Special Publication SJ2000-SP1

District Water Supply Plan

Edited by
Barbara A. Vergara, P.G.

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

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June 9, 2000

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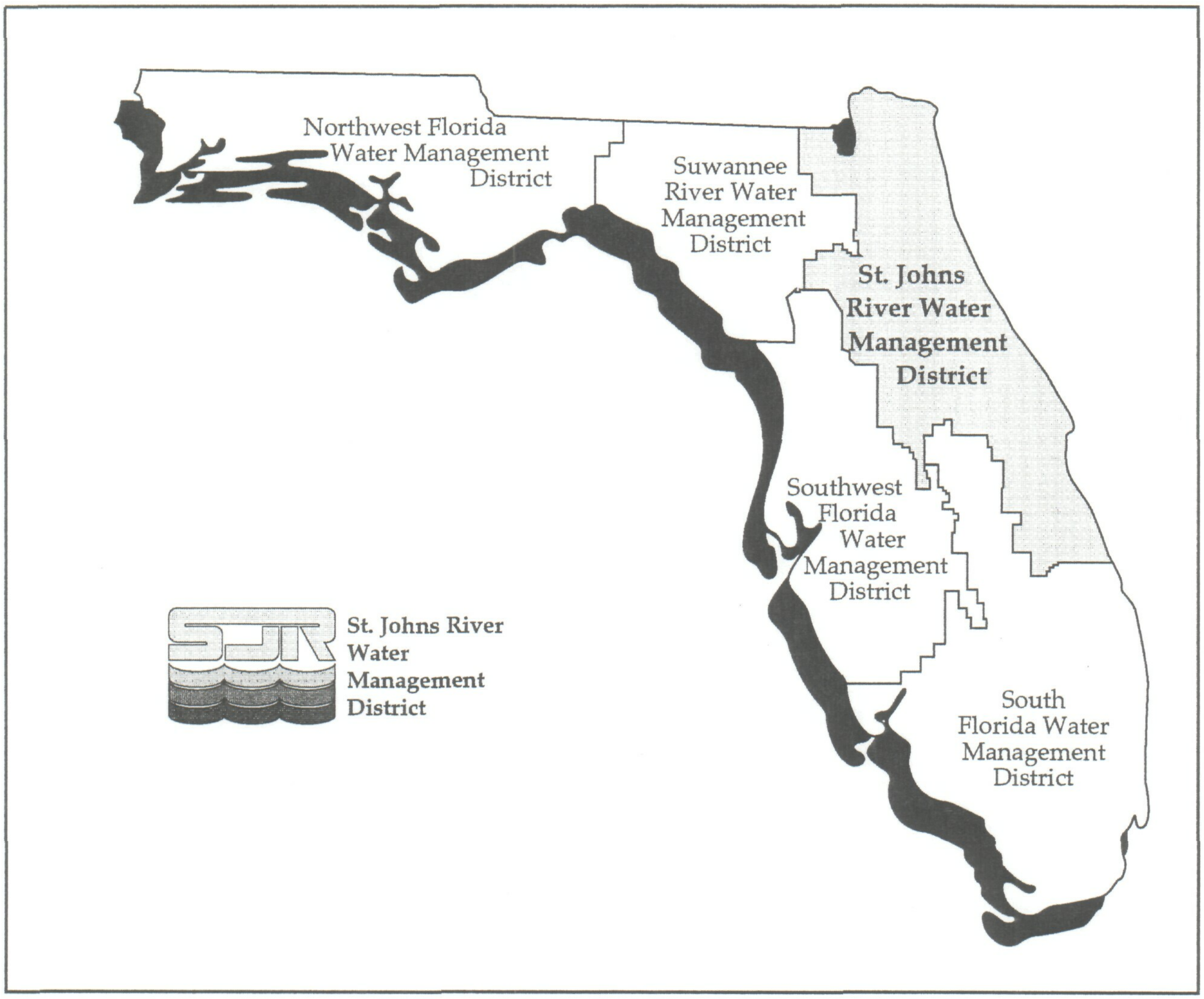
St. Johns River Water Management District
Palatka, Florida

2000



The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 19 counties in northeast Florida. The mission of SJRWMD is to manage water resources to ensure their continued availability while maximizing environmental and economic benefits. It accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

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ABSTRACT

Located in northeastern Florida, the St. Johns River Water Management District (SJRWMD) covers approximately 12,400 square miles (about 8 million acres), or about 21 percent of the state's total area. SJRWMD includes all or part of 19 counties, numerous cities and towns, and the major urban centers of Jacksonville and Orlando, with a total population of almost 3.5 million people. This population is projected to increase by about 50 percent, to nearly 5.2 million, by 2020.

Total water demand for SJRWMD is projected to increase from about 1.37 billion gallons per day in 1995 to about 1.85 billion gallons per day in 2020, based on water use projections provided by water users. The projected increase of approximately 480 million gallons per day represents a total districtwide growth of 35 percent. Public supply increases account for about 85 percent of the total projected increase.

For the last decade, SJRWMD's water supply planning and assessment investigations have documented that the rate of withdrawal of groundwater in certain areas of SJRWMD is approaching the rate that cannot be sustained without causing unacceptable adverse impacts to the water resources and related natural systems. Water supply planning results to date show that at some locations these sustainable rates will likely be approached in the foreseeable future, well within the current 20-year planning horizon.

This *District Water Supply Plan* (DWSP) addresses current and future water demands, traditional and alternative water sources, and water supply infrastructure improvements required to meet 2020 water supply needs while sustaining water quality, wetland and aquatic systems, and existing legal uses. The planning process has been ongoing for many years. The process has several distinct elements, including water supply assessments conducted in 1994 and 1998, alternative water supply strategies investigations conducted from 1995 through 1998, the *Water 2020* planning process conducted from 1997 through 1999, and this DWSP.

DWSP is designed to meet the requirements of the water supply planning provisions of Section 373.0361, *Florida Statutes*. DWSP is based on a 20-year planning horizon extending through 2020 and includes the following components:

- A water supply development component which includes a list of water supply source options, estimated costs, and funding sources

- A water resource development component which includes a funding strategy
- A minimum flows and levels component for priority surface waters and groundwater

Approximately 40 percent of SJRWMD has been identified as priority water resource caution areas. These are areas where existing and reasonably anticipated sources of water and conservation efforts may not be adequate (1) to supply water for all existing legal uses and anticipated future needs and (2) to sustain the water resources and related natural systems. Priority water resource caution areas are the focus of DWSP. Based on the priority water resource caution areas, six work group areas were delineated to facilitate the water supply planning process:

- Work Group Area I—east-central Florida, including all of Orange, Lake, and Seminole counties and parts of Marion, Polk, Osceola and Sumter counties
- Work Group Area IA—Brevard County
- Work Group Area II—Volusia County, southeastern Putnam County and southern Flagler County
- Work Group Area III—east-central Flagler County
- Work Group Area IV—western St. Johns County and eastern Putnam County
- Work Group Area V—northern St. Johns County and southern Duval County

This DWSP identifies water supply source options and projects for each work group area that will meet future water supply needs while sustaining water quality, wetland and aquatic systems, and existing legal uses. For portions of SJRWMD not included in a work group area, existing water supply sources and water supply development plans are considered reasonably adequate to meet projected needs while sustaining water quality, wetland and aquatic systems, and existing legal uses. In Work Group Areas I and II, where projected public supply growth is the greatest, alternative water supplies, including significant quantities of surface water, will probably be needed in addition to traditional groundwater supplies to meet future needs. The estimated cost (in 1996 dollars) of required water supply treatment and transport facilities for each work group area is summarized in Table A-1. The capital cost of required facilities for all work group areas is expected to total in the range of $1.3 billion to $1.7 billion.

Table A-1. Conceptual planning-level cost estimates for water supply facility needs by 2020

Work Group Area	Capital Cost ($ millions)	Unit Cost ($/1,000 gallons)
I—East-central Florida	1,025 to 1,323	1.39 to 1.79
IA—Brevard County	85 to 88	1.11 to 1.16
II—Volusia County, southeastern Putnam County, and southern Flagler County	136 to 145	1.27 to 1.34
III—East-central Flagler County	28	1.82
IV—Western St. Johns County and eastern Putnam County	Very small	Not applicable
V—Northern St. Johns County and southern Duval County	59 to 102	0.95
Total	1,333 to 1,686	

Water supply system improvements and expansions are primarily the responsibility of the water supply utilities and water users. In addition to the needed water supply improvements, DWSP identifies a number of water resource development projects designed to reduce the current level of uncertainty associated with DWSP and to facilitate plan implementation. The water resource development projects are primarily the responsibility of SJRWMD and are listed as follows:

- Abandoned artesian well plugging program
- Adaptive management project
- Aquifer protection program
- Aquifer storage recovery feasibility testing
- Central Florida artificial recharge demonstration program
- Cooperative well retrofit project
- Demineralization concentrate management project
- Facilitation of regional decision-making process
- Feasibility of seawater demineralization projects
- Hydrologic data collection and analysis
- Investigation of areas where domestic self-supply wells are sensitive to water level fluctuation
- Regional aquifer management project
- Surface water in-stream monitoring and treatability studies

- Wetland augmentation demonstration program

This DWSP is the beginning of an integrated water resource allocation and water supply decision-making process. In significant portions of the priority water resource caution areas, alternative water supply sources will probably have to be developed to meet future needs while sustaining water quality, wetland and aquatic systems, and existing legal uses. Groundwater alone probably cannot meet all future water supply needs. Development of alternative sources of supply will require cooperation among the water supply utilities and among the utilities, SJRWMD, and the Florida Department of Environmental Protection.

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INTRODUCTION

PLANNING MANDATES

The St. Johns River Water Management District's (SJRWMD) District Water Supply Plan (DWSP) is designed to meet the requirements of the water supply planning provisions of Section 373.0361, *Florida Statutes (FS)* (Appendix A). DWSP is based on a 20-year planning horizon extending through 2020 and includes the following components:

- A water supply development component
- A water resource development component
- A minimum flows and levels component

Subsection 373.0361(1), *FS*, requires SJRWMD to initiate water supply planning for each water supply planning region where priority water resource caution areas are identified (Figure 1). *Priority water resource caution areas* are areas where existing and reasonably anticipated sources of water and conservation efforts may not be adequate (1) to supply water for all existing legal uses and reasonably anticipated future needs and (2) to sustain the water resources and related natural systems. SJRWMD's *Water Supply Assessment: 1998* (Vergara 1998) includes a detailed description of the identification of priority water resource caution areas.

These priority water resource caution areas should not be confused with the water resource caution area pursuant to the requirements of Subsection 62-40.416(5), *Florida Administrative Code (F.A.C.)*. This subsection requires the water management districts (WMDs) to designate water resource caution areas as regions where reuse would be required if economically, environmentally, and technically feasible. Prior to the implementation of Subsection 62-40.416(5), *F.A.C.*, SJRWMD's Consumptive Use Permitting Rule required reuse throughout SJRWMD, where available and feasible. Therefore, when implementing Florida Department of Environmental Protection's (DEP) Subsection 62-40.416(5) requirement, SJRWMD designated its entire jurisdictional area a water conservation area (40C-23.001, *F.A.C.*). SJRWMD later changed the water conservation area designation to a water resource caution area designation to conform to statewide nomenclature.

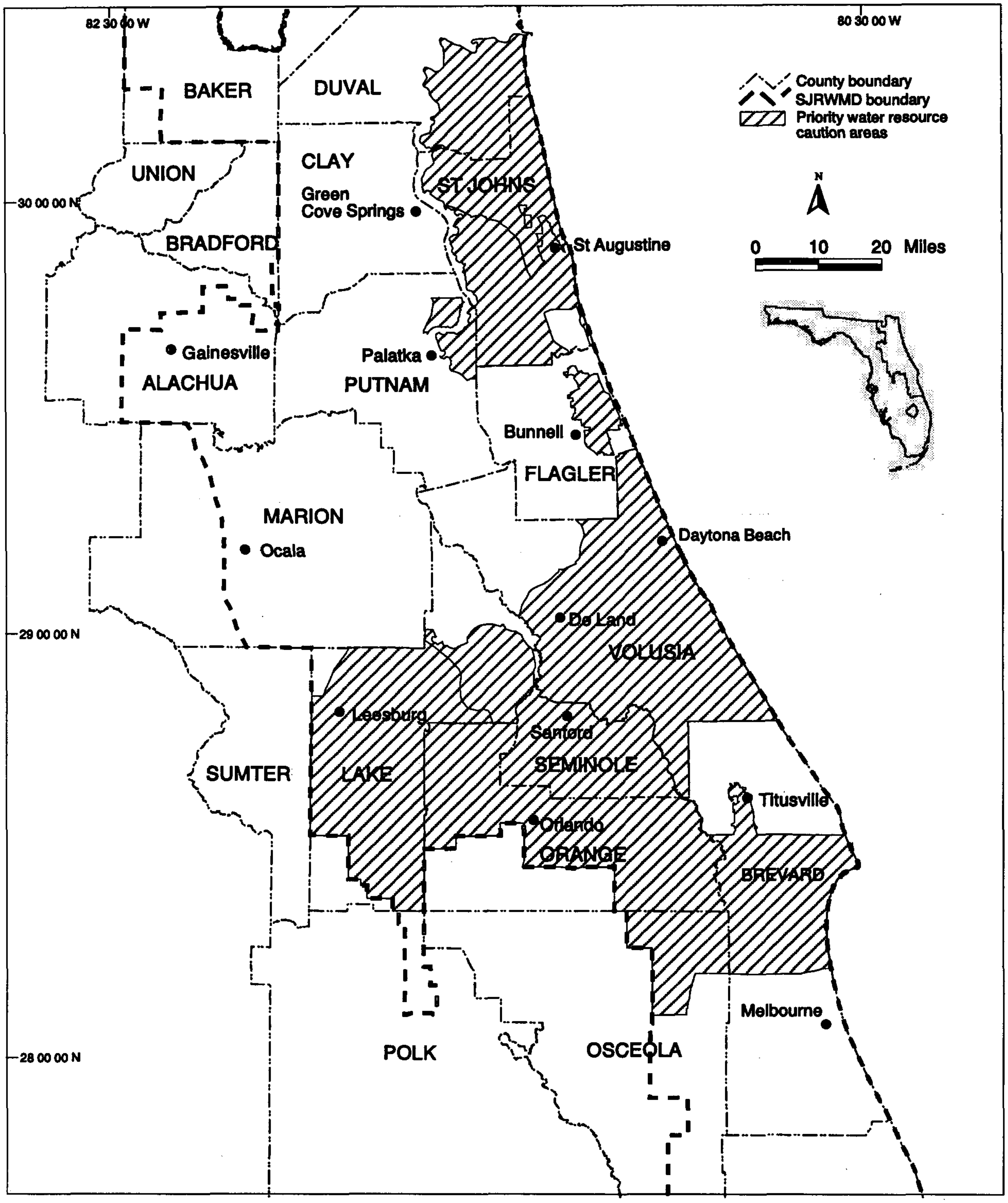

Figure 1. Priority water resource caution areas in the St. Johns River Water Management Distict

SJRWMD's Water Supply Management Program

SJRWMD has developed a Water Supply Management Program which is designed to perform the work necessary to meet the water supply planning, implementation, and regulatory requirements of Chapter 373, *FS*. This program is managed within the SJRWMD Department of Resource Management. However, many SJRWMD departments and offices contribute to this program.

In addition to significant staff resources, SJRWMD uses the services of consultants to accomplish portions of the program. To date, consultants have been involved in planning activities which include investigation of alternative water supply strategies, facilitation of water supply planning work group activities, and assistance in the preparation of reports. Since 1995, this consultant activity has accounted for about two-thirds of SJRWMD's water supply management program activities and costs.

About 90 percent of program-related work that is performed by SJRWMD staff, including program management, is performed within the Department of Resource Management. The department director supervises the division directors who are responsible for this work. This concentrated oversight provides a framework for efficient coordination and decision making.

SJRWMD's Water Supply Management Program includes significant intergovernmental, water supplier, and public coordination. The success of this coordination is critical to the success of the program. The water supply planning process structure, which is described in the Methods section of this document, was designed to encourage the participation of local governments, water suppliers, other interested and potentially affected parties, and the public. This process structure has contributed significantly to successful program coordination. Proposed actions concerning this coordination effort are included in the Recommendations section of this document.

Description of Planning Region

The Florida Legislature, in response to the need to protect and preserve the state's water resources, passed the Florida Water Resources Act of 1972, codified as Chapter 373, *FS*. This legislation established a statewide system of five WMDs and provided them with specific authorities and responsibilities. SJRWMD is one of these five WMDs.

Because SJRWMD has identified its entire jurisdictional area as one water supply planning region, DWSP encompasses the entire district. The plan focuses considerable attention on the identified priority water resource caution areas. DWSP identifies sustainable *water supply options* that will meet the projected reasonable-beneficial needs of all water users in SJRWMD through 2020.

SJRWMD focused its water supply planning efforts within six water supply planning *work group areas*: Work Group Areas I, IA, II, III, IV, and V (Figure 2). These work group areas include priority water resource caution areas and surrounding areas which are considered closely associated hydrologically and culturally.

DESCRIPTION OF SJRWMD

Location

Located in northeastern Florida, SJRWMD covers approximately 12,400 square miles (approximately 8 million acres), or about 21 percent of the state's total area (Figure 3). Nine percent of SJRWMD's area is water. SJRWMD's jurisdictional area is bounded by the following:

- On the north by the Florida/Georgia state line
- On the south by its boundary with the South Florida Water Management District (SFWMD)
- On the west by its boundary with the Southwest Florida Water Management District (SWFWMD) and the Suwannee River Water Management District
- On the east by the Atlantic Ocean

The most prominent natural feature of SJRWMD is the St. Johns River. The St. Johns River flows northward about 300 miles from its headwaters in Indian River County through Lakes Washington, Monroe, and George, and other lakes, to Jacksonville and the Atlantic Ocean. Because of the river's very low gradient, tidal effects normally extend into and beyond Lake George, over a hundred miles from the river's mouth.

The SJRWMD area includes all or part of 19 counties, numerous cities and towns, and the major urban centers of Jacksonville and Orlando, with a total population of almost 3.5 million people. This population is projected to increase by about 50 percent, to nearly 5.2 million, by 2020.

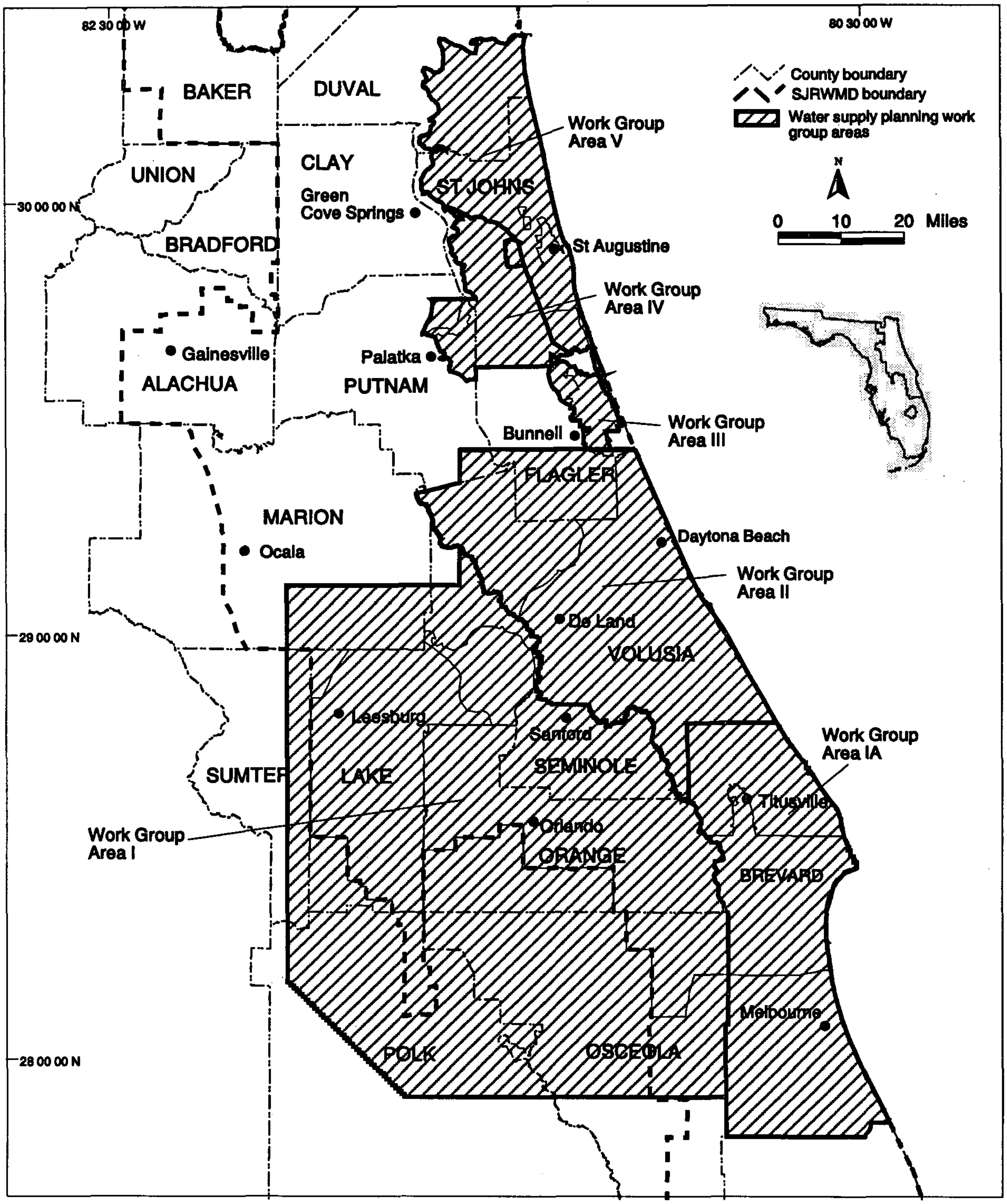

Figure 2. St. Johns River Water Management District water supply planning work group areas

Cultural Features

Tourism contributes significantly to the SJRWMD area economy. Area attractions include beaches such as Daytona Beach and Cocoa Beach along the Atlantic coast; commercial attractions such as Silver Springs; historical sites such as St. Augustine; and Kennedy Space Center. Though the Disney World complex and other attractions exist just south of SJRWMD's boundary with SFWMD, they generate substantial economic activity and water use in SJRWMD.

Four major interstate highway systems (I-4, I-10, I-75, and I-95) serve the SJRWMD area. Development, particularly along the I-4 corridor between Orlando and Daytona Beach, has been significant and is projected to continue to contribute to population growth.

Agriculture

SJRWMD's primary agricultural specialties consist of citrus, vegetables, and dairy and beef cattle. Pasture for beef and dairy production occupies the greatest amount of SJRWMD agricultural land. Although citrus acreage has declined in recent years, it remains the most prominent single crop type in SJRWMD. Cabbage, potatoes, and other vegetables are grown in the northern and central portions of SJRWMD. Ornamental fern crops occupy only a small part of SJRWMD's agricultural land but contribute significantly to the agricultural economy of the area. Of the various water use categories in SJWRMD, the agricultural self-supply category has historically had the highest use. However, agricultural acreage and associated water use are projected to experience slight decreases through 2020, and public supply water use is expected to surpass agricultural self-supply use.

Approximately half of the state's pulp and paper mills are located in SJRWMD. These are found in the northern part of SJRWMD, which encompasses large expanses of pine forest. Although there are only five such facilities, each uses an amount of water comparable to that consumed by a small to medium size city.

SJRWMD Water Resources (modified from Vergara 1998)

Both ground and surface water systems furnish water supplies in SJRWMD. Though these systems contain abundant water, the nature of these systems and their relationship to one another must be carefully considered when planning the development of water supplies.

Groundwater Resources

Three aquifer systems supply groundwater in SJRWMD: the surficial, the intermediate, and the Floridan (Figure 4).

The Southeastern Geological Society (1986) described the hydrogeologic nature of these aquifer systems as follows:

Surficial Aquifer System

System Components. The surficial aquifer system consists primarily of sand and sandy clay. It extends from land surface downward to the top of the confining unit of the intermediate aquifer system, where present, or to the top of the confining unit of the Floridan aquifer system. The surficial aquifer system contains the water table, which is the top of the saturated zone within the aquifer. Water within the surficial aquifer system occurs mainly under unconfined conditions, but beds of low permeability cause semiconfined or locally confined conditions to prevail in its deeper parts.

Water Quality. Water quality in the surficial aquifer system is generally good. Based on a review of U.S. Geological Survey (USGS) and SJRWMD data, chloride, sulfate, and total dissolved solids (TDS) concentrations generally occur below the secondary drinking water standards of 250, 250, and 500 milligrams per liter (mg/L), respectively (Subsection 62-550.320(1), *F.A.C.)*. Iron concentrations, however, are generally high and in many places exceed the secondary drinking water standard of 0.3 mg/L (Subsection 62-550.320(1), *F.A.C.)*. In coastal areas such as the barrier islands, this aquifer system is prone to saltwater intrusion.

Water Use. The surficial aquifer system serves as a source of water for public supply in St. Johns, Flagler, Brevard, and Indian River counties. It is also used as a source of water for domestic self-supply, mainly along the coastal portions of SJRWMD but also in inland areas scattered throughout SJRWMD.

Intermediate Aquifer System

System Components. The intermediate aquifer system consists of thin water-bearing zones of sand, shell, and limestone, which lie within or between less permeable units of clayey sand to clay. At the top of this aquifer system, poorly yielding to non-water-yielding strata occur. This strata, referred to as an upper confining unit, coincides with the base of the surficial aquifer system. This unit lies immediately above the Floridan aquifer system and is geologically referred to as the Hawthorn Group. In other places, one or more low-to-moderate yielding aquifers may be

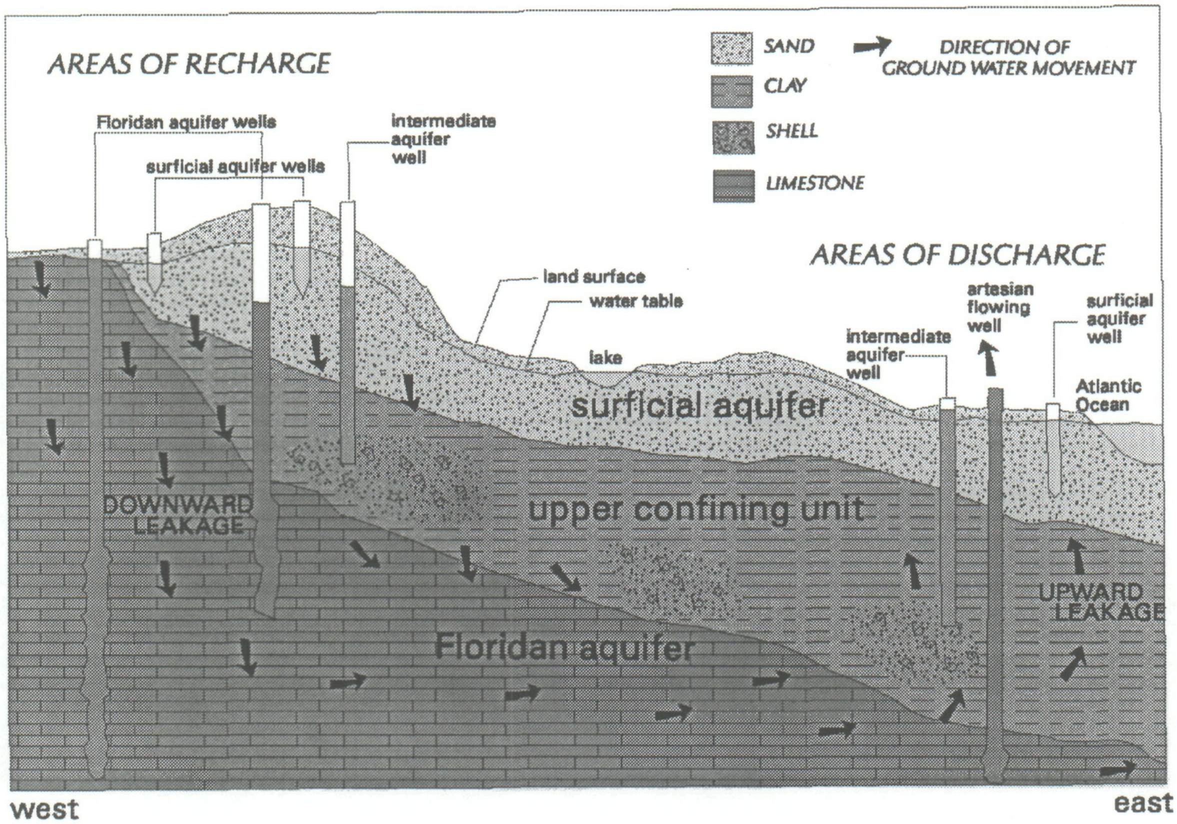

Figure 4. Generalized east-west hydrogeologic cross section for the St. Johns River Water Management District

interlayered with relatively impermeable confining beds. The aquifers within this aquifer system contain water under confined conditions. Within the intermediate aquifer system, confining units are generally more extensive than water-bearing units.

Water Quality. The available USGS and SJRMWD data suggest water quality in the intermediate aquifer system is generally good in the northern part of SJRWMD where chloride, sulfate, and TDS concentrations are below the secondary drinking water standards. Water quality in the southern part of SJRWMD approaches or exceeds the secondary drinking water standards for chloride and TDS concentrations.

Water Use. The intermediate aquifer system is used as a water source for domestic self-supply in Duval, Clay, and Orange counties.

Floridan Aquifer System

System Components. The Floridan aquifer system is one of the world's most productive aquifers. The rocks, primarily limestone and dolomite, that comprise the Floridan aquifer system underlie the entire state, although this aquifer system does not contain potable water at all locations. Water in the Floridan aquifer system occurs under confined conditions throughout most of SJRWMD. Unconfined conditions occur in parts of Alachua and Marion counties.

The Floridan aquifer system is subregionally divided on the basis of the vertical occurrence of two zones of relatively high permeability (Miller 1986). These zones are called the Upper and Lower Floridan aquifers. A less permeable limestone and dolomitic limestone sequence generally separates the Upper and Lower Floridan aquifers. This layer is referred to as the middle semiconfining unit. Throughout much of Baker, Union, Bradford, western Alachua, and northwestern Marion counties, the middle semiconfining unit is missing and the Lower Floridan aquifer does not occur (Miller 1986).

Water Quality. USGS and SJRWMD data indicate that water quality in the Upper Floridan aquifer varies, depending on its location in SJRWMD. Water quality in this aquifer is generally good in the northern and western portions of SJRWMD where chloride, sulfate, and TDS concentrations are below the secondary drinking water standards. Chloride and TDS concentrations in the Upper Floridan aquifer generally exceed the secondary drinking water standards in the following areas:

- Brevard and Indian River counties
- Southern St. Johns County and most of central and northern Flagler County
- Areas bordering the St. Johns River south of Clay County
- Eastern Volusia County

Sulfate concentrations also often exceed the secondary drinking water standards.

USGS and SJRWMD data indicate that water quality in the Lower Floridan aquifer also varies depending on its location in SJRWMD. Water quality in this aquifer is generally good in the northern and western portions of SJRWMD where chloride and TDS concentrations are below the secondary drinking water standards. However, chloride concentrations in the Lower Floridan aquifer generally exceed the secondary drinking water standards throughout the following areas:

- All of Flagler, Brevard, and Indian River counties
- Eastern Nassau and Volusia counties
- Areas bordering the St. Johns River in Putnam, Marion, Lake, Volusia, Seminole, Orange, and Osceola counties (Sprinkle 1989)

TDS concentrations in the Lower Floridan aquifer generally exceed the secondary drinking water standards throughout these areas:

- All of St. Johns, Flagler, Brevard, and Indian River counties
- Most of Nassau and Duval counties
- Eastern Clay and Volusia counties
- Areas bordering the St. Johns River in Putnam, Marion, Lake, Volusia, Seminole, Orange, and Osceola counties (Sprinkle 1989)

Water Use. The Upper Floridan aquifer is the primary source of water for public supply water use in SJRWMD, primarily in the northern and central portions of SJRWMD where the aquifer contains water that generally meets primary and secondary drinking water standards. The Upper Floridan aquifer also serves as a source of water for public supply in the southern portion of SJRWMD where water withdrawn from the aquifer is treated by *reverse osmosis*. Since the Floridan aquifer system in the southern portion of SJRWMD generally contains water that exceeds secondary drinking water standards for chloride, sulfate, and TDS, this portion of the aquifer generally supplies water for irrigation.

Portions of the Lower Floridan aquifer furnish water for public supply in Duval, central and western Orange, and southern and southwestern Seminole counties.

Surface Water Resources

Streams, lakes, canals, and other surface water bodies in SJRWMD provide water for various consumptive and nonconsumptive uses. Although aquifers usually contain relatively high-quality water and likely will remain the most widely used freshwater supply sources in SJRWMD, pressure to develop surface water sources could increase as groundwater becomes less available.

Surface Water Quality Issues

Water quality can limit surface water availability for certain uses if it is not economically or ecologically feasible to treat the water to the level required for those intended uses. Natural systems requirements, treatment and storage costs, and distribution facilities can limit the amount of water developed from surface water sources.

SJRWMD surface water quality varies both spatially and temporally as a result of the natural processes and human activities that affect the chemical and microbiological character of water bodies. The different intended water uses determine the relationship between water quality and water availability. For example, some industries can use water containing TDS concentrations of 35,000 mg/L (equivalent to seawater), whereas a maximum of 500 mg/L is recommended for public supply (Prasifka 1988).

Surface waters tend to contain silts and suspended sediments, algae, dissolved organic matter from topsoil, and chemical and microbiological contaminants from municipal wastewater discharges, stormwater runoff, and industrial and agricultural activities. In addition, the quality of surface water may vary seasonally with variation in flow rates or water levels. SJRWMD surface water is generally a lower quality water than SJRWMD groundwater.

Salinity is one of the most important water quality considerations in SJRWMD. In the coastal rivers of SJRWMD and the tidal reaches of the St. Johns, St. Marys, and Nassau rivers, the influx of seawater limits potential water uses to recreation and power plant cooling. Chloride concentrations generally decrease upstream from the mouths of these rivers as tidal influence diminishes.

In addition to tidal influence, inflows of brackish groundwater affect the spatial distribution of chloride concentrations in the St. Johns River. During low-flow periods when there is little dilution from freshwater inflows, higher TDS concentrations occur in the tidally influenced lower reach of the river and in portions of the upper reach. In the upper reach of the St. Johns River, the inflow of Floridan aquifer groundwater by diffuse upward leakage and possible spring discharge (Tibbals 1990) contributes to elevated TDS concentrations in the river. These high TDS concentrations are of particular concern when considering the use of the St. Johns River as a source of supply for agricultural irrigation and public supply.

In addition to the TDS concentrations, elevated bromide concentrations in the St. Johns River are a concern when considering the use of the river as a source for public supply systems. Raw water with elevated concentrations of bromide may require more expensive treatment in order for the treated water to meet U.S. Environmental Protection Agency (EPA) drinking water standards and regulations. The process of *ozonation*, used for disinfection purposes in the water treatment process, may produce unacceptably elevated concentrations of bromate.

Traditionally, surface water has not been used extensively for public supply in SJRWMD and additional water quality monitoring and treatability testing need to be completed before any new surface water source is developed for public supply. If additional monitoring and testing indicate that a particular water source cannot be treated to meet all applicable water quality standards and rules, that source will not be developed as a public supply.

Surface Water From Streams

USGS publishes *Water Resources for Northeast Florida* on a water year basis (October through September) for all active surface water gauges. These reports are the most comprehensive sets of surface water stage and discharge data available for SJRWMD water bodies.

Streamflow Characteristics. Monthly stream discharges generally reflect the seasonal distribution of annual rainfall. The highest average monthly discharges throughout SJRWMD tend to occur in August, September, and October, when summer thunderstorms are common and tropical storms are likely to occur. Streams in SJRWMD usually exhibit at least two high- and low-flow seasons over the course of the year.

The high-flow period in March and April affects the northern area of SJRWMD more than the southern area. The lowest average monthly discharges tend to occur during the late fall to early winter months (November and December) and the late spring to early summer months (May and June). Some of the highest demands for surface water occur during these low-flow periods. High irrigation water demands often occur during May, June, and December. December begins the season for frost-and-freeze protection.

USGS discharge data indicate very few sites in SJRWMD where substantial quantities of water are likely to be available year-round. Except for a few streams with very stable base flows stemming from constant groundwater discharge, most streams in SJRWMD would require artificial storage for an assured water supply. For example, Lake Washington, which is a natural water body with a dam to improve its water storage, is located within the St. Johns River near Melbourne. The City of Melbourne receives its water supplies from Lake Washington (about 12 million gallons per day [mgd]), even though flow occasionally ceases in the St. Johns River.

