which includes outstanding examples of the region's natural biological communities.

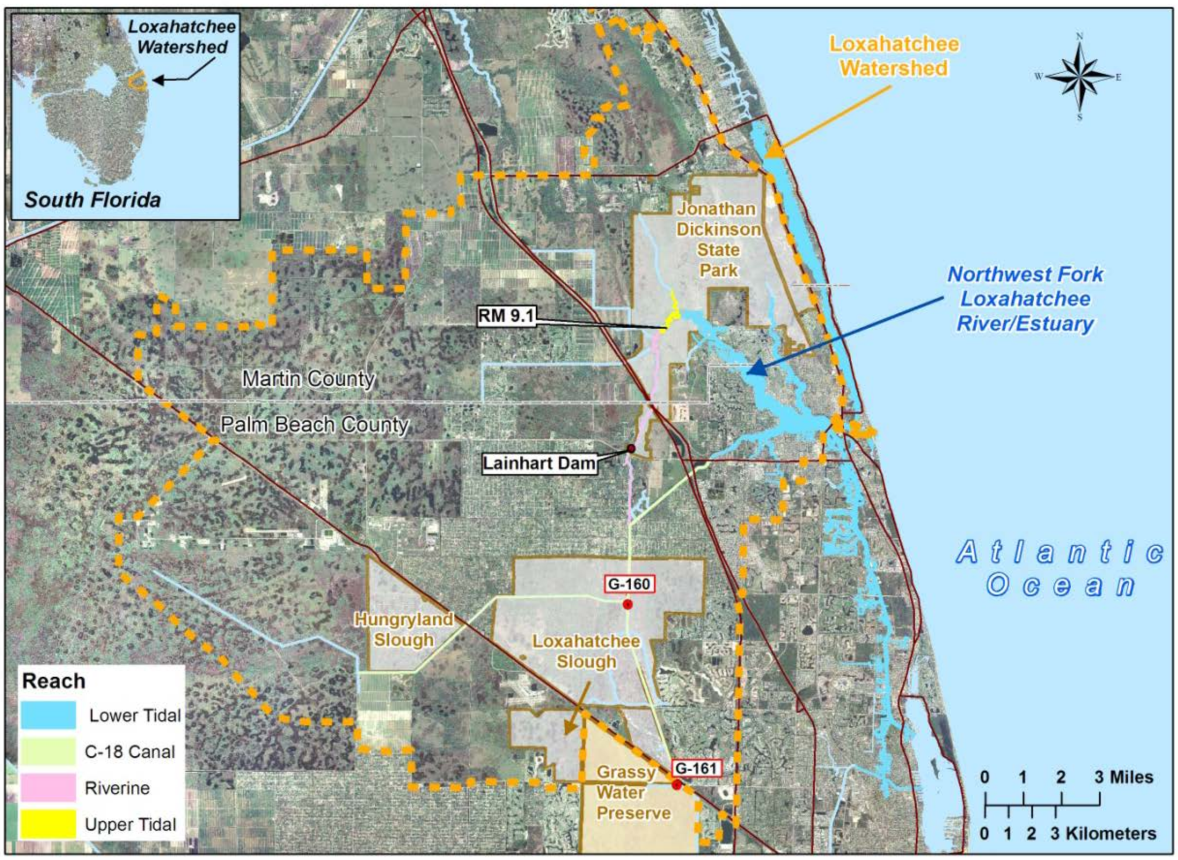


Figure 18. Major features of the Loxahatchee River and Estuary. (Note: RM – River Mile.)

A system of inland wetlands, known as Grassy Waters Preserve and the Loxahatchee and Hungryland sloughs, form the headwaters of the watershed and drain into the Northwest Fork of the Loxahatchee River. Floodplain plant communities, soils, and salinity regimes can be used to identify and characterize three distinct reaches along the system: riverine, upper tidal, and lower tidal. The Northwest Fork of the Loxahatchee River contains about 790 acres of riverine, 59 acres of upper tidal floodplain, and 111 acres of lower tidal floodplain regimes (SFWMD 2006). The riverine reach is generally unaffected by salinity. The upper tidal reach experiences some saltwater intrusion during the dry season. The lower tidal reach is highly influenced by tides and salinity in the water and soils.

Despite these enduring natural resources, the Loxahatchee ecosystem was permanently altered by the opening of the Jupiter Inlet in 1947, which allows a larger tidal amplitude and saltwater intrusion. Drainage canal systems also altered the natural pattern of freshwater inflow and inundation of the floodplain. Saltwater intrusion and reduced freshwater inflows to the riverine and upper tidal reaches of the Northwest Fork have particularly been problematic. As a result, in 2003, SFWMD adopted MFL criteria for the Northwest Fork of the Loxahatchee River (Chapter 40E-8, F.A.C.). The MFL criteria is exceeded when flow over the Lainhart Dam declines below 35 cubic feet per second (cfs) for more than 20 days or the average salinity at River Mile 9.1, expressed as a twenty-day rolling average, exceeds 2.[1] An MFL recovery strategy was adopted simultaneously with the MFL criteria. Since the recovery strategy's adoption, it has been revised and can be found in **Appendix B**.

In 2006, SFWMD developed a restoration plan for the Northwest Fork (SFWMD 2006). The restoration plan includes the ecological target species, performance measures, and monitoring requirements needed to track the success of restoration goals, and provide guidance for future adaptive management and operational practices. The plan identified five valued ecosystem components for the Northwest Fork of the Loxahatchee River: 1) cypress swamp and hydric hammock in the freshwater riverine floodplain, 2) cypress swamp in the tidal floodplain, 3) fish larvae in the low salinity zone, 4) oysters in the mesohaline zone, and 5) seagrasses in the polyhaline zone downstream. Monitoring of these communities continues along the river. Salinity concentrations and freshwater flows are examined each year to better understand dry and wet season hydrologic flow patterns and how water management can best be used to ecologically benefit the freshwater portions of the river and estuary.

The restoration plan describes a preferred restoration scenario that establishes a variable dry season flow between 50 and 110 cfs over Lainhart Dam, providing an additional 30 cfs of flow from the downstream tributaries (light blue line in **Figure 19**). SFWMD monitors compliance with the MFL criterion via results from the five tidal and salinity stations and a flow meter at Lainhart Dam. During Water Year 2011 (May 1, 2010–April 30, 2011), flow over Lainhart Dam was mostly maintained above the MFL criterion of 35 cfs, except for the periods of November 27, 2010 to March 3, 2011 (66 days) and April 20 to May 1, 2010 (12 days) (**Figure 19**). The twenty-day rolling average salinity at River Mile 9.1 did not exceed 2 during Water Year 2011.

[1] Common practice no longer uses measurements of salinity, which previously used parts per thousand or practical salinity units.

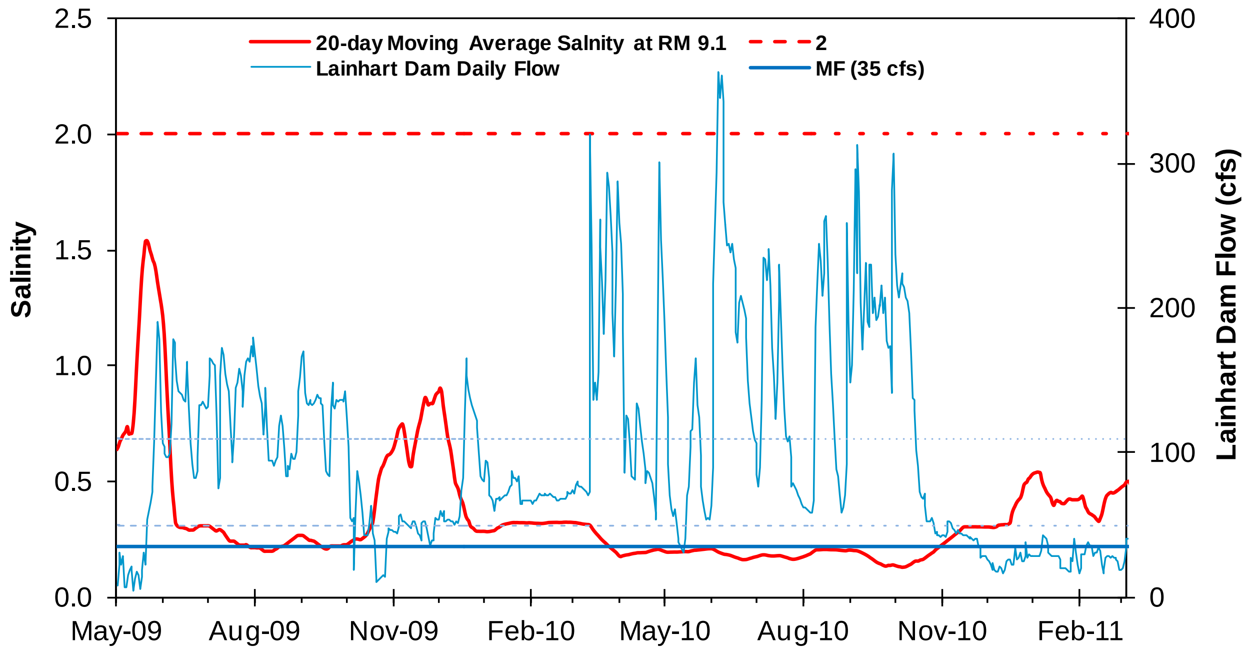


Figure 19. Flow rate and salinity related to the MFL criterion at Lainhart Dam in the Northwest Fork of the Loxahatchee River during Water Years 2010–2011. (Note: RM – River Mile, MF – Minimum Flow.)

Response to Recent Drought

During the 2011 drought, SFWMD experimented with operational options in an effort to get more water to the Loxahatchee River to meet the MFL criteria (Alleman 2012). Water from the L-8 site was pumped through a series of canals northward to the City of West Palm Beach's Grassy Waters Preserve. A portion of the water stored within Grassy Waters Preserve was then released north through the G-161, G-160, and G-92 structures to the Northwest Fork of the Loxahatchee River. These releases were a collaborative effort between SFWMD, City of West Palm Beach, Palm Beach County, and Loxahatchee River District. An estimated 10,872 ac-ft of water were delivered to the Loxahatchee River, meeting the MFL criterion for 48 days during the 2011 drought. A report on the pilot test results, *L-8 Reservoir Pilot Test Water Quality Results*, was submitted to the FDEP in June 2011 (SFWMD 2011a). The pilot test produced a broader understanding of the operational complexities involved in routing L-8 Reservoir water to the Loxahatchee River during extreme dry conditions and data on water conveyance losses associated with making these deliveries. SFWMD also gained a better understanding of changes in water quality, especially with respect to salinity and phosphorus concentrations.

Loxahatchee River Science Plan

As recommended in the *Restoration Plan for the Northwest Fork of the Loxahatchee River* (SFWMD et al. 2006), the Loxahatchee Interagency Science Team was established to collaboratively develop a science plan to address prioritization of monitoring efforts that support adaptive management of the system, and fill in gaps of critical knowledge regarding ecosystem restoration success. The science plan was completed in 2010 (SFWMD et al. 2010). Management and research objectives were described and linked to watershed, riverine, and estuarine resources. Several ongoing projects were identified along with new projects to address informational gaps. Results are expected to be used to evaluate the status of the system, and develop predictive tools and improved performance measures for assessing biological and hydrological effects of water management practices on the ecosystem.

Lake Worth Lagoon

Lake Worth Lagoon is a 22-mile long estuary adjacent to eastern Palm Beach County (**Figure 20**). It is bounded by land to the west and barrier islands to the east. Depths within the estuary are typically between 6 and 10 feet. Tidal exchange with the Atlantic Ocean occurs at Lake Worth (Palm Beach) and South Lake Worth (Boynton) inlets. Lake Worth Lagoon Watershed encompasses about 450 square miles of primarily urbanized land.

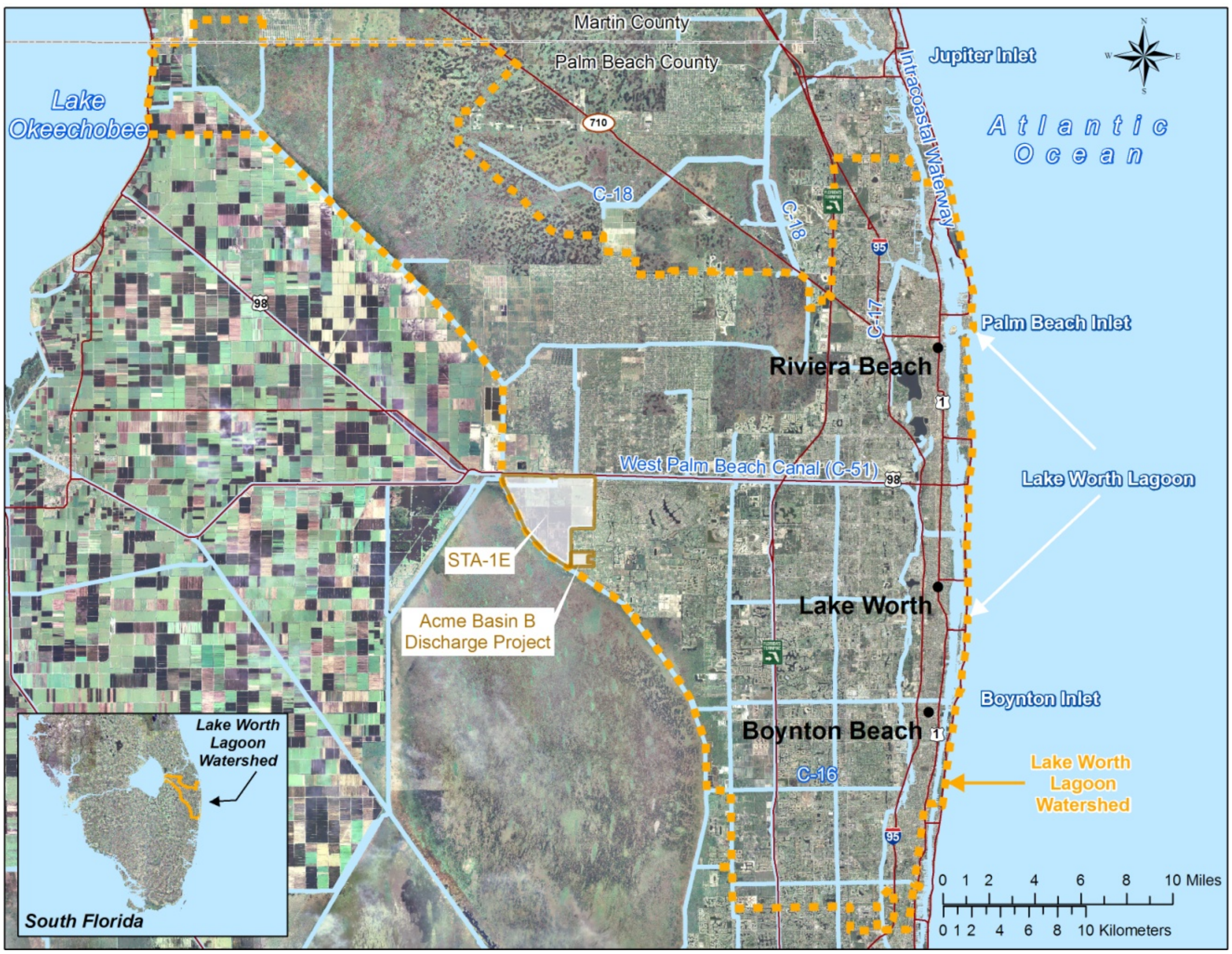


Figure 20. Major features of Lake Worth Lagoon.

Lake Worth Lagoon is divided into three geographical segments—north, central and south. Each segment has its own water quality, circulation and physical characteristics. Freshwater runoff from the watershed is collected in primary and secondary canals. The major sources of fresh water are the C-17 Canal (Earman River), C-51 Canal (West Palm Beach Canal), and the C-16 Canal (Boynton Canal). The C-51 Canal contributes about 50 percent of the freshwater runoff to the lagoon. Studies indicate that about 75 percent of the C-51 Canal discharge turns northward in the lagoon and about 25 percent turns southward (Chiu et al. 1970).

The Lake Worth Lagoon Management Plan was first drafted in 1998 by Palm Beach County's Department of Environmental Resource Management and updated in 2008 (PBCDERM 2008). The plan reviews progress made implementing the original goals and priorities. It also provides the status of the lagoon and actions plans for future projects. Implementation of the plan relies on partnerships and cooperative agencies, including SFWMD.

Excessive fresh water is sometimes discharged into the lagoon, reducing salinity and causing excessive sedimentation and turbidity. The average daily flow is 419 cfs, but can be greater than 7,000 cfs during wet periods. Salinity can be below optional thresholds for key species, such as the eastern oyster (*Crassostrea virginica*) and Johnson's seagrass (*Halophila johnsonii*). Current performance measures are targeted at limiting the discharges from the C-51 Canal so that salinity does not stay below 15 for more than 26 days or less than 5 for more than seven days from April through July each year. To accomplish these targets, two upper limitations are recommended: 1) eliminate flow events of 1,000 cfs or greater and 2) eliminate flows greater than 500 cfs for extended periods of time (seven days or greater). To attain this salinity threshold, the targets are as follows:

- Inflows should be maintained between 0 to 500 cfs based on a seven-day moving average.
- High flow events of 1,000 cfs or greater, based upon a two-day moving average, should not occur.
- Flow greater than 500 cfs based on a seven-day moving average should be eliminated (Rudolph 1998).

The CERP Environmental Preserve at the Marjorie Stoneman Douglas Habitat (formerly known as Acme Basin B Discharge Project), which includes C-51 pump station installations and C-51 Canal improvements, was completed in spring 2010. This project diverts urban runoff in Palm Beach County to the C-51 Canal, where it is subsequently directed to STA 1E for treatment before discharge to the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Along

Project construction kickoff

with environmental and flood control benefits, this project may reduce some of the harmful discharges to Lake Worth Lagoon, reducing the frequency of low salinity events (see **Chapter 4** for more information).

In partnerships with SFWMD and the City of West Palm Beach, the Palm Beach County Department of Environmental Resources Management conducted annual hydrographic surveys of the C-51 Canal system following the C-51 Canal Sediment Management Project completion in 2006 (Alleman 2012). About 101,500 cubic yards of muck were removed from a 3,500-linear foot section of the canal where a sediment trap was constructed. Annual hydrographic surveys were conducted between 2007 and 2010 to determine the effectiveness of a newly created sediment trap, and to examine volumetric changes (i.e., erosion or accretion) over the project area. The purpose of this analysis was to 1) determine if a correlation exists between annual discharge volumes at the S-155 structure and sediment accretion within the C-51 Canal, 2) estimate the annual rate of accretion within the sediment trap, 3) propose maintenance dredging requirements for the canal system, and 4) evaluate any remaining muck deposits that might exist outside of the dredged area. About 11,394 cubic yards of material accreted within the sediment trap throughout the project area between 2007 and 2009. During the final year of the study period (2009–2010), a substantial loss of material throughout all reaches of the canal occurred. The loss was attributed to an increase in rate and volume of water discharged through the S-155 structure.

A second sediment management project was conducted in 2009 and completed in 2010 near Ibis Isle, a mangrove fringed island located about 2.5 miles south of the confluence of the C-51 Canal and Lake Worth Lagoon (Alleman 2012). In this study, 41,000 cubic yards of sand were brought into the project area to cap the muck and raise the wetland shelf elevation to intertidal levels for the planting of mangroves and cord grass (*Spartina alterniflora*). In addition, lime rock was deposited to create oyster habitat. Both of these sediment projects were a part of the CERP North Palm Beach County – Part 1 Project (USACE and SFWMD 2005), now referred to as the CERP Loxahatchee River Watershed Restoration Project.


Ibis Isle restoration in Lake Worth Lagoon

Biscayne Bay

Biscayne Bay is a shallow, subtropical estuary located along Florida's southeastern coast (**Figure 21**). The bay covers about 428 square miles, with 270 square miles lying within Biscayne National Park. Biscayne National Park was designated in 1980 to protect, among other purposes, a combination of terrestrial and undersea life. The entire watershed area covers about 850 square miles. Most of the northern and central areas of the watershed are urban, with Miami being the largest city. Large parts of the southern watershed are dominated by agricultural land.

SFWMD manages and maintains a drainage network that includes 16 outfalls into Biscayne Bay. The water management system regulates water levels within the watershed for flood control and water supply. Drainage of the watershed altered the location and timing of freshwater inputs to the bay. On both an annual scale and during rainfall events, runoff into canals that historically flowed into the bay through small rivers, streams, and groundwater has been altered. In addition, construction of artificial inlets and channels, particularly in the northern area, contributed to the bay's transition from a freshwater estuary to a more saline environment.

From the 1900s to today, salinity increased in the southern area of the bay, especially along the western nearshore areas (Wingard et al. 2004). A primary concern has been both hypersalinity and the annual range of salinity near the western shore of south central Biscayne Bay and within Manatee Bay. The cause of increased salinity is not clear, but may be a combination of reduced average rainfall, sea level rise, and diversion or altered timing of freshwater inputs. About half of the total freshwater input to the bay consists of discharges from the primary canals, totaling an average of 1.4 million ac-ft per year on average. Additional significant sources of fresh water include rainfall, averaging about 60 inches per year, and groundwater influx, which is estimated to be roughly five percent of surface water inputs (Langevin 2001).

Water quality in Biscayne Bay has been impacted by increasing stormwater runoff from developed lands and raw sewage discharges. Raw sewage discharges ceased in the 1950s. More recently, water quality has been improving. Despite these dramatic physical and chemical changes, the bay supports extensive submerged aquatic vegetation, macroalgal, and hard ground communities. On the other hand, some fisheries that were once abundant, such as redfish or red drum (*Sciaenops ocellatus*), mullet (*Mugil* sp.) and spotted seatrout (*Cynoscion nebulosus*), declined substantially. The bay still supports a large recreational fishery and viable commercial pink shrimp (*Farfantepenaeus duorarum*) fishery. Eastern oysters were abundant prior to the changes to Biscayne Bay, and oyster bars were relatively common. Now oyster bars are rare, and individuals are mostly found on mangrove prop roots and bulkheads. Additionally, large areas of coastal wetlands have been filled, and most of the remaining coastal wetlands are in the central and southern areas of Biscayne Bay. These wetlands have been largely starved of fresh water because of diversion of storm water to canals.

Figure 21. Major features of Biscayne Bay.

The CERP BBCW Project will restore some overland freshwater flow to coastal wetlands in central Biscayne Bay. The project is likely to result in some incidental reduction of nutrient loads into the bay. SFWMD constructed some components of the project, including the Deering Estate Flow-way and culverts in the L-31E Canal. However, most of the project will not be completed for several years. SFWMD adopted a water reservation rule to reserve water needed for the BBCW Project in 2013. See **Chapter 4** for more information about the project.

SFWMD tracks salinity in the nearshore area of south-central Biscayne Bay to monitor how the system responds to inflows from the C-102, C-103, and Military canals. Salinity in this area tends to become hypersaline (i.e., salinity greater than 35) during the dry season (Alleman 2011). This condition is considered unhealthy for many estuarine species (Montagna et al. 2008). It is unlikely the current BBCW Project features will completely alleviate this condition.

SFWMD also tracks performance of the newly constructed components of the BBCW Project, which include culverts along the L-31E to divert canal water into coastal wetlands and a pump at the Deering Estate to divert canal water into the historic Cutler Creek and Deering Slough. The L-31E culverts are passive, flap-gated devices designed to divert available fresh water from the L-31E Canal into adjacent wetlands. During the 2011 dry season (November 2011–April 2012), SFWMD experienced below average rainfall in this region, which resulted in relatively low flows. The total quantity of water discharged through the L-31E culverts component area was approximately 4,703 ac-ft (**Figure 22**). The total fresh water diverted in 2011 and 2012 through the L-31E culverts was 4,444 and 4,927 ac-ft, respectively, which represents about 4 percent of the total flow available for diversion. The pump at Deering Estate began operation in 2012. The pump diverted about 3,350 ac-ft of water through February 2013, rehydrating wetlands. BBCW Project monitoring data and analyses are reported annually in the South Florida Environmental Reports (www.sfwmd.gov/sfer).

South Miami-Dade Area of Interest

Agriculture has been a key economic component in southeastern Miami-Dade County since the early 1900s. Crops vary year to year based on market conditions but winter vegetables and ornamental nursery stock are the primary agricultural staples in the region. Agriculture benefited from moderate temperatures during winter months. However, agriculture is also challenged by the low lying nature of the topography, which frequently results in thin unsaturated soil thicknesses and a high risk of crop loss due to flooding during moderate rainfall events.

Early farming interests worked together to develop local drainage through the construction and operations of canals, pumps, and structures. In the 1960s, USACE incorporated these local drainage features into the C&SF Project. In 1966 and 1967, operations of the S-21A structure, which provides drainage to the C-102 Basin, and the S-179 and S-20F structures, which drain the Florida City and C-103 basins, were transferred to the Central and Southern Flood Control District (predecessor to SFWMD).

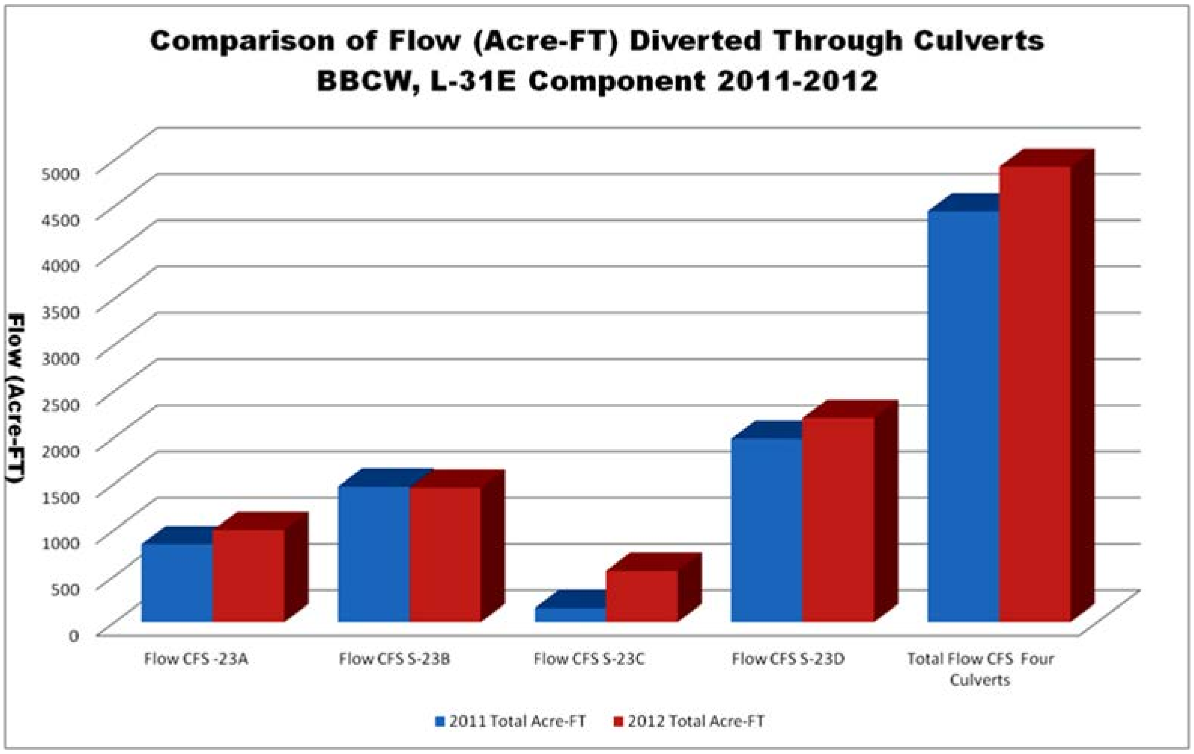


Figure 22. Flows diverted to the BBCW Project area in 2011 and 2012. (Note: Acre-FT – acre-feet.)

SFWMD, as local sponsor of the federal C&SF Project, operates these structures under the provisions contained in the *Master Water Control Manual, East Coast Canals, Volume 5* (USACE 1995). The manual identifies high and low operational ranges for these structures and provides for flexibility in selecting the operational settings to use depending on field conditions and agricultural needs. Initially, the structures were set at the low operational levels for most of the growing season (October–April) and raised to the high operational settings during the wet season (May–September). However, during dry years, the shift from the low to high operational ranges occurred earlier in the year as additional drainage was not needed under those conditions. In response to drought conditions during the 1980s, which caused coastal irrigation wells to become salty, local farmers worked with SFWMD to incorporate an intermediate operational range for the S-20F and S-21A structures, which holds slightly higher groundwater levels in the spring to reduce inland saltwater intrusion.

Concerns over the seasonal operations were raised by area environmental interests and Biscayne National Park. In particular, concerns were expressed that shifting to the low operational range in October drained area groundwater that may otherwise be available to moderate nearshore salinity levels in Biscayne Bay during the later months of the dry season (March–May). In 2010, SFWMD initiated a series of workshops and studies—the South Miami-Dade Water Issues Coordination Initiative—geared toward evaluating the historic seasonal operations and identifying feasible opportunities to manage water to support area agriculture and improve dry season salinity conditions in the nearshore south Biscayne Bay area. The statistical analysis report, *South Miami-Dade Statistical Data Analysis* (Smith 2010), can be found on the SFWMD website at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/south_miami-dade_statistical_data_analysis.pdf.

Through this process, SFWMD learned that delaying the initiation of the drawdown from October to later in the year would significantly impact winter vegetable crop marketability by delaying the timing of the crop delivery to market away from the December–January freeze window, which provided a competitive advantage to south Miami-Dade growers over other north and central Florida winter vegetable producers impacted by freeze losses and associated market valuation, and by reducing the number of crop cycles per year resulting from the shorter growing season. In addition, research conducted by the National Park Service identified that relatively small releases of fresh water from S-20F, S-21A, and/or S-12 (on the order of 76 cfs per any two of three structures) during the dry season effectively moderates the occurrence of high salinity and hypersalinity events in the productive nearshore areas of Biscayne Bay.

Efforts to redirect regional water supplies from outside of the coastal basins to make dry season deliveries to Biscayne Bay were thwarted in 2011 and 2012 due to drought conditions that affected water storage. However, in 2012, in a coordinated effort between the National Park Service, the United States Department of the Interior, and SFWMD, an operational test was conducted to move water from WCA 3A through S-21 over a two-week period at average discharge rates of 100 cfs. The test successfully reduced elevated salinity levels in nearshore monitoring stations in the bay. In addition, operation of available CERP BBCW Project components, including the L-31E culverts and the Deering Estate S-700 pump station, proved beneficial in distributing fresh water through coastal marine wetlands. During the 2012–2013 dry season, S-20F remained in the lower operational range, which provided daily low level freshwater flows to Biscayne Bay while maintaining area drainage for farming activities. These low level releases were shown to be successful in moderating nearshore bay salinities in the vicinity of the S-20F structure. SFWMD will continue to work closely with area interests to identify opportunities to optimize the management of water in southeastern Miami-Dade County based on real-time conditions consistent with the constraints of the system.

Florida Bay

Covering a triangular area of 850 square miles at the southern tip of the state, Florida Bay lies between the Everglades and the Florida Keys (**Figure 23**). About 80 percent of the estuary lies within Everglades National Park. The shallow bay has an average depth of about 3.3 feet, and most of the bottom is covered by submerged aquatic vegetation, particularly seagrass, which is beneficial habitat for many invertebrate and fish species. Since 1987, when widespread seagrass die-off began, a cascade of ecosystem changes occurred, including subsequent seagrass die-off events, algal blooms, high turbidity, widespread mortality of sponges, and decreases in some other invertebrates and fish species (Fourqurean and Robblee 1999). A major premise of Everglades restoration is that historical decreases in freshwater inflow from the Everglades and resultant increases in salinity contributed to these ecological changes (Rudnick et al. 2005).

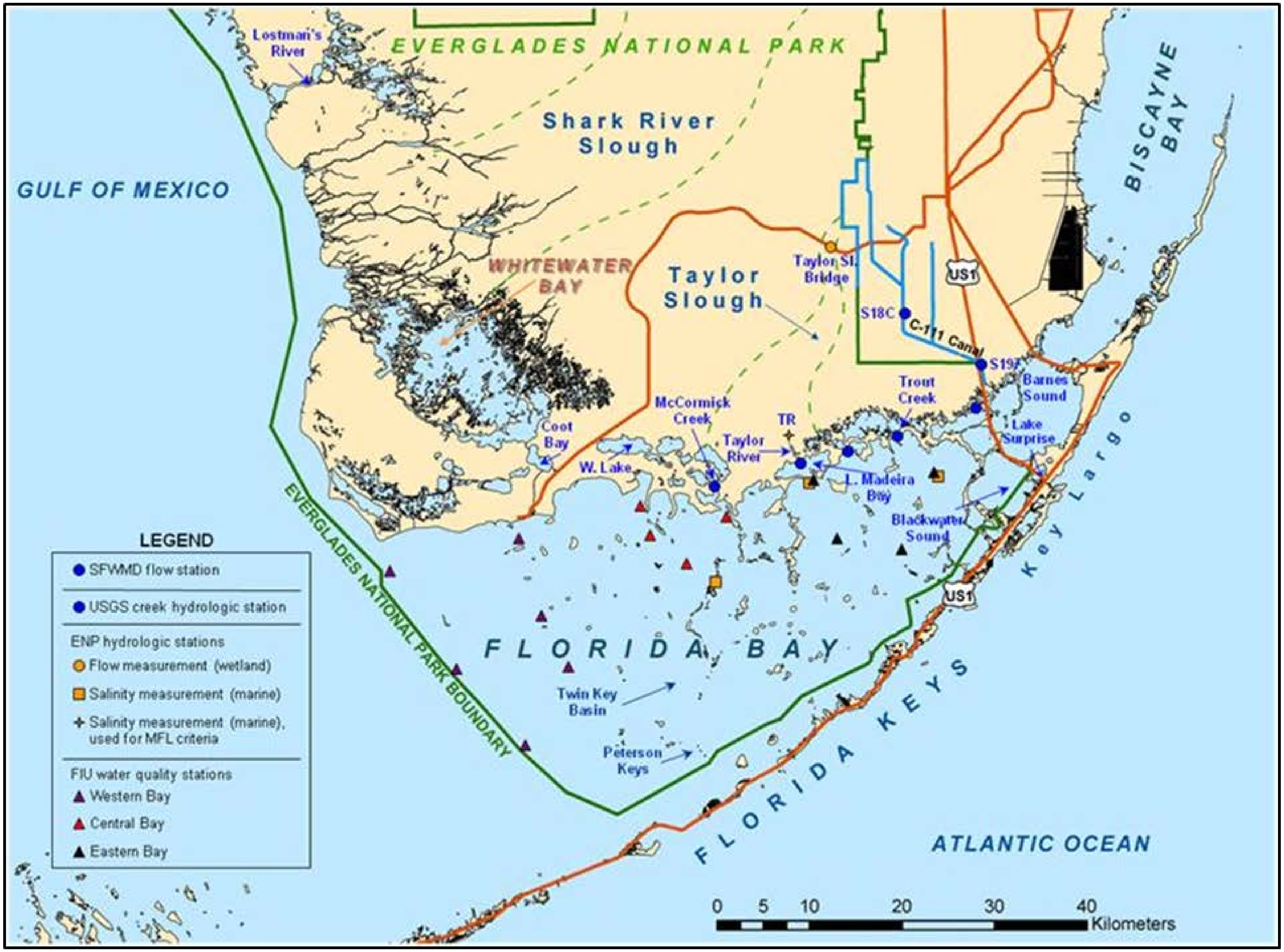


Figure 23. Major features of Florida Bay.


Florida Bay

Protective rules for Florida Bay include MFL criterion established in 2006. An MFL exceedance occurs in northeastern Florida Bay when the average salinity over 30 or more consecutive days exceeds 30 at the Taylor River salinity monitoring station. This criterion is based on the needs of submerged aquatic vegetation habitat within the Taylor River/Little Madeira Bay/Eagle Key gradient, which is responsive to conditions in the transition zone between the Everglades and Florida Bay. Submerged aquatic vegetation is a critical component of the Florida Bay ecosystem. An MFL prevention strategy has been in place since 2006 and is provided in **Appendix B**. Since adoption of the Florida Bay MFL in 2006, there have been three MFL exceedances, but no MFL violations.

SFWMD has a program of monitoring, research, and modeling in Florida Bay to 1) better understand the importance of water management as a driver of these and other ecological changes, 2) improve the ability to forecast the impacts of changing water management, and 3) improve management structures and operations for the protection and restoration of the Florida Bay ecosystem. Results from major monitoring projects emphasizing hydrologic and salinity conditions, water quality, seagrass habitat, and upper trophic levels including waterfowl, shrimp, and lobster can be found in Chapter 12 of Volume I of the *2010 South Florida Environmental Report* (Doering and Alleman 2010). An update on research and modeling activities and research planning is also provided, summarizing key results related to water management operations, the Florida Bay MFL, and CERP.

SFWMD is currently reevaluating the MFL criterion for Florida Bay. The technical assessment will consider the ecological and hydrologic components and include the research data collected since 2006. The MFL prevention strategy will be reevaluated as well, including whether to retain or modify the prevention strategy or develop a recovery strategy.

CERP C-111 Spreader Canal Western Project: Baseline and Post-Implementation Monitoring

The CERP C-111 Spreader Canal Western Project, which aims to reduce water losses from Taylor Slough to the eastern boundary of the Everglades, was completed in February 2012. This project creates a hydrologic ridge along the eastern border of Taylor Slough, thereby increasing the flow of water to Florida Bay via the slough. As a result of the project, important changes in the hydrology and ecology of the southern Everglades wetlands, the mangrove ecotone, and Florida Bay are expected to occur. For more information see www.evergladesplan.org/pm/projects/proj_29_c111.aspx.

The ecological effects of the CERP C-111 Spreader Canal Western Project are being assessed by comparing baseline monitoring to post-implementation monitoring. Previous monitoring efforts assisted with the development of baseline data for operational and restoration planning, performance measures and targets, and simulation models.

Post-implementation monitoring includes the following:

- Monitoring changes in nutrient and organic matter transport and transformations in water flowing from canals and through the wetlands of the southern Everglades to Florida Bay.
- Documenting changes in wetland salinity and vegetation.
- Synthesizing the findings from this large wetland monitoring network with complementary monitoring and research efforts in the region to assess status and trends and causes of change.

Additional Monitoring

SFWMD is conducting additional long-term monitoring. The monitoring includes 1) freshwater macrophyte species composition; 2) sawgrass biomass, productivity, and tissue nutrient content; 3) soil characteristics, geochemical parameters, porewater salinity, and nutrients in several transects across the salinity gradient; 4) water levels and hydroperiod within the study area; 5) nutrient concentrations in the wetland and in creek inputs to Florida Bay; and 6) periphyton biomass and nutrient ratios at selected sites. The project will provide water quality and ecological data necessary for meeting several mandates:

- CERP C-111 Spreader Canal Western Project
- Restoration Coordination and Verification Program system status reports (RECOVER 2007a, 2007b, 2009, 2012)
- Reevaluation of the Florida Bay MFL criteria
- Assessment of this portion of the Everglades Protection Area pertaining to the Everglades Forever Act
- Assessment of ongoing operational plans and effects

Lower East Coast Service Area

Surficial Aquifer System

The SAS extends across the LEC Planning area. It provides up to 94 percent of the fresh water for PWS and other urban uses within the planning area. The vertical extent and lateral variations within the aquifer are shown on the cross-section provided in **Figure 3** within **Chapter 1**. Groundwater withdrawals from the SAS for agricultural users are common in Palm Beach, Broward, and Miami-Dade counties. The highly transmissive Biscayne aquifer is part of the SAS, primarily extending across Broward and Miami-Dade counties and a small portion of southern Palm Beach County. A map of the transmissivity and spatial extent of the Biscayne aquifer is presented in **Figure 24**, and indicates the aquifer becomes more transmissive (i.e., permeable) to the south. The Biscayne aquifer is designated as a "sole source aquifer" by the United States Environmental Protection Agency (USEPA) under the Safe Drinking Water Act because it is a principal source of drinking water and highly susceptible to contamination due to its high permeability and proximity to land surface.

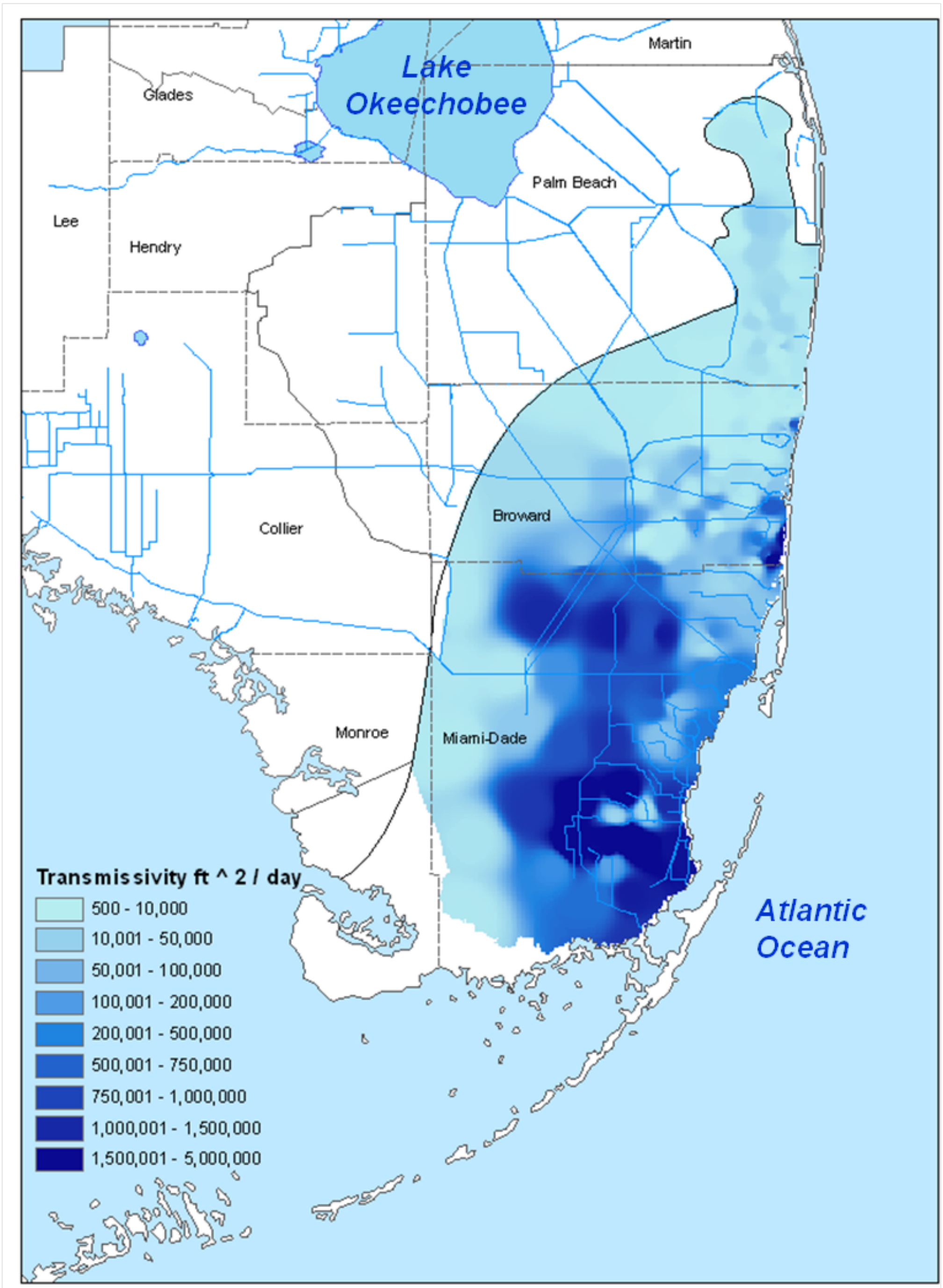


Figure 24. Map of the spatial extent and transmissivity of the Biscayne aquifer. (Note: in units of square feet per day.)

Protective rules for the Biscayne aquifer include MFL criterion established by rule in 2001. The minimum level for the Biscayne aquifer is the water level associated with preventing movement of the saltwater interface landward to the extent that groundwater quality at the withdrawal point is insufficient to serve as a water supply source. To meet the operational criteria, the canal stages at 11 primary structures cannot fall below identified levels for more than 180 days, and the average annual stage must be sufficient to allow levels and chloride concentrations in the aquifer to recover to levels that existed before a drought or discharge event occurred. An MFL prevention strategy has also been in place since 2001.

Water Levels

The SAS is an unconfined aquifer and responds rapidly to rainfall or the lack of rainfall. The Biscayne aquifer is also hydraulically connected to the surface water management systems in the LEC Planning Area, and is readily recharged and drained by canal water levels. As an example of this rapid response, **Figure 25** displays a 35-year period of record from a SAS well in east-central Broward County showing annual variations in water levels in response to seasonal rainfall and longer-term climactic variations. In this well (G-1221), average annual variations range within about 2 feet, although variations of as much as 6 feet can occur in response to heavy rain events.

Because of the shallow, unconfined nature and high transmissivity of the Biscayne aquifer, canal stages and groundwater elevations are highly interdependent. Surface water management systems function as aquifer drains during dry periods. Rainfall intercepted by canal systems is diverted before recharging the aquifer and can lead to recharge in other areas, diversion to downstream consumptive use, loss to evapotranspiration, or discharge to tide. Urban and agricultural development and construction of the C&SF Project canal system resulted in changes to the groundwater hydrology of the area and an increased concern about the inland movement of salt water in coastal areas.

The United States Geological Survey (USGS) maintains a network of wells that records water levels within the SAS throughout South Florida. This network is useful when comparing current water levels within each well with historical ranges. **Figure 26** displays USGS maps from May 2011 and May 2012, showing differences between water levels throughout most of the area, resulting from considerably wetter conditions during 2012 as compared to 2011. SFWMD monitors these comparison maps weekly and uses them to determine areas of potential concern, particularly with regard to saltwater intrusion or when considering operational adjustments.

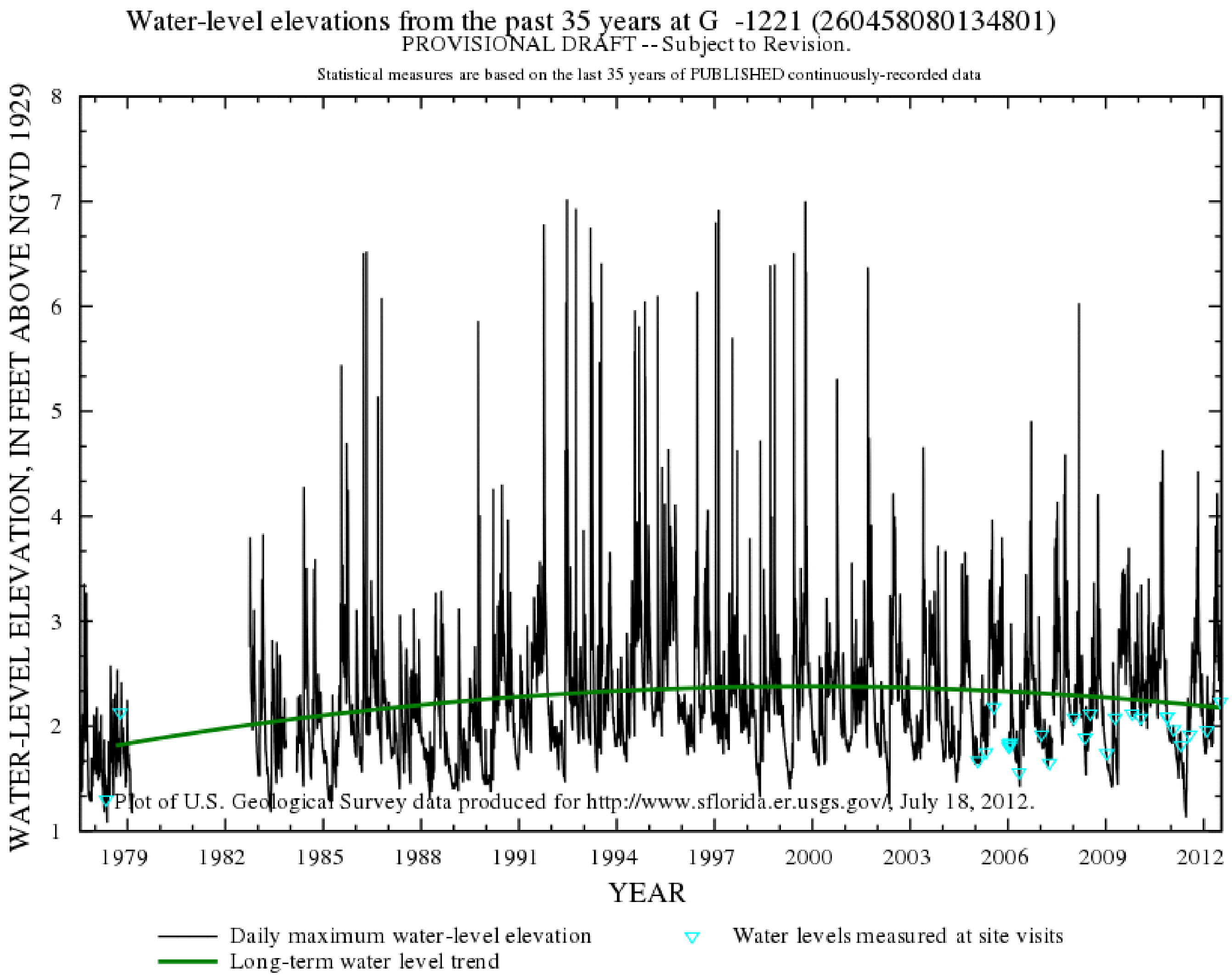
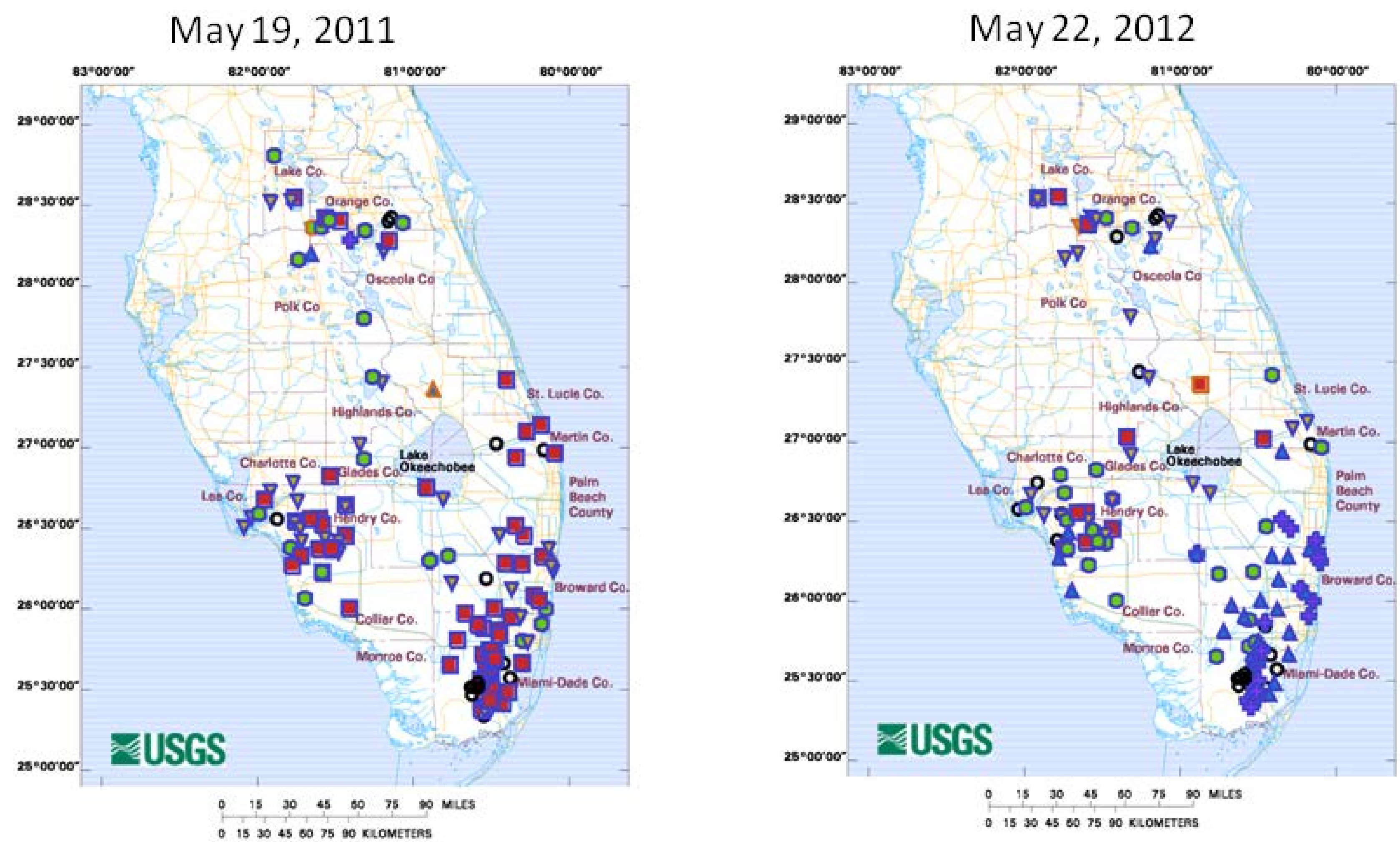


Figure 25. Long-term water levels in a Biscayne aquifer well in Broward County. (Source: USGS National Weather Information System database.)



Footnote: Red boxes denote water levels within lowest 10% of historical range; green circles denote water levels with 20% of historical mean; blue triangles denote water levels between highest 10 % to 30% of historical range; purple cross denotes water levels with highest 10% of historical range

Figure 26. Water levels recorded at USGS monitoring wells during May 2011 (left panel) and May 2012 (right panel).

Chloride Concentrations

SFWMD regulates withdrawals from the SAS to, among other items, prevent saltwater intrusion and to support ongoing environmental restoration programs among others. SFWMD implemented a rigorous program of chloride and water level monitoring to determine the extent of saltwater intrusion throughout the LEC Planning Area. Data from wells in the monitoring network in Palm Beach, Broward, and Miami-Dade counties are online at USGS' website at www.sflorida.er.usgs.gov/ddn_data/index.html.

SFWMD recently (May 2011) estimated the position of the saltwater interface for each coastal county within the SAS and documented this position on maps. **Figure 27** presents an example, showing the approximate extent of SAS saltwater intrusion for Broward County as of 2009. The maps were prepared based on periodic salinity monitoring conducted by USGS, SFWMD, and water use permit holders in select monitoring wells as of spring 2009. In general, the position of the interface remained relatively stable when compared to maps previously published by USGS. That said, the interface is certainly dynamic, and chloride concentrations increased in some areas (e.g., City of Lake Worth and southern Broward and Miami-Dade counties), while some wells in Palm Beach County exhibited freshening. SFWMD intends to periodically (i.e., every three to five years) compile chloride data from its salinity monitoring well network and prepare maps to estimate the position of the saltwater interface and allow comparison over time.

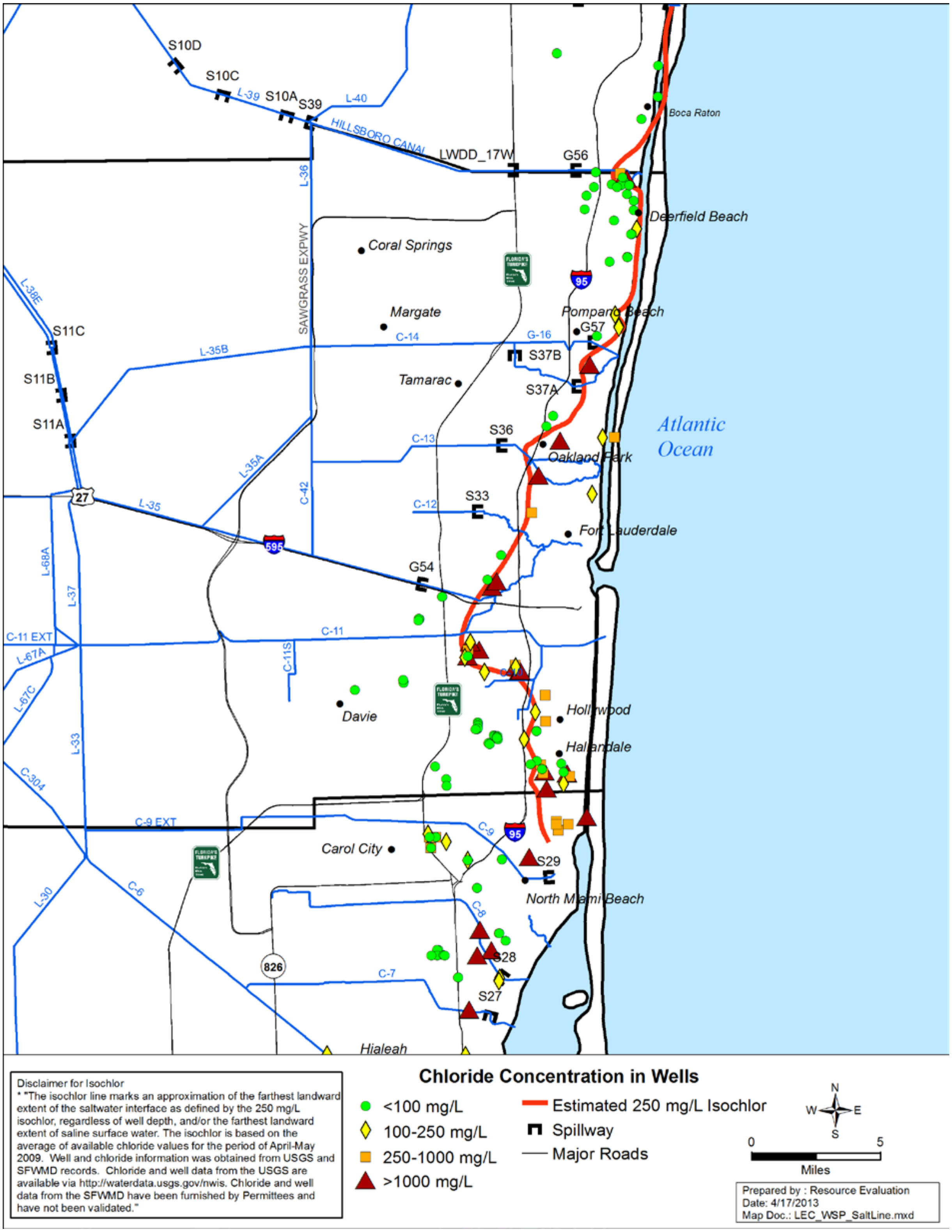


Figure 27. Estimated position of the saltwater intrusion extent in Broward County in 2009.

Utilities Response to Saltwater Intrusion

Saltwater intrusion was identified in the 2000 LEC Plan as a significant concern for 15 coastal utilities, which were asked to identify potential locations for new wellfields further inland. Following the adoption of the plan, the SFWMD planning and regulatory programs provided support to these utilities considered most at risk. Some of the utilities at risk had already begun planning either new wellfield sites or alternative source development. The *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update; SFWMD 2007) included specific alternative water supply projects for each utility.

During 2007 and extending into mid-2008, South Florida experienced an extended period of dry weather. Water levels declined throughout the region, creating concerns for accelerated saltwater intrusion, particularly in the areas of large water supply withdrawals at PWS wellfields located in close proximity to the coastline. As a result, SFWMD updated its analysis of utilities facing saltwater intrusion. Utilities were classified as "at risk" if they either did not have a western wellfield, an alternative source of water, or the ability to meet their needs through interconnection with other utilities. Additionally, other utilities were designated as "of concern" if they operated wellfields near the saltwater interface, but also had a western wellfield, or had developed an alternative source that was not threatened by saltwater intrusion.

The utilities at risk in the LEC Planning Area identified during the 2007 drought included City of Lake Worth Utilities, Town of Lantana, City of Dania Beach, Town of Hillsboro Beach, City of Hallandale Beach, Miami-Dade Water and Sewer Department (MDWASD) south wellfields, Florida City Water and Sewer Department, City of Homestead, and the Florida Keys Aqueduct Authority (FKAA). The locations of several of the wellfields relative to the historic saltwater intrusion line are shown in **Figure 28** and **Figure 29.** As a result of prudent management of the water withdrawals, each of the utilities was able to meet demands during the 2007 drought without loss of eastern wells to saltwater intrusion. Seven of the utilities at risk have taken steps to diversify their sources or otherwise reduce their vulnerability to saltwater intrusion. Two utilities, MDWASD and Florida City, are pursuing projects that would help reduce saltwater intrusion concerns. SFWMD anticipates reformulating its analysis of utilities at risk and utilities of concern prior to the next update of the LEC plan.

