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Issues and Evaluation

This chapter reviews water resource issues that affect the Lower West Coast (LWC) Planning Area and past and ongoing water resource evaluations. The issues identified in this chapter potentially affect the use of existing water resources and development of new supplies to meet projected water demands for 2030 within the planning area. Evaluations and analyses are discussed in the context of water resource issues. A brief summary of the resource protection tools available under Florida law is also provided. This chapter builds on resource evaluation efforts described in the *2005–2006 Lower West Coast Water Supply Plan Update* (2005–2006 LWC Plan Update) (SFWMD 2006). Additional water resource information can be found in the *2011–2012 Water Supply Plan Support Document* (Support Document) (SFWMD 2011).

TOPICS

APPROACH

As mentioned above, this plan update builds on previous work. In addition to utilizing the work done for the earlier LWC water supply plans and updates, analysis and projects completed since the 2005–2006 LWC Plan Update, current population and demand projections, and local government comprehensive planning documents were reviewed as part of this update. The sources used to identify and evaluate water resource issues include the following:

- Input from the planning area stakeholders and the public.
- Analysis and results from previous LWC water supply plan efforts.
- Water supply facilities work plans and capital improvements elements for the local governments in the planning region.
- Consumptive use permits and permit applications.
- Water supply demand projections for 2030.
- Local and regional projects and studies completed since approval of the 2005–2006 LWC Plan Update.
- Data from the Comprehensive Everglades Restoration Plan (CERP) Caloosahatchee River (C-43) West Basin Storage Reservoir Project's preconstruction test cells.

- Data from the aquifer storage and recovery (ASR) pilot test at the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project.
- Analyses performed in conjunction with the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) and the development of adaptive protocols for Lake Okeechobee (see **Appendix G**) in support of the revised lake schedule.

Based on the input, it was concluded that issues identified in the 2005–2006 LWC Plan Update are still valid. A review of the projected water demands in this update are similar to those previously analyzed, and the findings of the previous plans are representative of current and 2030 scenarios. Therefore, new modeling was deemed unnecessary for this current update.

SUMMARY OF ISSUES IDENTIFIED FOR 2030

Primary freshwater sources in the LWC Planning Area may not be sufficient to meet 2030 projected water use demands. Past analysis (SFWMD 2000b) indicated that fresh water in the surficial aquifer system (SAS) and intermediate aquifer system (IAS), and surface water in the Caloosahatchee River Watershed, are not adequate to meet the growing needs of the LWC Planning Area during 1-in-10 year drought conditions (see **Table 1** and **Table 2** in the *Resource Protection* section for definitions of resource protection tools and terms).

The water supply issues continuing to influence water supply planning efforts to meet 2030 projected water needs in LWC Planning Area are as follows:

- Increased withdrawals from the SAS and the freshwater portion of the IAS are generally limited due to potential impacts on wetlands and existing legal water users, the potential for saltwater intrusion, and the possibility of reaching the maximum developable limits (MDLs) of aquifers. New or increased allocations will likely require a cumulative impact analysis and will be evaluated on a case-by-case basis.
- Expanded surface water allocations from Lake Okeechobee and hydraulically connected surface waters are limited to base condition water use.
- Peak freshwater discharges during the wet season are affecting the health of the Caloosahatchee Estuary and additional storage is required in both the basin and the regional system.
- Surface water availability and current storage capacity is insufficient for the Caloosahatchee River and Estuary.

Previous LWC 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. The implementation of these recommendations is well under way. Efforts include increasing water conservation, use of reclaimed water, storage of water using ASR wells, and development and use of brackish water.

Fresh Groundwater Availability Is Limited

Surficial Aquifer System

Throughout the LWC Planning Area, the SAS has historically served as the major source of fresh groundwater for Public Water Supply (PWS), urban landscape irrigation, and agriculture. However, past and present analyses of the SAS indicate it is a limited water resource in many areas of the LWC Planning Area. Previous analyses demonstrated that the SAS did not have the capacity to be the primary source for projected urban water demands beyond the 1990 base year demand levels. Although the number of SAS withdrawals has increased since the 1990s, withdrawal quantities remain limited because of potential impacts to wetlands and saltwater intrusion concerns. Any significant increase in withdrawals from the SAS will continue to be constrained by resource protections limiting saltwater intrusion, wetland impacts, and impacts to existing legal users and other regulatory considerations. Additional supplies may be developed and permitted from these traditional (historical) sources depending on the quantities required, local resource conditions, changing land use, and the viability of other supply options.

In 2010, treatment capacity of water from the SAS accounted for approximately 48 percent of the region's PWS. By 2030, the treatment capacity of SAS water for PWS is projected to decrease to 34 percent, as infrastructure to develop additional alternative water sources, such as brackish groundwater and reclaimed water, increase. Further development of the SAS may be accomplished by relocating production wells further from wetlands and existing legal users to maximize use and minimize negative impacts. Changes in land use/land cover also affect potential development of the SAS. However, new or increased allocations from the SAS will likely require a cumulative impact analysis and will be evaluated on a case-by-case basis.

Saltwater intrusion is an ongoing concern resulting from continued use of shallow groundwater sources near the coast and potential sea level rise as well as the upward movements of saline water from the deeper aquifers. Coordination with utilities and other water users assists with comprehensive data collection and monitoring.

Intermediate Aquifer System

Historically, the Sandstone and Mid-Hawthorn aquifers within the IAS have been important freshwater sources for portions of Lee and Hendry counties. However, these local aquifers are not fresh or productive throughout the LWC Planning Area. Analyses indicate these localized aquifers are limited water sources in portions of the planning area due to the cumulative effects of withdrawals by all water users, which decrease water levels in the IAS and could cause harm to the resource or saltwater intrusion. MDLs have been adopted for the IAS. Proposed allocation increases from the IAS in Lee and Hendry counties will continue to be evaluated on a case-by-case basis and additional data is needed to help identify areas where water is potentially available.

Surface Water Availability is Limited

Traditionally, surface water has been the primary source of water supply for the agricultural industry in the Caloosahatchee River Watershed. Surface water availability from the existing canal and storage networks alone is insufficient to meet agricultural water use demands and environmental needs during 1-in-10 year drought conditions (SFWMD 2000a). Past analyses concluded that additional storage was necessary to provide adequate resources to meet existing and natural system needs in the LWC Planning Area (SFWMD 2000b).

The lack of storage within the Caloosahatchee River Watershed contributes to the three items listed below:

- The discharge of large volumes of water to tide has an adverse impact on estuarine ecosystems due to sudden declines in salinity during major storm events.
- The water discharged to tide during the wet season is no longer available when needed by the ecosystem during the dry season. The lack of sufficient dry season flows causes elevated salinities within the estuaries.
- The water discharged to tide is also lost for consumptive users.

Reduced dry season base flows to the estuary adversely affect habitats and organisms dependent on brackish or freshwater areas during their life cycle. High volume surface water discharges to the Caloosahatchee River and Estuary, sometimes coupled with Lake Okeechobee releases, produce rapid salinity fluctuations. The resultant changes in estuarine aquatic communities are indicated by a reduction in oysters and marine seagrasses at high flows, and mortality of tape grass in the upper estuary at low flows.

The current lake regulation schedule, 2008 LORS, has reduced the availability of water for meeting demands throughout the Lake Okeechobee Service Area, especially during the dry season. The first phase of construction of the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project calls for development of surface water storage for the watershed. The main objective of this project is to provide natural system water to enhance dry season flows to the Caloosahatchee Estuary. Additional reservoirs or water storage solutions are needed to increase water storage capacity. Currently, water supplies from the Caloosahatchee River (C-43 Canal) are dependent on Lake Okeechobee for supplemental water during the dry season.

RESOURCE PROTECTION

A goal of state statutes is to ensure the sustainability of Florida's water resources (Sections 373.016 and 373.701, Florida Statutes [F.S.]). Various water resource protection standards have been developed to accomplish this goal. 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 consumptive use permitting must prevent harm to the water resource. The conceptual relationship among the various harm standards and associated conditions and water shortage severity is shown in **Figure 1**.

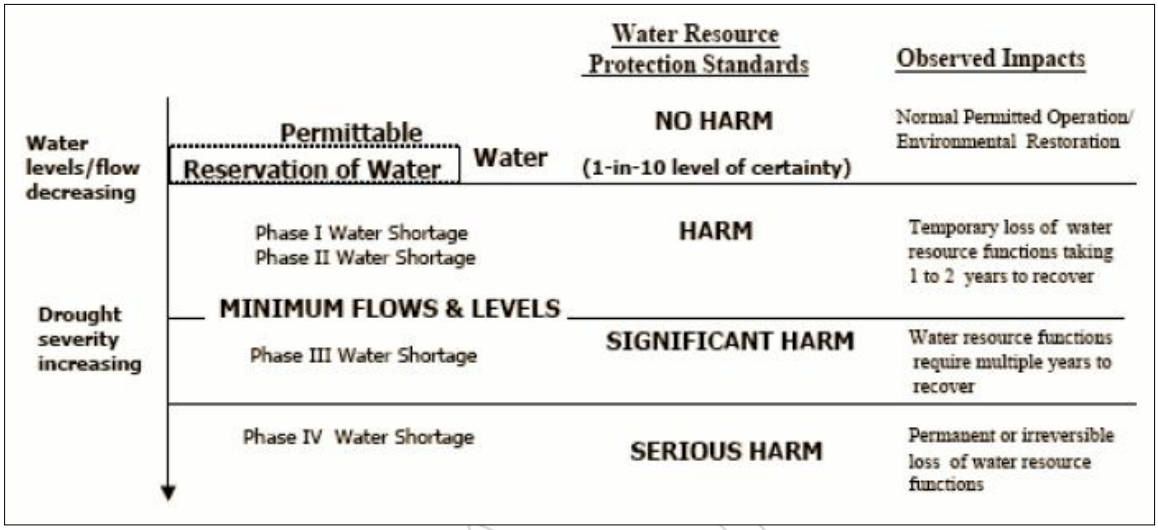

Figure 1. Conceptual relationship among the harm, significant harm, and serious harm water resource protection standards.

