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EXECUTIVE SUMMARY

The Lower West Coast (LWC) Planning Area is expected to experience substantial growth between now and the year 2020. Population is expected to increase by almost 70 percent from 1995 levels to about 1 million people, with expansion occurring mostly in the coastal areas. This growth will create additional water demands for potable and irrigation water. Likewise, agriculture - primarily citrus and sugarcane located in the eastern portion of the region - is projected to increase by ten percent to approximately 260,000 acres. In addition, there are numerous coastal and inland environmental resources within this region. This region receives approximately 52 inches of rainfall per year on average. Meeting water demands while addressing the water needs of the environment makes development of proactive water supply strategies imperative to the economic and environmental sustainability of the area. The District will be responsible for water resource development to facilitate development of source options at the local level; while, local governments, water users, and water utilities will responsible for water supply development.

This planning document is the product of a public process, that relied heavily on an advisory committee of diverse membership representing agricultural, urban, and environmental interests. The planning effort provided a forum to weigh projected water demands against available supplies.

Seven water source options were identified to address the water supply needs of the LWC Planning Area. These options either make additional water available from historically used sources or other sources, or provide additional management through conservation and storage of the options. The options are (no implied priority):

- Conservation
- Ground Water
  - Surficial Aquifer System
  - Intermediate Aquifer System
  - Floridan Aquifer System
- Reclaimed Water
- Regional Irrigation System
- Seawater
- Storage
  - Aquifer storage and recovery
  - Regional and local retention
  - Reservoirs
- Surface Water

Overall, from a regional perspective, it was concluded that with appropriate management and diversification of water supply sources, there is sufficient water to meet the needs of this region during a 1-in-10 drought condition through 2020. Implementation of the LWC Water Supply Plan, in conjunction with the Comprehensive Everglades Restoration Program, the Caloosahatchee Water Management Plan, and the Southwest Florida Study, should avert potential problems. Even though the volume of water available from the Gulf of Mexico (seawater) appears to be unlimited and could meet the needs of this region through the year 2020, it was concluded that it is not cost effective at this time.

This assessment concluded that the traditional source of water for urban water needs, the surficial and intermediate aquifer systems, has limited potential for expansion due to potential impacts on wetland systems, and increased potential for saltwater intrusion in coastal areas. The Floridan aquifer, a saline water source found at depths greater than 600 feet below the land surface in the LWC Planning Area, appears to be a promising source for additional potable water needs. Current knowledge of the Floridan aquifer indicates it has sufficient supplies to meet both existing and future potable water demands. Many urban utilities have already begun transitioning to the Floridan aquifer through desalination, which removes salt from saline water. Little is known about long-term water quality impacts of sustained withdrawals from this aquifer making the development of a regional Floridan aquifer ground water model and water quality and water level monitoring of the Floridan aquifer a research priority in this region.

From a regional perspective, the use of fresh ground water sources, reclaimed water, surface water, and storage, through development of a regional or subregional irrigation water distribution system(s), will be sufficient to meet the urban irrigation demands. Water from the surficial and intermediate aquifer systems, and reclaimed water have been used historically to meet these demands. However, these sources will not be sufficient to meet the projected urban irrigation demands such that additional supplemental sources and storage will have to developed. The concept of a regional irrigation water distribution system was identified as a means to meet these demands using ground water, reclaimed water, and surface water. This system would make irrigation water available for local supply entities/utilities to withdraw from for distribution. The recommended feasibility analysis will determine the design and magnitude of the irrigation water system. Potential configurations were discussed including one large regional system, subregional systems, or on a utility by utility basis. Storage will be a key component of this system, primarily through aquifer storage and recovery, to store excess surface water and reclaimed water for later use.

In the southeastern portion of the LWC Planning Area, it was concluded that existing surficial aquifer and intermediate aquifer system ground water sources are sufficient to meet the 2020 projected agricultural demands. Some modifications to wellfield configurations and well operation regimes will need to be done at the project level to avoid potential impacts to natural systems and other existing legal users.

The Caloosahatchee Water Management Plan (CWMP), a separate but complementary District planning effort to the LWC Water Supply Plan, evaluated water supply in the northeastern portion of the region in the Caloosahatchee River Basin. The CWMP determined the projected surface water needs of the Caloosahatchee River Basin and Estuary can be met based on recommended developments of water management and storage infrastructure that effectively captures and stores surface water flows in the Basin. The CWMP concluded that existing surface water supplies from the Caloosahatchee River (C-43) are inadequate to meet existing as well as future demands, including the needs of the environment. The C-43 is heavily relied on for agricultural water supply and to a much lesser extent, potable water supply. Surface water availability is essentially a function of climate and storage; there are excess amounts during the wet summer months, and at times, insufficient supplies during the dry winter months. This problem of timing is

particularly illustrated by the impacts of freshwater discharges to the Caloosahatchee Estuary. Excessive discharges decrease the salinity of the estuary that contribute to the loss of estuarine productivity. Insufficient freshwater discharges increase the salinity to essentially saltwater impacting freshwater grasses. A minimum flow and level is being established for the Caloosahatchee River and Estuary.

Improved management of surface water through storage could increase fresh water availability in the region and reduce potential impacts resulting from water use. Aquifer Storage and Recovery (ASR) technology shows promise both for treated and untreated water by providing a storage option during periods of water availability. This technology is currently being used by several utilities at the local level. In addition to continued use and development at the local level, application of ASR on a regional scale has been identified as a potential storage option to capture excess surface water in the Caloosahatchee River Basin, and potentially elsewhere in the region. Regional and local retention projects will reduce excess water discharged to estuarine systems and increase water availability inland by increasing water levels in canals and providing additional ground water recharge.

Strong emphasis should be placed on water conservation through implementation of a comprehensive water conservation plan that promotes cultivation of a conservation ethic. This ethic would be realized through proactive, cooperative efforts between water users, utilities, local governments, and the District. The conservation plan will incorporate many initiatives, including continued development and compliance with water conservation ordinances, development and implementation of public education programs, use of alternative water sources, continued emphasis on water conservation in the District's surface water and consumptive use permitting programs, and other means.

Local governments and users will play a key role in making these strategies a success through adoption of conservation ordinances, homeowner awareness programs, land use decisions, and development of water source options by local utilities and water users. Based on the analysis, it appears most of the water supply issues in the LWC Planning Area can be addressed at the local level with appropriate diversification and management. Exceptions would be addressing the needs of the estuaries and surface water availability in the Caloosahatchee Basin, and meeting the urban irrigation demands. It is likely that ongoing studies will result in future water resource development capital projects.

Other planning efforts are currently underway and are continuing to address some specific goals of this plan, including the Lower East Coast Regional Water Supply Plan, the Comprehensive Everglades Restoration Plan, and the Southwest Florida Study. The proposed Southwest Florida Study will evaluate the entire LWC Planning Area for flood control, water supply, environmental impacts, wildlife habitat including the needs of the estuaries, water quality, uplands, and others. The strategies outlined in this plan, in partnership with other efforts, should ensure that water in this region is prudently managed and available to meet the anticipated demands of the region. This plan will be reviewed and updated every five years to ensure that the water needs of this region can be met.

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LIST OF ABBREVIATIONS AND ACRONYMS

AC-FT	acre-feet
ADAPS	Automated Data Processing System (USGS)
AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation
AGWQMN	Ambient Ground Water Quality Monitoring Network
ASR	Aquifer Storage and Recovery
ATRP	Abandoned Tank Restoration Program
AWWA	American Water Works Association
BCBB	Big Cypress Basin Board
BCBWMP	Big Cypress Basin Water Management Plan
BMPs	Best Management Practices
BOD	Biochemical Oxygen Demand
BOR	Basis of Review
CARL	Conservation and Recreation Lands
C&SF Project	Central and Southern Florida Flood Control Project
CCMP	Comprehensive Conservation and Management Plan
CERP	Comprehensive Everglades Restoration Plan
CHNEP	Charlotte Harbor National Estuary Program
COD	Chemical Oxygen Demand
CR	County Road
CREW	Corkscrew Regional Ecosystem Watershed
CUP	Consumptive Use Permit
CWMP	Caloosahatchee Water Management Plan
DBP	Disinfection By-Product
D/DBPR	Disinfectant/Disinfection By-Product Rule
DEP	Florida Department of Environmental Protection
District	South Florida Water Management District
DRI	Developments of Regional Impact
DWMP	District Water Management Plan
DWSA	District Water Supply Assessment

DWSRF	Drinking Water State Revolving Funds
DSS	Domestic Self-Supplied
EAA	Everglades Agriculture Area
ECP	Everglades Construction Project
ECWCD	East County Water Control District
ED	Electrodialysis
EDD	Everglades Drainage District
EDI	Early Detection Incentive
EDR	Electrodialysis Reversal
EEL	Environmentally Endangered Lands
EOC	Emergency Operations Center
EPA	Everglades Protection Area
ERP	Environmental Resource Permitting
F.A.C.	Florida Administrative Code
FAU	Florida Atlantic University
FAS	Floridan Aquifer System
FCD	Central and Southern Florida Flood Control District
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FEMA	Federal Emergency Management Agency
FFA	Florida Forever Act
FFWCC	Florida Fish and Wildlife Conservation Commission (*now known as FWC*)
FGFWFC	Florida Game and Freshwater Fish Commission
FGS	Florida Geological Survey
FDHRS	Florida Department of Health and Rehabilitative Services (*now known as FDOH*)
F.S.	Florida Statutes
FWC	Florida Wildlife Commission
FY	Fiscal Year

GAC	Granular Activated Carbon
GIS	Geographic Information System
GWUDI	Ground Water under the Direct Influence of Surface Water
GPD	gallons per day
GPM	gallons per minute
IAS	Intermediate Aquifer System
IESWRT	Interim Enhanced Surface Water Treatment Rule
IFAS	Institute of Food and Agricultural Sciences
ISGM	Integrated Surface Water Ground Water Model
KOE	Kissimmee-Okeechobee-Everglades
LEC	Lower East Coast
LFA	Lower Floridan Aquifer
LWC	Lower West Coast
MCL	Maximum Contaminant Level
MED	Multiple Effect Distillation
MIL	Mobile Irrigation Laboratory
MFLs	Minimum Flows and Levels
mg/L	milligrams per liter
MGD	million gallons per day
MGY	million gallons per year
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSF	Multistage Flash Distillation
MWC	Molecular Weight Cutoff
NEP	National Estuary Program
NFIP	National Flood Insurance Program
NGVD	National Geodetic Vertical Datum
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRCS	Natural Resources Conservation Service

O&M	Operations and Maintenance
P2000	Preservation 2000
PACP	Pre-Approved Advanced Cleanup Program
PCPP	Petroleum Cleanup Participation Program
PIR	Project Implementation Report
PLRG	Pollution Loading Reduction Goals
PWS	Public Water Supply
RAA	Restricted Allocation Area
RECOVER	Restoration, Coordination, and Verification
Restudy	Central and Southern Florida Flood Control Project Comprehensive Review Study
RIB	Rapid Infiltration Basin
RO	Reverse Osmosis
RTA	Reduced Threshold Areas
RTE	Rare, Threatened, or Endangered Species
SALT	Saltwater Intrusion Database (SFWMD)
SAS	Surficial Aquifer System
SDWA	Safe Drinking Water Act
SFWMD	South Florida Water Management District
SGGE	South Golden Glades Estates
SJRWMD	St. Johns River Water Management District
SOR	Save Our Rivers
SOW	Statement of Work
STA	Stormwater Treatment Area
SWCD	Soil and Water Conservation District
SWFS	Southwest Florida Study
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement Management
TAZ	Traffic Analysis Zone
THM	Trihalomethane
TTHM	Total Trihalomethanes
TDS	Total Dissolved Solids

UEC	Upper East Coast
UFA	Upper Floridan Aquifer
UIC	Underground Injection Control
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USDW	Underground Source of Drinking Water
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WATBAL	Water Balance Model
WCA	Water Conservation Area
WHPA	Wellhead Protection Area
WICC	Water Independence for Cape Coral
WRCA	Water Resource Caution Area
WSTB	Water Science and Technology Board
WWTP	Wastewater Treatment Plant

Chapter 1
INTRODUCTION

The Lower West Coast (LWC) is one of four regional planning areas in the South Florida Water Management District. The LWC Planning Area covers approximately 4,300 square miles and includes all of Lee County, most of Collier and Hendry counties, and portions of Charlotte, Glades, and Monroe counties (**Figure 1**). The boundaries of the LWC Planning Area generally reflect the drainage patterns of the Caloosahatchee River Basin and the Big Cypress Swamp. The northern boundary generally corresponds to the drainage divide of the Caloosahatchee River, which is also the SFWMD/SWFWMD jurisdictional boundary in Charlotte County. The eastern boundary delineates the divide between the Big Cypress Swamp and the Everglades hydrologic system. The area east of this divide is in the Lower East Coast Planning Area. Land use within the LWC Planning Area is predominantly wetland, especially in the Charlotte, Collier, and Lee county areas. Collier County has the largest percentage and acres of wetlands, while Lee County contains the most urban land use. Urban land use is primarily located in the coastal portions of Lee and Collier counties. The highest percentages of agriculture are found in Hendry and Glades counties. Irrigated crops in these areas consist of citrus, sugarcane, vegetables, sod, and greenhouse/nursery.

The LWC Planning Area faces numerous challenges in maintaining adequate water supply for growing urban and agricultural demands while meeting the needs of the environment. The LWC Planning Area is expected to experience substantial growth between now and the year 2020. The region's population is expected to increase by 68 percent from 590,939 to 992,805, with urban expansion occurring mostly in the coastal areas. Urban water demand is projected to increase 79 percent by 2020, recreation demands will be the largest category of use with 29 percent of total urban demands. Agricultural water demand is projected to increase by 11 percent through the planning horizon, with the largest growth (25 percent) occurring in citrus acreage. The total average water demand is projected to increase by 28 percent, from 312,954 to 401,548 million gallons per year (MGD).

The planning time frame for this water supply plan is 1995 through 2020. Updates of this plan are required at least every five years. A water supply plan for the LWC Planning Area was completed in 1994. This plan had a planning horizon of 2010; however, with a decrease in the rate of growth of this area in the 1990's, the 2010 demands in the 1994 LWC Water Supply Plan are similar to those currently projected for 2020. The 1994 LWC Water Supply Plan concluded that sources of water used historically will not be sufficient to meet the projected demands due to potential saltwater intrusion and harm to wetlands, and that diversification of water supply sources is necessary to meet the future needs of this area. The Districtwide Water Supply Assessment (DWSA) follows the conclusions found in the 1994 LWC Water Supply Plan. Suggested alternatives were aquifer storage and recovery (ASR), reclaimed water and reverse osmosis of the Floridan aquifer.

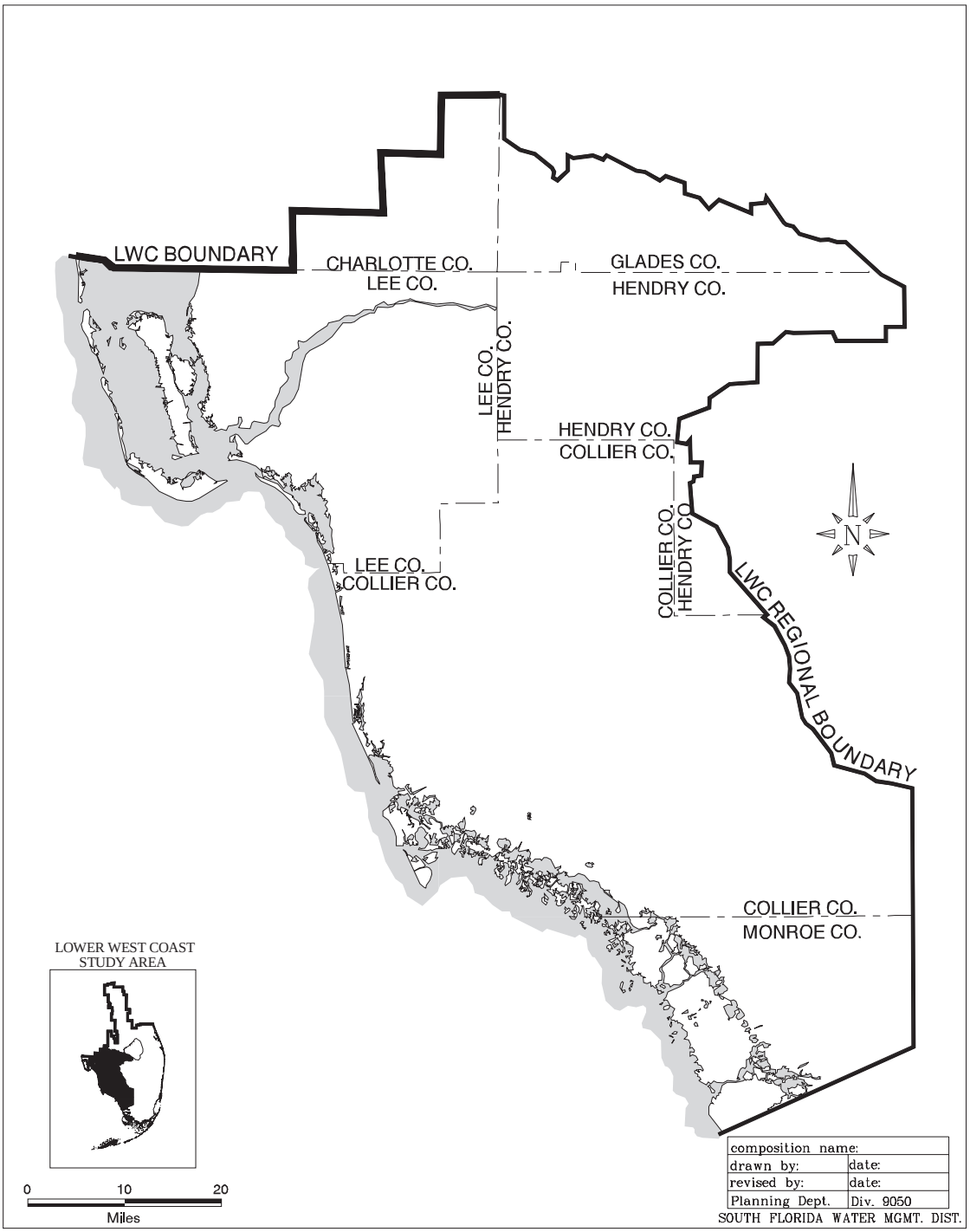


Figure 1. Lower West Coast Planning Area.

PURPOSE

The purpose of the LWC Water Supply Plan is to provide a framework for future water use decisions regarding adequate water supply for urban areas, agriculture, and the environment through 2020. The LWC Water Supply Plan estimates the future water supply needs of urban areas and agriculture, weighs those demands against historically used water sources, and identifies areas where demands cannot be met without potentially harming the resource and environment, including wetlands. The LWC Water Supply Plan evaluates the potential of various alternative water source options to address unmet demands and makes recommendations for their development.

An important part of the planning process was the identification of constraints to water supply and exploring opportunities to maximize the reasonable and beneficial use of the resource. This process involved extensive public input from the Lower West Coast Water Supply Plan Advisory Committee, whose members represent a variety of disciplines and interests, such as local governments, public water supply utilities, environmental interests, and agriculture, in addition to the general public.

Water management in South Florida is multifunctional, reflecting the District's four main areas of responsibility: water supply, flood protection, water quality, and natural systems management. Due to the interrelationships of these areas of responsibility, the LWC Water Supply Plan was coordinated with other planning efforts in the region such as the Caloosahatchee Water Management Plan and the development of minimum flows and levels (MFL) criteria (Chapter 2). This comprehensive, coordinated approach, combined with extensive public input throughout the planning process, ensures that solutions are balanced and considers all aspects of water management.

BASIS OF WATER SUPPLY PLANNING

The Florida Legislature has delegated authority to the District to protect South Florida's water supply by managing use to meet the future demand. The District has undertaken a water supply planning initiative to ensure prudent management of South Florida's water resources. This initiative began with the development of a District Water Supply Policy Document (1991), and continued with the District Water Management Plan (1995), District Water Supply Assessment (1998), and regional water supply plans (on going). The District's water supply planning functions are guided by the directives and policies embodied in the District's Water Supply Policy Document (SFWMD, 1991), Water Resource Implementation Rule (Chapter 62-40, F.A.C.), Chapter 373, F.S., the State Comprehensive Plan (Chapter 187, F.S.), and delegation of authority from the Florida Department of Environmental Protection (FDEP). In addition, the plan must meet the requirements of the 1996 Governor's Executive Order (96-297) and the 1997 legislative water supply amendments to Chapter 373, F.S. Legal authority and requirements, including new legislation, is outlined below and further described in Chapter 1 of the Support Document.

Regional water supply plans are to include:

- A twenty-year planning horizon
- A quantification of the water supply needs
- A list of water source options for water supply development which will exceed the identified needs
- For each water source option, the estimated amount of water available and the estimated costs
- A list of water supply development projects that meet the criteria in Section 373.0831(4)
- A list of those water resource development projects that support water supply development
- For each water resource development project listed:
  1. An estimate of the amount of water to become available
  2. The timetable and the estimated costs
  3. Sources of funding and funding needs
  4. Who will implement the project and how it will be implemented
- A funding strategy
- Consideration of how the options serve the public interest or save overall costs
- Technical data and information
- Minimum flows and levels and associated recovery and prevention strategies established within the planning region (Section 373.0361)

PLAN VISION, GOAL, AND OBJECTIVES

A critical component in the development of the LWC Water Supply Plan was the establishment of the plan's vision, goals, and objectives.

Plan Vision

The LWC Water Supply Plan Advisory Committee adopted the State's water resource goal in the State Comprehensive Plan as the vision for the LWC Water Supply Plan:

> Florida shall assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial and shall maintain the functions of natural systems and the overall present level of surface and ground water quality. Florida shall improve and restore the quality of waters not presently meeting water quality standards.

Plan Goal

The advisory committee developed the following goal for the LWC Water Supply Plan specific to this region:

> Identify sufficient sources of water and funding to meet the needs of all reasonable-beneficial uses within the LWC Planning Area through the year 2020 during a drought event that has the probability of occurring no more frequently than once every ten years, while sustaining the water resources and related natural systems.

Plan Objectives

To ensure that the LWC Water Supply Plan addresses the specific needs of the region, the advisory committee developed the following objectives (no implied priority):

> **Objective 1. Water Sources:** Identify and ensure sustainable and efficient use of water resources sufficient to meet future demands
>
> **Objective 2. Natural Systems Protection:** Protect natural resources from harm due to water use
>
> **Objective 3. Level of Certainty:** Establish a 1-in-10 level of certainty for all existing and proposed legal water uses and the environment
>
> **Objective 4. Compatibility with Local Governments:** Promote compatibility and linkage between the Lower West Coast Water Supply Plan and local land use decisions and policies
>
> **Objective 5. Linkage with Other Regional Plan Efforts:** Promote compatibility and integration with other related regional water resource planning efforts
>
> **Objective 6. Conservation of Water Supplies:** Promote water conservation and efficient use of water resources.
>
> **Objective 7. Water Supply Needs:** Meet existing and future water supply demands for all reasonable-beneficial uses for the appropriate level of certainty
>
> **Objective 8. Funding:** Identify adequate sources of funding to support water resource development and water supply development to meet the water supply needs of the Lower West Coast Region through the year 2020
>
> **Objective 9. Water Resource Protection:** Protect water resources from harm due to water use

These objectives captured the key issues and concerns in the LWC Planning Area and provided direction for the planning process.

Chapter 2
WATER SUPPLY PLANNING PROCESS

PLANNING PROCESS COMPONENTS

The planning process used for creation of this water supply plan can be generally divided into three broad components: assembling background information, issue identification and analysis, and solution development (**Figure 2**). Public participation was ongoing throughout the planning process, from gathering background information from local governments to holding advisory committee meetings where water supply issues and potential water supply alternatives were explored. The goals and objectives established by staff and the advisory committee provided the overall framework for the planning process.

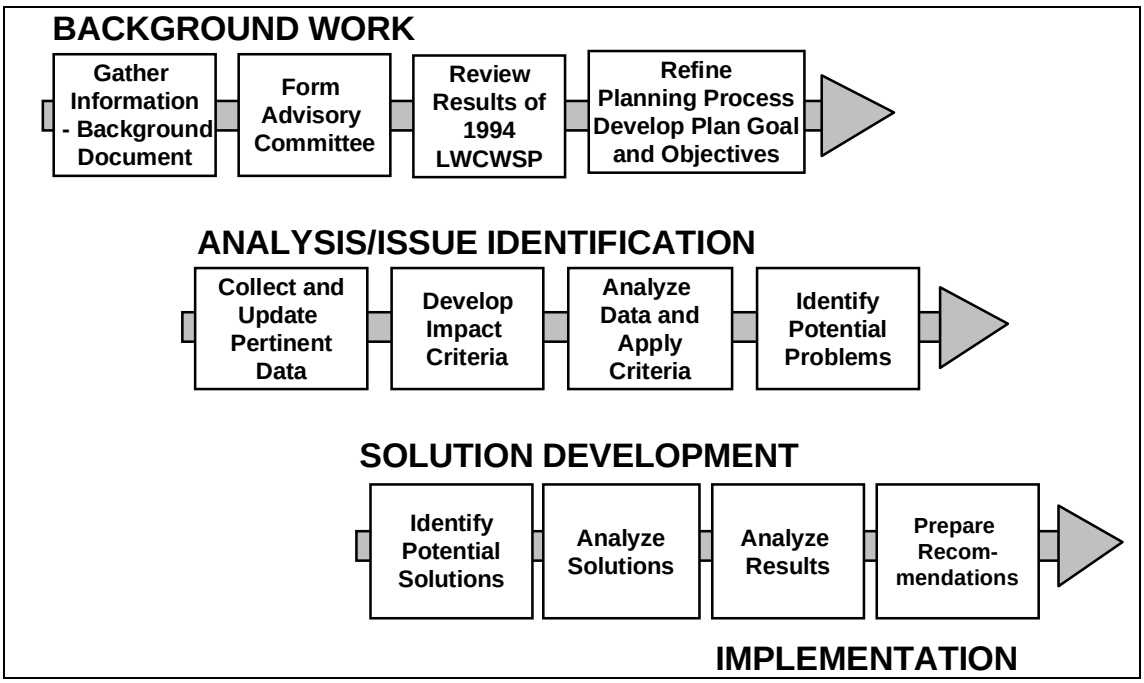


Figure 2. The Lower West Coast Planning Process Components.

Background Component

Background Information

The District project team initially compiled extensive background information required for informed decision making later in the process. This background information included pertinent statutes and technical documents, historical information, rainfall data, land use and population information, water use demand projections, hydrogeologic and water resource information, water use permit information, details of utilities in the LWC Planning Area, environmental information, and alternative water supply source concepts. The urban water use demand projections were based on population projections published

by the Bureau of Economic Business Research (BEBR), while agricultural demand projections were based primarily on long-term historical trends. All of this information was then consolidated into a draft LWC Water Supply Plan Support Document and Appendices in May and August 1999, respectively, to be used by the project team and advisory committee members. As the planning process ensued, these documents were updated where new information became available.

Advisory Committee Formation

A 47-member advisory committee, with approximately the same number of alternate members, was created to obtain public participation in the planning process. Membership included representatives of federal, state and local agencies, public water supply utilities, the local business community, environmental concerns, community leadership, and agricultural concerns. A member of the District's Governing Board chaired the advisory committee. All advisory committee meetings were advertised and open to the public.

The primary role of the advisory committee, as well as the general public, was to provide input at each stage of the water supply planning process, to contribute local knowledge and the expertise of the agencies being represented, and to reflect the collective concerns and interests of various stakeholders in the LWC Planning Area. The role of District staff was to facilitate the planning process, provide professional and technical direction, support and guidance, and prepare the LWC Planning Document recognizing the advisory committee's input.

The advisory committee spent several meetings on background presentations and sharing of information, along with development of the plan's vision, goal, and objectives (a listing of the plan goals is provided in Chapter 1). The goal and objectives established by the advisory committee served as a "road map" for the subsequent planning process. Topics scheduled for advisory committee discussion, research and analytical work, and formulation of final recommendations all centered on these goals. The advisory committee met a total of 17 times between December 1998 and April 2000.

In addition to regular advisory committee meetings, one technical workshop was conducted to respond to questions related to the ground water modeling associated with renewal of CUPs in the LWC Planning Area. Three minimum flow and level technical sessions were also conducted in concert with the advisory committee.

Analysis and Issue Identification

The following methods and sources were used and consulted during the analysis and issue identification phase of the development of this plan:

- Review of the analysis and issue identification results from the 1994 LWC Water Supply Plan

- Review of consumptive use permitting activities and related data that has occurred since the acceptance of the 1994 LWC Water Supply Plan
- Extensive review and input from the advisory committee
- Data and results from the Caloosahatchee Water Management Plan
- Use of issue areas

1994 LWC Water Supply Plan

The 1994 LWC Water Supply Plan incorporated regional ground water modeling as part of the analysis. The assumptions and demand projections used in this analysis were reviewed and compared to current information. The results of this comparison concluded that the population and demand projections of the 1994 LWC Water Supply Plan for 2010 are very similar to those projected for 2020. This similarity in projected demands was primarily due to a decrease in the rate of growth in the area. In addition, the 1994 LWC Water Supply Plan simulated a 1-in-10 drought event and used the same resource protection criteria that are appropriate today. Based on this, staff and the advisory committee recognized the findings and conclusions of the 1994 LWC Water Supply Plan as still representative of the issues in meeting the LWC Planning Area's projected water demands for 2020; and, the 1994 findings should be considered in the development of this 2000 Plan.

Consumptive Use Permitting Activities

The LWC Planning Area has experienced substantial growth since the completion of the 1994 LWC Water Supply Plan. Much of this growth has been represented through the District's consumptive use permitting (CUP) process. This process involves the review and consideration of large amounts of data directly related to water use and demands in the LWC Planning Area. These data include water demand projections, population projections, preferred water supply sources and treatment techniques, and geographic service areas. These data are directly related to the update of the LWC Water Supply Plan. Therefore, this information was brought into the planning process for review and consideration during the analysis and issue identification phase.

Input from the Advisory Committee

The LWC Water Supply Plan advisory committee consisted of a wide variety of water supply experts representing agriculture, the environment, and public water supply. These experts were constantly consulted and involved in the analysis and issue identification process of the plan. One entire meeting of the advisory committee was dedicated to technical presentations by members of the advisory committee related to the future needs and sources of water in the LWC Planning Area. This information played a critical role in the analysis and issue identification phase of the LWC Water Supply Plan.

Caloosahatchee Water Management Plan

Surface water availability and other issues related to the Caloosahatchee Basin were also addressed in development of the Caloosahatchee Water Management Plan (CWMP). The results of that effort have been incorporated into this plan. The CWMP is discussed in the Coordination section later in this chapter.

Issue Areas

The LWC Planning Area was divided into eight "issue" areas based on existing and future land use, historically used sources of water, projected water demands, and anticipated resource constraints using the methods and sources described above. Using this knowledge, the advisory committee and staff identified the issues within each issue area. These issues were used as the basis for discussion in the solution development component of the process.

Solution Development

Once potential problems/issues were identified, a series of water source options (also referred to as water supply alternatives) were identified and evaluated to determine their effectiveness in resolving the potential problems. Options included increased water conservation, alternative water sources (e.g., reclaimed water, Floridan aquifer), surface water storage, and other approaches that would serve to maximize water resources.

The advisory committee and staff then translated preferred options into recommendations. These advisory committee recommendations were further refined into implementable strategies for the LWC Planning Area. Recommendations are presented in Chapter 6.

The final product of the planning process is the LWC Water Supply Plan. The LWC Water Supply Plan documents the results of the planning process and provides recommendations and strategies for implementation.

PLAN IMPLEMENTATION

Implementation is one of the most important phases of the LWC Water Supply Plan, in that strategies developed during the planning process are actually carried out to ensure adequate water supply through 2020. Implementation will follow approval of the plan by the SFWMD Governing Board, and will involve coordination with other agencies and planning efforts, and the strengthening of linkages between land use and water supply planning. Other components of implementation may include additional data collection, research, cost-share projects, capital construction, and rulemaking when regulatory criteria are changed. Specific plan implementation strategies are discussed in Chapter 6. After approval by the SFWMD Governing Board, this plan will be updated at least once every five years.

COORDINATION

Development of the LWC Water Supply Plan was coordinated with several other planning efforts in the region, as well as with many other entities, to ensure an integrated approach and compatibility with local and regional plans. In addition, the LWC Water Supply Plan will be incorporated into the SFWMD District Water Management Plan (DWMP), which is intended to provide comprehensive long-range guidance for the actions of the water management district in implementing its responsibilities in state and federal laws.

Related Planning Efforts

There are several related water management planning efforts ongoing or planned in the LWC Planning Area. Each plan or study addresses unique water management issues while maintaining close relationships with water supply planning (**Table 1**). These efforts include the Caloosahatchee Water Management Plan (CWMP), the Caloosahatchee River and Estuary and LWC Aquifer System Minimum Flows And Level development, the Central and Southern Florida (C&SF) Comprehensive Review Study, and the Southwest Florida Study.

The CWMP is being developed to create a framework for future surface water use decisions to provide adequate surface water for uses within the Caloosahatchee Basin. The CWMP estimates future agricultural and urban surface water needs of this basin, weighs those against available supplies, and identifies areas where these demands cannot be met without harming the resource or the environment. The CWMP includes recommendations to address any surface water deficits. Inflows to the Caloosahatchee Estuary using the salinity envelope concept are incorporated in this study.

Establishment of a minimum flow and level (MFL) for the Caloosahatchee River and Estuary, and the LWC aquifer system are underway. A MFL is a limit (flow or water level) at which further withdrawals would significantly harm the water resources of the area. MFLs are primarily quantitative, not qualitative measures. Both the Caloosahatchee Estuary and the LWC aquifer system (includes the water table, lower Tamiami, Sandstone, mid-Hawthorn aquifers, and the Floridan aquifer) are incorporated in the District's MFL priority list for establishment of MFLs, based on the requirements of Chapter 373, F.S. The District has committed to establishing a MFL for each of these by the end of 2000.

The Central and Southern Florida Project Comprehensive Review Study (Restudy) was a five year effort that looked at modifying the current C&SF Project to restore the greater Everglades and South Florida ecosystem while providing for the other water-related needs of the region. The study concluded with the Comprehensive Plan being presented to the Congress on July 1, 1999. The recommendations made within the Restudy, that is, structural and operational modifications to the C&SF Project, are being further refined and will be implemented in the Comprehensive Everglades Restoration Plan (CERP).

Table 1. Lower West Coast Related Water Management Planning Efforts.

Plan	Scope/Primary Goal	Relationship to LWCWSP	Timeframes
Caloosahatchee Water Management Plan	Water supply / availability from Caloosahatchee River	Subregional component of the LWCWSP	Completed April 2000
Lake Okeechobee SWIM Plan	Protection and enhancement of Lake Okeechobee and its watershed (water quality)	Backflow/inflow from C-43 Canal	Update completed 1997
Lake Okeechobee Regulation Schedule Environmental Impact Study	Evaluates environmental and economic impacts associated with proposed Lake Okeechobee. Regulation Schedules (quantity)	Discharges from Lake Okeechobee to Caloosahatchee Estuary	1999
Central and Southern Florida Project Comprehensive Review Study (Restudy)	Comprehensive review of environmental impacts of C&SF project	Discharges from Lake Okeechobee to Caloosahatchee River	Completed 1999
Charlotte Harbor National Estuary Program Comprehensive Conservation and Management Plan	USEPA program for restoration	- Supports activities to enhance the Caloosahatchee Estuary - Creates framework to identify funding sources and support partnering	1999
Lower East Coast Regional Water Supply Plan	Adequate and reliable water supply for the Lower East Coast, for natural systems, and Lake Okeechobee service area	Quantify current and future demands and supplies, including surface water in the Caloosahatchee watershed	Draft Plan Completed 1997 Interim Plan 1998 Final Plan 2000
Caloosahatchee River and Estuary Minimum Flow and Level	Prevent significant harm to the water resources and ecology of the Caloosahatchee Estuary	Recovery or prevention strategy has potential to alter future water management activities, including water use	2000
LWC Aquifer System Minimum Flow and Level	Prevent significant harm to the LWC aquifers	Has potential to alter future water management activities, including water use	2000

The Restudy includes all of the area of the C&SF Project with the exception of the upper St. Johns River Basin. The area encompasses approximately 18,000 square miles from Orlando to Florida Bay. Major areas include the Kissimmee River, Lake Okeechobee, St. Lucie and Caloosahatchee Estuaries, Everglades Agricultural Area, Water Conservation Areas, Upper and Lower East Coast, Lower West Coast, Everglades National Park, Big Cypress National Preserve, and Florida Bay. The Kissimmee River, Lake Okeechobee, and the Everglades are the dominant watersheds that connect a mosaic of wetlands, uplands, and coastal and marine areas. The Restudy includes an evaluation of the water demands on Lake Okeechobee, including the C-43 Basin, and regulatory discharges. The Restudy Report was submitted to Congress in July 1999 for approval. The Restudy is being implemented through the Comprehensive Everglades Restoration Plan (CERP).

The Southwest Florida Study, formally the Southwest Florida Feasibility Study, is a cooperative effort by USACE and SFWMD and has been initiated as a result of the Restudy. The purpose of the study is to describe and evaluate alternative plans to address Southwest Florida water resource problems and to develop a comprehensive plan for the

system. The Southwest Florida Study will include traditional features such as navigation, shoreline erosion, flood control, and the enhancement of water supplies, as well as environmental restoration features.

Effective coordination among these mutually dependent studies was a priority throughout the water supply planning process. Project managers from each of these plans worked together to identify opportunities to address multiple water management concerns with comprehensive solutions and to minimize duplicative efforts. Several LWC Water Supply Plan advisory committee members also served on the CWMP advisory committee.

Local and Regional Governments

District staff coordinated development of the LWC Water Supply Plan with the local governments and other entities in the LWC Planning Area. In addition to participation on the advisory committee, local governments and water users have provided information on their activities as well as have reviewed information and products generated for the LWC Water Supply Plan including population projections, urban and agricultural demand projections, and future facilities plans. This involvement has provided compatibility between the LWC Water Supply Plan and local plans.

Chapter 3
PLANNING AREA DESCRIPTION

SUMMARY OF WATER RESOURCE SYSTEMS

Water for urban and agricultural uses in the LWC Planning Area comes from four main sources: the Floridan Aquifer System (FAS), the Intermediate Aquifer System (IAS), the Surficial Aquifer System (SAS), and surface water. Surface water is a major water supply source in the northern portion of the LWC Planning Area for agriculture and a few public water supply (PWS) utilities. However, ground water is the primary source of water for the rest of the LWC Planning Area. The SAS has been the principal ground water source except in the island communities of Lee County where the FAS is used. As the population in the LWC Planning Area increases, urban areas are anticipated to increase their use of FAS as a source of drinking water to meet these growing demands.

The SAS and surface water are dependent upon rainfall and Lake Okeechobee discharges to the Caloosahatchee River for recharge. The average annual rainfall in the LWC Planning Area is about 52 inches. Nearly two thirds of this rainfall occurs during the wet season months, from June through October. In addition to seasonal variation, rainfall varies significantly from year to year with historic annual amounts ranging from 30 inches to more than 86 inches in the LWC Planning Area. Rainfall also varies spatially, with rainfall amounts generally greatest in the south and west declining toward Lake Okeechobee in the northeast corner of the LWC Planning Area.

Surface water and ground water are highly interdependent. The construction and operation of surface water management systems affect the quantity and distribution of recharge to the SAS. Surface water management systems within the LWC Planning Area function primarily as aquifer drains, since the ground water levels generally exceed the ground surface elevations within the LWC Planning Area. The Caloosahatchee River and the Gulf of Mexico act as regional ground water discharge points (Wedderburn, et al., 1982).

Ground Water

The hydrogeology of South Florida is diverse. It includes aquifers that are confined, semi-confined (having some vertical recharge), and unconfined (ground water is at atmospheric pressure and water levels correspond to the water table). Within an individual aquifer, hydraulic properties and water quality may vary both vertically and horizontally. Because of this diversity, ground water supply potential varies greatly from one place to another.

The SAS may be divided into two aquifers, the water table and lower Tamiami, which are separated by leaky confining beds over much of the area. In northern Lee County, where the confining beds are absent or insignificant, the lower Tamiami is not a

separate aquifer but part of the unconfined water table aquifer. The thickness of the SAS ranges from more than 200 feet in central and southern Collier to four feet southwest of LaBelle in Hendry County. The SAS produces good quality water, except in areas near LaBelle and parts of the coast that have high concentrations of chlorides and dissolved solids, and isolated areas with high iron concentrations. Because it is close to the surface, this aquifer is easily recharged by local rainfall in the LWC Planning Area.

The lower Tamiami is the most prolific aquifer in Hendry and Collier counties. The lower Tamiami aquifer provides public water supply, domestic self-supply and landscape and agricultural irrigation uses. Because of the large demands on the aquifer, it has been endangered by saltwater intrusion on the coast, and is frequently included in water shortage declarations.

The IAS includes the Sandstone and mid-Hawthorn aquifers. The productivity of the Sandstone aquifer is highly variable. It is one source for public water supply in Lee County, but only marginally acceptable for potable uses in Hendry and Collier counties. Water from the Sandstone aquifer is suitable for irrigation purposes throughout its extent, with the exception of the LaBelle area, where it has been contaminated by flowing Floridan wells. In western Hendry County, where the lower Tamiami aquifer is absent, the IAS is an important source of water for agricultural irrigation, but is not capable of supporting large-scale agricultural operations in most areas.

Although present throughout the LWC Planning Area, the mid-Hawthorn Aquifer is not always productive. Its thickness is variable and relatively thin (it rarely exceeds 80 feet). This variability, combined with the presence of interbedded low permeability layers, results in low productivity of the aquifer. In addition to low productivity, the aquifer experiences degradation in water quality as it dips to the south and east, yielding only saline water in much of the LWC Planning Area.