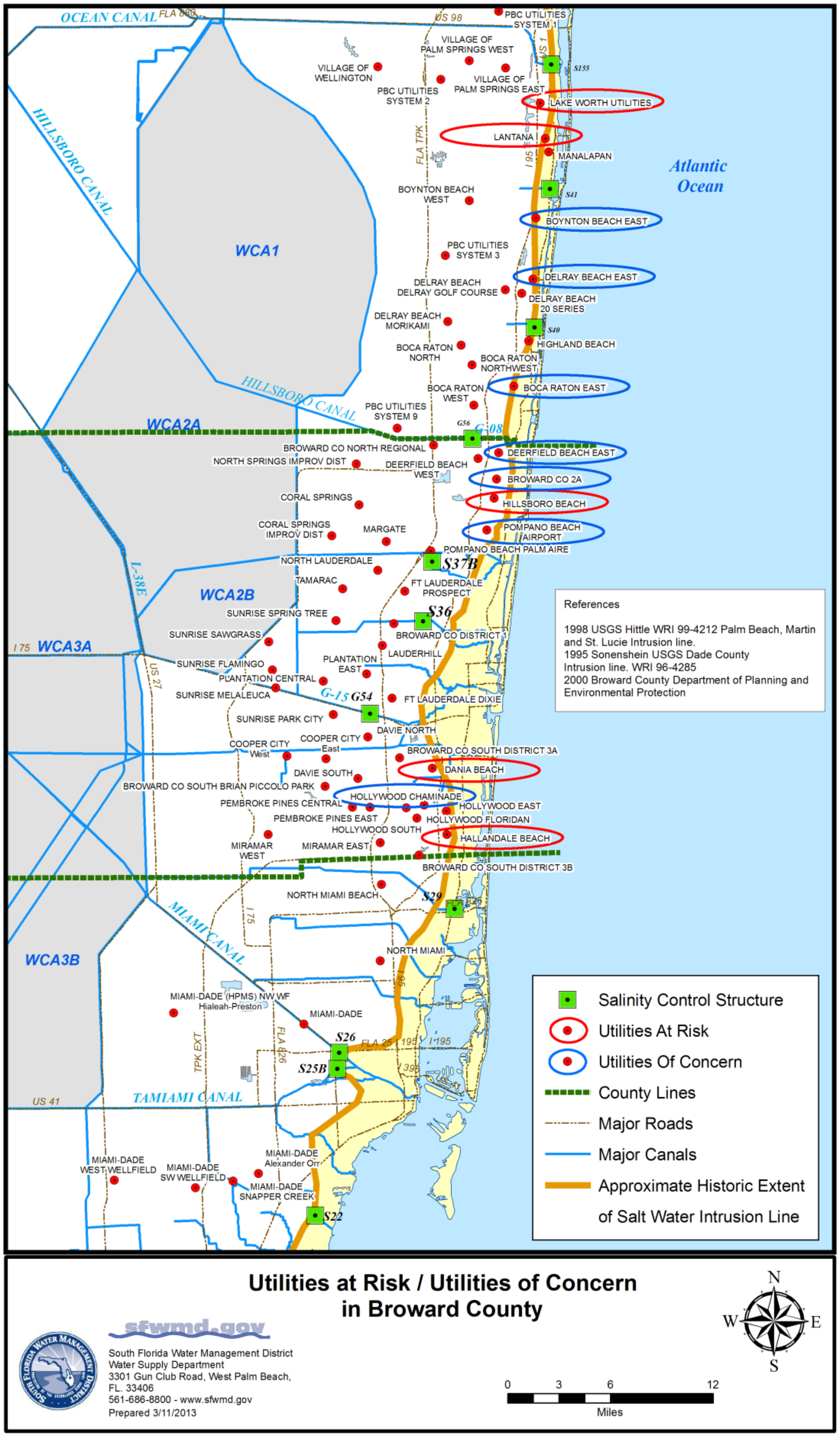


Figure 28. Utilities at risk and utilities of concern in southern Palm Beach and Broward counties in 2007 relative to the historic saltwater intrusion extent.

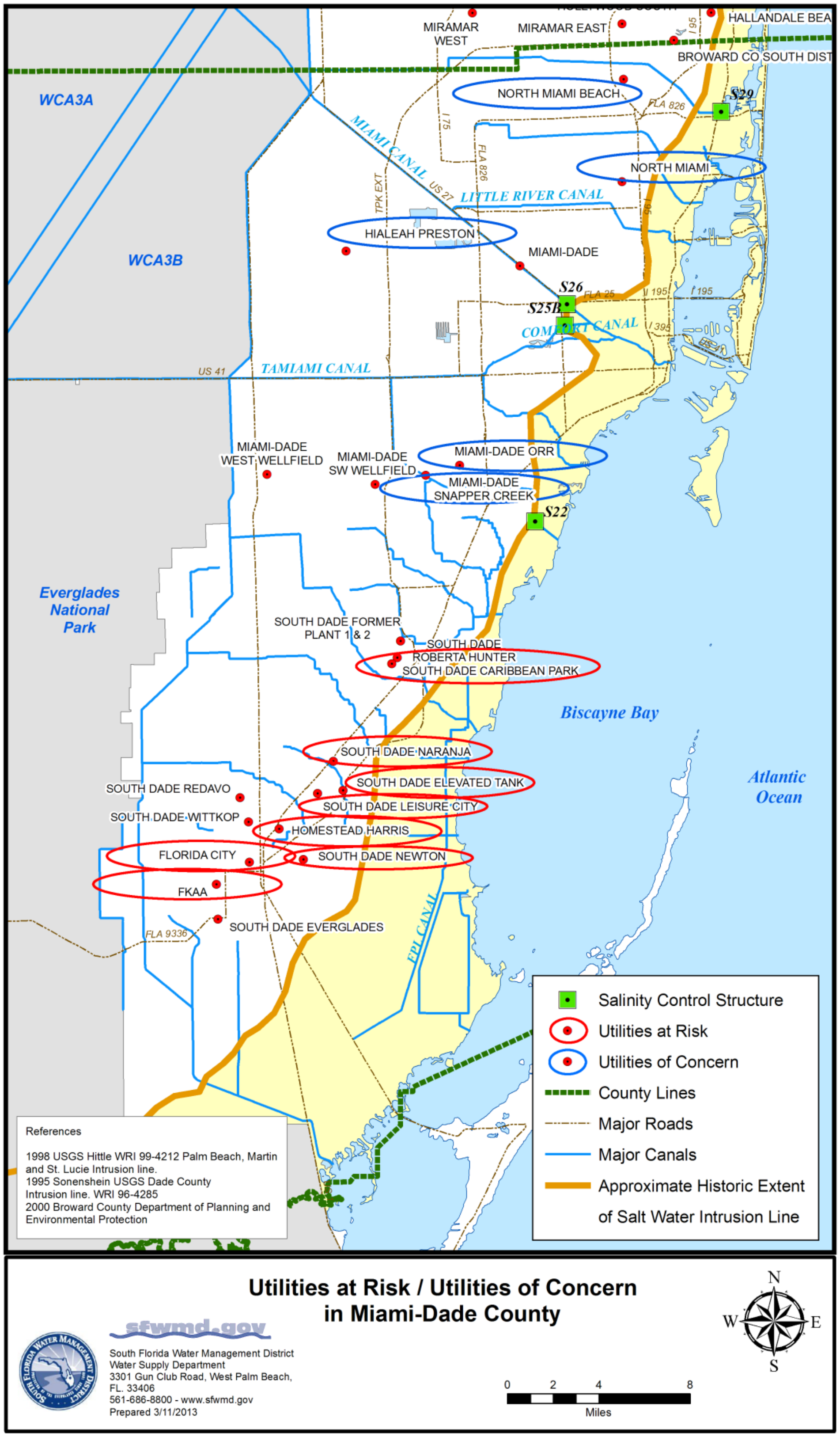


Figure 29. Utilities at risk and utilities of concern in Miami-Dade County in 2007 relative to the historic saltwater intrusion extent.

Floridan Aquifer System

Within the LEC Planning Area, the Floridan aquifer system (FAS) represents a source of brackish groundwater for water users to meet future demand. More than 500 feet of low permeability sediments of the Hawthorn Group separate the FAS from the overlying SAS. Under such conditions, the FAS is "confined" and water within the FAS exists under artesian pressure. Although the potentiometric surface of the FAS is above land surface, the low permeability sediments of the Hawthorn Group prevent upward migration of brackish waters into the shallower aquifers. From Jupiter to southern Miami, water from the FAS is highly mineralized and requires specialized treatment, such as reverse osmosis or blending, to be converted into drinking water. As a result of the brackish quality of the water, the FAS is not a suitable source of agricultural water supply in the LEC Planning Area without blending or treatment.

The FAS is generally subdivided into upper and lower sections separated by a relatively continuous low permeability, confining unit. The top of the upper FAS is approximately 900 to 1,000 feet below land surface in southeastern Florida, and the base of the upper Floridan aquifer extends as deep as 1,500 feet below land surface. More recently, the lower permeable zone of the upper Floridan aquifer, referred to as the Avon Park Permeable Zone, has been identified. This zone can be more productive and is frequently of better quality than the upper Floridan aquifer (Reese and Richardson 2007). Below this is the uppermost zone of the lower Floridan aquifer, which is more brackish than the upper Floridan aquifer. Several hundreds of feet of low transmissivity limestone are present at this depth, which effectively confine the formations in the FAS beneath it. At the base of the lower Floridan aquifer, at a depth of approximately 2,500 feet below land surface, are cavernous zones with extremely high transmissivity, known as the Boulder Zone, which provides a zone for disposal of treated wastewater, brine by-products of reverse osmosis treatment, and other FDEP-regulated discharges in the LEC Planning Area.

Since the *2005–2006 Lower East Coast Water Supply Plan Update* (SFWMD 2007) was published, water withdrawals from the FAS increased by approximately 20 MGD. Presently, utilities produce a total of about 30 MGD of treated "finished" water from the FAS. Construction of new systems and expansion of existing FAS wellfields were undertaken by the following utilities: Seacoast Utility Authority, Glades Utility Authority, City of Lake Worth Utilities, City of Deerfield Beach, Town of Davie, City of Miramar, MDWASD (City of Hialeah), City of North Miami Beach, and FKAA. Seven golf courses also use the FAS as an irrigation supply source. **Figure 30** presents a map with the location of permitted existing and proposed FAS wells within the LEC Planning Area.

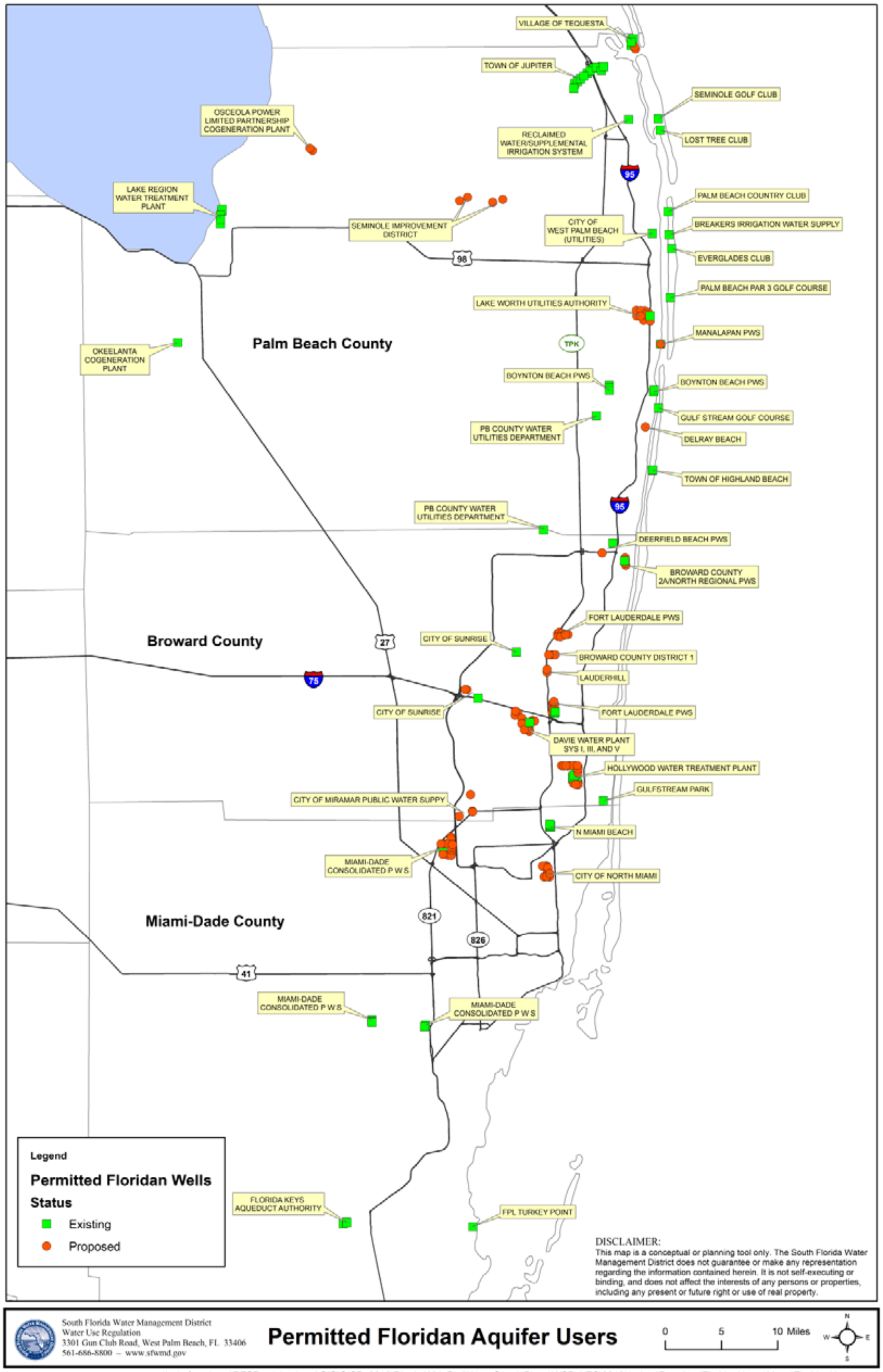


Figure 30. Locations of existing and potential FAS wells for PWS in the LEC Planning Area.

Water Levels

SFWMD maintains a FAS water level monitoring network throughout South Florida to observe long-term trends and serve as calibration points for groundwater models. The locations of wells within this network are shown in **Figure 31**. The data from this monitoring network is important, particularly in light of the trend of increasing withdrawals from the aquifer over the past few decades. To date, available water level data from wells monitoring the ambient conditions with the FAS—away from most permitted specific withdrawal locations—indicates that water levels within the aquifer remained fairly stable over the past decade.

Chloride Concentrations

To date, most of the usage of water from the FAS comes from the upper Floridan aquifer and the Avon Park Permeable Zone because the water in deeper portions of the FAS is more saline. A map of chloride concentrations in the upper Floridan aquifer is presented in **Figure 32**. In the recent periods of increasing withdrawals, the chloride concentration of water produced from FAS wellfields generally remained fairly stable. However, chloride concentrations within the aquifer are geographically variable. Within the past few years, the Glades Utility Authority wellfield in the Belle Glade area experienced an unanticipated increase in chlorides within the produced water. This phenomenon is probably a result of upconing of saline groundwater from deeper portions of the aquifer. This illustrates that supply wellfields drawing from the FAS need to be carefully evaluated, designed, and operated to minimize the potential for water quality degradation over time.

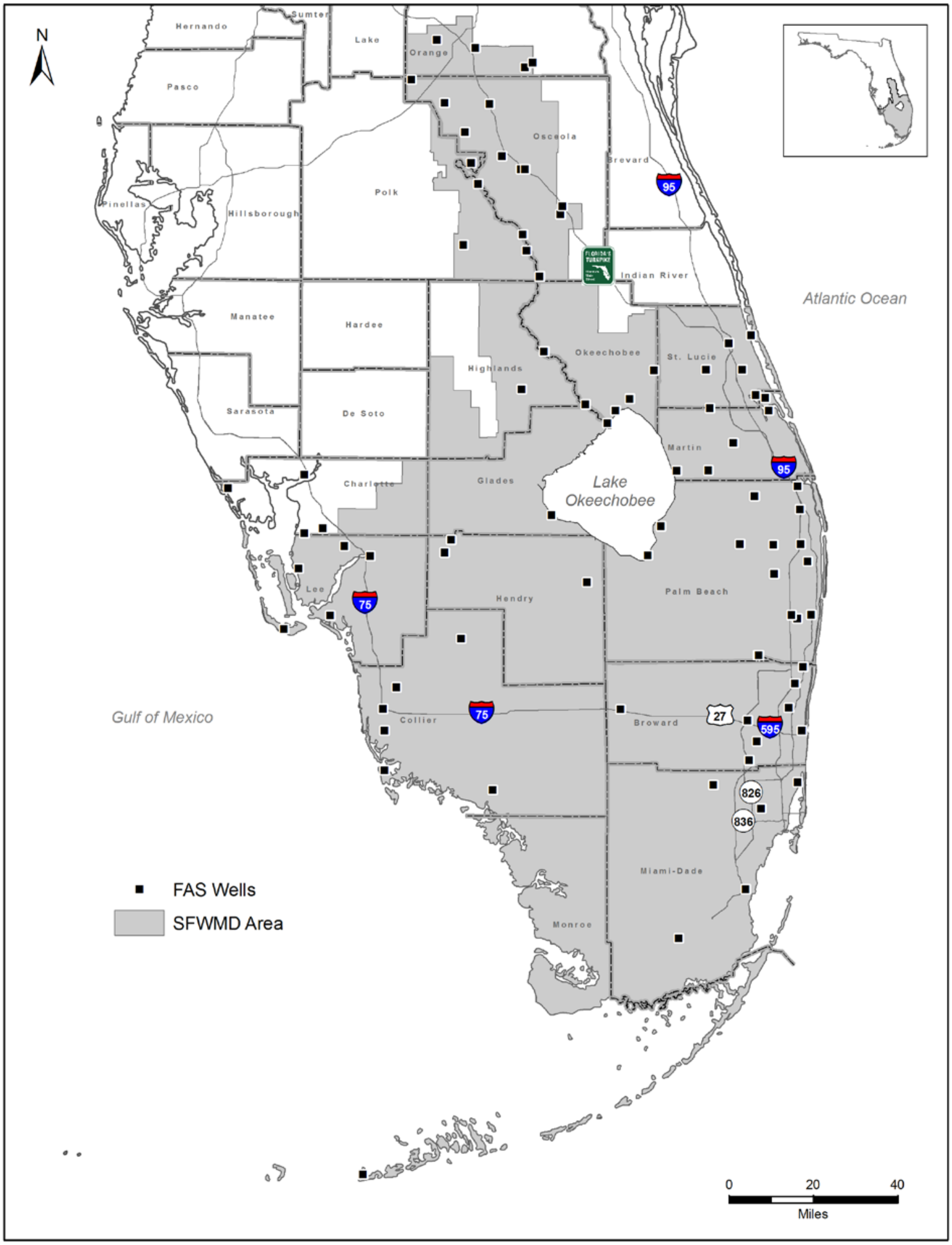


Figure 31. FAS monitoring wells.

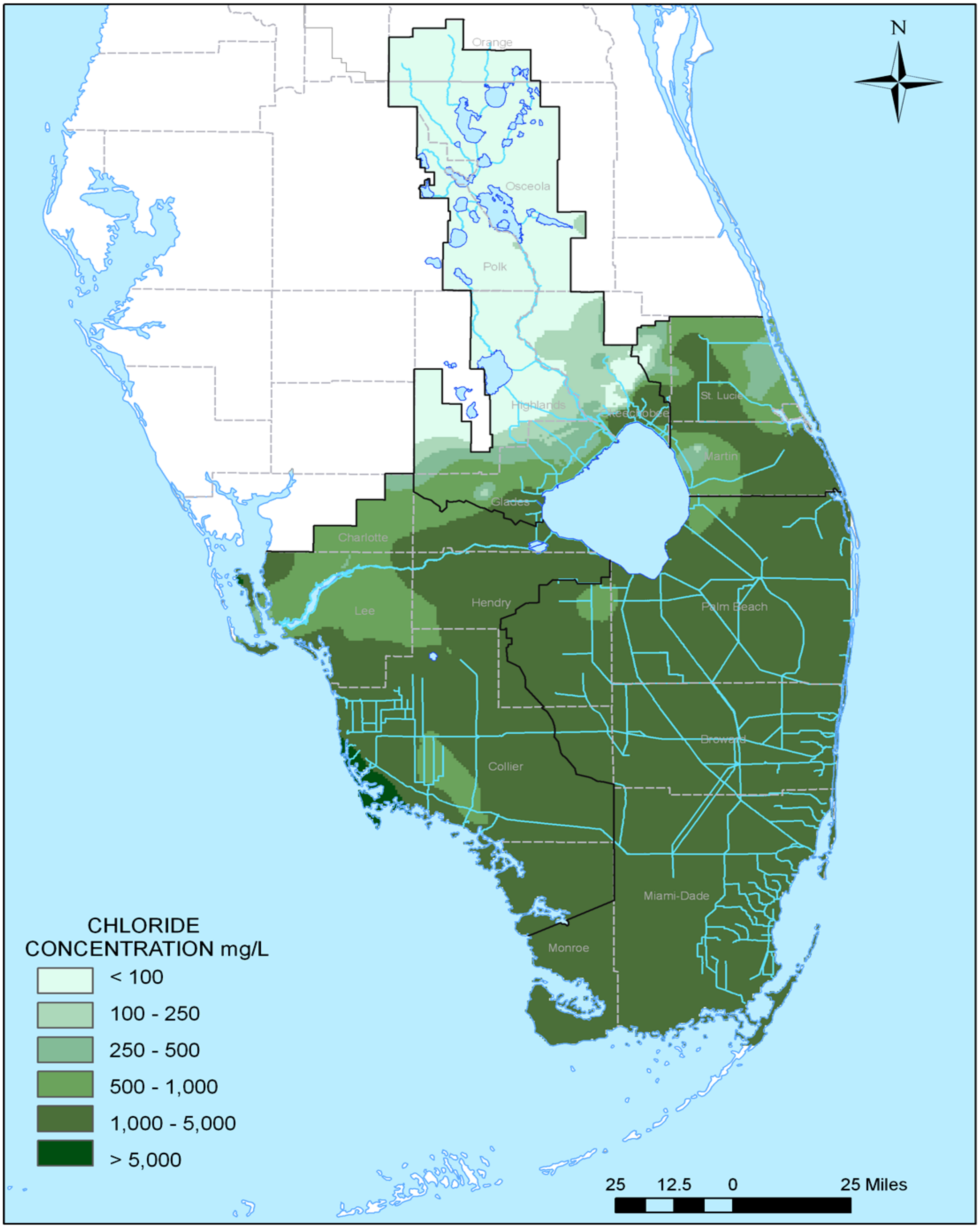


Figure 32. Estimated chloride concentrations in the upper FAS within SFWMD. (Note: mg/L – milligrams per liter.)

OUTLOOK ON CLIMATE CHANGE

Climate change, especially sea level rise, may affect the water supply in the LEC Planning Area. While climate change is occurring across the globe, the regional impact varies and the degree and rate of change remains uncertain. Long-term data show changes in parameters such as temperature, rainfall, and sea level. Despite the uncertainties, climate change and its effects on coastal freshwater aquifers should be included as a consideration in water supply planning (see **Chapters 1** and **7**).

The potential impacts of climate change vary. Rising sea levels will cause groundwater near the coast to become more saline and groundwater levels to increase. Shallow water supply wellfields within this area will potentially become brackish. The rising sea level has the strong potential to increase the salt content of water leaking into sewer collection systems and complicate the operations of wastewater treatment plants (Bloetscher et al. 2009).

Changes to evapotranspiration and weather patterns are not predictable today but will likely affect water supply and demand. If temperatures and evapotranspiration increase as many experts expect, both PWS and Agricultural Self-Supply water demands may increase. More frequent intense rainfall events with longer interim dry periods could increase total annual rainfall, but decrease effective rainfall, as more water may be lost to runoff or tide. These changes in precipitation and runoff will further alter estuarine circulation patterns and salinity regimes (Scavia et al. 2002).

The uncertainty of climate change challenges water utilities as they plan for the future. Traditionally, water resource planning used climate data from the past and current hydrology to represent future supply conditions because it was assumed the parameters of water resources, such as temperature, precipitation, stream flow, groundwater, and evaporation, would be the same as they had been in the past. While large variations in observed weather were experienced in the past, it was assumed that climate statistics would stay the same and variability would not increase in the future. With climate change, future planning must be able to consider additional uncertainties and larger variability (Water Utility Climate Alliance 2010).

Evaluation Efforts

Efforts to understand the effects of climate change and the approaches to deal with climate change are under evaluation by many agencies. At the national level, USEPA developed the *National Water Program 2012 Strategy: Response to Climate Change* (USEPA 2012). In this document, USEPA stated the following:

> …coastal areas are likely to see multiple impacts associated with climate change (e.g., sea level rise, increased damage from floods and storms, coastal erosion, changes in drinking water supplies, increasing temperature); acidification…; and nitrogen and phosphorus pollution, which could result in more profound consequences to water resources and

ecosystem services. These overlapping impacts make protecting water resources in coastal areas especially challenging.

USEPA states that many actions that could be taken to adapt to climate change are actions that add value absent climate change. The best management practices used by PWS utilities include water conservation and other efficiencies and have the ability to deal with climate change impacts as well as increasing demand caused by population growth. Three of the goals from this strategy relate to water supply planning:

- Efficiency in the use of energy and water should form the foundation of how we develop, distribute, recover, and use energy and water.
- Wastewater treatment facilities, which treat human and animal waste, should be viewed as renewable resource recovery facilities that produce clean water, recover energy, and generate nutrients.
- The water and energy sectors—governments, utilities, manufacturers, and consumers—should move toward integrated energy and water management from source, production, and generation to end user.

For more information on USEPA's 2012 National Water Program Strategy see water.epa.gov/scitech/climatechange/2012-National-Water-Program-Strategy.cfm.

The State of Florida passed the Community Planning Act in 2011 (Chapter 163, F.S.). This act provides for adaptation action areas to improve infrastructure resilience to flooding by extreme high tides, storm surges, and sea level rise in low lying coastal areas. Also in 2011, the Florida Department of Economic Opportunity received funding from the National Oceanic and Atmospheric Administration to fund a five-year project, Community Resiliency: Planning for Sea Level Rise. Among the goals of the project are to inventory sea level rise research and adaptation initiatives, identify technical resources for local communities, identify models to assess vulnerability, and determine the best way to incorporate sea level rise adaptation planning into state and local comprehensive plans.

To support regional and local efforts, Palm Beach, Broward, Miami-Dade, and Monroe counties established the Southeast Florida Regional Climate Change Compact to inform, improve, and advance regional planning efforts together. The SFWMD is an active but non-voting member of the compact. Compact participants recognized the need to protect and address the vulnerable water supply and infrastructure, and preserve both the natural system and agricultural resources. Participants in the process include the four counties, SFWMD, numerous local and city governments and utilities, other governmental agencies, and nonprofit organizations. In October 2012, the compact published *A Region Responds to a Changing Climate*, which serves as a regional climate action plan (Southeast Florida Regional Climate Change Compact 2012a). Because there are more than 100 local governments in the region with various government structures, management policies, land use authorities, charters, and political environments, implementation of the plan is expected to take different forms and must be flexible to address specific local conditions (Southeast Florida Regional Climate Change Compact 2012a). Additionally, Broward, Miami-Dade, and Monroe counties developed comprehensive county climate change action plans with goals, strategies, and action items.

Both Broward and Miami-Dade counties are working cooperatively with the USGS on development of groundwater models to address water supply planning while considering sea level rise. The Broward model will help to simulate the historical pattern and rate of saltwater intrusion in the central and southern portions of the county. The Miami-Dade model will be used to evaluate operational scenarios and effects and how sea level rise will affect the freshwater/saltwater interface in the Biscayne aquifer. Additionally, Broward County has developed a comprehensive surface water and groundwater model that can be used to simulate various water management scenarios. This model can be used to quantify the benefits to natural areas like wetlands, as well as to wellfields, from proposed improvements to water management, and it can help us identify ways to prevent saltwater intrusion in vulnerable areas.

As mentioned earlier in this chapter, SFWMD estimated the position of the saltwater interface for each coastal county within the SAS and documented this position with a series of maps. The maps were based on periodic salinity monitoring conducted by USGS, SFWMD, and water use permit holders in select monitoring wells as of spring 2009. Work on the next series of saltwater interface map updates will begin in 2014. This will allow comparison of the interface over time, and potentially identify areas of concern that may require additional monitoring or action to protect wellfields. These maps will be used in water supply planning, consumptive use permitting, and other areas of SFWMD.

Response to Sea Level Rise

In the LEC Planning Area, sea level rise is a key concern. Therefore, early in their efforts, members of the Southeast Florida Regional Climate Change Compact reviewed current projections and scientific literature regarding sea level rise. Compact members recommended the sea level rise projections used by the group be based on the USACE guidance document, *Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs* (USACE 2009), until more definitive information became available. USACE anticipates a sea level rise of 3 to 7 inches by 2030 and 9 to 24 inches by 2060. Related to the sea level rise projections is the need to understand the areas potentially vulnerable because of the rise. In support of the compact's efforts, SFWMD developed digital elevation data sets for mapping inundation layers to represent areas potentially vulnerable to one-, two-, and three-feet sea level rise scenarios. The maps and inundation layers were then used by the four counties to assess their jurisdictions (Southeast Florida Regional Climate Change Compact 2012a).

In concert with the regional climate action plan, the Southeast Florida Regional Climate Change Compact developed a *Regional Climate Action Framework: Implementation Guide* (Southeast Florida Regional Climate Change Compact 2012b) that describes initiatives, planning horizon, potential partners, potential funding sources, needed policies or legislation, estimated resources needed, and performance measures. Of the 110 recommendations, 18 relate to water supply, water management, and infrastructure. SFWMD will continue to collaborate with other compact participants on the implementation process.

The SFWMD has invested resources in developing numerical models and evaluating water management model scenarios of sea level rise and precipitation. Because of the changing weather patterns, the SFWMD will extend the climate data used in modeling more frequently than every five years, which is typical.

4

Water Resource Development Projects

TOPICS
Regional Projects
Districtwide Projects
Summary

This chapter addresses the roles of the South Florida Water Management District (SFWMD) and other parties in water resource development projects and provides a summary of projects in the Lower East Coast (LEC) Planning Area. The project summaries serve as a brief overview of the additional water supply-related activities in the LEC Planning Area and are listed by region where benefits accrue. The regions are Lake Okeechobee, the Everglades, the Loxahatchee River, Biscayne Bay, Florida Bay, and the LEC Service Area. Lastly, an update on the status of districtwide water resource development projects is provided. Annual updates on these projects can be found in Chapter 5 of Volume I of the South Florida Environmental Reports available from www.sfwmd.gov/sfer.

Florida water law identifies two types of projects to meet water needs: water resource development projects (subject of this chapter) and water supply development projects. Water resource development projects are generally the responsibility of water management districts. These projects support water supply development and are intended to ensure the availability of an adequate supply of water for all existing and future uses, including maintaining the functions of natural systems. To fulfill the responsibility to provide water for the natural system, the SFWMD monitors the health of the natural system. Therefore, projects related to monitoring are included in this chapter.

Water supply development projects are generally the responsibility of water users, such as utilities, and involve the water source options described in **Chapter 5** to meet their needs. Specific water supply development projects are identified in **Chapter 6** and **Appendix F**.

Water resource planning in the LEC Planning Area is strongly influenced by the Comprehensive Everglades Restoration Plan (CERP). Authorized by the United States Congress in 2000, CERP is a conceptual plan, the implementation of which is a significant restoration program. CERP builds upon and complements other state and federal initiatives to revitalize South Florida's ecosystem. In 2000, federal and state legislation authorized the United States Army Corps of Engineers (USACE) and SFWMD to equally fund restoration, protection, and preservation of water resources in Central and South Florida, including the

Everglades. To implement CERP, USACE and SFWMD employ the following phases: 1) project identification, 2) project planning, 3) approval and authorization, 4) project design, 5) project construction, and 6) operation and maintenance. These phases are supported by modeling, land acquisition, project controls, and technical services performed throughout the process. CERP projects are discussed by region in this chapter and are listed in **Table 11**. The CERP projects also form the capital projects element of the MFL recovery strategies found in **Appendix B**.

Table 11. Regions within the LEC Planning Area and CERP projects within each region.

Region	CERP Project
Lake Okeechobee	Lake Okeechobee Watershed Project
Everglades	Water Conservation Area 3A Decompartmentalization Physical Model
Loxahatchee River	Loxahatchee River Watershed Restoration Project
Biscayne Bay	Biscayne Bay Coastal Wetlands Project
Florida Bay	C-111 Spreader Canal Western Project
LEC Service Area	Fran Reich Preserve Reservoir
	Hillsboro Aquifer Storage and Recovery Pilot Project
	Broward County Water Preserve Areas
	Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat

REGIONAL WATER RESOURCE DEVELOPMENT PROJECTS

Lake Okeechobee

In this section, the following projects are discussed:

- CERP Lake Okeechobee Watershed Project
- Taylor Creek, Nubbin Slough, and Lakeside Ranch Stormwater Treatment Areas (STAs)
- USACE Herbert Hoover Dike Major Rehabilitation
- Lake Okeechobee Habitat Enhancements

The locations of these projects are shown in **Figure 33**.

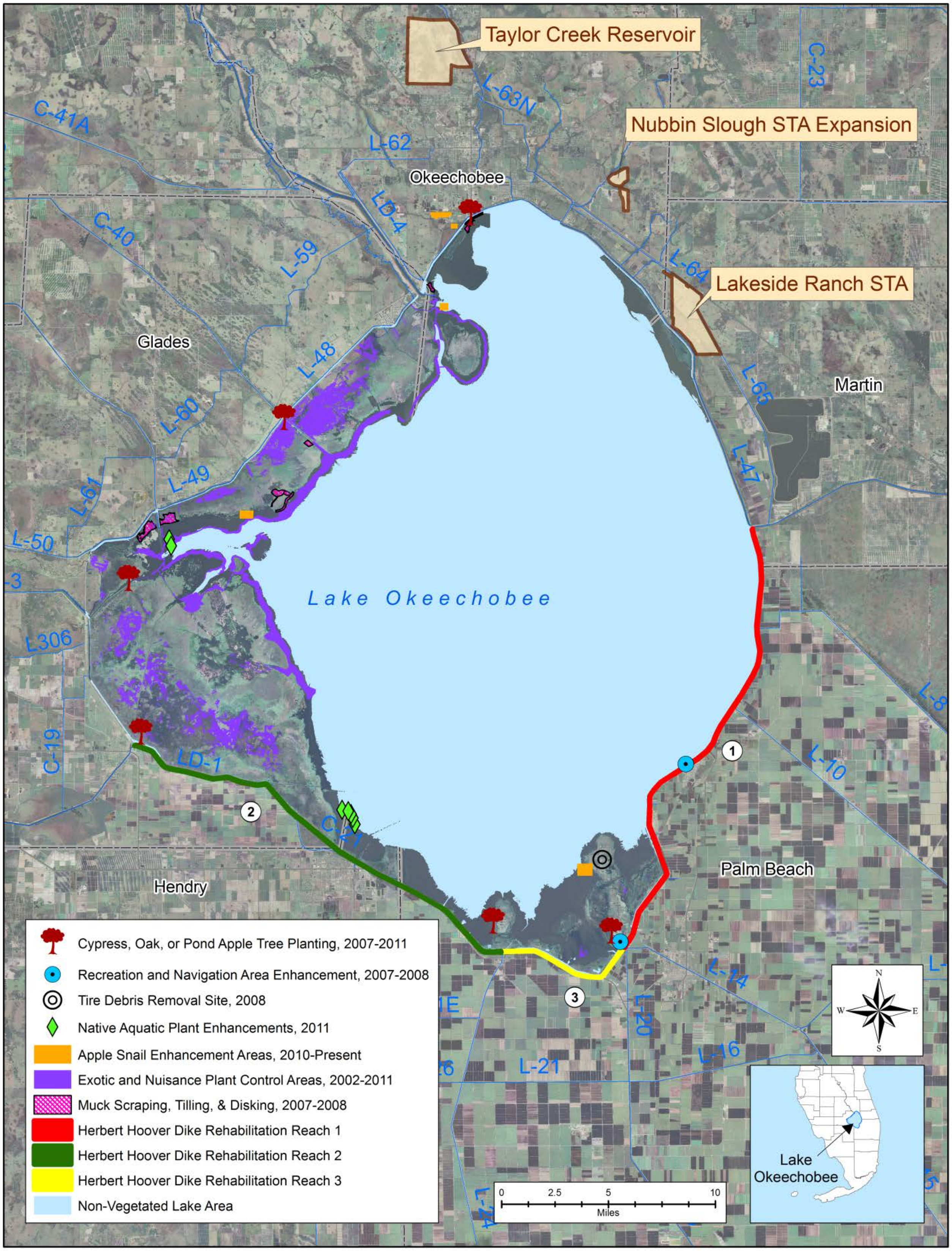


Figure 33. Projects in the Lake Okeechobee region.

CERP Lake Okeechobee Watershed Project

The CERP Lake Okeechobee Watershed Project area covers approximately 1,800 square miles and incorporates the four major tributary systems that drain the lower portion of the watershed into Lake Okeechobee. The purpose of this project is to reduce damaging releases to the surrounding estuaries, increase aquatic and wildlife habitat, regulate extreme highs and lows in lake staging, and reduce phosphorus loading. In addition, this project will focus on rehydrating wetlands in and around the areas north of Lake Okeechobee and improving the ecological health of Lake Istokpoga. Although located outside of the LEC Planning Area, this project includes additional storage that will provide water supplies needed for Lake Okeechobee minimum flows and levels (MFL) recovery.

The key components of the CERP Lake Okeechobee Watershed Project proposed tentatively selected plan consist of a recommended Lake Istokpoga regulation schedule and the following six structural water storage and treatment features:

- **Reservoir in the Taylor Creek/Nubbin Slough Basin** – an 1,984-acre reservoir will provide a maximum capacity of 32,000 acre-feet (ac-ft). It will receive inflows from, and discharge back to, Taylor Creek.
- **STA in the Taylor Creek/Nubbin Slough Basin –** a 3,975-acre treatment area will receive inflow from the L-64 Canal and discharge back to the L-47 Canal. It is projected to provide 15.8 metric tons per year total phosphorus load reduction.
- **Reservoir in the Kissimmee River Basin –** a 10,281-acre aboveground reservoir will provide a maximum storage capacity of 161,263 ac-ft within the Kissimmee River Basin. It will receive flow from and discharge back to the Kissimmee River.
- **Reservoir in the Lake Istokpoga Basin –** a 5,416-acre reservoir to provide a maximum storage capacity of 79,560 ac-ft. It will receive inflow from and discharge back to the C-41A Canal.
- **STA in the Lake Istokpoga Basin –** an 8,044-acre treatment area will receive flow from the C-41 Canal and discharge treated water to Lake Okeechobee. It is expected to provide approximately 29.1 metric tons per year total phosphorus load reduction.
- **Restored Wetland in Paradise Run** – a 3,730-acre wetland restoration site located at the ecologically significant confluence of Paradise Run, oxbows of the Kissimmee River, and Lake Okeechobee.

Implementation of the CERP Lake Okeechobee Watershed Project has been delayed primarily due to unresolved federal-state cost-sharing issues for project water quality components. However, water resource development projects progressed in the region under the auspices of other programs and initiatives. These include the Northern Everglades and Estuaries Protection Program, the Lake Okeechobee Protection Plan, the

Lake Okeechobee and Estuary Recovery Plan, and the Lake Okeechobee Watershed Construction Project Phases 1 and 2.

Taylor Creek, Nubbin Slough, and Lakeside Ranch STAs

Numerous efforts have been conducted under the Lake Okeechobee Watershed Project, including completion of the Lakeside Ranch STA Phase I construction and two pilot-scale STAs in Taylor Creek and Nubbin Slough.

Taylor Creek STA Pilot Project

The Taylor Creek STA pilot project was constructed in 2006 and implemented under the Lake Okeechobee Watershed Construction Project – Phase 1. The STA is located in central Okeechobee County and is approximately 142 acres in size with an effective treatment area of 118 acres. It is divided into two cells in series and is expected to treat about 10 percent of the water flow in Taylor Creek. The expected annual average total phosphorus removal performance of the Taylor Creek Pilot STA was estimated at 2.08 metric tons per year.

Initial flow-through operations at the Taylor Creek STA commenced in 2008, but were suspended due to a culvert failure at the discharge structure. After repairs were completed, the STA resumed continuous flow-through operation in September 2010. USACE and SFWMD, the project's co-sponsors, have a 50-50 cost share agreement. SFWMD is responsible for the operation, monitoring, and maintenance of the facility. Since May 2011, SFWMD has operated the facility under a Florida Department of Environmental Protection (FDEP) permit.

Nubbin Slough STA Pilot Project

The Nubbin Slough STA Pilot Project was also implemented under the Lake Okeechobee Watershed Construction Project – Phase 1. It is the larger of the two pilot STAs implemented north of the lake. USACE was responsible for the design and construction of the project. SFWMD is the local sponsor of the project and will be responsible for operation and maintenance.

Nubbin Slough STA Pilot Project

It is located about 6.5 miles southeast of the City of Okeechobee. This two-celled STA is approximately 809 acres in size with an effective treatment area of 773 acres. The projected long-term average total phosphorus reduction within the STA was estimated at 5 metric tons or about 85 percent of the total phosphorus load of Nubbin Slough at the project location.

Construction of the Nubbin Slough STA was completed in September 2006; however, it could not be operated as designed due to a series of electrical and mechanical problems uncovered during pump tests. Aggradations of sediment in the pump basin also impaired operations. Repairs and construction modifications to the intake basin were completed and the STA became operational in June 2012. Flooding associated with Tropical Storm Isaac revealed that remnant pipes exist within the STAs footprint and need to be plugged. SFWMD and USACE developed a repair plan for the S-385 bypass weir and piping under the levee. Repairs will begin when groundwater levels are low enough to proceed with the pipeline excavation and grouting. In the meantime, pumping operations and water quality monitoring at the Nubbin Slough STA are suspended.

Lakeside Ranch STA Project

The Lakeside Ranch STA Project is a key component of the Northern Everglades and Estuaries Protection Program and is featured in the *Lake Okeechobee Watershed Construction Project Phase 2 Technical Plan* (SFWMD et al. 2008). The Lakeside Ranch STA is in the Taylor Creek/Nubbin Slough Subwatershed, a nutrient hot spot in the Lake Okeechobee Watershed. The STA is expected to reduce total phosphorus loads to the lake by up to 19 metric tons per year. The STA will also be able to recirculate water from the lake, which may provide potential for internal phosphorus removal.

The Lakeside Ranch STA Project was designed in two phases. Phase I includes a northern STA (919-acre effective treatment area), canal improvements along the L-63 and L-64 levees, and installation of the S-650 pump station. State appropriations funded construction of Phase I, which was completed in May 2012. Phase II includes a southern STA (788-acre effective treatment area), a new pump station at S-191, and a discharge canal. Final design of Phase II was completed in December 2011 and implementation is subject to future funding. This STA is anticipated to be one of the tentatively selected plan components of the CERP Lake Okeechobee Watershed Project.

USACE Herbert Hoover Dike Major Rehabilitation

Herbert Hoover Dike rehabilitation construction

USACE is rehabilitating the Herbert Hoover Dike, a 143-mile series of levees and structures surrounding Lake Okeechobee, to address structural integrity concerns with the embankment and internal culvert structures. The Herbert Hoover Dike was first authorized in 1930. It was constructed by hydraulic dredge and fill methods. In 2007, USACE designated the Herbert Hoover Dike a dam safety action classification risk of Class I, representing the highest USACE dam risk of failure rating and requiring remedial action.

The project originally included construction of structural features, cut-off walls, and landside rehabilitation. It also included design of rehabilitation features in current and future segments (Reaches 1–8) of the Herbert Hoover Dike. The *Herbert Hoover Dike Major Rehabilitation Evaluation Report* (USACE 2000b) divided the 143-mile dike into eight reaches with the initial focus on Reach 1. This reach-by-reach approach has been replaced with the systemwide risk reduction approach USACE utilizes for safety modifications to dams. The current approved and planned remediation measures will address the highest points of potential failure in the system based on known areas of concern.

The implementation of the 21.4-mile cutoff wall component in Reach 1 satisfies the majority of the risk reduction goals. This component is scheduled to be completed in 2013. As part of this risk reduction approach, the 32 water control structures (culverts) operated by USACE are being replaced, removed, or abandoned with a scheduled completion in 2018. Culvert 14, north of Canal Point, was removed in 2011. Replacement work began in 2012 to Culverts 11 and 16 south of Port Mayaca, at Culverts 1 and 1A east of Moore Haven, and at Culverts 3 and 4A near South Bay. Additional contracts for the replacement of other culverts are expected to be awarded by late 2013.

USACE is currently conducting the Herbert Hoover Dike Dam Safety Modification Study, which is anticipated to be complete in 2015. The study is a comprehensive, systemwide study intended to identify risks in the system, and to recommend the necessary measures that can reduce the risk of failure. USACE expects the results of the study to provide the final roadmap toward the ultimate goal of reducing failure risk at the Herbert Hoover Dike. Culvert replacement will continue as the study progresses. Once the study is complete, USACE will execute projects identified by the study. Additional planned remediation measures consist of construction of a cutoff wall and/or a seepage management system in Reaches 2 and 3. These actions are scheduled for completion by 2022 (USACE and SFWMD 2013) and should lower the dam safety action classification from Class I.

USACE committed to revision of the Lake Okeechobee operations in its *Final Environmental Impact Statement Including Appendices A through G – Lake Okeechobee Regulation Schedule* (USACE 2007). Specifically, USACE stated, the following:

> Pending completion of rehabilitation in Reaches 1, 2 or 3, as HHD[2] rehabilitation progresses, the Corps[3] will evaluate the capacity to operate the Lake in a manner to provide more water storage in conjunction with achieving other project purposes. The anticipated points at which the Corps will utilize the flexibility within the schedule consistent with protection of health safety and welfare to provide additional storage include, at a minimum, completion of filling of the toe ditch, construction of the seepage berm within the existing right of way in Reach 1, and equivalent dike improvements in Reaches 2 or 3, which are currently under design. Upon changed circumstances, the Corps will provide additional storage, consistent with technical analysis, that might result from higher lake elevations.

[2] HHD – Herbert Hoover Dike
[3] Corps – United States Army Corps of Engineers

The USACE expects to operate under the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) until the earlier of 1) implementation of a new Lake Okeechobee schedule as a component of the systemwide operating plan to accommodate CERP projects, or 2) completion of the Herbert Hoover Dike seepage management system for Reaches 1, 2, and 3 as determined necessary to lower the dam safety action classification rating from Class 1. USACE intends to implement a new schedule or any necessary schedule modifications or deviations concurrent with the completion of item 1 or item 2 above (USACE and SFWMD 2013).

A revised regulation schedule could provide the additional water supplies needed for Lake Okeechobee MFL recovery, enhance the level of certainty to existing permitted users, and support other environmental objectives. For more information see www.saj.usace.army.mil/Missions/CivilWorks/LakeOkeechobee/HerbertHooverDike.aspx.

Lake Okeechobee Habitat Enhancements

The 2007 drought lowered Lake Okeechobee water levels, allowing SFWMD to cost-effectively conduct a series of management activities. Continued low water levels in both Lakes Okeechobee and Istokpoga during 2008 prompted SFWMD to garner input from various agencies to plan low lake stage restoration projects for the coming dry seasons, as well as helping to mitigate more the frequent low lake stages anticipated under the 2008 LORS. These low lake level activities resulted in further research and aided project formulation. The activities include muck scraping and disking/plowing, native aquatic plant enhancement, exotic and nuisance plant control, recreation and navigation area enhancement, in-lake debris removal, and initiation of an apple snail (*Pomacea paludosa*) nursery. These activities were implemented during subsequent droughts.

Everglades

The following projects are discussed in this section (**Figure 34**):

- Restoration Strategies Regional Water Quality Plan
- C-139 Annex Restoration
- Modified Water Deliveries to Everglades National Park (ModWaters)
- CERP Water Conservation Area (WCA) 3A Decompartmentalization (Decomp) Physical Model (DPM)
- Ongoing CERP Planning, including the Central Everglades Planning Project (CEPP)
- Wading Bird Monitoring Report
- Historical Tree Island Mapping


Green heron in Everglades National Park

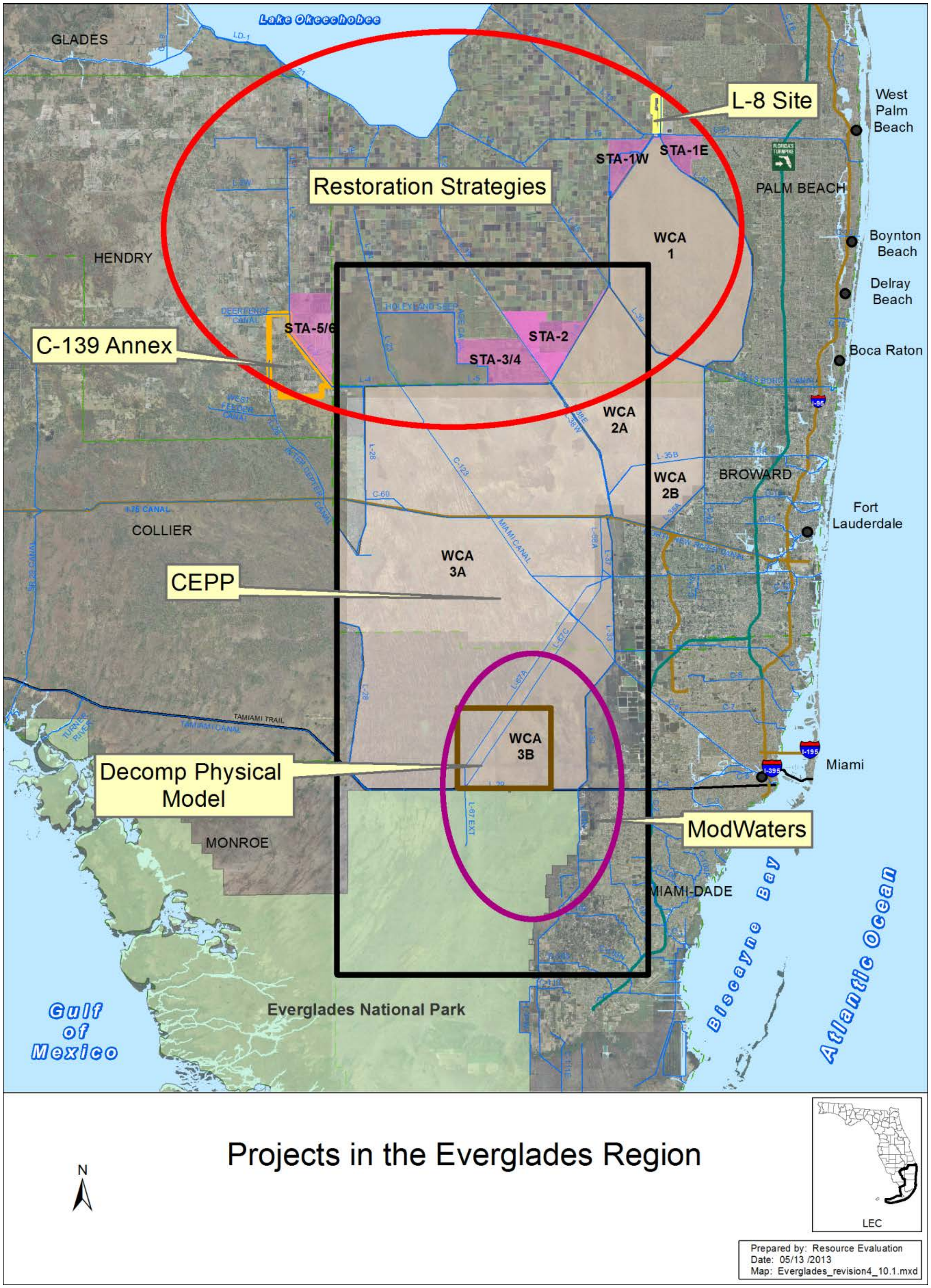


Figure 34. Projects in the Everglades region.

Restoration Strategies Regional Water Quality Plan

The Restoration Strategies Regional Water Quality Plan is a strategy and technical plan comprised of a suite of projects designed to meet water quality objectives supporting Everglades' restoration. FDEP and SFWMD worked in coordination with the United States Environmental Protection Agency to develop projects that will work in combination with the existing STAs to achieve the Water Quality Based Effluent Limit. The technical plan includes six projects that will create more than 6,500 acres of new STAs and 110,000 ac-ft of additional water storage through construction of flow equalization basins (FEBs) (**Figure 35**). FEBs are constructed storage features used to capture and store peak stormwater flows. FEBs provide a more steady flow of water to STAs, helping to maintain desired water levels needed to achieve optimal water quality treatment performance.

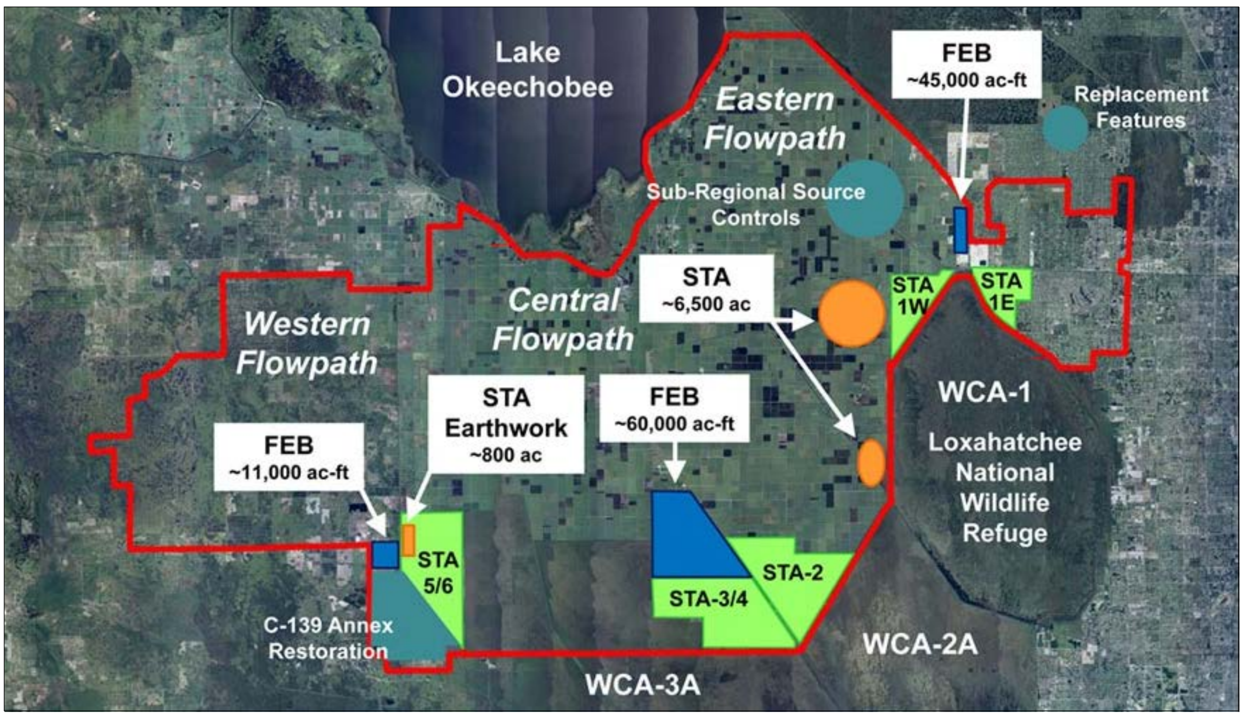


Figure 35. Key elements of the Restoration Strategies Regional Water Quality Plan.

The strategy also includes additional source controls—pollution reduction at its source—in the eastern Everglades Agricultural Area where phosphorus levels in stormwater runoff have been historically higher. In addition, a robust science plan will ensure continued research and monitoring to improve and optimize the performance of water quality treatment technologies.

In the L-8 Basin, located in central Palm Beach County, SFWMD purchased a 46,000 ac-ft belowground impoundment created by rock mining operations. The L-8 site was originally anticipated to provide water storage as a CERP component. The unique geology (low transmissivity limestone) at the L-8 site allows for deep, belowground storage, minimizing water loss through seepage. As part of the Restoration Strategies Regional Water Quality

Plan approved in 2012, the L-8 site is now under construction for use as an FEB. The L-8 FEB will provide storage for delivery of consistent flows needed to optimize performance of the STAs. In September 2012, SFWMD awarded a $63.9 million contract for design and construction of an inflow structure, internal improvements, revetment strengthening, a pump station, and six pumps to convey water into and out of the L-8 FEB, which can pull water from 40 feet below land surface.

The A-1 FEB is an 15,000-acre shallow impoundment area located south of Lake Okeechobee. It is designed to store approximately 60,000 ac-ft of storm water. The A-1 FEB is the largest of three FEBs identified in the plan. The A-1 FEB will attenuate peak stormwater flows, temporarily storing water so it can be delivered at a steady rate to STA 2 and STA 3/4 to improve their performance. FDEP issued a permit authorizing SFWMD to build, operate, and maintain the A-1 FEB in July 2013. Construction of the A-1 FEB is scheduled to be completed by July 2016.

Design and construction of the treatment and storage projects will be completed in three phases over a twelve-year timeframe, with completion set for 2025. More information is available at www.sfwmd.gov/restorationstrategies.

C-139 Annex Restoration

The C-139 Annex Restoration property is a restoration project funded in part by the Lake Belt Mitigation Fund. The Lake Belt Mitigation Committee[4] studied the restoration potential of the site and approved its use as mitigation for wetland impacts in the Lake Belt region in December 2012.

The project will restore historic Everglades hydrologic conditions to 15,000 acres formerly used as a citrus grove. Restoration will progress as mitigation funds allow and is expected to be by complete by 2018. The project will consist of the following elements:

- Buildings and structures removal
- Exotic vegetation removal
- Citrus tree clearing and planting bed leveling
- Irrigation system removal and well abandonment
- Canal backfilling, and road and levee degradation to restore sheetflow
- Native vegetation replanting and microtopographical contouring

[4] The Lake Belt Mitigation Trust Fund is designed to fund mitigation projects offsetting limerock mining impacts within areas of the Miami-Dade County Lake Belt. The fund is supported by a per-ton mitigation fee assessed on limestone sold from the Lake Belt area. The fund is used for acquiring environmentally sensitive lands and for restoration, maintenance, and other environmental purposes. Expenditures from the fund are managed by the Miami-Dade County Lake Belt Mitigation Committee, an interagency committee consisting of representatives from the Miami-Dade County Department of Environmental Resource Management, FDEP, SFWMD, and the Fish and Wildlife Conservation Commission.

Modified Water Deliveries to Everglades National Park

The United States Department of Interior and USACE co-sponsor ModWaters. Its purpose is to restore natural hydrologic conditions in Everglades National Park, which were altered by the construction of roads, levees, and canals. The project is a foundation project for CERP, providing the first major restoration effort for Everglades National Park. This project will provide water supplies needed for Everglades MFL recovery.

Many of the anticipated CERP projects will not be technically feasible without implementation of ModWaters. ModWaters is essential to provide the flow capacity necessary for future CERP projects.

ModWaters has five major components:

- **Tamiami Trail Modifications** – The L-29 Levee and Tamiami Trail Highway impede water flow from WCA 3B to northeastern Shark River Slough in Everglades National Park. These impediments will be overcome by completion of two new water control structures that will allow flow through the L-29 Levee, raising Tamiami Trail, and installation of a one-mile long bridge on Tamiami Trail. Construction of this project began in 2010 and the new bridge opened for use in April 2013 with additional site work continuing through the end of the year.
- **L-67A Conveyance Features –** This component involves the construction of new water control structures to allow water to flow from WCA 3A into WCA 3B. These features may not be executed as part of ModWaters due to budgetary constraints.
- **8.5-Square Mile Area Protection Features –** This component includes a protection levee, seepage collection canal, pump station, and detention area to maintain existing levels of flood protection to the 8.5-Square Mile Area under the higher stages expected with increased flow to northeastern Shark River Slough. Construction of this component was complete in 2008.
- **S-356 Pump Station –** This pump station will collect water that seeps out of WCA 3B and northeastern Shark River Slough into the L-30 and L-31 canals and pump it into the L-29 Canal, thereby returning water to northeastern Shark River Slough. This component will provide restoration benefits to Everglades National Park and avoid impacts on flood protection to the east. Construction was complete in 2002. However, FDEP has not issued an operational permit. Considerable stakeholder controversy surrounding the use of the S-356 pump station prevented it from reaching operational status. USACE submitted an application to FDEP in October 2012 requesting authorization to field test operations at the S-356 pump station and to modify G-3273 criteria. As of February 2013, action on the application is pending USACE response to FDEP's request for additional information.
- **Taylor Slough Bridge –** A replacement bridge was constructed in 2007 to increase the flow capacity under the main park road.