Source Development Feasibility. Streams with high flows generally offer greater potential for meeting projected needs. The feasibility of developing potential water supply sites should be assessed based on the quantity of water to be withdrawn, the associated impacts on the water resources and related natural systems, and the cost of treatment, storage, and distribution facilities.

SJRWMD assessed the feasibility of withdrawing surface water from the St. Johns River, from the upper Ocklawaha River Basin in Lake County (from the Apopka-Beauclair Lock and Dam and from the confluence of the Palatlakaha River with Lake Harris, downstream to SR 40) (Figures 5 and 6), and from the lower Ocklawaha River Basin (from SR 40 downstream to the St. Johns River) just upstream of its confluence with the St. Johns River. Preliminary assessment results indicate that developing water supplies of up to 351 mgd from the St. Johns River, up to 14 mgd from the upper Ocklawaha River Basin, and up to 107 mgd from the lower Ocklawaha River Basin is technically, environmentally, and economically feasible (CH2M HILL 1996a, 1996b, 1997b, 1997e; Hall 1990). These quantities are planning-level estimates that could change, based on the establishment of minimum flows and levels (MFLs).

SJRWMD is in the process of developing MFLs for these surface water systems and plans to complete adoption of MFLs for the St. Johns River and the upper Ocklawaha River by 2001, well before the anticipated development of these water supply sources. As a result, potential water supply sources identified in this plan are not anticipated to be developed until an MFL is adopted for that particular surface water source and an evaluation of the impacts of the proposed withdrawal on the adopted MFL is completed. If water supplies are ultimately obtained from any of these identified sources, the withdrawals will be limited so as to not cause the surface water system to fall below the adopted MFLs.

Stormwater Retention/Detention Facilities

Typically, constructed stormwater drainage and retention/detention systems capture storm water throughout the developed areas of SJRWMD. Water from these systems can be directly used to meet many

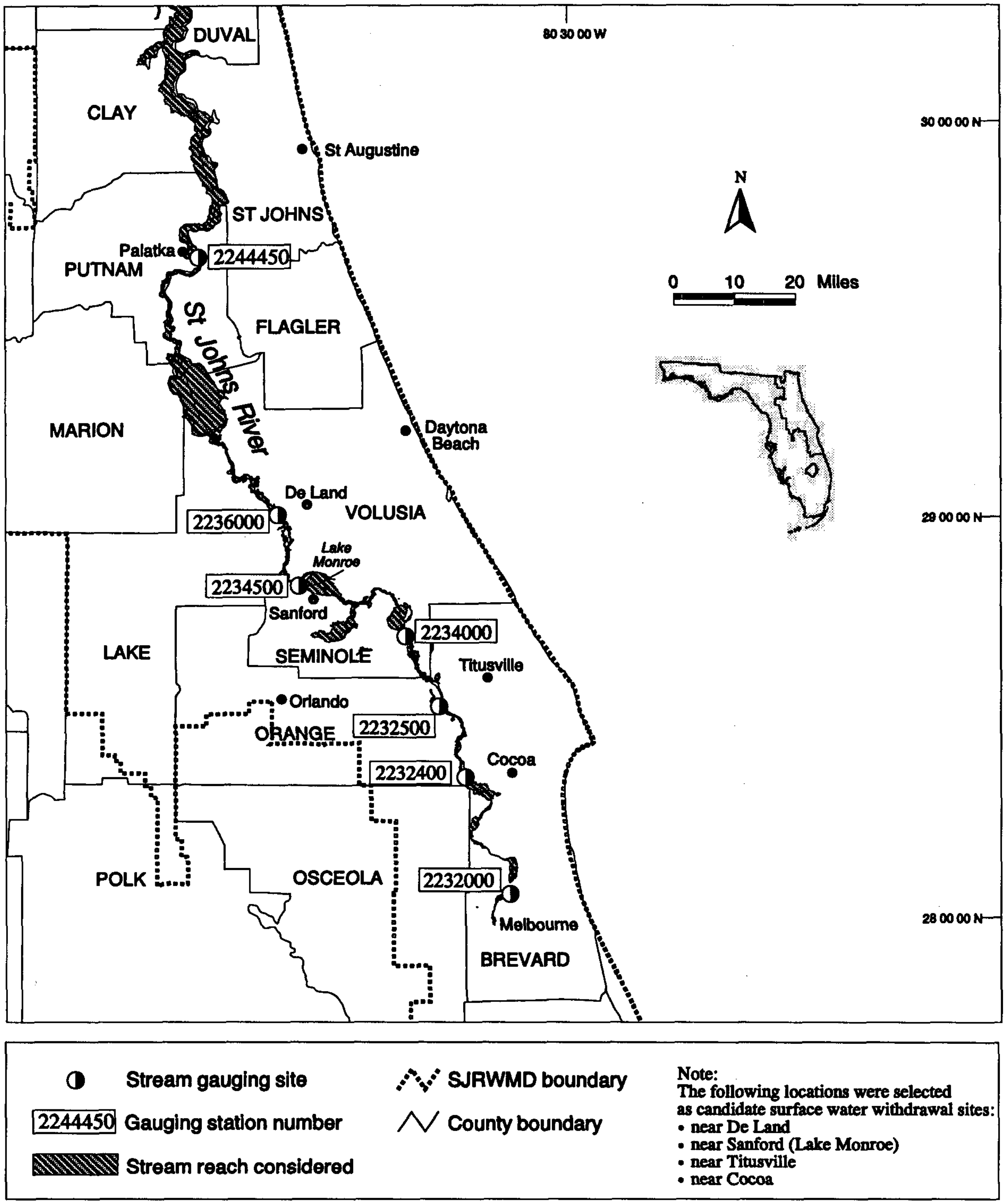

Figure 5. Stream reach of the St. Johns River evaluated for surface water supply potential

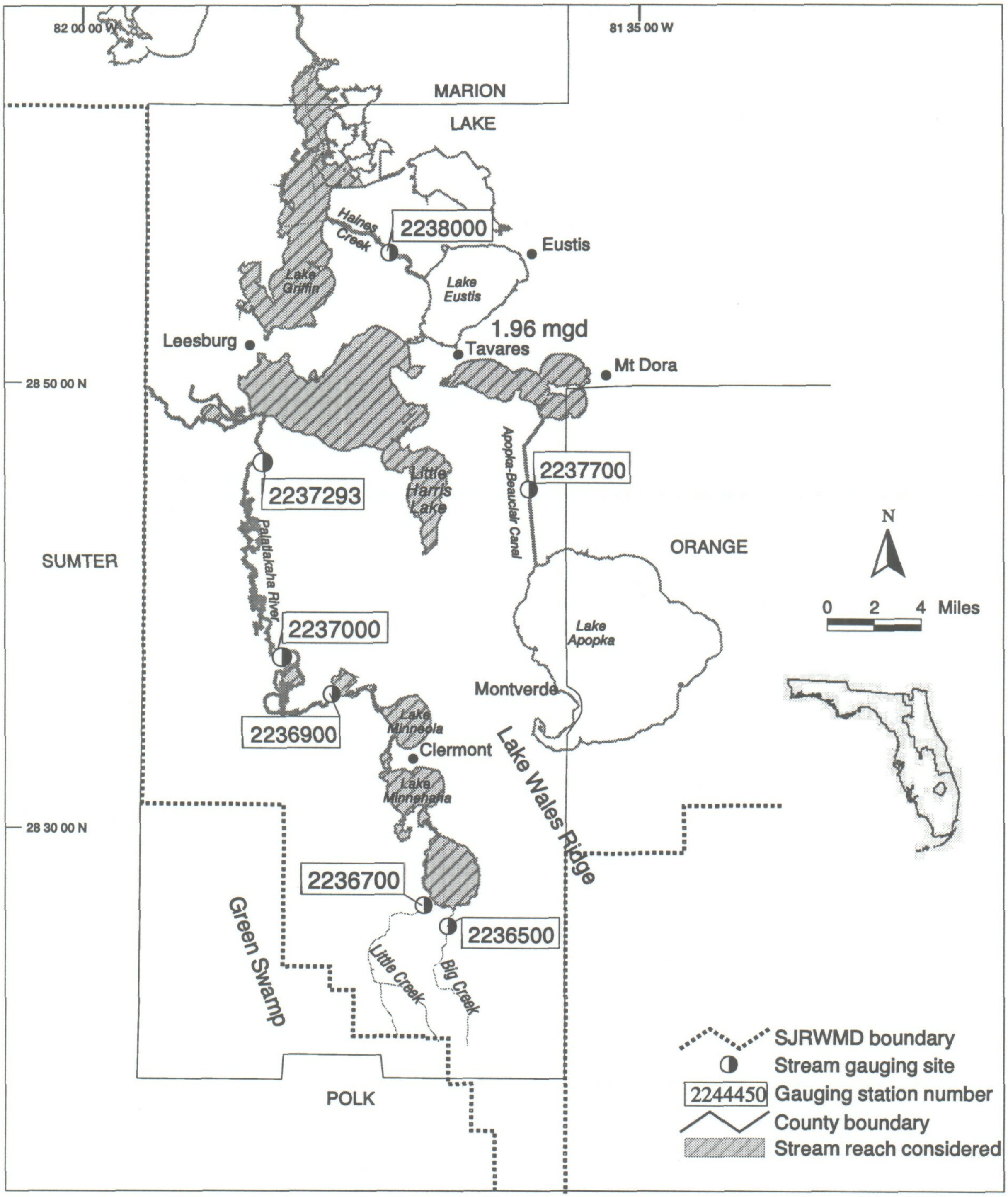

Figure 6. Lake County stream reaches evaluated for surface water supply potential

nonpotable water needs. Storm water usually serves as a source of golf course irrigation water. SJRWMD has not performed a comprehensive assessment of the water available from these facilities.

Water Availability From Lakes

Most of the larger lakes in SJRWMD are part of the Ocklawaha River or St. Johns River systems and the water quality and stage fluctuations of these lakes resemble those rivers of which they are a part. Major lakes in the upper Ocklawaha River chain of lakes include the following:

- Harris
- Eustis
- Griffin
- Dora

Major lakes of the St. Johns River system include the following:

- George
- Harney
- Monroe
- Jesup
- Poinsett
- Washington
- Crescent

Other major lakes, including Newnans, Lochloosa, and Orange, are located in the lower Ocklawaha River Basin.

SJRWMD has been engaged in the process of setting minimum lake levels pursuant to the provisions of Sections 373.042 and 373.0421, *FS.* These minimum lake levels may restrict the amount of water available from lakes. MFLs established to date are included in Chapter 40C-8, *F.A.C.* (Appendix B). SJRWMD's current MFL priority water body list and schedule (Appendix C) identifies the water bodies for which SJRWMD will develop MFLs through 2002.

METHODS

WATER 2020 PROCESS STRUCTURE

SJRWMD focused its water supply planning efforts within water supply planning work group areas. These work group areas include priority water resource caution areas and surrounding areas considered closely associated hydrologically and culturally. SJRWMD identified six water supply planning work group areas: Work Group Areas I, IA, II, III, IV, and V (Figure 2).

Water supply planning in these work group areas has been accomplished through SJRWMD's *Water 2020* Project. The *Water 2020* process has been a cooperative public process designed to maximize the participation and input of local governments, government-owned and privately owned utilities, self-suppliers, and other interested and potentially affected parties, pursuant to the requirements of Subsection 373.0361(1), *FS*. SJRWMD's Water Utility Advisory Board and Agricultural Advisory Committee contributed significantly to the active involvement of public water suppliers and agricultural self-suppliers, respectively, in the *Water 2020* process.

SJRWMD developed a general *Water 2020* process structure for all six of its *Water 2020* work groups to follow (Figure 7). This structure was designed to

- Ensure that planning was conducted in an open public process
- Use the best information available
- Provide consistency among work groups in the methods and procedures used to identify sustainable water supply options
- Facilitate coordination and cooperation with local governments, government-owned and privately owned utilities, self-suppliers, and other interested and potentially affected parties
- Identify water source options, available quantities, estimated costs, and potential funding sources for water supply development, including traditional and alternative sources, from which local government, government-owned and privately owned utilities, self-suppliers, and others may choose, which will exceed identified needs through 2020

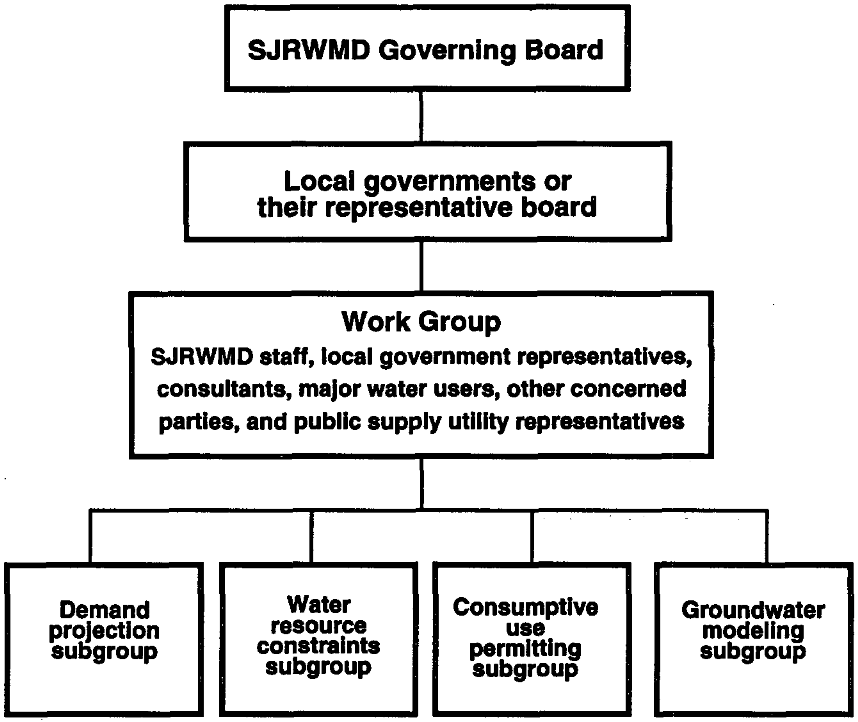

Figure ES-4. General planning process organization for *Water 2020* work groups

The *Water 2020* process was fully funded by SJRWMD, and the work groups were the focal points. All information produced in association with the *Water 2020* process was presented to and considered by the appropriate work group. An SJRWMD water resource consultant or SJRWMD staff member facilitated the activities of the work groups in Work Group Areas I, IA, III, IV, and V. In Work Group Area II, the Volusian Water Alliance's water resource consultant acted as facilitator. The *Water 2020* facilitators, by work group area, are

- Bill Dunn, Ph.D., CH2M HILL—Work Group Area I
- Ron Wycoff, P.E., CH2M HILL—Work Group Area IA
- Jo Ann Jackson, P.E., and Bob Morrell, P.E., PBSJ—Work Group Area II
- Ed Copeland, P.E., HDR—Work Group Area III
- SJRWMD staff—Work Group Area IV
- Ed Copeland, P.E., HDR—Work Group Area V

Each work group except the Area II and Area IV work groups has developed a draft work group plan or a conceptual water supply plan reflective of the work group's activities and has identified alternative water supply solutions for the work group area. These work group plans provided a substantial amount of information that was utilized by SJRWMD in the development of this DWSP. However, the work group plans are not approved by the SJRWMD Governing Board, and as such, they do not represent an official position of SJRWMD. DWSP, as approved by the SJRWMD Governing Board, is the only document that constitutes the SJRWMD water supply plan prepared in response to the requirements of 373.0361, *FS*.

For Area II, the work group identified source options but has not developed a draft or conceptual work group plan. For Area IV, the work group developed an approach to avoid unacceptable impacts but did not develop a written work group plan.

For issues requiring considerable focused attention, the work groups developed subgroups to the work groups. Each of these subgroups consisted of work group members who had a particular interest in the subgroup subjects. An SJRWMD water resource consultant or an SJRWMD staff member chaired each subgroup. The following subgroups were active in the work group process:

- Demand Projection
- Water Resource Constraints
- Consumptive Use Permitting

- Groundwater Modeling

Each work group except the Area IV work group had a Demand Projection Subgroup. Each of these subgroups discussed, reviewed, and eventually agreed on water supply demand projections proposed for use in the *Water 2020* process for its respective work group area.

The Water Resource Constraints Subgroup reviewed and discussed the *water resource constraints* proposed for use as the basis of determining the acceptability of projected water resource impacts. Because the water resource constraints are the same in all *Water 2020* work group areas, membership in this subgroup consisted of members from all *Water 2020* work groups. Bill Dunn, CH2M HILL, chaired this subgroup. This subgroup produced a handbook which describes its recommended constraints (CH2M HILL 1998d).

The Consumptive Use Permitting Subgroup identified and addressed issues concerning the relationship between SJRWMD's consumptive use permitting program and DWSP. Because all work group areas shared an interest in the relationship between permitting and planning, membership in this subgroup consisted of members from all *Water 2020* work groups. Hal Wilkening, director, Department of Resource Management, SJRWMD, chaired this subgroup. The Consumptive Use Permitting Subgroup did not develop final recommendations or produce a subgroup report. However, many of the concepts discussed by the subgroup are included in the consumptive use permitting process discussion in the recommendations section of this DWSP.

Groundwater Modeling Subgroups for Work Group Areas I, II, III, and V were established to identify and address issues concerning the SJRWMD groundwater models used in the water supply planning process. Regional groundwater flow models (Figure 8), as well as local-scale models, were applied in work group water supply plan development. Regional models include the east-central Florida groundwater flow model and the north-central Florida groundwater flow model used in Work Group Area I, the Volusia groundwater flow model used in Work Group Area II, and the northeast Florida groundwater flow model applied in Work Group Area V. Local-scale groundwater flow models were applied in Work Group Areas III, IV, and V. The groundwater modeling subgroups reviewed each of these models.

These modeling subgroups, chaired by Charles Tibbals, water resources consultant, identified the need for additional hydrologic analysis and peer review of the models. This additional analysis and peer review was

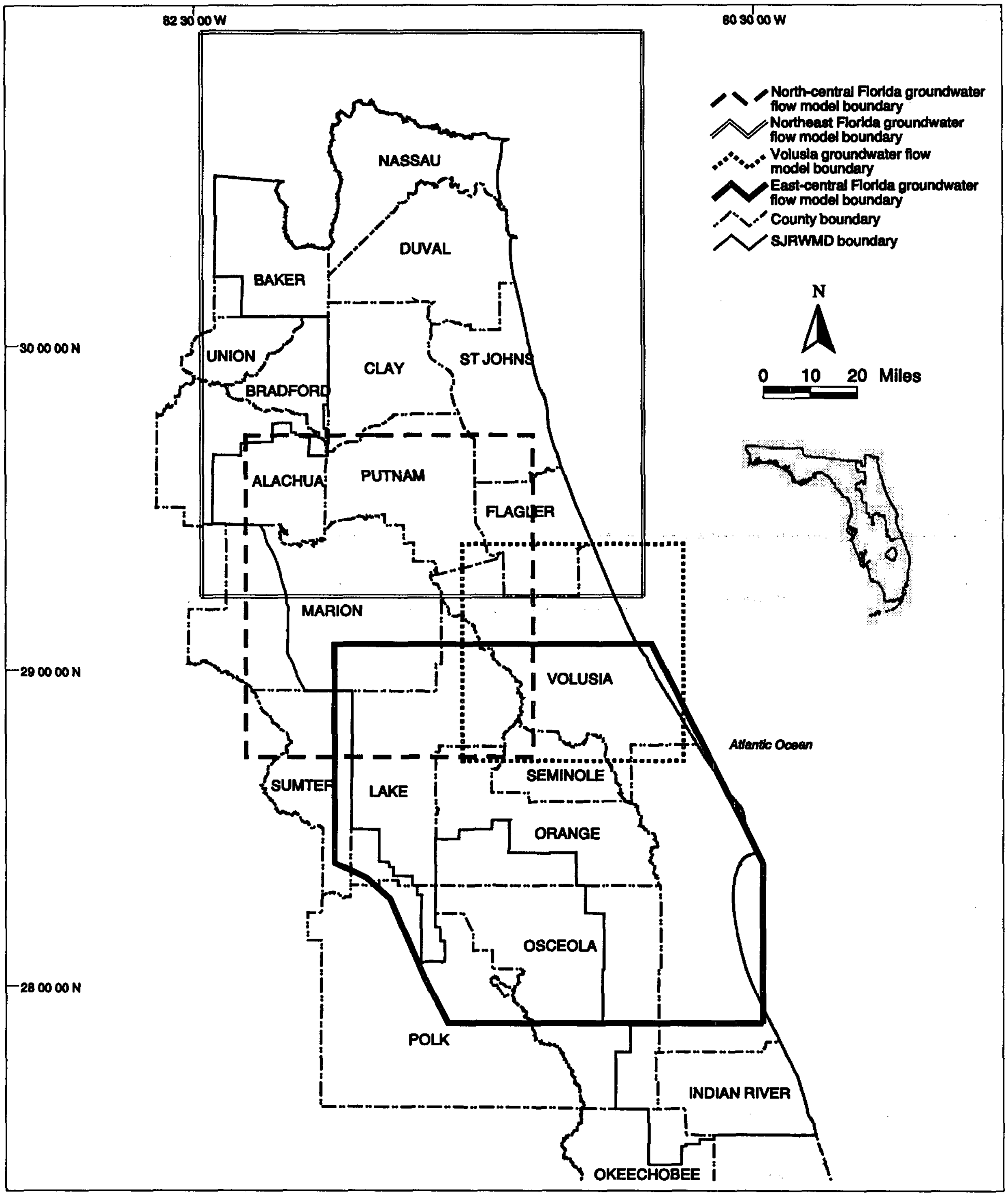

Figure 8. St. Johns River Water Management District regional groundwater flow model boundaries

performed as part of the *Water 2020* process. The activities of the subgroup, including a summary of the additional hydrologic analysis and peer review, are summarized in *Water 2020 Groundwater Modeling Subgroups Report* (Tibbals 1999).

SJRWMD staff and the assigned facilitators generally provided coordination among the subgroups. However, the dependence of the City of Cocoa's public supply system on groundwater withdrawn in Orange County and on surface water withdrawn from the Taylor Creek Reservoir in Orange County strongly links Work Group Areas I and IA. The City of Cocoa's public supply *service area* is located in Work Group Area IA, but its withdrawals occur in Orange County in Work Group Area I. In recognition of the relationship between these work groups, Work Group IA assigned one of its members to serve as a liaison with Work Group I. Carl Larrabee, Utilities Director, City of Cocoa, served in this liaison position.

SJRWMD considers the success of the *Water 2020* process to be largely dependent on the acceptability of SJRWMD's DWSP by local governments. Local governments control the majority of the public water supply systems in SJRWMD and, therefore, must be willing to make the financial commitments necessary to implement DWSP in order for it to be successful. In addition, these local governments make growth management decisions for their respective jurisdictions. Based on the provisions of Section 373.0395, *FS*, the Legislature intends that future growth and development planning reflect the limitations of the available groundwater and other available water supplies. Therefore, the availability of water should be an important consideration in growth management decisions. Developing a water supply plan that local governments and other major water suppliers do not support or are unwilling to implement would represent a failed effort—a scenario unacceptable to SJRWMD.

SJRWMD sought active participation of local government elected officials and staff members in the work group process and through the work group plan and the DWSP review processes. This effort to involve local government officials and staff began in November 1997 with a workshop to initiate the *Water 2020* process. Henry Dean, Executive Director, SJRWMD, notified each local government elected official and key staff members of the scheduled workshop and initiation of the *Water 2020* process. These officials and key staff were also informed of all work group meetings and provided with copies of draft work group plans.

Active participation by elected local government officials in work group meetings was generally limited. Primarily, local government staff members served as the fundamental link between the work group process and local government elected officials. Concern by the work groups that this link was not strong enough prompted SJRWMD to present the results of the *Water 2020* process to selected local government bodies and to receive the direct input of those bodies. This local government presentation process was carried out from April through August 1999. During this period, SJRWMD made presentations to 20 local government bodies and two private utility governing bodies.

Special links between elected local government officials already existed in Work Group Areas IA and II. The Brevard Water Supply Board (BWSB), representing all local governments in Brevard County, acted as the link between the Area IA work group and the local governments in Brevard County. The Volusian Water Alliance (VWA) represents local governments in Volusia County and was the primary link between the Area II work group and local governments in Volusia County.

The *Water 2020* process in Work Group Area IA was carried out cooperatively with BWSB. BWSB consists of one representative from the governing body of each municipality in Brevard County and a representative of the Brevard County Board of County Commissioners. BWSB was formed voluntarily in 1995 by the participating governments for the purpose of discussing water supply issues in Brevard County. Prior to the commencement of the SJRWMD/BWSB cooperative planning process, the governing body of each municipality and the Brevard County Board of County Commissioners adopted resolutions supporting the *Water 2020* process. The activities of *Water 2020* Work Group IA were regularly reported to BWSB.

VWA, representing local governments in Volusia County, acted as the link between the Area II work group and the local governments in Volusia County. The *Water 2020* process in Work Group Area II was carried out cooperatively with VWA based on the provisions of a formal agreement between SJRWMD and VWA. Based on the provisions of this agreement, SJRWMD provided funding to VWA to support the cost of consultant services and staff. VWA membership consists of Volusia County and all 16 cities in the county. The county's representation includes a representative of agriculture/fern and may include a representative of the largest nongovernment public supply utility. VWA was formed by interlocal agreement in 1996 to develop

- Regional water supply plans
- A coordinated countywide plan and an aquiferwide plan based on coordination of the regional plans and the standards of SJRWMD
- An operational system capable of meeting the purposes of VWA

VWA is also responsive to any other water-related purposes which are permitted by law and which are approved by a majority of its members.

The activities of Work Group Area II were regularly reported to VWA.

The work group planning process resulted in future water demand projections, future water supply deficit estimates, recommended water supply source options, and one or more recommended viable water supply alternatives. To develop a water supply plan for each work group area, each work group applied the most relevant methods and tools to its respective work group area. Although exact methods and procedures varied for each work group, all shared basic criteria.

A major objective of the planning process involved providing a consistent method for comparing water supply options and alternatives. A consistent set of alternative water supply evaluations, as well as cost estimating and economic evaluation criteria, helped reach that objective.

WATER SUPPLY DEMANDS AND DEFICITS

Demand Projections

SJRWMD staff developed future water supply demand projections in consultation with major water suppliers. Water supply demands for the year 2020 were estimated for the following use categories:

- Public supply
- Domestic self-supply and small public supply systems
- Commercial/industrial/institutional self-supply
- Thermoelectric power generation self-supply
- Agricultural self-supply
- Recreational self-supply

The SJRWMD *Water Supply Assessment: 1998* presents current water supply needs projections for these categories (Vergara 1998) as well as the methods applied to develop the projections. These projections address both long-term average demands and expected demands during a *1-in-10-year drought*. The county water supply data included in that assessment helped determine the future water supply demand projections used in DWSP.

Deficit Identification

A water supply *deficit* exists when proposed water supply sources or facilities are not able to meet projected demands. Water supply deficits can be of two types: source deficits and facility deficits.

A *source deficit* is the difference between the projected 2020 needs and the quantity of water the source can supply in a sustainable manner. SJRWMD used regional decision models to determine groundwater source deficits in Work Group Areas I and II. These regional models were used to identify maximum average annual groundwater withdrawals compatible with applicable water resource constraints. In Work Group Area IA, where local surficial aquifers provide most of the groundwater supply, it was assumed that these aquifers have been developed to their maximum potential and that additional demands will result in a source deficit requiring the development of alternative water supplies. In Work Group Areas III and V, local groundwater models, along with the applicable water resource constraints, were used to help determine the potential for groundwater source deficits. Work Group Area IV is a unique case involving interference with existing legal uses during peak demand periods and did not involve deficit identification.

A *facility deficit* is the amount of projected 2020 water supply needs that cannot be met by existing water supply facilities. Facility deficits depend on the existing capacity of the individual water supply system and the projected 2020 needs. The need to provide for peak day demand determines needed facility capacity and therefore often controls facility deficits.

Decision Modeling for Evaluating Water Supply Alternatives

Water supply options apply to individual service areas. A *water supply alternative*, as defined in the *Water 2020* planning process (see glossary), consists of any combination of water supply options that can meet the future needs of an entire work group area.

Economic decision models can be used in water resource planning to determine the most inexpensive water supply alternatives by incorporating water management constraints, water resource constraints, cost constraints, existing groundwater source withdrawal optimization estimates, political constraints, and alternative water sources. Appendix D details the decision-modeling process. No one set of decision model outputs adequately addresses future water resource problems. However, a decision model may be rerun and refined as necessary to gain additional information and insight about the water supply problem, the simulation model, projected future water demands, and the solutions capable of meeting demands and constraints.

Model Types

In the *Water 2020* process, SJRWMD relied on two types of *decision models* to determine water supply alternatives for Work Group Areas I and II. The first model, referred to as the *groundwater optimization model,* maximizes use of existing and proposed groundwater supplies while meeting specified water resource protection constraints. This model does not address costs, instead, it defines the nature and extent of the water supply problem by identifying deficit amounts for each service area.

The second model, referred to as the *economic optimization model,* considers alternatives to existing and proposed wells and all associated costs, comparing a number of existing, proposed, and alternative source options to find combinations that meet water resource constraints and minimize the cost of meeting projected 2020 demands.

Both models rely on the widely used three-dimensional groundwater simulation model MODFLOW (McDonald and Harbaugh 1988, 1996), a saltwater upconing model (CH2M HILL 1998a), the General Algebraic Modeling System (GAMS) (Brook et al. 1996), and the CPLEX linear and mixed integer programming solvers (CPLEX Optimization 1996).

Model Objectives

The two main decision-modeling objectives are (1) to maximize the use of existing and proposed groundwater supplies and (2) to minimize the total cost of providing water for a regional area. These two objectives must work within constraints limiting water resource impacts in sensitive areas. Model objective functions may be revised to assist water supply managers in comparing or contrasting different water supply strategies.

Application of Water Resource Constraints

Need for Water Resource Constraints

The *Water 2020* program and DWSP focus on developing an economically and technically feasible water supply plan that will meet future water supply needs in a manner that sustains the water resources and related natural systems. Sustainable sources must be able to supply the needed amounts of water, as defined by projected demands, without causing unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses.

The water resource constraints define thresholds, for planning purposes, beyond which unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses are expected to occur. For the planning process, a water resource constraint serves as a tool for two types of evaluations:

1. Application of constraints to analysis of a given withdrawal scenario (without optimization) identifies locations where future unacceptable impacts are expected to occur if that scenario were implemented.
2. Incorporation of constraints into the decision models prevents consideration of withdrawal scenarios that will exceed the constraint values and, therefore, will not be sustainable.

SJRWMD has routinely used water resource constraints for water supply assessment and planning. For instance, in the *1994 Needs and Sources Assessment: 1994* (Vergara 1994), the characterization of the extent and intensity of potential impacts to native vegetation due to lowered surficial water tables contributed to defining the water resource caution area boundaries.

The SJRWMD *Water Supply Assessment: 1998* (Vergara 1998) highlighted the priority water resource caution areas in which existing and anticipated water sources and conservation efforts appear inadequate to supply water for all existing legal uses and projected future needs through 2020 in a manner that sustains the water resources and related natural systems.

For DWSP, SJRWMD used four water resource constraints to identify and estimate source deficits and to identify sustainable withdrawal scenarios:

- Established MFLs
- Impacts to wetland and aquatic systems
- Impacts to groundwater quality
- Impacts to existing legal uses of water

The initial water resource constraint was that established by adopted MFLs. The development of other water resource constraints and the analyses associated with them occurred on a regional planning-level basis, using data that were available or were developed for the planning area as a whole. These analyses were not performed at the same level of detail as that used when a proposed water use is reviewed in the context of SJRWMD's consumptive use permitting program. While DWSP water resource constraints and associated analyses are conceptually consistent with the consumptive use permitting environmental and existing legal uses protection criteria, they should not be interpreted as a final determination or application of the consumptive use permitting criteria.

Application of Water Resource Constraints in Work Group Areas I and II

An objective of SJRWMD's *Water 2020* process is to develop a framework of sustainable regional water supply solutions. Because of the water use complexities in Work Group Areas I and II, SJRWMD applied the water resource constraints in the planning process in those areas through the use of groundwater and economic optimization models.

Incorporation of Constraints Into the Decision-Modeling Process

The Water 2020 Constraints Handbook (CH2M HILL 1998d) discusses specific constraint values and application methods for sensitive wetlands, MFLs for spring discharges, and groundwater quality.

Sensitive Wetlands

Wetland *drawdown* constraints specific to selected, sensitive wetlands are incorporated into SJRWMD's optimization models. CH2M HILL (1998d) and Kinser and Minno (1995) defined, selected, and located these sensitive wetlands. For planning-level purposes, each type of wetland was assigned an associated maximum allowable long-term average drawdown limit beyond which an unacceptable adverse impact would most likely occur. The modeling process links each wetland spatially to a grid cell in the decision model. A *control point* refers to the specific grid cell representing a particular wetland. The current models contain surficial aquifer drawdown limits ranging from 0.35 to 0.85 foot.

The wetland constraints are defined in terms of long-term maximum drawdown values for planning-level purposes. Long-term average wetland drawdowns in excess of these values are expected to alter the dominant wetland vegetation and therefore cause unacceptable adverse impacts. However, maintaining long-term average drawdown limits within these values should provide adequate protection of the wetlands under the full range of hydrologic conditions, including periodic droughts such as the 1-in-10-year drought.

Wetlands are adapted to transient extreme conditions, including floods and droughts. Droughts will temporarily stress a wetland system but will not cause a change in its dominant plant and animal populations as long as the natural long-term average hydrologic regime is maintained within acceptable limits. The wetland constraints identified in this DWSP should maintain the natural hydrologic regime within these acceptable limits. Therefore, groundwater withdrawal scenarios developed using the steady-state groundwater models and the long-term average wetland drawdown constraints developed for this planning process should provide water supplies during the 1-in-10-year drought while protecting the dominant assemblage of plant and animal species.

The technical basis for the wetland constraints is covered in detail in other publications (CH2M HILL 1997g, 1998c). Wetland drawdown criteria for Water 2020 were set based on a detailed review of published literature, reports and other available information related to wetland hydrology; the relationship between hydrology and ecological values; and the effect of hydrologic alteration under three broad categories:

- Characteristic hydrologic regime of major wetland types
- Effects of altered hydrologic regime on wetland structure and function
- Wetland hydrologic impact triggers

The review showed that wetland systems in Florida differ widely in their hydrologic regime characteristics; however, they can be arrayed along a hydrologic gradient, of deeply flooded to seasonally moist, based on the ranges of their respective hydrologic regime characteristics (depth, duration, frequency, and seasonality of flooding). Also within a given wetland type there is a range of variation in observed depth, duration, frequency, and seasonality of flooding. Using the hydrologic regime characteristics, the maximum allowable long-term average drawdown values were set for each wetland type for long-term steady-state conditions. The drawdown values were set at levels that prevent significant change in the dominant plant and animal species present in the wetland, thus preserving the type, nature, and function of the wetland. By definition, the criteria prevent a successional change in the biological community whereby dominant species are replaced by other species characteristic of a drier community type. These maximum allowable drawdown values were adopted as the wetland constraint values for *Water 2020* by the Water Resources Constraints Subgroup.

MFLs for Springs and Surface Water Bodies

MFL constraints protect sensitive springs and water bodies. MFLs are long-term hydrologic statistics used to define a threshold (i.e., the minimum acceptable) hydrologic regime which allows for consumptive use while protecting the water resources and the ecology from significant harm. MFLs are composed of a water level or flow (how much), duration (how long), and return interval (how often). The actual water levels or flows of the water system will fluctuate above, among, and below the MFLs during extreme wet, normal rainfall, and extreme drought periods, respectively. For a planning-level analysis, MFLs can be represented in decision models by (1) the formal, established MFL values adopted by SJRWMD and (2) general screening levels or flows used to protect any water body of concern for which there is no presently established MFL.

For example, the east-central Florida groundwater flow model includes 23 springs. Only eight of these springs have established minimum flows. The spring discharge constraint on these springs is the established MFLs (Rao and Clapp 1996). The other 15 springs included in the model do not currently have an established minimum flow. For these springs, a minimum flow constraint limiting the flow decrease to a 15 percent reduction of the long-term median flow value was included in the analyses.

Most SJRWMD-adopted lake MFLs include three levels: (1) the minimum frequent high, (2) the minimum average, and (3) the minimum frequent low. For this planning-level analysis, the minimum average level is used as a water resource constraint. In addition, a minimum level of 0.5-foot reduction in the historic average level was used for other sensitive lakes identified by SJRWMD. This screening level constraint was comparable to the average reduction allowed on lakes with established MFLs. These lake-level constraints are applied in a manner similar to the wetland constraints previously discussed. That is, the long-term lake drawdown constraints are applied to the steady-state groundwater modeling of water supply withdrawals. For planning-level purposes, maintaining long-term lake drawdown limits within these values should provide adequate protection of the lake systems under the full range of hydrologic conditions, including periodic droughts such as the 1-in-10-year drought.