The FAS, which underlies all of Florida and portions of southern Georgia and Alabama, contains several distinct producing zones, which are described by Wedderburn et al., 1982. Although it is the principal source of water in Central Florida, the FAS yields only nonpotable water throughout most of the LWC Planning Area. The quality of water deteriorates southward, increasing in hardness and salinity. Salinity also increases with depth.

The most productive zones of the FAS are the lower Hawthorn and Suwannee aquifers. Currently, the FAS supports several coastal PWS utilities. Improvements in desalination treatment technology will make development of these aquifers increasingly feasible. Portions of the producing zones also have potential for used by ASR projects. In the deeper producing zones of the FAS, there are areas of extremely high transmissivity. Although they are not used as supply sources within the LWC Planning Area due to the high salinity and mineral content, these formations serve other purposes. The lower portion of the FAS, a zone referred to as the "boulder zone", has been used for disposal of treated wastewater effluent and residual brines from the desalination process. The “boulder zone” is separated from upper portions of the FAS by confining layers that effectively separate the potential water resources from the injection zone.

The three major aquifer systems are summarized in **Tables 7**, **8**, **9**, **10**, and **11** in the Support Document by county for Charlotte, Collier, Glades, Hendry, and Lee. Appendix C includes a collection of ground water resources graphics as well as the temporal and physical relationships between these different aquifer systems. Information on ambient ground water quality, contamination sites, and saltwater intrusion is provided in Appendix G.

Surface Water

The Caloosahatchee River (C-43 Canal) flows east to west across the northern portion of the LWC Planning Area connecting Lake Okeechobee in the east and the Gulf of Mexico in the west. The southern portion of the LWC Planning Area has no major surface water features. The Caloosahatchee River is supplied by inflows from Lake Okeechobee and runoff from within it's own basin. As a result, water levels in the river are low during dry times, when demand is highest and the river is almost entirely dependent on Lake Okeechobee. However, during the rainy season, when demands are minimal, significant volumes of excess water are discharged into the Gulf of Mexico.

The Caloosahatchee River has been modified from its natural state into a navigable canal with three structures that control the flows from Lake Okeechobee. This canal is a major source of water for agricultural users in the canal basin as well as for two PWS systems.

SUMMARY OF NATURAL SYSTEMS

The natural systems within the LWC Planning Area consist of substantial areas of inland and coastal resources. A number of these systems are relatively pristine wetland areas and are recognized as having national importance. Before development of the region, inland areas were comprised of vast expanses of seasonally flooded wetlands, which experienced sheetflow of fresh water from the northeast to the southwest. Wetland areas serve as important habitat for a wide variety of wildlife and have numerous hydrological functions. **Plates 1** through **4** in the Support Document depict the many natural areas in the LWC Planning Area.

Inland Resources

Inland resources of the LWC Planning Area include numerous freshwater swamps, sloughs, and marshes. These include Lake Okeechobee, Caloosahatchee River and Estuary, Fred C. Babcock/Cecil Webb Wildlife Management Area, Telegraph Swamp, and Okaloacoochee Slough. In addition, the following systems are relatively pristine wetland areas that are recognized as having national and regional importance: Big Cypress National Preserve, Corkscrew Swamp Sanctuary, and Fakahatchee Strand.

Lake Okeechobee in the northeastern corner of the LWC Planning Area is the largest freshwater lake in the southeastern United States and is a major feeding and

roosting area for wading birds and migratory fowl. Discharges from Lake Okeechobee to the Caloosahatchee River and Estuary are a crucial component of the LWC surface water.

Coastal Resources

Description of Coastal Resources

Southwest Florida has some of the most pristine and productive coastal waters within the state. Five of these areas are contained in aquatic preserves, including Matlacha Pass, Pine Island Sound, Charlotte Harbor, Estero Bay, and Rookery Bay. The coastal resources include areas such as estuarine systems, barrier islands, and beaches.

Estuarine Systems

Coastal areas are dominated by large estuarine systems where the waters of the Gulf of Mexico mix with the freshwater inflows from numerous river systems, sloughs, and overland sheetflow. Two large open water estuarine systems, Charlotte Harbor and the Caloosahatchee Estuary, dominate the northwest portion of the LWC Planning Area. More than 40 percent of Florida's rare, endangered, or threatened species are found in Southwest Florida estuaries. Development of the watershed has changed the timing and quality of the freshwater flows to the estuary.

The Ten Thousand Island region, which dominates the southern portion of Collier County, is the largest protected mangrove forest in the world. These coastal mangroves, once commonly distributed along the entire coastline, serve as important nursery and feeding grounds and protect the shoreline against erosion from storms and high tides.

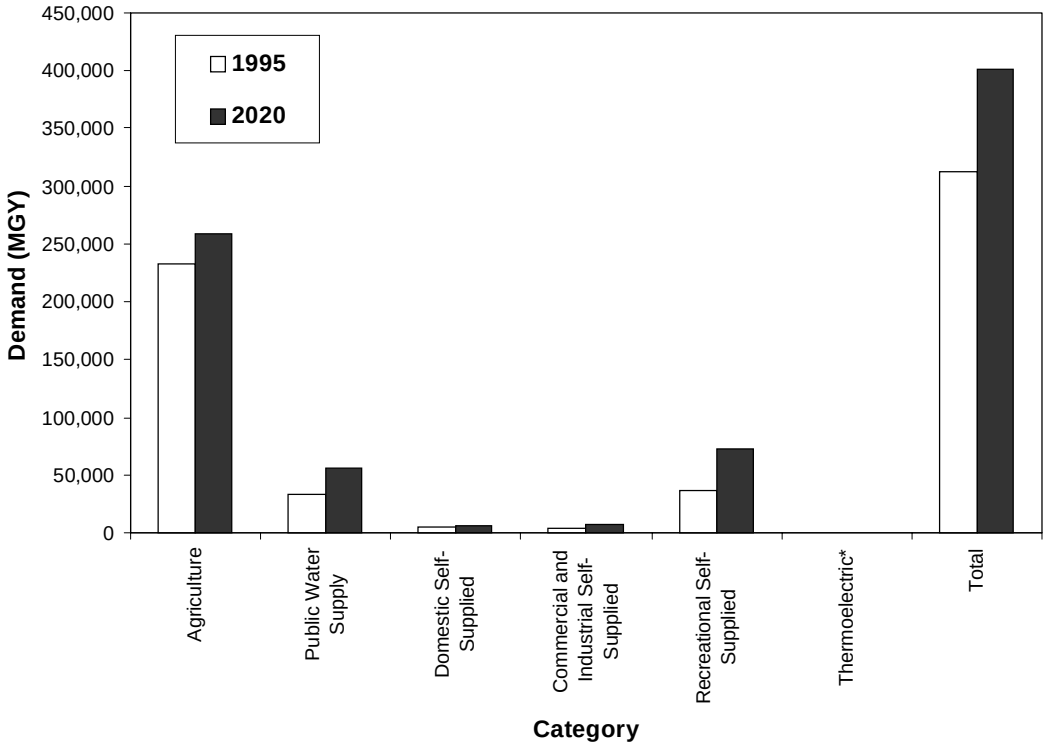
Barrier Islands

Barrier islands form a chain from northern Lee County to southern Collier County. Barrier islands protect the mainland from major storm events, act as a buffer for sensitive estuarine areas, and provide habitat for shorebirds and wildlife. These low lying, narrow strips of sand play an important role in the region's tourism economy by supporting tourism-related development and attracting visitors to the beaches.

LAND USE TRENDS AND WATER DEMANDS

Land use in the LWC Planning Area has been predominantly agricultural and is expected to remain so in the future (**Figure 3**). However, the percentage of agricultural land use in Collier and Lee counties is anticipated to decrease as a result of an increase in urban land use. Urban demands are concentrated in Lee and Collier counties, accounting for approximately 96 percent of the LWC Planning Area total population.

The water demand projections used in this plan are different than those presented in the 1995 Districtwide Water Supply Assessment (DWSA). The DWSA projections were updated with information that was published after completion of the DWSA for use



*281 MGY in evaporation losses, not circulation cooling demands.

Figure 3. Comparison of 1995 and 2020 Water Demands (MGY).

in this plan. From 1995 to 2020, the total average water demand is projected to increase by 28 percent from 312,954 to 401,548 million gallons per year (MGY), as shown in **Table 2**. Urban water demand in 1995 was estimated to be about 79,913 MGY, which is equivalent to 219 million gallons per day (MGD); this is projected to increase to almost 142,761 MGY (391 MGD) by 2020. In 1995, agriculture accounted for 74 percent of the total demand. Agricultural demands are projected to increase by 11 percent by 2020, accounting for 64 percent of the total demand in that year. Urban recreational self-supplied use, primarily golf courses, has the largest projected increase of 94 percent.

Table 2. Lower West Coast Population and Water Demands for 1995 and 2020 (MGY).

Category	Average Estimated Demands 1995	% of Total	Average Projected Demands 2020	% of Total	% Change 1995-2020	Projected 1-in-10 Demand 2020
Agriculture	233,041	74	258,787	64	11	306,978
Urban	79,913	26	142,761	36	79	158,522
Total	312,954	100	401,548	100	28	465,500
LWC Planning Area Population	**1995**		**2020**			
	590,939		992,805		68	

Chapter 4
ANALYSIS, METHODS, AND ISSUE IDENTIFICATION

Several methods and sources were used and consulted during the analysis and issue identification phase of the development of this plan including:

- Review of the analysis and issue identification results from the 1994 LWC Water Supply Plan
- Review of consumptive use permitting activities and related data that have occurred since the acceptance of the 1994 LWC Water Supply Plan
- Extensive review and input from the advisory committee
- Data and results from the Caloosahatchee Water Management Plan

The purpose of this chapter is to identify potential water supply related issues (potential problems) that may occur in developing historically used water sources to meet the 2020 projected water demands in the LWC Planning Area. The process and information used for issue identification is described along with the results. The results are summarized in the form of a list of issues that this plan needs to address and resolve. As part of this process, some preliminary water source options to resolve these issues were identified and presented in this chapter.

Potential solutions, or water source options, to resolve these issues are discussed in Chapter 5 (Solution Development). For each water source option, a definition, summary of the committee discussion, estimated costs, quantity of water that could be made available from that option, as well as regional and local recommendations to facilitate development of that option are listed. Chapter 6 (Plan Implementation) breaks the regional recommendations down into tasks and total and annualized cost to implement that recommendation, the entity/agency responsible for implementing the recommendation, and funding sources.

CHAPTER 373 RESOURCE PROTECTION TOOLS AND LEVEL OF CERTAINTY

Before discussing planning area specifics, it is important to understand the relationship between the different levels of harm referred to in statutes and the various programs the District has to protect the resources. The overall purpose of Chapter 373 is to ensure the sustainability of water resources of the state (Section 373.016, F.S.). To carry out this responsibility, Chapter 373 provides the District with several tools, with varying levels of resource protection standards. Protection programs include the District's surface water management and consumptive use permitting regulatory programs, minimum flows and levels (MFLs), and the District's Water Shortage Program.

Determination of the role of each of these and the protection that they offer are discussed below.

Sustainability is the umbrella of water resource protection standards Section 373.016, F.S.). Each water resource protection standard must fit into a statutory niche to achieve this overall goal. Pursuant to Parts II and IV of Chapter 373, surface water management and consumptive use permitting regulatory programs must prevent **harm** to the water resource. Whereas water shortage statutes dictate that permitted water supplies must be restricted from use to prevent **serious harm** to the water resources. Other protection tools include reservation of water for fish and wildlife, or health and safety (Section 373.223(3)), and aquifer zoning to prevent undesirable uses of the ground water (Section 373.036). By contrast, MFLs are set at the point at which **significant harm** to the water resources, or ecology, would occur. The levels of harm cited above, 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.

Level of Certainty

Certainty that sufficient water supplies will be available to water users and the environment is provided by varying tools. Level of certainty is the level of assurance provided to consumptive users and the environment that water will be available to meet reasonable demands to specific hydrologic conditions. The level of certainty evaluated in the planning process defines the availability of water to reasonable beneficial uses and the level of protection afforded to the water resources. The following resource protection framework in **Figure 4** is discussed in terms of the level of certainty and the varying tools available under Chapter 373 to protect water resources.

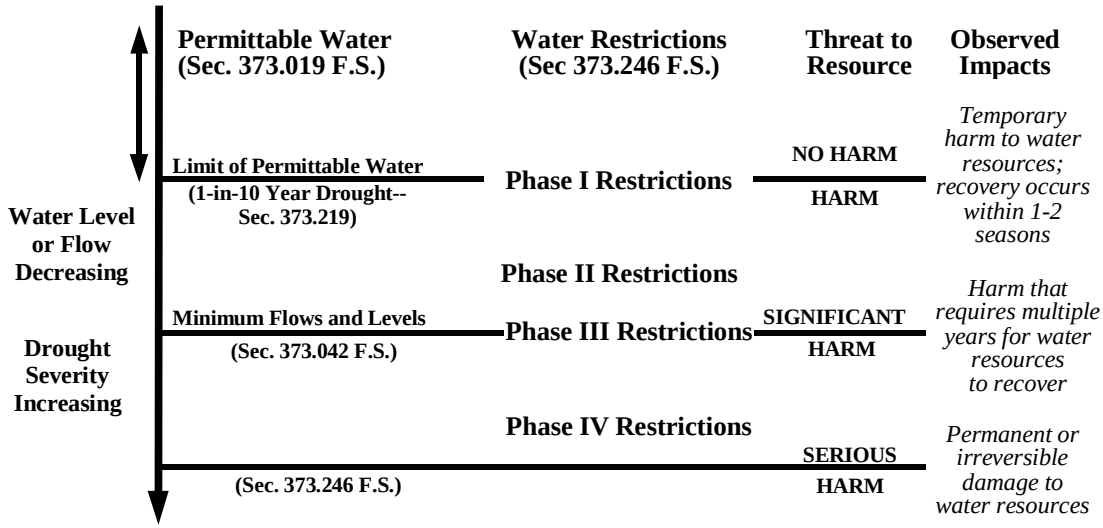


Figure 4. Conceptual Relationship among the Terms Harm, Significant Harm, and Serious Harm.

Water Supply Planning and Level of Certainty

Fundamental to water supply planning is the quantification of existing and projected demands with a level of certainty. The 1997 Water Supply Legislation (CS/HB 715, et al.), requires the water management districts to provide as a part of the regional water supply plan:

> [a] quantification of the water supply needs for all existing and reasonably projected future uses within the planning horizon. The level-of-certainty planning goal associated with identifying the water supply needs of existing and future reasonable-beneficial uses shall be based upon meeting those needs for a 1-in-10 year drought event.

These demands are evaluated by water availability assessment tools (ground water/surface water models) to estimate the potential impacts of the associated cumulative use. In this evaluation process, certain assumptions/constraints are defined to protect the water resources from over-development. These constraints identify where in the planning area threats, such as salt water intrusion, wetland stress, pollution, and others, to the water resources could potentially occur.

Another implication of the level of certainty in water supply planning is that it defines where water resource development and water supply development projects need to be implemented to meet the projected demands for the appropriate level of certainty Section 373.0361, F.S.). Once the water supply plan is completed and the water resource development and water supply development projects are defined, assure all reasonable demands will be met, the regulatory process becomes one of several plan implementation tools. To be consistent with the plan, CUP applications are reviewed using the planning level of certainty and resource protection constraints on a local (project) scale.

Consumptive Use Permitting Link to Level of Certainty

By Section 373.219, F.S., the yield of the source, or amount of water that can be permitted for use, is limited by the resource protection criteria which defines when "harm" will occur to the resource. Resource protection criteria have been adopted by the water management districts using the three-prong test referred to in Section 373.223, F.S., and particularly the reasonable-beneficial use test. These criteria are aimed at preventing saltwater intrusion and upconing, harm to wetlands and other surface waters, aquifer mining, and pollution.

Based on statutory guidance, staff recommends harm be considered as the point at which adverse impacts to water resources occur during drought conditions that are sufficiently severe that they cannot be restored within a period of one to two years of average rainfall conditions. These short-term adverse impacts are addressed in the CUP program, which calculates allocations to meet demands up to the appropriate level of certainty.

Water Shortage Link to Level of Certainty

By basing resource protection criteria on a specific uniform level of certainty, it is possible to predict when water uses may be restricted by water shortage declaration. In a drought more severe than the drought event associated with the level of certainty, consumptive users no longer have the assurances that water will be available for use in their permitted quantities. During these drought conditions, both consumptive users and the water resources will experience a shared adversity.

Pursuant to Section 373.246, F.S., water shortage declarations are designed to prevent serious harm from occurring to water resources. Serious harm, the ultimate harm to the water resources that was contemplated in Chapter 373, F.S., can be interpreted as long-term, irreversible, or permanent impacts. The water shortage trigger levels are tools used to "trigger" imposition of water shortage restrictions based on climatic events, continued decline in water levels and a need to curtail human demand to correspond to decreasing supplies. Each level corresponds to a level of water shortage restriction. These restrictions act to apportion among uses, including the environment, a shared adversity resulting from a drought event. Adoption of the resource protection criteria as water shortage trigger indicators also serves the purpose of notifying users of the risks of water shortage restrictions and potential for loss associated with these restrictions.

Minimum Flow and Level Link to Level of Certainty

Minimum flows and levels are the point at which further withdrawals would cause significant harm to the water resources. Significant harm is recommended to be defined as a loss of specific water resource functions that take multiple years to recover, which result from a change in surface water or ground water hydrology. According to the resource protection framework above, this level of harm requires that consumptive uses be cutback heavily, imposing the potential for economic losses, to prevent significant harm and serious harm. This shared adversity between the environment and water users is implemented through the water shortage program discussed above.

Section 373.0421, F.S. requires that once the MFL technical criteria have been established, the District must develop a recovery and prevention strategy for those water bodies that are expected to exceed the proposed criteria. It is possible that the proposed MFL criteria cannot be achieved immediately because of the lack of adequate regional storage and/or ineffective water distribution infrastructure. These storage and infrastructure shortfalls will be resolved through water resource development and water supply development projects, construction of facilities and improved operational strategies that will increase the region's storage capacity and improve the existing delivery system. Planning and regulatory efforts will, therefore, include a programmed recovery process that will be implemented with time to improve water supply and distribution to protect water resources and functions. The process for establishing MFLs can be summarized as follows:

1. Identify water resource functions of water body.
2. Identify considerations/exclusions.

3. Identify narrative definition of significant harm.
4. Identify numeric criteria to reflect significant harm.
5. Conduct independent scientific peer review of the MFL Technical Criteria and incorporate the revisions suggested by the panel and deemed appropriate.
6. Develop MFL Recovery and Prevention Strategy.
7. As part of the development of the recovery strategy, conduct appropriate technical analyses to determine the water supply implications of the proposed MFL criteria on existing legal uses. These results will be integrated into the Regional Water Supply Plan analysis with appropriate implementation measures developed consistent with Section 373.0421, F.S.
8. Following completion of the scientific peer review process, initiate Rule Development after Governing Board consideration of the peer review results and appropriate revisions.

Minimum Flows and Levels Recovery and Prevention Strategy

Section 373.0421, F.S. requires that once the MFL technical criteria have been established, the District must develop a recovery and prevention strategy for those water bodies that are expected to fall below the proposed criteria. It is possible that the proposed MFL criteria cannot be achieved immediately because of the lack of adequate regional storage and/or ineffective water distribution infrastructure. These storage and infrastructure shortfalls will be resolved through water resource development and water supply development projects, construction of facilities and improved operational strategies that will increase the region's storage capacity and improve the existing delivery system. Planning and regulatory efforts will, therefore, include a programmed recovery process that will be implemented over time to improve water supply and distribution to protect water resources and functions. Development of a MFL recovery and prevention plan for the water resource will be incorporated into the regional water supply planning process to ensure consistency.

1994 LWC WATER SUPPLY PLAN

The District's Governing Board approved the first LWC Water Supply Plan in February 1994 (1994 LWC Water Supply Plan). The 1994 LWC Water Supply Plan had a 2010 planning horizon and an advisory committee was established to provide public input throughout development of the 1994 LWC Water Supply Plan. The 1994 LWC Water Supply Plan incorporated regional ground water modeling as part of the analysis. The demand projections, assumptions, and resource protection criteria used in that analysis were reviewed and compared to current information and it was determined that many of the conclusions of the 1994 LWC Water Supply Plan are applicable today with the current planning horizon of 2020.

Staff and the committee recognized the findings and conclusions of the 1994 LWC Water Supply Plan as still representative of the issues in meeting the LWC Planning Area

projected water demands; and, they should be considered in the development of the 2000 LWC Water Supply Plan, in combination with other methods described below. It was concluded that the modeling associated with 1994 LWC Water Supply Plan is indicative of the 2020 scenario. Even though the 1994 LWC Water Supply Plan preceded the water supply planning requirements in Chapter 373, F.S., review of the 1994 LWC Water Supply Plan indicates many of the elements were addressed.

1994 LWC Water Supply Plan Level of Certainty

The 1994 LWC Water Supply Plan incorporated a 1-in-10 level of certainty for all users, including natural systems. The 1-in-10 level of certainty was based on a twelve month cumulative drought rainfall event, that statistically occurs once every ten years. This certainty level was simulated in each county model and is consistent with the level of certainty goal contained in the statutory requirements. The methodology used in determining the 1-in-10 drought event in the 1994 LWC Water Supply Plan is described in that Plan's Appendix C, and a similar discussion of methodology is provided in Appendix B of the 2000 LWC Water Supply Plan. The demand projections and resource protection criteria incorporated the 1-in-10 level of certainty.

1994 LWC Water Supply Plan Demands

The water demand projections in the 1994 LWC Water Supply Plan were compared with projections developed for the 2020 planning horizon in the 2000 LWC Water Supply Plan. The 1994 LWC Water Supply Plan incorporated a planning horizon of 2010. Population projections in the 1994 LWC Water Supply Plan were based on 2010 population projections contained in local government comprehensive plans. The 2000 LWC Water Supply Plan uses the 2020 medium range population projections, as published by the Bureau of Economic and Business Research (BEBR, 1998). The 2020 projections have been compared to recent updates of local government comprehensive plans, where available, and have been found to be similar. In both plans, irrigated acreage was based on historical growth patterns and irrigation demands were determined using the modified Blaney-Criddle method as described in the Basis of Review (BOR) for Consumptive Use Permitting (SFWMD, 1997) using a 1-in-10 drought event. See Appendix G of the 1994 LWC Water Supply Plan and Appendix F of the 2000 LWC Water Supply Plan for additional information regarding the projection and demand methodologies used in each plan.

The results of this comparison concluded that the total average water demand projections in the 1994 LWC Water Supply Plan for 2010 are approximately 15 percent higher than those projected for 2020 in the 2000 LWC Water Supply Plan. The total average water demands projected for 2010 in the 1994 LWC Water Supply Plan were 471,507 MGY; whereas, the total average water demands projected for 2020 in the 2000 LWC Water Supply Plan are 401,548 MGY. This reduction in total demands is attributed primarily to the decrease in the rate of population and agricultural growth in the LWC Planning Area from the late 80s to the 90s.

1994 LWC Water Supply Plan Resource Protection Criteria

Resource protection criteria in the 1994 LWC Water Supply Plan were designed to prevent harm to the resources up to a 1-in-10 drought event. These criteria are not intended to be a minimum flow and level. For drought conditions greater than a 1-in-10 event, it may be necessary to decrease water withdrawals to avoid causing significant and serious harm to the resource. Water shortage triggers, or water levels at which phased restrictions will be declared using the District's water shortage program, can be used to curtail withdrawals by water use types to avoid water levels declining to and below a level where serious harm to the resource could potentially occur.

Three resource protection criteria were used in the 1994 LWC Water Supply Plan: wetland protection criterion, seawater intrusion criterion, and general aquifer protection criteria. These criteria were intended to be equivalent to the existing CUP guidelines at that time, but for planning purposes. To be used in the planning analysis, the criteria had to be defined in terms of water levels, duration, and frequency of drawdowns, to assess the potential impacts (harm) of cumulative water use on the environment and ground water resources using the ground water modeling tools. The CUP guidelines were not expressed in this format, such that the CUP criterion had to be converted to an equivalent criterion, expressed in the format stated above, for planning purposes.

The resource protection criteria are guidelines to identify areas where there is potential for cumulative water use withdrawals to cause harm to wetlands and ground water resources. Areas where simulations indicate the resource protection criteria were exceeded during the selected level of certainty are areas where the water resource may not be sufficient to support the projected demand under the given constraints.

Wetland Protection Criterion

The wetland protection criterion was defined as follows: *Ground water level drawdowns induced by pumping withdrawals should not exceed 1 foot for more than 1 month during any drought event that occurs as frequently as once every 10 years in areas that are classified as a wetland.* This criterion was intended to be equivalent with the CUP guidelines, but for planning purposes. The wetland coverage used in the 1994 LWC Water Supply Plan was developed using information from the 1984 National Wetlands Inventory (NWI). The NWI data was updated by the District using 1990 and 1991 satellite images and aerial photographs.

The CUP criteria contained in Section 3.3, Environmental Impacts, of the District's Basis of Review for Water Use Permit Applications (SFWMD, 1997) requires that withdrawals of water must not cause adverse impacts to environmental features sensitive to magnitude, seasonal timing and duration of inundation. Maintaining appropriate wetland hydrology (water levels and hydroperiod) is scientifically accepted as the single most critical factor in maintaining a viable wetland ecosystem (Duever, 1988; Mitsch and Gosselink, 1986; Erwin, 1991). Water use induced drawdowns under wetlands potentially affect water levels, hydroperiod, and the areal extent of the wetland. A guideline of no greater than one foot of drawdown at the edge of a wetland after 90 days of no recharge

and maximum day withdrawals is used currently for consumptive use permitting (CUP) purposes to indicate no adverse impacts. Wetlands for CUP purposes are delineated using the statewide methodology as described in Chapter 62-340, F.A.C.

The District began a research project in 1995 referred to as the Wetland Drawdown Study to support refinement of the wetland drawdown criterion. This project involves long-term monitoring of wellfields and wetland systems at 20 sites throughout the District, including wetlands in the Flint Pen Strand adjacent to the Corkscrew wellfield in the LWC Planning Area. Three years of data collection and analysis has been conducted to determine the relationship between variations in hydrology and wetland functions. In May 1998, seventeen additional sites were established in the LWC Planning Area to monitor the effects of agricultural pumpage. The information gathered to date is being used to support incorporation of wetland protection criteria in the CUP program. These proposed criteria might differ in some cases from that used in the 1994 LWC Water Supply Plan. Three wetland system types with differing levels of protection are proposed. However, the criterion used in the 1994 LWC Water Supply Plan is sufficient for planning purposes in that a majority of the wetland systems in the LWC Planning Area would have a protection criterion similar to the criterion used in the Plan. The District has initiated a rulemaking effort this year to adopt rules districtwide to incorporate these concepts in the CUP process.

Seawater Intrusion Criterion

Generally, this criterion provided for a positive freshwater head to impede the movement of saline water inland up to and including a 1-in-10 year drought event. This criterion was applied to the Surficial Aquifer System (SAS) and Intermediate Aquifer System (IAS) in selected coastal locations in Lee and Collier counties and was intended to mimic the existing criterion used in the CUP program. The purpose of this criterion was to identify areas where water withdrawals would reduce the fresh water head along the coast below one foot, and increase the potential for seawater intrusion.

Current CUP criteria requires site-specific analysis and maintenance of a one foot freshwater head. In addition to using this CUP program criterion to minimize potential changes in salinity of these freshwater resources, the District also has an extensive complementary ground water monitoring network to monitor water quality for changes, including salinity, to maintain the sustainability of these resources. The District has initiated a rulemaking effort this year to adopt rules districtwide to incorporate these concepts in the CUP process. Current proposed criterion incorporated in information to support the current rulemaking uses net inward flow across the saltwater interface as criterion to determine the potential for seawater intrusion. This criterion is consistent with the 1994 LWC Water Supply Plan criterion.

General Aquifer Protection Criteria

The general aquifer protection criterion was defined as follows: *Ground water levels should not decline below the top of the aquifer for any period of time during any drought event that occurs as frequently as once every ten years*. This definition was

applied to all confined aquifer systems in the LWC Planning Area to identify areas where potential ground water level declines due to water use may cause aquifer compaction and dewatering, reduced well yields, land subsidence, and upconing of saline water. This concept will be developed to form the basis for defining significant harm to the aquifer and will be used for establishing minimum flows and levels for aquifer protection. The District has initiated a rulemaking effort this year to adopt rules districtwide to incorporate these concepts in the CUP process.

1994 LWC Water Supply Plan Results

The results of the 1994 LWC Water Supply Plan analysis indicated that if existing sources of water (base case) are used to meet the projected demands, this use has the potential to cause exceedances of the resource protection criteria. The areas where exceedances of the resource protection criteria were projected if historically used sources of water are used to meet the projected 2010 demands are generalized in **Figure 5**.

Taking into consideration the information and knowledge gained since the approval of the 1994 LWC Water Supply Plan, it was concluded that the 1994 LWC Water Supply Plan analysis represents a worst case scenario. This conclusion is based on several considerations, some of which are summarized next. The projected water demands in the 2000 LWC Water Supply Plan are less than those projected in the 1994 LWC Water Supply Plan, and the wetland coverage used in the 1994 LWC Water Supply Plan was developed in 1984, and was updated by the District using 1990 and 1991 satellite images and aerial photographs. More recent assessments of some of the wetlands have indicated that they have been affected by development, and in some cases, are nonexistent. Also, some of the potential problems that were identified on a regional scale in the 1994 LWC Water Supply Plan associated with 1990 withdrawals, were not identified as issues or have been resolved on a local scale through the District's CUP process. In addition, many PWS users have diversified supply sources with use of the FAS and enhancing freshwater water availability through ASR; reclaimed water use in the area has increased; several surface water management modifications to increase regional retention have been completed; and conversion of flood irrigation to micro irrigation has continued. Most of the recommendations in the 1994 LWC Water Supply Plan have been implemented, as summarized later in this chapter.

Several water resource options, and combinations of options, were evaluated to determine their potential effectiveness in meeting a portion of the projected demands and reducing potential exceedances. These source options included use of the FAS to meet PWS demands, increased use of reclaimed water, modifying surface water management in the Big Cypress Basin, and increasing agricultural efficiency. No analysis of the Floridan aquifer was conducted in the 1994 LWC Water Supply Plan. The analysis found reducing demands on the SAS and IAS, through the use of the FAS and reclaimed water in the coastal portions of the LWC Planning Area, was very effective at reducing potential exceedances of the wetland protection and seawater intrusion criteria. Increasing agricultural efficiency and improving surface water management in the Big Cypress Basin also had some effect on reducing potential exceedances. The analysis indicated minimal

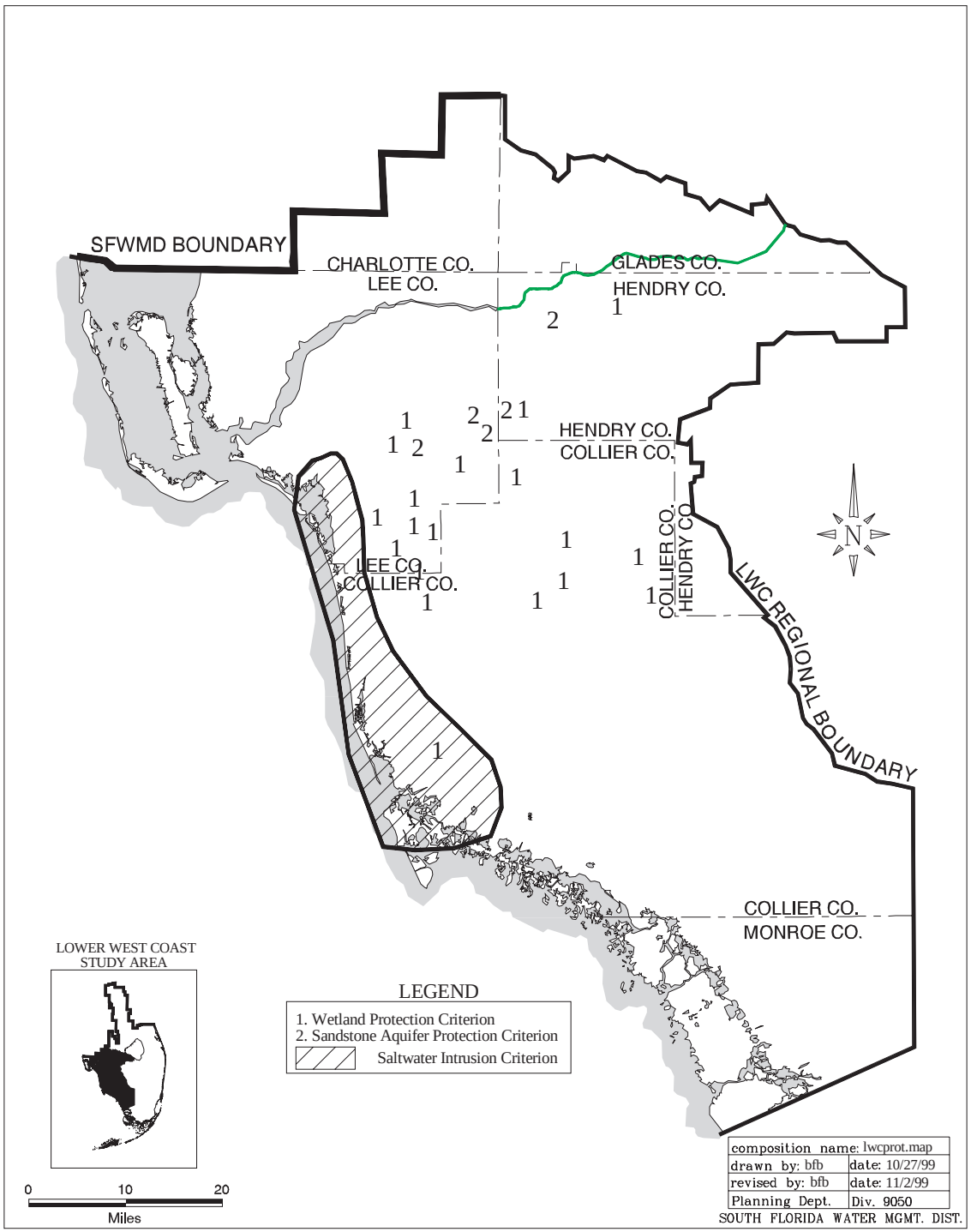


Figure 5. 1994 Lower West Coast Water Supply Plan 2010 Generalized Base Case Potential Resource Protection Criteria Exceedances.

exceedances of the general aquifer protection criterion for the Sandstone aquifer. It was concluded that these were attributed to local uses and could be managed through water supply development projects, as well as the CUP program.

The analysis indicated that with diversification of supply sources, through development and expansion of alternative sources, the number of exceedances were significantly reduced. However, the 1994 LWC Water Supply Plan identified areas where potential problems were not completely resolved. A majority of these were located in agricultural areas. Since the 1994 modeling and identification of these potential problem areas, additional work has been conducted related to these areas. Some of the factors that were examined included projected demands, current land use, CUP experience, field inspection, and the District's wetland drawdown study.

These additional efforts found projected 2020 agricultural acreage and demands are approximately 25 percent less than those projected and simulated in the 1994 LWC Water Supply Plan. The 2020 projections are approximate to those acreages that have been permitted to date by the District. Generally, actual crop acreages are less than permitted acreage due to lags between permitting and planting. The 2020 projected acreage represents anticipated actual land use rather than forecast permitted land use. As a result, most of the additional agricultural expansion in the LWC Planning Area will occur within existing permitted, and planted, areas.

Other factors included some of the agricultural land use associated with the potential problem areas in the 1994 LWC Water Supply Plan has been converted to urban land use with significantly less water demands than assumed in the 1994 LWC Water Supply Plan. Also, several applications for consumptive use permits in these areas have been approved since the 1994 LWC Water Supply Plan. Several of these projects required modification to wellfield locations and pumping regimes with respect to wetlands prior to approval. In other areas, aerial photography was reviewed over several decades and did not indicate changes in the size or vegetation of these systems. In addition, information collected as part of the District's wetland drawdown study suggests that seasonally inundated wetlands (a majority of the wetlands in the LWC Planning Area) are more sensitive to drawdowns during the wet season, rather than the dry season. Whereas, the 1994 LWC Water Supply Plan analysis evaluated drawdowns based on a 12-month 1-in-10 drought condition, and many potential problems were triggered on drawdowns that occurred during the dry season. Current wetland protection guidelines/criteria are being revised to address these findings.

The 1994 LWC Water Supply Plan analysis used the best available information at that time. Based on the knowledge that has been gained since the 1994 LWC Water Supply Plan was approved, the results may be considered conservative, but still provide value. Within these areas, water users and the District should carefully evaluate proposed withdrawals with respect to wetlands, during the CUP process. Based on the above, and that additional agricultural development will be distributed throughout the eastern portions of the LWC Planning Area and occur within existing permitted and planted areas, it was concluded the projected agricultural demands in these areas can be met through historically used ground water sources. In the future, refined regional ground water

models that are under development for renewal of CUPs, will be used to validate this conclusion, and will be available for future updates of this plan.

1994 LWC Water Supply Plan Conclusions and Recommendations

The 1994 LWC Water Supply Plan concluded that historically used sources of water, primarily fresh ground water sources, are not sufficient to meet the projected demands through the planning horizon. The 1994 LWC Water Supply Plan recommended new sources of water be explored and used, including the Floridan Aquifer System (FAS) and increased use of reclaimed water, increased water conservation, and research to meet the projected demands, to reduce the potential for harm to wetlands and the water resources. The 1994 LWC Water Supply Plan also recommended more efficient use of water by increasing urban and agricultural water conservation, revising drainage management practices, and developing cost-sharing partnerships. The 1994 LWC Water Supply Plan analysis concluded that implementation of the above significantly reduce the number of potential problems.

For consistency between the 1994 LWC Water Supply Plan and the CUP Program, it was recommended that the resource protection criteria used in the Plan be incorporated into the District's BOR for CUP. Additional research was also recommended to better understand the potential impacts to natural systems and to develop water shortage management strategies tied to the CUP process.

1994 LWC Water Supply Plan Implementation

Many of the recommendations in the 1994 LWC Water Supply Plan are being realized, including increased utilization of the FAS, aquifer storage and recovery, and reclaimed water usage. The District has provided funding through the Alternative Water Supply Grant Program for 27 alternative water supply projects in the LWC Planning Area totaling $6.3 million (District contribution) between 1996 and 2000. The projects included 10 reclaimed water/reuse projects ($1 million), 10 ASR projects ($2.5 million), 3 projects improving surface water management to retain more water in the system and recharge aquifers ($0.5 million), and one Floridan aquifer project ($0.2 million). In addition, the Big Cypress Basin has expended several million dollars in modifying their drainage system to retain more water within their system.

Research on the FAS was conducted as a result of the 1994 LWC Water Supply Plan. Based on the recommendations of the 1994 LWC Water Supply Plan, the District initiated a program of well construction, aquifer testing, and long-term monitoring to provide data needed to assess the FAS underlying the LWC Planning Area. The District drilled five test wells and five associated monitoring wells between 1994 and 1999. Aquifer performance tests were performed on these wells to define the hydraulic characteristics of various sections of the FAS. This testing provided information to characterize the water supply potential of the FAS and to support future development of a FAS ground water model. The total cost of this study was $3.1 million.

In addition, the recommendations in the 1994 LWC Water Supply Plan were used to initiate the District's wetland drawdown study. The District began formulating a research plan to support development of wetland drawdown criteria in 1995. The purpose of this study is to implement hydrobiological monitoring at various wetland sites throughout the District to determine the effects of ground water drawdowns on these systems. Twenty sites in four study areas were established and instrumented in 1997. Isolated wetlands in the Flint Pen Strand adjacent to the Corkscrew wellfield in the LWC Planning Area were included in the study. Three years of data collection and analysis has been conducted to determine the relationship between variations in hydrology and wetland functions. This information has been incorporated into a draft publication that will be used to support the District's 2000 CUP wetland rulemaking activity. In May 1998, seventeen additional sites were established in the LWC Planning Area to monitor the effects of agricultural pumpage. The District has invested $1.8 million into this study to date.

The 1994 LWC Water Supply Plan contained recommendations to incorporate certain aspects of that plan, such as the resource protection criteria and level of certainty, into the CUP Basis of Review. These recommended changes are still outstanding due to statutory changes and public concern regarding consistency with the other planning areas in the District (1994 LWC Water Supply Plan was completed before other regions). The District has initiated a rulemaking effort this year to adopt rules districtwide to incorporate the 1-in-10 level of certainty and other concepts in the CUP process.

2000 LWC WATER SUPPLY PLAN

Issue Identification

Implementation of the 1994 LWC Water Supply Plan recommendations is addressing most of the potential exceedances identified in that plan if historically used sources were utilized to meet projected 2010 demands. It is important to note that based on the demands that are projected for 2020 and other information referred to early in this chapter, it appears the 1994 LWC Water Supply Plan 2010 simulation overstates demand and potential exceedances that would be expected in 2020. To resolve the remaining issues/exceedances identified in the 1994 LWC Water Supply Plan, as well as those identified by the advisory committee and staff as part of this plan, a process was developed to address these issues in accordance with the water supply planning requirements in Chapter 373, F.S. This process utilized the knowledge and experience of the advisory committee, public, and staff; information from the analysis associated with the CWMP; information from the analysis associated with the 1994 LWC Water Supply Plan; and experience from consumptive use permitting activities and related data that have occurred since the acceptance of the 1994 LWC Water Supply Plan.