CERP WCA 3A Decompartmentalization Physical Model

DPM is a field-scale test that will assess the effects of pulsed flows on hydrology, sediment transport, vegetation, and wildlife. DPM results will determine how best to design and formulate plans for future decompartmentalization of WCA 3, as visualized in CERP. DPM is designed to address scientific, hydrologic, and water management uncertainties that require clarification prior to future planning and construction of Everglades restoration projects. This project will help determine the water supplies needed for Everglades MFL recovery. This project will temporarily install the following features: ten 60-inch culverts in the L-67A Levee, and a 3,000-foot gap in the L-67C Levee with three experimental backfill methods.

Deconstruction of these features will occur at the end of the DPM testing period and the project area will be restored to pre-DPM conditions. In 2012, USACE received the final permit for DPM construction and interim operations. A contract for construction was awarded in May 2012. SFWMD anticipates testing will begin November 2013 and continue through 2014.

Ongoing CERP Planning

In October 2011, the intergovernmental South Florida Ecosystem Restoration Task Force endorsed a state-federal initiative to speed up the CERP planning process for key restoration projects in the Everglades. Now under way, CEPP combines a series of CERP components into one project implementation report. CEPP will identify and plan for projects on land already in public ownership to direct more water south to the central Everglades, WCA 3, Everglades National Park, and Florida Bay while providing water for other water-related needs. The following CEPP components for storage and treatment, distribution and conveyance, and seepage management elements are under consideration (**Figure 36**):

Storage and Treatment

- Construction of an FEB on the Talisman A-2 parcel with integrated operations with the Restoration Strategies Regional Water Quality Plan A-1 FEB operations.
- Diversion of L-6 Canal flows and L-5 Canal improvements.
- Removal of approximately 2.9 miles of the western portion of the L-4 Levee and modification of the S-8 pump station.
- Miami Canal backfill and spoil mound removal (beginning approximately 1.5 miles south of the S-8 structure and ending at I-75).

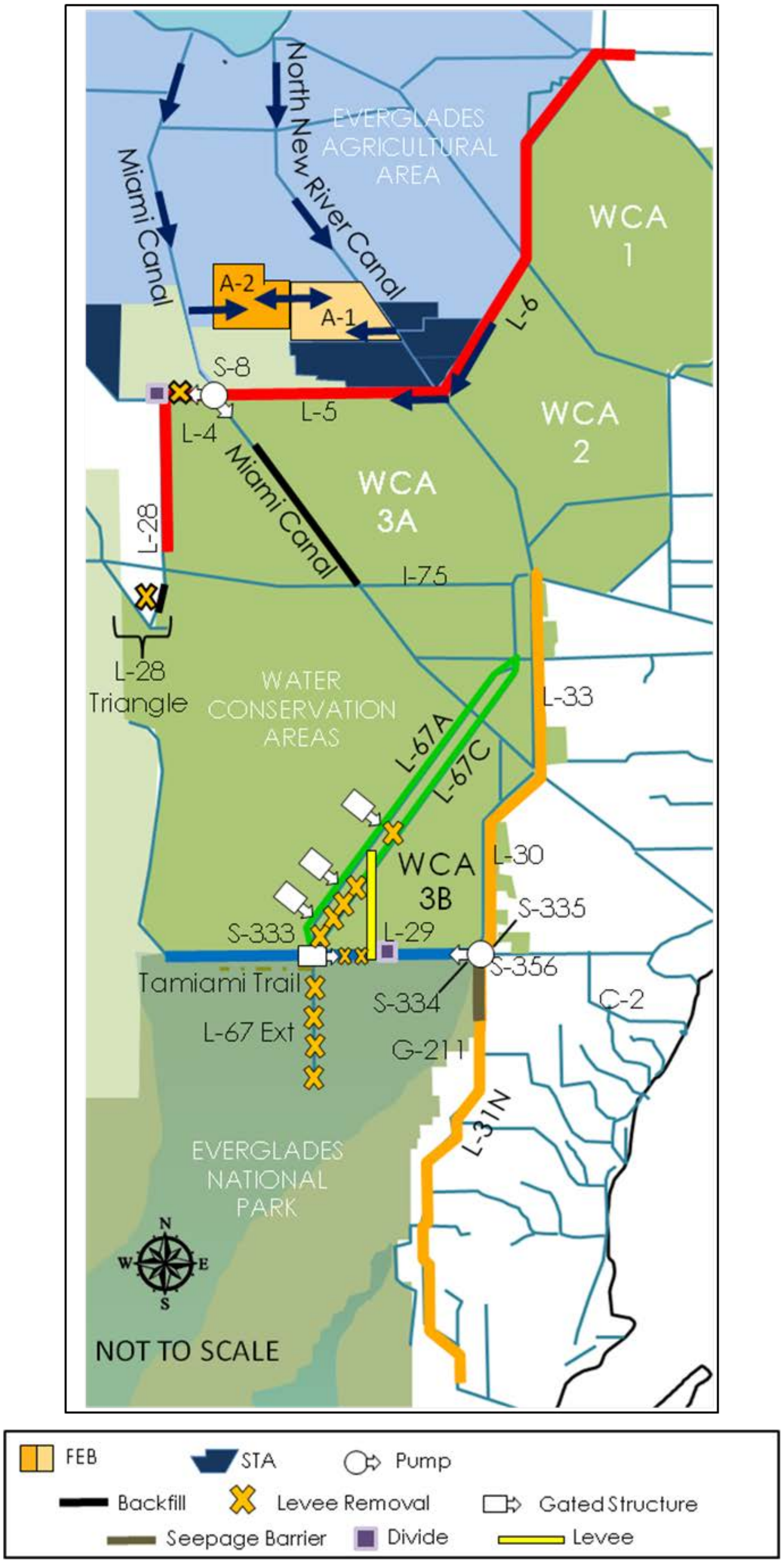


Figure 36. CEPP features under consideration.

Distribution and Conveyance (Southern WCA 3A/B)

- Increase the S-333 structure capacity.
- Construction of three structures and spoil removal west of the L-67A Canal north and south of the structures with two of the structures at the beginning of the flow-way from WCA 3A through WCA 3B to Everglades National Park.
- Construction of a levee in WCA 3B connecting the L-67A Levee to the L-29 Levee along with removal of the L-67C (no canal backfill) and L-29 levees, creating a flow-way from WCA 3A through WCA 3B to Everglades National Park.
- Construction of a gated structure along the L-67A Levee and 6,000-foot gap in the L-67C Levee.
- Removal of the entire L-67 Extension Levee and backfill the L-67 Extension Canal.
- Removal of the Old Tamiami Trail road from the L-67 Extension Levee to Everglades National Park's Tram Road.

Seepage Management

- Increase S-356 pump station capacity.
- Construction of a partial depth seepage barrier south of Tamiami Trail (along the L-31N Levee).
- G-211 structure operations refinement and use of coastal canals to convey seepage.

Wading Bird Monitoring Report

Wading birds are useful indicators of environmental health. The collection of data and analysis of the trends is a useful tool to track changes in the environment. Each year, SFWMD prepares the Wading Bird Monitoring Report covering all wading bird breeding colonies in South Florida. The 2012 report documents continued declines in the nesting activity of many wading bird species highlighting the need for Everglades restoration and development of regional water resources projects (Cook and Kobza 2012).

Historical Tree Island Mapping

Everglades tree islands are areas of critical habitat and centers of biodiversity. In 2011, this project mapped tree islands within Everglades National Park using stereoscopic analyses of historic aerial photography from 1952 through 2004. Previous mapping efforts found tree island degradation or loss on 90 percent of WCA 2A and 60 percent of WCA 3A since the 1940s due to hydrologic alterations.

This project sought to examine relatively healthy tree islands of Shark River Slough for comparison to the degraded tree islands in the WCAs. Data gained from this and previous tree island studies gives insight into the hydrologic conditions needed to sustain healthy tree islands. The study highlights the need for development of regional water resources projects to restore hydrologic conditions in the WCAs to sustain tree islands. Documentation of this additional information is necessary to provide a better understanding of how and why tree islands changed over the last 50 years and what might be in store for their future.

Loxahatchee River


Loxahatchee River

In this section, the following projects are discussed:

- Restoration Plan for the Northwest Fork of the Loxahatchee River
- CERP Loxahatchee River Watershed Restoration Project (formerly known as North Palm Beach County – Part 1)
- Storage for the Loxahatchee River

Restoration Plan for the Northwest Fork of the Loxahatchee River

In April 2003, a recovery strategy was approved, which included the commitment by SFWMD to develop, in partnership with FDEP, "a practical restoration plan and goal" for the Northwest Fork of the Loxahatchee River. The objective of the *Restoration Plan for the Northwest Fork of the Loxahatchee River* is to use the best available scientific and technical information to develop a practical restoration goal and plan to provide restorative flows to the ecosystem of the Northwest Fork of the Loxahatchee River (SFWMD et al. 2006).

The staff of SFWMD, FDEP, Jonathan Dickinson State Park, and the Loxahatchee River District collected and analyzed data to develop and evaluate the restoration flow alternatives. After evaluating the ability of each variable flow scenario to achieve the restoration goal, the preferred restoration flow scenario was selected. The preferred scenario provides near optimal inundation for the freshwater riverine floodplain forest, reverses saltwater intrusion within the tidal floodplain, and has minimal impact on the downstream estuarine biota. The *Restoration Plan for the Northwest Fork of the Loxahatchee River* with its preferred restoration flow scenario is the foundation for other important plans and projects within the Loxahatchee River Watershed. Projects benefitting the Loxahatchee River constructed by SFWMD, or with SFWMD support to other agencies, include the following:

- M-Canal Widening – completed 2007
- C-18 Project Culvert Replacements – completed 2007
- Nine Gems Restoration – completed 2010
- Culpepper Hydrologic Restoration – completed 2011
- Cypress Creek Weir Installation – completed 2012

- Cypress Creek Berm/Water Control Structures – ongoing 2013
- Loxahatchee Slough Restoration – ongoing 2013

SFWMD also acquired land in support of Loxahatchee River restoration including the following parcels: Culpepper (1,282 acres), Cypress Creek (3,398 acres), Palmar East – Nine Gems (2,895 acres), and Loxahatchee Slough (592 acres).

CERP Loxahatchee River Watershed Restoration Project

The purpose of the CERP Loxahatchee River Watershed Restoration Project, formerly known as the North Palm Beach County Project – Part 1, is to capture, store, and treat excess water currently discharged to Lake Worth Lagoon and use that water to enhance the Loxahatchee River and Slough and provide water supplies to Grassy Waters Preserve. This project provides water needed for Loxahatchee River MFL recovery.

Excess canal water would be back-pumped through existing and proposed water control structures and canals, which would provide water quality treatment prior to discharge into Grassy Waters Preserve. The CERP planning process will evaluate a suite of alternative flow-ways and components with respect to providing beneficial flows to the Loxahatchee River, achieving hydropattern restoration, and reducing flows to the Lake Worth Lagoon. Elements of Flow-way 1 that have already been constructed (i.e., G-160 and G-161 Structures, and M Canal Widening) will be included in the evaluation process.

SFWMD constructed the C-18 Canal Control Structure (G-160) Project and the G-161 Water Control Structure Phase II Project in 2004 and 2007, respectively. These structures are designed to restore a more natural hydroperiod to the Loxahatchee Slough while increasing flows to the Northwest Fork of the Loxahatchee River. These projects provide water supplies needed for Loxahatchee River MFL recovery.

G-160 structure

Construction of the G-161 Northlake Boulevard Water Control Structure was completed in January 2007. The structure consists of remotely operated gates and dual 60-inch steel culverts installed under Northlake Boulevard near its intersection with the Beeline Highway in northern Palm Beach County. The structure will assist with achieving the desired environmental hydroperiods in Grassy Waters Preserve as well as the Loxahatchee Slough. It also will facilitate gravity flows from these environmental areas to the C-18 Canal and the Northwest Fork of the Loxahatchee River during dry periods.

SFWMD initiated incremental operation of the G-160 structure on June 1, 2009. However, contribution of the G-161 project to the restoration of natural hydroperiod to this system, individually or together with the related G-160 project, is constrained by water availability. Full benefits of the G-160 and G-161 structures will not be realized until water is available in amounts adequate to provide restorative flows to the Northwest Fork of the Loxahatchee River.

Storage for Loxahatchee River

The L-8 Site was originally acquired to provide water storage as a component of the CERP Loxahatchee River Watershed Restoration Project and was an element of the MFL recovery strategy for the Loxahatchee River. Recently, the Restoration Strategies Regional Water Quality Plan incorporated the L-8 Site as one of its features. It is now under construction for use as an FEB for the eastern flow-way, and will provide storage to allow for the delivery of consistent flows that are needed to optimize performance of STAs.

While interim operations for the L-8 FEB may provide for the delivery of dry season flows to the Loxahatchee River, a permanent replacement storage feature for the Loxahatchee River is needed. In 2013, SFWMD and Palm Beach County conceptually agreed to the acquisition of approximately 1,800 acres owned by the county that could be used to store and deliver water to the Loxahatchee River. The Restoration Strategies Regional Water Quality Plan includes the cost to acquire property and to construct a storage facility on an alternative site. Acquisition of the site is expected to be complete in 2014, and design of the storage facility is expected to proceed in 2018.

Biscayne Bay

In this section, the following projects are discussed and locations of some are shown in **Figure 37**:

- CERP Biscayne Bay Coastal Wetlands (BBCW) Project (Phase 1)
- Developing Technical Information for Biscayne Bay
- Biscayne Bay Seepage Study
- Biscayne Bay and Watershed Water Quality Data Analysis
- Storm Event Sampling in the Biscayne Bay Watershed
- Characterization of Nearshore Epifauna Study

Development of surface drainage systems and groundwater extraction altered the quantity, quality, timing, and distribution of freshwater flows to Biscayne Bay. The links between development, freshwater inflows, and the bay's ecology are complex. The Biscayne Bay Seepage Study and Characterization of Nearshore Epifauna Study are part of the effort to clarify these relationships. The CERP BBCW Project seeks to restore areas impacted by channelization by restoring the quantity and distribution of fresh surface water discharging to the bay. Water quality in the bay also suffered as a result of rapid runoff entering the bay from surface drainage systems. The Storm Event Sampling in the Biscayne Bay Watershed Project seeks to understand these impacts more clearly. The overall mass balance of freshwater inflows to Biscayne Bay shifted as a result of development and altered the salinity of the bay. The project, Developing Technical Information for Biscayne Bay, seeks to build a technical basis for policies to protect the bay as a whole. SFWMD will also continue to work closely with area interests to identify opportunities to optimize the management of water in southeastern Miami-Dade County based on real-time conditions consistent with the constraints of the system.

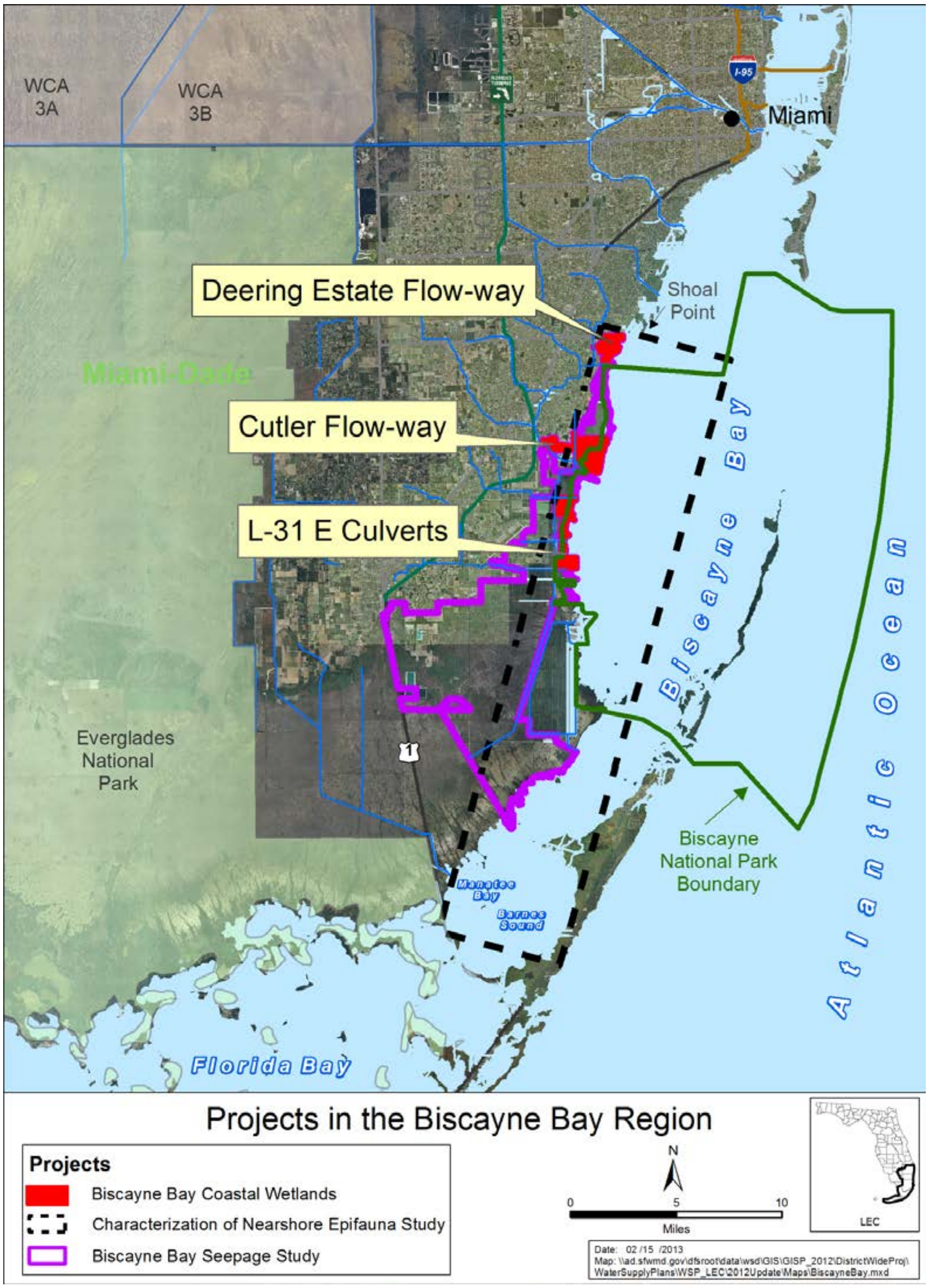


Figure 37. Projects in the Biscayne Bay region.

CERP Biscayne Bay Coastal Wetlands Project (Phase 1)

The CERP BBCW Project is essential to achieving restoration of tidal wetlands and nearshore habitats within Biscayne Bay, including Biscayne National Park. The project will divert runoff that currently discharges through regional canals and redistribute the fresh water through a spreader canal system into the coastal wetlands adjoining Biscayne Bay to provide a more natural and historic overland flow. The slower, more natural delivery of fresh water over a broad area is expected to provide more stable salinity conditions and reestablish appropriate estuarine salinities that are important for fish and shellfish nursery habitat in tidal wetlands and the nearshore bay. SFWMD expects this project will create conditions conducive to the reestablishment of oysters and other components typical of a healthy estuarine ecosystem.

The CERP BBCW Project is composed of three components: Cutler Wetlands Flow-way, Deering Estate Flow-way, and L-31 East Flow-way. In advance of congressional authorization and appropriations, SFWMD constructed the Deering Estates Flow-way and a portion of the L-31E Flow-way:

- **Cutler Wetlands Flow-way –** The infrastructure includes a pump station on the C-1 Canal, construction of a lined conveyance canal, construction of a spreader canal system, box culverts under roadways, and plugging of mosquito control ditches. The pump station will deliver water to the spreader canal located in the saltwater wetlands via a lined conveyance canal. The Cutler Wetlands Flow-way construction was completed in February 2013.
- **Deering Estate Flow-way –** This flow-way redistributes excess freshwater runoff, directing it away from existing canal discharges and spreading it out as sheetflow prior to discharging into Biscayne Bay. SFWMD completed construction in April 2012. The project became operational in November 2012 and is currently in the implementation stage.

Deering Estate Flow-Way pump station (S-700)

- **L-31 East Flow-way –** This flow-way is designed to reestablish, at least in part, historical sheetflow and wetland hydroperiods downstream of the project area. This component may also provide the additional benefit of mitigating impacts of discharging fresh water via the existing canals. SFWMD expects this component will achieve its objectives by redirecting flow through a series of new culverts. As of January 2013, SFWMD constructed four of the ten culverts planned for the L-31 East Flow-way.

USACE and its co-sponsor, SFWMD, completed the *Biscayne Bay Coastal Wetlands Phase I Final Project Implementation Report and Environmental Impact Statement* in January 2012 (USACE and SFWMD 2012). The final report describes the project purpose and need, location, evaluation of alternatives, and recommended plan. The chief of engineers report was signed in May 2012 and submitted to the Assistant Secretary of the Army for Civil Works for review. The signed record of decision was transmitted to the United States Congress for authorization.

Developing Technical Information for Biscayne Bay

In 2008, SFWMD compiled the report, *Adequacy of Technical Information to Support Minimum Inflow Needs for Biscayne Bay* (SFWMD 2009a) as part of continuing work undertaken to assess potential technical criteria for Biscayne Bay. SFWMD conducted a peer review of this report in advance of the development of criteria or a technical approach for water management strategies to protect inflows needed for Biscayne Bay (Montagna et al. 2008). The peer review independently evaluated the adequacy of available information to support a technical approach to manage minimum freshwater inflow needs of natural resources in Biscayne Bay.

As part of this effort, a mass balance analysis of freshwater inflows and salinity in Biscayne Bay was completed to describe how general salinity patterns relate to inflows in different areas of Biscayne Bay (Marshall et al. 2008). Also evaluated within the technical report were differing approaches of structuring estuarine criteria that have been used or proposed in South Florida and elsewhere (SFWMD 2009a).

Biscayne Bay Seepage Study

SFWMD needs a better understanding of the hydrogeologic framework of the surficial aquifer system (SAS) in the bay's coastal wetlands for the CERP BBCW Project to support modeling efforts and ongoing water resource management initiatives. To investigate aquifer salinity in the CERP BBCW Project area, 22 groundwater monitoring wells were installed at 13 sites along the western edge of Biscayne National Park. SFWMD will use this data to delineate the saltwater interface and study the hydrogeologic characteristics and groundwater quality within the upper portion of the Biscayne aquifer around the CERP BBCW Project. The initial findings of this study are in *Biscayne Bay Coastal Wetlands, Aquifer Salinity Investigation* (Janzen et al. 2008).


Seagrass in Biscayne Bay

Biscayne Bay and Watershed Water Quality Data Analysis

This project collected, organized, and analyzed water quality data for Biscayne Bay. The project's results are in *Biscayne Bay and Watershed Water Quality Data Analysis, Task 5:*

Final Report (Migliaccio 2008). The report includes 1) a summary of water quality in Biscayne Bay, 2) an analysis of time series results describing canal nutrient water quality entering the bay and within the bay, 3) comparisons of land uses from 1972 to the present, as available over time, and 4) examination of the relationships between land use changes and water quality.

Storm Event Sampling in the Biscayne Bay Watershed

Existing monthly grab sample monitoring of pollutants discharging into Biscayne Bay may not be sufficient to fully characterize loading that occurs during storm events. The primary purposes of this project were to 1) assess existing event mean concentration results for the Biscayne Bay Watershed to determine if the existing data were adequate to characterize nutrient loads into Biscayne Bay and 2) provide recommendations for the development of a monitoring plan to collect such data if it does not currently exist. The investigators concluded that, in some cases, existing data was inadequate for accurate characterization of nutrient loads into Biscayne Bay. Technical recommendations for improvement of sampling procedures and associated analysis are documented in the project's final report, *Storm Event Sampling in the Biscayne Bay Watershed: Final Project Report* (Migliaccio 2009).

Characterization of Nearshore Epifauna Study

Historical descriptions of the fisheries of Biscayne Bay suggest that a greater diversity and abundance of fishery species associated with mesohaline habitat once occurred in the bay. In southern Biscayne Bay, the Characterization of Nearshore Epifauna Study is designed to help assess CERP effectiveness, once implemented, in meeting this objective. The purpose of this project is to create a baseline characterization of the present day alongshore epifauna from Shoal Point to Manatee Bay, determine species relationships with salinity, classify species on the basis of these salinity relationships, identify indicators, and formulate performance measures and targets for assessing CERP implementation effects. Preliminary analytical results suggest that relationships between faunal distributions and salinity can be found in data acquired from shallow water, nearshore epifaunal sampling. Expanding sampling may increase understanding of relationships among mangrove and seagrass fauna, seagrass habitat, and salinity. This final report for this project—*Epifaunal Communities of Mainland Nearshore South Biscayne Bay* (Browder et al. 2011)—was completed in May 2011.

Florida Bay

The following projects are discussed in this section:

- USACE C-111 South Dade Project
- S-197 Structure Replacement Project
- CERP C-111 Spreader Canal Western Project
- Florida Bay MFL Prevention Strategy Monitoring and Research


Florida Bay

Locations of most these projects or their components are shown in **Figure 38**.

USACE C-111 South Dade Project

In 1994, USACE completed a study of potential alterations to the C-111 Canal to reduce impacts to Everglades National Park (USACE 1994). This report outlined new water control facilities and modifications to the existing Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project). The ongoing C-111 South Dade Project implements the report's recommendations in phases. This project provides water supplies identified in the Florida Bay MFL prevention strategy.

The C-111 South Dade Project is composed of twelve contracts or phases. The project began in 1994 with construction commencing in 1996. At present, seven of the twelve contracts have been executed. Work completed to date includes the following:

- Two interim pump stations and one permanent pump station were constructed between 1997 and 2002.
- 4.75 miles of spoil mounds along the lower C-111 Canal were removed in 1997.
- Taylor Slough Bridge was replaced in 1999.
- Partial retention/detention zones were completed in 2000 and 2002.
- S-331 Command and Control Center was constructed in 2009.
- A full retention/detention area linking previously separated pump station detention areas was constructed in 2009.

In April 2012, SFWMD issued a solicitation to identify qualified firms for the eighth contract. This contract includes construction to extend the S-332B North detention area and contain discharges from the 8.5-Square Mile Area STA component of ModWaters.

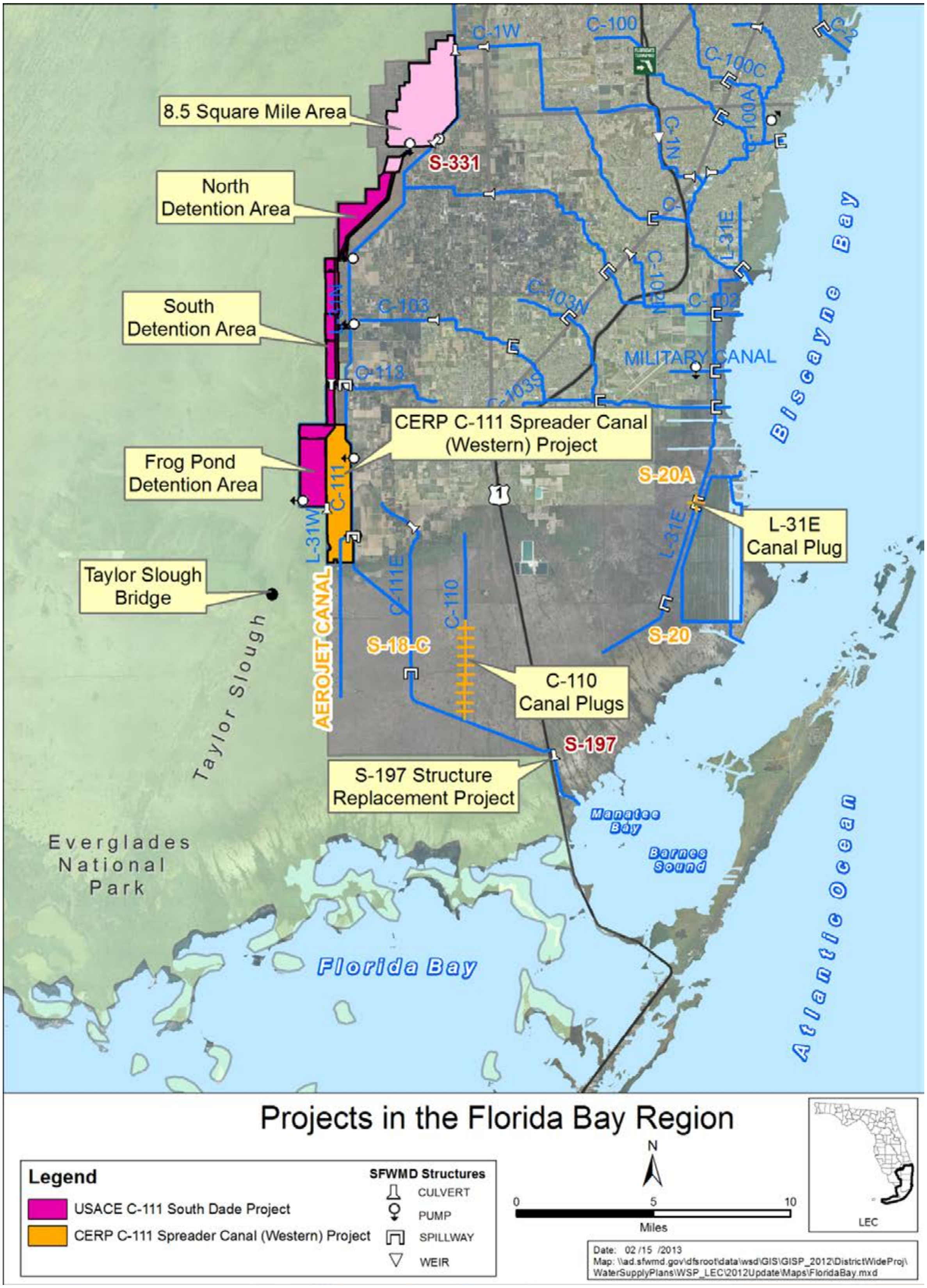


Figure 38. Projects in the Florida Bay region.

S-197 Structure Replacement Project

The S-197 structure is located in southern Miami-Dade County near Manatee Bay. SFWMD is replacing this structure to ensure it continues to be an effective component of flood control operations in the C-111 Canal until the CERP C-111 Spreader Canal Western Project is complete. The structure also provides important environmental benefits and water resource protection by preventing saltwater intrusion to coastal fresh waters, particularly during high tides. The new S-197 Structure will use the same operation criteria, is at the same location, and will have the same discharge capacity as the previous structure. SFWMD expects the S-197 Structure Replacement Project will be complete and operational before the end of 2013. The new S-197 design took into account a maximum (worst case) differential head on the gates, considering the C-111 Canal full of water on one side and empty on the other side.

CERP C-111 Spreader Canal Western Project

This project includes structural and operational changes to improve the quantity, timing, and distribution of water delivered to Florida Bay via Taylor Slough to improve hydroperiods within the wetlands of the Southern Glades and Model Lands. The project provides more natural sheetflow to Florida Bay and decreases damaging discharges through the C-111 Canal to Manatee Bay and Barnes Sound, without adversely impacting existing levels of flood protection provided to adjacent agricultural and urban lands. This project provides water supplies identified in the Florida Bay MFL prevention strategy (Subsection 40E-8.421(8), Florida Administrative Code).

The C-111 Spreader Canal Western Project created a nine-mile hydraulic ridge adjacent to Everglades National Park, which keeps more of the natural rainfall and water flows within Taylor Slough. The hydraulic ridge was created by the following:

- Construction of a 590-acre aboveground detention area in the Frog Pond area
- Installation of two 225-cubic feet per second pump stations
- Integration of other project features.

Project elements intended to provide ecosystem restoration benefits in the Southern Glades and Model Lands include the following:

- An operable structure in the lower C-111 Canal
- Incremental operational changes at the S-18C structure
- A plug at the S-20A structure
- Operational changes at the S-20 structure
- Construction of earthen plugs in the C-110 Canal

The Assistant Secretary of the Army for Civil Works signed the project's record of decision in 2012 and transmitted it to the United States Congress for authorization. In February 2012, SFWMD completed construction of key components of the CERP C-111 Spreader

Canal Western Project as part of its state-expedited program. Construction included the Frog Pond Detention Area, Aerojet Canal features, plugs in the C-110 Canal, a plug at the S-20A structure and operational changes at S-18C and S-20. A new structure in the lower C-111 Canal is still scheduled for construction in the future.

Florida Bay MFL Prevention Strategy Monitoring and Research

In 2006, SFWMD adopted MFL criterion for northeastern Florida Bay (see **Chapter 3**). A scientific peer review panel reviewed the 2006 technical documentation supporting MFL development—*Draft Technical Documentation to Support Development of Minimum Flows and Levels for Florida Bay* (SFWMD 2006)—and made recommendations for additional research, monitoring, and modeling. Many of the recommendations, including monitoring and modeling, have been initiated and are ongoing.

A review of information collected from Florida Bay is under way and expected to be complete at the end of 2013. Ecological and hydrological data are being considered for use in evaluating the condition of the protected resource and the performance of the MFL criteria. The ecological information includes distribution of various seagrasses and their response to variable salinity conditions. The hydrologic information will analyze existing flow, stage, rainfall, and modeling data. The ecological and hydrologic evaluations will be integrated into a single technical report to evaluate the effectiveness of the existing MFL criterion.

Lower East Coast Service Area

In this section, the following projects are discussed and locations of many are in **Figure 39**:

- CERP Fran Reich Preserve Reservoir (formerly Site 1 Reservoir)
- CERP Hillsboro Aquifer Storage and Recovery (ASR) Pilot Project
- CERP Broward County Water Preserve Areas
- CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat (formerly Acme Basin B Discharge Project)
- L-31N Seepage Management Project
- Lower East Coast Subregional Model (LECsR) Update
- Saltwater Interface Mapping
- East Coast Floridan Model
- Gun Club Road Satellite Reuse Facility Feasibility Study and Pilot Project
- Groundwater Replenishment via Canal Recharge Augmentation Study
- Alternative Water Sources Subregional Feasibility Study: Fort Lauderdale, Sunrise, and Miami-Dade County
- S-155A Divide Structure
- Florida City Canal Water Control Structure

CERP Fran Reich Preserve Reservoir

This project provides water supplies needed for Everglades MFL recovery. This facility will capture and store the excess surface water runoff from the Hillsboro Basin and releases from the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The project is located in Palm Beach County near the East Coast Protective Levee and Hillsboro Canal. The project will complete a 1,660-acre, 8-foot deep, aboveground impoundment to capture excess surface water in the Hillsboro Canal. With the reservoir in place, dry season water withdrawals from the refuge to meet water demands will be reduced, allowing more natural and consistent water levels within the refuge. Benefits to the downstream estuaries and reduced groundwater seepage from the refuge are also expected.

USACE and SFWMD executed the project partnership agreement for Phase I (L-40 improvements) construction in June 2010 and USACE initiated construction. The original construction strategy for the project involved a single contract. However, in order to utilize funding from the American Recovery and Reinvestment Act of 2009, a standalone and usable portion of the project was identified for construction. The standalone features are the embankment (L-40 modifications) and the S-530 spillway. These Phase 1 features will reduce the amount of seepage loss from the adjacent refuge. Reducing seepage will help increase the amount of water that remains in that natural system, especially during dry periods. Maintaining the additional water will allow for ecological habitat improvements in the refuge.

USACE terminated the Phase 1 contract in July 2012 with approximately 20 percent of the work completed. In January 2013, USACE awarded a contract to construct the remaining features. Work on the project began in April 2013 with expected completion by December 2014.

The Phase II of this project requires congressional authorization due to increased project cost. Phase II, if approved, will include additional site preparation, earthwork, construction of pump stations, canal improvements, embankment, placement of geocells on the embankment exterior, and placement of soil cement on embankment interior.

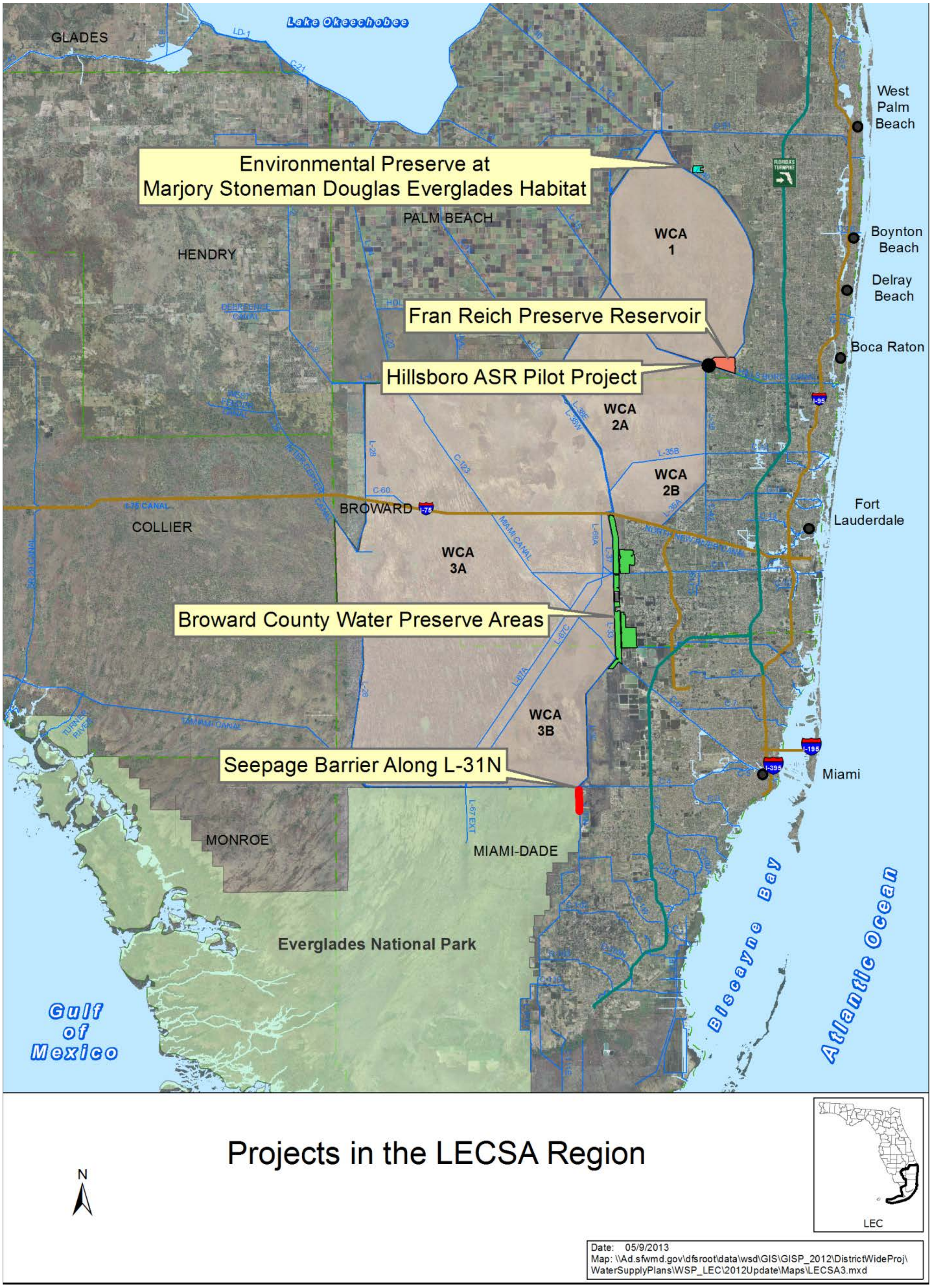


Figure 39. Projects in the Lower East Coast Service Area (LECSA).

CERP Hillsboro ASR Pilot Project

This project is located just south of the Arthur R. Marshall Loxahatchee National Wildlife Refuge and north of the Hillsboro Canal on a 1,660-acre tract of SFWMD-owned land in south-central Palm Beach County. The project includes the construction of a 5-million gallons per day (MGD) ASR well and several monitoring wells. The project's purpose is to evaluate and reduce the technical and regulatory uncertainties of implementing the full-scale Hillsboro ASR project as planned for CERP.

As the lead agency, SFWMD prepared the plans and specifications for the 5-MGD ASR system that was installed in fall 2008. Cycle testing began in January 2010 and finished in 2012. The system operated successfully. Although some arsenic was observed in water recovered during the first cycle, concentrations declined to below regulatory concern during subsequent cycles. Recovery efficiencies increased from approximately 21 percent during the first cycle to above 40 percent by third cycle. Continued improvement is anticipated as the system is operated in the future. Cycle testing indicates that ASR technology can be implemented near the Fran Reich Preserve Reservoir. The SFWMD and USACE are preparing the final project technical data report with finalization set for 2013. The future use of the project for non-CERP purposes is under evaluation.

CERP Broward County Water Preserve Areas

This project is designed to perform three primary functions:

- Reduce seepage loss from WCA 3A and WCA 3B to the C-11 and C-9 basins.
- Capture, store, and distribute surface water runoff from the western C-11 Basin.
- Wetland restoration

The project will construct the following major infrastructure features:

- An 1,168-acre impoundment to capture and store runoff from the C-11 Basin, reduce pumping of surface water into WCAs, and provide releases for other regional uses
- A 4,353-acre seepage management area that would establish a buffer, reducing seepage to and from WCAs, and maintain flood protection
- An 1,641-acre impoundment that would capture and store surface runoff from the C-9 Basin, store C-11 Impoundment overflow, manage seepage, and provide releases for regional benefit

Additional project functions include maintaining existing level of service flood protection, groundwater recharge, increasing spatial extent of wetlands, and improving hydroperiods and hydropatterns in WCA 3A and WCA 3B. The preserve areas will benefit federally-listed threatened and endangered species and many wading birds. This project provides water supplies needed for Everglades (including WCAs and Everglades National Park) MFL recovery. The chief's report was signed in May 2012 and the record of decision for the project implementation report was submitted in October 2012 to the United States Congress for authorization.

CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat

Marjory Stoneman Douglas Everglades Habitat adjacent to the Village of Wellington

The Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat (formerly called the Acme Basin B Discharge Project) is the first CERP project completed in Palm Beach County. The project's primary purpose is to provide water quality and flood mitigation benefits. It improves water quality by diverting the direct discharge of urban runoff away from the Arthur R. Marshall Loxahatchee National Wildlife Refuge. The project directs runoff north to STA 1 East, before it enters the refuge.

Two pump stations and a 365-acre water storage area were constructed to impound flood waters and provide a buffer between natural and developed areas. SFWMD and the Village of Wellington invested approximately $35 million in the project. Construction began in 2007 and finished in 2010. This project provides water supplies needed for Everglades (including WCAs and Everglades National Park) MFL recovery.

The project also has recreational and educational aspects. Visitors can access the site. Over two miles of paved pedestrian paths and a six-story observation tower are contained within the 365-acre site. The paths connect seven learning areas that explain native vegetation and wildlife.

L-31N Seepage Management Project

The Miami-Dade Limestone Products Association constructed the L-31N Seepage Management Project using funds collected through a state imposed fee on limestone products sold by the mining companies operating in the Lake Belt region of Miami-Dade County. The barrier's purpose is to reduce the seepage from Everglades National Park. In November 2011, the Lake Belt Mitigation Committee approved Phase 1 of the L-31N Seepage Management Project. Under Phase 1 and the L-31N Seepage Management Field Test, a 35-foot deep seepage barrier was constructed extending two miles south from Tamiami Trail along the berm of the L-31N Canal. Construction of the barrier was complete in July 2012.

A monitoring program is now under way to measure changes in water level and L-31N Canal flow using a network of hydrologic data gathering sites. The monitoring program, designed to last two years, will provide the necessary information to evaluate performance of the barrier. This project helps conserve water supplies needed for Everglades MFL recovery.

Lower East Coast Subregional Model Update

SFWMD developed the LECsR Model based on the United States Geological Survey's (USGS) Modular Three-dimensional Finite-difference Groundwater Flow Model code, referred to as MODFLOW. This model simulates groundwater flow in the LEC Planning Area (**Figure 40**). It is used for planning and regulatory purposes. SFWMD conducted a peer review of the LECsR Model. The peer review panel prepared a report in June 2006. SFWMD updated the model to reflect the majority of the primary peer review comments. The tool, and variations of the tool, were used to address a number of site-specific issues relating to water use permitting, the CERP Loxahatchee River Watershed Restoration Project, C-4 Impoundment Project, and C-51 Reservoir Feasibility Study.

Figure 40. Domain of the LECsR Model.

Saltwater Interface Mapping

In August 2011, SFWMD published maps displaying the estimated position of the freshwater-saltwater interface in the coastal SAS of St. Lucie, Martin, Palm Beach, Broward, Lee, and Collier counties. SFWMD used data from April and May 2009 (i.e., the end of the dry season) to document the current inland extent of the saltwater front within the aquifer for future comparison. The maps are based on measured or estimated chloride concentrations in water samples from three primary sources: 1) wells of water use permittees 2) USGS wells, and 3) SFWMD wells. In a separate effort, Miami-Dade County worked with USGS to develop saltwater intrusion maps of their county.

Maps for each county are at the following web locations:

- Palm Beach County: www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/palm_beach_isochlor_apr-may_2009opt.pdf
- Broward County: www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/broward_isochlor_apr-may_2009opt.pdf
- Miami-Dade County: An interactive saltwater intrusion map viewer is at www.envirobase.usgs.gov/FLIMS/SaltFront/viewer.htm

A review of previous freshwater-saltwater interface maps of South Florida indicate that the interface is dynamic but has not moved appreciably over time. This is due, in large part, to coastal salinity control structures maintaining adequate freshwater heads. Maps prepared at five years intervals document any progression of the saltwater front within the aquifers.

Gun Club Road Satellite Reuse Facility Feasibility Study and Pilot Project

From 2005 to 2006, SFWMD and Palm Beach County conducted the Gun Club Road Satellite Reuse Facility Feasibility Study and Pilot Project. The project evaluated the feasibility of providing reclaimed water for irrigation at SFWMD's headquarters and the immediate vicinity in West Palm Beach. Two types of membrane bioreactor treatments were tested to produce reclaimed water that meets applicable requirements. The study evaluated construction and operational costs, potential end users, the distribution system, and overall cost. Potential users included SFWMD headquarters, Trump International Golf Course, United States Army Reserve facilities, Lake Lytal Park, and Palm Beach International Airport.

Reuse system

The results of the study indicated limited benefits to the county's water supply because of the project's distance from supply wells. Based on these findings, as well as financial limitations and other priorities, Palm Beach County and SFWMD decided not to move forward with the project.

Groundwater Replenishment via Canal Recharge Augmentation Study

Canal recharge or indirect aquifer recharge refers to the replacement of existing fresh surface water regional water supply deliveries with highly treated reclaimed water. Canal recharge would reduce dependency on regional resources and reuse effluent that is currently disposed of by deep well injection or discharge to the ocean. A legislatively directed study was completed by FDEP in 2006 evaluating canal recharge. In addition, SFWMD sponsored, in coordination with two local utilities, two advanced wastewater treatment pilot studies to evaluate reusing highly treated reclaimed water for canal and groundwater discharge, which were completed in 2008.

2007 FDEP Report to the Legislature on Canal Recharge

In 2004, the Florida Legislature directed (Chapter 2004-381, Laws of Florida) FDEP, in coordination with SFWMD, to conduct a study to investigate the feasibility of discharging reclaimed water into canals and the aquifer system as an environmentally acceptable means of augmenting groundwater supplies and enhancing natural systems in the LEC Planning Area. The legislature recognized direct or indirect discharge of reclaimed water into canals and the aquifer system for transport and subsequent reuse may provide an environmentally acceptable means to augment water supplies and enhance natural systems, but also that there are water quantity and water quality challenges that must be better understood and resolved. The study process, including workshops, presentations, and findings can be found at www.dep.state.fl.us/water/wqssp/canals.htm.

FDEP published a preliminary final draft document, *Canal Recharge: A Report to the Governor and Legislature*, reflecting the outcome of this investigation (FDEP 2006). The report was never finalized. Three fundamental considerations guided FDEP's evaluation of canal recharge feasibility: 1) whether canal recharge could be considered beneficial reuse under Florida law; 2) whether those benefits could be achieved without compromising water quality; and 3) whether canal recharge, when compared with alternative types of reuse and water supply, would be cost effective. Modeling for the study indicates that reclaimed water could potentially reduce regional system releases by an average of 27 percent.

Water quality was another consideration. Under Florida's water quality standards, canal recharge likely could be authorized only if the highest available wastewater treatment technology were employed—generally speaking, reverse osmosis with advanced nutrient removal and high-level disinfection. Project-specific analyses would have to be undertaken to account for these costs and the revenue sources to underwrite them, as well as the potential value of the natural system or water supply benefits to be achieved.

Based on this study, FDEP concluded that individual canal recharge projects may prove worthwhile and recommends evaluating any proposed canal recharge project on its individual merits. However, the report also stated there is no basis to conclude at the time that canal recharge should be implemented on a regional scale.

The report contained the following specific recommendations:

- Canal recharge is one of many options that may help achieve water supply goals in southeastern Florida. These options should be evaluated and compared directly in terms of water supply and natural systems benefits, water quality implications, relative costs and economic value, and implementation demands.
- Canal recharge should be factored into local and regional water supply planning and development in the proper context, combined with other reuse and alternative water supply options to be judged based on relative environmental merit, cost-effectiveness, and public interest.
- It would be appropriate for entities interested in exploring specific canal recharge projects to work with FDEP and SFWMD to submit permit applications. A detailed review of a specific project, with this study as context, would yield much more information as to the value of canal recharge. Any such project would have to include a more refined accounting of the relationship between the amount of water released to the canals and the volume of groundwater recharge thereby achieved.

Local Pilot Studies

To further investigate treatment associated with direct and indirect canal recharge, SFWMD entered into interagency agreements with the cities of Plantation and Sunrise to perform advanced wastewater treatment pilot studies to evaluate reusing highly treated reclaimed water for canal and groundwater discharge. These pilot studies investigated the performance of different physical, chemical, and biological advanced wastewater treatment technologies. The studies also evaluated the removal of micro-constituents (pharmaceuticals or personal care products) from the wastewater; modeled the fate, transport, and impact of discharged reclaimed water; and evaluated the toxicity of reclaimed water discharge into natural water bodies. For more information see www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/reuse_pilot_swwwtf.pdf for the City of Sunrise (MWH Global, Inc. 2008) and www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/reuse_pilot_awt.pdf) for the City of Plantation (Hazen and Sawyer 2008).

Alternative Water Sources Subregional Feasibility Study

During the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2007), it was recognized that some of the assumptions of the *2000 Lower East Coast Regional Water Supply Plan* (2000 LEC Plan) (SFWMD 2000) were no longer valid, including the completion of certain CERP projects and the associated water that was assumed to be available. Moreover, establishment of the Everglades MFL and the associated recovery strategy limited the ability of Public Water Supply utilities to meet future water demands from traditional sources. Analyses conducted indicated that certain subregions of the LEC Planning Area—Fort Lauderdale, Sunrise, and Miami-Dade County—were likely to face greater challenges in meeting water demands. Towards that end, SFWMD initiated a feasibility study to evaluate the potential for subregional alternative water supply sources to meet these demands. The study, *Alternative Water Sources Sub-Regional Feasibility Study: Fort Lauderdale, Sunrise, and Miami-Dade County* (CDM 2006), included development of evaluation criteria and cost estimates for identified technologies as well as first and second tier screening of alternatives. Four projects were selected for more detailed analysis including preparation of conceptual designs. Given the subregional nature of the projects, a 20-MGD capacity was selected as the minimum amount to be provided that might be beneficial.

The study developed conceptual designs for a potential canal augmentation project coupled with a large user reclaimed water irrigation project for the City of Sunrise, and a combination of brackish reverse osmosis water treatment with a satellite wastewater treatment facility to provide indirect potable water recharge in Fort Lauderdale. Planning level data developed in the study, and subsequent conceptual designs, provided information helpful to LEC Planning Area water users during consideration of alternative water supply project options. Cost estimates developed for each treatment technology utilized in the conceptual designs provided a resource for alternative water supply feasibility assessment in the LEC Planning Area. The final report for this project was published in 2006.

S-155A Divide Structure

The 2000 LEC Plan contained recommendations for CERP planners to conduct additional analysis in the planning and placement of the proposed S-155A divide structure. USACE constructed S-155A and transferred it to SFWMD in 2004. The S-155A divide structure, along with S-319 and STA-1 East, were constructed by the USACE as part of the C-51

Western Basin Flood Control Project; which is considered part of the base condition of CERP. However, S-155A's intended use was substantially modified from the previous conceptual plan. Initially, the structure was to be integrated into the CERP North Palm Beach County Project. It was to be part of a system designed to benefit Lake Worth Lagoon by improving water quality and reducing discharges from the C-51 Canal using a backpumping and treatment concept. However, the CERP North Palm Beach County Project has since been reconfigured and renamed the Loxahatchee River Watershed Restoration Project. The C-51 backpumping and treatment elements were eliminated from the project. At present, the S-155A divide structure divides the C-51 Basin into the Western C-51 and Eastern C-51 basins. It passes flood discharges from the Western C-51 and S-5A basins to the east via the C-51 Canal when STA 1 East reaches maximum operational depths and no longer has the capacity for additional inflows. The S-155A also passes flood discharges from the L-8 Basin to the east via the C-51 Canal at times.

Florida City Canal Water Control Structure

The Florida City Canal located in southern Miami-Dade County is a tributary to the L-31E and C-103 canals, which discharge through the SFWMD's S-20F structure into Biscayne Bay. Miami-Dade County wishes to improve water management and wetland resources on environmentally endangered lands in the vicinity of the Florida City Canal. The county proposes to construct a water control structure in the Florida City Canal at the intersection with Southwest 107th Avenue, and to retrofit existing culverts to improve wetlands hydrology of Miami-Dade County owned environmentally endangered lands adjacent to the canal. Construction is anticipated to begin in early 2014 and take less than one year to construct; however, it is contingent upon funding.

DISTRICTWIDE WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects encompassing more than one planning area are considered districtwide projects. **Table 12** at the end of this section summarizes the estimated costs and timeframes of the described districtwide projects. Aspects specifically pertaining to or having relevance to the LEC Planning Area are identified within the context of these districtwide projects. **Table 12** does not include other programs with water resources development components, such as CERP, which are primarily budgeted as ecosystem restoration projects; however these were discussed earlier in the chapter.

SFWMD undertakes districtwide water resource development projects consistent with sections 373.05 and 373.019, Florida Statutes (F.S.). Specifically, Section 373.019(24), F.S. states the following:

> "Water resource development" means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and groundwater data; structural and nonstructural programs to protect and manage water resources; the development of regional water resource implementation programs; the construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and groundwater recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.

Most water resource development projects described in this section support and enhance water supply development projects but do not themselves yield specific quantities of water. For example, groundwater monitoring groundwater assessment and modeling provide important information about aquifer characteristics (e.g., hydraulic properties and water quality) but do not provide details on water quantities. Information derived from these water resource development projects supports water supply development projects (i.e., developing appropriate facility design identifying safe aquifer yields, and evaluating the economic viability of projects). SFWMD is the implementing agency for the projects described in this section.

The following projects have been completed since the last plan update and are discussed in this section:

- Evapotranspiration Measurement Project
- Water Supply Cost Estimation Study
- Water Desalination Concentrate Management and Piloting Study

The following ongoing and future projects are also discussed in this section:

- MFL, Water Reservation and Restricted Allocation Areas Rule Activities
- Comprehensive Water Conservation Program
- Alternative Water Supply
- Drilling and Testing
- Groundwater Assessment
- Groundwater, Surface Water, and Wetland Monitoring
- Groundwater Modeling

Completed Districtwide Projects

Evapotranspiration Measurement Project

Evapotranspiration (ET) is a large part of the hydrologic budget in Florida, ranging from 30 to over 100 percent of average precipitation. In the past, the accuracy of hydrologic models, basin-scale studies, water budgets, and other hydrologic analyses throughout the state was limited because of the lack of accurate estimates for this large water loss. Scientists and water managers in Florida benefit from having a network of consistently operated high quality ET stations from representative land use areas using state-of-the-science methods.

The ET Measurement Project collected information to improve methods for computing the potential ET and reference ET. Potential ET is a necessary data input for most hydrologic simulation models. Reference ET is a necessary input for SFWMD permit applications.

Over the years, USGS, in cooperation with SFWMD, completed a number of specialized hydrogeologic studies to address specific SFWMD needs. The information provided from these studies was necessary to enhance the understanding of ET rates in various wetland and upland plant communities, and similar issues. USGS completed a series of ET studies between October 2000 and September 2011.

The objectives of the studies were as follows:

- Measure actual ET from representative land covers in Florida
- Develop models to estimate projected ET from environmental variables such as depth to water, season, and net radiation
- Provide 2-kilometer gridded satellite-based estimates of potential and reference ET on a daily timescale for the entire state.

The data products for this series of studies include the following:

- Daily values of ET, archived in USGS National Weather Information System database, which are accessible at fl.water.usgs.gov/et/etdata.html.
- The daily potential and reference ET data sets, by year and county from 1995 through 2010, which are accessible at fl.water.usgs.gov/et/.
- Big Cypress field investigations are published in *Evapotranspiration over Spatially Extensive Plant Communities in the Big Cypress National Preserve, Southern Florida, 2007–2010* (Shoemaker et al. 2011), which is available at pubs.usgs.gov/sir/2011/5212/.

Water Supply Cost Estimation Study

The objective of this project was to develop engineering cost estimation relationships for evaluating water supply alternatives for SFWMD's regional planning areas. The study evaluated options using groundwater, surface water, seawater, ASR, and reclaimed water. The final cost study was published in two reports: *Water Supply Cost Estimation Study* (CDM 2007a) and *Water Supply Cost Estimation Study – Phase II Addendum* (CDM 2007b). Descriptions of these studies are as follows:

- ***Water Supply Cost Estimation Study –*** This study developed opinions of probable costs for various water treatment and disinfection technologies, water treatment plant and distribution components, and various wastewater treatment technologies for capacities of 5, 10, 15, and 20 MGD based on project records. The report provides estimates of costs for wells, well treatment methods, wastewater treatment methods, deep injection well disposal, ASR, and surface water storage projects. This report is available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/water%20supply%20cost%20estimation%20study%202-2007_cdm.pdf.
- ***Water Supply Cost Estimation Study – Phase II Addendum –*** This addendum complements the previous study providing cost estimates for additional capacities of 1 and 3 MGD, as well as estimates for wastewater granular filters and chlorine disinfection using onsite generation of hypochlorite. See www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/wtrsupply_costeststudy_phaseii_add_21-2007.pdf for this report.

Water Desalination Concentrate Management and Piloting Study

SFWMD undertook this study to evaluate alternatives for concentrate minimization in South Florida and provide technological recommendations. The study included two phases. Phase 1 constituted several desktop evaluations of four concentrate minimization methods and several representative reverse osmosis treatment plants in the SFWMD region. Phase 2 further evaluated, through pilot testing, a concentrate minimization method at a representative brackish water reverse osmosis plant site, which was selected based on Phase 1 evaluations.

The purpose of the pilot test was to demonstrate the feasibility of the selected concentrate minimization methodology and evaluate its performance. The pilot study was performed at the City of North Miami Beach Norwood–Oeffler Water Treatment Plant. The testing began in August 2009 and finished in November 2009. The pilot study demonstrated stable performance, effectively increasing the overall system recovery from 75 to 88 percent under conservative operating conditions for secondary reverse osmosis, implying an increase of 13 percent in production efficiency. The study showed the process is viable for representative South Florida brackish water.

The study recommended further optimization of the process and operational parameters in a subsequent study. This subsequent study would be conducted on a larger demonstration scale and operated over a longer duration to capture any size-related scale-up effects and seasonal variability. The report (Carollo Engineers 2009) can be found at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/waterdesalinationconcentratemgmtpiloting-dec09-carollo.pdf.

Ongoing and Future Districtwide Projects

MFL, Water Reservation and Restricted Allocation Areas Rule Activities

MFLs, water reservations, and restricted allocation area rules are water resource protection measures that have been developed to help ensure the sustainability of water resources within the SFWMD. The costs included in **Table 12** are for contracts (such as ecological monitoring) and staff time.