Water Quality

The groundwater quality constraint was developed to limit changes in groundwater quality that would occur as a result of increased withdrawals of fresh groundwater. These limits were set to prevent increased treatment costs for users resulting from water quality changes. This constraint is generally more limiting than a point at which unacceptable adverse impacts to the water resources and related natural systems would occur.

The decision-modeling process incorporated constraints that allow groundwater quality to increase in chloride concentration up to 250 mg/L in areas where the current concentration is lower than 250 mg/L. At locations where the chloride concentration already exceeds 250 mg/L, chloride concentrations are not allowed to increase in response to increased groundwater withdrawals.

Allowing wells currently producing water with chloride concentrations less than 250 mg/L to produce concentrations no greater than 250 mg/L provides some assurance that a certain type of interference related to water quality degradation with existing legal uses will not occur. Allowing wells currently producing chloride concentrations of 250 mg/L or greater to experience no increase in chloride concentration was included as a constraint to minimize additional degradation of groundwater quality in areas already experiencing marginal drinking water quality in the native groundwater.

This constraint had no significant impact in the decision-modeling process in Work Group Area I. However, in the modeling process, this constraint has proven to have a noticeable impact on existing wellfield production in coastal Volusia County. This has resulted in a renewed interest in the feasibility of developing brackish groundwater desalting facilities in the area, possibly in association with existing wellfields. Using the decision model to assess this feasibility requires relaxing the water quality constraint.

The groundwater quality constraint was not designed to address the development of brackish groundwater in association with desalting. To determine the feasibility of the development of brackish groundwater for desalting, SJRWMD has been guided by the information included in CH2M HILL 1997f, 1998a, and 1998b. These documents identify techniques that can be utilized to design brackish groundwater wellfields that will produce sustainable quantities of suitable quality groundwater, available treatment techniques, and associated costs. Application of these technologies is not addressed in the *Water 2020* Constraints Handbook (CH2M HILL 1998d).

DWSP allows for increases in salinity to support reasonable-beneficial uses provided unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses will not occur. This guideline has been applied whether the existing condition of the groundwater withdrawn is fresh or brackish. The planning-level approach used to deal with groundwater quality changes in DWSP could be more stringent in some cases than that resulting from a case-by-case determination made in the consumptive use permitting process. Conclusions reached in DWSP should not be interpreted as a final determination or application of SJRWMD's consumptive use permitting criteria.

Application of Water Resource Constraints in Work Group Areas IA, III, IV, and V

Water resource constraints were applied differently in the water supply planning process in Work Group Areas IA, III, IV, and V than in Work Group Areas I and II. The differences arise primarily because water use complexities in these work group areas are not as significant as in Work Group Areas I and II. Although groundwater models were used to project the magnitude of water level declines in all work group areas, groundwater and economic optimization models were linked to these groundwater models only in Work Group Areas I and II.

No additional significant fresh groundwater withdrawals have been identified as source options in Work Group Area IA. Therefore, no specific applications of water resource constraints in association with fresh groundwater withdrawals were necessary in this work group area. Brackish groundwater has been identified as a source option in this work group area, but because SJRWMD's recommendations concerning brackish groundwater development include recommended well spacings and withdrawal rates designed to avoid unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses, no additional specific applications of the water resource constraints were performed.

In Work Group Areas III and V, the water resource constraints were applied by comparing model-projected groundwater level declines to the water resource constraints in an effort to identify areas where unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses would occur. The results of this effort generally confirmed the conclusions reached in SJRWMD's *Water Supply Assessment: 1998* (Vergara 1998). These conclusions indicate that proposed increases in groundwater withdrawals are likely to cause unacceptable adverse impacts to some wetlands.

In Work Group Area IV, the only applicable water resource constraint was the interference with existing legal uses constraint. It was applied only to establish that interference with existing legal uses occurred during times of peak seasonal groundwater withdrawals associated with peak crop irrigation periods and low rainfall periods.

ALTERNATIVE DEVELOPMENT AND EVALUATION

For the smaller work group areas (IA, III, and V), options for each individual water supply utility were developed and evaluated by the work group. Any array of sustainable options is identified as a water supply alternative for that work group, and feasible alternatives are identified in DWSP.

Because of the large number of individual public water supply utilities (71 in Work Group Area I alone) and the hydrologic interaction of existing and proposed groundwater withdrawals, evaluating individual water supply options for each service area is not practical for Work Group Areas I and II. Therefore, DWSP focuses on developing and assessing a number of areawide water supply alternatives or scenarios for these work group areas. The areawide alternatives considered generally involve developing one or more water supply sources and applying optimization models to determine whether the alternative can feasibly meet DWSP goals. If the alternative proved feasible, the least costly combination of water supply facilities needed to implement the alternative was identified.

SJRWMD has concluded that public supply utilities can distribute the costs of regional water supply alternatives to their user base while remaining economically competitive. However, agricultural self-supply users have much less ability to do so. In addition, public supply accounts for the major portion of the projected water supply demand increases through 2020. Therefore, water supply alternatives evaluated to date using SJRWMD's optimization models have been evaluated primarily for public supply utilities. These evaluations have been performed for Work Group Areas I and II only. This should not be interpreted to mean that non-public supply water users should not participate financially in the development of alternative water supplies. However, it is likely that the greatest contributions of these users will be through participation in water conservation and reuse projects and not through the development of naturally occurring alternative sources.

Cost Estimates and Economic Criteria

Several water supply alternatives have been identified for Work Group Areas I and II. Conceptual, planning-level cost estimates have been developed for each feasible alternative identified, as well as a description of the advantages and disadvantages associated with each.

The conceptual, planning-level cost estimates for all work group areas use the same criteria in order to provide comparable cost estimates. The water supply cost estimates allow a relative comparison of the total cost for each alternative considered. To ensure this internal comparability, the following cost-estimate and economic criteria were established:

- Construction cost
- Capital cost
- Operation and maintenance cost
- Equivalent annual cost
- Unit production cost

The glossary defines each of these cost parameters. These parameters, which are expressed in constant 1996 dollars, have served as the cost basis throughout SJRWMD's planning process. *Total capital costs* consist of the sum of *construction costs, nonconstruction capital costs, land costs,* and *land acquisition costs,* if applicable. Nonconstruction capital costs are calculated as 45 percent of the estimated construction costs. These costs incorporate permitting, administration, engineering design services during construction, construction contingencies, and other miscellaneous costs associated with constructing facilities. Land acquisition costs were calculated as 25 percent of the land costs.

Equivalent annual costs, which account for all expenditures, are an estimate of life-cycle costs and are a function of the total capital costs, the expected life of the constructed facilities, the time value of money, and annual *operation and maintenance costs.* These cost estimates aid in comparing alternatives with differing economic characteristics. For DWSP, the time value of money equals 7 percent per year.

The *unit production cost* equals the equivalent annual cost divided by the annual finished water production, expressed in dollars per 1,000 gallons. This final cost parameter provides the single most meaningful comparison of the relative cost of potential water supply alternatives.

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

ESTABLISHMENT OF MINIMUM FLOWS AND LEVELS

BACKGROUND

SJRWMD has been engaged in a districtwide effort to develop MFLs for protecting priority surface water bodies, watercourses, associated wetlands, and aquifers from significant harm caused by water withdrawal. MFLs provide an effective tool to assist in sound water management decisions that prevent significant adverse impacts to the water resources or ecology of the area.

There are numerous SJRWMD initiatives associated with setting MFLs. These include the following:

- Developing districtwide lake and stream classification systems and databases
- Identifying priority water bodies for setting MFLs
- Setting minimum levels for priority aquifers and lakes, and MFLs for priority springs, streams, and rivers
- Performing applied research to support the development of MFLs
- Monitoring waters levels, hydrology, soils, and biological communities to verify that established MFLs are protecting the water resources

SJRWMD implements established MFLs primarily through its Water Supply Planning, Consumptive Use Permitting and Environmental Resource Permitting Programs.

Statutory and Regulatory Framework

The Florida Water Resources Act (Chapter 373, *FS*) and the Water Resource Implementation Rule (Chapter 62-40, *F.A.C.*, formerly the State Water Policy) provide the basis for establishing MFLs. Chapter ;373, *FS*, and Chapter 62-40, *F.A.C.*, explicitly include provisions for setting such flows and levels.

Florida Water Resources Act

Chapter 373, *FS*, requires the WMDs to establish minimum flows for both ground and surface waters and minimum levels for surface watercourses below which significant harm to the area's water resources or ecology would result. In addition, Chapter 373

- Mandates SJRWMD to set MFLs for the Wekiva River System by March 1, 1991—Subsection 373.415(3)
- Declares that a policy of the Legislature is the preservation of natural resources, fish, and wildlife—Paragraph 373.016(3)(g)
- Specifies that the WMDs must provide information concerning MFLs to local governments for development and revision of comprehensive plans—Subsection 373.0391(2)

Water Resource Implementation Rule

Chapter 62-40, *F.A.C.*, highlights the state's approach to water management (Rule 62-40.110, *F.A.C.*). WMD programs are required by Subsection 373.103(1), *FS*, to be consistent with Chapter 62-40, *F.A.C.*

Rule 62-40.310(4)(a), *F.A.C.*, directs the establishment of MFLs to protect water resources and the environmental values associated with marine, estuarine, freshwater, and wetlands ecology.

MFLs Program

The SJRWMD MFL program addresses all the requirements expressed in the previously referenced sections of the Florida Water Resources Act and the Water Resource Implementation Rule.

SJRWMD intends to continue the following efforts:

- Identify, prioritize, and schedule water bodies for setting MFLs
- Perform data collection and research needed to support establishing scientifically sound MFLs
- Perform more-detailed investigations and studies to established MFLs for priority water bodies
- Perform ongoing monitoring and periodic re-evaluation of MFLs
- Develop and refine groundwater and surface water models, including developing an interface between ground and surface water models where appropriate, to predict if water withdrawals will cause levels and flows to fall below established MFLs
- Provide information about MFLs to local governments for their comprehensive planning

Priority-Setting Process

In accordance with the requirements of Section 373.042, *FS*, SJRWMD has established a list of priority ground and surface waters for which MFLs will be set. This priority list is based upon the importance of waters to the region and the existence of or potential for significant harm to the water resources or ecology of the region. As part of determining the priority list, the following factors are considered:

- Whether the existing or projected demand for water in the area is sufficient to meaningfully affect flows and/or levels of the surface water or groundwater
- Whether any water supply development is planned in the area that may adversely affect regionally significant environmental resources
- Whether the system includes regionally significant environmental resources
- Whether the area is currently experiencing or is expected to experience stress resulting from chronic low groundwater or surface water levels or low surface water flows
- Whether historic hydrologic records (flows and/or levels) are available to allow statistical analysis and calibration of computer models when selecting particular water bodies in areas with many water bodies
- The proximity of MFLs already established for nearby water bodies

Establishment of Minimum Flows and Levels for the Region

SJRWMD's MFLs approach is designed to be applied to lakes, rivers, springs, isolated wetland systems, and aquifers. The approach assumes that alternative hydrologic regimes exist that are less than historic or optimal, but that will protect the structure and functions of aquatic and wetland resources from unacceptable harm. For instance, an historic condition could consist of an unaltered river or lake system with no withdrawal from local groundwater or surface water sources. A new hydrologic regime is associated with each increase in consumptive use, from very small withdrawals that have no measurable effect on the historic regime to very large withdrawals that markedly lower the long-term hydrologic regime. A threshold hydrologic regime exists that is lower than historic, but which protects the water resource and ecology of the system from unacceptable harm. Conceptually, the threshold regime, resulting primarily from consumptive use withdrawals, will have lower highs and lower lows compared to the historic regime.

The purpose of MFLs is to define this threshold hydrologic regime and allow for consumptive use while protecting the water resources and ecology from unacceptable harm. Thus, MFLs do not represent historic, optimal, or necessarily desirable hydrologic conditions, but rather represent minimum acceptable hydrologic conditions.

Development of Surface Water MFLs

SJRWMD bases its guidelines for determining MFLs on a two-stage statistical classification approach. The first stage is a hydrologic classification based on soil and basin variables. The second stage incorporates an ecological refinement that addresses the biotic health of the water resource and related natural system.

Hydrologic Assessment. The first stage, a hydrologic classification based on soil and basin variables, provides the following:

- Information for water budget model development
- A mechanism for incorporating related information
- A set of lake classes for the second level ecological analysis

Ecological Refinement. The second stage of the classification incorporates an ecological refinement that addresses the biotic health of the water resource and related natural system. SJRWMD developed a multiple flows and levels approach, where the MFLs consist of hydrologic statistics for setting minimum stream flows and lake levels. Multiple minimum levels define the minimum hydrologic regime that will prevent significant harm.

Ecologically robust criteria that protect important system structures or ecosystem functions over the range of high, average, and low water events help determine MFLs. These MFLs assimilate a series of ecological thresholds used with output from hydrologic computer simulation models, to evaluate potential environmental impacts to the ecology of aquatic and wetland habitats over a long time frame (typically on the order of 30 years).

Surface Water Hydrologic Regime. The threshold hydrologic regime can be defined by a series of up to five MFLs:

- Minimum Infrequent High
- Minimum Frequent High
- Minimum Average

- Minimum Frequent Low
- Minimum Infrequent Low

MFLs are not points chosen from a hydrograph. Instead, the MFLs are long-term hydrologic statistics composed of a water level or flow (how much), duration (how long), and return interval (how often). Water budget flow data are needed for developing, and verifying, the long-term (30+ years) water budget models needed for implementing these MFLs. The actual water levels or flows of the water system will fluctuate above, among, and below the recommended MFLs during extreme wet, normal rainfall, and extreme drought periods, respectively.

Minimum Infrequent High

The Minimum Infrequent High flow or level involves inundating the riparian wetlands at a frequency sufficient to support important ecological processes such as floodplain maintenance functions and the transport of sediment, detritus, nutrients, and propagules. Flooding upland plant communities is not required.

Minimum Frequent High

The Minimum Frequent High flow or level must serve the needs of surface water biota that use the floodplain habitat for feeding, reproduction, and refugia. Flooding should be of sufficient magnitude, duration, and frequency to maintain the floodplain plant community structure and composition adapted to periodic inundation. This level and flow should occur annually or biannually for several weeks.

Minimum Average

The Minimum Average flow or level is considered the minimum that must be sustained for extended periods to maintain riparian hydric soils and to impede the encroachment of upland plant species into the wetland plant community. This MFL should not restrict typical recreational uses of the surface water.

Minimum Frequent Low

The Minimum Frequent Low flow or level is the minimum level that should occur during mild droughts. When this water level and flow does not occur too frequently or for too great a duration, there is no significant harm to lotic and floodplain communities because this level provides the drawdown condition required for regeneration by many floodplain plant species. This level may limit some recreational potential of the stream or lake.

Minimum Infrequent Low

The Minimum Infrequent Low flow or level is a very low and infrequent flow or level that may occur for short durations during more extreme droughts. Significant ecological impacts may occur rapidly if the water flow or level falls below the specified values or occur more frequently or for durations longer than specified. To prevent the system from deteriorating to a point from which it cannot recover, the duration and frequency of this level, as a result of man's activities, must be limited.

Implementation of Surface Water MFLs

The actual implementation of MFLs typically requires the use of hydrologic water budget computer models to generate long-term hydrologic statistics. Using these models in water supply planning and permitting, hydrologic statistics under proposed water withdrawal scenarios can be evaluated to determine if the proposed water level condition will fall below established MFLs.

Minimum Groundwater Levels

Minimum groundwater levels are typically not expressed as absolute water table levels or potentiometric heads at specific locations because of the dynamic nature of groundwater levels in response to recharge and withdrawal. Instead, such levels are defined by establishing impact thresholds (constraints) for listed criteria. This consideration is especially relevant when minimum groundwater levels are related to water supply planning.

An infinite combination of groundwater withdrawal points and quantities is possible. The various potential withdrawal scenarios may yield highly differing quantities of water before triggering a constraint. The same withdrawal quantities at different locations may result in different levels of drawdown, and the same levels of drawdown at different locations may impact the specified constraint to differing degrees. Furthermore, the degree of impact from withdrawals at one location may be affected by the occurrence or nonoccurrence of withdrawals at various other points. Therefore, it is not generally feasible to set definite minimum groundwater levels without specifying a particular withdrawal scenario. For this reason, the application of the water resource constraints rather than minimum groundwater levels is generally used in the water supply planning process. In a few cases, minimum groundwater levels have been established by rule as a consequence of minimum flows being established for springs or minimum levels being established for lakes.

SJRWMD assessed groundwater availability on the basis of how much water can be withdrawn without resulting in unacceptable adverse impacts to the water resources, including wetland and aquatic systems. This determination included any groundwater minimum levels adopted by rule, along with the other water resource constraints that address groundwater quality and other water resource impacts.

MFLs Reassessment Process

MFLs are established based on the data available at the time. SJRWMD plans to conduct periodic reassessment of the adopted MFLs based on consideration of the significance of particular MFLs in water supply planning and the relevance of new data that may come available. To that end, SJRWMD plans to

- Collect additional data
- Recalibrate models
- Develop and test criteria
- Compare projected scenarios with actual events

The processes used in this phase generally resemble those for setting initial MFLs. This phase may substantiate earlier work or modify previously set MFLs.

MFLs Established to Date

A complete list of established MFLs is provided in Appendix C. MFLs currently adopted by rule include

- Surface watercourses
  - Wekiva River at State Road 46
  - Blackwater Creek at State Road 44
- Surface waters
  - Sixty-seven lakes
  - Blue Cypress Water Management Area
- Aquifers
  - Eight springs in the Wekiva River Basin (minimum spring flow and a level in the aquifer at the springhead)

Proposed MFLs which are currently the subject of rulemaking include Lake Washington and the St. Johns River downstream of Lake Washington in Brevard County, Blue Spring in Volusia County, Taylor Creek downstream of Taylor Creek Reservoir in Osceola and Orange counties, and 12 lakes and/or wetlands, eight of which are in priority water resource caution areas.

Water Supply Planning Constraints and MFLs

Sustainable sources must be able to supply the needed amounts of water, as defined by projected demands, without causing unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses. Unacceptable adverse impacts were defined in this planning process as impacts which exceed water resource constraints. These constraints serve to limit withdrawals to a sustainable condition that is not expected to result in unacceptable adverse impacts. The initial water resource constraint used was that established by adopted MFLs. The development of other water resource constraints, and the analyses associated with them, occurred on a regional planning-level basis, using data that were available or developed for the planning area as a whole. This process was not performed at the same level of detail as that used when a proposed water use is reviewed in the context of SJRWMD's consumptive use permitting program. While DWSP water resource constraints and associated analyses are conceptually consistent with the consumptive use permitting environmental and existing legal uses protection criteria and the permit application review process, they should not be interpreted as a final determination or application of the consumptive use permitting criteria.

As discussed elsewhere in this plan, the SJRWMD water supply planning process defines unacceptable adverse impacts as the limits of water resource impacts beyond which unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses would occur (as defined by a constraint or MFLs). SJRWMD used the following four water resource constraints:

- Established MFLs
- Impacts to wetland and aquatic systems
- Impacts to groundwater quality
- Impacts to existing legal uses of water

Recovery and Prevention Strategy

Subsection 373.0421(2), *FS*, requires that a recovery or prevention strategy be developed if the existing flow or level in a water body is below, or within 20 years is expected to fall below, established MFLs. When MFLs for a water body/system are not being met or are not expected to be met in the future, SJRWMD will first examine the established MFLs in light of any newly obtained scientific data or other relevant information to determine whether the MFL should be reassessed. If no reassessment is necessary, a number of management tools are available to restore the water body/system to meet MFLs, including the following:

- Developing additional supplies
- Implementing structural controls and/or augmentation systems to raise levels or flows in water bodies
- Reducing consumptive use permit (CUP) allocations
- Requiring use of alternative water supply sources

SJRWMD focuses on prevention. SJRWMD's prevention strategy involves developing and implementing DWSP and considering potential impacts to MFLs in the permitting process. Water supply options identified in this DWSP have been evaluated on a regional planning-level basis for effects on established MFLs and were identified, in part, because implementing the options should not reduce flows or levels in any water body below established minimums. SJRWMD plans to prevent flows and levels from falling below established MFLs by implementing DWSP and continuing to conduct a more detailed, site-specific analysis in consumptive use permitting actions to confirm that MFLs are protected.

WATER SUPPLY DEVELOPMENT COMPONENT

This portion of DWSP has been prepared to meet the requirements of Paragraph 373.0361(2)(a), *FS*. This paragraph requires that DWSP include the following:

1. 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.
2. A list of water source options for water supply development, including traditional and alternative sources, from which local government, government-owned and privately owned utilities, self-suppliers, and others may choose, which will exceed the needs identified in subparagraph 1.
3. For each option listed in subparagraph 2, the estimated amount of water available for use and the estimated costs of and potential sources of funding for water supply development.
4. A list of water supply development projects that meet the criteria in s. 373.0831(4).

Based on the definition of water supply development included in Subsection 373.019(21), *FS*, SJRWMD considers a *water supply development project* one that contributes to 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.

This section of DWSP focuses on future water supply needs and the water supply sources and facilities required to meet the projected needs through 2020. SJRWMD developed water supply needs estimates for a number of use categories including public supply and agricultural irrigation, the largest use categories within SJRWMD. Water supply needs for 2020 are summarized by county as well as by use category. The impact of the 1-in-10-year drought is also included.

SJRWMD anticipates the most significant growth in water supply needs relates to expected growth in public supply demands. This is particularly true in priority water resource caution areas (Figure 1). This section of DWSP identifies an array of traditional and alternative water supply source options associated with each work group area as well as estimated costs of the needed facilities and funding sources. Except where specifically noted, DWSP does not identify water supply source options for water use categories other than public supply because existing and reasonably anticipated sources of water for those uses are considered adequate. DWSP may be amended in the future to identify water supply source options for other water use categories should those categories experience significant increases in water needs.

WATER SUPPLY NEEDS

Demand Projections

SJRWMD determined water supply needs based on the requirements of Subparagraph 373.036(2)(b)4a, *FS*, following guidelines and conventions developed by the Water Planning Coordination Group (WPCG). Existing legal uses of water for 1995, the base year, and anticipated reasonable-beneficial needs (demands) for 2020 have been estimated for the following water use categories:

- Public supply
- Domestic self-supply and small public-supply systems
- Commercial/industrial/institutional self-supply
- Thermoelectric power generation self-supply
- Agricultural self-supply
- Recreational self-supply

The SJRWMD goal in projecting water demands was to estimate projected needs mutually acceptable to water users and SJRWMD and those which appear to be reasonable based on the best information available. The methodology used to develop estimates of existing and projected demand is described in SJRWMD's *Water Supply Assessment: 1998* (Vergara 1998). Demand projections in all use categories are based on the assumption that current efforts to promote water conservation and the use of reclaimed water will continue through 2020.

SJRWMD developed demand projections for a 1-in-10-year drought for the public supply, domestic self-supply and small public supply systems, agricultural self-supply, and recreational self-supply categories. Drought events do not significantly impact demands in the remaining categories, because use in these categories is related primarily to processing and production needs.

Public suppliers were asked to provide their best estimates of projected demand, as well as estimates of their service area population in 2020. SJRWMD made its own demand projections based on estimates of population growth within the service area boundaries of public suppliers. Suppliers were asked to review their projections if the difference between the two sets was greater than 20 percent. In many cases, suppliers submitted revised projections more consistent with the population-based projections. However, the user-based projections remain higher in total than the SJRWMD population-based projections.

The projections developed by each utility were used as the initial basis for projecting impacts to water resources and developing work group area water supply plans. SJRWMD is committed to a planning process that involves all major water users and seriously considers the water supply plans of these users.

Summary of SJRWMD Water Demand for 1995 and 2020

Total water demand for 1995 and 2020 for SJRWMD is projected to increase from 1,371 mgd in 1995 to 1,679 mgd (population-based projections) or 1,863 mgd (user-based projections) in 2020 (Table 1). This growth represents an increase of 22 percent, assuming SJRWMD's population-based rate of growth, or an increase of 36 percent using the user-based projections. Table 2 provides additional water use information relative to source (groundwater or surface water) and projected demand growth by county.

Public supply accounts for the major portion of the projected demand increase, accounting for about 80 percent of the increase in use under either demand projection scenario. Public supply demand is projected to increase by 52 percent based on the population-based demand projections (Table 3). The difference between the population-based projections and the user-based projections, 184 mgd, is well within the level of uncertainty inherent in demand projections.

Although this uncertainty in public supply demand projections is significant, its impact on the planning process relates primarily to the planning horizon. If the higher user-based estimates are used as the basis for planning and these estimates prove correct, then facilities identified in this DWSP will be needed by 2020 to fully meet projected water supply needs. If the higher user-based estimates are used and the lower population-based estimates prove correct, then all of the facilities identified in this report will not be fully needed until sometime beyond 2020.

If the lower population-based needs estimates are used to identify water supply alternatives, and the higher user-based needs estimates prove

Table 1. Total water use for 1995 and 2020 for the St. Johns River Water Management District (SJRWMD)*

County	1995 Actual Use Total (mgd)	2020 Demand Projections (mgd)			
		Average Rainfall Year		1-in-10-Year Drought	
		Population-Based Total	User-Based Total	Population-Based Total	User-Based Total
Alachua	35.34	51.37	55.40	54.46	57.65
Baker	4.63	5.42	5.80	5.77	5.99
Bradford	0.60	1.10	1.10	1.13	1.11
Brevard	194.18	184.55	190.89	196.45	195.91
Clay	21.65	31.45	32.98	32.99	34.45
Duval	144.12	179.99	202.73	188.37	212.17
Flagler	15.92	20.95	23.82	22.76	24.61
Indian River	259.66	269.60	281.25	324.78	283.00
Lake	108.19	156.11	191.13	175.35	195.66
Marion	35.05	50.70	54.95	54.20	57.44
Nassau	61.59	70.56	75.09	71.91	75.91
Okeechobee	14.25	13.42	13.42	16.17	13.43
Orange	155.64	227.35	258.88	243.67	271.61
Osceola	16.56	16.05	16.05	17.57	16.05
Polk	3.55	7.11	7.11	8.58	7.18
Putnam	82.73	109.00	110.44	113.63	111.11
Seminole	69.87	102.72	116.50	109.09	122.40
St. Johns	50.99	60.38	80.72	68.48	82.96
Volusia	96.64	121.22	144.26	132.39	150.44
SJRWMD Total	1,371.16	1,679.05	1,862.52	1,837.75	1,919.08

*Figures include only water withdrawn in SJRWMD.

correct, then the identified facilities will not be adequate to meet 2020 needs and additional sources of supply and facilities will need to be identified and built before 2020. To avoid this situation and to comply with the statutory directive to identify water supply sources that meet or exceed water supply demands, SJRWMD has chosen to use the higher user-based projections for its planning purposes at this time. SJRWMD plans to monitor the actual water use that occurs compared to the

Table 2. Total water demand for 1995 and 2020 for the St. Johns River Water Management District (SJRWMD) by source

County	1995 Actual Use (mgd)			2020 Demand Projections (mgd)														Percent Change 1995 to 2020 (average year)	
				Average Year						1-in-10-Year Drought									
				Population-Based			User-Based			Population-Based			User-Based						
	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total			Population	User
Alachua	34.55	0.79	35.34	50.16	1.21	51.37	54.19	1.21	55.40	53.19	1.27	54.46	56.44	1.21	57.65			45	57
Baker	3.77	0.86	4.63	4.56	0.86	5.42	4.94	0.86	5.80	4.84	0.93	5.77	5.13	0.86	5.99			17	25
Bradford	0.60	0.00	0.60	1.10	0.00	1.10	1.10	0.00	1.10	1.13	0.00	1.13	1.11	0.00	1.11			83	83
Brevard	164.06	30.12	194.18	146.73	37.82	184.55	153.07	37.82	190.89	156.34	40.11	196.45	157.08	38.83	195.91			-5	-2
Clay	21.13	0.52	21.65	30.60	0.85	31.45	32.13	0.85	32.98	32.12	0.87	32.99	33.60	0.85	34.45			45	52
Duval	143.06	1.06	144.12	178.55	1.44	179.99	201.29	1.44	202.73	186.89	1.48	188.37	210.73	1.44	212.17			25	41
Flagler	14.70	1.22	15.92	18.15	2.80	20.95	21.02	2.80	23.82	19.88	2.88	22.76	21.81	2.80	24.61			32	50
Indian River	87.23	172.43	259.66	93.30	176.30	269.60	104.95	176.30	281.25	108.51	216.27	324.78	106.70	176.30	283.00			4	8
Lake	92.40	15.79	108.19	133.58	22.53	156.11	168.60	22.53	191.13	150.43	24.92	175.35	173.13	22.53	195.66			44	77
Marion	33.18	1.87	35.05	48.01	2.69	50.70	52.26	2.69	54.95	51.37	2.83	54.20	54.75	2.69	57.44			45	57
Nassau	56.87	4.72	61.59	64.24	6.32	70.56	68.77	6.32	75.09	65.49	6.42	71.91	69.59	6.32	75.91			15	22
Okeechobee	14.25	0.00	14.25	13.42	0.00	13.42	13.42	0.00	13.42	16.17	0.00	16.17	13.43	0.00	13.43			-6	-6
Orange	136.44	19.20	155.64	215.92	11.43	227.35	247.45	11.43	258.88	230.48	13.19	243.67	260.18	11.43	271.61			46	66
Osceola	6.57	9.99	16.56	6.06	9.99	16.05	6.06	9.99	16.05	6.98	10.59	17.57	6.06	9.99	16.05			-3	-3
Polk	3.31	0.24	3.55	6.54	0.57	7.11	6.54	0.57	7.11	7.88	0.70	8.58	6.61	0.57	7.18			100	100
Putnam	32.67	50.06	82.73	50.42	58.58	109.00	51.86	58.58	110.44	54.82	58.81	113.63	52.53	58.58	111.11			32	33
Seminole	68.30	1.57	69.87	100.35	2.37	102.72	114.13	2.37	116.50	106.64	2.45	109.09	120.03	2.37	122.40			47	67
St. Johns	48.73	2.26	50.99	56.32	4.06	60.38	76.66	4.06	80.72	64.32	4.16	68.48	78.90	4.06	82.96			18	58
Volusia	90.81	5.83	96.64	114.26	6.96	121.22	137.30	6.96	144.26	124.40	7.99	132.39	143.48	6.96	150.44			25	49
SJRWMD Total	1,052.63	318.53	1,371.16	1,332.27	346.78	1,679.05	1,515.74	346.78	1,862.52	1,441.88	395.87	1,837.75	1,571.29	347.79	1,919.08			22	36

Note: Figures include only water withdrawn in SJRWMD.

Table 3. Total water demand for 1995 and 2020 for the St. Johns River Water Management District by category of use

Category	1995 Actual Water Use (mgd)			2020 Water Use (mgd)									Percent Change 1995 to 2020*		Percent of Total 2020 Change*	
				Average Rainfall Year						1-in-10-Year Drought						
				Population-Based			User-Based			Population-Based						
	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Ground	Surface	Total	Average	1-in-10	Average	1-in-10
Public supply	444.61	12.15	456.76	677.45	16.81	694.26	860.92	16.81	877.73	718.12	17.82	735.94	52	61	77	60
Domestic and other small public supply	71.98	0.00	71.98	64.84	0.00	64.84	64.84	0.00	64.84	68.73	0.00	68.73	–10	–5	–2	–1
Agricultural irrigation	363.58	223.39	586.97	368.45	220.69	589.14	368.45	220.69	589.14	430.76	267.55	698.31	0	19	1	24
Recreational irrigation	68.78	30.35	99.13	107.77	48.67	156.44	107.77	48.67	156.44	110.51	49.89	160.40	58	62	19	13
Commercial/industrial /institutional	96.02	38.14	134.16	102.63	44.19	146.82	102.63	44.19	146.82	102.63	44.19	146.82	9	9	4	3
Thermoelectric power generation	7.66	14.50	22.16	11.13	16.42	27.55	11.13	16.42	27.55	11.13	16.42	27.55	24	24	2	1
Total	1,052.63	318.53	1,371.16	1,332.27	346.78	1,679.05	1,515.74	346.78	1,862.52	1,441.88	395.87	1,837.75	22	34	101	100

Note: Figures include only water withdrawn in the St. Johns River Water Management District.

*Based on population-based projection.

projections made in this DWSP and to revise the projections in future updates of DWSP. For example, if growth projections prove to be too high or additional levels of water conservation or reuse can be achieved on a regional scale, then demand projections can be reduced.

For the remaining use categories, demand shifts are minor (Table 3). The net change in agricultural irrigation demand is expected to be insignificant; changes in acreage and crops in specific locations are expected to balance one another out so that the net change is negligible. Conservation efforts in agriculture are anticipated to result in improved efficiencies at the farm level. However, at this time, no major changes are anticipated in technology that would substantially reduce irrigation needs.

Appendix E provides a detailed breakdown of existing and projected water supply needs, by use category, for each of the 19 counties located in SJRWMD. In addition, individual demand projections have been developed for public supply utilities projected to provide at least 0.25 mgd by 2020. These demand projections served as the basis for groundwater modeling and facilities planning in the work groups.

Traditional and Alternative Water Supply Source Options

Water supply options applicable to this DWSP include these naturally occurring sources:

- Fresh groundwater
- Brackish groundwater
- Surface water
- Seawater

In addition, a number of management techniques can enhance the source of supply, sustain the water resources and related natural systems, or otherwise optimize water supply yield. These techniques include the following:

- Artificial recharge
- Aquifer storage recovery
- Avoidance of the impacts of groundwater withdrawal through artificial hydration
- Water conservation
- Use of reclaimed water
- Water supply systems interconnections

Naturally Occurring Sources

Fresh Groundwater

Fresh groundwater occurs in all three of the aquifer systems in SJRWMD: the Floridan, the surficial, and the intermediate. However, the distribution of fresh groundwater in these aquifer systems is variable. These aquifer systems and this variability in their water quality are described in the Introduction section of this DWSP.

The availability of water for reasonable-beneficial use from these aquifer systems is controlled by the extent to which groundwater withdrawals from these aquifer systems will impact water quality, wetland and aquatic systems, and existing legal uses. The water resource constraints described in the Methods section of this DWSP represent the limits of such impacts that are acceptable to SJRWMD for water supply planning purposes.

The water supply potential of these aquifer systems has been addressed in the *Water 2020* process. Groundwater flow and water quality models and decision models have been used by SJRWMD and the work groups to assess the extent to which groundwater withdrawals, particularly from the Floridan aquifer, can occur in a sustainable manner. Evaluations using these models indicate that some additional fresh groundwater can be developed from the Floridan aquifer in much of SJRWMD. The quantity of additional fresh groundwater that can be developed is dependent on the locations of withdrawals and the rates of withdrawals at those locations. Within much of SJRWMD's priority water resource caution areas, fresh groundwater withdrawal is nearing sustainable limits and alternative sources and/or management techniques will be needed to fully meet future needs without incurring unacceptable impacts to water quality, wetlands and aquatic systems, and existing legal uses.

The availability of fresh groundwater in each work group area is addressed more fully in the work group sections of the Water Supply Development Component of this DWSP.

Brackish Groundwater

Brackish groundwater from the Floridan aquifer is an abundant potential water source in much of the coastal area of SJRWMD and currently meets a portion of the water supply needs for several municipalities, including the City of Melbourne located in Brevard County. However, brackish groundwater is considerably more expensive than fresh groundwater to treat because it requires desalting, and waste concentrate disposal often complicates implementation.

The potential for developing brackish groundwater resources for public supply purposes has been evaluated at a number of sites within the priority water resource caution areas, including potential withdrawal sites located in northern and southern Brevard County, eastern Orange and Seminole counties, north-central Volusia County, and north-central St. Johns County (CH2M HILL 1998a). Treatment requirements and costs have also been investigated for these sites (CH2M HILL 1997f, 1998b).

The results of these investigations indicate that substantial quantities of slightly to moderately brackish groundwater could be developed in the coastal areas. Any long-term withdrawal of significant quantities of brackish groundwater would result in some deterioration in water quality. However, the rate of change in water quality can be controlled by careful wellfield design and operation. Anticipated changes in water quality would not impact treatability. A low-pressure membrane process would be sufficient to treat these brackish groundwater resources.

Although there is abundant brackish groundwater available for development in SJRWMD, prospective developers of this source should consider two challenges that may be encountered in its development. These challenges are (1) impacts on groundwater levels and (2) desalting concentrate management.

Withdrawals of brackish groundwater will result in declines in Floridan aquifer and surficial aquifer water levels. Such declines would contribute to impacts to water resources and must be considered along with declines resulting from freshwater withdrawals in order to avoid unacceptable adverse impacts to the water resources and related natural systems.