For the purposes of this approach, the LWC Planning Area was divided into eight "issue areas" (**Figure 6**) to facilitate discussion and identification of potential issues and options to resolve them. Several considerations were used to delineate these areas including land use, existing and projected water demands, drainage features, surface water

bodies, and historically used sources of water. These eight areas and general characteristics are summarized below (no implied priority).

Because most of the information regarding population, agricultural acreage, and their associated demands was available in formats not identical to the "issue areas" boundaries; population, agricultural acreage and their associated demands were qualitatively described versus using specific numbers in the "issue areas". For example, the service areas of water and wastewater utilities are not mutually exclusive, such that increases in public water supply (PWS) demand are not proportionate to increases in wastewater flows in some areas. Also, most of the PWS demand located in the coastal areas is supplied with water from inland wellfields, sometimes located in other issue areas. In addition, the interconnection of utility systems, such as in Lee County, allows water to be moved from one area to another.

For each of the issue areas, emphasis was placed on water conservation for both potable demands and irrigation demands. It is recommended advances in water conservation beyond those currently required be encouraged, and conservation be considered as a source option in meeting the 2020 demands.

Following the list of characteristics is a summary of the ensuing discussion of issues and potential solutions. It is important to recognize that the purpose of the area designation is viewed as only a means to organize the discussion and are presented here only to document the methodology followed in the public process.

Issue Area 1

Issue Area 1 includes the barrier islands and coastal communities in Northwest Lee County including Sanibel, Pine Island, Cape Coral, and Fort Myers. Natural features include the Ding Darling National Wildlife Refugee, the lower reaches of Gator Slough and many tidally influenced creeks that drain into the Caloosahatchee River. The area consists primarily of urban land use with minimal agricultural areas. The following generalized characteristics and issues were identified for Area 1:

Demand Characteristics

- Utilities: Island Water Association, Greater Pine Island, Cape Coral, Lee County Waterway Estates, Fort Myers
- Significant increases in population and PWS demands projected
- Large urban irrigation demands projected

Resource Availability

- Surface water from the Caloosahatchee River
- Limited freshwater sources available
- Most utilities utilizing (or proposing to utilize) FAS to meet existing and future PWS demands

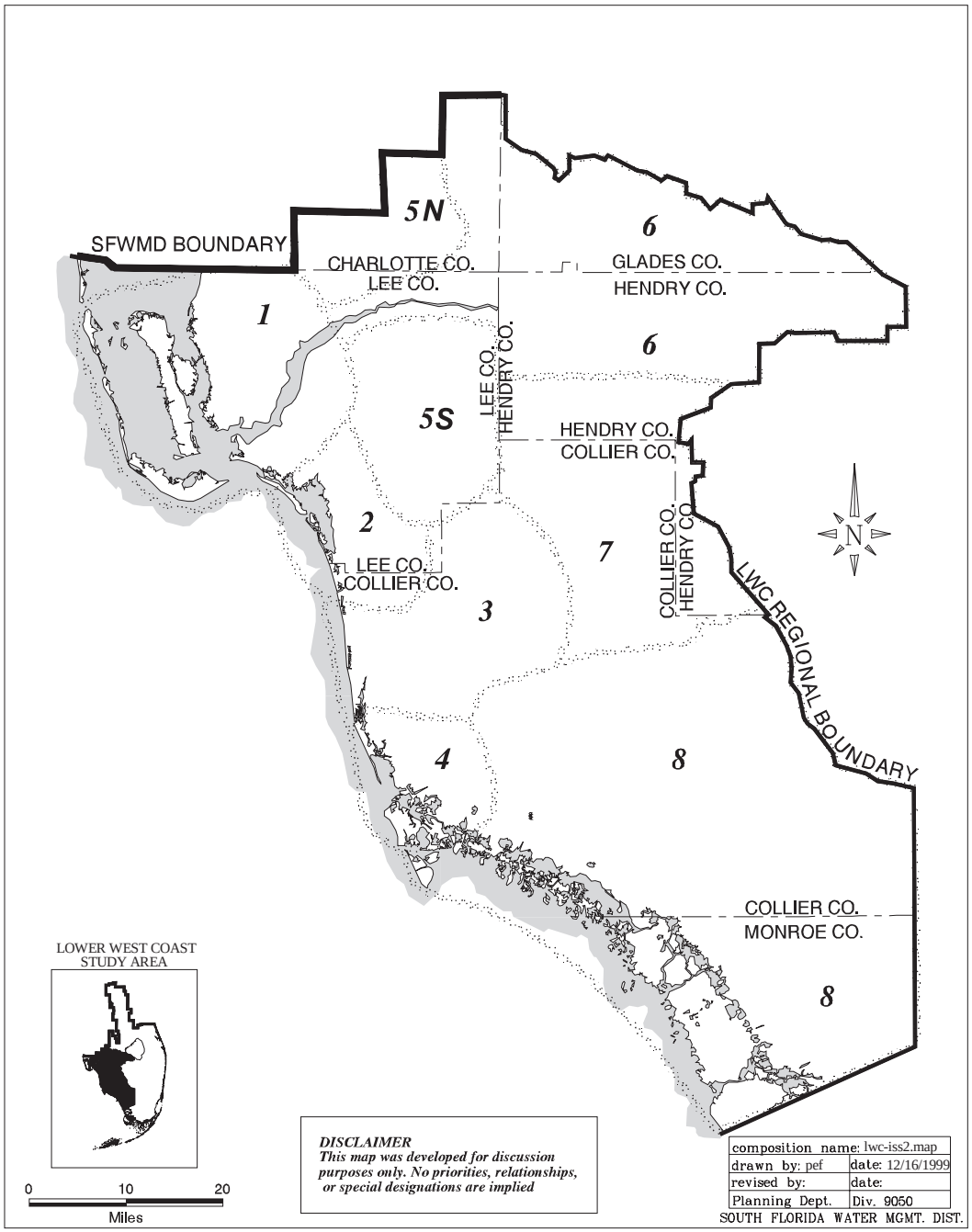


Figure 6. Lower West Coast Issue Areas.

- Fort Myers is developing a FAS wellfield and reverse osmosis for PWS and plan to abandon surface water for PWS

Reclaimed Water Availability

- 1997 wastewater treated - 27 MGD; 12 MGD reused
- 2020 projected wastewater flows - 45 MGD
- Cape Coral Utilities uses reclaimed water and water from canals for irrigation of residential lots (WICC)
- Future increases in reclaimed water supply will lag behind demands

Water Storage Ability

- Cape Coral canal system
- Surface water ASR
- Gator Slough Project
- Reservoirs

Based on the above, two major water supply related issues were identified in Area 1 in meeting the water needs of a growing population: potable water demands and nonpotable water demands for irrigation. There was support for current utility plans to continue using the FAS as a source for potable water with desalination treatment. However, because of the limited fresh ground water (due to wetland protection and saltwater intrusion) and surface water resources in this area, it was concluded additional water source options should be explored and developed to meet the future irrigation water needs of this area.

To address future demands for irrigation water, the concept of construction and operation of expanded reclaimed water systems to provide a series of regional or subregional irrigation distribution systems was discussed and supported. Potential sources of water to support the irrigation water distribution system include reclaimed water, ground water, and surface water, with ASR and reservoir storage options.

Issue Area 2

Issue Area 2 includes the coastal communities in Southwest Lee County and extreme Northwest Collier County and includes Bonita Springs City. Natural features include portions of the Corkscrew Regional Ecosystem Watershed lands and many tidally influenced tributaries that drain into the Estero Bay Aquatic Preserve including the Estero River, Imperial River, and Hendry, Mullock and Spring creeks. The area consists primarily of urban land use with minimal agricultural areas. The following generalized characteristics and issues were identified for Area 2:

Demand Characteristics

- Utilities: Bonita Springs, Gulf San Carlos & Corkscrew, Lee County Cypress Lakes/Green Meadows and Corkscrew, Orangetree

- Significant increases in population and PWS demands projected
- Large growth anticipated consisting of high density golf course developments
  - increase in PWS demands
  - increase in demands for irrigation water
- Transition in land use from agriculture to urban

Resource Availability

- Surface water from the Caloosahatchee River through interconnected PWS systems
- Limited expansion of historically used sources due to:
  -saltwater intrusion
  -wetland protection
- Chronic water shortage area
- Saline IAS and FAS
- mid-Hawthorn drawdown concerns
- Several PWS systems use ground water sources from Area 5

Reclaimed Water Availability

- 1997 wastewater treated - 11 MGD; 9 MGD reused
- 2020 projected wastewater flows - 19 MGD
- Available quantity significantly below demands
- Future increases in reclaimed water supply will lag behind demands

Water Storage Ability

- ASR source issues
- Limited surface water sources

Similar to Issue Area 1, two major water supply related issues were identified in Area 2 in meeting the water needs of a growing population: potable water demands and nonpotable water demands for irrigation. With the interconnection of utilities in Lee County and the ability to diversify supply sources such as surface water, along with utilization of the FAS in Collier County, it was concluded that PWS demands could be met. However, it was also concluded that the lower Tamiami aquifer may be insufficient to meet the 2020 projected demands in Bonita Springs primarily because of saltwater intrusion and excessive drawdowns in the aquifer, and that developing other source options would be necessary. Water source options, either on a local or regional scale, should be investigated.

In addition, because of the limited fresh ground water (due to wetland protection and saltwater intrusion) and surface water resources in this area, it was concluded additional water source options should be explored and developed to meet the 2020 projected cumulative irrigation water needs of this area. Similar to Issue Area 1, the

concept of construction and operation of expanded reclaimed water systems to provide a series of regional or subregional irrigation distribution system was discussed and supported. Besides reclaimed water, consideration should be given to potential surface water sources such as the Imperial River, Ten Mile Canal, Kehl Canal, and Six Mile Cypress Slough surface water resources.

Issue Area 3

Issue Area 3 encompasses Central Collier County including Naples and Golden Gate. Natural features include Lake Trafford and portions of Corkscrew Swamp and Picayune Strand State Forest. The area consists of urban and agricultural areas with some of the agriculture transitioning into urban land uses. The following generalized characteristics and issues were identified for Area 3:

Demand Characteristics

- Utilities: Naples, Collier County, Golden Gate
- Urban development to west; agriculture to east; some transition of land use anticipated in east
- Significant increases in population and PWS demands projected
- Low to moderate increase in Naples demands
- Low density in Golden Gate Estates/higher densities in golf course communities
- Moderate to high increase in demands in unincorporated Collier County
- 50,000+ acres of agriculture (citrus & vegetables) with moderate growth projected

Resource Availability

- Limited to moderate expansion of historically used sources due to:
  -saltwater intrusion in coastal areas
  -wetland protection with the SAS
- Collier County PWS diversified sources: FAS, ASR, reclaimed water
- Lower Tamiami aquifer available for increased domestic irrigation supply
- East Golden Gate Wellfield configuration currently considered maximized

Reclaimed Water Availability

- 1997 wastewater treated - 14 MGD; 9 MGD reused
- 2020 projected wastewater flows - 33 MGD
- Limited availability during peak demand
- Future increases in reclaimed water will lag behind demands

Water Storage Ability

- BCB canal optimization
- Collier County ASR

Three water supply related issues were identified in Area 3 in meeting the water needs of a growing population: potable water demands, urban irrigation water demands, and agricultural irrigation demands. There was support for Collier County's continued use of the FAS to meet future PWS demands. Other utility plans for continued use of the lower Tamiami Aquifer are marginal, but appear to be satisfactory. Collier County has developed an extensive reclaimed water distribution system. However, because of the limited fresh ground water (due to wetland protection and saltwater intrusion) and surface water resources in this area, it was concluded additional water source options should be explored and developed to meet the future urban irrigation water needs of this area.

It was concluded projected agricultural water demands could be met from existing sources through modifications to wellfield configurations and pumping regimes with respect to locations of wetlands.

Issue Area 4

Issue Area 4 generally consists of Southwest Collier County including Marco Island. Natural features include major portions of the Picayune Strand State Forest, Cape Romano Ten Thousand Islands National Wildlife Refuge, Rookery Bay Aquatic Preserve and Collier-Seminole State Park. The area is primarily urban land use and natural areas. The following generalized characteristics and issues were developed for Area 4:

Demand Characteristics

- Utilities: Marco Island, Collier County
- Minor increases in population and PWS demands projected on a regional basis
- Growth anticipated in golf course developments
  - -some increase in PWS demands
  - -increased demands for irrigation water
- Agriculture - small vegetables
- Transition in land use from agriculture to urban

Resource Availability

- Limited freshwater available due to saltwater intrusion
- Utility diversified sources: surface water, ASR, FAS

Reclaimed Water Availability

- 1997 wastewater treated - 1.4 MGD; 0.5 MGD reused
- 2020 projected wastewater flows - 3 MGD
- Limited availability during peak demand

Water Storage Ability

- ASR source issues

Marco Island is the only utility with withdrawal facilities in Issue Area 4. The utility is utilizing surface water, the FAS, ASR for storage, and has an expanding reclaimed water program. As a result, it was concluded projected potable water demands and irrigation demands on the island could be addressed at the local level.

However, because of the limited fresh ground water and surface water resources on the mainland within this issue area, it was concluded additional water source options should be explored and developed to meet the future irrigation water needs on the mainland. One source option that was suggested was a regional irrigation distribution system.

Issue Area 5

5 North. Issue Area 5 North generally incorporates the inland areas of northern Lee County and southern Charlotte County, including North Fort Myers. Natural features include the Fred C. Babcock/Cecil M. Webb Wildlife Management Area, Gator Slough, Telegraph Swamp, Trout Creek and many tidally influenced creeks that drain south into the Caloosahatchee River. The area consists of a mixture of low to medium density urban, agricultural and natural areas. The following generalized characteristics and issues were identified for Area 5 North:

Demand Characteristics

- Utilities: Lee County Olga
- Minor increases in population and PWS demands projected
- Anticipated low urban growth

Resource Availability

- Utility plans to use surface water from Caloosahatchee River
- Limited ground water resources

Reclaimed Water Availability

- North Fort Myers WWTF
- 1997 wastewater treated - 1 MGD; .75 MGD reused

Water Storage Ability

- ASR - Caloosahatchee as a source

Based on the above, it was concluded current levels of development are not harmful to the resources. The growth is anticipated to be supported by increased withdrawals from the C-43 Canal, self-supply, and continued expanded use of reclaimed water. There is some transitioning from agriculture to urban land uses.

5 South. Issue Area 5 South generally incorporates the inland areas of south-central Lee County, including Lehigh Acres and San Carlos Park. Natural features include the Six Mile Cypress Slough, portions of Corkscrew Swamp, Orange River and other tidally influenced creeks that drain north into the Caloosahatchee River. The area consists of urban and agricultural areas, with some of the agriculture transitioning into urban land uses. The following generalized characteristics and issues were identified for Area 5 South:

Demand Characteristics

- Utilities: Lee County Corkscrew and Green Meadows; Gulf San Carlos and Corkscrew; Lehigh
- Moderate increases in population and PWS demands projected
- Anticipated large urban growth in Lehigh Acres and South Lee County
- Transition in land use from agriculture to urban in south-central Lee County
- Medium scale development
- Cumulative domestic well impacts in Lehigh Acres area
- About 20,000 acres of agriculture (citrus & vegetables) with some increase projected

Resource Availability

- Utility plans to use surface water from Caloosahatchee River, water table aquifer and Sandstone aquifer
- Limited resources: water table limited in southern portion by wetlands; variable yield in Sandstone

Reclaimed Water Availability

- 1997 wastewater treated - 2 MGD; 1.25 MGD reused
- 2020 projected wastewater flows - 4 MGD
- Limited availability- regional utilities being developed by Lee County and Fort Myers

Water Storage Ability

- Rock pits
- Canal optimization
- ASR - Caloosahatchee as a source
- Lee County ASR

Based on the above, it was concluded current levels of development are not harmful to the resources. It was recognized that there are opportunities to expand the withdrawals from the SAS and Sandstone aquifer, as well as increased water use from the C-43 and other surface water sources. This area is transitioning from agriculture to urban land uses, such that potable needs and irrigation needs are issues.

Issue Area 6

Issue Area 6 generally incorporates primarily surface water supplied agriculture areas in Hendry County and portions of Glades and Charlotte counties, and includes LaBelle, Clewiston and Moore Haven. Natural features include a northern portion of Okaloacoochee Slough. The following generalized characteristics and issues were identified for Area 6:

Demand Characteristics

- 140,000+ acres of agriculture (citrus, sugarcane & vegetables) with significant increases projected
- CWMP
- Caloosahatchee Estuary

Resource Availability

- C-43
- Water table aquifer
- Sandstone aquifer- general aquifer protection exceedances projected in some areas
- FAS - lower salinity in this area than rest of LWC Planning Area

Reclaimed Water Availability

- None

Water Storage Ability

- Reservoirs: regional and on-site
- ASR using surface water from C-43 or local surface water systems

The CWMP is addressing surface water availability within this area, including the needs of the Caloosahatchee Estuary. As a result, the CWMP process and recommendations will be summarized in the LWC Water Supply Plan, and the CWMP document will be incorporated by reference. Many members of the CWMP Advisory Committee also serve on the LWC Water Supply Plan Advisory Committee.

For the ground water use in this area, it was concluded the potential general aquifer protection exceedances could be managed through modifications to wellfield configurations and pumping regimes. Another issue that was discussed related to the use of water from the Sandstone aquifer was the presence of inefficient withdrawal facilities on domestic wells. When water levels in these wells fall to greater than 20 feet below land surface, these withdrawal facilities (vacuum pumps or pump types whose centerline is above the surface of the water) fail. Historically, replacement of these facilities (pump and well) was the responsibility of adjacent agricultural water users. It was recommended local governments prohibit the construction of these types of facilities through ordinances.

There was a discussion about protection of inefficient facilities. Mobile irrigation labs (MILs) were supported to promote efficient use of the resources.

Issue Area 7

Issue Area 7 generally incorporates western Hendry County and northeastern Collier County, including the Immokalee area. Natural features include the southern portion of Okaloacoochee Slough, Twelve Mile Slough with small northern portions of the Florida Panther National Wildlife Refuge, and Big Cypress Preserve. The area is primarily ground water supplied agriculture. The following generalized characteristics and issues were identified for Area 7:

Demand Characteristics

- 20,000+ acres of agriculture (citrus & vegetables) with moderate increase projected

Resource Availability

- Sandstone, lower Tamiami and water table aquifer systems primarily used
- Sandstone aquifer primary source west of SR 29; lower Tamiami primary source east of SR 29
- Withdrawals limited by:
  -wetland protection
  -Sandstone aquifer protection criterion

Reclaimed Water Availability

- None

Water Storage Ability

- Reservoirs: regional and on-site

The primary water supply related issue in this area is meeting the water needs of agriculture. Even though there are some limitations on existing freshwater sources within this area, it was concluded projected agricultural water demands could be met from existing sources through modifications to wellfield configurations and pumping regimes with respect to location of wetlands. The potential of using water from the FAS for blending was also mentioned to extend freshwater supplies, if necessary.

Similar to Issue Area 6, domestic wells with inefficient withdrawal facilities was also identified as a potential issue and MILs were also supported in this area.

Issue Area 8

Issue Area 8 generally consists of the environmental areas in Southeast Collier County and Northwest Monroe County including Big Cypress National Preserve, Picayune State Forest, Fakahatchee Strand State Preserve, Florida Panther National

Wildlife Refuge, Everglades National Park, and southern Golden Gate Estates. The following generalized characteristics and issues were identified for Area 8:

Demand Characteristics

- Mainly environmental
- Includes Everglades City, Ochopee, Chokoloskee, and Port of the Islands PWS systems, and numerous domestic self-supply wells
- Represents large modified ecosystem

Resource Availability

- There may be water available as the result of environmental restoration
- Land acquisition underway

Reclaimed Water Availability

- None

Water Storage Ability

- Could be used as storage area (only when environmentally beneficial)

Most of this area represents a large modified ecosystem with significant land acquisition proposed. It was recommended that the land acquisition be completed. There may be water available as the result of environmental restoration. The need for identifying the water needs of the natural resources was discussed. With environmental restoration in this area and establishment of hydroperiods for the natural systems, increases in surface water availability during certain times of the year and ground water recharge should be realized and possibly transferred to other areas. The primary reason for this hydrological restoration is re-establishment of historic flowways, sheetflow and hydroperiods, that will also improve the health of the estuary. Also, it is recognized these are fringe areas and water quality, including saltwater intrusion, must be considered.

Summary of Natural Systems and Water Resource Analysis

Minimum Flows and Levels

Two water resources in the LWC Planning Area are on the District's priority list for establishment of MFLs: the Caloosahatchee River and Estuary and the LWC aquifer system. Both of these are scheduled for establishment by the end of Year 2000. White papers are being written to support establishment of each of the MFLs. A summary of the proposed approach for each of these is provided below. The establishment process will include public participation, peer review, and rulemaking. The established MFL will be incorporated into the update of this plan.

Caloosahatchee River and Estuary. The proposed Caloosahatchee River and Estuary MFL is based on maintaining salinity levels that would avoid significantly

harmful levels in the Caloosahatchee Estuary. Research data were used to relate flow rates from S-79 to salinity distributions along the Caloosahatchee Estuary and to correlate biologic community responses to varying salinity distributions. These relationships were established for submerged aquatic vegetation, fish and invertebrates with major emphasis on the salinity requirements of the freshwater grass, *Vallisneria*. It was determined that the distribution and abundance of *Vallisneria* at a location approximately 30 kilometers upstream of Shell Point is the best biological indicator addressing low flow needs for the restoration of the Caloosahatchee Estuary. The magnitude of die off that requires two years to recover from and the resulting impact to fisheries resulting from the loss of *Vallisneria* habitat was considered to be significantly harmful and formed the basis of the proposed MFL criteria.

A model was developed from field and laboratory information to determine the response of Vallisneria to various concentrations and duration of saltwater. This model was used to define low flow events that would produce salinity concentrations of sufficient duration and frequency that would result in significant die-off of Vallisneria. Significant die-off of Vallisneria would be defined as areas where the presence of Vallisneria is reduced to less than 20 shoots per square meter measured at a monitoring station located approximately 30 kilometers upstream of Shell Point during the months of February through April. Significant harm to the Caloosahatchee Estuary is considered to occur when Vallisneria die-back, due to high salinity from low freshwater inflows, occurs for three years in a row. Harm to the Caloosahatchee Estuary is considered to occur when Vallisneria die-back, due to high salinity from low freshwater inflows, occurs for two consecutive years measured at a monitoring station located approximately 30 kilometers upstream of Shell Point. It was determined the freshwater inflow associated with preventing harm or significant harm is an average monthly flow of 300 cfs per day at the S-79 Structure during the spring.

An evaluation of projected flows to the Caloosahatchee River was conducted via the LEC Water Supply Plan and the CWMP for 1990 base and 2020 base conditions. The results of these evaluations indicate that the proposed MFL criteria and the restoration base flow needs of the Caloosahatchee Estuary are not being met. Pursuant to the direction provided in Section 373.042 F.S., a recovery plan is provided in the LEC Water Supply Plan. The recovery plan consists of design and construction of enhanced basin storage capacity using surface water, ASR, and reservoirs as described in the Restudy and refined through the CERP and Southwest Florida Study. A 31-year time series of flows that would result from the works of the Restudy were also simulated and used to define the proposed "Recovery and Prevention Strategy for Minimum Flows". In the interim, an adaptive management strategy, with discretionary releases through the S-77, will be utilized.

Lower West Coast Aquifer System. The Lower West Coast (LWC) aquifer system is comprised of the water table aquifer, the lower Tamiami aquifer, the Sandstone aquifer, the mid-Hawthorn aquifer, and the Floridan aquifer. The principal issue regarding development of minimum level criteria for the LWC aquifer system is the problem of introduction of air into confined aquifers and depleting storage in unconfined aquifers. Confined aquifers are anaerobic, and the introduction of air into these can cause chemical

and physical changes to the confining layers of the aquifer resulting in changes to these confining layers. As a result, the permeability and specific storage of the aquifers, aquifer interbeds, and confining beds are reduced, thereby reducing the production potential of the affected aquifers. The minimum level for these aquifers will be established above the top of the aquifer to prevent introduction of air into the aquifer.

For unconfined aquifers, as the water level falls in the aquifer, the transmissivity, which is the product of the hydraulic conductivity and saturated thickness, declines. At the same time, water available in storage is depleted. The net result, especially in thin aquifers with low hydraulic conductivity, is an increasing rate of drawdown in the vicinity of pumping wells, and possible failure of wells due to local dewatering of the aquifer. In addition, the resulting depressurization can cause aquifer compaction, particularly in those aquifers comprising poorly consolidated sediments. Therefore, the approach taken is that the minimum water level in unconfined aquifers be limited to a drawdown that is no more than half of the pre-development average of saturated thickness of the aquifer.

The minimum levels that have been proposed for the LWC aquifer system represent a best estimate based on currently available information of the levels below which significant harm is likely to occur. Implicit in this determination is the assumption that water conditions that pose significant harm, will be of fairly infrequent occurrence and comparatively short duration. Therefore, it is assumed that if the physical system is more sensitive to introduction of air than estimated, the brevity of the occurrence would offset it. Development of minimum water level criteria for the LWC aquifer system as a means to protect the aquifers from significant harm should not change the application of drought management methods and criteria that affect operation of individual wellfields.

The results of the analysis associated with the 1994 LWC Water Supply Plan and CUP program suggests that the projected water levels, based on future demands, in the LWC aquifers, are above the proposed aquifer minimum levels. Pursuant to the direction provided in Section 373.042 F.S., a prevention strategy is required. The LWC aquifer system prevention strategy will be to establish regulatory levels for a 1-in-10 level of certainty at the no harm level. These will be established and implemented through the CUP process. For droughts greater than a 1-in-10 event, water use will be reduced through declarations of water shortage via Chapter 40E-21, F.A.C., to prevent significant harm.

Summary of Results

Based on the results of this assessment and the analysis associated with the 1994 LWC Water Supply Plan, there are several potential water supply issues projected to occur by 2020 during a 1-in-10 year drought event if current facilities and historically used sources of water are used. Many of these were identified in the 1994 LWC Water Supply Plan and can be resolved through the ongoing implementation of that plan. The potential issues identified in the individual issue areas could be summarized into coastal issues and inland issues. A summary of the water supply related issues in the LWC Planning Area is provided in **Table 3**.

Table 3. Lower West Coast Water Supply Issues Summary.

	Inland	Coastal
Collier County	• Cumulative impacts (wetlands)	• Cumulative impacts (wetlands) • Saltwater intrusion • Expansion of SAS limited • Limited freshwater for irrigation • Freshwater discharges to estuarine systems
Hendry County	• Surface water availability in C-43 Basin • Cumulative impacts (wetlands)	N/A
Lee County	• Surface water availability from the C-43 • Freshwater discharges to the Caloosahatchee Estuary	• Cumulative impacts (wetlands) • Expansion of SAS available, but limited • Saltwater intrusion (Lower Tamiami in South Lee County) • Freshwater discharges to the estuarine systems • Limited freshwater for irrigation

Coastal Issues

The area west of I-75 from the northern Lee County line to Ten Thousand Islands in Collier County and the coast is projected to experience significant increases in population and water demands in the form of potable water and irrigation demands. Within this corridor, the analysis indicated expansion of withdrawals from historically used fresh ground water sources might be limited due to the potential of saltwater intrusion and impacts to wetlands. However, there appears to be sufficient water sources through diversification with FAS water, surface water, and complemented with fresh water storage through ASR, in addition to the historically used fresh ground water sources, to meet potable water demands. It was also concluded that the combination of reclaimed water, surface water, and historically used fresh ground water sources are adequate to meet the projected irrigation demands, but additional work is necessary to identify the most effective method to make these sources available for use at the local level, including storage.

Inland Issues

Inland issues are generally issues related in meeting the LWC Planning Area agricultural water demands. In the Caloosahatchee Basin (the portion of the LWC Planning Area in the Lake Okeechobee Service Area), surface water availability from the C-43 Canal to meet agricultural and public water supply needs, as well as addressing freshwater discharges to the Caloosahatchee Estuary to maintain a healthy estuarine system, are being addressed in the Caloosahatchee Water Management Plan. A MFL for the Caloosahatchee River and Estuary is also being developed. These issues will be

resolved principally through storage and capture of rainfall/runoff in conjunction with the use of the C-43 Canal and water from Lake Okeechobee.

In southeastern Lee County and the remaining portion of Hendry County not in the Caloosahatchee Basin, this assessment indicates historically used ground water sources in some areas may be limited by potential impacts to wetlands and existing legal users; and in some limited areas, excessive drawdowns in the aquifer. However, based on several factors identified in the 1994 LWC Water Supply Plan Results section of this plan, many of these can be avoided through development of water supplies consistent with the CUP criteria for impacts to existing legal users, wetlands, and over drafting of the aquifer on a local scale.

Potential solutions, or water source options, to resolve these issues are discussed in Chapter 5 (Solution Development). For each water source option, a definition, summary of the committee discussion, estimated costs, quantity of water that could be made available from that option, as well as regional and local recommendations to facilitate development of that option are listed. Chapter 6 (Recommendations) breaks the regional recommendations down into tasks, total and annualized cost to implement that recommendation, the entity/agency responsible for implementing the recommendation, and funding sources.

Chapter 5
SOLUTION DEVELOPMENT

In moving from issue identification/analysis to solution development, seven water source options were identified to address the water supply needs in the LWC Planning Area. These options either make additional water available from historically used sources or other sources (e.g., the Floridan aquifer), or provide additional management of the options (e.g., conservation). The options are as follows (no implied priority):

1. Conservation
2. Ground Water
   - Surficial Aquifer System (SAS)
   - Intermediate Aquifer System (IAS)
   - Floridan Aquifer System (FAS)
3. Reclaimed Water
4. Regional Irrigation System
5. Seawater
6. Storage
   - Aquifer storage and recovery
   - Regional and local retention
   - Reserviors
7. Surface Water

Development of each of these options could have regional, as well as local responsibilities.

WATER RESOURCE DEVELOPMENT AND WATER SUPPLY DEVELOPMENT

Chapter 373, F.S., requires water supply plans include a list of water source options for water supply development for local water users to choose from. For each source option listed, the estimated amount of water available for use, the estimated costs, potential sources of funding, and a list of water supply development projects that meet applicable funding criteria are required. In addition, water supply plans must also include a listing of water resource development projects that support water supply development. For each water resource development project listed, an estimate of the amount of water to become available, timetable, funding, and who will implement the project, should be provided. These amendments were passed in 1997. These requirements are addressed in Chapters 5 and 6.

The statute defines water resource development and water supply development as follows:

> ‘Water resource development’ means the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and ground water 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 ground water recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities.

and,

> ‘Water supply development’ means 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.

The categorization of projects as water resource development or water supply development has received both water management district and statewide attention. Water management district budget decisions and state funding responsibilities will be influenced by how these terms are implemented. Interpretation of these terms in the water supply planning process will be driven by considerations from many forums, including the Governor's Office, the legislature, the Florida Department of Environmental Protection (FDEP), other water management districts, and stakeholder groups, such as the Lower West Coast Water Supply Plan Advisory Committee.

For the purposes of this report, it was concluded the water management district is responsible for water resource development to attain the maximum reasonable-beneficial use of water; to assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial; and to maintain the functions of natural systems. Local users have primary responsibility for water supply development and choosing which water source options to develop to best meet their individual needs. For an option to be a water resource development project it should have the following characteristics:

- Has the opportunity to address more than one resource issue
- Addresses a variety of use classes (e.g., environment, PWS)
- Protects/enhances resource availability for allocation
- Moves water from water surplus areas to deficit areas
- Has a broad application of technology

For an option to be a water supply development project, it should have the following characteristics:

- Localized implementation of technology
- Delivery of resource to consumer
- Regionalized interconnects to consumer

The water source options were reviewed to assess their potential on a regional scale of meeting the water supply needs of the region (**Table 4**). The table indicates the ability of that option to meet the identified need, except for the inland environmental needs. For inland environmental needs, the response shows the ability of that option to offset demands, primarily from the Surficial Aquifer System (SAS), that could potentially cause drawdowns that are harmful to these natural systems. The relative ability of each

Table 4. Potential of Water Source Options in Meeting 2020 Lower West Coast Water Supply Needs.

	LWC Water Supply Needs				
Water Source Option	**Public Water Supply**	**Urban Irrigation Demands**	**Agricultural Irrigation Demands**	**Freshwater Needs of Estuarine Systems**	**Inland Environmental Needs**
Conservation	L	L	L	N/A	L
Ground Water					
Surficial Aquifer System	M	M	H	N/A	L
Intermediate Aquifer System	M	L	H	N/A	M
Floridan Aquifer System	H	L	L	N/A	H
Reclaimed Water	L	M	L	N/A	H
Regional Irrigation System	L	H	L	N/A	H
Seawater[a]	L	L	L	N/A	L
Storage					
Aquifer Storage and Recovery	M	M	M	H	M
Regional and Local Retention	M	M	M	H	H
Reservoirs	M	M	M[b]	H[b]	L
Surface Water	M	M	H	H	L

a. Not cost-effective at this time.
b. Caloosahatchee Basin only.
L=Low; M=Medium; H=High; N/A=Not Applicable.

source option in this table was based on regional volumes (supply and demand), and does not in all cases reflect the advisory committee's sense of importance of that option. For example, significant emphasis was placed on the importance of conservation and the development of a conservation ethic, although from a regional perspective, the volume of water that could be made available through conservation is relatively low compared to other water source options. At the local level, the potential of each option may change based on the specific needs of that local situation. Elements of conservation are incorporated with the use of each of these options.

These options can be considered a menu that local water users should consider using to meet their individual water needs. In many cases, several options will be used to meet the demands depending on the specific situation.

WATER SOURCE OPTIONS AND STRATEGIES

Each water source option was discussed to identify its potential for use in the LWC Planning Area. For each option, the following information is presented: definition and discussion, estimated costs to develop that option, the quantity of water potentially available from that option, and water resource development (regional) and water supply development (local) recommendations to facilitate development of that option.

Conservation

Definition and Discussion

This option incorporates water conservation measures that address demand reduction, including practices that achieve long-term permanent reductions in water use. The other water source options in this chapter make additional water available through new sources or storage. However, elements of conservation are incorporated in each of the other water source options. For example, the use of reclaimed water could be used to replace existing use of potable water or ground water for irrigation, resulting in reduced demands on these sources.

Establishing a water conservation goal or conservation ethic for this plan was discussed. One suggestion was to establish a per capita water use maximum figure that all utilities would have to meet. It was questioned how this use number would be determined, how would it be implemented, and does it actually decrease the water used. The experience of some of committee members suggests that on the whole, a reduction in per capita use is not realized because people switch to sources of water other than public water supply (PWS). Another option discussed was to establish an annual percent reduction in per capita water use. It was agreed that a comprehensive water conservation program that promotes cultivation of a conservation ethic should be implemented. This ethic would be realized through proactive, cooperative efforts between water users, utilities, local governments, and the District. The conservation program should incorporate many initiatives, including continued development and compliance with water conservation ordinances, development and implementation of effective public education programs, use of alternative water sources, and other means. This program should encompass all use types, as well as indoor and outdoor uses. Consideration of Xeriscape™ principles should be included. Less water intensive landscaping should be promoted through compliance with District Consumptive Use Permitting (CUP) conditions, Developments of Regional Impact (DRI) review, and local government compliance with new and existing ordinances and land use regulations. Retrofit measures will be evaluated with the other options and implemented as deemed appropriate.

Other discussions explored whether advanced levels of water conservation should be implemented beyond current mandatory requirements regardless of the cost or whether advanced levels should be considered as a tool or source option to be evaluated with other source options to meet the water needs of the area. It is recommended the District create a water conservation coordinator position to assist water users in evaluating water conservation.

Mandatory Requirements

The District's CUP rules require submission of a water conservation plan for each water use type. The water conservation plans must incorporate the following elements: public water suppliers (irrigation hours ordinance, Xeriscape™ landscape ordinance, ultra-low volume fixture ordinance, rain sensor device ordinance, water conservation-based rate structure, leak detection and repair program, public education program, reclaimed water feasibility); commercial/industrial users (water use audits, employee water conservation awareness programs, implementation of cost-effective conservation measures); landscape and golf course users (Xeriscape™ landscaping, rain sensor devices, irrigation hour limitations); and agricultural users (micro irrigation systems for new citrus and container nursery projects). In addition to these CUP requirements, conservation requirements are also incorporated in the Recommended Orders for DRI.

The implementation status of the conservation elements within regional PWS service areas in the LWC Planning Area is indicated in **Table 5**. Depending on the demographics and location of the service area, utilities can choose to demonstrate which water conservation activities are more cost-effective for their situation and emphasize implementation of those activities in their conservation plan.

Four of the mandatory water conservation elements require adoption of an ordinance by local governments. Generally, because of the home rule autonomy of local governments in the LWC Planning Area, each ordinance has to be adopted by each unit of local government for the measure to be fully implemented. Positive responses in the table reflect the adoption of the appropriate ordinance by the applicable local government. For investor owned utilities (private) who do not have the authority to pass ordinances, the response in the table reflects the adoption of the appropriate ordinance by the local government who has jurisdiction in that utility's service area. Utilities are not required to have a leak detection program if their unaccounted for water is less than 10 percent. An integrated program between the CUP Program and local ordinances is created when local governments have adopted the ordinances and established a compliance program.

Table 5. Implementation Status of Mandatory Water Conservation Measures.

Area	Ordinance Required				Ordinance Not Required			
	Irrigation Hours	Xeriscape / Landscape	Ultra Low Vol. Plumbing Fixture	Rain Sensor Device	Conservation Rate Structure	Utility Leak Detection /Repair	Water Conservation Public Education	Reclaimed Water Feasibility
Lee County								
Lee County Utilities	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Bonita Springs	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Island Water Assoc.	Yes	Yes	Yes	No	Yes	Yes	Yes	No
City of Fort Myers	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
Greater Pine Island	Yes	No	Yes	No	Yes	No	Yes	No
Cape Coral	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gulf Corkscrew/San Carlos	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Lehigh	Yes	No	Yes	No	Yes	No	Yes	Yes
Collier County								
Immokalee	No	Yes	Yes	Yes	Yes	No	Yes	Yes
Naples	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marco Island Utilities	No	Yes	No	Yes	No	Yes	Yes	Yes
Golden Gate	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Everglades City	Yes	No	No	Yes	Yes	No	No	Yes
Collier County Utilities	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Port of the Islands	No	Yes	Yes	Yes	No	No	Yes	No
Hendry County								
Clewiston	No	No	No	No	No	Yes	No	Yes
LaBelle	No	No	Yes	No	No	Yes	No	Yes
Port LaBelle	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Glades County								
Moore Haven	No	Yes	Yes	No	No	Yes	No	No
Charlotte County								
No Public Water Supply Systems in Planning Area								

Supplemental Measures

There are also several supplemental water conservation measures that local users could implement if they deem any of the measures to be cost-effective. Measures for urban users include indoor and outdoor retrofits and landscape audit and retrofit; PWS utilities include filter backwash recycling and distribution pressure control; and agricultural users include irrigation audits and improved scheduling, and retrofitting with a micro irrigation system.

Mobile Irrigation Labs

Mobile Irrigation Labs (MIL) are usually identified as agricultural MILs or urban MILs. Urban labs typically serve landowners with less than 10 acres of irrigated lands. These labs conduct performance evaluations for both agricultural and urban irrigation systems free of charge as a public service. The objective of the MIL program is twofold: water conservation and public education. These labs provide outreach and education to the public while not invoking a regulatory stance.

There are currently two MILs in the LWC Planning Area. An agricultural lab is headquartered at the Collier Soil and Water Conservation District (SWCD) and serves Lee, Hendry, Collier, Glades, and Charlotte counties. This lab also performs some urban evaluations. The other lab is headquartered at the Lee SWCD and performs urban evaluations. Funding for these labs has been provided by the District and the Natural Resource Conservation Service (NRCS). However, the District is eliminating their financial involvement by June 2000. Other potential funding sources are being identified, such as the Florida Department of Agriculture and Consumer Services (FDACS). The annual operating cost for an urban MIL is approximately $70,000 and $130,000 for an agriculture MIL.

Both of these labs are working at their maximum potential in terms of the number of evaluations that can be performed in a year. A backlog of several months exists for both MILs. As a result, it is recommended that a separate agricultural MIL be established at the Lee SWCD to assist the existing lab at the Collier SWCD. In addition, because of the existing and projected urban needs, it is also recommended an urban MIL be established for Collier County at the Collier SWCD. Dedicated sources of funding need to be established for the existing, as well as, the recommended MILs.

Cost-Effectiveness Analysis of the FY 1998 LWC MIL Program. The costs and potential water savings contained in the 1998 annual reports for each lab located in the LWC Planning Area are presented in **Table 6**.

Table 6. 1998 Lower West Coast MIL Cost and Estimated Water Savings.

Lab	Annual Cost	Potential Water Savings (1,000 gallons per year)	Total Cost (per 1,000 gallons)
Urban (Fort Myers)	$70,000	79,500	$.88
Agriculture (Naples)	$130,000	1,470,000	$.09
Total	$200,000	1,549,500	$.13

The cost-effectiveness and water savings will be magnified to the degree that cost savings from a single mobile lab visit extend over several years. Another environmental benefit of the urban and agricultural MIL program is the reduction of pollution from fertilizers and pesticides applied to urban landscapes and cropland. One of the key components of the MIL program, education, is not illustrated in the above tables.

Conservation Estimated Costs

The information in this section should not be interpreted as a benefit-cost analysis of these conservation measures, since no discounting is applied.

Urban Conservation Measures

Cost and water savings for several indoor and outdoor urban retrofit water conservation measures are provided in **Tables 7** and **8**.

Table 7. Representative Water Use and Cost Analysis for Retrofit Indoor Water Conservation Measures.