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

- The Consumptive Use Permitting Program is intended to balance the needs of water users with the public's interest in protecting water resources for other uses (Sections 373.219 and 373.223, F.S.).
- Minimum Flow and Level (MFL) criteria define the point at which additional withdrawals will result in significant harm to the water resources or ecology of an area (Sections 373.042 and 373.0421, F.S.).
- Water reservations set aside water for the protection of fish and wildlife or public health and safety so that water cannot be allocated for consumptive use permitting (Subsection 373.223(4), F.S.).
- Water shortage management plans and water shortage orders are used to restrict 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.).
- In addition to statutory resource protection tools, the South Florida Water Management District (SFWMD) has adopted aquifer MDLs to provide a basis for defining a point at which additional withdrawals will cause harmful drawdowns that deplete semi-confined freshwater aquifers in the LWC Planning Area (Section 3.2.4, Basis of Review [SFWMD 2010b]).

Table 1 summarizes the statutory resource protection tools and definitions. **Table 2** summarizes definitions of other resource protection terms.

Table 1. Summary of statutory resource protection tools.

Tool	Description
Consumptive Use Permitting	The right to use water is authorized by permit. Consumptive use permitting protects the water resources from harm by ensuring water use is reasonable-beneficial, does not interfere with existing legal users, and is consistent with the public interest. 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 in Rules 40E-2.301(1) and 40E-20.301(1), F.A.C., are met, applicants must meet the criteria in the *Basis of Review for Water Use Permit Applications within the South Florida Water Management District* (SFWMD 2010b). The technical criteria used to evaluate the purpose, quantity and source of proposed water to be used concern the following: • Saltwater intrusion • Wetland impacts • Pollution • Impacts to off-site land uses • Interference with existing legal users • MFLs • Regulatory components of MFL prevention and recovery strategies. Permits are issued with conditions that specify the withdrawal quantity and permit duration.
Minimum Flows and Levels (MFLs)	MFLs are the flows or levels at which the specific water body would experience significant harm if further withdrawals are authorized. If water flows or levels are presently below the MFL, or are projected to fall below the established MFL criteria within the next 20 years, the 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 20-year planning horizon for the area. MFL criteria were adopted in 2001 for the LWC aquifer systems (Lower Tamiami, Sandstone and Mid-Hawthorn aquifers) occurring within Charlotte, Hendry, Glades, Lee and Collier counties. A MFL was also adopted for the Caloosahatchee River. The recovery strategy for the Caloosahatchee River and the prevention strategy for the LWC aquifers are provided in **Appendix G**.
Water Reservations	A water reservation sets aside water for the protection of fish and wildlife or public health and safety. When a volume of water is reserved, it is not available for allocation to consumptive use permittees. Water reservations can be developed based on an evaluation of existing water availability and/or consideration of future water that may be made available by water resource projects. Water provided by CERP projects under the Water Resources Development Act of 2000 require the SFWMD to reserve or allocate the water for the natural system identified for each CERP project.
Water Shortage Plan and Rules	Water shortages are declared by the SFWMD's Governing Board when available ground 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. The SFWMD's Water Shortage Plan and rules are contained in Chapters 40E-21 and 40E-22, F.A.C. In addition to protecting the water resource from serious harm, the goal of the Water Shortage Plan is to (1) assure equitable distribution of available water resources among all water users consistent with the goals of minimizing adverse economic, social and health related impacts; (2) provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and (3) promote greater security for water use permittees.

Table 2. Definitions of other resource protection terms.

Term	Description
Harm Standards	The SFWMD's Basis of Review (SFWMD 2010b) outlines narrative and numeric standards, and assessment methodologies used by the SFWMD to determine if a proposed consumptive use meets issuance conditions in Rules 40E-2.301 and 40E-20.301, F.A.C. If a proposed use meets the criteria, the SFWMD determines the applicant has provided reasonable assurances that the use will not cause harm to the resource. Conditions for issuance of permits, outlined in Chapters 40E-2 and 40E-20, F.A.C., define the harm standard for purposes of consumptive use allocation. These harm criteria are currently applied using climate conditions representing an assumed 1-in-10 year level of certainty. **Harm** is the temporary loss of water resource functions as defined for consumptive use permitting in Chapter 40E-2, F.A.C., that result from a change in surface or groundwater hydrology, and take a period of one to two years of average rainfall conditions to recover (Rule 40E-8.021(9), F.A.C.). **Significant harm** is the temporary loss of water resource functions that result 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.). **Serious harm** is the long-term loss of water resource functions, as addressed in Chapters 40E-21 and 40E-22, F.A.C., resulting from a change in surface water or groundwater hydrology (Rule 40E-8.021(30), F.A.C.).
1-in-10 Year Drought	A 1-in-10 year dought is a below average rainfall year of such intensity it is expected to have a return frequency of once in 10 years. It results in an increase in water demand to a magnitude that would have a 10 percent probability of being exceeded during any given year.
Level of Certainty	Existing legal uses of water must meet the conditions for issuance of a permit during a 1-in-10 year drought condition; this is referred to as the level of certainty. The level of certainty is a concept providing a probability of certainty that given a specific drought event, demands for reasonable-beneficial uses of water will be fully met. Certainty also means that the water resource from which the water is withdrawn will be evaluated to ensure no harm will occur during the specified drought event. The result is not a guarantee that droughts will not occur, but rather that the water resource will be available and the resource protected from harm under drought conditions expected to be experienced once every 10 years. The level-of-certainty planning criteria have been incorporated into the Consumptive Use Permitting Program and the Florida Statutes. The level-of-certainty planning goal established by the Florida legislature is the 1-in-10 year drought event provided in Paragraph 373.709(2)(a)1, F.S.
Maximum Developable Limit (MDL)	MDL water use permitting criteria to provide reasonable assurances that the proposed water use does not cause harmful drawdowns to semi-confined freshwater aquifers in the LWC Planning Area. MDLs have been established for the Lower Tamiami, Sandstone and Mid-Hawthorn aquifers.
Restricted Allocation Areas	Restricted allocation area criteria are regulatory mechanisms that protect specific water bodies from adverse impacts due to consumptive uses of water as defined in Subsection 373.223(1), F.S., and outlined in Section 3.2.1 of the Basis of Review (SFWMD 2010b). Restricted allocation area criteria for the Lake Okeechobee Service Area were developed as part of a recovery strategy for the Lake Okeechobee MFL. Restricted allocation area criteria limit surface water withdrawals to base condition water use (Subsection 3.2.1(G), Basis of Review). The criteria apply to the use of surface water from Lake Okeechobee and hydraulically connected canals, such as the Caloosahatchee River (C-43 Canal). More details on this criteria are provided in **Appendix G**.

Consumptive Use Permitting

Consumptive use permitting protects the water resources from harm by ensuring water use is reasonable-beneficial, does not interfere with existing legal users, and is consistent with the public interest. The *2000 Lower West Coast Water Supply Plan* (2000 LWC Plan) (SFWMD 2000b) recommended incorporation of resource protection criteria, level of certainty, special designations, and permit durations into consumptive use permitting. A series of rulemaking efforts was completed in September 2003 and resulted 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* (SFWMD 2010b). Among the most significant changes were the amendments to permit duration, permit renewal, wetland protection, supplemental irrigation requirements, saltwater intrusion, ASR and model evaluation criteria.

The renewal process for irrigation class water use permits in the LWC Planning Area began in 2004 and was mostly completed in 2006. Irrigation permit renewals located in the Lake Okeechobee Basin were processed beginning in 2008. All new water use permit applications, modifications, and renewals are subject to the terms of the current Basis of Review at the time of permit issuance. Many of the permits for public water suppliers have been renewed with 20-year durations under the rules updated since 2003. The processing of permit renewals, modifications, and new applications has assisted in the evaluation of conditions for this plan update.

Minimum Flows and Levels

The SFWMD is responsible for implementing the provisions of Section 373.042, F.S., requiring the establishment of MFLs for surface waters and groundwater in aquifers. To date, within the LWC Planning Area, MFL criteria were established in 2001 for the Caloosahatchee River (Rule 40E-8.221(2), F.A.C.), and the Lower Tamiami, Sandstone and Mid-Hawthorn aquifers (Rule 40E-8.331, F.A.C.) that occur within Charlotte, Hendry, Glades, Lee and Collier counties.

As a resource protection tool for major water bodies, MFLs provide a basis for defining the point at which additional 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, duration of flow, or water stage. A MFL is designed to prevent a loss of specific water resource functions that would require more than two years to recover. Changes and structural alterations to the hydrologic system may be considered when establishing a baseline condition for protected resource functions (Subsection 373.0421(1), F.S.).

When a MFL is established, it must be evaluated to determine if the existing flow or level criteria is currently being exceeded or will be exceeded within the next 20 years. If the existing water flow or level is below the relevant MFL, or projected to fall below the MFL within the next 20 years, then the SFWMD must develop and implement a recovery or prevention strategy (Subsection 373.0421(2), F.S.). A recovery strategy is needed for water

bodies currently exceeding the MFL. A prevention strategy is necessary when the MFL is not currently violated, but is projected to be exceeded within the next 20 years. The goal of a recovery strategy is to achieve the established MFL as soon as practicable, while the goal of a prevention strategy is for the water body to continue to meet the established MFL in the future. The recovery strategy must include the provision of sufficient water supplies for 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. 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. The strategy should include development of additional water supplies and implementation of water conservation and other efficiency measures consistent with the provisions in Sections 373.0421 and 373.709, F.S. **Appendix G** provides details on the MFL criteria and recovery and prevention strategies for the Caloosahatchee River and the LWC aquifers.