Approximately 15 to 20 percent of water withdrawn for desalting would become a waste concentrate containing dissolved constituent concentrations approximately 4.5 to 6 times the raw water concentrations. Environmentally sound and permittable management of this waste concentrate presents an important challenge to the development of significant quantities of brackish groundwater within SJRWMD.

Brackish groundwater from the Floridan aquifer can be blended with freshwater from the intermediate or shallow aquifers, or other available sources, to meet both peak demand and *average day demand*. This technique is currently used by several public supply utilities in SJRWMD and can be expanded further to meet future demands.

Surface Water

Available in relative abundance, surface water is also a potential water supply source. Surface water is currently used in limited quantities to meet both public supply and agricultural needs. Several surface water systems can potentially supply water to SJRWMD and have been considered in the development of this DWSP. These systems include the following:

- St. Johns River
- Ocklawaha River Basin
- C-1 Canal (in Brevard County)
- Taylor Creek Reservoir (in Osceola and Orange counties)

Estimated maximum potential water supply yield from these surface water sources is summarized in Table 4.

Table 4. Potential surface water supply yields from selected candidate withdrawal points

Candidate Water Supply Withdrawal Point	Estimated Maximum Potential Water Supply Yield (mgd)	Raw Water Quality
St. Johns River near Cocoa	108	Fresh to slightly brackish
St. Johns River near Titusville	143	Fresh to moderately brackish
St. Johns River at Sanford (Lake Monroe)	279	Fresh to moderately brackish
St. Johns River near De Land	351	Fresh to moderately brackish
Upper Ocklawaha River Basin	14	Fresh surface water
Lower Ocklawaha River Basin	107	Fresh, with large groundwater base flow
Taylor Creek Reservoir	20 to 25	Fresh surface water
C-1 Canal (Brevard County)	6 to 11	Fresh to slightly brackish

Note: Water supply yields for the St. Johns River sites are cumulative. The total estimated water supply yield for the St. Johns River upstream from De Land is 351 mgd. The total estimated potential surface water yield from all sources investigated is approximately 500 mgd.

St. Johns River. A previous alternative water supply strategies investigation (CH2M HILL 1996b) identified four possible withdrawal sites located on the St. Johns River (Table 4).

Though the St. Johns River can supply a large quantity of raw water, this water varies both in quantity and quality. The St. Johns River, like most rivers, is subject to floods and droughts. To accommodate these fluctuations, significant amounts of raw and/or finished water storage would be required to ensure a reliable water supply.

None of the St. Johns River candidate withdrawal points identified in the alternative water supply strategies investigation have established MFLs. Because MFLs have not been established for the St. Johns River, the surface water supply availability and yield analysis (CH2M HILL 1997b) included application of an interim withdrawal rule to account for withdrawal restrictions likely to be implemented as part of future MFL consideration. The interim withdrawal rule considers both low-flow maintenance and total maximum diversion rates. The preliminary analysis of water supply development potential was based on the assumption that withdrawal from the river would not be allowed during low-flow periods defined by the 95 percentile flow. This means that no river water withdrawal would be allowed when the river experienced low-flow conditions (5 percent of the time). Also, a maximum instantaneous withdrawal rate of 25 percent of the mean streamflow rate was assumed as the basis for setting a realistic upper limit on potential water supply withdrawal volume.

During low-flow periods, the St. Johns River water is also slightly to moderately brackish. Therefore, the diverted flow would require partial desalting and associated desalting concentrate management. Based on discussions to date with DEP staff, SJRWMD anticipates that desalting concentrate resulting from the treatment process would be discharged to the St. Johns River downstream of the point of withdrawal.

In addition, the need to control disinfection byproducts may increase membrane treatment requirements even further than required for salt removal. With ozone disinfection of brackish waters, bromate formation can be a major concern that could control the amount of diverted water needing membrane treatment, and, therefore, overall water supply development costs.

Surface water is generally more difficult to treat than groundwater because of the inherent flow and raw water quality variability. Given the partial desalting it requires (with associated desalting concentrate management) and the potential additional treatment to control unwanted disinfection byproducts, the St. Johns River is a more difficult and expensive water source than many other river systems.

The City of Melbourne currently obtains a portion of its water supply from Lake Washington, located on the main stem of the St. Johns River. This withdrawal point is considerably upstream from the four identified potential withdrawal points. Because the salinity of the St. Johns River generally tends to increase downstream, Lake Washington water is much less saline than downstream locations. Raw water withdrawn from Lake

Washington meets primary and secondary drinking water standards for dissolved salts and only requires conventional surface water treatment.

Ocklawaha River. Two candidate Ocklawaha River watershed surface water withdrawal sites were considered. The first is within the upper basin and was included in the alternative water supply strategies investigation (CH2M HILL 1996b). An estimate of potential yield was made based on long-term flow records available from Haines Creek, which connects Lake Eustis to Lake Griffin in northern Lake County. Although Haines Creek flow records were used in the preliminary water supply analysis, there is considerable flexibility in the location of the actual water supply withdrawal point. It could be located anywhere in the upper Ocklawaha River Basin in northern Lake County. A potential water supply yield of 14 mgd has been estimated for the upper Ocklawaha River Basin. Although limited in quantity, the raw water is always fresh and only conventional surface water treatment would be required. Desalting would not be required.

Determination of exact treatment requirements will require additional water quality monitoring and treatability testing. The upper Ocklawaha River Basin, as well as other SJRWMD surface waters including the middle St. Johns River, contain blue-green algae, which generates toxins under certain conditions. More needs to be known about the occurrence, distribution, and treatment requirements of these blue-green algae and associated toxins before the upper Ocklawaha River Basin or the middle St. Johns River are developed for public supply. If future treatability studies conclude that any candidate surface water source, including the upper Ocklawaha River Basin, cannot be treated to provide a safe public supply meeting all drinking water standards and rules, then this source will not be considered further for meeting future public supply needs.

SJRWMD plans to develop environmental restoration projects along the Ocklawaha River. The amount, duration, and/or frequency of water needed to meet project restoration goals may affect the amount, duration, and/or frequency of withdrawals from surface water sources for water supply. In most cases, water needs for restoration are still being analyzed and developed. When the SJRWMD Governing Board makes decisions on restoration project plans, it will consider environmental restoration needs and water supply needs and the preliminary estimate of available water supply may be revised.

The second Ocklawaha River site is located in the lower basin just upstream of the St. Johns River. Unique hydrologic factors make this location favorable for surface water supply development. Inflow to the lower reaches of the Ocklawaha River Basin includes discharge from Silver Springs, located near Ocala, in Marion County. Silver Springs is the largest spring in SJRWMD, with a long-term average discharge of about 876 mgd. It accounts for about 93 percent of spring discharge in the Ocklawaha River watershed and about 60 percent of the total outflow from Rodman Reservoir, located just upstream of the St. Johns River.

The water quality of the lower Ocklawaha River is very good, due in large part to the substantial fresh groundwater contribution of Silver Springs. The water is always fresh and would require only conventional surface water treatment prior to transport and distribution. The combination of good raw water quality and significant base flow makes this an attractive candidate site for surface water supply development. Neither expensive membrane treatment nor raw or finished water storage facilities would be required.

The water supply potential of the lower Ocklawaha River Basin was investigated by Hall (1995). The analysis focused on the environmental impact of withdrawal both to Rodman Reservoir and to the downstream portion of the Ocklawaha River Basin. It was concluded that an environmentally safe water supply yield of at least 107 mgd could be developed. Hall concluded that this water supply yield is environmentally feasible with or without Rodman Reservoir.

The main disadvantage of the lower Ocklawaha River Basin potential withdrawal point is its location relative to areas with significant projected demand growth. Significant and costly finished water transport facilities would need to be constructed to meet identified public supply needs.

Taylor Creek Reservoir. Taylor Creek Reservoir is located in Osceola and Orange counties near the City of Cocoa's Dyal Water Treatment Plant. This reservoir contains freshwater, which is generally of better quality than in the St. Johns River. Taylor Creek Reservoir raw water is always freshwater. The City of Cocoa is currently developing the Taylor Creek Reservoir as a water supply source, and SJRWMD has issued a CUP for water supply withdrawal from Taylor Creek Reservoir. Ultimate potential water supply yield has not yet been established but is likely to be on the order of 20 to 25 mgd. Following adoption of an MFL for Taylor Creek, this analysis can be made.

C-1 Canal. The C-1 Canal watershed is wholly contained within Brevard County and is located near the City of Palm Bay. Currently, all C-1 Canal waters discharge to the Indian River Lagoon through Turkey Creek. An ongoing SJRWMD re-diversion project will alter the current flow patterns and restore natural discharge patterns as much as practical. The re-diversion project will reintroduce flow into the St. Johns River and reduce freshwater discharge to the Indian River Lagoon.

The C-1 Canal re-diversion project provides an opportunity for developing a limited surface water supply. Investigation of the C-1 Canal as a potential public water supply source has been conducted at the conceptual planning level (CH2M HILL 1999a). This investigation found that a relatively small water supply (from 5.5 to 11 mgd) could be developed at the canal, and available water quality data indicate that the raw water is mostly fresh. However, this water exceeds the secondary drinking water standard for TDS from time to time. This source could be desalted to provide finished water that would meet all drinking water standards, or it could be treated without desalting and blended with an existing freshwater source.

Seawater

Seawater can meet public water supply needs. However, seawater is currently a relatively expensive water supply option compared to other water supply options that have been identified and investigated to meet projected needs in the priority water resource caution areas. Desalting of seawater to meet anticipated public water supply needs would generate a large waste concentrate stream. Environmentally and economically feasible concentrate management solutions will pose significant challenges to implementation of seawater desalting projects.

Because of the relative cost and availability of other less expensive options, seawater desalting is considered as a general option available to all water supply utilities but is not considered among the utility-specific options identified in this plan.

It is reasonable to assume that seawater will be developed as a water supply source within SJRWMD in the future. However, it is unlikely that significant quantities of seawater will need to be developed in SJRWMD before 2020. Seawater desalting technology is continually advancing, and the relative cost between seawater and other alternative public supply sources will likely narrow in the future. Coastal areas are more likely than inland areas to develop seawater resources. Special case situations, such as co-siting a seawater desalting plant with an electric power plant, may make this water supply source competitive with the development of other water supply sources. SJRWMD proposes to investigate the technical, environmental, and economic feasibility of co-siting seawater desalting facilities with specific electric power plants in association with future water supply planning efforts. This investigation is identified in the Water Resource Development Component of this DWSP.

Management Techniques

Artificial Recharge

Artificial recharge is the replenishment of groundwater by means of spreading basins, recharge wells, or other induced infiltration techniques. Landscape and crop irrigation also induces some artificial recharge, although most applied irrigation water is lost to the atmosphere through evapotranspiration. Source water can be surface water, reclaimed water, or irrigation water.

Managed artificial recharge can be used to help offset aquifer potentiometric surface declines resulting from groundwater withdrawals, thereby effectively increasing available supply. Hydraulically, the most effective artificial recharge techniques are those that maximize emplacement of water in the pumped aquifer(s).

Artificial recharge is currently used in SJRWMD, and this use is expected to increase in the future. Rapid infiltration basins (RIBs) are often used, along with reclaimed water, to provide aquifer recharge. This DWSP accounts for increased uses of RIBs in proportion to increased wastewater production.

Aquifer recharge wells have been used for drainage and lake-level control in the Orlando area since 1905. These wells emplace surface water directly into the Floridan aquifer, thereby increasing available water supply. Current artificial recharge via recharge wells, in Work Group Area I, is estimated to be between 39 and 52 mgd (CH2M HILL 1997d). Therefore, existing recharge wells provide a significant quantity of artificial recharge.

It is technically possible to substantially increase artificial recharge in Work Group Area I by construction of additional artificial recharge wells. However, existing regulatory policy discourages the construction of new artificial recharge wells. Current policy will not permit the emplacement of additional water in the Floridan aquifer unless all primary and secondary drinking water standards are met at the wellhead, which means only drinking water can be emplaced. This criterion is economically infeasible to meet in urban drainage and lake-level control applications.

Increased artificial recharge, via new recharge wells, was not included as a factor in the decision-modeling process in Work Group Area I. However, an artificial recharge demonstration project is proposed to further investigate the potential for use of new recharge wells to increase available fresh groundwater supplies.

Aquifer Storage Recovery (ASR)

ASR systems store treated drinking water underground in a suitable aquifer when sufficient water production capacities are available. The aquifer stores this treated water for later withdrawal and distribution, when water supply demands exceed the water supply. Although not a direct water source, ASR can be used to help manage and develop water supplies.

ASR has two major potential applications for public water supply development: (1) to provide system reliability and (2) to help meet peak flow demands.

Some sources of supply, including many surface water supply options, can be intermittent and therefore inherently unreliable. In this case, an ASR system can be used to store large quantities of finished water for distribution and use during drought periods when allowable surface water flow diversions are inadequate to meet the water supply demands.

ASR can also be used to help manage peak flow conditions. Without significant finished water storage capabilities, water supply treatment plants must be designed to supply the peak demand. *Maximum day demands* are typically 30 to 80 percent greater than average day demands. ASR can reduce the required maximum treatment rate, which in turn reduces the treatment plant size and operation costs. Specifically, water treatment plants can accommodate peak demand by combining real-time treatment with ASR system withdrawal.

Avoidance of the Impacts of Groundwater Withdrawal Through Artificial Hydration

In many of the priority water resource caution areas, the potential impacts of groundwater withdrawal on wetlands are a major concern. In many cases, the possibility of dehydrating wetlands limits the quantity of freshwater that can be withdrawn from the Floridan aquifer.

Lower water levels impact wetlands. These impacts include changes in natural vegetation patterns. Groundwater withdrawals reduce the potentiometric surface of the aquifer, which can in turn lower surficial aquifer water levels and water levels in nearby wetlands. Many wetland systems are sensitive to relatively small changes in long-term average water levels. To avoid adverse impacts to native wetland systems, groundwater withdrawal must be managed to avoid excessively dehydrating wetlands, on both a local and a regional scale.

Although this DWSP is primarily designed to prevent adverse impacts from occurring by limiting groundwater withdrawal quantities and utilizing management techniques such that unacceptable adverse impacts to wetlands do not occur, artificial hydration may be a potential additional tool to avoid adverse impacts.

The concept of wetland impact avoidance through artificial hydration techniques has been openly discussed by the work groups and is being investigated by SJRWMD through its Wetland Augmentation Demonstration Program as described in the Water Resource Development Component of this DWSP.

Water Conservation

Water conservation is considered a water supply option because reducing water supply needs contributes to the goal of assuring adequate future water supplies. As a water supply option, water conservation will be treated in SJRWMD's regional decision-making process in the same manner as other alternatives, including the consideration of cost versus benefits and technical feasibility. However, estimating potential savings from water conservation practices on a regional basis has many uncertainties. Potential water savings and the overall effectiveness of water conservation programs can be variable and can depend on a wide range of factors from local socio-economic conditions to the type of program incentives used during implementation. In addition, because a large percentage of water use by public supply utilities is for lawn and landscape irrigation (potentially as much as 40 to 50 percent of the annual average water use), many conservation programs and practices target this use. However, use of reclaimed water also results in a reduction of the quantity of potable water supply used for lawn and landscape irrigation. Therefore, the quantity of water savings potentially obtained through conservation and use of reclaimed water is not additive.

All SJRWMD CUP holders are required to implement comprehensive water conservation programs. However, specific increased quantities of water conservation were not considered in the development of water supply alternatives identified in this DWSP. Conservation options considered in this DWSP would supplement existing programs.

The water demand estimates for 2020 presented in this DWSP are based on the assumption that at least the existing level of conservation will be maintained in the future. Estimates of increased demand through 2020 would be about 10 percent higher if conservation were not a component of the plan. Additional water savings could probably be achieved through increased conservation efforts; however, the amount of savings is highly dependent on the extent of conservation already in place. Many users, such as agriculture, are already achieving high levels of conservation through management of their irrigation practices, and it appears unlikely that any significant additional conservation could be achieved by these users. The greatest potential for savings exists in public supply, because public supply has the greatest projected increase in demand by 2020 and the highest potential to achieve increased water savings through implementation of more extensive water conservation programs. Therefore, SJRWMD will focus a significant portion of its conservation efforts on public supply where commitment of staff time and funding have the greatest potential for further reducing water demand.

Several methods are available to public supply utilities to support water conservation programs. These methods include operational and consumer conservation practices, local water conservation ordinances, and conservation rate structures. SJRWMD investigated the potential water savings related to these methods (PBSJ 1998c, 1999a); the results of these investigations are summarized in Appendix F.

A report by PBSJ (1998c) summarized the results of utilizing SWFWMD's WATERRATE model to evaluate the impact of implementation of three water conservation rate structure types on water demand for eight representative utilities within SJRWMD. The study found that, while potential water savings from water conservation rate structure implementation can be significant, individual circumstances have a high degree of influence on the effectiveness of conservation rate implementation. The following conclusions were made:

- The water savings that can be potentially achieved with water conservation rate structures are dependent on a utility's current rate structure. For example, a utility that currently has a three-block inclining rate structure will see little to no additional savings by converting to a four-block structure. However, one that currently does not have a conservation rate structure could see more potential savings.

- Sewer usage rates can also interfere with the effects of conservation rates for water. Some utilities base sewer rates on water consumption up to a quantity at which it is assumed that no more of the water consumed will go into the sewer. At that point, the sewer fees become capped and the consumer is charged only for water. Under these circumstances, the combined consumer cost of water and sewer per unit for the lower volumes of water consumption may be higher than the per unit cost for just water after the sewer charge cap is reached. This situation was observed for one utility where it was estimated that implementation of a water conservation rate structure could actually result in an increase in water consumption.
- The greatest conservation effect can be achieved by reducing the fixed charge for utilities that currently have very high fixed charges.
- Conservation rates for the sample utilities tend, overall, to result in long-term water savings.
- Potential savings for the eight utilities analyzed ranged from a low of less than 0 percent (water use could actually increase with water conservation rate structure implementation) to nearly 18 percent.

PBSJ (1999a) evaluated the potential costs and effectiveness of operational conservation practices, consumer conservation programs, and local ordinances related to water consumption. The study included interviews with and data collection from Florida utilities and WMDs, with information available on the cost and effectiveness of existing conservation programs in the state. In addition, a nationwide literature review was conducted. A summary of the potential water savings that can be achieved by implementing various water conservation programs is presented in Table 5. The data summarized in Table 5 include some impressively high water savings. However, the water savings achieved under controlled experimental circumstances in specific locations should not be assumed to be possible, in general, under other conditions. For example, relatively little reduction in utility water loss can be achieved through leak detection and repair programs in many parts of SJRWMD because of the low average age of the piping systems. Likewise, the usefulness of plumbing retrofit programs for reducing water use is generally limited to older neighborhoods because newer homes were constructed with low-flow fixtures at the outset.

Costs for the various conservation programs and practices were developed using methodologies established in SJRWMD's alternative

Table 5. Potential water savings from water conservation programs

Conservation Type	Potential Water Savings
Utility leak detection and repair*	13%
Utility system water audits*	12%–33%
Monthly billing	Not available
Plumbing retrofit kit†	5%–20%
Plumbing retrofit toilet replacement/rebate†	20%–30%
Irrigation system retrofit	Not available
Consumer leak detection	Not available

Note: The savings presented in Table 5 represent the maximum potential savings that could be achieved based on no current conservation measures in place and for a utility customer base consisting primarily of residential domestic water use. These are potential savings based on data presented in the literature. Water savings are not necessarily additive. Actual savings will be utility-specific and dependent on conservation measures already in place.

*Savings based on percentage of average utility pumpage.

†Savings based on daily household consumption, not total for utility. Savings apply to residential domestic water use only.

water supply strategies investigation so that conservation measures could be compared to other alternative water supply strategies being evaluated (Table 6).

A study performed for the former West Coast Regional Water Supply Authority, now Tampa Bay Water, evaluated three scenarios of water conservation program implementation (Ayres Associates 1997). Scenario 1 was based upon utilities continuing with current levels of water conservation. This scenario was estimated to result in a potential range of water savings of approximately 9 to 17 percent compared to water demand projections based on no conservation. Scenario 2 assumed that a moderate conservation program would be implemented that includes voluntary and incentive approaches and was estimated to provide total water savings ranging from approximately 11 to 25 percent. Scenario 3 was based upon an aggressive program with regulatory and incentive approaches and was estimated to achieve savings ranging from 17 to 42 percent. The study concluded that the lower end of the ranges are most realistic and that significant levels of demand reduction can be achieved through conservation.

Based on the SJRWMD investigations performed during the water supply planning process and Ayres Associates 1997, it is estimated that public

Table 6. Cost effectiveness of operational and consumer conservation practices and programs

Conservation Type	Average ($/1,000 gallons saved)	Range	Service Life (years)	Number of Sources Referenced
Operational Conservation Practices				
Utility system leak detection and repair	0.12	0.04–0.27	5	3
Utility system water audits*	0.07	0.03–0.11	5	5
Consumer Conservation Programs				
Plumbing retrofits				
Retrofit kits†	0.60	0.04–1.69	10	30
Toilet rebate/replacement	1.60	0.51–3.70	20	11

Note: Costs based on data found in literature times a factor of 1.45 to account for nonconstruction capital costs. All costs in 1996 dollars.

*Includes one or more of the following: meter testing, leak detection (not repair), and system inventory.

†Includes retrofit kit costs for programs with and without audits.

Source: PBSJ 1999a

water supply projections for 2020 would have been approximately 10 percent higher than those that were used in the SJRWMD models without consideration of continuing current levels of conservation. The estimates of the quantity of water saved by current conservation practices are shown in column D of Table 7.

The potential exists for saving more water through increased efficiency of use, and avoidance of line losses and consumer wastage. It is estimated that another 10 percent of the remaining increase in water use through 2020 may potentially be saved through additional water conservation practices. The difference between current water use projections and those same projections minus an additional 10 percent for increased water conservation is 35.75 mgd.

The cost of increased conservation is difficult to quantify. The average costs presented in Table 6 range from less than $0.10 per 1,000 gallons to $1.60 per 1,000 gallons saved. The low end of the costs represents utility leak detection and repair, which is a component that would be considered in the existing levels of conservation being achieved by utilities. While the projections of potential water savings that could be achieved through

Table 7. Potential water savings from water conservation (mgd)

Work Group Area	A 1995 Water Use	B 2020 Projected Water Use	C Increase in Water Use 1995 to 2020 (B minus A)	D Estimated Water Savings From Conservation in 2020 Projections (10% of C)	E Potential Additional Water Savings With Increased Conservation in 2020 (10% of [C–D])
I*	288.06	558.22	270.16	27.02	24.31
IA	51.11	81.43	30.32	3.03	2.73
II	47.44	89.21	41.77	4.18	3.76
III	4.40	12.94	8.54	0.85	0.77
V	65.91	112.30	46.39	4.64	4.18
Total	456.92	854.10	397.18	39.72	35.75

*SJRWMD 1999

increased conservation appear significant, they do not eliminate the need for developing the facilities described in this DWSP. Increased conservation could, however, extend the need for these facilities sometime beyond 2020.

If the reduced projections are used to identify water supply alternatives and if the target level of water conservation is not achieved, then the identified facilities will not be adequate to meet 2020 needs and additional sources of supply and facilities would need to be identified and built before 2020. To avoid this situation, SJRWMD has chosen to base its future water supply needs on the assumption that present levels of water conservation will continue rather than assuming that yet unattained conservation levels will be reached. At worst, the sources and facilities identified in DWSP would not be fully needed in 2020 and additional time would be available for implementation.

Use of Reclaimed Water

Most utilities in SJRWMD practice some form of reuse. In 1995, it was estimated that over half of the 187.37 mgd of wastewater produced in Brevard, Lake, Orange, Seminole, and Volusia counties was reused (PBSJ 1998b). For the purpose of the DWSP, the only reuse which is considered is that which provides a water resource benefit. This would include reuse systems that result in the replacement of groundwater or potable water for nonpotable water uses or reuse systems that provide recharge to the Floridan aquifer. About 40 percent of the wastewater produced in 1995 in these five counties (75 mgd) was utilized in a reuse application. SJRWMD's demand estimates used in the options analysis were generally based upon continuing these existing levels of reuse in 2020.

For Work Group Areas I and II, the groundwater models used to estimate deficits in fresh groundwater supply included increased recharge resulting from expansion of reclaimed water systems at the existing level. This increased recharge would have the effect of lowering the potential deficits by recharging the surficial aquifer and thus reducing potential impacts to wetlands. Tables 8 and 9 show the estimated amounts of increased recharge associated with land application of reclaimed water either from RIBs or irrigation forms of reuse in Work Group Areas I and II. The analysis did not distinguish between the application of reclaimed water using RIBs or septic tanks in high recharge areas in Work Group Area II because both would serve to recharge the surficial aquifer (Table 9).

Table 8. Recharge rates (mgd) used in the east-central Florida groundwater flow model (Work Group Area I) by method of land application of reclaimed water

County	1995		2020	
	Spray Irrigation	RIBs	Spray Irrigation	RIBs
Brevard	6.24	0.27	12.41	0.54
Lake	9.55	1.15	12.77	13.64
Orange	12.21	25.76	23.11	42.08
Osceola	3.26	6.53	6.98	13.06
Seminole	9.20	2.69	18.40	4.38
Volusia	1.76	0.00	3.66	0.00
Total	42.22	36.40	77.33	73.70

Note: RIB = rapid infiltration basin

Source: McGurk and Presley 1999

Because the current amount of reuse and the ability to implement additional reuse vary significantly among users, SJRWMD has not attempted to project specific additional reductions in potable water use resulting from increased use of reclaimed water to meet nonpotable water needs for individual utilities. A generalized analysis by work group area was performed in order to determine potential quantities of reclaimed water that may be available for additional reuse within the five work group areas by 2020 (Table 10).

Table 9. Recharge rates (mgd) used in the Volusia groundwater flow model (Work Group Area II) to account for land application of wastewater and reclaimed water

Utility/Facility	Type	1995	2020	Increase
Daytona Beach	Golf course irrigation	3.5	3.5	0
	Residential/public access reuse	1.5	3.5	2
De Land—Brandywine	Residential/public access reuse	0.12	0.12	0
De Land—Regional	Golf course irrigation	0.266	0.40	0.134
	RIBs and/or septic tanks	2.04	2.37	0.33
Edgewater	Residential/public access reuse	0.475	1.54	1.065
New Smyrna Beach	Golf course irrigation	0.6	0.6	0
	Residential/public access reuse	0.5	3.08	2.58
Port Orange	Golf course and residential/public access reuse	1.0	3.37	2.37
Holly Hill	Golf course and residential/public access reuse	0.5	0.64	0.14
Ormond Beach	Golf course irrigation	0.29	0.3	0.01
	Residential/public access reuse	2.21	2.41	0.2
Breakaway Trails	Residential/public access reuse	0.106	0.106	0
Tymber Creek	Residential/public access reuse	0.044	0.044	0
Seabridge	Residential/public access reuse	0.058	0.058	0
FWS—Deltona	Golf course irrigation	0.887	1.82	0.933
	RIBs and/or septic tanks	5.95	9.11	3.16
Lake Helen	RIBs and/or septic tanks	0.18	0.64	0.46
Orange City	RIBs and/or septic tanks	1.0	2.12	1.12
VC—Southwest	RIBs and/or septic tanks	0.58	7.73	7.15
	Golf course irrigation	0.4	0.6	0.2
VC—Four Townes	Residential/public access reuse	0.195	0	-0.195
VC—Hacienda	RIBs and/or septic tanks	0.032	0.144	0.112
VC—Indian Harbor	RIBs and/or septic tanks	0	0.144	0.144
VC—Lighthouse Point	RIBs and/or septic tanks	0	0.072	0.072
VC—Deltona North	RIBs and/or septic tanks	0.313	1.01	0.697
VC—Spruce Creek	RIBs and/or septic tanks	0.173	0.46	0.287
VC—Northeast	RIBs and/or septic tanks	0.14	0.56	0.42
VC—Ag. Center	RIBs and/or septic tanks	0.01	0.02	0.01
VC—Cassadaga	RIBs and/or septic tanks	0.01	0.04	0.03
Total		23.08	46.51	23.43

Note: FWS = Florida Water Services
RIB = rapid infiltration basin
VC = Volusia County

Source: Stan Williams, pers. comm. 1999

Table 10. Potential annual average reclaimed water supply in priority water resource caution area work group areas (mgd)

Work Group Area	A	B	C	D	E	F	G
	Total Existing Treated Wastewater, 1998	Projected Percentage of Treated Wastewater Increase in 2020	Projected Total 2020 Treated Wastewater (A times % increase)	Existing Beneficial Reuse	Projected 2020 Treated Wastewater Minus Existing Reuse (C minus D)	Reusable Treated Wastewater in 2020 Without Mass Storage (50% of E)	Additional Effective Replacement of Potable Water Use, 2020 (60% of F)
I	79.78	205	143.93	41.14	102.79	51.39	30.84
IA	37.61	175	57.91	11.59	46.33	23.16	13.90
II	35.12	188	58.10	13.96	44.15	22.07	13.24
III	4.44	294	11.47	2.30	9.18	4.59	2.75
V	41.44	170	61.99	2.35	59.64	29.82	17.89
Total	198.39		333.40	71.33	262.08	131.04	78.62

Note: Because of greater reliability, 1998 wastewater treatment and reuse data were used rather than the available 1995 data. Projections are prorated from 1998 to correspond to 1995-based projections.

The projected 2020 total treated wastewater produced (column C of Table 10) was assumed to increase in proportion to projected increases in public supply water use. Based on estimates developed by PBSJ (1998b), without large volumes of storage (such as ASR systems), only about 50 percent of the annual average reclaimed water produced can be dedicated to irrigation reuse systems in order to reliably meet seasonal variations in reclaimed water demands. This leaves approximately 131 mgd of reclaimed water that could be dedicated to potential future reuse projects to increase levels of reuse by 2020 in priority water resource caution areas.

Under current conditions, the quantity of reclaimed water used for irrigation is about twice the amount of potable water used for the same purpose; that is, two gallons of reclaimed water committed to reuse usually replace only one gallon of potable water committed to public supply use (PBSJ 1998b). This difference is a result of typical utility practice, which is the offering of reclaimed water at a rate significantly less than the rate for potable water as a strategy to get customers to connect; however, this practice generally results in overuse of reclaimed water (Appendix G). This ratio should improve in the future with greater use of metering, volume-based rates, and other conservation and efficiency measures. Therefore, one way to increase the use of reclaimed water by

2020 is to promote reuse conservation measures, allowing utilities to serve a larger reclaimed-water customer base with a given quantity of reclaimed water. In Table 10, a 60 percent replacement rate is assumed to account for this potential increase in conservation being employed in reclaimed water systems, that is, 6 gallons of potable water savings for each 10 gallons of reclaimed water use. Therefore, because there is the potential to reuse an additional 131 mgd of reclaimed water in 2020 in the five planning regions, approximately 79 mgd of effective replacement of potable water and groundwater used for nonpotable purposes could occur.

SJRWMD is examining ways to increase the amount of reclaimed water used by 2020. Two studies were developed during the water supply planning process that examined the cost effectiveness of using reclaimed water to offset potable water and groundwater use for urban and agricultural irrigation practices. PBSJ (1998b) estimated that approximately 25 percent of the public water supply utility-projected demand represents nonpotable water use that could potentially be offset by the use of reclaimed water. Unit costs were developed to allow reclaimed water sources to be reviewed as potential supplies to meet these demands. PBSJ presented an example 1-mgd project that would provide reclaimed water to a reuse system located 1 mile from the water reclamation facility. The estimated equivalent cost of the project was $2.62 per 1,000 gallons of water saved. Because the estimated costs are greater than estimated costs for developing other supplies (surface water, new groundwater sources, brackish groundwater) and the quantities of reclaimed water available are projected to be insufficient to significantly reduce regional water supply deficits, specific reuse options were not examined in SJRWMD's regional decision modeling efforts. However, at the local level, the consumptive use permitting program requires utilities and other permitted water users to implement increased reuse where feasible to reduce the impacts of groundwater withdrawals.

A report by PBSJ (1998a) evaluated the cost effectiveness of using reclaimed water for irrigating citrus groves and ferneries in Work Group Areas I and II as a regional water supply strategy. The equivalent unit cost for irrigating citrus groves in high recharge areas of Orange and Lake counties was estimated to range from $1.79 to $5.40 per 1,000 gallons of water saved. The estimated costs were highly variable, depending on the distance from the water reclamation facilities to nearby areas of citrus groves. As urbanization of these two counties continues, it is expected that the transmission distances to viable citrus irrigation sites will increase and result in future costs being more in line with the upper end of the range. Irrigation of ferneries in Volusia County was more cost-effective, with estimated equivalent unit costs ranging from $1.39 to $1.84 per 1,000 gallons of water saved. However, the groundwater model and decision models for Volusia County do not project a deficit in the fern-growing region, so there would be little regional water supply benefit associated with serving the ferneries with reclaimed water for irrigation. While increased agricultural reuse is beneficial and may be practical on a local level, it was not determined to be an effective strategy to reduce the groundwater deficits on a regional basis and was not considered further in SJRWMD's decision-modeling process in Work Group Areas I and II.

Currently, SJRWMD is evaluating a more specific regional reuse alternative. SJRWMD is assessing the cost effectiveness of a regional reuse system that would involve interconnecting reclaimed water from the City of Orlando's Iron Bridge Regional Water Reclamation Facility with Orange County's Eastern Water Reclamation Facility to utilize excess reclaimed water for a regional reuse system. This assessment, being conducted for SJRWMD by PBSJ, is scheduled to be complete in early 2000. Currently, these water reclamation facilities have permitted surface water discharge capacity of over 50 mgd. In a regional reuse system, these discharges would remain in place to provide the needed seasonal wet weather disposal required for reuse systems relying on irrigation. Potential participants in the use of reclaimed water from the regional reuse system would include Seminole County, the Orlando Utilities Commission, Curtis Stanton Energy Center, the City of Oviedo, Alafaya Utilities, the University of Central Florida, Orange County Utilities Eastern Service Area, the City of Orlando Conserv I service area, and Park Manor Utilities. This project is identified as a proposed water supply project in the Water Supply Development Component of this DWSP.

Water Supply Systems Interconnections

A system interconnection is a water supply management technique that allows utilities with available supply to supplement a nearby service area. Liberal use of system interconnections would allow optimization of groundwater withdrawals, thus maximizing the quantity of fresh groundwater that can be developed regionally. In this manner, the need for developing alternative water supply sources, including brackish groundwater and surface water, would be minimized.

Interconnections typically require a water transmission main, ground storage reservoirs, and a pump station. Interconnecting water supply systems may require chemically adjusting the water if the two water supply systems produce significantly different finished water.

Interconnections can also be designed to supply emergency flows. As with ASR, system interconnections will not increase the total water supply but can help manage or optimize the available resource.

Role of Political Boundaries in Water Supply Planning

Political boundaries generally do not pose physical limitations to transfers of water for reasonable-beneficial use. However, transfers of water across political boundaries often raise political and legal concerns. Although Chapter 373, *FS*, does not prohibit transfers of water across political boundaries, it does specifically address transfers across WMD and county boundaries.

Transfers of Groundwater Across WMD Boundaries

Section 373.2295, *FS*, describes a process to be followed by Florida's WMDs when reviewing applications for consumptive uses of water which involve the withdrawal of groundwater from a point in one WMD for use outside the boundaries of that WMD. Such transfers of groundwater are referred to as *interdistrict transfers of groundwater*. As part of its CUP application review, the WMD within which the groundwater withdrawal is proposed is required to make a public interest determination and give other evidence on future needs of the areas. Included in a public interest determination would be consideration of projected populations as contained in the future land use elements of local comprehensive plans in areas where the water is proposed to be withdrawn and used. A CUP for the proposed withdrawal is to be issued if statutory and rule requirements are met and the needs of the areas within which the water is proposed to be withdrawn and used can be satisfied. The requirement to consider projected populations contained in the future land use elements of local comprehensive plans could result in inconsistencies in the magnitudes of water use projections and could restrict the development of water supply projects that are technically, environmentally, and economically feasible.

SJRWMD, in this DWSP, has not tried to specifically evaluate the feasibility of implementation of any of the identified water supply solutions based on the provisions of Section 373.2295, *FS*. Before any selected option can be permitted, the provisions of that section must be addressed. However, SJRWMD has performed limited analysis of the cost-related impact of developing water supplies with no transfer and use beyond WMD boundaries. This analysis is included in the east-central Florida (Work Group Area I) section of the Water Supply Development Component of this DWSP.

