Kissimmee Basin Water Supply Plan

Planning Document

Volume 1

prepared by

South Florida Water Management District

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Water Supply Planning and Development Department
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EXECUTIVE SUMMARY

The Kissimmee Basin is one of four regional planning areas in the South Florida Water Management District (SFWMD). The Kissimmee Basin (KB) Planning Area covers approximately 3,500 square miles and includes those portions of Orange, Osceola, Polk, Highlands, Okeechobee, and Glades counties that lie within the SFMWD. The KB Planning Area shares common boundaries with the St. Johns River Water Management District and the Southwest Florida Water Management District.

The KB Planning Area is expected to experience significant growth in the urbanized areas of Orange and Osceola counties and moderate agricultural expansion in portions of Highlands, Glades, and Okeechobee counties. Agricultural water demand accounted for 75 percent of the overall water use in the KB Planning Area in 1995 at 308 MGD. This use is expected to increase by approximately 170 MGD through the planning horizon of 2020. During the same period, the region's population is projected to increase by 89 percent, from about 363,000 to almost 687,000 people, resulting in an increase of 85 MGD in urban use over the existing use of 98 MGD. The overall basin water demand is projected to increase by 63 percent to 662 MGD for the average condition through the planning horizon of 2020.

The KB Water Supply Plan has been prepared to meet the legislative requirements of the 1996 Governor's Executive Order 96-297 and the 1997 water supply planning provisions of Section 373.0361, F.S. The KB Water Supply Plan is based on a 20-year planning period and includes the following components:

- A water supply development component
- A water resource development component
- A prevention strategy related to minimum flows and levels
- A funding strategy
- Consideration of how the water supply and resource development components serve the public interest or save costs
- Technical data supporting the plan

This plan is intended provide a framework to address future water use decisions regarding current and future water supply for urban areas, agriculture, and the environment through the year 2020. The plan estimates the future water supply needs of urban and agriculture and weighs those demands against historically used water sources and the needs of the environment. Through this process, areas are identified where the projected demands may result in possible harm to the resource or environment. In those areas where there is a potential for harm to the environment, the plan evaluates alternative water source options to meet any unmet demand and makes recommendations towards their development.

The development of the KB Water Supply Plan began in 1994 with the collection of field data in support of the planning effort. In 1998, a public participation process was developed that provided for the completion of water use projections, collection of water source information, identification of basin issues, solution development and ultimately for the preparation of the planning document itself. As part of this public participation process, the District created the KB Water Supply Plan advisory committee consisting of representatives of agricultural, environmental and urban interests. This group met 17 times over the course of the plan development.

As part of the planning process, analyses of the basin resources were completed. These analyses performed in the development of this plan included ground water modeling, surface water management assessments, vulnerability mapping and a comparative evaluation. The ground water flow models developed for this plan were used to simulate the affects of projected 2020 water demands on the environment and ground water sources within the KB Planning Area. A surface water management assessment focused on the management issues associated with the Lake Istokpoga and Indian Prairie system of waterworks that supply agricultural uses in that area. Vulnerability mapping was used to identify areas where the potential is greatest for future harm to wetlands as a result of ground water withdrawals. Where data was the least available to complete a rigorous analysis, a comparative evaluation was performed to determine of possible movement of poor quality water and the increased potential for sinkhole occurrence.

Based on the results of these analyses, the basin was divided into northern and southern areas to focus on the issues that were identified. In the northern portion of the basin, continued ground water use to supply the projected population growth in Orange and Osceola counties was identified as the primary issue. In the southern portion of the basin, increased surface water use in the Lake Istokpoga-Indian Prairie Basin resulting from proposed agricultural expansion was identified as the primary issue of concern.

In Orange and Osceola counties, the analyses performed identified areas at higher risk for harm to wetlands, significant saline water movement and sinkhole formation as a result of increased ground water withdrawals. In addition, the plan identifies future withdrawals occurring in the basin may be contributing to the reduction of spring flows in Orange and Seminole counties. The analysis completed under this planning effort is limited to identifying areas of risk associated with future withdrawals contributing to harm to the resource. Identification of these areas do not imply that harm will or will not occur, but instead provides guidance on the level of possible risk that may result from future ground water withdrawals and identifies where additional research efforts should be focused.

The examination of the surface water resources within the southern KB Planning Area focused on a determination of the availability of supplies from the Lake Istokpoga-Indian Prairie Basin. The analysis performed indicates that current supplies from Lake Istokpoga and surface water runoff in the Indian Prairie Basin are insufficient, under the current management/operation schedule, to meet the projected 2020 1-in-10 drought demands for water. The analysis further demonstrates that the combined uses of Lake Okeechobee and Lake Istokpoga are available to meet the projected 2020 demands. The

use of these sources, however, may require the construction of additional infrastructure to move water where needed.

While the long-term, the 20-year continued increased use of the Floridan aquifer is in question for southern Orange County and northern Osceola County, the immediate, short-term use of the Floridan is expected to continue. The recommendations of this plan that address continued water use in the northern portion of the basin focus on additional data collection and investigation into the options of reclaimed water, storm water, water conservation and surface water use feasibility. Three strategies are developed under this plan to address the future water supply issues in the Orange-Osceola County Area. These include the following:

- Recharge to the Floridan aquifer (through application of reclaimed water and stormwater)
- Demand reduction (through water conservation)
- Optimized use of the Floridan aquifer and development of alternative sources (through continued testing and modeling of the Floridan aquifer and development of surface water sources)

In the Lake Istokpoga-Indian Prairie Basin, the results of the surface water analysis indicate that the surface water availability during a 1-in-10 drought condition is not adequate to support the projected, 2020 water supply demands. The solution to meeting these projected demands lies in changing the operation/management of Lake Istokpoga and in obtaining additional supplies from Lake Okeechobee, local ground water or use of the Kissimmee River. Additional use of Lake Okeechobee and the Kissimmee River are highly controversial and implementation is contingent upon resolving water quality issues as well as addressing other ongoing projects linked to their restoration efforts. Continued use of Lake Istokpoga and future use of Lake Okeechobee are proposed through development of operational plans that will address the operation of pumps and control structures as well as operational agreements with land owners, tribal rights, water quality discharges, and lake regulation schedules among other items. An assessment is proposed for the Kissimmee River in conjunction with the restoration effort to determine the potential availability of the river as a future supply source.

In total, the KB Water Supply Plan identifies approximately $10.8 million dollars in projects to be completed over the next five years to further investigate and clarify the issues raised during the plan analysis. Local governments and users will play a key role in future implementation of these recommendations. Several of the recommendations in this plan are cost-share projects with local partners while other recommendations require the District to enter into agreements with local land owners. In all of these recommendations, the District anticipates continuing the public participation process to assist in guiding the implementation of the recommendations.

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LIST OF ABBREVIATIONS AND ACRONYMS

AC-FT	acre-feet
ADAPS	Automated Data Processing System (USGS)
ADF	Average Daily Flow
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
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
CDF	Cumulative Distribution Function
CERP	Comprehensive Everglades Restoration Plan
COD	Chemical Oxygen Demand
CR	County Road
CUP	Consumptive Use Permit
DBP	Disinfection By-Product
D/DBPR	Disinfectant/Disinfection By-Product Rule
DEP	Florida Department of Environmental Protection
District	South Florida Water Management District
DWMP	District Water Management Plan
DWSA	District Water Supply Assessment
DWSRF	Drinking Water State Revolving Funds
DSS	Domestic Self-Supplied
EC	Electrical Conductivity
ED	Electrodialysis
EDI	Early Detection Incentive
EDR	Electrodialysis Reversal
EOC	Emergency Operations Center

ERP	Environmental Resource Permitting
ET	Evapotranspiration
F.A.C.	Florida Administrative Code
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
FSRI	Florida Sinkhole Research Institute
FWC	Florida Wildlife Commission
FY	Fiscal Year
GAC	Granular Activated Carbon
GIS	Geographic Information System
GOH	Glades, Okeechobee, and Highlands
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
I/I	Infiltration and Inflow
KB	Kissimmee Basin
KBWSP	Kissimmee Basin Water Supply Plan
KOE	Kissimmee-Okeechobee-Everglades
LFA	Lower Floridan Aquifer
LWC	Lower West Coast

MCL	Maximum Contaminant Level
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
MSE	Mean Square Error
MWC	Molecular Weight Cutoff
NGVD	National Geodetic Vertical Datum
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
OUC	Orlando Utilities Commission
O&M	Operations and Maintenance
OLS	Ordinary Least Squares
OPE	Lake Istokpoga Regulation Schedule
P2000	Preservation 2000
PACP	Pre-Approved Advanced Cleanup Program
PCPP	Petroleum Cleanup Participation Program
PDF	Probability Distribution Function
PIR	Project Implementation Report
PLRG	Pollution Loading Reduction Goals
PWS	Public Water Supply
RAA	Restricted Allocation Area
RCID	Reedy Creek Improvement District
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
SAS	Surficial Aquifer System

SDWA	Safe Drinking Water Act
SFWMD	South Florida Water Management District
SFWMM	South Forida Water Management Model
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
SWFWMD	Southwest Florida Water Management District
SWIM	Surface Water Improvement Management
SWTP	Surface Water Treatment Plant
TAZ	Traffic Analysis Zone
THM	Trihalomethane
TTHM	Total Trihalomethanes
TDS	Total Dissolved Solids
UFA	Upper Floridan Aquifer
UIC	Underground Injection Control
ULV	Ultra-Low Volume
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
WCA	Water Conservation Area
WHPA	Wellhead Protection Area
WPCG	Water Planning Coordination Group
WRCA	Water Resource Caution Area
WVA	Wetlands Vulnerability Analysis
WWTP	Wastewater Treatment Plant

Chapter 1
INTRODUCTION

The Kissimmee Basin is one of four regional planning areas in the South Florida Water Management District (**Figure 1**). The Kissimmee Basin (KB) Planning Area covers approximately 3,500 square miles and includes parts of Orange, Osceola, Polk, Highlands, Okeechobee, and Glades counties (**Figure 2**). The KB Planning Area shares common boundaries with adjacent water management districts. The northern and eastern portions of the boundary are shared with the St. Johns River Water Management District, while the western boundary is adjacent to the Southwest Florida Water Management District.

Each of the three water management districts have identified areas that may experience harm to natural resources due to projected ground water withdrawals. The St. Johns and South Florida water management districts have identified the Orange-Osceola County Area as an area that may potentially experience harm to natural systems due to the anticipated combined ground water use occurring within each district. The SFWMD has also identified portions of Highlands and Glades counties as a problem area due to the limited supply of surface water from Lake Istokpoga. Finally, the Southwest Florida Water Management District has identified several stressed lakes along the Lake Wales Ridge which have been linked to declines in Floridan aquifer levels.

The KB Planning Area is experiencing high growth in the urbanized areas in the north and moderate agricultural increases in the south. Agricultural water demand, which accounts for 75 percent of the overall water demand in the KB Planning Area, is expected to increase by approximately 55 percent through the planning horizon of 2020. At the same time, the region's population is projected to increase by 89 percent, from about 363,000 to almost 687,000 people. Overall water demand is projected to increase by about 63 percent to over 242,000 million gallons per year by 2020.

PURPOSE

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

An important part of the planning process has been identifying constraints to water supply and exploring opportunities to optimize use of the resource. This involved extensive public input from the KB Water Supply Plan advisory committee, whose members represent a variety of disciplines and interests, such as local governments, public

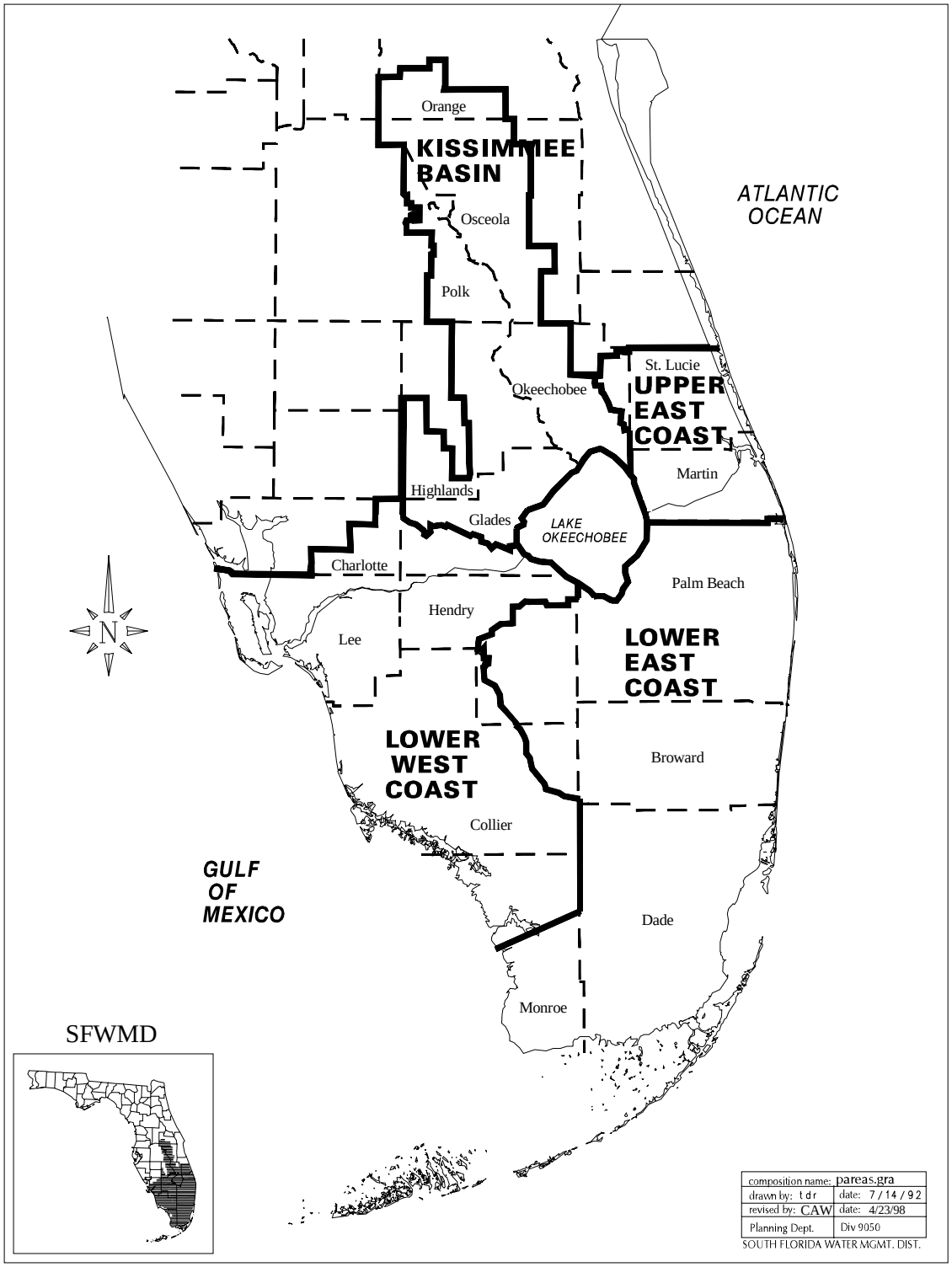

Figure 1. Regional Planning Areas.

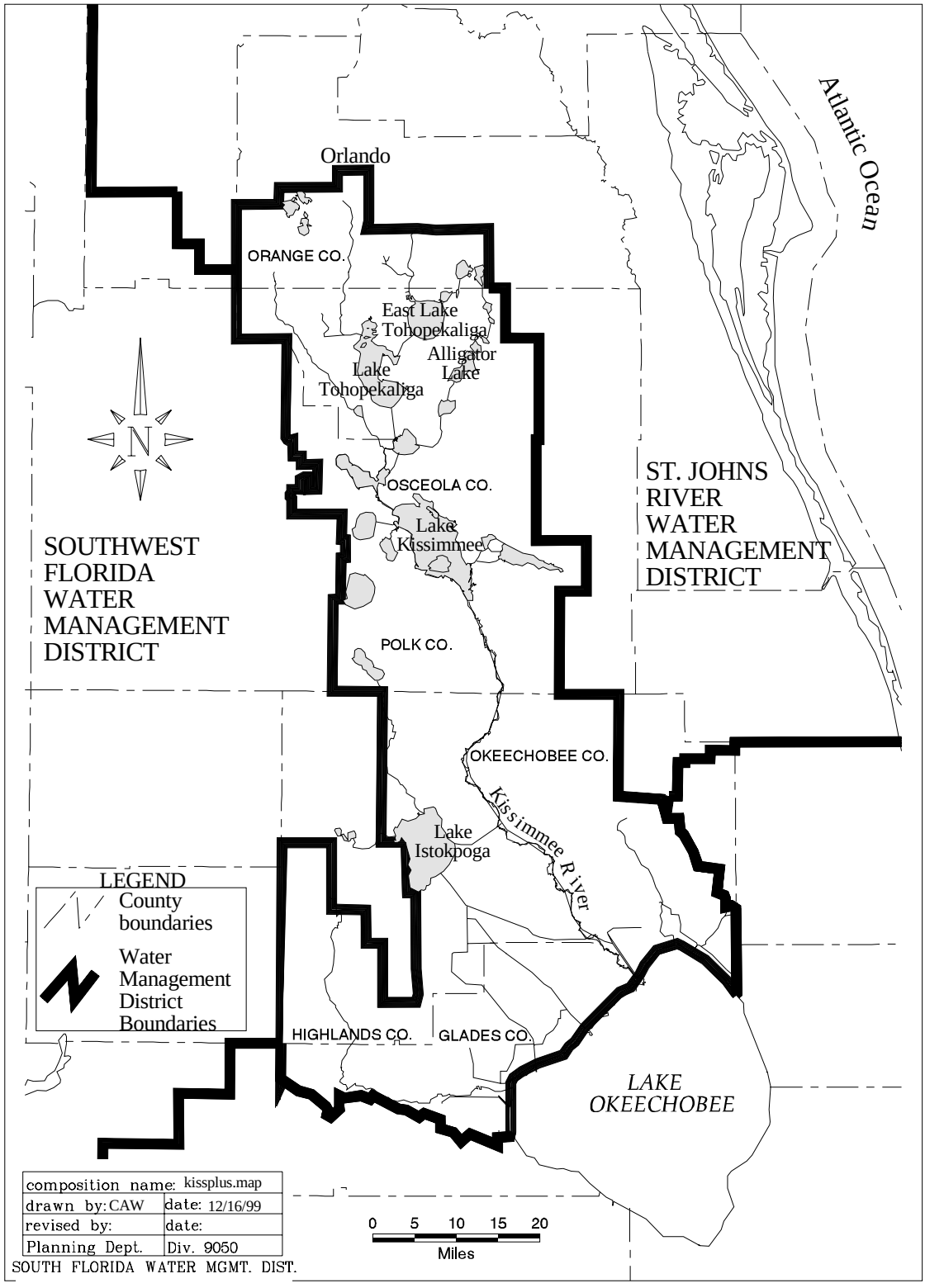

Figure 2. Kissimmee Basin Planning Area.

water supply utilities, environmental interests, and agriculture, as well as the general public. In addition, a focus group (subcommittee) for Lake Istokpoga-Indian Prairie Basin was formed by the advisory committee to address water resource problems within that basin.

The location and nature of the KB Planning Area warrants intensive coordination with adjacent water management districts, particularly in water resource investigation, water resource planning, water resource regulation, and water shortage declarations. To better coordinate these activities, the three water management districts have entered into a Memorandum of Understanding, which outlines guidelines for coordination in each of these four areas. In addition, the SFWMD has an agreement with the Seminole Tribe of Florida for the Brighton Reservation that outlines the tribe's entitlement of water within the Lake Istokpoga-Indian Prairie Basin.

BASIS OF WATER SUPPLY PLANNING

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), State Water Policy (Chapter 62-40, F.A.C.), Chapter 373, F.S., the State Comprehensive Plan (Chapter 187, F.S.), and delegation of authority from Florida Department of Environmental Protection (FDEP). In addition, the plan meets the legislative requirements of the 1996 Governor's Executive Order 96-297 and the 1997 water supply planning provisions of Section 373.0361, F.S.

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 meet 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, F.S.)

PLAN VISION, GOAL, AND OBJECTIVES

The KB Water Supply Plan advisory committee adopted the following vision, goal and objectives to guide development of the water supply plan to ensure the water needs of this region will be met through the year 2020.

Plan Vision

The KB Water Supply Plan advisory committee adopted the State's water resource goal in the State Comprehensive Plan (Chapter 187, F.S.) as the vision for the KB 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 adopted the following draft goal specific to this region for the KB Water Supply Plan:

> Identify sufficient sources of water and funding to meet the needs of all reasonable-beneficial uses within the KB Planning Area for 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 the KB Water Supply Plan addresses the specific needs of the region, the advisory committee developed the following draft regional objectives (no implied priority):

Objective 1. Water Sources: Optimize the use of all water sources.

Objective 2. Natural System Protection: Protect natural systems from harm due to water uses.

Objective 3. Level of Certainty: Identify options that will provide a 1-in-10 year level of certainty for all existing and projected reasonable-beneficial uses.

Objective 4. Compatibility with Local Governments: Promote compatibility of the KB Water Supply Plan with tribal and local government land use decisions and policies.

Objective 5. Linkage with Other Regional Planning efforts: Promote compatibility and integration with other related regional water resource planning efforts, including, but not limited to, Kissimmee River Restoration, Kissimmee Chain of Lakes, the Restudy, and Southwest Florida Water Management District and St. Johns River Water Management District water supply planning efforts without detriment to the Kissimmee Basin region.

Objective 6. Conservation of Water Sources: Promote water conservation and efficient use of water sources.

Objective 7. Water Supply Demands: Refine water supply demand projections for all reasonable-beneficial uses for average year and the 1-in-10 year level of certainty.

Objective 8. Funding: Identify adequate sources of funding to support water resource development and water supply development options identified in the plan.

Objective 9. Water Resource Protection: Protect water resources (aquifers, lakes) from harm due to water uses, including preventing harmful movement of saline water within the Floridan Aquifer System as a result of water use.

The goal and associated objectives captured the expectations and issues in the KB Planning Area, and in turn, provided direction for the planning process. Topics scheduled for committee discussion, research and analytical work, and formulation of final recommendations centered on these objectives. Completion of the plan's initial goal and objectives marked the transition into the analytical phase of the 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 phases: assembling background information and development of tools, issue identification and analysis, and solution development (**Figure 3**). 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 source options were explored. The goals and objectives, established with the assistance of the advisory committee, provided the overall framework for the planning process.

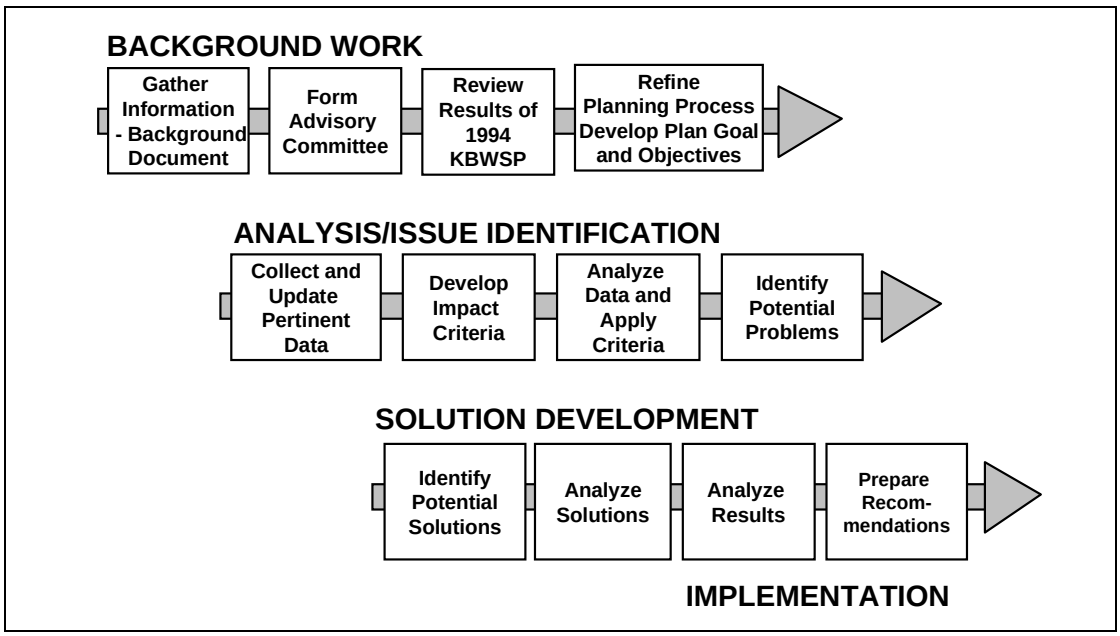

Figure 3. The Kissimmee Basin Planning Process.

Background Work

Background Information

The District project team compiled the initial background information required for 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 Kissimmee Basin (KB) Planning Area, environmental information, and water source option concepts. The urban water use demand projections were based on population projections published by the Bureau of Economic and Business Research (BEBR), while agricultural demand

projections were based primarily on long-term historical trends. All of this information was then consolidated into the Support Document and associated appendices 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.

Tool Development

Another significant preparatory task was the identification, development and refinement of analytical tools needed for subsequent stages of the process. This included the use of three regional ground water models for the (1) Orlando metropolitan area, (2) Osceola County, and (3) Glades, Okeechobee, and Highlands counties. In addition, a surface water budget assessment was developed for the Lake Istokpoga-Indian Prairie Basin. Model preparation involved the assembly of substantial amounts of information, including statistical analyses of rainfall events in the region, and descriptive data pertaining to aquifer characteristics such as transmissivity.

Advisory Committee Formation

A 24 member advisory committee, with approximately 12 alternate members, was created to obtain public participation in the planning process. Membership included representatives of federal, state and local agencies, planning officials, public water supply utilities, local business community, environmental interests, community leadership, and agricultural concerns. Each of the advisory committee meetings was advertised and open to the public.

The primary role of the committee, as well as the general public who attended these meetings, was to provide input at each stage of the water supply planning process, contribute local knowledge and expertise, and to reflect the collective concerns and interests of various stakeholders in the KB Planning Area. The role of District staff was to facilitate the planning process, provide professional and technical support and guidance, and prepare the planning document with committee input.

The advisory committee spent the initial monthly meetings listening to background presentations, sharing information and improving the District's understanding of the local issues. The goals and objectives established by the advisory committee served as a "road map" for the subsequent planning process. Topics scheduled for committee discussion, research and analytical work, and formulation of final recommendations all centered on these goals. Completion of the plan's initial goals marked the transition into the analytical phase of the process.

The advisory committee met a total of 17 times between November 1998 and April 2000. After plan approval, committee members will continue to be informed of the implementation activities through newsletters or periodic status meetings, and the Five-Year Water Resource Development work plan based on the KB Water Supply Program.

In addition, a subcommittee or focus group to the advisory committee was formed to evaluate options and develop recommendations for issues associated with surface water

availability in the Lake Istokpoga-Indian Prairie Basin. The focus group was composed of agricultural water users, the local government for Highlands County, local lake interest groups, representatives of the Seminole Tribe and members of the public. The members drew upon their local knowledge and experience with Lake Istokpoga and the Indian Prairie Canal system to formulate water supply strategies and recommendations. This focus group met four times during the period of May 1999 to January 2000.

The focus group was instrumental in providing input on projected agricultural water use and formulation of the water source options and strategies for the region. The group also provided critical review of the results of a surface water management analysis upon which the water source options were evaluated. The final water source options and associated recommendations were brought back to the full advisory committee prior to plan approval.

Analysis and Issue Identification

The analytical tools used in the development of this plan include ground water models, surface water management assessments, and wetland vulnerability mapping. Ground water modeling was conducted to predict the impacts of projected water demands on the resource. In an effort to better assess the ground water conditions within the planning basin, three ground water models were used. Two of these models were developed by SFWMD staff and include the Osceola County model and the Glades, Okeechobee, and Highlands (GOH) County model. The third model was developed under contract with the U.S. Geological Survey (USGS) in conjunction with the SFWMD and SJRWMD. This model focused on Orange County and the metropolitan Orlando area. In addition to these three models, efforts were made to compare the results of these simulations with those completed by the SJRMWD and SWFWMD where their respective work overlapped.

In addition to the ground water modeling, surface water availability in Lake Istokpoga and its associated canal system was evaluated. This analysis included statistical and water budget assessments of the availability of water afforded by the current regulatory operation through the primary release structure, S-68, and other canal structures. A relationship between individual structure releases and basin climatic conditions was identified to determine surface water availability during a 1-in-10 drought. These results were then compared to estimated water use demands for the years 1995 and 2020. The use of Lake Okeechobee as an alternative source was also investigated as part of the Lake Istokpoga area investigation. The evaluation was performed using the South Florida Water Management model (SFWMM), a tool utilized in the Lower East Coast Regional Water Supply planning effort.

A vulnerability mapping technique was used to identify wetland areas that have the highest potential for harm due to water use relative to the rest of the KB Planning Area. The vulnerability analysis incorporated factors influencing possible wetland drawdown, including thickness of confining units, location of wetlands, and drawdown in the Floridan aquifer. These factors were combined using Geographic Information System

(GIS) software in an overlay process. The overlay of these ranked factors identified areas where wetlands have the highest potential to experience harm.

In addition to ground water modeling, surface water management assessments, and vulnerability mapping, additional qualitative methods were used to assess the potential movement of poor quality water in the ground water system, impacts to lakes and the potential for the occurrence of sink holes. In addition to the spring discharge criterion in Chapter 4. There are currently 12 surface water bodies and the Floridan aquifer in the KB Planning Area on the District's priority water schedule. The purpose of establishing minimum flows and levels is to protect water resources from significant harm due to withdrawals. Additional detail on the potential problem areas identified and the analytical work conducted is provided in Chapter 4.

Solution Development

Results of the analytical work identified several water resource problem areas may occur as a result of the projected increase in water demand. Once these potential problems areas were identified, a series of water source options (also referred to as water supply alternatives) were evaluated to determine their effectiveness in resolving the potential problems. Options that were evaluated included increased water conservation, reclaimed water use, increased Floridan aquifer use, additional surface water storage and other approaches. This planning document presents the evaluation of the water source alternatives, and the resulting recommendations and strategies for implementation.

PLAN IMPLEMENTATION

Implementation is one of the most important phases of the KB Water Supply Plan, in that strategies developed during the planning process are 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 their planning efforts. Other components of implementation may include additional data collection, research, cost-share projects, capital construction, and rulemaking. Specific plan implementation strategies are discussed in Chapter 6. After approval by the SFWMD Governing Board, this water supply plan will be updated at least once every five years. Nothing herein is intended to affect the substantial interests of a party. Additional agency action, whether by order or rule, will be necessary to implement the plan.

Regional Water Supply Plan Implementation Assurances

Regional water supply plans (RWSPs) are developed and implemented pursuant to Chapter 373, F.S. Likewise, the level of assurances in protecting existing legal water users and the natural systems ("assurances") while implementing the RWSPs must be consistent with this state law.