Caloosahatchee River MFL

In 2001, a MFL was set for the Caloosahatchee River. A minimum mean monthly flow of 300 cubic feet per second (cfs) (equivalent to 194 million gallons per day [MGD]) at the S-79 structure was determined necessary to maintain sufficient salinities to prevent a MFL exceedance. A minimum flow of 300 cfs would create salinity conditions that support a sustainable population of submersed aquatic vegetation beds in the upper estuary. A MFL exceedance occurs during a 365-day period when (a) a 30-day average salinity concentration exceeds 10 practical salinity units (psu) at the Fort Myers salinity station, or (b) a single, daily average salinity exceeds a concentration of 20 psu at the Fort Myers salinity station. Exceedance of either "a" or "b" for two consecutive years is a violation of the MFL.

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The Caloosahatchee River is defined as the surface waters that flow through the S-79 structure combined with tributary contributions below S-79 that collectively flow southwest to San Carlos Bay.

Analyses completed for the *2000 Lower East Coast Water Supply Plan* (SFWMD 2000a) demonstrated that long-term regional storage was necessary to achieve proposed MFL criteria, and that MFL violations were projected to occur prior to implementation of a recovery strategy. As a result, the SFWMD projected that a recovery strategy based on construction of regional storage would be necessary to achieve the MFL. The structural features of the recovery plan are described in **Appendix G**.

Lower West Coast Aquifers MFL

Minimum water levels criteria for three LWC Planning Area aquifers are intended to prevent significant harm to the resource. In 2001, the SFWMD's Governing Board adopted a MFL rule specifying that the minimum water levels for the Lower Tamiami, Sandstone and Mid-Hawthorn aquifers must equal the structural top of the aquifer (SFWMD 2000b). A violation of the criteria occurs when water levels drop below the top of the uppermost

geologic strata comprising the aquifer at any point in time. Water level measurements used to determine the conditions of the aquifers for the purpose of this rule will be located no closer than 50 feet from any existing pumping well (Rule 40E-8.331, F.A.C.).

In order to prevent these aquifers from falling below the minimum water level, the SFWMD adopted MDLs in 2003. The MDL contained in the Basis of Review prohibits consumptive uses from lowering the potentiometric head within the Lower Tamiami, Sandstone and Mid-Hawthorn aquifers 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 (SFWMD 2010b). The prevention strategy, including the MDLs, for the LWC aquifers is described in **Appendix G**.

Water Reservations

A water reservation sets aside water for the protection of fish and wildlife or public health and safety (Subsection 373.223(4), F.S.). When a volume of water is reserved, it is not available for allocation to consumptive use permittees. Water reservations can be developed based on an evaluation of existing water availability and/or consideration of future water that may be made available by water resource projects. Water provided by CERP projects under the Water Resources Development Act of 2000 require the SFWMD to reserve or allocate the water for the natural system identified for each CERP project.

Picayune Strand and Fakahatchee Estuary

A water reservation rule was adopted for the Picayune Strand and Fakahatchee Estuary in February 2009 in support of the CERP Picayune Strand Restoration Project. This reservation sets aside water for the protection of fish and wildlife (Rule 40E-10.041, F.A.C.) and affects the availability of surface water and groundwater in the Picayune Strand area of the LWC Planning Area as described in the Basis of Review (SFWMD 2010b).

CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project

The SFWMD initiated rule development for a water reservation in December 2009 to fulfill its project assurance commitments for the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project. The water reservation rule will require consumptive use permit applicants to provide reasonable assurances that their proposed use of water will not withdraw water reserved for the natural system. The District's objective in establishing this water reservation is to ensure that all water contained in the C-43 Reservoir is protected for the natural system and to allow maximum flexibility in operations to support this objective. Additional information regarding this water reservation can be found in **Appendix G**.

EVALUATION AND ANALYSIS

This section of the chapter provides an overview and summary of previous analyses. The findings and conclusions of the *1994 Lower West Coast Water Supply Plan* (1994 LWC Plan), 2000 LWC Plan and 2005–2006 LWC Plan Updates (SFWMD 1994, 2000b, 2006) are still representative of the LWC Planning Area. Previously identified water resource and water supply issues remain considerations in this current update. Previous modeling analyses used assumptions and general hydrogeologic conceptualization that are consistent with current understanding of the groundwater systems. The projected 2030 gross water demands for all categories of water use in this plan update are three percent less than the projected demands in the 2005–2006 LWC Plan Update for 2025 (see **Chapter 2**). Because the previously identified issues are still valid, and projected water demands are similar to those previously analyzed, new modeling scenarios were not deemed necessary for the current update. For further information, refer to the 1994 and 2000 LWC Plans and 2005-2006 LWC Plan Update (SFWMD 1994, 2000b, 2006).

Previous Analyses

Previous water supply planning efforts analyzed the ability of traditional freshwater sources to meet future water demands. Evaluation tools used in these analyses included surface water budgets, groundwater models, integrated surface water and groundwater models, and saltwater intrusion vulnerability mapping. Additionally, the SFWMD examined projected demands, land use, and basin renewals of water use permits, performed field inspections, and revised water use permitting rules (SFWMD 2010b).

Three subregional groundwater models simulated the potential impacts of water use including the (1) Collier County Ground Water Flow Model, (2) Hendry County Ground Water Flow Model and (3) Lee County Ground Water Flow Model. Results from these models were used in vulnerability mapping to identify areas where potential for future saltwater intrusion in the SAS and IAS may occur. A detailed review of these modeling efforts conducted by the SFWMD for the LWC Planning Area can be found in the 1994 and 2000 LWC Plans (SFWMD 1994, 2000b).

Simulations of SAS and IAS withdrawals and associated drawdowns examined estimates of future water use under 1-in-10 year drought conditions. Performance targets were developed to simulate resource protection criteria and were applied to predict areas with potential wetland harm and possible saltwater intrusion. Based on extensive field research, updated resource protection criteria were ultimately developed and adopted as regulatory strategies (see the *Resource Protection* section of this chapter).

Other models developed for the LWC Planning Area, or portions of the planning area, evaluated environmental, water quality and water quantity concerns. These models were not developed specifically for water supply analysis but provided additional understanding of surface hydrology and hydrogeology.

These modeling efforts include the following:

- Regional Integrated Surface Water-Groundwater Model – the Southwest Florida Feasibility Study Integrated Hydrology Model (SDI Environmental Services et al. 2008)
- Subregional Integrated Surface Water-Groundwater Model – Caloosahatchee River Basin (C-43) Model (DHI and Stanley Consultants, Inc. 2005)
- Subregional Integrated Surface Water-Groundwater Model – Big Cypress Basin Subregional Model (CDM 2006a)
- Subregional Integrated Surface Water-Groundwater Model – Tidal Caloosahatchee River Basin Model (CDM 2006b)
- Subregional Integrated Surface Water-Groundwater Model – Estero Basin Subregional Model (CDM 2006c)
- SEAWAT Density-dependent Solute Transport Model – Big Cypress Basin Saltwater Intrusion Pilot Model (Schlumberger Water Services 2010)

In addition to demonstrating potential harm to water resources under certain planning conditions, previous LWC modeling results indicated that historically used water sources (fresh groundwater from the SAS and IAS, and surface water from the Caloosahatchee River [C-43 Canal]) were not adequate to meet the LWC Planning Area's growing water needs through 2020. Most agricultural water users in the Hendry and Glades counties portions of this area use surface water for irrigation. Analyses also indicated that surface water supplies were inadequate to meet existing and future agricultural irrigation demands. Updates related to this conclusion are discussed in the next section of this chapter.

Previous Plan Recommendations

The 1994 and 2000 LWC plans recommended new sources of water be identified and used to reduce the potential for harm to water resources where appropriate (SFWMD 1994, 2000b). The 2005–2006 LWC Plan Update continued emphasizing increased development of alternative water supplies to meet future needs including use of the FAS and reclaimed water, increased water conservation efforts, and use of innovative water treatment technologies to assist in meeting future water needs (SFWMD 2006).

Existing Conditions and Implementation of Previous Recommendations

This section discusses recent water resources trends and summarizes progress made in implementing prior recommendations. For purposes of water supply planning, the focus of this section is water resources in relation to the user demand categories presented in **Chapter 2**. Discussions concerning environmental restoration projects follow later sections of this chapter.

Existing conditions of fresh groundwater sources reflect multiple physical changes in land use/land cover, stormwater management, water use and climatic variations. Agricultural

and residential development within the region changed surface drainage patterns and increased water demands affecting groundwater resources. While hydrologic conditions at some locations have improved with the implementation of 2005–2006 LWC Plan Update recommendations, in other areas, natural changes (e.g., drought) and southwest Florida activities have intensified stress in locations with existing long-term declining water levels.

Surficial and Intermediate Aquifer Systems Water Levels

The hydrologic data used in this analysis was from the past five years and it has shown great variation in rainfall as well as changing water use volumes and increases and decreases in water levels in the SAS and IAS. The SAS depends on local rainfall for recharge. The wetland systems that are part of this aquifer system are dependent on rainfall and support from groundwater levels in the SAS. During dry or drought conditions, recharge diminishes, drainage persists, and irrigation demands and other demands increase, all of which compound stress on the aquifer and wetland systems.