Transfers of Water Across County Boundaries

During its 1998 session, the Florida Legislature amended the consumptive use permitting provisions (Subsection 373.223(3), *FS*) to include several factors to be considered by Florida's WMDs when evaluating whether a potential transport and use of ground or surface water across county boundaries is consistent with the public interest. This amendment, commonly referred to as "local sources first," could impact the development of water supply projects that are technically, environmentally, and economically feasible. The amendment language is as follows:

(3) Except for the transport and use of water supplied by the Central and Southern Florida Flood Control Project, and anywhere in the state when the transport and use of water is supplied exclusively for bottled water as defined in s. 50003(1)(d), any water use permit applications pending as of April 1, 1998, with the Northwest Florida Water Management District and self-suppliers of water for which the proposed water source and area of use or application are located on contiguous private properties, when evaluating whether a potential transport and use of ground or surface water across county boundaries is consistent with the public interest, pursuant to paragraph (1)(c), the governing board or department shall consider:

(a) The proximity of the proposed water source to the area of use or application.

(b) All impoundments, streams, groundwater sources, or watercourses that are geographically closer to the area of use or application than the proposed source, and that are technically and economically feasible for the proposed transport and use.

(c) All economically and technically feasible alternatives to the proposed source, including, but not limited to, desalination, conservation, reuse of nonpotable reclaimed water and storm water, and aquifer storage and recovery.

(d) The potential environmental impacts that may result from the transport and use of water from the proposed source, and the potential environmental impacts that may result from use of the other water sources identified in paragraphs (b) and (c).

(e) Whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for existing legal uses and reasonably anticipated future needs of the water supply planning region in which the proposed water source is located.

(f) Consultations with local governments affected by the proposed transport and use.

(g) The value of the existing capital investment in water-related infrastructure made by the applicant.

Where districtwide water supply assessments and regional water supply plans have been prepared pursuant to ss. 373.036 and 373.0361, the governing board or the department shall use the applicable plans and assessments as the basis for its consideration of the applicable factors in this subsection.

SJRWMD, in this DWSP, has not tried to specifically evaluate the feasibility of implementation of any identified water supply solutions based on "local sources first" criteria. Before any selected option can be permitted, "local sources first" criteria must be addressed by the permit applicant. However, SJRWMD has performed limited analysis of the cost-related impacts of developing water supplies with no transfer and use beyond county boundaries. That analysis is included in the east-central Florida (Work Group Area I) section of the Water Supply Development Component of this DWSP.

ESTIMATED QUANTITY OF WATER AND COSTS

For portions of SJRWMD not included in a work group area, existing water supply sources and water supply development plans are considered reasonably adequate to meet projected needs while sustaining wetland and aquatic systems. Freshwater from the Floridan aquifer currently meets most of these needs, and this traditional source of supply will continue to be adequate through 2020 in these areas.

Total average day water use in SJRWMD is expected to increase by about 491 mgd between 1995 and 2020, considering the user-based projections (Table 3). Of this total increase, about 421 mgd, or about 85 percent, results from expected increased public supply demand. Clearly, the challenge for meeting future water supply needs is to provide for the projected increase in public supply needs.

The focus of the *Water 2020* work groups, except in Work Group Area IV, was the development and evaluation of water supply source options and alternatives to meet projected increased public supply needs. General objectives and criteria were held constant in the water supply planning process so that water supply options developed in one work group area are comparable, on a cost and performance basis, to water supply options developed and evaluated by the other work groups.

The remainder of this section describes water supply options and alternatives for each work group area, including the least-cost environmentally feasible water supply alternative, where appropriate.

East-Central Florida (Work Group Area I)

East-central Florida, Work Group Area I, is the largest and most complex of the *Water 2020* work group areas. It includes all or parts of seven counties: Lake, Marion, Orange, Osceola, Polk, Seminole, and Sumter (Figure 2). In addition, because water supply withdrawals in Orange County provide a portion of the water supply needs in Brevard County, Work Group Area I is closely linked to Work Group Area IA.

Work Group Area I is a rapidly growing area which covers about 5,000 square miles, including the Orlando metropolitan area and environs, and is not wholly contained within SJRWMD. This work group area includes portions of both SFWMD and SWFWMD.

Consideration of this large and diverse area within a single work group was necessary because nearly all the water supply in this area is taken from a single source, the Floridan aquifer. There are more than 60 major public water supply utilities withdrawing water from more than 1,000 wells in Work Group Area I. Aquifer interactions among these withdrawals are complex, and the cumulative impacts of these withdrawals are a significant concern. Therefore, individual withdrawals cannot be considered in isolation. A regional analysis is necessary to adequately account for the number and magnitude of water withdrawals occurring from this single source of supply (CH2M HILL 2000).

SJRWMD has developed comprehensive groundwater flow models and decision models for Work Group Area I to assist in the resource evaluation, impacts analysis, and water supply plan development (Figure 9). The models incorporate areas beyond Work Group Area I in order to adequately simulate groundwater flow and adequately represent important boundary conditions. In addition to Work Group Area I, portions of Brevard County and Volusia County are included in the models.

The east-central Florida groundwater flow model accounts for water use in all, or portions of, nine counties (Table 11). The total projected increase in water use for the planning period within the east-central Florida model area is nearly 350 mgd, a 66 percent increase over 1995 use.

Water use data for each county are presented in greater detail in Table 12; public supply is the water use category projected to experience the greatest growth in Work Group Area I.

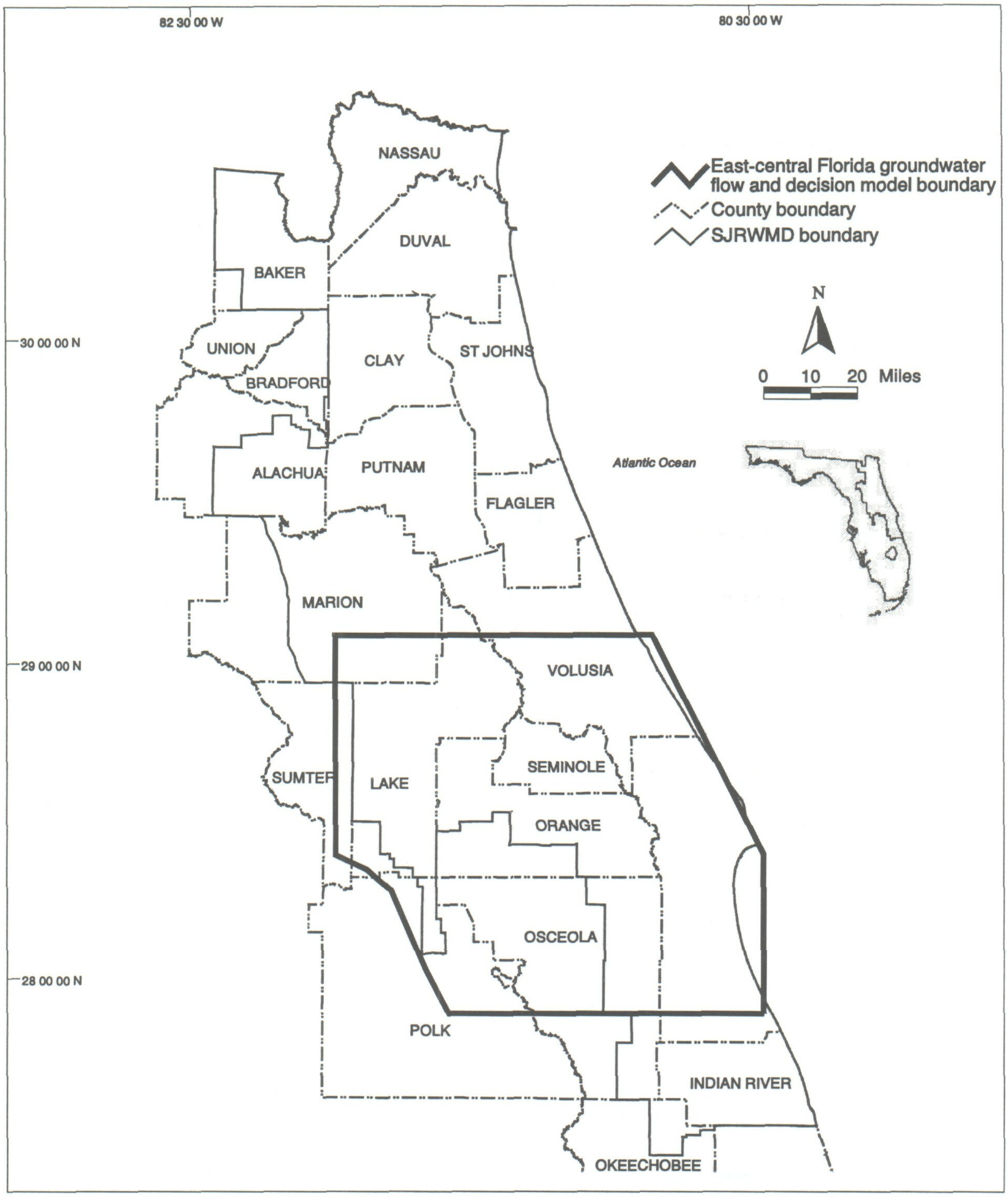

Figure 9. East-central Florida groundwater flow and decision model boundary

Table 11. Work Group Area I: East-central Florida groundwater flow model water use by county

County	1995 Actual Water Use	2020 Water Use	Percent Change
Brevard	14.07	28.81	105
Lake	86.67	151.65	75
Marion	7.66	13.65	78
Orange	201.68	352.50	75
Osceola	63.16	80.66	28
Polk	55.76	74.04	33
Seminole	61.09	102.82	68
Sumter	4.46	5.49	23
Volusia	33.02	65.71	99
Total	527.57	875.33	66

Note: Table includes water use in the total model area, including areas in the South Florida Water Management District, the Southwest Florida Water Management District, and the St. Johns River Water Management District.

Providing for the projected increase in water use in east-central Florida in a sustainable and affordable manner will be a significant challenge to SJRWMD, the water supply utilities, local governments, DEP, and all other interested and concerned parties. Application of the east-central Florida groundwater flow model indicates that current individual utility plans to increase withdrawals from the Floridan aquifer through 2020 will not be sustainable without causing unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses. If all current plans are implemented, surficial aquifer drawdowns will result in regional dewatering of sensitive wetlands sufficient to result in unacceptable adverse impacts. These wetlands impacts will occur regionally, but the ridge region of Lake County, which provides much natural recharge to the Floridan aquifer, will be impacted the greatest.

DWSP is designed to prevent these and other unacceptable adverse impacts to the water resources and related natural systems, including excessive springflow reductions, saltwater intrusion, and impacts to existing legal uses. Many different Work Group Area I water supply development scenarios are possible. In each case, however, significant quantities of alternative water sources will need to be developed to meet 2020 needs. Several technical and environmentally acceptable water

Table 12. Work Group Area I: East-central Florida groundwater flow model water use by county, water management district, and use category

Water Management District	Category	1995 Actual Water Use	2020 Water Use	Percent Change
Brevard County				
SJRWMD	Public supply	3.92	16.19	313
	Agriculture	8.76	11.23	28
	Commercial/industrial	1.39	1.39	0
	Total	**14.07**	**28.81**	**105**
Lake County				
SJRWMD	Public supply	27.04	79.70	195
	Agriculture	27.95	39.05	40
	Commercial/industrial	30.60	31.96	4
	Total	**85.59**	**150.71**	**76**
SWFWMD	Agriculture	1.08	0.94	-13
Marion County				
SJRWMD	Public supply	2.97	7.75	161
	Agriculture	3.93	5.14	31
	Commercial/industrial	0.76	0.76	0
	Total	**7.66**	**13.65**	**78**
Orange County				
SFWMD	Public supply	49.47	107.75	118
	Agriculture	10.24	7.32	-29
	Commercial/industrial	2.16	2.16	0
	Total	**61.87**	**117.23**	**89**
SJRWMD	Public supply	125.93	220.41	75
	Agriculture	10.12	11.10	10
	Commercial/industrial	3.76	3.76	0
	Total	**139.81**	**235.27**	**68**
Osceola County				
SFWMD	Public supply	20.17	40.87	103
	Agriculture	41.22	38.87	-6
	Commercial/industrial	0.04	0.04	0
	Total	**61.43**	**79.78**	**30**
SJRWMD	Agriculture	1.73	0.88	-49

Table 12—*Continued*

Water Management District	Category	1995 Actual Water Use	2020 Water Use	Percent Change
		Polk County		
SFWMD	Public supply	0.79	1.67	111
	Agriculture	11.60	11.75	1
	Total	**12.39**	**13.42**	**8**
SJRWMD	Public supply	1.66	1.02	-39
	Agriculture	2.60	5.01	93
	Total	**4.26**	**6.03**	**42**
SWFWMD	Public supply	8.90	15.40	73
	Agriculture	23.65	31.44	33
	Commercial/industrial	0.21	0.15	-29
	Mining	1.86	1.33	-28
	Recreation	4.49	6.27	40
	Total	**39.11**	**54.59**	**40**
		Seminole County		
SJRWMD	Public supply	52.35	94.55	81
	Agriculture	8.33	7.48	-10
	Commercial/industrial	0.41	0.79	93
	Total	**61.09**	**102.82**	**68**
		Sumter County		
SWFWMD	Public supply	1.31	2.26	73
	Agriculture	2.17	1.61	-26
	Recreation	0.98	1.62	65
	Total	**4.46**	**5.49**	**23**
		Volusia County		
SJRWMD	Public supply	27.81	51.67	86
	Agriculture	4.61	4.15	-10
	Commercial/industrial	0.60	9.89	1548
	Total	**33.02**	**65.71**	**99**

Note: SJRWMD Orange County public supply includes all the Orlando Utilities Commission, including the South Florida Water Management District's portion.

The commercial/industrial category includes water used in thermoelectric power generation.

supply development scenarios have been identified by the Area I work group. Each of the scenarios is based on differing sets of available water sources and development constraints. Implementing any of these alternatives will require regional cooperation among major water supply utilities.

Two possible scenarios, which were identified using SJRWMD's economic optimization model, are described here to illustrate possible solutions. The actual implemented solution will likely not be exactly identical to either of the scenarios presented here and may, in fact, be different from these two scenarios. Development of the final water supply alternative will take the cooperative efforts of all concerned. SJRWMD's role in the next phase of the planning process will be to facilitate decision-making, to make planning tools available to the Work Group Area I water supply utilities, and to assist those utilities in selecting sustainable water supply options.

The first scenario represents the least restrictive solution. It provides for consideration of all available water supply sources, including

- Existing and proposed Floridan aquifer wells
- New fresh groundwater wellfields
- New brackish groundwater wellfields
- Surface water

This scenario is based on the calibrated groundwater model and optimizes the solution such that overall costs are minimized. It contains no restrictions on the transport of water between counties or between WMDs. Therefore, this solution should be among the least-expensive, feasible scenarios for meeting 2020 water supply needs in Work Group Area I.

Based on this least-cost scenario, the following alternative sources and average day quantities would be developed:

- Expansion of existing and proposed Floridan aquifer wellfields—131 mgd
- New fresh groundwater wellfields—25 mgd
- New brackish groundwater wellfields—4 mgd
- Surface water from the St. Johns River near Lake Monroe—118 mgd
- Surface water from the upper Ocklawaha River Basin—11 mgd

Under this scenario, a total of 158 mgd of the increased 2020 needs of 340 mgd, or about 46 percent, would be met from alternative sources. The remaining increased needs would be met by existing facilities and by expanding existing and proposed Floridan aquifer wellfields. All water resource constraints would be met.

Estimated capital cost, in 1996 dollars, to implement this solution, including providing facilities capable of meeting 1-in-10-year drought needs, is $1.025 billion. Total unit production cost is estimated to be about $1.39 per 1,000 gallons. Expected production costs, including point-to-point transport costs, range from $0.79 per 1,000 gallons for expansion of existing Floridan aquifer wellfields, to $2.00 per 1,000 gallons for developing surface water from the St. Johns River near Lake Monroe.

The second scenario represents an extremely restrictive solution. It is based on conditions identical to the first, except that in this case, water from newly developed sources is not allowed to cross county or WMD boundaries. This scenario solves the regional problem, but the solution is restricted to new water supply sources located within a given county and WMD. This scenario hypothetically assumes the transport and use of water across county and district boundaries may be determined to be contrary to the public interest pursuant to Subsections 373.223(2), 373.223(3) and 373.229(5), *FS*. However, it should be stressed that such determinations were not made in DWSP and have not been made in the consumptive use permitting process to date.

Based on this scenario, the following alternative sources and average day quantities would be developed:

- Expansion of existing and proposed Floridan aquifer wellfields—67 mgd
- New fresh groundwater wellfields—34 mgd
- New brackish groundwater wellfields—none
- Surface water from the St. Johns River near De Land—18 mgd
- Surface water from the St. Johns River near Lake Monroe—55 mgd
- Surface water from the St. Johns River near Titusville—125 mgd
- Surface water from the upper Ocklawaha River Basin—9 mgd

Under this scenario, a total of 241 mgd of the increased 2020 needs of 340 mgd, or about 71 percent, would be met from alternative sources. The remaining increased needs would be met by existing facilities and by expanding existing and proposed Floridan aquifer wellfields. All water resource constraints would be met.

The estimated capital cost to implement this scenario, including providing facilities capable of meeting 1-in-10-year drought needs, is $1.353 billion. Total unit production cost is estimated to be about $1.79 per 1,000 gallons. Expected production costs, including point-to-point transport costs, range from $1.18 per 1,000 gallons for expansion of existing Floridan aquifer wellfields, to about $2.10 per 1,000 gallons for development of surface water from the St. Johns River near Titusville or from Lake Monroe.

These cost estimates are preliminary conceptual planning-level cost estimates. The cost of treating water obtained from the St. Johns River is based, in part, on partial desalting using membrane treatment to meet all primary and secondary drinking water standards for dissolved constituents.

Based on recent, more-detailed evaluations of St. Johns River raw water treatment requirements, preliminary indications are that treatment requirements may be more restrictive and costly than originally envisioned (CH2M HILL 1999b). Additional membrane treatment may be required to meet the federal Stage 1 Disinfectants Byproducts Rules adopted by EPA on November 30, 1998. Specifically, production of a finished water that meets the disinfection byproduct rule limit for bromate may control and increase the rate and duration of membrane treatment required. One significant problem and area of uncertainty is that there are very few bromide data available for St. Johns River water or SJRWMD brackish groundwater. Bromide has not historically been a constituent of concern. It is of concern only when ozone is used as the primary disinfection method and the controlled compound bromate is formed as a byproduct of that process. However, the few in-stream bromide data that are available are a cause for concern. Ultimately, more in-stream data and bench- and pilot-scale water treatment testing will be required to develop the most cost-effective treatment criteria for the slightly brackish St. Johns River.

Additional water conservation and reuse should continue to play a role in future water supply development in this work group area. In particular, water conservation rate structures should be investigated further for all public supply utilities that do not currently have such rate structures in place. Although the water savings of this option is expected to average less than 5 percent, implementing conservation rate structures is relatively inexpensive.

Brevard County (Work Group Area IA)

Work Group Area IA includes all of Brevard County. Brevard County has limited freshwater resources and has historically used a variety of sources to meet water supply needs, including surficial aquifer water, surface water from the St. Johns River, brackish groundwater from the Floridan aquifer, and fresh groundwater from the intermediate and Floridan aquifers in Orange County.

Total water use in Brevard County is expected to remain relatively unchanged during the planning period. Total 1995 water use was 187 mgd. Projected 2020 countywide water supply needs total 185.5 mgd.

The public supply category is anticipated to experience the greatest increase in water supply needs. Public supply needs are expected to increase from about 51.1 mgd in 1995 to approximately 81.4 mgd in 2020, an increase of about 59 percent. The increase in public supply needs directly corresponds to anticipated population increases. The projected increase in public supply use is largely offset by the anticipated decrease in agricultural irrigation needs. By 2020, agricultural irrigation needs are expected to decrease by about 34.4 mgd, from 124.8 mgd in 1995 to 90.4 mgd in 2020. The expected reduction in agricultural water use directly relates to the expected decreases in irrigated acreage of pasture and citrus. Demands in other water use categories are not projected to increase significantly.

Table 13 summarizes the estimated 2020 needs for each major Brevard County public supply utility. This table identifies the actual 1995 use, projected average day 2020 needs, and projected 2020 needs which include the effects of a 1-in-10-year drought.

Table 13. Brevard County public supply average day water supply needs

Utility	Needs (mgd)		
	1995	2020	2020 Plus 1-in-10-Year Drought
Florida Cities Water Company (formerly Avatar)	0.47	0.81	0.86
City of Cocoa	24.21	39.17	41.52
City of Melbourne	15.89	24.00	25.44
North Brevard Utilities	0.70	1.24	1.31
City of Palm Bay	4.94	7.77	8.24
City of Titusville	4.90	8.44	8.95
Total	51.11	81.43	86.32

Several Brevard County public supply utilities currently withdraw freshwater from surficial aquifers along the Atlantic Coastal Ridge. Wellfield operational experience suggests that further significant development of these freshwater sources is unlikely to result in sustainable sources. Therefore, DWSP does not consider increased withdrawal from the Brevard County surficial aquifers, except for certain site-specific, small-scale increases. Also, it is assumed that withdrawals from the City of Cocoa Orange County wellfield are fixed at the currently permitted withdrawal amounts and will not increase above current permitted amounts in the future. This assumption should not be construed as a determination that the city's wellfield will in fact be permitted to operate at its currently permitted rate in the future or as a permitting evaluation of the withdrawal and use of water by the city, pursuant to Section 373.223, *FS*.

Brackish groundwater is relatively abundant in Brevard County, so source deficits for brackish groundwater are not anticipated. The St. Johns River is also an abundant water source, with a potential water supply yield far exceeding total 2020 public supply needs. The C-1 Canal also is a potential source of limited water supply. It is currently unused and could meet a portion of the total 2020 needs. Existing raw water withdrawal facilities, treatment plants, and transport systems cannot meet future public supply demands. In many cases, meeting these demands could involve developing water supply sources other than fresh groundwater, such as additional brackish groundwater and surface water.

Table 14 summarizes the estimated 2020 deficits by major Brevard County water supply utility. These deficit estimates include the impact of the 1-in-10-year drought and were used for the evaluation of utility-specific water supply options.

The Brevard County work group identified and reviewed many utility-specific water supply options. In July 1998, the work group identified water supply options and then estimated preliminary conceptual costs. In September 1998, the work group reviewed each option and its associated costs, adding several options to the initial list. Table 15 presents a matrix of the utility-specific options identified by the work group. Organized by utility, each option meets or exceeds the anticipated 2020 water needs for its respective service area.

All options identified in Table 15 are considered sustainable source options. There are, however, some clear differences among the options evaluated, including a wide range of anticipated costs.

Table 14. Brevard County water supply deficits for major public utilities

Utility	ADD Deficit	MDD Deficit
Florida Cities Water Company (formerly Avatar)	0.00	0.00
City of Cocoa	3.05	8.68
City of Melbourne	2.44	10.07
North Brevard Utilities	0.19	0.00
City of Palm Bay	2.24	3.21
City of Titusville	2.45	6.12
Total	10.37	28.08

Note: ADD = average day demand
MDD = maximum day demand

Table 15. Utility-specific water supply options identified for Work Group IA

Utility	Surface Water			Brackish Ground-water	Fresh Ground-water	System Interconnects
	St. Johns River	C-1 Canal	Taylor Creek Reservoir			
City of Cocoa	*		*	*		
City of Melbourne	*	*		*		
North Brevard Utilities					*	
City of Palm Bay		*		*		
City of Titusville	*			*		*

The least expensive countywide alternative includes the following utility-specific options:

- **City of Cocoa**—Continue with current plans to fully develop the Taylor Creek Reservoir.
- **City of Melbourne**—Expand and upgrade Lake Washington treatment facilities.

- **North Brevard Utilities**—Continue with current plans to complete wellfield expansion to fully utilize the existing treatment plant capacity.
- **City of Palm Bay**—Further investigate the C-1 Canal as a potential source of supply.
- **City of Titusville**—Expand peaking capacity of interconnect with the City of Cocoa by adding ASR capabilities to the existing water supply system.

The estimated capital and total unit production costs associated with these Work Group Area IA least-cost options are reported in Table 16.

Table 16. Estimated costs to meet 2020 public supply needs for major Brevard County public supply utilities

Utility	Estimated Capital Cost ($ millions)	Estimated Unit Production Cost ($/1,000 gallons)
City of Cocoa	10.9	0.77
City of Melbourne	58.3	1.37
North Brevard Utilities	1.9	0.59
City of Palm Bay	8.5 to 11.5	1.32 to 2.02
City of Titusville	5.5	2.31
Total	85.1 to 88.1	

In some cases, such as for the City of Cocoa and North Brevard Utilities, the least expensive alternative conforms exactly to existing water supply utility plans.

For the City of Melbourne, existing plans include expanding the surface water facilities and the brackish groundwater facilities. Information presented in the Work Group Area IA report suggests that it may be less expensive to expand only the surface water facility. However, there are some significant advantages associated with the city's current plans, including minimizing the city's dependence on one supply source. Either approach is viable.

For the City of Palm Bay, developing the C-1 Canal appears to be less expensive than either developing brackish groundwater or forming interconnects with the City of Melbourne. The hydrology of the C-1 Canal, as well as the ultimate water quality and treatability of this source, needs further investigation.

The least expensive and least capital-intensive option for the City of Titusville involves expanding usage of the existing interconnect with the City of Cocoa. This expansion could be accomplished by adding ASR to the existing Titusville system to meet peak demands without enlarging either the treatment or transport facilities. If ASR proved to be infeasible within the Titusville service area, then development of brackish groundwater could provide the needed additional supply.

The least costly alternative also minimizes desalting and concentrate production. Only the C-1 Canal, an option for the City of Palm Bay, may require partial desalting. All other less expensive options involve only freshwater.

Additional water conservation and reuse should also continue to play a role in future water supply development in Brevard County. In particular, water conservation rate structures should be investigated further for all public supply utilities except the City of Titusville, which has a comprehensive water conservation rate structure currently in place. Although the water savings of this option is expected to average less than 5 percent, implementing conservation rate structures is relatively inexpensive. A countywide water use savings of 3 percent could reduce the 2020 needs by about 2.4 mgd, and any reduction in future demand will tend to extend the useful life of existing facilities.

For the most part, funding water supply facilities expansion in Work Group Area IA is expected to come from local sources ultimately paid for by the end user.

Volusia County Area (Work Group Area II)

Work Group Area II includes all of Volusia County and a small portion of southern Flagler County and southeastern Putnam County (Figure 2). It is bounded to the east by the Atlantic Ocean and to the west by the St. Johns River.

The primary source of freshwater in that work group area is groundwater from the Floridan aquifer. The Floridan aquifer in the Volusia County area is often referred to as the Volusia-Floridan Sole Source Aquifer, because of its designation by EPA as a sole source aquifer. Other less extensively used sources of freshwater include groundwater from the surficial aquifer that is used for domestic self-supply and irrigation, surface water used for agricultural and recreational/golf irrigation, and reclaimed water used for nonpotable irrigation demands in public utility service areas and for recreational/golf facilities.

For this work group area, the public supply category is expected to experience the greatest increase in water supply needs. Public supply needs are expected to increase 88 percent, from 47.4 mgd in 1995 to approximately 89.2 mgd in 2020. The increase in public supply needs directly corresponds to anticipated population increases.

Water use for recreational purposes (primarily golf courses) is anticipated to increase from 7.63 mgd in 1995 to 10.91 mgd in 2020. Because of regulatory requirements to promote reuse of reclaimed water and storm water, all of the expected increase in this category is expected to be served by one of these reuse options.

Increases in water supply needs have also been projected for domestic self-supply, commercial/industrial, and thermoelectric power generation; however, these increases are small in comparison to increases in public supply. The combined increase for these categories is approximately 24 percent, from 11.0 mgd in 1995 to 13.7 mgd in 2020.

Agricultural water use is expected to decrease slightly over the planning period, from an estimated 24.5 mgd in 1995 to 21.6 mgd in 2020. The agricultural water use projections include water used for freeze protection, a significant portion of which is supplied from surface storage ponds to minimize the short-term impact of freeze protection withdrawals on Floridan aquifer water levels.

Overall, water use in the Volusia County work group area is expected to increase by approximately 50 percent during the planning period, with most of the increase attributable to public water supply. The total 1995 water use in the county was 90.7 mgd. Projected 2020 countywide water supply needs total 135.44 mgd.

Table 17 summarizes water supply needs for large public utilities (utilitywide 1995 water use greater than 0.24 mgd) in Volusia County. The table identifies actual 1995 use, projected average day 2020 needs, and projected 2020 needs including the effects of a 1-in-10-year drought.

Because of the large increase in public supply water use, the water supply plan for Work Group Area II focuses on meeting the public water supply needs. The projected increase in public water supply cannot be sustained from existing and utility-proposed sources without causing unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses.

SJRWMD has developed comprehensive groundwater flow models and decision models for Work Group Area II to assist in the resource

Table 17. Volusia County public supply average day and 1-in-10-year drought water supply needs

Utility/ Service Center	1995 Water Use (mgd)	2020 Projected Water Use (mgd)	2020 Water Use Plus 1-in-10-Year Drought (mgd)
Daytona Beach	12.42	18.61	19.73
De Land	5.08	7.38	7.82
Edgewater	1.49	4.10	4.35
FWS Deltona	9.12	14.57	15.44
Holly Hill	1.16	1.70	1.80
Lake Helen	0.24	0.85	0.90
New Smyrna Beach	4.27	6.81	7.23
Orange City	1.33	2.82	2.99
Ormond Beach	4.90	7.23	7.66
Port Orange	5.28	8.98	9.52
VC Deltona North	0.34	1.35	1.43
VC Northeast	0.19	0.74	0.78
VC Southeast	0.12	0.48	0.51
VC Southwest	1.30	11.10	11.77
VC Ag Center	0.01	0.03	0.03
VC Cassadaga	0.01	0.05	0.05
VC Northwest	0.01	0.05	0.05
VC Spruce Creek	0.16	0.62	0.66
Total	47.44	87.46	92.73

Note: VC = Volusia County
FWS = Florida Water Services

evaluation, impacts analysis, and water supply plan development (Figure 10). The model area overlaps the east-central Florida groundwater flow model boundary to adequately simulate groundwater flow and adequately represent important boundary conditions. Total 1995 and projected 2020 water supply needs within the model boundary are summarized in Table 18.

Application of the Volusia groundwater flow model indicates that current individual utility plans to increase withdrawal from the Floridan aquifer, if implemented, will result in regional dewatering of wetlands sufficient to result in unacceptable adverse impacts. In addition, chloride concentrations would increase to unacceptable levels in some Floridan

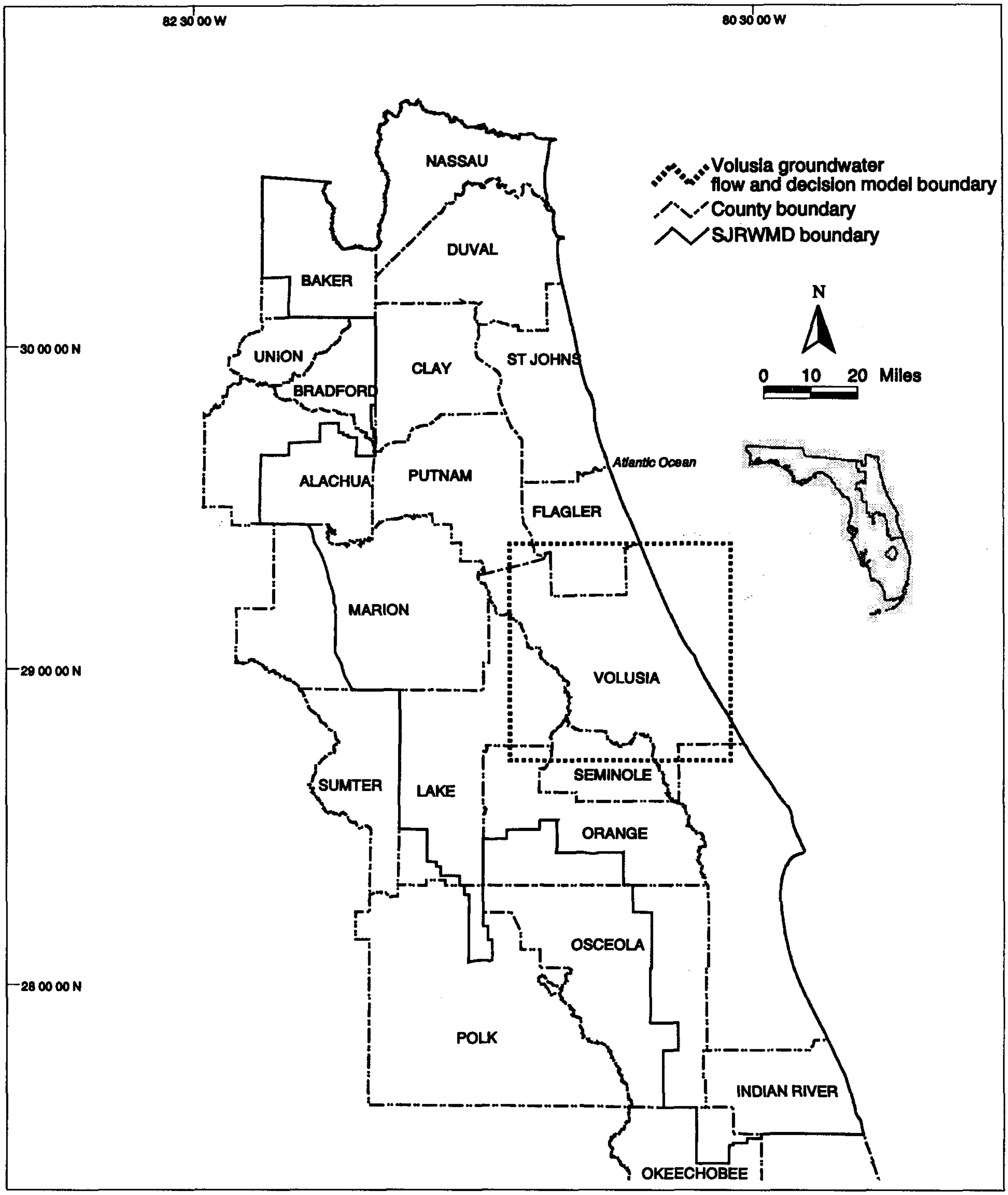

Figure 10. Volusia groundwater flow and decision model boundary

Table 18. Volusia groundwater flow model area demand projections

Category	1995 Actual Water Use	2020 Water Use	Percent Change
Public supply	59.68	112.50	89
Domestic self-supply	9.95	12.04	21
Agricultural irrigation	26.76	28.10	5
Commercial/industrial	1.07	1.75	64
Thermoelectric power generation	0.37	0.66	78

aquifer wells. Preliminary decision model results indicate that about 20 mgd of alternative water sources may need to be utilized by public supply utilities in Volusia County by 2020.

Alternative water supply sources investigated to meet the future public water supply needs in Work Group Area II included new fresh groundwater, brackish groundwater, surface water, and seawater. A number of management techniques have been identified that can enhance the supply source, sustain the water resources and related natural systems, or otherwise optimize water supply yield. These techniques include artificial recharge, aquifer storage recovery, conservation, reuse, water supply system interconnections and wetland augmentation.

Two scenarios are included here to describe possible solutions. The actual implemented solution will likely not be exactly identical to either of the two scenarios presented here. Development of the final water supply alternative will take the cooperative efforts of all concerned parties. SJRWMD's role in the next phase of the planning process will be to facilitate the decision-making to make the planning tools available to the Volusian Water Alliance and Work Group Area II utilities and to assist them in selecting sustainable water supply options.

The first scenario represents the least restrictive solution. It includes consideration of available water supply sources, including the following:

- Existing and proposed Floridan aquifer wells
- New fresh groundwater wellfields
- New brackish groundwater wellfields
- Surface water

The first scenario optimizes the solution such that overall costs are minimized. Based on this scenario, all environmental constraints would be met and the following sources and average day quantities would be developed:

- Expansion of existing and proposed Floridan aquifer wellfields—24.3 mgd
- New fresh Floridan aquifer wellfields—10 mgd
- Surface water from the St. Johns River near Lake Monroe—8 mgd
- Surface water from the St. Johns River near De Land—0.72 mgd

Under this scenario, a total of 18.7 mgd of the increased 2020 needs of 43 mgd (within the model area), or about 43 percent, would be met from new Floridan aquifer wellfields and from surface water from the St. Johns River. The remaining increased needs, about 24.3 mgd, would be met by existing and proposed Floridan aquifer wellfields.

Estimated equivalent annual cost, in 1996 dollars, to implement this solution, including providing facilities capable of meeting 1-in-10-year drought needs, is $20 million. Total unit production cost is estimated to be about $1.27 per 1,000 gallons.

The second scenario is based on conditions identical to the first, except that in this case, water from the St. Johns River is utilized to meet deficits in western Volusia County and groundwater from the Floridan aquifer is used to meet deficits in eastern Volusia County. Based on this scenario, the following alternative sources and average day quantities would be developed:

- Expansion of existing and proposed Floridan aquifer wellfields—21.7 mgd
- New fresh groundwater wellfields—7.73 mgd
- Surface water from the St. Johns River near De Land—4.3 mgd
- Surface water from the St. Johns River near Lake Monroe—9.27 mgd

Under the second scenario, a total of 21.3 mgd of the increased 2020 needs of 43 mgd, or about 50 percent, would be met from alternative sources. The remaining increased needs would be met by existing and proposed Floridan aquifer wellfields, and water resource constraints would be met.