In this implementation process, the 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 RWSPs 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 (Restudy) (April 1999), which was approved by the Governing Board. The language regarding "assurances" as incorporated into the Restudy was originally drafted by the Governor's Commission for a Sustainable South Florida and set forth in its final Restudy Plan Implementation Report (1999). This language is provided in Appendix A. 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 Florida law.

COORDINATION

Development of the KB 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.

Related Planning Efforts

Water management planning efforts in the KB Planning Area include a variety of interrelated studies and activities, in both the public and private sectors. Each plan or study addresses unique water management issues while maintaining close relationships with water supply planning (**Table 1**).

The related efforts with the most significant influence on the implementation of the KB Water Supply Plan include the Comprehensive Everglades Restoration Plan (CERP) and the establishment of minimum flows and levels to several lakes and the Floridan aquifer in the Kissimmee Basin. The CERP will address the regulation schedule of Lake Istokpoga and the amount of water potentially available from the lake. This plan will also consider construction of storage (reservoirs and ASR) north of Lake Okeechobee, primarily for water quality purposes. These facilities will influence recommendations regarding the use of Lake Istokpoga and Lake Okeechobee as water sources in the Lake Istokpoga-Indian Prairie Basin. In addition, establishing minimum flows and levels for 12 lakes and Floridan aquifer will more clearly define the quantity of water available for consumptive uses (these recommendations are further described in Chapter 5).

Other water supply planning efforts within the SFWMD include the Upper East Coast, Lower West Coast, and Lower East Coast water supply plans. The Upper East Coast Water Supply Plan is in its third year of implementation. The remaining plans were brought before (and approved) the Governing Board in April 2000. A common issue of the

Table 1. Kissimmee Basin Related Water Management Planning Efforts.

	Scope/Primary Goal	Relationship to KBWSP	Timeframes
KBWSP	Adequate and reliable water supply	Not applicable	Plan Completion: 2000 Horizon: 2020
Kissimmee Chain of Lakes Water Management Plan	Environmental enhancement of Kissimmee Chain of Lakes	Changing lake regulation schedules	Final plan FY99
Kissimmee River Restoration	Environmental restoration of Kissimmee River floodplain. Improved surface water quality.	Changing deliveries to Lake Okeechobee	2015
Lake Okeechobee (L.O.) SWIM Plan	Protection and enhancement of Lake Okeechobee and its watershed (water quality)	Discharge water quality and nutrient loading from the Kissimmee River	Update completed 1997. Next update 2000.
Lake Okeechobee Regulation Schedule Environmental Impact Study	Evaluates environmental and economic impacts associated with proposed L.O. Regulation Schedules (quantity)	Discharge quantity from the Kissimmee River	1999
C&SF Project Restudy	Comprehensive review of environmental impacts of C&SF project	L.O. storage and treatment, including reservoirs and aquifer storage and recovery (ASR)	Preparation: 1995-1999 Horizon: 2050
Comprehensive Everglades Restoration Plan	Implementation of C&SF Project Restudy	Lake Istokpoga Regulation Schedule, potential construction of reservoirs and ASR system north of L.O.	2000-2050
Kissimmee Basin Minimum Flows and Levels	Prevent significant harm to the water resources and ecology of surface water and ground water resources in the Kissimmee Basin	MFLs will more clearly define the quantity of water available for consumptive uses. Recovery or prevention strategy has potential to alter future water management activities, including use of water resources in the Kissimmee Basin	2004-2006

Kissimmee Basin and these other plans is the use of water from Lake Okeechobee as a water supply source.

Intergovernmental Agreements

Two existing intergovernmental agreements in the KB Planning Area that facilitate coordination between the SFWMD and other entities are the Memorandum of Understanding (MOU) between the SFWMD, SJRWMD, and SWFWMD; and the agreement between the SFWMD and Seminole Tribe.

The purpose of the MOU is to establish processes by which water resource investigations, planning, regulation and water shortage efforts may be coordinated and consistently applied between the three districts. The agreement with the Seminole Tribe outlines surface water control strategies to the Brighton Reservation to assure maximum

reliability of surface water deliveries to meet the Tribe's entitlement. These agreements are discussed in further detail in Chapter 5 of the Support Document.

In addition, the District will coordinate the implementation of the KB Water Supply Plan with local governments/utilities, the Lower East Coast Regional Water Supply Plan, the C&SF Comprehensive Review Study, the Comprehensive Everglades Restoration Plan (the implementation phase of the C&SF Restudy), and other related efforts to promote compatibility.

Chapter 3
PLANNING AREA DESCRIPTION

SUMMARY OF WATER RESOURCE SYSTEMS

The Kissimmee Basin (KB) Water Supply Planning Area encompasses that portion of the SFWMD extending from southern Orange County, south along the Kissimmee River to the north shore of Lake Okeechobee. The area has extensive surface water and ground water systems. The upper region of the KB Planning Area contains hundreds of lakes, including a series of interconnected lakes called the Kissimmee Chain of Lakes. The Chain of Lakes are managed according to a regulation schedule for each lake subbasin. The lower portion of the Kissimmee Basin includes the tributary watersheds of the Kissimmee River between Lake Kissimmee and Lake Okeechobee. The channelized portion of the Kissimmee River (C-38) contains six water control structures which divide it into five pools. The water levels of these pools are regulated. Additional inflows into Lake Okeechobee include the S-154, Taylor Creek-Nubbin Slough, Lake Istokpoga, and Fisheating Creek subbasins.

Surface Water Sources

Despite the abundance of surface water sources in the Kissimmee Basin, a relatively small amount or surface water is withdrawn for urban or agricultural uses. Although there is variation throughout the KB Planning Area, a majority of users rely on ground water as the primary source of water. One notable exception to this is a region of large agricultural activity located in the lower portion of the KB Planning Area near Lake Istokpoga. The area between Lake Istokpoga and the northwest shore of Lake Okeechobee is identified as the Lake Istokpoga-Indian Prairie Basin. Lake Istokpoga is a major source of water to the growers within the basin, including the Seminole Tribe of Florida. Several water shortages in the mid-1980s made the region aware that Lake Istokpoga was at or near its limit on available water for use. Studies and resulting corrective actions were taken in the late 1980s and 1990s to remediate the immediate availability concerns, but water use restrictions on additional surface water use have remained in place. In addition, the District has entered into a water rights compact with the Seminiole Tribe to ensure the Tribe’s estimated historic entitlement/allotment of water. To address water resource issues in the Lake Istokpoga-Indian Prairie Basin, the plan evaluated surface water supply availability and management options.

Ground Water Sources

The ground water resources in the Kissimmee Basin are divided into the Surficial, Intermediate, and Floridan aquifer systems. The Surficial Aquifer System (SAS) generally yields low quantities of water and generally consists of unconsolidated materials. With the exception of a few isolated areas, the Intermediate Aquifer System (IAS) does not produce large quantities of water either, but acts as a confining layer for the underlying Floridan

Aquifer System (FAS). The FAS is capable of producing large amounts of water throughout the KB Planning Area. However, total dissolved solids, sulfates, and chloride concentrations generally increase with depth and distance to the south.

The FAS has historically been the primary source of water supply for urban uses in the northern area of the region, where its water quality is good. As population and agricultural demands on this resource increase, the potential for impacts to natural systems and to the aquifer itself, particularly in the metropolitan Orlando area may also increase. An important part of this water supply plan was to examine the potential for adverse impacts to occur and to explore alternative water sources to avoid or mitigate these impacts where possible.

Climatic Conditions

Both surface water and ground water are dependent upon rainfall for recharge. However, this dependency on rainfall varies among different aquifer systems. The SAS, which is exposed at the land surface, is primarily recharged by rainfall. The deeper, confined FAS, by contrast, relies more heavily upon ground water inflow for recharge. This ground water inflow, in turn, originates in recharge areas where the confining unit is thin or where sinkholes are numerous. These conditions exist in the northwestern portion of the KB Planning Area and provide for the highest recharge to the FAS within the SFWMD. In addition, the FAS receives artificial recharge from about 400 drainage wells in the city of Orlando and by reclaimed water infiltration basins.

The average rainfall in the KB Planning Area is about 50 inches per year. There is a wet season from June through October, and a dry season from November through May. The heaviest rainfall occurs in June or July, averaging 7.7 inches for the month; the lightest rainfall month is usually in November or December, averaging 1.8 inches for the month. On average, 64 percent of the annual rainfall occurs in the wet season.

SUMMARY OF NATURAL SYSTEMS

The KB Planning Area contains a variety of natural wetland and upland communities. Most wetland systems in the KB Planning Area drain into the Kissimmee River, and subsequently Lake Okeechobee. The floodplain was once used by a larger number of birds, mammals, fish and other species. Restoration of parts of the original meandering channel is taking place, in order to improve wetland habitat. The Kissimmee River Restoration Project will restore over 40 square miles of the existing channelized system, including 43 continuous miles of river channel and about 27,000 acres of wetlands. The project is expected to benefit over 320 fish and wildlife species (Toth et al., 1998).

Shingle Creek and Reedy Creek swamps, two large forested wetlands in the northernmost reaches of the KB Planning Area, start the headwaters of the Kissimmee Chain of Lakes. These two wetland systems flow slowly southward and drain into Lake Tohopekaliga. Lake Tohopekaliga and the Alligator Chain of Lakes drain into Cypress

Lake, which in turn flows into Lake Hatchineha and then into Lake Kissimmee. Large herbaceous marshes surround Cypress Lake, the north end of Lake Hatchineha, and the entire shoreline of Lake Kissimmee. The Alligator Chain of Lakes is surrounded by large areas of forested cypress and mixed hardwood swamps, as well as smaller pockets of herbaceous marsh.

Native uplands, which are interspersed throughout the KB Planning Area, are non-wetland areas with intact ground cover, understory, and canopy. Native uplands in the KB Planning Area include longleaf and slash pine forests, live oak hammocks, sand pine scrub, cabbage palm, turkey oak, hardwood forest, palmetto prairies, and dry prairie grasslands. Uplands are also an important source of wildlife habitat.

LAND USE TRENDS AND WATER DEMANDS

The existing land use in the KB Planning Area is generally more urban in the north than in the south. Continued urbanization is anticipated in the north, while in the south, agricultural acreage is projected to increase (**Table 2**)

Table 2. Acreage and Percentage of Land Use by County Area.[a]

Land Use	Orange Area	Osceola Area	Polk Area	Highlands Area	Okeechobee Area	Glades Area	Kissimmee Basin Area
Agriculture	31,513 (17%)	218,656 (35%)	44,243 (16%)	259,362 (53%)	189,625 (52%)	139,470 (47%)	882,869 (40%)
Urban	60,243 (32%)	52,212 8%	51,449 (19%)	42,194 (9%)	21,928 (6%)	2,760 (1%)	230,786 (10%)
Wetlands	36,338 (20%)	164,355 (27%)	59,571 (22%)	76,821 (16%)	66,800 (18%)	59,678 (20%)	463,563 (21%)
Forest	30,264 (16%)	74,857 (12%)	65,136 (24%)	41,586 (9%)	32,591 (9%)	68,578 (23%)	313,012 (14%)
Rangeland	2,005 (1%)	26,012 (4%)	25,270 (9%)	33,489 (7%)	48,284 (13%)	20,223 (7%)	155,283 (7%)
Barren	3,419 (2%)	2,842 (1%)	1,420 (1%)	3,733 (0%)	3,588 (1%)	2,471 (1%)	17,473 (1%)
Water	21,796 (12%)	81,082 (13%)	23,885 (9%)	30,022 (6%)	4,299 (1%)	1,492 (1%)	162,576 (7%)
Total	185,578 (100%)	620,016 (100%)	270,974 (100%)	487,207 (100%)	367,115 (100%)	294,672 (100%)	2,225,562 (100%)

a. Data for the portion of county within the Kissimmee Basin Planning Area only.
Source: SFWMD Florida Land Use/Land Cover GIS database, 1995.

The rapid conversion of rural land into urban areas is expected to continue in southern Orange County and northwestern Osceola County. Additionally, continued urban development is expected in Polk County along the I-4 Corridor. The remaining areas in the Kissimmee Basin are expected to remain largely rural through the 2020 planning period.

Population in the planning region is projected to increase by 89 percent, from 362,837 in 1995 to 686,696 in 2020 (**Table 3**). Urban water demands are projected to increase by 76 percent from 35,602 million gallons per year (MGY) in 1995 to 68,153 in 2020. The majority of these urban demands will occur in the highly populated Orange-Osceola County Area, which includes southern Orange and northern Osceola counties. Agricultural water demands are forecast to increase by 54 percent, from 112,668 MGY in 1995 to 173,995 MGY in 2020 under average rainfall conditions. Under 1-in-10 year drought conditions, the projected agricultural water demands are forecast to increase to 206,590 MGY in 2020. The increases in urban water supply are projected to come initially from ground water sources.

Table 3. Population and Water Demands, 1995-2020.

	1995	2020 (average)	% Change	2020 (1-in-10)
Population	362,837	686,696	89	
Water Demands (MGY)				
Urban	35,602	68,153	76	72,851
Agricultural	112,668	173,995	54	206,590
Total Water Demands	148,270	242,148	63	279,441

Agriculture is the primary existing and projected water user within the basin. Information regarding the number and location of existing (1995) agricultural acres was determined through aerial photography collected by the USGS. The crop acreage, type and location determined by this method were used to calculate water use based upon the Blaney-Criddle evaporative loss model. These values became the baseline information from which future projections were made. Agricultural projections for 2020 came from the 1998 Districtwide Water Supply Assessment (DWSA) and from input from the agricultural community. Water use for the projected crops was again estimated using the Blaney-Criddle evaporative loss model. The summary of the estimated use is provided in **Table 3**.

Citrus is the major irrigated agricultural crop in the KB Planning Area. A major change in the geographic distribution of citrus production occurred in Central Florida following a series of severe freezes in the 1980s. Since then, a reduction in citrus acreage has taken place in the northern areas of the Kissimmee Basin. Conversely, to the south, significant increases in citrus acreage have been observed. These general trends in citrus acreage are projected to continue through 2020.

The second largest projected increase in agricultural water use comes as a result of the proposed addition of sugarcane. Until 1995, a relatively small amount of sugarcane was grown within the KB Planning Area. Recent water quality issues in areas south of Lake Okeechobee and the construction of a new mill have made the production of sugarcane more attractive for portions of Highlands and Glades counties. Sugarcane

production is projected to increase 362 percent over its current levels to an estimated total of 15,308 acres. Water for this additional use is projected to come from surface water.

Chapter 4
ANALYSIS AND ISSUE IDENTIFICATION

ANALYTICAL TOOLS

As part of the water supply planning process, it was necessary to develop several analytical tools to help identify potential issues and to provide insights on possible solutions. There are several tools available to assist in these types of analyses. In this planning effort, the ground water flow model MODFLOW was selected to assist in evaluating the reaction of the Floridan Aquifer System (FAS) under the projected increased use. Three MODFLOW models were used to cover different parts of the Kissimmee Basin (KB) Planning Area. These models were used in conjunction with a Geographic Information System (GIS) and other mapping techniques to project areas where possible adverse impacts might occur. Also completed as part of this planning effort was an analysis of the surface water system for the Lake Istokpoga-Indian Prairie Basin. In this evaluation, water budget and statistical models were utilized to assess the availability of surface water supplies for that region.

The following sections in this chapter provide the results of the modeling efforts employed to identify the potential problems projected for the 2020 water use. This chapter also provides information regarding other analytical techniques that were applied to assess the effect of the predicted aquifer response to the resource protection criteria identified by the advisory committee.

CHAPTER 373 RESOURCE PROTECTION TOOLS AND LEVEL OF CERTAINTY

It is important to have an understanding of the relationship between the different levels of harm specified in the statutes and the various District programs that operate to protect the resources. One goal of Chapter 373 is to ensure the sustainability of water resources of the state (Section 373.016, F.S.). This chapter 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), reservations of water and the District's Water Shortage Program. The role of each of these and the protection that they offer, are discussed in the following section.

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.

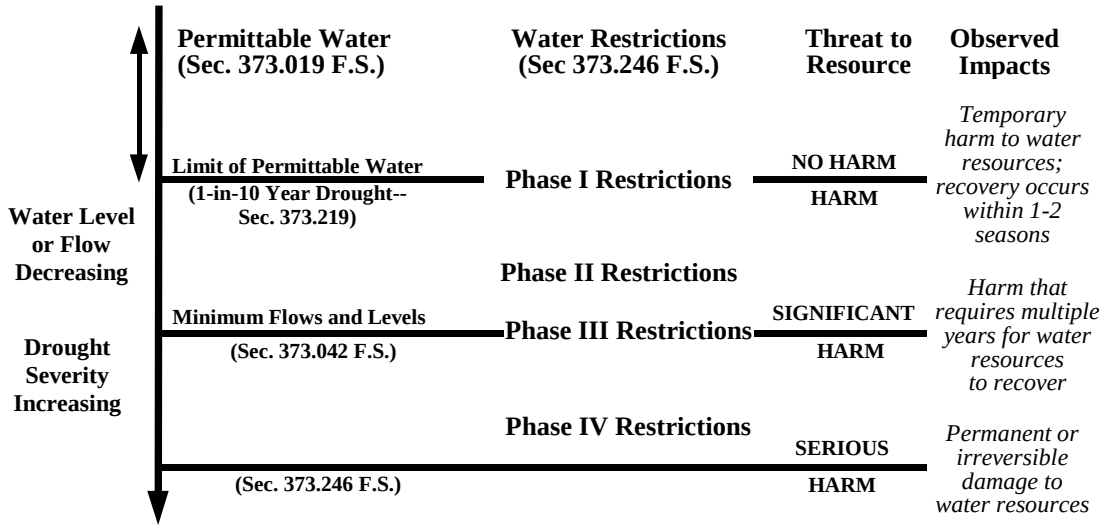

Figure 4. Conceptual Relationship among the Terms, Harm, Significant Harm, and Serious Harm.

Water Supply Planning Process and Level of Certainty

Fundamental to the water supply planning process is the quantification of existing and projected demands under 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 KB Planning Area threats, such as saltwater intrusion, wetland stress, pollution or 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 which assure all reasonable demands will be met, the regulatory process becomes one of several plan implementation tools.

Consumptive Use Permitting Link to Level of Certainty

Under Section 373.219, F.S., the yield of the source, or amount of water which 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 under the three-prong test referred to in Section 373.223, F.S., and particularly the reasonable-beneficial use test. Such criteria are aimed at preventing saltwater intrusion and upconing, harm to wetlands and other surface waters, aquifer mining and pollution.

Section 373.219 also recommends that harm be considered the point at which adverse impacts to water resources that occur during dry conditions 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 also addressed under the CUP Program, which calculates allocations to meet demands up to the appropriate level of certainty.

Water Shortage Link and 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 under 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 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 for those areas where harm has been identified.

GROUND WATER ANALYSIS

In an effort to assess the ground water conditions within the planning basin, three ground water models were used. Two of the models were developed by the SFWMD, and include the Osceola County model and the Glades, Okeechobee, Highlands (GOH) County model. The third model used in the evaluation, the Orlando Metropolitan model, was developed by the USGS in conjunction with the SFWMD and SJRWMD. This latter model focuses on the Orlando metropolitan area in Orange and Seminole counties. The spatial relationship of these three models is shown in **Figure 5**.

Each of the models developed used historical information as a means of calibrating the models. The year 1995 was identified as a base year for making predictions of potential Floridan aquifer water level changes resulting from water use during a 1-in-10

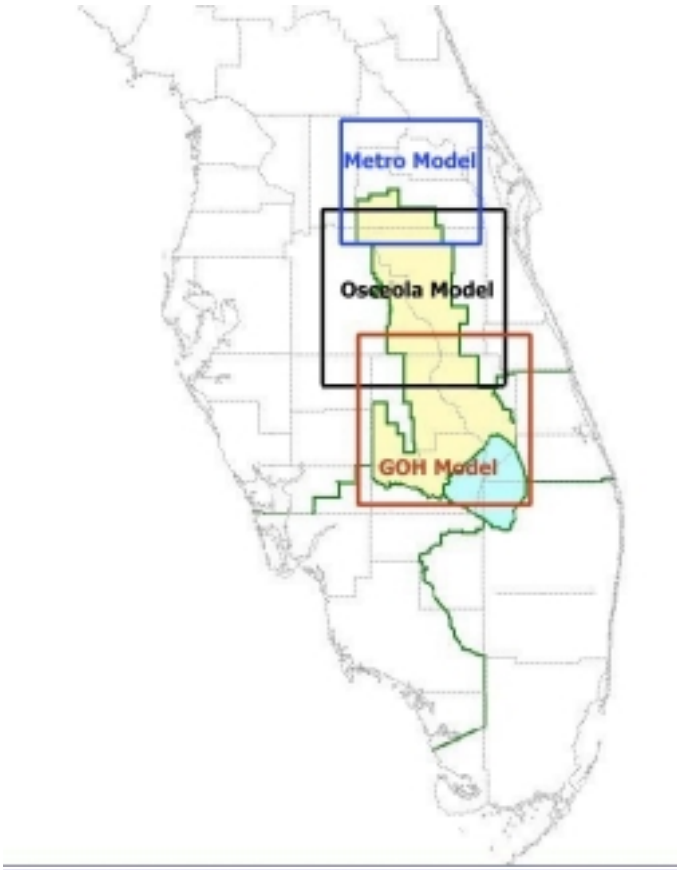

Figure 5. Location of Model Domains.

drought under a year 2020 water use pattern. Each of the models contains multiple layers, representing the various aquifers found in the planning region. The Osceola and GOH models concentrated on predicting the reaction of the Upper Floridan aquifer to the proposed 2020 water use stresses. In these two models, the surrounding aquifers, although active, were not the primary focus of the modeling effort. Therefore, the results pertaining to the aquifers other than the Upper Floridan aquifer are considered less reliable. The model layers representing the surficial aquifer in all three models were not active. Chapter 10 of the Support Document provides a discussion of the modeling assumptions and how each affects the modeling results. Appendix H describes the details on the construction and calibration of the modeling tools.

In addition to the use of these three models, efforts were made to compare the results of these models with the modeling efforts being made by the SJRWMD and SWFWMD where their respective work overlapped portions of the planning basin. The SJRWMD's model, the East Central Florida Regional Ground Water Flow model, encompasses all or portions of Lake, Orange, Osceola, Seminole, and Polk counties. The SWFWMD, in conjunction with the USGS, developed the Lake Wales Ridge model covering portions of Osceola, Polk, Hardee, Highlands, and Desoto counties. Results generated as part of the SFWMD analysis were compared to the results of these two models to assure similarity of results.

Results of the modeling analysis for the Upper Floridan aquifer are shown in **Figures 6** and **7**. **Figure 6** shows the anticipated change in water level between 1995 and 2020 for average water use conditions. **Figure 7** shows the predicted change in water level from 1995 to 2020 for the Upper Floridan aquifer with demands predicted for a 1-in-10-drought condition. These contours represent the impacts due to increases in withdrawals occurring within the SFWMD. For those areas within the SJRWMD that are covered by the model domain, the 2020 projections for that district were included in the simulations. These additional withdrawal amounts represent only a few percent in the total projected basin and is thought to have only minimal impact on the results of the model. The 1-in-10 drought definition used in this plan assumes a 1-in-10 drought rainfall condition preceded by an average rainfall year. The results of both of these climatic conditions are presented to illustrate that the anticipated change in Upper Floridan aquifer water levels from 1995 to 2020 are expected to be greater than the average condition presented in **Figure 6**, but less than steady-state drought conditions represented in **Figure 7**.

Results of the analysis indicate that Central Florida may experience between 10 and 15 feet of additional drawdown in the Upper Floridan aquifer in portions of southern Orange and northern Osceola counties under water use patterns projected for the year 2020. This change in predicted water levels is a result of the cumulative withdrawals of users located in the SFWMD portion of Orange and Osceola counties, and in particular, growth projected for those portions of the counties where the greatest amount of drawdown is projected to occur. The amount of drawdown is shown to decrease radially outward, extending into portions of Lake, northern Polk, and Brevard counties. Recharge occurring in western Orange, Lake, and Polk counties appears to be minimizing the extent to which the effects of drawdown extend further westward into the SWFMWD. It is likely that the simulated drawdown would be greater if the projected withdrawals from the SJRWMD and SWFWMD, located just outside of the modeled areas, were also included in this analysis.

The change in water levels projected for the lower portion of the basin, in parts of Glades, Okeechobee, and Highlands counties, is shown to be less than that predicted for the northern portion of the basin. This is due in part to the smaller amount of projected use of the Floridan aquifer in these counties, and in part, due to the hydraulic characteristics of the aquifer found in this area that work to limit the radial extent of the individual's projected drawdown. The model simulations for this area indicate that as much as 15 feet of drawdown may occur, however, the drawdown is believed to be associated with individual withdrawals and to a much lesser extent a cumulative effect. This gives a pattern of a series of isolated drawdown cones as seen in **Figure 6** and **7** for portions of Highlands and Glades counties.

RESOURCE PROTECTION CRITERIA

The resource protection criteria identify limits where further water use may cause harm to the resources. As part of the planning process, the advisory committee helped identify three limiting resource criteria: natural systems, water quality and land subsidence. The natural systems criteria included specific limits to protect wetlands, lakes

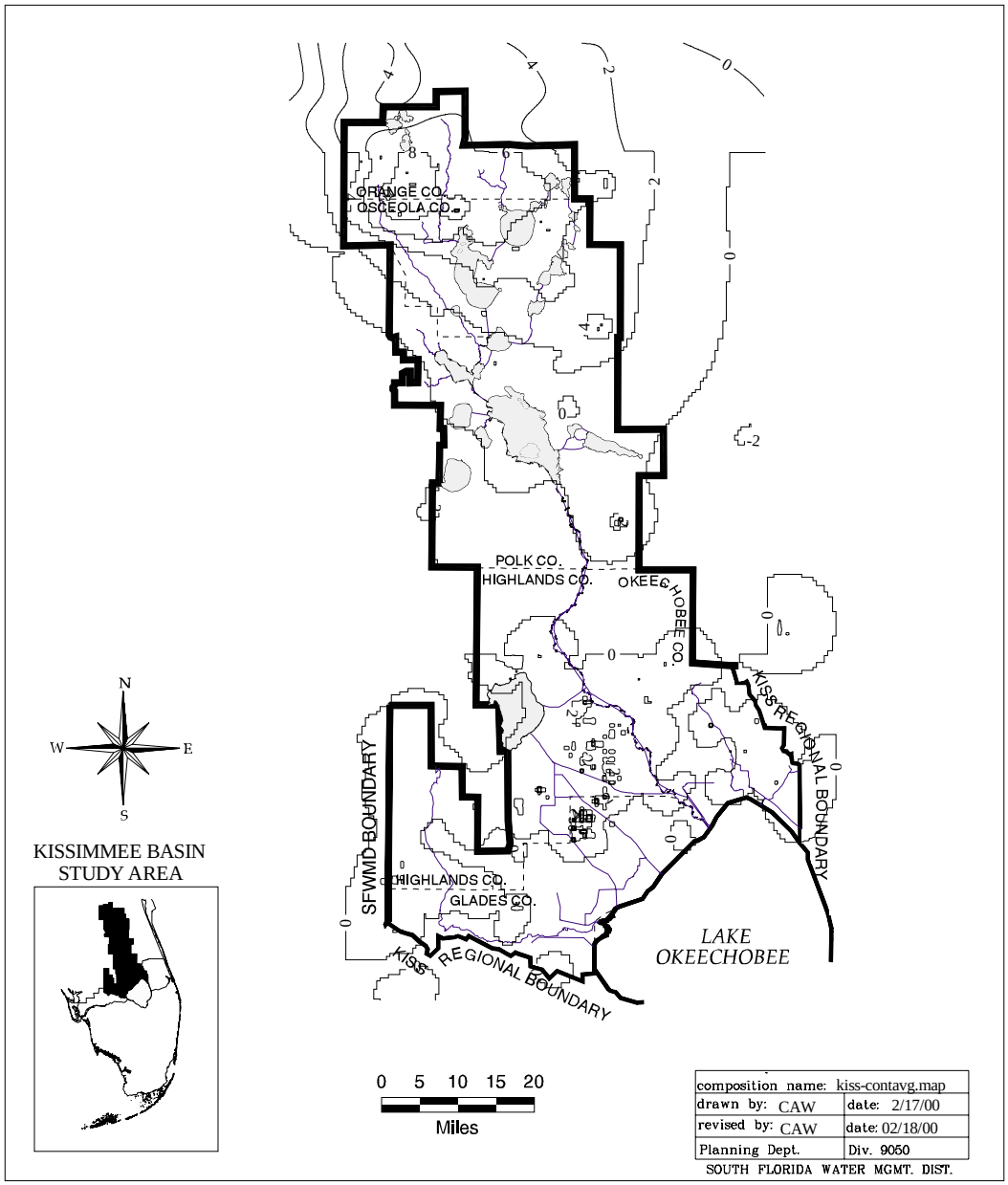

Figure 6. Change in Water Level in the Upper Floridan Aquifer for Average Conditions, 1995 to 2020.

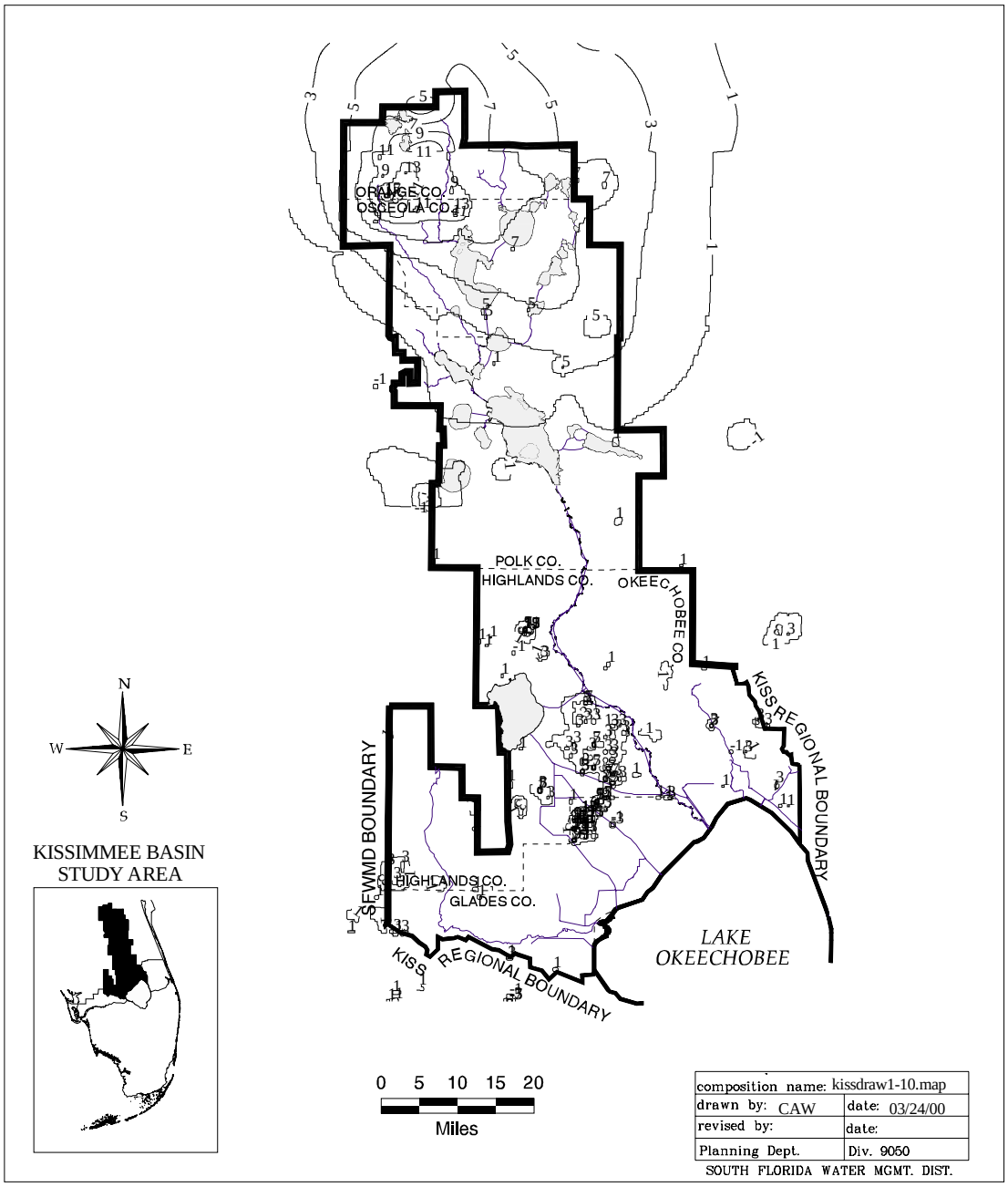

Figure 7. Change in Water Level in the Upper Floridan Aquifer during the 1-10 Drought, 1995 to 2020.

along Lake Wales Ridge, and spring flows in Orange County. Water quality was identified as a concern over the possible migration of poor quality water within the Floridan aquifer. Land subsidence is the last protection criterion identified and specifically addresses the formation of sinkholes as a result of water level changes. The following sections discuss each of these limiting criteria.