	Toilet	**Showerhead**
Cost/unit ($)	$200	$20
Flushes/day/person	5	--
Gallons saved/flush	1.9	--
Minutes/day/person	--	10
Gallons saved/minute	--	2
Persons/unit	2.5	2.5
Life (years)	40	10
Savings/year/unit (gallons)	8,670	9,125
Savings/unit over life (gallons)	346,800	91,250
Cost/1,000 gallons saved	$0.58	$0.22

Table 8. Representative Water Use and Cost Analysis for Retrofit Outdoor Water Conservation Measures.

	Rain Sensor
Cost/unit ($)	$68
Acres/unit	0.11
Water savings (inches/year)	70
Water savings (gallons/year)	209,070
Life (years)	10 years
Water savings/life (gallons)	2,090,700
Cost/1,000 gallons saved ($)	$0.033

Existing urban conservation efforts have resulted in significant water savings throughout the District. A review of per capita water use rates for PWS systems that have CUP allocations of 4,000 MGY or greater, and quantification of water savings as a result of reductions in per capita water use rates, indicates substantial water savings have been realized Districtwide. From 1988 to 1995, it is estimated that conservation has resulted in approximately 118 MGD reduction in PWS demands Districtwide. Major water savings are anticipated for PWS systems that have CUP allocations less than 4,000 MGY as a result of conservation also. In addition to water conservation, over 130 MGD of reclaimed water is being reused.

For the urban water conservation methods, the analysis indicated the value of the savings is greater than the costs of the methods. The savings per unit of cost associated with the outdoor conservation measures are generally greater than those for indoor conservation measures, primarily because of the larger volumes of water involved per unit affected by the outdoor conservation measures. Water savings associated with implementation of retrofit programs can be significant. For example, if 10,000 showerheads were retrofitted in an area, this action could result in a water savings of 182 MGY (0.50 MGD). Likewise, if 10,000 irrigation systems were retrofitted with rain sensor devices, this modification could result in a water savings of more than 2,000 MGY (5.73 MGD).

One potential urban conservation method is for local governments to adopt ordinances limiting the number of days per week a home could irrigate, such as odd addresses can only irrigate on Mondays and Thursdays, etc. This ordinance may achieve the same results of a rain sensor retrofit program, but at a significantly less cost. With all ordinances, mechanisms to enforce them have to be established.

Agricultural Conservation Methods

Within the agricultural industry, many efforts have been initiated to use water more efficiently. Since 1993, citrus and container nursery permittees have been required to use micro irrigation or other systems of equivalent efficiency. This requirement applies to new installations or modifications to existing irrigation systems. In addition, many existing operations have been retrofitted. These activities have resulted in more than 70 percent of the citrus in the LWC Planning Area currently using micro irrigation. Conversion of the remaining acres is occurring within the industry, where appropriate. In some situations, flood irrigation provides benefits to the hydrology of isolated wetlands through an elevated water table. In other situations, conversion to micro irrigation is not appropriate because of site-specific considerations. Some vegetable farms have also converted on a voluntary basis to a micro irrigation system.

A MIL also operates in the LWC Planning Area to assist growers in identifying additional opportunities to save water, such as water table management and determining irrigation frequency and needs. Within the industry, growers have implemented management practices that meet or exceed permitting requirements and agree favorably with University of Florida, Institute of Food and Agricultural Sciences (IFAS), recommendations. Conversion of existing flood irrigated citrus to micro irrigation is

another potential source of water savings (**Table 9**). It is estimated by UF-IFAS that the initial cost to install a micro irrigation system on citrus is $1,000 per acre and the system would have estimated annual maintenance costs of $25 per year (IFAS, 1993).

Table 9. Irrigation Costs and Water Use Savings[a] Associated with Conversion from Flood Irrigation to Micro Irrigation.

Initial cost ($/acre)	$1,000
Operating cost ($/acre)	$25
Water savings (inches/year)	8.519
Water savings (gallons per year)	230,805
Life (years)	20
Cost over life ($)	$1,500
Water savings over life	4,616,100
Cost/1,000 gallons saved ($)	$0.33

a. Addresses reductions in pumpage only and does not include return flow.
Source: IFAS and SFWMD.

The table summarizes the cost and potential water savings from one acre of conversion. This comparison used the modified Blaney-Criddle formula, and the only variable that changed between the two scenarios was the efficiency factor. Return flow for flood irrigation was not accounted for. The water savings from converting 25,000 acres of citrus from flood irrigation with a 50 percent efficiency to micro irrigation with an 85 percent efficiency could result in a water savings of approximately 6,000 MGY (15.8 MGD). The analysis illustrates that given the large volumes of water used for irrigation by agriculture, water conservation savings (which can be achieved at a reasonable cost) can be cost-effective compared to the costs of developing additional water supplies.

In addition to the water savings associated with conversion of flood irrigated citrus to micro irrigation, IFAS also has indicated that prescriptive applications of water and fertilizer can be made throughout the crop growing season with micro irrigation. However, micro irrigation systems generally have greater maintenance requirements than flood irrigation systems.

Quantity of Water Potentially Available from Conservation

Urban

Existing urban conservation efforts have resulted in significant water savings throughout the District. A review of per capita water use rates for PWS that have CUP allocations of 4,000 MGY or greater, and quantification of water savings as a result of reductions in per capita water use rates, indicates substantial water savings have been realized Districtwide. From 1988 to 1995, it is estimated that conservation has resulted in approximately 118 MGD reduction in PWS demands Districtwide. Major water savings are anticipated for PWS systems that have allocations of less than 4,000 MGY as a result of conservation also. In addition to water conservation, over 130 MGD of reclaimed water is being reused.

A 10 percent reduction in projected PWS and residential self-supplied water use from the late 1980s and early 1990s per capita uses is estimated with implementation of the appropriate mandatory conservation elements through the planning horizon. This equates to about a 17 MGD in water savings over the 20-year planning horizon. There are also retrofit opportunities in urban areas. In urban areas, the following water savings could occur per 10,000 units installed: toilet, 0.24 MGD; showerhead, 0.50 MGD; and rain sensor devices, 5.73 MGD.

Many of the urban retrofit measures need to be evaluated at the local level (water supply development). For example, utilities that have high outdoor water use may want to implement an incentive program to install rain sensor devices on existing irrigation systems. Utility per capita water use rates can be used to indicate where outdoor water use with potable water is occurring. It is recommended urban retrofit water conservation is one of several water source options that should be evaluated by the local utility/ government to meet existing and projected demands. A mandatory retrofit program is not recommended at this time.

Agriculture

Retrofitting the approximately 35,000 remaining acres of citrus that currently use flood irrigation to micro irrigation could result in a reduction in water use of up to 20 MGD. Approximately 95,000 acres currently use micro irrigation. It is recognized that conversion of existing flood irrigation systems to micro irrigation is occurring within the industry, where appropriate. It was stated that micro irrigation is not applicable in all cases because of water quality and other site specific considerations. As a result, it is recommended retrofitting of existing flood irrigation systems be done on a project-by-project basis, in addition to implementing Best Management Practices (BMPs). New citrus operations are required to install micro irrigation systems.

Overall

Additional water savings will be achieved through implementation of a comprehensive water conservation program that promotes cultivation of a conservation ethic. This ethic would be realized through proactive, cooperative efforts between water users, utilities, local governments, and the District. The comprehensive water conservation program efforts will incorporate many initiatives, including continued development and compliance with water conservation ordinances, development and implementation of public education programs, use of alternative water sources, and other means. This plan will encompass all use types, as well as, indoor and outdoor uses. The plan will incorporate consideration of Xeriscape™ principles. Less water intensive landscaping will be promoted through compliance with District CUP conditions, DRI review, and compliance with local government new and existing ordinances and land use regulations. Retrofit measures will be evaluated with the other options, and implemented as deemed appropriate. The conservation program will be developed through public meetings.

Conservation Recommendations

The following water resource development recommendations were made regarding conservation:

1. The District will develop and implement a comprehensive water conservation program to cultivate a conservation ethic in cooperation with water users, utilities, and local governments to promote water conservation and more efficient use of the water resources in the LWC Planning Area. The conservation program will incorporate continued development and compliance with water conservation ordinances, development and implementation of public education programs, use of alternative water sources, other conservation methods, and documenting new and existing water conservation efforts. The conservation program will encompass all uses, but should provide emphasis on the outside use of water and Xeriscape™ principles. The creation of a water conservation coordinator position and provisions for fiscal incentives are envisioned as potential tools to establish the water conservation plan to cultivate a conservation ethic.
2. The District will support maintaining the existing MILs (one agricultural, one urban) and encourage establishment of two additional MILs (one agricultural, one urban) in the LWC Planning Area through identification of dedicated non-District funding sources for existing and additional MILs.

The following water supply development recommendations were made regarding conservation:

1. Utilities and local governments must consider implementation and compliance with all appropriate PWS mandatory conservation elements and ordinances, where appropriate.
2. Water users and utilities must consider implementation of higher efficiency irrigation systems and other conservation measures, where appropriate.
3. Local governments and utilities must encourage the use of alternative water sources for nonpotable uses, versus using potable water.
4. Water users, utilities, and local governments must encourage maintaining the existing MILs and establishment of two additional MILs (one agricultural, one urban) in the LWC Planning Area. Assist in identifying dedicated non-District funding sources to support the MIL Program.
5. Water users and utilities must consider evaluating the need and potential of retrofit conservation measures, in addition to other source options.
6. Local governments and utilities must consider developing and implementing water conservation public education programs in cooperation with the District.
7. Local governments must consider developing and codifying, including a compliance program, land use regulations that require installation of and maintaining of less water intensive landscaping.
8. Local governments must consider developing and codifying, including a compliance program, with water conservation ordinances.

Ground Water Resources

Three major aquifer systems exist within the LWC Planning Area. These aquifers are identified as the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS). Within each of these aquifers hydraulic properties and water quality may vary both vertically and horizontally; thus, the ground water supply potential varies from one area to another. This section will focus on the aquifer properties characteristic of the LWC Planning Area, and the current water supply demand and water producing capability of each aquifer.

Surficial Aquifer System

Definition and Discussion

The Surficial Aquifer System (SAS) consists of two aquifers in the LWC Planning Area: the water table and the lower Tamiami. These aquifers are easily recharged from the surface and are separated by leaky confining units over the majority of the LWC Planning Area. Wellfields using these aquifers can be limited by the rate of recharge and water movement in the aquifer, environmental impacts, proximity to contamination sources, saltwater intrusion, and other existing legal users in the area.

Water Table. The water table aquifer is a primary source in central and northern Lee County. Within Lee County, Gulf Utilities, Lee County Green Meadows and Corkscrew, and the city of Fort Myers withdraw water from the water table aquifer. Fort Myers recharges their wellfield with water from the Caloosahatchee River via a pipeline. In addition, this aquifer supplies irrigation water for some agricultural purposes. In Hendry County, production from the water table aquifer is somewhat sporadic and is used only where no other suitable alternative is available. Typically, the water quality of this aquifer is good with the exception of areas near LaBelle and near the coast. Protection of wetlands from harm is the primary limiting factor on withdrawals from the water table aquifer.

Lower Tamiami Aquifer. The most prolific source of water in Collier County is the lower Tamiami aquifer. Bonita Springs, Collier County, the city of Naples, Immokalee, North Naples, numerous domestic self-suppliers and landscape/agricultural irrigation wells withdraw water from this source. Such heavy demands are being placed on this aquifer that potential saltwater intrusion along the coast and frequent water shortage declarations are major concerns.

Surficial Aquifer System Estimated Costs

The costs related to well construction for the SAS are provided in **Table 10**. There are additional costs for water treatment for potable uses. Many of the treatment facilities in the LWC Planning Area use lime softening for surficial aquifer water. Lime softening's cost advantages are in operating and maintenance expenses (**Table 11**), where costs are typically 20 percent less than for comparable membrane technologies. However, enhanced lime softening and membrane softening are being used by utilities to enhance or replace traditional lime softening due more stringent water quality standards. The cost of membrane softening is indicated in **Table 12**. One significant advantage over lime softening is membrane softening's effectiveness at removing organics that function as a precursor to the formation of disinfection by-products, such as trihalomethanes. .

Table 10. Surficial Aquifer System Well Costs[a].

Surficial Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Costs	$45,000	$62,000	$16,000	$.004	$.025

a. Costs based on a 16-inch diameter well and a maximum well depth of 200 feet.
Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 11. Lime Softening Treatment Costs.

Facility Size	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (Acres)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
3	$1.63	$.25	1.5	$.60	$.023
5	$1.57	$.24	2.5	$.56	$.023
10	$1.53	$.23	4.0	$.50	$.021
15	$1.26	$.19	6.0	$.41	$.020
20	$1.13	$.16	8.0	$.38	$.020

Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 12. Membrane Softening Costs.

Facility Size	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (Acres)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
3	$1.67	$.25	0.40	$.55	$.200
5	$1.52	$.23	0.40	$.53	$.200
10	$1.41	$.21	0.50	$.50	$.200
15	$1.38	$.21	0.63	$.48	$.200
20	$1.33	$.20	0.78	$.46	$.200

Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Quantity of Water Potentially Available from Surficial Aquifer System

Based on the 1994 LWC Water Supply Plan analysis and information contained in Chapter 4, from a regional perspective, increases in production from the SAS along the coast beyond existing demands appears limited due to potential wetland impacts and saltwater intrusion. However, it was concluded some further development of the SAS can be accomplished in these areas at the local level through modifications to wellfield configurations and pumping regimes with respect to locations of wetlands and saltwater. Increasing storage, through aquifer storage and recovery (ASR) or regional and local retention, will also allow further development of the SAS. As a result, additional, withdrawals from the SAS in these coastal areas will have to be evaluated on a project-by-project basis in these areas.

It was further concluded that the SAS is sufficient to meet the existing and proposed SAS projected agricultural demands through 2020 in eastern Collier County and southwestern Hendry County. The volume of water that could be withdrawn by any specific user must be determined through the District's CUP Program.

Surficial Aquifer System Recommendations

The following water resource development recommendations were made regarding the SAS:

1. The District should review existing water quality and water level monitoring for the SAS aquifers in the LWC Planning Area. Well locations and parameters should be compared with areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program will be maintained and should be expanded where appropriate. Emphasis should be placed on monitoring and analysis of water levels and salinity levels.
2. To promote consistency, the SAS concepts and criteria used in this plan should be incorporated into the District's CUP Program and other components of the District's overall water supply management responsibilities through rulemaking, such as Minimum Flows and Levels (MFLs), coastal saltwater intrusion prevention, wetland protection, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination.
3. As soon as it is feasible, but no later than the five-year update to this plan, the District shall conduct a regional evaluation using the finer grid models currently under development for renewal of CUPs of the effects the projected demands might have on these aquifers and the associated water resources. If this regional analysis identifies potential problems, the District

should revise this plan, and identify specific water resource and water supply development projects to meet the projected needs.

The following water supply development recommendations were made regarding the SAS:

1. The potential of using the SAS for new and expanded uses should be evaluated on a project-by-project basis.
2. Water users and utilities should consider development of alternative water sources that reduce reliance on the SAS.

Intermediate Aquifer System

Definition and Discussion

The Intermediate Aquifer System (IAS) consists of five zones of alternating producing and confining units, with the producing zones being the mid-Hawthorn and Sandstone aquifers.

Sandstone. Similar to the mid-Hawthorn, the Sandstone aquifer has variable thickness. The aquifer thins and eventually pinches out to the south around Alligator Alley, to the northwest in portions of Cape Coral, and to the east in the middle of Hendry County. The aquifer is thickest near Immokalee and portions of Central Lee County. The Sandstone aquifer is recharged through vertical leakance and allocation of this source has been limited by productivity of the aquifer and potential impacts to existing legal users.

Productivity of the Sandstone aquifer is highly variable where present across the LWC Planning Area. The aquifer is the sole source for Lehigh Utilities and is also used by Lee County Corkscrew and Green Meadows wellfields in addition to other sources. In portions of western Hendry County where the lower Tamiami aquifer is absent, the Sandstone aquifer is a primary source of water for agricultural irrigation; however, the limited productivity of this aquifer can not support large-scale agricultural operations in most areas. In Hendry and Lee counties, the Sandstone aquifer is suitable for irrigation purposes throughout its extent with the exception of the LaBelle area, where the aquifer has become contaminated by artesian Floridan wells.

In addition to the physical characteristics of the aquifer, withdrawals from the Sandstone aquifer have been limited by existing legal users, particularly domestic wells and other use type facilities equipped with centrifugal pumps (vacuum type pumps) and short wells. Centrifugal pumps are located on the land surface at the wellhead and withdraw water until water levels in the well fall 20 feet or greater below land surface. Submersible pumps, on the other hand, are located inside the well and can operate at great depths by pumping water up from the bottom of the well. Most large capacity wells are constructed wells with submersible pumps that can withdraw water from greater depths. During low rainfall periods, water use in these wells can cause water levels in the aquifer to drop greater than 20 feet below land surface, causing wells with centrifugal pumps to lose service. Hendry County is the only government that has adopted an ordinance

requiring installation of submersible pumps on new construction, but it is not retroactive. Replacement of these inefficient systems as they fail with submersible pumps and appropriately sized well was recognized as the most economic solution.

Mid-Hawthorn. The mid-Hawthorn aquifer is present throughout the LWC Planning Area; however, the aquifer is not always productive due to thickness variability and the presence of interbedded low permeability layers. In addition, the water quality of the aquifer decreases as it dips to the south and east, and produces only saline water in the majority of the LWC Planning Area.

In the past, the mid-Hawthorn provided water for the city of Cape Coral and the Greater Pine Island water utility; however, the limited water producing characteristics of the aquifer and water quality concerns made it an unreliable and insufficient source. The aquifer has limited use for domestic self-supply in areas of Cape Coral that are not served by city water and for small water utilities north of the Caloosahatchee River. Currently, the greatest use of the mid-Hawthorn is for domestic irrigation in Cape Coral and the area southwest of Fort Myers. Elsewhere across the LWC Planning Area, the aquifer is used sporadically for agricultural irrigation.

Intermediate Aquifer System Estimated Costs

The costs related to wellfield expansion for the IAS are provided in **Table 13**. There are additional costs for water treatment. Several of the water treatment facilities in the LWC Planning Area use lime softening for IAS water. Lime softening's cost advantages are in operating and maintenance expenses (**Table 11**), where costs are typically 10 to 20 percent less than for comparable membrane technologies. However, enhanced lime softening and membrane softening are being used by utilities to enhance or replace traditional lime softening due more stringent water quality standards. The cost of membrane softening is indicated in **Table 12**. One significant advantage over lime softening is membrane softening's effectiveness at removing organics that function as a precursor to the formation of disinfection by-products, such as trihalomethanes.

Table 13. Intermediate Aquifer System Well Costs[a].

Intermediate Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Costs	$44,000	$62,000	$16,000	$.004	$.030

a. Costs based on a 16-inch diameter well and a maximum well depth of 300 feet.
Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Quantity of Water Potentially Available from Intermediate Aquifer System

Based on the 1994 LWC Water Supply Plan analysis and information contained in Chapter 4, from a regional perspective, increases in production from the IAS beyond existing demands may be limited in some areas due to potential impacts on existing legal users and the productivity of the aquifer. Overall though, it was concluded that the IAS is sufficient to meet existing and proposed IAS projected urban and agricultural demands through 2020. In some areas, this may require modifications to wellfield configurations and pumping regimes with respect to locations of other existing legal users and demands. The volume of water that could be withdrawn by any specific user must be determined through the District's CUP Program.

Intermediate Aquifer System Recommendations

The following water resource development recommendations were made regarding the IAS:

1. The District should review existing water quality and water level monitoring for the IAS aquifers in the LWC Planning Area. Well locations and parameters should be compared with areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program will be maintained and should be expanded where appropriate. Emphasis should be placed on monitoring and analysis of water levels and salinity levels.
2. To promote consistency, the IAS concepts and criteria used in this plan should be incorporated into the District's CUP Program and other components of the District's overall water supply management responsibilities through rulemaking, such as MFLs, coastal saltwater intrusion prevention, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination.
3. As soon as feasible, but no later than the five-year update to this plan, the District shall conduct a regional evaluation using the finer grid models currently under development for renewal of CUPs, of the effects the projected demands might have on these aquifers and the associated water resources. If this regional analysis identifies potential problems, the District should revise this plan, and identify specific water resource and water supply development projects to meet the projected needs.

The following water supply development recommendations were made regarding the IAS:

1. The potential of using the IAS for new and expanded uses should be evaluated on a project-by-project basis.
2. Local governments should consider passage of an ordinance requiring installation of positive displacement submersible pumps and appropriately sized wells, especially in Charlotte, Collier, Glades, and Lee counties and in areas where water levels are projected to fall 20 feet or greater below land surface.

Floridan Aquifer System

Definition and Discussion

The Floridan Aquifer System (FAS) underlies all of Florida and portions of southern Georgia and Alabama. It is the principal source of water in Central Florida. However, the FAS yields only nonpotable water throughout most of the LWC Planning Area. The quality of water in the FAS deteriorates southward, increasing in hardness and salinity. With depth, the salinity increases, making the deeper producing zones less suitable for the water supply development than the shallower zones near the top of the aquifer. Within the LWC Planning Area, the FAS is not influenced by variations in rainfall.

Water from the shallow zones must be treated by desalination to produce a potable product. The most productive zones in the FAS are the lower Hawthorn, Suwannee, and Avon Park aquifers. Several utilities in the LWC Planning Area are currently utilizing the FAS to meet their needs including Collier County, the city of Cape Coral, Greater Pine Island, Marco Island Utilities, and the Island Water Association (Sanibel). In addition, the city of Fort Myers is in the permitting phase of development of a FAS wellfield. Elsewhere in the LWC Planning Area, these aquifers supply only a few agricultural irrigation wells. With continued growth and development in the LWC Planning Area, these aquifers will become an important source of water to meet the demand. Although desalination of the water will be necessary for potable use, blending of the raw water with higher quality water could produce a product suitable for irrigation purposes.

In the deeper zone of the FAS, areas of extremely high transmissivity exist, termed boulder zones. These zones are not used for supply sources within the LWC Planning Area due to high salinity and mineral content of the water. However, treated wastewater effluent and concentrate or residual brines from the desalination process are injected into this zone as a means of disposal. Marco Island Utilities, Collier County, Lee County, and North Fort Myers currently use deep well injection for disposal. Several other utilities are planning to use deep well injection including Immokalee and Sanibel.

In addition, zones within the upper portion of the FAS are also used for ASR. Utilities for Marco Island, Collier County and Lee County are currently using ASR.

Within the LWC Planning Area, there is limited information, data, and experience regarding the use of the FAS. Many utilities are using, or planning to use, the FAS to meet existing and future demands. There is a concern for water quality and the long-term sustainability of the FAS. However, based on existing information and experience with the FAS, significant changes in water quality are not anticipated. Consideration of development of a comprehensive FAS ground water model developed for Collier and Lee counties to be used for predictive analysis in the future by the District is recommended. Several local FAS models have been used by Cape Coral, Lee County, and others.

Currently, utilities are drilling into the FAS in the LWC Planning Area for water supply and wastewater disposal. The District should work in conjunction with water users/ utilities to gain water quality and hydraulic information during the scope of work development related to FAS well drilling programs. Information could be gained via packer tests, coring/testing of specific intervals plus geophysical logging (e.g. permeability logs) and aquifer performance testing. In most cases, these activities would be nominal compared to the actual well drilling cost. The District should consider budgeting for these items and cost-share for additional testing and data acquisition. It is also recommended that a FAS monitoring network be established to collect the data necessary to establish the relationship between water use, water levels, and water quality.

Floridan Aquifer System Estimated Costs

The costs related to wellfield development of the FAS are provided in **Table 14.** For potable water use, there are additional costs for desalination treatment, such as reverse osmosis (**Table 15**) and concentrate disposal (**Table 16**). Site-specific costs associated with reverse osmosis (RO) can vary significantly as a result of source water quality, concentrate disposal requirements, land costs, and use of existing water treatment plant infrastructure. As a general rule, RO costs are 10 to 50 percent higher than lime softening depending on the water quality of the source water. For brackish water with total dissolved solids up to 10,000 mg/L, electrodialysis and electrodialysis reversal are generally effective, but cost about five to 10 percent higher than RO treatment (Boyle Engineering, 1989).

Recent improvements in low pressure membranes has reduced the electrical costs associated with RO systems. Because RO pump power consumption is directly proportional to pressure, the low pressure systems can provide significant reductions in power consumption. The RO treatment cost presented herein do not reflect the recent improvements in membrane technology.

Quantity of Water Potentially Available from the Floridan Aquifer

The FAS has been used for many years by several of the coastal utilities in the LWC Planning Area. Several other utilities have recently initiated use of or plan to use the FAS. However, there is limited information, data, and experience on a regional scale regarding the use of the FAS in the LWC Planning Area. This plan did not incorporate the use of a FAS ground water model. A single regional FAS ground water model for the Lee and Collier area does not exist. Several local FAS models have been used by Cape Coral,

Table 14. Floridan Aquifer System Well Costs[a].

Floridan Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Costs	$115,000	$65,000	$18,000	$.004	$.040

a. Costs based on a 16-inch diameter well and a maximum Floridan well depth of 900 feet.
Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 15. Reverse Osmosis Treatment Costs[a].

Facility Size	Capital Cost (per gallon/ day capacity)	Engineering Cost (per gallon/ day capacity)	Land Requirements (Acres)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
3	$1.76	$.26	.40	$.58	$.29
5	$1.59	$.24	.40	$.54	$.29
10	$1.47	$.23	.50	$.51	$.29
15	$1.43	$.21	.63	$.50	$.29
20	$1.46	$.20	.78	$.38	$.29

a. Costs based on 2,000 mg/L TDS, 400 PSI.
Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Table 16. Concentrate Disposal Costs.

Deep Well Disposal Facility (MGD)	Capital Cost (per gallon/day capacity)	Engineering Cost (per gallon/day capacity)	Land Requirements (Acres)	Operations and Maintenance Cost (per 1,000 gallons)
3	$.73	$.109	0.5	$.040
5	$.55	$.083	0.5	$.030
10	$.50	$.075	1.0	$.028
15	$.46	$.070	2.0	$.025
20	$.38	$.056	3.0	$.020

Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Lee County and others. Additionally, this assessment did not incorporate a water quality component. Based on the existing data, knowledge, and experience in the LWC Planning Area, as well as FAS experience in other areas, it was concluded that the FAS could support all of the existing and 2020 projected demands, 56,615 MGY or 155 MGD, of the potable water utilities.

Floridan Aquifer System Recommendations

The following water resource development recommendations were made regarding the FAS:

1. The District should develop a comprehensive FAS ground water model based on all existing and future information available focusing on Lee, Collier, and possibly Hendry counties to conduct predictive analysis in the future. This model would be for use by the District and the public to evaluate both water withdrawals and storage via ASR. The model should be developed and refined with user participation and information collected through the CUP Program, water users, utilities, and other sources with regard to water quality, water levels, and hydrologic characteristics, when appropriate. Other sources that may be utilized include existing monitoring wells or wells that may be converted to monitoring wells instead of being abandoned. Appropriate well site selection should consider model boundary conditions and not be limited to the LWC Planning Area.
2. The District should expand the FAS ground water monitoring network to collect the data necessary to establish the relationship between water use, water levels, and water quality in the LWC Planning Area.
3. The District should develop and recognize partnership agreements during development of the scope of work with water users and utilities, who are or planning to develop the FAS for water supply, ASR, or wastewater effluent disposal. These partnerships will collect water quality, water level, and hydrologic information related to FAS. Information could be gained via packer tests, coring/testing of specific intervals plus geophysical logging (e.g. permeability logs), and aquifer performance testing. The District should budget for these items and cost-share for additional testing and data acquisition. The development of partnerships to share collected data will be in addition to and complementary to other data collection efforts.
4. The District should continue to work with other government entities, including the legislature, the FDEP, and the U.S. Environmental Protection Agency (USEPA) to explore

environmentally acceptable alternative desalination concentrate disposal options.

The following water supply development recommendations were made regarding the FAS:

1. Local water users should consider using the FAS to reduce demands on freshwater sources in the LWC Planning Area. Within the LWC Planning Area, the FAS is not influenced by variations in rainfall.
2. Local water users utilities should consider involving the District in development of their FAS well drilling programs for water supply, ASR, and wastewater effluent disposal to collect FAS water quality, water levels, and hydraulic information that could be used in predictive analysis and development or refinement of a FAS model.

Reclaimed Water

Definition and Discussion

Reclaimed water is water that has received at least secondary treatment and basic disinfection and is reused for a beneficial purpose after flowing out of a domestic wastewater treatment facility. Reuse is the deliberate application of reclaimed water, in compliance with FDEP and District rules, for a beneficial purpose. Potential uses of reclaimed water include landscape and agricultural irrigation, ground water recharge, industrial uses, and environmental enhancement. In 1997, the 22 LWC regional wastewater facilities treated an average of 58 MGD of wastewater, of which 37 MGD was reused. Reuse included irrigation of golf courses, residential lots, medians, and other green space, and ground water recharge via percolation ponds. Utility specific reuse applications can be found in the Support Document and Appendices of this plan.

Reclaimed water has played a significant role in meeting the needs of this region and this is expected to continue. The ground water modeling associated with the 1994 LWC Water Supply Plan found the existing and projected use of reclaimed water in the coastal portions of the LWC Planning Area to reduce demands on the SAS and IAS was very effective at reducing potential exceedances of the wetland protection and seawater intrusion criteria. The volume of reclaimed water that is reused is projected to increase as wastewater flows increase due to development, and as current/proposed reuse programs are implemented. This assessment did not anticipate additional industrial uses of reclaimed water beyond current use, especially for power plant cooling. In addition to supporting continuation of implementation of the utility plans, several options to increase the effectiveness and efficiency of these programs, especially during low rainfall periods, were discussed, including a regional irrigation water distribution system.

In addition to using reclaimed water for irrigation, the potential of using reclaimed water as a saltwater intrusion barrier was discussed. For the SAS, this use could possibly be accomplished by applying reclaimed water at land surface through percolation ponds or trenches along the coast, thereby creating a freshwater mound that would impede the movement of saltwater inland. Or, a series of injection wells could be constructed along the coast to accomplish the same result. However, compliance with federal and state underground injection requirements would have to be negotiated.

Reclaimed Water Estimated Costs

The costs associated with implementation of a reclaimed water program can vary significantly depending on the type of reuse system (i.e., ground water recharge, public access irrigation), the capacity of the reclamation facility, treatment components, the extent of the reclaimed water distribution system, and the regulatory requirements. Cost savings include negating the need for or reducing the use of alternative disposal systems, reducing the demand on ground water systems, and reducing the volume of potable water used for irrigation.

For a reuse system that utilizes reclaimed water for public access irrigation, utility representatives indicated infrastructure cost would be approximately $1.00 per 1,000 gallons, while the operation and maintenance of the system would be around $0.21 per 1,000 gallons. For public access irrigation systems using reclaimed water, the infrastructure cost would include the costs associated with construction of advanced secondary treatment components including filtration, high level disinfection facilities, online continuous water quality monitoring equipment, storage facilities, pumps, and transmission and distribution piping. Operation and maintenance costs would include chemical costs, pumping costs, and maintenance costs for the treatment and distribution system.

Quantity of Water Potentially Available from Reclaimed Water

Wastewater flows to the regional wastewater facilities in the LWC Planning Area and the potential volume of reclaimed water that could be made available is projected to increase to 97 MGD through the planning horizon, an increase of 40 MGD from 1997 flows.

The potential need in the future of applying conservation concepts to reclaimed water systems was discussed. It was suggested reuse systems should be designed to apply reclaimed water sufficiently to meet the needs of the plants, not as a disposal system.

Reclaimed Water Recommendations

There were no individual water resource development recommendations made regarding reclaimed water. Reclaimed water is one of the sources that is contained in the Regional Irrigation System section.

The following water supply development recommendations were made regarding reclaimed water:

1. Local governments should consider adopting building codes and land development regulations requiring proposed new projects exceeding a certain acreage threshold to construct infrastructure and use water from a reclaimed or irrigation water source.
2. Utilities should incorporate water supply considerations in development of their reclaimed water programs. These should include the resource efficiency concept of utilizing reclaimed water for the recharge of wellfields to minimize impacts to the resources.
3. Utilities should consider supplemental sources and interconnection with other utilities to maximize the volume of reclaimed water that is reused. ASR, among other options, should be explored to extend the use of current resources in order to meet future demands, including addressing peaks in demands or in availability of resources.

Regional Irrigation System

Definition and Discussion

To satisfy future demands for irrigation water, the concept of construction and operation of a regional irrigation distribution system as a water resource development project consistent with the provisions in Chapter 373, F.S., was discussed. The system would make irrigation water available for local supply entities/utilities to withdraw from for distribution. Several different configurations were discussed including one large regional system, several subregional systems, or on a utility by utility basis.

One concept involves interconnecting reclaimed water transmission/distribution systems of the regional wastewater treatment facilities. Using this system, reclaimed water would be transferred from areas of surplus to areas where there is not sufficient reclaimed water (and other sources) to meet demands. However, it is estimated that reclaimed water would not be sufficient to meet the demands at all times and would have to be supplemented with water from other sources, such as surface water. Storage could play a critical role in this system to store water (i.e. surface water, reclaimed water) during periods of surplus for use during periods of deficit. The development of this infrastructure may actually be built in components such that there are distinct separate systems. This development may occur as supplemental water sources and storage options are identified and may support different portions of a regional irrigation distribution system without interconnections. As a result, several subregional systems may be optimal.

There are many considerations that should be addressed in evaluating the feasibility of a regional irrigation distribution system further, including the following: the

benefits; service area and quantification of demands; institutional framework needed to establish; construction and operation of the system; funding; regulations; and water quality. Preliminary discussions resulted in the following:

Benefits. Some of the potential benefits identified were environmental protection, reduced demands on ground water systems, improved flood protection, water supply, and reduction in PWS demands, and reduced volume of wastewater effluent discharged to the Caloosahatchee River and other surface waters, and/or deep wells. Another benefit is decreasing excess freshwater discharges to estuaries by storing surface water runoff for supplemental supplies for irrigation.

Service Area and Demand Quantification. First, the service area of the system should be identified. It was recommended the service area consist of the urban areas of Lee and Collier counties. Within this area, there would be potential demands for irrigation associated with golf course development, landscaping, and other irrigation needs. In addition to the average demands associated with these uses, the seasonality of demands and supplies need to be addressed, and the lag time between irrigation demands of new developments and generation of wastewater flows should be considered.

Storage. Storage would be a critical part of the system to balance supply and demand, especially for supplemental sources such as surface water. Reservoirs and ASR were identified as potential storage options.

Supplemental Sources. Reclaimed water sources would not be sufficient to meet the projected demands. Several potential sources of supplemental water were identified including the Caloosahatchee River, the Cape Coral Canal System, Golden Gate Canal System, or from created surface water storage features in northern Lee County or in southern Charlotte County. One potential option for an ASR project is to use the Fort Myers Caloosahatchee River PWS withdrawal facilities and wellfield. This project could supplement an irrigation system. Fort Myers is in the process of permitting a Floridan aquifer wellfield to replace this surface water source.

Institutional Framework. Some type of framework to oversee design, construction, development, funding, and operation would have to be identified. The institution could vary from being a series of cooperative agreements between utilities to a taxing district. Cooperation and understanding of roles and responsibilities, including funding and regulation, will need to be agreed upon by participating entities. Utility representatives stated this understanding could be accomplished through interlocal agreements, thereby eliminating an additional layer of government.

Funding. Funding sources would have to be identified to construct an irrigation system. Several potential funding sources were identified including the District's Water Resource Development Funding Program, the District's Alternative Water Supply Grant Program, private funding, and contributions from developers, utilities, local governments, and the state. Projects that involve multiple beneficiaries and have regional benefits could qualify for funding from the District's Water Resource Development Funding Program.

Regulations. Local, regional, and state regulations that could influence an irrigation system were discussed. From the local perspective, local land use ordinances that require construction of dual water distribution systems and use of this system and rates could facilitate this system. To maximize the use and effectiveness of this system, local governments will play a significant role through requiring its use through adoption of building codes and land development ordinances, and through the regulation of rates to ensure its affordability. Regionally, the District issues CUPs that would be required of supplemental sources. At the state level, FDEP has jurisdiction concerning the quality of the water, including treatment and use.

Incentives. Incentives should be established by the District to encourage use of this system, such as longer duration permits and financial participation.

The irrigation system could involve many different aspects and features as indicated in the following example. Cape Coral and their Water Independence for Cape Coral (WICC) Program is projected to have 28 MGD of irrigation demand by 2020. Currently, this system uses a combination of reclaimed water and surface water from the network of secondary canals in Cape Coral to meet these needs. To enhance the supply sources of this program, surplus reclaimed water from Fort Myers could be transferred through the regional irrigation water system to Cape Coral. In addition, the storage in Cape Coral's surface water canal system could be increased through reservoirs and ASR. Surface water currently being discharged to tide through Matlacha Pass could be held in the system through reservoirs and other water retention methods, and potentially be used for environmental enhancement on recently purchased public lands and to augment supplies in the WICC system.

Regional Irrigation System Estimated Costs

The costs associated with construction of a regional irrigation distribution system would vary depending on the extent of the system, location of water sources, location of demands, and the location and size of distribution systems. The system could potentially be one large regional system or a series of subregional or utility systems. Under one extreme, the system could potentially consist of one large pipeline from northern Lee County to southern Collier County that would convey water for irrigation use from a variety of sources, including reclaimed water, surface water, and ground water. The system would make this water available to local distribution entities for ultimate distribution and use. ASR could play a significant role for seasonal storage and peaking in this system.

Another version could be a series of subregional systems where local distribution entities and, in most cases, wastewater utilities, interconnect their reclaimed water distribution systems. Reclaimed water would be supplemented with other sources of water, such as surface water or ground water. Seasonal storage, such as ASR, could also play a significant role in this system as well.

To move forward with this concept, it is recommended that a more detailed study beyond this regional plan be conducted to determine the most effective system to meet the

urban irrigation demands. The study should incorporate the following considerations and include participation from representatives of the utilities and users in the LWC Planning Area:

- Benefits
- Service area/demand quantification
- Storage
- Supplemental sources
- Institutional framework
- Funding
- Regulations
- Incentives

Quantity of Water Potentially Available from the Regional Irrigation System

The regional irrigation distribution system would utilize the other sources identified and quantified in this plan, including reclaimed water, ground water, and surface water. The recommended study will identify the most effective way to distribute these sources to maximize their use and satisfy the demands. Storage, primarily through ASR, is envisioned to be a key component of the ultimate system. The regional irrigation distribution system will provide a source of irrigation water in urban areas where historically used sources of ground water, primarily the SAS, will not be sufficient to meet the projected demands.

Regional Irrigation System Recommendations

The following water resource development recommendation was made regarding the regional irrigation system option:

1. The District will evaluate, with assistance from LWC local governments, water users, and utilities, the feasibility of constructing subregional irrigation water distribution system(s) and other options to meet the growing urban irrigation demands of this area. Reclaimed water should be used and where available should be incorporated into the evaluation. The results of this study should be incorporated in the update of this plan.

The following water supply development recommendations were made regarding the regional irrigation system option:

1. Local governments should consider adopting building codes and land development regulations requiring new projects, exceeding a certain acreage threshold, to construct infrastructure and use water from a reclaimed or irrigation water source.
2. Utilities should consider supplemental sources and interconnection with other utilities to maximize the volume of reclaimed water that is reused.

Seawater

Definition and Discussion

This option involves using seawater from the Gulf of Mexico as a raw water source. The Gulf of Mexico appears to be an unlimited source of water from a quantity perspective; however, removal of the salts is required before use for potable or irrigation uses. A desalination treatment technology would have to be used, such as distillation, reverse osmosis, or electrodialysis reversal (EDR).

Seawater Estimated Costs

The cost of desalination of seawater can be significant, several times the cost of reverse osmosis of the FAS. In addition, reverse osmosis and EDR facilities treating seawater would be expected to have an efficiency of 25 percent, resulting in increased concentrate/reject water disposal needs compared to desalination of the FAS.

Tampa Bay Water recently received proposals to construct a seawater desalination treatment facility initially capable of producing 25 MGD of drinking water. All four proposals first-year cost estimates for a thousand gallons of desalinated water were below $2.30 per thousand gallons (with one proposal's first year costs as low as $1.71 per thousand gallons), significantly lower than originally assumed and significantly below the costs for water at similar plants under construction elsewhere. For example, in Singapore, a 36 MGD desalination plant is estimated to cost between $7.52 and $8.77 per thousand gallons.

The Tampa Bay Water proposals total capitalization cost of the regional desalination plant ranged from $98 to $129 million for the facility (Tampa Bay Water, 1999). Some of the factors reducing the cost of this facility include colocating the water treatment plant with a power plant, using the power plant's existing cooling water discharge system for concentrate disposal, and using the power plant's existing facilities for the intake to the water treatment plant.

Quantity of Water Potentially Available from Seawater

The volume of water available from the Gulf of Mexico appears to be unlimited and could meet the needs of this region through 2020.

Seawater Recommendations

It was concluded that seawater is a potential source of water, but at this time, it is not cost-effective.

Storage

Three types of potential storage options were identified: ASR, regional retention, and reservoirs.

Aquifer Storage and Recovery

Definition and Discussion

Aquifer storage and recovery (ASR) is the underground storage of injected water into an acceptable aquifer (typically the FAS in southwest Florida) during times when water is available, and the subsequent recovery of this water during high demand periods. In other words, the aquifer acts as an underground reservoir for the injected water, reducing water loss to evaporation. Current regulations require injected water to meet drinking water standards when the receiving aquifer is classified as an Underground Source of Drinking Water (USDW) aquifer, unless an aquifer exemption is obtained from the USEPA. Obtaining an aquifer exemption is a rigorous process and few have been approved. However, the USEPA has indicated that a flexible assessment approach will be applied for systems that meet all drinking water standards except fecal coliform.