For information on MFLs, water reservations, and restricted allocation areas, see **Chapter 3** of this report. **Chapter 3** summarizes current rules in effect as of 2013. Additional information can also be found in **Appendix B**, which includes a table (Table B-3) that lists the status of water resource development projects that provide water supplies associated with MFL recovery and prevention strategies.

Comprehensive Water Conservation Program

The long-standing conservation goal of SFWMD is to prevent and reduce wasteful, uneconomical, impractical or unreasonable uses of water resources. This is addressed through planning, regulation, the use of alternative sources including reclaimed water, public education, and demand reduction through conservation technology, best management practices and water-saving funding programs. The costs included in **Table 12** are for contracts (such as WaterSIP) and staff time.

The Comprehensive Water Conservation Program is a series of implementation strategies designed to create an enduring conservation ethic and permanent reduction in water use. It was approved in 2008 and developed in conjunction with stakeholders through the SFWMD's Water Resources Advisory Commission. The program is organized into regulatory, voluntary and incentive-based, and educational and marketing initiatives. More detailed information about the Comprehensive Water Conservation Program, is found in **Chapter 5: Evaluation of Water Source Options**. Additional supporting information can be found in **Appendix D** and Chapter 5 of the *2011–2013 Water Supply Plan Support Document* (SFWMD 2013a).

Alternative Water Supply

The ability to meet the need for additional water supply hinges on efforts to develop region-specific sources that offer an alternative to traditional groundwater and surface water. The costs included in **Table 12** are for contracts and staff time. Through the Alternative Water Supply Funding Program, SFWMD assisted permittees in the development of reclaimed water projects, water reclamation facilities, brackish water wellfields, reverse osmosis treatment facilities, and ASR well systems. From fiscal year (FY) 2007 to FY 2012, SFWMD, in cooperation with the State of Florida, provided more than $123 million in alternative water supply funding for 212 projects. Ninety of these projects are within the LEC Planning Area. Between FY 2007 and FY 2011, projects funded by the Alternative Water Supply

Funding Program created 72 MGD of new water capacity in the LEC Planning Area. The water sources include 27 MGD of brackish water, 21 MGD of reclaimed water, and 23 MGD of surface water/storm water.

Additional information can be found in **Chapter 6** of this update. A full description of Alternative Water Supply-related projects and associated funding is contained in the SFWMD's Alternative Water Supply Annual Reports, prepared pursuant to Section 373.707(7), F.S., and published in Volume II of the annual South Florida Environmental Reports (www.sfwmd.gov/sfer).

Drilling and Testing

Drilling and testing includes the installation of wells for aquifer investigations of short to long-term monitoring of aquifer water levels. This work includes contract and staff time for items such as drilling and well construction, geophysical logging, pump tests, sediment analysis, and lithological descriptions. The costs included in **Table 12** are for contracts (such as drilling) and staff time.

The SFWMD's knowledge of South Florida hydrogeology is enhanced whenever exploratory/test wells are constructed. Such increased understanding has improved the accuracy of groundwater modeling and decision making regarding the approval of consumptive use permits.

Groundwater Assessment

Groundwater assessment includes items such as the development of hydrostratigraphic maps and saltwater interface maps. The costs included in **Table 12** are for staff time.

Saltwater Interface Mapping

SFWMD publishes maps displaying the estimated position of the freshwater-saltwater interface in the coastal SAS of St. Lucie, Martin, Palm Beach, Broward, Lee, and Collier counties to document the current inland extent of the saltwater front within the aquifer for future comparison. The SFWMD publishes saltwater interface maps in five-year intervals based on ongoing collection and analysis of groundwater monitoring data. Maps for Miami-Dade and Monroe counties are prepared by the USGS.

Groundwater, Surface Water, and Wetland Monitoring

Information regarding the groundwater and surface water levels is essential to managing and protecting South Florida's water resources. Real-time data combined with historical information about water levels, weather, rainfall, and water quality changes help managers make water resource decisions. The costs included in **Table 12** are for contracts (such as USGS contracts) and staff time.

Water level and water quality monitoring at existing wells provide critical information to aid SFWMD in the development of groundwater models, assessing groundwater conditions, and management of these resources. SFWMD maintains extensive groundwater monitoring networks. SFWMD partners with USGS, providing additional support for ongoing monitoring. Data are archived in DBHYDRO—SFWMD's corporate environmental database—which stores hydrological, meteorological, hydrogeological, and water quality data. USGS monitors, archives, and publishes data annually.

Districtwide groundwater monitoring activities related to the LEC Planning Area include the following:

- **USGS Water Level Monitoring –** An ongoing effort to collect data from groundwater level monitoring in the SAS. The project includes well and recorder maintenance as well as archiving data in the USGS database. In FY 2011, the groundwater monitoring network was reduced due to budgetary constraints, loss of sites, well destruction, and equipment damage.
- **Groundwater Monitoring –** An ongoing effort of monitoring groundwater levels in all water supply planning areas of the SFWMD. Monitoring includes 760 groundwater stations districtwide as of 2012. Monitoring is done for the SAS, intermediate aquifer system, and Floridan aquifer system (FAS), and recorders are maintained. Data are collected, analyzed, validated, and archived in DBHYDRO. Data are available through www.sfwmd.gov/dbhydro.
- **Regional FAS Exploration and Well Maintenance –** Water level and water quality monitoring is ongoing at select FAS well sites districtwide. SFWMD monitors water levels at 61 sites in its FAS well network. SFWMD has installed one FAS well in the LEC Planning Area since the 2005–2006 LEC Plan was published—a tri-zone monitor well on the L-8 Canal in Palm Beach County. Well maintenance is conducted at FAS well sites as needed. Data are collected, analyzed, validated, and archived in SFWMD's DBHYDRO database.
- **Hydrogeologic Database Improvements –** This effort involves uploading of backlogged data and conducting miscellaneous database corrections.
- **Monthly Groundwater Level Measurements** – Continued water level monitoring at select sites, including data collection, data analysis, and validation.

Groundwater Modeling

Regional groundwater flow models simulate the rate and direction of movement through the subsurface. The models include the major hydrologic components of the hydrologic cycle. They are used in water supply planning to understand the effects of current and future water supply usage. The costs included in **Table 12** are for contracts (such as peer review) and staff time.

Floridan Aquifer System Model and Database Development

SFWMD recognized the need to develop a FAS groundwater model in the LEC Planning Area to improve management of this water resource given projected limits on traditional sources (e.g., Biscayne aquifer) to meet future water demands. SFWMD developed Phase I of the Lower East Coast Floridan Model (HydroGeologic, Inc. 2006), using USGS' computer code SEAWAT 2000—a fully coupled or uncoupled density-dependent flow and transport model—to allow simulation of density-dependent flow given the brackish water quality of the FAS. The availability of additional hydrogeologic and validated water use data, as well as a desire to expand the model domain to include the Upper East Coast Planning Area, led to the initiation of a Phase II modeling project. Development of this combined LEC and Upper East Coast model, referred to as the East Coast Floridan Aquifer System Model, began in 2007 and was completed in October 2008 (Golder Associates 2008).

An independent peer review of this model was completed in June 2011. Peer review comments suggested development of a predevelopment steady-state model, changes in boundary conditions, incorporation of more recent hydrogeologic and time series data, and recalibration. SFWMD incorporated these comments using data available up until December 2011. The predevelopment model, including revised boundary conditions and updated hydrogeologic and historical water use data, was recently calibrated. The final transient, density-dependent model—now known as the East Coast Floridan Model—is scheduled for completion by the end of 2013. Model documentation will then follow. Once complete, the model will be available to address regional resource questions, including those that will arise during the next LEC water supply plan update. **Figure 41** shows the model boundary.

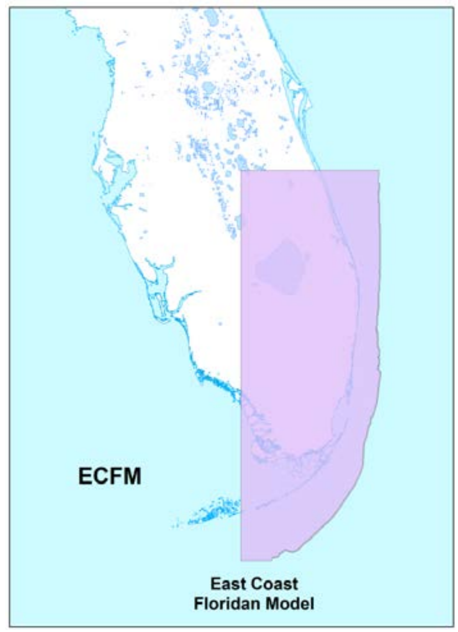


Figure 41. East Coast Floridan Model boundary.

Lower West Coast Floridan Aquifer Model, Incorporation of Peer Review Comments

The Lower West Coast Floridan Aquifer Model extends into the western portion of the LEC Planning Area (**Figure 42**). It includes Hendry County and fragments of western Broward and Miami-Dade counties. In 2008, SFWMD retained three independent groundwater modeling experts to conduct a technical peer review of its draft Lower West Coast Floridan Aquifer Model, which uses USGS's SEAWAT 2005 code. The peer review panel completed its report in August 2008.

Table 12 provides for estimated costs and timeframes for completion of water resource development projects described in this chapter or in **Chapter 5**.

Figure 42. Lower West Coast Floridan Aquifer Model boundary.

Table 12. Implementation schedule and costs for ongoing districtwide water resource development projects. Source: Table 5A-1 in Martin (2012).

Districtwide Water Resource Development Projects	Plan Implementation Costs ($ in thousands)					
	FY2013	**FY2014**	**FY2015**	**FY2016**	**FY2017**	**Total**
MFL, Water Reservation Activities and Restricted Allocation Areas [a] Est. start date: 1995 Est. finish date: ongoing	658	667	660	660	660	3,305
Comprehensive Water Conservation Program [a] Est. start date: 1977 Est. finish date: ongoing	903	867	850	850	850	4,320
Alternative Water Supply [a] Est. start date: 1997 Est. finish date: ongoing	2,900	1,590	1,840	1,840	1,840	10,010
Drilling and Testing [a] Est. start date: 1990 Est. finish date: ongoing	1,409	1,157	1,140	1,140	1,140	5,986
Groundwater Assessment [b] Est. start date: 2002 Est. finish date: ongoing	40	40	40	40	40	200
Groundwater, Surface Water, and Wetland Monitoring [a] Est. start date: 2002 Est. finish date: ongoing	1,517	1,380	1,380	1,380	1,380	7,037
Groundwater Modeling [a] Est. start date: 1997 Est. finish date: ongoing	402	406	406	406	406	2,026
Sub-Total	**7,829**	**6,107**	**6,316**	**6,316**	**6,316**	**32,884**

a. Includes staff time and contract dollars

b. Includes staff time only

SUMMARY

Water resource development projects serve various purposes in support of water supply development. Benefits of the water resource development projects discussed in this chapter include the following:

- Improved understanding of the hydrogeologic system that is the source of both traditional and alternative water supplies for the LEC Planning Area
- Prevention of the loss of natural resources
- Preservation of existing supplies through better resource understanding and management and continued implementation of regional resource monitoring
- Water conservation to protect water sources and provide an efficient way to expand current water supplies
- Increased future supply availability

Table 13 provides that status of all of the projects discussed in this chapter.

Table 13. Project status table.

Project	Completed Elements	Status of Uncompleted Elements
Lake Okeechobee Region		
CERP Lake Okeechobee Watershed Project		• Waiting for decisions on federal/state cost sharing.
Taylor Creek, Nubbin Slough, and Lakeside Ranch STA pilot projects	• Taylor Creek STA Pilot Project became operational in 2011. • Lakeside Ranch STA Pilot Project Phase 1 became operational in 2012.	• Lakeside Ranch STA Pilot Project Phase 2 waiting for construction funding. • Nubbin Slough STA Project is complete, but nonoperational until repaired.
USACE Herbert Hoover Dike Major Rehabilitation	• USACE completed assessment of Hebert Hoover Dike and classified it a damn safety action classification of Class 1. • Culvert 14 removed and replaced with fill in 2011.	• Reach 1 cutoff wall to be complete in 2013. • Replacement work began on culverts in 2012. • Replacement of other culverts to be awarded by late 2013. • Replacement of all 32 culverts to be completed by 2018. • Cutoff wall and/or seepage management systems to be implemented in Reaches 2 and 3 by 2022. • Remaining rehabilitation projects will be developed based on the findings of the Herbert Hoover Dike Dam Safety Modification Study, which is underway, and expected to be complete in 2015.
Lake Okeechobee Habitat Enhancements	• Most activities completed by 2011.	• Apple snail enhancement continues in 2013.
Everglades Region		
Restoration Strategies Regional Water Quality Plan	• In 2012, \$63.9 million contract awarded to design/build the L-8 FEB including an inflow structure, internal improvements, revetment strengthening, a pump station, and six pumps. • Final design of A-1 FEB completed in 2013. • In 2013, FDEP issued a permit authorizing SFWMD to build, operate, and maintain the A-1 FEB. • L-8 Divide Structure (G-541) preliminary design completed in 2013.	• L-8 FEB design and construction initiated and expected to be complete December 2016. • A-1 FEB construction expected to be complete July 2016. • S-5AS Divide Structure modification initiated and expected to be complete September 2016. • S-375 structure expansion initiated and expected to be complete December 2018. • STA 1 West expansion planned and expected to be complete December 2018. • L-8 Divide Structure (G-541) construction expected to be complete March 2016. • Completion of all elements estimated by 2025.
C-139 Annex Restoration	• The Lake Belt Mitigation Committee approved the C-139 Annex for wetlands mitigation in 2012.	• Restoration will progress as mitigation funds allow and is expected to be complete in 2018.

Table 13. Continued.

Project	Completed Elements	Status of Uncompleted Elements
Everglades Region (continued)		
Modified Water Deliveries to Everglades National Park	• 8.5-Square Mile Area protection features completed in 2008. • Taylor Slough Bridge completed in 2007. • 1-mile bridge on Tamiami Trail completed in 2013. • L-67 extension canal and levee has 4 of 9 miles degraded.	• S-356 pump station construction is complete and awaiting permit to operate.
Decomp Physical Model	• Final permit for DPM construction and interim operations received in 2012. • Construction contract was awarded in May 2012.	• Testing is anticipated to begin in November 2013 and continue through 2014.
Ongoing CERP Planning including CEPP	• Draft project implementation report (PIR) complete and available for public comment in September 2013.	• When the PIR is finalized, the SFWMD Governing Board will consider approval. • USACE to complete PIR and chief of engineer's report to transmit project to United States Congress for authorization. • CERP planning on other projects is ongoing.
Wading Bird Monitoring Report	• Most recent report has been published.	• Reports completed annually to identify breeding colonies.
Historical Tree Island Mapping	• Completed in 2011	
Loxahatchee River		
Restoration Plan for the Northwest Fork of the Loxahatchee River	• SFWMD acquired land in support of Loxahatchee River restoration. • M-Canal widening completed in 2007. • C-18 Project culvert replacements completed in 2007. • Nine Gems restoration completed in 2010. • Culpepper hydrologic restoration completed in 2011. • Cypress Creek weir installation completed in 2012.	• Cypress Creek berm/water control structures is ongoing in 2013. • Loxahatchee Slough restoration is ongoing in 2013. • Planning is ongoing in 2013.
CERP Loxahatchee River Watershed Restoration Project	• SFWMD acquired land in support of Loxahatchee River restoration. • M-Canal widening completed in 2007. • G-160 completed in 2004 and currently operational. • G-161 completed in 2007 and currently operational. • Operational testing of L-8 and flow-way was conducted by SFWMD in 2011.	• Planning is ongoing in 2013.
Storage for Loxahatchee River	• In 2013, SFWMD and Palm Beach County conceptually agreed to the acquisition of approximately 1,800 acres. Design is expected to proceed in 2018.	

Table 13. Continued.

Project	Completed Elements	Status of Uncompleted Elements
Biscayne Bay		
CERP BBCW Project Phase 1	• PIR and chief of engineer's report completed in 2012. • Cutler Wetlands Flow-way completed in 2013. • Deering Estate Flow-way construction completed and operational in 2012. • L-31 East Flow-way has 4 of 10 culverts completed.	• Signed record of decision transmitted to congress for authorization.
Developing Technical Information for Biscayne Bay	• Completed in 2008.	
Biscayne Bay Seepage Study	• Completed in 2008.	
Biscayne Bay and Watershed Water Quality Data Analysis	• Completed in 2008.	
Storm Event Sampling in the Biscayne Bay Watershed	• Completed in 2009.	
Characterization of Nearshore Epifauna Study	• Completed in 2011.	
Florida Bay		
USACE C-111 South Dade Project	• Seven of the twelve contracts for this project executed since work began in 1994.	• Execution of construction contracts is ongoing. In April 2012, SFWMD issued a solicitation to identify qualified firms for the eighth contract.
S-197 Structure Replacement Project		• Construction is ongoing with completion expected in 2013.
CERP C-111 Spreader Canal Western Project	• PIR completed in 2011 and chief of engineer’s report completed in 2012. • SFWMD construction of major elements completed in 2012.	• Signed record of decision transmitted to congress for authorization.
Florida Bay MFL Prevention Strategy Monitoring and Research	• Monitoring data collection completed in 2012.	• Review of data collected from Florida Bay is under way and expected to be complete by 2013.
Lower East Coast Service Area		
CERP Fran Reich Preserve Reservoir	• PIR completed in 2006 and congress authorized construction for Phase 1 in 2007.	• Phase 1 under construction and expected to be complete by December 2014. • Additional authorization from congress needed for Phase 2.
CERP Hillsboro ASR Pilot Project	• Cycle testing completed in 2012.	• Final technical data report expected to be complete in 2013.
CERP Broward County Water Preserve Areas	• PIR and chief of engineer’s report completed in 2012.	• Signed record of decision transmitted to congress for authorization.
CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat	• Completed and operational in 2010.	
L-31N Seepage Management Project	• Construction of the underground barrier completed in July 2012.	• A performance monitoring program is under way until 2014.

Table 13. Continued.

Project	Completed Elements	Status of Uncompleted Elements
Lower East Coast Service Area (continued)		
LECsR Model Update	• Completed in 2006.	• Updates ongoing in 2013.
Saltwater Interface Mapping	• Updated maps for LEC Planning Area completed in 2011.	• Monitoring is ongoing. • Preparation of saltwater interface maps will be complete in 2014.
Gun Club Road Satellite Reuse Facility Feasibility Study and Pilot Project	• Completed in 2006.	
Groundwater Replenishment via Canal Recharge Augmentation Study	• Completed in 2008.	
Alternative Water Sources Subregional Feasibility Study: Fort Lauderdale, Sunrise, and Miami-Dade County	• Completed in 2006.	
S-155A Divide Structure	• Completed in 2004 and operational.	
Florida City Canal		• If funded, construction is anticipated to begin in 2014 and be completed in 2015.
Districtwide Water Resource Development Projects		
ET Measurement Project	• Completed in 2011.	
Water Desalination Concentrate Management and Piloting Study	• Completed in 2009.	
Water Supply Cost Estimation Study	• Completed in 2007.	
MFL, Water Reservation and Restricted Allocation Areas Rule Activities	• Three water reservation rules and two restricted allocation area rules adopted since 2007.	• Continued implementation of MFL recovery and prevention strategies. Development of new water reservation rules.
Comprehensive Water Conservation Program	• Program completed in 2008. • Adopted year-round irrigation rule in 2010.	• Continued operation of recognition and certification programs, regulatory initiatives, education, and outreach with funding support through WaterSIP.
Alternative Water Supply	• Funds distributed on an annual basis.	• Continued support through Alternative Water Supply Funding Program
Drilling and Testing		• Installation of monitoring wells and subsurface testing as needed.
Groundwater Assessment		• Preparation of saltwater interface maps for six counties will be complete in 2014.
Groundwater, Surface Water, and Wetland Monitoring		• Ongoing monitoring of 760 groundwater stations districtwide.
Groundwater Modeling	• East Coast Floridan Model completed in 2008 and peer review completed in 2011. • Peer review for the Lower West Coast Floridan Aquifer Model completed in 2008.	• East Coast Floridan Model completion, including response to peer review, expected in 2013.

5

Evaluation of Water Source Options

The Lower East Coast (LEC) Planning Area historically relied on fresh water from aquifers and surface water sources to meet water supply needs. As population and water demand increased, the development of other water source options also increased. This chapter presents an evaluation of water source options available within the LEC Planning Area through 2030 to accommodate future urban and agricultural growth while meeting the needs of the ecosystem.

In the LEC Planning Area, traditional freshwater source options include groundwater from the surficial aquifer system (SAS) and surface water from Lake Okeechobee, the Water Conservation Areas (WCAs), and connected water bodies. Alternative water source options include brackish groundwater from the Floridan aquifer, reclaimed water, seawater, storage capacity by using reservoirs or aquifer storage and recovery (ASR) systems, and water conservation.

To evaluate the water source options, consideration must be given to several key factors, such as future water needs, source availability, water quality requirements for the intended uses, and cost. **Chapter 2** provides summaries of gross water demand for all water use categories: Public Water Supply (PWS), Domestic Self-Supply (DSS), Agricultural (AGR) Self-Supply, Industrial/Commercial/Institutional (ICI) Self-Supply, Recreational/Landscape (REC) Self-Supply, and Power Generation (PWR) Self-Supply. The LEC Planning Area population is expected to increase by 18 percent, from approximately 5.6 million people in 2010 to more than 6.6 million by 2030. Gross water demand for all water use categories is projected to increase by 214 million gallons per day (MGD) (12 percent) by 2030.

The PWS and AGR Self-Supply categories account for more than 88 percent of all water use in the LEC Planning Area. Currently, all but two PWS utilities in the LEC Planning Area utilize fresh groundwater from the SAS to supply the majority of potable water demand. Agricultural operations in the Everglades Agricultural Area (EAA) rely on surface water, while growers in the eastern portion of the planning area use a combination of groundwater and surface water. Water use permits have been issued and infrastructure exists to meet a significant portion of the 2030 water needs for PWS and AGR Self-Supply. This is important because restricted allocation area criteria limit new allocations from traditional groundwater and surface water sources, which are described in **Chapter 3** and discussed briefly later in this chapter.

Each water source option presented in this chapter briefly describes current and future uses. Additional information about water source options and their related costs is provided in Chapter 5 of the *2011–2013 Water Supply Plan Support Document* (Support Document) (SFWMD 2013a). Water treatment technologies and associated costs are presented in Chapter 6 of the Support Document.

GROUNDWATER

Groundwater sources in the LEC Planning Area include fresh groundwater from the SAS, including the Biscayne aquifer, and brackish groundwater from the Floridan aquifer. More information about these aquifers, including yields and characteristics specific to the LEC Planning Area, is provided in **Chapter 3** of this update and Chapter 10 of the Support Document.

Fresh Groundwater

Fresh groundwater is the primary source of supply for potable water consumption, landscape irrigation, and industrial and commercial uses in the LEC Planning Area. In the urban areas of the LEC Planning Area, PWS relies heavily on the SAS, including the Biscayne aquifer. The SAS produces good quality fresh water from relatively shallow wells. In some cases, the ambient water quality meets most primary and secondary drinking water quality standards. Local rainfall, canals, groundwater seepage from WCAs and Everglades National Park, and surface water deliveries from WCAs recharge these aquifers. When sufficient water is available, surface water from Lake Okeechobee can also be routed to WCAs, then to regional canals to maintain water levels and recharge the aquifer. During droughts, lower regional groundwater levels may cause inland movement of salt water at the interface of the aquifer with seawater. In this case, water shortage restrictions may be declared by the Governing Board of the South Florida Water Management District (SFWMD) to conserve freshwater supplies.

Figure 43 shows the distribution of SFWMD-permitted SAS wells for PWS utilities producing over 0.1 MGD. The map reveals that well capacities generally increase from Palm Beach County to the south towards Miami-Dade County as a result of the presence of the Biscayne aquifer. The transmissivity of the Biscayne aquifer generally increases from north to south. In 2010, PWS utilities utilized fresh groundwater to supply 94 percent of their total potable water demand. Existing allocations of fresh groundwater exceed projected 2030 demand for more than half of the PWS utilities (see **Chapter 6** for specifics). Most of the 2030 demand will continue to be met by fresh groundwater from the SAS. More details about actual and permitted withdrawals from each source can be found in **Appendix C**.

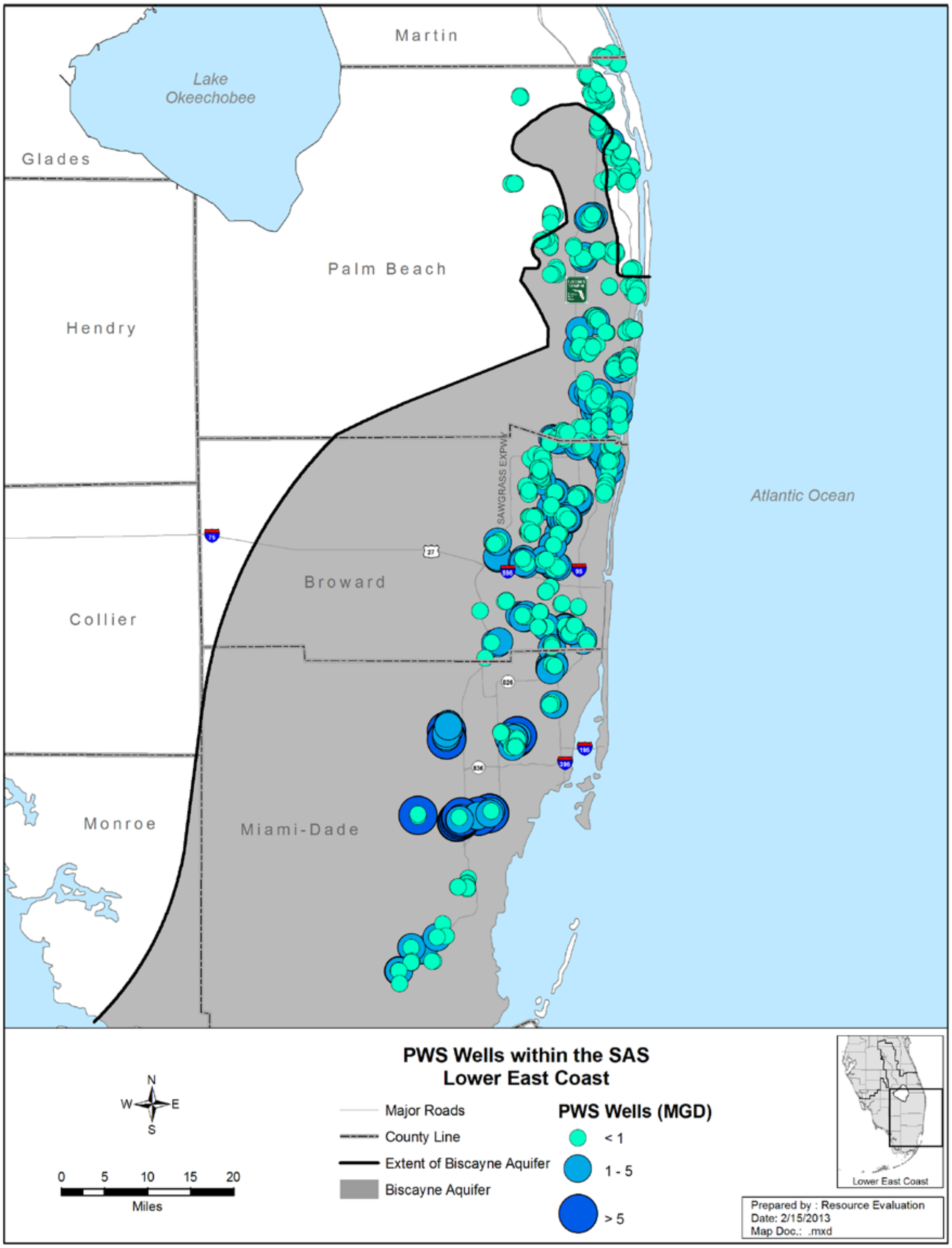


Figure 43. Location and approximate yield of SAS PWS production wells in the LEC Planning Area.

Fresh groundwater supplied all of the estimated 18 MGD of DSS in 2010. By 2030, DSS demand throughout the LEC Planning Area is expected to increase slightly to 19 MGD. Domestic wells are exempt from SFWMD water use permitting requirements. Fresh groundwater from the SAS will continue to supply DSS.

Agriculture in Broward and Miami-Dade counties, comprising approximately 8 percent of irrigated agricultural acres in the LEC Planning Area, is primarily dependent upon withdrawals from the Biscayne aquifer to supply supplemental irrigation for crops, livestock, and other purposes. Fresh groundwater supplied approximately 10 percent of the total AGR Self-Supply water demand in the LEC Planning Area. In 2010, the AGR Self-Supply demand met by fresh groundwater was approximately 68 MGD. AGR Self-Supply demand is expected to remain somewhat constant for the next 20 years. **Figure 44** shows the location and relative magnitude of agricultural allocations. The remainder of agriculture acreage and demand is supplied by fresh surface water and discussed below.

The primary use for water in the REC Self-Supply category is for irrigation of parks, athletic fields, golf courses, medians, and large landscaped areas. The largest water users in the ICI Self-Supply category are the aggregates mining and food processing industries, such as sugar mills. Fresh groundwater accounted for 40 percent of the total REC Self-Supply demand and 60 percent of the total ICI Self-Supply demand in 2010. The remainder of the water for these two categories is from diverse sources including surface water, brackish groundwater, and reclaimed water. Growth in the REC Self-Supply category is expected to be small, about 3 percent. The increased demand will likely be met by the same three sources, depending on availability at specific locations. By 2030, ICI Self-Supply demand is expected to increase by 28 percent. The increase will largely be met by groundwater where available.

Fresh groundwater provided less than 10 percent of the total water demand for PWR Self-Supply in the LEC Planning Area in 2010. It is anticipated that a similar volume of fresh groundwater will be used for PWR Self-Supply in 2030, while reliance on other sources, such as seawater, will expand. Reclaimed water use for cooling recently expanded and is anticipated to continue to grow to meet PWR Self-Supply needs through 2030.

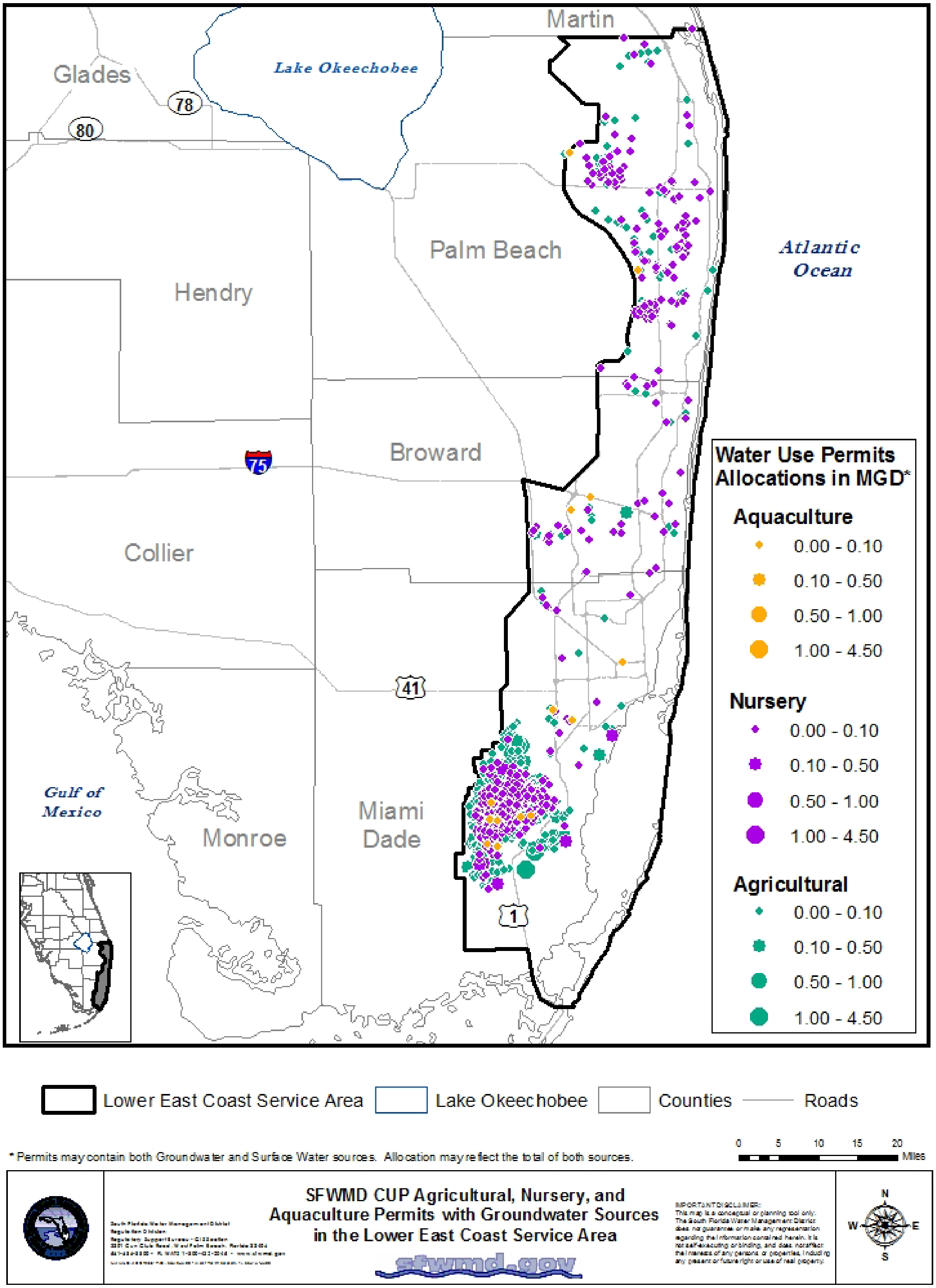


Figure 44. Location and relative magnitude of agricultural allocations from the SAS.

Western Basins

The Everglades Protection Area's tributary basins include the C-139, Feeder Canal, L-28 Interceptor, and L-28 Gap (located within the Big Cypress National Preserve) basins, which encompasses approximately 440,000 acres located primarily in eastern Hendry County (**Figure 45**). These basins are collectively called the Western Basins because they are along the western edge of the Everglades. Generally, land within these basins have three classifications: 1) agricultural (vegetable, sugarcane, and citrus), 2) cow-calf operations, and 3) wetlands and native areas. Agricultural land dominates the C-139 and Feeder Canal basins. While the L-28 interceptor basin land use is split between wetlands and agricultural. The L-28 Gap Basin consists almost entirely (98 percent) of wetlands. Urban land classifications occupy 4 percent of the C-139 Basin. Overall, agricultural land uses and urban lands are projected to remain stable. The Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida both have reservations in the Western Basins (**Figure 46**) with water supply needs for its residents, agriculture and wetlands. Both water supply and water quality of stormwater runoff are challenges facing the development of the Western Basins.

Florida's 1994 Everglades Forever Act, Section 373.4592, Florida Statutes (F.S.), mandated 1) the construction of stormwater treatment areas (STAs), 2) landowners within the C-139 Basin should implement best management practices (BMPs), and 3) landowners not collectively exceed average annual historic total phosphorus load adjusted for rainfall. In 2002, SFWMD adopted the C-139 Basin BMPs Regulatory Program, Chapter 40E-63, Florida Administrative Code (F.A.C.), to ensure the total phosphorous load requirements would be met. After four years with source control mandatory BMP permits, the C-139 Basin was not meeting the historic total phosphorus load required by rule. SFWMD amended Chapter 40E-63, F.A.C. to address future compliance. The amendments became effective in November 2010. The performance measure to meet historic total phosphorous loading adjusted by rainfall were met in water years 2008, 2010, 2011, and 2012 (a water year begins on May 1 and ends on April 30 of the following year).

Water management in general (water supply and discharges) is thought to be a critical factor affecting phosphorus loads from the basin. Water management, water availability, and the effects of allocation of water supply for the Western Basins require further study. Studies and data of the surface and groundwater in the Western Basins will assist with restoration of wetland hydroperiods on the Seminole Tribe of Florida's Big Cypress Reservation and in the Big Cypress National Preserve. The Seminole Tribe's long standing concerns in the Western Basins include adequate water supply for the environment and the lack of attention by federal and state resource agencies on its condition. To address this deficiency, a subset of South Florida Ecosystem Restoration Task Force member agencies, which includes federal and state agencies, has convened to discuss this issue and other specific concerns raised by the Seminole Tribe.

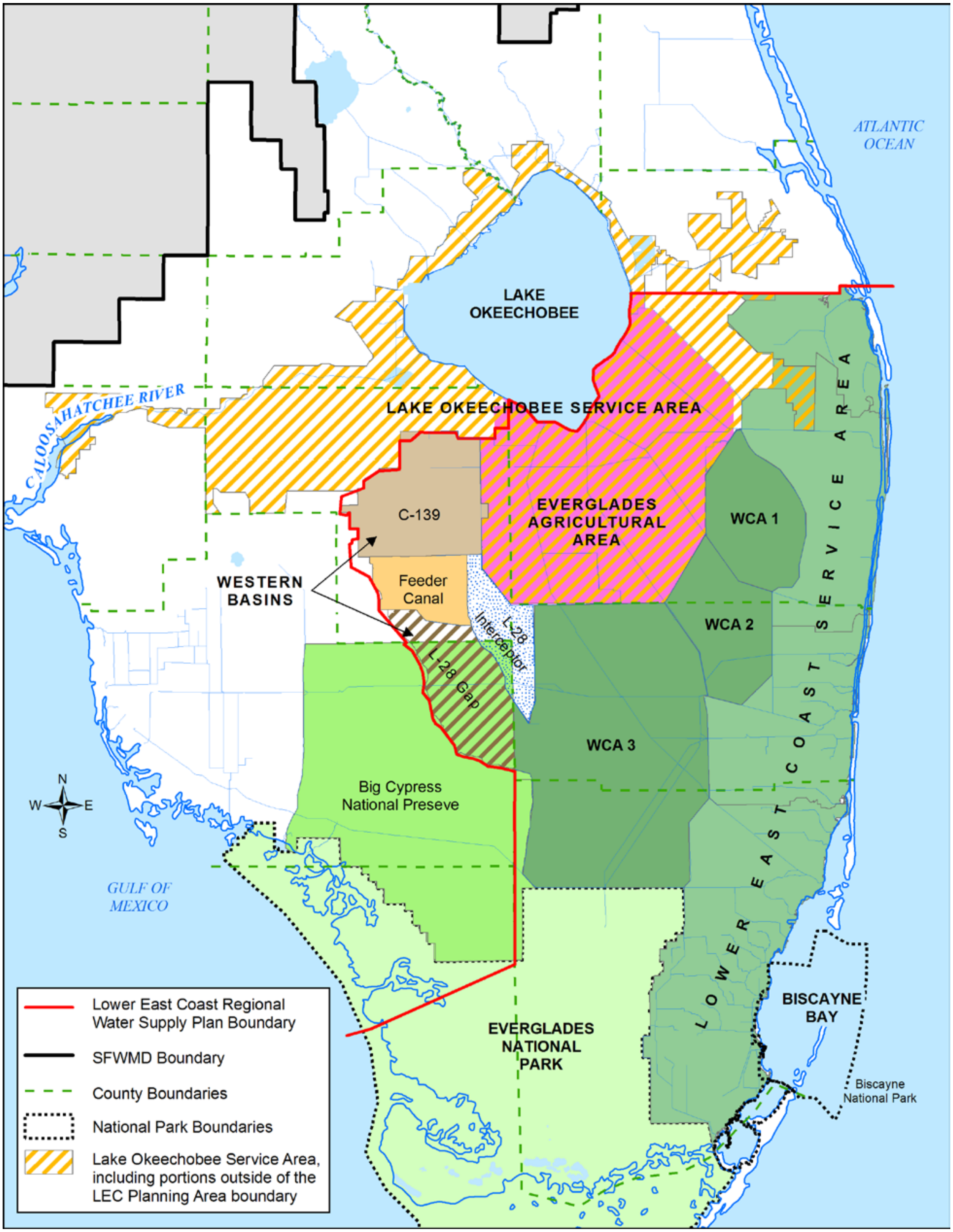


Figure 45. EAA, Western Basins, and surrounding areas.

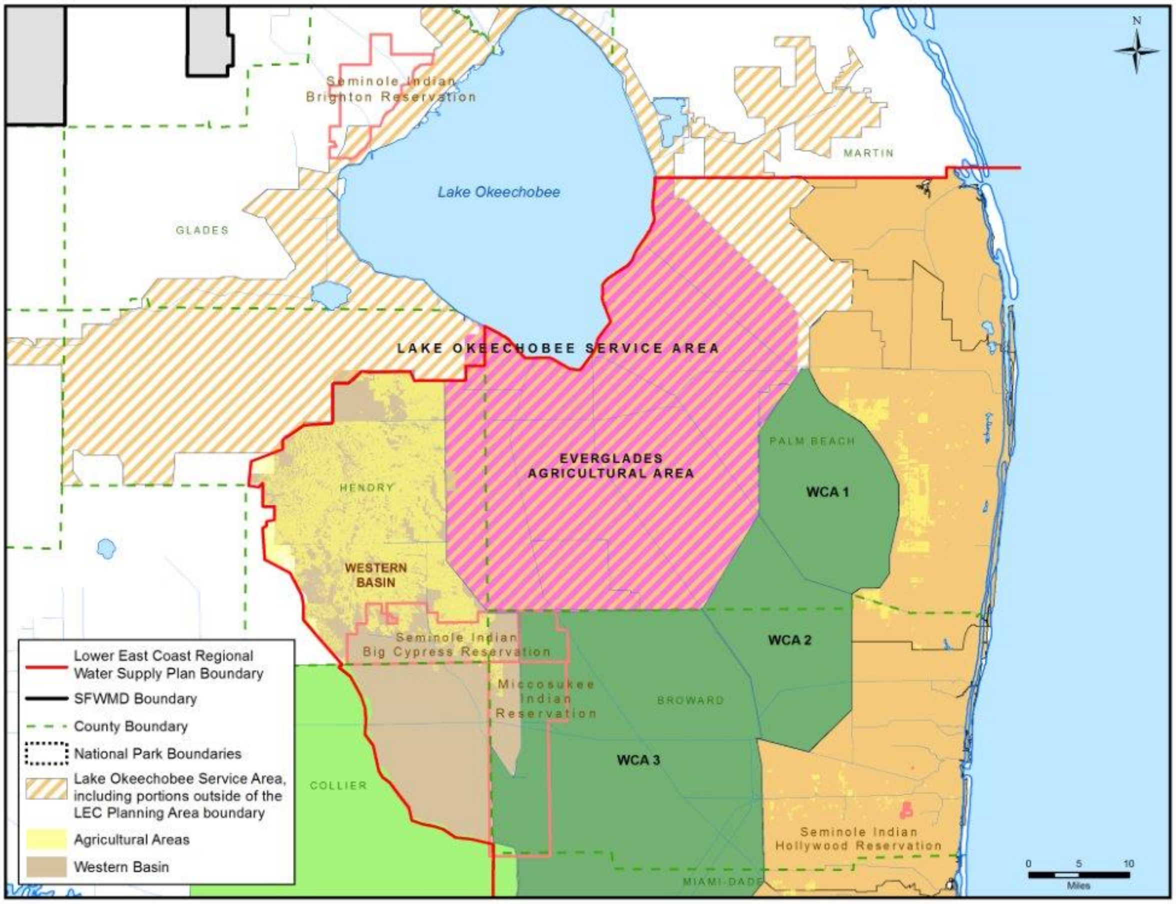


Figure 46. Western Basins map showing the Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida reservations.

Available water supplies for allocation for the basin from the SAS are constrained by the presence of isolated wetlands. Water supply demands fluctuate seasonally, with emphasis on the fall-to-winter and winter-to-spring growing seasons, which require optimal water table levels. However, some additional groundwater supplies may be available consistent with the wetland criteria and maximum developable limits applicable to this area. Maximum developable limits are discussed in Section 3.2.4 of the *Basis of Review for Water Use Permit Applications within the South Florida Water Management District*, commonly referred as the Basis of Review (SFWMD 2012b). Applicants must provide reasonable assurances that the proposed use shall not cause harmful drawdowns so as to deplete semi-confined freshwater aquifers within the Lower West Coast Planning Area, which is adjacent. The potentiometric head within the lower Tamiami aquifer shall not be allowed to drop to less than 20 feet above the top of the uppermost geologic strata that comprises the aquifer at any point during a 1-in-10 year drought condition.

Alternatives to increase the availability of water supply sources, permanently or seasonally, involve studying ways to develop water supply storage capacity for periods of need, and further supporting a means to optimize and reuse irrigation water in identified areas. Coordinated long-term plans are needed that consider alternative water supplies or matching demand to availability. To that end, SFWMD is updating the Lower West Coast Surficial Aquifer and Intermediate System Model, a groundwater flow model, to include the intermediate aquifer system. Once peer reviewed, which is tentatively scheduled for completion during Fiscal Year 2014, it will be applied to examine the potential impacts of existing and future groundwater withdrawals from the SAS and intermediate aquifer system.

In 2010, SFWMD purchased land from the United States Sugar Corporation, providing 26,800 acres (42 square miles) of strategically located property south of Lake Okeechobee for the construction of water storage and water quality improvement projects and wetland restoration that will bring meaningful environmental benefits to the Everglades. Currently, the land is leased back to agricultural producers for farming until plans can be developed and implemented for restoration projects. The purchase included 17,900 citrus acres in Hendry County to improve water quality in the Western Basins where phosphorus loads have historically been high. Approximately 14,400 acres of the C-139 Annex (see **Figure 34** in **Chapter 4**), located just west of thousands of acres of existing STAs that treat agricultural runoff, will be restored to a more natural condition. Removal of the citrus trees from production will begin in 2014 and finish by 2018. Removal of the citrus trees will reduce the demand for groundwater currently used for irrigation. Restoration will improve the quality, timing, and distribution of water flowing into the Everglades. See the C-139 Annex Restoration project description in **Chapter 4** for more information.

Limits on Availability

The SAS, including the Biscayne aquifer, is a source of limited availability to the extent that withdrawals result in induced seepage from the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project), except when stormwater or wet season discharge occurs, as defined by Section 1.7.2.2.B of the Basis of Review. In 2007, SFWMD adopted the LECSA and North Palm Beach County/Loxahatchee River Watershed water bodies restricted allocation area criteria (Section 3.2.1.E, Basis of Review). Within these areas, the SAS is generally limited due to potential impacts on the regional system, wetlands, existing legal water users including DSS, and the potential for saltwater intrusion. SFWMD will evaluate new or increased allocations on an application-by-application basis to determine if the project meets water use permitting criteria.

Brackish Groundwater

Brackish groundwater is defined as water with a chloride concentration greater than 250 milligrams per liter (mg/L) and less than 19,000 mg/L. In the LEC Planning Area, water produced from the Floridan aquifer system (FAS), the upper Floridan aquifer specifically, typically contains chlorides in excess of 500 mg/L. Appropriate desalination treatment technologies must be used before this type of water supply can be suitable for most uses, including human consumption. Brackish groundwater is generally not suitable for agricultural water supply.

In the LEC Planning Area, the upper Floridan aquifer provides brackish groundwater to supplement PWS and PWR Self-Supply demands. Water use from the FAS began in the late 1970s, and increased in the 1990s, with more significant use after 2000. By 2010, approximately 30 MGD was produced for PWS from brackish water sources in the LEC Planning Area and as of 2012, 11 PWS treatment plant facilities utilize a brackish water source (**Figure 47**). Combined, these facilities have an installed treatment capacity of 86 MGD. Overall, 23 utilities in the planning area obtained upper Floridan aquifer allocations totaling 190 MGD. Most of this volume has not been needed to date, and likely will not be needed prior to 2030, based on current demand projections.

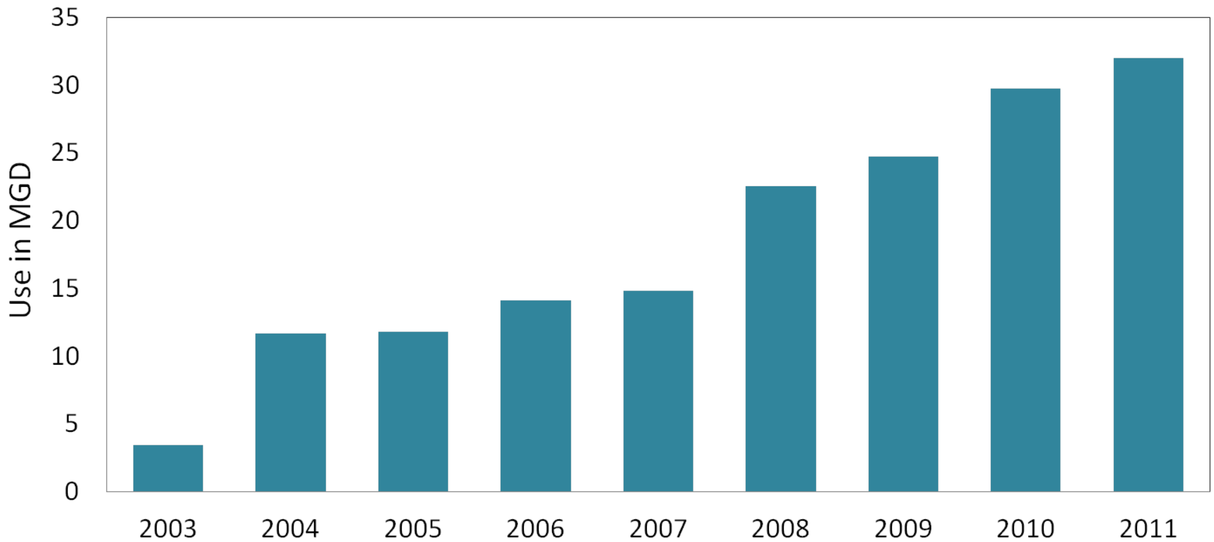


Figure 47. PWS withdrawals from brackish water sources in the LEC Planning Area for 2003–2011.

PWS utilities typically use the reverse osmosis (RO) process to remove excess salinity. The approximate production efficiency or recovery for brackish water RO facilities districtwide is between 75 and 85 percent, depending upon the membrane technology employed and the salinity of the water from the aquifer (Carollo Engineers, Inc. 2009). Some utilities blend brackish upper Floridan aquifer water with fresh groundwater and treat the blended product with lime softening or nanofiltration technology to meet drinking water standards. Blending can reduce treatment costs and increase production efficiency in order to meet drinking water standards.

Additional users of Floridan aquifer water in the LEC Planning Area include four golf courses—Seminole, Breakers, and Everglades Club golf courses in Palm Beach County, and Card Sound Golf Club in Monroe County. Only one power generating facility—the Florida Power & Light (FPL) Turkey Point Plant Unit 5—uses groundwater drawn from the Floridan aquifer for cooling.

SURFACE WATER

Lake Okeechobee and Water Conservation Areas

Surface water has been a major source of water in the LEC Planning Area and will continue to be in the future. An overview of water resources including Lake Okeechobee and WCAs is provided in **Chapter 3.**

Lake Okeechobee, its connected conveyance system, and the WCAs are the most significant surface water sources for the LEC Planning Area. Surface water from these sources supply water to the regional system via canals and recharges the SAS. Lake Okeechobee has multiple purposes and is critical for flood control during wet seasons as well as water supply during dry seasons. Agriculture in the Lake Okeechobee Service Area covered approximately 255,500 acres outside of the EAA and the 458,500 acres within the EAA (see **Figure 2** in **Chapter 1**) in 2010. It is the predominate user of lake water. Lake Okeechobee serves as a supplemental water supply source for agriculture when rainfall is insufficient and can be used as a backup source for urban users in the coastal basins of the LEC Planning Area during droughts and dry times, and depending upon availability, may provide 'pass through' water to the WCAs in accordance with their regulation schedules. The implementation of the 2008 Lake Okeechobee Regulation Schedule, referred to as 2008 LORS, resulted in an average loss of approximately 430,000 acre-feet of storage for all uses. Canals connected to the lake will continue to provide fresh surface water for supplemental irrigation in the future consistent with water use permits.

Subsequent to the implementation of 2008 LORS, South Florida experienced several years of below average rainfall. This resulted in lake levels substantially lower than those that characterized the Water Supply and Environment and predecessor schedules. To fulfill its water supply function when at lower lake levels, SFWMD is permitted to deploy portable pumps at S-351, S-352, and S-354 at extreme low lake stages (less than 10.5 feet in relation to the National Geodetic Vertical Datum of 1929). This enables SFWMD to meet water supply needs in the EAA and the Seminole Tribe of Florida's Big Cypress Reservation.

The Okeechobee Utility Authority in the Kissimmee Basin Planning Area is the only remaining PWS utility using water directly from Lake Okeechobee. Since the last plan update, Clewiston, South Bay, Belle Glade, and Pahokee discontinued their use of Lake Okeechobee and now use FAS water treated by RO for their PWS demand (SFWMD 2012a).

The City of West Palm Beach is the only PWS utility in the LEC Planning Area to rely on surface water as its primary source. The city draws its water from Clear Lake, which is indirectly connected to Lake Okeechobee via a series of tie-back canals. The city also supplies water to the towns of Palm Beach and South Palm Beach.

In 2010, AGR Self-Supply accounted for approximately 90 percent of surface water allocations in the LEC Planning Area (**Figure 48**). The majority of AGR Self-Supply acreage in Palm Beach and Hendry counties is located within the EAA (see **Figure 2** in **Chapter 1**) and supplemental irrigation supplied by surface water withdrawals from canals connected to Lake Okeechobee. Agriculture in eastern Palm Beach County also relies primarily on surface water in the regional canal network and WCA 1, as well as deliveries from Lake Okeechobee, for supplemental irrigation. Combined, they are the largest users of surface water in the LEC Planning Area. Some smaller agricultural uses, including nurseries and aquaculture utilizing surface water, occur in Broward and Miami-Dade counties.

The EAA accounts for approximately 80 percent of the agricultural acreage within the LEC Planning Area. It is a fully developed, very stable agricultural area where permitted acres and cropping practices are not projected to change significantly over the next twenty years. Projected water demands for the EAA from 2010 to 2030 do not increase because EAA cultivated acres are consistent throughout the planning horizon. Agricultural demand in eastern Palm Beach County is projected to increase slightly.

Water Supplies to Seminole Tribe of Florida

The Seminole Tribe of Florida has three reservations in the LEC Planning Area—Brighton, Hollywood, and Big Cypress (see **Figure 46**). Two reservations rely on Lake Okeechobee as a secondary supplemental irrigation supply source, with specific volumes of water identified for the Big Cypress Reservation and drought-water shortage operations for the Brighton Reservation. The Seminole Tribe also owns other facilities and land within the LEC Planning Area. Demands, if any, associated with these other properties and the Hollywood Reservation are included within the PWS water use category.

The Seminole Tribe of Florida has surface water entitlement rights pursuant to the 1987 Water Rights Compact between the Seminole Tribe of Florida, State of Florida, and SFWMD (Public Law 100-228, 101 Statute 1566, and Chapter 87-292, Laws of Florida, as codified in Section 285.165, F.S.). The parties executed subsequent additional documents addressing the compact entitlement provisions. These documents include agreements between the Seminole Tribe and SFWMD and a SFWMD final order. Of particular interest in this regard is the 1996 agreement that addresses SFWMD mitigation responsibilities regarding impacts to the Seminole Tribe's ability to obtain surface water supplies at both the Brighton and Big Cypress reservations, which may be diminished as a result of various activities.

For the Big Cypress Reservation, SFWMD can install four portable forward pumps, capable of delivering up to 400 cubic feet per second from Lake Okeechobee to the Miami Canal to maintain stages in the canal. The SFWMD acquired an interim permit to operate the pumps from the United States Army Corps of Engineers (USACE), who in turn, is consulting with the United States Fish and Wildlife Service as part of the permitting process. This option remains a part of drought management alternatives and was completed in coordination with water restriction plans. Real-time operational decisions made during a declared drought event are made while fully cognizant of the Seminole Tribe's water rights. These decisions remain a part of the drought management operations. In addition, SFWMD built a weir at G-404 to facilitate delivery of water from the Miami Canal.

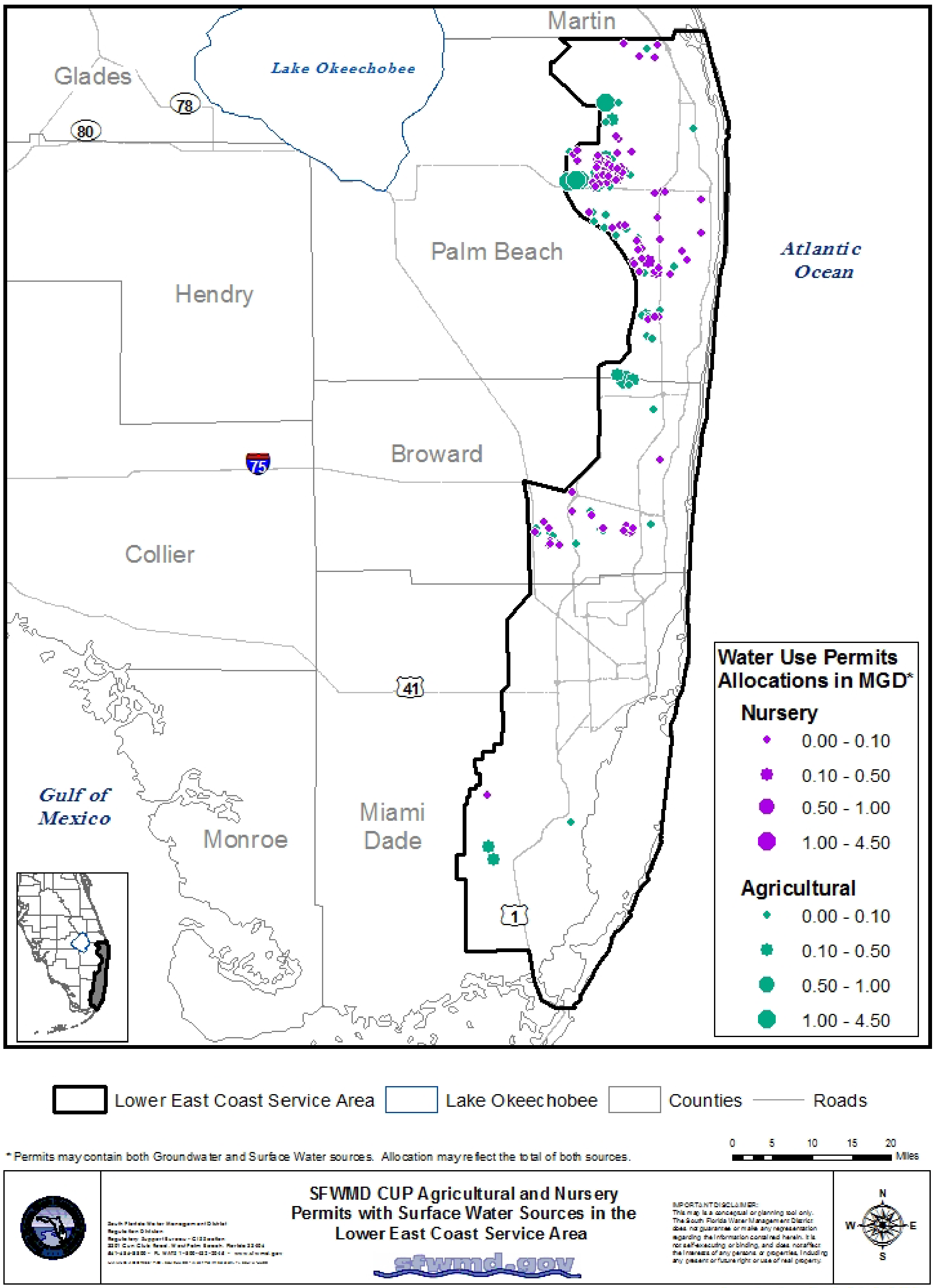


Figure 48. Location and relative magnitude of agricultural allocations utilizing surface water.

Limits on Availability

As discussed in **Chapter 3**, in October 2008, SFWMD developed restricted allocation area criteria for the Lake Okeechobee Service Area as part of the minimum flow and level recovery strategy for Lake Okeechobee. A recovery strategy was needed due to the USACE's adoption of 2008 LORS, which generally lowered the water levels in Lake Okeechobee by approximately one foot. These criteria limit allocations from Lake Okeechobee and connected surface waters, including the C-43 and C-44 canals, to base condition water uses that occurred from April 1, 2001 to January 1, 2008.