Wetland Protection Criterion

The District's Basis of Review (BOR) for Water Use Permit Applications requires that withdrawals of water must not cause harm 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; Mitch and Gosselink, 1986; Erwin, 1991). Water use inducing drawdowns under wetlands may potentially affect water levels, hydroperiod, and the aerial extent of the wetlands. The guideline currently used for Consumptive Use Permitting (CUP) states that harm to the wetland environment occurs when ground water level changes in the surficial aquifer, after a withdrawal of the maximum recommended allocation for 90 days with no recharge, are greater than one foot at the edge of the wetlands.

The District began a research project in 1995 to support refinement of the wetland drawdown criterion. This project involves long-term monitoring of wellfields and wetland systems including systems located in the Disney Wilderness Preserve area located in the KB Planning Area. Three years of data collection and analysis have been conducted to determine the relationship between variations in hydrology and wetland functions. This information is being used to develop revised CUP criteria for wetlands. These revised criteria are expected to include modifications to the existing guidelines by including recognition of differing wetland community types and seasonal hydroperiod requirements (Shaw and Huffman, 2000). The District has initiated a rulemaking effort this year to adopt rules Districtwide to incorporate these factors into the CUP process.

The complex geology found in the Central Florida area and the current limited information to define certain key hydraulic criteria make a demonstration of compliance with the current BOR criteria difficult. The modeling completed under this planning effort is also limited in its ability to predict compliance with the proposed BOR criteria. Recognizing these analytical limitations, the planning criterion identifies those areas where the risk of wetland harm, due to Floridan aquifer withdrawals, is greatest. The KB Water Supply Plan wetland resource protection criterion is defined as:

> The avoidance of large changes in Floridan aquifer levels in areas where the potential connection between the Floridan aquifer and the surficial aquifer is greatest.

This criterion was evaluated as part of the vulnerability analysis, discussed later in this chapter. The analysis identifies areas with the highest potential of experiencing a reduction of water levels in the surficial aquifer that might result in harm to wetlands.

Lake Level Criterion

The lake level protection criterion was identified by the advisory committee to address concerns over declining lake levels primarily along the Lake Wales Ridge. These lakes lie west of the KB Planning Area and within the SWFWMD. Geologic conditions along the ridge are such that the hydraulic connection between some lakes and the underlying aquifers appears enhanced. The SWFWMD has identified 46 "stressed" lakes along the ridge that have been below their historical range of levels for several years. SWFWMD has investigated the conditions surrounding these lakes and believes that that one cause of the lowered levels has been a reduction of levels in the Floridan aquifer. The planning effort undertaken by the SWFWMD seeks to have little or no future lowering of the Floridan aquifer water levels until other remedial actions are taken. The lake level criterion as it applies to the lakes along the Lake Wales Ridge is identified as:

> Little or no lowering of Floridan water levels beneath the Lake Wales Ridge.

In addition to the issue of lakes along the Lake Wales Ridge, a concern was raised about the possible impacts to water levels of unregulated lakes located in the KB Planning Area. Most of the major lakes within the KB Planning Area are managed according to a regulation schedule established by the USACE. It is the presumption of this plan that the possible impacts from water use withdrawals to lake levels on lakes that have a regulation schedule would be minor compared to those changes resulting from the regulation schedule. This includes the operational levels for lakes like Lake Istokpoga. For this planning level effort, lake levels for non-regulated lakes were presumed to be equally sensitive to water level changes as wetlands and therefore are addressed under the wetland criteria and subsequent analysis. This presumption is conservative and is proposed to be addressed more thoroughly when MFLs have been established for the lakes on the District's priority schedule.

Ground Water Quality Criterion

The significant movement of poorer quality water into fresh water zones of the Floridan aquifer represents a limit on the amount of ground water that can be withdrawn without causing harm to the resource. Significant saline water movement is defined in Section 3.4 of the District's Basis of Review for Water Use Permit Applications (BOR) as the saline interface moving to a greater distance inland or vertically than has historically occurred or as a consequence of seasonal fluctuations and is detected by a sustained increase in dissolved chloride concentrations. For the purposes of this planning effort, chloride concentrations in the ground water were taken as the identifying water quality parameter upon which the poor quality zones were designated. The water quality protection criteria is therefore defined as:

> Movement of the saline water interface (250 mg/L chloride concentration isochlor) to a greater distance inland or vertically.

Spring Discharges Criterion

Although there are no natural springs located within the KB Planning Area, several critical springs are located in northern Orange County in an area called the Wekiva Basin. The SJRWMD has identified these springs as having critical environmental function and has set minimum flow values for eight of these springs. These minimum flow requirements are established in rule under Chapter 40C-8, F.A.C. These identified flow requirements are based upon the long- term average flow requirements from the springs to maintain the environmental function of wetland communities along this river and its tributaries. The spring discharge criterion is a requirement to:

Maintain the minimum flow requirements set forth in Chapter 40C-8. F.A.C.

Sinkhole Formation Criterion

Sinkholes are a common occurrence in certain portions of the state where unstable geologic and fluctuating hydrologic conditions work together to cause potentially dangerous forms of land subsidence. In certain instances, the conditions that lead to the formation of sinkholes can be enhanced if the hydrostatic head difference between the surficial and Floridan aquifers is significantly increased. Chapter 40E-2.301(b) and Section 3.6 of the BOR requires the District to prevent impacts to off-site land uses. The sinkhole criterion is intended to prevent off-site impacts of land use that might be adversely affected by land subsidence caused by a reduction in water levels. Although a relationship between aquifer drawdown in the Floridan aquifer and the rapid formation of sinkholes has been documented in areas where the overburden is relatively thin, the degree to which these two factors are related is less defined. An existing District guideline, applied through the CUP Program, limits Floridan aquifer drawdowns to five feet, measured one foot from the well head in areas identified as having a higher number of sinkholes. This guideline is based upon two studies, one completed by the USGS and another by the Florida Sinkhole Research Institute (University of Central Florida), which describes the soil conditions in Central Florida in relationship to the formation of sinkholes. These studies identify the factors involved in sinkhole development and the locations where the combination of geologic factors result in the most frequent development of a specified type of sinkhole.

Figure 8 is presented to show the relationship between the water level in the Floridan aquifer in southwest Orange County and the occurrence of documented sinkholes within Orange and Osceola counties for the past 23 years. A total of 88 sinkholes, spread throughout these counties, are documented for this time period. The graph shows that the highest frequency occurred during 1981 when water levels were an estimated 8 feet below the average level of 58 feet. In reverse, the lowest frequency occurs between 1992 and 1997 when water levels are generally higher. This evaluation focuses on determining if there is a relationship between the water level in the Floridan and the increases in sinkhole occurrence. Much like the previous studies sited, the quantification of a unit relationship could not be defined. A separate analysis showed that approximately 50 percent of the sinkholes occurred when water levels were below the average Floridan water level, while the remaining 50 percent occurred when levels were above the average level. Neither of

these analyses conclusively demonstrates a connection between water level changes in the Floridan aquifer and the formation of sinkholes. The KBWSP criterion of sinkhole formation is described as:

> The avoidance of large changes in Floridan aquifer water levels in areas that have geologic conditions that have resulted in more frequent development of sinkholes.

The conclusion of this first portion of this evaluation is that additional studies are needed to clarify this relationship. These analyses also suggest that the five-foot guideline may be too restrictive and that a less prohibitive drawdown amount, applied to a limited geographic area would still be conservative, but adequate. For the purpose of this planning effort, ten feet of regional drawdown was selected as a reasonable compromise between following the current regulatory guideline and having no drawdown guideline at all. The technical basis for using a 10-foot guideline is limited and is based primarily upon professional judgement of the District geologists. Again, this analysis is designed to identify areas of potential concern and where further studies on the relationship between water levels and land subsidence could be focused.

ANALYSIS

Wetland Vulnerability Analysis

Ground water flow models developed for the KB Planning Area are steady-state in nature and have a “fixed” layer representing the surficial aquifer. These features limit the model’s utility in predicting drawdowns in the surficial aquifer, which in turn could be interpreted to indicate harm to wetlands. An alternative analysis was developed to provide insight into which areas are most vulnerable to wetlands being harmed as a result of Floridan aquifer withdrawals.

The wetland vulnerability analysis was an approach taken as an alternative to predicting a fixed drawdown criterion for a given wetland. This type of analysis approaches the issue of wetland harm by assessing those factors that influence the change in water levels within the aquifer controlling wetland water levels. These factors include: the ability of water to move vertically thought the intermediate (Miocene) confining layer, location of wetland features, and the change in potentiometric head within the upper FAS due to changes in water use from 1995 to 2020. This analysis was accomplished using a GIS overlay technique that combines these factors and identifies areas with the appropriate combination of conditions that identify the degree of vulnerability.

The technique used involves generating a series of digital, georeferenced maps with each map representing a separate factor used in the analysis. Each map is divided into a series of rectangular grids with each assigned a score based upon a weighting criterion. The scores were summed and averaged and displayed as resultant map. For the purpose of this planning effort, divisions of 0-5 feet, 5-10 feet, and greater than 10 feet of drawdown in the Floridan aquifer were selected as reasonable guidelines to assist in identifying

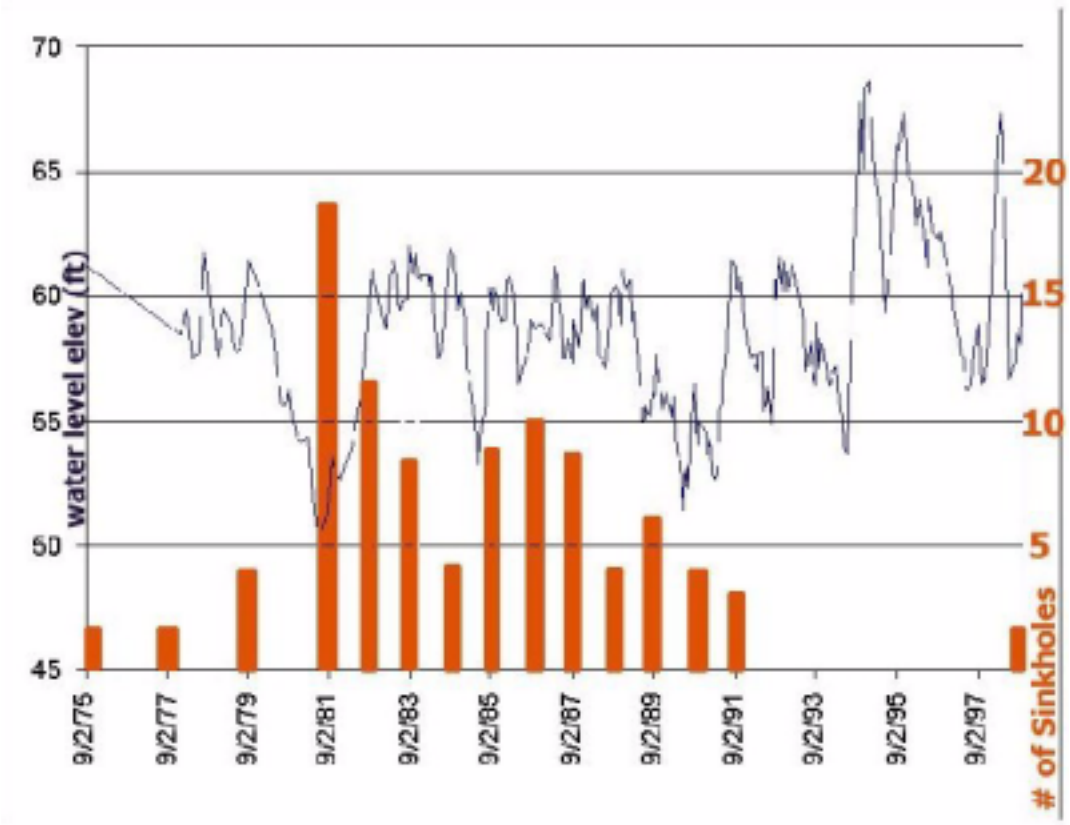

Figure 8. Water Level versus Occurrence of Sinkholes in Central Florida.

potential problem areas. The technical basis for using a 10-foot guideline is limited and is based primarily upon professional judgement of District geologists. An additional limitation of this analysis is the assumption of uniform vertical hydrologic conductivity throughout the basin. Appendix J provides a summary of this overlay process.

The results of the vulnerability analysis are shown in **Figure 9**. The darkest areas are areas where the combination of factors combine to create a region where water level changes in the surficial aquifer are most likely to occur within the KB Planning Area. Areas in medium gray tone are areas showing moderate risk, while areas in the lightest shade of gray show the least amount of risk for water level changes in the surficial aquifer due to Floridan withdrawals.

The purpose of this analysis was to identify areas most vulnerable to experiencing drawdown in the FAS translated to possible harm to wetland and non-regulated lake features. Areas in Southwest Orange and Northwest Osceola counties received the highest resultant score and are therefore identified as being the most vulnerable for lowering of the shallow aquifer as a result of the projected Floridan drawdowns from 1995 to 2020. This analysis identifies areas where, if harm to vegetation were to occur, the impact would most likely be first observed. Again, this analysis identifies areas where harm to wetlands is most likely to be observed, if it occurs. It also indicates where further studies on the relationship between water levels and possible wetland harm could be focused.

Lake Level Evaluation

The lake level protection criterion was identified to address concerns over declining lake levels primarily along the Lake Wales Ridge. These lakes lie west of the KB Planning Area and within the SWFWMD. The SWFWMD has identified 46 stressed lakes along the Lake Wales Ridge that have been below their historical levels for several years.

For the purposes of the planning effort, the lake level criterion was interpreted as drawdown of less than one foot at the boundary of the two districts. This one foot reflects a consideration of the level of predictive accuracy for the ground water models producing drawdown results in the Upper Floridan aquifer. A review of the projected Floridan aquifer drawdown along the western edge of the KB Planning Area (**Figure 10**) shows less than one foot of change in water level is projected beneath the ridge. This amount of predicted impact is considered minimal and is not expected to impede SWFMWD’s efforts to restore the level of lakes along the ridge.

Ground Water Quality Evaluation

The movement of poorer quality water into freshwater zones of the Floridan aquifer was determined to represent a limit on the amount of ground water that could be withdrawn without causing harm. For the purposes of this planning effort, movement of the saline water interface (250 mg/L chloride concentration isochlor) inland or vertically was considered problematic.

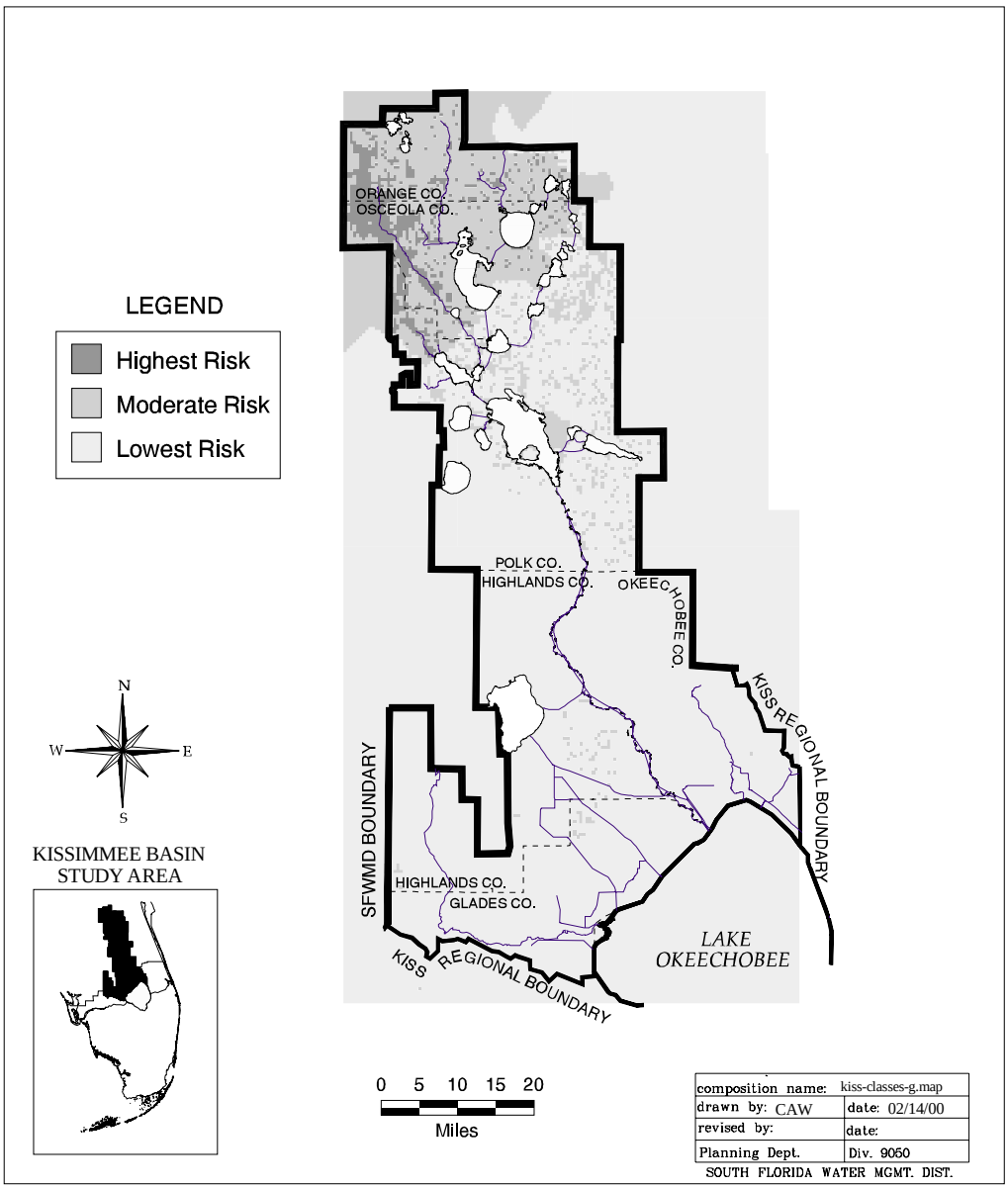

Figure 9. Location of Potential Wetland Impacts.

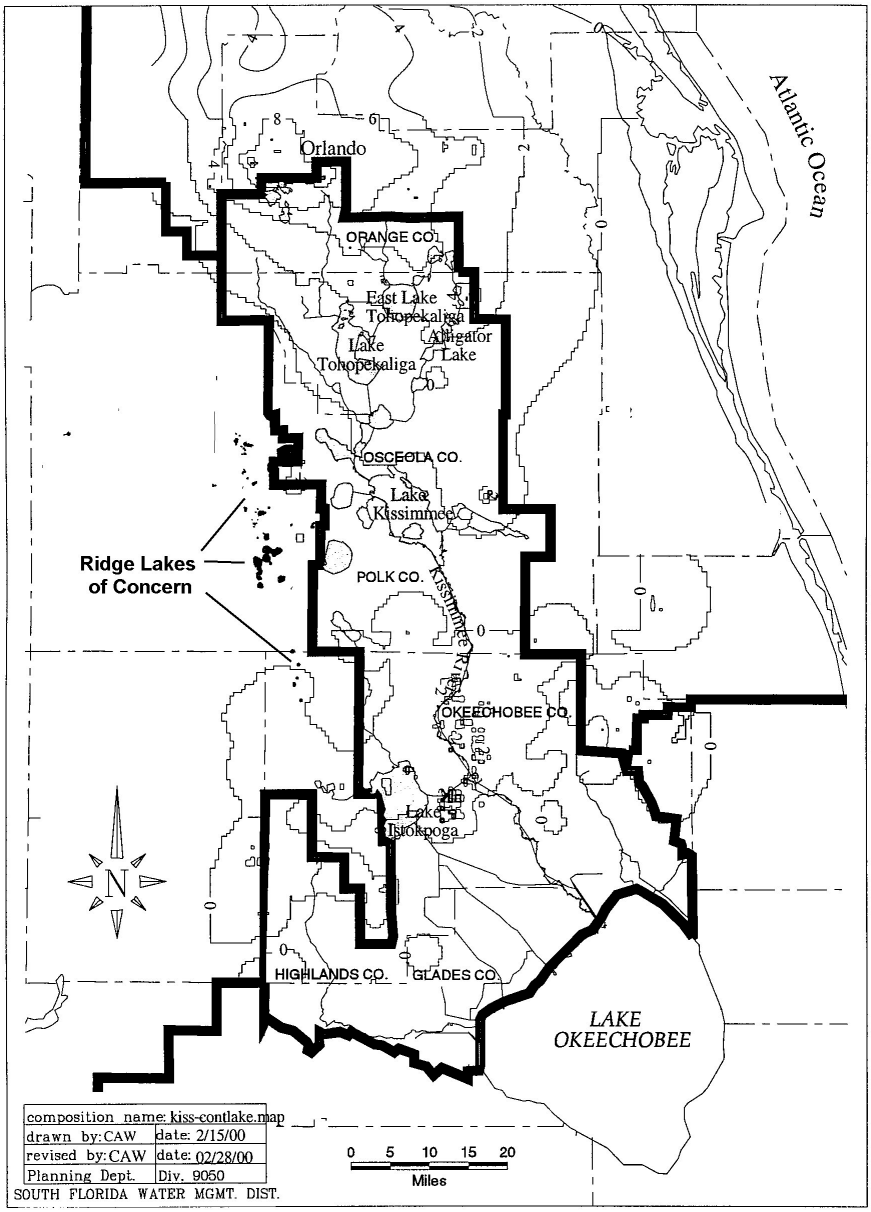

Figure 10. Location of Lakes along Lake Wales and Projected Floridan Drawdown.

The approach taken to address the movement of poorer quality water involved mapping the concentration of chloride levels within the upper FAS and comparing that information to the projected change in Floridan aquifer levels resulting from increased water use from 1995 and 2020 (1-in-10). The assumption of this analysis is that a lowering of hydrostatic heads adjacent to the location of the saline water interface will eventually cause the movement of poor quality water into existing freshwater zones. Areas identified as having greater than one foot of anticipated change in water level in the Upper Floridan aquifer, and where the chloride concentration in the Floridan is above 250 mg/L, were identified as areas of possible movement of the poor quality water. This one foot reflects a consideration of the level of predictive accuracy for the ground water models producing drawdown results in the Upper Floridan aquifer.

Results of this evaluation suggest that only the Cocoa Wellfield located in eastern Orange County will be as an area of concern. The city's wellfield is located near the existing saline/fresh water boundary. In addition, the easternmost wells of the Cocoa wellfield have historically had their withdrawals reduced due to increasing chloride concentrations. Future growth in Central Florida may worsen this condition. **Figure 11** shows the existing chloride concentration levels found within the Floridan aquifer for the KB Planning Area and the anticipated 1995 to 2020 drawdown. This analysis does not take into account other factors that may influence saline movement, which should be considered before a final determination of the actual movement of the interface is made.

Spring Discharge Evaluation

Although there are no natural springs located within the KB Planning Area, several critical springs are located in northern Orange County in an area called the Wekiva Basin. The SJRWMD has identified these springs as having critical environmental function and has set minimum flow values for eight of these springs. These minimum flow requirements are established in rule under Chapter 40C-8, F.A.C. These springs contribute to the baseflow of the Wekiva River and several of its tributaries. The estimated flow requirements are based upon the environmental demands of this river and its tributaries.

Spring discharges in northern Orange County were evaluated using the USGS Metro model. This model directly calculates spring discharges based upon changes in Floridan aquifer levels from 1995 to 2020. Unlike the other analyses presented in this plan, the USGS simulation evaluates the potential spring impact based upon the projected cumulative withdrawals from both the SFWMD and the SJRMWD portions occurring in Central Florida. This model, cooperatively developed with the SJRWMD and SFWMD, directly simulates spring discharges as a function of aquifer head levels.

The resultant 2020 spring discharges calculated by the model were compared to that set forth in Chapter 40C-8, F.A.C., to determine which might exceed the resource criteria. **Table 4** provides the results of the spring discharge estimates. The results represent the average of the wet and dry season runs made using the USGS model. The results of the model simulations show that five of the springs are anticipated to fall below

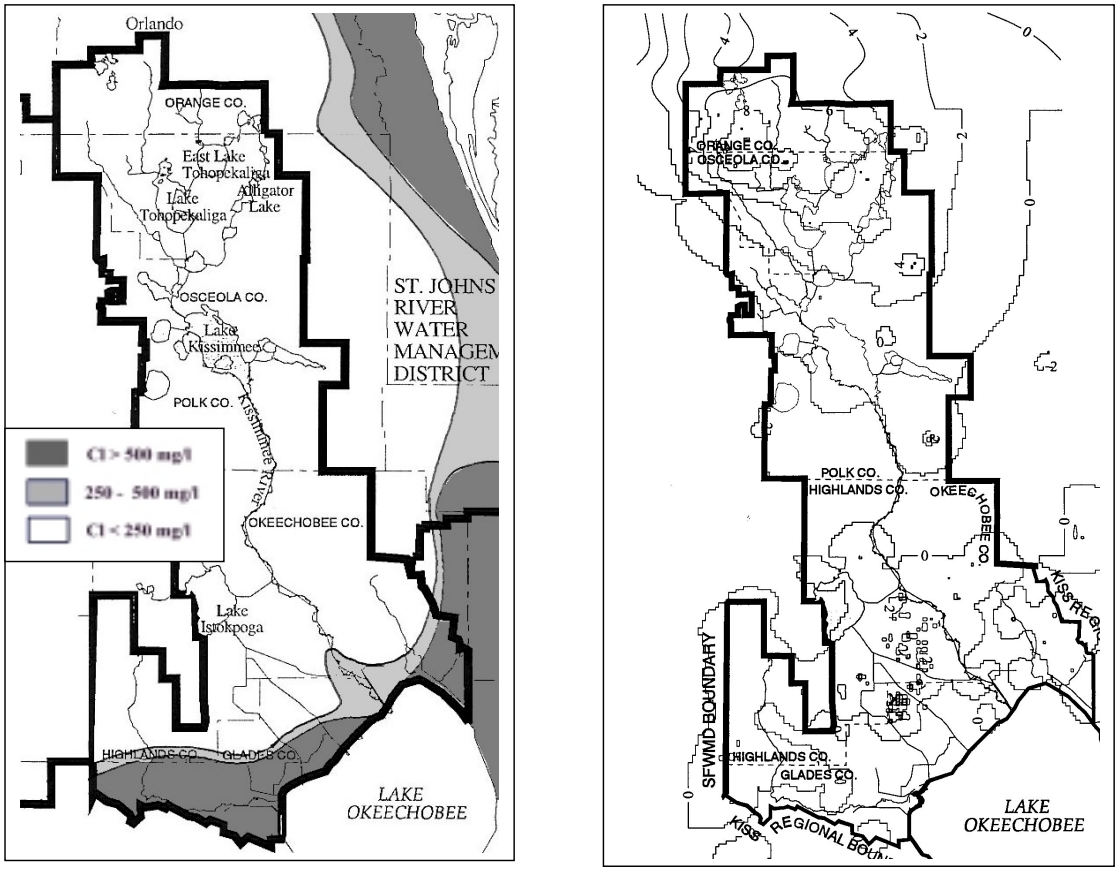

Figure 11. Location of Poor Quality Water and Projected Floridan Drawdown.

the required minimum flow amount set forth in 40C-8, F.A.C. These are the Wekiva, Rock, Sanlando/Palm/Starbuck, Miami, and Seminole springs.

Table 4. Simulated Spring Discharge (cubic feet per second).

Spring Name	Est. Pre-Dev. Discharge	Est. 1995 Discharge	Est. 2020 Discharge[a]	Min. Flow[b]	% Change
Wekiva	80	67.4	53.0	62	21
Rock	70	55.7	46.6	53	16
Sanlando/Palm/ Starbuck	50	39.0	18.6	35	53
Miami	6.5	4.7	3.3	4	29
Messant	20	15.5	13.8	12	11
Seminole	40	36.3	27.7	34	24

a. Average from wet and dry conditions.

b. As established in 40C-8; F.A.C.

Results presented in **Table 4** represent the reduction in average spring discharges due to the cumulative withdrawals occurring in both the SJRWMD and SFWMD portions of Central Florida. A separate analysis of the reduction in spring discharge due solely to withdrawals within the SFWMD was not completed as part of this planning effort. The conclusion of this evaluation is that the reduction of spring discharges is a concern that warrants further investigation. Prior to the determination on how best to address this issue, a separate analysis of the effects of ground water withdrawals in each respective water management district should and will be conducted.

Sinkhole Formation Evaluation

The sinkhole criteria is described as the avoidance of large changes in Floridan aquifer water levels that could encourage or trigger the formation of land subsidence. The analysis performed focuses on identifying areas with numerous previous sinkhole activity and projected large amounts of additional drawdown in the Floridan. For the purposes of this plan, areas were mapped that are projected to have the greatest amount of water level change (greater than 10 feet) and those areas that have been described by the USGS and Florida Sinkhole Research Institute as having the most suitable geologic conditions for sinkhole occurrence. These areas are identified as portions of Southwest Orange and Northwest Osceola counties are projected to be at increased risk.

SUMMARY OF GROUND WATER ANALYSIS

As part of the plan analysis, several ground water models were utilized. These models were used to simulate the projected change in water level in the Floridan aquifer from 1995 to 2020. Two simulations were made with these models, one representing the

average 2020 demands and another representing the 2020 demands under a 1-in-10 drought condition. These simulations were both performed to give the reader an estimation of the projected range of drawdown between the two simulations. The difference between the two is about 3 to 4 feet in the area of greatest drawdown (southern Orange County and northern Osceola County) and less than 1 foot in Central Osceola County, based on demands in the SFWMD.