Treated Water ASR. Treated water ASR involves using potable water as the injection water. Since potable water meets the drinking water standards, this type of ASR application is more easily permitted. There are many examples in Florida, including several in the LWC Planning Area, of utilities using treated water ASR. These include Collier County and Lee County utilities.

Raw Water ASR. The use of this technology in the LWC Planning Area was discussed in combination with surface water storage. For northern Lee County, this process involves injection of surface water that has been captured and stored in a reservoir, secondary canal system, or the C-43 Canal to supplement storage and enhance irrigation water supply. The reservoir or canal system would capture excess surface water and provide sufficient volumes of water for the ASR injection cycle. Water levels in the reservoir and canals would then be supplemented with water from the ASR system during drier periods or higher demand periods; or the water could possibly be pumped directly into the irrigation distribution following appropriate treatment. Currently, there are no operating untreated surface water ASR projects in Florida.

Reclaimed Water ASR. Reclaimed water ASR would involve using reclaimed water as the injection water. Several communities in Florida are interested in reclaimed water ASR and are investigating the feasibility of such a system.

Aquifer Storage and Recovery Estimated Costs

Estimated costs for an ASR system largely depend on whether the system requires pumping equipment (**Table 17**). In the table, one system uses pressurized water from a utility. The second ASR system uses unpressurized treated water, thus requiring pumping equipment as part of the system cost (refer to the Support Document for cost

assumptions). The latter system with its associated pumping costs is more indicative of an ASR system in combination with surface water storage. There may also be additional costs for screening and filtering untreated surface water to remove floating and suspended matter.

Table 17. Aquifer Storage and Recovery System Costs[a].

System	Well Drilling Cost (Per Well)	Equipment Cost (Per Well)	Engineering Cost (Per Well)	Operations and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Treated Water at System Pressure	$250,000	$40,000	$450,000	$.005	$.08
Treated Water Requiring Pumping	$250,000	$125,000	$500,000	$.008	$.08

a. Costs based on a 900-foot, 16-inch well, with two monitoring wells using treated water.
Source: PBS&J, 1991, Water Supply Cost Estimates, converted to 1999 dollars.

Quantity of Water Potentially Available from Aquifer Storage and Recovery

The volume of water that could be made available through ASR wells depends upon several local factors, such as well yield, water availability, variability in water supply, and variability in demand. Without additional information, it is not possible to accurately estimate the water that could be available through ASR in the LWC Region. Typical storage volumes for individual wells range from 10 to 500 million gallons or 31 to 1,535 acre-feet (Pyne, 1995). Where appropriate, multiple ASR wells could be operated as a wellfield, with the capacity determined from the recharge and/or recovery periods. There are potentially many different applications of ASR; however, all store sufficient volumes (adequate volumes to meet the desired need) during times when water is available and recover it from the same well(s) when needed. The storage time is usually seasonal, but can also be diurnal, long-term, or for emergencies. The volume of water that could be made available by any specific user must be determined through the District's CUP Program.

Aquifer Storage and Recovery Recommendations

The following water resource development recommendations were made regarding ASR:

1. The District should continue working with other governmental entities including the legislature, congress, USEPA, and FDEP to explore rule changes to the federal and state Underground

Injection Control (UIC) program to allow for (and encourage) injection of untreated or partially treated ground water or surface water with ASR. The level of treatment should be compatible with the water quality in the proposed storage zone.

2. The District should develop CUP rules to address the use of the Floridan aquifer for ASR, as well as water use, and to assure compatibility between use concepts.

The following water supply development recommendation was made regarding ASR:

1. Utilities should explore ASR, among other options, to extend the use of current resources in order to meet future demands, including addressing peaks in demands or in availability of resources.

Regional and Local Retention

Definition and Discussion

Regional and local retention looks at opportunities to increase water storage in watersheds through the manipulation and modification of the drainage system that serves that area, while still maintaining an appropriate level of flood protection. Much of the LWC Planning Area was drained to support agricultural and urban development. This has resulted in lowered ground water tables that may impact natural systems, as well as water availability in these areas. The analysis in the 1994 LWC Water Supply Plan concluded that modifying water levels in existing drainage canals and eliminating unnecessary canals can significantly elevate ground water levels in some areas. Committee members stated that the work completed by the Big Cypress Basin that increased water retention in their canal system to increase ground water levels, has resulted in reducing the frequency of irrigation. Several regional and local retention projects are being proposed and implemented including the Big Cypress Basin Watershed Management Plan, East Lee County Aquifer Recharge Project, and the city of Cape Coral's Gator Slough/Reuse System Enhancement Program.

Big Cypress Basin Watershed Management Plan. The Big Cypress Basin has developed the Big Cypress Basin Watershed Management Plan (BCBWMP). The BCBWMP considers a range of alternative water management strategies to augment water supply and restore historic flowways by interbasin transfer through modifications of its primary canal network. Some of the water supply enhancement alternatives being recommended in the BCBWMP are as follows:

- Diversion of a portion of Golden Gate Main Canal flows to the Henderson Creek Basin
- Assess implementability of ASR to store Golden Gate Canal wet season flows near County Road (CR) 951

- Diversion of a portion of Corkscrew Canal system flows eastward to Golden Gate Canal north of Weir No. 5
- Retrofit Faka Union Canal Weirs No. 4 and 5 to augment recharge potential for the city of Naples East Golden Gate Wellfield
- Modify C-1 Connector and relocate Miller Canal Weir No. 3 to enhance recharge of the Collier County South Wellfield
- Restore historical flowways of the Camp Keais Strand
- Implement Cocohatchee flowway in coordination with (Corkscrew Regional Ecosystem Watershed (CREW) trust and all proposed developments in northern Collier County
- Improve CR 951 Canal to design conveyance and install water control structure to prevent overdrainage
- Explore the integration of South Golden Gate Estates (SGGE) hydrologic restoration plan pumping elements with dry season return flows in the northern reaches of the Miller and Faka Union Canals within the constraints of the SGGE restoration

East County Water Control District. The East County Water Control District (ECWCD) is located in eastern Lee County and western Hendry County, encompassing approximately 70,000 acres. The ECWCD provides drainage for Lehigh Acres and western Hendry County. The ECWCD is currently implementing their East Lee County Aquifer Recharge Project. This project involves modification and replacement of control structures to raise water levels within their district. Phase II-1 covers 9,084 acres of their district. The project involves construction of five new structures, replacement or modification of nine existing structures, and installation of two culverts. The project will reduce runoff by adding about 220 acre-feet of storage in the canals, increase detention, increase recharge to the surficial and Sandstone aquifers, and restore the hydroperiod to 400 acres of wetlands. The cost of the project is $800,000 (ECWCD, 1999).

City of Cape Coral. The city of Cape Coral is also using regional retention to increase water availability in their canal system to supplement the city's reuse irrigation system. The Gator Slough/Reuse System Enhancement Program has involved improving weir structures, raising heights of some weirs and rehabilitation of others, and vegetative removal from the slough. The project increases the amount of water stored at the end of the wet season in the Cape Coral area, reduces excessive and harmful discharges of fresh water to the Matlacha Pass Estuary, increases drainage efficiency, and reduces flooding problems in the North Fort Myers area. The city is currently in Phase III of the program, which involves installation of a horizontal well and construction of a pump station and pipeline to transfer water from one area to another. It is estimated this project will increase the effective capacity of the reuse system by 19 MGD and have a total cost of $688,500 (City of Cape Coral, 1999).

Restore Historical Flow Patterns. Historically, flows on the mainland of the LWC Planning Area sheetflowed generally towards the south and southwest to what is now the Big Cypress Basin and Ten Thousand Islands. This flow regime has been significantly modified by surface water management features and practices. The possibility of returning, to some extent, the historic drainage direction was discussed. Restoration of historic flow patterns in the Big Cypress Basin Canal network is being addressed in the Big Cypress Basin Watershed Management Plan (see Surface Water Option).

Regional and Local Retention Estimated Costs

The cost of regional and local retention can vary depending on the extent and topography of the watershed being modified, the considerations used in the initial system design and construction, the condition of existing facilities, and the existing operations protocols. The Big Cypress Basin Five-Year Capital Improvement Project costs to implement the recommendations identified earlier in this chapter are identified in **Table 18**.

Table 18. Big Cypress Basin Five-Year Capital Improvement Project Costs.

Year	Project Description	Cost ($)
2000	CR 951 Canal Improvements	2,424,000
	Cocohatchee Phase 4	1,000,000
	Henderson Creek Structure Modification	200,000
	Southern Golden Gate Estates (SGGE)	500,000
	Critical Restoration (Managerial Reserve)	534,833
	Tamiami Trail Flow Enhancement	479,136
2001	Golden Gate No. 1 Retrofit	2,500,000
	Critical Restoration (Managerial Reserve)	800,000
	Land Acquisition - Faka Union No. 5 Retrofit	50,000
	Faka Union No. 5 Retrofit	750,000
2002	Critical Restoration (Managerial Reserve)	1,000,000
	Corkscrew Canal Structures	500,000
	Land Acquisition - Faka Union No. 4	50,000
	Henderson Creek Diversion	1,500,000
2003	Faka Union No. 4 Retrofit	2,000,000
	Land Acquisition - Miller No. 3 Retrofit	50,000
	Critical Restoration (Managerial Reserve)	1,000,000
2004	C1 Connector, Miller No. 3 Modification	2,000,000
	Critical Restoration (Managerial Reserve)	1,000,000

In Cape Coral, the Gator Slough/Reuse System Enhancement Program cost $688,500 and has the potential to increase water availability by 19 MGD. The East Lee County Aquifer Recharge Project Phase II-1 will raise water levels in 9,084 acres and the project cost is $800,000.

Quantity of Water Potentially Available from Regional and Local Retention

Similar to the cost of regional and local retention, the quantity of water that could be made available from regional and local retention is site-specific. The quantity of water that could be made available will vary depending on the extent and topography of the watershed being modified, the initial considerations used in the initial system design and construction, the condition of existing facilities, and the existing operations protocols. The Cape Coral Gator Slough/Reuse System Enhancement Project has the potential to increase water availability by 19 MGD, while the East Lee County Aquifer Recharge Project Phase II-1 will raise water levels in 9,084 acres watershed and provide 220 acre-feet of additional storage in their canal system.

The Big Cypress Basin estimates that implementation of the BCBWMP will increase water storage in their system by at least 60,000 acre-feet or 19,600 MG. This was based on the additional volume of water that will be stored in the canals resulting from increased water levels. Only in SGGE was the increase in the water table (water stored in the aquifer) accounted for. Additional storage will also be created with the other projects. These projects will conserve fresh water through retention of additional fresh water in the watershed and decreasing the volume of excess water discharged to estuarine systems, increase water availability through ground water recharge, and potentially reduce the frequency of irrigation (and demands) by increasing soil moisture through increased ground water levels.

It is anticipated several other regional and local retention projects could occur over the next five years. The projects might include additional work in the Gator Slough and the Fred C. Babcock/Cecile Webb Wildlife Management Area, the southern CREW land, and projects related to implementation of the South Lee County Watershed Plan.

Regional and Local Retention Recommendations

The following water resource development recommendation was made regarding regional and local retention:

1. Regional retention projects that raise water levels through either system modifications or operation changes and benefit water supply without causing environmental harm should be considered for cost-sharing from the District's Water Resource Development funds. Potential retention projects as described above include Big Cypress Basin projects and possibly additional work in the Gator Slough and the Fred C. Babcock/ Cecile M. Webb Wildlife Management Area, the southern

CREW land, and projects related to implementation of the South Lee County Watershed Plan.

The following water supply development recommendation was made regarding regional and local retention:

1. Local and subregional entities that have responsibility for surface water management, such as the 298 Drainage Districts, should evaluate their systems for the potential of increasing storage and raising ground water levels through changes in their operations and/or modifications to control levels.

Reservoir

Definition and Discussion

This option involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. Regionally, surface water storage could be used to attenuate freshwater flows to the Caloosahatchee Estuary and other estuarine water bodies during rainy periods and to meet minimum flows during drier times. In addition, these facilities could increase surface water availability for current and projected uses, and decrease the demand on aquifer systems. However, evaporative and seepage losses could significantly effect water availability and need to be considered.

Strategically located surface water storage (primarily storage in combination with improved storm water management systems) could recharge SAS wellfields, reduce the potential for saltwater intrusion, and reduce drawdowns under wetlands. On-site storage in agricultural areas may reduce the need for water from the regional canal system and withdrawals from other water source options. Storm water reservoirs could be colocated with ASR facilities and provide a water source for the facility.

Lower East Coast Regional Water Supply Plan, LWC Water Supply Plan, and the CWMP Relationship. Lake Okeechobee is a shared resource between the Lower East Coast (LEC) Regional Water Supply Plan and the LWC Water Supply Plan serving as a limited supply source for the Caloosahatchee Basin. The CWMP supported both of these water supply plans by identifying basin issues, defining the 2020 water demands in the basin, determining the balance of these demands that would have to be met through local storage, and recommendations. The LEC Regional and the LWC water supply plans include the surface water related recommendations from the CWMP. The LWC Water Supply Plan recognizes that implementation of these recommendations will be primarily addressed through the LEC Regional Water Supply Plan and the Southwest Florida Study. Refer to the CWMP and the LEC Regional Water Supply Plan for additional information.

The CWMP and LEC Regional Water Supply Plan incorporated the proposed facilities identified in the Restudy. The facilities were titled as the Caloosahatchee/C-43 Basin Storage Reservoir(s) with ASR, and the design includes 20,000 acres of reservoir(s)

at eight-feet maximum depth and ASR wellfields consisting of 22 10-mgd wells. The purpose of these facilities is to capture basin runoff and releases from Lake Okeechobee.

Reservoir Estimated Costs

Costs associated with surface water storage vary depending on site-specific conditions of each reservoir. A site located near an existing waterway will increase the flexibility of design and management and reduce costs associated with water transmission infrastructure. Another factor related to cost would be the existing elevation of the site. Lower site elevations would allow for maximum storage for the facility while reducing costs associated with water transmission and construction excavation. The depth of the reservoir will have a large impact on the costs associated with construction. Deeper reservoirs result in higher levee elevations that can significantly increase construction costs.

Costs associated with two types of reservoirs are depicted in **Table 19**. The costs typically reflect construction for larger regional scale systems and may not be applicable to smaller project scale systems. The first is a minor facility with pumping inflow structures and levees designed to handle a maximum water depth of four feet. It also has internal levees and infrastructure to control internal flows and discharges. The second type is a major facility with similar infrastructure as the minor facility. However, the design depths for this facility range from 10 to 12 feet. Costs increase significantly for construction of higher levees but can be offset somewhat by the reduced land requirements.

Table 19. Reservoir Costs.

Reservoir Type	Construction Cost ($/acre)	Engineering/ Design Cost ($/acre)	Construction Admin. ($/acre)	Land ($/acre)	Operations and Maintenance ($/acre)
Minor Reservoir	2,842	402	318	3,000 – 6,000	118
Major Reservoir	7,980	904	451	3,000 – 6,000	105

Source: SFWMD.

Minor reservoir costs are based on actual construction bid estimates received and awarded for similar projects built in the Everglades Agricultural Area (EAA). Costs of these four Stormwater Treatment Areas (STAs) were averaged to develop the dollar per acre costs. Land costs have been changed to generally reflect land values in the LWC Planning Area ($3,000 for undeveloped/fallow land and $6,000 for land in citrus production). Major reservoir costs were developed based on the average cost estimates from the proposed Ten Mile Creek project in St. Lucie County and from the Regional Attenuation Facility Task Force Final Report, April 30, 1997, estimates for major Water Preserve Areas on the east coast.

Liner Costs. The costs to install a high-density polyethylene liner vary depending on the depth of the area to be lined. For depths of 20 feet or less, the liner will cost approximately $0.20 per square foot installed, whereas it will cost about $0.50 per square foot installed for depths between 20 and 40 feet. Eighteen inches of fill cover will cost about $3.00 per cubic yard and clearing, grubbing, and leveling (does include fill) will cost approximately $1,000 per acre. These cost estimates were based on a combination of manufacturer information, consultant experience, Everglades Construction Project experience, and Means estimating guide.

Quantity of Water Potentially Available from Reservoirs

Reservoirs are considered more of a management option in that these systems allow more efficient use of other sources, such as surface water. Please refer to other source option descriptions for an estimate regarding the quantity of water that potentially could be made available.

Reservoir Recommendations

No water resource development recommendations were made regarding reservoirs. Regional and distributed small scale reservoirs are only being recommended in the Caloosahatchee Basin. Refer to the Surface Water section regarding this recommendation and others from the CWMP recommendations.

The following water supply development recommendation was made regarding reservoirs:

1. Agricultural operations should incorporate water conservation and water supply considerations in design of new or retrofitted surface water management systems.

Surface Water

Definition and Discussion

This option involves the use of surface water as a supply source. Surface water bodies in the LWC Planning Area include lakes, rivers, and canals. Lake Trafford and Lake Hicpochee are the two largest lakes within the LWC Planning Area, but neither is considered a reliable source of water supply. Currently, surface water is a major supply source in the Caloosahatchee Basin for agricultural irrigation and two PWS utilities (Fort Myers and Lee County utilities).

Several potential sources of surface water were identified that could be considered to meet future demands. Most of these potential sources convey water from inland areas and discharge to estuarine systems along the coast. The volume of surface water that could be considered available from these sources for human uses would be the volume that is discharged to the estuary that is considered harmful to the receiving water body and

exceeds the needs of the estuary. Water would usually be available during the wet season from these sources, but limited during the dry season.

The LWC Planning Area has been impacted significantly by development of the land to allow for agricultural and urban uses. This development has changed the volume and timing of surface water runoff, which has had a negative impact on the estuarine systems. This runoff condition is being evaluated throughout the LWC Planning Area. It is recommended that as solutions are developed to these conditions the potential to increase surface water availability be considered as, including storage systems, such as ASR and reservoirs, and alternative uses for this excess water. Potential sources of surface water include the Caloosahatchee River (C-43 Canal), the Golden Gate and Faka Union Canal System in Collier County, and several others in Lee County.

Caloosahatchee River

The Caloosahatchee River is the primary source of surface water in the region. The river is supplied by inflows from Lake Okeechobee and rainfall and runoff within its own basin. The freshwater portion of the river (C-43 Canal) extends eastward from the Franklin Lock and Dam (S-79) towards Lake Okeechobee. West of S-79, the river mixes with estuarine water as it empties into the Gulf of Mexico. The C-43 Canal is a significant source for agriculture water supply and to a much lesser extent, for PWS. MFLs criteria are also under development for the Caloosahatchee Estuary. Water availability from the C-43 Canal was addressed in the CWMP.

Caloosahatchee Water Management Plan

The CWMP supported both the LEC Regional and LWC water supply plans by identifying issues within the Caloosahatchee Basin, defining the 2020 water demands in the basin, determining the balance of these demands that could not be met from Lake Okeechobee and that would have to be met through local means, and making recommendations to meet the projected water demands in the basin. The LEC Regional and LWC Water Supply Plans include the surface water related recommendations from the CWMP. The LWC Water Supply Plan recognizes that implementation of these recommendations will be primarily addressed through the LEC Regional Water Supply Plan, the Southwest Florida Study, and the CERP.

The CWMP combines five storage options (regional and distributed reservoirs, ASR, backpumping, a water control structure on the C-43 Canal, and water harvesting) into nine potential alternatives varying from do nothing to do everything. The components are described in Chapter 4 of the CWMP Planning Document and in the CWMP Support Document. The nine alternatives, which were identified for assessment following preliminary screening are as follows:

- Do Nothing (A.01)
- Restudy Alternative (A.02)
- Restudy Without Backpumping (A.03)

- Regional and Distributed Small-scale Reservoirs (A.04)
- Regional Reservoir Only (A.05)
- Water Harvesting (A.06)
- Regional and Distributed Small-Scale Reservoirs with New Structure (S-78.5) (A.07)
- Regional Reservoir with New Structure (S-78.5) (A.08)
- Do Everything (A.09)

Do Nothing (A.01). The Do Nothing Alternative represents the status quo and involves a projection of demands including environmental, agricultural, and urban to 2020 conditions while maintaining the current sources and infrastructure within the Caloosahatchee Basin.

Restudy Alternative (A.02). The Restudy Alternative is based on the recommended Restudy Alternative D13R (USACE and SFWMD, 1999). It is made up of the components described in the D13R for the Caloosahatchee Basin and consists of 160,000 acre-foot reservoir, 44 ASR wells (up to 5 MGD capacity each) and backpumping of excess runoff to Lake Okeechobee following treatment in a STA.

Restudy without Backpumping Alternative (A.03). The Restudy Without Backpumping Alternative is the same as Alternative A.02 (Restudy Alternative) with the backpumping component removed. The Caloosahatchee Advisory Committee suggested this alternative.

Regional and Distributed Small-Scale Reservoirs Alternative (A.04). The Regional and Distributed Small-Scale Reservoirs Alternative models one large regional and distributed smaller reservoirs. The regional reservoir is modeled with the same parameters and assumptions as in Alternative A.02 (Restudy Alternative) with additional distributed reservoirs located in the east and west basins, and on the north and south sides of the river to supply irrigation demands.

Regional Reservoir Alternative (A.05). The Regional Reservoir Alternative considered the option of meeting the storage requirements within the Caloosahatchee Basin from a regional reservoir system. The regional reservoir would be similar to the regional reservoir considered for the Restudy Alternative (A.02), but would be larger in order to provide the storage that is provided by the ASR facility in Alternative A.02.

Water Harvesting Alternative (A.06). The Water Harvesting Alternative investigated the volume of water that would be generated by returning some of the drained area north of the river to predevelopment conditions. Water harvesting was suggested as a viable low cost method of detaining water and reducing the size of the regional reservoir system.

Regional and Distributed Small-Scale Reservoirs with a New Structure Alternative (A.07). The Regional and Distributed Small-Scale Reservoirs with a New Structure Alternative considered a regional reservoir system, smaller distributed reservoirs, and a new structure situated between S-78 and S-79 upstream of LaBelle. As part of this alternative, the existing structure at S-78 would be raised by approximately three feet from 11 feet to 14 feet (NGVD).

Regional Reservoir with a New Structure Alternative (A.08). The Regional Reservoir with a New Structure Alternative considered a regional reservoir system, and a new structure situated between S-78 and S-79 upstream of LaBelle. The structure is as described in Alternative A.07.

Do Everything Alternative (A.09). The Do Everything Alternative, as the name implies, considered all the storage components identified.

The results of this analysis indicated the existing configuration and water deliveries to the C-43 Canal are not sufficient to meet the projected water demands. The results also indicated that water availability with implementation of the CERP recommendations would not be sufficient to meet the 2020 demands. Alternative 9, which represents a combination of the five storage options, provided sufficient storage to meet the projected demands. Development of a preferred alternative will be undertaken as part of the Southwest Florida Study. These recommendations will be primarily addressed through the LEC Regional Water Supply Plan, the Southwest Florida Study, and the CERP. Refer to the CWMP the LEC Regional Water Supply Plan, and the CERP for additional information.

Golden Gate and Faka Union Canal System

The Golden Gate Canal and the Faka Union Canal System in the Big Cypress Basin provide drainage to a 330 square mile watershed, with combined average daily outflows of 560 cfs (362 MGD) and an average wet season flow of 1,020 cfs (660 MGD). In spite of control of flow through a series of water control structures, significant volumes of freshwater are lost to tide. This has resulted in undesirable salinity fluctuations in Naples Bay and Faka Union Bay estuaries. Big Cypress Basin presently operates three back pumping facilities to capture some of the fresh water outflows during the dry season to stimulate regional ground water recharge. The wet season flows of these canals can potentially be utilized for water supply needs if storage, such as ASR, is provided.

Other Potential Surface Water Sources

Several other potential surface water bodies were identified that should be evaluated for future water supply, including the Orange River, Ten Mile Canal, Six Mile Cypress Slough, Imperial River, and Kehl Canal. These were primarily discussed as supplemental sources to reclaimed water systems when water is available and as potential sources to capture and store (mostly through ASR) excess surface water during the wet season for use during the dry season.

An analysis of estuarine and other environmental needs similar to the analysis conducted on the Caloosahatchee River is necessary prior to using these sources for human needs. These systems need to be analyzed for availability of water and in doing so, the rate and no harm type contribution. Establishment of MFLs should be considered where appropriate. The vehicle for this determination could be the Southwest Florida Study. No recommendation is made regarding the specific water availability from these systems at this time. The identified use in this plan for any excess water would be to supplement other water sources to meet projected irrigation demands. The schedules for conducting the regional irrigation distribution feasibility study and the schedule for the Southwest Florida Study are relatively concurrent. There are sufficient quantities of water from other sources that could be used while these determinations are being done.

Several considerations need to be addressed in evaluating surface water availability, including seasonal fluctuations in water availability, environmental needs both upstream and downstream, established MFLs, storage options, and restoration efforts. Several critical restoration projects have been authorized in southwest Florida, including the Southern Corkscrew Regional Ecosystem Watershed (CREW) Project, Addition/Imperial River Flowway, and the Lake Trafford Restoration Project.

Orange River. The Orange River is located northeast of Fort Myers in west-Central Lee County. The Orange River flows northwest and outflows to the Caloosahatchee Estuary and receives inflows from the Able Canal, which provides drainage for Lehigh Acres.

Ten Mile Canal. Ten Mile Canal is located in the Estero Bay Basin in southern Lee County. Its runs north-south through the urbanized areas of south Fort Myers. Ten Mile Canal flows south into Mullock Creek, which discharges into Estero Bay. Ten Mile Creek is not tidally influenced and receives inflows from Six Mile Cypress Slough.

Six Mile Cypress Slough. Six Mile Cypress Slough is publicly owned, is about nine miles long, and encompasses approximately 2,000 acres. It flows southwesterly from southeast of the city of Fort Myers through a water control structure into Ten Mile Canal. Currently, Lee County is in the process of restoring this system.

Imperial River. The Imperial River is located in southern Lee County and flows through the Bonita Springs area. The Imperial River has been the center of several recent flooding events. The development of storage for use as part of an irrigation system could enhance, to some degree, flood protection in this area. The Imperial River receives water from the Kehl Canal.

Kehl Canal. The Kehl Canal lies east of the Imperial River in southern Lee County. The Kehl Canal discharges to the Imperial River. In recent times, this canal has received high flows that resulted in flooding of its banks and the Bonita Springs area. The capturing of high flows for storage may have additional flood protection benefits.

Surface Water Estimated Costs

The existing and potential projected uses for surface water in the LWC Planning Area include agricultural irrigation, potable water supply, and urban irrigation. Potential costs associated with use of this option include the cost of facilities to withdraw water, storage if appropriate, and treatment. Withdrawal costs would include the cost of intake piping and pumping. The costs associated with different storage options are identified in the storage section of this chapter. Treatment cost varies based on the use type. For potable water supply, Lee County is proposing to enhanced membrane softening treatment for water from the C-43 Canal. Membrane softening costs are listed in **Table 12**. For irrigation uses, some filtration would be required to remove suspended matter in the water that could potentially clog irrigation heads.

In addition to the required pumping appurtenances, filtration and disinfection would be required for water that would be used to supplement reclaimed water supplies. A canal pump station in Cape Coral, used to supplement reclaimed water supplies to their residential irrigation system, cost approximately $1.9 million a couple of years ago. This included a 20 MGD capacity pump station with auxiliary power generation equipment, strainer type filtration, disinfection, and a house structure to match the surrounding neighborhood. Recent reuse rule changes may effect some of these components for a similar structure built today.

Quantity of Water Potentially Available from Surface Water

Caloosahatchee River

Inflows to the Caloosahatchee Basin come from three major sources: precipitation, releases from Lake Okeechobee, and ground water seepage. The principle water use/loss mechanisms are evaporation, evapotranspiration (including irrigation), discharge to the estuary for environmental needs, and PWS.

Based on the recommended developments of water management and storage infrastructure to effectively capture and store the surface water flows in the Caloosahatchee Basin, the projected surface water needs of this basin and the estuary can be met. Supplemental agricultural demands from surface water sources within the basin are projected to increase from 230,000 acre-feet per year (200 MGD) based on 1995 land use to approximately 320,000 acre-feet per year (285 MGD) on average based on projected 2020 land use. PWS needs from the Caloosahatchee River are projected to increase from 13,000 (12 MGD) in 1995 to 18,000 acre-feet per year (16 MGD) on average by 2020. The environmental needs of the Caloosahatchee Estuary have been estimated at 450,000 acre-feet (400 MGD) while average flows to the estuary are estimated to be approximately 650,000 acre-feet per year (580 MGD) on average. Flow to the estuary in excess of the needs can, therefore, be as high as 200,000 acre-feet per year (180 MGD) on average. It was concluded that the evaluated components, once constructed, will be adequate to meet the demands during a 1-in-10 year drought condition.

Golden Gate and Faka Union Canal System

The Golden Gate Canal and the Faka Union Canal System in the Big Cypress Basin have combined average daily outflows of 560 cfs (362 MGD) and an average wet season flow of 1,020 cfs (660 MGD). This has resulted in undesirable salinity fluctuations in Naples Bay and Faka Union Bay estuaries. Big Cypress Basin presently operates three backpumping facilities to capture some of the freshwater outflows during the dry season to stimulate regional ground water recharge. There is significant potential for utilizing the wet season flows of these canals for water supply needs if storage is provided, such as ASR. The environmental needs of the estuarine systems and the SGGE Restoration Project will need to be identified to determine the specific volume of water available.

Other Potential Sources

Several other potential surface water bodies were identified that should be evaluated for water availability, including Orange River, Ten Mile Canal, Six Mile Cypress Slough, the Imperial River, and Kehl Canal. An analysis of estuarine and other environmental needs similar to the analysis conducted on the Caloosahatchee River is necessary and recommended in this plan prior to using these sources for human needs. These systems need to be analyzed for availability of water and in doing so, the rate and no harm type contribution, as well as the MFLs for the estuarine system would have to be defined. No recommendation is made at this time regarding the specific water availability from these systems.

Surface Water Recommendations

Water resource development recommendations were made regarding surface water These include the recommendations from the CWMP, as well as those identified during the LWC water supply planning process:

1. Recommendation from the CWMP - Caloosahatchee River ASR Pilot Project: The District should work cooperatively with the USACE to site, design, construct, and operate a pilot regional ASR project. Recovery performance and additional information obtained from the construction of and cycle testing at this facility will guide the design of the regional ASR wellfield.
2. Recommendation from the CWMP - The SFWMD should cooperate with the U.S. Army Corps of Engineers (USACE) in development of the PIR, design, construction, and operation of a regional reservoir and ASR project within the Caloosahatchee Basin. A comprehensive geologic and geotechnical investigation should be completed as a part of the PIR to provide the information needed to size and design the reservoir. Development of the PIR, land acquisition, design, and plans and specifications should be completed by 2005. Construction should be initiated in 2005.

3. Recommendation from the CWMP - The SFWMD should work in cooperation with the USACE to initiate and complete the Southwest Florida Study by 2005 as recommended in the CERP. The modeling work that has been completed as a part of the CWMP should be used as the basis for development of a preferred alternative to meet the demands within the Caloosahatchee Basin in 2020. The primary purpose of the Southwest Florida Study should be to provide a framework in which to address the health of aquatic ecosystems; water flows; water quality (including appropriate pollution reduction targets); water supply; flood protection; wildlife and biological diversity; and natural habitat. Evaluations involving surface water availability for water supply purposes should be based on providing a 1-in-10 level of certainty from surface water as an optimal goal.

4. Recommendation from CWMP - Establish MFLs for the Caloosahatchee River and Estuary by December 2000 in accordance with Section 373.042, F.S. The MFLs will be incorporated into rulemaking.

5. Recommendation from CWMP - The Well Abandonment Program that was administered by the SFWMD (ended in 1991) was a voluntary program that identified abandoned artesian wells, geophysically logged them, and plugged or rehabilitated the wells, as necessary, to prevent deterioration of the SAS through upland leakage or discharge at land surface. The program documentation indicates that there are unplugged wells remaining within the Caloosahatchee Basin that if plugged, could contribute an estimated net flow of 50,000-acre feet per year to the water budget of the Caloosahatchee Basin. In addition, the Florida Geological Survey, Bureau of Oil and Gas, have identified oil test wells within the Caloosahatchee Basin that have not been adequately plugged. Additional effort should be made to locate and properly abandon the free flowing wells in the Caloosahatchee Basin. The SFWMD should work with local and state officials to locate uncontrolled abandoned wells and identify plugging strategies and applicable funding sources for proper plugging of the wells.

6. Recommendation from CWMP - Saline water (in excess of 250 milligrams per liter [mg/L]) has been a recurring problem for the potable water intakes in the Caloosahatchee River (approximately one-mile upstream of S-79). During extended periods of low-flow, the chloride content of the surface water increases well beyond the recommended limit of 250 mg/L for drinking water. The actual number of times that releases have been made from Lake Okeechobee in response to saltwater in

excess of 250 mg/L is relatively few. A number of alternatives to these releases warrant further investigation. Among these are moving the intake farther upstream, modifications to the structure, limiting lockages during low flow periods, and improved maintenance and operation of the bubble curtain. Future freshwater releases for environmental purposes may also minimize saltwater influence. Additional analysis of the saline water problem should be initiated.

7. Recommendation from CWMP - The SFWMD should continue working with the legislature, USEPA, and FDEP to explore rule changes to the federal and state Underground Injection Control program to allow for (and encourage) injection of untreated or partially treated ground water or surface water with ASR. The level of treatment should be compatible with the water quality in the proposed storage zone.
8. Recommendation from LWC Water Supply Plan - The Southwest Florida Study should evaluate estuary and other environmental needs for the flows from surface water bodies including: Orange River/Harn's Marsh/East County Water Control District (Lehigh Canals), Imperial River/Kehl Canal, Ten Mile Canal/Mullock Creek, Golden Gate Canal/Gordon River, and the Faka Union Canal. The results of this evaluation should be incorporated into future LWC Water Supply Plan updates.

The following water supply development recommendation was made regarding surface water:

1. Identify potential sources and amounts of surface water available that could be used to meet projected demands.

Unit Production Costs for Water Source Option Development

Cost information has been provided throughout this chapter that could be used to estimate the planning level total cost for different capacities for each of the water source options. This cost information was presented using the same categories in order to provide comparable cost estimates. The water supply cost estimates allow a relative comparison of the total cost for each alternative considered. To ensure this internal comparability, the following cost estimate categories were used:

- Capital cost (including well drilling cost, construction cost, equipment cost, land cost and engineering cost)
- Operation and maintenance cost (including energy cost)

Total costs, which account for all expenditures, are an estimate of life-cycle costs and are a function of the total capital costs, the expected life of the constructed facilities,

the time value of money, and annual operation and maintenance costs. These cost estimates aid in comparing alternatives with differing economic characteristics.

This cost information was used to develop planning level unit production costs for each water source option (**Table 20**). The unit production cost equals the total costs divided by water production, expressed in dollars per 1,000 gallons. For all source options, the time value of money equals 6 5/8 percent per year, consistent with discount rates used by the USACE. A 30-year fixed capital asset life was assumed and an operating level of 70 percent of capacity was used. To arrive at the unit production costs over the 20-year planning horizon, the unused capital value at the end of the 20-year planning horizon (one-third of total capital value based on straight-line depreciation) was deducted from the expenditure based costs. All costs are expressed in constant 1999 dollars.

Because these cost criteria were used in all economic calculations, the relative cost between source options is comparable. However, the unit production costs presented here are not necessarily directly comparable to unit production costs developed in other investigations. To be considered comparable, cost estimates must use the same economic criteria.

For most of the water source options, general assumptions were used to generate the unit cost information. These costs can be highly variable depending on the specific situations of users, as reflected in the cost ranges for some of the options. In addition, the availability of water was not considered. Water supply costs vary for a number of reasons including, but not limited to the following:

1. Hydrogeologic and hydrologic conditions relating to the depth to the aquifer, the yield of the aquifer, the water availability, the degree of treatment required, etc.
2. Economies to scale in spreading fixed costs over a larger volume of output
3. In an area of slow growth a larger percentage of capacity can be utilized than in areas of more rapid growth
4. Depending upon the quality of the raw water and the nature of the end use, different levels of treatment will be needed

Table 20. Summary of Unit Production Costs for Water Source Options.[6]

Water Source Option	Water Production Range	Unit Production Costs[1] ($/1,000 gallons)
Conservation (indoor)	Variable	$.16 - $.31
Conservation (outdoor)	Variable	$.02 - $.71
Ground Water		
Surficial Aquifer - withdrawal only (no treatment)	3 - 20 MGD	$.02 - $.03
Surficial Aquifer w/lime softening	3 - 20 MGD	$.41 - $.71
Surficial Aquifer w/membrane softening[4]	3 - 20 MGD	$.70 - $.81
Intermediate Aquifer - withdrawal only (no treatment)	3 - 20 MGD	$.04 - $.07
Intermediate Aquifer w/lime softening	3 - 20 MGD	$.43 - $.72
Intermediate Aquifer w/membrane softening[4]	3 - 20 MGD	$.75 - $.83
Floridan Aquifer - withdrawal only (no treatment)	3 - 20 MGD	$.03 - $.07
Floridan Aquifer w/reverse osmosis[4]	3 - 20 MGD	$.73 - $.93
Reclaimed Water	Variable	$.40 - $2.20
Seawater w/reverse osmosis	Variable	$1.71 - $8.77[2]
Storage		
ASR	3 - 20 MGD	$.08 - $.10
Reservoir (4 feet deep)	6,000 acre-feet	$.15[3]
Reservoir (8 feet deep)	12,000 acre-feet	$.12[3]
Surface Water - withdrawal only (no treatment)	Variable	$.02 - $.15[5]
Surface Water w/lime softening	3 - 20 MGD	$.60 - $.89[5]
Surface Water w/membrane softening	3 - 20 MGD	$.81 - $.97[5]

[1] All costs are over a 30-year project life. Because of economies of scale, the lower cost represents cost per unit for the greater capacity.
[2] Lower cost in the range reflects a high degree of special site-specific circumstances.
[3] This represents the cost based on physical volume. Per unit cost for water made available is highly dependent on operational regimes.
[4] Deep well injection is used for concentrate disposal.
[5] Assumes withdrawal from existing surface water source, such as a canal or existing surface water management system. Cost could be significantly higher if separate storage area is required.
[6] These are planning level unit production costs. The relative cost between source options is comparable. However, the unit production costs presented here are not necessarily directly comparable to unit production costs developed in other investigations. To be considered comparable, cost estimates must use the same economic criteria.

Related Strategies

The LWC Water Supply Plan addresses various supply and demand parameters that serve to define the quantity of water that is available for allocation. These parameters are appropriate for use in the CUP Program. Additional LWC Water Supply Plan parameters related to environmental and water shortage are also appropriate for rulemaking and are related to the District's overall water management program, beyond CUP Program considerations. Thus, the plan recommends rulemaking for the purpose of incorporating salient portions of this plan in the CUP Program and other components of District's overall water supply management scheme. Matters that are recommended for rulemaking consideration include (1) level of certainty, (2) resource protection criteria, (3) water shortage triggers, (4) MFLs for the Caloosahatchee Estuary and the LWC aquifer system; and (5) special designation area amendments, including Reduced Threshold Areas (RTAs) and Water Resource Caution Areas (WRCAs).

RTAs are areas of the District where the volume average day demand of usage delineating a general permit from an individual permit has been reduced from 100,000 gallons per day (GPD) to 10,000 GPD. RTAs have typically been designated in resource depleted areas where there is an established history of substandard water quality, saline water movement, or the lack of water availability to meet the projected needs of a region. Based on the results of the LWC Water Supply Plan, it is recommended that the RTA designations (Lee County, coastal Collier County, and the Muse/LaBelle area of Glades and Hendry counties) in the LWC Planning Area and the RTA concept be eliminated in the LWC Planning Area.

WRCAs were formerly referred to as Critical Water Supply Problem Areas and are generally defined as areas that have existing water resource problems or areas in which water resource problems are projected to develop over the next 20 years. Currently, the entire LWC Planning Area is designated as a WRCA in Chapter 40E-23, F.A.C. Based on this assessment and the 2020 projected demands, it is recommended that the agricultural areas of southwestern Hendry County and eastern Collier County be removed from this designation; and that the Caloosahatchee Basin and the coastal utility service areas of Lee and Collier counties remain in this designation as indicated in **Figure 7**. This designation generally reflects the eastern boundary of the 2020 utility service area boundaries westward and the portion of the LWC Planning Area that is within the Lake Okeechobee Service Area. Diversification of supply sources is occurring within some of these areas and it is anticipated these areas will be removed from the designation in the future once sufficient diversification has been realized.

Additionally, the District will coordinate the implementation of the LWC Water Supply Plan with local governments/utilities, the CWMP, the LEC Regional Water Supply Plan, the Southwest Florida Study, the CERP, and other related efforts to promote compatibility.