Estimated equivalent annual cost to implement the second solution, including providing facilities capable of meeting 1-in-10-year drought needs, is $21 million. Total unit production cost is estimated to be about $1.34 per 1,000 gallons.

These cost estimates are preliminary conceptual planning-level cost estimates. The cost of treatment of water obtained from the St. Johns River is based, in part, on partial desalting using membrane treatment to meet all primary and secondary drinking water standards for dissolved constituents. As discussed previously regarding Work Group Area I, treatment requirements may be more restrictive and costly than originally envisioned.

Preliminary evaluations of St. Johns River raw water treatment requirements indicate that treatment requirements may be more restrictive and costly than originally envisioned. Additional membrane treatment may be required to meet the federal Stage 1 Disinfectants Byproducts Rules adopted by EPA on November 30, 1998. Specifically, production of a finished water that meets the disinfection byproduct rule limit for bromate may control and increase the rate and duration of membrane treatment required. One significant problem and area of uncertainty is that there are very few bromide observations available to characterize St. Johns River water or SJRWMD brackish groundwater. Bromide has not historically been a constituent of concern. It is of concern only when ozone is used as the primary disinfection method and the controlled compound bromate is formed as a byproduct of that process. However, the few in-stream bromide data that are available are a cause for concern. Ultimately, more in-stream data and bench- and pilot-scale water treatment testing will be required to develop the most cost-effective treatment criteria for the slightly brackish St. Johns River.

Although the cost of developing the St. Johns River source is higher than the cost of developing additional fresh groundwater, the river offers an opportunity to develop significant quantities of water to support future growth beyond 2020, whereas fresh groundwater will likely not support this growth. In addition, the cost of developing the St. Johns River source to meet public supply needs in Volusia County could be reduced through a cooperative effort with public suppliers in Seminole, Orange, and Lake counties.

Additional water conservation and reuse should continue to play a role in future water supply development in this work group area. In particular, water conservation rate structures should be investigated further for all public supply utilities that do not currently have such rate structures in place. Although the water savings of this option is expected to average less than 5 percent, implementing conservation rate structures is relatively inexpensive.

East-Central Flagler County (Work Group Area III)

Work Group Area III is located in east-central Flagler County near the Atlantic coast (Figure 2). Existing and estimated future water demands in this work group area are rather modest, but freshwater resources are limited and developing adequate future water supplies will be a challenge. Currently, public supply is developed from fresh groundwater withdrawn from the intermediate and Upper Floridan aquifers.

Agricultural irrigation is currently the largest single use category in Flagler County. By 2020, however, agricultural needs are expected to decrease by about 1.37 mgd, or 15 percent, because of anticipated reductions in irrigated acreage. This decrease offsets a portion of the expected increase in public supply needs, which are anticipated to increase by about 8.5 mgd or 194 percent, raising the 1995 average day demand of 4.4 mgd to 12.9 mgd in 2020. Countywide, anticipated total freshwater use for the year 2020 (23.8 mgd) is approximately 50 percent greater than the total 1995 use (15.9 mgd). Demands in other water use categories are not projected to increase significantly.

Table 19 summarizes the estimated 2020 needs for each major Work Group Area III public supply utility. The three utilities listed in Table 13 are also the only major public supply utilities located in Flagler County. Table 19 identifies the actual 1995 use, projected average day 2020 needs, and projected 2020 needs including the effects of a 1-in-10-year drought.

Table 19. Flagler County public supply average day needs

Utility	Needs (mgd)		
	1995	2020	2020 Plus 1-in-10-Year Drought
City of Flagler Beach	0.49	1.16	1.23
City of Bunnell	0.25	1.50	1.59
Florida Water Services, Palm Coast	3.66	10.28	10.90
Total	4.40	12.94	13.72

Flagler County's 2020 public supply deficits include both source deficits and facility deficits. Existing raw water withdrawal facilities, treatment plants, and transport systems cannot meet future public supply demands. It is possible that meeting these future demands will also involve developing water supply sources other than fresh groundwater. Specifically, groundwater modeling and wellfield operational experience suggest the Flagler County freshwater sources in the work group area—the intermediate and Floridan aquifers—may not be sufficient to meet all future needs. Fortunately, brackish groundwater is relatively abundant in Flagler County, so utilities can potentially develop this water supply source. Freshwater is also available in the Floridan aquifer in the southern portion of the county.

Projected water supply deficits in Flagler County stem from freshwater source deficits as well as from facility deficits. Existing treatment plants aren't large enough to accommodate additional groundwater withdrawal and cannot effectively treat additional brackish water. Table 20 summarizes the estimated 2020 deficits by major facility in Flagler County.

Table 20. Flagler County 2020 water supply deficits for major public supply utilities

Utility	ADD Deficit	MDD Deficit	Comments
City of Flagler Beach	0.23	1.21	Wellfield needs 0.71-mgd expansion; WTP needs 1.21-mgd expansion
City of Bunnell	0.99	1.50	Wellfield needs 1.1-mgd expansion; WTP needs 1.5-mgd expansion
Florida Water Services, Palm Coast	2.90	8.35	Wellfield needs 4.55-mgd expansion; WTP needs 8.35-mgd expansion
Total	4.12	11.06	

Note: ADD = average day demand
MDD = maximum day demand
WTP = water treatment plant

The Flagler County work group identified and reviewed several utility-specific water supply options (Table 21). To evaluate these options, total production costs, per 1,000 gallons, of the various supply and treatment options were estimated and compared, and the advantages and disadvantages of each were discussed. There are some clear differences among the options evaluated, including a wide range of expected costs (HDR 1999a).

Table 21. Utility-specific water supply options

Utility	Brackish Groundwater	Fresh Groundwater	System Interconnects
City of Flagler Beach		*	*
City of Bunnell		*	*
Florida Water Services, Palm Coast	*	*	*

The least expensive countywide alternative includes the following utility-specific options:

- **City of Flagler Beach**—Expand existing source.
- **City of Bunnell**—Expand existing source.
- **Florida Water Services, Palm Coast**—Continue with current plans to complete wellfield expansion to fully utilize existing treatment plant capacity.

The estimated capital and total unit production costs associated with these Work Group Area III least-cost options are reported in Table 22.

Table 22. Estimated costs to meet 2020 public supply needs for public supply utilities in Flagler County

Utility	Estimated Capital Cost ($ millions)	Estimated Unit Production Cost ($/1,000 gallons)
City of Flagler Beach	3.5	1.95
City of Bunnell	4.4	1.61
Florida Water Services, Palm Coast	20.5	1.84
Total	28.4	

Public supply utilities in Flagler County currently satisfy water supply needs from fresh groundwater and propose to continue to use this source in the future. However, public supply demands in Flagler County are projected to more than double by 2020. Fresh groundwater sources have the capability to meet needs for several years, but may not be able to meet all the projected needs for 2020. The City of Flagler Beach and the City of Bunnell, due to their relatively small projected 2020 needs (1.2 mgd and 1.5 mgd, respectively), can most likely meet future demand using fresh groundwater. Ongoing studies conducted jointly by SJRWMD and Florida Water Services, Palm Coast, will help determine whether or not the utility will need to develop alternative water sources to meet 2020 demands.

Current conservation efforts should continue, and utilities should explore new technology capable of reducing anticipated water supply costs. Utilities in this work group area should continue to research conservation and reuse options in cooperation with SJRWMD. For the first five-year update of DWSP, SJRWMD will develop a regional groundwater model to more accurately predict water supply capabilities and more fully evaluate the alternatives presented.

Brackish groundwater from the Floridan aquifer can be blended with freshwater from the intermediate or shallow aquifers, or other available sources, to meet both peak and average day demands. This technique is currently used by several public supply utilities in SJRWMD and can be expanded further to meet future demands. The Area III work group did not specifically evaluate this technique; however, it should be considered along with other utility-specific alternatives.

Southwestern St. Johns County and Eastern Putnam County (Work Group Area IV)

Work Group Area IV consists of a large portion of southwestern St. Johns County and the eastern portion of Putnam County (Figure 2). St. Johns County is located along the Atlantic coast and shares part of its western border with Putnam County. The size of Work Group Area IV is approximately 400 square miles.

Four existing or potential water supply sources exist in Work Group Area IV: the Floridan aquifer, the intermediate aquifer, the surficial aquifer and surface water. The Floridan aquifer is the primary source of water supply in Work Group Area IV. The remaining three water supply sources are used only minimally in Work Group Area IV. Major uses of the Floridan aquifer system in this area include agricultural irrigation (primarily potatoes), paper production, thermoelectric power generation, public water supply, and domestic self-supply. Water quality is generally within primary drinking water standards; however, the Floridan aquifer in the eastern portion of the work group area tends to exhibit high chloride and sulfate concentrations.

Work Group Area IV encompasses the premier potato farming area in Florida. Accordingly, potato irrigation demand represents a large portion of the total water demand in the work group area. The demand for irrigation water in this area peaks in the months of March through May, and is usually highest in April. As a result of this increased demand during a low rainfall period, water levels in the Floridan aquifer regionally can decline as much as 15 feet and in areas of concentrated withdrawals, levels can drop in excess of 25 feet in a 1-month period.

When these seasonal declines occur, other water users in the area may not be able to obtain adequate amounts of water to meet their needs due to lowered water levels in Floridan aquifer wells. The affected parties are typically domestic self-supply users. When problems occur, they typically fall into one of two categories: domestic systems that rely on free-flowing wells to supply an aerator but lose free-flow due to water level decline, or domestic systems that have pumps and piping not designed to pump water from the depths produced by the water level decline.

The water supply issue centers not on an insufficient water supply, but rather on the fact that certain domestic water supply installations are not designed to accommodate the seasonal fluctuations in water level resulting from potato irrigation pumpage. With the proper pump and piping, adequate water is available even during peak irrigation season declines.

This problem is best addressed by development of regulations focused on the pumping equipment associated with domestic well installations so that these installations will be constructed to avoid the impact of seasonal drawdowns. Because SJRWMD's regulatory jurisdiction under Part III of Chapter 373, *FS*, does not extend to pumping equipment, the pump regulations to address seasonal drawdowns should be enacted by local government. Resolution of the issue will require the cooperation of Putnam and St. Johns counties in promulgating well construction/pump ordinances.

The solution eliminates the impact of seasonal declines on existing legal domestic users and avoids the construction of new domestic well systems that are inadequate for producing water during the seasonal declines. The two-pronged solution developed by Work Group Area IV is as follows:

- **Eliminating the Impact of Seasonal Declines on Existing Legal Domestic Users**—The majority of the work group has agreed in concept to a cooperative effort to repair existing well systems when a flow loss occurs due to seasonal declines. Each loss-of-flow complaint will be investigated to verify that flow loss is directly attributable to the decline and not to a well system construction, operation, or maintenance problem. If the loss of flow is clearly due to decline, the well system will be repaired and the cost will be shared by SJRWMD and participating area water users who contribute to the problem. This cooperative approach is appropriate, considering the large number of consumptive use permittees whose withdrawals contribute to the interference with existing legal uses. Specific details regarding the cost-share arrangement and other administrative details have yet to be finalized.

The funding needed to resolve this water supply issue is modest. A repair of this type typically involves adding a pump between the well and aerator and/or increasing the length of drop pipe in the well, estimated to cost between $400 and $500 per well. It is estimated that there are less than 50 wells in the work group area subject to loss of flow during seasonal water level declines. The estimated maximum capital cost to resolve the existing problem is $25,000.

- **Avoiding Construction of Inadequate New Domestic Well Systems—** SJRWMD has worked with St. Johns County and Putnam County to get county ordinances adopted to ensure that new domestic well installations are capable of producing water during the peak seasonal water level declines.

  Putnam County's well construction ordinance, as originally adopted, did not apply to all areas of the county subject to seasonal water level declines due to potato irrigation. SJRWMD worked with county staff to revise the ordinance to include all affected areas. The revised ordinance has been adopted by the Putnam County Board of County Commissioners.

  St. Johns County did not have a well construction ordinance in place to address this water supply issue. SJRWMD, supported by the Northeast Florida Growers Exchange, worked with county staff to impress the county commissioners with the need for this type of ordinance. SJRWMD provided the county with draft language for a well construction ordinance, and the ordinance has been adopted by the St. Johns County Commission.

Northern St. Johns County and Southern Duval County (Work Group Area V)

Work Group Area V includes northern and eastern St. Johns County and southern Duval County (Figure 2). It is a low-lying coastal area located east of the St. Johns River, and it is currently experiencing very rapid growth. Public supply water is currently developed from the Floridan and surficial aquifers in St. Johns County and from the Floridan aquifer in Duval County.

In Work Group Area V, the greatest anticipated increase in water supply needs is in the public supply category. Public supply needs are expected to increase from about 65.9 mgd in 1995 to approximately 112.3 mgd in 2020, or about 46.4 mgd (70 percent). The increase in public supply needs results directly from population increases. During the same period, the total population for St. Johns and Duval counties is expected to increase by about 300,900—from 816,500 to 1,117,400.

By 2020, all other water supply needs categories are also expected to increase by about 11.2 mgd, except for domestic self-supply, which is projected to decrease by 4.3 mgd. Thus, the net change in these other use categories is an expected increase of 7 mgd (11 percent) by 2020. This increase means the total water use in the area of Work Group Area V is expected to rise during the planning period by about 53 mgd to a total water use of about 180 mgd.

The 2020 needs by major public supply utilities are summarized in Table 23. This table includes the actual 1995 use, projected average day 2020 needs, and projected 2020 needs including the effects of a 1-in-10-year drought.

For Work Group Area V, the ultimate sustainable source capacities are largely unknown. Therefore, deficits for the most part consist of facility deficits controlled by a water supply system's ability to meet the maximum day demand (MDD).

For some utilities, existing withdrawal and treatment facilities may be adequate to meet future public supply demands. In other cases, meeting future demands could involve developing additional facilities and possibly alternative water supply sources.

The public supply utilities in Work Group Area V currently withdraw fresh groundwater, mainly from the Floridan aquifer. Wellfield operational experience suggests that these fresh groundwater sources may be further developed on a limited basis. Therefore, DWSP considers increased withdrawal from the aquifer as an option in the work group area. However, the fresh groundwater source is not unlimited and the further development of this source within Work Group Area V must be carefully evaluated and monitored on a case-by-case basis.

Table 23. Work Group Area V public supply average day water supply needs

Utility	Needs (mgd)		
	1995	2020	2020 Plus 1-in-10-Year Drought
GDU Julington Creek	0.32	2.70	2.86
Intercoastal Utilities	1.08	6.09	6.46
North Beach Water System	0.22	1.20	1.27
City of St. Augustine	2.24	3.91	4.14
St. Joe Utilities	Not applicable	4.00	4.25
St. Johns County Utility	3.26	13.50	14.31
St. Johns Service Company	1.96	3.53	3.74
United Water Florida (St. Johns)	1.40	3.45*	3.66
Subtotal, St. Johns County	**10.48**	**38.38**	**40.69**
City of Atlantic Beach	3.15	4.35	4.61
Florida Water Services	1.83	3.26	3.46
City of Jacksonville Beach	2.90	3.80	4.03
JEA (City of Jacksonville)†	33.10	43.30	45.90
City of Neptune Beach	1.21	2.16	2.29
Regency Utilities	0.94	1.23	1.30
United Water Florida (Duval)	12.30	15.83	16.78
Subtotal, Duval County	**55.43**	**73.93**	**78.37**
Total	65.91	112.31	119.06

*Following completion of water use evaluations described in this DWSP, United Water Florida (St. Johns) requested revision of its 2020 projection to 18.12 mgd. This requested revision is not the basis of evaluations in this DWSP. Further investigation and refinement of projected water needs will be included in future revisions of DWSP.

†Supplies needs for only the portion of JEA service area within Work Group Area V. Percent of utility needs within Work Group Area V adapted from demand projection information presented in the Jacksonville Electric Authority Water Facilities Plan, August 1998.

Brackish groundwater is not abundant in the Duval County area of Work Group Area V, but it is abundant in St. Johns County; therefore, brackish groundwater is only a reliable alternative water source in the St. Johns County portion of Work Group Area V.

The St. Johns River is an abundant water source, but in the area of Work Group Area V, the water quality of the river is highly variable, and this source would require substantial treatment. It would be difficult and relatively costly to utilize the St. Johns River as an alternative water source in Work Group Area V. However, the water quality in the lower Ocklawaha River is very good, and its potential water supply yield far exceeds total 2020 public supply needs.

Table 24 summarizes the estimated MDD facility deficits by major water supply utility. These deficit estimates represent the difference between the projected MDD needs for 2020 and the current facility's capacity. The reported deficits include the effects of a 1-in-10-year drought.

Table 24. Water supply facility deficits for major public supply utilities

Utility	MDD Deficit—mgd for 1-in-10-Year Drought
GDU Julington Creek	4.50
Intercoastal Utilities	7.40
North Beach Water System	1.52
City of St. Augustine	0.00
St. Joe Utilities*	Not applicable
St. Johns County Utility	15.59
St. Johns Service Company	0.73
United Water Florida (St. Johns)	6.21
City of Atlantic Beach	0.00
Florida Water Services	3.52
City of Jacksonville Beach	5.36
JEA (City of Jacksonville)†	17.92
City of Neptune Beach	1.12
Regency Utilities	0.65
United Water Florida (Duval)	7.67

Note: MDD = maximum day demand

*Facilities not yet permitted or constructed.
†For the JEA systems, the deficit consists of 2020 needs minus 1995 actual demand.

Water supply planning for Work Group Area V is characterized by uncertainty. The area is growing, and water supply needs will increase significantly. Fully adequate planning tools, including expanded regional groundwater flow and water quality models, are not available to evaluate water resource management alternatives, such as the long-term consequences of increasing fresh groundwater withdrawals. SJRWMD is developing the information and tools needed for future water supply planning. These include improved groundwater flow and water quality models, additional wellfield monitoring and operational data, and continued wetland monitoring. This information will help mitigate the existing level of uncertainty and aid future water supply decision-making. Adaptive management will likely play a major role in future water supply development. Information in this DWSP concerning Work Group Area V is based largely on the collective judgment of the work group. Results and recommendations reported here may be updated as more information becomes available.

Future demand projections are also uncertain, especially for Work Group Area V, where increased population growth is both recent and rapid. Therefore, the exact rate and pattern of growth for this work group is subject to greater uncertainty than in areas with established growth patterns. If demand growth is faster than projected, then the water supply facilities discussed in this report will be needed sooner than presently expected. If growth is slower, then more time may be available to implement water supply plans.

Currently, there are no known regional adverse groundwater withdrawal impacts within Work Group Area V. Some local problems, including saltwater upconing and wetlands dehydration, currently occur or are suspected, but these impacts are not widespread. However, additional impacts will most likely occur without careful planning.

It is probable that Work Group Area V can increase fresh groundwater withdrawals beyond current levels, but the magnitude and optimal locations of the allowable increase are uncertain. Groundwater monitoring and model development are under way and will help to accurately estimate the optimal fresh groundwater withdrawal rates and locations.

This DWSP assumes utilities can increase fresh groundwater withdrawals, especially some of the utilities with smaller service areas with small 2020 deficits and limited alternatives. Future analysis, to be included in the first five-year update of this DWSP, will be needed to accurately estimate the magnitude of sustainable fresh groundwater withdrawal and decrease current planning uncertainty.

Table 25 presents a matrix of the utility-specific options identified by the work group. Organized by utility, nearly every listed option meets or

Table 25. Utility-specific water supply options identified by work group

Utility	Fresh Ground-water	Surface Water	Brackish Ground-water	Desalination	System Interconnects
GDU Julington Creek	*				
Intercoastal Utilities	*				
North Beach Water System	*				
City of St. Augustine	*				
St. Joe Utilities[1]					
St. Johns County Utility	*	*	*		*
St. Johns Service Company	*				
United Water Florida	*				
City of Atlantic Beach	*				*
Florida Water Services	*				
City of Jacksonville Beach	*				*
JEA (City of Jacksonville)	*	*		*	*
City of Neptune Beach	*				*
Regency Utilities	*				
United Water Florida	*				*

Note: In addition to the utility-specific options, this report discusses and evaluates selected work group areawide options. These options include additional water conservation and reuse strategies to reduce future demands and seawater desalting to meet increased demands.

[1]Not evaluated by work group.

exceeds the anticipated 2020 water supply needs for its respective service area. To evaluate these options, total production cost per 1,000 gallons of the various supply and treatment options was estimated, the costs were compared, and the advantages and disadvantages of each were discussed by the work group (HDR 1998b).

All of the water supply options in Table 25 are technically and economically feasible, and all are available to each utility. There are, however, some clear differences among the options evaluated, including a wide range of projected costs.

Additional water conservation and reuse should continue to play a role in future water supply development in this work group area. In particular, water conservation rate structures should be investigated further for all public supply utilities that do not currently have such rate structures in place. Although the water savings of this option is expected to average less than 5 percent, implementing conservation rate structures is relatively inexpensive.

Water Supply Utilities in St. Johns County

Seven major water supply utilities currently serve St. Johns County. However, just one utility, St. Johns County Utility, accounts for over half the 2020 average day demand (ADD) deficit (Table 24). The deficit for the remaining individual service areas is relatively small, and in many cases, expanding existing facilities appears to be the most feasible alternative likely to meet 2020 needs.

GDU Julington Creek. The recent CUP renewal quantities are very close to the 2020 needs. Upgrading and expanding the existing system to use additional fresh groundwater is the only logical option at this time.

Intercoastal Utilities. Intercoastal Utilities has existing facilities that will meet the 2020 ADD. Its deficit is based on the permitted wellfield capacity and facilities needs to meet the MDD. A decrease in the *system demand ratio*, possibly through additional water conversation or reuse activities, could lessen the MDD.

North Beach Water System. Compared to the total work group area 2020 needs, North Beach Water System needs are small. Upgrading and expanding the existing system to use additional brackish groundwater is the only logical option at this time.

City of St. Augustine. The City of St. Augustine currently has existing facility capacities to meet the 2020 needs. The existing source of supply has currently permitted withdrawal limits that are lower than 2020 needs. Preliminary results of a recently conducted wellfield stress test indicate that use of SJRWMD's groundwater model to predict declines in the elevation of the water table in the vicinity of the city's wellfield may result in overestimates of water table declines. If further evaluation of the current source indicates fresh groundwater availability (i.e., if wetland impacts associated with wellfield pumping are less than projected or can be avoided or mitigated), then the existing system should be adequate to meet future needs.

St. Joe Utilities. St. Joe Utilities is located in northwest St. Johns County. It currently has no facilities in place, but it is projected to have an ADD of 4 mgd by 2020. The Floridan aquifer is the proposed water supply source. Studies to determine groundwater availability and proposed treatment techniques have yet to be performed.

St. Johns County Utility. The largest percentage of the 2020 public supply needs and deficits in St. Johns County occurs within the St. Johns County Utility service area. The projected needs are large enough to make developing alternative sources potentially attractive, both technically and financially. The options include developing additional fresh groundwater, developing a new wellfield with a *membrane softening* treatment system in the northern portion of the county, developing a brackish water source with reverse osmosis water treatment in the southern portion of the county, building an interconnection to an adjacent utility, and securing fresh surface water from the lower Ocklawaha River.

St. Johns Service Company. St. Johns Service Company has existing facilities that appear to be adequate to meet 2020 needs. Deficit estimates are based on permitted wellfield capacity. Upgrading and expanding the existing system to use additional fresh groundwater is the only logical option at this time. A decrease in the system demand ratio, possibly through additional water conversation or reuse activities, could lessen the MDD and more closely match the existing facility's capacity.

United Water Florida (St. Johns County). Compared to the total work group area 2020 needs, the United Water Florida needs are small. Upgrading and expanding the existing system to use additional fresh groundwater is the only logical option at this time. (Following completion of water use evaluations described in this DWSP, United Water Florida (St. Johns) requested revision of its 2020 projection to 18.12 mgd. This requested revision is not the basis of evaluations in this DWSP. Further investigation and refinement of projected water needs will be included in future revisions of DWSP.)

Water Supply Utilities in Duval County

As with St. Johns County, approximately 50 percent of the 2020 ADD increase in public supply need will occur within one major service area. That area is the portion of the JEA system, south and east of the St. Johns

River. The deficits for the remaining service areas individually are relatively small, and in most cases the current facilities are likely to meet 2020 needs using fresh groundwater. All alternative water supply sources will be more costly than the fresh groundwater option.

City of Atlantic Beach. The City of Atlantic Beach has existing facilities that will meet the 2020 needs. Its deficit is based on wellfield permitted capacity. If future inland groundwater withdrawals can be optimized to avoid impacting groundwater quality in Atlantic Beach public supply wells, then the existing system will meet future needs. It may be appropriate to interconnect the beach communities, including Atlantic Beach, beyond the existing emergency interconnections, to provide redundancy and flexibility for the water supply systems.

Florida Water Services. Compared to the total work group 2020 needs, the Florida Water Services area needs are small. Upgrading and expanding the existing system to use additional fresh groundwater is the only logical option at this time.

City of Jacksonville Beach. The City of Jacksonville Beach has existing facilities that will meet all 2020 needs. Its deficit is based on current wellfield permitted capacity. The city has submitted a CUP application for quantities to meet its needs through 2020. The application includes the proposed relocation of the city's existing wells. The main area of the city is almost built out, and if future inland groundwater withdrawals are optimized to avoid impact to the water quality of the City of Jacksonville Beach, then the proposed system upgrade should be adequate to meet 2020 needs. It may also be appropriate to interconnect the beach communities, including Jacksonville Beach, beyond the existing emergency interconnections, to provide redundancy and flexibility for the water supply systems.

JEA. The largest percentage of the 2020 needs and deficits in the Duval County portion of Work Group Area V occurs within JEA's service area. JEA is developing a plan to meet this need and issued a Phase 1 Water Facilities Plan in August 1998. This plan recommends the phase-out of certain facilities and the improvement or expansion of others. JEA appears to have most of the facilities required to meet its projected 2020 needs. However, the projected needs are large enough to make developing alternative sources potentially attractive, both technically and financially. Options include new wellfields in the north grid portion of the JEA system, an interconnection to the south grid to convey the new supply, surface water supply from the lower Ocklawaha River, and seawater desalting.

Desalting seawater at the JEA electric power plants may have future potential if lower desalting costs can be realized by co-siting water treatment facilities with thermoelectric power generation facilities. The JEA Water Facilities Plan Phase 1 also discusses, in its demand projections, the potential of acquiring the private utilities within the south grid service area around the year 2005. Those purchases would impact the potential water supply options to be considered for those utilities and JEA.

City of Neptune Beach. The City of Neptune Beach has existing facilities that will meet all 2020 needs. Its deficit is based on its current wellfield permitted capacity. The main area of the city is almost built out, and compared to the total work group area 2020 needs, the City of Neptune Beach needs are small. If future inland groundwater withdrawals are optimized to avoid impact to the water quality of the City of Neptune Beach, then the existing system can meet future needs. It may be appropriate to interconnect the beach communities, including Neptune Beach, beyond the existing emergency interconnections, to provide redundancy and flexibility for the water supply systems.

Regency Utilities. Compared to the total countywide 2020 needs, the Regency Utilities needs are small. Upgrading and expanding the existing system to use additional fresh groundwater is the only logical option at this time.

United Water Florida (Duval County). United Water Florida has a relatively large current demand within the Duval County area of Work Group Area V. Its future needs will increase approximately 30 percent by 2020. If future inland groundwater withdrawals are optimized to avoid impacting the water quality of United Water Florida, then upgrading and expanding the existing system should be considered. If not, alternative sources, such as system interconnection with adjacent water systems, should be considered. A decrease in the system demand ratio, possibly through additional water conservation or reuse activities, could lessen the MDD.

Expected Cost of Water Supply Options

The estimated capital and total unit production costs associated with the Work Group Area V water supply options are reported in Table 26. Because of the uncertainty associated with this work group area, ranges of expected costs and unknowns are listed, as necessary.

Table 26. Estimated costs to meet 2020 public supply needs for northern St. Johns County and southern Duval County public supply utilities

Utility	Estimated Capital Cost ($ millions)	Estimated Unit Production Cost $/1,000 gallons
GDU Julington Creek	3.8	0.58
Intercoastal Utilities	3.2	0.40
North Beach Water System	4.7	2.72
City of St. Augustine*	—	—
St. Johns County Utility	29.1 to 34.6	1.73 to 1.86
St. Johns Service Company	0.7	0.68
United Water Florida (St. Johns)	4.8	0.53
Subtotal, St. Johns County	**46.3 to 51.8**	—
City of Atlantic Beach*	—	—
Florida Water Services	2.1	0.49
City of Jacksonville Beach	2.8	0.23
JEA (City of Jacksonville)	Up to 37.9	Up to 0.87
City of Neptune Beach	0.7	0.49
Regency Utilities	0.7	0.63
United Water Florida (Duval)	5.9	0.50
Subtotal, Duval County	**Up to 50.1**	—
Total	58.5 to 101.9	—

*Existing facilities are adequate.

Cost estimates for many of the smaller water supply utilities (e.g., GDU Julington Creek) are based on relatively small increased use of fresh groundwater. The Work Group Area V water supply options will incur modest capital investments and relatively low unit production costs. Estimated costs for the North Beach Water System include expansion of the existing membrane treatment system. The range of costs reported for the St. Johns County Utility options include membrane treatment at one of two potential wellfield locations.

By far the greatest cost uncertainty for Work Group Area V relates to future water supply development by JEA. If the 2020 deficit is met by construction of a Floridan aquifer wellfield north of the St. Johns River, with transport to the south grid service area, then new investment requirements will be substantial. However, if most or all of the increased demand can be met by optimization of fresh groundwater withdrawals at locations south of the St. Johns River, then these costs could be substantially reduced. Investigations are ongoing to more accurately determine optimum withdrawal locations and additional facility requirements.

Future Outlook for Work Group Area V

Public supply needs of Work Group Area V are currently met by fresh groundwater. This use is expected to continue in the future, and some additional fresh groundwater resources will be available to meet these future needs. However, fresh groundwater is limited. The exact limits are currently unknown, and in most parts of Work Group Area V, fresh groundwater resource limits may be reached by 2020. As fresh groundwater resource limits are approached, each new wellfield or wellfield expansion strains resources and incurs financial risks. Utilities should evaluate these risks before planning to further develop fresh groundwater.

Although in some cases existing wellfield and treatment facilities can meet the future needs, installation of additional pumping, treatment, and transmission infrastructure will be needed to meet the 2020 demands. Additional investigation is necessary to evaluate what portion of the new infrastructure should tap alternative supplies available to meet future needs, in order to diversify and reduce risks. When DWSP is revised in five years, more information will be available to guide this decision and reduce the current level of uncertainty.

WATER SUPPLY DEVELOPMENT FUNDING SOURCES

Subparagraph 373.0361(2)(a)3, *FS*, requires that SJRWMD identify potential sources of funding for water supply development for the identified source options. Although nontraditional funding sources such as a local option gross receipts tax on water could become available in the future, SJRWMD has identified only the more-traditional funding sources that are likely to be available. The potential funding sources identified are as follows:

- Water supply utility revenues from customer charges
- Local government ad valorem tax revenues
- Local government special assessments
- SJRWMD ad valorem tax revenues
- State of Florida general revenues

- Federal revenues
- Private investment

Water Supply Utility Revenues From Customer Charges

This source of revenue has historically been the primary and, in most instances, the sole source of funding for water supply development. The Florida Legislature has expressed its intent, based on the provisions of Paragraph 373.0831(2)(c), *FS*, that

1. 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; and
2. 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.

Based on historic practice and this legislative guidance, SJRWMD anticipates that water supply utility revenues from customer charges will continue to be the primary funding source for water supply development projects. SJRWMD anticipates that customer charges will increase to support the cost of alternative water supply source development. In Work Group Area I, this increase could range from about $0.85 per 1,000 gallons, based on the environmentally feasible least-cost solution, to about $1.25 per 1,000 gallons, based on the more restrictive solution. These increased rates apply only to new nontraditional alternative supplies, which are a small portion of the total supply. Therefore, if the cost of new nontraditional alternative supplies were blended with the cost of existing supplies, the actual rate increase to customers would be substantially less, probably on the order of $0.25 per 1,000 gallons.

Local Government Ad Valorem Tax Revenues

Local government ad valorem tax revenues are not typically used to fund water supply development. In some instances, an advance or transfer from a local government's general fund may be used as seed money to establish a water system. Advance payments of this sort are often repaid to the general fund from utility revenues from customer charges. This potential source is not expected to generate significant funds for future water supply development projects.

Local Government Special Assessments

Local government special assessments are typically used to fund portions of water supply development projects at the subdivision or neighborhood level. Because special assessments are levied against taxable property, the portions funded must directly benefit the taxable property. This usually includes only distribution lines to individual residences. This potential source of funding is not expected to contribute significantly to the implementation of water supply development projects.

SJRWMD Ad Valorem Tax Revenues

Based on the provisions of Paragraph 373.0831(1)(a), *FS*, WMDs are not precluded from providing assistance with water supply development. Further, Paragraphs 373.0831(4)(a) and (b), *FS* (Appendix H), provide guidance for prioritizing the distribution of state or water management district funds for water supply development projects.

SJRWMD has had an active Alternative Water Supply Cost-Share Program since 1996. This program is based on the requirements of Section 373.1961, *FS*. SJRWMD has annually funded this program from ad valorem tax revenues in an average amount of $704,578 per year (FY 1996–FY 2000).

SJRWMD's ad valorem tax revenues are limited by a constitutionally established cap of 1 mil and by a statutory cap of .6 mil. SJRWMD's FY 2000 budget includes about $63.3 million from ad valorem tax sources; the budget is based on .482 mil.

If the current statutory limit of .6 mil were to be increased to the constitutional limit of 1 mil, an additional $69 million, based on current property assessments, could be generated. The Governing Board could allocate all or a portion of this money to support water supply development projects. However, SJRWMD has no current plans to actively pursue such an increase in the constitutional millage limit.

SJRWMD's Governing Board has maintained a levy of .482 mil for six consecutive years. However, the Governing Board could levy an additional .118 mil without exceeding its statutory cap. This would generate an additional $16.3 million, based on current property assessments.

SJRWMD ad valorem tax revenues are allocated to various program accounts to support all of SJRWMD's areas of responsibility. Water supply development is only one of those programs. A significant change in funding allocations among programs by SJRWMD's Governing Board would be necessary to direct additional ad valorem revenues toward the support of water supply development projects.

State of Florida General Revenues

State of Florida general revenues have historically been the source of funding for relatively small local government water supply projects. However, this source of funding has not typically been appropriated for significant water supply development projects. This practice is not expected to change.

Preservation 2000 and Water Management Trust Funds

Section 259.101(3)(b), *FS*, currently authorizes SJRWMD to use Preservation 2000 Trust Fund moneys for the acquisition of lands for water supply development. However, the Florida Forever Act, Section 259.105, *FS*, will replace Preservation 2000. The Florida Forever Act does not authorize the use of funds for SJRWMD acquisition of lands for water supply development, but, pursuant to Subsections 259.105(6) and 373.1391(5), *FS*, SJRWMD lands which are purchased with Florida Forever funds may be used for water supply development projects that are funded through other sources.

Subsection 373.59(11), *FS*, authorizes SJRWMD to purchase lands for water supply development with funds from the Water Management Lands Trust Fund.

Federal Revenues

SJRWMD, in cooperation with SFWMD and SWFWMD, has actively sought and secured federal funding for water resource development and water supply development projects. The United States Congress in 1997 appropriated $870,000 for water supply projects in SJRWMD. An additional $3,116,000 was appropriated in 1998. These funds are administered through EPA.

Additional funds continue to be sought through the proposed Alternative Water Sources Act. If approved, this act would establish a more dependable source of funds in EPA to develop and demonstrate alternative water supply approaches which conserve, manage, reclaim, reuse, and de-salt water. Under this program, $75 million per year for five fiscal years would be authorized to provide grants to states not eligible for assistance from the Bureau of Reclamation. Florida would be eligible to receive a portion of this funding. However, at this time, there is no assurance that this proposed act will be enacted or what the SJRWMD portion of possible funding would be.

Private Investment

Private investment is a potential source of funds to support water supply development in SJRWMD. A range of public/private ownership and investment options is available. These options range from all-public ownership and operation to all-private ownership and operation. Typically, in projects that depend heavily on the use of private investment, that investment is used to support initial capital costs. In these cases, funds to pay back the private capital investment and to support project operation and maintenance ultimately come from revenues from customer charges. However, competition among private investors desiring to fund water supply development projects could act to reduce project costs, potentially resulting in lower customer charges. The financial dynamics of the regulated rate-making process make it difficult for a private owner to maintain profitability over the life of a large water supply facility such as a water treatment plant. For this reason, public/private partnerships are often more feasible. SJRWMD's consultant Burton and Associates has prepared a discussion of principles relative to private investment in water supply facilities (Appendix I).