Typically, the IAS receives little direct recharge from rainfall but is recharged by seepage from above or laterally from outside the boundaries of the planning area. Increased demand from the IAS source is therefore dependent upon available seepage from overlying strata and is limited.

Water demands from 2006 to 2008 increased due to population growth and an increase in recreational landscape irrigation acreage. Drought conditions started in 2007 and continued through much of 2008 and 2009. The resulting water demands placed additional stress on both the SAS and IAS and record low water levels were set in 2007 at many IAS monitoring wells. Water demand declined in late 2008 and 2009, and again in 2011 due to water shortage restrictions imposed across the region.

Chapter 4 of this document and Chapter 9 of the Support Document provide a review of the LWC Planning Area's water sources.

Surficial Aquifer System Water Levels

The Surficial (water table) and Lower Tamiami aquifers within the SAS are the primary sources for self-supplied potable drinking water and irrigation water as well as a major source for PWS in Collier, Lee and Hendry counties. As such, the aquifers are critically important to the region. Throughout the LWC Planning Area, no consistent downward or upward trend in water levels is apparent in the SAS. However, individual wells may show upward or downward trends in their periods of record; this demonstrates the importance of local hydrogeologic conditions. This can be seen in **Figure 2** below, which shows water levels and trends for two SAS wells in northwestern Collier County that are about ten miles apart. Seasonal variations in levels from wet and dry seasons are typical in rainfall-driven aquifers. The trend lines shown in the **Figure 2** United States Geological Survey (USGS) graphs were calculated by performing a regression against the daily water level elevations for the last 35 years at each well (USGS NWIS database 2012).

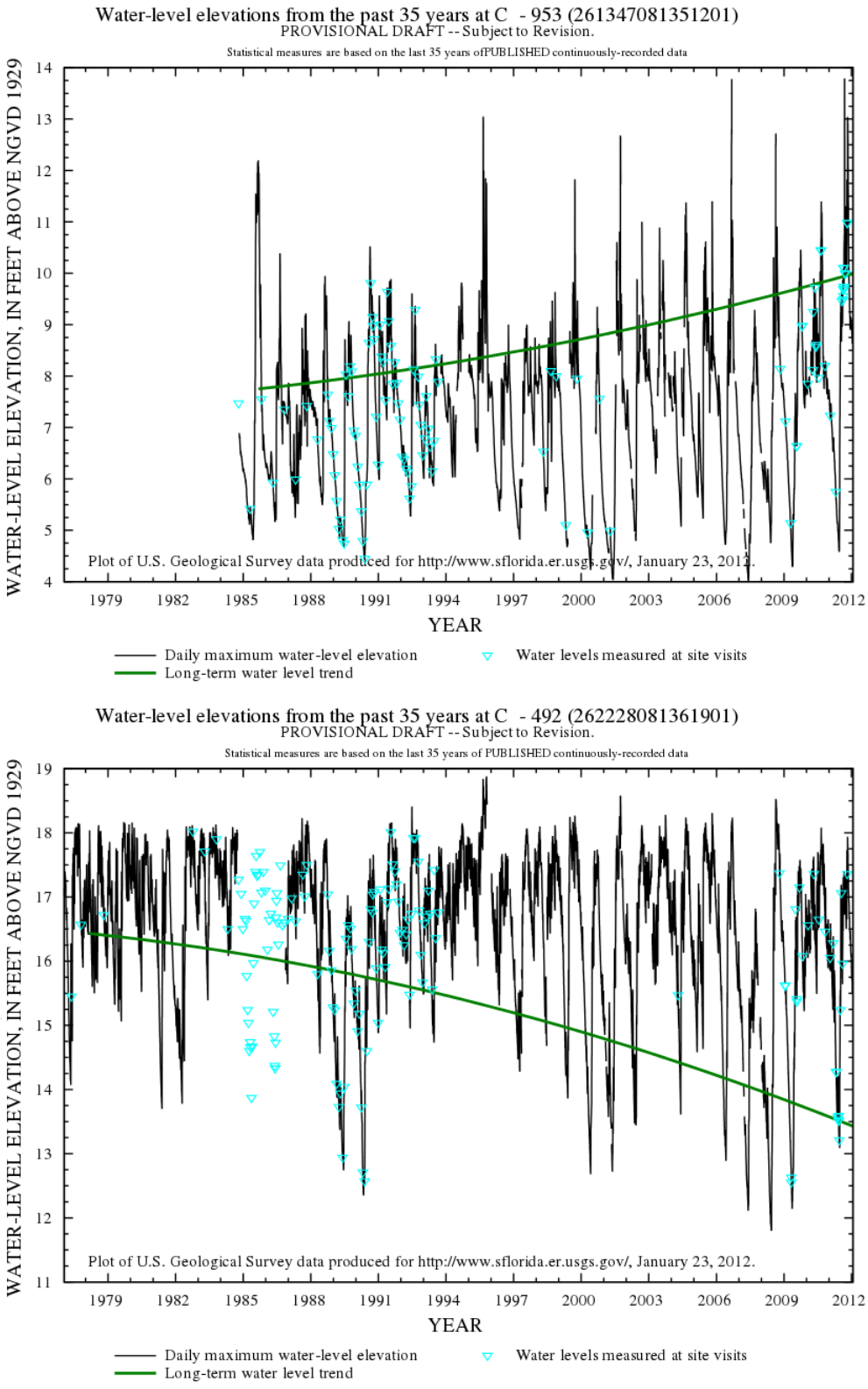

Figure 2. Long-term water level trends in SAS wells C-953 (top panel) and C-492 (bottom panel) in Northwestern Collier County (Source: USGS).

To increase surface and groundwater storage, which could diminish the effects of water use and drought, the SFWMD Big Cypress Basin Capital Improvement Program has made structural, operational and monitoring improvements to the Golden Gate Canal System to retain stormwater within the canal system.

Intermediate Aquifer System Water Levels

In the LWC Planning Area, the IAS includes the Sandstone and Mid-Hawthorn aquifers (see Chapter 9 of the Support Document). The Sandstone aquifer has shown a declining regional trend (Prinos et al. 2002), and this continued over the past five years in the Lehigh Acres area. Lehigh Acres is discussed in the 2005–2006 LWC Plan Update as an area with potential resource-related issues. **Figure 3** provides a comparison of Sandstone aquifer water levels in southern Lehigh Acres where water levels show a long-term decline, and near Green Meadows Wellfield (Well L-1998) in central Lee County where levels have recovered as a result of reduced demands by utilities. Since 2005, record low water levels have occurred for the period of record in Well L-729 and other Sandstone aquifer wells in Lehigh Acres (Well L-729) (**Figure 3**). These reduced water levels caused some Domestic Self-Supply (DSS) wells to become inoperable. During the 2007 drought, 64 percent of the 529 replacement wells permitted by Lee County were in Lehigh Acres. However, Sandstone aquifer water levels have recovered in wellfield areas where Lee County Utilities has reduced its withdrawals from this aquifer as can be seen in Well L-1998 (**Figure 3**). Overall, DSS and other withdrawals from the Sandstone aquifer have increased in the LWC Planning Area. In 2010, the SFWMD conducted a preliminary drilling and testing project adjacent to two Sandstone aquifer wells that are used to monitor conditions in Lehigh Acres to more accurately delineate the top of the Sandstone aquifer in that area.

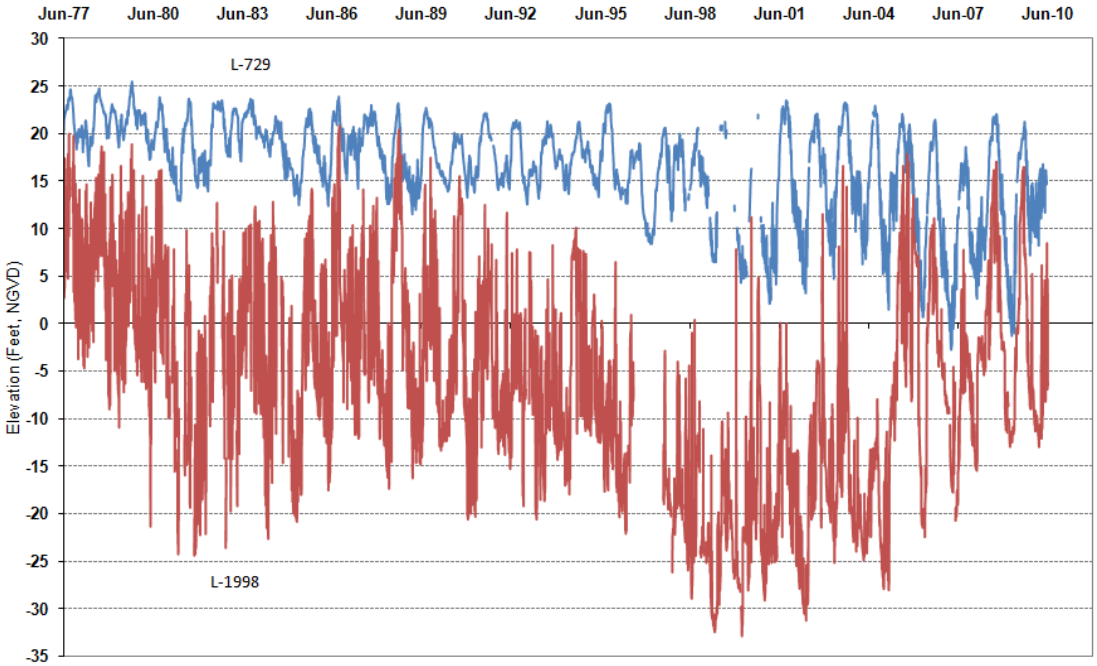

Figure 3. Sandstone aquifer water levels at Well L-729 in southern Lehigh Acres and Well L-1998 near Green Meadows Wellfield in central Lee County.