Implementation of the restricted allocation area criteria in the Lake Okeechobee Service Area began in fall 2008. During this time, irrigation water use permits for surface water were renewed or issued for twenty-year durations. The permits covered approximately 714,000 acres in the service area, of which approximately 458,500 acres were in the EAA. As part of the permit renewal process for agricultural permits in the EAA, SFWMD reviewed historical operations of actual water supply deliveries during a 1-in-10 year drought. This evaluation observed that crop management, water quality BMPs, and unique water management activities within the EAA result in a more efficient use of water when compared to other agricultural areas using similar seepage systems. As a result of this analysis, and in consultation with the industry, an efficiency of 75 percent rather than the typical 50 percent was applied to water use permit renewals for agricultural projects within the EAA Basin employing a flood irrigation system. This change in methodology resulted in a 33 percent decrease in allocation for the basin.

Another restricted allocation area found in the LEC Planning Area is located just south of the Lake Okeechobee Service Area in eastern Hendry County. The limited network of surface water canals within these basins are not connected to Lake Okeechobee. SFWMD will not allocate additional surface water from the L-1, L-2, and L-3 canals over the existing allocations (Section 3.2.1.C, Basis of Review).

RECLAIMED WATER

Reclaimed water receives at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility. In the LEC Planning Area, reclaimed water is used for landscape irrigation (e.g., medians, residential lots, and golf courses), groundwater recharge, cooling water, and environmental enhancement.

The State of Florida encourages and promotes the use of reclaimed water. The Water Resource Implementation Rule (Chapter 62-40, F.A.C.) requires the Florida Department of Environmental Protection (FDEP) and water management districts to advocate and direct the use of reclaimed water as an integral part of water management programs, rules, and plans. SFWMD requires all applicants for water use permits proposing to irrigate with more than 0.1 MGD of water and those applicants within a mandatory reuse zone to use reclaimed water if it is feasible. Mandatory reuse zones are geographic areas designated by local governments through ordinance where reclaimed water use is required if it is environmentally and technically feasible. Reclaimed water can be used for many purposes, including green space irrigation, industrial cooling and process water, groundwater recharge, saltwater intrusion barriers, and other nonpotable use activities.

The use of reclaimed water in the LEC Planning Area helps to reduce potential resource impacts by decreasing the reliance on traditional fresh sources, such as groundwater and surface water. Wastewater reuse reduces use of the traditional wastewater disposal methods, such as ocean outfalls and deep well injection. Wastewater reuse provides an environmentally sound alternative. Reclaimed water also provides additional supply for uses not requiring potable water, such as irrigation, although utilities require backup disposal methods during wet periods when irrigation demand is low.

Reclaimed water generally contains relatively high concentrations of nutrients that could justify decreased use of fertilizer when used for irrigation. The increased level of nutrients may also be a concern for numeric nutrient criteria in the region.

Existing Reuse in the LEC Planning Area

Wastewater management generally evolved from smaller subregional facilities to a partially integrated system of larger regional facilities and a limited, but growing network of pipelines to carry reclaimed water to end users. Maps showing the current extent of reclaimed water pipelines are shown in **Appendix C**. The volume of reclaimed water used for a beneficial purpose, such as landscape irrigation and cooling water, increased eight-fold from 1994 to 2011 as shown in **Figure 49**. Most of this growth occurred in Palm Beach County. Over this period, the volume of reclaimed water use varied from year to year, depending on the addition of new users and rainfall. This information was collected by SFWMD and supplemented by the *2011 Reuse Inventory* (FDEP 2012).

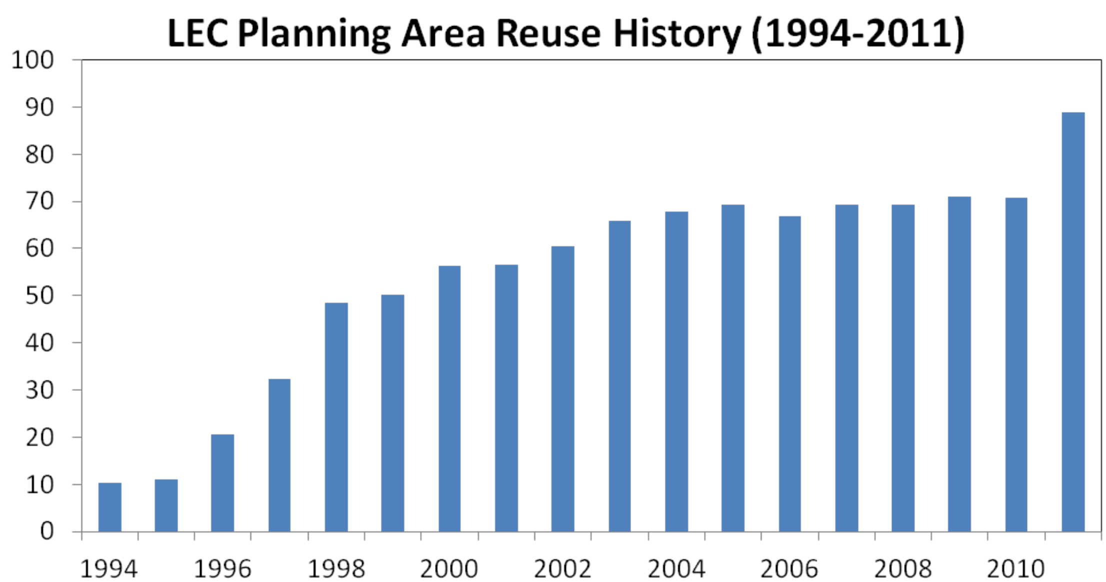


Figure 49. Annual average reclaimed water reuse in MGD in the LEC Planning Area from 1994 to 2011.

In 2010, 44 wastewater treatment facilities in the LEC Planning Area had a permitted treatment capacity of 0.1 MGD or greater. These facilities had a total wastewater treatment capacity of 860 MGD to meet peak daily flows and treated an average of 636 MGD of wastewater in 2010. The Miami-Dade Central District Wastewater Treatment Plant, operated by the Miami-Dade County Water and Sewer Department (MDWASD), remains the area's largest wastewater treatment facility, with a capacity of 143 MGD.

In 2010, approximately 93 percent, or 594 MGD of the LEC Planning Area's treated wastewater supply, was disposed through deep well injection (353 MGD) and ocean outfalls (240 MGD). Only 71 MGD was beneficially reused. About 1 MGD was disposed through shallow injection wells in the Florida Keys area of Monroe County.

Of the 44 wastewater treatment facilities, 25 facilities reused at least a portion of their wastewater in 2010 (71 MGD). Nearly 41 MGD was used to irrigate almost 20,000 residences, 55 golf courses, 47 parks, and 12 schools, mostly within Palm Beach County (FDEP 2011). Over 6 MGD of the reclaimed water supply was reused for groundwater recharge, mainly by the City of Homestead in Miami-Dade County, through rapid infiltration basins and percolation ponds. The remaining 24 MGD of reclaimed water was reused for various purposes, including hydration of two created wetlands in Palm Beach County and use at wastewater treatment facilities. Summaries of wastewater and reclaimed water facilities, including their capacities and locations, are provided in **Appendix C**.

The total amount of water reused in the LEC Planning Area in 2010 (71 MGD) exceeds the difference between wastewater treated (636 MGD) and wastewater disposed (594 MGD). Total wastewater treated and disposed cannot be simply subtracted to quantify the volume reused. Reclaimed water reused at the wastewater treatment facility may be double-counted by adding both to the treated wastewater flow and water reuse flow totals. This occurs, for example, when the utility reuses water at the treatment plant for process water, then returns it to the disposal system. In addition, several utilities have permits to blend either groundwater or surface water with their reclaimed water. This supplemental water is added into the total water reuse without being treated at the facility.

Reclaimed water is one of three primary sources of cooling water for PWR Self-Supply, along with tidal water and seawater. These sources do not require a permit from SFWMD. As a result, they are not included in the demand numbers provided in **Chapter 2** and **Appendix A**. Starting in late 2010, the use of reclaimed water for power generation increased when Palm Beach County began providing the FPL West County Energy Center with reclaimed water from the East Central Regional Wastewater Treatment Facility. The average flow of reclaimed water in 2010 to the West County Energy Center was 12 MGD (FDEP 2011) (see difference in reclaimed water use between 2010 and 2011 in **Figure 49**). This flow is expected to approach 20 MGD with the reuse utility's first full year of reporting, and up to 27 MGD in the future. It should be noted that the addition of the FPL West County Energy Center as a reclaimed water customer followed the reporting period for the *2010 Reuse Inventory* (FDEP 2011), which is used as the baseline year for this document. As a result, this reuse is not reflected in the totals provided above and in **Appendix C**.

Future Reuse in the LEC Planning Area

By 2030, wastewater flows are projected to increase from 636 MGD in 2010 to an estimated 832 MGD. In addition, 42 of the 44 utilities operating wastewater facilities indicated they will be reusing some portion of their treated wastewater flow. MDWASD is proposing to provide up to 90 MGD of reclaimed water to FPL for cooling water at a planned expansion of nuclear powered generation at Turkey Point (Units 6 and 7).

In the future, several other reuse options are worth noting. Reclaimed water for irrigation will continue to be an important and expanding part of future reuse in the LEC Planning Area. In addition to the traditional reuse methods, a few other methods might be available to help meet water demands or offset potential impacts associated with future withdrawals. Reclaimed water could be used by water suppliers to recharge and replenish the network of canals found in many areas of Palm Beach, Broward, and Miami-Dade counties and reduce water deliveries from the regional water management system, especially during the dry season. These canals could act as a distribution network for the reclaimed water. Reclaimed water could also be used as a saltwater intrusion barrier preventing or delaying saltwater intrusion along the coast. Under this scenario, reclaimed water would be injected into the aquifer between the saltwater source and the supply wells. Another potential use of reclaimed water is for the benefit of the environment. This application of water reuse for environmental benefit could be accomplished in a number of ways, including the hydration of natural or created wetlands. Elsewhere, inroads to utilizing reclaimed water for direct potable supply are taking place. Singapore's NEWater facilities have been producing potable water for over a decade. In the United States, locations in California and other areas in the southwest are turning to direct potable reuse for water supply.

Several local wastewater utilities have successfully implemented some of these reuse options. Irrigation using reclaimed water is prevalent in Palm Beach County, with substantially less in Broward and Miami-Dade counties. Irrigation with reclaimed water could result in a decrease in per capita demand to the local utility if replacing the use of potable water. If groundwater or surface water use is replaced, the utility has the potential to receive a substitution credit as part of their consumptive use permit. A couple of LEC PWS utilities have substitution credits, or similar, incorporated into their current consumptive use permit. Hydration of wetlands has been successfully implemented at two projects in the LEC Planning Area, which benefits the utility by providing an environmentally friendly means wastewater disposal in addition to indirectly recharging the aquifer.

Canal recharge and saltwater intrusion barriers reuse options have not been implemented by wastewater utilities in the LEC Planning Area. Studies discussed in Chapter 4 have evaluated canal recharge and advanced wastewater treatment. The concept remains viable. Saltwater intrusion barriers have been, and continue to be, viable reuse options for coastal utilities. State and local regulatory constraints would need to be addressed for any significant progress. One benefit to the utility for using reclaimed water as a saltwater intrusion barrier might be potential impact offsets that would allow the utility to pump more water from an inland wellfield.

The most significant increase in the projected reuse is expected by the utilities impacted by the 2008 amendment to the Florida Statutes concerning use of ocean outfall for disposal. Those facilities and the state requirements are discussed in the next section.

Leah Schad Memorial Ocean Outfall Program

In 2008, the Florida Legislature enacted an ocean outfall statute (Subsection 403.086(9), F.S.) requiring the elimination of the use of six ocean outfalls in southeastern Florida as the primary means for disposal of treated domestic wastewater. In addition, the affected wastewater utilities have to reuse at least 60 percent of the outfall flows by 2025. The objectives of this statute were to reduce nutrient loadings to the environment and to achieve the more efficient use of water for water supply needs. This statute became effective on July 1, 2008.

The 2008 Leah Schad Memorial Ocean Outfall Program applies to each of the facilities/utilities that have permits to discharge through an ocean outfall. All of the wastewater/reuse facilities utilizing ocean outfalls are located in the LEC Planning Area. The facilities are as follows:

- South Central Regional Water Reclamation Facility (Delray Beach and Boynton Beach)
- Boca Raton Water Reclamation Facility
- Broward County North Regional Water Reclamation Facility
- Hollywood Southern Regional Water Reclamation Facility
- Miami-Dade North District Wastewater Treatment Plant (MDWASD)
- Miami-Dade Central District Wastewater Treatment Plant (MDWASD)

Additionally, Cooper City and the Town of Davie are permitted to discharge effluent through the outfall operated by the City of Hollywood at the Southern Regional Water Reclamation Facility. Therefore, these two local governments also have obligations to meet the outfall requirements.

Requirements of the outfall program include the following:

- Discharge through ocean outfalls must meet either advanced wastewater treatment and management by December 31, 2018, or an equivalent reduction in outfall nutrient loading.
- A functioning reuse system that reuses a minimum of 60 percent of the facility's actual flow on an annual basis installed no later than December 31, 2025.
- Timely submission of certain progress and planning summary documents.
- Inclusion of projects that promote the elimination of wastewater ocean outfalls in SFMWD's regional water supply plans.

- State or SFWMD funding assistance must give first consideration to water supply development projects that replace existing sources or implement reuse projects to eliminate ocean outfalls.

By 2025, 60 percent of wastewater discharged through ocean outfalls must be beneficially reused as defined in Chapter 62-610, F.A.C. This percentage is computed from a baseline discharge flow of the ocean outfalls from 2003 through 2007. The baseline flows and the 60 percent reuse requirement for each utility are presented in **Table 14**. The reuse requirements for Miami-Dade County facilities may be met countywide since the North District, Central District, and South District facilities are owned and operated by the MDWASD and are interconnected.

Table 14. Baseline flows and 60 percent reuse requirement for the utilities affected by the 2008 Ocean Outfall statute.

Utility	Baseline Flow (MGD)	60 Percent Reuse Requirement (MGD)
South Central Regional Water Reclamation Facility (Delray & Boynton)	12.9	7.7
Boca Raton Water Reclamation Facility	10.3	6.2
Broward County North Regional Water Reclamation Facility	37.4	22.4
Hollywood Southern Regional Water Reclamation Facility	36.7	22.0[a]
Cooper City Wastewater Treatment Facility	1.5	0.9
Davie Wastewater Treatment Plant	1.9	1.1
Miami-Dade North District Wastewater Treatment Plant (MDWASD)	81.0	117.5
Miami-Dade Central District Wastewater Treatment Plant (MDWASD)	114.8	
Totals	**296.5**	**177.8**

a. Includes 1.6 MGD for the City of Miramar Water Reclamation Facility.

Each of the utilities using ocean outfalls submitted an annual report on July 1, 2013 to FDEP on the implementation of the ocean outfall statute. The utilities continue to implement and plan for these changes. The status of those changes for each of the ocean outfall utilities is as follows:

- **<u>South Central Regional Water Reclamation Facility</u> –** A deep injection well was installed to handle disposal. The ocean outfall will now only be used as a backup for emergencies. Sixty percent water reuse requirement is expected to be met by primarily increasing public access irrigation in the cities of Boynton Beach and Delray Beach.
- **<u>Boca Raton Water Reclamation Facility</u> –** The city is planning to increase capacity of its facility to provide 100 percent reuse. Reclaimed water will be provided for public access irrigation at additional locations in, or near, the city.

- **Broward County North Regional Water Reclamation Facility –** Broward County is planning to meet the 60 percent reuse requirement by expanding its public access irrigation in northern Broward and southern Palm Beach counties, including expanding reuse systems in the cities of Pompano Beach and Coconut Creek.
- **Hollywood Southern Regional Water Reclamation Facility –** Hollywood is planning to inject the upper Floridan aquifer with reclaimed water to meet the 60 percent reuse requirement.
- **Cooper City Wastewater Treatment Facility –** It is anticipated that Cooper City will be working together with one of its neighboring utilities to meet the ocean outfall requirements.
- **Davie Wastewater Treatment Plant –** Davie is in the process of constructing a city-owned water reclamation facility, thereby reducing the amount of wastewater effluent it sends to the Hollywood Southern Regional Water Reclamation Facility. Reclaimed water from the new facility will be reused for public access irrigation in the city, and to meet the ocean outfall requirements.
- **Miami-Dade North, Central, and South District Wastewater Treatment Plants –** The MDSAWD is planning a combination of alternatives to meet the 60 percent reuse requirement. These alternatives include providing up to 90 MGD of reclaimed water to the FPL Turkey Point Plant for cooling water, and injecting the upper Floridan aquifer.

Reclaimed Water Legislation

In 2012, the Florida Legislature amended Section 373.250, F.S. The amendments required FDEP to initiate rulemaking to incorporate criteria for the use of "substitution credits" and "impact offsets" when a water management district is reviewing a water use permit application. Impact offsets are derived from the use of reclaimed water to reduce or eliminate a harmful impact that has or would otherwise occur as a result of a surface or groundwater withdrawal. A substitution credit means the use of reclaimed water to replace all, or a portion of, an existing permitted use of a resource-limited surface water or groundwater, allowing a different user or use to initiate a withdrawal or increase its withdrawal from the same resource-limited water resource. Legislation in 2013 amended the 2008 Ocean Outfall statute and included that the LEC Plan must evaluate reuse demand in the context of future water supply demands, and recommend adjustments, as necessary to, the reuse requirements in the act. Prior to this legislation, SFWMD has considered the utilization of reclaimed water and its benefits in assessing proposed withdrawals during the water use permitting application process, and will continue to do so. Water management districts are in the process of modifying their rules, as needed, to be consistent with the amendments to Section 373.250, F.S., and amendments to FDEP's Chapter 62-40, F.A.C.

Supplemental Sources to Meet Reuse Demand

In some service areas, the demand for reuse exceeds the volume of wastewater treated by the utility. Meeting demands with reclaimed water may require the use of supplemental water supplies such as surface water, groundwater, or potable water, which enable a utility to maximize use of reclaimed water. However, during times of drought, other water sources, such as surface water, groundwater, or potable water, may not be available to supplement reclaimed water supplies. Use of supplemental water supplies is subject to water use permitting by SFWMD. The availability of these supplies to supplement reclaimed water will be evaluated on an application-by-application basis.

Two LEC Planning Area utilities used supplemental water in their water reuse systems in 2010. Usage (flow) is expressed in terms of annual average MGD, but tends to be greater during the dry season and less during the wet season. The Seacoast Utility Authority used a combination of surface water (0.7 MGD), drinking water (0.2 MGD), and groundwater (0.2 MGD) for supplementation. The City of Boca Raton used 0.6 MGD of supplemental groundwater in their water reuse system.

STORAGE: SURFACE WATER AND GROUNDWATER

Storage is an essential component of any supply system experiencing fluctuation in supply and demand. Capturing surface water and groundwater during wet conditions for use during dry conditions increases the use of available water. Two-thirds of South Florida's annual rainfall occurs in the wet season. Without sufficient storage capacity, much of this water discharges to tide through surface water management systems and natural drainage. In the LEC Planning Area, potential types of water storage include ASR wells, reservoirs, and surface water impoundments and ponds.

Aquifer Storage and Recovery

ASR is the underground storage of injected water into an aquifer. Water is collected during times when it is plentiful, typically during the wet season in South Florida, and pumped into an aquifer through a well that is also used for subsequent recovery of the water. In South Florida, most ASR systems store treated water in the FAS, which contains brackish water. When recharged into the aquifer, the stored water displaces the brackish water. The aquifer acts as an underground reservoir for the injected water. ASR provides for storage of large quantities of water for long-term storage and ultimate recovery that would otherwise be unavailable due to land limitations, lost to tide, or evaporation.

Potable water, surface water, groundwater, or reclaimed water can be stored using ASR technology. The quantity and quality of water recovered depends on subsurface conditions, such as the transmissivity of the aquifer or the ambient water quality within the aquifer. The level of treatment required after storage and recovery depends on whether the water is for public consumption, irrigation, surface water augmentation, or wetlands enhancement.

The volume of water made available through ASR wells depends on factors such as well yield, water availability, variability in water supply and demand, background water quality in the ASR well's storage zone, and use type. Uncertainty of storage and yield capabilities and water quality characteristics present associated risks for success.

To date, thirteen ASR systems have been constructed by ten different utilities and by the USACE and SFWMD within the LEC Planning Are (**Figure 50**). Many of these ASR wells store treated drinking water, although other source waters stored include raw groundwater, and raw or partially-treated surface water.

The 2010 revision of the arsenic standard from 50 to 10 parts per billion added uncertainty to obtaining an operation permit from FDEP for ASR systems. As a result of this uncertainty, some utilities opted to convert the ASR wells to raw water supply wells, used solely for withdrawing water from the Floridan aquifer for blending with other water sources in the treatment system.

Since the publication of the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2007), the City of Boynton Beach, MDWASD, and Florida Keys Aqueduct Authority (FKAA) constructed new ASR test and monitoring wells. The new Boynton Beach ASR well is now in service and represents the utility's second operating ASR well. The MDWASD has five ASR wells and associated monitoring wells at their West and Southwest wellfields. Most recently, MDWASD installed ultraviolet disinfection systems on their ASR wells and anticipate cycle testing during 2013. The results from the FKAA well indicated that subsurface conditions at the water treatment plant site were not conducive to ASR implementation. As a result, FKAA converted this well to a supply well for their RO facility.

Aquifer Storage and Recovery Investigations

To further the understanding of storing injected water into an aquifer, several investigations were conducted.

CERP ASR Pilot Projects

SFWMD and the USACE are conducting pilot tests on two ASR systems within SFWMD boundaries to evaluate the feasibility of ASR for the large-scale storage of surface water as part of the Comprehensive Everglades Restoration Plan (CERP). The Hillsboro ASR Pilot Project, located in western Boca Raton, recently completed three test cycles. The pilot facility recharged treated surface water into the FAS, at a depth of approximately 1,000 feet below sea level. Prior to recharge, the surface water passed through a coarse screen filter and was disinfected via ultraviolet radiation. The test cycles consisted of recharge periods between 30 to 90 days (at a daily rate of 5 MGD), storage periods from 0 to 80 days, and recovery set to limits defined by a National Pollutant Discharge Elimination System permit for the Hillsboro Canal.

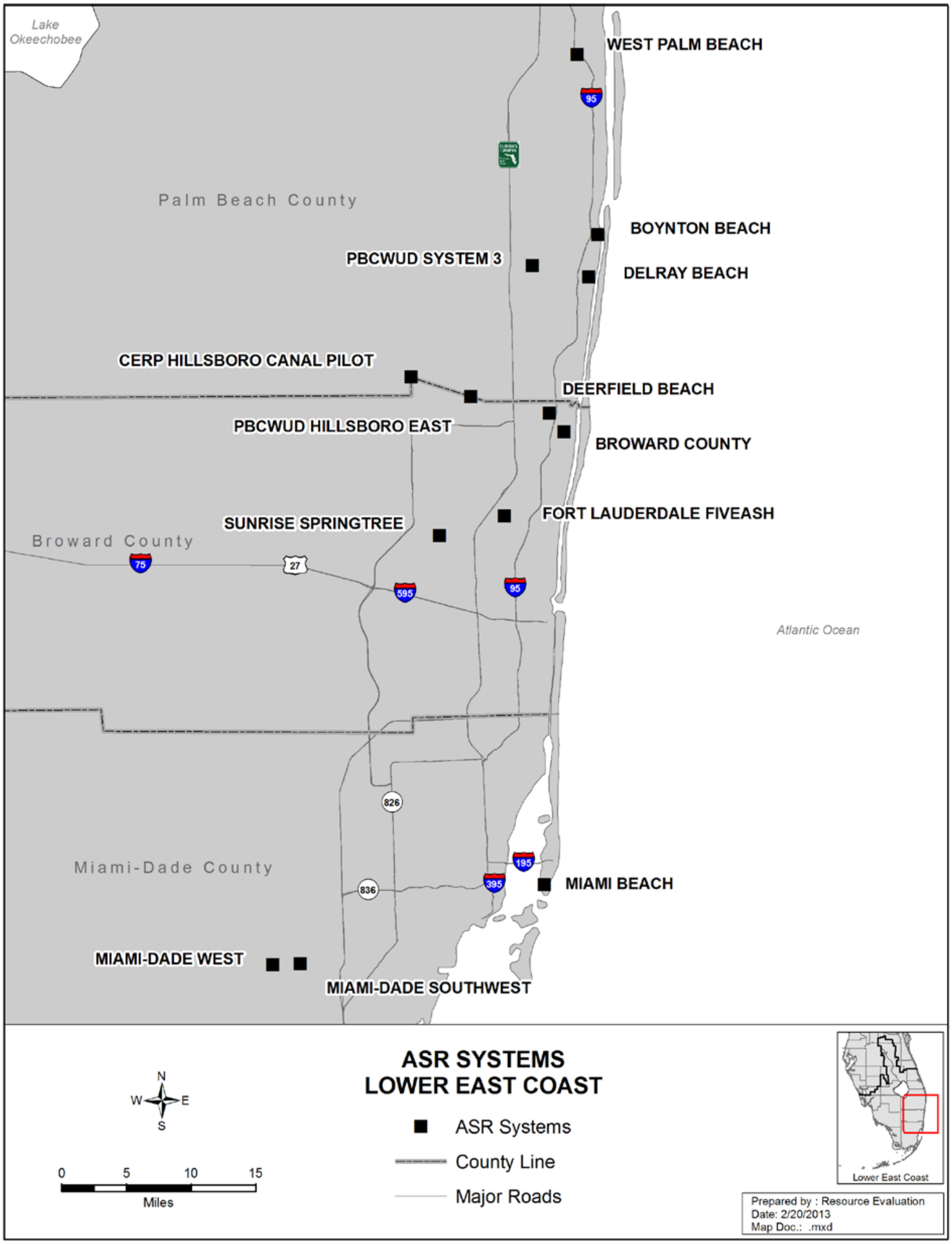


Figure 50. Location of ASR systems within the LEC Planning Area.

The results of the Hillsboro ASR Pilot Project indicate that high capacity ASR wells, on the order of 5 MGD per well, can be successfully installed and operated in this vicinity. Recovery efficiencies ranged from approximately 20 to 40 percent, which is not uncommon for the initial test cycles at ASR systems in the LEC Planning Area. Further improvement in the recovery efficiencies would be anticipated with continued cycling testing and investment in a freshwater “target storage volume” near the ASR well. A technical report on the CERP Hillsboro ASR Pilot Project is expected in 2013.

The second CERP ASR project is located in Okeechobee County at the confluence of the Kissimmee River and Lake Okeechobee. The pilot operation of this 5 MGD facility is scheduled to be completed in mid-2013. Recent test cycles produced 100 percent recovery and resulted in reduced phosphorus concentrations.

CERP ASR Regional Study

The results of the individual CERP ASR pilot projects will be integrated into the CERP ASR Regional Study, which is designed to address regional technical issues associated with the CERP ASR program beyond the scope and budget of the ASR pilot projects. Of the 68 project components recommended in CERP, seven recommended inclusion of up to 333 ASR wells. These include the Lake Okeechobee ASR (200 wells), Caloosahatchee (C-43) Reservoir ASR (44 wells), L-8 Basin ASR (10 wells), C-51 Canal ASR (34 wells), Central Palm Beach County (Agricultural Reserve) Reservoir ASR (15 wells), and Site 1/Hillsboro ASR (30 wells). Additional ASR wells are under consideration for inclusion in conjunction with other CERP projects.

The exact number of wells has not been finalized. In addition, the final number and disposition of all proposed ASR wells will be determined through scientific investigations conducted under the ASR Regional Study, the associated ASR pilot projects, and required project implementation report studies for each CERP ASR component. This project's major elements are a technology inventory, field data collection, geotechnical and geophysical evaluations, laboratory analysis, groundwater modeling, surface water modeling, water quality monitoring, and ecological assessments. The ASR Regional Study should be complete approximately one year after the completion of the ASR pilot projects, which is anticipated to be by 2014. The report will include conclusions regarding the actual quantity of ASR wells that may be feasible and recommendations on implementation of future components of the CERP ASR program.

ASR Pretreatment Investigation

This project investigated methods to suppress the mobilization of arsenic from the aquifer-rock matrix that is associated with ASR activities. The City of Bradenton, the Southwest Florida Water Management District, the St. Johns River Water Management District, and SFWMD (through CERP) cooperatively funded this project. The pilot project began in 2008 and ended in 2012. The project consisted of 1) evaluation of arsenic mobilization processes occurring during ASR activities, 2) bench-scale studies on storage zone cores, and 3) development of a degasification “pretreatment” system to remove dissolved oxygen from source water prior to recharge into an ASR well. The results of the investigation indicated the removal of dissolved oxygen from the recharge water successfully resulted in the elimination of arsenic mobilization within the aquifer. These findings are significant in that they represent a technical solution to the arsenic mobilization issue associated with some ASR systems.

CERP ASR Program Interim Report

In 2008, the *Aquifer Storage and Recovery Program Interim Report 2008* was published (SFWMD and USACE 2008). The report presented findings from the first seven years of technical studies conducted by the CERP ASR Program. Among the data presented were the progress of the ASR pilot projects, exploratory well drilling, water quality monitoring, geotechnical investigations, and geophysical surveys. The report also presented the development of ASR groundwater models, geochemical analyses, and ecological evaluations. At the time the report was published, no "fatal flaws" were uncovered that might hinder the implementation of ASR in South Florida, and that additional studies were warranted to fully evaluate the full-scale implementation of ASR technology as originally envisioned in CERP. The document is available at www.evergladesplan.org/pm/projects/pdp_32_33_34_44_asr_combined.aspx.

Local and Regional Reservoirs

Surface water reservoirs provide storage of water, primarily captured during wet weather conditions, for use in the dry season. Water is typically captured and pumped from rivers or canals and stored in aboveground or inground reservoirs. For example, individual farms use small-scale (local) reservoirs for storage of recycled irrigation water or the collection of local stormwater runoff. These reservoirs may also provide water quality treatment before off-site discharge. Large-scale (regional) reservoirs are used for stormwater attenuation, water quality treatment in conjunction with STAs, and storage of seasonally available supplies.

New surface reservoirs constructed near canals or surface water bodies are referred to as off-stream reservoirs. The concept of storing excess surface water runoff in regional reservoirs generated significant interest in the northern portion of the LEC Planning Area. The proposed C-51 Reservoir is an example of an off-stream, regional reservoir. Water resource development projects designed to capture, treat, and store water are discussed in **Chapter 4**.

C-51 Reservoir Project

A mining operation is under way that may provide an additional 75,000 acre-feet of storage, if converted to the C-51 Reservoir. SFWMD, Lake Worth Drainage District, Palm Beach Aggregates, and PWS utilities jointly investigated the feasibility of using these facilities to capture and store excess surface water runoff from the C-51 Basin for beneficial uses. Structures, pumps, and canals would be constructed to deliver water to and from the reservoir. The amount of water available to the reservoir would be supplemented by pumping water from eastern C-51 Basin at the S-155A structure into the western basins. Capturing this water would reduce discharges to the Lake Worth Lagoon. The water would then be pumped into the reservoir during wet periods and released into the C-51 Canal during dry periods to meet future demands for water users. This operation is based on modeling conducted for the *C-51 Reservoir – Preliminary Design and Cost Estimate Final Report* (Lake Worth Drainage District et al. 2013). At full construction, the reservoir could be capable of producing 185 MGD of water during the dry season in a 1-in-10 year drought.

LEC Planning Area utilities are currently evaluating a variety of potential implementation and funding options for the project. SFWMD continues to explore a potential operational role. Over time, SFWMD's role may evolve, depending on Governing Board direction. Recently, a memorandum of understanding between SFWMD and Palm Beach Aggregates was executed to identify the responsibilities of each in moving the project forward. The memorandum of understanding describes the responsibilities for design, finance, construction, conveyance, assistance in permitting and, eventually, operation of the project. As part of this process, the Broward County Board of County Commissioners approved creation of the C-51 Governance and Finance Workgroup. If permitted and constructed, the C-51 Reservoir could be available to LEC Planning Area utilities as a water supply option. To utilize this as a water source, utilities would have to revise their water use permits and address applicable regulatory criteria.

SEAWATER

The use of desalinated seawater from the Atlantic Ocean is an additional water source option for the LEC Planning Area. SFWMD does not require a user to obtain a water use permit for the use of seawater. The ocean is an essentially unlimited source of water; however, desalination is required before use of seawater for water supply purposes. Desalination treatment technologies include distillation, RO, or electrodialysis reversal. RO is currently the most utilized desalination technology in the LEC Planning Area. To date, two RO seawater desalination treatment plants are located within the LEC Planning Area. Both plants are located in Monroe County and operated by FKAA, and have a combined supply capacity of 3 MGD to the lower Florida Keys. One is located on Stock Island—the first desalination plant built in Florida—and the other is located in Marathon. However, the largest seawater desalination facility in Florida is the Tampa Bay Seawater Desalination System, which provides up to 25 MGD of drinking water to southwestern Florida.

Significant advances in treatment and efficiencies in seawater desalination occurred over the past decade. As a result, seawater treatment costs are declining. The cost of stand-alone seawater desalination facilities remain moderately higher than brackish water desalination. The cost of seawater desalination facilities co-located with coastal power plants result in additional cost savings, further decreasing the cost difference compared to other alternative water supply sources. In December 2006, SFWMD completed a feasibility study, *Technical and Economic Feasibility of Co-located Desalination Facilities*, for co-locating seawater treatment facilities with power plants in South Florida (Metcalf & Eddy 2006). The study concluded that the most feasible three sites are co-located with FPL facilities in Fort Myers, Fort Lauderdale, and Port Everglades. For additional information about desalination costs, see the Support Document.

WATER CONSERVATION

Water conservation is an integral part of water supply planning and water resource management. For planning purposes, water conservation is considered a water source option because it can reduce, defer, or eliminate the need for expansion of the water supply infrastructure. This section describes water conservation opportunities, programs, and tools available to users in the LEC Planning Area. Additional supporting information can be found in **Appendix D** and Chapter 5 of the Support Document.

Comprehensive Water Conservation Program

In 2008, SFWMD's Governing Board approved the Comprehensive Water Conservation Program. This program is organized into three initiatives: 1) regulatory, 2) voluntary and incentive-based, and 3) education and marketing (SFWMD 2008). Each of these initiatives has corresponding goals and specific yet adaptable implementation strategies. The overarching vision of the program is to achieve a measurable reduction in water use, inspire governments, citizens, and businesses to value and embrace a conservation ethic, and serve as a model for water conservation. Though the SFWMD is fully committed to implementing the action steps identified in the Comprehensive Water Conservation Program, it is independent from the consumptive use permitting process and is nonbinding. The scope and implementation schedule of the action steps outlined in the Comprehensive Water Conservation Program are subject to funding levels and voluntary participation by public water suppliers and other participating groups.

Public Water Supply

For PWS, one key indicator of long-term water conservation effectiveness is decreasing daily per capita use rates over time. A per capita use rate is calculated as PWS finished water demand in gallons per day divided by the number of permanent residents. While the per capita use rate is an effective measure of conservation effectiveness for a single community or utility over time, it is less effective when comparing communities or utilities to each other. Significant differences between communities, such as the quantity of industrial use, seasonal populations, and other demographic differences can affect the total amount of water used by a community. **Table 15** presents weighted average utility per capita use rates by county for 2000, 2005, and 2010. **Table 15** shows a downward trend in the per capita use rates. This reduction in water use reflects, in part, an emerging water conservation ethic. Utility-driven plumbing retrofit programs, building code standards, public education, and the effects of SFWMD and local government year-round irrigation rules all contributed to the reduction in finished water use. In addition, there are external factors that can affect measured per capita rates and trends. These include the passive replacement of inefficient water using devices for efficient ones, recent declines in the economy, fluctuating population demographics of an area (e.g., persons per household and vacancy rates) the local climate, and regional droughts. SFWMD's objective is to continue this downward trend by working with water users and PWS providers to achieve significant long-term water savings.

These external factors mentioned above make calculating the per capita reduction due to conservation highly complex. Modeling tools, such as those mentioned below and in the Support Document, are capable of accounting for many of these factors, but are predictive in design. Using those tools to retroactively examine past per capita trends for the purpose of isolated effects of conservation apart from any external factors may be possible, but would require significant modification of the tools.

For an expanded discussion about estimating the effects of water conservation, see the Support Document. **Appendix D** provides the status for PWS water conservation programs for municipalities and water utilities in the LEC Planning Area.

Table 15. Per capita use rates in gallons in the LEC Planning Area for PWS finished water.

County	Per Capita Use Rates (gallons)		
	2000	2005	2010
Palm Beach	219	203	166
Broward	153	139	123
Miami-Dade	168	157	140
Monroe	216	211	109
LEC Planning Area Weighted Average	**176**	**163**	**142**[a]

a. Reflects variations in demand by permanent and seasonal populations.

Comparing per capita use rates from utility to utility or county to county is challenging. Along with the conservation, economic conditions, and landscape rules mentioned earlier, additional factors that affect these use rates include the following:

- Changing demographics of a community (such as ages and persons per household)
- Location of community—is the quality of the surface water or shallow aquifer sufficient to be used for landscape irrigation?
- Availability of reclaimed water
- Age of home—newer homes generally have landscape irrigation systems
- Local ordinances that promote or restrict the use of potable water for landscape irrigation
- Number of seasonal visitors/residents

Water Conservation versus Alternative Water Supply Options

Meeting future water demand may require a blend of developing new alternative water supplies and increased water conservation. While most water supply development options require significant upfront investments and ongoing maintenance costs to expand water supply capacity, conservation can be the least costly means to reduce demand met by existing water supply capacity. **Table 16** compares the costs of developing 1,000 gallons of water supply through new facility construction or the expansion of an existing facility, and the costs of saving 1,000 gallons through water conservation.

Table 16. Comparison of alternative water supply development costs and water conservation costs for 1,000 gallons.

Water Conservation	New Facility Construction				Expansion of Existing Facility			
Typical Retrofit/ Replacement Programs	Nanofiltration Capacity		Low Pressure RO Capacity		Nanofiltration Process Train Capacity		Low Pressure RO Train Capacity	
	1 MGD	5 MGD	1 MGD	5 MGD	1 MGD	5 MGD	1 MGD	5 MGD
\$0.40 – \$3.00	\$9.46	\$3.42	\$11.33	\$4.41	\$9.07	\$3.13	\$10.38	\$3.69

Water conservation projects exceeding \$3.00 per 1,000 gallons of water saved are typically not implemented by utilities because that is the point where developing alternative water supplies can become price competitive. Therefore, projects with costs above this threshold were not included in this comparison.

PWS-Sponsored Conservation Programs and Tools

Typical PWS-sponsored water conservation programs support the purchase and installation of high efficiency plumbing and irrigation fixtures, the production of educational campaigns, and the adoption of conservation-related ordinances and codes. Additionally, many of the options prescribed for PWS users are also applicable for DSS users. SFWMD supports PWS water conservation efforts through the implementation of programs mentioned below. PWS utilities are encouraged to operate treatment facilities in a highly efficient manner including ongoing leak detection and repair campaigns.

Efficient Water Using Technology & Hardware

Many PWS-sponsored programs have incentives for the replacement of older, less efficient indoor plumbing fixtures, such as toilets, faucet aerators, showerheads, and restaurant pre-rinse spray valves. These programs are often implemented through rebates, trade-ins or give aways, depending on the technology and the target audience. Similar programs focus on reducing outdoor water use through the dissemination of efficient irrigation spray heads, rain and soil moisture sensors, and computerized irrigation controllers. These related hardware and technology-related programs are often accompanied by an end user educational component to “lock in” savings and reinforce a conservation ethic.

The United States Environmental Protection Agency developed a program called WaterSense designed to protect the future of our nation's water supply by promoting water efficiency and enhancing the market for water efficient products, programs, and practices. When designing and planning a retrofit program, SFWMD recommends utilities and municipalities refer to the WaterSense program for standards, criteria, and information. More information about this program is available from the WaterSense website, www.epa.gov/WaterSense/.

Upon request, SFWMD can provide technical assistance on water efficient technology and hardware. In addition, SFWMD administers a cost-sharing program accessible to local governments and utilities, homeowner associations, and commercial entities for technology and hardware-based conservation programs through the Water Savings Incentive Program (WaterSIP). Additional information on WaterSIP can be found in **Chapter 6**, **Appendix D**, and the Support Document.

Certification and Recognition Programs

Many public water suppliers support programs that recognize end user water conservation efforts. Some of these programs, which are referred to as certification programs, are driven by specific criteria that aim to improve efficiency in certain areas of water use. SFWMD implements and supports several recognition and certification programs. These programs include the following: 1) Water Conservation Hotel and Motel Program (Water CHAMP), which recognizes water efficiency efforts made by the lodging industry; 2) Florida Water Star program, which certifies existing buildings have been built or retrofit to high water efficiency standards; and 3) Florida-Friendly Yard program, which is administered by the University of Florida’s Institute of Food and Agricultural Sciences extension office. Additional information on these programs can be found in the Support Document.

Regulatory Initiatives

Ordinances and other regulatory measures can be a low cost means to significantly advance water use efficiency. Section 373.62(1), F.S requires the installation, operation, and maintenance of a rain sensor device that overrides the cycle of an irrigation system when adequate rainfall has occurred. Conservation-related ordinances that local governments can adopt include those requiring greater water use efficiency in construction, such as the International Green Construction Code and standards derived from the Florida Water Star program and the Florida Green Building Coalition, and landscaping and irrigation, such as the Florida-Friendly Landscape Ordinance and SFWMD’s Year-Round Landscape Irrigation Rule. One advantage of ordinance and code adoption is that they can be adopted wholesale or piece meal depending on pre-existing conditions in the locality. It is the responsibility of local governments to enforce compliance with landscape irrigation rules and ordinances.

In March 2010, the Mandatory Year-Round Landscape Irrigation Conservation Measures Rule (Chapter 40E-24, F.A.C.) became effective. Broadly, this rule limits irrigation of existing landscapes to two days per week with a three-day-per-week provision for counties wholly located within SFWMD’s jurisdictional boundaries, including Palm Beach, Broward, Miami-

Dade, and Monroe counties. The rule also provides local governments across the region the flexibility to adopt alternative landscape irrigation ordinances that are at least as stringent as SFWMD's rule. The Mandatory Year-Round Landscape Irrigation Conservation Measures does not supplant the SFWMD Regional Water Shortage Plan (Chapter 40E-22, F.A.C.). It contains water shortage restrictions related to specific water bodies, including Lake Okeechobee. Further information on water shortage management is available in the Support Document.

In accordance with Section 373.185, F.S, the SFWMD encourages all local governments to adopt an ordinance or amend a current ordinance to require Florida-Friendly Landscaping for all future development. SFWMD provides a model ordinance and technical support for local governments seeking to adopt a Florida-Friendly Landscaping ordinance or an irrigation ordinance consistent with Chapter 40E-24, F.A.C.

The state of Florida has undertaken an initiative, under the direction of FDEP, to bring more consistency to the consumptive use permitting programs implemented by the water management districts. Part of that initiative currently being contemplated entails making changes to the rules affecting conservation requirements for the PWS use class. It is not known at the time of this writing what changes in the permitting criteria will ultimately be made. Regardless of the required permitting criteria for water conservation, SFWMD will continue working with utilities utilizing voluntary conservation initiatives and providing assistance with goal-based planning, the use of analyses tools, and matching funding for conservation projects under SFWMD's WaterSIP program.

Water Conservation Rate Structures

Water pricing is one of the most effective means to promote water conservation. A water conservation-based rate structure provides a financial incentive to reduce use. In the LEC Planning Area, the majority of PWS providers have a block rate structure (also referred to as a "tiered" rate structure) in place. The block rate structure is generally expected to have the largest impact on heavy irrigation users. If properly structured, a tiered rate system can have a minimal impact on utility revenue. The customer's responsiveness to water conservation rate structures depends on the existing price structure, incentives of the new price structure, the customer base, and their water uses. For more information on rate structures please refer to **Appendix D**.

Education, Outreach, and Marketing

Education, outreach, and marketing are essential to accomplish a measurable change in water conservation and instill a lasting conservation ethic in South Florida businesses and communities. PWS are encouraged to have a robust and comprehensive conservation educational program. SFWMD continues to implement and support a wide variety of programs designed to build a conservation ethic and permanently reduce individual and commercial water use. Information on these programs is provided in the Support Document. **Appendix D** contains the implementation status of public education programs for PWS utilities in the LEC Planning Area.

Goal-based Water Conservation Plans

A goal-based water conservation program is a longer-term water use reduction program that has a specified numerical water use target. The target is expressed in per capita use or quantifiable volume of water saved. Because a well-designed goal-based conservation program can lower peak demands in addition to reducing overall per capita water use, they can help a utility meet future water supply demands without building new facilities or wells. In addition to being cost-effective, when properly planned and monitored, conservation can be as reliable as an alternative water supply source in many cases. A well designed program identifies a variety of methods and practices along with anticipated costs, savings, and estimates of revenue impacts that decrease water demand to meet numeric goals. The practices selected should reflect, among other parameters, the service area's population projections, existing per capita use, participation rates, existing housing stock, and the current and anticipated service area's water use profile. SFWMD recommends regular review and analysis of plan results, which allow for program adjustments as needed to meet water conservation goals. A good example of a goal-based water conservation plan is the *Miami-Dade County Water Use Efficiency 20-Year Plan* (Miami-Dade County 2007), which is described in greater detail in **Appendix D**.

Water Conservation Program Planning Tools for Public Water Supply Utilities

PWS utilities are strongly encouraged to use a water conservation planning tool when creating a goal-based water conservation program. In general, water conservation planning tools can help a utility develop a service area water use profile, evaluate and compare the costs and benefits of various conservation measures, show projected water savings, and create a mid- to long-range conservation (or demand management) plan. Some of these tools match actual billing data to property appraiser parcel data while others use proxy data.

The tools being developed today are highly comprehensive, accounting for many factors that affect per capita water use and conservation such as the (passive) replacement of old fixtures with new ones outside of utility-driven conservation programs. In addition, some tools identify specific points of capacity deferment and present value benefits, and calculate utility revenue and rate impacts.

Upon request, SFWMD provides support and assistance to utilities to access and apply these types of tools and creating service area demand management plans. Detailed descriptions and explanations on where to find two such tools—the Conserve Florida Water Clearinghouse's EZ Guide (EZ Guide) and the Alliance for Water Efficiency's Conservation Tracking Tool—can be found in the Support Document. The St Johns River Water Management District recently developed the Florida Automated Water Conservation Estimation Tool. This tool uses linear programming to process account-level billing data, county property appraiser information, and Florida Department of Revenue land use codes to develop customer water use profiles within utility service areas. Proxy data can be used to estimate consumption by individual accounts in the absence of actual billing data. The tool generates an optimized list of water conservation BMPs, as well as a geographic information system map of all customers in each consumption block. SFWMD will be using this and other similar tools in the future to conduct regional analysis of conservation. Conservation staff from SFWMD can assist public water suppliers to access and apply these tools to conduct similar analyses of their service areas.

Regional Approach to Water Conservation (Broward Water Partnership)

Smaller utilities may find it advantageous to create partnerships with other utilities in implementing water conservation projects or programs. This type of consortium may be able to capitalize on bulk buying and other economy of scale benefits by pooling and sharing resources. One such consortium is the Broward Water Partnership. This is a government service currently consisting of 18 municipalities and water utilities. The goal of the partnership is to achieve at least a 10 percent reduction in countywide water demand. The partnership was initiated in 2011 with the intent to provide regional programming, including rebates and other incentives, for high efficiency plumbing fixtures and messaging to residential and commercial water users. It is estimated that up to 30 MGD may be saved by this program by 2030. More information on the partnership can be found at www.conservationpays.com and the participating utilities' summaries in **Chapter 6**.

Agricultural Use

Agriculture is the second largest water user in the LEC Planning Area. As such, the AGR Self-Supply water use category offers significant water conservation potential. The water use permitting process bases water allocations for agriculture on a number of factors, including the crop type, growing and irrigation methods, and site-specific parameters such as soil type and anticipated rainfall. Because a number of these factors are fixed, demand reduction must be based on aspects that can be changed, such as irrigation and growing methods. Generally, these types of changes are expensive and require extensive planning and consideration. Because of the costs associated with moving water, which affects the profitability of the overall crop, it is assumed that most farmers are as efficient as practicable with their water use.

SFWMD requires new citrus and container nursery projects to use microirrigation systems or other systems of equivalent efficiency. Flood/seepage irrigation type systems are typically used for tomato, corn, rice, and sugarcane production. While flood/seepage irrigation systems are not as efficient as microirrigation, tailwater recovery can be applied. It is considered a water use efficiency measure that may be used on individual projects, depending on applicability, and does provide some recharge to the SAS. Most projects located within the EAA utilizing flood/seepage irrigation have unique conditions that allow for a more efficient use of water as the water is passed from farm to farm. For permitting purposes, a higher than normal efficiency value was applied for most of the flood/seepage projects located within the EAA. Projects in the EAA may not benefit as greatly, from a water conservation perspective, from the installation of a tailwater recovery systems when compared to other projects outside the EAA.

Agricultural Best Management Practices

Agricultural BMPs are actions agricultural businesses can take to protect or improve water quality or quantity while maintaining or even enhancing agricultural production. The Florida Department of Agriculture and Consumer Services and FDEP develop and adopt BMPs by rule for different types of agricultural operations, specific regions, or statewide. Most BMPs in the region are established to improve water quality; however, some contain an implicit water conservation component.

BMPs identified as having implicit water conservation benefits include tailwater recovery, land leveling, observation wells, regular system maintenance and evaluation, irrigation scheduling, irrigation system design, and irrigation efficiency. Tailwater recovery is a planned system to capture and recycle irrigation and storm water that runs off the field. Land leveling allows for a more uniform and efficient application of irrigation water. Observation wells provide a visual indication of surficial groundwater levels for sub-irrigation systems and can be used to optimize soil moisture while minimizing water use. Irrigation efficiency can be improved by either replacing an outdated or inefficient irrigation system or by optimizing the operations and maintenance of an existing irrigation system. The selection of a new system depends on the type of crop, soil, water source, and water availability. A review of irrigation scheduling—time between irrigation events and amount of water applied—might result in an increase of irrigation efficiency. Farmers can also use soil moisture sensors and weather-based irrigation controllers to customize irrigation based on site-specific soil and weather conditions. The volume of water that can be conserved on any individual project as a result of implementation of any of these voluntary BMPs is difficult to estimate.

Agricultural Mobile Irrigation Labs

Agricultural mobile irrigation labs evaluate the performance of irrigation systems and encourage the adoption of efficient irrigation management practices that conserve water. Three agricultural mobile irrigation labs service the LEC Planning Area and are managed and administered by the Soil Water Conservation Districts in Palm Beach, Broward, Miami-Dade, and Hendry counties. From 2006 to the third quarter of 2012, evaluations were conducted on 8,893 agricultural acres in the LEC Planning Area. Total water savings of 2.95 MGD has been estimated based on follow-up evaluations to a small number of farms.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program, implemented through the United States Department of Agriculture – Natural Resources Conservation Service, was reauthorized in the Farm Security and Rural Investment Act of 2002 to provide a voluntary conservation program for farmers and ranchers. The program promotes agricultural production and environmental quality as compatible national goals. Financial and technical assistance is offered to eligible participants to install or implement structural and management practices that address impaired water quality and conservation of water resources on eligible agricultural land. For example, reduction of soil erosion and sedimentation can have a positive impact on water quality and improve irrigation efficiency. During Fiscal Years 2009 and 2010, 28 farms encompassing approximately 12,000 acres participated in the program in the LEC Planning Area.

Recreational/Landscape Use

Recreational/Landscape water use includes water used to irrigate parks, athletic fields, golf courses, landscaped areas (e.g., homeowner association common areas and the areas around malls and office buildings), roadway medians, and cemeteries. The demand for water used for this purpose generally increases at a rate similar to population growth. While many recreational landscapes in the LEC Planning Area are self-supplied and irrigated drawing from either an on-site well, retention pond, canal, or even reclaimed water, many others are irrigated using potable utility-supplied water. In any case, some of the tools and programs mentioned throughout this chapter can be employed to increase efficiency and reduce wasteful use by self-supplied and PWS-supplied water users alike.

Demand reduction is possible through the use of increasing efficacy of landscape irrigation, which includes Florida-Friendly Landscaping principles, rain sensors, advanced irrigation technology, proper irrigation system design and scheduling, and maintenance of automatic irrigation systems. Other on-site options include capture of gray water or storm water in rain barrels or cisterns. The deployment of mobile irrigation labs can help residents and commercial water users identify areas where and how the aforementioned and other system efficiencies can be greatly improved. Information on smart irrigation technologies and mobile irrigation labs can be found in the Support Document.

Golf Courses

One of the largest subclass of users in the Recreational/Landscape water use category are made up of golf courses (37 percent of the region's total recreational water demand). As of 2010, 184 permitted golf courses (totaling 27,500 acres) were located within the LEC Planning Area. Estimated annual gross irrigation demand is 80 MGD.

Many golf courses currently employ best management and design practices and new irrigation technologies, including rain sensors or soil moisture sensors and weather-based irrigation system controllers, to maintain a high degree of water use efficiency. Golf courses using antiquated equipment should consider upgrading to the latest irrigation control technology and the use of Florida-Friendly Landscaping principles wherever feasible. For some projects, funding assistance through WaterSIP may be available to golf courses.

Industrial, Commercial, and Institutional Use

For many PWS, industrial, commercial, and institutional water users typically make up a relatively small number of accounts, yet make up a large proportion of a utility service area's water use profile. Working with this sector, therefore, presents an opportunity to have a significant impact on decreasing finished water demands by working with a lower number of users relative to other use categories. While many industrial, commercial and institutional users in the LEC Planning Area are self-supplied (i.e., draw water from either an on-site well, retention pond, canal, or even reclaimed water), some use potable utility-supplied water. The tools and programs mentioned throughout this chapter can be employed to increase efficiency and reduce wasteful use.

To assist industrial, commercial, and institutional users to improve water use efficiency, SFWMD published the *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities, A Guide for Facility Managers* (SFWMD 2013b). This guide assists facility managers through detailed self-conducted water use assessment procedures and evaluation of water usage and potential for conservation for the most common points of water use at commercial or institutional facilities. Utilities are encouraged to incorporate this guide into their outreach efforts toward commercial and institutional water users. The guidebook and its companion water use and savings calculators are available free for download from SFWMD's conservation webpage (www.savewaterfl.com) under Businesses.

Water Conservation Summary

Cooperative water conservation efforts among water users, utilities, local governments, and SFWMD are necessary to accomplish water savings. SFWMD also encourages long-term reductions in water consumption across all water use categories by promoting and implementing many of the water conservation measures and the Comprehensive Water Conservation Program initiatives presented in this chapter.

Appendix D of this update includes the status of water conservation implementation, water conservation rate structures, water conservation versus development of additional water supplies, goal-based water conservation plans, and the WaterSIP projects.

SUMMARY OF WATER SOURCE OPTIONS

The LEC Planning Area traditionally has relied on fresh groundwater from the SAS and fresh surface water as the primary water source for urban, agricultural, and industrial uses. In many areas of the LEC Planning Area, development of these sources has been maximized due to potential impacts on the regional system, wetlands, existing water users, and the potential for saltwater intrusion. Therefore, new or increased allocations from these freshwater sources will be reviewed on an application-by-application basis to determine if a project meets the consumptive use permitting criteria. As a result, diversification of water supply sources, such as use of the upper Floridan aquifer, increased storage, reclaimed water, and appropriate water conservation has been occurring in the LEC Planning Area and is expected to continue to occur in the future. The source options are dependent on location, use type, demand, regulatory requirements, and cost.

6

Water Supply Development Status and Projects

This chapter provides a summary of the water supply development projects anticipated to meet the water demands of the Lower East Coast (LEC) Planning Area for the 2010 to 2030 planning horizon. Information is provided for each water use category presented in **Chapter 2**. Additional details about demand projections, local government responsibilities, and water supply development projects can be found in **Appendices A**, **E**, and **F**, respectively.

TOPICS

- Regional and Local Planning Linkages
- Projects Identified
- Funding
- Summary
- Public Water Supply Utility Summary Sheets

A growing population in the LEC Planning Area is driving the demand increases and need to develop water supplies. The region's population is expected to increase by 18 percent, from approximately 5.6 million in 2010 to more than 6.6 million in 2030. The gross demand for Public Water Supply (PWS), the largest water use type in the LEC Planning Area, is expected to increase 20 percent to a projected demand of 1,007 million gallons per day (MGD). Water users, such as utilities, local governments, and self-suppliers, including agriculture, industrial/commercial/ institutional, and power generation, are primarily responsible for water supply development projects. PWS relies almost exclusively on fresh groundwater from the surficial aquifer system (SAS), which includes the Biscayne aquifer. However, as discussed in previous chapters, most utilities have allocations and infrastructure in place to meet their 2030 demands. The availability of fresh groundwater to meet the needs of future growth in the LEC Planning Area could be limited by local conditions if needed. The additional water to meet future PWS demand is generally expected to be developed from other sources, primarily through development of brackish groundwater, reclaimed water, and stormwater/surface water capture. The implementation of water conservation programs offers potential water use savings to reduce future water demand.

A utility summary is included at the end of this chapter for each PWS utility supplying 100,000 gallons per day (0.1 MGD) or greater to its service area. Each summary includes the water supply projects proposed by utilities. For other water use categories, specific projects are identified as provided to the South Florida Water Management District (SFWMD) for this plan update.

REGIONAL AND LOCAL PLANNING LINKAGE

SFWMD's water supply planning process is closely coordinated and linked to the water supply planning of local governments and utilities. Significant coordination and collaboration throughout the water supply plan development and approval process is needed among all water supply planning entities. In the LEC Planning Area, 52 PWS utilities had a capacity of 0.1 MGD or greater in 2010. In 2013, the number of utilities is 50 as a result of closure or reorganization. The Glades Utility Authority was incorporated into the Palm Beach County Water Utilities Department (PBCWUD) system in 2013. In future plan updates, this facility will be included as part of the PBCWUD. The State of Florida closed the AG Holley State Hospital in Palm Beach County in 2012. Of these, 40 are local government owned utilities and four are privately owned utilities serving 112 local governments and the Seminole Tribe of Florida. Five water control or special districts (Chapter 298) are also located within the LEC Planning Area and operate PWS utilities serving portions of local governments. **Appendix C** provides lists of utilities and local governments served as well as statutory requirements relevant to local government comprehensive plans.

For consistency in the water supply planning process, SFWMD, local governments, and utilities worked closely to project demand and identify water supply projects for the future. Projects proposed in local governments' water supply facilities work plans are listed in the annual utility progress reports provided to SFWMD each fall. The regional and local water supply planning process is illustrated in **Figure 51** and described in the Process box on the next page.

Comprehensive plans, water supply facilities work plans, and water use permit applications are prepared at different times, each using the latest and best data available at that time. Projections and estimates could differ between local governments' work plans (and comprehensive plans) and the applicable regional water supply plan. Local economic conditions and population growth rates may affect when water is needed and projects initiated. Local governments' future water supply development projects should generally be consistent among plans and permits and meet projected water demands.

Many of the projects identified in this plan update were listed in the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2007). Some of these projects are still proposed with future expansion phases (multiple phase projects), or were delayed and/or modified due to slower than projected population and demand growth.