Water Supply Development Projects

Subparagraph 373.0361(2)(a)4, *FS*, requires that this DWSP include a list of water supply development projects that meet the criteria in Subsection 373.0831(4), *FS*. Based on the provisions of Subsection 373.0831(4), *FS*, water supply development projects that are consistent with the relevant regional water supply plans and that meet one or more of the following criteria shall receive priority consideration for state or water management district funding assistance:

- The project supports establishment of a dependable, sustainable supply of water which is not otherwise financially feasible (Subparagraph 373.0831(4)(a)1, *FS*)
- The project provides substantial environmental benefits by preventing or limiting adverse water resource impacts, but requires funding assistance to be economically competitive with other options (Subparagraph 373.0831(4)(a)2, *FS*)
- The project significantly implements reuse, storage, recharge, or conservation of water in a manner that contributes to the sustainability of regional water sources (Subparagraph 373.0831(4)(a)3, *FS*)

SJRWMD has identified and described water supply source options for its entire jurisdiction in the Water Supply Development Component of this document. However, specific water supply development projects based on these identified source options, in most cases, have not been finally decided upon by water suppliers. SJRWMD anticipates that the proposed regional decision-making project, which is described in the Water Resource Development Component section of this document, will provide the mechanism for identifying specific water supply development projects in Work Group Areas I and II.

Several water supply development projects are being actively discussed, investigated, and, in one instance, implemented by public supply utilities in SJRWMD. These projects meet or exceed one or more of the criteria listed in Subsection 373.0831(4), *FS*. Three of these projects are components of SJRWMD's highest priority water supply effort, the Eastern I-4 Corridor Water Project, which is designed to identify and implement economically, technically, and environmentally feasible water supply and water resource development projects in the rapidly growing I-4 corridor area of east-central Florida.

Proposed water supply development projects are described as follows:

- St. Johns River Water Supply Facility Component of the Eastern I-4 Corridor Water Project
- Eastern Orange and Seminole Counties Regional Reuse Component of the Eastern I-4 Corridor Water Project
- City of Apopka Reuse Component of the Eastern I-4 Corridor Water Project
- North-Central St. Johns County Wellfield Project
- Strategic Water Conservation Assistance Project
- Strategic Reclaimed Water Assistance Project

St. Johns River Water Supply Facility Component of the Eastern I-4 Corridor Water Project

Water supply development alternatives included in this DWSP rely on the St. Johns River to supply up to 221 mgd to meet projected 2020 demands. SJRWMD anticipates that one or more surface water supply facilities will be developed on the St. Johns River from De Land in Volusia County upstream to Lake Washington in Brevard County. Consistent with the requirements of Subparagraph 373.0831(4)(a)2, *FS*, development of these facilities will provide substantial environmental benefits by preventing or limiting adverse water resource impacts, but will require funding assistance to be economically competitive with other options. Additionally, it is important that these facilities be developed in a manner that would sustain the resources of the St. Johns River. SJRWMD, in cooperation with the Volusian Water Alliance and Seminole County, has completed preliminary investigations of two potential sites along the St. Johns River near Lake Monroe (CH2M HILL 1999b).

Eastern Orange and Seminole Counties Regional Reuse Component of the Eastern I-4 Corridor Water Project

This project will provide for the effective use of large quantities of reclaimed water, which are available in eastern Orange and Seminole counties and which otherwise would be discharged to the St. Johns River. The project focuses on system interconnections to transport reclaimed water from areas of surplus to areas of need. Consistent with the requirements of Subparagraph 373.0831(4)(a)3, *FS*, this project will significantly implement reuse in a manner that contributes to the sustainability of regional sources. SJRWMD, in cooperation with the City of Orlando, Orange County, the Orlando Utilities Commission, Seminole County, the City of Oviedo, and the University of Central Florida, is currently developing specific reuse scenarios and cost estimates for this project.

City of Apopka Reuse Component of the Eastern I-4 Corridor Water Project

This project will relieve the use of substantial amounts of groundwater for irrigation in the area that supplies groundwater to springs in the headwaters of the Wekiva River. Consistent with the requirements of Subparagraph 373.0831(4)(a)3, *FS*, this project significantly implements reuse in a manner that contributes to the sustainability of regional sources. The additional reuse capacity provided by this project also will assure adequate flow to meet peak demands and prevent future shortfalls of reclaimed water supply as experienced by the City of Apopka during dry conditions for the last several years. Project components include the upgrade of an existing 2-mgd wastewater treatment facility to public area reuse standards, increased storage, additional pump station capacity, and installation of additional infrastructure to distribute reclaimed water.

North-Central St. Johns County Wellfield Project

Development of a new Floridan aquifer wellfield with a membrane softening treatment facility in the northern portion of St. Johns County has been identified as a feasible water supply option to meet projected 2020 needs for St. Johns County Utility. Land holdings adequate to provide for flexibility in wellfield design and management are critical to this project. In addition, management of desalting concentrate from the treatment process is likely to prove challenging and costly. Consistent with the requirements of Subparagraph 373.0831(4)(a)1, *FS*, this project will support the establishment of a dependable, sustainable supply of water which would otherwise not be financially feasible.

Strategic Water Conservation Assistance Project

SJRWMD is firmly committed to maximizing water conservation to the extent technically, environmentally, and economically feasible. This commitment to water conservation is districtwide, not focused only on priority water resource caution areas. To this end, SJRWMD has implemented the water conservation practices described in Appendix F.

SJRWMD's consumptive use permitting rules require that all permitted water users implement water conservation measures in order to demonstrate efficient water use. As a result, all water users, including all public supply utilities in SJRWMD, currently implement water conservation practices. The water conservation programs implemented by public supply utilities are designed primarily to improve utility efficiency and reduce individual customer water use. The *Water 2020* estimates used in the demand-center-specific options analysis account for these current programs. However, it is reasonable to assume that additional water conservation initiatives could be developed and become available in the future to further enhance current practices.

Water Conservation Plan

SJRWMD proposes to provide water supply development assistance by developing a Water Conservation Plan that will guide SJRWMD activities and assist water users by identifying additional water conservation strategies and projects that could be implemented to further reduce water demands. These strategies and projects will be designed to maximize conservation of water within environmentally, economically, and technically feasible limits. While conservation is the responsibility of the water users, SJRWMD anticipates that cooperative funding may be available to implement some strategies and projects that would otherwise be economically infeasible. The Water Conservation Plan is being developed in cooperation with SJRWMD's Water Utility Advisory Board and Agricultural Advisory Committee and other interested parties. SJRWMD proposes that this plan will be reviewed and updated on a regular basis. A draft of the plan is scheduled for completion in June 2000. The final Water Conservation Plan is scheduled for completion by December 2000 and will be presented to the Governing Board for consideration for inclusion in DWSP. Individual project schedules and costs will be identified as part of the plan development process.

At a minimum, this water conservation plan will address the following components:

- Further documentation of feasible conservation projects for different categories of water use
- Data collection and analysis, including estimating savings in water consumption and costs of conservation
- Research concerning the effectiveness of water conservation practices
- Cooperative development of water conservation education between SJRWMD and public supply utilities
- Provisions for consideration of cost-shared assistance for practices that would be otherwise economically infeasible

Strategic Reclaimed Water Assistance Project

SJRWMD's consumptive use permitting rules currently require that water users use reclaimed water and other lower quality sources whenever feasible. As a result, many utilities within SJRWMD have active reuse programs. SJRWMD is committed to the continuation and expansion of these reuse programs. Development of future water supply options identified in this plan does not lessen SJRWMD's commitment to this effort; reuse options considered in this DWSP would supplement existing programs.

SJRWMD is firmly committed to assisting water users in maximizing the use of reclaimed water to the extent technically, environmentally, and economically feasible. This commitment to reuse is districtwide, not focused solely on priority water resource caution areas. To this end, SJRWMD has already implemented numerous water reuse initiatives, which include the major elements described in Appendix G.

SJRWMD proposes to provide water supply development assistance by developing a Reclaimed Water Plan that will identify additional strategic reuse initiatives and regional projects. These initiatives and projects will be designed to assist water users in maximizing the use of reclaimed water within environmentally, economically, and technically feasible limits. While the use of reclaimed water is the responsibility of the water users, SJRWMD anticipates that cooperative funding may be available for implementation of some of these strategies and projects that would otherwise be economically infeasible. This plan will be developed in cooperation with SJRWMD's Water Utility Advisory Board and Agricultural Advisory Committee and other interested parties. The Reclaimed Water Plan is scheduled for completion by December 2000 and will be presented to the Governing Board for consideration for inclusion in DWSP. At a minimum, this plan should address the following components:

- Data collection, documentation, and analysis of the current status of reuse that can be used by utilities and others to plan for additional reuse
- Identification of additional regional reuse projects and coordination of planning between utilities and local governments
- Coordination between SJRWMD and public-supply utilities on development of educational programs on the use of reclaimed water
- Cost-shared assistance for implementation of reuse projects that would otherwise be economically infeasible
- Provisions for limited cost-sharing, when needed, for feasibility assessments of specific reuse projects

This ongoing project will be reviewed on a regular basis. Individual project schedules and costs will be identified as part of the plan development process.

WATER RESOURCE DEVELOPMENT COMPONENT

SJRWMD has developed a water resource development program in association with its regional water supply planning effort. This water resource development program includes water resource development projects based on the provisions of Paragraph 373.0361(2)(b), *FS*. This subsection requires that DWSP include

A water resource development component that includes:
1. A listing of those water resource development projects that support water supply development.
2. For each water resource development project listed:
   a. An estimate of the amount of water to become available through the project.
   b. The timetable for implementing or constructing the project and the estimated costs for implementing, operating, and maintaining the project.
   c. Sources of funding and funding needs.
   d. Who will implement the project and how it will be implemented.

Based on the definition of water resource development included in Subsection 373.019(19), *FS*, SJRWMD considers a water resource development project to be a project that contributes to the formulation and implementation of regional water resource management strategies. Based on the provisions of this subsection, these strategies include

- The collection and evaluation of surface water and groundwater data
- Structural and nonstructural programs to protect and manage water resources
- The development of regional water resource implementation programs
- The construction, operation, and maintenance of major public works facilities to provide for flood control, surface and underground water storage, and groundwater recharge augmentation
- Related technical assistance to local governments and to government-owned and privately owned water utilities

SJRWMD has historically performed projects that are consistent with the definition of water resource development projects. These projects are numerous and range in significance from major flood control and environmental enhancement projects, such as the Upper St. Johns River Basin Project, to smaller, very specialized hydrologic data collection and analysis efforts. Many of these projects are ongoing. These SJRWMD projects, although consistent with the definition of water resource development projects, are not necessarily identified as water resource development projects in DWSP. Water resource development projects identified in DWSP are projects that would increase the quantity of water available for water supply. Following is a description of SJRWMD's water resource development projects that are currently under way or that will be implemented by SJRWMD to support water supply development.

ABANDONED ARTESIAN WELL PLUGGING PROGRAM

Uncontrolled or improperly constructed artesian wells (abandoned artesian wells) can have an adverse impact on the quantity and quality of water in aquifers or other water bodies. Pursuant to the requirements of Section 373.207, *FS*, SJRWMD has an active program to plug or repair abandoned artesian wells. This program is known as the Abandoned Artesian Well Plugging Program. The goal of this program is to assure the continued availability of groundwater resources by detecting, evaluating, and controlling abandoned artesian wells.

SJRWMD annually prepares a report of the status of its Abandoned Artesian Well Plugging Program. Based on the most recently published report, 581 abandoned artesian wells were in need of plugging of repair in 1995 (Curtis 1998). The wasted flow from these wells is estimated to be about 106 mgd. Properly controlling the flow from these wells will have positive impacts on groundwater levels and quality, thus increasing the availability of water for reasonable-beneficial use. Abandoned artesian wells in priority water resource caution areas have the highest priority for plugging.

SJRWMD estimates that about $2,243,960 (1995 dollars) will be required to plug or repair these wells. SJRWMD has plugged or repaired an average of 97 abandoned artesian wells per year since the current program was established in 1983. At this rate, the 1995 inventory of 581 wells would not be plugged or repaired until 2002.

Funds to support this program historically have been supplied cooperatively by SJRWMD, individual well owners, and several counties. A description of this cooperative funding effort is included in Curtis 1998.

SJRWMD proposes to continue its Abandoned Artesian Well Plugging Program on the current schedule and with the current sources of funding.

ADAPTIVE MANAGEMENT PROJECT

For the last decade, SJRWMD's water supply planning and assessment investigations have indicated that there are finite limits to the amount of groundwater withdrawal that can be sustained without causing unacceptable adverse impacts to the water resource and related natural systems. The *Water 2020* planning effort results to date show that at some locations, withdrawal limits will be approached in the foreseeable future within the *Water 2020* planning horizon.

It has been acknowledged throughout the *Water 2020* and DWSP development process that uncertainty exists in water supply planning (see Appendix J). The level of uncertainty will be reduced as DWSP is revised and updated, but it will never be fully eliminated. Therefore, an *adaptive management*, or "learn as you go," approach is an important part of SJRWMD's water supply planning process.

Adaptive management involves long-term hydrologic and environmental monitoring as well as hydrologic modeling and analysis, with integration of the results into the decision-making process. All of these activities are ongoing; however, they should be coordinated and integrated into a continuous process of monitoring, modeling, and evaluation.

A major objective of adaptive management is that the resources of concern (aquifers, wetlands, lakes, streams, springs, etc.) be monitored in order to make better-informed future management decisions. SJRWMD will develop and implement a comprehensive and coordinated resource monitoring plan, with major focus on the priority water resource caution areas. These data will be stored in a well-designed database to facilitate retrieval and usefulness. The data will be used to further calibrate, verify, and enhance SJRWMD's hydrologic and decision models, thereby continually improving the basis for decision making.

It is anticipated that the resource components to be monitored as part of the regional program will include aquatic, wetland, and upland ecosystems; lakes and streams; and the surficial, intermediate, and Floridan aquifer systems. The first step for this effort will be the development of a plan for the regional water resources monitoring program. The monitoring program plan will address the following:

- Program goals and objectives
- Parameters to be monitored—flows, levels, water quality, ecology
- Equipment needs and options

- Monitoring station layouts/configurations
- Spatial distribution needs for monitoring network
- Criteria for siting monitoring stations
- Protocols and standards for data collection, validation, modeling, and analysis
- Protocols and standards for data storage, retrieval, and access

SJRWMD proposes to develop and implement an adaptive management monitoring plan that includes these program elements. SJRWMD proposes to develop this plan in concert with the regional decision-making process in Work Group Areas I and II.

SJRWMD proposes to begin plan development in FY 2000 and to complete it within 18 months. Plan implementation should begin immediately after the monitoring program plan is developed.

SJRWMD estimates the cost of plan development to be about $100,000. SJRWMD will fund the development of the plan. Estimated implementation costs will not be available until a plan is developed. Implementation will likely be funded by SJRWMD and water supply utilities benefiting from the program.

Implementation of the adaptive management project will provide for more careful management of the groundwater resources in SJRWMD. More careful management could result in the availability of increased quantities of groundwater that could be withdrawn for reasonable-beneficial use. In Work Group Area I, based on uncertainty analyses performed to date by SJRWMD, increases in groundwater availability of about 30 mgd could be realized.

AQUIFER PROTECTION PROGRAM

Protection of SJRWMD's aquifers from unacceptable contamination and loss of recharge is essential to the security of existing and future water supplies. The surficial aquifer provides an important source of water supply in parts of SJRWMD. Coastal areas such as Brevard, Flagler, and St. Johns counties make direct use of the surficial aquifers along the coastal ridges as water supply sources. The surficial aquifer sources are prone to contamination from overlying activities on the land surface. Inland, in parts of Alachua, Marion, Lake, and Orange counties, confining beds are thin or absent, making the Floridan aquifer itself similarly prone to contamination. The surficial and Floridan aquifers are projected to continue to be the primary sources of water supply in these areas of

SJRWMD. Therefore, these aquifers should be protected to ensure their continued availability as water supply sources.

Release of contaminants in a surficial aquifer recharge area can quickly render an aquifer unusable. Depending upon hydrologic conditions, the contaminated surficial aquifer may have the potential to locally contaminate the intermediate and Floridan aquifers as well.

Loss of recharge may occur when development causes a loss of natural land cover and an increase of impermeable surfaces, such as parking lots and roadways. Ditching, draining, and diversion of water out of closed basins may also contribute to the problem. These changes tend to reduce recharge and increase surface water runoff. Loss of recharge in this way is often slow and incremental, but the long-term result can be devastating.

SJRWMD's activities relating to source protection are guided by the State Comprehensive Plan, the Water Resources Act of 1972 (Chapter 373, *FS*), and SJRWMD rules.

Wellhead Protection

Florida's wellhead protection program is one element of surficial aquifer protection. This program was developed in Florida in response to the requirements of Section 1428 of the Safe Drinking Water Act. The wellhead protection program is implemented through the Minimum Criteria Rule for Review of Local Government Comprehensive Plans and Plan Amendments, Chapter 9J-5, *F.A.C.* Through this rule, local government comprehensive plans are required to address wellhead protection.

In wellhead protection zones, local governments limit or restrict land uses that have a high potential for contaminant release. Because wellhead protection is implemented at the local level, there are a variety of techniques used to identify the wellhead protection zones (areas around wellheads to be protected). Some techniques are technically rigorous, but many utilize a nominal 200-foot radius around the wellhead without regard to hydrologic conditions. The popular use of a 200-foot zone provides virtually no aquifer protection in most areas of Florida because of high permeability sandy soils, and only limited protection of the Floridan aquifer in areas where confining beds are thin or absent. Upon request from a local government, SJRWMD will assist in the determination of the area around a well that should be protected and how to protect it through local government regulations.

Recharge Area Protection

Section 373.0391, *FS*, requires the WMDs to provide information to local governments concerning the location of aquifer recharge areas, while Section 373.0395, *FS*, requires the WMDs to include "prime groundwater recharge areas" in their groundwater availability inventories. Floridan aquifer recharge areas are well documented in SJRWMD; this information is provided to local governments upon request. However, recharge areas for surficial aquifers have not been extensively mapped.

A recent development in the area of aquifer protection is DEP's Source Water Assessment and Protection Program, which is an outgrowth of the 1996 amendments to the Safe Drinking Water Act. The program is designed to evaluate potential sources of pollution to public drinking water supplies and to protect those supplies through pollution prevention programs.

SJRWMD proposes to develop an Aquifer Protection Plan. This plan would be developed cooperatively with DEP and local governments to identify and protect surficial aquifers, the Floridan aquifer in areas where confining beds are thin or absent, and associated recharge areas. This plan will integrate existing aquifer protection efforts with additional initiatives required to adequately protect the surficial and Floridan aquifers.

The Aquifer Protection Plan should include groundwater quality and recharge protection goals, objectives, and implementation strategies. At a minimum, the following strategies should be included:

- SJRWMD will cooperate with local governments to investigate specific strategies to retain and use storm water and reclaimed water to reduce existing or potential loss of recharge to reasonable levels and to potentially make more water available for potable or irrigation supply. To the extent practical, the identified strategies should include multiple objectives such as reducing development-induced freshwater discharge, as well as increasing recharge and wetlands hydration.

- SJRWMD will seek to identify strategic land acquisitions needed to implement these recharge strategies. SJRWMD will include lands identified to be strategic for recharge enhancement as a priority for land acquisition.

- SJRWMD will continue its wellhead protection technical assistance program to provide timely delineations and implementation assistance to requesting local governments.

- SJRWMD will continue a coordinated outreach program to inform local governments of the aquifer protection technical assistance available from SJRWMD upon request.
- SJRWMD will delineate surficial aquifer recharge areas and prime recharge areas as a basis for protective regulations by local governments.
- SJRWMD will consider incorporating recharge standards and criteria for important recharge areas into SJRWMD's surface water and stormwater rules.

A schedule and estimate of costs for development and implementation of this aquifer and recharge protection plan have not been developed. However, SJRWMD anticipates that project planning will begin in FY 2000. Potential funding sources for land acquisition to increase recharge include SJRWMD, Florida Forever, the federal government's fund for alternative water supply development, local governments, and privately owned public supply utilities.

Specific estimates of the amount of water to be made available as a result of this program have not been made by SJRWMD. However, this program has the potential of ensuring the availability of all existing and future groundwater supplies in SJRWMD.

Aquifer Storage Recovery Feasibility Testing

Significant quantities of storage will be required to develop a reliable water supply from most candidate surface water withdrawal sites investigated in DWSP, including all St. Johns River sites. ASR is a cost-effective method for providing the required storage and is generally feasible within SJRWMD. As part of the SJRWMD alternative water supply strategies investigations, a preliminary ASR feasibility assessment procedure was developed (CH2M HILL 1997a). This procedure may be applied to a given potential ASR location, to assess the technical feasibility of ASR relative to other storage methods. The desktop procedure relies on existing data, including general hydrogeologic characteristics of the target storage zone.

However, because a natural geologic formation is being used to store the treated water, performance uncertainties will exist until physical testing is performed. This testing will involve design, construction, and instrumentation of test ASR wells, and injection and recovery over several cycles, with careful monitoring of the quantities and quality of the injected and recovered water. Analysis of these data will define the true performance in given locations. Test data can be used to design ASR systems, develop operational criteria, and predict long-term ASR performance.

SJRWMD proposes to sponsor ASR feasibility testing in association with development of water supply systems. SJRWMD also proposes to enter cooperative agreements with individual utilities to perform ASR testing where ASR may contribute to better management of local water supplies.

Firm schedules and costs for this project are not available at this time, but will be developed when proposed ASR locations have been identified through the regional decision-making process.

In addition, SJRWMD proposes pursuing ASR demonstration projects for raw surface water and reclaimed water to test the feasibility of this technique as a means of managing the availability of water from these sources for agricultural irrigation and for public supply.

Firm schedules and costs for this work are not available at this time. However, SJRWMD estimates that project costs will be about $2.5 million. SJRWMD plans to fund the initial phase of this testing. Likely funding sources for future ASR testing and development include public supply utilities, Florida Forever, the federal government's fund for alternative water supply development, and SJRWMD.

ASR testing is necessary to ensure that this storage and recovery technique can be used successfully at specific locations. Therefore, performance of this project is critical to the development of ASR systems that may be associated with future water supply development projects. ASR of treated water is the primary storage technique planned for surface water source development projects for public supply, which could supply about 500 mgd of additional water supplies. ASR of raw surface water may offer significant potential in the development of new water supplies for reasonable-beneficial use. SJRWMD proposes to investigate this potential more fully and will develop estimates of the quantities of water that can be made available using this technique; such estimates are not available at this time.

Central Florida Aquifer Recharge Enhancement Program

Providing additional aquifer recharge in central Florida could significantly increase available fresh groundwater supplies and thereby reduce or delay the need for development of alternative water supplies.

Aquifer recharge could be increased by enhancing natural recharge or by providing artificial recharge, including infiltration basins or recharge wells. Recharge enhancement can be integrated with stormwater management systems to provide needed drainage and flood control as well as increased water supply. The purpose of the Central Florida Aquifer Recharge Enhancement Program is to maximize local recharge to the Floridan aquifer and to minimize the impacts of groundwater withdrawals in order in increase the sustainable fresh groundwater supply and reduce the need for development of alternative supplies.

The Central Florida Aquifer Recharge Enhancement Program will proceed in three main phases:

- Phase I—Artificial Recharge Demonstration Projects
- Phase II—Recharge Enhancement Evaluation and Design
- Phase III—Program Implementation

Phase I—Artificial Recharge Demonstration Projects

Artificial recharge was included in SJRWMD's alternative water supply strategies investigation. Artificial recharge using infiltration basins, as well as recharge wells, was investigated in the east-central Florida planning area. The use of RIBs to recharge high-quality reclaimed water to the surficial aquifer is a well-established and accepted practice. However, the use of recharge wells, although practiced for many years, has been the subject of much controversy. Recharge wells have historically been used in central Florida as a stormwater management and lake-level control technique. However, the aquifer recharge benefits and consequences of central Florida drainage wells have not been fully investigated. In addition, construction of new recharge wells has not been permitted in recent years due to aquifer contamination concerns. As a result, local governments have increasingly relied on diversion of water from recharge to nearby rivers to solve flooding problems, which has resulted in losses in aquifer recharge.

SJRWMD investigated the aquifer recharge characteristics of existing recharge wells and developed a preliminary assessment of the technical feasibility of increasing this recharge, thereby increasing the water supply potential of the Floridan aquifer in east-central Florida (CH2M HILL 1997d). Aquifer recharge provided by existing aquifer recharge wells is significant (from 39 mgd to 52 mgd) and that opportunity exists to significantly increase the current recharge rate, thereby supplementing current groundwater supplies.

The major issue preventing additional use of direct recharge wells is the potential for bacterial contamination of the aquifer using lake water or treated storm water as the source of recharge. The purpose of these artificial recharge demonstration projects is to demonstrate the use of recharge wells for net aquifer improvement. Net improvement may include increasing recharge volume without increasing aquifer contamination, or decreasing aquifer contamination while preserving existing artificial recharge rates. Because bacteria is of primary concern, the demonstration program will focus on the following:

- The fate of bacteria in the Floridan aquifer
- The effectiveness of passive stormwater treatment for reducing bacteria
- The effectiveness and cost feasibility of physically reducing bacteria in lake water recharge

The increase in recharge that would result from full implementation of the net improvement concept is not precisely known, but SJRWMD believes that 50 mgd is a reasonable estimate.

The artificial recharge demonstration program is a cooperative effort between central Florida local governments, SJRWMD, SFWMD, DEP, and EPA. Three projects have been identified for this program:

- Lake Orienta Recharge Well Project (City of Altamonte Springs)
- Urban Street Drainage Treatment Project (City of Orlando)
- Lake Sherwood Project (Orange County)

The Lake Orienta project involves construction of a new recharge well and monitoring wells on Lake Orienta, which is currently served by lake-level control wells. Monitoring of both lake water quality and the receiving-aquifer water quality will be performed prior to, during, and after recharge, to investigate the fate and transport of bacteria in the aquifer.

The Urban Street Drainage project is similar in scope and objective to the Lake Orienta project except that in this case, an existing street drainage well(s) with no stormwater treatment will be retrofitted with a passive stormwater treatment system and/or a subsurface treatment system to evaluate net water quality benefits.

The Lake Sherwood project involves comprehensive watershed planning and installation of stormwater pollutant reduction technologies to allow increased recharge volume in an existing lake-level control well without increasing pollutant loading to the aquifer.

These projects will provide vital data on the fate and transport of constituents introduced into the aquifer via direct recharge as well as provide criteria for the design of aquifer recharge systems, including recharge water pretreatment systems.

The artificial recharge demonstration projects are currently planned as five-year projects. These projects began in 1999 and are scheduled to extend through 2004.

The estimated total cost of this program will not be available until the design phase is complete and permits have been issued. However, the estimated cost of monitor well construction and associated data collection and analysis is $300,000. This element of the program will be funded by SJRWMD and SFWMD. Based on a cost-share agreement between SJRWMD and SFWMD (SJRWMD Contract No. 99H278), SJRWMD and SFWMD will share the cost of this element for work related to the Urban Street Drainage and Lake Sherwood projects, and SJRWMD will fund the work related to the Lake Orienta project. In addition, based on cost-share agreements with the local government cooperators, SJRWMD will design the monitoring plan for the program and will prepare the required permit applications and perform permit-related interagency coordination at an estimated cost of $250,000. SJRWMD will also reimburse local government cooperators in an amount up to $200,000 for their project-related expenses. It is expected that both DEP and EPA will participate by reviewing monitoring data to evaluate the benefits of the program.

The cost identified to date for Phase I is $750,000. Construction costs, other than monitor well construction, and other project-related expenses will be borne by the local government cooperators. These costs are expected to be considerable.

Phase II—Recharge Enhancement Evaluation and Design

Concurrent with the performance of Phase I work, evaluations of the feasibility of other artificial recharge enhancement approaches, such as the placement of storm water and reclaimed water in RIBs and naturally occurring closed depressions in upland recharge areas, are proposed. Upon completion of the Phase I demonstration projects and these evaluations, recharge water treatment requirements, costs, and hydrologic design requirements will be better defined. This information, along with local stormwater management and flood control needs, can be used to design an integrated central Florida aquifer recharge system. This system should meet stormwater management, aquifer protection, and water supply needs and will contribute to integrated regional water resource management.

A cost of $250,000 has been identified to date for Phase II evaluations of the feasibility of other artificial recharge enhancement approaches, such as the placement of storm water and reclaimed water in RIBs and naturally occurring closed depressions in upland recharge areas. It is estimated that these evaluations will be performed cooperatively with local governments and will require about five years to complete. Other Phase II costs and schedules have not been estimated.

Phase III—Program Implementation

The scope of the Central Florida Aquifer Recharge Enhancement Program can be determined only after completion of Phases I and II. However, it is likely that it will require the cooperative efforts of SJRWMD, SFWMD, DEP, EPA, local water supply utilities, and local stormwater management agencies. Priorities will need to be established, and detailed design, construction, and monitoring will follow. Costs and schedules for Phase III are not available at this time.

Cooperative Well Retrofit Project

The *Water 2020* Water Supply Planning Area IV work group has developed a proposed solution to deal with existing and potential future interference problems in southwestern St. Johns County and eastern Putnam County. The nature of this problem is discussed in more detail in the Water Supply Development Component of this DWSP. The proposed solution, if successfully implemented, will eliminate interference with existing legal domestic users and will avoid the construction of new domestic well systems that are inadequate for producing water during the peak irrigation period. The two-pronged solution developed by the Area IV work group is described as follows:

- **Eliminating the Impact of Seasonal Drawdowns on Existing Legal Domestic Users**—The majority of the work group has agreed in concept to a cooperative effort to repair existing well systems when a loss of flow occurs due to seasonal drawdown. Each loss-of-flow complaint will be investigated to verify that loss of flow is directly attributable to the drawdown and not to a well system construction, operation, or maintenance problem. If the loss of flow is clearly due to drawdown, the well system will be repaired and the cost will be shared by SJRWMD and major area water users. This cooperative approach is appropriate, considering the large number of consumptive use permittees whose withdrawals contribute to the interference with existing legal uses. Specific details regarding the cost-share split and other administrative details have yet to be finalized.

The funding needed to resolve this water supply issue is modest. A repair of this type typically involves adding a pump between the well and the aerator and/or increasing the length of drop pipe in the well. This type of repair is estimated to cost between $400 and $500 per well. It is estimated that there are fewer than 50 wells in the work group area that are subject to loss of flow during seasonal drawdown events. Estimated maximum capital cost to resolve the existing problem is $25,000.

Implementation of this project is expected to impact the continued availability of about 12,500 gallons per day of existing domestic self-supply in Work Group Area IV. This project is also designed to ensure the availability of water to supply future domestic self-supply systems.

SJRWMD proposes to develop a final implementation plan and schedule for this solution in FY 2000.

- **Avoiding the Construction of Inadequate New Domestic Well Systems**—SJRWMD has worked with St. Johns County and Putnam County to get county ordinances in place to ensure that new domestic well installations are capable of producing water during the seasonal drawdown events.

  Putnam County had a well construction ordinance, but it did not apply to all areas of the county subject to seasonal drawdowns due to potato irrigation. SJRWMD worked with county staff to revise the ordinance to include all affected areas. The revised ordinance has been approved by the county commission.

  St. Johns County did not have a well construction ordinance in place to address this water supply issue. SJRWMD, supported by the Northeast Florida Growers Exchange, worked with county staff and made a presentation to the St. Johns County Commission regarding the need for this type of ordinance. SJRWMD provided the county with draft language for a well construction ordinance, and the ordinance has been adopted by the St. Johns County Commission.

DEMINERALIZATION CONCENTRATE MANAGEMENT PROJECT

SJRWMD has identified brackish groundwater and surface water as potential significant sources of supply to meet projected 2020 demands. The use of this brackish water will require management of the waste concentrate that is a byproduct of the demineralization process. Available management options include placement in deep injection wells, discharge to surface waters, land spreading, discharge to wastewater treatment facilities, and so forth. Implementation of these management options is subject to DEP regulatory requirements; these regulatory requirements are based on federal guidelines administered by EPA. The history of the permitting of demineralization concentrate discharges in SJRWMD indicates the need to develop acceptable management strategies for demineralization concentrate discharge that can be dependably utilized by public supply utilities and other water users. This should be a cooperative effort with DEP and EPA. SJRWMD proposes to proactively work to develop these management strategies through the following actions:

- Develop acceptable management strategies for demineralization concentrate discharge that can be dependably utilized by public supply utilities and other water users. This should be accomplished through a cooperative effort with DEP, EPA, public supply utilities, and other affected parties
- Identify any required technical studies, data collection, or analysis needed to formulate management strategies and monitor the effectiveness of management strategies. This should be accomplished through a cooperative effort with DEP, EPA, public supply utilities, and other affected parties

SJRWMD proposes to begin this effort in FY 2000, but has not developed a comprehensive schedule or budget for this project. Such a schedule and budget will be developed at the time of contract negotiations with the consultant selected by SJRWMD to perform the work.

Specific estimates of the amount of water to be made available as a result of this project have not been made by SJRWMD. However, because acceptable concentrate management must be associated with any demineralization project, all existing and future potential brackish groundwater, surface water, and seawater source development could be impacted.

FACILITATION OF REGIONAL DECISION-MAKING PROCESS

SJRWMD has identified water supply source options that are adequate to meet the projected water demands of all users through 2020. However, decisions concerning the choice of options by public supply utilities may greatly influence the availability of these source options for other utilities. This is of particular concern for those options that differ significantly in cost, for example, fresh groundwater at a cost of about $0.75 per 1,000 gallons and surface water from the St. Johns River at a cost of approximately $2.00 per 1,000 gallons. SJRWMD anticipates that less-expensive fresh groundwater will be the first option of choice for most public supply utilities. However, in Work Group Areas I and II, there may be inadequate locally available fresh groundwater to meet all projected 2020 demands. The combination of some fresh groundwater, but not enough locally available to meet demands, and the considerably higher cost of development of alternative sources, such as surface water and brackish groundwater, sets the stage for competition for the less expensive additional groundwater. A regional decision-making process is recommended as a means of avoiding unnecessary and disruptive competition for the water resource.

As part of this regional decision-making process, SJRWMD will strive to maximize decision-oriented discussions between major water users, particularly public supply utilities. SJRWMD intends to proactively implement this regional decision-making process by taking the following actions:

- Coordinate with the work groups to develop a plan and schedule for the decision-making process
- Provide a facilitator for the process at SJRWMD's expense
- Provide SJRWMD staff and consultant expertise to support the process at SJRWMD's expense
- Develop a document that describes the decision-making process and the decisions achieved through the process
- Amend and update DWSP as necessary to incorporate sustainable water source options selected by water supply utilities that are consistent with this DWSP

This regional decision-making process has not been designed specifically for the purpose of creating any particular form of intergovernmental or institutional structure. Rather, the process seeks to encourage forms of cooperation which are mutually beneficial to all participants. SJRWMD intends to begin this effort in FY 2000 and anticipates that completion of this process may require up to two years.

An estimate of the cost of this decision-making process will be developed in association with the development of a plan for the process. However, based on the costs incurred to date by SJRWMD in association with the *Water 2020* process, SJRWMD estimates that the cost will be about $500,000. This project will be funded by SJRWMD.

SJRWMD considers this decision-making process to be critical to the development of additional public supplies in Work Group Areas I and II through the planning horizon. The estimated quantity of these additional public supplies is 340 mgd in Work Group Area I and 42 mgd in Work Group Area II.

Feasibility of Seawater Demineralization Projects

Seawater demineralization is considered as a general option available to all water supply utilities. However, because of the relative cost and availability of other less expensive options, seawater demineralization is not considered among the utility-specific options identified in this DWSP.

Significant quantities of seawater will probably not need to be developed in SJRWMD before 2020. However, it is reasonable to assume that seawater will be developed as a water supply source within SJRWMD in the future. Seawater demineralization technology is continually advancing, and the relative cost between seawater and other alternative public supply sources will likely narrow in the future. Coastal areas are more likely than inland areas to develop seawater resources. Special case situations, such as co-siting a seawater demineralization plant with an electric power plant, may make this water supply source competitive with the development of other water supply sources.

SJRWMD proposes to investigate the technical, environmental, and economic feasibility of seawater demineralization projects. This feasibility investigation will include an evaluation of

- Available technologies
- Potential sites, including sites on the Atlantic Ocean and along the Atlantic Intracoastal Waterway system, with special emphasis on opportunities to co-site with an electric power plant
- Demineralization concentrate management

- Costs

SJRWMD proposes to begin this feasibility investigation during FY 2000 and to complete it within 18 months. SJRWMD plans to fund this investigation.