Technical information generated in the planning process will also be made available to the public. Specifically, the District will make available and maintain the ground water models, data, and other relative information referenced in this plan to the

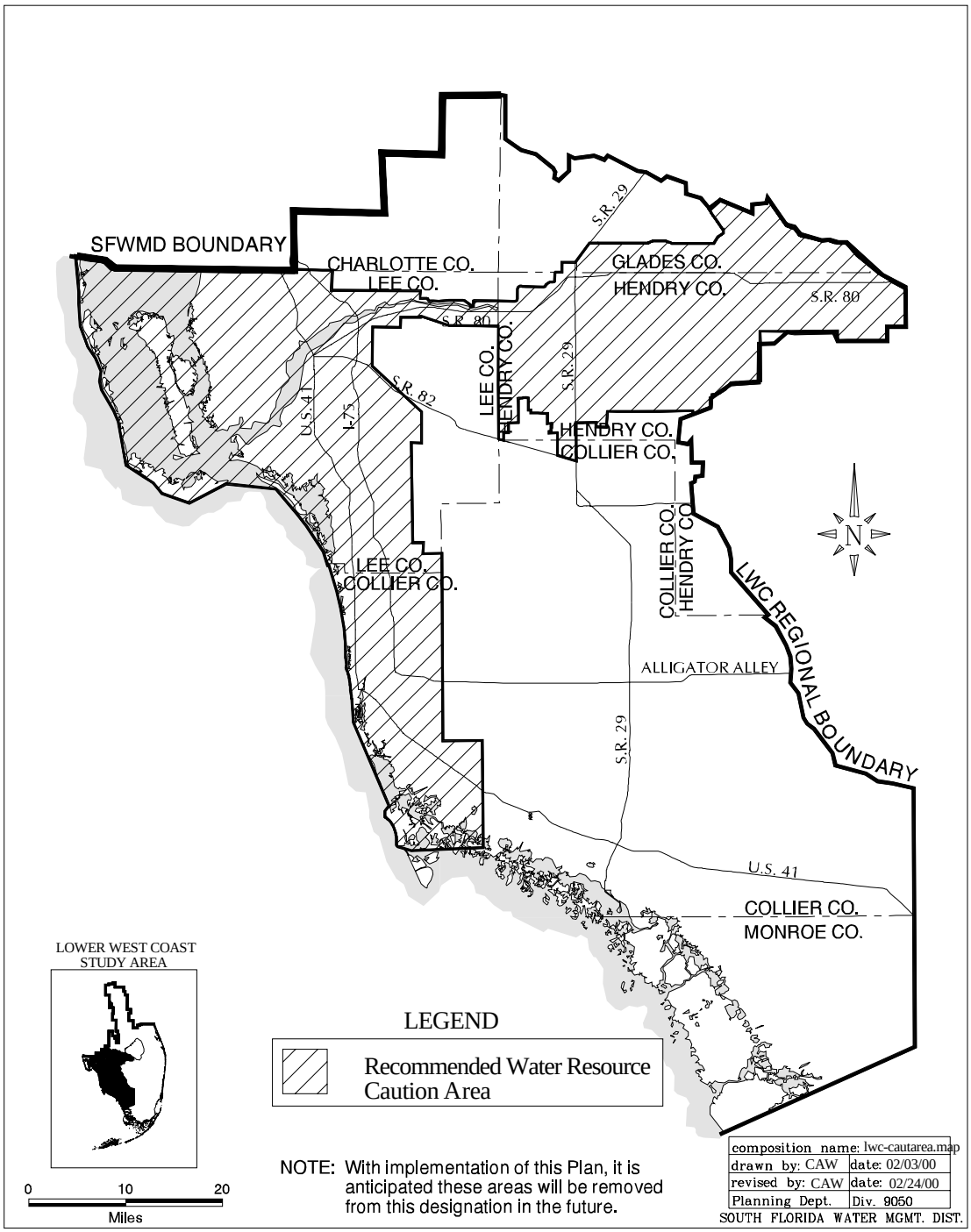


Figure 7. Recommended Lower West Coast Water Resource Caution Areas.

public. It is also recommended the District continue the existing wetland drawdown study that was initiated in 1997.

Related Strategies Recommendations

This section includes those recommended efforts that apply to several of the options or could not be associated with a specific source option.

1. To promote consistency, the concepts and guidelines used in this plan should be incorporated as criteria into the District's water management programs through rulemaking or other implementation processes.
2. The District will conduct a public rulemaking process in accordance with Chapter 120, F.S., for the purpose of incorporating salient portions of this plan into the CUP Program and other components of District's overall water supply management responsibilities. Matters that are recommended for rulemaking consideration include (1) level of certainty, (2) resource protection criteria, (3) water shortage triggers, (4) MFLs for the Caloosahatchee River and Estuary, and the LWC aquifer system; and (5) special designation area amendments, including RTAs and WRCAs.
3. Establish MFLs for the Caloosahatchee River and Estuary and the LWC Aquifer Systems by December 2000 in accordance with Section 373.042, F.S.
4. The District should continue working with other government entities including the legislature, USEPA, and FDEP to accomplish changes in ASR and desalination disposal regulations.
5. The District should continue the Wetlands Drawdown Study and use the knowledge gained during the rulemaking process. The CUP Program should continue to use the existing wetland protection guidelines until such time as rulemaking causes a change.
6. The District will make the ground water models, data, and other relative information referenced in this plan available to the public.

CONCLUSIONS

This section presents the conclusions of the LWC Water Supply Plan, as well as the conclusions of the CWMP.

Lower West Coast Water Supply Plan

The results of this regional assessment indicate that with diversification of supply sources, the projected 2020 water demands in the LWC Planning Area can be met during a 1-in-10 year drought condition while not causing harm to the water resources and natural systems. In the eastern portions (except the Caloosahatchee Basin) of the LWC Planning Area, it was concluded that existing ground water sources are sufficient to meet the 2020 projected demands with minimal potential impacts. Some modifications to wellfield configurations and well operation regimes will need to be done on a project-by-project basis to avoid potential impacts to natural systems and other existing legal users.

In the western portions of the LWC Planning Area, it was concluded that historically used sources of water, primarily the SAS in the urban coastal areas, are not adequate to meet the growing needs of the LWC Planning Area during a 1-in-10 year drought condition due to potential impacts on wetlands and the potential for saltwater intrusion. However, with diversification of supply sources (e.g., Floridan aquifer and increased use of reclaimed water and surface water), it was concluded the projected 2020 water demands can be met. Many of the utilities have begun to diversify supply sources, including using the Floridan aquifer, increasing the use of reclaimed water, and using ASR for storage. The use of reclaimed water and supplemental sources was emphasized to meet the projected irrigation demands in the urban areas, especially along the coast. Additional work is necessary to identify the most effective method to make these sources available for use at the local level, including storage. A regional or subregional irrigation distribution system was discussed and further analysis is supported.

Surface water availability from the C-43 Canal, as well as modifying freshwater discharges to the Caloosahatchee Estuary to maintain a healthy estuarine system, was addressed by the CWMP. The results of the CWMP and the surface water analysis verify that the surface water availability in the C-43 Canal during a 1-in-10 year drought condition under the existing canal and storage network is not adequate to support the projected water supply demands and environmental needs. Sufficient volumes of water to meet the projected demands have been identified, but the timing of water availability has to addressed. These issues will be resolved principally through storage and capture of rainfall/runoff in conjunction with the use of the C-43 Canal and water from Lake Okeechobee. Potential options will be further analyzed in the Southwest Florida Study.

The options in this plan should serve as a menu that local water users can consider to meet their needs. It was concluded that the 2020 water needs of this region (excluding the Caloosahatchee Basin) during a 1-in-10 year drought event, can be met without major water resource development construction projects. However, funding from outside the region may be necessary to implement some projects, such as the regional irrigation

system if it is determined to be the most effective method to make irrigation water available for use.

It is recommended the District review existing levels of water quality monitoring for the SAS and IAS in the LWC Planning Area with respect to areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program should be expanded where appropriate.

To promote consistency with other District programs, the concepts and criteria used in this plan should be incorporated into the District's CUP Program through rulemaking, such as MFLs, coastal saltwater intrusion prevention, wetland protection, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination. At this time, the resource protection criteria incorporated in this plan appear to be adequate for protecting the resources. However, existing and proposed data collection efforts and studies, such as the District's wetland study, should be continued to refine the criteria. The District should also make available and maintain the ground water models, data, and other relative information referenced in this plan to the public.

There is limited information, data, and in several areas experience regarding the use of the Floridan aquifer in the LWC Planning Area. Many utilities are using, or planning to use, the Floridan aquifer to meet existing and future demands. There is a concern for water quality in the Floridan aquifer, and the long-term sustainability of the Floridan aquifer as source of water. However, based on existing information and experience, significant changes in water quality are not anticipated. It is recommended a Floridan aquifer ground water model be developed for this area to conduct predictive analysis in the future. It is also recommended that a regional Floridan aquifer monitoring network be established to collect the data necessary to establish the relationship between water use, water levels, and water quality.

Freshwater discharges (minimums and maximums) are affecting the health of the Caloosahatchee Estuary, and results in the lose of water from the water supply inventory. The recommendations in the Restudy need to be reviewed as part of the Southwest Florida Study. Also the options explored in the CWMP to address retaining surface water discharges generated within the basin (including structural changes) must continue to be evaluated. The committee also supported establishment of MFLs for the Caloosahatchee Estuary and the LWC aquifer system.

Caloosahatchee Water Management Plan

The CWMP identified the need for storage within the basin using a regional optimization approach with underground storage of such amount that the ASR systems will tolerate extended withdrawals of 220 MGD and 220,000 acre-feet in aboveground storage (reservoirs plus other storage options). The analysis in the CWMP indicates that more detailed evaluation using more site-specific information may result in changes to the

sizing and combination of this storage and recommends that the detailed evaluation be continued as part of the Southwest Florida Study.

Five types of potential storage options or components were identified: reservoirs regional and distributed, ASR, backpumping to Lake Okeechobee, in-river storage due to structure S78.5, and water table harvesting. The five storage components were combined into nine alternatives that were evaluated utilizing reduced flows from Lake Okeechobee as modeled in the LEC Regional Water Supply Plan's 2020 with Restudy simulation. Of these components, model results indicate that backpumping has limited utility or benefit and, therefore, is not practical, based on the assumptions in the CWMP. Addition of a structure in the Caloosahatchee River (S78.5) and water table management showed minimal benefit but may be considered as part of an overall storage strategy. Regional and distributed reservoirs and ASR showed the greatest potential for meeting the storage needs in the Caloosahatchee Basin and are recommended for additional investigation and pilot testing within the basin.

A detailed assessment of the potential storage components is needed to identify a preferred alternative for meeting the demands in the Caloosahatchee Basin in 2020. It is recommended that the detailed assessment be completed as a part of the implementation of the Southwest Florida Study.

The modeling conducted as part of the CWMP to evaluate the performance of various storage components utilized revised Caloosahatchee Basin hydrology and demands from those used in the Restudy. This assessment showed higher demands and lower runoff from the basin, and consequently less water was available to be placed in storage. The CWMP evaluated options that focused on additional storage within the basin coupled with limited water supply deliveries (matching the results of the Restudy) from Lake Okeechobee. Under these assumptions the proposed water supply backpumping option performed poorly. It is recommended that the Southwest Florida Study and the analysis by the CERP Restoration, Coordination, and Verification (RECOVER) process further investigate the recommendations of the CWMP concerning in-basin storage and backpumping for storage in Lake Okeechobee (coupled with reasonable assurances of adequate deliveries from the lake to the Caloosahatchee Basin) to confirm the best combination that meets the cost effectiveness, water supply, and environmental goals recommended in the Restudy and for the Caloosahatchee Basin.

The Southwest Florida Study needs to be completed and implemented to address freshwater discharges to the Caloosahatchee Estuary and increase surface water availability for water use. The recommendations of the CWMP and the Restudy and associated funding should be pursued after detailed modeling is performed.

An evaluation of projected flows to the Caloosahatchee River was conducted via the LEC Regional Water Supply Plan and the CWMP for 1990 base and 2020 base conditions. The results of these evaluations indicate that the proposed MFLs criteria and the restoration base flow needs of the Caloosahatchee Estuary are not being met. Pursuant to the direction provided in Section 373.042, F.S., a recovery plan is provided in the LEC Regional Water Supply Plan. The recovery plan consists of design and construction of

enhanced basin storage capacity using surface water, ASR, and reservoirs as described in the Restudy and refined through the CERP and Southwest Florida Study.

Based on the recommended development of water management and storage infrastructure to effectively capture and store the surface water flows in the Caloosahatchee Basin, the projected surface water needs of the basin and the estuary can be met. Supplemental agricultural demands from surface water sources within the basin are estimated to increase from 230,000 acre-feet per year (200 MGD) based on 1995 land use to approximately 320,000 acre-feet per year (285 MGD) on average based on projected 2020 land use. PWS needs from the Caloosahatchee River are projected to increase from 13,000 (12 MGD) in 1995 to 18,000 acre-feet per year (16 MGD) on average by 2020. The environmental needs of the Caloosahatchee Estuary have been estimated at 450,000 acre-feet (400 MGD) while average flows to the estuary are estimated to be approximately 650,000 acre-feet per year (580 MGD) on average. Flow to the estuary in excess of needs can, therefore, be as high as 200,000 acre-feet per year (180 MGD) on average, that is adequate to meet increased demands through 2020. It was also concluded that the evaluated components, once constructed, will be adequate to meet the demands in the basin during a 1-in-10 year drought event.

The CWMP has identified that the future environmental, agricultural, and public water supply needs of the Caloosahatchee Basin and Estuary can be met from a combination of basin storage options with deliveries of water from Lake Okeechobee as identified in the South Florida Water Management Model (SFWMM) based on the “2020 with Restudy componments”. The evaluation of storage components conducted as part of the study show that components capable of providing short-term and long-term storage are required. The finding suggests that regional and distributed reserviors, as well as ASR systems would form an integral part of any successful storage development within the basin. A pilot testing program should be developed to verify the feasibility and effectiveness of these storage methods within selected sites in the Caloosahatchee Basin through the Southwest Florida Study.

Chapter 6
RECOMMENDATIONS

Seven water source options were identified and discussed in Chapter 5 that provide opportunities to address the water supply issues in the LWC Planning Area. The water source options were reviewed to assess their potential on a regional scale of meeting the water supply needs of the region (**Table 21**). The table indicates the ability of that option to meet the identified need, except for the inland environmental needs. For inland environmental needs, the response shows the ability of that option to offset demands, primarily from the Surficial Aquifer System (SAS), that could potentially cause drawdowns that are harmful to these natural systems. The relative ability of each source option in this table was based on regional volumes (supply and demand), and does not in all cases reflect the advisory committee's sense of importance of that option. For example, significant emphasis was placed on the importance of conservation and the development of a conservation ethic, although from a regional perspective, the volume of water that could be made available through conservation is low. At the local level, the potential of each option may change based on the specific needs of that local situation. Elements of conservation are incorporated with the use of each of these options.

These options can be considered a menu that local water users should consider using to meet their individual water needs. In many cases, several options will be used to meet the demands depending on the specific situation.

Chapter 5 provided recommendations for each water source option to facilitate the development of that option both at the regional level (water resource development) and the local level (water supply development). Water resource development recommendations are specific implementation strategies that support water supply development and are primarily the responsibility of the District. Water supply development recommendations are the responsibility of local governments, water suppliers, water users and utilities. Water supply development projects may be eligible for District funding assistance, if they meet appropriate criteria explained in the Funding section of this chapter. Water supply development recommendations are provided for consideration by local governments, water users and utilities. Water supply development recommendations provide guidance to local governments, water users and utilities; and will not be incorporated into the District's permitting programs and review processes.

Chapter 6 presents the implementation strategy for each of the water resource development recommendations identified in Chapter 5. Each water source option section contains: a description, the potential quantity of water that could be made available through development of that water source option, the water resource development recommendations, and the water supply development recommendations. For each water resource development recommendation, a description of the recommendation, a five-year (FY01 through FY05) implementation schedule, cost, funding source, and the implementing agency are provided. The District's fiscal year begins October 1st and ends

Table 21. Potential of Water Source Options in Meeting 2020 Lower West Coast Water Supply Needs.

	LWC Water Supply Needs				
Water Source Option	**Public Water Supply**	**Urban Irrigation Demands**	**Agricultural Irrigation Demands**	**Freshwater Needs of Estuarine Systems**	**Inland Environmental Needs**
Conservation	L	L	L	N/A	L
Ground Water					
Surficial Aquifer System	M	M	H	N/A	L
Intermediate Aquifer System	M	L	H	N/A	M
Floridan Aquifer System	H	L	L	N/A	H
Reclaimed Water	L	M	L	N/A	H
Regional Irrigation System	L	H	L	N/A	H
Seawater[a]	L	L	L	N/A	L
Storage					
Aquifer Storage and Recovery	M	M	M	H	M
Regional and Local Retention	M	M	M	H	H
Reservoirs	M	M	M[b]	H[b]	L
Surface Water	M	M	H	H	L

a. Not cost effective at this time.
b. Caloosahatchee Basin only.
L=Low; M=Medium; H=High; N/A=Not Applicable.

September 30th. For example, fiscal year 2001 (FY01) begins October 1, 2000 and ends on September 30, 2001.

Costs are presented in dollar cost and personnel time. Dollar costs include contract estimates, cost of materials, and cost-sharing with other agencies, while personnel time estimates, expressed in full-time equivalencies (FTEs), represent only District staff time.

Dollar costs in the tables are stated in 1000's and do not include the cost of FTEs. Costs include monies from the District and other agencies, unless otherwise specified. The funding approach for the LWC Water Supply Plan, as well as potential funding sources for water resource development recommendations and water supply development recommendations, are described in the Funding section of this Chapter.

The recommendations contained in this plan are subject to District Governing Board approval and budgetary appropriation for future fiscal years. As a result, the schedules identified in the plan are subject to change based on future resource and budgetary constraints. The Five Year Water Resource Development Work Program will be developed following approval of the water supply plans.

1. CONSERVATION

This option incorporates water conservation measures that address demand reduction, including practices that achieve long-term permanent reductions in water use. Whereas the other water source options in this chapter make additional water available through new sources or storage. Elements of conservation are incorporated in each of the other water source options. For example, the use of reclaimed water could be used to replace existing use of potable water or ground water for irrigation, resulting in reduced demands on these sources.

Conservation - Quantity of Water Potentially Available

Implementation of the existing mandatory water conservation elements (see Chapter 5) is estimated to result in a 10 percent reduction of the PWS and domestic self-supplied demand through 2020 or approximately 17 MGD. In 1998, the two existing mobile irrigation lab's (one agricultural, one urban) evaluations resulted in a potential water savings of 4.25 MGD (agricultural – 4.03 MGD, urban - 0.22 MGD). Similar savings could be anticipated in future years. With establishment of two additional labs (one agricultural, one urban) in the LWC Planning Area as recommended, the quantity of water savings would increase.

Retrofit measures with ultra-low volume fixtures and rainswitches in urban area could result in the following water savings if 10,000 units were installed: toilet, 0.24 MGD; showerhead, 0.50 MGD; and rainswitches, 5.73 MGD. Likewise, conversion of 10,000 acres of citrus from flood irrigation to micro irrigation could reduce pumpage by approximately 6.30 MGD **(**pumpage only, does not include return flow).

Additional water savings will be achieved through implementation of a comprehensive water conservation program that promotes cultivation of a conservation ethic. This ethic would be realized through proactive, cooperative efforts between water users, utilities, local governments, and the District. The comprehensive water conservation program efforts will incorporate many initiatives, including continued development and compliance with water conservation ordinances, development and implementation of public education programs, use of alternative water sources, and other

means. This plan will encompass all use types, as well as, indoor and outdoor uses. The plan will incorporate consideration of Xeriscape™ principles. Less water intensive landscaping will be promoted through compliance with District CUP conditions, DRI review, and compliance with local government new and existing ordinances and land use regulations. Retrofit measures will be evaluated with the other options, and implemented as deemed appropriate. The conservation program will be developed through public meetings.

Conservation Water Resource Development Recommendations

1.1 Recommendation - Water Conservation Program: The District will develop and implement a comprehensive water conservation program to cultivate a conservation ethic in cooperation with water users, utilities and local governments to promote water conservation and more efficient use of the water resources in the LWC Planning Area. The conservation program will incorporate continued development and compliance with water conservation ordinances, development and implementation of public education programs, use of alternative water sources, other conservation methods and documenting new and existing water conservation efforts. The conservation program will encompass all uses, but should provide emphasis on the outside use of water and Xeriscape™ principles. The creation of a water conservation coordinator position and provisions for fiscal incentives are envisioned as potential tools to establish the water conservation program to cultivate a conservation ethic.

Subtasks

1.1.a Redirect an existing position to a water conservation coordination position

1.1.b Develop a comprehensive conservation program in cooperation with water users, utilities and local governments, including the following:

- Identification of inefficiencies in water use
- Identification of projects and programs to improve water use efficiency through incentive and regulatory approaches
- An evaluation of the effectiveness of various options in meeting the existing and projected needs of the project area
- Identification of specific conservation measures that should be incorporated in the update to this plan
- Development and implementation of public education programs
- Assistance to local governments in development of water conservation ordinances, land use regulations and compliance programs
- Optimization of the use of the CUP Program and DRI review abilities to implement conservation

- Identification of cost sharing or incentive programs
- Development of numeric efficiency goals for each major user/ project area

Description - The District will develop and implement a comprehensive water conservation program. To implement this plan recommendation, it is envisioned that a water conservation coordination position be created from an existing position to focus on development of a comprehensive water conservation program and establishment of a strong water conservation ethic. The coordinator will also assist water users and utilities to develop their own customized water conservation program and establish numeric efficiency goals that are cost-effective and achievable, and to further public education. This program and position will be implemented Districtwide.

Total Cost: $425,000 FTEs: 1.50

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 22. Summary of Estimated Schedule and Costs for Recommendation 1.1.

Water Conservation Program		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
1.1.a, b	Redirect water conservation coordinator position, and develop conservation program Est. start date: 10/00 Est. finish date: ongoing	85	0.30	85	0.30	85	0.30	85	0.30	85	0.30	425	1.50
1.1 DW	Total	85	0.30	85	0.30	85	0.30	85	0.30	85	0.30	425	1.50

DW- LWC portion of a Districtwide program.

1.2 Recommendation - Mobile Irrigation Labs: The District will support maintaining the existing mobile irrigation labs (MILs) (one agricultural, one urban) and encourage establishment of two additional MILs (one agricultural, one urban) in the LWC Planning Area through identification of dedicated non-District funding sources for existing and additional MILs.

Subtasks

1.2.a Maintain existing MILs in the LWC Planning Area.

1.2.b Identify dedicated non-District funding sources to support existing MILs, and establishment of two additional MILs.

1.2.c Establish two additional MILs (one agricultural, one urban) in the LWC Planning Area.

Description: Continue existing MIL presence in the LWC Planning Area and identify dedicated non-District funding source(s) to replace current SFWMD participation. Establish two additional MILs in the LWC Planning Area and secure dedicated non-District funding for these.

Total Cost: $0 FTEs: 0.25

Funding Source: DEP, DACS, Soil and Water Conservation Districts (SWCD), User Fees, water users and utilities (potential sources)

Implementing Agency: SFWMD, SWCD and DACS.

Table 23. Summary of Estimated Schedule and Costs for Recommendation 1.2.

Mobile Irrigation Labs		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
1.2.a,c	Maintain MILs and expand existing program		0.01		0.01		0.01		0.01		0.01		0.05
1.2.b	Identifying Funding Sources Est. start date: 10/00 Est. finish date: 9/01		0.20										0.20
1.2	Total		0.21		0.01		0.01		0.01		0.01		0.25

Conservation - Water Supply Development Recommendations

- Utilities and local governments must consider implementation and compliance with all appropriate PWS mandatory conservation elements and ordinances, where appropriate.
- Water users and utilities must consider implementation of higher efficiency irrigation systems and other conservation measures, where appropriate.
- Local governments and utilities must encourage the use of alternative water sources for nonpotable uses, versus using potable water.
- Water users, utilities, and local governments must encourage maintaining the existing MILs and establishment of two additional MILs (one agricultural, one urban) in the LWC

Planning Area. Assist in identifying dedicated non-District funding sources to support the MIL program.

- Water users and utilities must consider evaluating the need and potential of retrofit conservation measures, in addition to other source options.
- Local governments and utilities must consider developing and implementing water conservation public education programs in cooperation with the District.
- Local governments must consider developing and codifying, including a compliance program, land use regulations that require installation of and maintaining less water intensive landscaping.
- Local governments must consider developing, and codifying, including a compliance program, water conservation ordinances.

2. GROUND WATER RESOURCES

Three major aquifer systems exist within the LWC Planning Area. These aquifers are identified as the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS). Recommendations regarding the aquifers will be presented in the order listed above.

Determining the safe yield of an aquifer system involves careful analysis of a number of technical and environmental issues. Although, total yield of an aquifer can be determined by analysis of recharge, aquifer flow characteristics and the areal extent and vertical extent of the formation. The safe yield of the system is limited by the need to protect the existing users of the system, environmental resources, and the aquifer system itself from degradation in quality or yield from saltwater intrusion, inter-aquifer migration, other contaminants or, physical changes in the aquifer.

2.1 Surficial Aquifer System (SAS)

The Surficial Aquifer System (SAS) consists of two aquifers in the LWC Planning Area, the water table and the lower Tamiami. These aquifers are recharged from the surface and are separated by leaky confining units over the majority of the LWC Planning Area. Wellfields using these aquifers are typically limited by the rate of recharge and water movement in the aquifer, environmental impacts, proximity to contamination sources, saltwater intrusion, and other existing legal users in the area.

SAS - Quantity of Water Potentially Available

Based on the 1994 Plan analysis and information contained in Chapter 4, from a regional perspective, increases in production from the SAS along the coast beyond existing demands appears limited due to potential wetland impacts and salt water intrusion. However, it was concluded some further development of the SAS can be

accomplished in these areas at the local level through modifications to wellfield configurations and pumping regimes with respect to locations of wetlands and salt water. Increasing storage, through ASR or regional and local retention, will also allow further development of the SAS. As a result, additional withdrawals from the SAS in these coastal areas will have to be evaluated on a project-by-project basis.

It was further concluded that the SAS is sufficient to meet the existing and proposed SAS projected agricultural demands through 2020 in eastern Collier County and southwestern Hendry County. The volume of water that could be withdrawn by any specific user must be determined through the District's consumptive use permitting program.

SAS - Water Resource Development Recommendations

2.1.1 Recommendation - Surficial Aquifer Monitoring: The District should review existing water quality and water level monitoring for the SAS aquifers in the LWC Planning Area. Well locations and parameters should be compared with areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program will be maintained and should be expanded where appropriate. Emphasis should be placed on monitoring and analysis of water levels and salinity levels.

Subtasks

2.1.1.a Review existing water quality and water level monitoring program and define additional data needs.

2.1.1.b Design network changes where appropriate.

2.1.1.c Establish modified water quality and water level monitoring network, including drilling additional wells and installing sampling equipment, where appropriate. This may involve increasing cooperative programs with the USGS.

2.1.1.d Collect samples and conduct lab analysis.

Description: The existing water quality and water level monitoring program in the SAS will be evaluated and expanded, where appropriate, to ensure sufficient data is being collected to study and detect changes in the aquifer. The recently implemented real-time monitor well network should be expanded, or at least maintained at current levels. It is recommended this data be used in the analysis including developing appropriate tools to develop threshold groundwater levels for future water shortage declarations to prevent significant and serious harm to the resources (see recommendation 8.1.2). Historically, the majority of the long-term and regionally extensive monitoring within the basin has been conducted through cooperative programs between the District and the USGS. These cooperative programs should be continued and augmented where necessary. These cooperative

programs have proven to be an effective way to collect data. In some cases, they are the only source of historical data that present and future conditions can be compared to. The real time network allows the District to maximize use of the resource while conducting monitoring on a real-time basis to make certain that no detrimental impacts are occurring.

Total Cost: $ 460,000 FTEs: 3.35

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 24. Summary of Estimated Schedule and Costs for Recommendation 2.1.1.

Surficial Aquifer Monitoring		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
2.1.1.a & b	Define data needs Est. start date: 10/00 Est. finish date: 9/01		0.60										0.60
2.1.1.c	Establish modified network drill wells and install data loggers Est. start date: 10/01 Est. finish date: 9/01			170	0.50	70	0.50					240	1.00
2.1.1.d	Data collection and lab analysis Est. start date: 10/01 Est. finish date: 9/05			50	1.00	50	0.25	60	0.25	60	0.25	220	1.75
2.1.1	Total	0	0.60	220	1.50	120	0.75	60	0.25	60	0.25	460	3.35

2.1.2 Recommendation - Surficial Aquifer Rulemaking: To promote consistency, the SAS concepts and criteria used in this plan should be incorporated into the District's CUP Program and other components of the District's overall water supply management responsibilities through rulemaking, such as MFLs, coastal saltwater intrusion prevention, wetland protection, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination.

Total Cost: Costs and FTEs are incorporated into Recommendation 8.1 of Related Implementation Strategies.

Funding Source: SFWMD

Implementing Agency: SFWMD

2.1.3 Recommendation - Surficial Aquifer Modeling: As soon as feasible, but no later than the five-year update to this plan, the District shall conduct a regional

evaluation using the finer grid models currently under development for renewal of CUP's of the effects the projected demands might have on these aquifers and the associated water resources. If this regional analysis identifies potential problems, the District should revise this plan, and identify specific water resource and water supply development projects to meet the projected needs.

Total Cost: Costs and FTEs are associated with the ongoing modeling effort in support of Recommendation 8.1 in the Related Implementation Strategies section.

Funding Source: SFWMD

Implementing Agency: SFWMD

SAS - Water Supply Development Recommendations

- The potential of using the SAS for new and expanded uses should be evaluated on a project-by-project basis.
- Water users and utilities should consider development of alternative water sources that reduce reliance on the SAS.

2.2 Intermediate Aquifer System (IAS)

The Intermediate Aquifer System (IAS) consists of five zones of alternating producing and confining units, with the producing zones being the Sandstone and mid-Hawthorn aquifers.

IAS - Quantity of Water Potentially Available

Based on the 1994 Plan analysis and information contained in Chapter 4, from a regional perspective, increases in production from the IAS beyond existing demands may be limited in some areas due to potential impacts on existing legal users and the productivity of the aquifer. Overall though, it was concluded that the IAS is sufficient to meet the existing and projected urban and agricultural demands through 2020. In some areas, this may require modifications to wellfield configurations and pumping regimes with respect to locations of other existing legal users and demands. The volume of water that could be withdrawn by any specific user must be determined through the District's consumptive use permitting program.

IAS - Water Resource Development Recommendations

2.2.1 Recommendation - Intermediate Aquifer Monitoring: The District should review existing water quality and water level monitoring for the IAS aquifers in the LWC Planning Area. Well locations and parameters should be compared with areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program will be maintained and should be

expanded where appropriate. Emphasis should be placed on monitoring and analysis of water levels and salinity levels.

Subtasks

2.2.1.a Review existing water quality and water level monitoring program and define additional data needs.

2.2.1.b Design network changes where appropriate.

2.2.1.c Establish modified water quality and water level monitoring network, including drilling additional wells and installing sampling equipment, where appropriate.

2.2.1.d Collect samples and conduct lab analysis.

Description: The existing water quality and water level monitoring program in the IAS will be evaluated and expanded where appropriate to ensure sufficient data is being collected to study and detect changes in the aquifer. The recently implemented real-time monitor well network should be expanded, or at least maintained at current levels. It is recommended this data be used in the analysis including developing appropriate tools to develop threshold ground water levels for future water shortage declarations to prevent significant and serious harm to the resources (see recommendation 8.1.2). Historically, the majority of the long-term and regionally extensive monitoring within the basin has been conducted through cooperative programs between the District and the USGS. The District's long-term water level and water quality monitoring cooperative programs with the USGS should be continued and augmented where necessary. These cooperative programs have proven to be an effective way to collect data. In some cases, they are the only source of historical data that present and future conditions can be compared to. The real time network allows the District to enable the maximum possible use of the resource while monitoring on a real-time basis to make certain that no detrimental impacts are occurring.

Total Cost: $ 490,000 FTEs: 1.65

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 25. Summary of Estimated Schedule and Costs for Recommendation 2.2.1.

Intermediate Aquifer Monitoring		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
2.2.1.a & b	Define data needs Est. start date: 10/00 Est. finish date: 9/01		0.60										0.60
2.2.1.c	Establish network drill wells and install autosamplers Est. start date: 10/01 Est. finish date: 9/01			240	0.25							240	0.25
2.2.1.d	Data collection of monthly samples and lab analysis Est. start date: 10/01 Est. finish date: 9/05			100	0.20	50	0.20	50	0.20	50	0.20	250	0.80
2.2.1	Total		0.60	340	0.45	50	0.20	50	0.20	50	0.20	490	1.65

2.2.2 Recommendation - Intermediate Aquifer Rulemaking: To promote consistency, the IAS concepts and criteria used in this plan should be incorporated into the District's CUP Program and other components of the Districts overall water supply management responsibilities through rulemaking, such as MFLs, coastal saltwater intrusion prevention, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination.

Total Cost: Costs and FTEs are incorporated into Recommendation 8.1 of Related Implementation Strategies.

Funding Source: SFWMD

Implementing Agency: SFWMD

2.2.3 Recommendation - Intermediate Aquifer Modeling: As soon as feasible, but no later than the five year update to this plan, the District shall conduct a regional evaluation using the finer grid models currently under development for renewal of CUP's of the effects the projected demands might have on these aquifers and the associated water resources. If this regional analysis identifies potential problems, the District should revise this plan, and identify specific water resource and water supply development projects to meet the projected needs.

Total Cost: Costs and FTEs are associated with the ongoing modeling effort in support of Recommendation 8.1 in the Related Implementation Strategies section.

Funding Source: SFWMD

Implementing Agency: SFWMD

IAS - Water Supply Development Recommendations

- The potential of using the IAS for new and expanded uses should be evaluated on a project-by-project basis.
- Local governments should consider passage of an ordinance requiring installation of positive displacement submersible pumps and appropriately sized wells, especially in Charlotte, Collier, Glades and Lee counties and in areas where water levels are projected to fall 20 feet or greater below land surface.

2.3 Floridan Aquifer System (FAS)

The Floridan Aquifer System (FAS) underlies all of Florida and portions of southern Georgia and Alabama. It is the principal source of water in Central Florida; however, the FAS yields only nonpotable water throughout most of the LWC Planning Area. The quality of water in the FAS deteriorates southward, increasing in hardness and salinity. With depth, the salinity increases, making the deeper producing zones less suitable for the water supply development than the shallower zones near the top of the aquifer. Within the LWC Planning Area, the FAS is not influenced by variations in rainfall. Water must be treated by desalination to produce a potable product. The most productive zones in the FAS in the LWC Planning Area are the lower Hawthorn, Suwannee, and Avon Park aquifers.

The recommendations that follow are presented as distinct and separate programs but are complementary and share resources in the development of knowledge regarding the FAS. Knowledge gained is shared among the other programs.

FAS - Quantity of Water Potentially Available

The FAS has been used for many years by several of the coastal utilities in the LWC Planning Area. Several other utilities have recently initiated use of or plan to use the FAS. However, there is limited information, data, and experience on a regional scale regarding the use of the FAS in the LWC Planning Area. A single regional FAS ground water model for the Lee, Collier, and Hendry counties does not exist. Several local FAS models have been used by Cape Coral, Lee County and others. Additionally, this assessment did not incorporate a water quality component. However, based on the existing data, knowledge, and experience in the LWC Planning Area, as well as FAS experience in other areas, it was concluded that the FAS could support all of the existing and 2020 projected demands (56,615 MGY or 155 MGD) for the potable water utilities.

FAS - Water Resource Development Recommendations

2.3.1 <u>Recommendation</u> - Floridan Aquifer Model: The District should develop a comprehensive FAS ground water model based on all existing and future information available focusing on Lee, Collier, and possibly Hendry counties to conduct predictive analysis in the future. This model would be for use by the

District and the public to evaluate both water withdrawals and storage via ASR. The model should be developed and refined with user participation and information collected through the CUP Program, water users, utilities, and other sources with regard to water quality, water levels, and hydrologic characteristics, when appropriate. Other sources that may be utilized include existing monitoring wells or wells that may be converted to monitoring wells instead of being abandoned. Appropriate well site selection should consider model boundary conditions and not be limited to the LWC Planning Area.

Subtasks

2.3.1.a. Determine sufficiency of existing data to support model development. If existing data is not sufficient, identify additional data needs.

2.3.1.b Collect additional data as determined appropriate in 2.3.1.a.

2.3.1.c Develop FAS model for Lee, Collier and possibly Hendry counties.

2.3.1.d Refine model with data collected through sharing agreements, CUP Program and other available sources.

Description: Development of a FAS model covering Lee, Collier, and possibly Hendry counties with the abilities to evaluate FAS use, as well as storage through ASR, and changes in water quality. The FAS model will be developed according to the data anticipated to be available. ASR, identified in the CWMP for storage needs developed as part of the CERP or SWFS, will provide opportunities to develop water quality, water level and hydrologic data in the Hendry County portion of the LWC Planning Area. FTE's address development of the model.

Total Cost: $ 2,530,000 FTEs: 9.70

Funding Source: SFWMD, water users, utilities

Implementing Agency: SFWMD

Table 26. Summary of Estimated Schedule and Costs for Recommendation 2.3.1.

Floridan Aquifer Model		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
2.3.1.a	Determine data sufficiency Est. start date: 10/00 Est. finish date: 4/01		0.50										0.50
2.3.1.b	Collect additional data well drilling pump tests auto samplers Est. start date: 10/01 Est. finish date: 9/04			700	1.00	1,420	2.20	390	0.90	20	0.10	2,530	4.20
2.3.1.c	Develop FAS model Est. start date: 10/02 Est. finish date: 9/04						2.00		2.00				4.00
2.3.1.d	Refine model Est. start date: 10/02 Est. finish date: 9/09										1.00		1.00
2.3.1	Total		0.50	700	1.00	1,420	4.20	390	2.90	20	1.10	2,530	9.70

2.3.2 Recommendation - Floridan Aquifer Monitoring: The District should expand the FAS ground water monitoring network to collect the data necessary to establish the relationship between water use, water levels, and water quality in the LWC Planning Area.

Subtasks

2.3.2.a Define data needs.

2.3.2.b Design water quality monitoring network.

2.3.2.c Establish water quality monitoring network.

2.3.2.d Collect samples and conduct lab analysis.

Description: Establish a water quality monitoring network to initiate collecting data necessary to determine the relationship between water use, water levels, and water quality in the future.

Total Cost: $299,000 FTEs: 3.70

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 27. Summary of Estimated Schedule and Costs for Recommendation 2.3.2.

Floridan Aquifer Monitoring		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
2.3.2.a & b	Define data needs and design network Est. start date: 10/00 Est. finish date: 9/01		a										
2.3.2.c	Establish network Est. start date: 10/01 Est. finish date: 9/04	80	1.10	10	0.20	10	0.20	10	0.20	10	0.20	120	1.90
2.3.2.d	Initiate sampling Est. start date: 10/01 Est. finish date: 9/05	27	0.30	31	0.30	39	0.40	41	0.40	41	0.40	179	1.80
2.3.2	Total	107	1.40	41	0.50	49	0.60	51	0.60	51	0.60	299	3.70

a. Completed in task 2.3.1 a & b.

2.3.3 Recommendation - Floridan Aquifer Data Partnerships: The District should develop and recognize partnership agreements during development of the scope of work with water users and utilities who are or planning to develop the FAS for water supply, ASR, or wastewater effluent disposal. These partnerships will collect water quality, water level, and hydrologic information related to the FAS. Information could be gained via packer tests, coring/testing of specific intervals plus geophysical logging (e.g. permeability logs) and aquifer performance testing. The District should budget for these items and cost-share for additional testing and data acquisition. The development of partnerships to share collected data will be in addition to and complementary to the data collection efforts described in tasks 2.3.1 and 2.3.2.

Subtasks

2.3.3 Utilize analysis in subtasks 2.3.1.a and 2.3.2.a to determine information needs and geographic locations desired for the expansion of FAS hydrologic and water quality data gathering. Explore data sharing with utilities and others for new and existing wells. Write sharing agreements to gather data, where possible, for existing wells and during well drilling and pump tests.

Description: Collect additional information to enhance FAS knowledge in conjunction with water users and utilities as they develop well drilling programs for the FAS as a source, ASR, and wastewater effluent disposal.

Total Cost: $500,000 FTEs: 1.40

Funding Source: SFWMD, water users and utilities

Implementing Agency: SFWMD.

Table 28. Summary of Estimated Schedule and Costs for Recommendation 2.3.3.

Floridan Aquifer Data Partnerships		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
2.3.3	Expand FAS Hydrologic and water quality data base through cooperative data sharing and collecting agreements Est. start date: 10/00 Est. finish date: 9/05	100	0.20	100	0.40	100	0.40	100	0.20	100	0.20	500	1.40
2.3.3	Total	100	0.20	100	0.40	100	0.40	100	0.20	100	0.20	500	1.40

2.3.4 Recommendation - Floridan Aquifer Government Cooperation: The District should continue to work with other government entities, including the legislature, FDEP and USEPA to explore environmentally acceptable alternative desalination concentrate disposal options.

Total Cost: Costs and FTEs are incorporated into Recommendation 8.2 of Related Implementation Strategies.

Funding Source: SFWMD

Implementing Agency: SFWMD

FAS - Water Supply Development Recommendations

- Local water users and utilities should consider using the FAS to reduce demands on freshwater sources in the LWC Planning Area. Within the LWC Planning Area, the FAS is not influenced by variations in rainfall.
- Local water users and utilities should consider involving the District in development of their FAS well drilling programs for water supply, ASR and wastewater effluent disposal to collect FAS water quality, water level, and hydrologic information that could be used in predictive analysis and development or refinement of a FAS model.

3. RECLAIMED WATER

Reclaimed water is water that has received at least secondary treatment and basic disinfection and is reused for a beneficial purpose after flowing out of a domestic wastewater treatment facility. Whereas, reuse is the deliberate application of reclaimed water, in compliance with FDEP and District rules, for a beneficial purpose. Potential uses of reclaimed water include landscape and agricultural irrigation, ground water

recharge, industrial uses and environmental enhancement. Reclaimed water has played a significant role in meeting the needs of this region and this is expected to continue.

Reclaimed Water - Quantity of Water Potentially Available

Wastewater flows to the regional wastewater facilities in the LWC Planning Area and the potential volume of reclaimed water that could be made available is projected to increase to 97 MGD through the planning horizon, an increase of 40 MGD from 1997 flows.

The potential need in the future of applying conservation concepts to reclaimed water systems was discussed. It was suggested reuse systems should be designed to apply reclaimed water sufficiently to meet the needs of the plants, not as a disposal system.