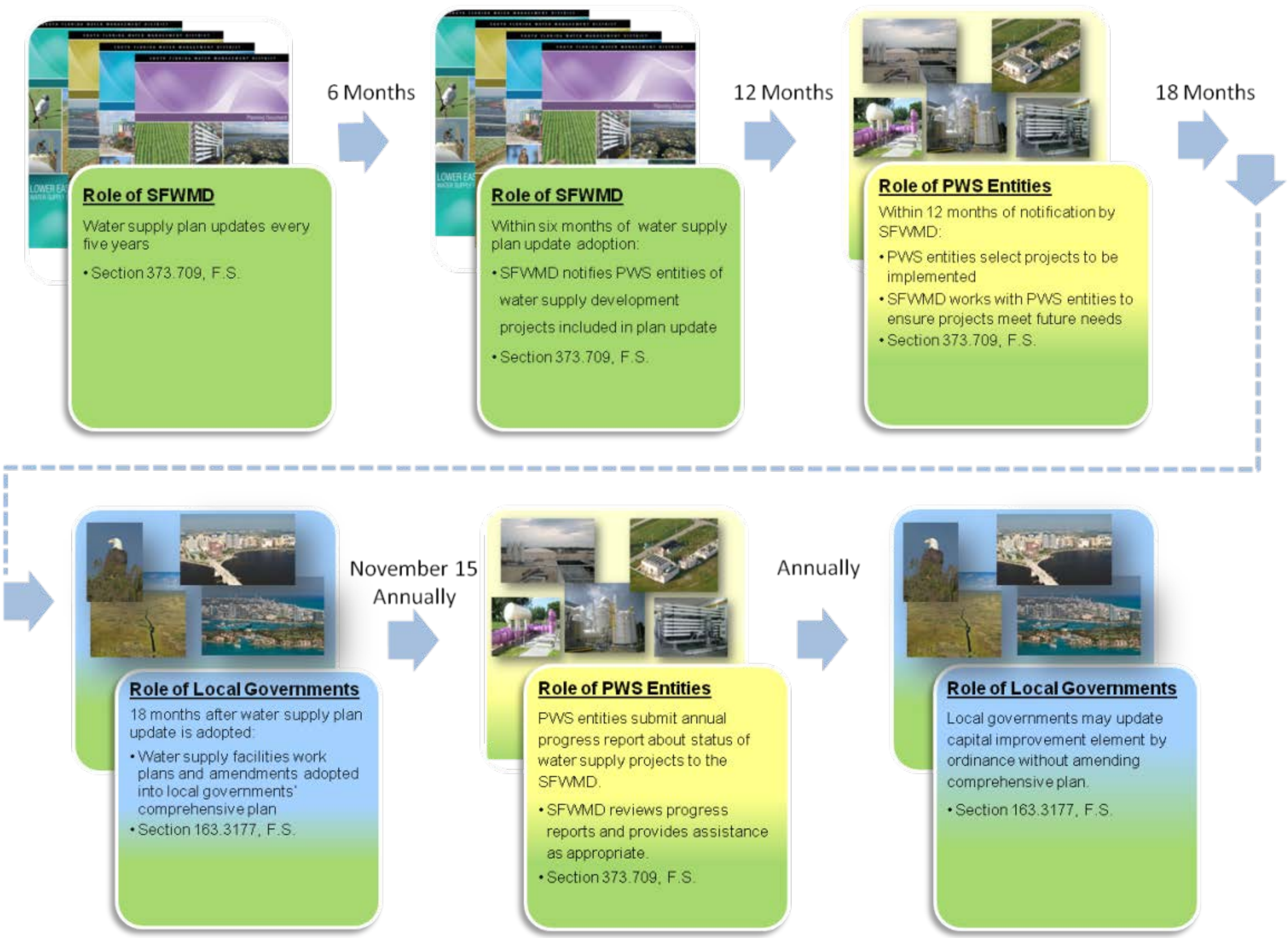


Figure 51. Linking regional water supply planning with local government comprehensive planning. (Note: F.S. – Florida Statutes.)

PROCESS

Regional and Local Water Supply Planning Process

SFWMD is required to notify each PWS utility of the projects identified in this plan update for that utility to consider and incorporate into its corresponding government's required water supply facilities work plan in order to meet future water demand. This notification must occur within six months following approval of the water supply plan update. Once the notice is received, PWS utilities then must respond to SFWMD within 12 months about their intentions to develop and implement the projects identified by the plan or provide a list of other projects or methods to meet these needs (Section 373.709, Florida Statutes [F.S.]).

Additionally, local governments are required to adopt water supply facilities work plans and related amendments into their comprehensive plans within 18 months following approval of the regional water supply plan. The work plans contain information to update the comprehensive plan's capital improvements element, which outlines specifics about the need for, and the location of, public facilities, principles for construction, cost estimates, and a schedule of capital improvements.

Local governments are required by Subsection 163.3177(6)(c)3, F.S. to modify the potable water sub-element of their comprehensive plan to include the following:

- Incorporate the water supply project or projects selected by the local government from those projects identified in the updated regional water supply plan or proposed by the local government.
- Identify water supply projects to meet the water needs identified in the updated regional water supply plan within the local government's jurisdiction.
- Include a work plan, covering at least a ten-year planning period, for building public, private, and regional water supply facilities, including the development of alternative water supplies, which are identified in the potable water element to meet the needs of existing and new development.

By November 15 of each year, all utilities are required to submit a progress report about the status of their water supply projects (completed, underway, or planned for implementation). Local governments are required to perform an annual review of the capital improvements element to update the five-year capital improvements schedule. The local governments are encouraged to send updates to the Florida Department of Economic Opportunity and SFWMD.

Link to Water Use Permitting

Although comprehensive plans, water supply facilities work plans, and water use permit applications are prepared at different times, each uses the latest and best data available at that time. Local governments' future water supply development projects should generally be consistent among plans and permits and meet projected water demands. However, local economic conditions and population growth rates may affect when water is needed and when water use permits should be modified to accommodate demands. When this takes place, projects may need to be proposed that may not be consistent with earlier dated documents.

A Florida Department of Environmental Protection (FDEP) guidance memo addresses coordination between SFWMD's water use permitting and water supply planning staff on projects included in water supply plans. By increasing coordination during the water supply planning process, water use permit applicants planning one of the identified water supply projects will be assured that SFWMD staff is familiar with the projects, have supporting data, and will be able to facilitate the permitting process. The proposed projects considered for this plan update were reviewed at a cursory level by SFWMD staff working in water use permitting and water supply planning using the following set of questions:

- Does the proposed project use a source of limited availability?
- Is the project located in a restricted allocation area?
- Is the proposed source from a minimum flows and levels (MFL) water body or is it connected, directly or indirectly, to an MFL water body? If yes, is the proposed use consistent with MFL recovery or prevention strategies?
- What other environmental water needs (i.e., Comprehensive Everglades Restoration Plan [CERP] targets, water reservations, etc.) may be impacted?
- What resource issues have been identified in recent permit applications in the general area for the same source (i.e., wetlands, saltwater intrusion, MFLs, etc.)?
- Have existing legal users of the same source had resource-related compliance issues?
- Have any new technical studies been completed related to source availability?

However, each proposed use of water must meet the conditions for permit issuance found in Section 373.223, Florida Statutes (F.S.), and the implementing criteria found in Chapters 40E-2 and 40E-20, Florida Administrative Code (F.A.C.). Section 373.223, F.S. requires applicants to establish that the proposed use of water 1) is a reasonable-beneficial use as defined in Section 373.019, F.S., 2) will not interfere with any presently existing legal use of water, and 3) is consistent with the public interest. Water use permits are required for all water supply development projects, except for those using 100 percent seawater or reclaimed water under direct pressure or from a lined pond.

The availability of new freshwater supplies in the LEC Planning Area is limited due to existing permitted users and source limitations, including environmental protection criteria such as saltwater intrusion (see **Chapter 3**). This is reflected in existing permitted allocations. The availability and permittability of freshwater supplies to meet projected water demands through 2030 will be determined on an application-by-application basis. Some freshwater supply development may be feasible depending on local conditions.

PROJECTS IDENTIFIED FOR THIS PLAN UPDATE

A discussion of the demand and supply conditions for each of the six major water use categories follows. Because most of the growth in demand during the next 20 years will occur in the urban sector, more specifically PWS uses, all of the proposed potable and nonpotable water and conservation projects will be implemented by PWS utilities.

The demand for PWS in the LEC Planning Area is projected to increase through 2030. A combination of existing and additional capacity developed by new water supply development projects will be used to meet the demand. The utility summaries indicate all LEC Planning Area utilities can meet their projected 2030 demand with existing treatment capacity or by supplementing that capacity by developing one or more identified projects. In addition to meeting demands, utilities may propose water supply development projects due to their own unique situations. These can include accommodating a change in treatment processes or sources; or optimizing distribution systems to match future demand locations. Each utility's proposed projects are displayed in their summary found at the end of this chapter and in **Appendix F**.

To manage the water resources in the region, this update promotes the diversification of sources for the water supply projects needed to meet future demands. Projects proposed for inclusion in this update were evaluated based on factors discussed in the previous section, level of detail provided (i.e., project scope, cost, and schedule), and whether the project is expected to contribute to new water supply, resulting in a potentially permittable increase in their allocations or a treatment system's rated capacity.

The majority of the PWS water providers appear to be able to meet their 2030 projected demand without additional allocation or infrastructure. Utilities have been expanding and upgrading their water treatment infrastructure since the last plan update. Between 2007 and 2009, utilities added 41 MGD of potable water supply capacity. Between 2010 and 2013, ten utilities built potable water supply projects with a capacity of 49 MGD.

In this plan update, nine utilities have proposed 11 new potable water supply projects totaling 50 MGD to implement planned system expansions, source diversification, or changes in treatment technology between 2014 and 2030 (**Figure 52**). Several of the 11 proposed projects are in response to utilities anticipating future growth at a faster rate than projected in this plan update.

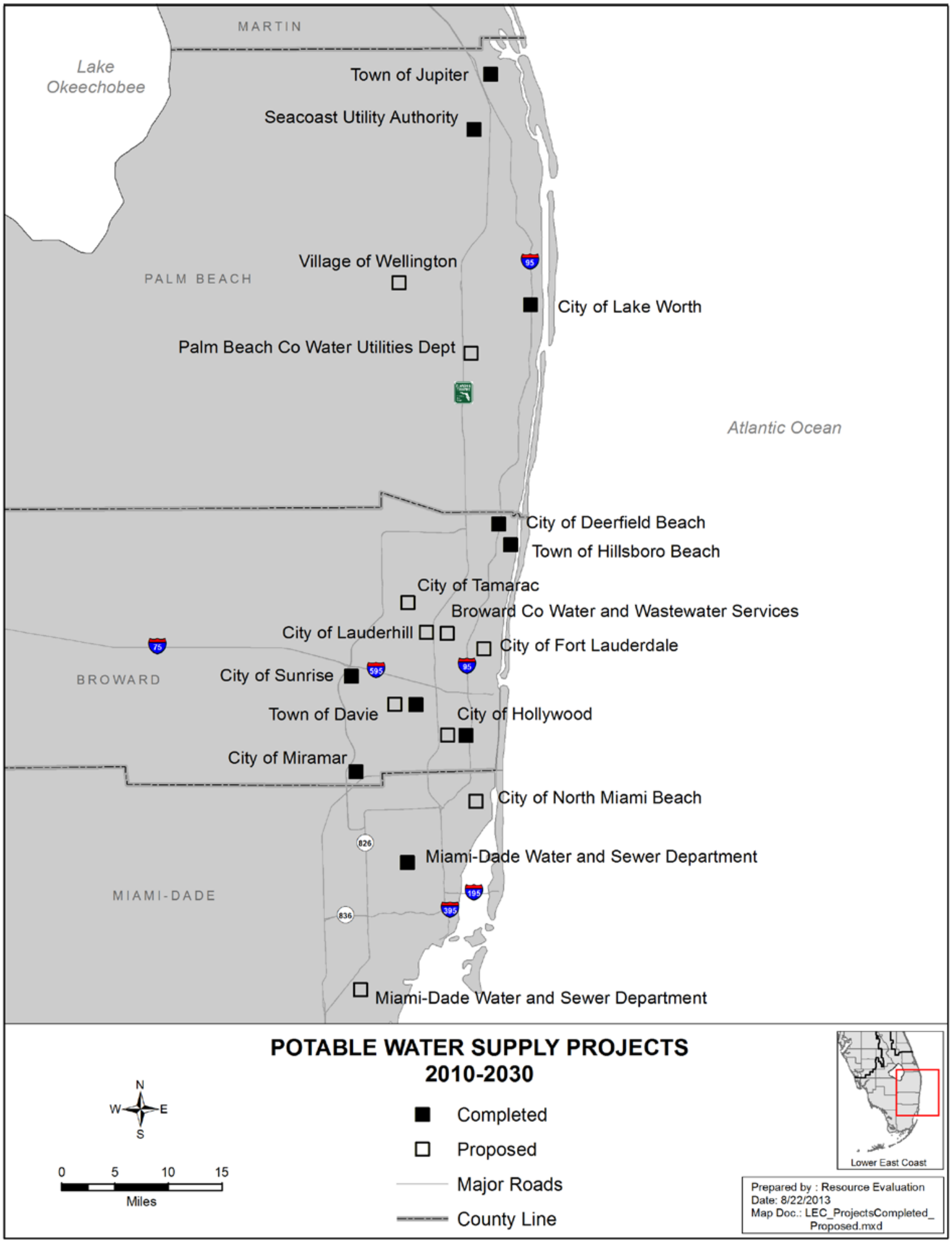


Figure 52. Completed and proposed potable water supply projects for 2010–2030.

Based on the 2030 demand projections, two utilities appear to need their proposed potable water supply projects during the planning period. The Town of Davie has proposed a 6 MGD expansion project. Miami-Dade Water and Sewer Department (MDWASD) has proposed to build a new 20 MGD water treatment plant to meet the projected growth within the southern portion of its service area. The timing and sizing of each proposed project in this plan may depend on several factors (e.g., economic recovery, conservation programs, and constraints within treatment and distribution systems) that affect the actual demand increases over the next 20 years.

Utilities with Completed Potable Projects 2010–2013

- Seacoast Utility Authority
- Town of Jupiter
- City of Lake Worth Utilities
- Town of Hillsboro Beach
- City of Deerfield Beach
- City of Sunrise
- Town of Davie
- City of Hollywood
- City of Miramar
- MDWASD

Utilities with Proposed Potable Projects 2014–2030

- PBCWUD
- Wellington Public Utilities Department
- Broward County Water and Wastewater Services (District 1)
- City of Tamarac
- City of Lauderhill
- City of Fort Lauderdale
- Town of Davie
- City of Hollywood
- City of North Miami Beach
- MDWASD

Furthermore, a project identified for inclusion in this plan update may not necessarily be selected for development by the utility. In accordance with Section 373.709(6), F.S. nothing contained in the water supply component of a regional water supply plan should be construed to require local governments, public or privately owned utilities, special districts, self-suppliers, multijurisdictional entities, and other water suppliers to select the identified project. If the projects identified in this plan update are not selected by a utility, the utility must identify another method to meet its needs and advise SFWMD of the alternative projects(s). The local government then needs to include the project information in its water supply facilities work plan.

One reason a project may not be selected for implementation is need, or lack thereof. Several utilities proposed projects that exceed the projected demands for 2030. As happened with the 2005–2006 LEC Plan Update, utilities may replace or delete projects that are not needed or defer projects beyond the twenty-year planning horizon of this update.

Public Water Supply

PWS demand includes all potable uses served by public and private utilities with a production capacity equal to or greater than 0.1 MGD. The PWS finished (net) demand is projected to increase by 154 MGD from 784 MGD in 2010 to 938 MGD in 2030, while gross (raw) water demand is projected to grow by 166 MGD from 842 MGD to 1,007 MGD in 2030. In aggregate, the utilities of the LEC Planning Area have both adequate permitted water use allocation and adequate permitted potable water treatment capacity to meet the LEC Planning Area's 2030 demands. This is due in part to proactive water supply planning by utilities in coordination with SFWMD's regional planning, slower than anticipated growth rates over the past five years, and the issuance (including renewals and modifications) of water use permits with twenty-year durations.

As of 2010, PWS demand was met by fresh groundwater from the SAS (94 percent), brackish groundwater from the upper Floridan aquifer system (FAS) (3 percent), and surface water (3 percent). Although reclaimed water and conservation of potable water do not produce potable water per se, it is a means to meet nonpotable demand or extend the existing potable supplies to meet future demand.

All PWS water use permits contain provisions limiting the volume of water withdrawn from each source. If permitted allocations cannot meet 2030 demand, water supply development projects, increased allocation, or other options may be necessary. Some utilities, such as the cities of Dania Beach and Homestead expect to meet future supplemental demands by purchasing bulk or finished water through interconnections with nearby utilities that have sufficient water capacity. Other utilities, such as Seacoast Utility Authority, City of Deerfield Beach, City of Sunrise, Town of Davie, and MDWASD, have developed alternative water supplies using brackish groundwater from the FAS. Brackish water projects in the LEC Planning Area include construction of reverse osmosis (RO) water treatment plants, expansion of existing plants, and construction of new production wells.

In total, the proposed potable water supply development projects will potentially create new treatment capacity yielding 76 MGD of finished water by 10 utilities (**Table 17**). Together with existing capacity, this will exceed the projected 2030 PWS total finished demand of 938 MGD. Of the 76 MGD of new potable treatment capacity, 67 MGD would be produced by 11 brackish water source projects. An additional 10 MGD would be produced by two freshwater source projects.

Table 17. Proposed potable water supply development projects and capacity for 2010–2030.

Water Source	Number of Projects [a]	Capacity (MGD)
Fresh groundwater (SAS)	2	9.90
Brackish groundwater (FAS)	11	66.50
Total	**13**	**76.40**

a. Some projects consist of more than one construction component and will be implemented in multiple phases.

PWS utilities identified 11 new reclaimed water projects with 151 MGD of new treatment capacity (**Table 18**). The reclaimed water projects will meet multiple types of demand, including 1) landscape irrigation, including golf courses and parks, 2) groundwater recharge, and 3) power generation. Some reclaimed water projects will produce new treatment capacity by construction or expansion of reclaimed water production facilities. Other projects involve increasing reuse distribution lines and storage facilities. PWS utilities also identified 12 reclaimed distribution projects with total capacity of 104 MGD. The capacities for reclaimed distribution and treatment projected are not summed to avoid double counting. The largest proposed reclaimed water project is located in Miami-Dade County and will supply 90 MGD to the Florida Power & Light (FPL) Turkey Point plant expansion. The City of West Palm Beach is reactivating their existing ASR system. The city is also increasing pumping capacity to move a higher volume of water to Grassy Waters Preserve. Florida City is proposing two stormwater capture projects.

Table 18. Proposed nonpotable water supply projects and capacity for 2010–2030.

Project Type	Number of Projects [a]	Capacity (MGD)
Reclaimed water (new treatment capacity)	11	151.10
Stored surface water/storm water/ASR	4	17.00
Total	**15**	**168.10**

a. Some projects consist of more than one construction component and will be implemented in multiple phases.

Conservation is an important component of utilities' plans for meeting future demands. Four specific conservation projects were proposed. Additionally, seventeen water utilities in the LEC Planning Area are participating in the Broward Water Partnership, a multiple year program that provides rebates and other water conservation tools and tips to businesses and homeowners (see **Chapter 5**). The program was recently expanded to include multiple family units, commercial buildings, and not-for-profit agencies, as well as single family homes. It is estimated that up to 30 MGD can be saved throughout Broward County by 2030 through this program. Three utilities are also planning on implementing discrete water conservation programs that will result in a combined total of savings of 45.4 MGD by 2030.

Domestic Self-Supply

Domestic Self-Supply (DSS) includes potable water from a private domestic well serving a private residence, and utilities that produce less than 0.1 MGD on an annual basis. DSS finished (net) demands in the LEC Planning Area are only projected to increase by less than 1 MGD from 17 MGD in 2010 to 18 MGD in 2030 (gross [raw] demands are projected to increase by less than 1 MGD from 18 MGD in 2010 to 19 MGD in 2030). DSS needs are met almost exclusively with fresh groundwater from the SAS, and will continue to do so in the future. As such, no water supply development projects are proposed for this use class.

Agricultural Self-Supply

Agricultural (AGR) Self-Supply is expected to remain the second largest water use category within the planning area after PWS. Irrigated agricultural acreage in the LEC Planning Area collectively is very stable and not projected to change significantly over the next twenty years. This is especially true in the Everglades Agricultural Area where permitted acres (458,210) and cropping practices are not projected to change. The Western Basins, which are in Hendry County but outside of the Everglades Agricultural Area and Lake Okeechobee Service Area, are projected to have a slight increase in irrigated acres. Using an estimate of irrigated acres in 2010 (575,316) as a starting point, the total irrigated acres is projected to be 575,897 acres in 2030. Consequently, estimated AGR Self-Supply irrigation needs (gross demand) is projected to be 664 MGD in 2030, the vast majority of which is already permitted. AGR Self-Supply water use accounts for 34 percent of the region's total gross demand.

The primary water sources used for agricultural irrigation in the LEC Planning Area are fresh surface water in Palm Beach County, the portions of Hendry County in the LEC Planning Area, and the portions of Okeechobee, Glades, and St. Lucie counties within the Lake Okeechobee Service Area, and fresh groundwater in Hendry, Broward, and Miami-Dade counties. However, agricultural operations use both sources in the LEC Service Area (Palm Beach, Broward and Miami-Dade counties). Monroe County relies upon potable water and/or cisterns for the limited amount of supplemental irrigation needed by nurseries.

The Everglades Agricultural Area within Lake Okeechobee Service Area will continue to rely on fresh surface water from Lake Okeechobee and connected conveyance canals consistent with the existing water use permits. For the remaining portion of the Lake Okeechobee Service Area, which encompasses basins in the other three planning areas plus the C-21 and S-236 basins in the LEC Planning Area, up to 156,171 acres will be provided supplemental irrigation by fresh surface water from the lake consistent with their existing water use permits. In addition, the portion of irrigated acres in Hendry County that fall outside of the Lake Okeechobee Service Area is supplied by fresh surface and groundwater.

The projected increase in irrigated acreage (581 acres) is minimal in comparison to the estimated 2010 actual irrigated acreage. No specific water supply development projects for agriculture were provided or have been identified in this plan update. The continued use of and increased voluntary use of the Florida Department of Agriculture and Consumer Services' best management practices, including water conservation, could reduce the amount of water needed to meet crop demands. These efforts are discussed in **Chapter 5**.

Industrial/Commercial/Institutional Self-Supply

The Industrial/Commercial/Institutional (ICI) Self-Supply water use category is comprised of large facilities for production processing with the largest uses being mining (i.e., aggregates industry) and food processing (dominated by the sugar industry). In the LEC Planning Area, the water use projection for ICI Self-Supply assumes that growth for this region is proportional to the underlying economic activity that generates PWS demand in the area. The projected demand for this category is expected to be 57 MGD by 2030, 28 percent greater than the 2010 demand.

Currently, the ICI Self-Supply water use category has sufficient supply to meet future needs. Any increase in water demands must meet the requirements of water use permitting criteria, however, existing water use permits cover the majority of the projected growth. Although fresh groundwater supplies are generally considered adequate to meet the relatively small new demands projected for this use category, alternative water supply options should be considered based on local conditions. If reclaimed water is available to meet existing and new ICI Self-Supply water demands, the feasibility of such opportunities will be evaluated through SFWMD's Water Use Permitting Program. No specific projects for ICI Self-Supply were provided or identified in this plan update.

Recreational/Landscape Self-Supply

Recreational/Landscape (REC) Self-Supply includes the use of water for irrigation of common areas, golf courses, parks, cemeteries, schools, commercial developments, and other self-supplied irrigation uses with demand of 0.1 MGD or greater. REC Self-Supply gross demand is projected to increase by 3 percent (149 MGD in 2010 compared to 153 MGD in 2030). Historically, irrigation supplies for this category include local fresh groundwater and surface water captured from canals or stormwater management systems. In recent years, irrigation for new golf courses often includes reclaimed water and on-site blending of brackish groundwater with surface water. Four golf courses use brackish groundwater treated by RO.

The small demand increase for REC Self-Supply should be met, for the most part, by currently proposed reclaimed water projects or by locally derived groundwater, which may be included in existing water use permits if applicable. Projects submitted by utilities and wastewater treatment facilities indicate that use of reclaimed water will increase significantly in the future. Expansion of water reuse systems for REC Self-Supply may reduce withdrawal demands on the water resources. Where reclaimed water is not available, users may qualify for limited freshwater withdrawals on an application-by-application basis.

Implementation of the Mandatory Year-Round Landscape Irrigation Conservation Measures Rule (Rule 40E-24.201, F.A.C.), water conservation methods using more efficient irrigation systems, and Florida-Friendly Landscaping offer potential cost savings and may reduce future demand. However, no specific projects for REC Self-Supply were provided or identified in this plan update.

Power Generation Self-Supply

The Power Generation (PWR) Self-Supply water use category is expected to grow by approximately 21 MGD (gross demand) during the next 20 years from 12 to 33 MGD as FPL plans to build a new facility in the LEC Planning Area in order to meet electrical power demand. FPL utilizes an assessment method incorporating environmental, economic, and technical feasibility when selecting power generation and cooling technologies most appropriate for site-specific conditions, including water supply and wastewater disposal. Different technologies may require and utilize both traditional and alternative water supply sources.

Currently, three power generation plants in the LEC Planning Area are permitted to withdraw groundwater: 1) West County Energy Center, 2) FPL Turkey Point Plant, and 3) Homestead Municipal Power Plant. The West Energy facility's back-up source is the SAS. FPL increased its power resources at the existing Turkey Point plant by adding combined-cycle generating technology (Unit 5). This facility uses FAS water and water from a closed-loop cooling canal system. The Homestead Municipal plant is a peaking plant that only supplies electricity when needed utilizing water from the Biscayne aquifer.

A potential plant may be sited in the LEC Planning Area, possibly in Hendry County where FPL has purchased land. The demand associated with this future plant is 22.8 MGD in 2030.

In addition, other FPL plants also use alternative water sources. Several power generation plants use seawater: Cutler, Lauderdale, Port Everglades, and Riviera Beach. The FPL West County Energy Center, located in northwestern Palm Beach County, utilizes reclaimed water (approximately 22 to 27 MGD contracted) supplied by PBCWUD since late 2010. In the future, MDWASD will provide up to 90 MGD of reclaimed water to meet FPL cooling needs at Turkey Point for the planned nuclear generating expansion units (Units 6 and 7). These plants are not addressed in the water supply plan because SFWMD does not regulate the use of seawater and reclaimed water.

FUNDING

Funding of water supply development and water conservation projects at the local level is the shared responsibility of water suppliers and users. The State of Florida and the water management districts provided funding assistance to local water users developing alternative water supplies and measurable water conservation programs. One criterion for funding consideration is that the project has to be included in, or be consistent with, a regional water supply plan update. Some projects not included in this update, but are consistent with the plan's goals, may also be funded.

When SFWMD deems it appropriate, a plan update may specifically identify the need for multijurisdictional approaches to project options based on analysis, the ability to permit and finance, and technical feasibility. SFWMD provides funding for alternative water supply and measurable water conservation through its Alternative Water Supply and Water Savings Incentive (WaterSIP) funding programs. Funds for these programs are allocated annually through the Governing Boards approval of SFWMD's budget. An alternative water supply or water conservation project identified in this update makes that project eligible for future funding, although funding is not guaranteed. An application must be submitted during the program solicitation period and processed for the determination of whether funding will be granted for the project.

Alternative Water Supply Program

Alternative water supply sources in the LEC Planning Area include brackish water from the Upper Floridan aquifer, reclaimed water, seawater, capture of surface or storm water, new storage capacity, and conservation. Although declining per capita use rates help to reduce or defer development of new water production capacity, in some cases, new water supplies will also be needed to accommodate the region's future growth. SFWMD's Alternative Water Supply Program funds up to 40 percent of an alternative water supply project's construction cost to qualified applicants seeking cost-sharing assistance.

Since 1997, SFWMD, in cooperation with the State of Florida through the Florida Water Protection and Sustainability Program, approved over $204 million in cost-share funding for the construction of 474 alternative water supply projects throughout SFWMD boundaries. Funds provided by the state are matched dollar for dollar with SFWMD funds. While the legislature has not provided funding to the program since 2009, SFWMD continued appropriating ad valorem revenues to the program at significantly reduced levels since Fiscal Year (FY) 2011. In FY 2012 and FY 2013, budgeted Alternative Water Supply Program funding was $1.25 million and $1.6 million, respectively, including reallocated funds from prior fiscal years. In the LEC Planning Area, $53.8 million was allocated to 121 projects from FY 2006 to FY 2012. The projects created 112 MGD of new water capacity within the LEC Planning Area.

Water Savings Incentive Program

WaterSIP is SFWMD's conservation funding assistance program. Through WaterSIP, SFWMD provides matching funds (up to 50-50 cost share) up to $50,000 to water providers and users (e.g., cities, utilities, industrial groups, schools, hospitals, and homeowners associations) for noncapital water efficiency improvement projects that reduce urban water use utilizing water saving technologies. These technologies include low flow plumbing fixtures, rain sensors, fire hydrant flushing devices, cisterns, and other hardware. Examples of projects are toilet and bathroom fixture retrofit programs, irrigation system retrofits involving the use of micro-irrigation or the latest irrigation scheduling technologies, automatic hydrant flushing devices that eliminate the need for manual line flushing, and low flow prerinse spray valve retrofits to improve water efficiency in commercial kitchens.

Program funds are budgeted annually. From FY 2005 to FY 2012, the SFWMD budgeted a total of $4.1 million, including reallocated funds from prior fiscal years, for WaterSIP with annual funding amounts between $250,000 and $1,000,000 allocated between FY 2011 and FY 2013, funding amounts ranged between $250,000 and $300,000. Approximately $2.4 million has been allocated for projects in the LEC Planning Area since FY 2005. The funded projects represented an estimated potential savings of 1.5 billion gallons per year (4.1 MGD). Please refer to the *2011–2013 Water Supply Plan Support Document* (Support Document) (SFWMD 2013a) for additional information. **Appendix D** provides WaterSIP projects funded in the LEC Planning Area through 2012.

SUMMARY

As discussed in **Chapter 2**, economic trends in South Florida over the past five years resulted in a lowering of population and demand projections for the next twenty years when compared to the projections in the 2005–2006 LEC Plan Update. During the twenty-year planning horizon period, the PWS category projects only a 20 percent increase in finished demand. This, combined with PWS utilities water treatment facilities expansions over that same period, resulted in most PWS utilities possessing sufficient treatment capacity and permitted allocations to meet their estimated 2030 demands. Ten utilities proposed 22 potable water projects. Of the 10, only two utilities appear to need the projects before 2030 based on LEC Planning Area projections or their respective treatment system requirements. Some utilities will meet future demand by purchasing water from other suppliers.

Amongst the DSS, AGR Self-Supply, ICI Self-Supply, REC Self-Supply, and PWR Self-Supply sectors, no new projects have been proposed, and future needs can be met under existing permit allocations; by use of existing and alternative sources, and conservation. However, future increases in withdrawals from Lake Okeechobee; the L-1, L-2, and L-3 canal system; the Everglades; and North Palm Beach/Loxahatchee Watershed water bodies must comply with the restricted allocation area criteria.

A total of 17 utilities proposed water supply development projects.[5] SFWMD staff evaluated all proposed water resource development projects and incorporated 28 new projects for this update, which includes projects that develop fresh and brackish groundwater sources, provide reclaimed water treatment or storage of surface and storm water. Of these, 10 utilities proposed 13 potable water projects, and eight of the 10 utilities may be able to defer some or all of their potable water projects until after 2030. Four water conservation projects proposed in this plan may also assist utilities to defer capital expenses for potable water projects. As a result, potential new PWS supply capacity is significantly greater than the projected increase in demand for the planning horizon of this update. The proposed design capacity may have several purposes including meeting peak demands or operational flexibility. Most water supply development options require significant upfront investments and ongoing maintenance costs. Individual utilities may find that a portion of future water needs can be met in a more immediate and cost-effective way through a demand management program, purchasing water from neighboring utilities, or by implementing a reclaimed water project.

PUBLIC WATER SUPPLY UTILITY SUMMARIES

In this section, a utility summary is provided for each PWS utility in the LEC Planning Area. The summaries are organized by county and alphabetically within each county. A sample utility summary explains the descriptions provided.

No PWS utilities are located within the portion of Hendry County within the LEC Planning Area. However, a small portion of Clewiston Utilities' service area extends into Palm Beach County and the LEC Planning Area. Given that the majority of the Clewiston Utilities service area and population served are located within the Lower West Coast Planning Area, Clewiston Utilities is included in the *2012 Lower West Coast Water Supply Plan Update* (SFWMD 2012a).

5 Does not include the three utilities that have proposed reclaimed distribution projects.

Descriptions of each numbered item are provided on the next two pages.

SAMPLE CITY

County: Broward County

Service Area: Sample city and portions of unincorporated county.

Description: This description includes the number and type of water treatment plants (WTPs), water sources, areas served, bulk sales or purchases, and other issues of concern to the utility. If the utility produces reclaimed water, information regarding the quantity and customers may also be be included. Utilities that participate in the Broward Water Partnership conservation program are identified here.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population (1)	100,000	110,000	120,000
Per Capita (gallons per day finished water) (2)	100	100	100
Potable Water Demands (daily average annual finished water in MGD) (3)	**10.0**	**11.0**	**12.0**

SFWMD WATER USE PERMITTED (00-00000-W) ALLOCATION (MGD)			
Potable Water Source	Existing	Projected	
	2010	2020	2030
Fresh Water (4)	14.00	14.00	14.00
Brackish Water	0.00	2.00 (5)	4.00
Total Allocation	**14.00**	**16.00**	**18.00** (6)

POTABLE WATER TREATMENT CAPACITY			
FDEP Permitted Capacity	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
	2012	2020	2030
Fresh Water (7)	18.00	18.00	18.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	2.00 (8)	3.00
Total Capacity	**18.00**	**20.00**	**21.00** (9)
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	1.00 (10)	1.00	1.00

PROJECT SUMMARY (11)					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Potable Water					
New Floridan RO WTP (2MGD)	Brackish Water	2017	$4.00	2.00	2.00
Additional RO Train (+1 MGD)	Brackish Water	2025	$2.00	0.00	1.00
Total			**$6.00**	**2.00** (12)	**3.00** (13)
Conservation and Irrigation Restrictions (14)	Conservation	2025	$0.00	0.10	0.10

Descriptions of numbered items on the sample utility summary provided on the previous page.

1. **Population:** The 2010 population was determined using the map of the area served by the utility in 2010 and the census block data from the 2010 United States Census (U.S. Census Bureau 2010). Projections are generally based on the Bureau of Economic and Business Research population projections report published in *Florida Population Studies* in July 2011 (BEBR 2011). For some utilities, the growth rate to project the 2020 and 2030 populations were based on additional data provided by the utility (see **Appendix A** for more information).

2. **Per Capita Water Use:** This number was calculated by dividing the 2010 total <u>finished</u> water produced by the utility (from monthly operating reports submitted by each utility to FDEP) by the 2010 population. It is expected that this number will differ from the per capita rate used during the water use permitting process.

3. **Potable Water Demands:** The 2010 amount is the daily average <u>finished</u> water produced by the utility in 2010 (from monthly operating reports submitted by each utility to FDEP). The 2020 and 2030 projected demands are the respective populations multiplied by the 2010 per capita water use for that utility (see **Appendix A** for more information).

4. **Allocation from the Current Water Use Permit:** The allocation is composed of fresh and brackish <u>gross</u> water allocations as described in the permit.

5. **Projected Allocation 2020/2030:** If the current water use permit specifies a change in the allocation, the 2020 or 2030 allocation is listed. Otherwise, the current allocation is assumed to continue through 2030.

6. **Total Allocation:** The total <u>gross</u> water allocation found in the water use permit. The total allocation may be less than the sum of the freshwater and brackish water allocations providing the utility with some operational flexibility.

7. **FDEP Permitted Capacity:** The total capacity of the WTPs used by the utility as listed on FDEP website as of May 2012. The capacity is split into the capacity available to process fresh water or brackish water.

8. **Planned Project Capacity:** The volumes of water created by projects listed in the Project Summary as proposed by the utilities. Project capacity to be completed by 2020 are shown in the 2020 column and project capacity to be completed between 2021 and 2030 are shown in the 2030 column.

9. **Total Capacity:** The existing capacity of the WTPs owned/operated by this utility plus the volumes of water produced by future planned projects.

10. **Reclaimed Water:** The capacity of the wastewater treatment plant(s) (WWTP) to produce reclaimed water. The 2010 capacity is from the *2010 Reuse Inventory* (FDEP 2011). Additional capacity is from projects planned by the utility. These projects are listed under item 11.

11. **Project Summary:** A description of the projects the utility is proposing to construct. Only projects that produce additional water (i.e., wells, water treatments plants, etc.) or distribute water are included. Maintenance or replacement projects are not included. Each project has an anticipated completion date, water source, estimated capital cost, and volume of water produced or planned treatment capacity. Water volumes associated with distribution projects are not included in the volume summaries. The project information was provided by the utility. Not all utilities reported a project; however, all utilities that have a need for additional water did plan a project or projects.

12. **Total Projected Cumulative Design Capacity for 2020:** The total volume of projects expected to be completed between 2012 and 2020. These totals are added to the existing total in items 8 or 10, as appropriate.

13. **Total Projected Cumulative Design Capacity for 2030:** The total volume of projects expected to be completed between 2021 and 2030. These totals are added to the existing total in 8 or 10, as appropriate.

14. **Conservation:** Conservation projects projected to save at least 0.1 MGD were included by some utilities. Because these save water, rather than producing additional water, they are not included in the projected cumulative design capacity total.

Palm Beach County Utilities

AG HOLLEY STATE HOSPITAL

County: Palm Beach County

Service Area: AG Holley State Hospital

Description: This utility is located at a State of Florida hospital in the Town of Lantana. Withdrawals were from the SAS (two wells), with an annual allocation of 0.09 MGD. The hospital was closed in July 2012; therefore, future use of the existing water treatment facility is unknown at this time.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	32	0	0
Per Capita (gallons per day finished water)	0	0	0
Potable Water Demands (daily average annual finished water in MGD)	**0.07**	**0.00**	**0.00**
SFWMD WATER USE PERMITTED (50-01092-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	0.09	0.09	0.09
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.09**	**0.09**	**0.09**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	0.36	0.36	0.36
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**0.36**	**0.36**	**0.36**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF BOCA RATON

County: Palm Beach County

Service Area: City of Boca Raton and unincorporated areas of Palm Beach County

Description: Water supply for the City of Boca Raton is from the SAS. The city owns and operates two water treatment facilities that blend a 1:2 ratio of lime softened and membrane softened water. The water use permit was renewed in 2008 and provides for the completion of reclaimed water projects in 2013 that authorize the city to withdraw additional water based on the termination of identified base condition water use through the provision of reclaimed water to meet the projected increased demands in 2020. The city implemented a fully operational reclaimed water system that has the capacity to utilize 100 percent of its annual average daily flow for reuse as authorized by FDEP. The city's water reclamation facility has met the requirements of a 100 percent reuse facility to meet the requirements of the Ocean Outfall statute (Subsection 403.086(9), F.S.). In 2011, the city provided customers with an average of 7.0 MGD and a maximum of 10.09 MGD of reclaimed water for irrigation demands that would otherwise come from the Biscayne aquifer. The city is planning a membrane concentrate and reclaimed water blending project that will increase the availability of reclaimed water.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	107,224	120,539	133,854
Per Capita (gallons per day finished water)	320	320	320
Potable Water Demands (daily average annual finished water in MGD)	**34.31**	**38.57**	**42.83**
SFWMD WATER USE PERMITTED (50-00367-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	51.54	51.54	51.54
Brackish Water	0.00	0.00	0.00
Total Allocation	**51.54**	**51.54**	**51.54**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	70.00	70.00	70.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**70.00**	**70.00**	**70.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	17.50	17.50	17.50

PROJECT SUMMARY					
				Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	**Source**	**Completion Date**	**Total Capital Cost ($ Million)**	**2020**	**2030**
Nonpotable Water					
Recycling of Membrane Concentrate for Reuse Water	Reclaimed Water	2013	$2.00	4.25 [a]	4.25 [a]
Total			**$2.00**	**4.25**	**4.25**

a. This project adds capacity to the reclaimed water distribution system but does not increase the actual treatment capacity of the reclaimed water plant.

CITY OF BOYNTON BEACH

County: Palm Beach County

Service Area: City of Boynton Beach; towns of Briny Breezes, Hypoluxo, and Ocean Ridge; and unincorporated areas of Palm Beach County

Description: Water supply for the City of Boynton Beach is from the SAS. The city owns and operates two WTPs that use lime softening and nanofiltration processes. The water supply system is also augmented by the use of two ASR wells, which provide water in the dry season and allow the city to reduce pumping of the eastern wellfield. The city's recent water supply plan includes a water conservation program and expanded use of reclaimed water to help with the reuse requirement of the Ocean Outfall statute (Subsection 403.086(9), F.S.) at the South Central Regional WWTP. The city shares the South Central Regional WWTP with the City of Delray Beach. This plant produces reclaimed water, which is used by both cities. If Boynton Beach is successful in hooking up a pre-approved set of large users to its reuse system, the city can seek up to 25 percent more water from the SAS, pursuant to conditions in its consumptive use permit. The city currently purchases 2 MGD of potable water from the PBCWUD. This purchased amount will be reduced to 1 MGD after 2013. The city is planning a membrane concentrate blending project to decrease treatment losses. The city also built a pipeline to connect its western SAS wellfield to its eastern lime softening plant to further improve treatment efficiency.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	102,512	115,242	127,972
Per Capita (gallons per day finished water)	131	131	131
Potable Water Demands (daily average annual finished water in MGD)	**13.43**	**15.10**	**16.76**
SFWMD WATER USE PERMITTED (50-00499-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	16.58 [a]	16.58 [a]	16.58 [a]
Brackish Water	6.42 [b]	6.42 [b]	6.42 [b]
Bulk Water Purchase (from Palm Beach County)	2.00	1.00	1.00
Total Allocation (including bulk water purchase)	**20.86** [c]	**20.86** [c]	**20.86** [c]
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	29.64	29.64	29.64
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**29.64**	**29.64**	**29.64**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	10.00	10.00	10.00

a. The cities baseline SAS allocation is 16.58 MGD. The current consumptive use permit provides that the city may apply for an increase SAS allocation of up to 4.23 MGD if the city can document increased demand and completes a reuse implementation plan that includes the termination of existing permits by future reuse customers.

b. The majority of the 6.42 MGD FAS allocation is for ASR withdrawals during the dry season. Those withdrawals are tied reductions in the eastern wellfield pumpage such that the city does not exceed its annual allocation.

c. The water use permit limits the total annual withdrawals from all sources to 7,615 million gallons, an average of 20.86 MGD.

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Nonpotable Water					
Reclaimed Water Transmission Phase 2 (US 1 Corridor & Cypress Creek)	Reclaimed Water	2014	$2.00	1.00[a]	1.00[a]
Leisureville Golf Course	Reclaimed Water	2014	$2.00	0.65[a]	0.65[a]
Galaxy Elementary Water Line	Reclaimed Water	2013	$0.26	0.10[a]	0.10[a]
Total			**$4.26**	**1.75**[a]	**1.75**[a]

a. This project adds capacity to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

CITY OF DELRAY BEACH WATER AND SEWER DEPARTMENT

County: Palm Beach County

Service Area: City of Delray Beach, Town of Gulf Stream, and unincorporated areas of Palm Beach County

Description: Water supply for the City of Delray Beach Public Utilities Department is from the SAS and FAS. Delray Beach owns and operates one lime softening treatment system located in the vicinity of their Eastern Wellfield. The water use permit provides for operation of the Eastern, Morikami, 20-series, and Golf Course wellfields, in addition to occasional operation of an ASR well for backup supply of brackish water for blending with fresh groundwater. Delray Beach is committed to replacing permitted SAS irrigation withdrawals within its service area with reclaimed water. The projects listed below will help meet the reuse requirements of the Ocean Outfall statute (Subsection 403.086(9), F.S.) at the South-Central Regional WWTP.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	63,341	71,207	79,072
Per Capita (gallons per day finished water)	232	232	232
Potable Water Demands (daily average annual finished water in MGD)	**14.70**	**16.52**	**18.34**
SFWMD WATER USE PERMITTED (50-00177-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	19.01	19.10	19.10
Brackish Water	0.00 [a]	0.00 [a]	0.00 [a]
Total Allocation	**19.10**	**19.10**	**19.10**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	26.00	26.00	26.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**26.00**	**26.00**	**26.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	5.00	5.00	5.00

a. The city's FAS well does not have an allocation, but may be used as a backup source for blending if needed. Such occasional use is capped at 1.5 MGD.

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD)	
				2020	2030
Nonpotable Water					
Reclaimed Water (Area 12A Phase 1 – Barrier Island South, Atlantic Avenue to Casuarina Road and Gleason Street Trunk Line)	Reclaimed Water	2013	$1.70	0.25[a]	0.25[a]
Reclaimed Water (Area 12A Phase 2 and Area 12B Barrier Island South)	Reclaimed Water	2014	$1.20	0.25[a]	0.25[a]
Total			**2.90**	**0.50**[a]	**0.50**[a]

a. This project adds capacity to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

GLADES UTILITY AUTHORITY

PALM BEACH COUNTY WATER UTILITIES DEPARTMENT

County: Palm Beach County

Service Area: Cities of Belle Glade, Pahokee, and South Bay

Description: Water supply for the Glades Utility Authority comes from the FAS, which is treated at an RO WTP. The water use permit was renewed in 2010 and later modified to address an increase in the chloride concentrations in water produced from the wells. The three cities within the service area have been designated as Rural Areas of Critical Economic Concern. Glades Utility Authority is being absorbed into the PBCWUD effective April 2013, and will be described as such in the next update. The water distribution systems, which PBCWUD acquired from municipal governments have historically high rates of losses. PBCWUD has agreed to distribution system improvements to reduce losses in future years.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	25,051	28,164	31,276
Per Capita (gallons per day finished water)	195	195	195
Potable Water Demands (daily average annual finished water in MGD)	**4.88**	**5.49**	**6.10**
SFWMD WATER USE PERMITTED (50-06857-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	0.00	0.00	0.00
Brackish Water	9.43	9.43	9.43
Total Allocation	**9.43**	**9.43**	**9.43**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	0.00	0.00	0.00
Brackish Water	10.00	10.00	10.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**10.00**	**10.00**	**10.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

VILLAGE OF GOLF

County: Palm Beach County

Service Area: Village of Golf and unincorporated areas of Palm Beach County

Description: The water supply for the Village of Golf is from the SAS. The water is treated by lime softening and ultrafiltration processes. Wastewater from the service area is treated at the South Central Reclamation Wastewater Treatment Facility with more than 1.62 MGD contracted irrigation reuse at golf courses and for groundwater recharge.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	2,755	3,097	3,439
Per Capita (gallons per day finished water)	145	145	145
Potable Water Demands (daily average annual finished water in MGD)	**0.40**	**0.45**	**0.50**
SFWMD WATER USE PERMITTED (50-00612-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.60	0.69	0.69
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.60**	**0.69**	**0.69**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.86	0.86	0.86
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**0.86**	**0.86**	**0.86**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

TOWN OF HIGHLAND BEACH

County: Palm Beach County

Service Area: Town of Highland Beach

Description: The Town of Highland Beach is a residential community located on a barrier island east of the Intracoastal Waterway. The water supply for the town comes from the FAS, treated by RO.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	3,631	4,082	4,533
Per Capita (gallons per day finished water)	372	372	372
Potable Water Demands (daily average annual finished water in MGD)	**1.35**	**1.52**	**1.69**
SFWMD WATER USE PERMITTED (50-00346-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.00	0.00	0.00
Brackish Water	3.15	3.15	3.15
Total Allocation	**3.15**	**3.15**	**3.15**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.00	0.00	0.00
Brackish Water	3.00	3.00	3.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**3.00**	**3.00**	**3.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

TOWN OF JUPITER

County: Palm Beach County

Service Area: Towns of Jupiter and Juno Beach, and unincorporated areas of Martin and Palm Beach counties

Description: The water supply for the Town of Jupiter is from the SAS and FAS. The town owns and operates an RO plant for the FAS source and a nanofiltration process for the SAS source. Wastewater is treated at the Loxahatchee River District facility, with 5 MGD of reclaimed water returned to the town for irrigation purposes. The water use permit includes an overlap in allocations from SAS and FAS sources to provide operational flexibility on a seasonal basis but has a maximum annual allocation (24.41 MGD) from the two sources combined.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	70,840	86,224	101,608
Per Capita (gallons per day finished water)	188	188	188
Potable Water Demands (daily average annual finished water in MGD)	**13.32**	**16.21**	**19.10**
SFWMD WATER USE PERMITTED (50-00010-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	18.80	18.80	18.80
Brackish Water	5.61	11.71	11.71
Total Allocation	**24.41**	**24.41** [a]	**24.41** [a]
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	16.30	16.30	16.30
Brackish Water	13.70	13.70	13.70
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**30.00**	**30.00**	**30.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. The town's total pumping may not exceed 24.41 MGD on an annual basis. The water use permit provides flexibility for the utility to maximize either SAS or FAS dependent on rainfall conditions.

CITY OF LAKE WORTH UTILITIES

County: Palm Beach County

Service Area: City of Lake Worth, Town of Lake Clarke Shores, and unincorporated areas of Palm Beach County

Description: The water supply for the City of Lake Worth Utilities is from the SAS and FAS. Lake Worth was designated a "utility of concern" due to the vulnerability of its Eastern Wellfield to saltwater intrusion. In 2011, the utility brought online a wellfield that utilizes the FAS. Additionally, the utility is implementing a program of plugging and abandoning SAS wells in its Eastern Wellfield and constructing replacement wells further inland.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	45,137	50,742	56,347
Per Capita (gallons per day finished water)	98	98	98
Potable Water Demands (daily average annual finished water in MGD)	**4.42**	**4.97**	**5.52**
SFWMD WATER USE PERMITTED (50-00234-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	7.58 [a]	5.25 [b]	5.25 [b]
Brackish Water	9.00	6.00	6.00
Bulk Water Purchase (from Palm Beach County)	1.00	0.00	0.00
Total Allocation (including bulk water purchase)	**13.07**	**11.25**	**11.25**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	12.90	12.90	12.90
Brackish Water	4.50	4.50	4.50
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**17.40**	**17.40**	**17.40**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. The city entered into an operational agreement with SFWMD in May 2010, which restricted SAS withdrawals to 5.3 MGD.

b. The city's allocation has seasonal source limits of 5.00 MGD in the dry season and 5.50 MGD in the wet season. Over the course of any year, the annual withdrawals may not exceed an average of 5.25 MGD.

TOWN OF LANTANA

County: Palm Beach County

Service Area: Town of Lantana

Description: The water supply for the Town of Lantana is from the SAS. The water supply is considered vulnerable to saltwater intrusion; hence, the town recently constructed two additional wells farther from the coast to provide for additional wellfield operational flexibility and reduce the potential for saltwater intrusion.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	10,348	11,633	12,918
Per Capita (gallons per day finished water)	171	171	171
Potable Water Demands (daily average annual finished water in MGD)	**1.77**	**1.99**	**2.21**
SFWMD WATER USE PERMITTED (50-00575-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	2.48	2.48	2.48
Brackish Water	0.00	0.00	0.00
Total Allocation	**2.48**	**2.48**	**2.48**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	3.84	3.84	3.84
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**3.84**	**3.84**	**3.84**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

TOWN OF MANALAPAN

County: Palm Beach County

Service Area: Towns of Manalapan and Hypoluxo

Description: The water supply for the Town of Manalapan comes from the SAS and FAS. The town operates an RO WTP that has the capability of blending the fresh and brackish water sources.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	2,421	2,722	3,022
Per Capita (gallons per day finished water)	440	440	440
Potable Water Demands (daily average annual finished water in MGD)	**1.07**	**1.20**	**1.33**
SFWMD WATER USE PERMITTED (50-00506-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.58	0.58	0.58
Brackish Water	1.33	1.33	1.33
Total Allocation	**1.91**	**1.91**	**1.91**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.65	0.65	0.65
Brackish Water	1.70	1.70	1.70
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**2.35**	**2.35**	**2.35**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

TOWN OF MANGONIA PARK

County: Palm Beach County

Service Area: Town of Mangonia Park

Description: The water supply for the Town of Mangonia Park is from the SAS.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	1,888	2,122	2,357
Per Capita (gallons per day finished water)	168	168	168
Potable Water Demands (daily average annual finished water in MGD)	**0.32**	**0.36**	**0.40**
SFWMD WATER USE PERMITTED (50-00030-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.58	0.58	0.58
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.58**	**0.58**	**0.58**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	1.08	1.08	1.08
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**1.08**	**1.08**	**1.08**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

MARALAGO CAY

County: Palm Beach County

Service Area: Unincorporated area of Palm Beach County

Description: Maralago Cay is a manufactured home community. It is not expected to exceed its allocation in future years.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	1,008	1,133	1,258
Per Capita (gallons per day finished water)	182	182	182
Potable Water Demands (daily average annual finished water in MGD)	**0.18**	**0.21**	**0.23**
SFWMD WATER USE PERMITTED (50-01283-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.27	0.27	0.27
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.27**	**0.27**	**0.27**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.42	0.42	0.42
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**0.42**	**0.42**	**0.42**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

PALM BEACH COUNTY WATER UTILITIES DEPARTMENT

County: Palm Beach County

Service Area: Cities of Atlantis, Boynton Beach, Greenacres, Lake Worth, and West Palm Beach; towns of Cloud Lake, Glen Ridge, Haverhill, Lake Clarke Shores, and Loxahatchee Groves; villages of Palm Springs, Royal Palm Beach, and Wellington; and unincorporated areas of Palm Beach County.

Description: PBCWUD has two lime softening and two nanofiltration WTPs. The source of water is the SAS with brackish water from FAS ASR wells to be used for blending. ASR wells are still planned as part of the alternative water supply plans in addition to expansion of reclaimed water facilities. PBCWUD's current bulk sales are 9.63 MGD, which are distributed to FPL, the cities of Boynton Beach, Atlantis, and Lake Worth, and the Town of Lake Clark Shores. The 2003 water use permit requires Palm Beach County to provide 33 MGD of alternative water supplies to avoid increased seepage from canals resulting from increased withdrawals at nearby wellfields. PBCWUD is currently supplying reclaimed water to Century Village, Emerald Dunes, and between 22 and 27 MGD to the FPL West County Energy Center. Current projections indicate that the WTP 2 expansion project may not be needed during the twenty-year planning horizon. In 2013, PBCWUD acquired the Glades Utility Authority. Hence, in future plan updates, the Glades Utility System will be included within the PBCWUD utility profile. PBCWUD is also considering a reclaimed water partnership project with Broward County to expand the distribution of reclaimed water in southern Palm Beach County.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	458,839	515,412[a]	572,795[a]
Per Capita (gallons per day finished water)	115	115	115
Potable Water Demands (daily average annual finished water in MGD)	**52.77**	**59.30**	**65.90**
SFWMD WATER USE PERMITTED (50-00135-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	79.99	79.99	79.99
Brackish Water	7.00	7.00	7.00
Total Allocation	**86.99**	**86.99**	**86.99**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	101.38	101.38	101.38
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	8.50
Total Capacity	**101.38**	**101.38**	**109.88**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	17.50	42.00[b]	51.00[c]

a. The Palm Beach County Planning Division has recently projected that the 2020 and 2030 populations served by the utility could be as high as 558,249 and 626,388, respectively. The difference between the Palm Beach County Planning Division and the estimate used in this plan, which is from the PBCWUD, is largely due to assumptions about the rate at which existing self-supplied users will be provided centralized water services.

b. Based upon information contained in the 2008 Palm Beach County 20-Year Water Supply Work Plan.

c. Based upon SFWMD staff estimation of anticipated flow quantities provided by the PBCWUD.

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD)	
				2020	2030
Potable Water					
WTP 2 Expansion	Fresh Water	2025	$15.00	0.00	8.50
Total			**$15.00**	**0.00**	**8.50**
Nonpotable Water					
Morikami Reclaimed Pump Station	Reclaimed Water	2013	$0.05	2.00[a]	2.00[a]
Total			**$0.05**	**2.00**	**2.00**

a. This project adds capacity to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

VILLAGE OF PALM SPRINGS

County: Palm Beach County

Service Area: Village of Palm Springs, Town of Lake Clarke Shores, and unincorporated areas of Palm Beach County

Description: The SAS is the source of water for the Village of Palm Springs. The two water treatment facilities are interconnected and utilize ion exchange, followed by lime softerning, filtration, and disinfection. The Town of Lake Clarke Shores purchases water from the Village of Palm Springs to serve 3,126 people. The village's water use permit does not contain an allocation sufficient to meet anticipated demands through 2030. The village previously recognized the potential shortfall. The utility indicates it will purchase water from Palm Beach County. The village will need to execute a bulk purchase agreement or implement other projects to increase its water supply by 2030.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	45,204	50,817	56,431
Per Capita (gallons per day finished water)	84	84	84
Potable Water Demands (daily average annual finished water in MGD)	**3.80**	**4.27**	**4.74**
SFWMD WATER USE PERMITTED (50-00036-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	4.74	4.62	4.62
Brackish Water	0.00	0.00	0.00
Total Allocation	**4.74**	**4.62**	**4.62**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	10.00	10.00	10.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**10.00**	**10.00**	**10.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF RIVIERA BEACH

County: Palm Beach County

Service Area: City of Riviera Beach and Town of Palm Beach Shores

Description: The SAS is the source of water for the City of Riviera Beach. It is treated by lime softening.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	37,757	42,446	47,134
Per Capita (gallons per day finished water)	173	173	173
Potable Water Demands (daily average annual finished water in MGD)	**6.53**	**7.34**	**8.15**
SFWMD WATER USE PERMITTED (50-00460-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	9.08	9.08	9.08
Brackish Water	0.00	0.00	0.00
Total Allocation	**9.08**	**9.08**	**9.08**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	17.50	17.50	17.50
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**17.50**	**17.50**	**17.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

SEACOAST UTILITY AUTHORITY

County: Palm Beach County

Service Area: Towns of Juno Beach and Lake Park, Village of North Palm Beach, City of Palm Beach Gardens, and unincorporated areas of Palm Beach County

Description: Seacoast Utility Authority withdraws from the SAS and FAS. The authority replaced its lime softening plant with a nanofiltration treatment plant in 2013. In addition, a new RO plant is anticipated to come online in 2013. The Seacoast Utility Authority also provided 7.9 MGD of reclaimed water in 2011.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	87,686	98,575	109,464
Per Capita (gallons per day finished water)	201	189	189
Potable Water Demands (daily average annual finished water in MGD)	**17.62**	**18.63**	**20.69**
SFWMD WATER USE PERMITTED (50-00365-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	19.31	22.30	22.30
Brackish Water	0.00	8.90	8.90
Total Allocation	**19.31**	**26.92** [a]	**26.92** [a]
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	30.50	26.00	26.00
Brackish Water	0.00	3.00 [b]	3.00 [b]
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**30.50**	**29.00**	**29.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	12.00	15.00	15.00

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Nonpotable Water					
Nanofiltration Concentrate Blending for Reuse Water	Reclaimed Water	2013	$4.50	3.00	3.00
Total			**$4.50**	**3.00**	**3.00**

a. Permit provides flexibility to select sources but must stay within the total allocation.

b. Project will be online by 2013.

VILLAGE OF TEQUESTA

County: Palm Beach County

Service Area: Village of Tequesta and Town of Jupiter Inlet Colony

Description: The Village of Tequesta obtains water from the SAS and FAS. The SAS water supply is treated with sand filtration. The FAS supply is treated by RO. In 1996, the village began to reduce its dependence on the SAS and use the FAS as its primary source. This approach continued with the village's 2011 permit renewal.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	11,581	13,345	15,108
Per Capita (gallons per day finished water)	235	235	235
Potable Water Demands (daily average annual finished water in MGD)	**2.72**	**3.14**	**3.55**
SFWMD WATER USE PERMITTED (50-00046-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	2.70 [a]	1.10	1.10
Brackish Water	4.40 [a]	3.43	3.43
Total Allocation	**4.84**	**4.37**	**4.37**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	2.73	2.73	2.73
Brackish Water	3.60	3.60	3.60
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**6.33**	**6.33**	**6.33**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. The permit in effect in 2010 did not have annual or monthly source limits for the SAS or FAS. The numbers shown here are maximum day allocations, which are further limited by the total annual allocation for both sources of 4.84 MGD.

WELLINGTON PUBLIC UTILITIES DEPARTMENT

County: Palm Beach County

Service Area: Villages of Wellington and Royal Palm Beach, and unincorporated areas of Palm Beach County

Description: The Wellington Public Utilities Department currently obtains water from the SAS. The village's northern wellfields are slightly brackish and are treated using membrane softening. Water from the southern and eastern wellfields is fresher and treated via lime softening.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	55,408	62,289	69,169
Per Capita (gallons per day finished water)	105	105	105
Potable Water Demands (daily average annual finished water in MGD)	**5.82**	**6.54**	**7.26**
SFWMD WATER USE PERMITTED (50-00464-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	8.02	8.02	8.02
Brackish Water	0.00	0.00	0.00
Total Allocation	**8.02**	**8.02**	**8.02**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	6.50	6.50	6.50
Brackish Water	6.30	6.30	6.30
Planned Project Capacity	0.00	0.50	1.40
Total Capacity	**12.80**	**13.30**	**14.20**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	1.00	1.00	1.00

PROJECT SUMMARY					
				Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	2020	2030
Potable Water					
WTP Low Pressure RO Expansion Phase 1 and 2 (efficiency improvements)	Fresh Water	2025	$0.80	0.50	1.40
Total			**$0.01**	**0.50**	**1.40**
Nonpotable Water					
Phased Reclaimed System Expansions	Reclaimed Water	2011 -2030	$0.01	1.30[a]	2.90[a]
Total			**$0.01**	**1.30**	**2.90**

a. This project adds capacity to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

CITY OF WEST PALM BEACH PUBLIC UTILITIES

County: Palm Beach County

Service Area: City of West Palm Beach, and towns of Palm Beach and South Palm Beach

Description: The source of water for the City of West Palm Beach Public Utilities is surface water and a SAS wellfield. The city is currently constructing a forward pump and gate structure at Clear Lake to enable the city's intake system to remain operational during drought conditions when unusually low surface water levels persist. The city faced challenges during recent water shortages and developed plans to address water shortages and long-term growth. Alternative water supply and drought management projects include urban stormwater treatment, advanced wastewater treatment at the East Central Regional Wastewater Reclamation Facility, wetland rehydration, and aquifer recharge. Future plans include ASR, capture water otherwise lost to tide from the C-17 and C-51 canals (via replacement of Control Structure 2 with a 300-cubic feet per scond pumping system and additional wells along the M Canal).