An evaluation was performed to determine which, if any, of the defined resource protection criteria are at most risk of being exceeded. The evaluation suggests that ground water use in areas south of the Osceola-Okeechobee county line are at least risk of causing harm to the resources over the next 20 years. The analyses for the areas north of this line show a significantly different picture. The analysis indicates that areas in Orange and Osceola counties are at an increased risk of showing harm to wetlands and lakes. In addition, there may be an increase in the risk for the formation of sinkholes in Southwest Orange and Northwest Osceola counties. The analysis also shows that the proposed water use may contribute to saltwater movement in eastern Orange County and the reduction of natural spring flows in northern Orange County. Lakes along the Lake Wales Ridge are projected to be unharmed from the withdrawals identified in this plan.

An effort was made to compare the results of the evaluations performed under this plan with evaluations made by the SJRWMD. The SJRWMD has made similar efforts to model the FAS in Central Florida. Although the results of the two modeling efforts are not directly comparable, the conclusions reached by each district parallel one another. Both planning efforts identified potential problems with harm to wetland, saltwater intrusion, and the reduction of spring flows in Central Florida.

The ground water related analyses performed as part of this planning effort are intended to provide a screening level look at the potential problems that may arise from future water use. This analysis is intended to provide insights into what problems may occur, where they may occur, and to provide a preliminary identification of options that may be warranted. A screening level approach was taken for the ground water evaluation because of the limitations on the accuracy of the models being developed and the ability to specify when harm occurs for each of the identified resource protection criteria. For this reason, many of the analyses completed identify the risks associated with future water use more than an estimation of the actual impacts. Results of these analyses are intended to provide guidance on the possible risks that may result from future ground water withdrawals and to identify where future research efforts should be focused.

SURFACE WATER ANALYSIS

The analysis of the surface water systems performed under this plan was limited to the Lake Istokpoga-Indian Prairie Basin. Many of lakes in the KB Planning Area are either directly controlled or influenced by lakes under a regulation schedule adopted by the U.S. Army Corps of Engineers and managed by the District. It was assumed under this plan that the potential impacts to these lakes as a result of ground water withdrawals would be small in comparison to the water level changes controlled through the annual lake level

regulation schedules. Although a large direct withdrawal from one of these lakes could have potential impact, no such withdrawals were projected or requested. For these reasons, no analytic effort was made for these regulated lakes.

The discussions on the evaluation presented in this chapter focus on those analyses performed in evaluating the Lake Istokpoga-Indian Prairie Basin located northwest of Lake Okeechobee. In this evaluation, water budget and statistical models were utilized to assess the availability of supplies for the region.

Lake Istokpoga-Indian Prairie Basin Analysis

For the past decade, the use of additional surface water from the Lake Istokpoga-Indian Prairie Basin has been restricted as a result of several water shortages that occurred in the area during the 1980s. As part of the KBWSP planning effort, an evaluation of the water use problems of the Lake Istokpoga-Indian Prairie Basin and the preparation of recommendations regarding alternate water supply sources was completed. Under this analysis, the Lake Istokpoga-Indian Prairie Basin is defined as those areas that have access to the C-40, C-41, C-41A canals or Lake Istokpoga, either directly or via other canals.

The analysis evaluates water availability in the basin during a 1-in-10 drought condition. For purposes of this analysis, it was assumed that the drought was preceded by an average rainfall year and that the water level of Lake Istokpoga was at or near its average level at the end of the wet season in October.

A presumption in this analysis is that water currently released from the basin to either Lake Okeechobee or the Kissimmee River south of S-65D could be utilized as the first source in meeting the projected demands. As part of the analysis, the amount of discharge leaving the basin through water control structures S-68, S-71, S-72, and S-84 was quantified for the 1-in-10 drought condition. **Figure 12** shows the features of the Lake Istokpoga-Indian Prairie Basin and the location of these control structures. The second effort of the analysis was to determine if additional supplies could be released from Lake Istokpoga while maintaining the required minimum operational schedule and minimum canal levels set forth in the Water Shortage Rule 40E-22, F.A.C.

The analysis contains three major components, estimation of 1-in-10 water demands, determination of 1-in-10 drought discharges from the basin under the existing operation/management, and analysis of alternative sources. Water use estimates were determined using the methods described in Chapter 6 of the Support Document. All water use demands were calculated on a monthly basis using a statistically derived 1-in-10 drought condition. A description on how the 1-in-10 drought definition was determined can be found in Appendix B.

The analysis took two approaches to estimate the discharges from the control structures in the basin. These approaches included statistical and empirical methods. The statistical approach attempted to develop a mathematical correlation between rainfall patterns and releases from the control structures. The empirical approach reviewed 20

Figure 12.
Removed for Security Purposes

years of records to find years that matched the seasonal rainfall conditions of a 1-in-10 drought. The statistical approach was found to track the trends in discharge relatively well, but had less success in matching month to month values and the extreme discharge events. The statistical method is described in Appendix B. The results of this analysis were used only as a gauge for the results of the empirical method.

Under the empirical method, a search was made to find years within the period of record that were reasonably representative of a 1-in-10 drought condition. The analysis assumes that discharges from the lower three structures (S-71, S-72, and S-84) during these years are representative of the potentially available water during a drought year. The years of 1981, 1985, and 1996 were found to most closely represent the desired rainfall condition. The year 1981 and 1984 were preceded by drought years while 1996 was preceded by slightly wetter conditions. The method used to select these years is provided in Appendix I as an attachment to the water budget analysis. Although the three years selected reasonably represented 1-in-10 drought conditions on a seasonal basis and annually, each year had varying monthly total rainfall amounts. The flow data from these three years was averaged and used to generate synthetic monthly discharge estimates for the lower three structures. The synthetic discharge for the lower structures was created by taking the average annual discharge for the three selected years and distributing the volume monthly based upon the pattern of average year discharge for the same three structures. This was done to make the discharge information comparable to the generated water demands that were also based on a synthetic rainfall year. The synthetic monthly flows predicted for the lower three structures represent the water released and potentially available for use under the current operation/management of Lake Istokpoga and the Indian Prairie Basin structures. These discharge rates are shown in **Table 5**.

Once estimated, the projected synthetic flows were compared, on a monthly basis, to the estimated demand increases for the basin. The projected increase in demand is comprised of two components, the increased agricultural demands from 1995 to 2020, and the minimum discharge requirement as specified in Chapter 40E-22, F.A.C. The amount of water that is unmet by the current discharge from the basin during a 1-in-10 drought event is defined as the *deficit*.

A water budget model was created to address the use of additional sources of water to meet the remaining 2020 demand or deficit. These alternative sources include storage above Lake Istokpoga's minimum operation schedule and the delivery of water from Lake Okeechobee via existing or proposed pumps. **Table 5** shows the results of this analysis. The analysis indicates that use of the additional storage in Lake Istokpoga and the use of pumps on Lake Okeechobee can meet the projected deficit under the 1-in-10 drought condition. The demands presented in the table represent the projected increase in withdraws from 1995 to 2020. The results of the analysis presented in **Table 6** represents one example of a solution to meet the projected 2020 (1-in-10 drought) demands for the Indian Prairie Basin using a combination of additional water obtained from Lake Istokpoga and Lake Okeechobee. The analysis also presumes the 40E-22, F.A.C. minimum flow requirements will be removed through rulemaking. This example does not represent the only solution available using these two sources, but instead represents the solution that maximizes the use of Lake Okeechobee to meet the needs of new agricultural

areas having access to canals C-40 and C-41 below the S-70 and S-75 structures. Mean water levels for the months of August and October are above the maximum regulatory schedule (line A) and indicate that releases for flood control may also be necessary during these months or could be stored as further reserves. Historical average monthly water levels for Lake Istokpoga can be found in Appendix I.

Table 5. Budget Demands Based on Capture of Existing Flow, Use of Istokpoga, and Use of Lake Okeechobee during 1-in-10 Drought Conditions.

Month	Demands & Min. Flow Req. (ac/ft)	Discharge to Lk Okeechobee (S-71,S-72, and S-84)	Min. Flow Req. 40E-22	Deficit[a] (ac/ft)	Additional Supply from Lk Istokpoga (ac/ft)	Pumping from Lk Okeechobee	Resulting Monthly Lk Istokpoga Stage (ft-MSL)
January	9,906	3,056	220	-6,630	2,188	4,442	39.22
February	11,737	3,209	650	-7,878	1,733	6,145	39.14
March	18,199	5,046	800	-12,353	2,718	9,635	38.92
April	12,858	2,771	540	-9,547	2,291	7,256	38.63
May	10,133	1,935	440	-7,759	1,707	6,052	38.04
June	24,785	12,157	6,500	-6,128	797	5,331	37.87
July	22,660	15,496	5,800	-1,364	546	818	38.12
August	20,964	23,763	5,500	8,300	0	0	38.60
September	26,958	16,893	6,100	-3,966	1,983	1,983	39.04
October	26,181	17,255	9,200	274	0	0	39.53
November	11,342	4,579	1,600	-5,164	1,033	4,131	39.52
December	9,140	4,632	360	-4,148	2,074	2,074	39.33
Total	204,865	110,791	37,710	-64,937	17,069	47,868	N/A

a. positive values indicates no deficit for that period.

The analysis performed does not address the issue of seasonal or annual drought events greater than the design event. In those instances, the availability of water to meet the entire growing season becomes more uncertain. Additional sources of back-up supply may be warranted during periods of greater than 1-in-10 year drought.

The results of the analysis presented in **Table 5** demonstrate the need for the release of an additional 17,069 acre/ft of water, above the historic 1-in-10 releases, from Lake Istokpoga to meet additional needs for the Indian Prairie Basin during a 1-in-10 drought event. During average rainfall conditions no additional releases from Lake Istokpoga beyond those currently delivered are anticipated. **Table 5** shows the anticipated 1995 to 2020 average increase in demands for the Indian Prairie Basin and the historic mean monthly combined discharge from the S-71, S-72, and S-84 structures. As seen in the table, the mean discharges are greater during each month than the anticipated increase in demands for the average condition. Values in column 5 of this table are all positive suggesting that sufficient water is discharged through the lower three basin structures under the current operational/management guidelines to meet the anticipated monthly increase in demands under average conditions.

Table 6. Budget Demands Based on Capture of Existing Flow, Use of Istokpoga, and Use of Lake Okeechobee during Average Conditions.

Month	Demands & Min. Flow Req. (ac/ft)	Mean Discharge to Lk Okeechobee (S-71,S-72, and S-84)	Min. Flow Req. 40E-22	Deficit (ac/ft)[a]	Additional Supply from Lk Istokpoga (ac/ft)
January	8,727	11,284	220	2,557	0
February	10,374	13,212	650	2,838	0
March	13,153	22,900	800	7,747	0
April	11,450	13,567	540	2,117	0
May	9,147	11,842	440	2,695	0
June	19,674	22,158	6,500	2,484	0
July	18,307	38,050	5,800	19,743	0
August	12,991	49,725	5,500	32,734	0
September	21,256	38,442	6,100	17,186	0
October	22,824	37,608	9,200	14,784	0
November	10,160	22,143	1,600	11,983	0
December	8,028	14,983	360	6,955	0
Total	172,091	295,914	37,710	123,822	0

a. positive values denote no deficit.

Lake Okeechobee Analysis

The analysis of Lake Istokpoga and Indian Prairie Basin indicates that in order to meet the projected demands, the use of water from Lake Okeechobee or other outside sources will be necessary. An evaluation of the use of water from Lake Okeechobee to supply a portion of the projected 2020 demands for the Indian Prairie Basin was made using the South Florida Water Management model (SFWMM). The SFWMM is a regional-scale computer model that simulates the hydrology and the management system of the surface water resources from Lake Okeechobee to Florida Bay. It covers an area of 7,600 square miles using a mesh of 2 mile x 2 mile cells. In addition to accounting for the systems within the model domain, the model includes inflows from the Kissimmee River, discharges and withdrawals from the Lake Istokpoga-Indian Prairie Basin, and runoff and demands in the Caloosahatchee River and St. Lucie canal basins.

The model simulates the major components of the hydrologic cycle in South Florida including rainfall, evapotranspiration, infiltration, overland and ground water flow, canal flow, canal to ground water seepage, levee seepage, and ground water pumping. It incorporates current or proposed water management control structures and current or proposed operational rules. The ability to simulate water shortage policies affecting urban, agricultural, and environmental water uses in South Florida is a major strength of this model.

The SFWMM simulates hydrology on a daily basis using climatic data for the 1965-1995 period which includes many droughts and wet periods. The model has been calibrated and verified using water level and discharge measurements at hundreds of locations distributed throughout the region within the model boundaries. Technical staff of many federal/state/local agencies and public/private interest groups have accepted the SFWMM as the best available tool for analyzing regional-scale structural and/or operational changes to the complex water management system in South Florida.

Projected surface water demands from each of the District's four planning areas as well as consideration of the components identified in the Restudy and minimum level for Lake Okeechobee were incorporated into simulations of the model. As part of these simulations, requests for additional use for the Lake Istokpoga-Indian Prairie Basin were made along with the other components listed above. Results of the SFWMM simulations suggest that an amount of 85,700 ac/ft may be diverted from Lake Okeechobee to the Indian Prairie Basin during a 1-in-10 drought year and still meet the required performance measures for Lake Okeechobee. This amount reflects the total combined amount from the reduction of flows to and backpumping from Lake Okeechobee.

SUMMARY OF SURFACE WATER ANALYSIS

The examination of the surface water resources within the KB Planning Area focused on a determination of the availability of supplies from the Lake Istokpoga-Indian Prairie Basin. This is an area that has historically had water supply issues due to its dependency on Lake Istokpoga for water. Statistical and empirical approaches were taken to evaluate the amount of water currently being released from the basin that might be captured and utilized for future growth. This analysis indicated that supplies from Lake Istokpoga and surface water runoff in the Indian Prairie Basin are insufficient under the current management/operation schedule to meet the projected 2020 1-in-10 drought demands for water.

Using the estimates of available water determined from the analysis, an evaluation of the alternative sources was performed. A water budget model was created to evaluate the use of additional water from Lake Istokpoga in combination with water backpumped from Lake Okeechobee into the basin. The analysis determined that the 2020 1-in-10 drought demands could be met through the combined use of the two sources. The analysis also indicates that, under the designed drought event (1-in-10 drought preceded by average rainfall), pumps G-207 and G-208 are sufficient to meet the 2020 demand needs.

These analysis performed do not address the issue of seasonal or annual drought events greater than the design event. In those instances, the availability of surface water to meet the entire growing season becomes questionable.

SUMMARY OF RESULTS

Based on the results of the analyses, there are several potential water supply problems projected for the 2020 planning horizon that warrant the attention of the water management districts in Central Florida. For Orange and Osceola counties, the analysis performed defines areas where withdrawals place the users at higher risk of contributing to harm to wetland, significant saline water movement and sinkhole formation. The identification of these higher risk areas does not imply that impacts under these criteria will occur, but instead is intended to provide guidance on the possible risks that may result from future ground water withdrawals and to identify where future research efforts should be focused.

The examination of the surface water resources within the KB Planning Area focused on a determination of the availability of supplies from the Lake Istokpoga-Indian Prairie Basin. This is an area that has historically had water supply issues due to its dependency on Lake Istokpoga for water. An analysis performed indicates that current supplies from Lake Istokpoga and surface water runoff in the Indian Prairie Basin are insufficient under the current management/operation schedule to meet the projected 2020 1-in-10 drought demands for water. The analysis further demonstrates that the combined uses of Lake Okeechobee and Lake Istokpoga are available to meet the projected 2020 demands. The use of these sources, however, may require the construction of additional infrastructure to move water to the areas needed.

Resolution of these issues is the basis of developing water source options and recommendations for the advisory committee presented in Chapter 5.

Chapter 5
WATER SOURCE OPTIONS AND SOLUTION DEVELOPMENT

Chapter 4 described the results of the analyses that were performed and identified the issues that may be of concern in the future. Several water source options were considered to address the water supply issues identified. These options were developed to address the distinct water resource issues in the Orange-Osceola County Area and Lake Istokpoga-Indian Prairie Basin (**Table 7**).

The options listed in **Table 7** reflect the consensus of the advisory committee. This chapter represents a summary of the thoughts expressed by the advisory committee to the District through written comments and input collected as part of the advisory committee meetings and information presented to the committee by the District. Each water source option discussed in this chapter contains a summary of the committee meeting discussions followed by a listing of the suggested recommendations to be considered by the District. These committee recommendations and comments were reviewed by the District and then formulated into strategies as part of Chapter 6. The views expressed in this chapter are the views of advisory committee members or District staff, but reflect the input and, largely, consensus of the committee.

Table 7. Overall Water Source Options of the Kissimmee Basin Planning Area.

Water Source Option	Orange-Osceola County Area	Lake Istokpoga-Indian Prairie Basin
Stormwater Drainage Well	X	N/A
Stormwater Reuse	X	N/A
Wastewater Reuse	X	N/A
Urban Conservation	X	N/A
Agricultural Conservation	X	X
Floridan Aquifer	X	X
Surface Water	X	X
Brackish Ground Water	X	N/A
Reservoirs	X	X
Aquifer Storage and Recovery	X	X
Surficial Aquifer	X	X

N/A = not applicable.

During the initial identification of water supply issues within the Kissimmee Basin (KB) Planning Area, it became apparent to the advisory committee that two distinct regions, each with their own unique issues, could be distinguished. Overall, the advisory committee identified 11 water source options for the entire KB Planning Area. The committee also decided it would be best to address the water supply options surrounding surface water use in the Lake Istokpoga-Indian Prairie Basin as part of a separate subcommittee or focus group. The full advisory committee focused on the water source options in the Orange-Osceola County Area, which are geared towards addressing the potential impacts to natural systems associated with use of the Floridan aquifer in southern Orange County and northern Osceola County. Likewise, the focus group addressed the issue of surface water availability in the Lake Istokpoga-Indian Prairie Basin. Each group considered options according to their potential to address water resource issues in their respective areas.

There are several important issues related to water supply planning, but are not addressed as part of this plan. Among these are watershed issues, flood control and land management. Concerns were raised by members of the committee related to unregulated drainage activities in the area of Gore, Ash, and Chandler sloughs and the resulting flooding that has occurred. Although these issues are important to the District and will continued to be addressed, this plan's focus is on water supply and does not examine these issues.

WATER RESOURCE DEVELOPMENT AND WATER SUPPLY DEVELOPMENT

Amendments to Chapter 373, F.S. require that water supply plans include a list or menu 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 which meet applicable funding criteria should also be provided. 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, are required. These amendments were passed in 1997 and are addressed here and in Chapter 6 of this document.

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 Department of Environmental Protection, other water management districts, and stakeholder groups, such as the KB Water Supply Plan advisory committee.

For the purposes of this report, the advisory committee and the District agreed that 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, the following considerations should be taken into account:

- Opportunity to address more than one resource issue
- Address a variety of use classes (e.g., environment, public water supply)
- Protect/enhance resource availability for allocation
- Move water from water surplus areas to deficit areas
- Broad application of technology ("broad-reaching")

For an option to be a water supply development project, the following considerations should be taken into account:

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

WATER SOURCE OPTIONS AND STRATEGIES

Water source options and strategies are organized in this chapter into the Orange-Osceola County Area and the Lake Istokpoga-Indian Prairie Basin. Each section describes the pertinent characteristics of each option, including cost, feasibility, permitability, constraints, and quantity. Advisory committee recommendations follow each option.

Orange-Osceola County Area

The advisory committee reviewed the water source options to assess those that had the most potential to address the greatest number of potential water resource issues in the Orange-Osceola County Area (**Table 8**). The issues in this area include greater wetland vulnerability, reductions in spring discharge, possible saline water movement, and increased risk of sinkhole formation.

Table 8. Results of Water Source Options Ranking for the Orange-Osceola County Area.

Water Source Options	Water Resource Issues				
	Wetland Vulnerability	Spring Discharges	Saline Water Movement	Sinkhole Formation	Overall Ranking
Wastewater Reuse	H	H	H	H	H
Surface Water	M	M	M	M	M
Reservoirs	M	M	M	M	M
Aquifer Storage and Recovery	M	M	M	M	M
Stormwater Drainage Wells	L	M	H	L	M
Stormwater Reuse	M	M	M	L	M
Urban Conservation	L	L	L	L	L
Agricultural Conservation	L	L	L	L	L
Surficial Aquifer	L	L	L	L	L
Brackish Water	L	L	N/A	N/A	L
Floridan Aquifer	L	L	L	L	L

N/A = Not applicable: Does not address water resource issues.

L = Low: Least potential to address water resource issues.

M = Medium: Moderate potential to address water resource issues.

H = High: Most potential to address water resource issues.

In this ranking process, wastewater reuse was identified as the water source option with the most potential. The water source options presented in **Table 8** are listed in the order ranked by the committee. As indicated in the table, the Floridan aquifer remains a viable source of water for the immediate future. However, the analyses performed in this plan suggests that the withdrawals occurring in Orange and Osceola counties by 2020 will place these areas at the greatest risk of causing harm to wetlands, reduced springs discharges and inducing saline water movement. Although these areas are identified as being at greater risk, a number of issues must be resolved prior to fully determining whether there is sufficient or insufficient water available from the Floridan aquifer to meet the 2020 demands. To this end, the District has identified recommendations in Chapter 6 that address these unresolved issues through future studies, modeling and pilot projects. Chapter 6 also includes recommendations that seek to develop facilities to deliver alternative sources of water.

Wastewater Reuse

Wastewater reuse is an important water source option in the Orange-Osceola County Area. It was the highest ranked of all options considered by the advisory committee (see **Table 8**). It was ranked high in addressing the four water resource issues while minimizing the costs of developing a new source. Wastewater reuse has a long history in the Central Florida area. For instance, Conserv II, one of the world's largest reuse projects, has been operating for nearly 20 years and today transports nearly 30 million gallons per day of reclaimed water to high recharge areas in Orange County. Nearly every utility in the Central Florida area has identified some type of ongoing reclaimed water project.

Certain applications of wastewater reuse are more beneficial than others. In evaluating the potential impact that wastewater reuse may have, it is important to understand how reuse might best be applied to maximize its long-term potential benefits. **Figure 13** briefly describes a scale of the most to least beneficial use of reclaimed water in offsetting demands from the Floridan aquifer.

Any of the identified types of wastewater reuse applications may have multiple benefits that would raise or lower the application in its beneficial use. **Table 9** shows a summary of the existing disposal methods used by the various utilities within the KB Planning Area. These disposal methods have been separated by lower and higher efficiency type uses. Lower efficiency uses include surface water discharges and infiltration basins located in lower recharge areas. Higher efficiency type uses include direct offset of demand, infiltration ponds in high or moderate recharge areas to the Floridan aquifer, and direct injection. The table also indicates the potential increases in reuse assuming all newly developed wastewater is applied in the most beneficial manner and that current lower beneficial uses will improve.

The volume of wastewater within the District's portion of Orange and Osceola counties is projected to more than double from the existing 61 MGD to 136 MGD by the year 2020. In 1995, an estimated 49 MGD of treated wastewater was used to replace

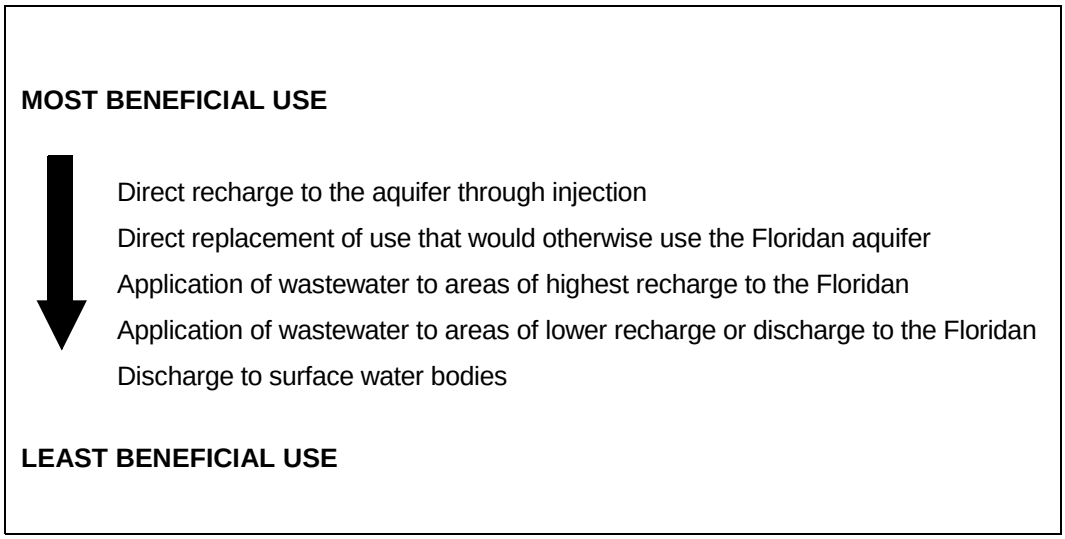

Figure 13. Scale of the Most to the Least Beneficial Uses of Reclaimed Water.

Table 9. Summary of Wastewater Facility Disposal Methods within the Kissimmee Basin Planning Area.

Facility	1995 Avg. Flow	Disposal System		2020 Projected Avg. Flow (MGD)	2020 Projected High Beneficial Use (MGD)
		Lower Efficiency Application (MGD)	Higher Efficiency Application (MGD)		
Okeechobee Utility	0.47	0.24	0.23	0.47	0.24
Orange Co. Utility	18.26	0.00	18.26	41.44	22.85
City of Orlando	18.99	2.26	16.73	32.50	15.77
Reedy Creek	9.03	0.00	9.03	25.00	15.97
Buenaventura Lakes	1.48	1.31	0.17	1.98	1.31
City of Kissimmee	9.45	5.07	4.06	26.00	23.92
City of St. Cloud	1.65	1.53	0.12	4.60	4.48
Poinciana Utilities	1.26	0.87	0.39	3.84	3.52
Total	60.59	11.28	48.99	135.83	88.06

irrigation demand or for application in high or moderate recharge areas. The volume of additional wastewater that could be available for beneficial uses by 2020 is estimated at 88 MGD. Direct offset of demand and recharge to the Floridan aquifer are among the most beneficial uses and should be preferred where economically feasible.

Although **Table 9** identifies potential for future utilization of reuse, several factors such as storage, supplemental sources and utility interconnects need to be addressed before a significant portion of the capacity may be realized. Storage is necessary to address because wastewater for reuse is produced on a fairly consistent basis year-round. Demand for reuse is seasonal, however, peaking in the drier winter/spring months. This typically results in disposal during the rainy summer months when the demand for reuse water is low, and problems meeting demand during the dry months. Providing storage for reclaimed water during the wet season would address this seasonal discrepancy between production and demand and increase the amount of annual reuse. The addition of back-up freshwater supply wells can also help reduce this discrepancy.

Another concern over reuse is the perception of some customers that reuse is a commodity to be wasted. It is not uncommon that when a reuse system replaces a conventional freshwater tap, consumption by the end user will rise significantly. This problem may be best addressed through education, appropriate rate structures or use restrictions.

Table 10 provides a summary of the characteristics of the option followed by a series of recommendations for implementing this option.

Table 10. Characteristics of the Wastewater Reuse Option.

Cost	Different in Orlando vs. southern Kissimmee Basin Moderate - incremental costs to wastewater treatment (about $1 per 1,000 gallons), cost can be partially offset by wastewater treatment costs
Feasibility	Technically feasible, advancing technology has improved dependability, perception of public has become more acceptable with the exception of direct injection
Implementing Agency	Utilities and some private entities, WMD, and FDEP
Permitability	Very permittable, except for direct injection
Quality	Improvements in water treatment methods have reduced the risk of "spikes"
Quantity	Potentially large increase in upper basin of the Kissimmee Basin Planning Area; less availability expected in the lower basin Estimated Quantity Made Available by 2020: 136 MGD, of which 88 MGD is available for beneficial uses
Constraints	Water quality, operation and maintenance costs, transport radius from WWTP, storage
Other	Recharge Floridan through injection or RIBs, possible interconnects between utilities could improve availability; location critical
Summary	Wastewater reuse is highly viable source of water for the future. Projections of urban growth for the upper basin suggest 88 MGD of additional use will be available for beneficial uses; less will be available in the lower basin. Improving reuse availability is limited by location of suitable sites and WWTP treatment capacity, as well as storage.

Recommendations

- Encourage efficient use of reclaimed water.
- Focus the use of reclaimed water in high recharge areas.
- Investigate potential cost-share options and other financial incentives for construction of reclaimed water systems to use reclaimed water for recharge.
- Investigate the potential for utility interconnects to improve availability of reclaimed water.
- Consider the use of reclaimed water for lake augmentation and other forms of regional storage.
- Encourage the development of reclaimed water master plans that include where injection should occur.

Surface Water

The use of surface water was also considered as an option to meet future demands. The advisory committee gave it an overall ranking of medium. Several issues were identified related to the use of surface water. Some of the issues are technical and resource based, while others are related to coordination with other water management districts, and state and federal agencies.

In order to understand the availability of surface water to satisfy future demands, it is necessary to consider technical factors which both provide the framework for permitting decisions and operate to restrict the amount of water available for allocation. First, 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. 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 in Chapter 4, 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. In order to properly manage the resource, including issuance of consumptive use permits, it is necessary to define water availability or restrictions in light of this construct.

The process of establishing minimum flows and levels (MFLs) for the Kissimmee Chain of Lakes would provide the basis for identifying the amount of water that could be withdrawn from the Chain of Lakes without causing significant harm to the lakes. MFLs are scheduled to be prepared by 2004 for the Kissimmee River and Lake Kissimmee, and by 2006 for East Lake Tohopekaliga, Lake Tohopekaliga, Alligator Lake, Lake Hatchineha, Cypress Lake, Fish Lake, Lake Jackson, Lake Marian, Lake Pierce, and Lake Rosalie.

As mentioned, 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 in Chapter 4.

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.

Issues related to coordination with other water management districts include a preliminary study completed by CH2M Hill (1997) for the SJRWMD examining the feasibility of the St. Johns River as a possible source of brackish water for Central Florida. Under this investigation, they evaluated five sites along the river including Lake Monroe and the river near the city of Cocoa. Results of this work indicated that peak yields as high as 300 MGD might be obtainable from the St. Johns River on a seasonable basis. Cost feasibility obtained from this study estimates the costs associated with the treatment, storage and transport of the river water is $2.10 per 1,000 gallons.

Coordination issues related to the use of surface water are important and ongoing. SFWMD, SJRWMD, and SWFWMD have been working closely over the years to address common and related water supply issues. These efforts are expected to continue and expand over the next five years. A later section in this chapter entitled "Related Strategies" outlines the specific recommendations to address this important issue. **Table 11** provides a summary of the characteristics of this option, and is followed by the committee's recommendations.

Table 11. Characteristics of the Surface Water Option.