In contrast to the general declining trend observed for the IAS in the LWC Planning Area, water levels within the Mid-Hawthorn aquifer have risen significantly in southern Cape Coral due to decreasing DSS withdrawals from this water source (**Figure 4**). PWS for this portion of the City of Cape Coral is now derived from the underlying Floridan aquifer system (FAS), which is hydraulically isolated from the overlying IAS or SAS. Expansion of the city utility's service area and increased use of the FAS and reclaimed water were identified in the 2005–2006 LWC Plan Update as partial solutions for diminishing IAS water availability in this location. In the northern portion of Cape Coral and in the southern portion of Fort Myers not served by PWS, water levels in the Mid-Hawthorn aquifer have continued to decline (**Figure 4**). Because continual, increasing use of the Mid-Hawthorn and Sandstone aquifers is not sustainable, alternative water supply development will continue to be needed to ensure adequate future supply (see **Chapter 4**).

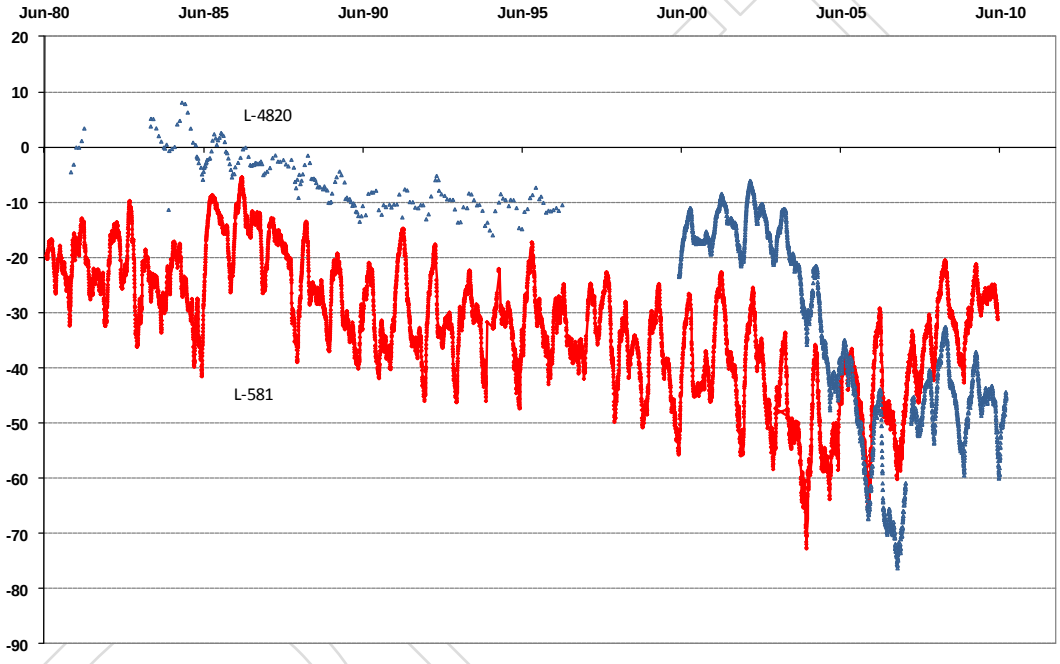

Figure 4. Mid-Hawthorn aquifer water levels at Well L-581 in southern Cape Coral and Well L-4820 in northern Cape Coral in Lee County.

Surficial and Intermediate Aquifer Systems Chloride Levels

Elevated salinity content above the amount allowed in drinking water, in the form of total dissolved solids, chloride, and sodium concentrations, is present in various SAS and IAS locations. The United States Environmental Protection Agency drinking water standard for chloride is 250 milligrams per liter (mg/L).

Saltwater intrusion is the inland movement of the saline water interface or the sustained upward movement of saline groundwater (upconing). In the LWC Planning Area, the potential for both saline sources to migrate into freshwater sources exists. Another mechanism is upward leakage from wells with open intervals that cross multiple aquifers

(short-cased) or leaking casings (Schmerge 2001, Shoemaker and Edwards 2003, Sherwood and Klein 1963, Burns 1983).

Lateral encroachment of seawater into the Lower Tamiami aquifer has occurred to varying extents in the region. Saline groundwater beneath the Gulf of Mexico could move through the permeable rock comprising the Lower Tamiami aquifer to come into equilibrium with modern natural and anthropogenic stresses, such as withdrawals, sea level and drought. Some evidence indirectly suggests the occurrence of lateral encroachment in the lower Tamiami aquifer near Bonita Springs (Shoemaker and Edwards 2003).

Since 2006, monitoring sites and water use permit application submittals have shown that some areas inland of coastal Collier and Lee counties have salinity content above 250 mg/L in the SAS and IAS. The Lee County Natural Resource Division plugged and abandoned 68 Floridan aquifer wells from June 12, 2007 through March 24, 2010 that allowed saline water to migrate into the overlying Mid-Hawthorn and Sandstone aquifers. Data with sufficient periods of record indicate chloride concentrations have increased over time at some locations, but concentrations have decreased at other locations. **Appendix F** contains chloride concentration data for the water table and the Lower Tamiami, Sandstone and Mid-Hawthorn aquifers within the SAS and IAS.

In 2011, the SFWMD examined April–May 2009 chloride data from a number of USGS wells and from data submitted by permittees as part of their consumptive use permit limiting conditions. A series of isochlor maps were developed to show the locations of data source wells, proximal wellfields, and lines where wells at any depth in a specific aquifer showed chlorides greater than 250 mg/L. These maps are provided in **Appendix F**. Maps such as these are very useful in maintaining a watchful eye for changes in water quality including possible migration of the saltwater interface.

Increasing chloride trends can be seen in two Lower Tamiami aquifer well graphs created by the SFWMD in **Figure 5**. Chlorides in well C-525 (top panel of **Figure 5**) have increased significantly over the 250 mg/l drinking water standard since 1998. In other wells, such as C-489 (bottom panel of **Figure 5**), chlorides have increased more gradually and are well below the drinking water standard.

Saltwater intrusion can be exacerbated by excessive drainage, canal leakage and water supply withdrawals. The Big Cypress Basin Board, in collaboration with the USGS, is developing a Saltwater Encroachment Monitoring Network Improvement Plan for Big Cypress Basin, which was part of its 2010–2015 Strategic Plan (SFWMD 2010c).

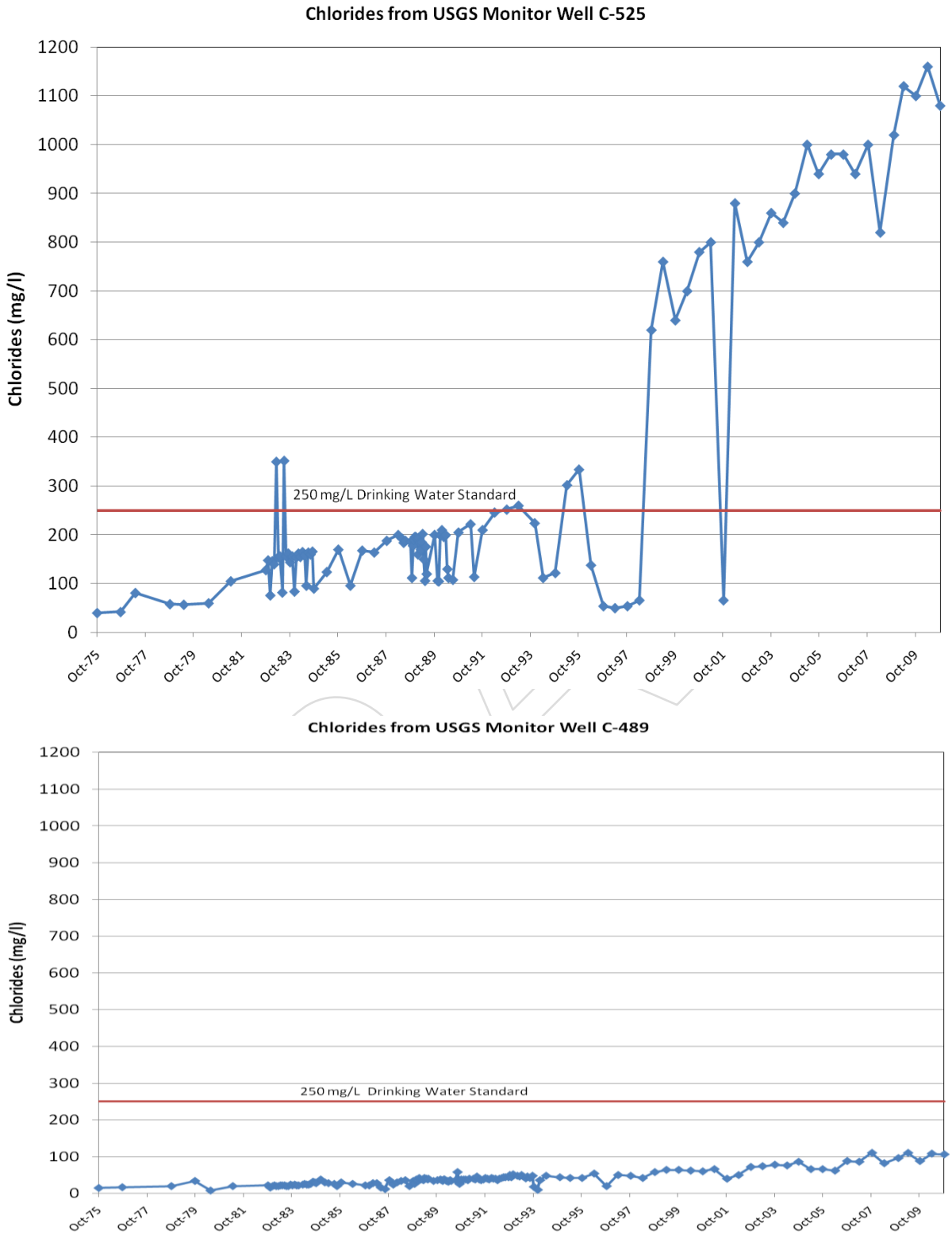

Figure 5. Chloride levels from USGS monitor wells C-525 (top panel) and C-489 (bottom panel) for 1975–2010.