Reclaimed Water – Water Resource Development Recommendations

Refer to the Regional Irrigation System Source Option

Reclaimed Water – Water Supply Development Recommendations

- Local governments should consider adopting building codes and land development regulations requiring proposed new projects exceeding a certain acreage threshold to construct infrastructure and use water from a reclaimed water or irrigation water source.
- Utilities should incorporate water supply considerations in development of their reclaimed water programs. These should include the resource efficiency concept of utilizing reclaimed water for the recharge of wellfields to minimize impacts to the resources.
- Utilities should consider supplemental sources and interconnection with other utilities to maximize the volume of reclaimed water that is reused. Aquifer storage and recovery among other options, should be explored to extend the use of current resources in order to meet future demands, including addressing peaks in demands or in availability of resources.

4. REGIONAL IRRIGATION SYSTEM

Significant increases in urban irrigation demands are projected through 2020. This assessment concluded that in some areas, historically used ground water sources and reclaimed water might not be sufficient to support these demands. In addition, the seasonality in demands and potential supplies, is limiting the use of some sources. For example, there is 100 percent utilization of reclaimed water supplies in some portions of

the LWC Planning Area during the dry months, while there is a surplus during the wet months. It was determined that sufficient sources of water do exist within the LWC Planning Area to meet these projected irrigation demands, including ground water, reclaimed water, and surface water. The concept of construction and operation of a regional irrigation distribution system was identified to transfer water from areas of surplus to areas of deficit. The regional irrigation system is intended to provide a source of water for urban irrigation needs. This system could conserve the fresh ground water sources, while maximizing the use of reclaimed water that would have otherwise been discharged to surface water or deep well injected and lost from the inventory. Storage will be a key component to bridge the gap between the seasonality and geographic relationships of available sources and demands. Storage through ASR is envisioned as an integral part of this system for seasonal storage. This system would make irrigation water available for local supply entities/utilities to withdraw from for distribution to meet their individual needs. This system could have many different configurations, including one large regional system, several subregional systems, or on a utility-by-utility basis.

Regional Irrigation System - Quantity of Water Potentially Available

The regional irrigation system would utilize the water sources identified and quantified in this plan, including reclaimed water, ground water, and surface water. Storage, primarily through ASR, is envisioned to be a key component of the ultimate system. The regional irrigation system option and its recommendations will provide a source for irrigation needs where the surficial is least capable of doing so and is identifying the most effective way to distribute these sources to maximize their use and satisfy the demands.

Regional Irrigation System - Water Resource Development Recommendations

4.1 Recommendation - Regional Irrigation System Study: The District will evaluate, with assistance from LWC local governments, water users, and utilities, the feasibility of constructing subregional irrigation water distribution system(s) and other options to meet the growing urban irrigation demands of this area. Reclaimed water should be used, and where availabl, should be incorporated into the evaluation. The results of this study should be incorporated in the update of this plan.

Subtasks

4.1.a Develop Statement of Work (SOW) to conduct feasibility analysis with input from representatives of local utilities and users.

4.1.b Contract and conduct feasibility analysis with consultant.

4.1.c Review results of feasibility analysis and identify preferred alternative with input from representatives of local utilities and users.

4.1.d Develop implementation strategy for preferred alternative with input from representatives of local utilities and users.

Description: The purpose of this recommendation is to conduct a refined analysis of projected urban irrigation water demands, potential water sources, and methods to distribute these sources, including storage, to meet these demands. The District will contract out this analysis. This work will involve participation from representatives of local governments, water users, and utilities. It is envisioned that partnerships will have to be developed between local governments, utilities, and the District for this system to be realized. Under one scenario, a regional irrigation system will make irrigation water available that local distribution entities, such as utilities, could utilize as a source to distribute to individual users. Local governments should consider requiring the use of this system as part of the development approval process.

Total Cost: $200,000 FTEs: 4.50

Funding Source: SFWMD, water users, and utilities. The determination of funding sources and needs for capital expenditures to develop a regional irrigation system will be determined within the feasibility analysis.

Implementing Agency: SFWMD

Table 29. Summary of Estimated Schedule and Costs for Recommendation 4.1.

Regional Irrigation System Study		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
4.1.a	Develop SOW Est. start date: 7/00 Est. finish date: 11/00		2.00[a]										2.00
4.1.b	Conduct feasibility analysis Est. start date: 2/01 Est. finish date: 4/02	200	1.50		0.50							200	2.00
4.1.c	Review results of feasibility analysis Est. start date: 5/02 Est. finish date: 9/02				0.20								0.20
4.1.d	Develop implementation strategy Est. start date: 11/02 Est. finish date: 1/03						0.30						0.30
4.1	Total	200	3.50		0.70		0.30					200	4.50

a. Includes work conducted in FY00.

Regional Irrigation System - Water Supply Development Recommendations

- Local governments should consider adopting building codes and land development regulations requiring new projects, exceeding a certain acreage threshold, to construct infrastructure and use water from a reclaimed or irrigation water source.
- Utilities should consider supplemental sources and interconnection with other utilities to maximize the volume of reclaimed water that is reused.

5. SEAWATER

This option involves using seawater from the Gulf of Mexico as a raw water source. The Gulf of Mexico appears to be an unlimited source of water from a quantity perspective; however, removal of the salts is required before use for potable or irrigation uses. A desalination treatment technology would have to be used, such as distillation, reverse osmosis, or electrodialysis reversal (EDR).

Seawater – Quantity of Water Potentially Available

The volume of water available from the Gulf of Mexico appears to be unlimited and could meet the needs of this region through 2020.

Seawater - Recommendations

It was concluded that seawater is a potential source of water, but at this time, it is not cost-effective.

6. STORAGE

Three types of potential storage options were identified: aquifer storage and recovery, regional and local retention, and reservoirs.

Storage - Quantity of Water Potentially Available

This is discussed under each of the following three headings.

6.1 Aquifer Storage and Recovery (ASR)

Aquifer storage and recovery (ASR) is the underground storage of injected water into an acceptable aquifer (typically the FAS in Southwest Florida) during times when water is available, and the subsequent recovery of this water during high demand periods. In other words, the aquifer acts as an underground reservoir for the injected water,

reducing water loss to evaporation. Current regulations require injected water to meet drinking water standards when the receiving aquifer is classified as an underground source of drinking water (USDW) aquifer, unless an aquifer exemption is obtained from the U.S. Environmental Protection Agency (USEPA). Obtaining an aquifer exemption is a rigorous process and few have been approved. However, the USEPA has indicated that a flexible assessment approach will be applied for systems that meet all drinking water standards except total coliform.

There are many local and regional ASR initiatives underway in the LWC Planning Area, as well as the District. These projects involve the use of potable water, reclaimed water, and partially treated ground water and surface water. The District, in cooperation with the USACE, is currently developing a pilot ASR program to determine the feasibility of using ASR for large scale storage of surface water in the Caloosahatchee River Basin. In addition, there are numerous local initiatives, some constructed and operational, involving injection of potable water and the potential use of reclaimed water. Depending on the results of these regional and local efforts, additional ASR locations and testing should be considered in the LWC Planning Area in the future.

ASR Quantity of Water Potentially Available

The volume of water that could be made available through ASR wells depends upon several local factors, such as well yield, water availability, variability in water supply, and variability in demand. Without additional information, it is not possible to accurately estimate the water that could be available through ASR in the LWC Planning Area. Typical storage volumes for individual wells range from 10 to 500 million gallons or 31 to 1,535 acre-feet (Pyne, 1995).

Aquifer storage and recovery would utilize the water sources identified and quantified in this plan. The availability of these sources varies, primarily by wet and dry season. For example, surface water availability is at its greatest during the wet season. Excess surface water is currently being discharged to tide. Aquifer storage and recovery provides a great opportunity to capture this excess water when it is available for use during drier times, maximizing the use these sources while conserving others. This would be the same for other sources, including ground water and reclaimed water. Aquifer storage and recovery wells would be typically colocated with reservoirs. The reservoirs would serve as a holding area for injection, as well as provide some treatment of the water prior to injection.

ASR Water Resource Development Recommendations

6.1.1 Recommendation - ASR Water Quality: The District should continue working with other government entities, including the legislature, Congress, USEPA, and FDEP, to explore rule changes to the federal and state Underground Injection Control (UIC) program to allow for (and encourage) injection of untreated or partially treated ground water or surface water with ASR. The level of treatment should be compatible with the water quality in the proposed storage zone.

Total Cost: Costs and FTEs are incorporated into Recommendation 8.2 of Related Implementation Strategies.

Funding Source: SFWMD

Implementing Agency: SFWMD

6.1.2 Recommendation - ASR Rulemaking: The District should develop CUP rules to address the use of the Floridan aquifer for ASR, as well as water use, to assure compatibility between use concepts.

Total Cost: Costs and FTEs are incorporated into Recommendation 8.1 of Related Implementation Strategies.

Funding Source: SFWMD

Implementing Agency: SFWMD

ASR - Water Supply Development Recommendations

- Utilities should explore ASR, among other options, to extend the use of current resources in order to meet future demands, including addressing peaks in demands or in availability of resources.

6.2 Regional and Local Retention

Regional and local retention looks at opportunities to increase water storage in watersheds through manipulation and modification of the drainage system that serves that area, while still maintaining an appropriate level of flood protection. Much of the LWC Planning Area was drained to support agricultural and urban development. This has resulted in lowered ground water tables that may impact natural systems as well as water availability in these areas. The analysis in the 1994 LWC Water Supply Plan concluded that modifying water levels in existing drainage canals and eliminating unnecessary canals can significantly elevate ground water levels in the Big Cypress Basin. Committee members stated that the work completed by the Big Cypress Basin has increased water retention in their canal systems and that has resulted in increased ground water levels. This has resulted in reducing the frequency of irrigation.

Regional and Local Retention – Quantity of Water Potentially Available

The quantity of water that could be made available from regional and local retention is site-specific, and will vary depending on the extent and topography of the watershed being modified, the considerations used in the initial system design and construction, the condition of existing facilities, and the current operational protocols.

The Cape Coral Gator Slough/Reuse System Enhancement Project has the potential to increase water availability by 19 MGD, while the East County Aquifer Recharge Project Phase II-1 will raise water levels in a 9,084 acre watershed and provide 220 acre-feet of additional storage in their canal system.

The Big Cypress Basin estimates that implementation of the Big Cypress Basin Water Management Plan will increase water storage in their system by at least 60,000 acre-feet or 19,600 MG. This was based on the additional volume of water that will be stored in the canals resulting from increased water levels. Only in southern Golden Gate Estates was the increase in the water table (water stored in the aquifer) accounted for. Additional aquifer storage will also be created with the other projects. These projects will conserve freshwater through retention of additional freshwater in the watershed and decreasing the volume of "excess" water discharged to estuarine systems, increase water availability through ground water recharge, and potentially reduce the frequency of irrigation (and demands) by increasing soil moisture through increased ground water levels.

It is anticipated several other regional and local retention projects could occur over the next five years. The projects might include additional work in the Gator Slough and the Fred C. Babcock/Cecile M. Webb Wildlife Management Area, the southern CREW land, and projects related to implementation of the South Lee County Watershed Plan.

Regional and Local Retention - Water Resource Development Recommendations

6.2.1 Recommendation - Regional and Local Retention: Regional retention projects that raise water levels through either system modifications or operation changes and benefit water supply without causing environmental harm should be considered for cost-sharing from the District's Water Resource Development funds. Potential retention projects as described above include Big Cypress Basin projects and possibly additional work in the Gator Slough and the Fred C. Babcock/Cecile M. Webb Wildlife Management Area, the southern CREW land, and projects related to implementation of the South Lee County Watershed Plan.

Description: Regional and local retention projects that can benefit water supply without causing environmental harm should receive consideration for cost-share through the District's Water Resource Development funds.

Total Cost: $ 1,500,000 FTEs: 0.50

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 30. Summary of Estimated Schedule and Costs for Recommendation 6.2.1.

Regional and Local Retention		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
6.2.1	Regional and local retention cost share Est. start date: 10/00 Est. finish date: 9/04	300	0.10	300	0.10	300	0.10	300	0.10	300	0.10	1,500	0.50
6.2.1	Total	300	0.10	300	0.10	300	0.10	300	0.10	300	0.10	1,500	0.50

Regional and Local Retention - Water Supply Development Recommendations

- Local and subregional entities that have responsibility for surface water management, such as 298 Drainage Districts, should evaluate their systems for the potential of increasing storage and raising ground water levels through changes in their operations and/or modifying control levels.

6.3 Reservoirs

This option involves the capture and storage of excess surface water during rainy periods and subsequent release during drier periods for environmental and human uses. Regionally, surface water storage could be used to attenuate freshwater flows to the Caloosahatchee Estuary and other estuarine water bodies during rainy periods and meet minimum flows during drier periods. In addition, these facilities could increase surface water availability for current and projected uses, and decrease the demand on aquifer systems. However, evaporative and seepage losses could significantly effect water availability and need to be considered.

Reservoirs - Quantity of Water Potentially Available

Reservoirs are considered more of a management option in that these systems allow more efficient use of other sources, such as surface water. Reservoirs typically capture excessive surface water during rainy periods for future use. Please refer to other source option descriptions for an estimate regarding the quantity of water that potentially could be made available.

Reservoirs - Water Resource Development Recommendations

At this time, regional and distributed small scale reservoirs are only being recommended in the Caloosahatchee Basin. Refer to Surface Water section regarding this recommendation and others from the CWMP.

Reservoirs - Water Supply Development Recommendations

- Agricultural operations should incorporate water conservation and water supply considerations in design of new or retrofitted surface water management systems.

7. SURFACE WATER

This option involves the use of surface water as a supply source. Surface water bodies in the LWC Planning Area include lakes, canals, and rivers. Lake Trafford and Lake Hicpochee are the two largest lakes within the LWC Planning Area, but neither is considered a reliable source of water supply. The Caloosahatchee River Basin and the associated flows from Lake Okeechobee form the largest source of surface water in the LWC Planning Area. The Caloosahatchee Water Management Plan (CWMP) addressed surface water availability from the C-43. The recommendations in the CWMP were developed through a public participation process, and incorporated extensive modeling and coordination with the both the LEC and LWC water supply planning processes. This section provides surface water recommendations developed in the LWC Water Supply Plan and incorporates the surface water recommendations in the CWMP. The CWMP recommendations became recommendations of the LWC Water Supply Plan.

Surface Water - Quantity of Water Potentially Available

Caloosahatchee River

Inflows to the Caloosahatchee Basin come from three major sources: precipitation, releases from Lake Okeechobee, and ground water seepage. The principle water use/loss mechanisms are evaporation, evapotranspiration (including irrigation), discharge to the estuary for environmental needs, and PWS.

Based on the recommended developments of water management and storage infrastructure to effectively capture and store the surface water flows in the Caloosahatchee Basin, the projected surface water needs of the basin and the estuary can be met. Agricultural demands from surface water sources within the basin are projected to increase from 230,000 acre-feet per year (200 MGD) based on 1995 land use to approximately 320,000 acre-feet per year (285 MGD) on average based on projected 2020 land use. PWS needs from the Caloosahatchee River are projected to increase from 13,000 (12 MGD) in 1995 to 18,000 acre-feet per year (16 MGD) on average by 2020. The environmental needs of the Caloosahatchee Estuary have been estimated at 450,000 acre-feet (400 MGD) while average flows to the estuary are estimated to be approximately 650,000 acre-feet per year (580 MGD) on average. Flow to the estuary in excess of the needs can, therefore, be as high as 200,000 acre-feet per year (180 MGD) on average. It was concluded that the evaluated components, once constructed, will be adequate to meet the demands during a 1-in-10 year drought condition.

Golden Gate and Faka Union Canal System

The Golden Gate Canal and the Faka Union Canal System in the Big Cypress Basin have combined average daily outflows of 560 cfs (362 MGD) and an average wet season flow of 1,020 cfs (660 MGD). This has resulted in undesirable salinity fluctuations in Naples Bay and Faka Union Bay estuaries. Big Cypress Basin presently operates three backpumping facilities to capture some of the freshwater outflows during the dry season to stimulate regional ground water recharge. There is significant potential for utilizing the wet season flows of these canals for water supply needs if storage is provided, such as ASR. The environmental needs of the estuarine systems and the Southern Golden Gate Estates Restoration Project will need to be identified to determine the specific volume of water available.

Other Potential Sources

Several other potential surface water bodies were identified that should be evaluated for water availability, including the Kehl Canal, Imperial River, Ten Mile Canal, Orange River, and Six Mile Cypress Slough. An analysis of estuarine and other environmental needs similar to the analysis conducted on the Caloosahatchee River is necessary and recommended in this plan prior to using these sources for human needs. These systems need to be analyzed for availability of water and in doing so, the rate and no harm type contribution. Establishment of MFLs should be considered where appropriate. No recommendation is made at this time regarding the specific water availability from these systems.

Surface Water – Water Resource Development Recommendations

The Surface Water - Water Resource Development Recommendations include the recommendations from the CWMP as well as those identified during the LWC Water Supply Plan process. Recommendations 7.1, 7.2, and 7.3 are from the CWMP and are identified in the Comprehensive Everglades Restoration Plan.

7.1 Recommendation from CWMP - Caloosahatchee River ASR Pilot Project: The District should work cooperatively with the USACE to site, design, construct, and operate a pilot regional ASR project. Recovery performance and additional information obtained from the construction of and cycle testing at this facility will guide the design of the regional ASR wellfield.

Description: Construct a pilot ASR project in the Caloosahatchee Basin.

Total Cost: $2,998,000 (SFWMD portion only) FTEs included in dollar costs

Funding Source: SFWMD and USACE

Implementing Agency: SFWMD and USACE

Table 31. Summary of Estimated Schedule and Costs for Recommendation 7.1.

Caloosahatchee River ASR Pilot Project		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
7.1	Pilot ASR Project Est. start date: 10/00 Est. finish date: 9/05	250		2,300		280		84		84		2,998	
7.1 CWMP	Total[a]	250		2,300		280		84		84		2,998	

a. In-kind service includes FTEs for design and implementation of the ASR Pilot Project and will be applied against the SFWMD's portion of the 50/50 cost-share requirement.

7.2 Recommendation from CWMP - C-43 Storage Project: The SFWMD should cooperate with the USACE in development of the Project Implementation Report (PIR), design, construction, and operation of a regional reservoir and ASR project within the Caloosahatchee Basin. A comprehensive geologic and geotechnical investigation should be completed, as a part of the PIR to provide the information needed to size and design the reservoir. Development of the PIR, land acquisition, design, and plans and specifications should be completed by 2005. Construction should be initiated in 2005.

Description: C-43 Regional Reservoir Project

Total Cost: $138,094,000 (SFWMD portion only) FTE's included in dollar costs

Funding Source: SFWMD and USACE (50/50 cost share)

Implementing Agency: SFWMD and USACE.

Table 32. Summary of Estimated Schedule and Costs for Recommendation 7.2.

C-43 Storage Project		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
7.2	C-43 Regional Reservior Project Est. start date: 10/00 Est. finish date: 9/05	2,154		2,163		23,925		66,386		43,466		138,094	
7.2 CWMP	Total[a]	2,154		2,163		23,925		66,386		43,466		138,094	

a. In-kind service includes FTEs for design and implementation of the Project Implementation Report and will be applied against the SFWMD's portion of the 50/50 cost share requirement.

7.3 Recommendation from CWMP - Southwest Florida Study: The SFWMD should work in cooperation with the USACE to initiate and complete the Southwest Florida Study (SWFS) by the year 2005 as recommended in the CERP. The modeling work that has been completed as a part of the CWMP should be used as the basis for development of a preferred alternative to meet the demands within the Caloosahatchee Basin in 2020. The primary purpose of the SWFS should be to provide a framework in which to address the health of aquatic ecosystems; water flows; water quality (including appropriate pollution reduction targets); water supply; flood protection; wildlife and biological diversity; and natural habitat. Evaluations involving surface water availability for water supply purposes should be based on providing a 1-in-10 level of certainty from surface water as an optimal goal.

Subtasks

7.3.1 Complete problem identification/Project Study Plan (PSP) phase by October 2000.

7.3.2 Complete development of a preferred alternative for the Caloosahatchee Basin by 2003.

7.3.2.a It is recommended that the demand projections that were developed for the CWMP form the basis for evaluation of demands in the Caloosahatchee Basin in the SWFS.

7.3.2.b The ISGM and other models that were developed to model the Caloosahatchee Basin should be incorporated into the SWFS and be utilized to evaluate the performance of water supply storage options, such as a distributed reservoir system. During the SWFS analysis, the CWMP demands and ISGM should be refined and updated as needed for evaluation of alternatives for meeting demands in the Caloosahatchee Basin in 2020.

7.3.2.c Continue development of the modeling tools that were developed for the CWMP. These tools include the ISGM (MIKE SHE), AFSIRS/WATBAL, and optimization models that were developed for the Caloosahatchee Basin.

7.3.2.d Continue the seepage study that was initiated during development of the CWMP.

7.3.2.e The Plan of Study for the SWFS should include an evaluation of the feasibility of constructing a distributed reservoir system. In addition, the SFWMD should investigate the feasibility of public/private partnerships for funding and implementing a distributed reservoir system.

7.3.2.f There are areas immediately adjacent to the CWMP Planning Area where distributed, small-scale reservoirs could be developed that can offer improved water resource management through increased environmental and flood protection,

and increased surface water resource availability that should be investigated in the SWFS.

Description: Complete the Southwest Florida Study

Total Cost: $6,100,000 (cost estimated, SFWMD portion only) FTEs included in dollar costs

Funding Source: SFWMD and USACE (50/50 Cost Share)

Implementing Agency: SFWMD and USACE.

Table 33. Summary of Estimated Schedule and Costs for Recommendation 7.3.

Southwest Florida Study		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
7.3	Complete the Southwest Florida Study Est. start date: 10/00 Est. finish date: 09/01	1,000		1,800		1,800		1,000		500		6,100	
7.3 CWMP	Total	1,000		1,800		1,800		1,000		500		6,100	

7.4 Recommendation from CWMP - Minimum Flows and Levels: Establish MFLs for the Caloosahatchee River and Estuary by December, 2000 in accordance with Section 373.042 F.S. The MFLs will be incorporated into rulemaking described in Recommendation 8.1.1 and 8.1.2.

Surface Water Related Strategies

7.5 Recommendation from CWMP - Well Abandonment Program: The Well Abandonment Program that was administered by the SFWMD (ended in 1991) was a voluntary program that identified abandoned artesian wells, geophysically logged them, and plugged or rehabilitated the wells, as necessary, to prevent deterioration of the SAS through upland leakage or discharge to the land surface. The program documentation indicates that there are unplugged wells remaining within the CWMP Planning Area that if plugged could contribute an estimated net flow of 50,000-acre feet per year to the water budget of the Caloosahatchee Basin. In addition, the Florida Geological Survey, Bureau of Oil and Gas have identified oil test wells within the planning area that have not been adequately plugged. Additional effort should be made to locate and properly abandon the free flowing wells in the Caloosahatchee Basin. The SFWMD should work with local and state officials to locate uncontrolled abandoned wells and identify plugging strategies and applicable funding sources for proper plugging of the wells.

Description: Coordinate with local and state agencies to identify abandoned, unplugged wells and to identify potential funding sources. This involves staff support and coordination only.

Total Cost: No direct cost associated with this recommendation. FTEs: 0.60

Funding Source: Landowners, local government, Water Resource Development Funds (potential sources).

Implementing Agency: SFWMD

Table 34. Summary of Estimated Schedule and Costs for Recommendation 7.5.

Well Abandonment Program		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
7.5	Coordinate identification of unplugged wells. Est. start date: 10/00 Est. finish date: 09/01		0.30		0.30								0.60
7.5 CWMP	Total		0.30		0.30								0.60

7.6 Recommendation from CWMP - Salt Water Influence: Saline water (in excess of 250 milligrams per liter [mg/L]) has been a recurring problem for the potable water intakes in the Caloosahatchee River (approximately one-mile upstream of S-79). During extended periods of low-flow, the chloride content of the surface water increases well beyond the recommended limit of 250 mg/L for drinking water. The actual number of times that releases have been made from Lake Okeechobee in response to salt water in excess of 250 mg/L is relatively few. A number of alternatives to these releases warrant further investigation and include moving the intake farther upstream, modifications to the structure, and improved maintenance and operation of the bubble curtain. Future freshwater releases for environmental purposes may also minimize salt water influence. Additional analysis of the saline front migration should be initiated.

Description: Coordinate additional analysis of the salt water influence problem at S-79. This involves staff support and coordination only.

Total Cost: No direct cost associated with this recommendation. FTEs: 0.30

Funding Source: USACE, local government.

Implementing Agency: SFWMD

Table 35. Summary of Estimated Schedule and Costs for Recommendation 7.6.

Salt Water Influence		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
7.6	Coordinate identification of needed additional anaysis Est. start date: 10/00 Est. finish date: 09/01		0.30										0.30
7.6 CWMP	Total		0.30										0.30

7.7 Recommendation from CWMP - Permitting Issues Associated with ASRs: The SFWMD should continue working with the legislature, USEPA, and FDEP to explore rule changes to the federal and state Underground Injection Control program to allow for (and encourage) injection of untreated or partially treated ground water or surface water with ASR. The level of treatment should be compatible with the water quality in the proposed storage zone. This recommendation is included in Recommendation 8.2.

Description: Continue working with other government entities to identify and modify existing rule criteria to facilitate changes in ASR regulations that will facilitate development of source options.

Total Cost: Costs and FTEs are in recommendation 8.2 FTEs: 0

Funding Source: SFWMD

Implementing Agency: SFWMD

7.8 Recommendation - Southwest Florida Study: The Southwest Florida Study should evaluate estuary and other environmental needs for the flows from surface water bodies including: Orange River/Harn's Marsh/East County Water Control District (Lehigh Canals), Imperial River/Kehl Canal, Ten Mile Canal/Mullock Creek, Golden Gate Canal/Gordon River, and the Faka Union Canal. The results of this evaluation should be incorporated into future LWC Water Supply Plan updates.

Description: These evaluations completed as part of the Southwest Florida Study will determine the needs of the environment and the remaining water available for water supply.

Total Cost: Costs and FTEs are in recommendation 7.3 FTEs: 0

Funding Source: SFWMD (SFWMD portion only)

Implementing Agency: SFWMD and USACE

Surface Water – Water Supply Development Recommendations

- Identify potential sources and amounts of surface water available that could be to used to meet projected demands.

8. RELATED IMPLEMENTATION STRATEGIES

This section includes those recommended efforts that apply to several of the options or could not be associated with a specific source option.

Related Implementation Strategies - Water Resource Development Recommendations

8.1 Rulemaking

To promote consistency, the concepts and guidelines used in this plan should be incorporated as criteria into the District's water management programs through rulemaking or other implementation processes.

8.1.1 Recommendation - Rulemaking: The District will conduct a public rulemaking process in accordance with Chapter 120, F.S. for the purpose of incorporating salient portions of this plan in the CUP Program and other components of District's overall water supply management responsibilities. Matters that are recommended for rulemaking consideration include: (1) Level of Certainty; (2) Resource Protection Criteria; (3) Water Shortage Triggers; (4) MFLs for the Caloosahatchee River and Estuary, and the LWC aquifer system; and (5) Special Designation Area amendments, including Reduced Threshold Areas and Water Resource Caution Areas.

Subtasks

8.1.1.a Continue ongoing rule development and rulemaking.

8.1.1.b Present draft rules to Governing Board to initiate rulemaking.

8.1.1.c Present final rules to Governing Board for adoption.

Description: Rulemaking is an existing District effort.

Total Cost: No direct cost associated with this recommendation FTEs: 2.00

Funding Source: SFWMD

Implementing Agency: SFWMD

8.1.2 Recommendation - Minimum Flows and Levels: Establish MFLs for the Caloosahatchee River and Estuary and LWC aquifer system by December, 2000 in

Table 36. Summary of Estimated Schedule and Costs for Recommendation 8.1.1.

Rulemaking		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
8.1.1 a, b, c	Incorporation into the District's CUP Program through rulemaking Est. start date: ongoing Est. finish date: 06/01		2.00										2.00
8.1.1 DW[a]	Total		2.00										2.00

a. DW- LWC portion of Districtwide Program.

accordance with Section 373.042, F.S. The MFL will be incorporated into rulemaking, described in recommendation 8.1.1.

Subtasks

8.1.2.a Continue with establishment process for the subject MFLs.

8.1.2.b Incorporate proposed MFLs, and recovery and/or prevention strategy into the rulemaking process (recommendation 8.1.1) or other implementation process.

8.1.2.c Define threshold levels for water shortage declarations for the SAS and the IAS, including development of appropriate analytical tools, and collection of additional water quality and water level data, when necessary.

Description: Establish MFLs for the Caloosahatchee River and Estuary and the LWC aquifer system (water table, lower Tamiami, Sandstone, mid-Hawthorn, and Floridan aquifers) in accordance with the District's MFL priority list that was developed pursuant to Section 373.042, F.S. The District has committed to establishing a MFL for these water resources by the end of 2000. To complement the establishment of the MFLs, water shortage triggers or thresholds for water shortage declarations need to be defined for the aquifer systems. The water shortage trigger levels are tools used to "trigger" imposition of water shortage restrictions based on climatic events, continued decline in water levels and a need to curtail human demand to correspond to decreasing supplies. Each level corresponds to a level of water shortage restriction. This information will be incorporated into the five year update of the LWC Water Supply Plan.

Total Cost: $450,000 FTEs: 3.25

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 37. Summary of Estimated Schedule and Costs for Recommendation 8.1.2.

Minimum Flows and Levels		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
8.1.2 a & b	Establish MFLs including rulemaking Est. start date: ongoing Est. finish date: 12/00		1.00										1.00
8.1.2.c	Est. start date: 10/01 Est. finish date: 9/04			150	0.75	150	0.75	150	0.75			450	2.25
8.1.2	Total		1.00	150	0.75	150	0.75	150	0.75			450	3.25

8.2 Recommendation - Government Cooperation: The District should continue working with other government entities including the legislature, USEPA and FDEP to accomplish changes in ASR and desalination disposal regulations.

Description: Continue working with other government entities to identify and modify existing rule criteria to facilitate changes in ASR and desalination disposal regulations that will facilitate development of source options.

Total Cost: No direct cost associated with this recommendation. FTEs: 0.13

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 38. Summary of Estimated Schedule and Costs for Recommendation 8.2.

Government Cooperation		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
8.2	Work with the legislature, FDEP, and USEPA Est. start date: 10/00 Est. finish date: 9/05		0.05		0.05		0.01		0.01		0.01		0.13
8.2 DW[a]	Total		0.05		0.05		0.01		0.01		0.01		0.13

a. DW- LWC portion of Districtwide Program.

8.3 Recommendation - Wetlands Drawdown Study: The District should continue the Wetlands Drawdown Study and use the knowledge gained during the rulemaking process in recommendation 8.1.1. The CUP Program should continue to use the existing wetland protection guidelines until such time as rulemaking causes a change.

Description: The District's Wetlands Drawdown Study was initiated in part, pursuant to the recommendations of the 1994 LWC Water Supply Plan and is an ongoing research project staffed by the District. This Study continues to conduct hydrobiological monitoring to determine the effects of ground water drawdowns on wetlands and refine the Wetland Resource Protection Criteria.

Total Cost: $600,000 FTEs: 6.50

Funding Source: SFWMD

Implementing Agency: SFWMD

Table 39. Summary of Estimated Schedule and Costs for Recommendation 8.3.

Wetland Drawdown Study		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
8.3	Continuation of Wetland Drawdown Study Est. start date: Existing Est. finish date: ongoing	120	1.30	120	1.30	120	1.30	120	1.30	120	1.30	600	6.50
8.3 DW[a]	Total	120	1.30	120	1.30	120	1.30	120	1.30	120	1.30	600	6.50

a. DW- LWC portion of Districtwide program.

8.4 Recommendation - Public Information: The District will make the ground water models, data, and other relative information referenced in this plan available to the public.

Total Cost: No direct costs are associated with recommendation 8.4. This is an ongoing District policy.

FTEs: 0

Funding Source: SFWMD

Implementing Agency: SFWMD

SUMMARY OF WATER RESOURCES DEVELOPMENT RECOMMENDATIONS

This section summarizes the recommendations presented earlier in this chapter.

1. Conservation

1.1 Recommendation - Water Conservation Program: The District will develop and implement a comprehensive water conservation program to cultivate a conservation ethic in cooperation with water users, utilities and local governments to promote water conservation and more efficient use of the water resources in the LWC Planning Area. The conservation program will incorporate continued development and compliance with water conservation ordinances, development and implementation of public education programs, use of alternative water sources, other conservation methods and documenting new and existing water conservation efforts. The conservation program will encompass all uses, but should provide emphasis on the outside use of water and Xeriscape™ principles. The creation of a water conservation coordinator position and provisions for fiscal incentives are envisioned as potential tools to establish the water conservation program to cultivate a conservation ethic.

1.2 Recommendation - Mobile Irrigation Labs: The District will support maintaining the existing mobile irrigation labs (MILs) (one agricultural, one urban) and encourage establishment of two additional MILs (one agricultural, one urban) in the LWC Planning Area through identification of dedicated non-District funding sources for existing and additional MILs.

2. Ground Water Resources

2.1 Surficial Aquifer System (SAS)

2.1.1 Recommendation - Surficial Aquifer Monitoring: The District should review existing water quality and water level monitoring for the SAS aquifers in the LWC Planning Area. Well locations and parameters should be compared with areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program will be maintained and should be expanded where appropriate. Emphasis should be placed on monitoring and analysis of water levels and salinity levels.

2.1.2 Recommendation - Surficial Aquifer Rulemaking: To promote consistency, the SAS concepts and criteria used in this plan should be incorporated into the District's CUP Program and other components of the District's overall water supply management responsibilities through rulemaking, such as MFLs, coastal saltwater intrusion prevention, wetland protection, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination.

2.1.3 Recommendation - Surficial Aquifer Modeling: As soon as it feasible, but no later than the five year update to this plan, the District shall conduct a regional evaluation, using the finer grid models currently under development for renewal of CUP's, of the effects the projected demands might have on these aquifers and the

associated water resources. If this regional analysis identifies potential problems, the District should revise this plan, and identify specific water resource and water supply development projects to meet the projected needs.

2.2 Intermediate Aquifer System (IAS)

2.2.1 Recommendation - Intermediate Aquifer Monitoring: The District should review existing water quality and water level monitoring for the IAS aquifers in the LWC Planning Area. Well locations and parameters should be compared with areas of current and projected land use development, utilization of the aquifer, areas of existing saltwater intrusion, and areas where there is a potential for saltwater intrusion. The District's monitoring program will be maintained and should be expanded where appropriate. Emphasis should be placed on monitoring and analysis of water levels and salinity levels.

2.2.2 Recommendation - Intermediate Aquifer Rulemaking: To promote consistency, the IAS concepts and criteria used in this plan should be incorporated into the District's CUP Program and other components of the Districts overall water supply management responsibilities through rulemaking, such as MFLs, coastal saltwater intrusion prevention, aquifer protection from excessive drawdowns, aquifer monitoring, and protection from contamination. In addition, the District should incorporate a rule in the CUP Program that does not provide protection for "inefficient" facilities, such as centrifugal pumps located at land surface. Consideration of interim protection of existing facilities should be included.

2.2.3 Recommendation - Intermediate Aquifer Modeling: As soon as it feasible, but no later than the five year update of this plan, the District shall conduct a regional evaluation, using the finer grid models currently under development for renewal of CUP's, of the effects the projected demands might have on these aquifers and the associated water resources. If this regional analysis identifies potential problems, the District should revise this plan, and identify specific water resource and water supply development projects to meet the projected needs.

2.3 Floridan Aquifer System (FAS)

2.3.1 Recommendation - Floridan Aquifer Model: The District should develop a comprehensive FAS ground water model based on all existing and future information available focusing on Lee, Collier and possibly Hendry counties to conduct predictive analysis in the future. This model would be for use by the District and public to evaluate both water withdrawals and storage via ASR. The model should be developed and refined with user participation and information collected through the CUP Program, water users, utilities, and other sources with regard to water quality, water levels and hydrologic characteristics, when appropriate. Other sources that may be utilized include existing monitoring wells or wells that may be converted to monitoring wells instead of being abandoned. Appropriate well site selection should consider model boundary conditions and not be limited to the LWC Planning Area.

2.3.2 Recommendation - Floridan Aquifer Monitoring: The District should expand the FAS ground water monitoring network to collect the data necessary to establish the relationship between water use, water levels, and water quality in the LWC Planning Area.

2.3.3 Recommendation - Floridan Aquifer Data Partnerships: The District should develop and recognize partnership agreements during development of the scope of work with water users and utilities who are planning to develop the FAS for water supply, ASR, or wastewater effluent disposal. These partnerships will collect water quality, water level, and hydrologic information related to the FAS. Information could be gained via packer tests, coring/testing of specific intervals plus geophysical logging (e.g. permeability logs) and aquifer performance testing. The District should budget for these items and cost-share for additional testing and data acquisition. The development of partnerships to share collected data will be in addition to and complementary to the data collection efforts described in tasks 2.3.1 and 2.3.2.

2.3.4 Recommendation - Floridan Aquifer Government Cooperation: The District should continue to work with other government entities, including the legislature, FDEP and USEPA to explore environmentally acceptable alternative desalination concentrate disposal options.

3. Reclaimed Water

Refer to the Regional Irrigation System Source Option

4. Regional Irrigation System

4.1 Recommendation - Regional Irrigation System Study: The District will evaluate, with assistance from LWC local governments, water users, and utilities, the feasibility of constructing a subregional irrigation water distribution system(s) and other options to meet the growing urban irrigation demands of this area. Reclaimed water should be used, and where available, should be incorporated into the evaluation. The results of this study should be incorporated in the update of this plan.

5. Seawater

None

6. Storage

6.1 Aquifer Storage and Recovery (ASR)

6.1.1 Recommendation - ASR Water Quality: The District should continue working with other government entities, including the legislature, Congress, USEPA and FDEP, to explore rule changes to the federal and state Underground Injection Control (UIC) program to allow for (and encourage) injection of untreated or partially treated ground water or surface water with ASR. The level of treatment should be compatible with the water quality in the proposed storage zone.

6.1.2 Recommendation - ASR Rulemaking: The District should develop CUP rules to address the use of the Floridan aquifer for ASR, as well as water use, to assure compatibility between use concepts.

6.2 Regional and Local Retention

6.2.1 Recommendation - Regional and Local Retention: Retention projects that raise water levels through either system modifications or operation changes and benefit water supply without causing environmental harm should be considered for cost-sharing from the District's Water Resource Development funds. Potential retention projects as described above include Big Cypress Basin projects and possibly additional work in the Gator Slough and the Fred C. Babcock/Cecile M. Webb Wildlife Management Area, the southern CREW land, and projects related to implementation of the South Lee County Watershed Plan.

6.3 Reservoirs

Regional and distributed small scale reservoirs are being recommended in the Caloosahatchee Basin. Refer to Surface water section for CWMP recommendations.

7. Surface Water

7.1 Recommendation from CWMP - Caloosahatchee River ASR Pilot Project: The District should work cooperatively with the USACE to site, design, construct, and operate a pilot regional ASR project. Recovery performance and additional information obtained from the construction of and cycle testing at this facility will guide the design of the regional ASR wellfield.

7.2 Recommendation from CWMP - C-43 Storage Project: The SFWMD should cooperate with the USACE in development of the Project Implementation Report (PIR), design, construction, and operation of a regional reservoir and ASR project within the Caloosahatchee Basin. A comprehensive geologic and geotechnical investigation should be completed, as a part of the PIR to provide the information needed to size and design the reservoir. Development of the PIR, land acquisition,

design, and plans and specifications should be completed by 2005. Construction should be initiated in 2005.

7.3 Recommendation from CWMP - Southwest Florida Study: The SFWMD should work in cooperation with the USACE to initiate and complete the Southwest Florida Study (SWFS) by the year 2005 as recommended in the CERP. The modeling work that has been completed as a part of the CWMP should be used as the basis for development of a preferred alternative to meet the demands within the Caloosahatchee Basin in 2020. The primary purpose of the SWFS should be to provide a framework in which to address the health of aquatic ecosystems; water flows; water quality (including appropriate pollution reduction targets); water supply; flood protection; wildlife and biological diversity; and natural habitat. Evaluations involving surface water availability for water supply purposes should be based on providing a 1-in-10 level of certainty from surface water as an optimal goal.

7.4 Recommendation from CWMP - Minimum Flows and Levels: Establish MFL for the Caloosahatchee River and Estuary by December, 2000 in accordance with Section 373.042, F.S. The MFLs will be incorporated into rulemaking described in the LWC Water Supply Plan in Recommendation 8.1.1 and 8.1.2.

7.5 Recommendation from CWMP - Well Abandonment Program: The Well Abandonment Program that was administered by the SFWMD (ended in 1991) was a voluntary program that identified abandoned artesian wells, geophysically logged them, and plugged or rehabilitated the wells, as necessary, to prevent deterioration of the SAS through upland leakage or discharge to land surface. The program documentation indicates that there are unplugged wells remaining within the planning area that if plugged could contribute an estimated net flow of 50,000-acre feet per year to the water budget of the Caloosahatchee Basin. In addition, the Florida Geological Survey, Bureau of Oil and Gas have identified oil test wells within the planning area that have not been adequately plugged. Additional effort should be made to locate and properly abandon the free flowing wells in the Caloosahatchee Basin. The SFWMD should work with local and state officials to locate uncontrolled abandoned wells and identify plugging strategies and applicable funding sources for proper plugging of the wells.