Cost	Costs for pumping surface water is lower than ground water, however, treatment costs of surface water can be very high especially for public water supply
Feasibility	Highly feasible for agricultural and landscape use
Implementing Agency	Utilities/land owner, WMD/FDEP (PWS)
Permitability	Moderate to difficult - PWS Less difficult - agriculture
Quality	Sufficient for irrigation uses Additional treatment required for public water supply
Quantity	Kissimmee River - offline storage 200-300 MGD from St. Johns River (from SJR study) Estimated Quantity Made Available by 2020: Further research is needed to quantify this amount
Constraints	MFLs - environmental Operational schedules Flood protection Fish/wildlife values Agency and local government permitting and coordination Lack of storage to address fluctuating availability
Other	Reservoirs - need for storage Reduce drainage which may impact natural systems
Summary	Surface water is a viable localized source, but has many environmental constraints. Transportation distance is limited due to cost of piping from limited individual sources.

Recommendations

- Identify potential sources, and amounts of surface water available that could be used to meet projected consumptive use demands in the Orange-Osceola County Area.
- Assess the potential for interdistrict transfers of water between SFWMD and SJRWMD.
- Establish MFLs by 2004 for the Kissimmee River and Lake Kissimmee, and by 2006 for East Lake Tohopekaliga, Lake Tohopekaliga, Alligator Lake, Lake Hatchineha, Cypress Lake, Fish Lake, Lake Jackson, Lake Marian, Lake Pierce, and Lake Rosalie (please refer to the "Minimum Flows and Levels" section later in this chapter).
- Identify potential impacts associated with using rivers and lakes for water supply on natural systems that are either adjacent to or hydrologically connected to these bodies of water.
- Identify and quantify environmental impacts of surface water use on lakes.
- Investigate the St. Johns River as a potential source.

Reservoirs

The reservoir (storage) option received an overall ranking of medium for addressing water supply in the Orange-Osceola Area; however, it has more potential in the lower basin of the KB Planning Area related to Lake Istokpoga concerns. This management option relates to surface water, as well as other sources, such as reclaimed water. **Table 12** summarizes the characteristics associated with the reservoir option.

Table 12. Characteristics of the Reservoir Option.

Cost	Relatively high due to land and operation and maintenance costs
Feasibility	Long-term fix which can be used quickly after installation
Implementing Agency	User, WMD, Army Corps, FDEP if used for drinking water
Permitability	Environmental concerns
Quality	Good for irrigation, requires treatment for drinking use
Quantity	Estimated Quantity Made Available by 2020: Unknown
Constraints	Willingness of property owners to sell large blocks of land Depth of water held in reservoir High ET losses
Other	Environmental concerns Provides surface water runoff treatment
Summary	Storage in the form of reservoirs is a viable local option best suited for agriculture, but may be suited to supplement urban irrigation systems

Recommendations

There are no recommendations appropriate for the Orange-Osceola County Area.

Aquifer Storage and Recovery

The concept of aquifer storage and recovery (ASR) was considered as a water supply option for the Orange-Osceola Area and was ranked medium. ASR can be used in three ways from a source perspective; (1) utilizing reclaimed water as a source for ASR, (2) utilizing treated potable water as a source for ASR, or (3) using untreated ground or surface water. The use of reclaimed water as a source for ASR in the Orange-Osceola Area was determined to be more viable than using treated water or untreated water.

The use of reclaimed water as a source for injection was determined to be more feasible than treated water primarily due to the greater certainty of the availability. The availability of reclaimed water as a source for ASR is more reliable and its use less costly than treated water. Reclaimed water could be used to improve the brackish zones of the Floridan by introducing less saline reclaimed water. By doing so, the Floridan could be recharged, making available more water for other users. If this were to occur, permitting concerns of the USEPA and FDEP would need to be overcome. In addition, zones of higher saline concentrations in the Floridan aquifer would need to be identified and targeted as receiving areas. This would need to be combined with an inventory of where and when reclaimed water would be available, thereby, optimizing the costs of co-locating the source of reclaimed water with the location of appropriate receiving zones of the Floridan.

The advisory committee thought the ASR concept had high potential with reclaimed water as a storage option. However, current regulations require injected water to meet primary drinking water standards when the receiving aquifer is classified as an underground source of drinking water, unless an aquifer exemption is obtained.

Within this area, the committee concluded that there is not an appropriate aquifer zone for ASR due to the lack of confinement. As a result, an ASR application becomes direct recharge (injection) into the Floridan aquifer.

The potential for using treated water as a source for ASR was thought to be very limited in the Orange-Osceola Area. The source of drinking water, for all practical purposes, is the same water that would be receiving injection. **Table 13** provides a summary of the characteristics of this option.

The focus group also discussed the potential of ASR to address water supply issues in the Lake Istokpoga area. This area has more favorable geology for ASR than the Orange-Osceola Area and may also benefit from an ongoing ASR pilot project, which is a component of the C&SF Restudy. This project is further discussed under the water source options for the Lake Istokpoga-Indian Prairie Basin.

Table 13. Characteristics of the Aquifer Storage and Recovery Option.

Cost	Cost of ASR wells is high, between $500,000-$1 million in initial costs
Feasibility	The feasibility of ASR is determined on a case-by-case basis. In general, it is still deemed a hi-tech solution that has proven itself in only limited, geologically favorable locations
Implementing Agency	User, WMD
Permitability	Difficult, except for treated potable water
Quality	Current USEPA standards require that all water entering ASR wells must meet primary drinking water standards.
Quantity	Estimated Quantity Made Available by 2020: Unknown
Constraints	Permitability issues, geology /hydrology must be conducive
Other	Part of the solutions proposed for the Restudy could affect the feasibility of ASR in the Metro Orlando Area.
Summary	ASR is generally an expensive option limited to urban utilities, which can defer the costs. ASR may have additional application in this planning area if combined with other ongoing efforts in the District.

Recommendations

- Investigate and identify potential receiving zones for ASR, especially in high recharge areas.
- If a suitable zone is identified, investigate and catalog the availability of using reclaimed water with appropriate receiving zones of the Floridan aquifer.
- Investigate reclaimed water ASR.

Stormwater Drainage Wells

According to the USGS, approximately 377 drainage wells are located in the Orange-Osceola Area. Estimates on the total amount of recharge from these wells to the Floridan aquifer ranges between 20 to 50 MGD. The wells are used as a means of disposal of stormwater. Typically the water entering these well is a result of overflow from lakes receiving stormwater; however, several wells exist that accept run-off directly from street drainage. Historically, the stormwater was not treated prior to entering the aquifer. More recently, some of the wells include a flow-through treatment technique to improve the quality of the runoff water prior to entering the aquifer. Under current regulatory requirements, any water entering an aquifer through a new drainage well would have to meet drinking water standards. Initial assessments of the potential increases in recharge to the Floridan aquifer in Central Florida through the addition of new drainage wells are estimated at as high as 50 MGD (CH2M Hill, 1999).

Stormwater drainage wells were given a ranking of medium by the advisory committee for addressing future water demands in the Orange-Osceola Area. Three major

benefits are associated with drainage wells. The first benefit is their potential contribution to meet the water supply demands in the area. The concept is that the stormwater drainage wells can be used to recharge the Floridan aquifer, thereby making more water available for consumptive use. The second benefit of drainage wells is to provide an increased level of service for flood control by providing a disposal method. Finally, the third benefit is to reduce reliance upon existing receiving water bodies.

Issues related to expanding the number and use of stormwater drainage wells include meeting drinking water (primary and secondary) standards for water entering any new wells. This requirement was established by USEPA to avoid the potential of permanently contaminating an existing freshwater source used for consumptive use. It is important to note that the FDEP and SJRWMD in conjunction with SFWMD are developing demonstration projects to use water treated to primary (except bacteria) and secondary standards for stormwater drainage wells. These standards are less stringent that the primary standards required by USEPA and, if determined acceptable by the USEPA and FDEP, have the potential of expanding the development of new drainage wells.

Due to water quality concerns related to the use of stormwater drainage wells, it is preferred to use drainage water from lakes instead of direct drainage from roads. The committee suggested that the East Orlando region may provides the most suitable region for expansion of stormwater drainage wells due to its poor drainage, projected urbanization, and related opportunities to incorporate water quality treatment components of new drainage systems. The cleaner water coming out of the new drainage systems could be used to feed new drainage wells. Another ongoing effort to evaluate the USEPA water quality standards for untreated or moderately treated injection water. **Table 14** provides a summary of the characteristics of this option, and is followed by a series of recommendations.

Table 14. Characteristics of the Stormwater Drainage Well Option.

Cost	Costs are comparable to that of normal well drilling - $50,000-$100,000 per well. Treatment costs would significantly increase this amount. Many of these costs however, may be offset by a reduction in stormwater drainage costs.
Feasibility	This is a long-term, regional solution that can begin implementation shortly pending completion of permitting hurdles
Implementing Agency	WMDs, FDEP, user
Permitability	Primarily through USEPA, but managed through local FDEP office. Stringent water quality requirement to meet for permitability.
Quality	Drainage from lakes is relatively good; water quality from lakes generally meets primary and secondary standards, except bacterial. Drainage directly from roads is generally poor.
Quantity	USGS estimates that the 377 existing drainage wells in the Orange-Osceola Area contribute between 20 and 50 MGD of recharge to the Floridan aquifer Estimated Quantity Made Available by 2020: 20-50 MGD
Constraints	Current permitting requirements have effectively put a moratorium on the installation of new drainage/injection wells
Other	Recharge of Floridan Good locations include the city of Orlando, poor drainage areas, and existing receiving water bodies
Summary	Drainage wells offer a relatively low cost water source alternative to increase recharge to the Floridan Aquifer System. The difficulty in regulatory permitting due to the potential risks associated with ground water contamination is the major constraint on this option.

Recommendations

- Promote and participate in demonstration projects that use water treated to primary and secondary standards for water entering drainage wells.
- Identify areas where new development is expected to occur in the East Orlando area that are appropriate for the expansion of stormwater drainage wells which would provide recharge to the Floridan aquifer.
- Continue to work with the USEPA and FDEP to evaluate water quality standards for water entering the Floridan aquifer if this would not contribute to harm to the aquifer.
- Conduct an inventory of drainage wells.
- Assess the impact on the hydrologic regime of natural communities that might be affected by water diversions associated with the development and use of stormwater drainage wells.

Stormwater Reuse

The advisory committee suggested that due to the high water treatment costs, stormwater reuse may be a more viable water source option for irrigation use. It was ranked medium by the committee in addressing wetland vulnerability, spring discharges, and saline water movement; and low for addressing sinkhole formation. **Table 15** provides a summary of the characteristics of this option, followed by recommendations.

Table 15. Characteristics of Stormwater Reuse Option.

Cost	Use of water for drinking supplies would have high cost. Costs for landscape or agricultural irrigation would be lower.
Feasibility	Very feasible for landscape and agricultural irrigation
Implementing Agency	Utilities and individual land owners
Permitability	Regional implementation or addition to drinking water supply may have a high cost factor
Quality	In urban systems water quality can be variable; in agricultural applications the water quality is generally acceptable
Quantity	Availability may be highly variable and may be limited during periods of drought Estimated Additional Quantity Made Available by 2005: Unknown
Constraints	---
Other	Recharge Floridan through injection Wetland mitigation value (requires suitable water quality) Supplemental to other systems
Summary	Stormwater reuse is most feasible for irrigation uses due to treatment costs. The dependability of stormwater requires that a backup source be available or that stormwater be designated as a supplemental source.

Recommendations

- Focus stormwater reuse in golf courses and public access irrigation areas, especially in new developments.
- Focus stormwater reuse capture in low recharge areas and use in high recharge areas.
- Look for opportunities to use as a supplemental source to reclaimed water.
- Evaluate the costs of regionally utilizing storm water.
- Promote the development of stormwater master plans.

Urban Conservation

Urban conservation was ranked low by the advisory committee in addressing the four water resource issues. **Table 16** provides a summary of the characteristics of this option. The primary reason it was ranked low was due to the efforts currently underway to address urban water conservation. Each consumptive use permit (CUP) issued to a utility includes a series of conservation strategies that must be implemented by the utility.

Table 16. Characteristics of Urban Conservation Option.

Cost	Costs of programs vary, but most are relatively inexpensive Some expensive options may not provide much water savings
Feasibility	Short term for educational (unless repetitive) Long term reduction for construction projects
Implementing Agency	Utilities, water management districts (rebate programs), local governments
Permitability	Through plumbing codes and building permits, water management district CUP Program
Quality	N/A
Quantity	5-10% reduction in public water supply on average; as much as 50% for specific cases Estimated Additional Quantity Made Available by 2005: 10 MGD
Constraints	Efficiency of existing system may limit additional gains Demographics (higher incomes use more water)
Other	Source of funding: impact fees, additional charges for higher use, District sponsorship of specific programs
Summary	Water conservation currently plays a role in reducing water demands. These efforts are relatively inexpensive when compared to other water reduction tools.

Several areas for improvement, however, were also identified. The existing CUP requirements apply a similar set of conservation requirements on each utility. A summary of conservation plan for each utility in the KB Planning Area is provided in Chapter 7 of the Support Document. This process could be improved by allowing the individual utilities to identify which of the conservation strategies presented in the CUP process are best suited to their utility. In essence, each utility would develop its own conservation plan choosing from a variety of conservation strategies such as dual distribution systems, rain sensors, Xeriscape™ and tie-in of water use into surface water permits for new developments. These individual select strategies would then be enforced for the utility, as opposed to all of the strategies being required for all utilities. The utilities would also be required to provide follow-up analyses to determine the effectiveness of the chosen strategies. This information would be consulted at the time the utilities come in for new permits.

Another suggestion for urban conservation is for the District to develop regional conservation plans. These plans would target specific conservation strategies to the most appropriate areas, regardless of utility service boundaries. Urban retrofit projects and public education campaigns were suggested as possible aspects of such a conservation plan.

Recommendations

- Tailor water conservation plans to individual utilities during the CUP process.
- Utilities should determine the effectiveness of various mandatory water conservation measures.
- Incorporate an irrigation efficiency test in the CUP Program or fund mobile irrigation labs for both urban and agricultural applications.
- The District, in cooperation with utilities and other water management districts, should promote and participate in public education campaigns on the methods and benefits of urban water conservation techniques, including utility rate structures.
- Investigate the potential for developing urban water conservation tie-ins between the CUP process and the environmental resource permitting (ERP) surface water permitting process.
- Coordinate with SJRWMD on regional conservation plans.
- Look into water conservation incentive programs.

Agricultural Conservation

The advisory committee ranked agricultural conservation low in addressing the four water resource issues for the Orlando metropolitan area. Agricultural acreage in the upper basin of the KB Planning Area is declining, while it is projected to increase in the lower basin. Therefore, the committee agreed that this option would be more effective in the Lake Istokpoga-Indian Prairie Basin. **Table 17** provides a summary of the characteristics of this option.

Table 17. Characteristics of Agricultural Conservation Option.

Cost	Capital costs for retrofit high (e.g., micro irrigation piping) Maintenance costs higher for micro irrigation, some cost deferral through agricultural support programs
Feasibility	Thought of as a long-term solution with immediate reduction of water use
Implementing Agency	IFAS, land owner, DACS, NRCS cost-share programs, water management districts
Permitability	Easy (water shortage benefits)
Quality	Most efficient systems (micro) require higher quality water
Quantity	Potential reduction in demands depending on crop type Estimated Additional Quantity Made Available by 2005: Unknown
Constraints	Crop specific/dependent (feasibility) Lack of research on more efficient systems Cost/benefit ratio for irrigation system - related to competition and economics
Other	Source of water: Free-market partnership between businesses and agriculture Many crops have already transitioned
Summary	More efficient irrigation method can play a significant role in water use reduction, but its implementation is crop specific. Due to the low margin on certain crop types, the installation of more efficient irrigation methods must be carefully reviewed This option is more applicable to the Lake Istokpoga area section of this plan

Recommendations

There are no recommendations appropriate for the Orange-Osceola County Area.

Surficial Aquifer

The advisory committee ranked the surficial aquifer low in addressing the four water resource issues for the Orange-Osceola County Area. The surficial aquifer is considered a local source of water, lending itself to local implementation. As a result, no

regional issues or recommendations were identified. **Table 18** provides a summary of the characteristics of this option.

Table 18. Characteristics of the Surficial Aquifer Option.

Cost	Inexpensive in the northern portion of the basin ($1,000-$3,000); more expensive in the southern portion of the basin where the aquifer deepens ($5,000-$20,000) Pumping cost can be higher for larger wells due to low production of wells
Feasibility	Low yield - often less than 10 GPM in northern basin
Implementing Agency	User, WMD
Permitability	Relatively easy
Quality	Poor
Quantity	Low yields Small percentage of overall demands Estimated Additional Quantity Made Available by 2005: Unknown
Constraints	Environmental impacts and aquifer productivity is low
Other	---
Summary	This is generally a source limited to small demands to the low production of wells - additional production in southern basin

Recommendations

- Promote the use of the surficial aquifer on individual projects.

Brackish Ground Water

The advisory committee ranked brackish ground water low in addressing wetland vulnerability and spring discharges, and not applicable to saline water movement or sinkhole formation. Issues that make brackish ground water a less viable alternative include treatment costs and permitting hurdles associated with concentrate disposal. In addition, transport costs associated with the piping of water from location outside if the basin where the easiest access to brackish water occurs make this option less desirable. However, as costs of membrane technologies decline, brackish water may become a more viable source in the future. **Table 19** provides a summary of the characteristics of this option, followed by recommendations.

Table 19. Characteristics of the Brackish Ground Water Option.

Cost	Relatively high Costs declining - $2 per 1,000 (desal) - $4-5
Feasibility	Long-term solution, supplies of saline water virtually untapped
Implementing Agency	Utilities, WMD/DEP
Permitability	Reject disposal - difficult Supply - more simple
Quality	Requires treatment
Quantity	Potentially large Estimated Additional Quantity Made Available by 2005: Unknown
Constraints	Distribution systems - additional cost centralized system Large customer base needed to support costs
Other	Majority of highly productive (quantity) saline producing areas are located outside of the planning area
Summary	RO production of saline water may provide a supplement to the overall water demand of the future, however, its higher production costs and location outside the planning basin limit its usefulness

Recommendations

There are no recommendations appropriate for the Orange-Osceola County Area.

Floridan Aquifer

The Floridan aquifer was ranked by the advisory committee as low in addressing the four water resource issues identified for Central Florida. Although it will likely continue to be the primary source of water in the immediate future, the planning analysis shows that some concern is warranted over the 20-year planning horizon. The analysis shows that the areas of greatest proposed withdrawal are in areas identified as having the highest risk for harm the resources. However, additional factors that may influence the extent of harm caused to the resources should be considered before a final determination is made. The analysis defined areas where withdrawals place the users at higher risk of contributing to harm to wetland and sinkhole formation. This harm may also extend into areas located outside the SFWMD boundaries to contribute to reductions in spring flows and saline water movement. The identification of these higher risk areas indicates that concerns of future viability of the Floridan aquifer may be warranted. However, their identification does not imply that impacts to these resources will definitely occur. Instead the analyses are intended to provide guidance on the possible risks that may result from future ground water withdrawals and to identify where future research efforts should be focused. **Table 20** provides a summary of the characteristics of this option.

Use of the Floridan was also studied by the St. Johns River Water Management District (SJRWMD) for their regional water supply planning efforts in the metropolitan Orlando area. A document entitled the "Work Group Area I - Central Florida Conceptual Water Supply Plan" was published as part of this study. SJRWMD also projects potential

Table 20. Characteristics of the Floridan Aquifer Option.

Cost	Relatively low for PWS and other urban uses Higher costs than surface water for agriculture
Feasibility	Continued short-term use appears feasible in the metro area, however, long-term continued use in the central/western Orange County area is not recommended
Implementing Agency	Utilities, private land owners, and respective WMDs
Permitability	Location of saline water, wetlands impacts, impacts to springs, and lake levels make long-term use less permitable
Quality	Excellent in most location not directly adjacent to saltwater
Quantity	Appears adequate for the immediate future; 20-year planning horizon shows possible use limitations in the central/western portions of Orange County Estimated Additional Quantity Made Available by 2005: Further analysis recommended to determine amount
Constraints	Water quality Wetland impacts Spring discharge Lake levels
Other	---
Summary	Use of the Floridan aquifer has been the primary source of water for urban and agricultural uses in the planning basin. Additional uses of the Floridan aquifer in Okeechobee, Highlands, and Glades counties appear to be acceptable within the planning horizon. However, future use of the Floridan aquifer in the central/western portion of Orange County area is limited.

harm to wetlands associated with continued use of the Floridan aquifer to meet 2020 demands. SFWMD and SJRWMD have coordinated closely on the preparation of their respective regional water supply plans.

In order to investigate continued use of the Floridan aquifer, the committee recommended that the two water management districts continue to coordinate the development of a regional analytic ground water modeling tool and hydrologic investigations. The desired outcome is to have one single, shared and publicly available tool to analyze future water demands on the aquifers, including the surficial aquifer. The water management districts should also continue to consult each other in the review of permits in the CUP process that may have cross-district impacts.

Recommendations

- Preserve, encourage and optimize recharge of the aquifer in recharge areas such as ridge and sand hill areas.
- Prioritize land acquisition in high recharge areas and look for funding from Florida Forever funding.

- Determine/quantify maximum sustainable yield to better manage resources. Long-term studies with 50-70 year horizons are suggested.
- Support shared model development between the water management districts and local users to more accurately cumulative impacts.
- Water management districts should facilitate cooperative, regional solutions for utilities and local governments.
- The District should not issue 20-year duration permits for additional uses until such time as the other recommendations of this plan are in place and the estimates of available Floridan aquifer yield for Central Florida is resolved satisfactorily. However, the advisory committee recommends issuance of 20-year permits for existing uses.
- The District, in partnerships with the SJR and SWF water management districts, USGS and local governments, should continue existing studies and begin appropriate new studies to more accurately access the hydrologic and geologic factors involved in estimating the results of ground water withdrawals on the natural systems in Central Florida.
- Water management districts should work together to evaluate consistent resource protection criteria.

Please refer to the Related Strategies section for further details regarding coordination, permitting, and research.

Lake Istokpoga-Indian Prairie Basin

A critical part of the KB Water Supply Plan is evaluation of the water use problems of the Lake Istokpoga-Indian Prairie Basin (Istokpoga Basin) and identification of alternate supply options where deemed necessary. An evaluation of the current and projected ground water use for this basin showed that an adequate supply existed; therefore alternative sources need not be identified. Historically, the use of additional surface water from Lake Istokpoga has been restricted as a result of several water shortages that occurred in the area. Agricultural areas within the Istokpoga Basin, south of Lake Istokpoga, are dependent upon the lake as the primary irrigation supply.

In order to address the surface water deficits more fully, the advisory committee formed a subcommittee or focus group. This group identified the issues to address within the Istokpoga Basin and reviewed the analysis developed to address these concerns. The group also identified and discussed several water resource options that would address the projected shortfalls in water supply specific to the Istokpoga Basin. The options discussed looked at either making additional water available or reducing projected demand. The options discussed were broken down in two groups, as shown in **Table 21**.

Table 21. Water Source Options Identified by the Advisory Committee for the Lake Istokpoga-Indian Prairie Basin.

Group A[a]	Group B[b]
Lake Okeechobee backpumping	Increase irrigation efficiency
Water from the Kissimmee River at S-84	Regulation schedule/minimum operational level on Lake Istokpoga
Changes for minimum operational flows	Removal of tussocks from Lake Istokpoga
Increase use of Lake Istokpoga	Water from Kissimmee at G-85
Regional Reservoirs	Increasing flows to Lake Istokpoga
	Additional ground water
	Aquifer storage and recovery
	Surficial Aquifer System
	Local reservoirs
	Increase canal storage

a. Group A options: alternatives with the most potential for development of significant additional supplies or would work to reduce the projected demand deficits.

b. Group B options: alternatives with limited potential for development of significant additional supplies or reduction of projected demands.

All of the options were discussed at length with the focus group and brought back to the full committee for development of the recommendations. Development of each of these options could have regional, as well as local responsibilities. The focus group divided the options into two groups. Group A are those alternatives that showed the most potential for development of significant additional supplies or would work to reduce the projected demand deficits found within the Istokpoga Basin. Those options in Group B are expected to yield limited additional supply or reduction of projected demands. The following discussion does not reflect an order of importance or ranking among the options.

Lake Okeechobee Backpumping

The Water Rights Compact, described in Chapter 5 of the Support Document, created the Seminole Tribe's entitlement to a certain percentage of surface water in this planning basin. Agreement #C-4121, between the District and Tribe creates an operational scheme for delivery of the Tribe's water entitlement rights to the Brighton Reservation. The source of surface water supplies to the Brighton Reservation varies and is primarily dependent upon water shortage conditions and canal levels. Ultimately, this Agreement reserves specific quantities of Lake Okeechobee water for the Brighton Reservation, if water shortage restrictions exist and optimum canal levels are not maintained. In order to meet the Tribe's water entitlement, two pumps (G-207 and G-208) were installed in the early 1990s adjacent to water control structures S-71 and S-72. These pumps function to move water from Lake Okeechobee around the respective structures to the lower pools of the C-40 and C-41 canals which run through the Brighton Reservation. At this time, water

delivered by these pumps can only by accessed by activities having access to the canals below the S-70 and S-75 structures.

Since the installation of G-207 and G-208, records show that the pumps have not been used to their full capacity of 60,000 GPM each. This option evaluates utilizing these pumps in an increased manner. Under this option, the pumps would be identified as the primary source of water to meet the demands for users having access to the C-40 and C-41 canals below the S-70 and S-75 structures. This would allow water currently supplied from Lake Istokpoga to meet the demands originating below the S-70 and S-75 structures to be redirected to other areas within the basin.

During the discussion of this item, the focus group raised several concerns that need to be resolved in order to enact this option. Among these concerns were the existing water quality of Lake Okeechobee water, the cost of pump operation and competition with Lake Okeechobee water resources.

Water Quality

The quality of water in Lake Okeechobee was the most significant concern raised by the focus group. The concern relates to current efforts on the part of the USEPA, FDEP, and SFWMD to set water quality discharge standards to Lake Okeechobee. Discharge concentration levels to the lake for several water quality parameters are expected to be developed over the next several months, with the implementation strategies to be developed over the following year. The discharge standard for phosphorus is expected to be about 40 ppb. The focus group expressed concerns over meeting this standard if the area accepts water from Lake Okeechobee, which is currently experiencing levels that range between 40 and 180 ppb total phosphorus.

Competition for Water Resources from Lake Okeechobee

Lake Okeechobee performs a wide variety of functions, which make its management complex. The lake is a water supply source for substantial environmental needs including the Caloosahatchee and St. Lucie estuaries, the Loxahatchee National Wildlife Refuge, the Water Conservation Areas, the Everglades National Park, Biscayne Bay, and Florida Bay. The lake also provides water for agricultural and human demands. An evaluation of the entire Lake Istokpoga-Indian Prairie Basin demands was not assessed for a number of reasons. First, the entire basin has not, historically, relied upon Lake Okeechobee for water supply. In fact, Lake Istokpoga has served as the entire region's primary water supply.

Given the expectations placed on Lake Okeechobee and concerns for its ability to sustain these functions, the District, as well as other state and federal agencies, have undertaken many studies related to Lake Okeechobee's water supply and quality. The Lower East Coast Water Supply Plan, the Comprehensive Everglades Restoration Plan, the Total Maximum Daily Load effort, and the Okeechobee SWIM Plan are examples of the various projects which are underway and address Lake Okeechobee issues.

Appreciation for the lake's various functions yields an understanding of its appropriate role in supplying the future water needs for the Lake Istokpoga-Indian Prairie Basin.

Costs

Pumps G-207 and G-208 have been in operation since the early 1990s. During that time the operational costs associated with the pump operation have been monitored. The operational costs are broken down into pump operation, machinery maintenance and facility maintenance. Although the total cost of operation varies slightly between the two pumps and from year to year, the average cost of operation is estimated to be between $60 and $65 per hour of use for each pump. Results of the analysis described in Chapter 4 indicate that the use of pumps G-207 and G-208 is estimated at 2,142 hours of operation during the 1-in-10 drought condition. Using this estimate of hours of operation, the cost of the pump operation is estimated at $128,590 annually.

Issues

- Water quality from Lake Okeechobee is still an unknown but is higher than the anticipated TMDL.
- Landowners asked to use water may raise concerns over future water quality discharge requirements.
- Competition for Lake Okeechobee resources.
- Cost of the operation of the pumps.
- Operational agreements with individual landowners and the Seminole Tribe.

Recommendations

- District needs to assist in finalizing the concentration standards to be set on Lake Okeechobee.
- The District should work with the Tribe to assure that the changes in water source do not cause undue regulatory burden.

Water from the Kissimmee River at S-84

This option, like the option above, evaluates additional use of water from Lake Okeechobee. The option focuses on withdrawing additional water from the Kissimmee River near the S-84 Structure (via adding a new pump) located on the C-41A Canal. The connection of the C-41A Canal and the Kissimmee River lies below the S-65E Structure. Pool E of the Kissimmee River is in direct connection with Lake Okeechobee and is effectively removing water from Lake Okeechobee. Water quality and competition issues associated with this source are the same as those for the direct use of Lake Okeechobee listed in the first option.

A component of this option also evaluates the addition of a new pump at the S-83 Structure to move water around this structure into the uppermost reach of the canal

system. Two pumps (one at S-84 and one at S-83) working in coordination, would allow water to be moved to the uppermost reaches of the system for distribution to other areas within the basin. The construction of two pumps will provide additional reliably to the delivery system that supplies water from Lake Okeechobee to this basin via the existing pumps G-207 and G-208. This option has additional benefits of acting as a source of water to replace lost water supply from Lake Istokpoga during lake restoration efforts currently proposed by the Florida Wildlife Commission (FWC).

A variation on this supply option discussed at the focus group meetings was to divert water to the C-41A Canal above the S-65E Structure, thereby removing water from the Pool D of the Kissimmee River. This option was discussed as a means to avoid the withdrawal point being located within the currently designated Lake Okeechobee service area. This would require engineering improvements to existing culverts and structures between the river and the canal. Water quality in Pool D has been determined to be some of the worst entering Lake Okeechobee, due in part to upstream dairy farms located in this area. For this reason, this option was given less consideration than removing water below the S-65E Structure.

Costs

Implementation of delivering water to the Istokpoga Basin under this option will require the installation of two new pumps and small modifications to the existing control structures at S-84 and S-83. These structures are currently proposed for construction improvements in the next year. If the design modifications required for the installation of pumps at these structures can be incorporated into the new structure design, costs of the S-84 and S-83 structure modifications can be minimized. The estimated cost of design, construction, and operation of these two pumps are provided in **Table 22**.

Table 22. Total Estimated Pump Costs.[a]

Pump Type	Engineering/ Design Cost	Construction Cost	Operation and Maintenance
Electric	$50,000	$3-4 million	$120,000 per year
Diesel	$50,000	$1.5-3 million	$80,000 per year

a. Based on 2,000 hours of operation per year.
Source: SFWMD.

Using the known operating costs of electric pumps G-207 and G-208 as a guide, the cost of operation and maintenance for electric pumps is estimated at $60 per hour. Discussions among the focus group suggested that diesel pumps might be less expensive to construct and operate. Estimates of operation and maintenance costs for diesel pumps were estimated to be about $40 per hour.