Floridan Aquifer System

Monitoring Network

As recommended in the 2000 LWC Plan, the local FAS water level and water quality monitoring network was expanded in the LWC Planning Area. This network includes cooperative agreements with agricultural owners and PWS utilities. The data gathered are used to evaluate current conditions and trends, and provide additional observed data for calibration of an updated numerical model of the FAS for the LWC Planning Area. As a greater understanding of the FAS evolves, modification of the monitoring network may be required.

Use Trends

Over the last decade, several utilities have developed the FAS as a water source to meet a portion of existing and future demands in addition to Marco Island Utilities and Cape Coral Utilities. These utilities include City of Fort Myers Public Utility, Clewiston Utilities, Collier County Water Department, Bonita Springs Utilities, Greater Pine Island Water Association, Island Water Association, Lee County Utilities, and LaBelle Department of Public Works. Also, 20 percent of the golf courses in this region use the FAS as a supplemental water source for landscape and golf course irrigation.

As **Table 3** shows, use of the FAS by utilities is increasing in the LWC Planning Area. Withdrawals from the FAS by utilities averaging 53.51 MGD in 2009 compared to 21.93 MGD in 1998 — an increase of 31.58 MGD. The SFWMD anticipates this trend will continue as most utilities in the LWC Planning Area intend to use the FAS for future water supplies. From 1998 to 2009, use of the SAS decreased from 52.58 to 48.95 MGD. **Appendix D** contains more information on PWS use of the FAS.

Water Levels

Regional potentiometric surface maps of FAS water level data, prepared by the USGS (Johnston and Bush 1988) and Florida Atlantic University and the SFWMD (FAU and SFWMD 2008), estimate potentiometric surfaces of the FAS for predevelopment and average 2004 conditions, respectively. These maps, provided in **Appendix F**, display similar areal distribution of hydraulic gradients and water levels. Some differences between the maps are evident along the coast and in the northern portion of the LWC Planning Area because the average 2004 water levels are lower. The maps also illustrate how most of south Florida has Floridan potentiometric levels well above land surface, indicating the wells are under artesian pressure.

Table 3. PWS water sources and use in MGD for 1998–2009.

Aquifer	1998	1999	2000	2005	2009
Floridan Aquifer System					
Total from FAS	21.93	23.93	20.01	48.64	53.51
Percent of total withdrawals	23%	24%	19%	37%	41%
Intermediate Aquifer System					
Total from IAS	13.66	14.68	15.18	23.13	20.41
Percent of total withdrawals	14%	15%	15%	18%	16%
Surficial Aquifer System					
Total from SAS	52.58	51.70	61.07	50.26	48.95
Percent of total withdrawals	55%	53%	58%	38%	38%
Surface Water					
Total from surface water	8.29	7.71	8.51	9.67	6.66
Percent of total withdrawals	8%	8%	8%	7%	5%
Total withdrawals	96.46	98.02	104.77	130.71	129.52

Figure 6 presents water level data from an Upper Floridan monitor well at a location and depth typical for agricultural withdrawals in Glades County. The data show seasonal variations in water levels and declines in levels during drought periods where increased irrigation use of the FAS occurs due to lack of rainfall. The period of record (1973–2011) indicates water levels have declined approximately five feet and that a declining trend is apparent over the past 13 years.

Figure 7 presents water level data from an Upper Floridan monitor well at a location and depth typical for PWS withdrawals in Lee County. Again, the data show swings of a few feet over the period of record due to seasonal variations and levels declining during droughts because of the need for increased supplemental irrigation.

Major PWS wellfields withdrawing water from the FAS produce drawdowns in the potentiometric surface that may reach 60 feet, depending on the wellfield and proximity to production wells. However, these depressed water levels remain hundreds of feet above the top of the aquifer system and are not as important as the changes in hydraulic gradients that may induce the upward movement of higher salinity water into the wells' producing zones. Increases in salinity of groundwater are important because they can increase water treatment costs or negatively affect users that do not require treatment prior to use.

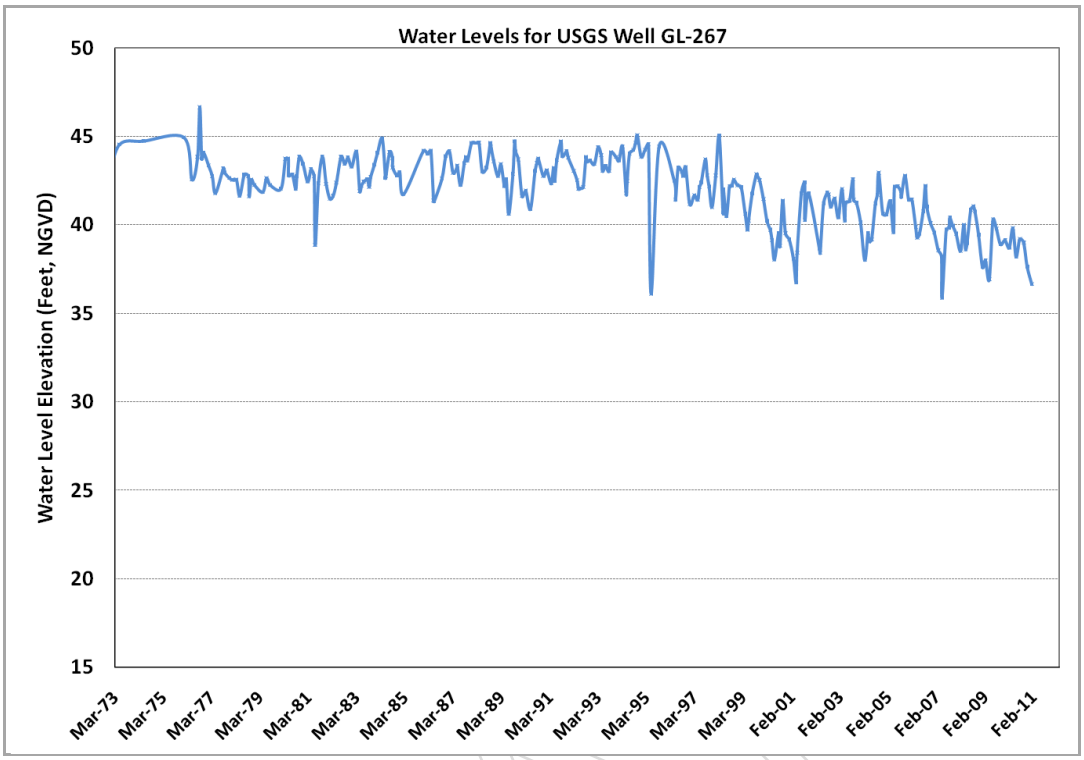

Figure 6. Water levels in an Upper Floridan monitor well at a location and depth typical of agricultural withdrawals in Glades County.

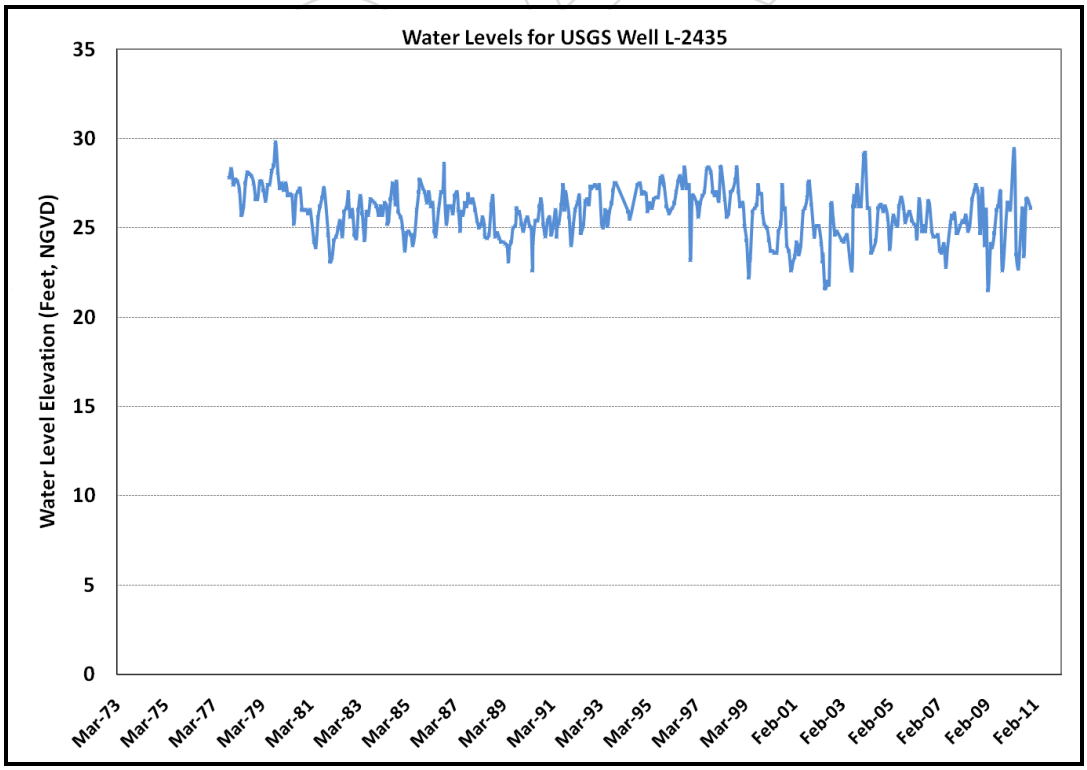

Figure 7. Water levels in an Upper Floridan monitor well at a location and depth typical of PWS withdrawals in Lee County.