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	109,958	123,853	143,134
Per Capita (gallons per day finished water)	253	253	253
Potable Water Demands (daily average annual finished water in MGD)	**27.87**	**31.33**	**36.21**
SFWMD WATER USE PERMITTED (50-00615-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	39.30	41.20	41.20
Brackish Water	0.00	0.00	0.00
Total Allocation	**39.30**	**41.20**	**41.20**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	47.00	47.00	47.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**47.00**	**47.00**	**47.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	6.00	6.00	6.00

PROJECT SUMMARY					
		Completion	Total Capital Cost	Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	Source	Date	($ Million)	2020	2030
Potable Water					
ASR Well Reactivation at Clear Lake	Surface Water	2013	$10.00	8.00[a]	8.00[a]
C-17 Pump Station	Storm Water	2020	$2.50	8.00[a]	8.00[a]
Total			**$12.50**	**16.00**	**16.00**

a. This project adds flexibility to the water distribution system, but does not increase the actual treatment capacity of the potable water treatment plant.

Broward County Utilities

BROWARD COUNTY WATER AND WASTEWATER SERVICES DISTRICT 1

County: Broward County

Service Area: All or portions of the cities of Fort Lauderdale, Lauderdale Lakes, Lauderhill, North Lauderdale, Oakland Park, Plantation, Pompano Beach, and Tamarac, and unincorporated areas of Broward County

Description: The SAS provides the majority of the water supply; however the permit includes allocation from the FAS. The county is currently in the process of requesting a modification in the permit allocation from the SAS. The county is expected to start drilling the FAS wells in 2013. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	71,395	75,892	80,388
Per Capita (gallons per day finished water)	99	99	99
Potable Water Demands (daily average annual finished water in MGD)	**7.05**	**7.49**	**7.93**
SFWMD WATER USE PERMITTED (06-00146-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	10.67	9.20	9.20
Brackish Water	4.70	4.70	4.70
Total Allocation	**13.90**	**13.90**	**13.90**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	16.00	16.00	16.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	1.50	2.50
Total Capacity	**16.00**	**17.50**	**18.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Potable Water					
District 1A Treatment Plant Expansion (RO WTP, Floridan wells, and a disposal well)	Brackish Water	2017	$41.10	1.50	2.50
Total			**$41.10**	**1.50**	**2.50**

BROWARD COUNTY WATER AND WASTEWATER SERVICES DISTRICT 2A/NORTH REGIONAL WELLFIELD

Service Area: All or portions of the cities of Coconut Creek, Deerfield Beach, Lighthouse Point, Parkland, and Pompano Beach, and unincorporated areas of Broward County

Description: The SAS is the primary source of water supply for the District 2A system. The 2A wellfield includes SAS wells and a proposed FAS wellfield to provide water to a proposed RO treatment plant. The demand projections developed for this plan update suggest the proposed FAS project may not be needed until after the 2030 planning horizon so, at this time, the county has indefinitely postponed the project. The North Regional Wellfield is one of two wellfields the county developed to provide raw water to Deerfield Beach and the District 2A WTP. The Broward County North Regional WWTP provides 4.4 MGD of reuse water. The 2008 Ocean Outfall statute requires the county to achieve 25 MGD of reuse by 2025. The county is considering a project wherein it will provide reclaimed water to PBCWUD to comply with the statute. The City of Coconut Creek is currently developing a program to provide reclaimed water from North Regional WWTP throughout Coconut Creek.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	110,939	116,274	121,609
Per Capita (gallons per day finished water)	110	110	110
Potable Water Demands (daily average annual finished water in MGD)	**12.20**	**12.79**	**13.38**

SFWMD WATER USE PERMITTED (06-01634-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	19.95	17.50	17.50
Brackish Water	4.60	4.60	4.60
Total Allocation	**22.06**	**22.06**	**22.06**

POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	40.00	40.00	40.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**40.00**	**40.00**	**40.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	10.00	10.00	10.00

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Nonpotable Water					
Reclaimed Water Highlands Pompano Beach	Reclaimed Water	2013	$6.50	0.30[a]	0.30[a]
Total			**$6.50**	**0.30**[a]	**0.30**[a]

a. This project adds capacity to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

BROWARD COUNTY WATER AND WASTEWATER SERVICES SOUTH REGIONAL WELLFIELD

Service Area: The Broward County Water and Wastewater Services South Regional Wellfield, also known as the Brian Piccolo Wellfield, suppiles raw water to FPL and the cities of Hollywood, Hallandale Beach, and Dania Beach. Since this system provides raw water to other facilities, no population is assigned.

The county contracts with the City of Hollywood to treat water for the county's service area formerly known as System 3. The county distributes finished water to the Town of Pembroke Park, the City of West Park, the western portion of the City of Dania Beach, and unincorporated areas of Broward County. The System 3 WTPs have been dismantled, and the county proposed to abandon the remaining System 3 water wells and transfer that allocation to the South Regional Wellfield.

Description: Modifications to the South Regional Wellfield have not been permitted as of the end of 2012. The existing proposal calls for the City of Hallandale to develop its own wellfield, using its share of the South Regional Wellfield allocation. In addition to the System 3 allocation, a portion of water previously allocated to the City of Dania Beach would be moved to the South Regional Wellfield. See related discussions on the utility summaries for the cities of Hallandale Beach and Dania Beach.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	0	0	0
Per Capita (gallons per day finished water)	0	0	0
Potable Water Demands (daily average annual finished water in MGD)	**0.00**[a]	**0.00**[a]	**0.00**[a]
SFWMD WATER USE PERMITTED (06-01474-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	14.20	14.20	14.20
Brackish Water	0.00	0.00	0.00
Total Allocation	**14.20**	**14.20**	**14.20**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.00	0.00	0.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**0.00**	**0.00**	**0.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. Since this system provides raw water to other facilities, no population is assigned.

CITY OF COOPER CITY UTILITY DEPARTMENT

County: Broward County

Service Area: City of Cooper City

Description: The water supply for the City of Cooper City is obtained from the SAS and treated via membrane softening. The city is projected to have minimal growth beyond 2020. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	28,543	33,335	33,585
Per Capita (gallons per day finished water)	95	95	95
Potable Water Demands (daily average annual finished water in MGD)	**2.71**	**3.17**	**3.19**
SFWMD WATER USE PERMITTED (06-00365-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	4.55	4.55	4.55
Brackish Water	0.00	0.00	0.00
Total Allocation	**4.55**	**4.55**	**4.55**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	7.00	7.00	7.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**7.00**	**7.00**	**7.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF CORAL SPRINGS

County: Broward County

Service Area: A portion of the City of Coral Springs

Description: The water supply for the City of Coral Springs is obtained from the SAS. Portions of the city are served by other utilities: Coral Springs Improvement District, North Springs Improvement District, and Royal Utilities Corporation. The information on this page addresses only the city's service area. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	58,029	60,820	63,610
Per Capita (gallons per day finished water)	114	114	114
Potable Water Demands (daily average annual finished water in MGD)	**6.62**	**6.93**	**7.25**
SFWMD WATER USE PERMITTED (06-00102-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	9.44	9.44	9.44
Brackish Water	0.00	0.00	0.00
Total Allocation	**9.44**	**9.44**	**9.44**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	16.00	16.00	16.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**16.00**	**16.00**	**16.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CORAL SPRINGS IMPROVEMENT DISTRICT

County: Broward County

Service Area: A portion of the City of Coral Springs

Description: The water supply for the Coral Springs Improvement District is obtained from the SAS. The water is treated using a lime softening process.

POPULATION AND FINISHED WATER DEMAND			
	Existing	**Projected**	
	2010	**2020**	**2030**
Population	36,969	38,747	40,525
Per Capita (gallons per day finished water)	103	103	103
Potable Water Demands (daily average annual finished water in MGD)	**3.81**	**3.99**	**4.17**
SFWMD WATER USE PERMITTED (06-00100-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	5.42	5.42	5.42
Brackish Water	0.00	0.00	0.00
Total Allocation	**5.42**	**5.42**	**5.42**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	7.20	7.20	7.20
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**7.20**	**7.20**	**7.20**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF DANIA BEACH

County: Broward County

Service Area: A portion of the City of Dania Beach

Description: The water supply for the City of Dania Beach comes from the SAS. Its service area covers the eastern portion of the city. The city's wellfield is limited to 1.1 MGD due to concerns about saltwater intrusion. To meet its current and future demand above its allocation, the city purchases and treats raw water from Broward County's South Regional Wellfield at Brian Piccolo Park. The city does not have a WWTP. The city's wastewater is treated by Hollywood's Southern Regional Water Reclamation Facility. This city is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	14,840	15,554	16,267
Per Capita (gallons per day finished water)	154	154	154
Potable Water Demands (daily average annual finished water in MGD)	**2.29**	**2.40**	**2.51**
SFWMD WATER USE PERMITTED (06-00187-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	1.80[a]	1.10	1.10
Brackish Water	0.00	0.00	0.00
Bulk Water Purchase (from Broward County Water and Wastewater Services South Regional Wellfield)	1.30	2.20	2.50
Total Allocation (including bulk water purchase)	**3.10**	**3.30**	**3.60**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	5.02	5.02	5.02
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**5.02**	**5.02**	**5.02**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. In 2013, the City of Dania Beach allocation of 1.80 MGD was reduced to 1.10 MGD to reduce the risk of saltwater intrusion into the wellfield.

TOWN OF DAVIE

County: Broward County

Service Area: A portion of the Town of Davie and the Seminole Tribe of Florida's Hollywood Reservation

Description: The water supply of the Town of Davie is currently obtained from the SAS. The town has constructed a 6-MGD RO plant to treat water from the FAS, which will be operational by 2013. An expansion of the new RO facility is proposed for later in the planning period and currently is listed at 6.0 MGD, although the demand projections developed for this plan suggest the full project may not be needed. The town is also developing a reclaimed water system. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide. The combination of continued conservation and the implementation of reuse will also benefit Davie in meeting its 2030 demand.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	27,548	59,320	91,091
Per Capita (gallons per day finished water)	146	146	146
Potable Water Demands (daily average annual finished water in MGD)	**4.02**	**8.66**	**13.30**
SFWMD WATER USE PERMITTED (06-00134-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	5.53	5.02	5.02
Brackish Water	0.00	14.83	14.83
Total Allocation	**5.53** [a]	**19.85**	**19.85**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	7.40	7.40	7.40
Brackish Water	0.00	6.00 [b]	6.00 [b]
Planned Project Capacity	0.00	0.00	6.00
Total Capacity	**7.40**	**13.40**	**19.40**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	3.50	3.50

a. Town of Davie operated under its 2005 water use permit as reflected here until late 2010.

b. Project will be online in 2013.

PROJECT SUMMARY					
Water Supply Projects	**Source**	**Completion Date**	**Total Capital Cost ($ Million)**	**Projected Cumulative Design Capacity (MGD)**	
				2020	**2030**
Potable Water					
RO Addition to WTP	Brackish Water	2030	$16.00 [a]	0.00	6.00
Total			**$16.00**	**0.00**	**6.00**
Nonpotable Water					
Reclaimed Water Facility	Reclaimed Water	2014	$7.50	3.50	3.50
Total			**$7.50**	**3.50**	**3.50**

a. The annual operation and maintenance cost (including power, chemicals, parts, materials, labor, administration, and compliance) for operating a 6-MGD brackish water RO water treatment plant was estimated to be approximately $2,580,000 per year, as estimated from the *2007 Water Supply Cost Estimation Study* by CDM (2007a).

CITY OF DEERFIELD BEACH

County: Broward County

Service Area: City of Deerfield Beach

Description: Until recently, the City of Deerfield Beach operated two interconnected WTPs: East WTP and West WTP. The city decomissioned the East WTP in 2012 and continues operation of the West WTP. The West WTP has three separate treatment systems: lime softening (7.5 MGD), nanofiltration (10.5 MGD), and RO treatment (3.0 MGD) systems. The 3.0-MGD RO unit was completed in 2013 to treat brackish water from the city's FAS wellfield. Future demands will be met 75 percent from the SAS and 25 percent from the FAS. The city's water use permit capped the East Wellfield at 3.35 MGD due to saltwater intrusion concerns. The city also purchases 0.59 MGD of raw water from Broward County's District 2A/North Regional Wellfield. This city is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	51,842	54,335	56,828
Per Capita (gallons per day finished water)	191	191	191
Potable Water Demands (daily average annual finished water in MGD)	**9.90**	**10.38**	**10.85**
SFWMD WATER USE PERMITTED (06-00082-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	11.91	11.91	11.91
Brackish Water	4.00	4.00	4.00
Bulk Water Purchase (from Broward County)	0.59	0.59	0.59
Total Allocation (including bulk water purchase)	**14.74**	**14.74**	**14.74**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	34.80	18.00	18.00
Brackish Water	0.00	3.00[a]	3.00[a]
Total Capacity	**34.80**	**21.00**	**21.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. Project was online in 2013.

CITY OF FORT LAUDERDALE

County: Broward County

Service Area: Cities of Fort Lauderdale, Oakland Park, Wilton Manors, and Hollywood; portions of the City of Tamarac; towns of Lauderdale-By-The-Sea and Davie; and villages of Lazy Lake and Sea Ranch Lakes.

Description: The SAS currently provides the water supply for the City of Fort Lauderdale. The city has two water treatment facilities. The Fiveash WTP has a 70-MGD design capacity and uses lime softening. The city's membrane plant (Peele-Dixie) was completed in 2008 and has a design capacity of 12 MGD. Before growth slowed in 2008, the city planned to construct a 6.0-MGD RO plant. Current projections indicate the RO plant may not be needed during the twenty-year planning horizon. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	212,945	223,045	233,145
Per Capita (gallons per day finished water)	190	190	190
Potable Water Demands (daily average annual finished water in MGD)	**40.46**	**42.38**	**44.30**
SFWMD WATER USE PERMITTED (06-00123-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	52.55	52.55	52.55
Brackish Water	8.97	8.97	8.97
Total Allocation	**61.19**	**61.19**	**61.19**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	82.00	82.00	82.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	6.00
Total Capacity	**82.00**	**82.00**	**88.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

PROJECT SUMMARY					
		Completion	Total Capital Cost	Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	Source	Date	($ Million)	2020	2030
Potable Water					
Dixie Floridan Water Supply/WTP	Brackish Water	2030	$22.90	0.00	6.00
Total			**$22.90**	**0.00**	**6.00**

CITY OF HALLANDALE BEACH

County: Broward County

Service Area: City of Hallandale Beach

Description: The water supply for the City of Hallandale Beach comes from the SAS. The city's existing wellfield allocation is capped at 3.5 MGD due to the risk of saltwater intrusion. The city also purchases up to 6.2 MGD of raw water from Broward County's South Regional Wellfield. Hallandale Beach proposed to develop a new wellfield located west of the city and abdandon its existing wellfield. The city was unable to find a viable western wellfield site. In 2013, Hallandale Beach decided to develop infrastructure to reduce the risk of saltwater intrusion at its existing wellfield. The city will remain a customer of the South Regional Wellfield. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	37,113	38,898	40,683
Per Capita (gallons per day finished water)	**146**	**146**	**146**
Potable Water Demands (daily average annual finished water in MGD)	**5.42**	**5.68**	**5.94**
SFWMD WATER USE PERMITTED (06-00138-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	3.50	3.50	3.50
Brackish Water	0.00	0.00	0.00
Bulk Water Purchase (from Broward County)	6.20[a]	6.20[a]	6.20[a]
Total Allocation (including bulk water purchase)	**9.70**	**9.70**	**9.70**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	16.00	16.00	16.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**16.00**	**16.00**	**16.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. The City of Hallandale has an agreement to purchase up to 6.20 MGD of raw water from the Broward County Water and Wastewater Services' South Regional (Brian Piccolo) Wellfield.

TOWN OF HILLSBORO BEACH

County: Broward County

Service Area: Town of Hillsboro Beach

Description: The water supply for the Town of Hillsboro Beach comes from the SAS and is treated using a lime softening process. The town is currently replacing its existing plant with new lime softening treatment equipment. This utility is a contributing member to the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	1,875	1,965	2,055
Per Capita (gallons per day finished water)	351	351	351
Potable Water Demands (daily average annual finished water in MGD)	**0.66**	**0.69**	**0.72**
SFWMD WATER USE PERMITTED (06-00101-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.88	0.88	0.88
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.88**	**0.88**	**0.88**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	2.25	2.25	2.25
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**2.25**	**2.25**	**2.25**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF HOLLYWOOD

County: Broward County
Service Area: Cities of Hollywood and West Park, portions of the City of Dania Beach, Town of Davie, Seminole Tribe Hard Rock Casino, and portions of unincorporated Broward County
Description: The majority of the City of Hollywood's water supply comes from the SAS. The city operates three distinct WTPs, utilizing lime softening, membrane, and RO treatment technologies. It is anticipated that the FAS will provide about 25 percent of future demands. The city also purchases bulk water from the Broward County's South Regional Wellfield. The city provides treated water to Broward County for distribution to Pembroke Park, West Park, and the western portions of Dania Beach. The city operates a regional WWTP that is subject to the requirements of the 2008 Ocean Outfall statute. Additionally, the city has proposed a reuse program to recharge the FAS as its primary project to meet the resuse requirements of the Ocean Outfall statute for the South Regional WWTP. More than 23 MGD of reclaimed water projects are expected to be developed by 2025. This city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide. Current projections indicate that the RO expansion project may not be needed during the twenty-year planning horizon.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	186,798	198,559	210,320
Per Capita (gallons per day finished water)	111	111	111
Potable Water Demands (daily average annual finished water in MGD)	**20.73**	**22.04**	**23.35**
SFWMD WATER USE PERMITTED (06-00038-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	24.80	24.80	24.80
Brackish Water	8.68	8.68	8.68
Bulk Water Purchase (from Broward County Water and Wastewater Services' South Regional Wellfield)	5.90	5.90	5.90
Total Allocation (including bulk water purchase)	**39.38**	**39.38**	**39.38**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	55.50	55.50	55.50
Brackish Water	4.00	4.00	4.00
Planned Project Capacity	0.00	0.00	2.00
Total Capacity	**59.50**	**59.50**	**61.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	3.00	4.00[a]	23.40[a]

PROJECT SUMMARY					
				Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	**Source**	**Completion Date**	**Total Capital Cost ($ Million)**	**2020**	**2030**
Potable Water					
RO Expansion (one train and two Floridan wells)	Brackish Water	2027	$7.10	0.00	2.00
Total			**$7.10**	**0.00**	**2.00**

a. Projection conveyed by city staff regarding anticipated compliance with the 2008 Ocean Outfall statute.

CITY OF LAUDERHILL

County: Broward County

Service Area: City of Lauderhill

Description: The water supply for the City of Lauderhill is obtained from the SAS and treated using a lime softening process. The city anticipates construction of FAS wells and an RO plant to meet future demands. Current projections indicate the FAS wells and RO plant may not be needed during the twenty-year planning horizon. The city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	58,114	60,909	63,704
Per Capita (gallons per day finished water)	95	95	95
Potable Water Demands (daily average annual finished water in MGD)	**5.52**	**5.79**	**6.05**
SFWMD WATER USE PERMITTED (06-00129-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	7.70	7.70	7.70
Brackish Water	1.02	1.02	1.02
Total Allocation	**8.72**	**8.72**	**8.72**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	16.00	16.00	16.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	1.00	3.00
Total Capacity	**16.00**	**17.00**	**19.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

PROJECT SUMMARY					
		Completion	Total Capital Cost	Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	**Source**	**Date**	**($ Million)**	**2020**	**2030**
Potable Water					
Floridan Well and RO WTP Phase 1 (disposal well and RO WTP)	Brackish Water	2017	$27.50	1.00	1.00
Floridan Well and RO WTP Phase 2 (expansion of RO WTP)	Brackish Water	2018	$5.50	0.00	2.00
Total			**$33.00**	**1.00**	**3.00**

CITY OF MARGATE

County: Broward County

Service Area: City of Margate and a portion of the City of Coconut Creek

Description: The water supply for the City of Margate is obtained from the SAS and treated through a lime softening process. The city intends to utilize reclaimed water to irrigate three golf courses and two residential communities. In the future, the city intends to modify its water use permit to account for reclaimed water usage. This city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide .

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	58,314	61,118	63,923
Per Capita (gallons per day finished water)	98	98	98
Potable Water Demands (daily average annual finished water in MGD)	**5.71**	**5.99**	**6.26**
SFWMD WATER USE PERMITTED (06-00121-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	9.30	8.51	8.51
Brackish Water	0.00	0.00	0.00
Total Allocation	**9.30**	**8.51**	**8.51**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	18.00	18.00	18.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**18.00**	**18.00**	**18.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	1.50	1.50

PROJECT SUMMARY					
		Completion	Total Capital Cost	Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	Source	Date	($ Million)	2020	2030
Nonpotable Water					
WWTP Effluent Reuse System	Reclaimed Water	2015	$9.50	1.50	1.50
Total			**$9.50**	**1.50**	**1.50**

CITY OF MIRAMAR

County: Broward County

Service Area: City of Miramar

Description: The water supply for the City of Miramar is obtained from the SAS and FAS. The city obtained an SAS allocation above its 11.56-MGD base condition water use by committing its reclaimed water program to provide reuse irrigation water to current water use permit holders in the vicinity of the city's West Wellfield. Once the approximately 65 irrigation class permits are retired, the city can use another 1.78 MGD from the SAS. As a result, the city has a SAS allocation of 13.33 MGD. The city also constructed an RO treatment plant and FAS wells. This city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	116,715	125,225	133,734
Per Capita (gallons per day finished water)	97	97	97
Potable Water Demands (daily average annual finished water in MGD)	**11.32**	**12.15**	**12.97**
SFWMD WATER USE PERMITTED (06-00054-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	13.89[a]	11.56[b]	13.33[c]
Brackish Water	2.67	2.67	2.67
Total Allocation	**16.00**	**14.23**[b]	**16.00**[c]
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	15.25	15.25	15.25
Brackish Water	2.50	2.50	2.50
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**17.75**	**17.75**	**17.75**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	2.00	4.00[d]	4.00[d]

a. The 2008 consumptive use permit included a temporary allocation of 2.33 MGD to provide adequate supply while the city developed a FAS wellfield and an RO treatment plant.

b. The city's SAS allocation dropped to 11.56 MGD when the temporary allocation expired in 2013. However, the consumptive use permit provided opportunity for the City of Miramar to obtain an additional 1.78 MGD by providing reuse to approximately 65 businesses and getting those users to retire their irrigation class consumptive use permits for the SAS.

c. 13.33 MGD assumes the 65 water use permits have been retired and the city has its full allocation.

d. As described in the city's water supply work plan in 2008.

CITY OF NORTH LAUDERDALE

County: Broward County

Service Area: City of North Lauderdale

Description: The water supply for the City of North Lauderdale is obtained from the SAS and is treated using a lime softening process. The city's water use permit was modified in 2005 and does not anticipate a substantial increase in demand in the future. This is consistent with the demand projections provided in this plan.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	32,994	34,581	36,167
Per Capita (gallons per day finished water)	76	76	76
Potable Water Demands (daily average annual finished water in MGD)	**2.51**	**2.63**	**2.75**
SFWMD WATER USE PERMITTED (06-00004-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	3.64	3.24	3.24
Brackish Water	0.00	0.00	0.00
Total Allocation	**3.64**	**3.24**	**3.24**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	7.50	7.50	7.50
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**7.50**	**7.50**	**7.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

NORTH SPRINGS IMPROVEMENT DISTRICT

County: Broward County

Service Area: A portion of the City of Coral Springs and the City of Parkland

Description: The water supply for the North Springs Improvement District is obtained from the SAS. The utility incorporated the “wedge” land parcel recently annexed from Palm Beach County into their service area. If zoning in the wedge changes from agricultural to residential, the district plans to modify its water use permit to add FAS wells and an RO plant to meet future water demands. Wastewater is currently treated at the Broward County’s North Regional WWTP. However, the district is planning to develop a reuse facility by 2020.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	34,895	36,573	38,251
Per Capita (gallons per day finished water)	124	124	124
Potable Water Demands (daily average annual finished water in MGD)	**4.33**	**4.54**	**4.74**
SFWMD WATER USE PERMITTED (06-00274-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	5.18	5.18	5.18
Brackish Water	0.00	0.00	0.00
Total Allocation	**5.18**	**5.18**	**5.18**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	6.80	6.80	6.80
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**6.80**	**6.80**	**6.80**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	4.00	4.00

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Nonpotable Water					
Water Reuse Plant	Reclaimed Water	2017	information not available	4.00	4.00
Total				**4.00**	**4.00**

PARKLAND UTILITIES, INC.

County: Broward County

Service Area: City of Parkland

Description: Parkland Utilities, Inc. is a private utility that obtains its water supply from the SAS and treats it using a lime softening process.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	2,161	2,265	2,369
Per Capita (gallons per day finished water)	113	113	113
Potable Water Demands (daily average annual finished water in MGD)	**0.24**	**0.26**	**0.27**
SFWMD WATER USE PERMITTED (06-00242-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.35	0.35	0.35
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.35**	**0.35**	**0.35**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.58	0.58	0.58
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**0.58**	**0.58**	**0.58**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF PEMBROKE PINES

County: Broward County

Service Area: City of Pembroke Pines and Town of Southwest Ranches (five homes)

Description: The water supply for the City of Pembroke Pines is obtained from the SAS and treated using a lime softening process. The city has two wellfields: East and Central. The city owns and operates a WWTP and investigated the feasibility of producing reclaimed water for aquifer recharge in the future. At this time, the city indicated it will not proceed with the reuse project. This city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	152,002	159,312	166,622
Per Capita (gallons per day finished water)	78	78	78
Potable Water Demands (daily average annual finished water in MGD)	**11.86**	**12.43**	**13.00**
SFWMD WATER USE PERMITTED (06-00135-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	15.60	15.60	15.60
Brackish Water	0.00	0.00	0.00
Total Allocation	**15.60**	**15.60**	**15.60**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	18.00	18.00	18.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**18.00**	**18.00**	**18.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF PLANTATION

County: Broward County

Service Area: City of Plantation

Description: The water supply for the City of Plantation is obtained from the SAS and treated at two treatment facilities that use membrane filtration. Each plant has a 12-MGD capacity. The city operates a WWTP and treats a portion of the wastewater for irrigation, process water, and equipment washdown at the plant. This city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	91,812	97,595	103,377
Per Capita (gallons per day finished water)	127	127	127
Potable Water Demands (daily average annual finished water in MGD)	**11.66**	**12.39**	**13.13**
SFWMD WATER USE PERMITTED (06-00103-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	17.24	17.24	17.24
Brackish Water	0.00	0.00	0.00
Total Allocation	**17.24**	**17.24**	**17.24**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	24.00	24.00	24.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**24.00**	**24.00**	**24.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.77	0.77	0.77

CITY OF POMPANO BEACH

County: Broward County

Service Area: Cities of Pompano Beach and Lighthouse Point, and the Town of Lauderdale-By-The-Sea

Description: The water supply for the City of Pompano Beach is obtained from the SAS from eastern and western wellfields (Airport and Palm Aire, respectively). The eastern wellfield has seasonal pumpage limits due to saltwater intrusion. The city operates one WTP that utilizes lime softening and membrane processes. The city also operates a reclaimed water facility that serves residential neighborhoods, golf courses, parks, and road medians. The expansion of the city's reclaimed water system is ongoing. The city does not have a wastewater treatment facility. The source of water for reuse is the ocean outfall line from Broward County's North Regional Water Reclamation Facility.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	79,917	83,765	87,613
Per Capita (gallons per day finished water)	170	170	162
Potable Water Demands (daily average annual finished water in MGD)	**13.59**	**14.24**	**14.19**

SFWMD WATER USE PERMITTED (06-00070-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	17.75	17.75	17.75
Brackish Water	0.00	0.00	0.00
Total Allocation	**17.75**	**17.75**	**17.75**

POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	50.00	50.00	50.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**50.00**	**50.00**	**50.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	7.50	7.50	7.50

PROJECT SUMMARY					
			Total Capital	Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	Source	Completion Date	Cost ($ Million)	2020	2030
Nonpotable Water					
Reuse Distribution Expansion Program through Fiscal Year 2025	Reclaimed Water	underway	$5.70	1.40[a]	2.20[a]
Broward County Reuse Distribution	Reclaimed Water	underway	information not available	0.10[a]	0.10[a]
Total			**$5.70**	**1.50**	**2.30**
Conservation Projects					
Conservation and Irrigation Restrictions	Conservation	2025	$0.00	0.10	0.10
Total			**$0.00**	**0.10**	**0.10**

a. This project adds to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

ROYAL UTILITY CORPORATION

County: Broward County

Service Area: A portion of the City of Coral Springs

Description: The water supply for the Royal Utility Corporation is obtained from the SAS. The utility operates a lime softening WTP with a capacity of 1 MGD.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	3,234	3,390	3,545
Per Capita (gallons per day finished water)	98	98	98
Potable Water Demands (daily average annual finished water in MGD)	**0.32**	**0.33**	**0.35**
SFWMD WATER USE PERMITTED (06-00003-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.48	0.48	0.48
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.48**	**0.48**	**0.48**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	1.00	1.00	1.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**1.00**	**1.00**	**1.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

SEMINOLE TRIBE OF FLORIDA

County: Broward County

Service Area: Seminole Tribe of Florida's Hollywood Reservation

Description: Water supply for the Seminole Tribe of Florida's Hollywood Reservation is obtained from the SAS. SFWMD does not issue a water use permit to the Seminole Tribe of Florida for this location. Rather, the Water Rights Compact Among the Seminole Tribe of Florida, the State of Florida and the South Florida Water Management District provides information about water supply planning through an annual work plan. The information recently submitted by the Seminole Tribe of Florida is contained in the Fourth Amendment to the Seventeenth Annual Work Plan.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	1,368	1,434	1,500
Per Capita (gallons per day finished water)	810	810	810
Potable Water Demands (daily average annual finished water in MGD)	**1.11**	**1.16**	**1.21**
SFWMD WATER USE RIGHTS (MGD)			
	Existing	Projected	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	2.40	2.40	2.40
Brackish Water	0.00	0.00	0.00
Total Allocation	**2.40**	**2.40**	**2.40**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	2.00	2.00	2.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**2.00**	**2.00**	**2.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

CITY OF SUNRISE

County: Broward County

Service Area: Cities of Sunrise and Weston, Town of Southwest Ranches, a portion of the Town of Davie, and unincorporated Broward County

Description: The City of Sunrise obtains its water supply from the SAS and FAS. The city operates four wellfields and three WTPs primarily utilizing lime softening and membrane processes. In 2013, the city added a 1.5-MGD RO treatment system at its Springtree Plant. The city previously planned to develop 9 MGD of RO treatment capacity and acquired a FAS allocation of 10.98 MGD to accommodate expected demand. Slower growth and successful conservation efforts should allow the city to postpone development of additional capacity from the FAS aquifer beyond 2030. The city is upgrading the treatment system at its Southwest WWTP to provide 1 MGD of reclaimed water capacity and is in the design phase to develop reuse facilities at its Sawgrass WWTP. The city is a contributing member of the Broward Water Partnership conservation program, which has the goal of saving a total of 30 MGD countywide.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected [a]	
	2010	2020	2030
Population	211,403	221,570	231,736
Per Capita (gallons per day finished water)	116	116	116
Potable Water Demands (daily average annual finished water in MGD)	**24.52**	**25.70**	**26.88**
SFWMD WATER USE PERMITTED (06-00120-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	31.39	29.09	29.09
Brackish Water	4.76	10.98	10.98
Total Allocation	**36.15**	**40.07**	**40.07**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	50.00	50.00	50.00
Brackish Water	0.00	1.50[b]	1.50[b]
Planned Project Capacity (Brackish)	0.00	0.00	0.00
Total Capacity	**50.00**	**51.50**	**51.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.80	2.80	4.80

PROJECT SUMMARY					
Water Supply Projects	**Source**	**Completion Date**	**Total Capital Cost ($ Million)**	**Projected Cumulative Design Capacity (MGD)**	
				2020	**2030**
Nonpotable Water					
Irrigation Reuse at the Sawgrass WWTP	Reclaimed Water	2018	information not available	2.00	4.00
Total			**$0.00**	**2.00**	**4.00**

a. The city estimates 10,000 housing units are currently vacant. If these units become occupied at a rate than is higher than medium Bureau of Economic and Business Research growth rates, then demands could increase above projections.

b. Project will be online by 2013.

CITY OF TAMARAC

County: Broward County

Service Area: City of Tamarac

Description: The water supply for the City of Tamarac is obtained from the SAS and treated using a lime softening process. City officials indicated that the city is experiencing a change in demographics that could result in more rapid growth in population and water demand than those anticipated by the analysis presented in this plan. The 2005-2006 LEC Plan Update recommended the city consider the construction of FAS wells and a 2-MGD RO treatment system to meet future demands. Current projections, however, indicate that the project may not be needed during the twenty-year planning horizon.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	56,064	58,760	61,456
Per Capita (gallons per day finished water)	105	105	105
Potable Water Demands (daily average annual finished water in MGD)	**5.89**	**6.17**	**6.45**
SFWMD WATER USE PERMITTED (06-00071-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	7.19	7.19	7.19
Brackish Water	0.00	0.00	0.00
Total Allocation	**7.19**	**7.19**	**7.19**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	16.00	16.00	16.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	2.00
Total Capacity	**16.00**	**16.00**	**18.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

PROJECT SUMMARY					
				Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	2020	2030
Potable Water					
RO WTP	Brackish Water	2022	$19.00	0.00	2.00
Total			**$19.00**	**0.00**	**2.00**

TINDALL HAMMOCK IRRIGATION AND SOIL CONSERVATION DISTRICT

County: Broward County

Service Area: Town of Davie

Description: The water supply for the Tindall Hammock Irrigation and Soil Conservation District (formerly known as Ferncrest Utilities) is obtained from the SAS. The district reuses the wastewater generated by the service area for aquifer recharge.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	2,639	2,766	2,893
Per Capita (gallons per day finished water)	158	158	158
Potable Water Demands (daily average annual finished water in MGD)	**0.42**	**0.44**	**0.46**
SFWMD WATER USE PERMITTED (06-00170-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.74	0.74	0.74
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.74**	**0.74**	**0.74**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	1.00	1.00	1.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**1.00**	**1.00**	**1.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.60	0.60	0.60

Miami-Dade County

AMERICANA VILLAGE

County: Miami-Dade County

Service Area: Unincorporated areas of Miami-Dade County

Description: The water supply for this mobile home community is obtained from the SAS. The demand for this community is not expected to exceed its allocation in future years.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	1,582	1,727	1,871
Per Capita (gallons per day finished water)	138	138	138
Potable Water Demands (daily average annual finished water in MGD)	**0.22**	**0.24**	**0.26**
SFWMD WATER USE PERMITTED (13-02004-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	0.26	0.26	0.26
Brackish Water	0.00	0.00	0.00
Total Allocation	**0.26**	**0.26**	**0.26**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	0.50	0.50	0.50
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**0.50**	**0.50**	**0.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

FLORIDA CITY WATER AND SEWER DEPARTMENT

County: Miami-Dade County

Service Area: City of Florida City

Description: The water supply for the Florida City Water and Sewer Department is obtained from the SAS and treated using a lime softening process. Florida City has reduced its historically high rate of unaccounted for water losses, but its rate still exceeds SFWMD guidelines. Continued reductions should result in a lower per capita use rate, which should decrease the 2030 demand below 2.07 MGD.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	11,230	12,256	13,283
Per Capita (gallons per day finished water)	156	156	156
Potable Water Demands (daily average annual finished water in MGD)	**1.75**	**1.91**	**2.07**
SFWMD WATER USE PERMITTED (13-00029-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	2.44	2.44	2.44
Brackish Water	0.00	0.00	0.00
Total Allocation	**2.44**	**2.44**	**2.44**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	4.00	4.00	4.00
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**4.00**	**4.00**	**4.00**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	1.00	1.00

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Nonpotable Water					
Stormwater Reuse Program	Stormwater	planned	$13.50	0.35	0.35
Friedland Manor Storm Water for Indirect Potable Use	Stormwater	planned	$30.30	0.65	0.65
Total			**$43.80**	**1.00**	**1.00**

CITY OF HOMESTEAD

County: Miami-Dade County

Service Area: Cities of Homestead and Florida City, and unincorporated areas of Miami-Dade County

Description: The water supply for the City of Homestead is obtained from the SAS and treated using a lime softening process. Unmet needs above the existing allocation are purchased from MDWASD, which agreed by contract to provide the city with up to 3 MGD of finished water. The city's allocation is dependent on maintaining an aquifer recharge system using reclaimed water.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	65,679	71,682	77,686
Per Capita (gallons per day finished water)	157	157	157
Potable Water Demands (daily average annual finished water in MGD)	**10.31**	**11.25**	**12.20**
SFWMD WATER USE PERMITTED (13-00046-W) ALLOCATION (MGD)			
	Existing	**Projected**	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	10.55	10.55	10.55
Brackish Water	0.00	0.00	0.00
Bulk Water Purchase (from MDWASD)	3.00	3.00	3.00
Total Allocation (including bulk water purchase)	**13.55**	**13.55**	**13.55**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	16.90	16.90	16.90
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**16.90**	**16.90**	**16.90**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	6.00	6.00	6.00

MIAMI-DADE WATER AND SEWER DEPARTMENT

County: Miami-Dade County

Service Area: Cities of Aventura, Coral Gables, Doral, Hialeah*, Hialeah Gardens*, Homestead*, Miami, Miami Beach*, Miami Gardens, Miami Springs, North Bay Village*, North Miami*, Opa-Locka*, South Miami, Sweetwater, and West Miami*; towns of Bay Harbor Islands*, Cutler Bay, Key Biscayne, Medley*, Miami Lakes, and Surfside*; villages of Bal Harbour*, El Portal, Indian Creek*, Miami Shores, Palmetto Bay, Pinecrest, and Virginia Gardens*; and unincorporated areas of Miami-Dade County. Those cities marked by an asterick are wholesale customers of MDWASD. MDWASD handles distribution and billing for the other municipalities.

Description: The water supply for MDWASD is obtained from the SAS, the FAS, and operation of ASR wells. MDWASD is the largest water and sewer utility in Florida. It operates three large regional and five small WTPs. Two of the county's three regional WWTPs are subject to the requirements of the 2008 Ocean Outfall statute. The county is required to achieve 117.5 MGD of reuse by 2025. The county has proposed a reuse project to recharge the FAS as a key element of its program to meet the reuse requirements of the Ocean Outfall statute for its combined flow from its regional WWTPs. Current projections indicate that some of the planned RO WTP expansion projects may not be needed during the twenty-year planning horizon.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	2,141,885	2,337,660	2,533,436
Per Capita (gallons per day finished water)	141	141	141
Potable Water Demands (daily average annual finished water in MGD)	**302.01**	**329.61**	**357.21**
SFWMD WATER USE PERMITTED (13-00017-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	388.56	349.50 [a]	386.50 [a]
Brackish Water	19.95	46.66	46.66
Total Allocation	**408.51**	**396.16**	**410.70**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	453.93	447.18	447.18
Brackish Water	0.00	10.00 [b]	10.00 [b]
Planned Project Capacity	0.00	20.00	27.50
Total Capacity	**453.93**	**477.18**	**484.68**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	16.49	16.49	149.49

a. In 2012, MDWASD's allocation was modified to 349.50 MGD, pending completion of aquifer recharge projects. These reuse offsets are listed as totaling 37 MGD by 2027, supporting an allocation of 386.50 MGD in 2030. If projects are not built, allocation remains at 349.50 MGD.

b. Project will be online by 2013.

PROJECT SUMMARY					
Water Supply Projects	**Source**	**Completion Date**	**Total Capital Cost ($ Million)**	**Projected Cumulative Design Capacity (MGD)**	
				2020	**2030**
Potable Water					
South Miami Heights RO WTP [a]	Brackish Water and 3 MGD Fresh Water	2015	$194.70	20.00	20.00
Hialeah Floridan Aquifer RO WTP Phase 2 and 3 (including concentrate disposal)	Brackish Water	2026	$37.80	0.00	7.50
Total			**$344.80**	**20.00**	**27.75**
Nonpotable Water					
North District WWTP Reuse	Reclaimed Water	2025	$13.50	0.00	7.00
Central District WWTP Reuse – Floridan Aquifer Recharge	Reclaimed Water	2025	information not available	0.00	27.10 [b]
West District Canal Water Reclamation Plant Recharge Phase 2	Reclaimed Water	2021	$665.00	0.00	21.00
West District Canal Water Reclamation Plant Recharge Phase 3	Reclaimed Water	2021	$593.00	0.00	16.00
Biscayne Coastal Wetlands Rehydration [c]	Reclaimed Water	2022	$1,120.00	0.00	89.00
South District WWTP – FPL Distribution (72-inch pipeline)	Reclaimed Water	2021	$95.00	0.00	90.00 [d]
Total			**$2,486.50**	**0.00**	**250.10**
Conservation					
Conservation Program	Conservation	2030	$20.00	12.01	15.19
Total			**$20.00**	**12.01**	**15.19**

a. The annual operation and maintenance cost (including power, chemicals, parts, materials, labor, administration, and compliance) for operating a 20-MGD brackish water RO water treatment plant was estimated to be approximately $6,990,000 per year, as estimated from the Water Supply Cost Estimation Study by CDM (2007a)

b. The Central District WWTP Reuse – Floridan Aquifer Recharge 27.10 MGD does not increase the actual treatment capacity to the reclaimed water plant and was not included in capacity totals.

c. Feasibility of this project will be determined in the future.

d. This project adds capacity to the reclaimed water distribution system, but does not increase the actual treatment capacity of the reclaimed water plant.

CITY OF NORTH MIAMI

County: Miami-Dade County

Service Area: City of North Miami, Village of Biscayne Park, and unincorporated areas of Miami-Dade County

Description: The water supply for the City of North Miami is obtained from the Biscayne aquifer, treated using a lime softening process, and augmented with the purchase of bulk water from MDWASD. The City of North Miami has a twenty-year contract to purchase water from MDWASD. Future demands are expected to be met by development of water supply from the FAS by 2018. However, the city deferred the project. Without the RO plant, the city will need to continue purchases from MDWASD to meet 2020 and 2030 demands.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	90,397	98,660	106,922
Per Capita (gallons per day finished water)	117	117	117
Potable Water Demands (daily average annual finished water in MGD)	**10.58**	**11.54**	**12.51**
SFWMD WATER USE PERMITTED (13-00059-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	9.30	9.30	9.30
Brackish Water	7.97	7.97 [a]	7.97 [a]
Bulk Water Purchase (from MDWASD)	3.20	3.00	4.00
Total Allocation (including bulk water purchase)	**20.47**	**20.27**	**21.27**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	**Projected**	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	9.30	9.30	9.30
Brackish Water	0.00	0.00	0.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**9.30**	**9.30**	**9.30**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

a. The city has a FAS allocation but has placed construction of the RO WTP to treat the brackish water on indefinite hold.

CITY OF NORTH MIAMI BEACH

County: Miami-Dade County

Service Area: Cities of North Miami Beach, Aventura, Miami Gardens, North Miami, and Sunny Isles Beach; Town of Golden Beach; and unincorporated areas of Miami-Dade County

Description: The water supply for the City of North Miami Beach is obtained from the SAS and FAS, and treated using a lime softening process and RO, respectively. Current projections indicate that the RO WTP expansion projects may not be needed during the twenty-year planning horizon.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population	161,968	176,772	191,577
Per Capita (gallons per day finished water)	125	129	129
Potable Water Demands (daily average annual finished water in MGD)	**20.25**	**22.80**	**24.72**
SFWMD WATER USE PERMITTED (13-00060-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	**2010**	**2020**	**2030**
Fresh Water	26.31	26.31	26.31
Brackish Water	12.07	12.07	12.07
Total Allocation	**38.38**	**38.38**	**38.38**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	**2012**	**2020**	**2030**
Fresh Water	25.50	25.50	25.50
Brackish Water	6.50	6.50	6.50
Planned Project Capacity	0.00	12.50	17.50
Total Capacity	**32.00**	**44.50**	**49.50**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.00	0.00	0.00

PROJECT SUMMARY					
			Total Capital Cost	Projected Cumulative Design Capacity (MGD)	
Water Supply Projects	**Source**	**Completion**	**($ Million)**	**2020**	**2030**
Potable Water					
Floridan Wells, Lines, Mains, and RO WTP Phases 2 and 3	Brackish Water	planned	$8.21	12.50	12.50
Floridan Wells, Lines, Mains, and RO WTP Phase 4	Brackish Water	planned	$37.50	0.00	5.00
Total			**$45.71**	**12.50**	**17.50**

Monroe County

FLORIDA KEYS AQUEDUCT AUTHORITY

County: Monroe County

Service Area: Cities of Key Colony Beach, Key West, Layton, and Marathon; Village of Islamorada; and unincorporated areas of Monroe County. The FKAA also has a contract to provide up to 2.4 MGD to the United States Navy.

Description: The water supply for FKAA comes from the SAS and the FAS, and is treated using a lime softening process and RO, respectively. FKAA also has two desalination plants that can produce up to 3.0 MGD of finished water from seawater. These plants are used for emergencies and extreme peaks in demand. The FKAA profile recognizes the seasonal population in Monroe County now exceeds the permanent population on an annual basis. Current forecasts project a continued decline in permanent population and an increase in seasonal population (according to analyses developed by Monroe County). Data from Monroe County and FKAA indicates that the growing seasonal population appears to be driving per capita use rates upward.

POPULATION AND FINISHED WATER DEMAND			
	Existing	Projected	
	2010	2020	2030
Population (permanent)	73,090	71,195	69,300
Population (seasonal)	78,401	82,151	86,855
Per Capita (gallons per day finished water)	109	124	139
Potable Water Demands (daily average annual finished water in MGD)	**16.45**	**19.00**	**21.70**
SFWMD WATER USE PERMITTED (13-00005-W) ALLOCATION (MGD)			
	Existing	Projected	
Potable Water Source	2010	2020	2030
Fresh Water	17.79 [a]	17.79 [a]	17.79 [a]
Brackish Water	9.70	9.70	9.70
Total Allocation	**23.97**	**23.97**	**23.97**
POTABLE WATER TREATMENT CAPACITY			
	Cumulative Facility & Project Capacity (MGD)		
	Existing	Projected	
FDEP Permitted Capacity	2012	2020	2030
Fresh Water	23.80	23.80	23.80
Brackish Water	6.00	6.00	6.00
Planned Project Capacity	0.00	0.00	0.00
Total Capacity	**29.80**	**29.80**	**29.80**
NONPOTABLE WATER TREATMENT CAPACITY			
Reclaimed Water	0.62	1.62	2.72

a. Dry season restriction reduces allocation to 17.00 MGD from December 1 to April 30 of each year to ensure consistency with the Everglades Minimum Flow and Level criteria.

PROJECT SUMMARY					
Water Supply Projects	Source	Completion Date	Total Capital Cost ($ Million)	Projected Cumulative Design Capacity (MGD) 2020	2030
Nonpotable Water					
Reclaimed Water Systems in Unincorporated Monroe County	Reclaimed Water	2015	$12.00	1.00	2.10
Total			**$12.00**	**1.00**	**2.10**
Conservation					
Low Flow Fixture Distribution	Conservation	underway	$0.25	0.10	0.15
Total			**$0.25**	**0.10**	**0.15**

7

Future Direction

This chapter summarizes the future direction for water supply in the Lower East Coast (LEC) Planning Area. Public Water Supply (PWS) demands projected to increase in the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2007) did not materialize. PWS demand actually decreased over the past five years. The reasons for the decrease are likely due to the economic downturn, water shortage restrictions during droughts, conservation efforts by the utilities, and the South Florida Water Management District's (SFWMD's) and local governments' year-round landscape irrigation conservation measures.

TOPICS

- Water Sources
- Environmental Restoration
- Future Analysis
- Coordination
- Climate Change
- Conclusion

Herbert Hoover Dike

Analyses conducted during this plan indicate that almost all PWS utilities have sufficient treatment capacity and permit allocation to meet projected 2030 demands. Rehabilitation of the Herbert Hoover Dike by the United States Army Corps of Engineers (USACE) is important for protection of the citizens living the vicinity of the lake. Additionally, completion of this project in part or wholly may enable revision of the lake operating schedule.

Meeting the 1-in-10 level of service for all water users in the LEC Planning Area is not possible within the next five years due to the interrelationship of the federal projects outlined in the plan. Future LEC water supply plans will address the progress of these water resource development projects based on project sequencing, project funding, and implementation partnerships as applicable. Until this occurs, this plan update continues to rely upon the existing programs and regulations, along with the identified potable water supply development projects, and their correlation with water supply demands and available sources.

This plan update also concludes that future water needs of the region can be met through the 2030 planning horizon with appropriate management, conservation, and implementation of projects identified in this plan. SFWMD anticipates any additional water from Lake Okeechobee resulting from revision of the lake operating schedule could return the lake to minimum flow and level (MFL) prevention status, enhance the level of certainty to existing permitted users, and support other environmental objectives. Meeting the future water needs is dependent on the following:

- Construction of two potable water supply development projects by PWS utilities.
- Utilization of the flexibility within the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) as incremental dam safety improvements are completed; and in the longer term, completion of the seepage berm construction or equivalent repairs to the Herbert Hoover Dike for Reaches 1, 2 and 3 by USACE and implementation of a new Lake Okeechobee regulation schedule.
- Implementation of Comprehensive Everglades Restoration Plan (CERP) and other projects identified in MFL prevention and recovery strategies.

The guidance offered in this plan update should be considered in developing water supply options to meet future needs. Statutory requirements, existing conditions, resource constraints (including protection tools and criteria), and the needs of all water users are addressed, with emphasis placed on alternative water supply development, conservation, and projects for environmental needs. SFWMD's future direction for water supply planning in the LEC Planning Area requires continued coordination with utilities and other water users, natural resource protection, and continued monitoring to develop responses to saltwater intrusion and the potential of sea level rise.

WATER SOURCES

Groundwater remains the primary source of PWS drinking water throughout the LEC Planning Area. Withdrawals from the surficial aquifer system (SAS) are limited due to potential impacts on wetlands, MFL criteria, the potential for saltwater intrusion, pollution, interference with existing legal users, and off-site land uses. In addition, the Floridan aquifer system (FAS) is a source planned to augment some of the future PWS water demands in the LEC Planning Area. PWS utilities have proactively diversified supply sources, including use of the FAS. The use of reclaimed water has also increased significantly since the 2005–2006 LEC Plan Update, partially offsetting the use of fresh groundwater.

Primary surface water sources in the LEC Planning Area include Lake Okeechobee, the Water Conservation Areas (WCAs), and regional canals, such as the L-8, Hillsboro, North New River, and Miami canals. Agricultural (AGR) Self-Supply is the largest surface water user in the planning area. Based on current and projected water demands, this traditional source will continue to be available to meet irrigation requirements. However, regulatory criteria limits withdrawals. Fresh groundwater in the Lower East Coast Service Area may be available, but quantities will depend on local conditions, including other uses in the area.

Reclaimed water can be used to meet new uses or replace traditional freshwater sources currently used for irrigation, industrial purposes, or offsetting of regional water deliveries through canal recharge or other potable reuse options. Water storage features, such as reservoirs, aquifer storage and recovery (ASR) and impoundments, can be used to capture storm water, groundwater and surface water during wet weather periods, and provide supplemental supply for PWS and natural systems. Seawater is a potential alternative water supply. The technology costs for this source continue to decline, making it a more feasible option. Water conservation is an important component in integrated water resource management. Water conservation projects are often easier to implement than supply projects due to lower costs, extending the life of existing supplies, and acceptance by the public.

SFWMD offers recommendations and guidance in the following sections for consideration by local governments, utilities, other water users, and SFWMD water supply managers and staff as a basis for the future direction of water supply planning in the LEC Planning Area.

Groundwater

Additional allocation of fresh groundwater sources to meet future PWS demand in the LEC Planning Area is highly dependent on location, source limitations, reclaimed water availability, and water conservation measures. Approximately 94 percent of the PWS demand in 2010 was met using fresh groundwater. Fresh groundwater is also one of the primary sources of supply for agricultural and urban irrigation in the LEC Service Area.

Surficial Aquifer System

The potential use of the SAS for new or increased allocations will be evaluated on an application-by-application basis to determine if the project meets water use permitting criteria. When appropriate, water users are encouraged to continue diversifying water sources to meet future water demands.

To sustain existing permitted uses and to identify the potential for limited development of fresh groundwater sources through the following:

- Careful design of wellfield locations, configurations, and pumping regimes to maximize withdrawals while avoiding saltwater intrusion, pollution sources, harm to natural systems or increased dependence on the regional system as demonstrated through modeling that meets water use permitting criteria.
- Expansion of reclaimed water systems to provide “substitution credits” and/or impact offsets after demonstration of water demand.

- Continued coordination of saltwater intrusion monitoring between SFWMD, the United States Geological Survey (USGS), and the counties is essential to ensure resource protection of the SAS. Maps delineating the extent of the saltwater interface should be published periodically to allow comparison with previous maps and identify areas of concern and/or future supply development.
- Utilities at risk and utilities of concern should continue to reduce the uncertainties and potential impacts from saltwater intrusion by implementing options such as interconnections, alternative water supply development, and wellfield configuration.

Floridan Aquifer System

Some utilities are proposing modest increases in FAS water source development in conjunction with reverse osmosis treatment facilities over the next 20 years in addition to the 86 million gallons per day (MGD) of existing capacity.

Floridan aquifer monitor well

Recommendation for the FAS include the following:

- Local water users and utilities developing FAS well drilling programs are encouraged to collaborate with SFWMD. Water quality, water level, and hydrologic data from these wells can increase the understanding of the FAS and be utilized in SFWMD models.
- Brackish water from the FAS may be blended with fresh groundwater and surface water to produce acceptable quality water for PWS. Blended water supplies are dependent on water sources, volume of stored water, and natural system requirements, and require monitoring to ensure acceptable finished water quality.
- An incremental wellfield assessment and development approach should be used by utilities to design, test, and monitor production wells to minimize changes in water quality due to heterogeneities within the FAS and overstressing production zones.
- SFWMD anticipates finalizing the East Coast Floridan Model by the end of 2013. Once completed, the model will be available for simulations to address regional resource questions.

Surface Water

Surface water sources, including Lake Okeechobee, are integrally connected as part of the Kissimmee-Okeechobee-Everglades ecosystem and regional water supply system. Recommendations and opportunities regarding surface water include the following:

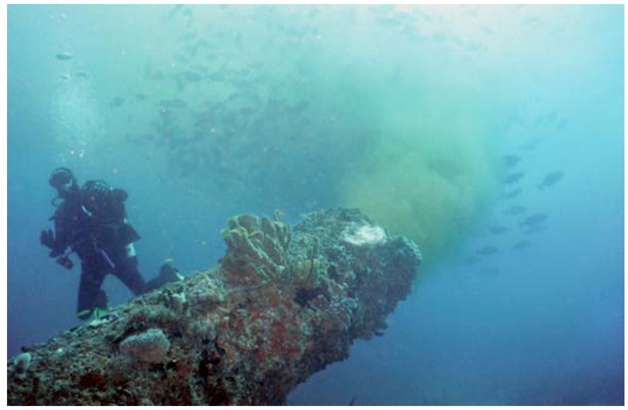
- USACE should complete seepage berm construction or equivalent repairs to the Herbert Hoover Dike for Reaches 1, 2, and 3 no later than 2022 and revise the Lake Okeechobee regulation schedule, as recognized in the *Final Environmental Impact Statement including Appendices A through G – Lake Okeechobee Regulation Schedule* (USACE 2007) and the *Draft Integrated Project Implementation Report and Environmental Impact Statement – Central Everglades Planning Project* (USACE and SFWMD 2013).
- SFWMD will continue to implement MFL recovery and prevention strategies and review and update these, when appropriate, in conjunction with future plan updates. Within the LEC Planning Area, MFL criteria have been adopted for Lake Okeechobee, six areas within the Everglades (WCA 1, WCA 2, WCA 3, Everglades National Park, and Rotenberger and Holey Land wildlife management areas), the Biscayne aquifer, the Northwest Fork of the Loxahatchee River and Estuary, and Florida Bay.
- Local governments and utilities are encouraged to create additional storage capacity for excess surface water for water supply purposes, when feasible.
- Consideration must be given to the availability of the lowest quality source of water to meet any particular demand. Blending multiple alternative water sources to achieve acceptable water quality is a prudent approach to water supply.

Reclaimed Water

In the LEC Planning Area, reclaimed water is used for landscape irrigation, groundwater recharge, cooling water, and environmental enhancement. Opportunities to expand reclaimed water use are as follows:

- Local governments should consider requiring construction of reclaimed water infrastructure in new developments and establishing mandatory reuse zones. SFWMD will provide technical assistance to local governments to establish mandatory reuse zones.
- Support the development of additional reclaimed water lines for green space irrigation, such as residential lots, medians, common areas, and golf courses.

- As part of the Leah Schad Memorial Ocean Outfall Program, six PWS utilities are required to comply with the statutory requirements. SFWMD encourages the development of creative solutions to beneficially reuse reclaimed water such as saltwater intrusion barriers, recharge of the SAS, canal recharge, environmental water supply, potable reuse, and for impact offsets and substitution credits.


Ocean outfall

- To promote efficient use, utilities should consider, where appropriate, strategies to support the expansion of reclaimed water supply, such as metering for residential customers, tiered rate structures, limiting days of the week for landscape irrigation, and facilitating interconnects with other reclaimed water utilities.
- Providers may consider the use of supplemental water supplies to meet peak reclaimed system demands. Supplemental water may enable a utility to extend its supply of reclaimed water system over a larger area. However, during times of drought, availability of supplemental water sources, such as surface water, groundwater or storm water, to supplement reclaimed water supplies may be limited in some areas.
- The Florida Department of Environmental Protection (FDEP) completed rulemaking on Chapter 62-40, Florida Administrative Code, to incorporate amendments to Section 373.250, Florida Statues (F.S.), which recognized the use of "substitution credits" and "impact offsets" to promote increased availability and distribution of reclaimed water. Where appropriate, SFWMD is amending its criteria to reflect statutory and FDEP amendments.

New Storage Capacity for Surface Water or Groundwater

In the LEC Planning Area, potential types of water storage include reservoirs, ASR wells, and surface water impoundments. Proposed projects that develop new storage and create additional water supply may be considered alternative water sources. Opportunities for new storage capacity include the following:

L-8 Site in Palm Beach County

- Construction of new or retrofitted surface water storage systems for agricultural operations could provide additional supply for irrigation.
- Utilities and other entities should continue to evaluate the feasibility of the C-51 Reservoir Project, including a variety of potential implementation and funding options. SFWMD will continue to explore a potential operational role associated with this feature. If permitted and constructed, the reservoir could be available to LEC Planning Area utilities as a water supply option.

Hillsboro ASR Pilot Project

- Utilities should continue use of ASR and other storage options to capture wet weather flows when available and use at a later time. ASR extends water supplies for use during peak demand periods.
- SFWMD and USACE should continue studies to address local and regional implementation of ASR associated with CERP and related issues, such as arsenic mobilization.

Seawater

The ocean is an essentially unlimited source of water. The desalination process is required before use of seawater for water supply purposes. Where appropriate, utilities should consider the feasibility of desalinated seawater from the Atlantic Ocean as an additional water source option for the LEC Planning Area.

Water Conservation

The decline in per capita water consumption rate shows in part the importance of conservation programs since the last plan update. The implementation of robust water conservation programs throughout the LEC Planning Area offers the potential to reduce future water demand. All water suppliers are urged to implement water conservation measures to reduce water supply demands and defer the construction of capital-intensive projects. Recommendations for water conservation include the following:

- SFWMD should continue to implement the 2008 Comprehensive Water Conservation Program and support programs, such as the Water Savings Incentive Program (WaterSIP), Water Conservation Hotel and Motel Program (Water CHAMP), and Florida Water Star.
- PWS utilities are encouraged to develop goal-based conservation plans to implement water conservation measures with numerical goals for achievable water savings.
- Local governments should develop or enhance existing ordinances to be consistent with Florida-Friendly Landscaping provisions (Section 373.185, F.S.).
- Water users should implement advanced irrigation technology, improved landscape design and management practices, and participate in recognition programs to further increase landscape water use efficiency.
- Water conservation public education programs help instill a year-round conservation ethic. Local governments and utilities are encouraged to continue providing water conservation-related educational programs in cooperation with SFWMD.
- Local governments are encouraged to implement two-day-per-week landscape irrigation ordinances, as successfully adopted in Broward and Miami-Dade counties.
- Local municipalities are encouraged to partner with adjoining municipalities to leverage resources in public outreach and education, such as the Broward Water Partnership.
- Installation of higher efficiency irrigation systems by agricultural water users is encouraged where applicable and appropriate for specific crop types.