Issues

- Requires construction of new pumping facility to move water around the S-84 Structure.

- Cost of operation and maintenance.
- Utilization of pumps G-207 and G-208 in conjunction with additional supplies from Lake Istokpoga may not make the pumps at S-84 and S-83 necessary.
- Installation of pumps at S-84 and S-83 will provide better assurances to those farms withdrawing water from the C-41A Canal between structures S-83 and S-84.
- This option takes on additional importance if the Lake Istokpoga drawdown occurs.
- Competition for Lake Okeechobee resources.
- Water quality of Lake Okeechobee.

Recommendations

- The District should review the plans for modification of structures S-83 and S-84 prior to construction to determine if the necessary improvements for water supply could be incorporated.
- The District should assist in finalizing the concentration standards to be set on Lake Okeechobee.

Increase Use of Lake Istokpoga

This option evaluates obtaining additional water from storage held in Lake Istokpoga above its current minimum operational level. This is a no-cost option that makes additional water available immediately. Studies completed as part of this planning effort estimated that the use of additional storage might resolve a large portion of the projected deficit. Water quality from the lake is currently meeting the target goals for the Lake Okeechobee SWIM Program.

This option received the largest amount of debate from the focus group. Concerns were raised as to what the proper regulation schedule and the minimum operation levels for the lake should be. Some members of the committee thought that the existing level of 37.5 feet was too low due to navigational issues. Others thought that the lake did not fluctuate enough and should be allowed to drop to 36.5 feet on occasion. Concerns were also expressed about the timing of the year at which these levels should be achieved. Everyone agreed that maximizing the annual fluctuation of water levels on the lake while maintaining navigation and flood protection constraints would be a benefit.

Recommendations published in an April 1999 report on the Central and South Florida Comprehensive Review Study (Restudy) contain a proposed project to study the current regulation schedule for Lake Istokpoga. The project is part of the long-term comprehensive management plan anticipated to enhance fish and wildlife in South Florida. This project specifically reviews the lake fluctuation pattern with regards to balancing environmental habitat, flood protection, and water supply issues. Funding for this project has been authorized as part of the federally authorized Water Resources

Development Act and assumes a 50/50 cost share on the part of the District. This component of the comprehensive plan is expected to begin in year 2000 with completion of the review during 2001.

Costs

There is only minimal cost to utilize water in storage from Lake Istokpoga. Costs associated with a review of the regulation schedule are estimated to be $84,000 under the Restudy, with the federal government and the District having a 50/50 cost share.

Issues

- The minimum operational level for Lake Istokpoga, including the low water stage and duration.
- Conflicting management objectives for Lake Istokpoga.
- The Restudy has proposed to evaluate the Lake Istokpoga regulation schedule.
- The need to establish a MFL for this lake may effect the long-term availability of water.

Recommendations

- District should review existing minimum operational level for Lake Istokpoga.
- District should incorporate the issues of the 2020 water supply demands into the review of the Lake Istokpoga regulation schedule proposed by the Restudy.
- District should initiate a review of the impact of long-term lower water levels in Lake Istokpoga and the effects this may have on lakes along the Lake Wales Ridge.

Local Reservoirs

This option considers the use of reservoirs used by individual farms for storage of recycled irrigation water or the collection of local storm water runoff. These local reservoirs are also useful in providing water quality treatment before off-site discharge.

Concern was expressed by the focus group over the conflicting goals used to regulate construction and use of these local reservoirs. In many cases, wetland environments are preserved in the reservoirs. District regulations appear to have competing issues in protecting the environment, while maximizing use of these reservoirs as a water supply source.

Costs

The estimated costs associated with local reservoirs are provided in **Table 23**.

Table 23. Local Reservoir Estimated Costs ($/Acre).

Reservoir Type	Construction Cost	Engineering/ Design Cost	Administrative Cost	Land Cost	Operations and Maintenance Cost
Minor Reservoir	2,850	400	320	5,500	120

Source: SFWMD.

Issues

- Cost of construction, operations and maintenance to individual farmers.
- Use of reservoir will help in meeting off-site water quality discharge requirements as well as help attenuate volume of discharges

Recommendations

- The District should encourage construction of multi-purpose reservoirs, which include a water supply benefit.

Regional Reservoirs

This option considers a possible large regional water storage facility. The benefits of this type of facility include storm water attenuation, water quality treatment and dry season storage. The location of such a reservoir could be north or south of Lake Istokpoga, although the maximum benefit for water quality treatment could be achieved south of the lake. The analysis completed as part of this plan suggests that the amount of water that might be stored in a regional reservoir may be limited during a 1-in-10 drought. These modeling efforts show monthly demands for water from Lake Istokpoga in excess of the supply for all months except for August. The focus group also pointed out the water quality treatment benefits of a large reservoir and the pending water quality discharge requirements being set for Lake Okeechobee.

Recommendations published in an April 1999 report on the Central and South Florida Comprehensive Review Study (Restudy) call for the construction of a storage reservoir to be located north of Lake Okeechobee within the KB Planning Area. The total storage capacity of the reservoir is estimated to be 200,000 acre-feet. No specific location has been identified, although the location is projected for Glades, Highlands, or Okeechobee counties. Initial design for the reservoir is 17,000 acres in size with a 2,500 acre treatment area. Final designs will be based on sight selection and evaluation. The purpose of the reservoir is to attenuate water discharges and reduce nutrient loading to Lake Okeechobee and the Kissimmee River. Funding for this project is expected to be proposed for future federally authorized Water Resources Development acts after the year 2010. This component of the comprehensive plan is projected to begin in year 2011 with

completion before 2015. Funding for this comprehensive plan component is estimated at $285 million.

Costs

The cost of reservoir construction and operation/maintenance is the major deterrent to reservoir use. In particular, land costs will be higher than normal for a reservoir in this region since land areas suited for the location of a reservoir are most likely lands currently in agricultural production. **Table 24** summarizes the estimated cost components associated with constructing and operating a regional reservoir.

Table 24. Regional Reservoir Estimated Costs ($/Acre).

Reservoir Type	Construction Cost	Engineering/ Design Cost	Administration Cost	Land Cost	Operations and Maintenance Cost
Major Reservoir	7,980	900	450	5,500	105

Source: SFWMD.

Issues

- Expensive construction and maintenance.
- Water balance on use versus storage shows limited volume of water during a 1-in-10 drought.
- Water quality control component for increasing agricultural activities and meeting future.
- Lake Okeechobee discharge requirements.
- Allow more flexibility on operation levels for Lake Istokpoga.
- Restudy is looking at a possible reservoir location.

Recommendations

- District should prioritize the construction of a regional reservoir in the Istokpoga Basin that has been identified in the Restudy.
- District should undertake an effort to evaluate the effectiveness of a reservoir located in the Istokpoga Basin toward meeting future water demand and water quality improvements.

Changes for Minimum Operational Flows

This option considers the relaxation of the minimum operational flow requirements set in the District's Water Shortage Rule, 40E-22, F.A.C., that establish prescribed total monthly minimum flows through the lower structures S-71, S-72, S-84, S-127, S-129, and S-131, with the bulk of the flow coming from the first three structures.

This option looks to reduce the projected deficit by reducing the required amounts to be discharged from the Istokpoga Basin. These discharge amounts vary each month, with winter and spring having the lowest requirements. The annual total discharge required is 37,740 acre/feet. The discharge requirements were initially established based upon the findings of a 1974 report (Storch, et. al, 1974) which looked at structure integrity and water quality components of the canal systems.

The potential impact on the reduction of the demand deficit is expected to be limited. Although the total annual reduction is significant at 37,740 acre/feet, the reduction on the deficit in the spring and winter is often less than 1,000 acre/feet each month. The cost of this option is anticipated to be small with completion of a study to evaluate lower flow requirements as a basis for future rulemaking efforts. Such a study might dovetail well as a component of the Restudy evaluation of the Lake Istokpoga regulation schedule.

Issues

- This option supplies only minimal additional flexibility during the spring and winter months when the shortfall is greatest; the bulk of the supply becomes available in the summer.
- This option will take some time to implement, as it will require a rule change.
- Research is needed to examine and consider revising current minimum operational flows.

Recommendations

- The District should complete a study to re-evaluate the required minimum operational flows through the lower basin structures.
- Pending the results of the study, the District should initiate rulemaking efforts to modify Chapter 40E-22, F.A.C., to incorporate the revised flows.

Increased Irrigation Efficiency

This option evaluates reducing irrigation requirements as one method of decreasing future demands. Since a bulk of the additional surface water use in this basin is proposed for crop types that have historically used lower efficiency irrigation methods such as seepage, there is a potential for substantial water reductions. The major concern raised by the focus group was that the more efficient methods of irrigation have little or no track record proving the viability or economic variables associated with the alternate method. Local farmers raised concerns that the margin on sugarcane and other crop types projected for this area may be too small to allow for the use of other sources of water such as ground water. Other replacement crops could be grown such as citrus to reduce the overall demand projections.

Issues

- Lower efficiency methods may increase the amount of off-site discharges.
- Alternative methods of irrigation are possible, but do not have a long-track record.

Recommendations

- Prepare a pilot study reviewing alternate means of irrigation.

Water from the Kissimmee River at G-85

This option looks to withdraw water from the Kissimmee River using the Istokpoga Canal. A gate structure/pump is proposed for installation adjacent to the G-85 Structure. Water would then be diverted south along existing canals located on the Lykes Brothers, Inc. property to the C-41 Canal just downstream from the S-68 control structure. From this location, water could be distributed to other users in the basin using the existing operation/management guidelines. The G-85 Structure is currently scheduled for replacement within the next year.

The access point of the Istokpoga Canal with the Kissimmee River is in the area currently being restored. The Kissimmee River Restoration Project is a $448 million project to restore the ecosystem, flood attenuation and water quality treatment characteristics to channeled sections of the river. Construction of the project started in June 1999. The success of the restoration effort has been tied to specified target goals based upon anticipated flows within the Kissimmee River and its tributaries. Studies completed as part of the restoration effort indicate that during certain months there may be insufficient water to meet all of the targeted restoration goals. This suggests that seeking water from the restored section of the Kissimmee River may worsen chances of achieving the specified targets.

Water quality from this portion of Kissimmee River is good. The diversion point is located north of the dairies and other known contamination sources. Water quality is expected to improve as the river restoration effort moves forward.

Costs

The estimated costs associated with this option are in **Table 25**.

Table 25. Istokpoga Canal Diversion Estimated Costs (dollars).

Engineering/ Design Cost	Construction of Culvert/ Pump Cost	Canal Improvements Cost	Land/Lease Cost	Operations & Maintenance Cost
60,000	---	---	---	---

Source: SFWMD.

Issues

- This option would allow water to be placed near the top of Indian Prairie Canal system for downstream distribution.
- G-85 is proposed for replacement, which would minimize the costs of this option.
- Landowner agreements needed to address transport of water from the Istokpoga Canal to other canals or Lake Istokpoga.
- Concerns over Kissimmee River Restoration effort. The restoration effort has identified the need for additional water beyond the current surface water flows to the river to meet restoration goals.
- Water quality is good from this portion of Kissimmee River.

Recommendations

- Re-evaluate the restoration effort to identify water available from the Kissimmee River.

Additional Ground Water

Ground water is used extensively in the Lake Istokpoga-Indian Prairie Basin as a source for citrus and other crops. Based upon the modeling analysis completed as part of this planning effort, there appears to be ample ground water within this basin. Water wells installed in this area yield good quantities of water. Concentrations of sulfur appear to be high, but not prohibitive for agricultural activities. Wells located south of the Glades-Highlands County line show elevated concentrations of chlorides, worsening further south.

The financial margin on the crop types proposed for new production, particularly sugarcane, is stated to be small. The focus group indicated that the operations and maintenance costs associated with the use of ground water for these low margin crops would make growing such crops economically questionable.

Costs

The estimated costs associated with this option are presented in **Table 26**.

Table 26. Estimated Well Costs for the Floridan Aquifer System[a].

Floridan Aquifer System	Drilling Cost (per well)	Equipment Cost (per well)	Engineering Cost (per well)	Operations and Maintanence Costs (per 1,000 gallons)
Costs	$92,000	$52,000	$14,000	$.062

a. Costs based on a 16-inch diameter well and a depth of 900 feet.

Source: PBS&J, 1991, Water Supply Cost Estimates.

Issues

- According to the farmers, the operations and maintenance cost on the well operation is prohibitive to growing certain types of the projected crops due to the small margin of profit. These crops include sugarcane, pasture, sod, and some field crops.
- Back up supply potential.

Recommendations

There are no recommendations appropriate for the Lake Istokpoga-Indian Prairie Basin.

Removal of Tussocks from Lake Istokpoga

This option looks at the water supply benefits associated with the proposed lake drawdown and restoration of Lake Istokpoga. This option was considered for two benefits; the increase in additional storage as a result of the removal of materials, and as a maintenance consideration to maintain the existing storage in the lake. The additional storage expected from the restoration efforts is approximately 4,000 acre/feet, a relatively small amount. The costs for the project have not been completely determined. However, initial estimates suggest the total cost will be about $6-8 million. Cost sharing with the Florida Wildlife Commission and other agencies is possible.

Issues

- Expected to yield about 4,000 acre/feet per year of addition storage for use.
- Possible merit for the long-term maintenance of storage from the lake.
- Expensive solution solely as a water supply option.
- Restoration work will help maintain water volumes in lake and prevent possible gate structure releases.

Recommendations

There are no recommendations appropriate for the Lake Istokpoga-Indian Prairie Basin.

Regulation Schedule/Minimum Operational Level on Lake Istokpoga

This option has the potential of delivering substantial amounts of additional water to the basin if the schedule is changed to promote additional storage or the minimum operational levels are changed. This was not evaluated under this planning effort, as the Restudy project has proposed to address this issue starting in 2001. Both of these factors could significantly alter the availability of water as determined under this study.

Recommendations

- The District should establish a minimum level in accordance with Chapter 373, F.S. for Lake Istokpoga no later than 2003.
- The District should incorporate the issues of the 2020 water supply demands into the review of the Lake Istokpoga regulation schedule proposed by the Restudy.

Increasing Flows to Lake Istokpoga

This option looks at this possibility of increasing water flowing into Lake Istokpoga from its tributaries of Josephine and Arbuckle creeks. The headwater for each of these creeks is located outside the District boundaries, within the SWFWMD. USGS measuring devices are located on both of these creeks and the District's water shortage rule has specified minimum flow requirements for each of these measuring stations. Concerns were raised by the focus group about the competing use of these creeks.

Issues

- Competition for resources with the SWFWMD lake restoration efforts.
- Need to assure other restoration efforts do not reduce flows to Lake Istokpoga.

Recommendations

- The water management districts should work together to look at the issue of water inflows to Lake Istokpoga.

Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) is the underground storage of injected water into an acceptable aquifer (typically the Floridan aquifer in South Florida) during times when water is available, and the subsequent recovery of this water when it is needed. In this operation, the aquifer acts as an underground reservoir for the injected water. Current regulations require injected water to meet primary drinking water standards when the receiving aquifer is classified as an underground source of drinking water (USDW) aquifer, unless an aquifer exemption is obtained.

The focus group discussed the application of this technology in the Lake Istokpoga-Indian Prairie Basin utilizing water that might be released from Lake Istokpoga for flood control. Water captured from the lake would require some treatment to meet primary drinking water standards prior to injection, or require that an aquifer exemption from the U.S. Environmental Protection Agency (USEPA) would have to be obtained. Obtaining an aquifer exemption is a difficult process with few approved. Currently, there are no operating, untreated surface water ASR projects in Florida although SFWMD was

granted a limited aquifer exemption to inject untreated surface water for the ASR Demonstration Project for Lake Okeechobee.

The original purpose of the ASR Demonstration Project for Lake Okeechobee was to determine the role of ASR technology in diverting nutrients from Lake Okeechobee, with diversion of water from the Taylor Creek/Nubbin Slough Basin. Other goals that were developed as the project progressed were to: determine the physical ability of storing large volumes of surface water; the effects of storage on the water quality, including bacterial survival; and recovery efficiency. The results of the study indicate large volumes of surface water could be stored through ASR wells, beneficial changes in water quality could occur (especially phosphorus), fecal coliform could be eliminated by storage in the Floridan aquifer, and high permeability zones reduce the recovery efficiency in ASR wells. The project concluded in 1989 and the well has not been used since. The decision whether to reactivate this well is currently being considered in a Restudy component called the "Lake Okeechobee ASR Pilot Project." It is anticipated that the evaluation and decision to reactivate this well will begin in FY 2001.

Costs

Estimated costs for an ASR system largely depend on whether the system requires pressurized pumping equipment. As shown in **Table 27**, one system uses pressurized water from a utility; whereas the second ASR system uses unpressurized treated water, thus requiring pumping equipment as part of the system cost. The latter system with its associated pumping costs is more indicative of an ASR system in combination with surface water storage. There will also be additional costs for screening and filtering untreated surface water, as well as other required treatment.

Table 27. Aquifer Storage and Recovery System Estimated Costs[a].

System	Well Drilling Cost (Per Well)	Equipment Cost (Per Well)	Engineering Cost (Per Well)	Operation and Maintenance Cost (per 1,000 gallons)	Energy Cost (per 1,000 gallons)
Treated Water at System Pressure	$200,000	$30,000	$360,000	$.004	$.06
Treated Water Requiring Pumping	$200,000	$100,000	$400,000	$.006	$.06

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.

Water Quantity

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. Typical storage volumes for individual wells range from 10 to 500 million gallons (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. The storage time is usually seasonal, but can also be diurnal, long term or for emergencies.

Issues

- Due to the expense associated with construction, this option is unlikely to be implemented solely on the water source needs of the Lake Istokpoga-Indian Prairie Basin.
- Research is needed to assist in permitting this technology.

Recommendations

- The District should evaluate the potential of co-locating ASR and surface water storage to supplement storage or enhance water supply, if required and cost effective.
- The District will support the Restudy component to evaluate the potential of reactivating the District ASR Demonstration Project for Lake Okeechobee.
- The District will look at the potential of a public/private partnership with the Lake Okeechobee ASR projects.
- The District will continue working with the USEPA and FDEP to explore rule changes to the federal and state underground injection control program to allow for (and encourage) injection of untreated surface water and ground water with ASR.

Surficial Aquifer System

This option considers the surficial aquifer as a source of water through shallow wells. This option was given a lower ranking as a regional source due to the low production rates of wells and the generally high iron content of water. The aquifer may have some application to local uses such as cattle watering or residential use. There may also be some applicability of the shallow aquifer through the use of horizontal wells. These type wells, however, have a higher risk of effecting environmentally sensitive areas because they use water from the same aquifer as wetlands. Use of horizontal wells should be reviewed on a case-by-case basis.

Recommendations

There are no recommendations appropriate for the Lake Istokpoga-Indian Prairie Basin.

Increased Canal Storage

This option considers adding storage in the basin. This option was given a lower ranking because it is not expected to yield a large amount of additional storage with current right-of way areas.

Recommendations

There are no recommendations appropriate for the Lake Istokpoga-Indian Prairie Basin.

SUMMARY OF COSTS FOR WATER SOURCE OPTION DEVELOPMENT

Cost information has been provided throughout this chapter that could be used to estimate the planning-level cost for each of the water source options. This cost information is presented as a unit cost per 1,000 gallons of water to ease comparison of the identified options. In preparing these unit cost estimates, the following were considered:

- Capital costs including well drilling, construction, and equipment costs, land and engineering costs)
- Operation and maintenance costs (including energy general up-keep costs)

The unit costs are an estimate of life-cycle costs and are a function of the capital construction, a 30-year expected life of the constructed facilities, time value of money, and the annual operation and maintenance costs for the facility. The costs associated with construction and operation and maintenance of the distribution system are not included in this evaluation and can greatly change the total cost of each option.

The cost information was used to develop planning-level unit production costs for each water source option (**Table 28**). 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 U. S. Army Corps of Engineers. A 30-year fixed capital asset life was assumed and an operating level of 70 percent of capacity was used. In order to arrive at the unit production costs over the twenty-year planning horizon, the unused capital value at the end of the twenty-year planning horizon (1/3 of total capital value based on straight-line depreciation) was deducted from the expenditure based costs. All costs are expressed in constant 1999 dollars.

Table 28. Summary of Unit Production Costs for Water Source Options.

Water Source Option	Water Production Range	Unit Production Costs ($/1000 gallons)[1]
Conservation (urban indoor)	Variable	$0.22 - $3.70[2]
Conservation (urban outdoor)	Variable	$0.03 - $0.88
Irrigation System Conversion (based 25,000 citrus)	Variable	$0.25 - $0.35
Ground Water		
Surficial Aquifer - withdrawal only	1-2 MGD	$.03 - $.05
Surficial Aquifer w/chlorination/filtration	1-2 MGD	$.83 - $1.58
Surficial Aquifer w/membrane treatment[4]	1-2 MGD	$1.30 - $3.05
Intermediate Aquifer - withdrawal only	1-2 MGD	$.06 - $.08
Intermediate Aquifer w/lime softening	1-2 MGD	$.56 - $.2.96
Intermediate Aquifer w/membrane treatment[4]	1-2 MGD	$1.33 - $3.08
Floridan Aquifer - chlorination only	3-20 MGD	$.12 - $.22
Floridan Aquifer w/ membrane treatment	3-20 MGD	$1.23 - $2.76
Reclaimed Water	1-5 MGD	$.40 - $2.20
Drainage Well (passive treatment req.)	1-5 MGD	$0.02-$0.06[6]
Storage		
Aquifer Storage & Recovery	3 - 20 MGD	$.09 - $.12
Surface water Reservoir (4 feet deep)	6,000 acre-feet	$.21[3]
Surface Water Reservoir (8 feet deep)	12,000 acre-feet	$.18[3]
Surface Water - withdrawal only	3 - 20 MGD	$.03 - $.21[5]
Surface Water w/coagulation/filtration	3 - 20 MGD	$.90 - $1.28[5]
Surface Water w/membrane treatment	3 - 20 MGD	$.98 - $3.20[5]

[1] All costs are over a 30-year project life and are not discounted. Because of economies of scale, the lower cost represents cost per unit for the greater capacity.

[2] Ranges for retrofit kits to toilet rebates.

[3] Represents the cost based on construction and operation and maintenance. Unit cost can be highly variable depending on operational regimes.

[4] Assumes deep well injection used for concentrate disposal.

[5] Assumes withdrawal from existing surface water source, such as a canal or existing surface water management system. Separate storage area not included in cost estimate.

[6] Costs based on well construction and passive treatment system such as retention ponds and UV treatment.

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. 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 of scale in spreading fixed costs over a larger volume of output

3. Capacity utilization. In an area of slow growth a larger percentage of capacity can be utilized than in areas of more rapid growth
4. Water quality concerns. Depending upon the quality of the raw water and the nature of the end use, different levels of treatment will be needed

RELATED STRATEGIES

The advisory committee also recommended the District consider the following strategies to implement the KB Water Supply Plan. These strategies address coordination between the water management districts and consistency between planning and permitting.

Coordination Among Water Management Districts

The location and nature of the KB Planning Area warrants intensive coordination with adjacent water management districts, particularly in water resource investigation, water resource planning, water resource regulation, and water shortage declarations. To better coordinate these activities, the three water management districts have entered into a Memorandum of Understanding (MOU), which outlines guidelines for coordination in each of these four areas. In addition to the MOU, the advisory committee recommended the strategies outlined below. The committee felt that the water management districts needed to improve their coordination and communications. Among the items to coordinate between the Districts are:

- Consistent resource protection criteria
- Hydrologic investigations
- Improved hydrologic modeling
- Interdistrict transfers of water
- Local sources first
- Minimum flows and levels
- Water shortage declarations

Permitting

A major theme of the advisory committee meetings was for the St. Johns River, Southwest Florida, and South Florida water management districts to have consistent permitting criteria. These criteria include the following:

- Level of certainty
- Resource protection criteria
- Cumulative analysis

- Water shortage triggers
- Permit duration
- Minimum flows and levels
- Special Designation Area amendments, including Restricted Allocation Areas

The KB 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 KB 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 committee recommended for future rulemaking to considering addressing salient portions of this water supply plan into the CUP Program and other components of District's overall water supply management scheme.

Research

To advance many of the strategies, the advisory committee recommended further research on interactions among aquifers, resource protection criteria, common models, and the effects of urbanization on water budgets.

- Develop better information on:
  - amount of water available for consumptive use
  - cumulative impacts
  - resource protection criteria (e.g., wetland impacts)
  - interaction between aquifers
  - and costs of water sources and technologies
- Develop one regional ground water modeling tool to assess resource impacts of future demands
- Study urbanization effects on water budgets

Other

Other coordination efforts include potentially establishing a Water Resource Caution Area (WRCA) in Orlando and implementing a public awareness program in common planning areas of the water management districts as described in the following section.

Water Resource Caution Areas

There was much discussion in advisory committee meetings regarding the need to establish a WRCA in the SFWMD portion of the Orange-Osceola County Area. The primary benefit of this strategy is to allow participation in the District's Alternative Water Supply Funding Program. The committee asked for a discussion to clarify this strategy. During the discussion, the committee addressed potential consequences of declaring a

WRCA, especially in terms of the local source first concept and interdistrict transfers. In the end, the consensus of the committee was not to establish a WRCA designation in the Orange-Osceola County Area.

Public Awareness

The advisory committee recommended that the water management districts develop a consistent message regarding water supply problems and solutions in common planning areas. A public awareness program could be an effective vehicle to educate the public on the role of the water management districts and to open the interdistrict coordination process to the public.

Consistency Between Planning and Water Use Permitting

The strategies addressed under this section relate to consistency between planning and water use permitting within the SFWMD. In order for effective transition from the planning stage to the implementation stage, through the CUP Program, several matters must be addressed to fully integrate the plan's forecast with permit criteria.

Restricted Allocation Areas

Restricted allocation areas are District designated areas where the water resources are managed in response to specific surface water and ground water sources for which there is a lack of water availability to meet the needs of the region. Surface water in the Istokpoga Basin is the only restricted allocation in the KB Planning Area.

The advisory committee recommends that the District evaluate lifting the moratorium on new surface water allocations from the Istokpoga Basin-Indian Prairie Basin as part of the water use rulemaking process. This issue received a great deal of debate in the committee with certain interests expressing a desire to a reduced dependence on Lake Istokpoga. The consensus of the committee was that Lake Istokpoga should be the last option for additional supplies. The committee further recommended that that any further allocations be contingent upon implementation of the other identified water source options.

Permit Duration

House Bill 715 amended Section 373.236, Duration of Permits. The new statute provides that:

> Permits shall be granted for a period of 20 years, if requested for that period of time, if there is sufficient data to provide reasonable assurance that the conditions for permit issuance will be met for the duration of the permit; otherwise permits may be issued for shorter durations which reflect the period for which such reasonable assurances can be provided.

The advisory committee recommends that the District evaluate requests for 20-year permits for consistency with the KB Water Supply Plan. The committee felt that additional research on the aquifer systems in the KB Planning Area is necessary before issuing long-term permits for additional water.

Minimum Flows and Levels for Priority Water Bodies

In addition to water resource and water supply development strategies, Chapter 373, F.S. requires the water management districts (WMDs) to establish minimum flows and levels (MFLs) for priority water bodies within their jurisdictions. The statutes direct water management districts to prepare a priority list and schedule for the development of MFLs in November of every year.

The District informed the committee that the KB Planning Area contains 12 surface water bodies and the Floridan aquifer on the priority list (**Table 29**), which have been previously identified by the SFWMD. Lake Istokpoga is not currently on the MFL priority list and schedule. The District has made a commitment to consider whether Lake Istokpoga should be added to the list and schedule for establishment of a MFL during the next update of the list in November 2000 (letter dated December 3, 1999 from Kenneth G. Ammon, Director, Water Supply Planning, Permitting and Development, SFWMD). Future revisions to the list and schedule will reflect the understanding gained from this water supply plan on the potential for harm to the lake from water use withdrawals. In addition, the Restudy recommendation that the District and U.S. Army Corps of Engineers (USACE) review the regulation schedule for Lake Istokpoga will be considered.

Table 29. Minimum Flows and Levels Priority List and Schedule.

Surface Water	Year Established
Kissimmee River	2004
Lake Kissimmee	2004
Lake Tohopekaliga	2006
East Lake Tohopekaliga	2006
Alligator Lake	2006
Lake Jackson	2006
Lake Rosalie	2006
Cypress Lake	2006
Lake Hatchineha	2006
Lake Pierce	2006
Lake Marian	2006
Fish Lake	2006
Ground Water	**Year Established**
Floridan Aquifer	2004

Source: District Water Management Plan (SFWMD, 2000).

The District will coordinate with the USACE in establishing minimum flows and levels for the surface water bodies to ensure regulations schedules are consistent with the technical criteria established during the MFL process. In addition, the District will coordinate with the other water management districts in establishing minimum levels for the Floridan aquifer.

CONCLUSIONS

The results of this regional analysis indicate that historically used sources of water, primarily the Floridan aquifer in southern Orange County and northern Osceola County, may not be adequate to meet the future demands of the Kissimmee Planning Area during a 1-in-10 drought condition through 2020. Potential impacts on natural systems, as well as the potential for ground water quality impacts, are limiting the future use of this source. This points to the importance of coordinating with adjacent water management districts to investigate water source options that will meet long-term demands.

While the long-term, 20-year development of the Floridan aquifer is in question for southern Orange County and northern Osceola County, the immediate, short-term use of the Floridan can continue on a case-by-case basis while more information on potential impacts and limitations is being collected. The primary message of this plan for the Orange-Osceola County Area is that over the next five years, existing use of the Floridan aquifer can continue while additional data is collected and analyzed on potential impacts associated with increased use of the Floridan aquifer. As consumptive use permit applications requesting additional allocations are filed, they will be considered on a case-by-case basis. When determined appropriate, alternative sources and techniques to meet new demands may be required.

In the Lake Istokpoga-Indian Prairie Basin, the results of the surface water analysis indicate that the surface water availability during a 1-in-10 drought condition under the existing lake and canal storage network, is not adequate to support existing or projected, 2020 water supply demands. The solution to meeting these projected demands lies in changing the operation/management of Lake Istokpoga and obtaining additional supplies from Lake Okeechobee and/or the Kissimmee River. Both of these additional sources are highly controversial as they relate to potential impacts on these resources and water quality. The future use of water from Lake Okeechobee and the Kissimmee River depends upon resolution of issues that extend outside of this KB Planning Area and need to be resolved in context with the efforts in the other planning areas.

Chapter 6
RECOMMENDATIONS

An evaluation of the demands and water resources for the Kissimmee Basin (KB) Planning Area suggests that the ground water supplies in the Orange-Osceola County Area and surface water supplies in the Lake Istokpoga-Indian Prairie Basin may not be sufficient to meet the 2020 (1-in-10 drought year) water supply needs for these areas. In the Orange-Osceola County Area, the continued use of the Floridan aquifer has been projected to contribute to possible harm to wetlands, reduction in spring flow and may be an factor in the formation of sinkholes. In the Lake Istokpoga-Indian Prairie Basin, there have historically been concerns over the availability of water from the canal system to meet the existing demands. In both of these cases, the analyses performed also indicated that a number of issues must be resolved prior to fully determining whether there is sufficient water available for each of these areas. To this end, the District has identified 14 recommendations that address the unresolved issues and that seek to develop facilities to deliver alternative sources of water.