Chloride Levels

The FAS contains brackish water with varying chloride and total dissolved solids concentrations, from just above allowable drinking water standards to concentrations typical of seawater. Generally, salinity in the FAS is lower in the northern portion of the LWC Planning Area than in the southern and coastal areas. In all areas, salinity levels are higher at the bottom of the FAS than levels near the top of the system.

The occurrence of more saline water in lower portions of the FAS is a consideration in the development of the upper portion of the FAS for water supply. Over pumping of the upper portions of the FAS can result in upconing of more saline water in the lower portions of the FAS. The treatment of brackish water for potable water and the blending of brackish and fresh water for irrigation purposes becomes more costly as salinity increases. Based on regional areal extent, thickness and average yielding capabilities, a large volume of brackish water is available from the FAS. However, local aquifer variability, the pumping rates of production wells, and the proximity of these wells to saltwater sources will influence the long-term sustainability of the FAS for specific locations.

The Lower Hawthorn aquifer producing zone, a portion of the Upper Floridan aquifer, is targeted for water supply production in the LWC Planning Area. Tables F-7 and F-8 in **Appendix F** contain chloride concentration data for the Lower Hawthorn producing zone in the LWC Planning Area.

Raw water chloride concentrations and withdrawals from the Cape Coral Southwest brackish water wellfield are depicted in **Figure 8** (Schers et al. 2007). This figure reflects trends in average monthly chloride concentrations and wellfield pumping over time in Cape Coral. These trends suggest that proper monitoring, maintenance, and wellfield operation management can moderate the rate of increase in chloride concentrations. Although average chloride concentration increased approximately 50 percent in 20 years, from about 600 to 900 mg/L, it remains well within the treatment capabilities of the Cape Coral treatment facility.

Figure 9 illustrates changes in chloride concentrations over time from Floridan aquifer production wells at the North Lee County wellfield. The use of Production Well 6 was discontinued due to high chloride concentrations. Additional FAS production wellfields were added with greater spacing between wellfields to reduce the potential of upconing of saline water and to provide greater operational flexibility and capacity.

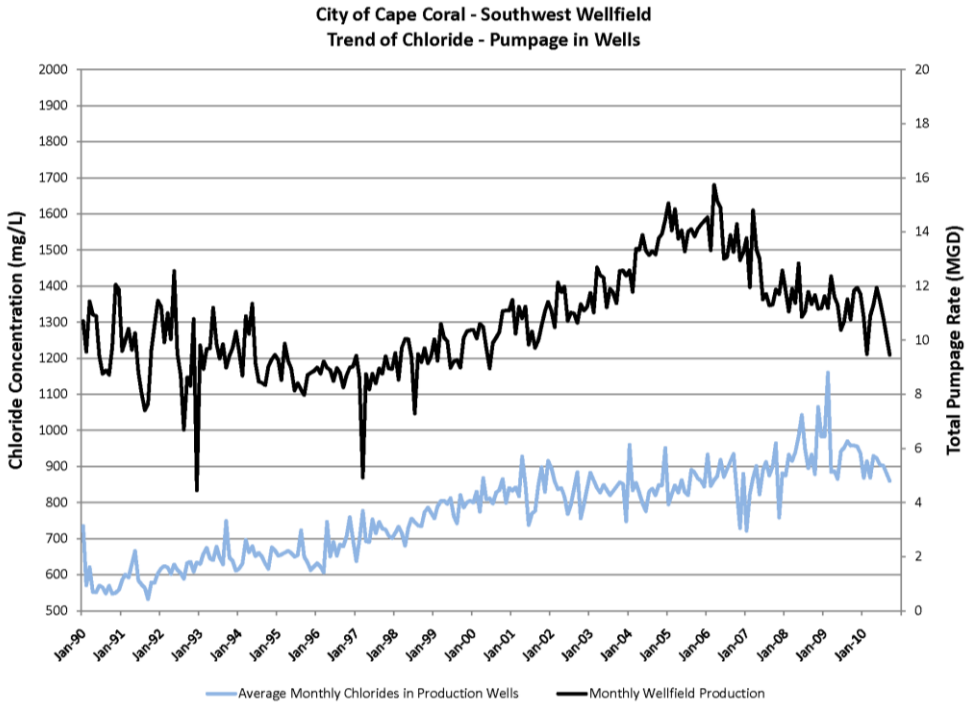

Figure 8. Raw water chloride concentrations and withdrawals from the Cape Coral Southwest brackish water wellfield (Schers et al. 2007).

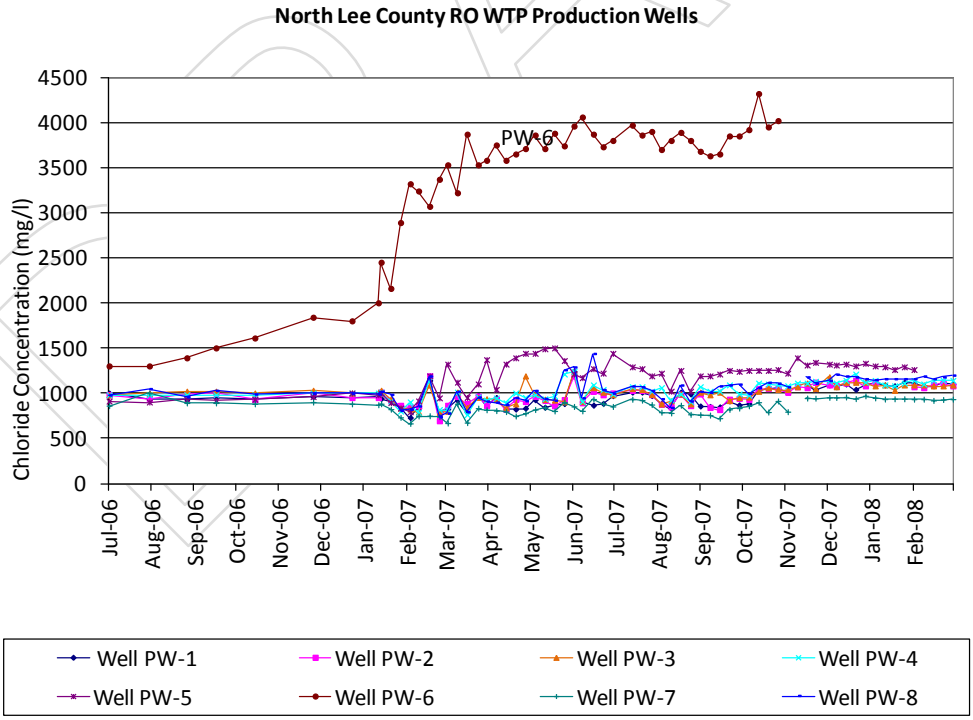

Figure 9. Chloride concentrations from production wells (PW) at the North Lee County FAS wellfield.

FAS Demands

The projected 2030 gross water demands for all categories of water use in this plan update are three percent less than the 2025 projected demands in the 2005–2006 LWC Plan Update (see **Chapter 2**). Previous water supply planning analyses of the FAS and consumptive use permitting activities have indicated that the FAS has the potential for supplying sufficient water to meet the regional PWS demands through the planning horizon. However, the rate at which water can be withdrawn is dependent on localized aquifer properties, water quality and the proximity to other FAS production wells.

Experience gained from the past five years demonstrated the variability and complexity of the FAS system and the need for testing and long-term monitoring to better understand this resource. The depth, location, withdrawal rates, and well spacing of a proposed FAS wellfield needs to be carefully investigated and planned to minimize the potential for salinity increases that compromise the proposed existing treatment technologies.

Lower West Coast Floridan Aquifer System Model

The Lower West Coast Floridan Aquifer System Model has the ability to incorporate density effects while calculating hydraulic head, groundwater flow, and chloride concentration within the modeled system on a monthly basis. This model was developed in 2008 and uses the USGS's SEAWAT-2000 program to numerically represent the hydrogeology of the region, nearshore portions of the Gulf of Mexico and Florida Bay. Model boundaries allow interaction with external flow and solute transport to simulate the effects from internal sources and sinks. This model was reviewed by an independent peer review panel and the recommendations were incorporated into the model. During Fiscal Year 2010, a revised steady state model was created to represent estimated predevelopment conditions in the FAS. The model has recently been updated, incorporating peer review comments, and has been recalibrated to transient conditions (Schlumberger Water Services and SFWMD 2011). This revised model will be used for future regional water supply planning efforts to evaluate the use of the FAS and potential impacts of water withdrawals on the resource.

Surface Water

Most surface water in the LWC Planning Area is derived from rainfall making the resource seasonally variable and subject to extreme rainfall events or droughts. The exception to this is the Caloosahatchee River (C-43 Canal), which also receives water from the Caloosahatchee Basin tributaries and Lake Okeechobee. The Caloosahatchee River (C-43 Canal) is the major surface water source used for agricultural water supply in the portions of Hendry, Glades and Lee counties in the LWC Planning Area. To a lesser extent, the canal systems in the City of Cape Coral and Big Cypress Basin provide surface water for water supply but these canals were originally designed to convey water for drainage.