High efficiency toilet

- Industrial, commercial, and institutional entities are encouraged to utilize the *Draft Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities, A Guide for Facility Managers* (SFWMD 2013b) to improve water use efficiency and reduce operating costs.

ENVIRONMENTAL RESTORATION

Comprehensive Everglades Restoration Plan

Water resources, including natural systems, their needs, and regulatory criteria, are discussed in **Chapter 3** and **Appendix B** and are a limitation on water available for allocation. These water supply needs are addressed by water resource development projects such as CERP as detailed in **Chapter 4**. CERP is an ongoing joint effort between USACE and SFWMD that was approved in the Water Resources Development Act of 2000. This plan includes region-specific projects to improve the quality, timing, volume, distribution, and delivery of water to the natural system. CERP and related projects will provide improved water quality, timing, and distribution of flows for the enhancement of the Everglades ecosystem and benefit other water related needs.

Restoration Strategies Regional Water Quality Plan


STA 1 West, Cell 3

In 2012, the State of Florida and the United States Environmental Protection Agency reached consensus on a new strategy for improving water quality in the Everglades. This strategy will expand water quality improvement projects to achieve the ultra-low phosphorus water quality standard established for the Everglades. SFWMD is implementing a technical plan to complete six projects that will create more than 6,500 acres of new stormwater treatment areas and 110,000 acre-feet of additional water storage. A robust science plan will ensure continued research and monitoring to improve and optimize the performance of water quality treatment technologies. Design and construction of the projects will be completed in three phases over a twelve-year time frame, with completion set for 2025.

FUTURE ANALYSIS

A wide range of activities outside of the LEC Planning Area water supply planning process can affect future water supply within the planning area. These include the finalization of the configuration of Central Everglades Planning Project components; changes by USACE to regulation schedules for the Everglades, Lake Okeechobee, and other water bodies of the Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project); and local or subregional water supply or stormwater projects. In addition, new or modified analytical tools, such as the East Coast Floridan Aquifer Groundwater Model, are expected to become available for regional-scale water resource planning. SFWMD, in coordination with stakeholders, should determine whether available tools could be applied to better understand specific water supply issues in the LEC Planning Area.

COORDINATION

Coordination and collaboration throughout the water supply planning process is essential among regional and local governments and utilities. Coordination guidance includes the following:

- Local entities are encouraged to work together to develop consistent PWS demand projection methodologies.
- An emerging trend within the past five years has been the development of multi-jurisdictional partnerships to implement a program or project to benefit a greater number of people than one entity might benefit by itself. Examples of these partnerships include the Broward Water Conservation Partnership and the C-51 Reservoir Project utility participants.
- Water supply facilities work plans are due within 18 months of the adoption of this plan update. Local governments and utilities must provide linkage to and coordination with this plan update and the local government water supply-related components of comprehensive plans.
- Agricultural stakeholders and agencies need to work together to develop methodologies and data sources for future crop projections.
- In 2013, Chapter 373.709, F.S. was amended to provide that for future water supply plans, the Florida Department of Agriculture and Consumer Services provide data indicative of future AGR Self-Supply water demands. Any adjustments of or deviation from the data provided by Florida Department of Agriculture and Consumer Services must be described and presented with the original data.

CLIMATE CHANGE

Long-term data show increasing worldwide temperatures and a corresponding sea level rise. For planning purposes, SFWMD is estimating a sea level rise of 5 to 20 inches in South Florida by 2060 (SFWMD 2009b). The anticipated rise in sea level may change the hydrodynamics of the coastal estuaries, change the location and shape of the freshwater-seawater interface, and increase the intrusion of salt water into coastal aquifers. Analysis is needed to identify the potential impact of sea level rise on utility wellfields and other users at risk of saltwater intrusion within SFWMD. In addition, comprehensive monitoring is needed to accurately characterize and measure aquifer conditions and saltwater movement.

The following direction and guidance is provided for climate change and sea level rise:

- Saltwater intrusion monitoring networks should be periodically reviewed for adequacy by utilities, counties, USGS, and SFWMD. Recommendations may be needed for additional or revised monitoring regimes.
- SFWMD, USACE, and potentially affected utilities and municipalities should evaluate the consequences of sea level rise, changing rainfall and storm patterns, temperature effects, and cumulative impacts to existing structures and existing legal users.
- SFWMD should update climate data used in the models more frequently than every five years, which is the norm.
- Local governments and water providers are encouraged to participate in the Southeast Florida Regional Climate Change Compact to support regional planning efforts and initiatives to adapt to rising sea level in the LEC Planning Area. More information can be found at southeastfloridaclimatecompact.org/.
- Analyze the sea level rise and saltwater intrusion data to identify the utility wellfields and other users at potential risk of saltwater intrusion within the LEC Planning Area. If problematic areas are identified, SFWMD should work collaboratively with county and utility staff in these areas to identify existing numerical models and modify/update them as necessary. SFWMD should also reformulate its analysis of utilities at risk and utilities of concern prior to the next update of this plan.

Southeast Florida Regional Climate Change logo

CONCLUSION

This update concludes that the future water demands of the LEC Planning Area can continue to be met through the 2030 planning horizon with appropriate management, conservation, and implementation of projects identified in this plan. Future challenges in water resource development and natural resource protection require concerted efforts to monitor, characterize current hydrologic conditions, and project future conditions. Successful implementation of this plan update requires close coordination with other regional and local governments, utilities, and water users. Collaboration among stakeholders is also essential for directing implementation of the preceding guidance. Public and private partnering can ensure that water resources in the LEC Planning Area are prudently managed and available to meet future demands.

Miami Skyline from Biscayne Bay

Glossary

1-in-10 year drought A drought of such intensity that it is expected to have a return frequency of once in 10 years. A drought in which below normal rainfall occurs and has a 90 percent probability of being exceeded over a twelve-month period. A drought event that results in an increase in water demand to a magnitude that would have a 10 percent probability of being exceeded during any given year.

Acre-foot, acre-feet (ac-ft) The volume of water that covers 1 acre to a depth of 1 foot. The equivalent of 43,560 cubic feet, 1,233.5 cubic meters, or 325,872 gallons, which is approximately the amount of water it takes to serve two typical families for one year.

Agricultural best management practice (BMP) A practice or combination of agricultural practices, based on research, field testing, and expert review, determined to be the most effective and practicable means of improving water quality or quantity while maintaining or even enhancing agricultural production.

Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) A simple water budget model for estimating irrigation demands that estimates demand based on basin-specific data. The AFSIRS model calculates both net and gross irrigation requirements for average and 1-in-10 year drought irrigation requirements. A crop's net irrigation requirement is the amount of water delivered to the root zone of the crop, while the gross irrigation requirement includes both the net irrigation requirement and the losses incurred in the process of delivering irrigation to the crop's root zone.

Agricultural (AGR) Self-Supply The water used to irrigate crops, water livestock, and for aquaculture (e.g., fish production) that is not supplied by a Public Water Supply utility.

Alternative water supply "Salt water; brackish surface water and groundwater; surface water captured predominately during wet-weather flows; sources made available through the addition of new storage capacity for surface water or groundwater, water that has been reclaimed after one or more public supply, municipal, industrial, commercial, or agricultural uses; the downstream augmentation of water bodies with reclaimed water; storm water; and, any other water supply source that is designated as nontraditional for a water supply planning region in the applicable regional water supply plan" (Section 373.019, Florida Statutes).

Aquatic preserve Water body set aside by the state to be maintained in essentially natural or existing condition for protection of fish and wildlife and public recreation so the aesthetic, biological, and scientific values may endure for the enjoyment of future generations.

Aquifer A geologic formation, group of formations, or part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs.

Aquifer storage and recovery (ASR) The underground storage of storm water, surface water, fresh groundwater or reclaimed water, which is appropriately treated to potable standards and injected into an aquifer through wells during wet periods. The aquifer (typically the Floridan aquifer system in South Florida) acts as an underground reservoir for the injected water, reducing water loss to evaporation. The water is stored with the intent to recover it for use during future dry periods.

Aquifer system A heterogeneous body of (interbedded or intercalated) permeable and less permeable material that functions regionally as a water yielding hydraulic unit and may be composed of more than one aquifer separated at least locally by confining units that impede groundwater movement, but do not greatly affect the hydraulic continuity of the system.

Artesian A commonly used expression, generally synonymous with "confined," referring to subsurface (ground) bodies of water, which, due to underground drainage from higher elevations and confining layers of soil material above and below the water body (referred to as an Artesian aquifer), result in groundwater at pressures greater than atmospheric pressures.

Available supply The maximum amount of reliable water supply including surface water, groundwater, and purchases under secure contracts.

Base flow Sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced stream flows. Natural base flow is sustained largely by groundwater discharges.

Baseline condition A specified period of time during which collected data are used for comparison with subsequent data.

Basin (groundwater) A hydrologic unit containing one large aquifer or several connecting and interconnecting aquifers.

Basin (surface water) A tract of land drained by a surface water body or its tributaries.

Basis of Review *Basis of Review for Water Use Permit Applications within the South Florida Water Management District* (SFWMD 2012b). Read in conjunction with Chapters 40E-2 and 40E-20, Florida Administrative Code, the Basis of Review further specifies the general procedures and information used by SFWMD staff for review of water use permit applications with the primary goal of meeting SFWMD water resource objectives.

Below land surface Depth below land surface regardless of land surface elevation.

Benthos/benthic Macroscopic organisms that live on or in the bottom substrate, such as clams and worms (contrast to plankton and nekton).

Biota The plant and animal life of a region or ecosystem, as in a stream or other body of water.

Biscayne aquifer A portion of the surficial aquifer system, which provides most of the fresh water for Public Water Supply and agriculture within Miami-Dade, Broward, and southeastern Palm Beach counties. It is highly susceptible to contamination due to its high permeability and proximity to the land surface in many locations.

Boulder Zone A highly transmissive, cavernous zone of limestone within the Lower Floridan aquifer used to dispose of secondary-treated effluent from wastewater treatment plants and concentrate from membrane water treatment plants via deep injection wells.

Brackish water Water with a chloride level greater than 250 milligrams per liter (mg/L) and less than 19,000 mg/L (Basis of Review, SFWMD 2012b).

Capacity Capacity represents the ability to treat, move, or reuse water. Typically, capacity is expressed in millions of gallons per day (MGD).

Central and Southern Florida Project for Flood Control and Other Purposes (C&SF Project) A complete system of canals, storage areas, and water control structures spanning the area from Lake Okeechobee to the east and west coasts and from Orlando south to the Everglades. It was designed and constructed during the 1950s by the United States Army Corps of Engineers to provide flood control and improve navigation and recreation.

Central Everglades Planning Project (CEPP) CEPP is a planning process for key restoration projects in the Everglades. Now under way, CEPP combines a series of Comprehensive Everglades Restoration Plan (CERP) components into one project implementation report. Through this effort, projects will be identified and planned on land already in public ownership to allow more water to be directed south to the central Everglades, Everglades National Park, and Florida Bay while protecting coastal estuaries.

Comprehensive Everglades Restoration Plan (CERP) The federal-state partnership framework and guide for the restoration, protection, and preservation of the South Florida ecosystem. CERP also provides for water-related needs of the region, such as water supply and flood protection.

Confined aquifer (1) Water-bearing stratum of permeable rock, sand, or gravel overlaid by a thick, impermeable stratum. An aquifer that contains groundwater that is confined under pressure and bounded between significantly less permeable materials such that water will rise in a fully penetrating well above the top of the aquifer. In cases where the hydraulic head is greater than the elevation of the overlying land surface, a fully penetrating well will naturally flow at the land surface without means of pumping or lifting. (2) Also known as artesian or pressure aquifer, the confined aquifer exists where the groundwater system is between layers of clay, dense rock, or other materials with very low permeability. Water is under more pressure in a confined aquifer than in an unconfined aquifer. Thus, when tapped by a well, water is forced up, sometimes above the soil surface. This is how a flowing artesian well is formed.

Confining unit A body of significantly less permeable material than the aquifer, or aquifers, that it stratigraphically separates. The hydraulic conductivity may range from nearly zero to some value significantly lower than that of the adjoining aquifers, and impedes the vertical movement of water.

Consumptive use Any use of water that reduces the supply from which it is withdrawn or diverted.

Control structure An artificial structure designed to regulate the level/flow of water in a canal or other water body (e.g., weirs, dams).

Cubic feet per second (cfs) A rate of flow (e.g., in streams and rivers) equal to a volume of water 1 foot high and 1 foot wide flowing a distance of 1 foot in 1 second. One cfs is equal to 7.48 gallons of water flowing each second. For example, if a car's gas tank was 2 feet by 1 foot by 1 foot (2 cubic feet), then gas flowing at a rate of 1 cfs would fill the tank in two seconds.

DBHYDRO The South Florida Water Management District's corporate environmental database, storing hydrological, meteorological, hydrogeological, and water quality data.

Demand The quantity of water needed to fulfill a requirement.

Demand management Also known as water conservation, demand management involves reducing the demand for water through activities that alter water use practices, improve efficiency in water use, reduce losses of water, reduce waste of water, alter land management practices, and/or alter land uses.

Desalination A process that treats saltwater water to remove or reduce chlorides and dissolved solids, resulting in the production of fresh water.

Discharge The rate of water movement past a reference point, measured as volume per unit of time (usually expressed as cubic feet per second or meters per second).

Disinfection The process of inactivating microorganisms that cause disease. All potable water requires disinfection as part of the treatment process prior to distribution. Disinfection methods include chlorination, ultraviolet radiation, and ozonation.

Disposal Effluent disposal involves the wasteful practice of releasing treated effluent back to the environment using ocean outfalls, surface water discharges, or deep injection wells.

Dissolved oxygen The concentration of oxygen dissolved in water, sometimes expressed as percent saturation, where saturation is the maximum amount of oxygen that theoretically can be dissolved in water at a given altitude and temperature.

Domestic Self-Supply (DSS) The water used by households whose primary source of water is water treatment facilities and/or private wells with pumpages of less than 100,000 gallons per day.

Drainage basin Land area where precipitation runs off into streams, rivers, lakes, and reservoirs. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge. The drainage basin is a part of the earth's surface that is occupied by a drainage system, which consists of a surface stream with all its tributaries and impounded bodies of water. It is also known as a watershed, a catchment area, or a drainage area.

Drawdown (1) The vertical distance between the static water level and the surface of the cone of depression. (2) A lowering of the groundwater surface caused by pumping.

Drought A long period of abnormally low rainfall, especially one that adversely affects growing or living conditions.

Ecology The study of the inter-relationships of plants and animals to one another and to their physical and biological environment.

Ecosystem Biological communities together with their environment, functioning as a unit.

Ecosystem restoration The process of reestablishing to as near its natural condition as possible, the structure, function, and composition of an ecosystem.

Effective rainfall The portion of rainfall that infiltrates the soil and is stored for plant use in the crop root zone.

Effluent Treated water that is not reused after flowing out of any plant or other works used for treating, stabilizing, or holding wastes. Effluent is "disposed" of.

Electrodialysis Dialysis that is conducted with the aid of an electromotive force applied to electrodes adjacent to both sides of the membrane.

Elevation The height in feet above mean sea level according to the National Geodetic Vertical Datum of 1929. May also be expressed in feet above mean sea level as reference datum.

Environmental impact statement Required under United States environmental law by the National Environmental Policy Act for federal government agency actions "significantly affecting the quality of the human environment." It evaluates the positive and negative environmental effects of a proposed agency action.

Estuary The part of the wide lower course of a river where the current is met by ocean tides or an arm of the sea at the lower end of a river where fresh water and salt water meet.

Evapotranspiration (ET) The total loss of water to the atmosphere by evaporation from land and water surfaces and by transpiration from plants.

Exceedance The violation of the pollutant levels permitted by environmental protection standards.

Existing legal use of water A water use authorized under a SFWMD water use permit or existing and exempt from permit requirements.

Fallow Land left unseeded during a growing season. The act of plowing land and leaving it unseeded. The condition or period of being unseeded.

Finished water Water that completed a purification or treatment process; water that passed through all the processes in a water treatment plant and is ready to be delivered to consumers.

Finished water demand (see *Net water demand*)

Fiscal Year (FY) SFWMD's fiscal year begins on October 1 and ends on September 30 the following year.

Florida Administrative Code (F.A.C.) The Florida Administrative Code is the official compilation of the administrative rules and regulations of state agencies.

Florida-Friendly Landscaping Quality landscapes that conserve water, protect the environment, are adaptable to local conditions, and are drought tolerant. The principles of such landscaping include planting the right plant in the right place, efficient watering, appropriate fertilization, mulching, attraction of wildlife, responsible management of yard pests, recycling yard waste, reduction of stormwater runoff, and waterfront protection. Additional components include practices such as landscape planning and design, soil analysis, the appropriate use of solid waste compost, minimizing the use of irrigation, and proper maintenance.

Florida Statutes (F.S.) The Florida Statutes are a permanent collection of state laws organized by subject area into a code made up of titles, chapters, parts, and sections. The Florida Statutes are updated annually by laws that create, amend, or repeal statutory material.

Floridan aquifer system (FAS) A highly used aquifer system composed of the upper Floridan and lower Floridan aquifers. It is the principal source of water supply north of Lake Okeechobee. The upper Floridan aquifer is used for drinking water supply in parts of Martin and St. Lucie counties. From Jupiter to southern Miami, water from the FAS is mineralized (total dissolved solids are greater than 1,000 milligrams per liter) along coastal areas.

Flow The actual amount of water flowing by a particular point over some specified time. In the context of water supply, flow represents the amount of water being treated, moved, or reused. Flow is frequently expressed in millions of gallons per day.

Flow equalization basin (FEB) A constructed storage feature used to capture and store peak stormwater flows. They provide a more steady flow of water to stormwater treatment areas, helping to maintain desired water levels needed to achieve optimal water quality treatment performance.

Fresh water An aqueous solution with a chloride concentration less than or equal to 250 milligrams per liter (Basis of Review, SFWMD 2012b).

Geophysical log A record of the structure and composition of the earth with depth encountered when drilling a well or similar type of test or boring hole.

Gross irrigation demand or **gross irrigation requirement** (AFSIRS model) The amount of water that must be withdrawn from the source in order to be delivered to the plant's root zone. Gross irrigation demand includes both the net irrigation requirement and the losses incurred irrigating the plant's root zone.

Gross water demand (or raw water demand) is the amount of water withdrawn from the water resource to meet a particular need of a water user or customer. Gross demand is the amount of water allocated in a water use permit. Gross or raw water demands are nearly always higher than net or user/customer water demands.

Groundwater Water beneath the surface of the ground, whether or not flowing through known and definite channels. Specifically, that part of the subsurface water in the saturated zone, where the water is under pressure greater than the atmosphere.

Harm As defined in Chapter 40E-8, Florida Administrative Code, the temporary loss of water resource functions that result from a change in surface or groundwater hydrology and takes a period of one to two years of average rainfall conditions to recover.

Headwaters (1) Water that is typically of higher elevation (with respect to tailwater) or on the controlled side of a structure. (2) The waters at the highest upstream point of a natural system that are considered the major source waters of the system.

Hydrogeology The geology of groundwater, with particular emphasis on the chemistry and movement of water.

Hydrologic condition The state of an area pertaining to the amount and form of water present.

Hydrology The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hypersaline Salinity conditions that are above what is typical of open marine conditions. Salinity conditions in excess of typical marine conditions.

Impoundment Any lake, reservoir, or other containment of surface water occupying a depression or bed in the earth's surface and having a discernible shoreline.

Industrial/Commercial/Institutional (ICI) Self-Supply Water used by industrial, commercial, or institutional operations withdrawing a water quantity of 100,000 gallons per day or greater from individual, on-site wells.

Infiltration The movement of water through the soil surface into the soil under the forces of gravity and capillarity.

Inflow (1) The act or process of flowing in or into. (2) The measured quantity of water that moved into a specific location.

Injection well Refers to a well constructed to inject treated wastewater directly into the ground. Wastewater is generally forced (pumped) into the well for dispersal or storage in a designated aquifer. Injection wells are generally drilled below freshwater levels, or into unused aquifers or aquifers that do not deliver drinking water.

Intermediate aquifer system This aquifer system consists of five zones of alternating confining and producing units. The producing zones include the Sandstone and Mid-Hawthorn aquifers.

Irrigation efficiency (AFSIRS model) (1) A measure of the effectiveness of an irrigation system in delivering water to a plant for irrigation and freeze protection purposes. It is expressed as the ratio of the volume of water used for supplemental plant evapotranspiration to the volume pumped or delivered for use. (2) The average percent of total water pumped for use that is delivered to the root zone of a plant. (3) As a modeled factor, irrigation efficiency refers to the average percent of total delivered water applied to the plant's root zone.

Irrigation water use Uses of water for supplemental irrigation purposes, including agricultural lands, as well as golf courses, nurseries, recreational areas, and landscapes.

Landscape irrigation The outside watering of shrubbery, trees, lawns, grass, ground covers, vines, gardens, and other such flora, not intended for resale, which are planted and are situated in such diverse locations as residential and recreational areas, cemeteries, public, commercial and industrial establishments, and public medians and rights-of-way.

Leak detection Systematic method to survey the distribution system and pinpoint the exact locations of hidden underground leaks.

Level of certainty A water supply planning goal to assure at least a 90 percent probability during any given year that all the needs of reasonable-beneficial water uses will be met, while sustaining water resources and related natural systems during a 1-in-10 year drought event.

Marsh A frequently or continually inundated unforested wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions.

Maximum developable limit Maximum developable limit water use permitting criteria provide reasonable assurances that the proposed water use does not cause harmful drawdowns to semi-confined freshwater aquifers in the Lower West Coast Planning Area. The potentiometric head within the Lower Tamiami aquifer, Sandstone aquifer, and Mid-Hawthorn aquifer shall not be allowed to drop to less than 20 feet above the top of the uppermost geologic strata that comprises the aquifer at any point during a 1-in-10 year drought condition.

Micro irrigation The application of small quantities of water on or below the soil surface as drops or tiny streams of spray through emitters or applicators placed along a water delivery line. Micro irrigation includes a number of methods or concepts, such as bubbler, drip, trickle, mist or micro spray, and subsurface irrigation.

Million gallons per day (MGD) A rate of flow of water equal to 133,680.56 cubic feet per day, or 1.5472 cubic feet per second, or 3.0689 acre-feet per day. A flow of one million gallons per day for one year equals 1,120 acre-feet (365 million gallons). To hold one million gallons of water, a swimming pool approximately 267 feet long (almost as long as a football field), 50 feet wide, and 10 feet deep would be needed.

Minimum flows and levels (MFL) The point at which further withdrawals would cause significant harm to the water resources or natural systems. An MFL is established by water management districts pursuant to Sections 373.042 and 373.0421, Florida Statues, for a given water body and set forth in Parts II and III of Chapter 373.

Mobile irrigation laboratory A vehicle furnished with irrigation evaluation equipment that is used to carry out on-site evaluations of irrigation systems and to provide recommendations on improving irrigation efficiency.

Model A computer model is a representation of a system and its operations, and provides a cost-effective way to evaluate future system changes, summarize data, and help understand interactions in complex systems. Hydrologic models are used for evaluating, planning, and simulating the implementation of operations within SFWMD's water management system under different climatic and hydrologic conditions. Water quality and ecological models are also used to evaluate other processes vital to the health of ecosystems.

MODFLOW A modular, three-dimensional, finite-difference groundwater modeling code created by the United States Geological Survey, which is used to simulate the flow of groundwater through aquifers. SFWMD uses it for subregional groundwater modeling.

Monitor well Any human-made excavation by any method to monitor fluctuations in groundwater levels, quality of underground waters, or the concentration of contaminants in underground waters.

National Geodetic Vertical Datum of 1929 (NGVD) A geodetic datum derived from a network of information collected in the United States and Canada. It was formerly called the "Sea Level Datum of 1929" or "mean sea level." Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific coasts, it does not necessarily represent local mean sea level at any particular place.

Natural system A self-sustaining living system that supports an interdependent network of aquatic, wetland-dependent, and upland living resources.

Net irrigation demand or **net irrigation requirement** (AFSIRS Model) The amount of water the plant needs in addition to anticipated rainfall. This is an estimate of the amount of water (expressed in inches per year) that should be delivered to the plant's root zone.

Net water demand (or user/customer water demand) is the water demand of the end user after accounting for treatment and process losses, and inefficiencies. When discussing Public Water Supply, the term "finished water demand" is commonly used to denote net demand.

Nutrient loading Discharging of nutrients from the watershed (basin) into a receiving water body, such as a lake, stream, or wetland. Expressed usually as mass per unit area per unit time kilograms per hectare per year or pounds per acre per year.

Outflow (1) The act or process of flowing out of. (2) The measured quantity of water that left an area or water body during a certain period of time.

Outlet An opening through which water can be freely discharged from a reservoir.

Overland flow The flow of rainfall or snowmelt over the land surface toward stream channels. After overland flow enters a watercourse it becomes runoff.

Per capita use (1) The average amount of water used per person during a standard time period, generally per day. (2) Total use divided by the total population served.

Performance measure A scientifically measurable indicator or condition that can be used as a target for meeting water resource management goals. Performance measures quantify how well or how poorly an alternative meets a specific objective. Good performance measures are quantifiable, have a specific target, indicate when a target has been reached, and measure the degree to which the goal has been met.

Permeability The capacity of a porous rock, sediment, or soil for transmitting a fluid.

Planning Area The South Florida Water Management District is divided into four areas within which planning activities are focused: Kissimmee Basin, Upper East Coast, Lower West Coast, and Lower East Coast.

Potable water Water that is safe for human consumption.

Potentiometric surface A surface that represents the hydraulic head in an aquifer and is defined by the level to which water will rise above a datum plane in wells that penetrate the aquifer.

Power Generation (PWR) Self-Supply The difference in the amount of water withdrawn by electric power generating facilities for cooling purposes and the water returned to the hydrologic system near the point of withdrawal.

Process water Water used for nonpotable industrial usage, e.g., mixing cement.

Public Water Supply (PWS) Water supplied by water treatment facilities for potable use (drinking quality) with projected average pumpages greater than 0.1 million gallons per day.

Public Water Supply (PWS) demand All potable (drinking quality) water supplied by water treatment facilities with projected average pumpages of 0.1 million gallons per day or greater to all types of customers, not just residential.

Rapid infiltration basin A wastewater treatment method by which wastewater is applied in deep and permeable deposits of highly porous soils for percolation through deep and highly porous soil.

Ratoon A shoot sprouting from a plant base, as in banana, pineapple, or sugarcane.

Raw water (1) Water that is direct from the source—groundwater or surface water—without any treatment. (2) Untreated water, usually that entering the first unit of a water treatment plant.

Raw water demand (see *Gross water demand*)

Reasonable-beneficial use Use of water in such quantity as is needed for economic and efficient use for a purpose, which is both reasonable and consistent with the public interest.

Recharge (groundwater) The natural or intentional infiltration of surface water into the ground to raise groundwater levels.

Recharge (hydrologic) The downward movement of water through soil to groundwater; the process by which water is added to the zone of saturation; or the introduction of surface water or groundwater to groundwater storage, such as an aquifer. Recharge or replenishment of groundwater supplies consists of three types: 1) natural recharge, which consists of precipitation or other natural surface flows making their way into groundwater supplies; 2) artificial or induced recharge, which includes actions specifically designed to increase supplies in groundwater reservoirs through various methods, such as water spreading (flooding), ditches, and pumping techniques; 3) incidental recharge, which consists of actions, such as irrigation and water diversion, which add to groundwater supplies, but are intended for other purposes. Recharge may also refer to the amount of water so added.

Reclaimed water Water that received at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility (Rule 62-610.200, Florida Administrative Code)

Recreational/Landscape (REC) Self-Supply Water used for landscape and golf course irrigation. The landscape subcategory includes water used for parks, cemeteries, and other irrigation applications of 0.1 million gallons per day or greater. The golf course subcategory includes those operations not supplied by a Public Water Supply or regional reuse facility.

Regional Simulation Model A regional hydrologic model developed principally for application in South Florida. It is developed on a sound conceptual and mathematical framework that allows it to be applied generically to a wide range of hydrologic situations. It simulates the coupled movement and distribution of groundwater and surface water throughout the model domain using a hydrologic simulation engine to simulate the natural hydrology and a management simulation engine to provide a wide range of operational capability.

Water supply plan Detailed water supply plan developed by the South Florida Water Management District under Section 373.709, Florida Statues, providing an evaluation of available water supply and projected demands at the regional scale. The planning process projects future demand for 20 years and recommends projects to meet identified needs.

Restricted allocation areas Areas designated within the South Florida Water Management District boundaries for which allocation restrictions are applied with regard to the use of specific sources of water. The water resources in these areas are managed in response to specific sources of water in the area for which there is a lack of water availability to meet the projected needs of the region from that specific source of water (Basis of Review, SFWMD 2012b).

Retention The prevention of stormwater runoff from direct discharge into receiving waters; included as examples are systems that discharge through percolation, exfiltration, filtered bleed-down, and evaporation processes.

Retrofit (1) Indoor: the replacement of existing water fixtures, appliances, and devices with more efficient fixtures, appliances, and devices for the purpose of water conservation. (2) Outdoor: **t**he replacement or changing out of an existing irrigation system with a different irrigation system, such as a conversion from an overhead sprinkler system to a micro irrigation system (Basis of Review, SFWMD 2012b).

Reuse The deliberate application of reclaimed water for a beneficial purpose. Criteria used to classify projects as “reuse” or “effluent disposal” are contained in Rule 62-610.810, Florida Administrative Code. The term “reuse” is synonymous with “water reuse.”

Reverse osmosis (RO) A membrane process for desalting water using applied pressure to drive the feed water (source water) through a semipermeable membrane.

Runoff That component of rainfall, which is not absorbed by soil, intercepted and stored by surface water bodies, evaporated to the atmosphere, transpired and stored by plants, or infiltrated to groundwater, but which flows to a watercourse as surface water flow.

Saline water (1) An aqueous solution with a chloride concentration greater than 250 mg/L and less than that of seawater (Basis of Review). (2) Water containing significant amounts or concentrations of dissolved salts or total dissolved solids. The concentration is the amount (by weight) of salt in water, expressed in parts per million or milligrams per liter (mg/L) (~1 mg/L total dissolved solids = 0.5 mg/L of chlorides). The terms fresh, brackish, saline, and brine are used to describe the quality of the water. Any water that contains more than 500 mg/L of total dissolved solids is considered saline water. This may be brackish water (500 to 15,000 mg/L of total dissolved solids), seawater (15,000 to 40,000 mg/L of total dissolved solids), or brine (more than 40,000 mg/L of total dissolved solids). It is common in the literature to define coastal water that is very brackish simply as saline water.

Salinity Of or relating to chemical salts usually measured in parts per thousand, milligrams per liter, or practical salinity units.

Salt water (see *Seawater or salt water*)

Saltwater interface The hypothetical surface of chloride concentration between fresh water and seawater where the chloride concentration is 250 milligrams per liter at each point on the surface.

Saltwater intrusion The invasion of a body of fresh water by a body of salt water due to its greater density. It can occur either in surface water or groundwater bodies. The term is applied to the flooding of freshwater marshes by seawater, the upward migration of seawater into rivers and navigation channels, and the movement of seawater into freshwater aquifers along coastal regions.

SEAWAT A program developed to simulate three-dimensional, variable-density, transient groundwater flow in porous media. The source code for SEAWAT was developed by combining MODFLOW and MT3DMS into a single program that solves the coupled flow and solute-transport equations.

Seawater or **salt water** Water with a chloride concentration at or above 19,000 milligrams per liter (Basis of Review, SFWMD 2012b).

Sedimentation The action or process of forming or depositing sediment.

Seepage irrigation Irrigation that conveys water through open ditches. Water is either applied to the soil surface (possibly in furrows) and held for a period of time to allow infiltration, or is applied to the soil subsurface by raising the water table to wet the root zone.

Seepage irrigation system A means to artificially supply water for plant growth that relies primarily on gravity to move the water over and through the soil, and does not rely on emitters, sprinklers, or any other type of device to deliver water to the vicinity of expected plant use.

Self-supplied The water used to satisfy a water need, not supplied by a Public Water Supply utility.

Semi-confined aquifer A completely saturated aquifer that is bounded above by a semi-pervious layer, which has a low, though measurable permeability, and below by a layer that is either impervious or semi-pervious.

Serious harm As defined in Chapter 40E-8, Florida Administrative Code, the long-term, irreversible, or permanent loss of water resource functions resulting from a change in surface water or groundwater hydrology.

Service area The geographical region in which a water supplier has the ability and the legal right to distribute water for use.

Significant harm As defined in Chapter 40E-8, Florida Administrative Code, the temporary loss of water resource functions that result from a change in surface water or groundwater hydrology and takes more than two years to recover, but which is considered less severe than serious harm.

Storm water Water that does not infiltrate, but accumulates on land as a result of storm runoff, snowmelt runoff, irrigation runoff, or drainage from areas, such as roads and roofs.

Stormwater discharge Precipitation and snowmelt runoff from roadways, parking lots, and roof drains. A major source of nonpoint source pollution to water bodies and a challenge to sewage treatment plants in municipalities where the storm water is combined with the flow of domestic wastewater (sewage) before entering the wastewater treatment plant.

Stormwater treatment area (STA) A system of constructed water quality treatment wetlands that use natural biological processes to reduce levels of nutrients and pollutants from surface water runoff.

Submersed aquatic vegetation Aquatic plants that exist completely below the water surface.

Substrate The physical surface upon which an organism lives. The natural or artificial surface upon which an organism grows or to which it is attached.

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

Surficial aquifer system (SAS) Often the principal source of water for urban uses within certain areas of South Florida. This aquifer is unconfined, consisting of varying amounts of limestone and sediments that extend from the land surface to the top of an intermediate confining unit.

Tailwater Water that is typically of lower elevation or on the discharge side of the structure.

Time series A statistical process analogous to the taking of data at intervals of time.

Treatment facility Any facility or other works used for the purpose of treating, stabilizing, or holding water or wastewater.

Turbidity The measure of water clarity caused by suspended material in a liquid.

Unconfined aquifer (1) A permeable geologic unit or units only partly filled with water and overlying a relatively impervious layer. Its upper boundary is formed by a free water table or phreatic surface under atmospheric pressure. Also referred to as water table aquifer. (2) An aquifer containing water that is not under pressure; the water level in a well is the same as the water table outside the well.

Upconing Process by which saline water underlying fresh water in an aquifer rises upward into the freshwater zone as a result of pumping water from the freshwater zone.

Uplands Nonwetlands**.** An area with a hydrologic regime that is not sufficiently wet to support vegetation typically adapted to life in saturated soil conditions. Upland soils are nonhydric soils.

Utility Any legal entity responsible for supplying potable water for a defined service area.

Wastewater The combination of liquid and water carried pollutants from residences, commercial buildings, industrial plants, and institutions together with any groundwater, surface runoff, or leachate that may be present.

Water budget An accounting of total water use or projected water use for a given location or activity.

Water conservation The permanent, long-term reduction of daily water use. Permanent water use reduction requires the implementation of water saving technologies and measures that reduce water use while satisfying consumer needs. Water conservation is considered a water source option because it reduces the need for future expansion of the water supply infrastructure (see *Demand management*).

Water Conservation Areas (WCAs) Part of the original Everglades ecosystem that is now diked and hydrologically controlled for flood control and water supply purposes. These are located in the western portions of Miami-Dade, Broward, and Palm Beach counties, and preserve over 1,350 square miles, or about 50 percent of the original Everglades.

Water conservation rate structure A water rate structure designed to conserve water. Examples of conservation rate structures include, but are not limited to, increasing block rates, seasonal rates, and quantity-based surcharges.

Water quality (1) A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose. (2) The physical, chemical, and biological condition of water as applied to a specific use. Federal and state guidelines set water quality standards based on the water's intended use, whether it is for recreation, fishing, drinking, navigation, shellfish harvesting, or agriculture.

Water reservation A legal mechanism to set aside water for the protection of fish and wildlife or the public health and safety from consumptive water use. The reservation is composed of a quantification of the water to be protected, which includes a seasonal and a location component.

Water Resources Advisory Commission A commission of the South Florida Water Management District that serves as an advisory body to the Governing Board. The WRAC is the primary forum for conducting workshops, presenting information, and receiving public input on water resource issues affecting Central and South Florida.

Water resource development The formulation and implementation of regional water resource management strategies, including collection and evaluation of surface water and groundwater data; structural and nonstructural programs to protect and manage the water resources; development of regional water resource implementation programs; construction, operation and maintenance of major public works facilities to provide for flood control, surface and groundwater storage, and groundwater recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities (Section 373.019, Florida Statutes).

Watershed A region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water. Watersheds conform to federal hydrologic unit code standards and can be divided into subwatersheds and further divided into catchments, the smallest water management unit recognized by South Florida Water Management District operations. Unlike drainage basins, which are defined by rule, watersheds are continuously evolving as the drainage network evolves.

Water Shortage Plan This effort includes provisions in Chapters 40E-21 and 40E-22, Florida Administrative Code, and identifies how water supplies are allocated to users during declared water shortages. The plan allows for supply allotments and cutbacks to be identified on a weekly basis based on the water level within Lake Okeechobee, demands, time of year, and rainfall forecasts.

Water supply development The planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use. (Section 373.019, Florida Statues)

Water table The surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere; defined by the level where water within an unconfined aquifer stands in a well.

Water use Any use of water that reduces the supply from which it is withdrawn or diverted.

Water use permitting The issuance of permits by the South Florida Water Management District, under the authority of Chapter 40E-2, Florida Administrative Code, allowing withdrawal of water for consumptive use.

Wellfield One or more wells producing water from a subsurface source. A tract of land that contains a number of wells for supplying a large municipality or irrigation district.

Wetland An area that is inundated or saturated by surface water or groundwater with vegetation adapted for life under those soil conditions (e.g., swamps, bogs, and marshes).

Wild and Scenic River A river as designated under the authority of the of Public Law 90-542, the *Wild and Scenic Rivers Act,* as amended, is a means to preserve selected free-flowing rivers in their natural condition and protect the water quality of such rivers. A portion of the North Fork of the Loxahatchee River was federally designated as the first Wild and Scenic River in Florida on May 17, 1985.

Withdrawal Water removed from a groundwater or surface water source for use.

Yield The quantity of water (expressed as rate of flow or total quantity per year) that can be collected for a given use from surface or groundwater sources.

References

Abtew, W., L. Cadavid and V. Ciuca. 2013. Chapter 2: South Florida Hydrology and Water Management. In: *2013 South Florida Environmental Report — Volume I*, South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

Alexander, T.R. and A.G. Crook. 1973. *South Florida Ecological Study, Appendix G: Recent and Long-term Vegetation Changes and Patterns in South Florida*. University of Miami, Miami, FL.

Alleman, R. 2011. Chapter 12: Coastal Ecosystems. In: *2011 South Florida Environmental Report, Volume I*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

Alleman, R. 2012. Chapter 10: Coastal Priorities. In: *2012 South Florida Environmental Report, Volume I*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

BEBR. 2011. Projections of Florida Population by County, 2010–2040. Bureau of Economic and Business Research, University of Florida, *Florida Population Studies* Volume 44, Bulletin 159. (Authors: S.K. Smith and S. Rayer)

Bloetscher, F., D.H. Meeroff and B.N. Heimlich. 2009. *Improving the Resilience of a Municipal Water Utility Against the Likely Impacts of Climate Change – A Case Study: City of Pompano Beach Water Utility*. Florida Atlantic University, Boca Raton, FL.

Bromwell G., S. Vick, G. Leslie and R. Dean. 2006. *Report of Expert Review Panel Technical Evaluation of Herbert Hoover Dike Lake Okeechobee, Florida*. Prepared by BCI Engineers and Scientists, Inc., Lakeland, FL for South Florida Water Management District, West Palm Beach, FL.

Browder, J., M. Robblee, G. Liehr, D. Johnson, E. Buck and T. Jackson. 2011. *Epifaunal Communities of Mainland Nearshore South Biscayne Bay*. Southeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Miami, FL.

Carollo Engineers, Inc. 2009. *Water Desalination Concentrate Management and Piloting*. Prepared by Carollo Engineers, Inc., Sunrise, FL, for South Florida Water Management District, West Palm Beach, FL. December 2009.

CDM. 2006. *Alternative Water Sources Sub-Regional Feasibility Study: Fort Lauderdale, Sunrise, and Miami-Dade County*. Prepared by Camp Dresser & McKee, Inc., Naples, FL, for South Florida Water Management District, West Palm Beach, FL. December 2006.

CDM. 2007a. *Water Supply Cost Estimation Study*. Prepared by Camp Dresser & McKee, Inc., Naples, FL, for South Florida Water Management District, West Palm Beach, FL.

CDM. 2007b. *Water Supply Cost Estimation Study – Phase II Addendum*. Prepared by Camp Dresser & McKee, Inc., Naples, FL, for South Florida Water Management District, West Palm Beach, FL.

Chastant J. and D. Gawlik. 2011. *Wading Bird Colony Size, Location and Timing on Lake Okeechobee*. Department of Biological Sciences, Florida Atlantic University, Boca Raton FL.

Chiu, T., J. Van de Kreeke and R. Dean. 1970. *Residence Time of Waters Behind Barrier Islands*. Completion Report to the Office of Water Resources Research, United States Department of Interior, Denver, CO.

Conserve Florida Water Clearinghouse. 2009. *EZ Guide, Version 1.1*. Conserve Florida Water Clearinghouse, University of Florida, Gainesville, FL. Available at www.conservefloridawater.org/ezguidedescription.asp.

Cook, M.I. and M. Kobza. 2012. Appendix 6-1: South Florida Wading Bird Report. *2012 South Florida Environmental Report – Volume I*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

DCFB. 2012. *Agriculture: The Lifeblood of South Dade*. Dade County Farm Bureau, www.dade-agriculture.org/.

Doering, P. and R. Alleman. 2010. Chapter 12: Management and Restoration of Coastal Ecosystems. In: *2010 South Florida Environmental Report, Volume I*, South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

Duever, M.J., D.P. Spangler, R.L. Myers, T.R. Alexander and L.A. Riopelle. 1986. *The Big Cypress National Preserve*. National Audubon Society, New York, NY.

FDEP. 2006. Canal Recharge: A Report to the Legislature and Governor. Florida Department of Environmental Protection, Tallahassee, FL. December 2006. Available at www.dep.state.fl.us/water/wqssp/docs/CanalRechargeReport.pdf.

FDEP. 2011. *2010 Reuse Inventory*. FDEP Water Reuse Program. Florida Department of Environmental Protection, Tallahassee, FL. Available at www.dep.state.fl.us/water/reuse/inventory.htm.

FDEP. 2012. *2011 Reuse Inventory*. FDEP Water Reuse Program. Florida Department of Environmental Protection, Tallahassee, FL. Available at www.dep.state.fl.us/water/reuse/inventory.htm.

Fourqurean, J.W. and M.B. Robblee. 1999. Florida Bay: A history of recent ecological changes. *Estuaries* 99:345–357.

Golder Associates. 2008. *East Coast Floridan Aquifer System (ECFAS) Phase II Project Southeastern Florida (Model Documentation Report)*. Golder Associates, Boca Raton, FL.

Havens, K.E., K. Jin, A.J. Rodusky, B. Sharfstein, M.A. Brady, T.L. East, N. Iricanin, R.T. James, M.C. Harwell and A.D. Steinman. 2001. Hurricane effects on a shallow lake ecosystem and its response to controlled manipulation of water level. *The Scientific World* 1:44-70.

Hazen and Sawyer. 2008. *City of Plantation Final Report Advanced Wastewater Treatment Pilot Project*. Submitted to the City of Plantation, Plantation, FL.

HydroGeoLogic, Inc. 2006. *Development of a Density-Dependent Saltwater Intrusion Model for the Lower East Coast Project Area*. HydroGeoLogic, Inc., Reston, VA.

Janzen, J., S. Sunderland, S. Krupa and C. Gefvert. 2008. *Biscayne Bay Coastal Wetlands, Aquifer Salinity Investigation*. Technical Publication WS-26, South Florida Water Management District, West Palm Beach, FL. September 2008. Available at www.sfwmd.gov/portal/page/portal/pg_grp_tech_pubs/PORTLET_tech_pubs/ws-26_bbcw_aquifer_salinity_investigation.pdf.

Jawitz, J.W., R. Munoz-Carpena, S. Muller, K.A. Grace and A.I. James. 2008. *Development, Testing, and Sensitivity and Uncertainty Analyses of a Transport and Reaction Simulation Engine (TaRSE) for Spatially Distributed Modeling of Phosphorous in South Florida Peat Marsh Wetlands.* Scientific Investigations Report 2008-5029, Florida Integrated Science Center, United States Geological Survey, Reston, VA. Available at pubs.usgs.gov/sir/2008/5029/pdf/sir2008-5029.pdf.

Kitchens, W.M. et al. In press. *2013 Annual Snail Kite Report*. University of Florida, Gainesville, FL.

Lake Worth Drainage District, Palm Beach County, Broward County and South Florida Water Management District. 2013. *C-51 Reservoir – Preliminary Design and Cost Estimate – Final Report*. South Florida Water Management District, West Palm Beach, FL. February 2013.

Langevin, C.D. 2001. *Simulation of Ground-Water Discharge to Biscayne Bay, Southeastern Florida*. Water Resources Report 00-425, United States Geological Survey, Washington, DC. Available at fl.water.usgs.gov/PDF_files/wri00_4251_langevin.pdf.

Marshall, F., W. Nuttle and B. Crosby. 2008. *Final Report: Biscayne Bay Freshwater Budget and the Relationship of Inflow to Salinity*. Environmental Consulting and Technology, Inc. Prepared for South Florida Water Management District, West Palm Beach, FL.

Martin, P. 2012. Chapter 5A: Five-Year Water Resource Development Work Program. In *2012 South Florida Environmental Report – Volume II*, South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

Martin, P. 2013. Chapter 5A: Five-Year Water Resource Development Work Program. In *2013 South Florida Environmental Report – Volume II*, South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

McVoy, C.W., W.A. Park, J. Obeysekera, J.A. VanArman and T.W. Dreschel. 2011. *Landscapes and Hydrology of the Pre-drainage Everglades*. University Press of Florida, Gainesville.

Medellin, D. 2013. Chapter 3: 2013 Priority Water Bodies List and Schedule. In: *2013 South Florida Environmental Report – Volume II.* South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

Metcalf & Eddy. 2006. *Technical and Economic Feasibility of Co-located Desalination Facilities*. Prepared by Metcalf & Eddy, Wakefield, MA, for South Florida Water Management District, West Palm Beach, FL.

Miami-Dade County. 2007. *Miami-Dade County Water Use Efficiency 20-Year Plan*. Miami-Dade County Water and Sewer Department, Miami, FL.

Migliaccio, K. 2008. *Biscayne Bay and Watershed Water Quality Data Analysis, Task 5: Final Report*. Submitted to South Florida Water Management District, West Palm Beach, FL.

Migliaccio, K. 2009. *Storm Event Sampling in the Biscayne Bay Watershed: Final Project Repor*t. Submitted to South Florida Water Management District, West Palm Beach, FL.

MWH Global, Inc. 2008. *Southwest Wastewater Treatment Facility Advanced Wastewater Treatment (AWT) and Ruse Pilot Texting Program Final Report*. Submitted to City of Sunrise, Sunrise, FL.

Montagna, P., N. Smith, M. Peterson and C. Stevenson. 2008. *Peer Review of Adequacy of Technical Information to Support Minimum Inflow Needs for Biscayne Bay*. Submitted to South Florida Water Management District, West Palm Beach, FL.

PBCDERM. 2008. *Lake Worth Lagoon Management Plan Revision*. Palm Beach County Department of Environmental Resources Management, West Palm Beach, FL. Available at www.co.palm-beach.fl.us/erm/lakes/estuarine/lake-worth-lagoon/pdf/LWLMP.pdf.

RECOVER. 2007a. *Final Draft 2006 System Status Report, Pilot Assessment System-wide Repor*t. Restoration Coordination and Verification Program, United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. February 2007. Available at www.evergladesplan.org/pm/recover/assess_team_ssr_2006.aspx.

RECOVER. 2007b. *Final 2007 System Status Report*. Restoration Coordination and Verification Program, United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. November 2007. Available at www.evergladesplan.org/pm/recover/assess_team_ssr_2007.aspx.

RECOVER. 2009. *2009 System Status Report*. Restoration Coordination and Verification Program, United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. September 2010. Available at www.evergladesplan.org/pm/ssr_2009/ssr_main.aspx.

RECOVER. 2012. *2012 System Status Report*. Restoration Coordination and Verification Program, United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. December 2012. Available at www.evergladesplan.org/pm/ssr_2012/ssr_main_2012.aspx.

Reese, R.S. and E. Richardson. 2007. *Synthesis of the Hydrogeologic Framework of the Floridan Aquifer System, Delineation of a Major Avon Park Permeable Zone in Central and Southern Florida*. Scientific Investigations Report 2007-5207, United States Geological Survey, Reston, VA. Available at pubs.usgs.gov/sir/2007/5207/.

Rudnick, D.T., P.B. Ortner, J.A. Browder and S.M. Davis. 2005. A conceptual model of Florida Bay. *Wetlands* 25(4):870-883.

Rudolph, H.D. 1998. *Freshwater Discharges to the Lake Worth Lagoon – Recommendations for Maximum and Minimum Discharges to Maintain Optimum Salinity Ranges for the Lake Worth Lagoon's Ecosystem*. Palm Beach County Department of Environmental Resources Management. West Palm Beach, FL.

Scavia, D., J.C. Field, D.F. Boesch, R.W. Buddemeier, V. Burkett, D.R. Cayan, M. Fogarty, M.A. Harwell, R.W. Howarth, C. Mason, D.J. Reed, T.C. Royer, A.H. Sallenger and J.G. Titus. 2002. Climate change impacts on U.S. coastal and marine ecosystems. *Estuaries* 25:149-164.

SFWMD. 2000. *2000 Lower East Coast Regional Water Supply Plan*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/watersupply.

SFWMD. 2002. *Northern Palm Beach County Comprehensive Water Management Plan*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2007. *2005–2006 Lower East Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/watersupply.

SFWMD. 2006. *Draft Technical Documentation to Support Development of Minimum Flows and Levels for Florida Bay*. South Florida Water Management District, West Palm Beach, FL. March 6, 2006. Available at www.sfwmd.gov/mfls.

SFWMD. 2008. *Water Conservation: A Comprehensive Program for South Florida*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/waterconservationplan.pdf.

SFWMD. 2009a. *Adequacy of Technical Information to Support Minimum Inflow Needs for Biscayne Bay including Final Peer Review Report*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/bb_minimum_flow_report_2009.pdf.

SFWMD. 2009b. *Climate Change and Water Management in South Florida*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/climate_change_and_water_management_in_sflorida_12nov2009.pdf.

SFWMD. 2010. *Final Adaptive Protocols for Lake Okeechobee Operations*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/ap_lo_final_20100916.pdf.

SFWMD. 2011a. *L-8 Reservoir Pilot Test Water Quality Result*s. South Florida Water Management District, West Palm Beach, FL. June 3, 2011.

SFWMD. 2011b. *Lake Okeechobee Protection Plan Update*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/lopp_update_2011.pdf.

SFWMD. 2012a. *2012 Lower West Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/watersupply.

SFWMD. 2012b. *Basis of Review for Water Use Permit Application within the South Florida Water Management District*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/bor_wu.pdf.

SFWMD. 2013a. *2011–2013 Water Supply Plan Support Document*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/watersupply.

SFWMD. 2013b. *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities, A Guide for Facility Managers*. South Florida Water Management District, West Palm Beach, FL. June 2013. Available at issuu.com/southfloridawatermanagement/docs/water_efficiency_improvement_guide?e=4207603/1241437.

SFWMD, FDEP and FDACS. 2008. *Lake Okeechobee Watershed Construction Project Phase 2 Technical Plan*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL. February 2008. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/ne_lakeo_watershed_phase2_summary.pdf.

SFWMD, FDEP FPS District 5, LRD and LRIT. 2006. *Restoration Plan for the Northwest Fork of the Loxahatchee*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection Florida Park Service, District 5, Hobe Sound, FL; Loxahatchee River District, Jupiter, FL; and Loxahatchee River Interagency Team. April 12, 2006. Also published as Appendix 12-2 in *2007 South Florida Environmental Report – Volume I*, South Florida Water Management District, West Palm Beach, FL.

SFWMD, FDEP FPS District 5, LRD and LRIT. 2010. *Loxahatchee River Science Plan*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection Florida Park Service, District 5, Hobe Sound, FL; Loxahatchee River District, Jupiter, FL; and Loxahatchee River Interagency Team. Final Draft, July 12, 2010. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/lr_science_plan_2010.pdf.

SFWMD and USACE. 2008. *Aquifer Storage and Recovery Program Interim Report 2008*. South Florida Water Management District, West Palm Beach, FL, and United States Army Corps of Engineers, Jacksonville, FL. June 5, 2008. Available at www.evergladesplan.org/pm/projects/pdp_32_33_34_44_asr_combined.aspx.

Shoemaker, W.B., C.D. Lopez and M.J. Duever. 2011. *Evapotranspiration over Spatially Extensive Plant Communities in Big Cypress National Preserve, Southern Florida, 2007–2010*. Scientific Investigative Report 2011-5212, United States Geological Survey, United States Department of the Interior, Washington, DC. Available online at pubs.usgs.gov/sir/2011/5212/.

Smajstrla, A.G. 1990. *Technical Manual, Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) Model, Version 5.5*. Prepared by Agricultural Engineering Department, University of Florida, Gainesville, FL, for the St. Johns River Water Management District, Palatka, FL. Special Publication SJ2008-SP17.

Smith, E.P. *South Miami-Dade-Statistical Data Analyses*. Prepared for the South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/south_miami-dade_statistical_data_analysis.pdf.

Southeast Florida Regional Climate Change Compact. 2012a. *A Region Responds to a Changing Climate*. Broward County, Fort Lauderdale, FL; Miami-Dade County, Miami, FL; Monroe County, Key West, FL; and Palm Beach County, West Palm Beach, FL. October 2012. Available at southeastfloridaclimatecompact.org/pdf/Regional%20Climate%20Action%20Plan%20FINAL%20ADA%20Compliant.pdf.

Southeast Florida Regional Climate Change Compact. 2012b. *Regional Climate Action Framework: Implementation Guide*. Broward County, Fort Lauderdale, FL; Miami-Dade County, Miami, FL; Monroe County, Key West, FL; and Palm Beach County, West Palm Beach, FL. October 2012. Available at southeastfloridaclimatecompact.org/pdf/Implementation%20Guide.pdf.

U.S. Census Bureau. 2010. *2010 Census*. United States Census Bureau, United States Department of Commerce, Economics and Statistics Administration, Washington, DC. Available at www.census.gov/2010census/.

USACE. 1994. *Canal 111 (C111) South Dade County, Florida, Final Integrated General Reevaluation Report and Environmental Impact Statement*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 1995. *Master Water Control Manual, East Coast Canals, Volume 5*. United States Army Corps of Engineers, Jacksonville, FL. March 1995.

USACE. 1996. *Master Water Control Manual–Water Conservation Areas, Everglades National Park, and ENP-South Dade Conveyance System*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 1999. *1998 Emergency Deviation from Test 7 of the Environmental Program of Water Deliveries to Everglades National Park to Protect the Cape Sable Seaside Sparrow, Central and Southern Florida Project for Flood Control and Other Purposes Final Environmental Assessment*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2000a. *Final Environmental Assessment, Central and Southern Florida Project for Flood Control and Other Purposes, Interim Structural and Operational Plan (ISOP), Emergency Deviation from Test 7 of the Experimental Program of Water Deliveries to Everglades National Park for Protection of the Cape Sable Seaside Sparrow, Dade County, Florida*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2000b. *Herbert Hoover Dike Major Rehabilitation Evaluation Report*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2002. *Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow, Central and Southern Florida Project for Flood Control and Other Purposes, Final Environmental Impact Statement, Miami-Dade County, Florida*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2006. *Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow, Central and Southern Florida Project for Flood Control and Other Purposes Final Supplemental Environmental Impact Statement, Miami-Dade County, Florida*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2007. *Final Environmental Impact Statement Including Appendices A through G – Lake Okeechobee Regulation Schedule*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2008. *Central and Southern Florida Project Water Control Plan for Lake Okeechobee and Everglades Agricultural Area*. United States Army Corps of Engineers, Jacksonville, FL.

USACE. 2009. *Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs*. Department of the Army Engineering Circular 1165-2-212, United States Army Corps of Engineers, Washington, DC. July 2009. Available at 140.194.76.129/publications/eng-circulars/index.html.

USACE. 2011. *Everglades Restoration Transition Plan Final Environmental Impact Statement*. United States Army Corps of Engineers, Jacksonville, FL. Available at www.evergladesplan.org/pm/program_docs/ertp.aspx.

USACE. 2012. *Record of Decision Central and Southern Florida Project Everglades Restoration Transition Plan*. United States Army Corps of Engineers, Jacksonville, FL. October 19, 2012. Available at www.evergladesplan.org/pm/program_docs/ertp.aspx.

USACE and SFWMD. 1999. *Central and Southern Florida Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement.* United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

USACE and SFWMD. 2005. *North Palm Beach County – Part 1 Project Management Pla*n. United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

USACE and SFWMD. 2009. *C-111 Spreader Canal Western Project Draft Project Implementation Report (PIR) and Environmental Impact Statement (EIS), Annex E (Draft Project Monitoring Plan)*. United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. Available at www.evergladesplan.org/pm/projects/proj_29_c111.aspx.

USACE and SFWMD. 2012. *Biscayne Bay Coastal Wetlands Phase I Final Integrated Project Implementation Report and Environmental Impact Statement*. United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

USACE and SFWMD. 2013. *Central Everglades Planning Project Draft Integrated Project Implementation Report and Environmental Impact Statement*. United States Army Corps of Engineers, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL. August 2013.

USDA–NASS. 2007. *2007 Census of Agriculture for Florida*. United States Department of Agriculture – National Agricultural Statistics Service, Washington, DC. Available at www.nass.usda.gov/fl/.

USEPA. 2011. *WaterSense/Outdoor, Smart Outdoor Practices*. United States Environmental Protection Agency, Washington, DC. Available at www.epa.gov/WaterSense/outdoor/.

USEPA. 2012. *National Water Program 2012 Strategy: Response to Climate Change*. United States Environmental Protection Agency, Washington, DC. Available at water.epa.gov/scitech/climatechange/2012-National-Water-Program-Strategy.cfm.

USFWS. 2010a. *Draft Multi-Species Transition Strategy for Water Conservation Area 3A*. United States Fish and Wildlife Service, South Florida Ecological Services Office, Vero Beach, FL.

USFWS. 2010b. *National Wetlands Inventory*. National Wetlands Inventory Program, Branch of Resource and Mapping Support, United States Fish and Wildlife Service, Washington, D.C. Available at wetlands.fws.gov.

Water Utility Climate Alliance. 2010. *Decision Support Planning Methods: Incorporating Climate Change Uncertainties into Water Planning*. Water Utility Climate Alliance, San Francisco, CA. January 2010.

Wingard, G.L., T.M. Cronin, C.W. Holmes, D.A. Willard, G. Dwyer, S.E. Isman, W. Orem, C.P. Williams, J. Albietz, C.E. Bernhardt, C.A. Budet, B. Landacre, T. Lerch, M. Marot and R.E. Ortiz. 2004. *Ecosystem History of Southern and Central Biscayne Bay: Summary Report on Sediment Core Analyses – Year Two*. Open File Report 2004–1312, United States Geological Survey, Washington, DC. Available at sofia.usgs.gov/publications/ofr/2004-1312/.

Zhang J. and B. Sharfstein. 2012. Chapter 8. Lake Okeechobee Protection Program. In: *2012 South Florida Environmental Report – Volume I*. South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.

Zhang J. and B. Sharfstein. 2013. Chapter 8. Lake Okeechobee Watershed Protection Program. In: *2013 South Florida Environmental Report – Volume I*, South Florida Water Management District, West Palm Beach, FL. Available at www.sfwmd.gov/sfer.