7.6 Recommendation from CWMP - Salt Water Influence: Saline water (in excess of 250 milligrams per liter [mg/L]) has been a recurring problem for the potable water intakes in the Caloosahatchee River (approximately one-mile upstream of S-79). During extended periods of low-flow, the chloride content of the shallow water increases well beyond the recommended limit of 250 mg/L for drinking water. The actual number of times that releases have been made from Lake Okeechobee in response to salt water in excess of 250 mg/L is relatively few. A number of alternatives to these releases warrant further investigation and include moving the intake farther upstream, modifications to the structure, and improved maintenance and operation of the bubble curtain. Future freshwater releases for environmental

purposes may also minimize salt water influence. Additional analysis of the saline front migration should be initiated.

7.7 Recommendation from CWMP - Permitting Issues Associated with ASRs: The SFWMD should continue working with the legislature, USEPA, and FDEP to explore rule changes to the federal and state Underground Injection Control program to allow for (and encourage) injection of untreated or partially treated ground water or surface water with ASR. The level of treatment should be compatible with the water quality in the proposed storage zone. This recommendation is included in Recommendation 8.2.

7.8 Recommendation - Southwest Florida Study: The Southwest Florida Study should evaluate estuary and other environmental needs for the flows from surface water bodies including: Orange River/Harn's Marsh/East County Water Control District (Lehigh Canals), Imperial River/Kehl Canal, Ten Mile Canal/Mullock Creek, Golden Gate Canal/Gordon River, and the Faka Union Canal. The results of this evaluation should be incorporated into future LWC Water Supply Plan updates.

8. Related Implementation Strategies

8.1.1 Recommendation - Rulemaking: The District will conduct a public rulemaking process in accordance with Chapter 120, F.S. for the purpose of incorporating salient portions of this plan in the CUP Program and other components of District's overall water supply management responsibilities. Matters that are recommended for rulemaking consideration include: (1) Level of Certainty; (2) Resource Protection Criteria; (3) Water Shortage Triggers; (4) Minimum flows and levels for the Caloosahatchee River and Estuary, and the LWC aquifer system; and (5) Special Designation Area amendments, including Reduced Threshold Areas and Water Resource Caution Areas.

8.1.2 Recommendation - Minimum Flows and Levels: Establish MFLs for the Caloosahatchee River and Estuary and LWC aquifer system by December, 2000 in accordance with Section 373.042, F.S. The MFL will be incorporated into rulemaking, described in recommendation 8.1.1.

8.2 Recommendation - Government Cooperation: The District should continue working with other government entities including the legislature, USEPA and FDEP to accomplish changes in ASR and desalination disposal regulations.

8.3 Recommendation - Wetlands Drawdown Study: The District should continue the Wetlands Drawdown Study and use the knowledge gained during the rulemaking process in recommendation 8.1.1. The CUP Program should continue to use the existing wetland protection guidelines until such time as rulemaking causes a change.

8.4 Recommendation - Public Information: The District will make the ground water models, data, and other relative information referenced in this plan available to the public

Table 40. Recommendation Summary Table.

Recommendation Summary Table		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
1.1 DW	Water Conservation Program	85	0.30	85	0.30	85	0.30	85	0.30	85	0.30	425	1.50
1.2	Mobile Irrigation Labs		0.21		0.01		0.01		0.01		0.01		0.25
2.1.1	Surficial Aquifer Monitoring		0.60	220	1.50	120	0.75	60	0.25	60	0.25	460	3.35
2.2.1	Intermediate Aquifer Monitoring		0.60	340	0.45	50	0.20	50	0.20	50	0.20	490	1.65
2.3.1	Floridan Aquifer Model		0.50	700	1.00	1,420	4.20	390	2.90	20	1.10	2,530	9.70
2.3.2	Floridan Aquifer Monitoring	107	1.40	41	0.50	49	0.60	51	0.60	51	0.60	299	3.70
2.3.3	Floridan Aquifer Data Partnerships	100	0.20	100	0.40	100	0.40	100	0.20	100	0.20	500	1.40
4.1	Regional Irrigation System Study	200	3.50		0.70		0.30					200	4.50
6.2.1	Regional and Local Retention	300	0.10	300	0.10	300	0.10	300	0.10	300	0.10	1,500	0.50
7.1 CWMP	Caloosahatchee River ASR Pilot Project	250		2,300		280		84		84		2,998	
7.2 CWMP	C-43 Storage Project	2,154		2,163		23,925		66,386		43,466		138,094	
7.3 CWMP	Southwest Florida Study	1,000		1,800		1,800		1,000		500		6,100	
7.5 CWMP	Well Abandonment Program		0.30		0.30								0.60
7.6 CWMP	Salt Water Influence		0.30										0.30
8.1.1 DW	Rulemaking		2.00										2.00
8.1.2 DW	Minimum Flows and Levels		1.00	150	0.75	150	0.75	150	0.75			450	3.25
8.2 DW	Government Cooperation		0.05		0.05		0.01		0.01		0.01		0.13
8.3 DW	Wetland Drawdown Study	120	1.30	120	1.30	120	1.30	120	1.30	120	1.30	600	6.50
Total		4,316	12.36	8,319	7.36	28,399	8.92	68,776	6.62	44,836	4.07	154,646	39.33

DW-Lower West Coast portion of a Districtwide Program; all costs are in $1,000's.

RELATIONSHIP OF PROJECTS TO FIVE-YEAR WORK PROGRAM

The District is required to prepare a Five-Year Water Resource Development Work Program annually. This report is submitted to DEP, and documents the District's progress in implementing water supply plan recommendations. The time frame for the work program is a five year minimum. For each recommendation or strategy, the work program will provide the following information:

- The total cost of the project
- An estimate of the amount of water to become available by implementation of a project
- Funding source
- Implementing agency
- A summary of any changes to the recommendation since the plan was implemented
- Timetables for the Five-Year Work Program
- A description of the District's progress towards achieving water resource development objectives

The recommendations in this plan will be incorporated into the the Five-Year Water Resource Development Work Program following Governing Board approval. Development of the next Five-Year Water Resource Development Work Program is anticipated to begin in mid-2000.

FUNDING

This section addresses the funding strategy and options for implementation of this Water Supply Plan. The approach takes into account the requirements of Chapter 373, F.S., feedback and comments from the advisory committee, and input from District staff. Chapter 373 requires water supply plans to include a funding strategy that is reasonable and sufficient to pay the costs of constructing or implementing all of the water resource development projects.

In general, the funding approach is divided into two major categories: water resource development and water supply development. The water resource development category addresses funding for projects that are primarily the responsibility of the District. Water supply development projects, on the other hand, are primarily the responsibility of local governments, utilities, and other water users. However, information is included on programs that target funding of water supply development projects in general.

Water Resource Development

Water resource development projects are generally regional in nature and are primarily the responsibility of the District. The water resource development projects for the LWC Planning Area were itemized earlier in this chapter. In addition, pursuant to Chapter 373, F.S., each water management district governing board is required to include in its annual budget the amount needed for the fiscal year to implement water resource development projects, as prioritized in its regional water supply plans. In addition to this plan, the District is also completing regional water supply plans for two other planning areas while approaching the third year of implementation of the Upper East Coast Water Supply Plan.

Besides implementation of the water supply plans, the SFWMD is initiating implementation of the $8 billion Comprehensive Everglades Restoration Plan (CERP), a cost-shared effort with the U. S. Army Corps of Engineers (USACE). It is anticipated significant District financial resources will be used for this project. It is not known to staff at this time the impact that these efforts will have on the District's resources in the future. Consequently, timelines for implementation of the plan recommendations may have to be adjusted in the future. Any future changes to these timelines will be identified in the annual updates to the District's Five-Year Water Resource Development Work Program. The recommendation tables in the plan show the costs of the projects and potential sources of funding. Timeframes for completing the projects are preliminary and are subject to funding availability in the future years.

The traditional funding source for these types of projects has been primarily ad valorem taxes. Non-CERP projects, most of those listed in this plan, will be ranked and prioritized along with projects in all other regional water supply plans during annual District budget preparation, and funded as money is available. Priority considerations for a project include availability of a cost-share partner and if a project makes "new" water available. Sustainability of the regional system is also an important consideration of project prioritization.

Some of the recommendations in this plan are studies. These studies may result in construction projects at a later date. Funding associated with these will be addressed at that time. Potential funding sources for water resource development include funds provided on a project-by-project basis by the SFWMD's budget.

Water Supply Development

Water supply development projects are local in nature and generally involve the withdrawal, treatment, and distribution of water. Chapter 373 states that, “local governments, regional water supply authorities, and government-owned and privately owned water utilities take the lead in securing funds for and implementing water supply development projects. Generally, direct beneficiaries of water supply development projects should pay the costs of the projects from which they benefit, and water supply development projects should continue to be paid for through local funding sources." It is

not the intent that regional water supply plans mandate actions to be taken by local agencies, utilities, and other water users. Therefore, the overall theme of this section is to provide direction and assistance, but not to mandate directives to local governments or utilities.

Chapter 373 requires water supply plans to identify potential sources of funding for water supply development projects. In addition to funding the projects themselves through utility rates, there are several other funding programs to assist local entities.

Water Resource Protection and Restoration Projects Funding Program

On January 18, 2000, Governor Jeb Bush announced his proposal to finance the protection and preservation of Florida's water resources. The Governor's proposed budget provides $73 million dollars to fund water resource restoration projects, which include wastewater treatment plant upgrades and storm water treatment areas. This represents an increase of 38 percent over last year's water project funding.

Projects eligible for the funding must address such criteria as resolving violations of state water quality standards, preventing drainage and flood control problems, and resolving public health threats. Projects requesting funding for surface water restoration and wastewater improvements will be reviewed by the Water Advisory Panel to ensure eligibility.

The Governor created the Water Advisory Panel to ensure that efforts to protect and preserve Florida's water resources is priority-driven, objective, and policy-based. Projects determined by the panel as meeting the criteria will be forwarded to the legislature for funding consideration. This process ensures that state dollars are providing needed and meaningful improvements to state water resources.

The featured project must be identified in a water management district or Florida Department of Environmental Protection plan as part of a surface water restoration effort. In addition, storm water related restoration projects that have a flood component must be identified in a storm water mitigation master plan and have quantifiable flood protection targets. For wastewater facilities projects, grant recipients must have or agree to adopt an ordinance requiring mandatory waste management hookup upon failure of individual systems. The sponsor, or recipient, of the wastewater facilities projects is expected to fund at least 25 percent of the total project costs.

District's Alternative Water Supply Grant Program

Vastly increased demands on natural supplies of freshwater led the Florida legislature in 1995 to enact the Alternative Water Supply Grant Program to increase the potential for the development of alternative water supplies in the state; help utilities develop cost-effective reclaimed water supplies; and fulfill a public purpose to fund such programs. Since FY97, the District has funded 82 projects in its Water Resource Caution Areas for a total of approximately $20 million.

The funds available vary annually as determined during the District's budget process. Increased funding needs for Everglades restoration are currently competing with funding for other District programs, including the Alternative Water Supply Grant Program. Significant decreases in funding of this program are projected in FY01. The Advisory Committee recommends that the Governing Board reasses the funding needs of the Alternative Water Supply Grant Program on an annual basis or periodic basis, recognizing its significant potential benefit to water supply development in the District.

The Alternative Water Supply Grant Program is a cost share program that provides a portion of funding for alternative water supply projects built by local, county, or private water purveyors. Since FY97, the District has provided funds for projects that save or offset millions of gallons of water every day.

To be considered for this funding support, the project must be consistent with the local government plan and must be located in a Water Resource Caution Area. The local government must require all appropriate new facilities within the project service area to connect and use the project's alternative water supplies. Funding support shall be applied only for the capital or infrastructure costs for the construction for alternative water supply systems and the project must fall within guidelines established by the District.

Projects are scored and ranked by a selection committee of non-SFWMD representatives from utilities, the environment, and agricultural interests. They score and rank submitted project proposals based on criteria from the enabling legislation, the SFWMD, and the Water Resources Development Act, described earlier.

Drinking Water State Revolving Fund Program

The 1996 Amendments to the Safe Drinking Water Act (SDWA) authorized USEPA to award grants to states for capitalization of Drinking Water State Revolving Funds (DWSRF). These are intended to be a source of financial assistance to public water systems to achieve compliance with Drinking Water Regulations and protecting public health. States must provide matching funds equal to at least 20 percent of the grant.

There are two elements of a DWSRF. The first element is establishment of a loan fund enabling a state to make below-market loans to public water systems for the construction of projects. (A PWS can be publicly or privately-owned but some states have statutory or constitutional restrictions limiting funding for privately-owned systems.) States must adopt a priority system, ranking projects based on considerations of public health, compliance and affordability (systems most in need), and are required to fund to the maximum extent practical in priority order.

The second element of a DWSRF is the ability to provide set-aside money to assist PWSs in meeting regulatory requirements through direct assistance, loans, and/or state grants funding capacity development, source water assessment, source water protection, and operator certification.

REGIONAL WATER SUPPLY PLAN IMPLEMENTATION ASSURANCES

Background

During the next 20 years, the SFWMD, the State of Florida, and consumptive users will be partners in implementing regional water supply plans (RWSPs) per a directive of state statute in Section 373.0361, F.S. The RWSPs provide a guide map for meeting consumptive user demands and natural system demands projected in 2020. There are economic, technical and political uncertainties associated with implementing water resource development projects of the complexity and scope recommended in the regional water supply plans. These uncertainties will be particularly evident during the interim period during which the various elements will be implemented and become operational. Reasonable certainty is needed for the protection of existing legal users and the water resources during the interim period.

Water resource development projects, operational changes, consumptive use permitting and rulemaking associated with the RWSPs are proposed to occur in phases. The increasing demands of consumptive users and the environment must, to the extent practicable, correspond with the timing of increased water availability. Where shifts from existing sources of water are required for environmental enhancement, it is crucial that replacement sources are available when such shifts occur.

Existing Florida law provides the framework and includes several tools to protect and maintain this phased or incremental consistency between increasing supplies and demands for both consumptive users and the environment. These include water reservations, consumptive use permits, minimum flows and levels recovery strategies, and water shortage declarations. The framework for implementing these tools for resource restoration and protection from harm, significant harm and serious harm.

A composite schedule for implementation of these water resource tools in concert with water resource development projects will be proposed in the RWSPs. This schedule will be further refined during the five year water resource development work plan, five year water supply plan updates, annual budget reviews, periodic rule updates, and consumptive use permit renewals. Processes for contingency planning will also be developed to address uncertainties in the fulfillment of the water supply plans with the goal of complying with State requirements for the protection of existing legal users and environmental resources.

Water User and Natural System Assurances

The level of assurances in protecting existing legal water users and the natural systems (assurances) while implementing the regional water supply plans must be consistent with Chapter 373, F.S. In this implementation process, the District's Governing Board will be faced with many policy decisions regarding the application and interpretation of the law. The unique legal, technical, economical, and political

implications of the regional water supply plans will all be considered in making these policy decisions. The District will be facing many of these issues for the first time in terms of their scale and significance.

The subject of assurances has been addressed in other forums, particularly in the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* (Restudy) (USACE and SFWMD, 1999). Although these assurances were developed in the context of the Restudy implementation, such assurances are applicable to implementation of regional water supply plan recommendations under state law and have been approved by the District's Governing Board. The Governing Board directs staff to implement the LWC Water Supply Plan in accordance with the following assurances (from section 10.2.9 of Restudy):

Assurances To Water Users

The concept of "assurances" is key to the successful implementation of the Comprehensive Plan. Assurances can be defined in part as protecting, during the implementation phases of the Comprehensive Plan, the current level(s) of service for water supply and flood protection that exist within the current applicable Florida permitting statutes. Assurances also involve protection of the natural system.

The current C&SF Project[1] has generally provided most urban and agricultural water users with a level of water supply and flood protection adequate to satisfy their needs. Florida law requires that all reasonable beneficial water uses and natural system demands be met. However, the C&SF Project, or regional system, is just one source of water for South Florida to be used in concert with other traditional and alternative water supplies.

The Governor's Commission for a Sustainable South Florida developed a consensus-based set of recommendations concerning assurances to existing users, including the natural system (GCFSSF, 1999). The following text is taken from the Commission's *Restudy Plan Report*, which was adopted on January 20, 1999:

> *"Assurances are needed for existing legal users during the period of plan implementation. It is an important principle that has helped gain consensus for the Restudy that human users will not suffer from the environmental restoration provided by the Restudy. At the same time, assurances are needed that, once restored, South Florida's natural environment will not again be negatively impacted by water management activities. Getting 'from here to there' is a challenge. The implementation plan will be the key to assuring predictability and fairness in the process.*
>
> *<u>Protecting Current Levels of Service (Water Supply and Flood Protection) during the Transition from the Old to the New C&SF Project.</u>*

1. C&SF Project refers to the Central and Southern Florida Project for Flood Control and Other Purposes.

The goal of a sustainable South Florida is to have a healthy Everglades ecosystem that can coexist with a vibrant economy and quality communities. The current C&SF Project has generally provided most urban and agricultural water users with a level of water supply and flood protection adequate to satisfy their needs. In fact, if properly managed, enough water exists within the South Florida system to meet restoration and future water supply needs for the region. However, past water management activities in South Florida, geared predominantly toward satisfying urban and agricultural demands, have often ignored the many needs of the natural system (GCSSF, 1995; transmittal letter to Governor Chiles, p. 2). Specifically, water managers of the C&SF Project historically discharged vast amounts of water to tide to satisfy their mandate to provide flood protection for South Florida residents, oftentimes adversely impacting the region's estuarine communities.

The Commission recommended that in the Restudy, the SFWMD and the Corps[1] should ensure that the redesign of the system allows for a resilient and healthy natural system (GCSSF, 1995; p. 51) and ensure an adequate water supply and flood protection for urban, natural, and agricultural needs (GCSSF, 1996a; p.14). In response to the need to restore South Florida's ecosystem, and in light of the expected future increase of urban and agricultural water demands, the Restudy aims to capture a large percentage of water wasted to tide or lost through evapotranspiration for use by both the built and natural systems. In order to maximize water storage, the Restudy intends to use a variety of technologies located throughout the South Florida region so that no one single area bears a disproportionate share of the storage burden. This direction reinforces the Commission's recommendation that water storage must be achieved in all areas of the South Florida system using every practical option (GCSSF, 1996a; p. 25).

However, concerns have been expressed that a water user would be forced to rely on a new water storage technology before that technology is capable of fully providing a water supply source or that existing supplies would otherwise be transferred or limited, and that the user would thereby experience a loss of their current legal water supply level of service. Any widespread use of a new technology certainly has potential limitations; however, the Restudy should address technical uncertainties prior to project authorization and resolve them before implementation in the new C&SF Project. With the addition of increased water storage capabilities, water managers will likely shift many current water users to different water sources.

Additionally, stakeholders are concerned that a preservation of the current level of service for legal uses would not encompass all the urban uses, some of which are not incorporated in the term 'legal' and covered by permit. Specifically, an adequate water supply is needed to address urban environmental preservation efforts as well as water level maintenance to reduce the impact of salt water intrusion.

1. U.S. Army Corps of Engineers

The Commission believes that in connection with the Restudy, the SFWMD should not transfer existing legal water users from their present sources of supply of water to alternative sources until the new sources can reliably supply the existing legal uses. The SFWMD should implement full use of the capabilities of the new sources, as they become available, while continuing to provide legal water users as needed from current sources. It is the Commission's intent that existing legal water users be protected from the potential loss of existing levels of service resulting from the implementation of the Restudy, to the extent permitted by law.

The Commission also recognizes that the SFWMD cannot transfer the Seminole Tribe of Florida from its current sources of water supply without first obtaining the Tribe's consent. This condition exists pursuant to the Seminole Tribe's Water Rights Compact, authorized by Federal (P.L. 100-228) and State Law (s285.165, F.S.).

However, the issues surrounding the development of specific assurances to water users are exceedingly complex and will require substantial additional effort to resolve.

RECOMMENDATION

- *The SFWMD and the Corps should work with all stakeholders to develop appropriate water user assurances to be incorporated as part of the Restudy authorizations. These water user assurances should be based on the following principles:*

  A. Physical or operational modifications to the C&SF Project by the federal government or the SFWMD will not interfere with existing legal uses and will not adversely impact existing levels of service for flood management or water use, consistent with State and federal law.

  B. Environmental and other water supply initiatives contained in the Restudy shall be implemented through appropriate State (Chapter 373 F.S.) processes.

  C. In its role as local sponsor for the Restudy, the SFWMD will comply with its responsibilities under State water law (Chapter 373 F.S.).

  D. Existing Chapter 373 F.S. authority for the SFWMD to manage and protect the water resources shall be preserved.

<u>Water Supply for Natural Systems</u>

Concerns have been raised about long term protection of the Everglades ecosystem. According to WRDA 1996[1], the C&SF Project is to be rebuilt 'for the purpose of restoring, preserving, and protecting the South Florida ecosystem' and 'to provide for all the water-related needs of the region, including flood control, the enhancement of water supplies, and other objectives served by the C&SF Project.'

1. The Water Resource Development Act of 1996 (WRDA 1996) is legislation passed by the U.S. Congress that authorized the Restudy, the Water Preserve Area Feasibility Study, etc.

Environmental benefits achieved by the Restudy must not be lost to future water demands. When project implementation is complete, there must be ways to protect the natural environment so that the gains of the Restudy are not lost and the natural systems, on which South Florida depends, remain sustainable.

A proactive approach which includes early identification of future environmental water supplies and ways to protect those supplies under Chapter 373 F.S. will minimize future conflict. Reservations for protection of fish and wildlife or public health and safety can be adopted early in the process and conditioned on completion and testing of components to assure that replacement sources for existing users are on line and dependable. The SFWMD should use all available tools, consistent with Florida Statutes, to plan for a fair and predictable transition and long term protection of water resources for the natural and human systems.

Apart from the more general goals of the Restudy, there are specific expectations on the part of the joint sponsors - the State and the federal government. The more discussion that goes into an early agreement on expected outcomes, the less conflict there will be throughout the project construction and operation.

RECOMMENDATIONS

- *The SFWMD should use the tools in Chapter 373 F.S. to protect water supplies necessary for a sustainable Everglades ecosystem. This should include early planning and adoption of reservations. These reservations for the natural system should be conditioned on providing a replacement water source for existing legal users which are consistent with the public interest. Such replacement sources should be determined to be on line and dependable before users are required to transfer.*

- *The SFWMD should expeditiously develop a 'recovery plan' that identifies timely alternative water supply sources for existing legal water users. The recovery plan should consist of water supply sources that can reliably supply existing uses and whose development will not result in a loss of current levels of service, to the extent permitted by law. To assure that long term goals are met, the State and federal governments should agree on specific benefits to water users, including the natural system, that will be maintained during the recovery.*

- *In the short term, the Restudy should minimize adverse effects of implementation on critical and/or imperiled habitats and populations of State and federally listed threatened and/or endangered species. In the long term, the Restudy should contribute to the recovery of threatened species and their habitats.*

Protecting Urban Natural Systems and Water Levels

Water supply for the urban environment is connected to water supply for the Everglades and other natural areas targeted for restoration and preservation under the Restudy.

It is essential that the Restudy projects proposed to restore and preserve the environment of the Everglades do not reduce the availability of water to such an extent in urban areas that the maintenance of water levels and the preservation of natural areas becomes physically or economically infeasible.

The successful restoration of Everglades functions is dependent not only upon the establishment of correct hydropatterns within the remaining Everglades, but also upon the preservation and expansion of wetlands, including those within urban natural areas that once formed the eastern Everglades. Some of the westernmost of these areas have been incorporated in the Restudy as components of the WPAs[1]. However, the on-going preservation efforts of local governments have acquired hundreds of millions of dollars worth of additional natural areas for protection both inside and outside of the WPA footprint.

Water supplies for these urban wetlands are not covered by existing permits or reservations and are therefore, not adequately protected. Efforts are underway at both the SFWMD and the local level to preserve these vital areas and assure their continuing function as natural areas and in ecosystem restoration.

Detailed design for the Restudy, in particular the detailed modeling associated with the WPA Feasibility Study, will make possible plans to protect these urban wetlands from damage and to assure maximum integration with Restudy components.

RECOMMENDATIONS

- *The SFWMD and the Corps should acknowledge the important role of urban natural areas as an integral part in the restoration of a functional Everglades system. As a part of the implementation plan, the SFWMD and the Corps should develop an assurance methodology in conjunction with the detailed design and modeling processes, such as the WPA Feasibility Study, to provide the availability of a water supply adequate for urban natural systems and water level maintenance during both implementation and long term operations.*

- *Expand and accelerate implementation of the WPAs. Accelerate the acquisition of all lands within the WPA footprint to restore hydrologic functions in the Everglades ecosystem, and ensure hydrologic connectivity within the WPA footprint. The WPA Feasibility Study process should be given a high priority. The WPA concept should be expanded into other SFWMD planning areas such as the Upper East Coast.*

- *The Restudy should assure that the ecological functions of the Pennsuco wetlands are preserved and enhanced."*

There is a substantial body of law that relates to the operation of Federal flood control projects, both at the state and federal level. Much of the Governor's

1. Water Preserve Areas

Commission language is directed to the South Florida Water Management District and matters of state law. To the extent that the Governor's Commission's guidance applies to the Corps' actions, the Corps will give it the highest consideration as Restudy planning proceeds and as plan components are constructed and brought on-line consistent with state and federal law. The recommended Comprehensive Plan does not address or recommend the creation or restriction of new legal entitlements to water supplies or flood control benefits.

GLOSSARY

Acre-foot The volume would cover one acre to a depth of one foot; 43,560 cubic feet; 1,233.5 cubic meters; 325,872 gallons.

Application Efficiency The ratio of the volume of irrigation water available for crop use to the volume delivered from the irrigation system. This ratio is always less than 1.0 because of the losses due to evaporation, wind drift, deep percolation, lateral seepage (interflow), and runoff that may occur during irrigation.

Aquifer A portion of a geologic formation or formations that yield water in sufficient quantities to be a supply source.

Aquifer Compaction The reduction in bulk volume or thickness of a body of fine-grained sediments contained within a confined aquifer or aquifer system. The compaction of these fine-grained sediments results in subsidence, and sometimes fissuring, of the land surface.

Aquifer Storage and Recovery (ASR) The injection of freshwater into a confined aquifer during times when supply exceeds demand (wet season), and recovering it during times when there is a supply deficit (dry season).

Aquifer System A heterogeneous body of intercalated permeable and less permeable material that acts as a water-yielding hydraulic unit of regional extent.

Artesian When ground water is confined under pressure greater than atmospheric pressure by overlying relatively impermeable strata.

Available Supply The maximum amount of reliable water supply including surface water, ground water and purchases under secure contracts.

Average-day Demand A water system's average daily use based on total annual water production (total annual gallons or cubic feet divided by 365).

Average Irrigation Requirement Irrigation requirement under average rainfall as calculated by the District's modified Blaney-Criddle model.

Backpumping The practice of pumping water that is leaving the area back into a surface water body.

Basin (Ground Water) 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.

BEBR Bureau of Economic and Business Research is a division of the University of Florida, with programs in population, forecasting, policy research and survey.

Best Management Practices (BMPs) Agricultural management activities designed to achieve an important goal, such as reducing farm runoff, or optimizing water use.

BOR Basis of Review (for Water Use Applications with the South Florida Water Management District).

Brackish Water with a chloride level greater than 250 mg/L and less than 19,000 mg/L.

Budget (water use) An accounting of total water use or projected water use for a given location or activity.

Central and Southern Florida Project Comprehensive Review Study (Restudy) A five-year study effort that looked at modifying the current C&SF Project to restore the greater Everglades and South Florida ecosystem while providing for the other water-related needs of the region. The study concluded with the Comprehensive Plan being presented to the Congress on July 1, 1999. The recommendations made within the Restudy, that is, structural and operational modifications to the C&SF Project, are being further refined and will be implemented in the Comprehensive Everglades Restoration Plan (CERP).

Cone of Influence The area around a producing well which will be affected by its operation.

Control Structures A man-made structure designed to regulate the level and/or flow of water in a canal (e.g., weirs, dams).

Conservation (water) Any beneficial reduction in water losses, wastes, or use.

Conservation Rate Structure A water rate structure that is designed to conserve water. Examples of conservation rate structures include but are not limited to, increasing block rates, seasonal rates and quantity-based surcharges.

Consumptive Use Use that reduces an amount of water in the source from which it is withdrawn.

Demand The quantity of water needed to be withdrawn to fulfill a requirement.

Demand Management (Water Conservation) 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.

Demographic Relating to population or socioeconomic conditions.

Desalination A process which treats saline water to remove chlorides and dissolved solids.

Domestic Use Use of water for the individual personal household purposes of drinking, bathing, cooking, or sanitation.

Drawdown The distance the water level is lowered, due to a withdraw at a given point.

DWMP District Water Management Plan. Regional water resource plan developed by the District under Ch. 373.036, F. S.

Effective Rainfall The portion of rainfall that infiltrates the soil and is stored for plant use in the crop root zone, as calculated by the modified Blaney-Criddle model.

Evapotranspiration Water losses from the surface of soils (evaporation) and plants (transpiration).

Exotic Nuisance Plant Species A non-native species which tends to out-compete native species and become quickly established, especially in areas of disturbance or where the normal hydroperiod has been altered.

FASS Florida Agricultural and Statistics Service, a division of the Florida Department of Agriculture and Consumer Services.

Flatwoods (Pine) Natural communities that occur on level land and are characterized by a dominant overstory of slash pine. Depending upon soil drainage characteristics and position in the landscape, pine flatwoods habitats can exhibit xeric to moderately wet conditions.

Florida Water Plan State-level water resource plan developed by the FDEP under Ch. 373.036, F.S.

Governing Board Governing Board of the South Florida Water Management District.

Ground Water Water beneath the surface of the ground, whether or not flowing through known and definite channels.

Harm *(Term will be further defined during proposed Rule Development process)* An adverse impact to water resources or the environment that is generally temporary and short-lived, especially when the recovery from the adverse impact is possible within a period of time of several months to several years, or less.

Hydroperiod The frequency and duration of inundation or saturation of an ecosystem. In the context of characterizing wetlands, the term hydroperiod describes that length of time during the year that the substrate is either saturated or covered with water.

IFAS The Institute of Food and Agricultural Sciences, that is the agricultural branch of the University of Florida, performing research, education, and extension.

Infiltration The movement of water through the soil surface into the soil under the forces of gravity and capillarity.

Inorganic Relating to or composed of chemical compounds other than plant or animal origin.

Irrigation The application of water to crops, and other plants by artificial means.

Irrigation Audit A procedure in which an irrigation systems application rate and uniformity are measured.

Irrigation Efficiency The average percent of total water pumped or delivered for use that is delivered to the root zone. of a plant.

Irrigation Uniformity A measure of the spatial variability of applied or infiltrated water over the field.

Lake Okeechobee Largest freshwater lake in Florida. Located in Central Florida, the lake measures 730 square miles and is the second largest freshwater lake wholly within the United States.

Leakance Movement of water between aquifers or aquifer systems.

Leak Detection Systematic method to survey the distribution system and pinpoint the exact locations of hidden underground leaks.

Levee An embankment to prevent flooding, or a continuous dike or ridge for confining the irrigation areas of land to be flooded.

Level of Certainty Probability that the demands for reasonable-beneficial uses of water will be fully met for a specified period of time (generally taken to be one year) and for a specified condition of water

availability, (generally taken to be a drought event of a specified return frequency). For the purpose of preparing regional water supply plans, the goal associated with identifying the water supply demands of existing and future reasonable beneficial uses is based upon meeting those demands for a drought event with a 1-in-10 year return frequency.

Marsh A frequently or continually inundated wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions.

Micro Irrigation The application of water directly to, or very near to the soil surface in drops, small streams, or sprays.

Mobile Irrigation Laboratory A vehicle furnished with irrigation evaluation equipment which is used to carry out on-site evaluations of irrigation systems and to provide recommendations on improving irrigation efficiency.

NGVD National Geodetic Vertical Datum, a nationally established references for elevation data relative to sea level.

NRCS The Natural Resources Conservation Service is a federal agency that provides technical assistance for soil and water conservation, natural resource surveys, and community resource protection

One-in-Ten Year Drought Event A drought of such intensity, that it is expected to have a return frequency of 10 years (see Level of Certainty).

Organics Being composed of or containing matter of, plant and animal origin.

Overhead Sprinkler Irrigation A pressurized system, where water is applied through a variety of outlet sprinkler heads or nozzles. Pressure is used to spread water droplets above the crop canopy to simulate rainfall.

Per Capita Use Total use divided by the total population served.

Permeability Defines the ability of a rock or sediment to transmit fluid.

Potable Water Water that is safe for human consumption (USEPA, 1992).

Potentiometric Head The level to which water will rise when a well is drilled into a confined aquifer.

Potentiometric Surface An imaginary surface representing the total head of ground water.

Process Water Water used for nonpotable industrial usage, e.g., mixing cement.

Projection Period The period over which projections are made. In the case of this document, the 25 year period from 1995 to 2020.

Public Water Supply (PWS) Utilities Utilities that provide potable water for public use.

Rapid-Rate Infiltration Basin (RIB) An artificial impoundment that provides for fluid losses through percolation/seepage as well as through evaporative losses.

Rationing Mandatory water-use restrictions sometimes used under drought or other emergency conditions.

Reasonable-Beneficial Use Use of water in such quantity as is necessary for economic and efficient utilization for a purpose and in a manner which is both

reasonable and consistent with the public interest.

Reclaimed Water Water that has received at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility.

RECOVER A comprehensive monitoring and adaptive assessment program formed to perform the following for the Comprehensive Everglades Restoration Program: restoration, coordination, and verification.

Reduced Allocation Areas Areas in which a physical limitation has been placed on water use.

Reduced Threshold Areas (RTAs) Areas established by the District for which the threshold separating a General Permit from an Individual Permit has been lowered from the maximum limit of 100,000 GPD to 20,000 GPD. These areas are typically resource-depleted areas where there have been an established history of sub-standard water quality, saline water movement into ground or surface water bodies, or the lack of water availability to meet projected needs of a region.

Regional Water Supply Plan Detailed water supply plan developed by the District under Ch. 373.0361, F.S.

Retrofit The replacement of existing equipment with equipment that uses less water.

Retrofitting The replacement of existing water fixtures, appliances and devices with more efficient fixtures, appliances and devices for the purpose of water conservation.

Restudy Shortened name for C&SF Restudy.

Reverse Osmosis (RO) Process used to produce fresh water from a brackish supply source.

Saline Water Water with a chloride concentration greater than 250 mg/L, but less than 19,000 mg/L.

Saline Water Interface The hypothetical surface of chloride concentration between fresh water and saline water, where the chloride concentration is 250 mg/L at each point on the surface.

Saline Water Intrusion This occurs when more dense saline water moves laterally inland from the coast, or moves vertically upward, to replace fresher water in an aquifer.

Sea Water Water which has a chloride concentration equal to or greater than 19,000 mg/L.

Seepage Irrigation Systems Irrigation systems which convey 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.

Semi-Closed Irrigation Systems Irrigation systems which convey water through closed pipes, and distribute it to the crop through open furrows between crop rows.

Semi-Confining Layers Layers with little or no horizontal flow, and restrict the vertical flow of water from one aquifer to another. The rate of vertical flow is dependent on the head differential between the aquifers, as well as the vertical permeability of the sediments in the semi-confining layer.

Sensitivity Analysis An analysis of alternative results based on variations in assumptions (a "what if" analysis).

Serious Harm (*Term will be defined during proposed Rule Development process)* An extremely adverse impact to water resources or the environment that is either permanent or very long-term in duration. Serious harm is generally considered to be more intense than significant harm.

Significant Harm *(Term will be defined during proposed Rule Development process)* An adverse impact to water resources or the environment, when the period of recovery from the adverse impact is expected to take several years; more intense than harm, but less intense than serious harm.

Slough A channel in which water moves sluggishly, or a place of deep muck, mud or mire. Sloughs are wetland habitats that serve as channels for water draining off surrounding uplands and/or wetlands.

Stage The elevation of the surface of a surface water body.

Storm Water Surface water resulting from rainfall that does not percolate into the ground or evaporate.

Subsidence An example of subsidence is the lowering of the soil level caused by the shrinkage of organic layers. This shrinkage is due to biochemical oxidation.

Surface Water Water that flows, falls, or collects above the surface of the earth.

Superfund Site A contamination site, of such magnitude, that it has been designated by the federal government as eligible for federal funding to ensure cleanup.

SWIM Plan Surface Water Improvement and Management Plan, prepared according to Ch. 373, F. S.

TAZ Traffic analysis zone; refers to a geographic area used in transportation planning.

Transmissivity A term used to indicate the rate at which water can be transmitted through a unit width of aquifer under a unit hydraulic gradient. It is a function of the permeability and thickness of the aquifer, and is used to judge its production potential.

Turbidity The measure of suspended material in a liquid.

Ultra-low-volume Plumbing Fixtures Water-conserving plumbing fixtures that meet the standards at a test pressure of 80 psi listed below.

Toilets - 1.6 gal/flush

Showerheads - 2.5 gal/min.

Faucets - 2.0 gal/min.

Uplands Elevated areas that are characterized by non-saturated soil conditions and support flatwood vegetation.

Wastewater The combination of liquid and waterborne discharges from residences, commercial buildings, industrial plants and institutions together with any ground water, surface runoff or leachate that may be present.

Water Resource Caution Areas Areas that have existing water resource problems or where water resource problems are projected to develop during the next 20 years (previously referred to as critical water supply problem areas).

Water Resource Development The formulation and implementation of regional water resource management strategies, including: the collection and evaluation of surface water and ground water data; structural and nonstructural programs to protect and manage the water resource; 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 ground water recharge augmentation; and, related technical assistance to local governments and to government-owned and privately owned water utilities.

Water Shortage Declaration *Rule 40E-21.231, Fla. Admin. Code:* "If …there is a possibility that insufficient water will be available within a source class to meet the estimated present and anticipated user demands from that source, or to protect the water resource from serious harm, the Governing Board may declare a water shortage for the affected source class." Estimates of the percent reduction in demand required to match available supply is required and identifies which phase of drought restriction is implemented. A gradual progression in severity of restriction is implemented through increasing phases. Once declared, the District is required to notify permitted users by mail of the restrictions and to publish restrictions in area newspapers.

Water Supply Plan District plans that provide an evaluation of available water supply and projected demands, at the regional scale. The planning process projects future demand for 20 years and develops strategies to meet identified needs.

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.

Wetlands Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions.

Wetland Drawdown Study Research effort by the South Florida Water Mangement District to provide a scientific basis for developing wetland protection criteria for water use permitting.

Xeriscape™ Landscaping that involves seven principles: proper planning and design; soil analysis and improvement; practical turf areas; appropriate plant selection; efficient irrigation; mulching; and appropriate maintenance.

REFERENCES CITED

Boyle Engineering. 1989. Process evaluation and testing program - Sarasota County Water Improvements Program Phase 1. Boyle Engineering Corporation, Fort Myers, FL. 5 pp.

Bureau of Economic and Business Research (BEBR). 1997. *Florida Population Studies*. Volume 30, Number 2, Bulletin 117. Bureau of Economic and Business Research, UF, Gainsville, FL.

City of Cape Coral. 1999. SFWMD alternative water supply funding program fiscal year 1999 - Gator Slough/Reuse System Enhancements: Phase III. City of Cape Coral Utilities Division, Cape Coral, FL. vari. pag.

Duever, M.J. 1988. Hydrologic processes for models of freshwater wetlands In: Mitsch, William, J. M. Jorgensen and S. E. Jorgensen (Eds.), *Wetlands Modeling*. Elsevier: Amsterdam. pp. 9-39.

East County Water Control District. 1999. SFWMD alternative water supply fiscal year 1999 funding application. East County Water Control District, Leigh Acres, FL vari. pag.

Erwin, K. 1991. South Florida Water Management District wetland mitigation study, Volume 1. Report to the South Florida Water Management District, West Palm Beach, FL. 124 pp.

Mitsch, W.J. and J.G. Gosselink. 1986. *Wetlands*. New York: Van Nostran Reinhold Company.

Post, Buckley, Shuh, & Jernigan, Inc. 1991. Water supply cost estimates. Final Report. PBS&J, Tampa, FL. vari. pag.

Pyne. 1995. *Ground Water Recharge and Wells: A Guide to Aquifer Storage Recovery*. Boca Raton: CRC.

South Florida Water Management District. 1991. *Water Supply Policy Document*. Planning Department, SFWMD, West Palm Beach, FL. 82 pp.

South Florida Water Management District. 1993. *Economic Impact Statement for Changes to 40e-1.901 and 40e-2, F.A.C., and The Addition of Appendices 1 And 2 to the "Basis of Review for Water Use Permit Applications within the South Florida Water Management District."* Planning Department, SFWMD, West Palm Beach, FL. 46 pp.

South Florida Water Management District. 1995. *District Water Management Plan*. Planning Department, SFWMD, West Palm Beach, FL. vari pag.

South Florida Water Management District. 1998. *Districtwide Water-Supply Assessment*, Planning Department, SFWMD, West Palm Beach, FL. vari pag.

South Florida Water Management District. 1994. *Lower West Coast Water Supply Plan*. Planning Department, SFWMD, West Palm Beach, FL. vari. pag.

Tampa Bay Water. 1999. News release - Tampa Bay desalinated water will be cheapest in the world. *Tampa Bay Water.* Clearwater, FL, February 22, 1999.

USACE and SFWMD. 1999. *The Central and Southern Florida Flood Control Project Comprehensive Review Study.* U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL, and South Florida Water Management District, West Palm Beach, FL.

University of Florida, 1993. *Micro Irrigation in Florida: Systems, Acreage, and Costs*. Bulletin 117. Bureau of Economic Business Research, University of Florida, Gainsville, FL.

Wedderburn, L., M. Knapp, D. Waltz and W. Burns. 1982. *Hydrogeologic Reconnaissance of Lee County, Florida.* Technical Publication 82-1. South Florida Water Management District, West Palm Beach, FL. 192 pp.