Surface water availability and level of certainty in the Lake Okeechobee Service Area has been reduced since the Lake Okeechobee regulation schedule was modified in 2008 as a result of dike integrity. As a result, Lake Okeechobee transitioned from a MFL with a

prevention strategy to a MFL under recovery. Restricted allocation area criteria for the Lake Okeechobee Service Area were developed as part of a recovery strategy refer to **Appendix G**. The criteria limit surface water withdrawals to base condition water use (Subsection 3.2.1(G), Basis of Review, SFWMD 2010b). The rule applies to any integrated conveyance system that is hydraulically connected to and receives water from Lake Okeechobee including the Caloosahatchee River (C-43 Canal) up to the S-79 structure.

Surface Water Storage

Reservoirs and changes to local and regional surface water management systems can be used to increase surface water availability. These include the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project, Big Cypress Basin surface water control modifications, and local drainage district improvements including Cape Coral and East County Water Control District.

CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project

The purpose of the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project is to improve the quantity, timing and distribution of freshwater flows to the Caloosahatchee River and Estuary. This planned reservoir project will capture and store surface water runoff from the C-43 Basin and Lake Okeechobee to provide a more natural and consistent flow of fresh water to the estuary. After construction and flow-through testing, operation of this project is expected to improve the Caloosahatchee Estuary's salinity balance by reducing a portion of the peak discharges during the wet season and providing essential flows during the dry season.

The project includes an aboveground reservoir located south of the Caloosahatchee River and west of the Ortona Lock (S-78) on a 10,700-acre parcel west of LaBelle formerly known as Berry Groves. The reservoir will provide a total storage capacity of approximately 170,000 acre-feet of aboveground storage volume in a two-cell reservoir. To date, land has been cleared and designs for construction are permitted. However, the project is awaiting congressional authorization and funding to start construction.

Caloosahatchee River Watershed Protection Plan

The *Caloosahatchee River Watershed Protection Plan* (SFWMD et al. 2009a) identifies the need for additional storage and proposes reservoirs and stormwater treatment areas to address the volume and timing of fresh surface water for the Caloosahatchee Estuary. These efforts were planned to meet the natural system needs. The *Caloosahatchee River Watershed Protection Plan* is part of the Northern Everglades and Estuaries Program, which is discussed in **Appendix G** and in the Support Document (SFWMD 2011b).

Big Cypress Basin

The Big Cypress Basin canal systems also provide surface water supply, and to a lesser extent, local stormwater ponds for landscape irrigation. The Big Cypress Basin canal system in Collier County was constructed as a surface water drainage system; however, improvements to structures, operations and management, and monitoring have resulted in an estimated 850 acre-feet of additional surface water storage in canals since 2000.

Local Drainage District Improvements

The Canal Weirs Improvement Program for the City of Cape Coral added higher control elevations to operable weirs to store more fresh water in the canal system during wet conditions, providing 1.7 MGD additional supply to the city's reclaimed irrigation system.

The *East County Water Control District Consolidated Plan for Water Management* (ECWCD 2008) includes improvement projects to reduce high flows to the Orange River (which currently discharges into the Caloosahatchee Estuary), capture and store stormwater runoff, and raise groundwater levels for wetland restoration, water storage and aquifer recharge.

Reclaimed Water

Since 1994, the volume of reclaimed water use has doubled in the region. In 2010, the reclaimed water use rate was 70.4 MGD (**Table 4**) (FDEP 2010). Where available, reclaimed water provides many communities with all or a portion of their irrigation demands. Water supply development projects (**Chapter 6**) under way or proposed by utilities are expected to continue this trend. The LWC Planning Area's increasing production of reclaimed water may require utility reclaimed water interconnects and construction of seasonal storage, such as ASR.

Table 4. Reclaimed water use in the LWC Planning Area in MGD for 1994–2010.

	1994	1996	1998	2000	2002	2004	2006	2008	2010
Annual Average (MGD)	32.30	44.70	50.24	63.19	61.90	71.69	68.93	68.25	70.40

Aquifer Storage and Recovery

ASR is the underground storage of storm water, surface water, fresh groundwater or reclaimed water, which is injected into an aquifer through wells during wet periods. The aquifer acts as an underground reservoir for the injected water, reducing water loss to evaporation. The water is then recovered for use during dry periods or periods of increased demand.

To date, over 19 ASR wells have been built by water and wastewater utilities in the LWC Planning Area. Many of these wells store treated drinking water, although some store raw groundwater and raw or partially treated surface water. Approximately half of these ASR

wells are fully permitted for operation. The remaining wells are in operational testing or are inactive.

Water Conservation

Several SFWMD water conservation programs have been initiated since publication of the 2005–2006 LWC Plan Update. These include the approval of the Comprehensive Water Conservation Program and adoption of the Mandatory Year-Round Landscape Irrigation Conservation Measures Rule. For more details about the Comprehensive Water Conservation Program, see **Chapter 4** of this planning document, and Chapters 4 and 5 in the Support Document (SFWMD 2011b).

The Mandatory Year-Round Landscape Irrigation Conservation Measures Rule became effective March 15, 2010. This rule limits landscape irrigation to two days per week with no irrigation allowed between 10 a.m. and 4 p.m., with an allowance for three days a week in communities where utility operations cannot support two days. However, three day per week year-round measures have been in place in the LWC Planning Area since 2003. Some municipalities and counties in the LWC Planning Area, such as Lee County and Cape Coral, have chosen to enact the two-day-per-week irrigation schedule.

The SFWMD has observed reductions in regional utility base year per capita finished water use since 1990 (**Table 5**). The base year regional utility per capita use rates in the 1994 and 2000 LWC Plans and 2005–2006 and current LWC Plan Updates have decreased from a high in the 1994 LWC Plan of 194 gallons per day per person to a low of 151 gallons per person per day in this plan update. These values are calculated by dividing the utility finished water produced by the estimated permanent population connected in the service area for that year. Since the 2005-2006 LWC Plan Update, several conditions contributed to declining per capita rates including the SFWMD's Comprehensive Water Conservation Program, local government conservation programs, water shortage restrictions, and the economic downturn.

Table 5. Regional utility per capita use rates in the LWC Planning Area using overall finished water.

LWC Plan Year	Base Year Used	Per Capita (gallons per day per person)
1994	1990	194
2000	1995	167
2005–2006	2000	176
2012	2005	151

SUMMARY AND FUTURE DIRECTION

The findings and conclusions of the previous LWS plans and updates are still representative of the issues involved in meeting the 2030 projected water demands in the LWC Planning Area. These findings were considered in the development of this plan update. Projected 2030 gross water demands for all categories of water use in this plan update are three percent less than the projected demands in the *2005–2006 Lower West Coast Water Supply Plan Update* (see **Chapter2**).

The following accomplishments have been made towards fulfilling recommendations made in previous plans:

- Users of the surficial aquifer system and the intermediate aquifer system have diversified their supply sources and reduced their reliance on these aquifers. Most coastal utilities are using the Floridan aquifer system or other alternative water supply sources to meet some of the current needs and their future needs. Of the total water withdrawn by major Public Water Supply utilities, use of brackish water increased from 23 percent in 1998 to 41 percent in 2009.
- The use of reclaimed water use has doubled since 1994 and offsets existing and proposed use of fresh groundwater. Utilities have successfully increased the use of reclaimed water from an annual average of 32 million gallons per day in 1994 to 68 million gallons per day in 2008.
- Water conservation measures have resulted in reduced Public Water Supply per capita use rates over last two decades. The overall per capita use rate has decreased from 194 gallons per day per person in 1990 to 151 gallons per day per person in 2005.
- Over 19 aquifer storage and recovery wells have been constructed.
- A water reservation rule has been developed for Picayune Strand and Fakahatchee Estuary.
- Intermediate aquifer system water levels at some locations have risen, likely because of reduced usage.
- Plans continue on construction of the Comprehensive Everglades Restoration Plan Caloosahatchee (C-43) West Basin Storage Reservoir Project and other storage projects.

Since the *2005–2006 Lower West Coast Water Supply Plan Update*, changes have occurred affecting the availability of water to the Caloosahatchee River and Estuary. These include operational, regulatory and planning changes such as the following:

- The Lake Okeechobee Regulation Schedule was updated in 2008 to optimize operations within existing structural constraints and to meet the diverse requirements of the lake, its receiving waters and its users.
- Adaptive protocols for Lake Okeechobee were updated in 2010, with a key goal to improve water supply, flood protection and ecosystem benefits within the constraints of the 2008 Lake Okeechobee Regulation Schedule and the *Central*

and Southern Florida Project Water Control Plan for Lake Okeechobee and Everglades Agricultural Area (USACE 2008).

- To update the Caloosahatchee River Minimum Flow and Level criteria in the future, the South Florida Water Management District has planned several activities over the next five years to gain an improved understanding of salinity and flow relationships and the effects of minimum flows on biological resources in the Caloosahatchee Estuary.
- Rule development has been initiated for a water reservation to ensure the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir Project provides water needed by the natural system.
- Intermediate aquifer system water level declines persist in some locations.
- Saltwater intrusion into coastal aquifers is an ongoing concern due to a variety of factors, including wellfield withdrawals and potential sea level rise.
- Surface water supplies continue to be limited for agriculture.

Additional LWC Water Supply-Related Efforts

Significant water supply development and restoration efforts are under way throughout the LWC Planning Area including CERP projects. **Appendix G** provides descriptions of the additional water supply-related activities in and around the LWC Planning Area.