SJRWMD estimates the cost of this project to be about $300,000. Decisions concerning further investigation of seawater demineralization projects will be made following completion of this feasibility investigation.

HYDROLOGIC DATA COLLECTION AND ANALYSIS

SJRWMD has identified the need for hydrologic data collection and analysis in association with required five-year revisions of DWSP and in association with DWSP implementation. Based on this need, SJRWMD proposes the following data collection and analysis efforts.

SJRWMD's Hydrologic Data Collection Network

SJRWMD operates and maintains a hydrologic data collection network. This network provides a source of valuable hydrologic information concerning parameters, including rainfall, evapotranspiration, surface water and groundwater flows and levels, and surface water and groundwater quality. SJRWMD proposes the following actions in association with this effort:

- Maintain the existing network, making changes as necessary based on site evaluations and consideration of the adaptive management monitoring program
- Develop and implement a plan to improve the surficial aquifer monitoring network to support recalibration of groundwater models
- Develop and implement a plan for the construction of additional Lower Floridan aquifer monitor wells in SJRWMD's regional groundwater flow model areas

Water Use Data Management

SJRWMD collects, manages, and analyzes water use data in association with its water supply assessment and water supply planning efforts. SJRWMD's water use data management project includes verification of the location of public supply wells and water treatment plants, mapping of public supply service area boundaries, and development of population projections and demand projections for water use categories examined in the water supply assessment. SJRWMD proposes the following actions in association with this effort:

- Continue the water use data management program
- Expand the well and water treatment plant inventory to include all public supply utilities using at least 0.1 mgd; include country clubs with a resident population in the public supply water use category
- Continue efforts to make water use information available to internal and external customers, using SJRWMD's database and Internet systems
- Continue coordination with SJRWMD permitting staff to assure consistency between demand projections and permit allocations
- Develop demand projections for public supply at the water treatment plant level and, if possible, at the well level

Hydrology of Native Plant Communities

SJRWMD recognizes the need to determine the hydrologic conditions associated with native plant communities that have not been impacted by groundwater withdrawals, surface water diversions, or other man-induced activities that would alter the natural character of the communities. SJRWMD operates and maintains a network of native vegetation monitoring sites located in unimpacted native plant communities. Surficial aquifer monitor wells have been installed at each site for the collection of groundwater level data. In addition to groundwater level data, vegetation and soils data are collected at the sites. The network was installed in 1995 and has been monitored regularly since that time. Data from these sites are analyzed to better understand the relationships between vegetation, soils, and groundwater level changes. SJRWMD plans to use this information as a reference for assessments at other sites that may be impacted by proposed groundwater withdrawals. SJRWMD proposes the following actions in association with this effort:

- Continue to operate and maintain the monitoring network
- Analyze data and prepare written reports of analyses at five-year intervals

Groundwater Modeling

SJRWMD relies heavily on the use of groundwater models for evaluation of hydrologic data in association with its water supply planning effort.

These groundwater models include regional-scale groundwater flow models, local-scale analytical flow models, and regional and subregional groundwater quality models.

SJRWMD's regional groundwater flow models are currently capable of simulating only steady-state conditions. Development of transient calibrations for these regional groundwater flow models will allow for the simulation of time-varying conditions in the aquifer. The simulation of smaller time-steps than that represented by the steady-state condition can lead to improved model calibration and thus to improved confidence in SJRWMD's predictive simulations. In addition, simulation of smaller time-steps will aid in assessing the response time of water levels to pumping stresses. SJRWMD proposes the following actions in association with this effort:

- Complete the steady-state recalibration of the northeast Florida regional groundwater flow model to 1995 conditions
- Develop a decision model based on the northeast Florida regional groundwater flow model
- Determine an appropriate methodology for prediction of water quality changes in the Floridan aquifer with respect to time in the northeast Florida regional groundwater flow model area. Implement this methodology
- In cooperation with SFWMD and SWFWMD, develop and implement a groundwater modeling strategy for the east-central Florida area that will meet the needs of the three WMDs. At a minimum, the following elements shall be considered in development of this strategy:
    - Joint development of a central Florida regional groundwater flow model
    - Development of a new or revised groundwater quality model for SJRWMD's east-central Florida groundwater flow model area
    - Development of transient calibrations for SJRWMD's east-central Florida regional groundwater flow model
- Improve the decision models associated with the east-central and Volusia regional groundwater flow models based on flow model revisions, as necessary

- Consider the need to develop local-scale MODFLOW models and optimization models of the St. Augustine, St. Johns County, and Palm Coast Utility wellfields; develop these models as deemed necessary
- Consider the need to develop groundwater flow models for the Indian River County area; develop these models as deemed necessary
- Maintain close coordination with the U.S. Geological Society and other WMDs concerning the MEGA model to ensure appropriate incorporation of boundary conditions in future predictive scenarios
- Evaluate groundwater/surface water interactions in Bennett Swamp and other flow-through wetland areas, as necessary
- Develop and implement a plan to project water level declines in lakes with established minimum levels or in lakes that are included on the MFLs project priority list using the MODFLOW LAKE PACKAGE and other appropriate techniques
- Assess the need to develop local-scale groundwater flow and water quality models in association with proposed new wellfield sites identified as a result of the proposed regional decision-making process; develop these models as deemed necessary

Surface Water Modeling

SJRWMD utilizes surface water modeling to simulate the surface runoff responses of watersheds to precipitation by representing the watersheds as interconnected systems of hydrologic and hydraulic components. Each component models an aspect of the precipitation-runoff process within a portion of the watershed, commonly referred to as a basin or a subbasin. Each basin or subbasin is represented by a combination of model components that include runoff, river routings, reservoirs, and diversion and pump components. Daily rainfall, evapotranspiration, seepage losses, soil and land use data, and hydraulic rating curves are basic input requirements for these model programs. The watershed divisions and their components are linked together to represent the connectivity of the defined project areas.

The purpose of the continuous simulation modeling is to provide long-term hydrologic data for project areas under existing, historical, and projected future conditions. These simulations are needed to evaluate the conditions associated with establishing the hydrologic criteria required for maintaining a balance between the consumptive use of water for human purposes and that required for maintaining a healthy ecological environment. Examples of the type of information provided are

- Supplemental irrigation requirements for agricultural areas under historic rainfall conditions for existing and projected future land use conditions
- Long-term hydrologic data to ensure that any withdrawals for water supply will not cause water flows or levels to fall below established MFLs and environmental hydrologic criteria established for protecting healthy ecosystems
- Information essential in determining the amount of surface water available for water supply for meeting a 1-in-10-year drought requirement

SJRWMD proposes to take the following actions in association with this effort:

- Continue the simulation modeling of the upper St. Johns River to more accurately define the existing and future agricultural water demands and the impact the established environmental criteria will have on the ability of the water supply to meet these demands
- Develop suitable river flow simulation modeling of the middle St. Johns River to provide a more accurate description of the water supply available from the St. Johns River in this area, including Lake Monroe
- Include water supply withdrawal scenarios in the simulation modeling of the upper Ocklawaha River Basin to provide a more accurate description of the water supply available from the basin

Integrated Decision Modeling

SJRWMD, in cooperation with the University of Florida's Center for Applied Optimization, has developed and used decision models to assist in its water supply planning efforts in the east-central Florida and Volusia regional groundwater flow model areas. These models allow SJRWMD and the water supply planning work groups to identify possible regional water supply solutions based on the integration of water resource impact criteria, cost, and other considerations such as sociopolitical or regulatory restrictions. These models are based on the regional groundwater flow models and must be revised as the flow models are updated and revised. SJRWMD proposes to take the following actions in association with this effort:

- Assess the need to develop a decision model based on the northeast Florida regional groundwater flow model. Develop this model as deemed necessary
- Improve the decision models associated with the east-central and Volusia regional groundwater flow models based on changes to the flow models

Specific estimates of the amount of water to be made available as a result of this project have not been made by SJRWMD. However, this project will support all existing and proposed future source development.

Investigation of Areas Where Domestic Self-Supply Wells Are Sensitive to Water Level Fluctuation

Certain areas of SJRWMD have high concentrations of domestic self-supply wells. As growth has continued and demands on the aquifers have increased, regional lowering in the aquifers has occurred. This regional lowering, in combination with natural or induced seasonal fluctuations, has caused loss of flow to some self-supply installations. Installations relying upon free-flowing wells to supply a household are particularly susceptible to this problem. Also, pumps or drop pipes designed for historically higher water levels may no longer be adequate for the fluctuations that now occur. This investigation will identify areas where high concentrations of domestic self-supply wells exist and hydrologic conditions are such that the potential for loss of flow is high. Management strategies will be developed for these areas so that interference with these self-supply wells can be avoided. This information will assist permitted water users in managing impacts and mitigating for any interference with existing legal uses.

Regional Aquifer Management Project

Projected 2020 groundwater withdrawals for public supply in Volusia County are projected to result in cumulative impacts that could cause unacceptable adverse impacts to the water resources and related natural systems in the area. Impacts to wetlands and lakes and saltwater intrusion are of particular concern. The area includes existing public supply wellfields belonging to the cities of Ormond Beach, Holly Hill, Daytona Beach, Port Orange, New Smyrna Beach, Edgewater, Lake Helen, De Land, Orange City, and Pierson; Florida Water Services (for the City of Deltona); and Volusia County. The cumulative impacts of the withdrawals from these wellfields rather than the impacts of withdrawals from any one of these wellfields are the source of concern. Therefore, the regional aquifer management project (RAMP) is proposed as a means of increasing the quantity of sustainable wellfields while protecting the water resources and related natural systems.

RAMP will consist of the following phases:

1. Plan development
2. Feasibility assessments and demonstration projects
3. Design and construction
4. Operation and maintenance

Based on information available to date, the following water supply strategies are expected to be incorporated into RAMP:

1. Avoidance of wetland impacts using wetland hydration with storm water and reclaimed water
2. Aquifer storage recovery
3. Water supply facility interconnection
4. Wellfield optimization

SJRWMD proposes to work cooperatively with the Volusian Water Alliance to develop a plan for RAMP. SJRWMD estimates that plan preparation will cost $250,000 and can be completed in two years, beginning in FY 2001. Costs and time frames for the remaining phases of RAMP will be estimated as part of the plan preparation process.

SURFACE WATER IN-STREAM MONITORING AND TREATABILITY STUDIES

Surface water is an alternative water supply source in SJRWMD. Its current use for public supply is limited to withdrawal by the City of Melbourne from Lake Washington on the upper St. Johns River and by the City of Cocoa from the Taylor Creek Reservoir.

DWSP has identified several opportunities for development of additional surface water resources, including

- The St. Johns River between Cocoa and De Land
- The upper and lower Ocklawaha River basins
- The C-1 Canal watershed in Brevard County

Compared to groundwater, surface water is difficult and expensive to develop as a public water supply source, because rivers and streams are inherently variable in both quantity and quality of flow available for use.

DWSP has been developed based on the best available data. For the most part, historic streamflow records are adequate for evaluation of the quantity of water available, and some water quality data are available for preliminary characterization of treatment requirements. However, much uncertainty exists regarding the impact of surface water quality on total water treatment costs.

Historically, there has been little interest in surface water for public supply because high-quality groundwater was usually available. In addition, the number of water quality parameters important to water treatment process selection and design is increasing rapidly, as a result of recent and ongoing revisions to national drinking water standards and rules.

There is a need to establish a comprehensive surface water quality monitoring program to gather the data necessary to adequately characterize surface water quality at likely water supply withdrawal locations. The most critical monitoring locations include the main stem of the St. Johns River between Cocoa and De Land. Siting of one or more regional water treatment plants along this reach is likely.

One very important and evolving issue is disinfection byproducts control. Historic water quality data of interest to the evaluation of disinfection byproducts are largely unavailable and are critical for developing accurate assessments of treatment requirements and costs.

Other locally important candidate surface water withdrawal sites could also be investigated (e.g., the C-1 Canal) if local governments or utilities are interested in joining a cooperative effort. Bench- and pilot-scale treatability studies should also be initiated once sufficient data are obtained to adequately characterize the raw water quality.

SJRWMD proposes to begin the water quality monitoring program in FY 2000 and estimates that the program will require about 18 months to complete, at a cost of about $200,000.

Surface water in-stream monitoring and treatability studies must be performed before adequate surface water withdrawal and treatment systems can be designed. Therefore, performance of this project is critical to the development of new surface water sources, including the St. Johns River (up to 351 mgd), the upper Ocklawaha River Basin (up to 14 mgd), the lower Ocklawaha River Basin (up to 107 mgd), and the C-1 Canal (up to 11 mgd).

Strong local interest has been expressed at this time in the development of a surface water supply system on the St. Johns River near Lake Monroe, but not at the other sites. Therefore, the costs and schedules for surface water in-stream monitoring and treatability studies are based on performance of this work only for the St. Johns River at Lake Monroe at this time. SJRWMD plans to initiate treatability testing in FY 2000. SJRWMD estimates that this work will cost $1.5 million and will require two years to complete. Potential funding sources for construction of a regional surface water supply facility include public supply utilities (both government and privately owned), Florida Forever, the federal government's fund for alternative water supply development, private investors, and SJRWMD.

Wetland Augmentation Demonstration Program

Augmentation of water levels in wetlands is one approach to avoiding wetland impacts resulting from lowering of adjacent surficial aquifer water levels. Although this technique could be used to offset or avoid some of the undesirable impacts of groundwater withdrawals, operational experience is limited. The purpose of the impact-avoidance demonstration program is to initiate and monitor several wetland hydration projects to generate a monitoring, design, construction, and operational history which can be used in future water supply planning to fully evaluate this technique as an alternative water supply development strategy.

The feasibility of avoiding wetland impacts through hydration was assessed in SJRWMD's alternative water supply strategies investigation. The wetlands augmentation demonstration program is a continuing phase of the alternative strategies investigations documented by CH2M HILL (1997c).

The wetland augmentation demonstration program is a cooperative effort between SJRWMD and participating water supply utilities. Five demonstration projects have been identified and are included in the current program:

- Project 1—Tillman Ridge wellfield, St. Johns County
- Project 2—Bennett Swamp, Volusia County
- Project 3—Port Orange wellfield, Volusia County
- Project 4—City of Titusville wellfield (Parkland Wetland), Brevard County
- Project 5—City of Sanford wellfield, Seminole County

Projects 1, 3, and 4 are very similar in scope and format. Each demonstration project involves assessment of baseline hydrologic, biologic, and water quality conditions. Permitting, design, construction, and operation of the required hydration facilities are also included. Construction of the hydration facilities will be the responsibility of the utility owner. The other activities will be completed by SJRWMD. Each hydration system will then be operated to maintain the desired wetland hydrologic regime as necessary, with monitoring of important hydrologic and biologic parameters, as well as water requirements and costs. Raw groundwater will be used for augmentation in Projects 1 and 3, local stormwater runoff will be used for augmentation in Project 4, and reclaimed water will be used for augmentation in Project 5.

Project 2 is somewhat more complex then the other demonstration projects and involves optimal management of a regional surface water wetland and drainage system to maximize environmental and water supply benefits. The initial phase of this project includes environmental baseline monitoring to establish existing conditions. Monitoring and simulation modeling will then be used to determine optimal surface water control structure locations and operating elevations to achieve the desired benefits.

Cooperative agreements between SJRWMD and the participating owner/utilities have been developed for Projects 1 through 4, and all of these projects have recently been initiated. Discussions concerning Project 5 are under way with the City of Sanford.

Information provided from each wetland augmentation demonstration project will be useful in ascertaining the potential cost and effectiveness of this technology as a water supply and environmental management alternative. Such an assessment will improve the quality and completeness of future DWSP updates.

The Wetland Augmentation Demonstration Program began in 1999 and is scheduled to extend through 2005.

The estimated total cost of this program is $1.5 million. Based on existing and contemplated agreements with the local government cooperators, SJRWMD plans to provide $1.25 million of this cost, with local government cooperators providing $250,000.

The specific quantity of additional groundwater that will be made available for withdrawal and use as a result of this demonstration project cannot be determined prior to performance of the demonstration project.

SJRWMD believes that wetland augmentation can be used to increase the quantity of groundwater that can be withdrawn without causing unacceptable adverse impacts to the water resources and related natural systems. However, operational experience necessary to precisely quantify this increase is lacking. This demonstration project is designed to provide that operational experience.

RECOMMENDATIONS

SJRWMD has developed strategies for implementation of this DWSP. These implementation strategies are included in the following categories:

- Minimum flows and levels
- Water supply development projects
- Water resource development projects
- Consumptive use permitting process
- Intergovernmental, water supplier, and public coordination

Following is a discussion of the strategies by category.

MINIMUM FLOWS AND LEVELS

SJRWMD's MFLs program is described in the Establishment of Minimum Flows and Levels section of this document. SJRWMD annually publishes an approved priority list and a schedule for establishment of MFLs for water bodies on the priority list. The current priority list and schedule has been published in the *Florida Administrative Weekly.*

Proposed Action

- As part of the annual update to SJRWMD's Priority List and Schedule for the Establishment of Minimum Flows and Levels, give due consideration to water supply sources identified in DWSP

- Continue with the establishment of MFLs in accordance with the approved priority list and schedule

- Perform ongoing monitoring and periodic re-evaluation of MFLs

- Develop and refine groundwater and surface water models, including an interface between ground and surface water models, where appropriate, to predict if water withdrawals will cause water levels and flows to fall below established MFLs

WATER SUPPLY DEVELOPMENT PROJECTS

SJRWMD has identified and described water supply source options for its entire jurisdiction in the Water Supply Development Component section of this document. SJRWMD anticipates that specific water supply development projects will be selected as a result of the proposed regional decision-making project, described in the Water Resource Development Component section of this DWSP.

Several water supply development projects are being actively discussed, investigated, and, in one instance, implemented by public supply utilities in SJRWMD. These projects meet or exceed one or more of the criteria listed in Subsection 373.0831(4), *FS*, and are described as follows:

- St. Johns River Water Supply Facility Component of the Eastern I-4 Corridor Water Project
- Eastern Orange and Seminole Counties Regional Reuse Component of the Eastern I-4 Corridor Water Project
- City of Apopka Reuse Component of the Eastern I-4 Corridor Water Project
- North-Central St. Johns County Wellfield Project
- Strategic Water Conservation Assistance Project
- Strategic Reclaimed Water Assistance Project

Proposed Action

- Assist in identifying water supply development projects through the proposed regional decision-making process
- Complete timely and regular updates of DWSP as needed to incorporate the results of regional decision making and further feasibility investigations
- Assist in implementing water supply development projects through technical assistance and cooperative funding

WATER RESOURCE DEVELOPMENT PROJECTS

SJRWMD has identified and described proposed water resource development projects in the Water Resource Development Component section of this document. Identified water resource development projects include the following:

- Abandoned artesian well plugging program
- Adaptive management project
- Aquifer protection program
- Aquifer storage recovery feasibility testing

- Central Florida aquifer recharge enhancement program
- Cooperative well retrofit project
- Demineralization concentrate management project
- Facilitation of regional decision-making process
- Feasibility of seawater demineralization projects
- Hydrologic data collection and analysis
- Investigation of areas where domestic self-supply wells are sensitive to water level fluctuation
- Regional aquifer management project
- Surface water in-stream monitoring and treatability studies
- Wetland augmentation demonstration program

Proposed Action

- Implement water resource development projects as described in the Water Resource Development Component section of this document
- Complete timely and regular updates of DWSP as needed to incorporate the results of regional decision-making and further feasibility investigations

CONSUMPTIVE USE PERMITTING PROCESS

Both the DWSP and the consumptive use permitting programs are tools which the legislature has provided SJRWMD to ensure that sufficient water will be available for existing legal uses and reasonably anticipated future needs and to sustain the water resources. A successful planning process should provide an effective means for avoiding the adverse effects of competition for water supplies which could occur in the consumptive use permitting process. Simply put, these two processes—planning and permitting—complement each other.

The District has identified a number of actions which will help ensure that these two processes are fully complementary:

- **Make available all data, scientific analyses, modeling, and other information developed in the DWSP process for use by permit applicants as part of establishing that their water use meets the applicable consumptive use permitting criteria**

SJRWMD will make this information available in readily usable formats and will provide assistance to permit applicants in using the modeling tools.

Although the water resource constraints utilized in the planning process are not direct substitutes for SJRWMD's consumptive use permitting criteria and some of the consumptive use permitting criteria (e.g., water conservation) are not encompassed within these constraints, nonetheless, the options included in the plan have withstood a rigorous planning-level analysis and should therefore be very useful to applicants seeking to focus on options which have been identified as potentially sustainable sources.

- **Encourage participation by water supply utilities and other CUP applicants in a regional decision-making process in areas where such a process is important to the successful future development of regional public water supplies**

SJRWMD has identified the need for regional decision making concerning the choice of water supply sources to meet projected 2020 demands in Work Group Areas I and II. Numerous public supply utilities exist in close proximity to one another in these work group areas. These utilities currently have proposed to use groundwater to meet most demands through 2020. To successfully meet the 2020 demands, a combination of additional groundwater and alternative sources has been identified as the most sustainable approach. The alternative sources most likely to be used are surface water and brackish groundwater. The costs of developing these resources could range from about $0.75 per 1,000 gallons for additional fresh groundwater to about $2.00 per 1,000 gallons for surface water. This combination of some fresh groundwater, but not enough locally available to meet demands, and the considerably higher cost of development of alternative sources, such as surface water and brackish groundwater, sets the stage for competition for the less expensive additional groundwater. A regional decision-making process is recommended as a means of avoiding unnecessary and disruptive competition for the water resource. A cooperative regional decision-making process rather than a more piecemeal allocation of water among competing permit applicants pursuant to Section 373.223, *FS*, is more likely to result in the most beneficial use of the water resource for all existing and reasonably anticipated future uses.

The facilitated process will include appropriate groupings of users. The goal of the process will be to select regional water supply options (1) which meet existing and reasonably anticipated future water needs of all users while sustaining the water resources and related natural systems and (2) which the participants are willing to support and implement. SJRWMD envisions the successful completion of this process will result in revisions to DWSP to incorporate the selected regional water supply options.

- **If one or more utilities attempt to disrupt or bypass the regional decision-making process, SJRWMD should consider initiation of rulemaking to amend its consumptive use permitting rules to establish specific public interest factors to be used in the case of competing applications pursuant to Section 373.233, *FS*.**

As part of its consideration, SJRWMD should weigh the public interest served by the water supply planning process, DWSP, and the regional decision-making process implemented as a recommendation of DWSP.

- **Consider initiation of the rulemaking process to amend the permit duration provisions of SJRWMD's consumptive use permitting rules which may serve to encourage selection of water supply options consistent with DWSP and the subsequent regional decision-making process.**

- **Use the coordinated review of CUPs as provided for in the Memorandum of Understanding (MOU) between SJRWMD, SFWMD, and SWFWMD to address and resolve concerns about interdistrict impacts.**

SJRWMD's water supply planning Work Group Area I includes portions of SFWMD and SWFWMD. Water use in those areas beyond the SJRWMD boundary could contribute to unacceptable water resource impacts in SJRWMD, and vice versa (Vergara 1998). The potential for interdistrict impacts exists because the Floridan aquifer is hydrologically continuous across the jurisdictional boundaries of the three WMDs. All three WMDs have consumptive use permitting rules promulgated based on the requirements of Part II, Chapter 373, *FS*. In 1998, the three WMDs entered into an MOU (Appendix K) which commits the districts to coordination of these permitting programs. SJRWMD should continue to participate in the MOU coordination and review process to help address interdistrict impacts.

Intergovernmental, Water Supplier, and Public Coordination

DWSP was developed through a cooperative public process designed to maximize the participation and input of local governments, government-owned and privately owned utilities, self-suppliers, and other interested and potentially affected parties, pursuant to the requirements of Subsection 373.0361(1), *FS*. SJRWMD recognizes the need for continued significant intergovernmental, water supplier, and public coordination in association with its water supply plan development and implementation efforts.

Implementation of this DWSP will be subject to applicable provisions of Chapters 120 and 373, *FS*. Pursuant to Section 373.0361(4), *FS*, any portion of this DWSP which affects the substantial interests of a party shall be subject to Section 120.569, *FS*. Additionally, pursuant to Section 373.0361(2)(e), *FS*, the considerations referenced in paragraph (e) of that subsection, unless adopted by rule, do not constitute final agency action.

Coordination With Other WMDs and DEP

SJRWMD recognizes the importance of coordination with Florida's four other WMDs and DEP concerning the water supply planning process. This coordination has historically been carried out primarily through the following organized efforts:

- Water Planning Coordination Group (WPCG)
- Interdistrict MFLs Framework Group
- MOU between SJRWMD, SFWMD, and SWFWMD (Appendix K)

WPCG was formed following the signing of Executive Order 96-297 and the enactment of the water supply planning provisions of Section 373.0361, *FS*. WPCG is composed of representatives of DEP and the five WMDs. The purpose of WPCG is to deal with consistency issues among WMDs concerning water supply planning matters.

The Interdistrict MFLs Framework Group was formed by the five WMDs and DEP for the purpose of developing consistent methodologies for the determination of MFLs.

SJRWMD, SFWMD, and SWFWMD entered into an MOU on October 28, 1998, for the purpose of establishing guidelines for interdistrict coordination of matters concerning water resource investigations, water supply planning, water use regulation, and water shortage management.

The three districts are currently involved in separate but coordinated water supply planning efforts in the area of the tri-district boundary. SFWMD is currently developing its Kissimmee Basin Water Supply Plan in the area immediately south of its boundary with SJRWMD. SWFWMD is currently developing its Southern Water Use Caution Area

Management Plan in the area immediately west of its boundary with SJRWMD. These planning processes are being performed based on the requirements of Section 373.0316, *FS*. However, the three separate planning processes are being carried out on different schedules. The three WMDs should jointly develop water resource constraints, which can be used in the required five-year update of DWSP, the Kissimmee Basin Water supply Plan, and the Southern Water Use Caution Area Management Plan.

In addition to these organized efforts, SJRWMD coordinates on an as-needed basis with the other WMDs and DEP concerning water supply planning matters.

Proposed Action

- Continue active participation in WPCG
- Continue active participation in the Interdistrict MFLs Framework Group
- Continue to implement the provisions of the tri-district MOU and develop a cooperative planning strategy with SFWMD and SWFWMD for areas which could experience interdistrict impacts, to be implemented in future updates of the water supply plans of these WMDs
- Continue coordination with other WMDs and DEP on an as-needed basis

Coordination With Local Governments

SJRWMD recognizes the importance of coordination with local governments on matters concerning water supply planning. SJRWMD's water supply planning process has been linked to local governments through the participation of local government elected officials and staff members in the work group process and through the work group plan and the DWSP review processes. Active participation by local government elected officials in work group meetings was generally weak; therefore, the primary links between the work group process and local government elected officials were local government staff members. The work groups expressed concern that this linkage was not strong enough. This concern prompted SJRWMD to present the results of the *Water 2020* process to selected local government bodies and to receive the direct input of those bodies.

SJRWMD coordination with local governments in Brevard and Volusia counties was considerably more organized than in other counties in SJRWMD. Local government coordination in Brevard and Volusia counties was primarily through the Brevard Water Supply Board (BWSB) and the Volusian Water Alliance (VWA), respectively. This organized coordination resulted in very valuable and direct input by local elected officials.

SJRWMD anticipates that the recommended regional decision-making process will require continued and even stronger coordination with local government staffs and elected bodies. Continuation of the work group process, development of the facilitated regional decision-making process, and meetings with local government staffs on an as-needed basis should provide adequate coordination at the local government staff level. However, the value of actively encouraging the development of groups such as BWSB and VWA in other areas of SJRWMD should be considered.

Proposed Action

- Continue coordination with local governments through water supply planning work groups and through meetings on an as-needed basis
- Develop and implement strategies for improved coordination with local government elected officials, with special consideration given to the formation of groups such as BWSB and VWA

Coordination With Water Suppliers

SJRWMD recognizes the importance of coordination with water suppliers, including publicly owned and privately owned water supply utilities, agricultural water users, and other self-suppliers, on matters concerning water supply planning. SJRWMD's water supply planning process has been linked to these users primarily through SJRWMD's water use projection process, work group process, and DWSP review processes. In addition, SJRWMD has focused considerable attention on public supply utilities and agricultural users through coordination with SJRWMD's Water Utility Advisory Board and Agricultural Advisory Committee and through the consumptive use permitting process. Active participation in work group activities by public supply utilities and by agriculture has been generally strong.

Proposed Action

- Continue current coordination links, particularly those with SJRWMD's Water Utility Advisory Board and Agricultural Advisory Committee, adjusting the intensity of coordination as necessary based on the regional decision-making process

Coordination With the State of Georgia

SJRWMD recognizes the importance of coordination with the state of Georgia concerning water supply development in northeast Florida and southeast Georgia. SJRWMD's northern boundary is coincident with the state of Georgia's southern boundary. The Floridan aquifer is continuous throughout the coastal areas of Georgia and Florida and is the primary source of water supply in the northeast Florida/southeast Georgia area. Groundwater withdrawals in the northeast Florida area impact groundwater levels in southeast Georgia, and vice versa.

SJRWMD and the Georgia Environmental Protection Division have actively coordinated for several years concerning the potential impacts of groundwater withdrawals. This coordination has been on an as-needed basis and has included technical workshops, project development coordination and report review, and meetings as needed.

Proposed Action

- Continue coordination with the State of Georgia Environmental Protection Division

Coordination With the Federal Government

SJRWMD recognizes the importance of coordination with the federal government in association with its water supply plan development and implementation efforts. This coordination involves primarily the areas of funding and regulation.

SJRWMD, in cooperation with SFWMD and SWFWMD, has actively sought and secured federal funding for water resource development and water supply development projects. The United States Congress in 1997 appropriated $870,000 for water supply projects in SJRWMD. An additional $3,116,000 was appropriated in 1998. These funds are administered through EPA.

Additional funds continue to be sought through the proposed Alternative Water Sources Act. If approved, this act would establish a more dependable source of funds in EPA to develop and demonstrate alternative water supply approaches which conserve, manage, reclaim, reuse, and de-salt water. Under this program, $75 million per year for five fiscal years would be authorized to provide grants to states not eligible for assistance from the Bureau of Reclamation. Florida would be eligible to receive a portion of this funding.

In addition to coordination on funding matters, SJRWMD coordinates with EPA concerning EPA regulation of water supply development and water resource development projects. The focus of this coordination has involved federal requirements for underground injection and discharge to surface waters, which are administered by DEP. These requirements could impact the implementation of important water resource and water supply development projects involving desalting concentrate management, artificial recharge, aquifer storage recovery, and public supply treatment technologies.

Proposed Action

- Continue to actively seek federal funding for identified water supply and water resource development projects
- Continue to coordinate with EPA and DEP to improve the ability to implement identified water supply development projects while ensuring necessary water resource protection

Coordination With Other Affected Parties and the Public

SJRWMD recognizes the importance of coordination with affected parties and the public concerning water supply planning matters. This coordination has occurred mainly through the work group and workshop processes. In an effort to maximize the involvement of affected parties and the public, SJRWMD developed and implemented an outreach plan. Based on this outreach plan, significant attention has been directed at obtaining the involvement of all interested parties. SJRWMD's Division of Water Supply Management (DWSM) maintains a comprehensive communications database to support SJRWMD's water supply planning effort. This database includes the *Water 2020* mailing list, which includes more than 1,700 names and is used as the basis of dissemination of water supply planning information. When initially compiled, this list included about 3,300 names gathered from all pertinent SJRWMD mailing lists. Following the first several work group meetings, the initial list was culled to eliminate the names of parties who did not want to continue to participate.

In addition to coordination with work group participants based on the *Water 2020* mailing list, SJRWMD maintains a World Wide Web site at http://sjr.state.fl.us. This Web site includes pertinent information concerning SJRWMD's water supply planning activities.

Proposed Action

- Update SJRWMD water supply planning outreach plan annually and implement updated plan
- Continue to manage the DWSM comprehensive communications database
- Continue to maintain the SJRWMD Web site, updating as necessary with pertinent water supply planning information

GLOSSARY

adaptive management—An approach to water resources and water supply management frequently described as a *learn as you go* process. Adaptive management involves long-term hydrologic and environmental monitoring, hydrologic modeling, and adjustment of withdrawal rates (allowed increases or required decreases) as more is learned about each alternative water supply source and its ability to deliver sustainable water supplies without resulting in unacceptable adverse impacts to the water resources or related natural systems.

average day demand (ADD)—Existing or projected future water use for an average or typical day. ADD is equal to the total annual water supply volume divided by the number of days per year. ADD is usually expressed in units of million gallons per day.

construction cost—The total amount expected to be paid to a qualified contractor to build the required facilities.

control point—A location in the simulation model where environmental or hydrologic limits or values are specified in order to achieve a management objective.

decision models—Water supply planning tools that incorporate regional groundwater flow models, saltwater upconing models, and mathematical optimization models to identify groundwater withdrawal scenarios that maximize the use of fresh groundwater while ensuring compliance with selected environmental constraints. Decision models can also be used to find the least-cost solution for providing necessary alternative water supplies to meet future needs. Decision models provide for the rapid and systematic evaluation of numerous regional water supply development scenarios.

deficit—The quantity of water that cannot be withdrawn from existing groundwater supplies without violating the specified constraints.

drawdown—A decline in the water level of the surficial aquifer or the potentiometric surface of the Floridan aquifer.

economic optimization model—A decision model that identifies the combination of alternative water supply source options that will provide future water supply needs at minimum total cost. An economic optimization model is applied only when the desired water supply cannot be fully met by fresh groundwater.

equivalent annual cost—Total annual life cycle cost of a water supply option, based on service life and time value of money criteria established for the *Water 2020* program. Equivalent annual cost includes amortized capital cost plus annual operation and maintenance cost. Equivalent annual cost represents total water supply development cost with the water supply facilities operating at design capacity.

facility deficit—Amount of projected 2020 water supply needs that cannot be met by existing water supply facilities.

groundwater optimization model—A decision model that identifies the water supply withdrawal scenario (i.e., pumpage rate at each well) that will maximize the use of fresh groundwater while ensuring compliance with selected environmental constraints and other groundwater withdrawal constraints specified by the user.

interdistrict transfers of groundwater—The withdrawal of groundwater from a point in one water management district for use outside the boundaries of that water management district.

land acquisition cost—The estimated cost of acquiring the required land. For the *Water 2020* program, land acquisition cost equals 25% of the land market value.

land cost—The market value of the land required to implement the water supply option.

maximum day demand (MDD)—Existing or projected future water use for the peak or maximum day during the year. MDD is equal to the highest daily volume used during a given year. MDD is usually expressed in units of million gallons per day.

membrane softening—Membrane softening is a water treatment process that reduces hardness by membrane treatment, usually nanofiltration. In addition to softening the water, membrane treatment will also remove color and disinfection byproduct precursors.

nonconstruction capital cost—The cost of construction-related services including engineering design, permitting, administration, and construction contingency associated with the constructed facilities. For the *Water 2020* program, nonconstruction capital cost equals 45 percent of the estimated construction cost.

1-in-10-year drought—A drought event that results in an increase in water demand with a 10 percent probability of occurrence in any given year. The level-of-certainty water supply planning goal is to assure at least a 90 percent probability, during any given year, that all reasonable-beneficial water uses will be met while sustaining water resources and related natural systems.

operation and maintenance cost—The estimated annual cost of operating and maintaining the water supply option when operated at design capacity.

ozonation—The application of ozone to water for the purpose of disinfection.

priority water resource caution areas—Those areas where existing and reasonably anticipated sources of water and conservation efforts may not be adequate (1) to supply water for all existing legal uses and reasonably anticipated future needs and (2) to sustain the water resources and related natural systems.

reverse osmosis—Reverse osmosis is a water treatment process that removes salts and other dissolved constituents from raw water by forcing the water under pressure through a semipermeable membrane. Principal applications include brackish water and saline water desalting.

service area—The area served by a single water supply utility.

source deficit—The difference between the projected 2020 needs and the quantity of water the source can supply.

system demand ratio—The ratio of the maximum day demand (MDD) to the average day demand (ADD)—[MDD/ADD]—for a given demand center. In general, this ratio varies for each public supply utility.

total capital cost—Construction cost, plus nonconstruction capital cost, plus land cost, plus land acquisition cost.

unit production cost—Equivalent annual cost divided by the annual production rate. The unit production cost is expressed in terms of dollars per 1,000 gallons.

water resource constraints—The limits of water resource impacts beyond which unacceptable adverse impacts to water quality, wetland and aquatic systems, and existing legal uses are expected to occur.

water supply alternative—An array of water supply options that will provide future water supply needs; applies to an entire work group area. An alternative will meet all future water supply needs of a work group area and is a subset of the water supply plan.

water supply development project—A project that contributes to 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.

water supply option—Applies to a given water service area, usually a public supply utility. It is an action, that may or may not involve construction of new facilities (projects), that will meet a given service area's future water supply needs.

work group area—A subdivision of the *Water 2020* planning area intended to facilitate the water supply planning process. The individual work group areas share water supply sources and issues.

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