With the assistance of the advisory committee, the District identified a series of water source options for each of the two areas of concern. **Table 30** summarizes the options that address issues for the Orange-Osceola County Area and Lake Istokpoga-Indian Prairie Basin.

Table 30. Water Source Options of the Kissimmee Basin Planning Area.

Water Source Option	Orange-Osceola County Area	Lake Istokpoga-Indian Prairie Basin
Stormwater Drainage Well	X	N/A[a]
Stormwater Reuse	X	N/A
Wastewater Reuse	X	N/A
Urban Conservation	X	N/A
Agricultural Conservation	X	X
Floridan Aquifer	X	X
Surface Water	X	X
Brackish Ground Water	X	N/A
Reservoirs	X	X
Aquifer Storage and Recovery	X	X
Surficial Aquifer	X	X

a. N/A = not applicable.

The advisory committee suggested that the District consider a number of recommendations under each of the identified water supply options. These recommendations are summarized in Chapter 5. The recommendations in this chapter are organized into water resource development recommendations and water supply development recommendations. Water resource development recommendations are primarily the responsibility of the District. Activities such as research, testing, operations and construction are examples of where the District might participate in resource development projects. Recommendations in the water supply development category are primarily the responsibility of local governments, water suppliers, and water users. Activities such as construction and development of infrastructure related to individual facilities are examples of water supply development projects. Water supply development projects may be eligible for District funding assistance if they meet the statutory requirements explained later in this chapter.

The recommendations and insights provided by the advisory committee were reviewed by the District and then formulated into strategies directed at addressing the identified water resource concerns occurring in both the SFWMD and SJRWMD. Where possible, the District incorporated the recommendations of the committee into these strategies, but in some instances addressing all of the committee's suggestions was not possible. Strategies, with recommendations on implementation, have been developed separately for the Orange-Osceola County Area and for the Lake Istokpoga-Indian Prairie Basin. Where appropriate, tasks have been identified to clarify major components of a recommendation. Each recommendation ends with a summary of the pertinent information including estimated costs, potential quantity of water developed, funding and implementing agencies, and a schedule for activities.

Costs and funding sources are provided for each water resource and water supply development recommendation. Funding includes both monetary sources and human resources expressed in full-time equivalencies (FTEs). Monetary sources of funding are described in dollar amounts and include monies from the District and other agencies, while FTEs represent the estimated hours to be worked by District staff. The costs associated with FTE assignments are not included in the total dollar amounts presented. The funding approach for the KB Water Supply Plan as well as potential funding sources for water resource development recommendations and water supply development recommendations are described later in this chapter. The recommendations contained in this plan are subject to District Governing Board budgetary appropriation for future fiscal years. Further discussion of funding and the funding approach is provided in a later section of this chapter.

For the purposes of organization, water resource development recommendations and water supply development recommendations are organized in this chapter into groupings for the Orange-Osceola County Area and the Lake Istokpoga-Indian Prairie Basin.

ORANGE-OSCEOLA COUNTY AREA

A number of water source options were reviewed to assess those which have had the most potential to address the identified water supply issues in the Orange-Osceola County Area. These options strive to resolve the identified concerns of wetland vulnerability, reduction of spring discharges, potential for saline water movement, and sinkhole formation. **Table 31** shows how the options were ranked with regards to addressing the identified water resource protection issues. The Floridan aquifer, which is ranked "low" in the table, remains a viable source of water for the immediate future. However, the results of the regional analysis indicate that a number of issues must be resolved prior to fully determining whether there is sufficient water available for long-term allocation.

Table 31. Water Source Options Ranking for the Orange-Osceola County Area.

Water Source Options	Water Resource Issues				
	Wetland Vulnerability	Spring Discharges	Saline Water Movement	Sinkhole Formation	Overall Ranking
Wastewater Reuse	H[a]	H	H	H	H
Surface Water	M[b]	M	M	M	M
Reservoirs	M	M	M	M	M
Aquifer Storage and Recovery	M	M	M	M	M
Stormwater Drainage Wells	L[c]	M	H	L	M
Stormwater Reuse	M	M	M	L	M
Urban Conservation	L	L	L	L	L
Agricultural Conservation	L	L	L	L	L
Surficial Aquifer	L	L	L	L	L
Brackish Ground Water	L	L	N/A[d]	N/A	L
Floridan Aquifer	L	L	L	L	L

a. H = High: Most potential to address water resource issues.
b. M = Medium: Moderate potential to address water resource issues.
c. L = Low: Least potential to address water resource issues.
d. N/A = Not applicable: Does not address water resource issues.

An examination of the identified options indicates a grouping of the options can be made based upon the approach or strategy that each takes in trying to address possible harm to the resource. The options of wastewater reuse, stormwater reuse, reservoirs, drainage wells, and aquifer storage and recovery (ASR) have been grouped as an aquifer recharge strategy. The options of urban and agricultural conservation and reuse as a replacement for irrigation have been combined into a demand reduction strategy. The

options of the surficial aquifer, surface water, brackish ground water and additional ground water use are grouped as a strategy of alternative sources and optimization of future Floridan aquifer use.

Identified Strategies

In summary, the three identified strategies for the Orange-Osceola County Area are as follows:

1. Minimize drawdown through Floridan aquifer recharge
2. Minimize drawdown through demand reduction
3. Optimize use of the Floridan aquifer and develop alternative water supply sources

The following sections discuss each of these strategies and how the options identified were incorporated into the plan recommendations.

Strategy 1.0: Minimize Drawdown through Floridan Aquifer Recharge

Comments

This strategy strives to reduce the amount of projected drawdown on the Floridan aquifer by placing more water into the Floridan aquifer to replenish the amount removed. The identified sources for this recharge are reclaimed water and storm water.

Water Resource Development Recommendations

Recommendation 1.1: Develop a Regional Reclaimed Water Optimization Plan

Discussion

The volume of wastewater within the District's portion of Orange and Osceola counties is projected to more than double from the existing 61 MGD to 136 MGD by the year 2020. In 1995, an estimated 49 MGD of treated wastewater was used to replace irrigation demand or for application in high or moderate recharge areas. The volume of additional wastewater that could be available for beneficial uses by 2020 is estimated at 88 MGD. Direct offset of demand and recharge to the Floridan aquifer are among the most beneficial uses and should be preferred where economically feasible.

The District proposes to approach the regional reuse of reclaimed water supply sources by first identifying areas where the most beneficial use of reclaimed water should occur and then determining the appropriate actions that should then be taken to maximize reuse of reclaimed water in these areas. Among the considerations affecting wastewater reuse are supply availability versus the peak use and the transport of water to where it can

be best utilized. Other concerns that need to be addressed include storage; supplemental sources; utility interconnects; institutional framework and inter-local agreements; local, District and FDEP regulations; funding incentives; and high use by residential reuse customers. Each of these items requires additional study to evaluate the potential costs and identify policy issues that need to be addressed.

A study is recommended to determine where best to use the anticipated supply of reclaimed water. Newly developed or existing ground water flow models are recommended for determining the optimal distribution and the benefits of properly locating the use of reclaimed water. Current geologic and hydrologic information for the Central Florida area is thought to be a limitation on the ability to accurately predict benefits from reuse. A cooperative effort between SFWMD, the USGS, local governments, and the SJRWMD is recommended in the collection of this information and the development of the additional modeling tools.

Summary of Tasks

Task 1.1.a: The District will participate, along with local utilities, and other WMDs in the development of a regional wastewater reuse plan to optimize the use of reclaimed water to offset Floridan aquifer drawdown and avoid potential harm to the resources. Components of this plan will address storage; supplemental sources; utility interconnects; institutional framework and interlocal agreements; local, District and FDEP regulations; funding incentives; off-peak reclaimed water use and water conservation. An additional component of this plan will also evaluate the most beneficial use of reclaimed water through the use of existing or to be developed ground water modeling tools. The total cost of this task is estimated at $300,000 with a District cost share at 75 percent.

Task 1.1.b: The District will complete hydrologic investigations, in cooperation with local, state, and federal agencies, on the surficial, intermediate and Floridan aquifers in support of recharge optimization modeling. Focus of these studies should be on Orange, Osceola, and Polk counties and in areas where the risk of harm to the resources is estimated to be the greatest. The total cost of this task is estimated at $1,200,000, with District cost share estimated at 80 percent.

Task 1.1.c: The District should, in conjunction with local government, evaluate the benefits of deep aquifer injection of treated reclaimed water as a means of addressing water storage problems. A Deep Injection Aquifer Recharge Pilot Study is proposed, in partnership with a local sponsor, to investigate the feasibility of injecting treated reclaimed water into the Floridan aquifer as a form of aquifer recharge. This project is expected to improve the understanding of the hydrologic interactions of the upper and lower Floridan aquifer zones, demonstrate the cost effectiveness and improved wet season disposal benefits of injection over surface water disposal. This project also demonstrates a technology that could be implemented by other utilities in

Central Florida. The estimated cost of this project is $2,000,000 with the District's cost share at 25 percent. Partnership funding is also sought from SJRWMD and the FDEP.

Summary Information

Total Recommendation Cost: $3,500,000

Estimated District Participation: $1,825,000 FTEs: 1.6

Potential Funding Source: SFWMD, SJRWMD, USGS, and local governments

Implementing Agency: SFWMD, SJRWMD, USGS, FDEP, and local governments

Quantity of Water Made Available: 87 MGD

Table 32. Summary of Estimated Schedule and District Costs for Recommendation 1.1.

Reclaimed Water Optimization Plan		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
1.1.a	Development of Reuse Plan Est. start date: 10/1/00 Est. finish date: 2/1/05	20	0.10	20	0.10	50	0.10	85	0.10	50	0.25	225	0.55
1.1.b	Hydrologic Investigation for Recharge Modeling Est. start date: 10/1/00 Est. finish date: 2/1/04	300	0.10	400	0.10	200	0.10	100	0.25			1,000	0.55
1.1.c	Reclaimed Water Injection Pilot Project Est. start date: 10/1/00 Est. finish date: 2/1/05	25	0.10	400	0.10	50	0.10	25	0.10	0	0.10	500	0.50
Total		345	0.20	820	0.30	300	0.30	210	0.45	50	0.35	1,725	1.60

a. FTE: Full Time Equivalency.

Recommendation 1.2: Develop Storm Water Reuse Master Plans

Discussion

Storm water is similar to reclaimed water in that opportunities to recharge the Floridan aquifer exist that contribute to offsetting impacts associated with use. It is recommended that the optimization plan described in Recommendation 1.0 should examine storm water reuse as a potential supply.

The use of storm water reuse has historically been limited to irrigation use due to higher treatment costs. The dependability of storm water is also an issue and usually relegates storm water to a backup or supplemental source. On a local scale, storm water has been used for irrigation of landscape. On a regional scale, storm water might be used as a source for augmenting a reclaimed water system. Water storage issues for storm water are much like those discussed under reclaimed water. Elements under this recommendation strive to improve the collection and distribution of storm water for local and regional applications through irrigation.

Another use of collected storm water is for aquifer recharge. Drainage wells located in the metropolitan Orlando area have been used as part of the Orange County storm water system since the early 1900s. An estimated 400 drainage wells currently exist, providing the Orlando area with an estimated 20 to 50 MGD of recharge to the Floridan aquifer. The population in Central Florida is anticipated to nearly double over the planning horizon. Based upon this increase in population and the associated urbanization that will follow, the estimated potential for additional recharge from stormwater injection is also projected to double over the next 20 years.

It is believed that recharge to the aquifer could be substantially increased through the addition of more drainage wells. However, water quality concerns and regulatory issues discourage the construction of new wells. Under current USEPA and FDEP regulatory requirements, water entering an aquifer through a new drainage well would have to meet primary and secondary drinking water standards. Limited information is available about the effects of introducing untreated water into the aquifer through these wells.

The District is currently participating in the Artificial Recharge Demonstration Project along with the Orange County and the SJRWMD. This is a three-year project to evaluate the water quality of water entering the aquifer through these drainage wells and the effectiveness of passive forms of storm water treatment for improving the water quality entering these wells. An additional study is proposed to evaluate more active treatment methods applied to drainage wells such as ultraviolet, membrane, and chemical technologies, off-line storage ponds and other more conventional water treatment technologies.

Summary of Tasks

Task 1.2.a: Evaluate the regional stormwater drainage systems to determine if water is available to augment wastewater reuse systems or to be used for local irrigation. Components of this plan will address stormwater routing, water quality, collection of water to supplement reclaimed water systems and the use of drainage wells to enhance aquifer recharge. This task should be done in conjunction with local government development of stormwater master drainage plans. Determination of the recharge potential from drainage wells completed in conjunction with master storm water planning will be included in the reuse optimization plan described in Recommendation 1.0.

Task 1.2.b: Continue participation in the Artificial Recharge Demonstration Project to evaluate the regulatory, water quality and recharge aspects of drainage wells by participating in demonstration projects. This is a cooperative effort between SFWMD, SJRWMD, Orange County and the city of Orlando and other local governments. The project reviews the effects of injecting untreated storm water on the Floridan aquifer and the effectiveness of passive treatment methods to reduce bacteria. This project also involves working with the USEPA and FDEP to evaluate the water quality standards for water entering the Floridan aquifer. Results of the project will contribute to a determination of the recharge potential of drainage wells in conjunction with master stormwater planning and the optimized reuse plan. Regional ground water modeling tools will be utilized to assist in these determinations.

Task 1.2.c: The District should, in conjunction with local and state governmental agencies, evaluate the benefits of alternative treatment methods for storm water entering drainage wells. The quality of water entering existing and proposed drainage wells is of critical concern and must currently meet primary and secondary drinking water standards on new or modified wells. The proposal creates a demonstration project in conjunction with Orange County Utilities to identify wells receiving the worst water quality and to devise cost-effective treatment to meet the FDEP and USEPA water quality requirements for injection. Treatment methods considered will include ultraviolet, membranes, chemicals, and off-line storage ponds to more conventional water treatment technologies. Increasing the net recharge capacities will be attempted as part of the project in addition to the water quality improvements. Partnerships with the SJRWMD and the FDEP will also be sought on the project. The total cost of this project is estimated at $1.0 million with the District participation estimated at 50 percent.

Summary Information

Total Recommendation Cost: $1,155,000

Estimated District Participation: $655,000 FTEs: 1.0

Potential Funding Source: SFWMD, SJRWMD, city of Orlando, and Orange County

Implementing Agency: SFWMD, SJRWMD, Orange County, and other local governments

Quantity of Water Made Available: 20 to 40 MGD

Table 33. Summary of Estimated Schedule and District Costs for Recommendation 1.2

Storm Water Reuse Master Plans		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
1.2.a	Evaluate Stormwater Drainage Systems Est. start date: 10/1/00 Est. finish date: 12/31/04	50	0.10	50	0.10	25	0.10		0.10			125	0.4
1.2.b	Artificial Recharge Project Est. start date: 10/1/00 Est. finish date: 6/1/02	30	0.10									30	0.1
1.2.c	Drain Well Treatment Pilot Est. start date: 10/1/00 Est. finish date: 1/30/05	50	0.10	200	0.10	150	0.10	75	0.10	25	0.10	500	0.5
Total		130	0.30	250	0.20	175	0.20	75	0.20	25	0.10	655	1.0

a. FTE = Full Time Equivalency.

Water Supply Development Recommendations

Recommendation 1.3: Recommendations from the developed wastewater optimization plan should be included by local governments into their own wastewater master plans. Local governments should adopt building codes and land development recommendations requiring proposed new development to construct infrastructure and use water from the reclaimed water system, if this type of reuse is projected in their master plan.

Recommendation 1.4: Utilities should consider supplemental sources and interconnection with other utilities to maximize the volume of reclaimed water reused.

Strategy 2.0: Minimize Floridan Aquifer Drawdown through Reduction of Demands

Comments

The District's water conservation roles consist of a supply management/water resource development function that includes reclaimed water use, and a demand reduction/permitting function. These roles are separated into two strategies in addressing the resource concerns. Reclaimed water is anticipated to be one of the largest alternative sources to be developed in the Central Florida region and is addressed as part of Strategy 1.0. The second component, conservation to promote less water use, is the focus of Strategy 2.0.

Water Resource Development Recommendations

Recommendation 2.1: Develop a comprehensive water conservation program, in conjunction with local utilities, to address irrigation, education and specialty programs

Discussion

Water conservation was given a low ranking by the committee for its small potential contribution to solving the projected water resource concerns. Conservation in agriculture was ranked particularly low because of the expected future reduction in total agricultural acreage in Orange and Osceola counties. Urban water conservation was thought to be adequately addressed under the CUP permitting process and through the state's low-flow plumbing code requirements. Water conservation was estimated to reduce projected demands by 5-10 percent of the projected 90 MGD increase or an estimated 9 MGD.

The advisory committee assisted in identifying areas for improvement in the current conservation activities. The existing CUP could be improved by allowing individual utilities to demonstrate which of the conservation strategies presented in the CUP process are best suited to their utility. These individually tailored conservation strategies would then be enforced for the utility, as opposed to all of the strategies being required for all utilities. A recommendation for improving District enforcement measures was also suggested.

A recommendation for the appointment of two conservation program coordinators is proposed. Under the conservation program coordinators, the District will develop and implement a comprehensive water conservation program. The program will be developed to assist water users in identifying and implementing cost-effective conservation measures and developing new or utilizing existing policies to further public education. This program and position will be implemented Districtwide and focus on urban areas and outdoor uses. The costs presented with this recommendation are Districtwide with the KB Water Supply Plan representing an estimated 25 percent of that total.

Summary of Tasks

Task 2.1.a: The District should appoint two water conservation coordinators. These persons would be responsible for developing a comprehensive water conservation program for the District. The program will be designed to coordinate local government and water management district efforts in water conservation education. This program will look to promote a consistent Districtwide and interdistrict message on water conservation and water shortage, and increase educational benefits through cooperative funding.

Task 2.1.b: The District will encourage and assist in the development of effective water conservation plans for individual public water supply utilities. As part of this program, the District will provide for water use audits for utilities requesting

this service.

1. identifying inefficiencies in water use
2. identifying projects and programs to improve water use efficiency through incentive and regulatory appproaches
3. evaluating the effectiveness of various options in meeting the existing and projected needs of the region
4. identifing specific conservation measures that should be incorporated in the updated regional water supply plan

Based upon the audit, recommendations for individually tailored water conservation plans will be made. The recommendations, if adopted, would be considered a means of satisfying a portion of the water conservation requirements for the CUP.

Summary Information

Total Recommendation Cost: $330,000

Estimated District Participation: $330,000 FTEs: 1.55

Potential Funding Source: SFWMD and SJRWMD

Implementing Agency: SFWMD, SJRWMD, and local governments

Quantity of Water Made Available: 9 MGD

Table 34. Summary of Estimated Schedule and District Costs for Recommendation 2.1.

Water Conservation Program		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
2.1.a	Comprehensive Conservation Program Est. start date: 10/1/00 Est. finish date: N/A	60	0.25	60	0.25	60	0.25	60	0.25	60	0.25	300	1.25
2.1.b	Assist in Individual Plan Development Est. start date: 10/1/00 Est. finish date: N/A			10	0.10	10	0.10	10	0.10			30	0.30
Total		60	0.25	70	0.35	70	0.35	70	0.35	60	0.25	330	1.55

a. FTE: Full Time Equivalency.

Strategy 3.0: Optimize use of the Floridan Aquifer and Develop Alternative Sources

Comments

The recommendations under this strategy examine developing alternative water sources that would reduce future dependence on the Floridan aquifer in areas of the greatest projected drawdown. Surface water, reclaimed water, storm water and brackish ground water are identified as possible alternative sources in Central Florida. Reclaimed water and storm water are addressed as part of Strategy 1.0. Recommendation 3.1 proposes an investigation into the availability of the surface water resources, such as lakes, within the basin. In addition, an investigation is proposed for the St. Johns River to determine how this source may provide supplies to entities located within Central Florida. In addition, this strategy looks to optimize the continued use of the Floridan aquifer.

Water Resource Development Recommendations

Recommendation 3.1: Research and Develop Alternative Water Supplies

Discussion

Alternative water source options identified by the advisory committee include reclaimed water, surface water, brackish ground water and additional fresh ground water. Of these alternatives, the use of surface water was given the second highest ranking behind reclaimed water. Surface water sources identified include the Kissimmee River, Kissimmee Chain of Lakes, and Alligator Chain of Lakes, and the St. Johns River. Technical and resource based issues to quantify the availability of these sources were not addressed as part of this planning effort. Integral to determining availability is the establishment of minimum flows and levels (MFLs) and the harm standard.

For those water resources within the SFWMD's boundaries, the SFWMD will take the lead role in the investigation and determination as to how these various alternative supplies will be distributed. Likewise, for those water resources within the SJRWMD, that district will have the lead role in the investigation and determination as to how these various alternative supplies will be distributed. The results of such district investigations should be coordinated, yet not be binding upon either water management district.

Brackish ground water is considered a less viable alternative due to treatment costs and permitting hurdles associated with concentrate disposal. In addition, transport costs associated with the piping of water from locations outside of the basin where access to brackish water occurs make this option less desirable. The surficial aquifer is also not considered a regionally viable option due to very low yields and the high iron content of the water.

Summary of Tasks

Task 3.1.a: For the following surface water bodies, the District should conduct a comprehensive research project to: (1) determine the amount of water available for allocation without causing harm; (2) determine appropriate minimum flows and levels; (3) recommend integration of these minimum flows and levels with the water shortage program; and (4) propose a quantity of water in the Kissimmee River which should be reserved from use under Section 373.223(3), F.S. Each of the research project's recommendations should be implemented after incorporating the same in District rules. The following is a list of the water bodies which should be the subject of this comprehensive research project: Kissimmee River and Lake Kissimmee in 2004, and by 2006 for East Lake Tohopekaliga, Lake Tohopekaliga, Lake Hatchineha, Cypress Lake, Fish Lake, Lake Jackson, Lake Marian, Lake Pierce, and Lake Rosalie.

Task 3.1.b: The District should coordinate with the SJRWMD on the investigation of the St. Johns River as a water supply option for the Central Florida area.

Summary Information

Total Recommendation Cost: $500,000

Estimated District Participation: $500,000 FTEs: 5.0

Potential Funding Source: SFWMD

Implementing Agency: SFWMD

Quantity of Water Made Available: N/A

Table 35. Summary of Estimated Schedule and District Costs for Recommendation 3.1.

Research and Develop Alternative Supplies		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
3.1.a	Surface Water Availability and MFL's Est. start date: 2/1/01 Est. finish date: 6/30/05	100	0.95	100	0.95	100	0.95	100	0.95	100	0.95	500	4.75
3.1.b	Investigation of the St. Johns River	0	0.05	0	0.05	0	0.05	0	0.05	0	0.05	0	0.25
Total		100	1.0	100	1.0	100	1.0	100	1.0	100	1.0	500	5.00

a. FTE: Full Time Equivalency.

Recommendation 3.2: Determine Optimized Use of the Floridan Aquifer

Discussion

The amount of fresh ground water that is available and the best location for its withdrawal are issues that remain unresolved. A determination of the quantity of the available fresh ground water supplies will require gathering of additional hydrologic data and modeling. The collection of the necessary hydrologic information and development of models to accurately identify resource concerns is recommended to address this issue.

Task 3.2.a: The District, in partnership with local governments and state and federal agencies, will complete hydrologic investigations of the aquifer systems within the basin in support of the development of new or revised ground water modeling tools. Focus of these studies should be on Orange, Osceola and Polk counties and in areas where the risk of harm to the resources is estimated to be the greatest. The total cost of this task is estimated at $2,900,000.

Task 3.2.b: New or revised ground water models will be developed to make better predictions for the next planning cycle. These models are proposed to be developed in cooperation with the USGS, local governments, and other WMDs. These models should improve the ability of the District to predict the severity of potential resource harm to wetlands, saltwater movement, spring discharges and lakes. In addition, the model will improve the District's ability to establish a MFL for the Floridan aquifer. Part of this evaluation will include an evaluation partitioning the impacts of the differing water management districts on the respective criteria. The total cost of this task is estimated at $750,000 with the District cost share at 50 percent.

Summary Information

Total Recommendation Cost: $3,650,000

Estimated District Participation: $3,275,000 FTEs : 8.25

Potential Funding Source: SFWMD, SJRWMD, SWFWMD, and local government

Implementing Agency: SFWMD, SJRWMD, SWFWMD, and local government

Quantity of Water Made Available: N/A

Table 36. Summary of Estimated Schedule and District Costs for Recommendation 3.2.

Determine Optimized Use of the Floridan Aquifer		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
3.2.a	Hydrologic Investigation Est. start date: 10/1/00 Est. finish date: 2/1/04	750	1.00	1,000	2.00	700	2.00	350	1.00	100	1.00	2,900	7.00
3.2.b	Ground Water Modeling Est. start date: 2/1/01 Est. finish date: 1/30/05	25	0.25	50	0.25	100	0.25	100	0.25	100	0.25	375	1.25
Total		775	1.25	1,050	2.25	800	2.25	450	1.25	200	1.25	3,275	8.25

a. FTE: Full Time Equivalency.

LAKE ISTOKPOGA-INDIAN PRAIRIE BASIN

The agricultural operations within the Lake Istokpoga-Indian Prairie Basin have experienced a series of water shortages related to a lack of supplies from Lake Istokpoga and runoff from the basin. During the late 1980s and early 1990s, several actions were taken by the District that appear to have corrected these problems. An analysis of the Lake Istokpoga-Indian Prairie system, completed as part of this plan, suggests that although there appears to be sufficient water to meet the current water supply demands, surface water from the Lake Istokpoga-Indian Prairie Basin is not sufficient to meet all of the projected 2020 water needs. The recommendations considered as part of this plan look to develop alternative supplies to meet the projected future need.

Several water resource options were identified and reviewed that would address the projected shortfalls in water supply specific to the Lake Istokpoga-Indian Prairie Basin. The options were divided into the two groups shown in **Table 37**. This table differs from those seen in Chapter 5, that were identified by the advisory committee. Group A are those alternatives that the District believes to show the most potential for development of significant additional supplies or would work to reduce the projected demand deficits found within the Istokpoga Basin. Those options in Group B are expected to yield limited additional supply or reduction of projected demands. The options discussed looked at either making new supplies available or reducing projected demand.

Lake Istokpoga is currently under an effort by the FWC, Highlands County and local residents to restore the environmental function to the lake. These groups advocate development of a continuous management plan for the lake. The first step in their plan includes the environmental drawdown of the Lake Istokpoga to address water quality, fish and wading bird habitat, water supply and flood control problems related to excessive vegetative accumulation. An application for the drawdown has been filed with the U.S. Army Corps of Engineers (USACE), however, the schedule for the drawdown is unknown.

Table 37. Water Source Options for the Lake Istokpoga-Indian Prairie Basin.

Group A[a]	Group B[b]
Lake Okeechobee backpumping	Increase irrigation efficiency
Changes for minimum operational flows	Regulation schedule/minimum operational level on Lake Istokpoga
Additional pumps to move water above S-82 and S-83 structures	Removal of tussocks from Lake Istokpoga
Regional reservoirs	Water from Kissimmee at G-85
Aquifer storage and recovery	Increasing flows to Lake Istokpoga
Increase use of Lake Istokpoga (during drought)	Surficial Aquifer System
Kissimmee River	Increase canal storage
Additional ground water	Local reservoirs

a. Group A options: alternatives with the most potential for development of significant additional supplies or would work to reduce the projected demand deficits.

b. Group B options: alternatives with limited potential for development of significant additional supplies or reduction of projected demands.

Some of those advisory committee members involved in the Lake Istokpoga ecosystem sustainability indicated they could not give their full support to the water supply plan if further use of Lake Istokpoga would be detrimental to the restoration effort. These participants and others of the committee, expressed an interest in meeting all of the future basin demands from Lake Okeechobee as an alternative. However, given the current structure and pumping facilities in place and the wide variety of environmental and human uses dependent upon Lake Okeechobee supplies, it was determined appropriate that only a portion of the basin demands could be met from Lake Okeechobee. Moreover, Lake Okeechobee performs a wide variety of functions which make its management complex. Lake Okeechobee is a water supply source for substantial environmental needs including the Caloosahatchee and St. Lucie estuaries, the Loxahatchee National Wildlife Refuge, the Water Conservation Areas, the Everglades National Park, Biscayne Bay, and Florida Bay. The estimated transfer amount was based upon an evaluation of the projected 1-in-10 drought demands for the lower portion of the basin that could be serviced by existing facilities moving water to the lower pools of the C-40 and C-41 canals.

In addition to Lake Okeechobee as an alternate source, the Kissimmee River, ground water and additional supplies from Lake Istokpoga were identified as potential sources. Studies performed as part of the restoration efforts of the Kissimmee River indicate a difficulty in meeting the success criteria established for the project with the current inflows to the river. Recommendation 3.1, presented earlier, addresses an evaluation on water availability of the Kissimmee River after a sufficient portion of the restoration effort has been completed to determine the success in meeting the project goal criteria and the establishment of an MFL for the river. Recommendations regarding further use of Lake Istokpoga are presented as part of Strategy 6.0.

Water conservation options were identified, but are believed to provide only minimal potential reduction in water use. In this basin, irrigation water not used for crop

growth is collected by the canal system and is made available for the use of others in the basin via these same canals.

Strategy 4.0: Development of Alternative Water Resources

Comments

The alternative water resources identified include obtaining additional water from Lake Okeechobee, the Kissimmee River and additional ground water. Recommendations to make these options available to users in the basin are included as part of this strategy.

Water Resource Development Recommendations

Recommendation 4.1: Develop an Operational Plan for Backpumping from Lake Okeechobee

Discussion

Lake Okeechobee has been identified as the primary alternative resource to Lake Istokpoga. This recommendation examines the utilization of existing pumps G-207 and G-208, and the installation of additional pumps at other structures to deliver water from Lake Okeechobee back into the Indian Prairie Basin. Utilization of such pumps will require the development of a set of operational guidelines defining the circumstances for the pump use, location of new pumps if constructed, District operated structure control, water quality of the source water, water quality discharges from the farms to the canals, agreements with the Seminole Tribe, and operation of gates and pumps not owned by the District among other items. This recommendation proposes development of a plan that addresses these issues.

The advisory committee requested the District look at the installation of additional pumps to move water above the S-82 and S-83 structures. These new pumps would be installed as temporary pumps or permanent pumping facilities that operate on a temporary basis. Under the defined 1-in-10 drought conditions, the use of these proposed additional pumps are not required in order to meet the long-term demands of the basin. An analysis on the availability of surface water indicates that during the defined 1-in-10 drought condition, Lake Istokpoga has sufficient supply to meet the proposed 2020 demands when working in concert with water from Lake Okeechobee supplied by pumps G-207 and G-208. The supply availability from Lake Istokpoga is, however, a concern due to possible irregular seasonal climatic conditions and the proposed restoration efforts for the lake. The additional pumps in this strategy are proposed for temporary use to add to the dependability of the system and for use during drought events and during the proposed lake restoration efforts.

The cost of operation of delivery pumps is estimated at $60 per hour, based upon the cost of operation of pumps G-207 and G-208. Results of the analysis described in Chapter 4 indicate that the use of pumps G-207 and G-208 is estimated at 2,142 hours of

operation during the 1-in-10 drought condition. Using this approximate number of hours of operation, the cost of the pump operation of pumps G-207 and G-208 would be about $128,590 annually. The restoration of Lake Istokpoga has environmental, water quality and some water supply benefits. The addition of two pumps has been proposed in support the restoration effort and to deliver water during declared water shortages in the Indian Prairie Basin. Local landowners and the FWC are pursuing this installation of temporary use pumps to deliver water north of the S-83 and S-82 structures pending the outcome of the District-sponsored design and a funding determination. Estimated costs for construction of these pumps is $2 million to $3 million, with an additional annual operating cost of about $60 per hour. Operation of these pumps should be included in the Lake Okeechobee operation plan.

Summary of Tasks

Task 4.1.a: The District should develop an operational plan for backpumping water from Lake Okeechobee into the Indian Prairie Basin using pumps G-207 and G-208 and any other pumps that might be constructed to move water in the basin. As part of this plan, the District should address operation of existing and proposed pumps, operational agreements with local land owners and the Tribe, water quality TMDLs for Lake Okeechobee, MFLs for Lake Okeechobee and Lake Istokpoga, Lake Okeechobee Protection legislation (HB 991), the Tribe's entitlement rights, canal water levels, land acquisition necessary to effectuate the plan, Lake Istokpoga release and restoration requirements, water shortage conditions, and cost of operation of existing and proposed pumps. Additionally, the operational plan should address any water quality monitoring program which might be necessary to integrate with the agreements described in Task 4.1.b.

Task 4.1.b: The District should obtain the necessary agreements, or amendments to existing agreements, with local land owners and the Tribe to operate the system in accordance with a operational plan under Task 4.1.a and address basin issues such as water quality, flood control, water supply and environmental concerns. These agreements should establish appropriate partnerships, including party responsibilities and funding for same, with the Tribe and area landowners on the various basin issues.

Task 4.1.c: The District should pursue the design and determine the operational protocol for new by-pass pumps to deliver water from Lake Okeechobee to points above the S-82 and S-83 structures located the Indian Prairie Basin. This will include evaluating the potential placement of pumps at the S-84 and S-83 structures to remove water from the Kissimmee River below the S65-E Structure as well as other options. These pumps are intended to assure supplies during the Lake Istokpoga restoration efforts and during declared water shortages in the Indian Prairie Basin when water is determined to be available from Lake Okeechobee or the Kissimmee River. The District will evaluate the location and temporary/permanent status of these pumps. Funding for the construction or delivery of these pumps is proposed to be

resolved as part of a future design and funding determination. Operation of these pumps should be included under the operational plan developed. Annual operation of these pumps is estimated at $100,000 annually during the restoration effort or 1-in-10 drought event.

Task 4.1.d: The District agrees to assist the Tribe in assuring that the change in quality of water delivered does not create compliance issues or an undue regulatory burden on the Tribe. Such assistance may include, but is not limited to, development of the master operational plan, undertaking water quality studies and other appropriate actions as may be agreed upon by the parties.

Task 4.1.e: Nothing in these recommendations, however, is intended to modify the District or Tribe's rights, from that set forth in an Agreement dated November 30, 1992 entitled "Agreement Between the South Florida Water Management District and the Seminole Tribe of Florida and Water Supply Plan for the Brighton Reservation Implementing Section VI. B. of the Water Rights Compact and Subparagraph 3.3.3.2.A.3 of the Criteria Manual (Agreement No. C-4121)," unless and until such modification is specifically agreed to in writing by the Parties.

The District should track the progress of the USEPA and FDEP in finalizing the load standard (TMDLs) to be set on Lake Okeechobee.

Summary Information

Total Recommendation Cost: $170,000

Estimated District Participation: $170,000 FTEs : 2.3

Potential Funding Source: SFWMD

Implementing Agency: SFWMD

Quantity of Water Made Available: 41.0 MGD (annualized)

Table 38. Summary of Estimated Schedule and District Costs for Recommendation 4.1.

Okeechobee Backpumping Plan		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
4.1a	Develop Operational Plan Est. start date: 10/1/00 Est. finish date: 12/31/03	0	0.20	0	0.20	0	0.10	0	0.10			0	0.60
4.1.b	Obtain Operational Agreements Est. start date:10/1/00 Est. finish date: 6/1/03	0	0.30	0	0.30	0	0.20					0	0.80
4.1.c	Design and Locate Additional Pumps[b] Est. start date: 10/1/00 Est. finish date: 12/31/01	60	0.25	20	0.25	20	0.00	20	0.00	20	0.00	140	0.50
4.1.d	Assist Tribe with Water Quality Est. start date: 10/1/00 Est. finish date: 5/1/02	10	0.10	10	0.10							20	0.20
4.1.e	Follow TMDLs for Lake Okeechobee Est. start date: 10/1/00 Est. finish date: 2/1/02	0	0.10	0	0.10							0	0.20
Total		70	0.95	30	0.95	30	0.30	20	0.10	20	0.00	170	2.30

a. FTE: Full Time Equivalency.

b. Assumes annual operating cost of $20,000 for new pumps ($100,000/5 yrs); pump capital costs to be resolved during design and funding task.

Recommendation 4.2: Investigate the Availability of Water from the Kissimmee River

Discussion

The use of the Kissimmee River has been identified as a potential new source of water for the basin. The availability of water from the Kissimmee River is a question that was left unresolved under this plan. The District has a current $480 million dollar restoration project underway for the river with established hydrologic success criteria. A determination of the availability of water from the river is necessary. A study is recommended to determine the amount of water that should be reserved from use for the purpose of river restoration. Further, the study should recommend withdrawal amounts which would cause harm and propose minimum flows and levels.

Summary of Tasks

Task 4.2.a: The District should conduct a comprehensive research project to determine the amount of water required for reservation for the Kissimmee River, that water available from the river for allocation without causing harm, and

establish a MFL for the river.

Task 4.2.b: Propose a quantity of water in the Kissimmee River that should be reserved from use under Section 373.223(3), F.S.

Summary Information

Total Recommendation Cost: $150,000

Estimated District Participation: $150,000 FTEs: 1.5

Potential Funding Source: SFWMD

Implementing Agency: SFWMD

Quantity of Water Made Available: N/A

Table 39. Summary of Estimated Schedule and District Costs for Recommendation 4.2.

Investigation of Kissimmee River		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
4.2a	Investigate Availability of Kissimmee River Est. start date: 10/1/04 Est. finish date: 5/1/05	0	0.00	0	0.00	0	0.00	100	0.50	50	0.50	150	1.00
4.2.b	Reservation of Water Est. start date: 11/01/04 Est. finish date: 7/1/05	0	0.00	0	0.00	0	0.00	0	0.25	0	0.25	0	0.50
Total		0	0.00	0	0.00	0	0.00	100	0.75	50	0.75	150	1.50

a. FTE: Full Time Equivalency.

Water Supply Development Recommendations

Recommendation 4.3: Increase Use of Ground Water

Discussion

Ground water is used extensively in the Lake Istokpoga-Indian Prairie Basin as a source for citrus and other crops. Based upon the modeling analysis completed as part of this planning effort, there appears to be ample ground water within this basin for the 2020 planning horizon. Water wells installed in this area yield good quantities of water. Concentrations of chlorides and sulfur appear to be high, but not prohibitive for most agricultural activities if proper irrigation techniques are used.

The reliability of Lake Istokpoga and Lake Okeechobee as water supply sources has come in question under this evaluation. Concerns on the availability of water during drought events that exceed the defined 1-in-10 event are warranted. Ground water wells are recommended for installation as a back-up source during those times when surface water becomes unavailable. Cost of these wells are estimated at $150,000 per well, with an operating cost of about $0.06 per 1,000 gallons.

Summary of Tasks

Task 4.3.a: The District will encourage individual agricultural operations to install Floridan aquifer wells as a back-up supply source in the event of a drought event greater than 1-in-10 condition.

Strategy 5.0: Develop a Water Management Plan for the Lake Istokpoga-Indian Prairie Basin

Comments

This strategy evaluates the lifting of the current moratorium on the use of additional surface water from the Indian Prairie Basin. The primary source of water made available for this purpose will come from water held in storage in Lake Istokpoga above its current minimum operational level. Before the moratorium on the Indian Prairie system can be completely lifted, several items must be addressed in order to assure long-term dependability of the supply source. Among these items are the current regulation and minimum operation schedules, and the MFL for the lake.

Water Resource Development Recommendations

Recommendation 5.1: Develop a Water Management Plan for the Lake Istokpoga-Indian Prairie Basin

Discussion

This recommendation option received the largest amount of discussion from the advisory committee. The committee identified the current restoration efforts of Lake Istokpoga as a high priority and expressed their desire to see no further additional supplies taken from the lake. Some of the advisory committee members involved in the Lake Istokpoga restoration effort indicated they could not give their full support to the water supply plan if further use of the lake would be detrimental the restoration effort. The Florida Wildlife Commission (FWC), Highlands County and several local lake support groups have been involved in an effort to have a drawdown and tussock removal completed on the lake. The drawdown is expected to reduce the amount of total phosphorus from the lake. Lake Istokpoga is identified as an uncontrolled source in the Lake Okeechobee Action Plan.

The availability analysis performed on Lake Istokpoga indicates that under the defined 1-in-10 drought condition, some additional water could be released without levels in the lake dropping below the minimum operation level. This analysis is predicated on using the existing regulation schedule and the minimum operation schedule set for the lake. Both of these items have been identified for review as part of the implementation of the Restudy, and therefore bring into question the future availability and reliability of supply from the lake. In addition, an MFL that considers environmental issues needs to be established for Lake Istokpoga. Recommendations regarding the future use of additional supplies from Lake Istokpoga are pending consideration of the recommended changes on regulation and minimum operational schedules and the setting of a revised MFL for the lake. Future use of this lake will also require lifting the existing moratorium on its use.

The analysis completed under this plan focuses on meeting the supply demands under a 1-in-10 drought condition. Under this condition, additional releases from Lake Istokpoga are anticipated. During less severe drought conditions, the demands for additional releases from Lake Istokpoga are anticipated to be less than those identified in the 1-in-10 drought analysis. This is true due to the reduction in the demand from the 1-in-10 drought and the increase in water storage/runoff in Lake Istopkoga over the drought condition. Under average climatic conditions, the water released from the Lake Istopkoga, under the current operation management guidelines and that collected from runoff in the basin, appears sufficient to meet the average water supply demands for the year 2020. The average condition analysis was completed and presented in Chapter 4, and assumes no change in the current operation management guidelines. This conclusion presumes that use of the current and proposed Lake Istokpoga releases are properly managed in conjunction with the supplies delivered to this basin from Lake Okeechobee. Development of an operational plan to address this and other management issues is the recommendation under Strategy 5.0.

Historically, the range of seasonal water fluctuations on Lake Istokpoga were greater than they are today. Many feel the reduction in fluctuation has contributed to an increase in nuisance vegetation found in the lake. The current operation of the S-68 Structure by the District has controlled the mean lake water level above the minimum operation schedule. This is depicted in **Figure I-1** in Appendix I. This water storage is the source of the projected additional releases from Lake Istokpoga during the 1-in-10 drought. The release of this additional water from storage in the lake, may in fact improve the range of lake fluctuation once every 10 years.

In addition to the prospective water supply issues on Lake Istokpoga, several flood control problems have persisted since the completion of the C&SF project works. Problems include discharge restrictions due to design deficiencies at S-68, S-82, and S-83; the deteriorated state of the G-85 Structure in the Istokpoga Canal; and the overflow of County Road 621. Also, prior efforts of the C&SF Project did not consider the effects of the Kissimmee River Restoration project on existing structures in the Lake Istokpoga drainage basin. As an effort independent of the water supply plan, the District has a proposed project outlined in the Comprehensive Review Study to modify the Lake Istokpoga Regulation Schedule (OPE). The project would (1) identify modifications or additions to the Lake Istokpoga Basin project works to reduce flooding in the basin and

(2) address water resource problems in the Lake Istokpoga Basin. The major focus of this project is to create a balance between the environmental needs, water supply and flood control issues for the Lake Istokpoga Basin. This effort strives to examine the regulation schedule on Lake Istokpoga with a view towards enhancing fish and wildlife benefits, navigation and water supply needs through development of a long-term comprehensive management plan.

As part of Recommendation 5.1, a review of the District's Water Shortage Rule, 40E-22, F.A.C. is proposed. This rule establishes prescribed total monthly minimum flows through the lower structures S-71, S-72, S-84, S-127, S-129, and S-131. This review would be directed at reducing amount to be discharged from the Indian Prairie Basin. The annual total discharge required under 40E-22, F.A.C. is 37,710 ac/ft.

Although water conservation for agricultural is not expected to yield significant reductions in demand, District agricultural conservation efforts will continue though implementation of its water use permitting program. Through the regulatory program efforts are made to: 1) identify inefficiencies in water use; 2) evaluate the effectiveness of various options in meeting the existing and projected needs of the region; 3) make recommendations on specific conservation measures that should be incorporated and require these though the permitting effort.

Summary of Tasks

Task 5.1.a: The District should work with the USACE in revising the operational plan for Lake Istokpoga and the Indian Prairie system. This work is proposed to be conducted as part of the Comprehensive Everglades Restoration Plan (CERP). The revisions to the operational plan should consider the following:

- Revisions to the regulation and minimum operation schedules
- Established MFL for Lake Istokpoga and minimum levels in the canal system
- Minimum flow requirements through the lower structures (S-71, S-72, and S-84)
- Operational plan for backpumping water from Lake Okeechobee
- Evaluation of the effects of revisions to the regulation schedule on surrounding lakes
- Development of a long-term management plan for Lake Istokpoga

Task 5.1.b: The District should evaluate the need for the minimum operation flow requirements under 40E-22 and modify them accordingly. Pending the results of the study, the District should initiate rulemaking efforts to modify Chapter 40E-22, F.A.C., to incorporate the revised flows. Results of the effort should be included in the revised operational plan.

Task 5.1.c: The District should complete the technical work on establishing a MFL for Lake Istokpoga no later than 2003.

Summary Information

Total Recommendation Cost: $442,000

Estimated District Participation: $400,000 FTEs: 1.4

Potential Funding Source: SFWMD (CERP) and USACE

Implementing Agency: SFWMD (CERP) and USACE

Quantity of Water Made Available: Preliminary estimate is 15.2 MGD

Table 40. Summary of Estimated Schedule and District Costs for Recommendation 5.1.

Develop Operational Plan for Lake Istokpoga-Indian Prairie Basin		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
5.1a	Revise Operational Plan for Lake Istokoga Est. start date: 10/1/00 Est. finish date: 2/1/05	100	0.20	100	0.10	100	0.10	0	0.10	0	0.10	300	0.60
5.1.b	Evaluate Minimum Flow Requirements Est. start date: 10/1/01 Est. finish date: 2/1/03	0	0.10	0	0.10	0	0.10					0	0.30
5.1.c	Complete MFL Technical Work Est. start date: 10/1/01 Est. finish date: 3/1/03			50	0.25	50	0.25					100	0.50
Total		100	0.03	150	0.45	150	0.45	0	0.10	0	0.10	400	1.40

a. FTE: Full Time Equivalency.

Recommendation 5.2: Evaluate Regional Storage

Discussion

This option considers creation of a regional water storage system such as a reservoir or ASR. The benefits of a reservoir include storm water attenuation, water quality treatment and dry season storage. The benefits of ASR are primarily drought attenuation. The location of such a reservoir could be north or south of Lake Istokpoga, although the maximum benefit for water quality treatment could be achieved south of the lake.

Recommendations published in an April 1999 report on the Central and South Florida Comprehensive Restudy Project call for the construction of a storage reservoir to be located north of Lake Okeechobee and within the KB Planning Area. The location of this reservoir is identified for Glades, Highlands, or Okeechobee counties. The CERP effort proposes to investigate the location of a reservoir north of Lake Okeechobee in 2011. The advisory committee recommended that the District pursue a reservoir for the Indian Prairie Basin at that time. A recommendation for placement of this reservoir in the Indian Prairie Basin is included within in the five-year costs estimates presented in this plan in the event that installation of this reservoir accelerated beyond its current schedule.

In addition, a draft study recently completed by CH2M Hill (2000) for the SWFWMD identified a possible project for aquifer recharge located near Lake Istokpoga. The project, as currently proposed, identifies the injection of surface water for a goal of restoring aquifer levels along the Lake Wales Ridge. Discussions with the SWFWMD indicate they may be interested pursuing a ASR facility at this location to store and return water from Lake Istokpoga. Targeted water would be above the regulation schedule normally released to Lake Okeechobee.

Summary of Tasks

Task 5.2.a: Enter into an agreement with SWFWMD to conduct a feasibility assessment on an ASR type facility on or near Lake Istokpoga. The District should work with the SWFWMD to assess the potential for interdistrict transfers of water. The estimated cost of additional studies is $300,000.

Task 5.2.b: The District will review the potential for placing the regional storage reservoir, identified in the Restudy to be located north of Lake Okeechobee, in a location that may assist in supplying water to the Indian Prairie Basin. The timing of this review will be coordinated with the implementation of the CERP effort.

Summary Information

Total Recommendation Cost: $300,000

Estimated District Participation: $150,000 FTEs: 0.4

Potential Funding Source: SFWMD, SWFWMD, FDEP and local government

Implementing Agency: SFWMD and SWFWMD

Quantity of Water Made Available: Estimated at 3 MGD

Table 41. Summary of Estimated Schedule and District Costs for Recommendation 5.2.

Evaluation of Regional Storage		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
5.2.a	Lake Istokpoga ASR Est. start date: 1/1/02 Est. finish date: 6/30/04			50	0.10	50	0.10	50	0.10			150	0.30
5.2.b	North of Lake Reservior Est. start date: 10/1/02 Est. finish date: 11/30/03				0.05		0.05						0.10
Total				50	0.15	50	0.15	50	0.10			150	0.40

a. FTE: Full Time Equivalency.

RELATED STRATEGIES

The District is also considering the following strategies to implement the KB Water Supply Plan. These strategies address coordination among the water management districts and consistency between planning and permitting.

Strategy 6.0: Coordination Among Water Management Districts

The location and nature of the KB Planning Area warrants intensive coordination with adjacent water management districts, particularly in water resource investigation, water resource planning, water resource regulation, and water shortage declarations. To better coordinate these activities, the three water management districts have entered into a Memorandum of Understanding (MOU), which outlines guidelines for coordination in each of these four areas. In addition, the District's participate in several other less formalized, but still organized cooperative efforts. Among these are (1) the Water Planning Coordination Group (WPCG), which includes members of the five water management districts and the DEP to deal with consistency on planning issues; (2) the Interdistrict Framework Group, which looks at consistency in the determination of MFLs; and (3) the Inter-District Irrigation Water Use Working Group, which looks to arrive at consistent methods of determining agricultural water use projections.

A constant theme in the development of this plan is that the impacts of withdrawals in one District may affect the water resources in another District. A recommendation is made for the SFWMD, SJRWMD, and the SWFWMD to continue coordination efforts in water resource planning and that this coordination be continued through the MOU and other working groups established between the districts.

A recommendation of the plan is the continuing hydrologic investigations and the development of an improved modeling effort covering Central Florida. Limited hydrologic information and steady-state modeling tools restricted the degree to which the analyses could predict harm to the resource criteria. The recommendation is to complete

additional hydrologic investigations and develop new modeling tools to improve the accuracy of future predictions. These modeling tools will also be used in determining optimal use of reclaimed, storm water, and continued Floridan aquifer sources.

The District will coordinate the implementation of the KB Water Supply Plan with local governments/utilities, the Lower East Coast Water Supply Plan, the Comprehensive Everglades Restoration Plan, the C&SF Comprehensive Review Study, and other related efforts to promote compatibility. In addition, the implementation of the KB Water Supply Plan will address the recommendation in the Upper East Coast Water Supply Plan concerning activities in the KB Planning Area that could have a negative impact on recharge to the Floridan aquifer in the UEC Planning Area.

As to all recommendations contained within this Plan concerning coordinated efforts, the Governing Board specifically intends to retain its authority under Chapter 373, F.S., to make independent decisions based upon the outcome of this coordinated effort, as the plan is implemented. Nothing herein interferes with the authority of the SFWMD Governing Board to set water policy for the region within its jurisdiction.

Recommendation 6.0: The SFWMD will coordinate with the SJRWMD, SWFWMD and the FDEP for the purpose of maximizing consistent criteria and approaches concerning the following:

- Consistent resource protection criteria
- Hydrologic investigations
- Improved hydrologic modeling
- Local sources first
- Minimum flows and levels
- Water shortage declarations

Summary Information

Total Recommendation Cost: $0

Estimated District Participation: $0 FTEs 1.0

Potential Funding Source: SFWMD

Implementing Agency: SFWMD, SJRWMD, and SWFWMD

Quantity of Water Made Available: N/A

Table 42. Summary of Estimated Schedule and District Costs for Recommendation 6.0.

Inter-DistrictCoordination		Plan Implementation Costs ($1,000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
6.0	Inter-District Coordination Est. start date: Immediate Est. finish date: None	0	0.20	0	0.20	0	0.20	0	0.20	0	0.20	0	1.00
Total		0	0.20	0	0.20	0	0.20	0	0.20	0	0.20	0	1.00

a. FTE: Full Time Equivalency.

Strategy 7.0: Consistency Between Planning and Water Use Permitting

The KB 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 KB 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 WSP in the CUP Program and other components of District's overall water supply management scheme. Among these issues are:

- Level of certainty
- Resource protection criteria
- Cumulative analysis
- Water shortage triggers
- Permit duration
- Minimum flows and levels
- Special Designation Area amendments, including Restricted Allocation Areas
- Local sources first

The District currently has consumptive use rulemaking efforts underway to address these topics for the KB Water Supply Plan, as well as the three other water supply plans also under development. The following is a brief explanation of these rulemaking areas:

Level of Certainty - Incorporate the 1-in-10 drought planning level goal into the CUP allocation and impact assessment criteria.

Resource Protection Criteria - Update the wetlands protection, saline water intrusion and movement of contaminate criteria.

Cumulative Analysis - Incorporate requirements of ground water modeling approaches, including cumulative impact, into the CUP rules.

Water shortage triggers - Update the water shortage requirements and triggers into the CUP rules.

Permit Duration - Concern was expressed by the advisory committee on the issuance of consumptive use permits (CUP) for a period of 20 years in areas where the potential resource impacts remain unresolved. In the Orange-Osceola County Area, several concerns have been raised about the availability of the Floridan aquifer for future demands. This effort considers issuance of permits for durations less than 20 years for the additional use of Floridan aquifer water in portions of the northern planning basin.

Minimum Flows and Levels - Incorporate a process for adopting MFLs into the District rules. 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. Planning and regulatory efforts will include a programmed recovery process that will be implemented, where necessary, over time to improve water supply and distribution to protect water resources and functions.

Restricted Allocation Areas - The Lake Istokpoga-Indian Prairie system currently has a moratorium on additional surface water use in the District rules. This effort considers a rulemaking effort to lift the moratorium and to what degree.

Local Sources First - This planning process does not specifically evaluate the feasibility of implementing any identified water supply solutions based on “local sources first” criteria. Further, the District has not identified the water supplied by the Central and Southern Flood Control Project. Before any selected option can be permitted, “local sources first” criteria, as appropriate, must be addressed by permit applicants. Additionally, this rulemaking effort will consider technical implementation considerations related to application of the statutory criteria.

Recommendation 7.0: Continue Rulemaking Efforts

Discussion

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 program.

Summary of Tasks

Task 7.0.a: Continue ongoing rule development and rulemaking.

Task 7.0.b: The District should consider granting 20-year permits for currently demonstrated uses of fresh ground water from the Floridan aquifer in areas

where it has been demonstrated to be available. The District should consider not granting 20-year permits in Orange, Osceola and Polk counties for additional uses of fresh ground water from the Floridan aquifer beyond the demonstrated withdrawals at the time of permit renewal.

Task 7.0.c: The District should consider rulemaking for the purpose of lifting the moratorium identified in 3.2.1(A) of the Basis of Review for Water Use Permitting for the Lake Istokpoga-Indian Prairie system after addressing the issues discussed in Recommendation 4.1. The revised level of allocation should be equal to the amount determined to be the combined discharge through the structures S-71, S-72, and S-84 during a defined 1-in-10 drought event and the amount of water delivered to the basin through pumps G-207 and G-208, as determined by the evaluation performed under the KB Water Supply Plan. The breadth of tasks detailed in Recommendation 4.1 necessitates an internal work effort as well as detailed negotiation/ coordination efforts with area stakeholders. Given the necessity to comprehensively integrate the interests of all area stakeholders with the master operational plan, it is difficult to specifically schedule tasks that will ultimately result in this rulemaking effort. The District's goal is to accomplish the necessary tasks within a two-year period and prior to the expiration of water use permits within the basin.

Task 7.0.d: The District should continue with its research and rulemaking efforts in developing and adopting a wetlands resource protection criteria.

Task 7.0.e: The District should complete a hydrologic investigation to further refine the relationship between water levels, geologic conditions and the formation of sinkholes. Results of this, and existing studies will be the basis for future rulemaking efforts on sinkholes.

Summary Information

Total Recommendation Cost: $40,000

Estimated District Participation: $40,000 FTEs 2.2

Potential Funding Source: SFWMD

Implementing Agency: SFWMD

Table 43. Summary of Estimated Schedule and District Costs for Recommendation 7.0.

Rulemaking		Plan Implementation Costs ($1000s and FTEs[a])											
		FY01		FY02		FY03		FY04		FY05		Total	
Task #	Recommendation	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
7.0.a	Incorporation into the District's CUP Program through rulemaking Est. start date: 11/1/00 Est. finish date: N/A	0	0.20	0	0.20	0	0.20	0	0.10	0	0.10	0	0.80
7.0.b	20 Yr. Permits Rulemaking Est. start date: 10/1/00 Est. finish date: 2/2/02	0	0.10	0	0.10							0	0.20
7.0.c	Lift Moratorium Est. start date: 6/30/01 Est. finish date: 12/30/02	0	0.30	0	0.20	0	0.20					0	0.80
7.0.d	Resource Protection Criteria Rulemaking Est. start date: 10/1/01 Est. finish date: 4/1/03			0	0.10	0	0.10					0	0.20
7.0.e	Sinkhole Study and Rulemaking Est. start date: 10/1/01 Est. finish date: 6/30/04			20	0.20	20	0.10	0	0.10			40	0.40
Total		0	0.60	20	0.80	20	0.60	0	0.10	0	0.10	40	2.20

a. FTE: Full Time Equivalency.

RELATIONSHIP OF PROJECTS TO FIVE-YEAR WORK PROGRAM

The purpose of the Five-Year Water Resource Development Work Program (Five-Year Work Program) is to report the District's progress in implementing recommendations once the KB Water Supply Plan is approved by the Governing Board. The time frame for the work program will be 2001-2005. 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 the 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

In anticipation of developing a work program after Governing Board approval of the KB Water Supply Plan, the recommendations under the water resource development component of this plan incorporate the work program information listed above. This will facilitate the writing of the work program, which is anticipated to begin in mid-2001.

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 recommended 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 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 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 Plan. The recommendation tables in the KB Water Supply Plan show the costs of the projects and potential sources of funding. Timeframes for specific plans are preliminary and are subject to funding availability in future years.

Total cost of the water resource development projects for this Plan is $11.217 million over the course of the next five 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 stormwater 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, stormwater related restoration projects that have a flood component must be identified in a stormwater 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

The District's Alternative Water Supply Grant Program was codified in statute by the Florida Legislature in 1995 to increase the potential for the development of alternative water supplies in the state; assist utilities in developing 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 Alternative Water Supply Funding Program is a cost-share program and requires a project's sponsor to provide a portion of the funding for the project. The District publishes guidelines for implementing this program that are consistent with the statutory language provided below. These guidelines address the application and review process, ranking criteria, and the time frame for implementation.

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. It is also recommended that the Alternative Water Supply Grant committee give high ranking to projects that involve data collection that support recommendations in this plan, such as Floridan aquifer storage hydraulic data collection when constructing Floridan wells for ASR or as a PWS source.

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.

SUMMARY OF RECOMMENDATIONS

Table 44 provides a summary of the water resource development recommendations and the District associated costs over the next five years. The total estimated costs to implement the KB Water Supply Plan are $10.402 million, with the District's share of $7,395 million.

Table 44. Sumary of Estimated Schedule and District Costs for Water Resource Development Recommendations.

Strategies and Recommendations		Plan Implementation Costs ($1,000s and FTEs)											
		FY01		FY02		FY03		FY04		FY05		Total	
		$	FTE	$	FTE	$	FTE	$	FTE	$	FTE	$	FTE
Orange-Osceola County													
Strategy 1.0 Minimize Floridan Aquifer Drawdown through Recharge													
1.1	Develop a regional reclaimed water optimization plan	345	0.20	820	0.30	300	0.30	210	0.45	50	0.35	1,725	1.60
1.2	Develop a storm water reuse plan	130	0.25	280	0.25	175	0.20	75	0.20	25	0.10	655	1.00
Strategy 2.0 Minimize Floridan Aquifer Drawdown through Demand Reduction													
2.1	Develop a comprehensive water conservation plan	60	0.25	70	0.35	70	0.35	70	0.35	60	0.25	330	1.55
Strategy 3.0 Research and Develop Alternative Sources													
3.1	R & D Alternatives Sources	100	1.00	100	1.00	100	1.00	100	1.00	100	1.00	500	5.00
3.2	Optimize Use of Floridan Aquifer	775	1.25	1,050	2.25	800	2.25	450	1.25	200	1.25	3,275	8.25
Lake Istokpoga-Indian Prairie Basin													
Strategy 4.0 Develop Alternative Resources													
4.1	Develop an operation plan for backpumping from Lake Okeechobee	70	0.95	30	0.95	30	0.3	20	0.10	20	0	170	2.30
4.2	Investigate availability of water from Kissimmee River	0	0.00	0	0.00	0	0.00	100	0.75	50	0.75	150	1.50
Strategy 5.0 Develop Water Management Plan for Lake Istokpoga													
5.1	Develop Water Management Plan for Lake Istokpoga	100	0.30	150	0.45	150	0.45	0	0.10	0	0.10	400	1.40
5.2	Evaluate ASR regional storage			50	0.15	50	0.15	50	0.10			150	0.40
Related Stategies													
Strategy 6.0 WMD Coordination													
6.1	WMDs coordinate on protection criteria development	0	0.20	0	0.20	0	0.20	0	0.20	0	0.20	0	1.00
Strategy 7.0 Continue Rulemaking Efforts		0	0.60	20	0.80	20	0.60	0	0.10	0	0.10	40	2.20
Total		1,580	5.00	2,570	6.70	1,695	5.80	1,075	9.60	505	4.10	7,395	26.20

GLOSSARY AND LIST OF ABBREVIATIONS

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 Section 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 Section 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 Section 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 Chapter 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.

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